

MCAT ANSWER SHEET

PRACTICE TEST 2

Physical Sciences		Verbal Reasoning		Biological Sciences	
1. (A)(B)(C)(D)	40. (A)(B)(C)(D)	78. (A)(B)(C)(D)	108. (A)(B)(C)(D)	138. (A)(B)(C)(D)	177. (A)(B)(C)(D)
2. (A)(B)(C)(D)	41. (A)(B)(C)(D)	79. (A)(B)(C)(D)	109. (A)(B)(C)(D)	139. (A)(B)(C)(D)	178. (A)(B)(C)(D)
3. (A)(B)(C)(D)	42. (A)(B)(C)(D)	80. (A)(B)(C)(D)	110. (A)(B)(C)(D)	140. (A)(B)(C)(D)	179. (A)(B)(C)(D)
4. (A)(B)(C)(D)	43. (A)(B)(C)(D)	81. (A)(B)(C)(D)	111. (A)(B)(C)(D)	141. (A)(B)(C)(D)	180. (A)(B)(C)(D)
5. (A)(B)(C)(D)	44. (A)(B)(C)(D)	82. (A)(B)(C)(D)	112. (A)(B)(C)(D)	142. (A)(B)(C)(D)	181. (A)(B)(C)(D)
6. (A)(B)(C)(D)	45. (A)(B)(C)(D)	83. (A)(B)(C)(D)	113. (A)(B)(C)(D)	143. (A)(B)(C)(D)	182. (A)(B)(C)(D)
7. (A)(B)(C)(D)	46. (A)(B)(C)(D)	84. (A)(B)(C)(D)	114. (A)(B)(C)(D)	144. (A)(B)(C)(D)	183. (A)(B)(C)(D)
8. (A)(B)(C)(D)	47. (A)(B)(C)(D)	85. (A)(B)(C)(D)	115. (A)(B)(C)(D)	145. (A)(B)(C)(D)	184. (A)(B)(C)(D)
9. (A)(B)(C)(D)	48. (A)(B)(C)(D)	86. (A)(B)(C)(D)	116. (A)(B)(C)(D)	146. (A)(B)(C)(D)	185. (A)(B)(C)(D)
10. (A)(B)(C)(D)	49. (A)(B)(C)(D)	87. (A)(B)(C)(D)	117. (A)(B)(C)(D)	147. (A)(B)(C)(D)	186. (A)(B)(C)(D)
11. (A)(B)(C)(D)	50. (A)(B)(C)(D)	88. (A)(B)(C)(D)	118. (A)(B)(C)(D)	148. (A)(B)(C)(D)	187. (A)(B)(C)(D)
12. (A)(B)(C)(D)	51. (A)(B)(C)(D)	89. (A)(B)(C)(D)	119. (A)(B)(C)(D)	149. (A)(B)(C)(D)	188. (A)(B)(C)(D)
13. (A)(B)(C)(D)	52. (A)(B)(C)(D)	90. (A)(B)(C)(D)	120. (A)(B)(C)(D)	150. (A)(B)(C)(D)	189. (A)(B)(C)(D)
14. (A)(B)(C)(D)	53. (A)(B)(C)(D)	91. (A)(B)(C)(D)	121. (A)(B)(C)(D)	151. (A)(B)(C)(D)	190. (A)(B)(C)(D)
15. (A)(B)(C)(D)	54. (A)(B)(C)(D)	92. (A)(B)(C)(D)	122. (A)(B)(C)(D)	152. (A)(B)(C)(D)	191. (A)(B)(C)(D)
16. (A)(B)(C)(D)	55. (A)(B)(C)(D)	93. (A)(B)(C)(D)	123. (A)(B)(C)(D)	153. (A)(B)(C)(D)	192. (A)(B)(C)(D)
17. (A)(B)(C)(D)	56. (A)(B)(C)(D)	94. (A)(B)(C)(D)	124. (A)(B)(C)(D)	154. (A)(B)(C)(D)	193. (A)(B)(C)(D)
18. (A)(B)(C)(D)	57. (A)(B)(C)(D)	95. (A)(B)(C)(D)	125. (A)(B)(C)(D)	155. (A)(B)(C)(D)	194. (A)(B)(C)(D)
19. (A)(B)(C)(D)	58. (A)(B)(C)(D)	96. (A)(B)(C)(D)	126. (A)(B)(C)(D)	156. (A)(B)(C)(D)	195. (A)(B)(C)(D)
20. (A)(B)(C)(D)	59. (A)(B)(C)(D)	97. (A)(B)(C)(D)	127. (A)(B)(C)(D)	157. (A)(B)(C)(D)	196. (A)(B)(C)(D)
21. (A)(B)(C)(D)	60. (A)(B)(C)(D)	98. (A)(B)(C)(D)	128. (A)(B)(C)(D)	158. (A)(B)(C)(D)	197. (A)(B)(C)(D)
22. (A)(B)(C)(D)	61. (A)(B)(C)(D)	99. (A)(B)(C)(D)	129. (A)(B)(C)(D)	159. (A)(B)(C)(D)	198. (A)(B)(C)(D)
23. (A)(B)(C)(D)	62. (A)(B)(C)(D)	100. (A)(B)(C)(D)	130. (A)(B)(C)(D)	160. (A)(B)(C)(D)	199. (A)(B)(C)(D)
24. (A)(B)(C)(D)	63. (A)(B)(C)(D)	101. (A)(B)(C)(D)	131. (A)(B)(C)(D)	161. (A)(B)(C)(D)	200. (A)(B)(C)(D)
25. (A)(B)(C)(D)	64. (A)(B)(C)(D)	102. (A)(B)(C)(D)	132. (A)(B)(C)(D)	162. (A)(B)(C)(D)	201. (A)(B)(C)(D)
26. (A)(B)(C)(D)	65. (A)(B)(C)(D)	103. (A)(B)(C)(D)	133. (A)(B)(C)(D)	163. (A)(B)(C)(D)	202. (A)(B)(C)(D)
27. (A)(B)(C)(D)	66. (A)(B)(C)(D)	104. (A)(B)(C)(D)	134. (A)(B)(C)(D)	164. (A)(B)(C)(D)	203. (A)(B)(C)(D)
28. (A)(B)(C)(D)	67. (A)(B)(C)(D)	105. (A)(B)(C)(D)	135. (A)(B)(C)(D)	165. (A)(B)(C)(D)	204. (A)(B)(C)(D)
29. (A)(B)(C)(D)	68. (A)(B)(C)(D)	106. (A)(B)(C)(D)	136. (A)(B)(C)(D)	166. (A)(B)(C)(D)	205. (A)(B)(C)(D)
30. (A)(B)(C)(D)	69. (A)(B)(C)(D)	107. (A)(B)(C)(D)	137. (A)(B)(C)(D)	167. (A)(B)(C)(D)	206. (A)(B)(C)(D)
31. (A)(B)(C)(D)	70. (A)(B)(C)(D)			168. (A)(B)(C)(D)	207. (A)(B)(C)(D)
32. (A)(B)(C)(D)	71. (A)(B)(C)(D)			169. (A)(B)(C)(D)	208. (A)(B)(C)(D)
33. (A)(B)(C)(D)	72. (A)(B)(C)(D)			170. (A)(B)(C)(D)	209. (A)(B)(C)(D)
34. (A)(B)(C)(D)	73. (A)(B)(C)(D)			171. (A)(B)(C)(D)	210. (A)(B)(C)(D)
35. (A)(B)(C)(D)	74. (A)(B)(C)(D)			172. (A)(B)(C)(D)	211. (A)(B)(C)(D)
36. (A)(B)(C)(D)	75. (A)(B)(C)(D)			173. (A)(B)(C)(D)	212. (A)(B)(C)(D)
37. (A)(B)(C)(D)	76. (A)(B)(C)(D)			174. (A)(B)(C)(D)	213. (A)(B)(C)(D)
38. (A)(B)(C)(D)	77. (A)(B)(C)(D)			175. (A)(B)(C)(D)	214. (A)(B)(C)(D)
39. (A)(B)(C)(D)				176. (A)(B)(C)(D)	

MCAT Practice Test 2
Writing Sample 1 (continued)

Periodic Table of the Elements

s-block		p-block																18		
1		17																0		
IIA		VIIA																0		
1	H																	He		
2	Li	Be											B	C	N	O	F	Ne		
3	Na	Mg											Al	Si	P	S	Cl	Ar		
4	K	Ca											Ga	Ge	As	Se	Br	Kr		
5	Rb	Sr											In	Sn	Sb	Te	I	Xe		
6	Cs	Ba											Tl	Pb	Bi	Po	At	Rn		
7	Fr	Ra											Po	At	Rn					
			Transition Elements																	
			GROUP 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
			IA	IIA	IIIB	IVB	VB	VIB	VII	VIII	VIII	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	0

KEY

Atomic Mass: 12.0111

Symbol: **C**

Atomic Number: 6

Electron Configuration: 1s²2s²2p²

Selected Oxidation States: -4, +2, +4

Relative atomic masses are based on ¹²C = 12.0000

MASS NUMBERS IN PARENTHESES ARE MASS NUMBERS OF THE MOST STABLE OR COMMON ISOTOPE.

57	La											71	Lu	
89	Ac											103	Lr	
58	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
90	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

PHYSICAL SCIENCES

Time: 100 Minutes
Questions 1–77

Directions: This test contains 77 questions. Most of the questions consist of a descriptive passage followed by a group of questions related to the passage. For these questions, study the passage carefully and then choose the best answer to each question in the group. Some questions in this test stand alone. These questions are independent of any passage and independent of each other. For these questions, too, you must select the one best answer. Indicate all your answers by blackening the corresponding circles on your answer sheet.

Passage I (Questions 1–7)

In its simplest form a capacitor consists of two parallel plates of conducting material separated by an insulator called a dielectric. When the conductors are connected to the terminals of a voltage source, electrons move to one plate, giving it a net negative charge. This forces electrons to leave the opposite plate, giving it a net positive charge. When the capacitor is removed from the power source, charge can't leave the plate. The capacitor stores the electric energy in the dielectric.

Capacitance indicates the amount of charge a particular capacitor can store per volt of potential difference across its plates.

- I. In terms of the charge, stored capacitance is the ratio of the charge q on either plate to the potential difference V between the plates.

$$C = q/V$$

Capacitance is measured in the unit farad = coulomb/volt, $F = C/V$.

- II. In terms of the geometry of the capacitor,

$$C = 8.85 \times 10^{-15} \text{ KA}/d$$

where A is the area on one of the plates and d is the separation between the plates.

K is the unitless dielectric constant of the insulating material between the plates. The total charge on the plates increases by the factor K :

$$q = KC_0V$$

C_0 is the capacitance when the plates are separated by air. For air, $K = 1$.

For capacitors connected in series, the reciprocal of the total capacitance is equal to the sum of the reciprocals of all the separate capacitances. For capacitors

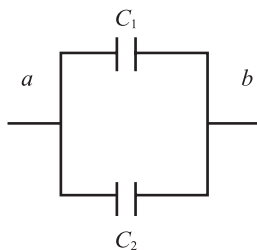
connected in parallel, the total capacitance is the sum of the individual capacitances.

1. A particular parallel plate capacitor has square plates separated by an air gap 0.012 mm wide. If the length of the sides of the plates are tripled, what is the separation required to keep the capacitance the same?
 - A. 0.0013 mm
 - B. 0.004 mm
 - C. 0.036 mm
 - D. 0.108 mm
2. A 10 V power source charges a 5 μF capacitor with air as its dielectric. The power source is removed and the air gap is carefully replaced with a material of dielectric constant $K = 5$. What is the final charge on the capacitor?
 - A. 250 μC
 - B. 50 μC
 - C. 25 μC
 - D. 5 μC

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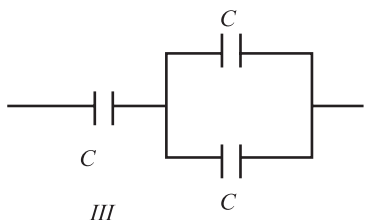
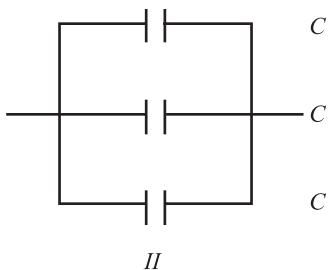
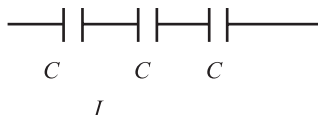
3. A 6000 V power supply charges a $10\ \mu\text{F}$ capacitor, C_1 . The power supply is removed and C_1 is connected to an uncharged capacitor C_2 of capacitance $5\ \mu\text{F}$ as shown. What is the final potential difference V_{ab} across the combination of C_1 and C_2 ?

- A. 3000 V
 B. 4000 V
 C. 5000 V
 D. 6000 V



4. Three identical capacitors are connected in three patterns shown below. List the circuits in order of increasing capacitance.

- A. $I < II, III$
 B. $III < II < I$
 C. $I < III < II$
 D. $II < I < III$



5. The constant in the equation $C = 8.85 \times 10^{-15} \text{KA}/d$ comes from $C = \text{KA}/(4\pi k)d$ where k is the Coulomb constant, $9 \times 10^9 \text{Nm}^2/\text{C}^2$. Which of the following is equivalent to the unit F?

- A. C^2/Nm^2
 B. C^2/J
 C. V/C
 D. Nm^2/C^2

6. A parallel plate capacitor has a capacitance of $19.2\ \mu\text{F}$ when the insulator between the plates is glass, $K = 8.0$. When the glass is replaced with rubber, the capacitance becomes $6.0\ \mu\text{F}$. What is the dielectric constant of the rubber?

- A. 2.5
 B. 4.7
 C. 7.5
 D. 12.0

7. A parallel plate capacitor is charged to a given voltage by a battery. While the battery is still connected, the plates are pulled farther apart. Which statement most accurately describes what happens?

- A. The capacitance increases and the charge on each plate decreases.
 B. The capacitance increases and the charge on each plate increases.
 C. The capacitance decreases and the charge on each plate decreases.
 D. The capacitance decreases and the charge on each plate increases.

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Passage II (Questions 8–13)

An enterprising physics student has developed a software package that calculates gravity-based parameters for actual and theoretical planets and satellites. The program is based on the following simple principles and approximations:

- Newton's second law, $F = ma$, applies.
- Newton's law of universal gravitation states that every body attracts every other body with a force of magnitude $F_{\text{gravity}} = GMm/r^2$, where M and m are the masses of two interacting bodies, r is the distance between their centers of mass, and G is the gravitational constant.
- For a pair of interacting bodies if one is significantly more massive than the other, the heavier body is considered stationary with the smaller body orbiting around it.
- The orbit of the smaller body is a circle. The smaller body experiences a centripetal force, $F_{\text{centripetal}} = mv^2/r$, directed towards the center of the more massive body.
- For bodies on or near the surface of a planet, r is simply the planet's radius, R .
- Planets are spheres with volume, $V = (4/3)\pi R^3$.
- The total mechanical energy of a satellite is the sum of its kinetic and gravitational potential energy. $E = E_k + E_p = mv^2/2 - GMm/r = \text{constant}$.
 - Since the more massive planet is stationary, E_k depends only on the motion of the satellite.
 - The potential gravitational energy increases from a large negative value to zero as the distance increases to infinity.

The speed needed for a projectile to completely escape the pull of the planet is called the escape velocity. A projectile that is completely beyond the gravity of a planet has a total mechanical energy of zero with respect to that planet. Conservation of energy requires that the total mechanical energy of the projectile when it was at the planet's surface must also equal zero.

- Two commercial satellites, Seeker I and Seeker II, have circular orbits of R and $2R$, respectively, about the same planet. What is the orbital velocity of Seeker II if the orbital velocity of Seeker I is v ?
 - $v/2$
 - $v/(2)^{1/2}$
 - $v(2)^{1/2}$
 - $2v$
- Two boxes of negligible mass are placed 2 meters apart on the surface of Planet X. Initially 15 identical steel ball bearings are placed in each box. Which statement is most accurate if 10 of the ball bearings are transferred from box 1 to box 2?
 - The force of gravity between the two boxes remains the same.
 - The force of gravity between the two boxes increases.
 - The force of gravity between the two boxes decreases.
 - Any change in F_{gravity} between the boxes cannot be determined without knowing the mass of the steel ball bearings.
- Planet Y has density D , and surface gravitational acceleration, g . The radius of Planet Y is suddenly doubled while its density remains the same. Compared to the original g , the new value of the surface gravitational acceleration would be which of the following?
 - $4g$
 - $2g$
 - g
 - $g/2$
- Which expression is an accurate description of the kinetic energy for a satellite of mass m in a circular orbit of radius r around a planet of mass M ?
 - $2GMm/r$
 - GMm/r
 - $GMm/2r$
 - GM/r^2

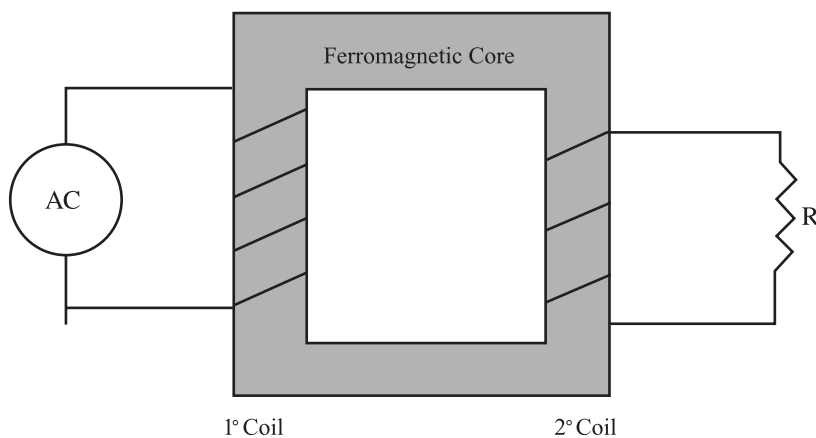
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12. Which expression is an accurate description of the total mechanical energy of a satellite of mass m in a circular orbit of radius r around a planet of mass M ?
- A. GMm/r
 B. $-GMm/r$
 C. $GMm/2r$
 D. $-GMm/2r$
13. What is the minimum velocity required to launch a rocket from the surface of Planet Z? The planet has a mass of M and a radius of R .
- A. $(2GM/R^2)^{1/2}$
 B. $(2GM/R)^{1/2}$
 C. $(GM/R^2)^{1/2}$
 D. $(GM/R)^{1/2}$

Passage III (Questions 14–18)

A freshman physics lab is designed to study the transfer of electrical energy from one circuit to another by means of a magnetic field using simple transformers. Each transformer has two coils of wire electrically insulated from each other but wound around a common core of ferromagnetic material. The two wires are close together but do not touch each other.

The primary (1°) coil is connected to a source of alternating (AC) current. The secondary (2°) coil is connected to a resistor such as a light bulb. The AC source produces an oscillating voltage and current in the primary coil that produces an oscillating magnetic field in the core material. This in turn induces an oscillating voltage and AC current in the secondary coil.



Students collected the following data comparing the number of turns per coil (N), the voltage (V), and the current (I) in the coils of three transformers.

	Primary Coil			Secondary Coil		
	N_{1°	V_{1°	I_{1°	N_{2°	V_{2°	I_{2°
Transformer 1	100	10 V	10 A	200	20 V	5 A
Transformer 2	100	10 V	10 A	50	5 V	20 A
Transformer 3	200	10 V	10 A	100	5 V	20 A

14. The primary coil of a transformer has 100 turns and is connected to a 120 V AC source. How many turns are in the secondary coil if there's a 2400 V across it?
- A. 5
 B. 50
 C. 200
 D. 2000
15. The primary coil of a given transformer has $1/3$ as many turns as its secondary coil. What primary current is required to provide a secondary current of 3.0 mA?
- A. 1.0 mA
 B. 6.0 mA
 C. 9.0 mA
 D. 12.0 mA

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16. A transformer with 40 turns in its primary coil is connected to a 120 V AC source. If 20 watts of power is supplied to the primary coil, how much power is developed in the secondary coil?

A. 10 W
 B. 20 W
 C. 80 W
 D. 160 W

17. Which of the following is a correct expression for R , the resistance of the load connected to the secondary coil?

A. $(V_1/I_1)(N_2/N_1)$
 B. $(V_1/I_1)(N_2/N_1)^2$
 C. $(V_1/I_1)(N_1/N_2)$
 D. $(V_1/I_1)(N_1/N_2)^2$

18. A 12 V battery is used to supply 2.0 mA of current to the 300 turns in the primary coil of a given transformer. What is the current in the secondary coil if $N_2 = 150$ turns?

A. 0 A
 B. 1.0 mA
 C. 2.0 mA
 D. 4.0 A

Passage IV (Questions 19–25)

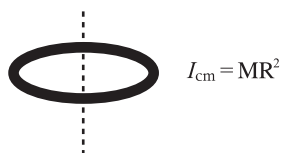
The moment of inertia, I , measures an object's resistance to rotational motion about a specific axis. The observed value depends on the object's mass, M ; distance of the mass from the axis of rotation, R ; and a parameter, β , that depends on the object's shape.

I depends on the location and orientation of the axis of rotation. In general, but not necessarily, this axis passes through the object's center of mass. When it does:

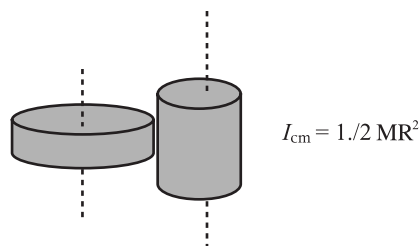
$$I_{\text{cm}} = \beta MR^2$$

Moments of Inertia for Some Common Shapes

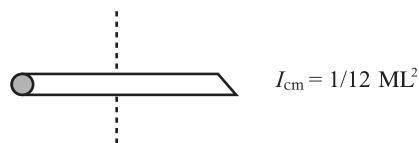
Thin hoop, axis through center
 R is radius



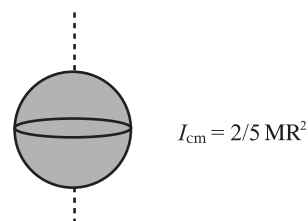
Solid uniform disk or cylinder, axis through center
 R is radius



Thin uniform rod, axis through center
 L is length



Uniform solid sphere, axis through center
 R is radius



Two important rules for manipulating moments of inertia are:

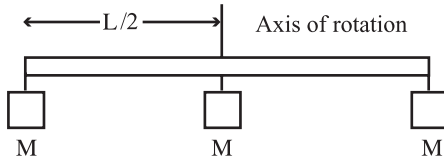
- I. *Moments of inertia add.* If two bodies are rigidly connected, the total moment of inertia is the sum of the two individual moments of inertia.
- II. *Parallel Axis Theorem.* If I_{cm} , the moment of inertia of an object about any axis through its center of mass is known, then the moment of inertia about any axis parallel to this axis and a distance d away is:

$$I_{\text{new}} = I_{\text{cm}} + Md^2$$

Finally, if the object rolls as well as rotates then it has translational kinetic energy as well as rotational kinetic energy. The fraction of the kinetic energy that will be rotational depends on the moment of inertia and is given by: $\beta/(1 + \beta)$.

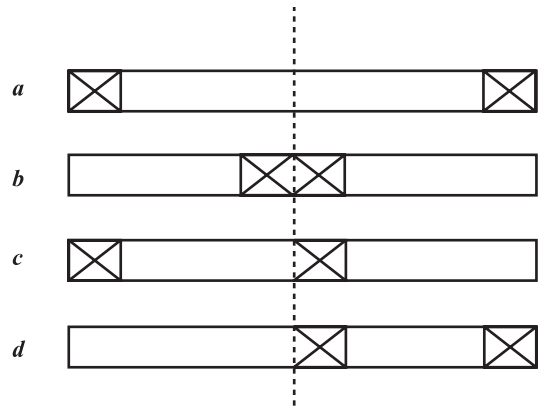
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19. Three objects of identical shape and mass, M , are attached to a rod of length L and negligible mass. The entire system rotates about the center of the rod as shown below. If $\beta = 1$ for each object, what is the moment of inertia of the system?



- A. $\frac{1}{2} ML^2$
 B. ML^2
 C. $2 ML^2$
 D. $3 ML^2$
20. A 20.0-kg steel cylinder has an 80-cm diameter. What is the cylinder's moment of inertia when it is rotated through an axis parallel to its length and 10 cm from its center?
- A. 1.8 kg m^2
 B. 6.6 kg m^2
 C. $1.8 \times 10^4 \text{ kg m}^2$
 D. $6.6 \times 10^4 \text{ kg m}^2$
21. A uniform thin rod of mass, M , and length, L , rotates around an axis perpendicular to its length and located at one of its ends. What is the moment of inertia for this arrangement?
- A. $7 ML^2/12$
 B. $ML^2/3$
 C. $ML^2/12$
 D. $13 ML^2/12$

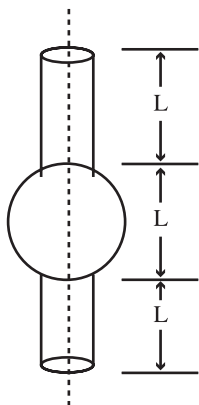
22. Two identical weights are placed inside a long thin-walled tube. The diameter of each weight is slightly less than the inner diameter of the tube so the weights are free to move. The tube is suspended by a thin wire attached to what would be the center of mass of the empty tube. Four of the possible configurations for the system are shown below. In each case the tube is perfectly horizontal. List the configurations in order of increasing inertia about the suspending wire.



- A. d b c a
 B. b c d a
 C. b d c a
 D. a d c b

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23. An artist makes a scale model of a kinetic sculpture. Two identical solid cylinders and a solid sphere with diameter equal to the cylinder length L are attached as shown. The sphere and each cylinder have the same mass, M . The sculpture is suspended by a small wire running vertically along the axis of rotation. The hole for the wire is negligible.



In the actual sculpture L is the only dimension altered. The new value of L is three times the value in the model. The materials are altered so that the new masses of the three components are still equal. How does the moment of inertia of the final sculpture compare to that of the model?

- A. $I_{\text{sculpture}}$ will be the same as I_{model}
 B. $I_{\text{sculpture}}$ will be three times greater I_{model}
 C. $I_{\text{sculpture}}$ will be less than I_{model} by $4/5 ML^2$
 D. $I_{\text{sculpture}}$ will be greater than I_{model} by $4/5 ML^2$
24. A hoop, a disk, and a solid sphere initially at rest are released simultaneously and allowed to roll down a ramp of length, L , inclined at an angle θ . What is the order in which they reach the bottom of the ramp?
- A. Hoop is first, then disk, then sphere.
 B. Sphere is first, then disk, then hoop.
 C. Disk is first, then sphere, then hoop.
 D. Since the only force acting is gravity, they all arrive at the same time.

25. A certain star collapses to $1/10^{\text{th}}$ its original radius. If the star is treated as a solid sphere, how does the new moment of inertia compare with the pre-collapsed value?
- A. The moment of inertia increases by a factor of 10.
 B. The moment of inertia decreases by a factor of 10.
 C. The moment of inertia increases by a factor of 100.
 D. The moment of inertia decreases by a factor of 100.

Passage V (Questions 26–32)

In the normal human eye, light from an object is refracted by the cornea-lens system at the front of the eye and produces a real image on the retina at the rear of the eye. For a given eye, its lens-to-retina distance is fixed at about 2.5 cm. Most of the focusing of an image is done by the cornea, which has a fixed curvature that is convex with respect to incoming light. The importance of the lens is that its radius of curvature can be changed, allowing the lens to fine-tune the focus.

The lens is surrounded by the ciliary muscle. Contraction of the muscle decreases tension on the lens. This allows the natural elasticity of the lens to produce an increase in the radius of curvature. When the muscle relaxes, the lens flattens out, decreasing its radius of curvature. Unfortunately, the lens loses elasticity with age and the ability to alter curvature decreases.

The range over which clear vision is possible is bounded by the *far point* and the *near point*. In normal vision the *far point* is infinity and the *near point* depends on the radius of curvature of the lens. For normal eyes the average near point for reading is 25 cm.

AGE, years	NEAR POINT, cm
10	7
20	10
30	14
40	22
50	40
60	200

In the myopic (nearsighted) eye, the lens-to-retina length is too long and/or the radius of curvature of the cornea is too great. This causes rays from an object at infinity to focus at a point in front of the retina. The far point is closer than normal. A corrective lens will put a virtual image of a distant object at the position of the actual far point of the eye.

In the hyperopic (farsighted) eye, the lens-to-retina length is too short and/or the radius of curvature of the

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cornea is not great enough. This causes rays from an object at infinity to focus at a point behind the retina. The near point is farther away than normal. A corrective lens will put a virtual image of the close object at the position of the actual near point.

The relation among the object (o) and image (i) distances from the eye and the focal length (f) of the lens is given by the lens-distance rule:

$$1/o + 1/i = 1/f$$

When using this equation, all distances are given in centimeters.

The power of corrective lenses is usually given in units called diopters. Power, in diopters, is the reciprocal of the focal length in meters: $P_{\text{diopter}} = 1/f_{\text{meter}}$

By convention:

- I. Converging lenses have positive focal lengths, and diverging lenses have negative focal lengths.
- II. Real images have positive distances from the lens, and virtual images have negative distances from the lens.

26. The lens system of the myopic eye is best described as:

- A. producing too much convergence.
- B. producing too little convergence.
- C. producing too much divergence.
- D. producing too little divergence.

27. An optometrist examined John's eyes. The farthest object he can clearly focus on with his right eye is 50 cm away. What is the power of the contact lens required to correct the vision in his right eye?

- A. -0.50 diopters
- B. -2.0 diopters
- C. $+2.0$ diopters
- D. $+5.0$ diopters

28. In a mildly hyperopic eye, the focal length of the eye's natural lens can be corrected by:

- A. contracting the ciliary muscle and increasing the radius of curvature.
- B. contracting the ciliary muscle and decreasing the radius of curvature.
- C. relaxing the ciliary muscle and increasing the radius of curvature.
- D. relaxing the ciliary muscle and decreasing the radius of curvature.

29. Jane must wear a contact lens with a power of $+3.00$ diopters in one eye to be able to clearly focus on an object 25 cm in front of the eye. Based on the vision in this eye, which of the following is the most likely age range for Jane?

- A. Less than 40 years old
- B. From 40 to 49 years old
- C. From 50 to 59 years old
- D. 60 years or older

30. George wears eyeglasses that sit 2.0 cm in front of his eyes. His uncorrected far point is 50 cm. What is the focal length of his eyeglasses?

- A. -50 cm
- B. $+50$ cm
- C. -48 cm
- D. $+48$ cm

31. In a surgical procedure called radial keratotomy, (RK), a laser is used to flatten the cornea by placing a series of hairline cuts around the perimeter of the cornea. Which statement is most accurate?

- A. RK corrects myopia by decreasing the focal length of the eye.
- B. RK corrects myopia by increasing the focal length of the eye.
- C. RK corrects hyperopia by decreasing the focal length of the eye.
- D. RK corrects hyperopia by increasing the focal length of the eye.

Questions 32–38 are independent of one another and not based on any passage.

32. A 100-kg space probe lands on Planet X. The planet's mass is three times that of Earth and its radius is also three times that of Earth. Approximately what is the weight of the probe on Planet X?

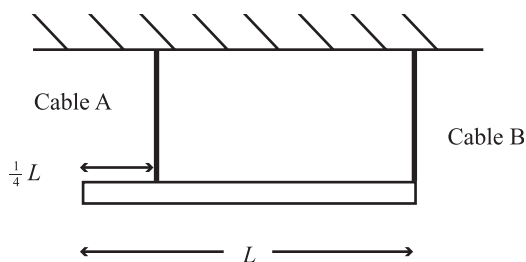
- A. 2.4×10^2 N
- B. 3.3×10^2 N
- C. 4.9×10^2 N
- D. 9.8×10^2 N

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33. An object is moved along the principal axis of a converging lens from a position 5 focal lengths from the lens to a position that is 2 focal lengths from the lens. Which statement about the resulting image is most accurate?

- A. The image increases in size and decreases in distance from the lens.
- B. The image increases in size and increases in distance from the lens.
- C. The image decreases in size and decreases in distance from the lens.
- D. The image decreases in size and increases in distance from the lens.

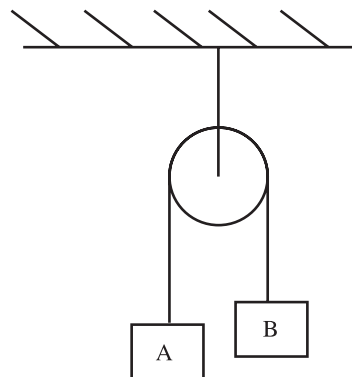
34. A uniform bar of mass M and length L is horizontally suspended from the ceiling by two vertical light cables as shown. Cable A is connected $\frac{1}{4}$ the distance from the left end of the bar. Cable B is attached at the far right end of the bar. What is the tension in cable A?



- A. $\frac{1}{4} Mg$
 - B. $\frac{1}{3} Mg$
 - C. $\frac{2}{3} Mg$
 - D. $\frac{3}{4} Mg$
35. What is the magnitude of the intensity of an electric field E if a $4 \mu\text{C}$ charge placed in the field experiences a force of 0.08 N ?

- A. $5 \times 10^{-3} \text{ kg m/s}^2\text{C}$
- B. $2 \times 10^{-4} \text{ kg m/s}^2$
- C. $5 \times 10^3 \text{ kg m/s}^2$
- D. $2 \times 10^4 \text{ kg m/s}^2$

36. Blocks A and B of masses 15 kg and 10 kg , respectively, are connected by a light cable passing over a frictionless pulley as shown below. Approximately what is the acceleration experienced by the system?

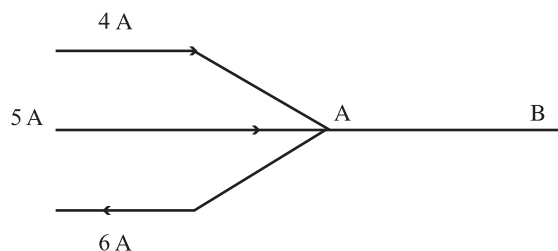


- A. 2.0 m/s^2
- B. 3.3 m/s^2
- C. 4.9 m/s^2
- D. 9.8 m/s^2

37. A 50-kg ice skater, initially at rest, throws a 0.15-kg snowball with a speed of 35 m/s . What is the approximate recoil speed of the skater?

- A. 0.10 m/s
- B. 0.20 m/s
- C. 0.70 m/s
- D. 1.4 m/s

38. The four wires from a larger circuit intersect at junction A as shown. What is the magnitude and direction of the current between points A and B?

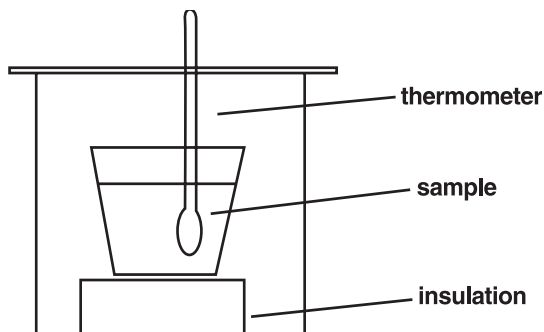


- A. 2 A from A to B
- B. 2 A from B to A
- C. 3 A from A to B
- D. 2 A from B to A

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Passage VI (Questions 39–44)

Chemists' seemingly insatiable need to measure heat has led to a broad spectrum of measurement methods. Beginning students are familiar with simple "coffee-cup" style calorimeters that rely on the known specific heat of water to infer heat values from measurements of temperature change. A student uses the calorimeter shown in Figure 1 below to determine the enthalpy of solution, $\Delta H_{\text{solution}}$, of KOH:



Coffee-cup Calorimeter

Figure 1

She finds that when a 4.56-g sample of solid KOH is added to 100 mL of water, the temperature in the solution rises from 24.0°C to 34.6°C.

Another traditional style of calorimeter is the ice calorimeter, in which the heat released in an exothermic reaction is trapped in an ice-water mixture, causing ice to melt (Figure 2). Each gram of ice that melts produces a gram of liquid having a somewhat greater density, with the result that the volume of the ice-water mixture contracts by 0.091 mL per gram of ice melted. Thus, a measurement of volume change, together with the knowledge that the specific heat of fusion of ice is 334 J/g, leads to a value for the heat liberated in a reaction.

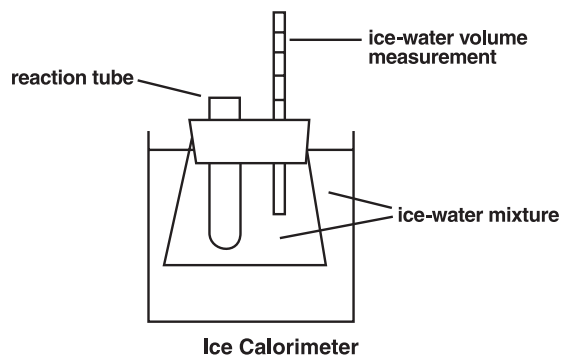
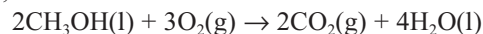


Figure 2

A student employs this method to determine the enthalpy of the combustion of methanol. He finds that when a sample of methanol weighing 0.300 g is burned in excess oxygen in an ice calorimeter, according to the reaction,



the volume of ice and water surrounding the sample decreases by 1.86 mL.

Calorimetry has become quite sophisticated, and one of the methods available to analytical laboratories is thermal gravimetric analysis (TGA), a technique that measures the mass of a sample as heat is applied at a constant rate. The result is a graph, as illustrated in Figure 3 for hydrated copper (II) sulfate, $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$.

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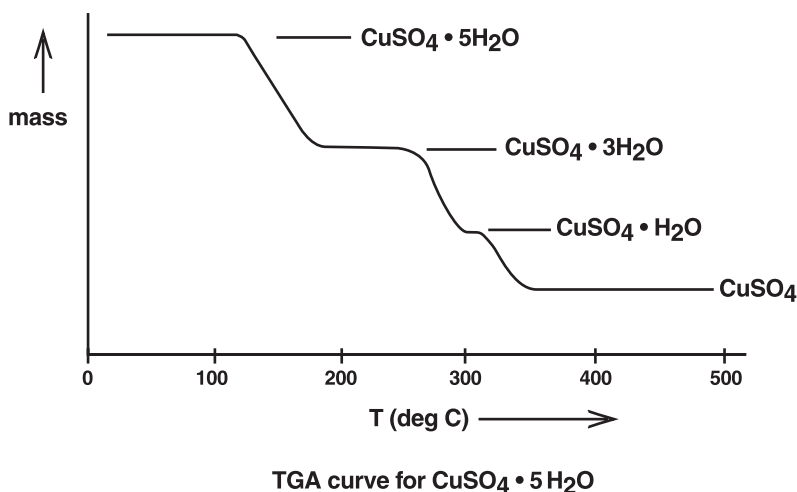


Figure 3

Figure 3 shows that as heat is added to the sample, mass is lost in distinct stages, each characterized by a loss of either one or two water molecules from an original molecule of hydrate.

39. If the specific heat of the solution of KOH in water is assumed to be $4.18 \text{ J/g}^\circ\text{C}$, what is the approximate value of $\Delta H_{\text{solution}}$ for KOH? (Assume that the calorimeter is thermally insulated from its surroundings.)
- -57 kJ/mol
 - -4.6 kJ/mol
 - 57 kJ/mol
 - 4.6 kJ/mol
40. Which of the following changes in the KOH solubility experiment would be the LEAST likely to change the measured value of ΔT ?
- Doubling the amount of water used
 - Doubling the amount of KOH used
 - Doubling the amount of water and doubling the amount of KOH used
 - Substituting an equal mass of NaOH for the KOH sample
41. Which of the following is the most serious *limitation* of ice calorimetry as a method of measuring enthalpies of the given reaction in the narrative?
- The method cannot be used to determine enthalpies of endothermic reactions.
 - The method cannot be used directly to determine enthalpies of reactions that take place at 25°C .
 - Because of the reliance on ice and water, the method cannot be used to determine enthalpies of reactions that involve water or ice as reactants or products.
 - Although satisfactory for determining the heat of a reaction, this method cannot evaluate a reaction enthalpy.
42. What was the approximate value of the heat of the chemical reaction in the ice calorimetry determination described?
- 20 J
 - 14 J
 - -7 kJ
 - 20 kJ

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43. An experimenter wishes to substitute a mixture of solid and liquid benzene, C_6H_6 (which are in equilibrium at $5.5^\circ C$), for the ice-water mixture described above. The enthalpy of fusion of benzene is 10.59 kJ/mol . In which liquid-solid mixture will more grams of solid melt? (You may assume that the enthalpy of combustion of methane is the same at $5.5^\circ C$ as it is at $0^\circ C$.)
- A. The ice-water mixture
 B. The liquid-solid benzene mixture
 C. There will be no difference.
 D. More information is needed.
44. Refer to the thermogravimetric analysis curve in Figure 3. If the initial mass of the fully hydrated sample was 0.100 g , what was its mass when it had been completely converted to $CuSO_4 \cdot 3H_2O$?
- A. 0.007 g
 B. 0.014 g
 C. 0.085 g
 D. 0.093 g

Passage VII (Questions 45–50)

Reduction potentials for elements and molecules are frequently presented in tables, but diagrams often convey their relationships more quickly. Figure 1, which is basically an ordered table, shows several half reactions and their relative reduction potentials.

	Half Reaction	Reduction Potential
_____	$MnO_4^-(aq) + 4H^+ + 3e^- \rightarrow MnO_2(s) + 2H_2O(l)$	1.700
_____	$Cu^{2+} + 2e^- \rightarrow Cu(s)$	0.340
_____	$Sn^{4+}(aq) + 2e^- \rightarrow Sn^{2+}(aq)$	0.154
_____	$2H^+(aq) + 2e^- \rightarrow H_2(g)$	0.000
_____	$Ni^{2+} + 2e^- \rightarrow Ni$	-0.236

Figure 1

When we want to focus attention on different oxidation states of the same element, we often use a *Latimer diagram*, such as the one illustrated in Figure 2 below, that describes several different states of chlorine in 1 M acid solution.

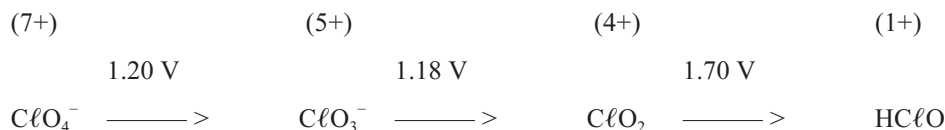


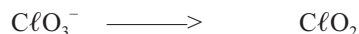
Figure 2

The diagram presents in condensed form a series of half reactions, together with the corresponding reduction potentials (above each arrow) and the oxidation state of each form of chlorine (above each species). For example, the middle segment of the diagram,

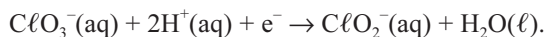
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1.18 V



is a shorthand form of the half reaction



If we want to derive a new half reaction potential from the diagram, we cannot (except in special cases) simply add two potentials to get a new one. Rather, because of the relationship of free energy to potential,

$$\Delta G^\circ = -nFE^\circ$$

(where ΔG° is the standard free energy of a half reaction, E° is the potential, F is Faraday's constant, and n is the number of electrons transferred), we find the potential for a half reaction that is a combination of two other half reactions as follows:

If E°_1 is the potential for the first half reaction, which transfers n_1 electrons, and E°_2 is the potential for the second half reaction, which transfers n_2 electrons, then the overall potential E°_{total} is given by

$$E^\circ_{\text{total}} = (n_1E^\circ_1 + n_2E^\circ_2) / (n_1 + n_2).$$

For the overall reaction $\text{ClO}_4^- \rightarrow \text{ClO}_2$, the Latimer diagram shows that two electrons are transferred in the first half reaction, and one in the second, giving

$$\begin{aligned} E^\circ_{\text{total}} &= [2(1.20) + (1)(1.18)] / (2 + 1) \\ &= 1.19 \end{aligned}$$

The Latimer diagram can quickly predict whether a species is unstable with respect to disproportionation, i.e., a reaction of the form $2A \rightarrow B + C$.

We expect that disproportionation can occur if the potential to the right of a species is greater than the potential to the left.

Convenient as the Latimer diagram is, it can be usefully extended to the *Frost diagram*, as in Figure 3 for oxygen. In this depiction of reduction potentials, we plot oxidation state on the x-axis and the quantity nE° on the vertical axis, where n is the oxidation state and E° is the potential for the reduction from that oxidation state to the neutral element.

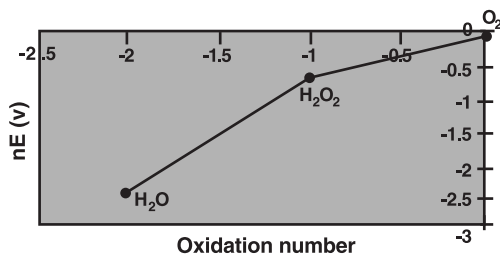


Figure 3

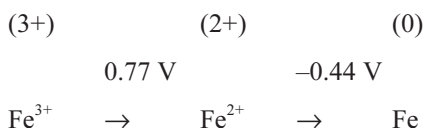
Figure 3 gives us quick information about several key points about the various oxidation states of O:

- The most stable state comes at the lowest point on the chart (H_2O , where O is in the 2- state).
- The slope of the line drawn between any two points gives the value of the reduction potential for the corresponding half reaction. Qualitatively, we can say 5; e.g., E° for $\text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{O}$ is greater than E° for $\text{O}_2 \rightarrow \text{H}_2\text{O}_2$.
- Disproportionation is expected in cases such as the point for H_2O_2 on the diagram, because the point lies above the line that can be drawn connecting the point to the left (H_2O) with the point to the right (O_2).

45. Which of the following will oxidize Sn^{2+} at standard conditions?
- A. MnO_4^-
 - B. Cu
 - C. H^+
 - D. Sn^{4+}
46. Which of the following reactions is expected to react more completely at pH 1 than at pH 5? (Assume standard concentrations of all species except H^+ .)
- A. $\text{Sn}(\text{NO}_3)_2$ with $\text{Cu}(\text{NO}_3)_2$
 - B. NiCl_2 with $\text{Sn}(\text{NO}_3)_2$
 - C. KMnO_4 with Cu
 - D. NiCl_2 with $\text{Cu}(\text{NO}_3)_2$
47. Find the balanced reaction for the section of the chlorine Latimer diagram that is written:
- $$\text{ClO}_2 \rightarrow \text{HClO}$$
- (Assume that $\text{H}^+ = 1 \text{ M}$)
- A. $\text{ClO}_2 + \text{H}_2\text{O} + 3\text{e}^- \rightarrow \text{HClO} + 3\text{OH}^-$
 - B. $\text{ClO}_2 + 3\text{H}^+ + 3\text{e}^- \rightarrow \text{HClO} + \text{H}_2\text{O}$
 - C. $\text{ClO}_2 + 2\text{H}^+ + 3\text{e}^- \rightarrow \text{HClO} + \text{H}_2\text{O}$
 - D. $\text{ClO}_2 + 5/2 \text{H}^+ + 3\text{e}^- \rightarrow \text{HClO} + 2\text{H}_2\text{O}$

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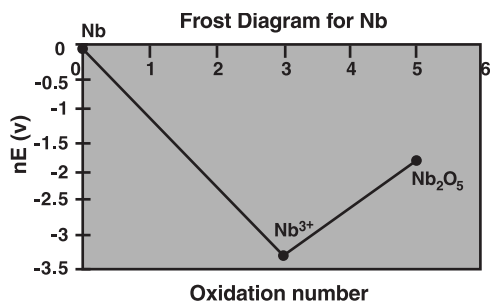
48. Consider the following Latimer diagram.



Calculate E° for the half reaction $\text{Fe}^{3+} + 3e^- \rightarrow \text{Fe}$.

- A. -0.04
- B. 0.17
- C. 0.37
- D. 0.55

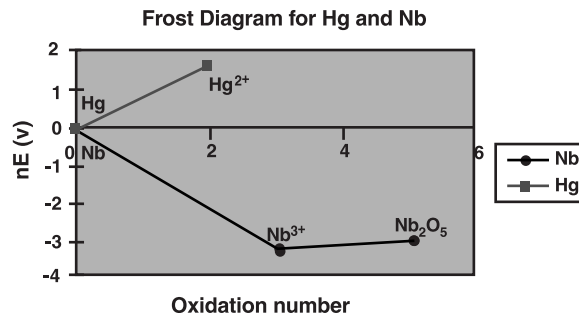
49. The Frost diagram for several Nb species in acidic solution is shown below. Using this diagram, plus any other relevant information from the passage, determine which of the following is/are true. (In the following, E° refers to reduction potential.)



- I. Nb^{3+} is stable with respect to disproportionation in acidic solution.
- II. $E^\circ(\text{Nb}^{3+}/\text{Nb}) > E^\circ(\text{Nb}_2\text{O}_5/\text{Nb}^{3+})$
- III. Nb is the most stable of the 3 species on the diagram.

- A. I only
- B. II only
- C. III only
- D. I and II only

50. The Frost diagram below combines parts of the diagrams for Nb and for Hg. Which of the reactions below will proceed spontaneously?

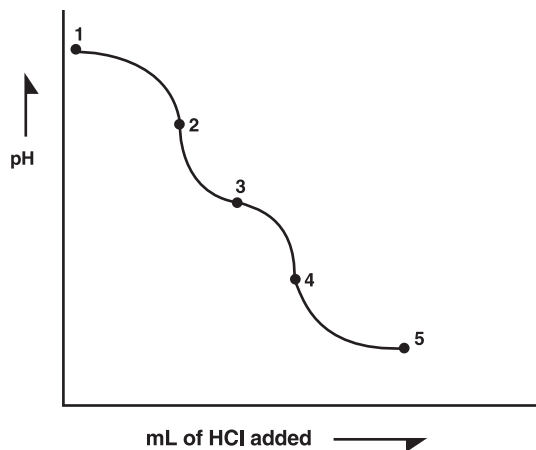


- I. $\text{Hg}^{2+}(\text{aq}) + \text{Nb}(\text{s}) \rightarrow \text{Hg}(\text{s}) + \text{Nb}^{3+}(\text{aq})$
- II. $\text{Hg}(\text{s}) + \text{Nb}^{3+}(\text{aq}) \rightarrow \text{Hg}^{2+}(\text{aq}) + \text{Nb}(\text{s})$
- III. $\text{Hg}(\text{s}) + \text{Nb}(\text{s}) \rightarrow \text{Hg}^{2+}(\text{aq}) + \text{Nb}^{3+}(\text{aq})$

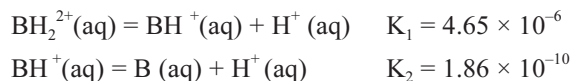
- A. I only
- B. II only
- C. III only
- D. I and III only

Passage VIII (Questions 51–56)

The titration curve for a 0.100 M solution of the weak base piperazine with 0.200 M HCl is given in the figure below.



If the most basic form of piperazine is represented as B, then acid constants for the species $\text{BH}^+(\text{aq})$ and $\text{BH}_2^{2+}(\text{aq})$ are given as follows:

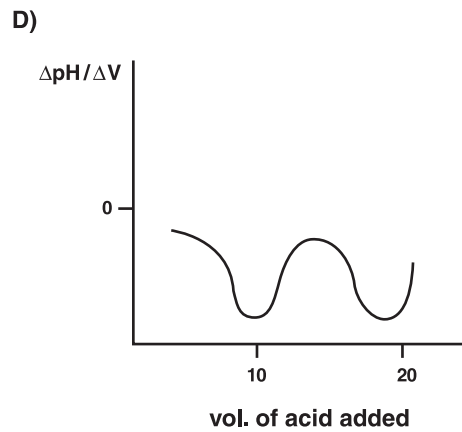
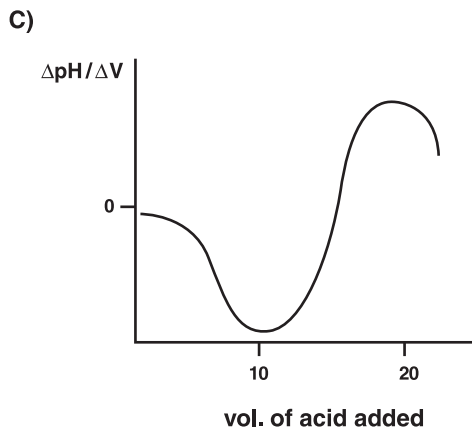
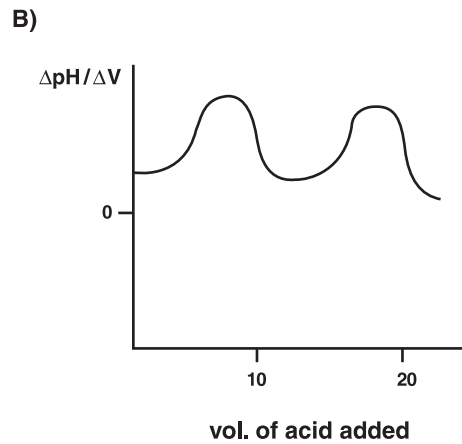
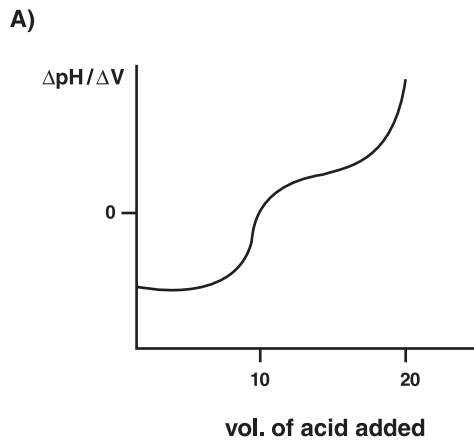


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51. At which of the numbered points on the titration curve would the species $\text{BH}^+(\text{aq})$ and $\text{BH}_2^{2+}(\text{aq})$ both be found in appreciable quantities?
- A. Point 2
 - B. Point 3
 - C. Point 4
 - D. Point 5
52. If the original volume of 0.100 M B solution was 20.00 mL, what is the approximate volume of acid that has been added at point 2?
- A. 5 mL
 - B. 10 mL
 - C. 15 mL
 - D. 20 mL
53. What is the approximate pH at point 4 on the titration curve?
- A. 3
 - B. 7
 - C. 10
 - D. 13
54. What is the predominant pH-determining reaction in the titration flask before any HCl is added?
- A. $\text{BH}_2^{2+}(\text{aq}) = \text{BH}^+(\text{aq}) + \text{H}^+(\text{aq})$
 - B. $\text{BH}^+(\text{aq}) = \text{B}(\text{aq}) + \text{H}^+(\text{aq})$
 - C. $\text{B}(\text{aq}) + \text{H}_2\text{O}(\text{l}) = \text{BH}^+(\text{aq}) + \text{OH}^-(\text{aq})$
 - D. $\text{BH}^+(\text{aq}) + \text{OH}^-(\text{aq}) = \text{B}(\text{aq}) + \text{H}_2\text{O}(\text{l})$
55. Suppose that the indicator Phenol Red is used to monitor the titration. Phenol Red is a monoprotic acid with $\text{pK}_a = 7.81$; its acidic form, HInd, is yellow in solution, and its basic form, Ind^- , is red. Which of the following correctly predicts the colors that Phenol Red will take on at two different pHs during the titration?
- A. pH 5: yellow; pH 10: yellow
 - B. pH 5: yellow; pH 10: red
 - C. pH 5: red; pH 10: yellow
 - D. pH 5: red; pH 10: red

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56. In an effort to discover combinations of piperazine species that will have buffering properties, a student decides to graph the rate of change of pH against volume of acid added. Which of the following best illustrates the graph that she would obtain?



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Passage IX (Questions 57–61)

The concept of electronegativity is central to discussions of molecular bonding and structure. Linus Pauling compiled the values of electronegativity (EN) that are most widely used, and that are displayed for a few compounds in Table 1 below. To assign numerical values to individual atoms, Pauling used bond energy differences between atoms bonded to themselves (e.g., C–C) and to other atoms (e.g., C–Cl).

H 2.1						
Li 1.0	Be 1.5	B 2.0	C 2.5	N 3.0	O 3.5	F 4.0
Na 0.9	Mg 1.2	Al 1.5	Si 1.8	P 2.1	S 2.5	Cl 3.0
K 0.8	Ca 1.0	Ga 1.6	Ge 1.8	As 2.0	Se 2.4	Br 2.8

Table 1: Pauling electronegativities

Robert Millikan also defined a scale of electronegativities, using the formula

$$EN_{\text{Mill}} = 1/2(\text{IE} + \text{EA})$$

where IE is the first ionization energy of the atom and EA is its first electron affinity. (Both quantities are measured in electron volts, eV.) Several values of IE and EA are given in Table 2.

atom	IE (eV)	EA (eV)
H	13.6	0.76
Li	5.32	0.622
C	11.25	1.27
N	14.52	-0.07
O	13.66	1.46
F	17.42	3.34
Cl	13.0	3.62
S	10.4	2.07
Br	11.8	3.40

Table 2: IE and EA for calculating Millikan electronegativities

Table 3 shows values of dipole moment and bond energy for several simple molecules.

molecule	dipole moment (Debye)?	bond energy (kJ/mol)
HF	6.37	565
H ₂ O	6.17	463
NH ₃	4.90	388
NCI	3.60	431
HBr	2.67	366
HI	1.40	299

Table 3

Table 4 gives acid dissociation constants K_a for a number of acids.

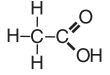
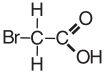
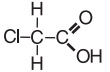
Compound	Structure	K_a
Acetic Acid		1.8×10^{-5}
Bromoacetic acid		1.25×10^{-3}
Chloroacetic acid		1.36×10^{-3}

Table 4

57. Use the data provided to determine a criterion for classifying bonds as “ionic” versus “polar covalent” based on electronegativity difference.
- “Ionic” if $\Delta\text{EN} < 1.2$; “polar covalent” if $\Delta\text{EN} > 1.2$
 - “Ionic” if $\Delta\text{EN} > 1.2$; “polar covalent” if $\Delta\text{EN} < 1.2$
 - “Ionic” if $\Delta\text{EN} < 2.0$; “polar covalent” if $\Delta\text{EN} > 2.0$
 - “Ionic” if $\Delta\text{EN} > 2.0$; “polar covalent” if $\Delta\text{EN} < 2.0$
58. Which of the following best explains the reason for Millikan’s decision to define electronegativity as he did?
- If the IE is high, an atom is more likely to lose it to another atom when a bond is formed. If the EA is high, an atom is more likely to attract the electron from another atom when a bond is formed.
 - If the IE is high, an atom is less likely to lose it to another atom when a bond is formed. If the EA is high, an atom is more likely to attract the electron from another atom when a bond is formed.
 - If the IE is high, an atom is less likely to lose it to another atom when a bond is formed. If the EA is high, an atom is less likely to attract the electron from another atom when a bond is formed.
 - If the IE is high, an atom is more likely to lose it to another atom when a bond is formed. If the EA is high, an atom is less likely to attract the electron from another atom when a bond is formed.

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59. Which of the following is a difference in the order of electronegativities predicted by the Pauling method versus the Millikan method?

- A. Pauling: $EN(F) > EN(Cl)$
 Millikan: $EN(F) < EN(Cl)$
 B. Pauling: $EN(C) > EN(H)$
 Millikan: $EN(C) < EN(H)$
 C. Pauling: $EN(N) > EN(C)$
 Millikan: $EN(N) < EN(C)$
 D. Pauling: $EN(O) > EN(N)$
 Millikan: $EN(O) < EN(N)$

60. Which of the following best describes the relationship of electronegativity, bond enthalpy, and dipole moment?

- A. For a diatomic molecule (or a larger molecule with only one type of bond), as electronegativity increases, bond enthalpy *increases* because of the increasingly ionic character of the bond. Dipole moment *increases* because it depends on charge separation between atoms.
 B. For a diatomic molecule (or a larger molecule with only one type of bond), as electronegativity increases, bond enthalpy *decreases* because of the increasingly ionic character of the bond. Dipole moment *increases* because it depends on charge separation between atoms.
 C. For a diatomic molecule (or a larger molecule with only one type of bond), as electronegativity increases, bond enthalpy *increases* because of the increasingly ionic character of the bond. Dipole moment *decreases* because of the diminishing charge separation between atoms.
 D. For a diatomic molecule (or a larger molecule with only one type of bond), as electronegativity increases, bond enthalpy *decreases* because bonds are strongest between similar atoms. Dipole moment *decreases* because of the diminishing charge separation between atoms.

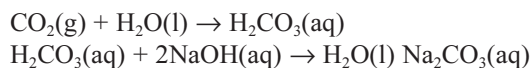
61. Use the trends illustrated in the given data to predict the order of acid dissociation constant of the acids HOCl, HOBr, and HOI.

- A. $K_a(\text{HOCl}) < K_a(\text{HOI}) < K_a(\text{HOBr})$
 B. $K_a(\text{HOCl}) < K_a(\text{HOBr}) < K_a(\text{HOI})$
 C. $K_a(\text{HOI}) < K_a(\text{HOBr}) < K_a(\text{HOCl})$
 D. $K_a(\text{HOBr}) < K_a(\text{HOI}) < K_a(\text{HOCl})$

Passage X (Questions 62–70)

Chemists have a variety of tools at their disposal to determine the carbon dioxide concentration in a gas mixture.

Method 1: A mixture containing CO_2 is introduced into a flask containing aqueous NaOH , after which the following reaction occurs:



The pressure in the flask is monitored, and the pressure change allows us to compute the amount of CO_2 that has reacted.

Method 2: CO_2 can be trapped by an ion-exchange resin, where it is bound to resin cations in the form of carbonate ions. The resin is then rinsed with NaNO_3 and the resulting carbonate ions are titrated with sodium hydroxide.

Method 3: Because CO_2 absorbs efficiently in the infrared region of the spectrum, it can be detected and measured using infrared spectroscopy.

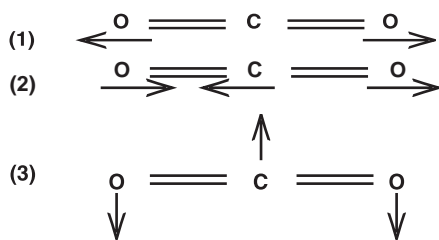
If infrared radiation enters a sample cell with intensity I_0 and exits with intensity I , then the transmittance T is defined as

$$\begin{aligned} T &= I/I_0 \\ \text{and the absorbance } A &\text{ is defined as} \\ A &= -\log T = -\log (I/I_0) \end{aligned}$$

Beer's Law states that $A = abc$, where a is the molar absorptivity, a property of both the wavelength and the molecule itself; b is the path length of the cell in cm; and c is the concentration of the absorbing species in mol/L. Thus if A , a , and b are known, Beer's Law can then be used to determine the concentration of the gas.

The figure on page 125 shows the "normal modes" of CO_2 , together with absorption frequencies that excite these modes.

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- (1) symmetric stretch; $\nu_1 = 4.16 \times 10$
 (2) asymmetric stretch; $\nu_2 = 7.05 \times 10$
 (3) bend; $\nu_3 = 2.00 \times 10$

62. Using Method 1, a student attempts to determine the mass of CO_2 contained in a gaseous mixture of CO_2 , O_2 , and N_2 in a 250-mL flask. When 25.0 mL of 2.00 M NaOH is added and the flask is resealed, the pressure inside is observed to drop from 760 torr to 745 torr. Which of the following is closest to the original mass of CO_2 ?

- A. 0.004 g
 B. 0.009 g
 C. 0.020 g
 D. 0.050 g

63. For which of the following gas mixtures might this method fail to determine the mass of CO_2 ?

- A. CO_2 , H_2 , and N_2
 B. CO_2 , H_2S , and O_2
 C. CO_2 , Ar, F_2
 D. CO_2 , N_2 , Ne

64. Assume that the reaction to remove CO_2 is carried out at a constant temperature of 25.0°C . Which of the following best describes the process at a molecular level?

- I. The number of collisions per second of gas molecules with the wall of the flask is greater before the reaction than after.
 II. The average kinetic energy of gas molecules is greater before the reaction than after.
 III. The number of gas molecules per cm^3 is greater before the reaction than after.

- A. I only
 B. II only
 C. III only
 D. I and III only

65. A 10.0 mL gas sample, containing CO_2 as well as other gases, is collected at 760 torr and 25°C . The sample is passed through a moist ion-exchange resin, converting each CO_2 molecule to a CO_3^{2-} ion, and the resin is rinsed with NaNO_3 . The rinse solution is titrated with 0.0200 M HNO_3 , and a phenolphthalein endpoint is reached at 20.40 mL. Which of the following best approximates the partial pressure of CO_2 in the original sample?

- A. 150 torr
 B. 380 torr
 C. 560 torr
 D. 760 torr

66. In a different analysis using the same method, a sample containing 8.00 mmol of CO_2 is passed through a resin column, then rinsed out as 10.00 mL of Na_2CO_3 solution. What is the approximate pH of this solution? (For H_2CO_3 , $K_1 = 4.45 \times 10^{-7}$ and $K_2 = 4.69 \times 10^{-11}$.)

- A. 2
 B. 6
 C. 9
 D. 12

67. The figure included in the passage shows the "normal modes" of CO_2 , where a normal mode is defined as an independent mode of vibration. Each normal mode has a characteristic vibrational frequency given to the right of its illustration. Which of the following shows the correct order of wavelengths of absorption for each mode, in order from shortest to longest wavelength? (Assume, for this question, that all of the modes permit absorption.)

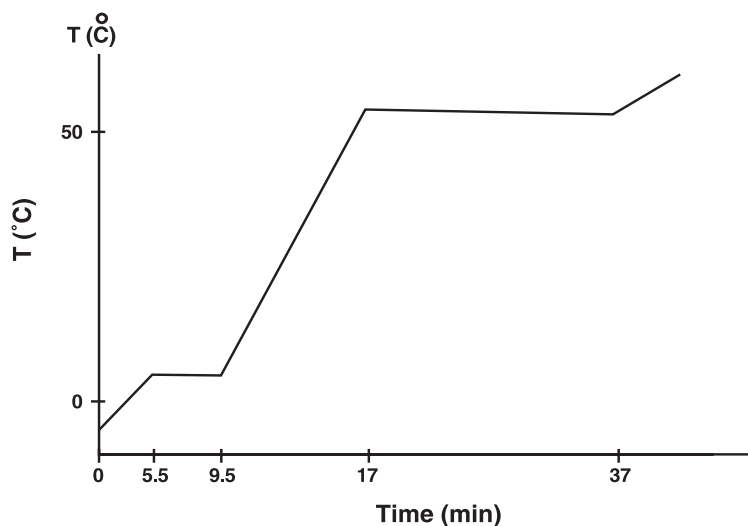
- A. $\lambda_1 < \lambda_2 < \lambda_3$
 B. $\lambda_2 < \lambda_1 < \lambda_3$
 C. $\lambda_3 < \lambda_1 < \lambda_2$
 D. $\lambda_1 < \lambda_3 < \lambda_2$

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68. A molecule will absorb infrared light at a frequency that excites one of its normal modes, but only if that frequency produces a change in the dipole moment of the molecule. Which of the modes shown in the figure included in the passage would NOT lead to absorption of light?
- A. The symmetric stretch
 - B. The asymmetric stretch
 - C. The bend
 - D. Both the symmetric and asymmetric stretches
69. An investigator wishes to determine the concentration of CO_2 in a gas mixture. She sets the spectrometer to record absorption by the mode at $7.05 \times 10^{13} \text{ s}^{-1}$ and finds that when she measures a sample whose concentration is known to be $2.5 \times 10^{-4} \text{ M}$, the absorbance is 0.195. The known sample is removed, an unknown CO_2 sample is introduced, and the measurement is repeated under identical conditions, producing an absorbance of 0.452. Which of the following best approximates the concentration of CO_2 in the unknown sample?
- A. $1 \times 10^{-4} \text{ M}$
 - B. $4 \times 10^{-4} \text{ M}$
 - C. $6 \times 10^{-4} \text{ M}$
 - D. $9 \times 10^{-4} \text{ M}$

INDIVIDUAL PROBLEMS

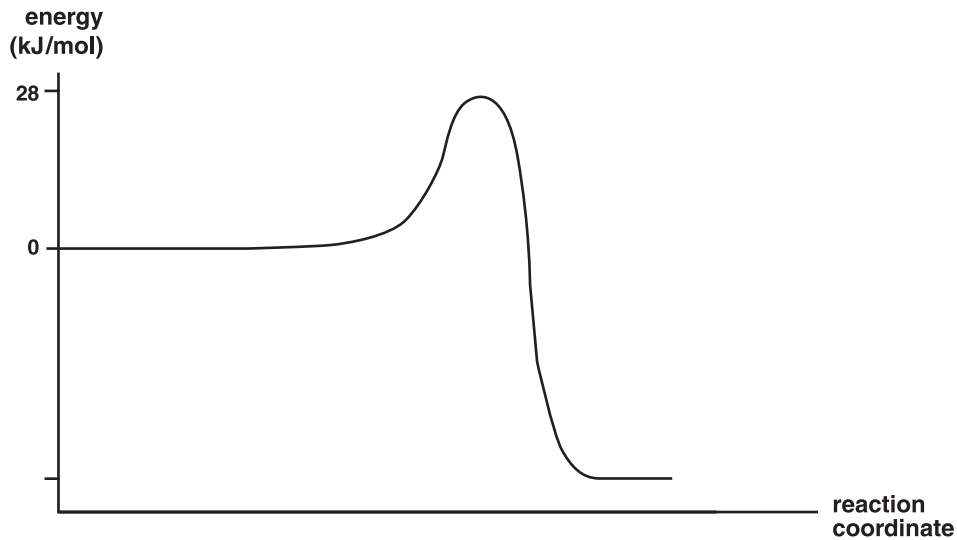
70. A sample containing 1.00 mol of substance X was heated at a constant rate of 1.00 kJ/min, and the resulting temperature of the sample was recorded. The results of this process over several minutes are displayed in the figure below. What is the enthalpy of vaporization for substance X?



- A. 4.0 kJ/mol
- B. 7.5 kJ/mol
- C. 20.0 kJ/mol
- D. 37.0 kJ/mol

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71. The figure below shows the energy change as the reaction $A + B \rightarrow C + D$ proceeds from reactants to products. ΔG for this reaction is -34 kJ/mol .



What is the activation energy, E_a , for the reaction $C + D \rightarrow A + B$?

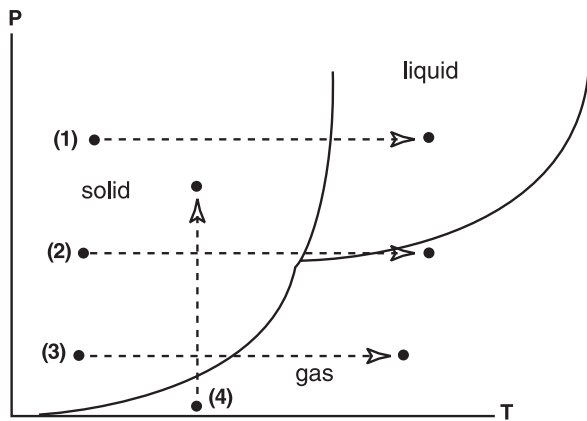
- A. -6 kJ/mol
 B. 6 kJ/mol
 C. 34 kJ/mol
 D. 62 kJ/mol
72. Which of the following will be expected to have the *lowest* vapor pressure at 25°C ?
- A. Pure H_2O
 B. 1.0 M ethanol (boiling point = 78.0°C)
 C. 1.0 M glucose
 D. 1.0 M NaCl
73. Aluminum reacts with HCl according to the following reaction:
- $$2\text{Al}(s) + 6\text{HCl}(aq) \rightarrow 2\text{AlCl}_3(aq) + 3\text{H}_2(g)$$
- Find the volume of hydrogen gas that will be produced (at STP) when 2.70 mg of metallic aluminum reacts with 20.00 mL of 0.0100 M HCl .
- A. 0.20 mL
 B. 0.30 mL
 C. 2.0 mL
 D. 30 mL
74. In an effusion experiment, a 52.0-mL container holds argon gas at 1.00 atm pressure. A pinhole-sized valve is then opened, and the gas is allowed to escape into a large, evacuated container. After 24.0 minutes, the gas pressure in the original container has dropped effectively to zero.
- The experiment is repeated with gas X, under otherwise identical conditions, and the time required for the pressure to drop to zero is found to be 20.0 min . What is the molar mass of gas X?
- A. 28 g/mol
 B. 35 g/mol
 C. 48 g/mol
 D. 57 g/mol

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75. A sample of 0.25 M NaCl is diluted with 48.0 mL of water, with the result that the concentration drops to 0.20 M. What was the volume of the original sample?
- A. 38 mL
 - B. 85 mL
 - C. 106 mL
 - D. 192 mL

77. Chromatography can be used to:
- A. separate nonvolatile liquids.
 - B. separate volatile liquids.
 - C. separate a nonvolatile liquid from a volatile liquid.
 - D. All of the above

76. The figure below shows a phase diagram for a single-component system. Which of the paths indicated describes sublimation?



- A. 1
- B. 2
- C. 3
- D. 4

VERBAL REASONING

Time: 85 Minutes

Questions 78–137

Directions: There are nine passages in this test. Each passage is followed by questions based on its content. After reading a passage, choose the one best answer to each question and indicate your selection by blackening the corresponding space on your answer sheet.

Passage I (Questions 78–84)

A hurricane is a cyclonic storm that forms in the tropics or subtropics over large bodies of warm water where the water temperature is at least 80 degrees Fahrenheit. This kind of storm must have a minimum sustained wind speed of at least 74 miles an hour and is one of the most powerful storms known to humanity.

For years, the development and paths of hurricanes and tropical storms (which are also cyclonic storms with sustained wind speeds of 39 to 74 miles an hour) were largely unpredictable. These storms intensify, change direction unpredictably, and make landfall where least expected, causing severe damage to people and property. But now that scientists have better knowledge of hurricanes and tropical storms, there is an increasing ability to predict the direction and intensity of such storms in advance of their landfall.

The ability to predict the paths of hurricanes has been greatly enhanced by the use of computers and satellites. The existence of better knowledge of the storm tracks of previous hurricanes has helped predict storms, although spotter planes are still used to obtain exact readings. In addition, the increased knowledge of the role that steering winds play at high altitudes has become one of the most important factors in predicting storm paths. Such winds will steer a tropical system in clearly defined directions, allowing the forecaster to map a path for a tropical system days in advance of the storm hitting.

Other reasons for the better understanding of storm tracks include a better understanding of the effects of wind shear (a situation where winds are blowing in different directions at different altitudes) on hurricanes and tropical storms. Strong wind shear is not conducive to the development of hurricanes, and strong cold fronts can often block the paths of approaching hurricanes, which act as a wall that redirects the hurricane. With this improved prediction of frontal passages,

the influence fronts will have on the paths of hurricanes and tropical storms can be better predicted.

Computers are also an enormous asset in predicting the possible paths of hurricanes, because a computer can generate likely models for the development and direction of hurricanes based on information on the histories of previous hurricanes. The models can be easily adjusted as new information comes in, allowing for increasing reliability of prediction as the hurricane comes closer to landfall. This data has also been useful in prediction of the direction and intensity of hurricanes and tropical storms.

Still, some traditional approaches to the prediction of tropical systems are used. Flying into the eye of a hurricane is still the best way to obtain accurate information about the tropical system, because other sources might be either unavailable or unable to confirm existing information. Only by using planes can a truly accurate reading on barometric pressure in the eye of the storm and exact wind speed be obtained. Though satellites give a good image of the eye of a hurricane and the expanse of the tropical system, the instruments on the planes can provide more accurate readings and therefore, a better understanding of how the storm is likely to develop. These exact readings become crucially important as the storm approaches landfall.

There is still much to learn about tropical systems that develop into tropical storms and hurricanes. It would be arrogant to imagine that the progress of all such storms days in advance can be accurately predicted. However, the reliability of forecasts has greatly advanced our ability to give advanced warning of systems that are among the most destructive known. As understanding grows, the reliability of forecasting will continue to improve, and the safety of the populations affected by tropical systems will increase. Yet hurricanes are still very capable of the unpredictable and will remain that way for the foreseeable future.

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78. A hurricane forms in which of the following conditions?
- A. Only at water temperature over 80 degrees Fahrenheit
 - B. In the tropics or subtropics of water temperature over 80 degrees Fahrenheit
 - C. In the tropics or subtropics over large bodies of water with water temperature at 80 degrees Fahrenheit
 - D. In the tropics or subtropics over large bodies of water with a high water temperature
79. According to the passage, a hurricane can also be called a:
- A. tropical storm.
 - B. maelstrom.
 - C. tornado.
 - D. cyclonic storm.
80. The prediction of the hurricane paths has been improved by the use of:
- A. computers, satellites, and following storm tracks of previous hurricanes.
 - B. computers and satellites.
 - C. computers, satellites, and knowledge of previous hurricane storm tracks.
 - D. computers, satellites, and airplanes.
81. The author sees the use of computers in predicting possible hurricane paths as:
- A. simply a useful tool.
 - B. an asset.
 - C. a machine to record information.
 - D. one of several tools to rely on.
82. The ability to better forecast tropical systems has been enhanced by a better understanding of:
- A. the role of wind shear.
 - B. the role of steering winds at different altitudes.
 - C. the role of different storm fronts.
 - D. predicting frontal passages.
83. According to the author, what is still the best way to obtain accurate information about a tropical system?
- A. Flying into the eye of the storm in a plane
 - B. Using radar
 - C. Using only previous information
 - D. Using only computers
84. The author points out that traditional methods of studying and tracking hurricanes, along with the use of modern technology, are beneficial but also believes that:
- A. without both, the ability to predict the paths of tropical storms and hurricanes cannot be accomplished.
 - B. understanding advanced warning systems does not necessarily help predict future hurricanes.
 - C. forecasting future tropical storms will continue to advance, thereby increasing the chances of ensuring protection for people in areas prone to tropical storms.
 - D. forecasting can be reliable as long as we understand that it is possible to make mistakes in predicting the beginnings of hurricanes.

Passage II (Questions 85–91)

Of the 35 million Europeans who arrived in the United States between 1820 and 1920, one third were women. A larger wave of immigration that started in 1880 included approximately 20 million men, women, (5) and children who emigrated mostly from southern and eastern Europe. These newer immigrants were Poles, Italians, Jews, Slovaks, Bohemians, Greeks, and Armenians. The majority were from the rural areas in their home countries. For the immigrant women, the transition from the life and routine of the rural countryside to the slum conditions of the urban cities where most immigrant families settled was particularly difficult.

In many small European villages, a way of life was maintained for generations. For the peasant woman, (15) life followed a simplistic order: she worked, married, raised children, and maintained customs and beliefs handed down from her mother, grandmother, and great-grandmother that she in turn would pass down to her own daughter. A woman was defined by her place in (20) the family; a sense of individuality separate from one's family did not exist in Europe. Peasant society was based on a patriarchal system, so a woman's existence legally was dependent on her father or husband. Women

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did not inherit property, which was passed from fathers
(25) to sons. Despite this restriction, a woman had considerable power within her family. She was respected as a mother and a worker, as she was responsible for her family's well-being. In many of these cultures, the mother was recognized as the moral and spiritual heart
(30) of the household, and many women carried these important bonds with them when they immigrated to America.

Immigrant women, however, found life during their early years in America arduous and challenging
(35) as they struggled to help their families survive in urban cities such as Chicago, Boston, and New York, where many immigrant families chose to live. Housing could be found, but only in densely populated immigrant enclaves. There was no longer open countryside to own
(40) land and garden vegetables, as the family had done in the old country. Instead, the immigrant woman lived in a tenement flat, usually on a slum street with no open space. Her small, but clean house built of logs was replaced in America by a cramped flat with three or four
(45) rooms in which one, and sometimes two, families lived. The average tenement flat in the early 1900s had a parlor, a kitchen, and one or two bedrooms in between, so small that at times there was space for only a bed. The rooms tended to be dark as most flats had one room
(50) with a window facing the street while other windows had back alleys to look out at. At night, no open-floor space could be found in a tenement, as every corner and inch of floor became sleeping space. Privacy in the cramped space was achieved by hanging sheets from
(55) ropes to divide rooms in half and quarter spaces.

The traditional jobs an immigrant woman was accustomed to doing in the old country had to give way as she adjusted to her new surroundings. In the old country, work such as gardening, milking cows, and harvesting the crops were done outdoors. Forced to live in
(60) closed and uncomfortable spaces, it took much skill and ingenuity to keep some order in a room housing perhaps eight people, when there was hardly space enough for one to walk. Not only was she constantly working
(65) at finding space for family members in the cramped apartment, she also was trying to keep the flat clean. Resourcefulness was a necessity in juggling the space in the apartment to accommodate so many people. In addition, the kitchen had to be organized to be a work-
(70) room, a laundry room, a living room, and a bedroom. In the kitchen would be a coal stove, which was unfamiliar to the immigrant woman who used to cook on an open hearth in the old country. The oven in the kitchen could be broken, and when not properly ventilated,
(75) smoke would leak out of several joints. When she had garbage or "slops" in the old country, she would be able to sweep it into her garden or feed it to the livestock. In America, however, garbage could not be disposed in

the same way nor did it serve any purpose. It was quite
(80) common for a woman to toss it out the window, often in overflowing buckets, into the street. Doing so was easier because she would not have to walk down the stairs to throw the garbage out.

A trip to the market was an ordeal for the immigrant woman. In the old country, an immigrant peasant
(85) woman fed her family with the produce from her garden and the family's farmyards. But in America she had to buy food instead and use cash. Market shopping was a daunting task that included pushing through
(90) crowds, fighting with other customers over produce that was often damaged or not fresh, and spending money on foods such as bread, which was normally homemade in the old country. In America, it became a practice to buy bread already baked. Money had to be stretched as
(95) far as possible, so the immigrant woman became an aggressive bargainer with merchants or peddlers.

Because immigrant men were paid too low a wage to support the family, other family members had to work as well. So, in addition to household duties, an immigrant woman would often take on other jobs to earn
(100) wages to pay for food and rent. Immigrant mothers with small children earned money at home in different ways, such as doing piecework for one of the manufacturing trades that still employed home workers. Women in different ethnic groups tended to work at different trades.
(105) For example, Jewish and Italian women sewed in their homes for the needle trades (the largest employers of immigrant women), which included manufacturers of coats, dresses, millinery, shirtwaists, and underwear.
(110) Married women stitched in their tenement flats, and unmarried women sewed in shops and factories.

While immigrants arriving in America adhered to traditional values and customs, the way of life they knew in the old country was not continued with their
(115) children, who were more readily absorbed into the American culture. This often created conflicts between parents and their children. The traditions handed down from mother to daughter in the old country, which had preserved a sense of continuity, were not possible to maintain in America. Perhaps one of the worst difficulties of the immigrant mother was the loss of a daughter's
(120) desire to observe the customs of the old country. The traditional way of life no longer could be handed down from mother to daughter, particularly if the daughter insisted on making her own choices and not having them made for her by her family.
(125)

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85. One of the greatest difficulties an immigrant mother faced adjusting to life in America was:
- A. the inability to find suitable factory work.
 - B. moving to a slum from the countryside.
 - C. not being able to have a daughter preserve the customs from the old country.
 - D. being forced to haggle with food vendors.
86. European peasant women were accustomed to observing specific customs and beliefs:
- A. handed down by the women in their family.
 - B. that allowed them to adjust to American culture.
 - C. handed down by the women in their family that permitted women to be individualistic.
 - D. handed down that did not have to be followed should an individual choose not to.
87. The passage refers to housing for the poor at this time as a tenement flat, which means:
- A. a private apartment with spacious rooms.
 - B. a run-down, low-rental apartment building whose facilities barely meet minimum standards.
 - C. a rental apartment with adequate facilities.
 - D. sharing a bath and toilet on the same floor with another family.
88. Although living in the city, an immigrant woman was able to substitute traditional chores done in the old country by:
- A. selling baked items at the neighborhood market.
 - B. taking care of the children of women in the manufacturing trades.
 - C. spending time to care only of the apartment.
 - D. keeping the tenement flat clean, juggling space to allow people to fit, and turning the kitchen into several work areas.
89. The passage points out that in the old country the immigrant women were accustomed to:
- A. gardening vegetables to feed the family.
 - B. gardening vegetables to feed the family and often selling some in the marketplace.
 - C. using money to buy bread already baked.
 - D. using money to bargain at the market.
90. According to the passage, an immigrant woman in America often had to earn additional money because:
- A. it was expected that she also work.
 - B. the immigrant man received such low wages that other family members had to work.
 - C. the immigrant women received higher wages than did immigrant men.
 - D. the family would starve and be evicted from their apartment.
91. One can infer from the passage's tone that the author is largely sympathetic about the:
- A. unsanitary and poorly maintained apartments immigrant families were forced to live in.
 - B. immigrant woman's struggles to adapt to a different language.
 - C. many difficulties an immigrant woman faced in adapting to another culture.
 - D. poverty-stricken conditions the immigrant family lived in on a daily basis.

Passage III (Questions 92–98)

What were the results at the end of the Spanish-American War, which was fought in 1898 between the United States and Spain? The answer may seem obvious, but it is not. Why the war was fought is not completely clear. There was growing desire among many Americans for a colonial empire but the feeling was hardly universal, and in fact, President William McKinley opposed a war with Spain. Four colonies owned by Spain were affected by the war: Cuba, Puerto Rico, Guam, and the Philippine Islands. By the 1890s, American citizens in Cuba owned about 50 million dollars' worth of Cuban property, primarily in the sugar, tobacco, and iron industries. The president was under tremendous pressure to defend U.S. interests on the island. By 1898, both Cuba and the Philippine Islands had revolted against Spain.

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Jose Marti, who had lived in exile in the United States, led the revolution for Cuban independence. As the intensity of the revolution increased, with Cubans waging guerrilla warfare in trying to wear out the Spanish, the brutality of the Spanish response grew in retaliation. In the United States, sympathy for the Cuban revolution increased. Many Americans wanted the United States to intervene on the side of the Cuban rebels, because the Spanish were seen as unwanted foreigners to be driven out of the hemisphere. Two events crystallized American sentiment for going to war with Spain. One was a letter written by the Spanish minister in Washington, Enrique Dupuy de Lome, criticizing President McKinley as a “weakling and a bidder for admiration of the crowd.” The second event was the sinking of the battleship *U.S.S. Maine* in Havana harbor, where 266 United States naval troops lost their lives. This event galvanized U.S. opinion and gave President McKinley little choice but to declare war on Spain, even though a Spanish inquiry claimed that the ship had an internal problem leading to its explosion. The American investigation of the *Maine*, ordered by McKinley, determined that the cause was a submarine mine, although no people or party was officially blamed for the ship’s explosion. Spain broke diplomatic relations with the U.S. on April 23, 1898, and war was declared by Congress retroactively to April 21. From the beginning of hostilities, the United States made it clear that the sole motive at the beginning of the struggle was to win Cuban independence. Congress passed a resolution, the Teller Amendment, that made it clear that the U.S. had no intention of annexing Cuba. Although neither Spain nor the United States had desired war, both made preparations as the crisis deepened after the sinking of the *Maine*.

Once war broke out, the United States expanded the war to include the Philippine Islands, Puerto Rico, and Guam. In addition to a blockade of Cuba, the United States Navy, under the leadership of Commodore George Dewey, attacked the Spanish colony in the Philippine Islands by sea in Manila Bay. In addition, Dewey used Filipino troops under the leadership of Emilio Aguinaldo, who had become the leader of a revolutionary outburst against Spain in 1896–1897 that ended in a truce. Although Aguinaldo attempted to re-energize his movement and capture Manila, seat of the Spanish colony, Dewey did not recognize the government. Aguinaldo was forced to form an uneasy alliance with American troops. The cooperation between the Filipino insurgents and the U.S. forces culminated in Spain surrendering in August. The U.S. did not want the Filipinos to gain control and was negotiating a separate surrender with the Spanish. Despite appreciation among the Filipinos for the U.S. helping evict Spanish rule, tensions increased as Filipinos realized that the inter-

est of the U.S. was not about protecting democracy but about territorial expansion. Before the peace treaty between the U.S. and Spain was formally signed, U.S. troops fired on a group of Filipinos, starting the Philippine-American War. The uprising of the Filipinos and the war in the Philippines continued until 1914, when the United States finally crushed the insurrection and annexed the Philippines. The estimated number of civilians killed ranged from 200,000 to 600,000.

By August, the Spanish realized they had no hope to win the Spanish-American War and signed a protocol ending all hostilities on August 12, 1898. The war officially ended December 10, 1898, with the signing of the Treaty of Paris. The treaty allowed the United States to annex Puerto Rico in lieu of indemnities, gave the United States the Philippines for the sum of \$25,000,000, and also gave the United States control of Guam. Guam had surrendered without a fight. Puerto Rico was also annexed, mostly without resistance.

One of the results of the war was that Cuba received its independence, but with severe limitations through the Platt Amendment. The Platt Amendment gave the United States the right to intervene in Cuban internal affairs and determine Cuba’s foreign affairs and granted the U.S. a naval base at Guantanamo Bay for perpetuity without rent. With this, the United States felt it had secured the Caribbean and felt secure in building the Panama Canal. In the case of Guam, the Philippine Islands, and Puerto Rico, the result of the war simply meant the replacement of one colonial ruler with another. At the end of the war, the United States had begun its own colonial empire.

92. According to the passage, the Spanish colonies involved in the Spanish-American War of 1898 were:

- A. Puerto Rico, the Dominican Republic, Cuba, and Guam.
- B. Puerto Rico, the Philippine Islands, Guam, and Haiti.
- C. Puerto Rico, Cuba, the Philippine Islands, and Guam.
- D. Puerto Rico, Cuba, the Philippine Islands, and Mexico.

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93. Many Americans supported the idea of war because they:
- A. wanted to show the superiority of American troops in battle.
 - B. believed that the colonies should be independent of Spanish rule.
 - C. saw it as a means of preserving U.S. investments in all four colonies.
 - D. envisioned having an American colonial empire by acquiring the four colonies.
94. An official American investigation of the explosion of the *U.S.S. Maine* was ordered by President McKinley with the findings that:
- A. Spanish insurgents were determined to gain independence by implicating Spain in the explosion.
 - B. the cause was unofficially a Spanish submarine mine.
 - C. the cause was an internal explosion, as a Spanish investigation determined.
 - D. the cause was a submarine mine with no one officially blamed.
95. The Spanish-American War was fought primarily:
- A. on the terrains of all four colonies.
 - B. on the seas, with a blockade of Cuba and an attack on the Spanish colony in the Philippine Islands.
 - C. on the seas and finished with the surrender on land by the governor of Cuba.
 - D. by the revolutionary insurgents of each colony.
96. The alliance between the Filipino insurrectionists and American troops ended at the end of the war:
- A. with an uprising by the Filipino population, lasting until 1914, when the United States destroyed the Filipino opposition.
 - B. when Aguinaldo took over leadership of the Philippine Islands.
 - C. with Filipino allegiance to the United States.
 - D. immediately after the U.S. and Spain formally signed the peace treaty.
97. Actual fighting during the Spanish-American War occurred in the following Spanish colonies:
- A. Cuba, the Philippine Islands, and Puerto Rico.
 - B. Cuba, the Philippine Islands, and Guam.
 - C. Cuba and the Philippine Islands.
 - D. the Philippine Islands and Guam.
98. The passage points out that although Cuba was given independence, the Philippine Islands, Puerto Rico, and Guam were:
- A. to remain under the protection of the United States as colonies.
 - B. promised eventual freedom after a fifty-year period.
 - C. thought to be incapable of self-determination after years of colonization.
 - D. expected to pledge allegiance to the United States once freedom was granted to them by the U.S.

Passage IV (Questions 99–104)

Redwood trees once covered much of the world. Millions of years ago the climate was ideal for the development of many species of redwood trees throughout the northern hemisphere. They were particularly (5) common during the Jurassic period, or the age of dinosaurs. As the climate grew less moderate, the range of the redwood tree began to get smaller. The current range has existed for several million years. Many species of redwood trees disappeared and today only three varieties remain and of the three, two have very limited (10) ranges.

The rarest variety of all is the Dawn Redwood or *Metasequoia Gilyptostroboides*. This variety was thought to be extinct, but a small number of these trees (15) was found in a remote valley in China in the 1940s. As far as is known, these trees had survived in a single grove. This variety is the only non-evergreen variety still in existence and is also the smallest of the redwoods, reaching a height of 115 feet with a diameter of (20) less than 15 feet. The fact that they survived at all is quite surprising.

The second variety that has survived is the Sequoia Redwood, *Sequoia Giganteum*, which also has a very limited range. It is only found between 5,000 and (25) 8,000 feet on the west side of the Sierra Nevada Mountain Range. It is found from Yosemite National Park in the north to Sequoia National Park in the south, a range

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of no more than 70 miles. Even in this region, the tree is only found in a few groves and some isolated individual specimens. The tree reaches a height of more than 300 feet and a diameter of up to 35 feet. Logging in the late 1800s and early 1900s would have destroyed the tree altogether except for a particular quality of this tree. When it falls to the ground, it breaks into splinters and is therefore not usable for lumber. Nonetheless, many of the few surviving groves were cut down.

The third variety of redwood is the California Coastal Redwood Tree, *Sequoia Sempervirens*, which is the redwood with the largest range. It is found from Big Sur, California, in the South to central Oregon in the north. It is found from right along the coast to as much as 20 to 30 miles inland and is not confined to groves but instead is found in significant forests. This tree is also the tallest tree known to humanity. Some trees reach a height of 360 feet or more, the height of a 36-story building and can have a diameter of 22 feet. This variety of redwood occupies a small micro-climate of mild winters and cool summers.

Though the redwood tree is very climate sensitive, in other ways it is remarkably well adapted for survival. The tree is almost completely fire resistant and can withstand major forest fires with minimal damage. It is also largely insect resistant due to unusually high levels of *tannin* in its bark. Insects that attack other evergreens are unable to attack redwood trees. Depending on the variety, these trees are also remarkably long lived. Many specimens live more than 2,000 years. Redwood trees are unusual in yet another way. They have no tap root like most other trees. This means that they are more likely subject to toppling. They reproduce in two ways: like many other trees they reproduce using sexual reproduction, which leads to the development of cones, but they can also produce asexually by producing genetic clones. This gives the species added ability to survive.

Redwood forests also create a micro-climate that is moist and ideal for the development of ferns. Coastal redwood forests are characterized by the moist ground in an otherwise dry summer climate. While coastal redwoods can survive long dry summers, though this survival is in large part made possible by the near daily penetration of coastal fog that keeps humidity levels very high for much of the night and morning, they need wet winters to flourish. Usually they need at least 30 inches of rain a year. They are also rapid growers and can grow several feet in a year.

While redwood trees have a limited natural range, both Dawn Redwoods and Mountain Sequoias have been successfully planted in much of the northern hemisphere and have thrived. You can find these redwoods in Europe, Asia, and much of North America. Coastal Redwoods have also been planted in regions where they

do not grow naturally. As long as the climate is not too hot, not too cold, and not too dry, they too have been successful. As climate continues to moderate, the range of the redwood may grow.

99. The passage states that redwood trees existed as far back as:

- A. 50 million years ago.
- B. 100 million years ago.
- C. several million years ago.
- D. about one million years ago.

100. Of the varieties of redwood trees, the three that still exist have survived due to:

- A. immunity from fire and insects, and longevity.
- B. immunity from fire and insects and infrequent logging from the lumber industry.
- C. immunity from old age, no reliance on water, and asexual reproduction.
- D. immunity from old age, asexual reproduction, and the ability to create moist, humid climates for growth.

101. According to the passage, the Dawn Redwood was believed to be extinct but a small grove was discovered in:

- A. California in the 1940s.
- B. an enclosed canyon in California in the 1940s.
- C. China in a rural area in the 1940s.
- D. a remote valley in California in the 1940s.

102. An interesting fact about the Sequoia Redwood is that:

- A. its size of 300 feet was a major factor in its survival.
- B. it can be as tall as 300 feet with a diameter of up to 35 feet.
- C. despite its giant size, it can be found along the California and Oregon coastline.
- D. the logging industry was not interested in cutting down this variety of tree due to its indestructibility.

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103. Redwood forests have the ability to foster an environment:

- A. where the climate is continuously damp.
- B. to perpetuate its growth.
- C. that allows for its tremendous growth and height.
- D. that hinders the development of ferns, plants that can choke the trees' roots.

104. The word *tannin* in paragraph 5 means:

- A. the type of chemicals found in redwood forests.
- B. the particular chemical that makes the trees insect resistant.
- C. material gathered from the base of the redwood trees.
- D. material derived from the bark and fruit of many plants.

Passage V (Questions 105–111)

More than 200 years ago, in his ground-breaking book on economics called *The Wealth of Nations*, Adam Smith said that capitalism functions best when left alone. He meant that the government should have little (5) or no involvement in the economy, which is the concept of *laissez faire*, and the book became the bible of capitalism. To this day, capitalist and many other governments, particularly the United States, espouse the doctrine of *laissez faire*. But, in fact, governments in- (10) volved themselves in the economy almost from the beginning of capitalism and often with the support of capitalism. This has been particularly true in the United States, in spite of the doctrine of *laissez faire*.

With the birth of the new nation, the United States (15) began to regulate trade and protect American industry with tariffs that made imported goods more expensive than American goods, and the new government began to build and maintain roads to facilitate trade. In the early nineteenth century, one of the biggest public works (20) projects ever undertaken began in New York State: the building of the Erie Canal, which linked Albany and Buffalo by a water channel. This channel was built at massive public expense to improve access to western markets. Other forms of government intervention in the (25) economy continued throughout the nineteenth century. One of the most important of these interventions was the building of the transcontinental railroad, which would not have been built without government support. The government gave large land grants to the two com- (30) panies that built the railroad, clearly a form of subsidy, and even picked the place that the two railroads were

to come together. Government also helped regulate wages during the nineteenth and early twentieth century by using federal troops to break strikes and federal (35) courts to issue injunctions against unions. This involvement helped to make capitalism more profitable. All these forms of government intervention were welcomed by the capitalist class.

As the twentieth century approached, government (40) intervention in the economy only increased. First, the Sherman Antitrust Act was passed, which regulated industries by giving the government power to break up monopolies and greater power to control unions. This act was followed by other antitrust acts. Though these (45) acts were initially opposed by most industrial leaders, they were mainly used to benefit capitalism either by controlling unions or by breaking up companies such as Standard Oil, which had a virtual stranglehold on industry, making it difficult for other industries to buy (50) oil at a reasonable price and expand.

Beginning with the progressives and continuing to the present, the government has increasingly regulated the conditions of work. First, child labor was out- (55) lawed and the exploitation of women was monitored. Also, beginning with the progressive movement, the quality of food and medications has been regulated by the government through the Pure Food and Drug Act. Then in the 1930s, by setting conditions of the work (60) environment and setting labor standards that included the right of unions to negotiate in good faith, the government expanded its intervention into the workings of capitalism. During the 1930s, government continued (65) to expand its role in regulating the economy. For the first time, the government began to regulate banks, the stock market, and brokers. This was done to create a reliable financial foundation so that capitalism could expand in a more rational way. Though many capital- (70) ists opposed these measures, it is clear that without them modern capitalism would not have survived and prospered in its present form. During the same period of time, the government began to regulate the money sup- (75) ply. The goal was to end deflation and create enough inflation so that it would be profitable for companies to expand. While initially the policy was only moderately successful, to this day—whether the president is a Re- (80) publican or Democrat—monetary control of the economy has been a cornerstone of economic policy.

While critics continue to press the idea that gov- (85) ernment should have little or no involvement in the economy, new legislation that increases government regulation of capitalism is passed each year at the federal and state levels. Everything from how much control of the media can one company have to what rules (90) brokers must follow when selling stocks to customers are regulated either at the federal or state level or both. The environmental movement has added another level

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of regulation of capitalism by the government. Every car, every electric power plant, and every factory must meet environmental standards. Everything from how many miles per gallon a car must get to how much particulate matter factories can pump into the atmosphere is regulated by the federal government and in some cases by state governments as well. Which products can be sold and which cannot is regulated by the federal government. It is obvious that capitalism has flourished not because of little regulation, but because of extensive and continuous expanded regulation and that this trend is likely to continue for the foreseeable future. How often do industries ask for subsidies, loans, and the blockage of imports so that their company will be successful? Were Adam Smith alive today, he would be shocked by the way the capitalist system has developed and expanded into a highly regulated environment with government involvement often requested by the very capitalist that Adam Smith thought would not survive with such involvement. Obviously, while governments like the United States talk of *laissez faire*, they practice something much different.

105. The concept of *laissez faire* can best be understood by one of the following statements:

- A. For capitalism to survive, the government must be involved in the economy.
- B. Capitalism is most successful when the government has little or no involvement in the economy.
- C. There are times that government must protect the people from the excesses of capitalism.
- D. It is okay for the government to build roads, railroads, and canals, but otherwise the government should leave capitalism to develop on its own.

106. According to the passage, which of the following were the beginnings of involvement of the United States in the country's economy?

- I. Building of the Erie Canal and the trans-continental railroad
 - II. Support of union strikes with the help of federal troops and federal courts
 - III. Building and maintenance of transportation routes
 - IV. Non-regulation of workers' wages
- A. I and III
 - B. II and IV
 - C. I and IV
 - D. II and III

107. By the beginning of the twentieth century, the government's involvement in the economy expanded to passing antitrust acts in order to:

- A. work cooperatively with unions and regulate productivity.
- B. allow large corporations to continue monopolizing specific industries.
- C. allow private federal information gathered by the government to help private industries.
- D. break up major companies with monopolies and limit labor unions' ability to strike.

108. The implication in the passage is that the government:

- A. has gained so much control over its economy that it is a danger to the growth of capitalism.
- B. views its role as a balance of power between the *laissez-faire* policy and capitalism.
- C. does not practice *laissez faire* but rather has continuously been involved in regulating the economy since the beginning.
- D. has been successful in regulating numerous work conditions in various industries.

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109. One can infer from the author's tone that the author believes:
- A. the government has the right to be involved with the country's economy.
 - B. it is the government's role to take control of the country's economy.
 - C. the government's actions contradict its actual practice of involvement in the economy with its declared policy of *laissez faire*.
 - D. the government's regulation of the country's economy is necessary for the development of capitalism.
110. By regulating banks, the stock market, and brokers in the 1930s, the government:
- A. was planning to end inflation and develop deflation.
 - B. would work with those capitalists willing to cooperate.
 - C. would be able to determine policies to be used with the public.
 - D. created a foundation for modern capitalism.
111. The author concludes with the premise that:
- A. the federal government realized its need to lessen its involvement in the country's economy.
 - B. the federal government was forced to become involved in the country's economy.
 - C. since the creation of the U.S. government, it has involved itself gradually with the economy and expanded its role and power.
 - D. since the creation of the U.S. government, it has involved itself due to many economic situations that the state governments were unable to handle.

Passage VI (Questions 112–118)

Since the Constitutional Convention of 1787, the power of the presidency has grown in relationship to the legislative and judicial branches of the national government. While our forefathers saw three branches of government of equal power, the reality has been quite different.

(5) Our forefathers were afraid of the development of tyranny and therefore tried to limit the power of the executive branch of the government. Laws originated in the legislative branch, and even if the president refused to sign a bill passed by Congress, Congress could legitimately override a veto with a two-thirds vote. The president could negotiate treaties with foreign powers, but the Senate had to approve them. The president was commander and chief of the armed forces, but only Congress could declare war. The president had the ability to appoint people to the cabinet and also federal judges, but the Senate had to approve those choices. The president administered the laws passed by Congress, but Congress could overview the administration. Finally, the Constitution gave Congress the power to impeach a president and federal appointees.

(10) While the role of the judicial branch of the government is not spelled out clearly in the Constitution, the role of judicial review was established from almost the very beginning of the federal government. This branch was yet another check and balance. The courts had the right to review federal and state laws to establish whether they were constitutional. Doing so meant that even if Congress passed and the president signed a law, the federal court system and ultimately the Supreme Court could rule that a law violated the Constitution and therefore could not be enforced. The only way around this situation was to pass a constitutional amendment.

(15) With these kinds of limitations on the presidency, how has the office become so powerful? Beginning with George Washington, the presidency came to represent the country in a way that Congress and the judiciary never could. Members of Congress represent their districts, senators represent their states, and the federal courts are thought to represent nobody, as they are appointed. But the president represents the whole nation. The development of a national media has become extremely important in increasing the power of the presidency. Newspapers became widespread in the 1830s and literacy gradually became more universal throughout the nineteenth century. In addition, technology, beginning with the telegraph, made the coverage of events national. The whole country could learn what the president was doing as he was doing it. While coverage was

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and is given to congressional figures, that coverage is usually regional. Thus, increasingly, the president has become the embodiment of the nation. Obviously, the twentieth and twenty-first centuries have only enhanced this process with the development of first radio in the 1920s, then television, which was not common in American households until the 1940s and, finally, the Web, which became common in households in the early 1990s.

Franklin Delano Roosevelt was the first president who recognized the power of the media radio, with his fireside chats to the people nationwide. The use of the radio to communicate his policies was helpful because it helped him gain support for the legislation that he wanted passed through Congress. He could and did go to the nation to encourage people to put pressure on Congress to pass his bills and to see that those members of Congress who did not support his programs would not be re-elected. Today, no day goes by when the president isn't featured in the media. If Congress does not support his actions, he can focus negative attention on Congress. Congress has completely lost its power to declare war. All wars since World War II have only required a commitment from the executive branch. Sometimes Congress has been asked for its approval, but Congress was usually told even if the approval wasn't granted that the president would still continue to conduct the war. Internationally, Congress has all but abdicated its role. The president was always expected to conduct diplomacy, but it was assumed that Congress, and particularly the Senate, would also play a role. With the exception of the approval of treaties which the Senate must still perform, all other foreign policy is conducted by the president. Congress's role is still important on the domestic level, but even here the power of the president has increased. It was assumed in the Constitution that legislation would originate in Congress, but today virtually all major legislation originates in the executive branch of government. The legislation is formally introduced by a member of Congress, but written in the executive branch. In addition, broad powers have been granted to the president to implement legislation and to use executive orders that come directly from the president as legislation.

The most recent example of this expansion of presidential powers is the Homeland Security Act. The act was passed by Congress, but it originated in the executive office and was passed with significant pressure from that office. This act strengthens the presidency and weakens the role of the courts. The president, through the attorney general, has been given power for wiretaps and the issuing of certain warrants like arrest warrants. While the courts have maintained more of their power than Congress, they also are influenced by the presidency, as it is the president who appoints

federal judges. Recently, the president, through the attorney general, has been monitoring decisions made by federal judges with the implication that those judges who make unfavorable rulings will be punished in some unspecified way. The significance of this is a clear attempt to increase executive power in the judicial branch of government. With the Homeland Security Act, the president now has clear power granted by Congress to do what was formerly done by the court system.

What becomes clear is that the power of the presidency has grown far beyond what our forefathers envisioned and that this power continues to grow. It is also likely that the power of the presidency will grow even stronger as there is now no clear counterbalance.

112. According to the author of the passage, one reason the power of the presidency has grown over the last 200 years is because:

- A. of the need for a national leader.
- B. Congress has abdicated its legislative role.
- C. of the development of a national media.
- D. of the increased importance of foreign policy.

113. It would be reasonable, based on the passage, to assume that the author:

- A. supports the growth of presidential power.
- B. opposes the growth of presidential power.
- C. has no opinion on the growth of presidential power.
- D. There is not enough information in this passage to answer this question.

114. According to the passage, news became national with the:

- A. ability of newspapers to reach a wide audience.
- B. invention of the telegraph.
- C. invention of the radio.
- D. invention of television.

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115. The following are powers the president currently has:
- I. Sign warrants for unspecified reasons.
 - II. Appoint federal judges.
 - III. Approve wiretaps.
 - IV. Sign arrest warrants.
- A. I, II, and III
B. II, III, and IV
C. I, III, and IV
D. II, III, and IV
116. The passage points out that one of the following reasons was responsible for increasing the president's image of power:
- A. The president conducted all foreign policies.
B. It was difficult for the country to be aware of the president's actions as they were being carried out.
C. It was expected that the media did not focus news primarily on the president.
D. Legislation continued to be written by Congress.
117. Congress's power to declare war:
- A. also includes giving the military monetary support.
B. does not need presidential approval today.
C. after World War II was not curtailed.
D. means the president is accountable for being supportive.
118. One can infer from the passage that:
- A. the system of checks and balances for the government has worked well.
B. Congress has been more powerful than either the presidency or the judicial branch.
C. despite powers given to the three branches of government by the Constitution in 1787, the power of the presidency has overwhelmingly grown.
D. the judicial branch is free of retaliations from either the legislature or the president for decisions the Supreme Court gives.

Passage VII (Questions 119–125)

Whales, or Cetaceans, as they are scientifically known, are the largest animals to have ever lived. They are even bigger than any known dinosaur and belong to a family that actually includes whales, dolphins, and

(5) porpoises. Cetaceans are mammals and are not closely related to fish. They breathe air, not water, have hair, give birth to live young, and nurse and raise those young.

- During millions of years of evolution, Cetaceans went from being land mammals to being sea mammals.
- (10) It may be assumed that the sea provided more food and more buoyancy than the land for an already large animal. As they entered the oceans, their bodies adapted. Their hind limbs disappeared, their bodies became more tapered, and most body hair disappeared. They also developed the ability to breathe very infrequently. The lost body hair was replaced by the development of blubber as a form of protection from cold. Cetaceans' breathing apparatus moved to the top of the body, which allowed Cetaceans to breathe more efficiently in a water
- (15) environment. The external ears disappeared, as they were only effective for collecting sound waves in the air. Instead, Cetaceans developed a sonar system where they bounce sound off an object and in doing so, can tell both the size and the distance of that object. In fact,
- (20) this system is so effective that the armed forces have attempted to use dolphins to track undersea objects.

- Of course, animals as large as Cetaceans need immense amounts of food to maintain their huge size. Generally, Cetaceans feed in one of two ways. The
- (30) Odontoceti use teeth to catch fish and other food, though they do not use their teeth to chew their food. Examples of Odontoceti are porpoises, dolphins, and whales such as the Sperm Whale. The second group, known as Mysticeti, do not have teeth, but instead have plates
- (35) made of keratin that act as filters to capture small sea creatures and is a substance similar to what our fingernails are made. They will eat plankton, krill fish, and other small sea life. Examples of this group are the Blue whale and the Orca.

- (40) Cetaceans show a high level of intelligence, and many species seem to show communication skills. Dolphins are particularly vocal and may even have developed something that resembles a language. Like other members of the Cetacean family, they also use the
- (45) sounds they make to pinpoint objects both in terms of size and distance. There is evidence that they can warn each other of danger and also let other members of the group know where food is located. Cetaceans are also very social animals and will often travel in large groups.
- (50) They will use these groups to protect the young. Dolphins are unusually strong swimmers and often can keep up with speed boats.

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One can only speculate why the evolutionary development of whales has led to such large size. Some (55) whales can be 33 meters long and weigh 200 metric tons. This size would absolutely not be sustainable by the land, and in many ways it is remarkable that such a large size is even sustainable in the ocean.

While these mammals have adjusted extremely (60) well to their water environment, they do face a serious threat to their survival. That threat comes from human activity. Besides active hunting of whales that almost drove some species to extinction, there are other threats to their survival. Dolphins often die in the nets of tuna (65) fishing boats. The increase in water pollution and the decrease of the ozone layer are also a threat to the survival of Cetaceans. We do not yet know how much these environmental changes affect the survival of Cetaceans, but some have suggested that the beaching of large numbers of whales may be related to environmental pollution. While some strong steps have been made to help (70) sustain the Cetacean population, it is not clear that what has been done has been enough. While some populations have shown signs of recovery, others have continued to decline. (75)

A final serious threat particularly to whales is the return of whaling. At least three nations have become actively involved in whaling: Iceland, Japan, and Norway. These countries argue that the species which they (80) whale are now abundant enough that there is no danger to the species and further that the limits they have put on their whaling fleet will guarantee this. However, environmentalists remind us that it was previous whaling that brought so many species to the brink of extinction and also ask, what might happen if other nations (85) also begin to hunt whales?

The future of Cetaceans is clearly in the hands of humans; it will require a continued international effort to protect Cetaceans and get a better understanding of (90) these animals, if future generations are to see these magnificent creatures.

119. According to the passage, the fate of Cetaceans can be ensured:

- A. by an international effort to protect them.
- B. if countries cooperate by signing a binding agreement.
- C. by an agreed international punishment of countries that threaten the Cetaceans' existence.
- D. if the three countries—Iceland, Japan, and Norway—agree to stop hunting whales.

120. One of the following is NOT true about the adaptation of Cetaceans to being sea mammals.

- A. Blubber replaced body hair.
- B. The breathing system moved to the top of their bodies.
- C. They lost four limbs.
- D. Their body shape changed.

121. Whales, or using their scientific nomenclature, Cetaceans, are considered to be the largest animals alive. Their family also includes:

- A. sharks and salmon.
- B. all mammals that breathe water.
- C. dolphins and seals.
- D. dolphins and porpoises.

122. According to the passage, the communication skills of Cetaceans appear to be useful for them in:

- A. situations where they are forced to attack aggressors.
- B. warning one another of danger.
- C. eating.
- D. playful activities.

123. The Odontoceti's ability to consume tremendous amounts of food involves:

- A. using their teeth to catch fish but not to eat their food.
- B. their sizes in catching fish.
- C. their need to continuously feed themselves.
- D. roaming wide regions of the oceans for sufficient food.

124. The passage points out that humans are a threat to Cetaceans by doing all the following activities EXCEPT:

- A. polluting the oceans.
- B. affecting the ozone layer.
- C. actively advocating for their survival.
- D. continuing to catch dolphins instead of tuna.

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125. Although the author discusses the positive attributes of Cetaceans, he points out that
- A. they are not enough to validate their existence.
 - B. their extinction is inevitable.
 - C. their continued existence depends on humankind.
 - D. their existence is temporary.

Passage VIII (Questions 126–131)

Slave narratives are autobiographical or semi-autobiographical accounts of emancipated slaves' lives under slavery written in the nineteenth century. Often, these narratives were written by the slaves themselves, (5) but some narratives were written by white northerners based on accounts given by slaves. Though read by the public, at the time, the authenticity of many slave narratives as autobiographies was questioned, particularly when a second author was included. Many of these nar- (10) ratives were written by male writers. The first autobiography of the life of a female slave, *Incidents in the Life of a Slave Girl, Written by Herself*, by Harriet Jacobs, was the first such book, released in 1861. *Incidents* recounts accurately and expressively Jacobs's (15) experiences growing up as a house slave in the South before the Civil War. She tells how she was able to resist sexual attention from her master, and how she was able to escape from his attention by first going into hiding and later escaping to the North, where Harriet Jacobs (20) became involved with the abolitionist movement and was determined to tell her life story. For the rest of her life, Jacobs also helped raise money for Southern Blacks with the profits from her writing.

Incidents, however, is an example of those books (25) not seen as authentic at the time because they were written by a ghost writer; in the case of *Incidents*, the ghost writer was a white author, Lydia Maria Child. Initially, Jacobs sought the assistance of a more influential voice, novelist Harriet Beecher Stowe. She persuaded Amy (30) Post, an influential white abolitionist who was also involved in women's rights, to approach Harriet Beecher Stowe. Stowe had a novel ready for publication already, so she offered Jacobs the opportunity to include her story in the novel. Harriet Jacobs declined because she (35) wanted to tell her own story. She began writing her narrative, but publishers were unwilling to print Jacobs's manuscript. One publisher finally agreed to print it but only if Lydia Maria Child would write an introduction to the autobiography and claim in this preface that her (40) editorial work was limited.

In *Incidents*, Harriet Jacobs decided to use the pseudonym Linda Brent and to disguise the names of people mentioned in her narrative in order to protect them from harm by their slave masters. At the time (45) Jacobs was writing, authors who used pseudonymous names and published a book with no manuscript were suspect in the eyes of the public who believed the text was not authentic, whether the writer was an emancipated slave or not. In addition, critics of the time questioned whether Jacobs had the necessary skills to write an autobiography by emphasizing her style of writing and dynamic use of language and literary conventions. Critics also felt Lydia Maria Child may have superimposed her own views as a white woman into the book. (50) This critical speculation about Child's involvement eventually led to her being named the primary author of *Incidents*, even though Child wrote in the preface that she was not the author and had not made significant changes, emphasizing the small role she played as the editor. Child did help Harriet Jacobs to secure a contract that enabled Jacobs's work to get published and made widely available for public reading. In addition, Child recommended that the letters of correspondence from Amy Post to Harriet Jacobs be included as (60) appendices, which was part of a tradition in verifying the authorship of African-American literature that first began with the 1773 publication of Phillis Wheatley's poetry. This practice in the publication of slave narratives had two advantages: It testified to the trustworthiness of the narrator and helped disperse Southern accusations that fictitious narratives were being used to fan antagonism against the South and slavery. (70)

Yet, the belief that *Incidents* was ghost-written was never dismissed. Although Jacobs's book received (75) immediate publicity after its publication, it was largely ignored by modern scholars who doubted the authenticity and the authorship of the autobiography. It was believed that the narrative was dictated to Lydia Maria Child—despite her preface claiming the book's legitimacy—or that, in fact, the text was an anti-slavery novel written by Child herself. The fact that Harriet Jacobs was a Black woman raised doubts that she wrote the book, a reflection of the racism and sexism of the time. (80)

Jean Fagan Yellin, professor of History at Pace (85) University, extensively researched to validate Jacobs's authorship through painstaking archival work. She also searched for and located Jacobs's home and surroundings in the South and identified the people referred to in the autobiography. Yellin also found the papers of (90) Amy and Isaac Post, abolitionists and advocates of temperance and women's rights, whose correspondence with Jacobs further served to confirm the validity of *Incidents*. Through this research, Yellin substantiated *Incidents* as an authentic autobiography. The conclusive proof of Jacobs's authorship and the authenticity

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of the events she described in *Incidents*, included in (95) Yellin's edition of Jacobs's work, published in 1981, erased the doubts about the validity and authorship of *Incidents*.

126. Harriet Jacobs's *Incidents in the Life of a Slave Girl* was:

- A. the first autobiography written by a female ex-slave.
- B. actually written by Lydia Maria Child.
- C. written by the owner of a former slave.
- D. written by a man.

127. When Harriet Beecher Stowe offered to include Jacobs's story in Stowe's forthcoming novel, Jacobs refused because:

- A. Stowe was unable to provide Jacobs assurance that the autobiography would be accepted by the public.
- B. Jacobs wanted to tell her own story.
- C. Stowe only wanted to include Jacobs's story in the novel since it was ready for publication.
- D. Jacobs decided that Stowe was not influential enough to help.

128. By using pseudonyms for the people she wrote about in her autobiography, Jacobs:

- A. wanted to keep their identities secret from each other.
- B. wanted to safeguard them from abuse by their masters.
- C. could not allow the public to search and identify these people.
- D. gave the public an opportunity to speculate further on the authenticity of her work.

129. Many people believed at the time that Lydia Maria Child had written or at least editorialized Jacobs's autobiography because:

- A. it was assumed that Jacobs could not write such a well-written book.
- B. Child's views on slavery were in the story.
- C. Child vehemently denied writing the autobiography.
- D. the public resented the involvement of Child, who was a well-known abolitionist.

130. Modern literary scholars would not accept Jacobs's autobiography as authentic due to:

- A. the fact that Jacobs was a woman.
- B. the belief that she dictated the story to Child.
- C. the belief that Lydia Maria Child, an abolitionist, wrote it as an anti-slavery novel.
- D. All of the above.

131. The main idea of the passage focuses on:

- A. the inability of sexist white Northerners to accept a slave narrative written by a woman.
- B. Jacobs's difficulties in having her autobiography published.
- C. the validation and authenticity of Jacobs's autobiography.
- D. the issue of slavery as an institution.

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Passage IX (Questions 132–137)

The International Committee of the Red Cross (ICRC) was created through the efforts of Henri Dunant, a Swiss businessman from Geneva, and four other Genevan citizens in 1863. The reason for the founding (5) can be found in events that began a few years earlier, in 1859, with the battle of Solferino in northern Italy, fought between Napoleon's French forces and the forces of the Austro-Hungarian Empire that occupied parts of Italy. Dunant, passing by the battlefield, was so over- (10) whelmed with pity on hearing the tormented cries of the forty thousand soldiers helpless and unattended that he organized help from the nearest village, Solferino. He gathered volunteers who helped despite the chaos and horror of the battlefield, turning their homes and (15) barns into makeshift hospitals, where soldiers from both sides were tended to. On his return to Geneva, Dunant wrote of his and the volunteers' experiences in a book titled *A Memory of Solferino*. In the book, Dunant expressed his idea to form volunteer relief societies to (20) give care to the wounded in wartime.

Dunant's book became the incentive for him and four other Genevan citizens to establish an international organization dedicated to providing aid to victims of war. This aim was later widened to include assistance (25) to all, not just war victims, regardless of nationality, religion, and politics. The Geneva Public Society set up the International Committee of the Red Cross. The first members were Guillaume Henri Dufour, a general of the Swiss army and a writer of military booklets, (30) who became the committee's president for its first year and its honorary president thereafter; Gustave Moynier, a young lawyer and president of the sponsoring Public Welfare Society, who dedicated himself soon after to Red Cross work; Louis Appia and Theodore Maunoir, (35) both medical doctors; and Henri Dunant.

In October of the same year the committee was founded, its members held an international conference, which was attended by sixteen nations, to adopt resolutions and principles along with an international em- (40) blem. The committee also appealed to all nations to form voluntary units to help wartime sick and wounded. The aim of the 1863 Geneva Conference was to have its Red Cross principles become a part of international law. It was decided to hold an international convention, (45) which was the historic Geneva Convention of 1864, to address specifically provisions to guarantee neutral status to military hospitals and medical personnel of the armies of the signing countries. To identify these non-combatants, the convention adopted a red cross on a (50) white field, a reversal of the colors of the Swiss national flag. It was signed by the attending twelve European countries and Great Britain and Canada added their names a year later.

The Red Cross today is a strictly neutral and im- (55) partial organization dedicated to humanitarian interests in general and to relieve human suffering in particular. There are three basic components of the organization. The first is the self-governing National Red Cross So- (60) cieties, including the Red Crescent in Muslim countries and the Red Lion and Sun in Iran, which work on the national level and can also participate in international work. Each society must be recognized by the International Committee and also have Junior Red Cross Societies. Secondly, there is the League of Red Cross (65) Societies, which is the coordinating world federation of these societies, a result of proposals in 1919 by Henry P. Davison of the American Red Cross. The League performs multiple tasks: It continues contact between the societies, operates as a clearinghouse for information, (70) facilitates the societies in setting up new programs and in improving or expanding old ones, and coordinates international disaster operations. The third component of the Red Cross is the International Committee of the Red Cross (ICRC) which acts today as a private, inde- (75) pendent group of elected Swiss citizens, limited to 25 individuals. The ICRC acts during war or conflict whenever intervention by a neutral body is necessary, an action that emphasizes its special field of activity. The ICRC, as the protector of the Geneva Convention and (80) Red Cross principles, is involved in numerous fields to encourage, for example, acceptance by governments, further development of international humanitarian law, and recognition of new Red Cross Societies.

The American Red Cross was created through the (85) efforts of Clara Barton who, under doctor's orders to rest from her strenuous involvement in the Civil War, went to France. There, she discovered the existence of the Red Cross. The Franco-Prussian War of 1870 broke out while she was in Geneva. Miss Barton offered her (90) services—even though the United States was not allied to the Red Cross—as she was familiar with the needs of war. She went to the war zone with volunteers of the International Red Cross. Miss Barton wore the interna- (95) tionally accepted symbol of the Red Cross by using a red ribbon she was wearing and making a cross to pin on her coat. She also helped to distribute relief supplies to the suffering people of Strasbourg and in other areas of France. Miss Barton corresponded with Red Cross officials in Switzerland after she returned home. (100) The officials saw her as the natural leader for carrying the Red Cross movement to the United States and for pressuring it to sign the Geneva Treaty. In 1877, the head of the International Committee of the Red Cross sent her a letter addressed to the President of the United (105) States, asking her to present it. Despite doing so, then President Hayes was reluctant to ally the United States with the Geneva Treaty. Clara Barton was persistent in her efforts and due to her determination, President

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Arthur signed and the Senate ratified the treaty in 1882.

- (110) Today, the Red Cross is internationally known and respected with 114 National Red Cross Societies. The International Red Cross Movement is the largest disaster relief and community development organization in the world, carrying out emergency relief operations in
- (115) more than 50 crises and war zones.

132. The origins of the foundation of the Red Cross was based on

- A.** Swiss citizens' concern for proper care of soldiers wounded and left behind on the battlefield during the conflict between the French and the Austro-Hungarian Empire.
- B.** the efforts of a Swiss businessman who had wounded soldiers from a battle temporarily taken care of by volunteering local townspeople.
- C.** the experiences of a Swiss businessman who wrote a book about his involvement in assembling volunteer local townspeople to take in wounded soldiers left behind from a nearby battlefield.
- D.** All of the above

133. Henri Dunant's novel describing his involvement with the local townspeople of Solferino in taking care of wounded soldiers from a nearby battle stressed the:

- A.** horrors of the battle so vividly that it became a best-selling book in Europe that captured the public's attention.
- B.** need to create agencies in times of peace that used qualified and dedicated volunteers to tend to the wounded during war.
- C.** need to create agencies whose skillful and dedicated volunteers were willing to die on the battlefield during war while nursing the wounded.
- D.** possibility of countries cooperating during peace times to create relief societies that relied on trained and efficient volunteers to take care of the wounded during war.

134. The Red Cross is internationally recognized for its neutral and impartial organization and dedication to humanitarian interests. Its organization is composed of several elements. The first element mentioned in the passage are:

- A.** National Red Cross Societies that are self-run, the Red Crescent in Muslim countries, and the Red Lion and Sun in Iran.
- B.** National Red Cross Societies run by a host country, the Red Crescent in Muslim countries, and the Red Lion and Sun in Iran.
- C.** National Red Cross Societies that are self-run and the Red Crescent and Lion and Sun in Muslim countries.
- D.** National Red Cross Societies that are run by Christian countries and two other separate divisions based on non-Christian religions.

135. The Geneva Convention of 1864 guaranteed that:

- A.** member countries of the Red Cross had the choice to grant neutral status to military hospitals and that medical personnel as non-combatants would wear the badge of a red cross on a white field.
- B.** member countries of the Red Cross would recognize any agency on the battlefield if members wore the badge of a red cross on a white field and cooperate with it.
- C.** member countries of the Red Cross would observe neutral status for military hospitals and medical personnel as non-combatants who would be recognized by the badge of a red cross on a white field.
- D.** countries, whether or not members of the Red Cross, would be offered neutral status for their hospitals and that medical personnel would be allowed to wear the badge of a red cross on a white field.

136. The passage refers to the American Red Cross, which was founded through the determined efforts of an American woman named:

- A.** Harriet Tubman.
- B.** Florence Nightingale.
- C.** Clara Barton.
- D.** Eleanor Roosevelt.

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137. According to the passage, the Red Cross, from its inception in 1863 to today, is:
- A. considered to be a well-run, efficient organization dedicated to saving lives around the world during catastrophes.
 - B. known as the largest worldwide disaster and relief organization.
 - C. known for its development organizations throughout the world that train volunteers in responding professionally to disasters involving human lives.
 - D. considered the only disaster relief organization in the world that can handle international emergencies.

MCAT Practice Test 2

WRITING SAMPLE

Time: 60 Minutes

2 Essays

Directions: This test consists of two parts. You will have 30 minutes to complete each part. During the first 30 minutes, you may work on Part 1 only. During the second 30 minutes, you may work on Part 2 only. You will have three pages for each essay answer (see pages 101–106), but you do not have to fill all three pages. Be sure to write legibly; illegible essays will not be scored.

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Part 1

Consider this statement:

In war, truth is the first casualty.

Write a unified essay in which you perform the following tasks: Explain what you think the above statement means. Describe a specific situation in which truth is not the first casualty. Discuss what you think determines whether or not truth is a casualty of war.

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Part 2

Consider this statement:

Practice yourself what you preach.

Write a unified essay in which you perform the following tasks: Explain what you think the above statement means. Describe a specific situation in which you do not follow what you advise. Discuss whether or not others accomplish what you tell them to follow.

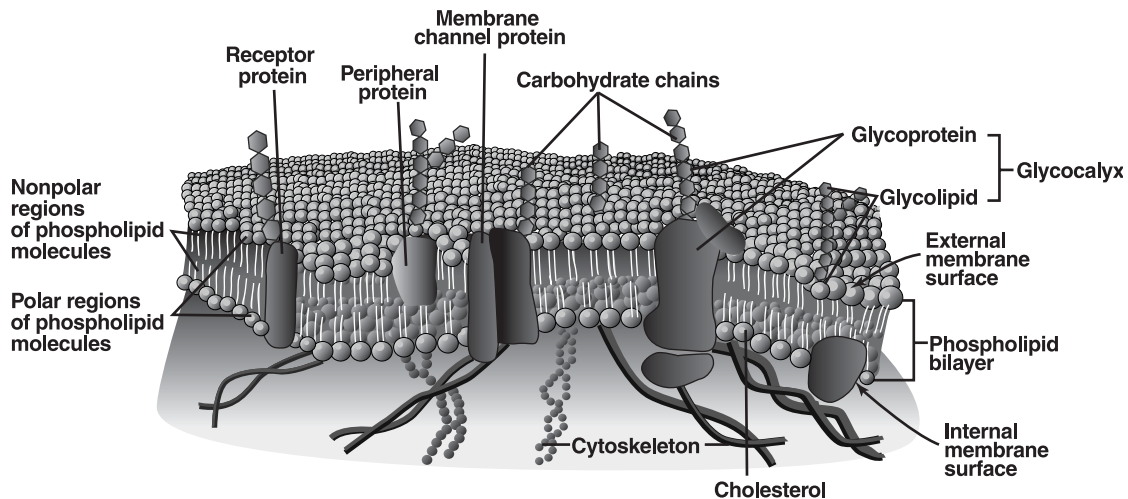
BIOLOGICAL SCIENCES

Time: 100 Minutes
Questions 138–214

Directions: This test contains 77 questions. Most of the questions consist of a descriptive passage followed by a group of questions related to the passage. For these questions, study the passage carefully and then choose the best answer to each question in the group. Some questions in this test stand alone. These questions are independent of any passage and independent of each other. For these questions, too, you must select the one best answer. Indicate all of your answers by blackening the corresponding circles on your answer sheet.

Passage I (Questions 138–144)

The fluid-mosaic model of the cell membrane put forward by Singer and Nicholson in the early 1970s presents a complex arrangement of diverse molecules that interact with each other and their surrounding environment in a number of ways. Membrane molecules can function as markers, as enzymes in signal-transduction, as attachment sites to maintain cell shape and tissue structure, and as transport channels or carriers involved with moving substances across the membrane. Transport proteins can be either ligand-gated or voltage-gated, depending on which type of stimulus causes them to open and close.



138. In the figure, the cytoskeletal structures just inside the plasma membrane are most likely:
- cilia.
 - fibrous extensions of endoplasmic reticulum.
 - centrosomes and centrioles.
 - microtubules and microfilaments.
139. Which of the following can pass directly through the phospholipid bilayer?
- Hydrophobic molecules and water
 - Hydrophobic molecules and glucose
 - Water and glucose
 - Hydrophobic molecules, water, and glucose

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140. Certain carrier proteins in the membrane can undergo conformational changes after being phosphorylated by ATP so that two different substances can be transported in opposite directions. This type of carrier protein provides the cell with the capacity to:
- A. carry out phagocytosis.
 - B. maintain its resting potential.
 - C. respond to passing hormones.
 - D. distinguish between “self” and “non-self” markers.
141. The molecules that are part of the glycocalyx are most likely involved in functions associated with:
- A. active transport.
 - B. diffusion and facilitated transport.
 - C. cell recognition.
 - D. structural support.
142. Ligand-gated channels and voltage-gated channels are found on both neuron and muscle cell membranes. The ligand-gated channels that initiate depolarization in skeletal muscle cells respond to a signal from:
- A. acetylcholine.
 - B. sodium ions.
 - C. calcium ions.
 - D. norepinephrine.
143. Cholesterol within the phospholipid bilayer helps maintain the fluidity of cell membranes. It is also a vital building block in the synthesis of all steroid hormones. Cholesterol is such an important molecule that if there is not enough in the diet, it will be synthesized in the:
- A. kidney.
 - B. liver.
 - C. bone marrow.
 - D. spleen.
144. Intercalated discs in cardiac muscle cells allow ions to pass from cell to cell so that electrical activity is synchronized. This type of membrane junction is called a:
- A. tight junction.
 - B. desmosome.
 - C. gap junction.
 - D. plasmodesmata.
- Passage II (Questions 145–150)**
- Amines are derivatives of ammonia and are classified as primary, secondary, and tertiary. Except for tertiary amines, they form intermolecular hydrogen bonds and thus have higher than expected boiling points. Aliphatic amines, like ammonia, are basic, while aromatic amines are considerably less basic. Only the quaternary ammonium salts can show optical activity.
145. Which of the following statements about amines are correct?
- A. All classes of amines can form hydrogen bonds with water.
 - B. Only primary and secondary amines form hydrogen bonds with water.
 - C. All classes of amines form hydrogen bonds with each other.
 - D. Some amines are optically active.
146. When nitrogen is bonded to three different groups:
- A. the molecule is optically active.
 - B. the molecule is tetrahedral.
 - C. the molecule is not superimposable on its mirror image.
 - D. the amine is not basic.
147. Which of the following compounds exist as configurational isomers?
- A. $(\text{CH}_3)_4\text{N}^+\Gamma^-$
 - B. methylallylphenylbenzylammonium bromide
 - C. methylethylamine
 - D. None of the above

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148. Methyl ethylamine is not optically active because:
- A. it is superimposable on its mirror image.
 - B. it is not tetrahedral.
 - C. the enantiomers are rapidly interconverted.
 - D. the hybridization around the nitrogen is sp^2 .
149. Which is the best explanation for why aromatic amines are not as basic as aliphatic amines?
- A. Aromatic amines are sterically hindered.
 - B. The compounds have different hybridization.
 - C. The aromatic ring donates charge to the nitrogen via resonance.
 - D. The aromatic ring removes charge from the nitrogen via resonance.
150. One would expect that the infrared spectra of primary and tertiary amines would differ by the appearance in the former of:
- A. N-H stretching absorption peaks.
 - B. N-H bending absorption peaks.
 - C. N-H bending and stretching absorption peaks.
 - D. an excitation of the unshared electrons on nitrogen.
- Passage III** (Questions 151–156)
- Agouti (y) is a grayish-brown coat color in mice. The yellow allele (Y) is dominant and produces a yellow coat but acts as a recessive lethal in utero when homozygous. In addition, coat color in mice is influenced by alleles at a separate locus for melanin production. Homozygous recessive individuals at this second locus are albinos (aa). A cross between heterozygous individuals at both loci does not produce the typical phenotypic ratio of 9:3:3:1.
151. What is the phenotype of the two mated individuals?
- A. Agouti
 - B. Yellow
 - C. Albino
 - D. None of the above
152. What proportion of offspring is expected to die before birth?
- A. 25%
 - B. 50%
 - C. 67%
 - D. 75%
153. What proportion of individuals born will be expected to have a pigmented coat?
- A. 50%
 - B. 67%
 - C. 75%
 - D. 100%
154. What is the probability that the first offspring produced by two agouti mice heterozygous at the albino locus will be albino?
- A. 0%
 - B. 25%
 - C. 50%
 - D. 75%
155. When alleles at one locus influence the expression of alleles at a separate locus, this phenomenon is called:
- A. linkage.
 - B. pleiotropy.
 - C. polymorphism.
 - D. epistasis.
156. A monohybrid cross between two yellow mice is carried out. What is the expected phenotypic ratio of the offspring born to this pair?
- A. 3 yellow : 1 agouti
 - B. 1 agouti : 3 yellow
 - C. 2 yellow : 1 agouti
 - D. 1 yellow : 2 agouti

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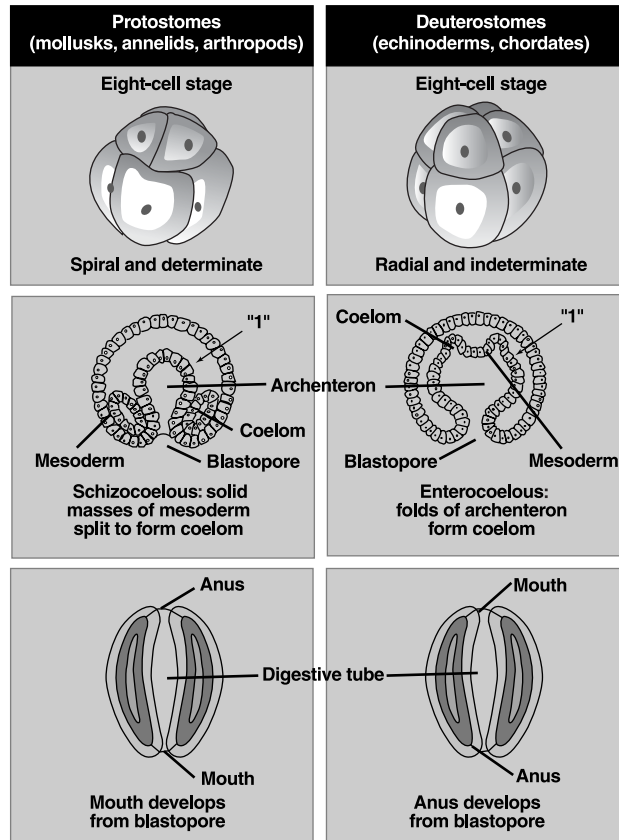
Questions 157 through 161 are NOT based on a descriptive passage.

157. The human body is an ecosystem that supports 500 to 1000 species of microbes. In which part of the body would you expect to find the *fewest* number of microbial species?
- A. Skin
 - B. Stomach
 - C. Small intestine
 - D. Large intestine
158. Which of the following conditions are maintained by the countercurrent multiplier effect at the loop of Henle in the human nephron?
- A. Hypertonicity in the renal medulla and hypotonicity in the urinary filtrate
 - B. Hypotonicity in the renal medulla and hypertonicity in the urinary filtrate
 - C. Hypertonicity in both the renal medulla and urinary filtrate
 - D. Hypotonicity in both the renal medulla and urinary filtrate
159. Which of the following receptors do NOT always respond to changes in mechanical forces (mechanoreceptors)?
- A. Proprioceptors
 - B. Hearing receptors
 - C. Pain receptors
 - D. Balance receptors
160. In addition to genetic sequences of DNA that encode mRNAs to be transcribed during protein synthesis, sequences of DNA have been identified that encode a cell's transfer RNAs (tRNAs), ribosomal RNAs (rRNAs), and the small nuclear RNAs (snRNAs) that are components of spliceosomes. Which of the following statements is correct?
- A. One of the four types of RNA is found in eukaryotes and prokaryotes.
 - B. Two of the four types of RNA are found in eukaryotes and prokaryotes.
 - C. Three of the four types of RNA are found in eukaryotes and prokaryotes.
 - D. All four types of RNA are found in eukaryotes and prokaryotes.
161. Which of the following is correct?
- A. All amines react with acid chlorides to form amides.
 - B. All peptides have amide linkages.
 - C. Alkylation of a tertiary amine produces an amide.
 - D. The alkylation of amines by alkyl halides is an electrophilic substitution reaction.

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Passage IV (Questions 162–167)

The figure below shows some of the developmental differences between coelomate phyla that are categorized as either protostomes or deuterostomes. All coelomates have a fluid-filled body cavity completely lined with mesodermal tissues, whereas acoelomates lack this cavity between their digestive tract and body wall. Pseudocoelomates (Nematoda: roundworms) have such a cavity, but they are not completely lined with mesoderm. Phyla belonging to each coelomate category share characteristics associated with the planes of division that lead to the formation of cells in the early embryo, as well as the “fates” of these early cells.



162. The region in the figure labeled “1” is the:

- A. trophoblast.
- B. blastocoel.
- C. pre-coelom.
- D. diploblast.

163. The coelom forms during the stage of development called:

- A. morulation.
- B. blastulation.
- C. gastrulation.
- D. neurulation.

164. Which of the following developmental patterns makes identical twins possible in humans?

- A. Spiral cleavage
- B. Radial cleavage
- C. Determinate cleavage
- D. Indeterminate cleavage

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165. Which statement is true?
- A. Some organisms that undergo radial cleavage early in development exhibit radial symmetry as adults, while others exhibit bilateral symmetry as adults.
 - B. Some organisms that undergo spiral cleavage early in development exhibit radial symmetry as adults, while others exhibit bilateral symmetry as adults.
 - C. Both A and B
 - D. Neither A nor B
166. In which of the following organisms does the blastopore eventually become the anus?
- A. Earthworm
 - B. Grasshopper
 - C. Snail
 - D. Shark
167. In which of the following organisms will a cell removed from the 8-cell stage and grown separately in an appropriate medium form an inviable embryo that lacks important components?
- A. Fruit fly
 - B. Frog
 - C. Hagfish
 - D. Sea star

Passage V (Questions 168–173)

The small intestine is one of many organs that has endocrine functions in addition to its more familiar roles in the body. By producing such hormones as intestinal gastrin, gastric inhibitory peptide (GIP), secretin, and cholecystokinin, the small intestine regulates the activities of neighboring digestive organs and their secretions.

The thymus gland secretes thymosin, a protein hormone that stimulates the maturation and differentiation of T-lymphocytes. These cells of the immune system provide cell-mediated immunity, which not only includes attacks on infectious agents, but on infected cells as well.

Other endocrine-producing structures include the pineal gland, the kidney, and the heart. In response to light stimuli entering the eye, the pineal gland (located in the brain) releases melatonin, which is believed to play a role in regulating daily circadian rhythms. The kidney regulates red blood cell production through the secretion of erythropoietin. The heart, by secreting atrial natriuretic factor (ANF), helps regulate blood pressure, salt, and water balance.

168. The factor(s) that these structures have in common is that:
- A. they are all glands.
 - B. they release chemicals into the blood.
 - C. their secretory function is regulated by the hypothalamus.
 - D. All of the above
169. An indirect effect of erythropoietin is the increase in blood volume that accompanies increased red blood cell production. This, in turn, helps raise blood pressure. In contrast, ANF helps lower blood pressure by increasing the kidney's:
- A. reabsorption of sodium and excretion of water.
 - B. reabsorption of water and excretion of sodium.
 - C. reabsorption of sodium and water.
 - D. excretion of sodium and water.

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170. Secretin acts as a signal to the pancreas to release bicarbonate ions through the pancreatic duct. The release of secretin is itself stimulated because:
- A. acidic chyme arrives in the small intestine.
 - B. digestive pancreatic enzymes require a slightly alkaline environment.
 - C. Both A and B
 - D. Neither A nor B
171. When cells from the pineal gland of various vertebrates are cultured in a dish under conditions of darkness, they release melatonin in a cyclic pattern. This suggests that:
- A. the pineal cells themselves have an intrinsic rhythmic property.
 - B. melatonin production varies proportionately with light and dark cycles.
 - C. melatonin production is not cyclic during daylight.
 - D. pineal tissue probably has neural connections with the hypothalamus.
172. Thymosin can directly:
- A. respond to specific foreign antigens and bind to receptors on invading organisms.
 - B. destroy infected host cells.
 - C. produce chemical (humoral) antibodies.
 - D. None of the above
173. Cholecystokinin stimulates the gallbladder to release bile when fats arrive in the small intestine. While in the gallbladder, bile can become overly concentrated and gallstones may form. If this necessitates removal of the gallbladder, which of the following statements is true?
- A. Fats can no longer be emulsified before digestion in the small intestine.
 - B. Bile can still reach the small intestine from the liver.
 - C. Fats can no longer be digested.
 - D. None of the above

Passage VI (Questions 174–179)

The physical and chemical properties of carboxylic acids are determined by the carboxyl group, $-\text{COOH}$. Although the carboxyl group consists of $\text{C}=\text{O}$ and $-\text{OH}$, it is the $-\text{OH}$ that undergoes change—either loss of H^+ or replacement by another group. The carbonyl group, however, markedly influences the reactions of carboxylic acids. For example, their acidity is due to the resonance stabilization of its anion, which is possible due to the presence of the carbonyl group. The presence of the carbonyl group also is responsible for nucleophilic substitution reactions, which are characteristic of carboxylic acids and their derivatives.

174. Which statement best accounts for the acidity of carboxylic acids?
- A. You can draw two inequivalent resonance structures for the acid.
 - B. You can draw two equivalent resonance structures for the anion.
 - C. Resonance stabilization is much greater for the anion than the acid.
 - D. Both acid and anions are resonance hybrids.
175. Chloroacetic acid is more acidic than acetic acid because:
- A. electron-withdrawing groups increase the stability of the acid.
 - B. electron-donating groups destabilize the acid.
 - C. electron-withdrawing groups stabilize the carboxylate anion.
 - D. there is no resonance stabilization in the acetate anion.
176. The acidity of benzoic acid is also affected by the presence of substituents. Which statement is correct about acid-weakening groups?
- A. Acid-weakening groups activate the ring toward nucleophilic substitution.
 - B. Acid-weakening groups activate the ring toward electrophilic substitution.
 - C. Acid-weakening groups deactivate the ring toward electrophilic substitution.
 - D. None of the above

MCAT Practice Test 2

177. The carbonyl group in carboxylic acids and their derivatives make acyl compounds more reactive than alkyl compounds toward nucleophilic attack because:
- A. attack of a nucleophile on a flat acyl compound is less sterically hindered.
 - B. alkyl groups are electron donating.
 - C. the carbonyl group is an electron-donating substituent.
 - D. tetrahedral carbon atoms cannot have pentavalent transition states.
178. One would expect that the infrared spectrum of carboxylic acids would include:
- A. O—H stretching band.
 - B. O—H and C=O stretching bands.
 - C. O—H, C=O, and C—O stretching bands.
 - D. C=O stretching band.
179. Aldehydes and ketones also undergo attack by nucleophiles, but they undergo nucleophilic addition because:
- A. they are more acidic.
 - B. they are less acidic.
 - C. they are sterically hindered.
 - D. C-H and C-C bonds do not break easily.
- Questions 180 through 184 are NOT based on a descriptive passage.**
180. If the codon sequence for the dipeptide histidine-leucine is 5'CAU-CUA3', what is the sequence of nucleotides on the template strand of DNA from which it was transcribed?
- A. 5'GTA-GAT3'
 - B. 5'GAT-GTA3'
 - C. 3'GAT-GTA5'
 - D. 3'GTA-GAT5'
181. In birds, females have the sex chromosomes Z and W, while males are homogametic (ZZ). Which statement is correct?
- A. Offspring that receive a Z chromosome from the father will usually be males.
 - B. Offspring that receive a Z chromosome from the father will usually be females.
 - C. Offspring that receive a W chromosome from the mother will usually be males.
 - D. Offspring that receive a W chromosome from the mother will usually be females.
182. Toluene will show peaks in its:
- A. IR spectrum only.
 - B. UV and IR spectrum only.
 - C. IR, UV, and NMR spectrum.
 - D. UV spectrum only.
183. The vitamins niacin and riboflavin are components of NAD and FAD, respectively. Based on this fact, which of the following processes would be affected *directly* by a lack of these vitamins?
- A. Gas exchange between alveoli and pulmonary capillaries
 - B. Movement of water from hypotonic tissue cells to hypertonic capillaries
 - C. Maintenance of the normal resting membrane potential via the sodium/potassium ATP pump
 - D. Facilitated diffusion of glucose from capillaries to tissue cells
184. Which of the following is NOT a function of the liver?
- A. Synthesis of coagulation proteins
 - B. Breakdown of fatty acids to ketones during beta oxidation
 - C. Synthesis of digestive enzymes
 - D. Destruction of old erythrocytes

MCAT Practice Test 2

Passage VII (Questions 185–190)

The analysis of mRNA molecules enables researchers to examine which genes (and their protein products) are active in a particular cell at a particular time, and to investigate differences in gene activity in different cells at the same time. Useful in such analyses is complementary DNA or cDNA, a double-stranded molecule made from mRNA.

In the first step of producing cDNA, a single-stranded DNA molecule is made using single-stranded mRNA as a template. Then, after the mRNA is degraded, a second step involves using the newly synthesized single-stranded DNA as a template for producing its complement. Since mRNA molecules transcribed during cellular activities are less stable than DNA, and techniques for purifying and amplifying these mRNAs are lacking, cDNAs derived from mRNA can be used to leisurely characterize mRNAs as well as their encoded products. This is especially important in eukaryotes, since considerable modification takes place between genomic activation and translation.

- 185.** The first step in cDNA production involves the enzyme:
- A. reverse transcriptase.
 - B. DNA polymerase.
 - C. DNA helicase.
 - D. Two of the above
- 186.** The degradation of the template mRNA strand can be carried out by:
- A. deoxyribonuclease only.
 - B. ribonuclease only.
 - C. any nuclease.
 - D. any protease.
- 187.** The second step in cDNA production involves the enzyme:
- A. reverse transcriptase.
 - B. DNA polymerase.
 - C. DNA helicase.
 - D. Two of the above
- 188.** In eukaryotes, the final mRNA molecule does not reflect the precise DNA sequence of the gene from which it was transcribed because:
- A. introns have been added.
 - B. exons have been added.
 - C. introns have been removed.
 - D. exons have been removed.
- 189.** If cDNA molecules isolated from both a muscle cell and a brain cell are found to be identical, what conclusion can be drawn from this evidence?
- A. The two cells are genetically identical.
 - B. The two cells are genetically identical but have different functions.
 - C. The same gene has been activated in both cells.
 - D. All of the above
- 190.** Which gene product may be encoded by the cDNA in the previous question?
- A. Peptidyl transferase
 - B. ATPase
 - C. Acetylcholinesterase
 - D. All of the above

MCAT Practice Test 2

Passage VIII (Questions 191–196)

All metabolic reactions that take place within cells in the interstitial fluid and in blood plasma are influenced by the pH of their immediate environment. As a result, acid-base balance is closely regulated. In the human body, normal blood pH is 7.35–7.45.

Although acidic substances that are sources of free hydrogen ions (H^+) can enter the body in foods, most are metabolic by-products. Carbon dioxide, which readily combines with water to form carbonic acid, is a constant and major source of acidity in cells and venous blood. Proper H^+ concentration is subsequently maintained through a combination of mechanisms including urinary adjustments, respiratory adjustments, and the activity of circulating chemical buffers that usually work in pairs. The alkaline member of the buffering pair binds to free H^+ whenever pH drops too low, while the acidic partner releases H^+ when pH rises too high. When one of the mechanisms fails to function adequately, one or both of the other mechanisms tries to compensate.

191. In healthy individuals, a rise in plasma H^+ concentration would be expected to:
- A. excite the respiratory center and produce deeper and more rapid breathing.
 - B. excite the respiratory center and produce shallower and slower breathing.
 - C. inhibit the respiratory center and produce deeper and more rapid breathing.
 - D. inhibit the respiratory center and produce shallower and slower breathing.
192. Proteins present in blood plasma and in cells can act as buffers. Proteins can act as bases if they contain amino acids with exposed:
- A. carboxyl groups that dissociate to form $R-COO^-$ and H^+ .
 - B. amino groups that can bind to H^+ to form $R-NH_3^+$.
 - C. carboxyl groups that can bind to H^+ to form $R-COOH_2$.
 - D. amino groups that can dissociate to form $R-NH^-$ and H^+ .
193. The pair of molecules in the bicarbonate buffering system are sodium bicarbonate and carbonic acid. In an acidic solution, most carbonic acid molecules do not dissociate. When H^+ concentration greatly increases and threatens homeostasis, the sodium bicarbonate dissociates into Na^+ and HCO_3^- , and the bicarbonate ions tie up excess H^+ to form carbonic acid. This is an example of forming a weak:
- A. base to substitute for a strong base.
 - B. acid to substitute for a strong base.
 - C. base to substitute for a strong acid.
 - D. acid to substitute for a strong acid.
194. Which of the following would NOT be an appropriate urinary adjustment in response to temporary metabolic acidosis?
- A. Increase H^+ secretion.
 - B. Combine H^+ with ammonia and then increase secretion of NH_4^+ .
 - C. Decrease bicarbonate ion reabsorption.
 - D. All are appropriate.
195. Extended periods of fasting can lead to metabolic:
- A. alkalosis as fats are broken down and blood ketones increase.
 - B. acidosis as fats are broken down and blood ketones increase.
 - C. alkalosis as fats are stored and blood ketones decrease.
 - D. acidosis as fats are stored and blood ketones decrease.
196. If blood pH is measured to be 7.25 and blood carbon dioxide levels are lower than normal, this suggests a condition of:
- A. acidosis, with the respiratory system as the cause.
 - B. acidosis, with the respiratory system compensating.
 - C. alkalosis, with the respiratory system as the cause.
 - D. alkalosis, with the respiratory system compensating.

MCAT Practice Test 2

Passage IX (Questions 197–202)

Reactions of an alcohol involve either breaking of the C—OH bond or the O—H bond. Both of these reactions can involve substitution or elimination with the formation of a double bond. Cleavage of the C—OH bond must always involve converting the OH group into a good leaving group.

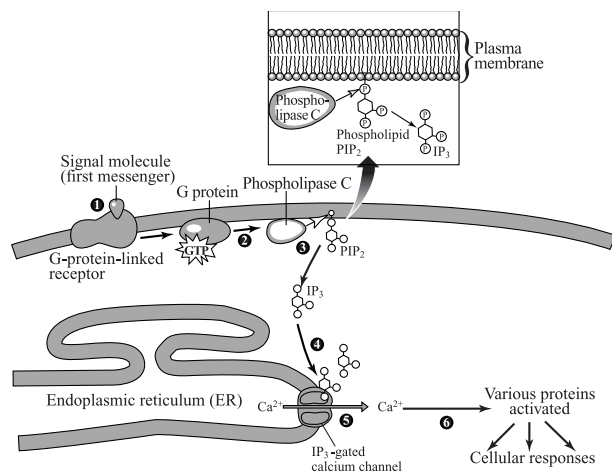
197. Which statement is always true about the reaction of hydrogen halides with alcohols?
- Elimination occurs.
 - Substitution occurs.
 - The alcohol is protonated.
 - The reaction occurs in one step.
198. Rearrangement of alkyl groups occur when hydrogen halides react with alcohols except with most primary alcohols. The best explanation is the:
- reaction is catalyzed by acids.
 - formation of a carbanion intermediate.
 - O—H bond is broken.
 - formation of a carbocation intermediate.
199. Neopentyl alcohol, although primary, reacts with HX according to an S_N1 mechanism. This is due most likely to:
- steric hindrance.
 - a polar effect.
 - a bimolecular reaction.
 - an elimination reaction.
200. Both alkyl halides and alcohols react by S_N1 and S_N2 reactions. Alcohols lean more towards the latter because:
- OH is a better leaving group than —X.
 - the —OH group must be protonated so strong nucleophiles cannot be present.
 - alcohols are sterically hindered.
 - alcohols are acidic.
201. It can be said that dehydrohalogenation is base promoted while dehydration is acid catalyzed. The difference is that:
- base is consumed in dehydrohalogenation while it is regenerated in dehydration.
 - dehydration can only occur in an acidic medium, while dehydrohalogenation can only occur in a basic medium.
 - dehydration occurs in basic solution as well.
 - acid can be in trace amounts for both dehydration and dehalogenation to occur.
202. Tertiary alcohols readily undergo dehydration in the presence of an acid because:
- they form the most stable carbocations.
 - a base can readily abstract a proton from the protonated alcohol.
 - they form the less substituted alkenes.
 - the protonation of the —OH group is rate determining.

MCAT Practice Test 2

Passage X (Questions 203–209)

The formed elements of the blood—erythrocytes (RBCs), leukocytes (WBCs), and thrombocytes (platelets)—all develop in red bone marrow from a common stem cell, the hemocytoblast. In newborns, the medullary cavity in the diaphysis, or shaft of a long bone, as well as both epiphyses at the ends, contain hemopoietic tissues. In adults, however, the medullary cavity contains fat, and hemopoiesis occurs only in the proximal epiphyses of the femur and humerus, and in some flat bones of the axial skeleton and appendicular girdles.

Erythrocytes are numerous (5–6 million/mm³ blood) and go through many stages before entering the circulation. Late normoblasts lose their nuclei and reticulocytes must first lose their ribosomes and rough endoplasmic reticulum before becoming mature erythrocytes. Only about 2 percent of circulating RBCs are reticulocytes.



Leukocytes are categorized as granular or agranular, depending on the presence or absence of cytoplasmic granules with unique staining properties. They all carry out one or more protective functions, but are far less numerous than RBCs (5,000–10,000/mm³ blood). All leukocytes except T-lymphocytes or T-cells, a type of agranulocyte, complete their maturation before leaving the bone marrow.

Thrombocytes are not complete cells. They are tiny fragments of enormous cells called megakaryocytes (approximately 600 platelets form from one such cell). Thrombocytes (150,000–400,000/mm³ blood) are major contributors in the steps leading to coagulation during the hemostatic process.

203. In which of the following locations would new blood cells be LEAST likely to form in adults?
- Heads of the femur and humerus
 - Sternum
 - Ilium
 - Vertebrae
204. Which statement is *false* about the various stages of erythrocyte development?
- Transcription of hemoglobin can occur in the early erythroblast.
 - Transcription and translation of hemoglobin can occur in the late erythroblast.
 - Neither transcription nor translation of hemoglobin can occur in the reticulocyte.
 - None of the above
205. The hormone erythropoietin (EPO) stimulates erythropoiesis. Which of the following factors is most likely to stimulate an increase in EPO production *directly*?
- Lower than normal oxygen levels in the kidney
 - Decreased numbers of RBCs circulating in the spleen
 - High blood viscosity detected in the medulla oblongata
 - Higher than normal oxygen levels in the blood
206. The final maturation of T-lymphocytes after they enter the bloodstream is influenced by the hormone:
- thyroxine.
 - triiodothyronine.
 - thymosin.
 - thyroid stimulating hormone (TSH).

MCAT Practice Test 2

207. Which of the following is probably true concerning complete blood count (CBC) procedures during clinical evaluations?
- A. Leukocytes are included in the sample when erythrocytes are counted.
 - B. Erythrocytes are destroyed in the sample before leukocytes are counted.
 - C. Both A and B
 - D. Neither A nor B
208. Thromboxanes, which are derived from certain prostaglandins, help in the activation of platelets. Aspirin, by inhibiting prostaglandin synthesis, has the indirect effect of:
- A. increasing antibody production.
 - B. slowing normal hemostasis.
 - C. stimulating excess inflammation.
 - D. causing unnecessary blood clots.
209. Vitamin B₁₂ and folic acid are required for normal DNA synthesis. Which cells produced in the bone marrow would be most affected by deficiencies in these vitamins?
- A. Thrombocytes
 - B. Granular leukocytes
 - C. Agranular leukocytes
 - D. Erythrocytes

Questions 210 through 214 are NOT based on a descriptive passage.

210. To which taxonomic group do microbes such as methanogens, thermophiles, and halophiles most likely belong?
- A. Archaea
 - B. Bacteria
 - C. Protista
 - D. Fungi
211. Phenols have a characteristic acidity in that they are stronger acids than water but weaker than carbonic acid. Therefore they are:
- A. soluble in aqueous NaOH and NaHCO₃.
 - B. insoluble in aqueous NaOH but soluble in NaHCO₃.
 - C. insoluble in both bases.
 - D. soluble in NaOH but insoluble in NaCO₃.
212. Which hormone is *least* affected by the direct influence of the anterior pituitary gland?
- A. Estrogen
 - B. Progesterone
 - C. Parathyroid hormone
 - D. Thyroxine
213. In skeletal muscle tissue, the troponin-tropomyosin complex has a strong affinity for actin. To what does the troponin-tropomyosin complex have an even greater affinity?
- A. Sodium
 - B. Potassium
 - C. Calcium
 - D. Acetylcholine

MCAT Practice Test 2

214. Telomeres contain repetitive noncoding sequences at the ends of eukaryotic chromosomes. Parts of these sequences are lost each time a cell replicates its DNA during the cell cycle. The shortening of these telomeres with each cell division limits the number of divisions cells can undergo because important coding sequences of DNA will eventually be lost once the telomeres are gone. The enzyme telomerase seems to “reset the clock” of a cell’s life span by replacing the repetitive noncoding DNA sequences of the telomeres. In which type of cells would telomerase be expected to be active?
- A. Oogonia
 - B. Skeletal muscle cells
 - C. Cancer cells
 - D. Yeast cells

PRACTICE EXAM II ANSWER KEY

PHYSICAL SCIENCES

1. D
2. B
3. B
4. C
5. B
6. A
7. C
8. B
9. C
10. B
11. C
12. D
13. B
14. D
15. C
16. B
17. B
18. A
19. A
20. A
21. B
22. C
23. D
24. B
25. D
26. A
27. B
28. C
29. C
30. C
31. B
32. B
33. B
34. C
35. D
36. A
37. A
38. C
39. A
40. C

VERBAL REASONING

41. B
42. C
43. B
44. C
45. A
46. C
47. B
48. A
49. A
50. D
51. C
52. B
53. C
54. C
55. B
56. D
57. D
58. B
59. B
60. A
61. C
62. B
63. B
64. D
65. B
66. D
67. B
68. A
69. C
70. C
71. D
72. D
73. C
74. A
75. D
76. C
77. D
78. A
79. D
80. A
81. B
82. B
83. A
84. C
85. B
86. B
87. B
88. D
89. A
90. B
91. C
92. C
93. B
94. D
95. B
96. A
97. C
98. A
99. C
100. D
101. C
102. B
103. A
104. B
105. B
106. A
107. D
108. B
109. C
110. D

BIOLOGICAL SCIENCES

111. C
112. D
113. D
114. B
115. B
116. A
117. D
118. C
119. A
120. C
121. D
122. B
123. A
124. C
125. C
126. A
127. B
128. B
129. A
130. D
131. C
132. D
133. B
134. A
135. C
136. C
137. B
138. D
139. A
140. B
141. C
142. A
143. B
144. C
145. A
146. C
147. B
148. C
149. D
150. C
151. B
152. A
153. C
154. B
155. D
156. C
157. B
158. A
159. C
160. C
161. B
162. B
163. C
164. D
165. A
166. D
167. A
168. B
169. D
170. C
171. A
172. D
173. B
174. C
175. C
176. B
177. A
178. C
179. D
180. D
181. D
182. C
183. C
184. C
185. A
186. B
187. B
188. C
189. C
190. D
191. A
192. B
193. D
194. C
195. B
196. B
197. C
198. D
199. A
200. B
201. A
202. A
203. D
204. C
205. A
206. C
207. C
208. B
209. D
210. A
211. D
212. C
213. C
214. C

PRACTICE EXAM II EXPLANATORY ANSWERS

PHYSICAL SCIENCES

1. **The correct answer is (D).** Area = side², therefore if the length of the side is tripled the area increases by a factor of 9.

From the capacitance $C = 8.85 \times 10^{-15} \text{ KA}/d$, the area and separation are directly proportional. As the area increases, the separation must increase. This eliminates choices (A) and (B). The calculated value for the new separation between the plates is $9(0.012 \text{ mm}) = 0.108 \text{ mm}$.

2. **The correct answer is (B).** Once the capacitor is isolated by removing the power source, no net current flows:

$$q = CV = (5 \times 10^{-6} \text{ F})(10\text{V}) = 50 \times 10^{-6} \text{ C} = 50 \mu\text{C}.$$

Changing the dielectric material will change the strength of the electric field between the plates but not the charge on each plate.

3. **The correct answer is (B).** Be careful, C_1 and C_2 are connected in parallel, therefore the potential difference across each capacitor is the same but the charge q on each is different.

$$C_1 V_{\text{original}} = C_1 V_{\text{final}} + C_2 V_{\text{final}} = (C_1 + C_2) V_{\text{final}}$$

$$V_{\text{final}} = C_1 V_{\text{original}} / (C_1 + C_2) = 6000 \text{ V} (10 \text{ mC} / 15 \text{ mC}) = 4000 \text{ V}$$

4. **The correct answer is (C).** In pattern I the capacitors are connected in series: $1/C_{\text{equivalent}} = \Sigma 1/C_{\text{individual}} = 3/C$, therefore $C_{\text{equivalent}} = C/3$

In pattern II the capacitors are connected in parallel: $C_{\text{equivalent}} = \Sigma C_{\text{individual}} = 3C$

In pattern III two capacitors are connected in parallel giving $C_{\text{equivalent}} = 2C$. This is in series with the third capacitor giving $1/C_{\text{equivalent}} = 1/C + 1/2C = 3/2C$.

Therefore $C_{\text{equivalent}} = 2C/3$.

The order of increasing capacitance is $C/3 < 2C/3 < 3C$ or $\text{I} < \text{III} < \text{II}$.

5. **The correct answer is (B).** Remember, the dielectric constant K is unitless. In terms of units:

$$C = \text{KA}/(4\pi k)d. = \text{m}^2/(\text{Nm}^2/\text{C}^2)\text{m} = \text{C}^2/\text{Nm} = \text{C}^2/\text{J} = \text{C}/(\text{J}/\text{C}) = \text{C}/\text{V} = \text{F}$$

The unit of work and energy is the joule, $\text{J} = \text{Nm}$ for force \times distance.

Actually you didn't have to do the derivation to find the answer. Choices (A) and (D) are the units for $1/k$ and k , respectively, and they don't include units for area and distance. From the definition of the farad given in the passage, choice (C) is the reciprocal of the farad.

6. **The correct answer is (A).** Rearranging $C = q/V$ and $q = \text{KC}_0 V$ gives $C_0 = C/K$. For comparing two conditions of the same capacitor:

$$C_1/K_1 = C_2/K_2 = C_0 = \text{constant}$$

Let case 1 be for glass and case 2 for rubber:

$$K_2 = C_2 K_1 / C_1 = (6.0 \mu\text{F})(8) / 19.2 \mu\text{F}$$

$$K_2 = K_{\text{rubber}} = 2.5$$

MCAT Practice Test 2

- 7. The correct answer is (C).** From $C = 8.85 \times 10^{-15} \text{ KA}/d$. C and d are inversely proportional:

$$Cd = \text{constant}$$

d increases as the plates are pulled apart, therefore the capacitance, C , decreases. This eliminates choices (A) and (B).

From $C = q/V$ q and C are directly proportional. As C decreases, q increases. Be careful, V is constant because the capacitor remained connected to the battery so the potential difference between the plates remains fixed.

- 8. The correct answer is (B).** For a circular orbit $F_{\text{centripetal}} = F_{\text{gravity}}$: $mv^2/r = GMm/r^2$ which reduces to

$$v^2 = GM_{\text{planet}}/r.$$

Rearranging gives: $[v^2r]_{\text{SeekerI}} = [v^2r]_{\text{SeekerII}} = GM_{\text{planet}} = \text{constant}$. The square of the velocity and the distance are inversely proportional. If r doubles in value, v^2 must be reduced to half its value:

$$v^2 R_{\text{SeekerI}} = (v^2/2)(2R_{\text{SeekerII}}),$$

therefore, $v_{\text{SeekerII}} = (v^2/2)^{1/2} = v/2^{1/2}$

- 9. The correct answer is (C).** From the law of universal gravitation: $(F_g/m_1m_2)_{\text{initial}} = (F_g/m_1m_2)_{\text{final}} = \text{constant} = G/r^2$.

We don't need to know the actual mass of a ball bearing, just that all of them have the same mass. We can then use any arbitrary value for the mass of one ball bearing. So, let each mass = 1.

Initially: $m_1m_2 = 15 \times 15 = 225$ mass units

Finally: $m_1m_2 = 25 \times 5 = 125$ mass units

Since F_g and m_1m_2 are directly proportional, the final F_g is less than the initial F_g .

In fact the gravitational attractive force has decreased by a factor of 5/9.

$$F_g(\text{final}) = (125/225)F_g(\text{initial}) = (5/9)F_g$$

- 10. The correct answer is (B).** From Newton's second law, $F_{\text{gravity}} = ma$. Therefore, the acceleration due to gravity at the surface of a body is:

$$a = GM_i/R_i^2 = g.$$

From density, $D = M/V = M/[(4/3)\pi R^3] = \text{constant}$.

If the radius doubles we get: $(2R)^3 = 8R^3$. Since M and R are directly proportional, the planet's mass, M , must increase by a factor of 8 if the density is to remain the same.

$g = GM/R^2$ becomes $G(8M)/(2R)^2 = (8/4)(GM/R^2) = 2GM/R^2 = 2g$. The value is twice the original value.

- 11. The correct answer is (C).** Since kinetic energy is $mv^2/2$ we're looking for an expression that contains mv^2 . From $F_c = F_g$ we get: $mv^2/r = GMm/r^2$ or $mv^2 = GMm/r$. Therefore, $(1/2)mv^2 = (1/2)GMm/r = GMm/2r = E_K$

- 12. The correct answer is (D).** Solving this problem quickly relies on knowing that the kinetic energy can be expressed by $E_K = GMm/2r$. (See Question 4 above).

$E_{\text{total}} = E_K + E_P = GMm/2r + (-GMm/r) = -GMm/2r$. The total mechanical energy is equal to the negative of the kinetic energy.

- 13. The correct answer is (B).** From point a-g of the paragraph, for a projectile to escape gravity:

$$E_{\text{total}} = 0 = E_K + E_P = mv^2/2 + (-GMm/R).$$

This rearranges to:

$$v^2 = 2GM/R \text{ or } v = (2GM/R)^{1/2}$$

MCAT Practice Test 2

- 14. The correct answer is (D).** Results for the test transformer show that the number of turns/coil and the voltage are directly proportional. In Transformer 1 the number of turns in the secondary coil is twice that of the primary coil and the secondary voltage is twice that of the primary. Similarly in Transformer 2 the secondary coil has half as many turns as the primary and the secondary voltage is half of the primary voltage:

$$N_1/V_1 = N_2/V_2$$

$$N_2 = (N_1 V_2)/V_1 = (100 \times 2400\text{V})/120\text{V} = 2000 \text{ turns}$$

- 15. The correct answer is (C).** Again looking at the test transformers we see that the number of turns/coil and the current are inversely proportional. Transformer 1 doubles the turns in going from the primary to the secondary coil but the current in the secondary coil is half that of the primary coil:

$$N_1 I_1 = N_2 I_2$$

$$I_1 = I_2 (N_2/N_1) = (3.0\text{mA})(3N_1/N_1) = 3.0\text{mA} \times 3 = 9.0\text{mA}$$

- 16. The correct answer is (B).** This requires that you remember the definition for electric power, $P = IV$. A transformer changes the ratio of the voltage and current. Comparing the primary and secondary coil values for any of the three test transformers, we see that if the voltage increases the current decrease (and vice versa) but that their produce, IV , is constant for the given transformer. Transformers transform voltage and current but not power.

- 17. The correct answer is (B).** From Ohm's Law, $R = V_2/I_2$ but all of the choices involve (V_1/I_1) . Therefore use the relation between voltage and number of turns/coil to eliminate V_2 .

$$N_1/V_1 = N_2/V_2 \rightarrow V_2 = (N_2 V_1)/N_1$$

Similarly, use the relation between current and turns/coil to eliminate I_2 .

$$N_1 I_1 = N_2 I_2 \rightarrow I_2 = (N_2 I_1)/N_1$$

Then, $R = V_2/I_2$ becomes:

$$R = ((N_2 V_1)/N_1) / ((N_2 I_1)/N_1) = (V_1/I_1)(N_2/N_1)^2$$

- 18. The correct answer is (A).** A battery is a DC source, not an AC source. While it produces a direct current in the primary coil, it can't produce an oscillating magnetic field required to induce current in the secondary coil.

- 19. The correct answer is (A).** The center mass is on the axis of rotation so its radius is zero and it does not contribute to the moment of inertia. The two end masses are a distance $L/2$ from the axis of rotation. Therefore:

$$I = \sum m_i r_i^2 = m(L/2)^2 + m(L/2)^2 = mL^2/4 + mL^2/4 = mL^2/2$$

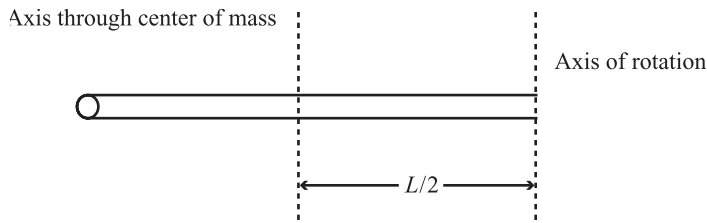
- 20. The correct answer is (A).** Use the Parallel Axis Theorem: $I = I_{\text{cm}} + Md^2 = MR^2/2 + Md^2$

I_{cm} for a cylinder is given in the passage. Since the units in the answer are kg m^2 , convert cm to m. Also note that 80 cm is the diameter.

$$I = 20.0 \text{ kg } (0.40\text{m})^2/2 + 20.0 \text{ kg } (0.10\text{m})^2 = 1.6 \text{ kg m}^2 + 0.2 \text{ kg m}^2 = 1.8 \text{ kg m}^2$$

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21. The correct answer is (B).



Use the Parallel Axis Theorem:

$$I = I_{\text{cm}} + Md^2 = ML^2/12 + M(L/2)^2 = ML^2/12 + ML^2/4 = 4ML^2/12 = ML^2/3$$

22. The correct answer is (C). The moment of inertia depends on the distance of a rotating mass from the axis of rotation. The greater the distance, the larger its contribution to the total inertia of the system.

Arrangement **a** has the greatest I_a because the center of each weight is the maximum distance from the axis of rotation, $r = L/2$.

In **b** the centers of both weights are very close to the axis of rotation and I_b should be quite small. This should be the minimum moment of inertia arrangement.

In **c** one weight is at the maximum distance from the axis of rotation and the other is very close.

In **d** the weight at the center of rotation doesn't contribute to I because $r = 0$. I_d is $1/2 I_a$ and less than I_c .

23. The correct answer is (D). The moment of inertia of the sculpture is the sum of the moments of inertia of its three components.

For the model:

$$\begin{aligned} I_{\text{model}} &= 2I_{\text{cmCylinder}} + I_{\text{cmSphere}} = 2(MR^2/2) + 2/5 MR^2 \\ &= MR^2 + 2/5 M(L/2)^2 = MR^2 + 1/10 ML^2 \end{aligned}$$

For the sculpture:

$I_{\text{cmCylinder}}$ depends on the radius of the cylinder, NOT on its length, so the contributions of the two cylinders are unaltered.

However, for the enlarged sphere, $I_{\text{cmSphere}} = 2/5 M(3L/2)^2 = 9/10 ML^2$

$$I_{\text{sculpture}} = MR^2 + 9/10 ML^2$$

The best answer is choice (D).

MCAT Practice Test 2

- 24. The correct answer is (B).** The smaller the percentage of rotational kinetic energy, the greater the percentage of translational energy. The greater the translational energy, the faster the object's linear motion. From the relation $I_{\text{cm}} = \beta MR^2$ it's clear that β is simply the coefficient in front of MR^2 . For the three objects, we get:

Object	Moment of Inertia	100% $\times \beta / (1 + \beta)$
Hoop	MR^2	50%
Disk	$\frac{1}{2} MR^2$	33%
Sphere	$\frac{2}{5} MR^2$	29%

The sphere has the smallest fraction of its kinetic energy in the form of rotational energy. Therefore, it has the greatest translational motion. It will cover the length of the ramp more quickly.

- 25. The correct answer is (D).** $I_{\text{sphere}} = \frac{2}{5} MR^2$, therefore $I/R^2 = \text{constant.}$, I and R are directly proportional.

$$I/R^2 = I_{\text{NEW}}/(R/10)^2 = I_{\text{NEW}}/(R^2/100) = (I/100)/(R^2/100) = (I/100)(100/R^2) = I/R^2$$

Therefore, I decreases by a factor of 100 when R decreases by a factor of 10.

- 26. The correct answer is (A).** In myopia (nearsightedness) the curvature of the cornea-lens system shows too much convergence. This eliminates choices (B) and (C). While choices (A) and (D) are acceptable, based on the definition of the passage, choice (A) is the better choice.

- 27. The correct answer is (B).** The far point is closer to the eye than normal. John is, therefore, nearsighted and requires a diverging lens that creates a virtual image of the object at the far point for his eye. Since a diverging lens is required, this eliminates choices (C) and (D).

$$P = 1/f = 1/o + 1/i = 1/\infty - 1/0.50\text{m} = -2.0 \text{ diopters}$$

- 28. The correct answer is (C).** In farsightedness, the image of a distant object appears to focus behind the retina. The lens must increase its convergence power to move the image forward onto the retina. Relaxing the ciliary muscle increases the radius of curvature which decreases the focal length.

- 29. The correct answer is (C).** Power is the reciprocal of the focal length measured in meters. Since the power is +, Jane is farsighted.

Since $P = 3.00$ diopters, the focal length of the corrective lens is $f = 0.33 \text{ m} = 33 \text{ cm}$. A corrective lens creates a virtual image, therefore, $1/i$ is negative.

The object distance is 25 cm.

The lens distance equation rearranges to:

$$1/i = 1/o - 1/f = 1/25 \text{ cm} - 1/33 \text{ cm} \sim 1/100 \text{ cm}$$

$$i \sim 100 \text{ cm}$$

In order to see the image of the object 25 cm in front of the eye, the contact lens must form a virtual image of the object 100 cm in front of the eye. 25 cm is where the near point should be, 100 cm is where the near point actually is.

According to the table in the passage, her near point of 100 cm is greater than the near point for a 50-year-old but less than that of a 60-year-old.

MCAT Practice Test 2

- 30. The correct answer is (C).** George is myopic and requires a converging lens. This eliminates choices (B) and (D). The lens creates a virtual image at his natural far point which is 50 cm from his eyes but 48 cm from his eyeglass lenses. It is the focal length of the eyeglasses we need to calculate:

$$1/f = 1/o + 1/i = 1/\infty - 1/48 \text{ cm} = -1/48 \text{ cm} \text{ and } f = -48 \text{ cm}$$

- 31. The correct answer is (B).** Flattening the cornea reduces its radius of curvature which increases its focal length. This is needed to correct nearsightedness (myopia).

- 32. The correct answer is (B).** $F_{\text{Gravity}} = G Mm/r^2 = mg$, therefore, $g = G M/r^2$

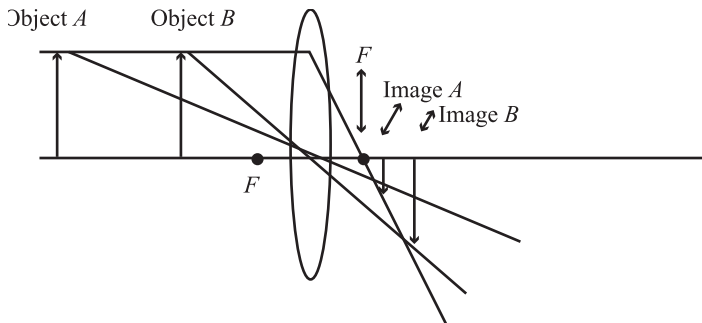
where M is the mass of the planet and for objects on the surface, r is the radius of the planet.

$$\begin{aligned} g_{\text{Planet X}} &= G(3M_{\text{Earth}})/(3r_{\text{Earth}})^2 = 3GM_{\text{Earth}}/9r_{\text{Earth}}^2 = (3/9)g_{\text{Earth}} \\ &= (1/3)(9.8 \times 10^6 \text{ m/s}^2) \sim 3.3 \times 10^6 \text{ m/s}^2 \end{aligned}$$

Therefore, weight of probe is approximately:

$$mg = (100 \text{ kg})(3.3 \times 10^6 \text{ m/s}^2) = 3.3 \times 10^2 \text{ N}$$

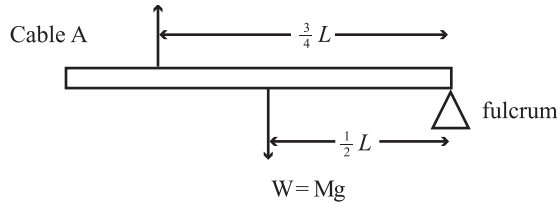
- 33. The correct answer is (B).** The easiest way to answer this question is with a fast sketch. For a given object's position, draw two rays from the top of the object. One ray is parallel to the principal axis and passes through the focal point on the opposite side of the lens. The other ray passes through the center of the lens. The top of the image appears where these two rays intersect.



Change the object's position and repeat the process. You will observe that as the object approaches the lens while remaining beyond the focal length, the image produced on the opposite side of the lens moves away from the lens and increases in size. As an aside, the image is real and inverted.

MCAT Practice Test 2

- 34. The correct answer is (C).** This is a torque problem. While the fulcrum can be placed anywhere, placing it at the far right end of the bar eliminated cable B from the calculation. There are now only two forces acting on the bar: the weight that produces a counterclockwise rotation and the tension in cable A that produces a clockwise rotation. Since the bar is in equilibrium, these two torques must sum to zero.



$$\Sigma\tau = T_A(3/4 L) - Mg(1/2 L) = 0$$

$$\text{Therefore, } T_A = (MgL/2)/(3L/4) = (MgL/2)(4/3L) = 2Mg/3$$

- 35. The correct answer is (D).** By definition $E = F/q = 8 \times 10^{-2} \text{ N}/4 \times 10^{-6} \text{ C} = 2 \times 10^4 \text{ N/C} = 2 \times 10^4 \text{ kg m/s}^2\text{C}$

- 36. The correct answer is (A).** Two external forces, F_A and F_B , act on the system and move in opposite directions. Let's arbitrarily assume that the downward direction is positive and that F_A provides downward motion while F_B provides upward motion.

$$F_A = (+15\text{kg})(9.8 \text{ m/s}^2) = 147 \text{ N} \quad \text{and} \quad F_B = (-10\text{kg})(9.8 \text{ m/s}^2) = -98 \text{ N}$$

$$F_{\text{total}} = F_A + F_B = 147 \text{ N} + (-98 \text{ N}) = 49 \text{ N}$$

The total mass that must be set in motion is $15 \text{ kg} + 10 \text{ kg} = 25 \text{ kg}$.

$$\text{Since } F_{\text{total}} = m_{\text{total}}a, \quad a = F_{\text{total}}/m_{\text{total}} = 49 \text{ N}/25 \text{ kg} \sim 2 \text{ m/s}^2$$

- 37. The correct answer is (A).** Momentum is always conserved. Since the skater and snowball are initially at rest, the initial momentum is zero. Therefore, the final momentum after the toss must also be zero.

$$P_{\text{skater}} + P_{\text{snowball}} = 0 \quad \text{or} \quad m_{\text{skater}} v_{\text{skater}} + m_{\text{snowball}} v_{\text{snowball}} = 0$$

$$v_{\text{skater}} = -m_{\text{snowball}} v_{\text{snowball}}/m_{\text{skater}} = -(0.15 \text{ kg})(35 \text{ m/s})/50 \text{ kg} = -0.10 \text{ m/s}$$

The negative sign indicates that the momenta of the skater and the snowball are in opposite directions.

- 38. The correct answer is (C).** Kirchhoff's junction rule states that the algebraic sum of all currents into and out of any branch point is zero: $\Sigma I = 0$. By convention, the sign of current entering a junction is positive and current leaving a junction is negative.

$4A + 5A - 6A + I_{AB} = 0$, therefore, $I_{AB} = -3A$. The wire between points A and B carries a current of 3A away from the junction.

MCAT Practice Test 2

39. **The correct answer is (A).** We can use the following relationship:

$$q_{\text{solution}} = m(\text{sh}) \Delta T = (100 \text{ g} + 4.56 \text{ g})(4.18 \text{ J/g}^\circ\text{C})(34.6^\circ\text{C} - 24.0^\circ\text{C}) = 4630 \text{ J}$$

But since the calorimeter is thermally insulated,

$$q_{\text{reaction}} + q_{\text{solution}} = 0$$

$$q_{\text{reaction}} = -q_{\text{solution}} = -4630 \text{ J}$$

To convert this heat value to enthalpy of solution, we need to calculate the moles of KOH:

$$\text{moles KOH} = (4.56 \text{ g}) / (56.11 \text{ g/mol}) = 0.08127 \text{ mol}$$

$$\Delta H_{\text{solution}} = -4630 \text{ J} / 0.08127 \text{ mol} = -5.70 \times 10^5 \text{ J/mol}$$

$$= -57.0 \text{ kJ/mol}$$

[Note: We expect ΔH to be negative since the temperature rose. Thus, we could have eliminated choices (C) and (D) at the outset.]

40. **The correct answer is (C).** Doubling the mass of water will “dilute” the temperature change due to the heat evolved by a factor of two; doubling the mass of KOH as well will produce twice as much heat and will restore the temperature change to that of the original experiment. Choice (D) is unlikely to be true for two reasons: equal masses of KOH and NaOH contain different numbers of moles, and without further data we have no way of knowing how the enthalpies of solution of these two solids are related.

41. **The correct answer is (B).** Since the method requires a constant temperature of 0°C , heat measured in this way would have to be modified based on additional information to give information about other temperatures. Choice (A) is incorrect, since a reaction that absorbed heat would be expected to cause more ice to form quantitatively, resulting in a measurable increase in the ice-water volume. Choice (C) is incorrect, since the ice-water mixture does not come in contact with the reacting chemicals. As for choice (D), any measured-reaction heat can be converted to an enthalpy by adjusting for the number of moles of limiting reactant and for the coefficient in the balanced reaction.

42. **The correct answer is (C).** We need to use the change in volume to determine the mass of ice that melted and the specific heat of fusion to find the heat needed to melt that mass of ice. Since the ice absorbed positive heat when it melted, q_{reaction} must be negative:

$$m_{\text{ice}} = (-1.86 \text{ mL})(1.00 \text{ g ice} / -0.091 \text{ mL})$$

$$= 20.4 \text{ g}$$

$$q_{\text{ice}} = (20.4 \text{ g})(334 \text{ J/g}) = 6810 \text{ J}$$

$$q_{\text{reaction}} = -q_{\text{ice}} = -6810 \text{ J} \approx -7 \text{ kJ}$$

43. **The correct answer is (B).** We need to calculate the specific heat of fusion of benzene in order to make the necessary comparison:

$$(10.59 \text{ kJ/mol}) / (78.1 \text{ g/mol}) = 0.136 \text{ kJ/g} = 136 \text{ J/g}$$

Since the corresponding value for water-ice is higher, 334 J/g , the heat produced by identical samples of methanol will melt a greater mass of solid benzene. Specifically, the mass of benzene melted will be

$$(6810 \text{ J})(1.00 \text{ g benzene}/136 \text{ J}) = 50.1 \text{ g benzene.}$$

This is considerably larger than the value of 20.4 g of ice that was calculated to have melted from the same amount of heat.

MCAT Practice Test 2

44. **The correct answer is (C).** One way to approach this problem is to compute the molar mass of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ (249.7 g/mol), then find the number of moles present in 0.100 g. After the conversion to $\text{CuSO}_4 \cdot 3\text{H}_2\text{O}$, we can use the same number of moles to find the new mass, using the molar mass of the lighter hydrate (213.7 g/mol).

$$\begin{aligned}\text{moles CuSO}_4 \cdot 5\text{H}_2\text{O} &= (0.100 \text{ g}) / (249.7 \text{ g/mol}) \\ &= 4.00 \times 10^{-4} \text{ mol} \\ \text{mass CuSO}_4 \cdot 3 \text{H}_2\text{O} &= (4.00 \times 10^{-4} \text{ mol})(213.7 \text{ g/mol}) \\ &= 0.085 \text{ g}\end{aligned}$$

45. **The correct answer is (A).** A good oxidizing agent for Sn^{2+} must be capable of being reduced itself [ruling out choice (B)] and must have a reduction potential that is greater than 0.154. Only MnO_4^- meets these criteria.
46. **The correct answer is (C).** The question could be rephrased as asking for a reaction that is driven to the right by increased H^+ concentration. Of the species mentioned, only MnO_4^- has H^+ in its half reaction, and since H^+ will be on the left-hand side of the overall reaction with Cu, LeChatelier's Principle predicts that increasing the amount of H^+ will drive the reaction farther to the right.
47. **The correct answer is (B).** Choice (A) would be correct if the reaction took place in basic solution.

48. **The correct answer is (A).** Use the formula from the passage:

$$\begin{aligned}E^\circ_{\text{total}} &= (n_1 E^\circ_1 + n_2 E^\circ_2) / (n_1 + n_2) \\ &= [(1)(0.77) + (2)(-0.44)] / (2 + 1) \\ &= -0.04\end{aligned}$$

49. **The correct answer is (A).** Response I is correct, since Nb^{3+} lies below the midpoint of the line between Nb and Nb_2O_5 . Response II is false, since the $\text{Nb}_2\text{O}_5 / \text{Nb}^{3+}$ couple has the more positive slope. Response III is false—since Nb^{3+} is the lowest point on the diagram, it is the most stable.
50. **The correct answer is (D).** In reaction I, both the mercury and niobium species change in the “downhill” direction on the graph, toward more stable products. In reaction III, Hg must change “uphill” to Hg^{2+} , but Nb changes in a “downhill” direction to Nb^{3+} , and the steeper slope of the Nb^{3+}/Nb couple makes the overall process favorable. In contrast, reaction II requires that Hg be oxidized “uphill” to Hg^{2+} , while Nb^{3+} must be reduced “uphill” to Nb; this reaction is not spontaneous.
51. **The correct answer is (B).** Point 3 is a buffer region that is approximately halfway between the first equivalence point (at which all of the original B was converted to BH^+) and second equivalence point (at which all of the original B will be converted to BH_2^{2+}). Thus, it contains both BH^+ and BH_2^{2+} .
52. **The correct answer is (B).** Point 2 represents the first equivalence point, at which the moles of acid added are equal to the original moles of B. Since the HCl is twice as concentrated as the B, this equivalence point comes at half the value of the original base volume, or 10.00 mL.

Alternatively, the original 0.100 M sample of base contains

$$(20.00 \text{ mL})(0.100 \text{ mmol}) = 2.00 \text{ mmol}$$

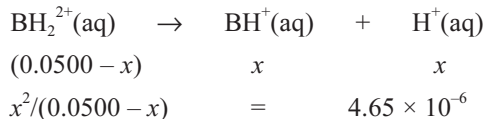
To obtain an equal number of mmol acid, we need

$$V_{\text{acid}} = (2.00 \text{ mmol}) / (0.200 \text{ mmol/mL}) = 10.00 \text{ mmol}$$

MCAT Practice Test 2

- 53. The correct answer is (A).** Point 4 represents the second equivalence point, at which all of the original base B has been converted to BH_2^{2+} . Since 20.00 mL of HCl was required to reach this point, the total volume is 40.00 mL. Therefore the concentration of BH_2^{2+} equals one-half the concentration of the original B, or 0.0500 M.

We now have the problem of finding the pH of a weak acid solution; for K_a , we use K_2 for BH_2^{2+} . (Note that we might guess an answer at this point, since only one of the choices is less than 7!)



Using the approximation that $0.0500 \gg x$, we have

$$\begin{aligned} x^2/0.0500 &= 4.65 \times 10^{-6} \\ x &= [\text{H}^+] = 4.82 \times 10^{-4} \text{ M} \\ \text{pH} &= -\log(4.82 \times 10^{-4} \text{ M}) \\ &= 3.3 \end{aligned}$$

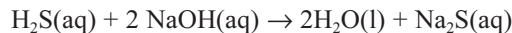
- 54. The correct answer is (C).** A pure solution of a weak base undergoes hydrolysis, leading to small amounts of hydroxide ion, which causes the pH to rise above 7.
- 55. The correct answer is (B).** The color change from yellow (for low pH values) to red (for high pH values) occurs when $[\text{HInd}] = [\text{Ind}^-]$, which corresponds to a pH determined as follows:
- $$\begin{aligned} [\text{H}^+] &= K_a ([\text{HInd}] / [\text{Ind}^-]) = (10^{-7.81})(1) \\ &= 1.5 \times 10^{-8} \text{ M} \end{aligned}$$
- At pH 5, where $[\text{H}^+] = 1.0 \times 10^{-5} \text{ M}$, the solution is more acidic than the value calculated, so the yellow color will predominate; at pH 10, where $[\text{H}^+] = 1.0 \times 10^{-10} \text{ M}$, the solution is less acidic than the value calculated, so the red color will predominate.
- 56. The correct answer is (D).** This graph shows sharply negative values for the rate of change at the places in the original graph that correspond to steep drops in pH, and less negative values at the places in the original graph that correspond to buffer regions.
- 57. The correct answer is (D).** Here we need to use Table 1 to test compounds that we consider to be strongly ionic, such as NaF and CaCl_2 , against the Pauling electronegativity differences. (For NaF, $\Delta\text{EN} = 3.1$; for CaCl_2 , $\Delta\text{EN} = 2.0$.)
- 58. The correct answer is (B).** The Millikan definition ranks a bond high on the electronegativity scale if it holds on tightly to its own valence electron and successfully competes for a valence electron of other atoms.
- 59. The correct answer is (B).** The large value of IE shown in Table 2 for H puts the Millikan EN for H above that for carbon, in contrast to the order given in the Pauling system.
- 60. The correct answer is (A).** Table 3 (used together with Table 1 for EN values) shows a general trend of increased bond enthalpy and dipole moment as EN increases.
- 61. The correct answer is (C).** The data in Table 4 show consistently that the strength of an acid increases as the electronegativity of a neighboring atom is increased by substitution. In this case, the highly electronegative chlorine is better than bromine at pulling negative charge toward itself and away from the hydrogen atom, leaving it freer to leave as H^+ . Bromine, in turn, is more effective than iodine.

MCAT Practice Test 2

- 62. The correct answer is (B).** We can use the ideal gas law, using “ ΔP ” = 760 torr – 745 torr = 15 torr to determine Δn , the decrease in moles of gas. Note that (15 torr)(1 atm/760 torr) = 0.0197 atm

$$\begin{aligned}\Delta n &= \Delta P V / RT = (0.0197 \text{ atm})(0.250 \text{ L}) / (0.08206 \text{ L atm/K mol}) (298 \text{ K}) \\ &= 2.02 \times 10^{-4} \text{ mol CO}_2 \\ \text{mass of CO}_2 &= (2.02 \times 10^{-4} \text{ mol})(44.0 \text{ g/mol}) \\ &= 8.89 \times 10^{-3} \text{ g}\end{aligned}$$

- 63. The correct answer is (B).** Since the method relies on the reaction of carbon dioxide with sodium hydroxide, we need to be aware of any other species that would react similarly. H_2S dissolves in water to form a weak acid, which would also react with NaOH .



- 64. The correct answer is (D).** Since gas molecules are removed by the reaction with NaOH , both the total pressure in the flask—interpreted as the number of wall collisions per second—and the total number of molecules per unit volume—will decrease.

- 65. The correct answer is (B).** Use the titration data to determine the number of moles of carbonate, equate this value to moles of original CO_2 , then use the ideal gas law to determine the partial pressure of CO_2 in the original sample.

The titration reaction is

$$\begin{aligned}\text{CO}_3^{2-}(\text{aq}) + 2\text{H}^+(\text{aq}) &\rightarrow \text{H}_2\text{O} + \text{CO}_2(\text{g}) \\ \text{mmol CO}_3^{2-} &= (1/2) \text{ mmol H}^+ = (1/2)(0.0200 \text{ mmol/mL})(20.40 \text{ mL}) \\ &= 0.204 \text{ mmol} = 2.04 \times 10^{-4} \text{ mol} = \text{moles original CO}_2 \\ P_{\text{CO}_2} &= n_{\text{CO}_2} RT / V \\ &= (2.04 \times 10^{-4} \text{ mol})(0.08206 \text{ Latm/Kmol})(298 \text{ K}) / (0.0100 \text{ L}) \\ &= 0.499 \text{ atm} \\ 0.499 \text{ atm} &(760 \text{ torr/1 atm}) = 379 \text{ torr}\end{aligned}$$

- 66. The correct answer is (D).** Since carbonate is a weak base, the pH of a carbonate solution is determined primarily by the hydrolysis reaction.

$$\begin{aligned}\text{CO}_3^{2-} + \text{H}_2\text{O} &= \text{HCO}_3^-(\text{aq}) + \text{OH}^-(\text{aq}) \quad K_h \\ \text{where } K_h &= K_w/K_2 = (1.00 \times 10^{-14}) / (4.69 \times 10^{-11}) \\ &= 2.13 \times 10^{-4}\end{aligned}$$

The concentration of CO_3^{2-} before dissociation is 8 mmol/10 ml, or 0.80 M. Setting x equal to $[\text{OH}^-(\text{aq})]$ and to $[\text{HCO}_3^-]$ produced, we have

$$2.13 \times 10^{-4} = x^2 / (0.80 - x)$$

For an approximate answer, we may neglect x in the denominator, so

$$\begin{aligned}x^2 &\approx (2.13 \times 10^{-4})(0.80) \\ x &\approx [\text{OH}^-] = 0.013 \text{ M} \\ \text{pOH} &= -\log(0.013) = 1.9 \\ \text{pH} &= 14.0 - 1.0 = 12.1\end{aligned}$$

- 67. The correct answer is (B).** Since $\lambda = c/v$, we can list the modes in order of increasing wavelength by going in order of decreasing frequency.

- 68. The correct answer is (A).** The dipole moment of the molecule remains at zero during all phases of this mode. Both of the other modes produce a varying dipole moment.

MCAT Practice Test 2

69. **The correct answer is (C).** We cannot use Beer's Law directly, since we haven't been given a (a property of the molecule) or b (the optical path length). But the "identical conditions" mentioned ensure that these are fixed for both measurements. Therefore

$$C_2 / C_1 = A_2 / A_1 = (0.452 / 0.195) = 2.32$$

$$C_2 = 2.32 C_1 = 2.32 (2.5 \times 10^{-4} \text{ M})$$

$$= 5.8 \times 10^{-4} \text{ M}$$

70. **The correct answer is (C).** The first horizontal region of the curve represents melting, while the second horizontal region represents evaporation. Since the rate of heating was 1.00 kJ/mol, the 20-min. interval represents 20.0 kJ/mol as the enthalpy of vaporization.

71. **The correct answer is (D).** E_a for the reverse reaction is the barrier faced going from right to left. From the diagram, the products must climb first by +34 kJ/mol (since ΔG is -34 kJ/mol) and then by an additional 28 kJ/mol, for a total of 62 kJ/mol.

72. **The correct answer is (D).** Ethanol has the highest vapor pressure of the four choices because it is much closer to its boiling point at 25.0°C than are water or aqueous solutions. Choices (C) and (D) both have lower vapor pressure than pure water, since a nonvolatile solute lowers the vapor pressure in proportion to its mole fraction. Since NaCl has more solute particles than glucose, it will have the lowest vapor pressure.

73. **The correct answer is (C).** First find the limiting reactant, using mg and mmol as time savers:

$$2.70 \text{ mg Al} (1 \text{ mmol Al} / 27.0 \text{ mg}) = 0.100 \text{ mmol}$$

$$20.00 \text{ mL HCl} (0.0100 \text{ mmol/mL}) = 0.200 \text{ mmol}$$

We have twice as much HCl as Al, but we would need three times as much for all of the reactants to be used up; therefore HCl is the limiting reactant, and there will be some excess Al.

$$(2.00 \times 10^{-4} \text{ mol HCl})(3 \text{ mol H}_2/6 \text{ mol HCl})(22.4 \text{ L/mol H}_2)$$

$$= 2.24 \times 10^{-3} \text{ L} \approx 2 \text{ mL}$$

74. **The correct answer is (A).**

$$(\text{rate for X} / \text{rate for Ar}) = (\text{time for Ar} / \text{rate for X}) = (M_{\text{Ar}} / M_{\text{X}})^{1/2}$$

$$(M_{\text{Ar}} / M_{\text{X}}) = (t_{\text{Ar}}/t_{\text{X}})^2$$

$$M_{\text{X}} = M_{\text{Ar}} (t_{\text{X}}/t_{\text{Ar}})^2 = (39.9 \text{ g/mol}) (20.0 \text{ min} / 24.0 \text{ min})^2$$

= 27.7 g/mol [Note that the shorter time for gas x leads us to predict at once that x has a lower molar mass than Ar, thus, narrowing the choices to (A) or (B).]

75. **The correct answer is (D).** If V is the original volume of the sample, then

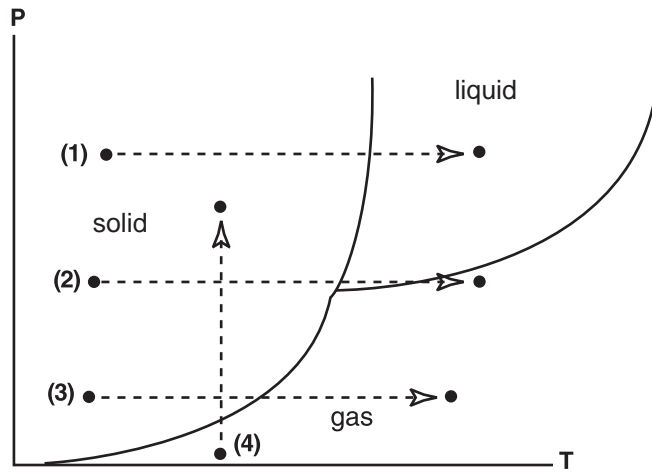
$$M_1 V_1 = M_2 V_2$$

$$V(0.25) = (V + 48)(0.20)$$

$$V = 192 \text{ mL}$$

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76. The correct answer is (C). The diagram can be interpreted with the following labels for the phases:



We see that path 3, which leads from solid directly to gas, represents sublimation, which by definition is to go directly from a solid to a gas.

77. The correct answer is (D).

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VERBAL REASONING

78. **The correct answer is (A).** This is stated in the first sentence of the paragraph.
79. **The correct answer is (D).** This answer can be found in the parenthetical reference in the first sentence of the second paragraph.
80. **The correct answer is (A).** The author states in the third paragraph that “The ability to predict the paths of hurricanes has been greatly enhanced by the use of computers and satellites. The existence of better knowledge of the storm tracks...”
81. **The correct answer is (B).** In the fifth paragraph, the author says computers are an “enormous asset.”
82. **The correct answer is (B).** Steering winds are discussed in the third paragraph.
83. **The correct answer is (A).** The author states that flying into the eye of a storm in an airplane is the best way to obtain information not provided by computers and previous predictions.
84. **The correct answer is (C).** The author makes this point in the last paragraph.
85. **The correct answer is (B).** This is stated in the last sentence of the first paragraph.
86. **The correct answer is (A).** The second paragraph discusses the way of life and customs of peasant women and how they were passed down through the generations.
87. **The correct answer is (B).** Tenements are described in the third paragraph. Many immigrants at this time lived in tenement buildings in large cities.
88. **The correct answer is (D).** Immigrant mothers were often consumed with responsibility, which included keeping the flat as livable as possible. This can be found in the fourth paragraph.
89. **The correct answer is (A).** The article mentions women gardening vegetables but does not mention selling them in a marketplace.
90. **The correct answer is (B).** Immigrant wages were often so low that the man alone could not support the family, causing others in the family to work. This can be found in the first sentence of paragraph 6.
91. **The correct answer is (C).** Although the author mentions the conditions of the whole immigrant family, it is clear that his focus is on the hardships of immigrant women, and that the author is sympathetic.
92. **The correct answer is (C).** The third paragraph explicitly states this.
93. **The correct answer is (B).** Although the other choices are true of some, the article states in paragraph 2 that “Many Americans wanted the United States to intervene on the side of the Cuban rebels, because the Spanish were seen as unwanted foreigners to be driven out of the hemisphere.”
94. **The correct answer is (D).** This is stated in the second paragraph. Although the American investigation found that a land mine caused the explosion, no one was ever officially blamed.
95. **The correct answer is (B).**
96. **The correct answer is (A).** This answer can be found near the end of the third paragraph.
97. **The correct answer is (C).**
98. **The correct answer is (A).** The last paragraph talks about the results of the war and mentions that these three islands simply had one colonial ruler replaced by another.
99. **The correct answer is (C).** The second sentence in the first paragraph states, “Millions of years ago...” Thus, choice (C) makes the most sense. Choice (D) can be eliminated as millions is plural, so it’s not less than a million, and (A) and (B) are too large.
100. **The correct answer is (D).** These things are all mentioned in the fifth paragraph.
101. **The correct answer is (C).** This is explicitly stated in the second paragraph.
102. **The correct answer is (B).** This is explicitly stated in the third paragraph.

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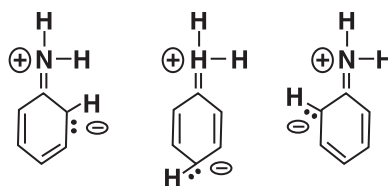
103. **The correct answer is (A).** This can be found in the fifth paragraph.
104. **The correct answer is (B).** This is explicitly stated.
105. **The correct answer is (B).** This is the traditional definition of *laissez faire*.
106. **The correct answer is (A).** The passage mentions both the Erie Canal and transportation routes.
107. **The correct answer is (D).** This can be found in the third paragraph.
108. **The correct answer is (B).**
109. **The correct answer is (C).** See the last paragraph.
110. **The correct answer is (D).**
111. **The correct answer is (C).**
112. **The correct answer is (D).** This can be inferred from the first paragraph.
113. **The correct answer is (D).** Although it seems the author is uncomfortable with the growth of presidential power, it is not explicitly stated, and therefore more information is necessary.
114. **The correct answer is (B).** This can be found in the second paragraph.
115. **The correct answer is (B).** This is all stated in the passage.
116. **The correct answer is (A).**
117. **The correct answer is (D).**
118. **The correct answer is (C).**
119. **The correct answer is (A).** This is stated in the first sentence of the last paragraph.
120. **The correct answer is (C).** The passage mentions the loss of hind limbs, not all four limbs.
121. **The correct answer is (D).** This can be found in the first paragraph of the passage.
122. **The correct answer is (B).** The passage states that there is some evidence that communication skills are used to warn others of danger.
123. **The correct answer is (A).** The third paragraph explains that Odontoceti use their teeth to catch fish.
124. **The correct answer is (C).** A person actively advocating for the survival of Cetaceans would not be a threat.
125. **The correct answer is (C).** The author states that human intervention is essential to their survival.
126. **The correct answer is (A).** This is stated in the first paragraph.
127. **The correct answer is (B).** Jacobs did not want her story to be included in another novel. She wanted to tell her own story.
128. **The correct answer is (B).** Jacobs did not want the people she wrote about to suffer reprisals from their masters.
129. **The correct answer is (A).** Many believed at the time that an African-American woman could not write a work of such quality. This is mentioned in the third paragraph.
130. **The correct answer is (D).** Support for each of these claims can be found in the passage.
131. **The correct answer is (C).** Although the passage mentions choices (A) and (B), the focus of the passage is the eventual validation of the narrative.
132. **The correct answer is (D).**
133. **The correct answer is (B).** Dunant wanted to create a society of volunteers to help the wounded in battle.
134. **The correct answer is (A).**
135. **The correct answer is (C).** The passage states that the privileges were for signing members only.
136. **The correct answer is (C).**
137. **The correct answer is (B).** This is explicitly stated in the last paragraph.

MCAT Practice Test 2

BIOLOGICAL SCIENCES

- 138. The correct answer is (D).** Microtubules and microfilaments help maintain cell shape, provide structural support, and influence cell motility. They are considered the cell's cytoskeleton.
- 139. The correct answer is (A).** The lipid bilayer allows other lipids (hydrophobic molecules) to cross the membrane freely. Small polar molecules such as water can pass *between* the membrane phospholipids. Glucose molecules, however, require channel proteins to assist in facilitated diffusion.
- 140. The correct answer is (B).** The described carrier proteins are involved with the sodium/potassium ATP pump. The active transport of these ions is vital in repolarization and in the maintenance of the cell's resting potential.
- 141. The correct answer is (C).** The glycocalyx includes glycoproteins, glycolipids, and other carbohydrate components of the membrane. These molecules are important as markers in the embryonic arrangement of cells into tissues and organs, as well as in the ability to distinguish between "self" and "non-self" by the body's immune system.
- 142. The correct answer is (A).** Acetylcholine, released from motor neuron vesicles, is the ligand that binds to ligand-gated channels. This event leads to the inflow of sodium ions at the onset of depolarization of the sarcolemma.
- 143. The correct answer is (B).** Cholesterol can be synthesized by the liver.
- 144. The correct answer is (C).** Although plasmodesmata are membrane connections that allow material through, they are only found in plant cells.
- 145. The correct answer is (A).** All amines have a lone-pair of electrons on the nitrogen which enables a hydrogen bond to form. Tertiary amines cannot form hydrogen bonds because the N is not bonded to a hydrogen atom. Amines are not optically active because of their rapid rate of inversion which convert between enantiomers.

- 146. The correct answer is (C).** This molecule is not superimposable on its mirror image. However, it is not optically active because of rapid inversion of its configuration; the energy barrier between the two arrangements of groups is exceedingly low so that enantiomers have not been isolated.
- 147. The correct answer is (B).** Quarternary ammonium salts containing four different groups has a tetrahedral arrangement and therefore exist as configurational enantiomers.
- 148. The correct answer is (C).** Rapid inversion about the pyramidal N precludes the isolation of enantiomers.
- 149. The correct answer is (D).** The nonbonding electrons on aromatic amines are delocalized according to



They therefore are less available for attack by a H^+ .

- 150. The correct answer is (C).** A free N-H group stretches at $3050\text{--}3550\text{ cm}^{-1}$ while the N-H bending occurs at $1600\text{--}1640\text{ cm}^{-1}$.
- 151. The correct answer is (B).** Heterozygous individuals at both loci (YyAa) produce pigment (A_) and have a yellow coat (Yy).
- 152. The correct answer is (A).** If a Punnett square is completed for this cross, four out of sixteen possible offspring will have the lethal YY combination as part of their genotype.
- 153. The correct answer is (C).** Further examination of this same Punnett square reveals that out of the twelve possible offspring that will live to birth, nine will have a pigmented coat (6 yellow, 3 agouti) and three will be albinos.

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- 154. The correct answer is (B).** The cross described ($yyAa \times yyAa$) has a 25% chance of producing an albino individual ($yyaa$) and a 75% chance of producing an agouti individual ($yyAA$ or $yyAa$).
- 155. The correct answer is (D).** A common incorrect choice is pleiotropy, which refers to an allele at one locus affecting many different traits or aspects of the individual's phenotype.
- 156. The correct answer is (C).** This monohybrid cross disregards alleles at the albino locus. Two yellow mice (Yy) can produce two yellow offspring (Yy) and one agouti offspring (yy). YY individuals die prior to birth.
- 157. The correct answer is (B).** A highly acidic pH limits the number of *any* cells that can survive in the environment of the stomach.
- 158. The correct answer is (A).** By maintaining a hypertonic renal medulla between the ascending loop of Henle and the collecting duct and a hypotonic urinary filtrate in the distal convoluted tubule and collecting duct, water can be reabsorbed with extreme efficiency when ADH is present.
- 159. The correct answer is (C).** Proprioceptors respond to mechanical stretch in the muscles, tendons, and joints. Hearing receptors respond to mechanical vibrations caused by sound waves and (subsequently) fluids in the cochlea. Balance receptors respond to mechanical forces caused by otoconia (sacculle and utricle) and fluid movements (semicircular canals). Pain receptors *may* respond to intense mechanical forces. However, they also respond to chemicals and thermal changes as well.
- 160. The correct answer is (C).** mRNAs, tRNAs, and rRNAs are needed for protein synthesis in both eukaryotes and prokaryotes. However, snRNAs are components of spliceosomes, which help in post-transcriptional modification by removing introns from pre-mRNA in eukaryotes.
- 161. The correct answer is (B).** Tertiary amines do not react with acid chlorides to form amides because tertiary amines cannot lose a proton after attacking the carbon. The alkylation of amines by alkyl halides is a nucleophilic substitution reaction in which the organic halide is attacked by the nucleophilic amine. Peptides are formed by the reaction between the carboxyl group of an amino acid and the amino terminal of another amino acid to form an amide linkage.
- 162. The correct answer is (B).** The region shows the blastocoel of the former blastula decreasing in size as the archenteron of the gastrula forms.
- 163. The correct answer is (C).** The coelom forms as the three primary germ layers proceed through gastrulation.
- 164. The correct answer is (D).** Each cell produced by indeterminate cleavage in the early embryo maintains its capacity to develop into a complete embryo.
- 165. The correct answer is (A).** Radial and spiral cleavage are terms that refer to particular planes of division with respect to the vertical axis in the early embryo (parallel or perpendicular vs. diagonal, respectively). Organisms with radial cleavage include the sea star (an echinoderm with radial symmetry) and the elephant (a chordate with bilateral symmetry). Choice (B) is not considered correct because the phyla that exhibit spiral cleavage (mollusks, annelids, and arthropods) are all bilaterally symmetrical. Although the octopus (a cephalopod mollusk) appears to be radially symmetrical, the distinct head and tail regions confirm bilateral symmetry.
- 166. The correct answer is (D).** In deuterostomes (echinoderms and chordates), the anus develops from the blastopore. The shark (a chordate) is the only correct answer.
- 167. The correct answer is (A).** The question describes an organism with determinate cleavage (a protostome). The only protostome among the choices is the fruit fly, an arthropod. The hagfish is a chordate (a jawless vertebrate like the lamprey, belonging to the class Agnatha).
- 168. The correct answer is (B).** If each of these structures has endocrine functions, the secretions must enter the blood. The hypothalamus only regulates the activity of the pituitary gland.

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- 169. The correct answer is (D).** The question states that an increase in blood volume will increase blood pressure. When reabsorption of sodium occurs, reabsorption of water usually follows (increasing blood volume). Therefore, without knowing anything about ANF, choice (D) is the only possible answer.
- 170. The correct answer is (C).** Knowledge about the role of bicarbonate ion (here, in the form of sodium bicarbonate) as an alkaline secretion that helps neutralize acidity is helpful. The arrival of acidic chyme signals the small intestine to release secretin (“proximate” reason). The fact that pancreatic enzymes are most active in the slightly alkaline pH of the small intestine (they require a slightly alkaline environment to function properly) is the “ultimate” reason.
- 171. The correct answer is (A).** When cells in a noncyclic environment (darkness) display a cyclic pattern of response, an “internal” cyclic rhythm is suggested. Choices (B) and (C) do not apply to the conditions described in the question. There is no relevant basis for selecting choice (D).
- 172. The correct answer is (D).** The passage states that thymosin only influences the differentiation of T-lymphocytes. Choices (A), (B), and (C) are each specific roles of lymphocytes (either T- or B-lymphocytes).
- 173. The correct answer is (B).** Knowledge of the source and function of bile is important. The liver produces bile, while the gallbladder stores and concentrates bile. The role of bile is to emulsify fats so that they can be efficiently digested by pancreatic lipase. Without the gallbladder, bile can still be sent to the small intestine via the liver directly.
- 174. The correct answer is (C).** Resonance structures can be drawn for both the acid and its anion, but those for the acid are inequivalent. Thus, resonance stabilization is greater for the anion.
- 175. The correct answer is (C).** Acidity increases as electron-withdrawing groups are added to the acid. Electron-withdrawing groups attached to the α -carbon are particularly effective in raising the acidity of the acid.
- 176. The correct answer is (B).** Acid-weakening groups donate charge so that they activate the ring toward attack by an electron-deficient species.
- 177. The correct answer is (A).** The carbonyl carbon is sp^2 hybridized so it is planar near the site of attack and therefore less sterically hindered.
- 178. The correct answer is (C).** The carboxyl group is made of these three groups and therefore they will appear in the infrared spectrum.
- 179. The correct answer is (D).** For substitution to occur, C-C or C-H bonds would need to break.
- 180. The correct answer is (D).** A DNA sequence is complementary and antiparallel to its mRNA transcript.
- 181. The correct answer is (D).** In birds, sex determination works in the opposite way from humans, where the male is heterogametic (XY). The female bird is heterogametic (ZW) and will produce a male offspring if her egg carries the Z chromosome (ZZ), and a female offspring if her egg carries the W chromosome (ZW).
- 182. The correct answer is (C).** Aromatic systems show strong absorptions in the UV region of the system. C—C and C—H bonds will absorb in the IR region. The NMR will show the inequivalent hydrogens.
- 183. The correct answer is (C).** NAD and FAD are hydrogen acceptors in cellular respiration during which time most of a cell’s ATP is produced. Among the answers, only active transport via the sodium/potassium pump requires ATP.
- 184. The correct answer is (C).** The liver produces bile, which emulsifies fats prior to digestion by pancreatic lipase. However, the liver makes no enzymes that digest food directly.
- 185. The correct answer is (A).** To make DNA from an RNA template requires the enzyme reverse transcriptase (originally identified in retroviruses).
- 186. The correct answer is (B).** Ribonuclease is specifically needed to break down RNA. Deoxyribonuclease can degrade DNA, while proteases can initiate the breakdown of proteins.

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- 187. The correct answer is (B).** The complementary strand of DNA is synthesized using DNA polymerase. DNA helicase is not needed to separate the DNA double helix because there is no DNA double helix.
- 188. The correct answer is (C).** In eukaryotes, as a result of post-transcriptional modification, the final mRNA transcript has had introns (intervening sequences) removed. Only the exons (expressed sequences) remain.
- 189. The correct answer is (C).** Although all answers are true statements, only choice (C) is a statement that one can conclude from the evidence presented.
- 190. The correct answer is (D).** All three protein gene products are utilized by both brain cells and muscle cells. Peptidyl transferase is used during translation, ATPase is used during cellular respiration, and acetylcholinesterase is used after depolarization.
- 191. The correct answer is (A).** Since increased carbon dioxide levels contribute to increased acidity (too many H^+), the appropriate response to a rise in plasma H^+ concentration would be to breathe more deeply and more rapidly. This will decrease blood carbon dioxide levels.
- 192. The correct answer is (B).** Bases remove free H^+ from solution. An exposed $R-NH_2$ can bind to H^+ to form $R-NH_3^+$. An exposed $R-COOH$ has no available site for binding to an additional H^+ .
- 193. The correct answer is (D).** Buffers either substitute weak acids for strong acids or weak bases for strong bases. Carbonic acid is a weak acid that does not dissociate as much as a strong acid such as hydrochloric acid.
- 194. The correct answer is (C).** Acidosis is a condition in which H^+ concentration is too high. The kidney will *increase* reabsorption of bicarbonate ions under these conditions so that this basic ion can tie up many of the excess H^+ .
- 195. The correct answer is (B).** Without adequate intake of glucose, fats will be mobilized to form glycerol and fatty acids to be used as substitutes in cellular respiration. The utilization of fatty acids for energy produces acidic ketone bodies.
- 196. The correct answer is (B).** A pH lower than 7.35 indicates acidosis. If the respiratory system was the cause, carbon dioxide levels would be higher than normal. Since carbon dioxide levels in this example are lower than normal, the respiratory system seems to be eliminating carbon dioxide faster than usual in order to compensate for the acidity caused elsewhere.
- 197. The correct answer is (C).** The $-OH$ group when protonated becomes the good leaving group, H_2O .
- 198. The correct answer is (D).** Alkyl groups rearrange to form the most stable carbocation. Most primary alcohols do not react with a carbocation intermediate.
- 199. The correct answer is (A).** The neopentyl group is bulky, thus making a bimolecular reaction less favorable.
- 200. The correct answer is (B).** Strong nucleophiles are generally strong bases so they will become protonated in acidic solution.
- 201. The correct answer is (A).** In dehydration the proton is used to generate H_2O but is then produced when a neighboring hydrogen is removed by the conjugate base.
- 202. The correct answer is (A).** In acid solution the $-OH$ group is protonated, which then undergoes heterolysis to release the weakly basic H_2O and form the carbocation. The most stable carbocation contains the most alkyl groups around the site of positive charge.
- 203. The correct answer is (D).** The heads of the femur and humerus are the proximal ends. The sternum is a flat bone of the axial skeleton, while the ilia are flat bones of the pelvic girdle. Although vertebrae are part of the axial skeleton, they are not flat bones.
- 204. The correct answer is (C).** Since reticulocytes still contain ribosomes and rough ER, translation of previously transcribed mRNA can still take place.

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- 205. The correct answer is (A).** Erythropoietin is made by the kidney in direct response to hypoxia. A drop in RBCs in the spleen will cause the spleen to release stored RBCs into the circulation, but will not *directly* affect kidney production of EPO. High blood viscosity can have an inhibitory effect on EPO, since increased RBCs can further increase viscosity.
- 206. The correct answer is (C).** T-cells derive their name from the influence of the thymus gland and its hormone, thymosin, on their maturation.
- 207. The correct answer is (C).** Since the number of WBCs is insignificant compared to the number of RBCs in a sample, they are counted and ignored. In contrast, RBCs in a sample are destroyed with a hemolyzing agent before WBCs can be counted accurately.
- 208. The correct answer is (B).** The inhibition of prostaglandin synthesis by aspirin will reduce thromboxane activation of platelets and thereby slow down the various stages of hemostasis, including coagulation. Since prostaglandins can stimulate inflammation, choice (C) cannot be correct.
- 209. The correct answer is (D).** DNA synthesis occurs during interphase in all cells undergoing mitosis and meiosis. Since there are so many RBCs, and the rate of turnover is so high, anything that would interfere with mitosis would affect them the most.
- 210. The correct answer is (A).** Methanogens, thermophiles, and halophiles are organisms belonging to the prokaryotic domain Archaea.
- 211. The correct answer is (D).** Phenols distinguish themselves by being a water-soluble compound that dissolves in NaOH but not in NaHCO₃. They can form the weaker acid water but not the stronger carbonic acid.
- 212. The correct answer is (C).** Parathyroid hormone is influenced directly by calcium levels in the blood. Anterior pituitary hormones affect the other three hormones (FSH/estrogen, LH/progesterone, TSH/thyroxine).
- 213. The correct answer is (C).** During resting conditions in skeletal muscle tissue, the troponin-tropomyosin complex binds to actin. Depolarization results in the outflow of calcium from the sarcoplasmic reticulum and the release of actin by the protein complex in order to bind with calcium.
- 214. The correct answer is (C).** Telomerase activity has been detected in cancer cells. This helps explain their seemingly limitless ability to divide.