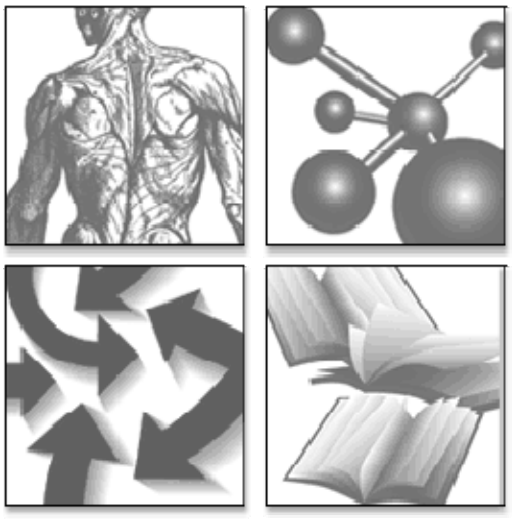
ASSOCIATION OF AMERICAN MEDICAL COLLEGES

MCAT
Practice Test 3 - CBT



MCAT
MEDICAL COLLEGE ADMISSION TEST

Association of American Medical Colleges

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for the

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If you started a practice test online, the answer sheet provided at the end of this printout does not include the answers you entered online. Your online answers will appear on the online answer sheet used to submit your answers for scoring.

Once you have completed your offline practice test, follow these steps to enter your answers and submit them for scoring.

- Login to the web site.
- If this is a new test, click the "Start on Paper" link provided in the "Start a New Test" table of your home page.
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- Click the "Ready to Enter Your Answers? Click Here" link.
- Enter your answers in the provided form. Any answers previously entered using your online practice test or this answer sheet will appear in the form.
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- From the diagnostic score report you can review your answers and the solution for each question.

Printing Guide

Use this printing guide as a reference to print selected sections of this practice test.

To print, click the PRINTER icon located along the top of the window and enter one of the following options in the PRINT RANGE section of the print dialog window:

To Print	Enter Print Range Options
Complete Practice Test	Click ALL radio button
Physical Sciences Section	Click PAGES FROM radio button and enter pages 5 to 22
Verbal Reasoning Section	Click PAGES FROM radio button and enter pages 23 to 37
Writing Sample Section	Click PAGES FROM radio button and enter pages 38 to 40
Biological Sciences Section	Click PAGES FROM radio button and enter pages 41 to 58
Periodic Table	Click PAGES FROM radio button and enter page 6 to 6
Answer Sheet	Click PAGES FROM radio button and enter page 59 to 59

Physical Science

Time: 70 minutes
Questions: 1-52

Most questions in the Physical Sciences test are organized into groups, each containing a descriptive passage. After studying the passage, select the one best answer to each question in the group. Some questions are not based on a descriptive passage and are also independent of each other. If you are not certain of an answer, eliminate the alternatives that you know to be incorrect and then select an answer from the remaining alternatives. Indicate your selected answer by marking the corresponding answer on your answer sheet. A periodic table is provided for your use. You may consult it whenever you wish.

Periodic Table of the Elements

1 **H** 1.0																	2 **He** 4.0
3 **Li** 6.9	4 **Be** 9.0											5 **B** 10.8	6 **C** 12.0	7 **N** 14.0	8 **O** 16.0	9 **F** 19.0	10 **Ne** 20.2
11 **Na** 23.0	12 **Mg** 24.3											13 **Al** 27.0	14 **Si** 28.1	15 **P** 31.0	16 **S** 32.1	17 **Cl** 35.5	18 **Ar** 39.9
19 **K** 39.1	20 **Ca** 40.1	21 **Sc** 45.0	22 **Ti** 47.9	23 **V** 50.9	24 **Cr** 52.0	25 **Mn** 54.9	26 **Fe** 55.8	27 **Co** 58.9	28 **Ni** 58.7	29 **Cu** 63.5	30 **Zn** 65.4	31 **Ga** 69.7	32 **Ge** 72.6	33 **As** 74.9	34 **Se** 79.0	35 **Br** 79.9	36 **Kr** 83.8
37 **Rb** 85.5	38 **Sr** 87.6	39 **Y** 88.9	40 **Zr** 91.2	41 **Nb** 92.9	42 **Mo** 95.9	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.9	46 **Pd** 106.4	47 **Ag** 107.9	48 **Cd** 112.4	49 **In** 114.8	50 **Sn** 118.7	51 **Sb** 121.8	52 **Te** 127.6	53 **I** 126.9	54 **Xe** 131.3
55 **Cs** 132.9	56 **Ba** 137.3	57 **La*** 138.9	72 **Hf** 178.5	73 **Ta** 180.9	74 **W** 183.9	75 **Re** 186.2	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.1	79 **Au** 197.0	80 **Hg** 200.6	81 **Tl** 204.4	82 **Pb** 207.2	83 **Bi** 209.0	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** (226)	89 **Ac†** (227)	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (281)	111 **Uuu** (272)	112 **Uub** (285)		114 **Uuq** (289)		116 **Uuh** (289)		

*	58 **Ce** 140.1	59 **Pr** 140.9	60 **Nd** 144.2	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 152.0	64 **Gd** 157.3	65 **Tb** 158.9	66 **Dy** 162.5	67 **Ho** 164.9	68 **Er** 167.3	69 **Tm** 168.9	70 **Yb** 173.0	71 **Lu** 175.0
†	90 **Th** 232.0	91 **Pa** (231)	92 **U** 238.0	93 **Np** (237)	94 **Pu** (244)	95 **Am** (243)	96 **Cm** (247)	97 **Bk** (247)	98 **Cf** (251)	99 **Es** (252)	100 **Fm** (257)	101 **Md** (258)	102 **No** (259)	103 **Lr** (260)

Passage I

A series of chemical reactions was carried out to study the chemistry of lead.

Reaction 1

Initially, 15.0 mL of 0.300 *M* $Pb(NO_3)_2(aq)$ was mixed with 15.0 mL of 0.300 *M* $Na_2SO_4(aq)$. All the $Pb(NO_3)_2$ reacted to form Compound A, a white precipitate. Compound A was removed by filtration.

Reaction 2

Next, 15.0 mL of 0.300 *M* $KI(aq)$ was added to Compound A. The mixture was agitated and some of Compound A dissolved. In addition, a yellow precipitate of $PbI_2(s)$ was formed.

Reaction 3

The $PbI_2(s)$ was separated and mixed with 15.0 mL of 0.300 *M* $Na_2CO_3(aq)$. A white precipitate of $PbCO_3(s)$ formed. All of the $PbI_2(s)$ was converted into $PbCO_3(s)$.

Reaction 4

The $PbCO_3(s)$ was removed by filtration and a small sample gave off a gas when treated with dilute HCl.

1. Which of the following reactions depicts the formation of the gas in Reaction 4?

A) $PbCO_3(s) + 2\ HCl(aq) \rightarrow PbCl_2(aq) + CO_2(g) + H_2O(l)$

B) $Na_2CO_3(aq) + 2\ HCl(aq) \rightarrow 2\ NaCl(aq) + CO_2(g) + H_2O(l)$

C) $PbCO_3(s) + 2\ HCl(aq) \rightarrow PbC_2(s) + Cl_2(g) + H_2O(l)$

D) $PbI_2(s) + HCl(aq) \rightarrow PbCl_2(aq) + HI(g)$

2. The identity of Compound A is:

A) $Pb(NO_3)_2$.

B) PbI_2.

C) $NaNO_3$.

D) $PbSO_4$.

3. $Pb(OH)_2(s)$ is slightly soluble in water. How would the amount of $Pb(OH)_2(s)$ that normally dissolves in 1 L of water be affected if the pH were 9.0?

A) Less would dissolve.

B) The same amount would dissolve.

C) More would dissolve.

D) There is no way to predict the effect of the change in pH of the water.

4. A soluble form of Pb^{2+} can be carefully added to a solution to sequentially precipitate and separate anions present in the solution. When Pb^{2+} is added, in what order will the following anions be precipitated?

A) SO_4^{2-} then I^-

B) CO_3^{2-} then I^-

C) SO_4^{2-} then CO_3^{2-}

D) I^- then CO_3^{2-}

5. How many moles of Na^+ ions are there in the initial $Na_2SO_4(aq)$ solution used in Reaction 1?

A) 0.0018 mole

B) 0.009 mole

C) 0.045 mole

D) 0.090 mole

Passage II

When X-rays are produced in an X-ray tube, two types of X-ray spectra are observed: *continuous spectra* and *line spectra.*

A continuous spectrum is produced by *bremsstrahlung,* the electromagnetic radiation produced when free electrons are accelerated during collisions with ions.

A line spectrum results when an electron having sufficient energy collides with a heavy atom, and an electron in an inner energy level is ejected from the atom. An electron from an outer energy level then fills the vacant inner energy level, resulting in emission of an X-ray photon. For example, if an electron in the $n = 1$ energy level is ejected from an atom, an electron in the $n = 2$ level of the atom can fill the vacancy created in the $n = 1$ level, and a photon with an energy equal to the energy difference between the two levels will be emitted.

A scientist produced both types of spectra using the X-ray tube shown in Figure 1 below.

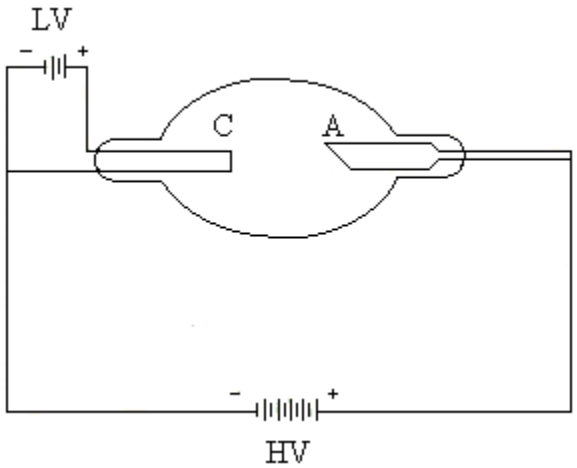


Figure 1 Heated cathode X-ray tube

The tube contains a heated filament cathode (C), which emits electrons. A power supply (LV) regulates the filament temperature, the electrical current in the tube, and the number of X-rays produced at the anode (A). Another power supply (HV) regulates electron acceleration.

The scientist used an X-ray tube to determine the relationship between X-ray wavelength, λ, and X-ray intensity, *I,* which is proportional to the number of X-ray photons emitted at λ. The scientist then graphed the results of the experiment, as shown in Figure 2.

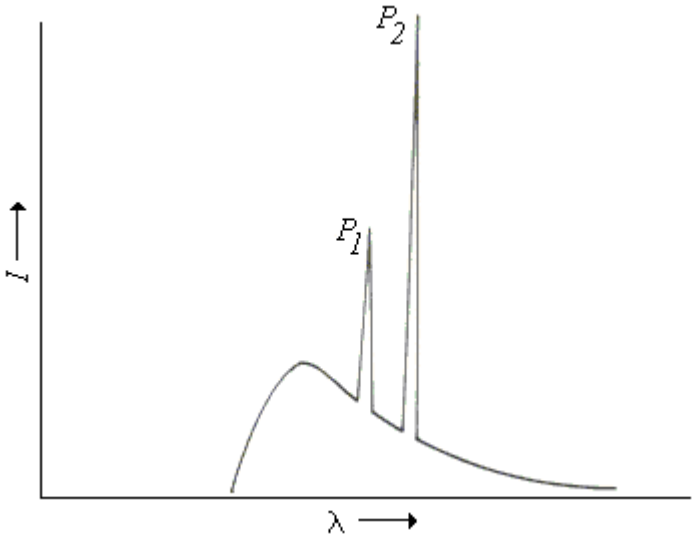


Figure 2 X-ray intensity versus wavelength

6. In Figure 2, which of the following represents the source of emission peaks P_1 and P_2?

A) Bremsstrahlung

B) Absorption of X-ray photons resulting in electronic excitations in atoms

C) Emission of X-ray photons as a result of electronic transitions in atoms

D) Acceleration of electrons in a magnetic field

7. Based on the tube in Figure 1, to maintain an electron current of 0.005 A and a potential drop of 10^5 V between the anode and the cathode, approximately how much power must the tube consume?

A) 5×10^2 W

B) 1×10^3 W

C) 2×10^5 W

D) 2×10^7 W

8. The ionization potentials for electrons in the $n = 1$, 2, and 3 energy levels of Pb are $1{,}400 \times 10^{-17}$ J, 240×10^{-17} J, and 48×10^{-17} J, respectively. When an electron in the $n = 2$ level fills a vacancy in the $n = 1$ level, what is the energy of the X-ray that is emitted?

A) 1.92×10^{-15} J

B) 2.40×10^{-15} J

C) 1.16×10^{-14} J

D) 1.40×10^{-14} J

9. According to the passage, bremsstrahlung will NOT be produced by collisions between electrons and:

A) He.

B) He^{2+}.

C) Li^{1+}.

D) protons.

10. In order to increase the maximum kinetic energy of electrons colliding with the anode, the scientist made which of the following changes?

A) The voltage of HV was increased.

B) The voltage of HV was decreased.

C) The voltage of LV was increased.

D) The voltage of LV was decreased.

11. In Figure 2, peaks P_1 and P_2were produced by events that occurred with unequal probabilities. Which peak was produced by the more probable event?

A) P_1, because the peak has the longer wavelength

B) P_1, because the peak has the lower intensity

C) P_2, because the peak has the longer wavelength

D) P_2, because the peak has the higher intensity

These questions are not based on a descriptive passage and are independent of each other.

12. How much work is done when a constant horizontal 20-N force pushes a 50-kg block a distance of 10 m on a horizontal surface?

A) 50 J

B) 100 J

C) 200 J

D) 500 J

13. Evaporation occurs when molecules at the surface of a liquid overcome the attractive forces of the liquid. This occurs when molecules within the liquid attain a sufficient amount of:

A) resonance.

B) kinetic energy.

C) surface tension.

D) potential energy.

14. How long will it take a runner, starting from rest and accelerating uniformly at 1.5 m/s^2, to travel 3.0 m?

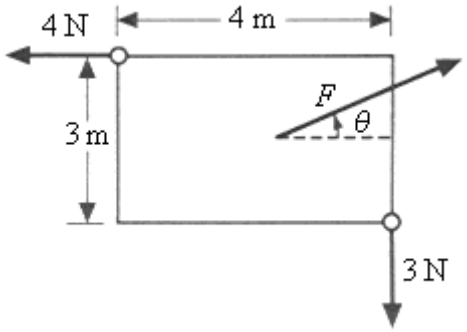
A) $2^{1/2}$ sec

B) 1.5 sec

C) 2.0 sec

D) 3.0 sec

15. A rectangular sheet of material has a width of 3 m and a length of 4 m. Forces with magnitudes of 3 N and 4 N, respectively, are applied parallel to two edges of the sheet, as shown in the figure below.



A third force, *F*, is applied to the center of the sheet, along a line in the plane of the sheet, at an angle θ = arctan 0.75 with respect to the horizontal direction. The sheet will be in translational equilibrium when *F* has what value?

A) $F = 3$ N

B) $F = 4$ N

C) $F = 5$ N

D) $F = 7$ N

Passage III

A chemist performed the following experiments to investigate the melting and freezing behaviors of acetamide.

Experiment 1: Melting

A large beaker of water was heated to a slow boil. A thermometer was placed in a test tube and 10 g of acetamide crystals was added. The test tube was then lowered into the boiling water (100°C). The temperature was immediately read, and was reread every 15 sec. The acetamide was stirred before each reading. When the temperature reached 80°C, the acetamide started melting. After a period of time, when all the acetamide had melted, the temperature began to increase again. Results are shown in Figure 1.

Experiment 2: Freezing

Trial 1

The test tube from Experiment 1 was removed from the hot water and left to cool in air at 20°C. The temperature readings and stirring were continued every 30 sec. The temperature dropped to 80°C, where it remained constant. The acetamide slowly began freezing and was completely solid after 23 min. After this, the temperature again decreased. The time for freezing was considered to be excessive, so another trial was completed.

Trial 2

The same test tube was placed in boiling water until the acetamide was completely melted. For this trial, however, the test tube was then placed in a beaker of water at 20°C. The results are shown in Figure 1.

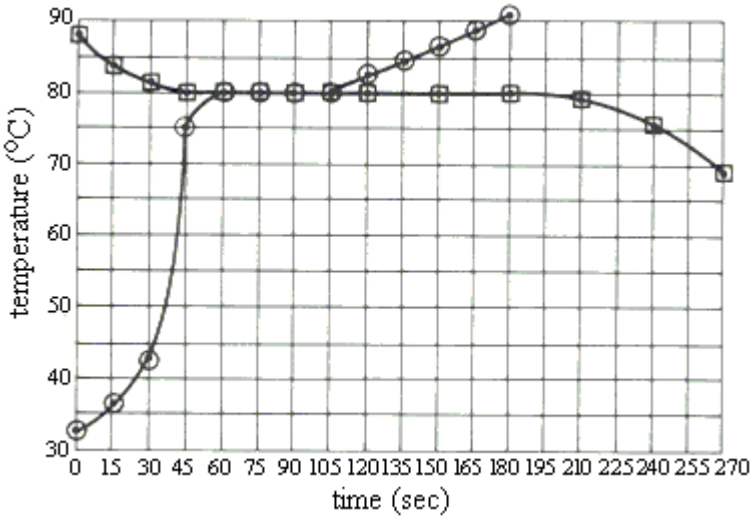


Figure 1 Melting and freezing behavior of acetamide

16. In Experiment 2, which of the following is the most important difference in the procedures used for Trials 1 and 2?

A) The amounts of acetamide used in each test tube

B) The surroundings that were used to cool the acetamide

C) The temperatures at which the trials were started

D) The lengths of time allowed for the acetamide to melt

17. During Experiment 1, which of the following would most likely have occurred if the water had only reached 90°C before the test tube was placed into it?

A) More water would have been needed to melt the acetamide.

B) Less water would have been needed to melt the acetamide.

C) The acetamide would not have melted.

D) The acetamide would have taken longer to completely melt.

18. How are the designs of the two experiments important for producing useful results?

A) Both processes, melting and freezing, take place under controlled conditions.

B) Both processes, melting and freezing, take place without being controlled or monitored.

C) The amounts of acetamide are shown to control the temperatures of melting and freezing.

D) The amounts of acetamide are shown to control the times needed for melting and freezing.

19. During Trial 1 of Experiment 2, if the temperature readings were taken at 1-min intervals instead of 30-sec intervals, the acetamide would most likely have become completely frozen at:

A) 11 min, 30 sec.

B) 23 min.

C) 46 min.

D) a lower temperature.

20. In Experiment 2, why was it necessary to place the test tube in hot water for Trial 2, in view of the fact that this was NOT done in Trial 1?

A) The water was boiling for Trial 1, but it needed to be cold for Trial 2.

B) The acetamide was cooled by air in Trial 1, but by water in Trial 2.

C) The temperature lowered more quickly for Trial 2 than it did for Trial 1.

D) The acetamide was liquid before Trial 1, but it was solid before Trial 2.

21. If the data for Trial 1 were plotted in Figure 1, compared to the data for Trial 2, they would:

A) slope less steeply downward, and not all of the data could be shown.

B) slope more steeply downward, and all of the data could be shown.

C) slope upward, and all of the data could be shown.

D) slope upward, and not all of the data could be shown.

Passage IV

The *timbre*, or quality, of a musical tone depends on the number and relative strengths of the harmonics including the fundamental frequency of the note. Figure 1a illustrates the first three harmonics of a tone. The addition of the first two harmonics is pictured in Figure 1b, and the addition of the first 3 harmonics is shown in Figure 1c.

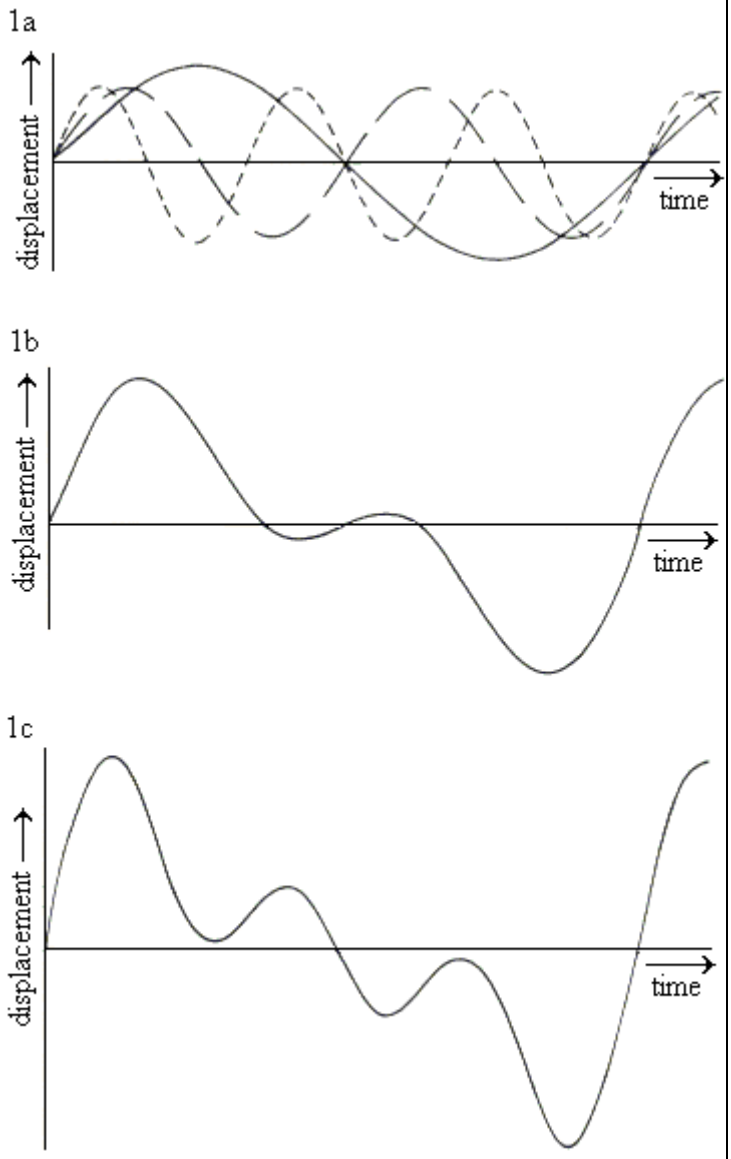


Figure 1 Elements of a complex tone

The graphs in Figure 2 illustrate the characteristics of two adjacent tones from a bassoon. Figure 2a shows the pressure variations and the amplitudes of the harmonics for one of the tones, and Figure 2b shows the same information for the other tone.

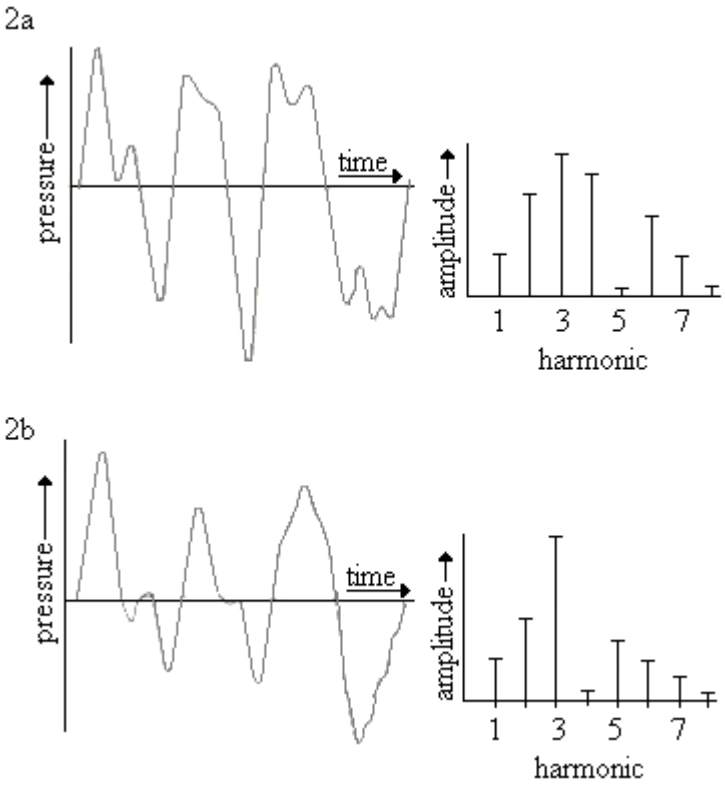


Figure 2 Pressure variations and amplitudes of harmonics for adjacent bassoon tones

22. Which of the waveforms shown in Figure 1 has the shortest period?

A) First harmonic

B) Second harmonic

C) Third harmonic

D) The waveform in Figure 1c

23. At the second position where the three curves intersect in Figure 1a, the curves are all:

A) in phase.

B) out of phase.

C) at zero displacement.

D) at maximum displacement.

24. If the frequency of the first harmonic in Figure 2a is 100 Hz, what is the period of the second harmonic?

A) 0.005 sec

B) 0.01 sec

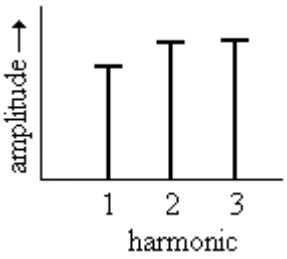
C) 50.0 sec

D) 200.0 sec

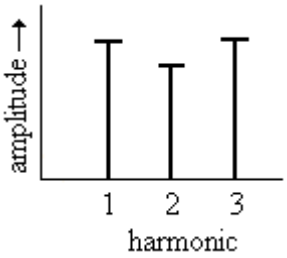
25. Which of the following graphs best illustrates the relative amplitudes of the harmonics in Figure 1?

A)

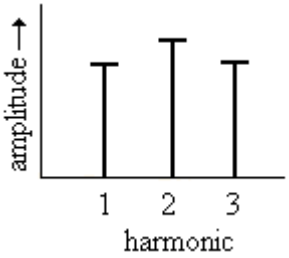
B)



C)



D)



26. If a fourth harmonic exists for the tone graphed in Figure 1, then, compared to the third harmonic, the fourth harmonic will have:

A) lower amplitude.

B) higher amplitude.

C) lower frequency.

D) higher frequency.

27. The period of the waveform shown in Figure 1c is the:

A) same as the period of the first harmonic.

B) same as the period of the second harmonic.

C) same as the period of the third harmonic.

D) sum of the periods of the first, second, and third harmonics.

Passage V

Photoelectric materials can be used to supply electrical power. Suppose a photoelectric material has an electronic energy level with a work function, ø. If the material is struck by a photon of frequency *f*, resulting in the ejection of an electron from the energy level, the electron is said to be free. The kinetic energy (*K*) of the free electron will be given by

$$K = hf - ø$$

where h is Planck's constant. The *conversion efficiency* (ε) of a photoelectric material is the fraction of light energy incident on the surface of the material that is converted into electrical energy.

A physicist constructed a photoelectric device to determine the individual conversion efficiencies of Materials A and B. For a material to be tested, a metal grid was sandwiched between two thin layers of that material. The grid was used to collect the electrons generated by the device. The photoelectric material had a coating that maximized the absorption of light at certain frequencies. Monochromatic light of varying wavelengths (λ) was shone on the device, and the conversion efficiency was determined at each λ. The results are given in Table 1.

Material	λ (10^{-6}m)	(ε)
A	0.80	0.36
A	1.02	0.45
A	1.06	0.25
A	1.10	0.20
B	0.80	0.23
B	1.02	0.35
B	1.06	0.42
B	1.10	0.30

Table 1 Conversion Efficiency Versus Wavelength

28. The conversion efficiency of Material B is 0.42 at a frequency of:

A) 3.5×10^{-15} Hz.

B) 2.8×10^{2} Hz.

C) 2.8×10^{14} Hz.

D) 3.5×10^{15} Hz.

29. The purpose of the absorption coating is most likely to:

A) cool the device.

B) warm the device.

C) maximize the conversion efficiency.

D) reduce the magnitude of the current.

30. Suppose that 2 identical photoelectric devices are connected to the same electrical circuit, and the devices are connected in parallel with each other. Compared to the voltage generated by a single device, the total voltage supplied to the circuit by the parallel devices will be:

A) 4 times as large.

B) 2 times as large.

C) 1/2 as large.

D) the same.

31. For a photon of energy h*f* to eject an electron from a material with a work function ø, the photon's energy must be:

A) greater than ø.

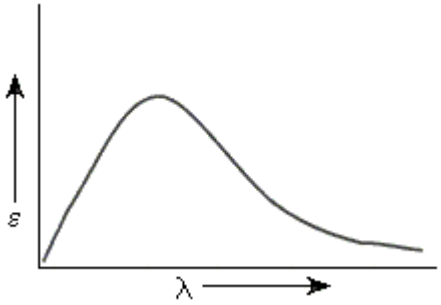
B) less than ø.

C) less than *K*.

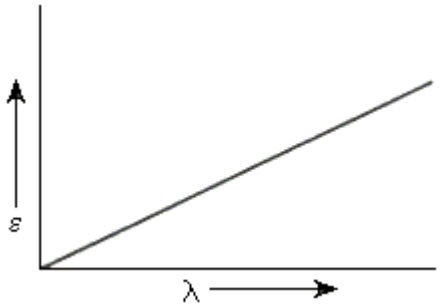
D) equal to *K*.

32. Suppose the physicist applies an additional absorption coating on top of the original coating, so that the conversion efficiency ε of Material A will be independent of wavelength (λ). A graph of ε versus λ for Material A with the additional coating will most likely be represented by which of the following functions?

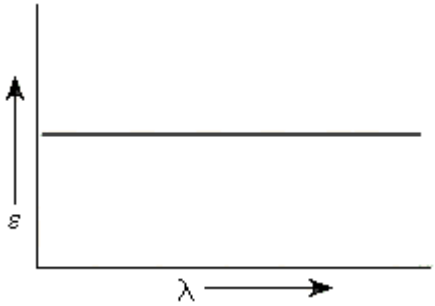
A)



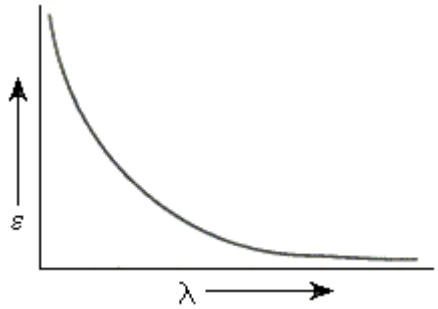
B)



C)



D)



Passage VI

A student was asked to determine the identity of an unknown acid that was liquid at room temperature (20°C). The student was told that the acid was one of those listed in Table 1.

Acid	Structure	Molecular weight (g/mole)	Melting point (°C)	pK_a
Propionic	CH_3CH_2COOH	74.08	–21.5	4.88
Crotonic	$CH_3CH{=}CHCOOH$	86.09	71.6	4.69
Butyric	$CH_3CH_2CH_2COOH$	88.10	–7.9	4.82
Oxalic	HOOCCOOH	90.04	101	3.14 4.77

Table 1 Characteristics of Several Acids

The student added 0.22 g of the acid to 30.0 mL of $H_2O(l)$. The student then titrated the solution with 0.10 *M* NaOH(*aq*) while monitoring the pH with a pH meter. The results are summarized in Figure 1.

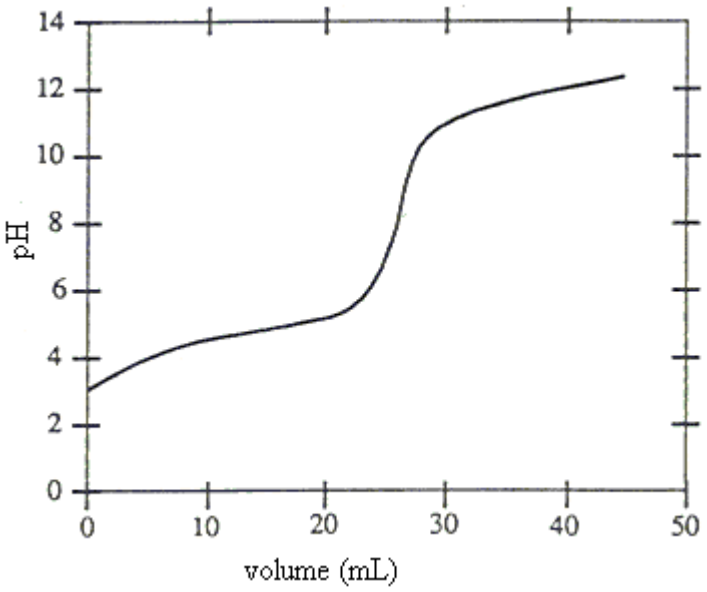


Figure 1 Titration of the acid with 0.1 *M* NaOH(*aq*)

Based on the titration curve, the student proposed that the unknown acid had 1 –COOH group and a molecular weight between 85 and 92.

33. A comparison of which two compounds from Table 1 best shows the effect of molecular weight alone on melting point?

A) Propionic acid and crotonic acid

B) Propionic acid and oxalic acid

C) Propionic acid and butyric acid

D) Butyric acid and crotonic acid

34. Before titrating with NaOH(*aq*), what was the approximate $H_3O^+(aq)$ concentration of the solution containing the unknown acid?

A) 0.001 *M*

B) 0.01 *M*

C) 0.03 *M*

D) 0.3 *M*

35. The student prepared a 0.1 *M* aqueous solution of crotonic acid and a 0.1 *M* aqueous solution of oxalic acid, then adjusted the pH of each to 4.7 by adding NaOH. Which solution has a lower freezing point?

A) The crotonic acid solution, because it contains a lower molar concentration of solute particles

B) The crotonic acid solution, because it contains a greater percent mass of solute

C) The oxalic acid solution, because it contains a greater molar concentration of solute particles

D) The oxalic acid solution, because it contains a smaller percent mass of solute

36. During the titration summarized in Figure 1, the concentration of R–COOH equalled the concentration of $R–COO^-$ when the pH approximately equalled which of the following? (Note: R is a hydrocarbon.)

A) 4.8

B) 6.2

C) 7.0

D) 9.2

37. The student rejected crotonic acid as a possible identity of the unknown acid because crotonic acid:

A) is a strong acid.

B) is insoluble in H_2O.

C) is solid at room temperature.

D) has a molecular weight of 86.09.

These questions are not based on a descriptive passage and are independent of each other.

38. Radium, ^{226}Ra, spontaneously decays to radon with the emission of an α particle and a γ ray. If the speed of the α particle upon emission from an initially stationary radium nucleus is 1.5×10^7 m/s, what is the recoil speed of the resultant radon nucleus? (Assume the momentum of the γ ray is negligible compared to that of the α particle.)

A) 2.0×10^5 m/s

B) 2.7×10^5 m/s

C) 3.5×10^5 m/s

D) 1.5×10^7 m/s

39. $$2\ NO_2(g) + F_2(g) \rightarrow 2\ NO_2F(g)$$

The chemical reaction shown above has the following rate law:

$$\text{Rate} = k[NO_2][F_2]$$

What is the overall order of this reaction?

A) Zero order

B) First order

C) Second order

D) Third order

40. What is the change in enthalpy for the reaction below at 25°C?

$$2HCl(g) \rightarrow H_2(g) + Cl_2(g)$$
$$\Delta H_f \text{ at } 25^oC\text{:}HCl(g) = -92.5 kJ/mol$$

A) -185.0 kJ

B) -92.5 kJ

C) +92.5 kJ

D) +185.0 kJ

41. An object is placed upright on the axis of a thin convex lens at a distance of four focal lengths (4 *f*) from the center of the lens. An inverted image appears at a distance of 4/3 *f* on the other side of the lens. What is the ratio of the height of the image to the height of the object?

A) 1/3

B) 3/4

C) 4/3

D) 3/1

Passage VII

Several features of sulfuric acid are given below.

Preparation of Sulfuric Acid
Sulfuric acid is commonly prepared by the combustion of elemental sulfur to sulfur dioxide, followed by the catalytic oxidation of sulfur dioxide to sulfur trioxide. Sulfur trioxide is then absorbed into a 98% aqueous solution of H_2SO_4, and water is added to maintain a 98% concentration. SO_3 reacts with the water in the aqueous solution according to Reaction 1.

$$SO_3(g) + H_2O(l) \longrightarrow H_2SO_4(l)$$

Reaction 1

Properties
Concentrated sulfuric acid is 98% H_2SO_4 and 2% water by mass. It has a density of 1.84 g/mL and a boiling point of 338°C.

Preparation of Other Acids
$HCl(g)$ and $HNO_3(l)$ may be prepared by the reaction between sulfuric acid and the sodium salt of the corresponding conjugate base (Cl^- or NO_3^-, respectively).

Formation of SO_2
Sulfuric acid forms SO_2 gas when it reacts with several compounds. For example, I_2 and SO_2 are formed when I^- reacts with concentrated H_2SO_4; Br_2 and SO_2 are formed when Br^- reacts with concentrated H_2SO_4. Cu^+ and SO_2 are formed in hot solutions of $Cu(s)$ in H_2SO_4. This last reaction is unusual, because most metals react with solutions of H_2SO_4 to form hydrogen gas and a metal sulfate.

42. When sulfuric acid reacts with copper, how does the oxidation number of the sulfur change?

A) From +4 to +6

B) From +6 to +4

C) From +6 to +8

D) From +8 to +6

43. Which of the following is the balanced equation describing the combustion of elemental sulfur?

A) $2\ H_2S + 3\ O_2 \longrightarrow 2\ SO_2 + 2\ H_2O$

B) $H_2S + 2\ O_2 \longrightarrow SO_3 + H_2O$

C) $2\ SO_3 \longrightarrow 2\ S + 3\ O_2$

D) $S + O_2 \longrightarrow SO_2$

44. In the second step of preparing H_2SO_4 from elemental sulfur (the catalytic oxidation of SO_2), which strategy is most likely to increase the yield of SO_3 formed?

A) Reducing the reaction temperature

B) Reducing the reaction pressure

C) Removing SO_3 from the reaction mixture

D) Removing O_2 from the reaction mixture

45. Which of the following expressions can be used to determine the number of moles of water in 1 mL of concentrated H_2SO_4?

A) $\frac{(1.84)(0.98)}{98} + \frac{(1.84)(0.02)}{18}$

B) $\frac{(1.84)(0.02)}{18}$

C) $\frac{(1.84)(0.98)}{18}$

D) $\frac{(1.84)(0.98)(18.0)}{98.0}$

46. If $H_2(g)$ is formed from the reaction of $Fe(s)$ with dilute $H_2SO_4(aq)$, which species acts as the reducing agent?

A) Fe

B) $FeSO_4$

C) SO_4^{2-}

D) H_3O^+

47. Which of the following species has the smallest concentration in 98% H_2SO_4?

A) SO_4^{2-}

B) H_2SO_4

C) H_3O^+

D) HSO_4^-

These questions are not based on a descriptive passage and are independent of each other.

48. The standard potential for the reaction

$$Zn^{2+} + 2\ e^- \rightleftharpoons Zn$$

equals –0.763 V. When a strip of Zn is placed in a 0.1 *M* solution of HCl(*aq*), does the zinc strip begin to dissolve?

A) Yes; $H_2(g)$ and $ZnCl(aq)$ are produced.

B) Yes; $H_2(g)$ and $ZnCl_2(aq)$ are produced.

C) No; no reaction occurs because Zn is less reactive than is H_2.

D) No; no reaction occurs because Zn^{2+} is less reactive than is H^+.

49. Which of the following must be known in order to determine the power output of an automobile?

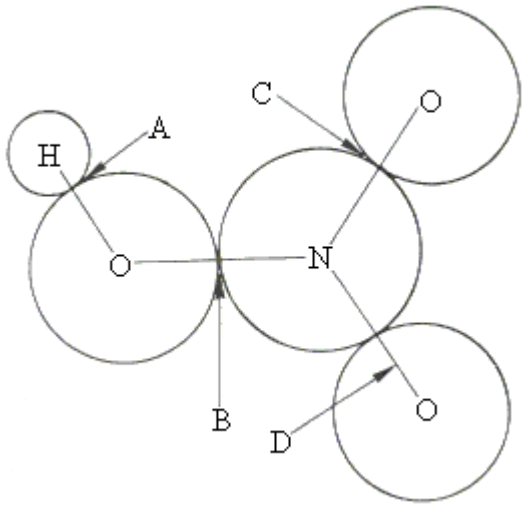
A) Final velocity and height

B) Mass and amount of work performed

C) Force exerted and distance of motion

D) Work performed and elapsed time of work

50. In the molecule shown below, which bond is the longest?



A) A

B) B

C) C

D) D

51. A 15.0-eV photon collides with and ionizes a hydrogen atom. If the atom was originally in the ground state (ionization potential =13.6 eV), what is the kinetic energy of the ejected electron?

A) 1.4 eV

B) 13.6 eV

C) 15.0 eV

D) 28.6 eV

52. When $_4{}^7Be$ undergoes radioactive decay by electron capture (a form of β^+ decay), the resulting nucleus is:

A) $_3{}^6Li$.

B) $_3{}^7Li$.

C) $_4{}^7Be$.

D) $_4{}^8Be$.

Verbal Reasoning

Time: 60 minutes
Questions: 53-92

There are seven passages in the complete Verbal Reasoning test. Each passage is followed by several questions. After reading a passage, select the one best answer to each question. If you are not certain of an answer, eliminate the alternatives that you know to be incorrect and then select an answer from the remaining alternatives. Indicate your selected answer by marking the corresponding answer on your answer sheet.

Passage I

What can be done about the "drug problem"? Despite frequent proclamations of war and dramatic increases in government funding… there are many indications that the problem is not going away and may even be growing worse….

If there were a serious public debate on this issue, far more attention would be given to one policy option that has just begun to be seriously considered…: legalization….

There are three reasons why it is important to think about legalization scenarios, even though most Americans remain hostile to the idea. First, current drug-control policies have failed, are failing, and will continue to fail…. Second, many drug-control efforts are… proving… costly and counter-productive; indeed, many of the drug-related evils that Americans identify as part… of the "drug problem" are in fact caused by our drug-prohibition policies. Third, there is good reason to believe that repealing many of the drug laws would not lead, as many people fear, to a dramatic rise in drug abuse….

By most accounts, the dramatic increase in drug-enforcement efforts over the past few years has had little effect on the illicit drug market in the United States….

Since 1981, federal expenditures on drug enforcement have more than tripled…. State and local police were estimated to have devoted 18 percent of their total investigative resources, or close to five billion dollars, to drug-enforcement activities in 1986….

…Of greater concern than the actual expenditures, however, has been the diversion of limited resources--including the time and energy of judges, prosecutors, and law-enforcement agents, as well as scarce prison space….

…There are… connections between drugs and crime,… which would be much diminished if the drug-prohibition laws were repealed….

…Many cocaine and heroin addicts spend hundreds and even thousands of dollars a week. If the drugs to which they are addicted were significantly cheaper–which would be the case if they were legalized–the number of crimes committed by drug addicts to pay for their habits would, in all likelihood, decline dramatically….

All vice-control efforts are particularly susceptible to corruption, but none so much as drug enforcement…. What makes drug enforcement especially vulnerable to corruption are the tremendous amounts of money involved in the business. Today, many law-enforcement officials believe that police corruption is more pervasive than at any time since Prohibition [of alcohol[….

Some police also recognize that enforcing the drug laws does not protect victims from predators so much as it regulates an illicit market that cannot be suppressed, but can be kept underground. In every respect, the analogy to Prohibition is apt….

Repealing the drug-prohibition laws promises tremendous advantages. Between reduced government expenditures on enforcing drug laws and new tax revenue from legal drug production and sales, public treasuries would enjoy a net benefit of at least ten billion dollars a year, and possibly much more. The quality of urban life would rise significantly. Homicide rates would decline. So would robbery and burglary rates….

…There is good reason to doubt that many Americans would inject cocaine or heroin into their veins even if given the chance to do so legally…. The logic of legalization thus depends upon two assumptions: that most illegal drugs are not so dangerous as is commonly believed; and that the drugs and methods of consumption that are most risky are unlikely to prove appealing to many people, precisely because they are so obviously dangerous….

…Repealing the drug-prohibition laws would eliminate or greatly reduce… the "drug problem." Yet legalization is repeatedly and vociferously dismissed, without any attempt to evaluate it openly and objectively.

Material used in this test passage has been adapted from the following source:
E. A. Nadelmann, *The Case for Legalization*. ©1988 by E. A. Nadelmann.

53. According to one authority on the drug problem, "tobacco shortens one's life, cocaine debases it; nicotine alters one's habits, cocaine alters one's soul." This authority would probably:

A) support the legalization of cocaine.

B) approve the abolition of both cigarette and cocaine sales in the U.S.

C) not consider either cocaine or tobacco particularly dangerous.

D) consider both cocaine and tobacco to be harmful but cocaine more so.

54. The author of the passage would probably support most strongly a federal law that:

A) requires mandatory drug-treatment programs for convicted drug users.

B) grants tax-exempt status to income earned in the drug trade.

C) dispenses, free of charge, federally certified sterile needles to addicts.

D) assigns to the military the task of intercepting drugs from foreign nations.

55. Which of the following claims is(are) explicitly presented in the passage to justify the supposition that public treasuries would enjoy a net benefit as a result of drug legalization?

I. Income earned from the drug trade would be subject to taxation.
II. Fewer law-enforcement personnel would be retained.
III. Fewer public funds would be spent on drug enforcement.

A) I only

B) I and II only

C) I and III only

D) I, II, and III

56. Which of the following findings best supports the author's belief that drug legalization would not result in a dramatic increase in drug abuse?

A) Most Americans are currently hostile to the idea of drug legalization.

B) Most Americans are unlikely to engage in an obviously dangerous activity.

C) Most Americans do not take the legal status of a substance into account when deciding whether or not to ingest it.

D) The consumption of alcohol rose after the repeal of prohibition.

57. According to the passage, which of the following is most likely to be true about the relationship between the enforcement of drug-prohibition laws and the street prices of illicit drugs?

A) The more strict the enforcement, the higher the street price.

B) The more strict the enforcement, the lower the street price.

C) The less strict the enforcement, the higher the street price.

D) There is no systematic connection between the strictness of enforcement and the street price.

Passage II

The truth is we know little about the wolf. What we know a good deal more about is what we imagine the wolf to be….

The Nunamiut Eskimo of the central Brooks Range [in Alaska] speak of wolves as hunters something like themselves. They believe that wolves know where they are going when they set out to find caribou, and that perhaps wolves learn from the behavior of ravens where caribou might be. They believe certain wolves in a pack never kill, while others in the pack specialize in killing small game. Always, to requests for generalizations, they say that each wolf is a little different, that new things are always seen. If someone says big males always lead the pack and do the killing, the Eskimo shrug and say, "Maybe. Sometimes."

Wolves vary their hunting techniques, share food with the old who do not hunt, and give gifts to each other. They can live for a week without food and travel twenty miles without breaking stride. They have three systems of communication – vocal, postural, and olfactory. Their pelages range from slate blue to almost pure white, through chocolate brown, ocher, cinnamon, gray, and blond. And like primates they spend a good part of their time with their young and playing with each other. I once saw a wolf on the tundra winging a piece of caribou hide around like a Frisbee for an hour by himself.

You can look at a gray wolf standing in the snow in winter twilight and not see him at all. You may think I'm pulling your leg–I'm not. Sometimes even the Eskimos can't see them, which causes the Eskimos to smile….

The wolf exerts a powerful influence on the human imagination. It takes your stare and turns it back on you. (The Bella Coola Indians believed that someone once tried to change all the animals into men but succeeded in making human only the eyes of the wolf.) People suddenly want to explain the feelings that come over them when confronted with that stare–their fear, their hatred, their respect, their curiosity. Wolf-haters want to say they are born killers, which isn't true. Wolf-lovers want to say no healthy wolf ever killed anyone in North America, which isn't true either. They have killed Indians and Eskimos.

Everything we have been told about wolves in the past should have been said, I think, with more care, with the preface that it is only a perception in a particular set of circumstances, that in the end it is only an opinion.

To be rigorous about wolves – you might as well expect rigor of clouds.

I have looked for a wolf different from that ordinarily given us in the course of learning about animals. I have watched captive wolves in Barrow, Alaska; in Saint Louis, and in Nova Scotia. I drove across the Dakotas and Montana and Wyoming, speaking with old men who killed wolves for a living when they were young. In New York I read in libraries like the Pierpont Morgan what men thought of wolves hundreds of years ago. I read in the archives of historical societies of outlaw wolves. I went out with field biologists in Minnesota and Alaska and spoke with Eskimos. I spoke with people who loved wolves and with people who hated them.

I remember sitting in this cabin in Alaska one evening reading over the notes of all these encounters, and recalling Joseph Campbell, who wrote in the conclusion to *Primitive Mythology* that men do not discover their gods, they create them. So do they also, I thought, looking at the notes before me, create their animals.

Material used in this test passage has been adapted from the following source:
B. H. Lopez, *Of Wolves and Men*. ©1978 by B. H. Lopez.

58. The Bella Coola Indian legend best illustrates the author's point that:

A) humans know very little about the wolf.

B) wolves provoke fanciful thinking.

C) people have always revered the wolf.

D) wolves resemble humans in certain ways.

59. In the context of the passage, the word *rigorous* means:

A) unyielding.

B) harsh.

C) precise.

D) judgmental.

60. Which of the following statements, if true, would most *weaken* the author's contention that the wolf is less known than created by us?

A) The incident the author described as a wolf's "winging a piece of caribou hide around like a Frisbee" never in fact occurred.

B) Nunamiut Eskimos have very little interaction with wolves, and base their beliefs about wolves on folklore.

C) The apparently intelligent behaviors that wolves exhibit, and that people have always found so intriguing, are entirely instinctive.

D) Scientists have produced a wealth of knowledge about the wolf, the preponderance of which corresponds closely to the beliefs of Eskimo and Indian cultures.

61. In organizing a party of natural historians to study wolves, the author would most likely advise them to approach the wolf with:

A) love, because contrary to popular belief, a healthy wolf will seldom harm a human being.

B) caution, because wolves are hunters, and some have been known to kill humans.

C) contempt, because while they may be similar to domestic dogs, wolves are usually quite dangerous.

D) confidence, because we now know much more about the wolf than we did in the past.

62. The 1928 edition of the *World Book Encyclopedia* defines the wolf as "a rapacious, flesh-eating animal belonging to the dog family" and states that the wolf "lacks [the dog's] courage and loyalty." If the author were to include this description in the passage, it would probably be used to:

A) support the point that wolves are excellent hunters.

B) illustrate the point that people often see wolves as being like themselves.

C) emphasize that what we think we know about wolves is often the product of our imagination.

D) explain the author's own opinion about wolves.

Passage III

The relationship of the professional artist to the class that ruled or aspired to rule was complicated, various and should not be simplified. [The artist's] training however – and it was… training which made the artist a professional – taught [the artist] a set of conventional skills. That is to say, the artist became skilled in using a set of conventions… of composition, drawing, perspective, chiaroscuro, anatomy, poses, symbolism. And these conventions corresponded so closely to the social experience–or anyway to the social manners – of the class [the artist] was serving, that they were not even seen as conventions but were thought of as the only way of recording and preserving eternal truths. Yet to the other social classes such professional painting appeared to be so remote from their own experience, that they saw it as a mere social convention, a mere accoutrement of the class that ruled over them: which is why in moments of revolt, painting and sculpture were often destroyed.

During the 19th century certain artists, for consciously social or political reasons, tried to extend the professional tradition of painting, so that it might express the experience of other classes…. Their personal struggles, their failures, and the opposition they met with, were a measure of the [ambition] of the undertaking. Perhaps one pedestrian example will give some idea of the extent of the difficulties involved. Consider Ford Madox Brown's well known painting of *Work*…. It shows a team of [laborers], with passersby and bystanders, working on a sidewalk. It took the painter ten years to complete, and it is, at one level, extremely accurate. But it looks like a religious scene…. Some would argue that this is because the artist's attitude to his subject was ambivalent. I would argue that… all the visual means he was using with such care preempted the possibility of depicting manual work, as the main subject of a painting, in any but a mythological or symbolic way.

The crisis provoked by those who tried to extend the area of experience to which painting might be open… continued into the 20th century. But its terms were reversed. The tradition was indeed dismantled. Yet, except for the introduction of the Unconscious, the area of experience from which most European artists drew remained surprisingly unchanged. Consequently, most of the serious art of the period dealt either with the experience of various kinds of isolation, or with the narrow experience of painting itself. The latter produced painting about painting, abstract art.

One of the reasons… the potential freedom gained by the dismantling of the tradition was not used may be… the way painters were still trained. In the academies and art schools they first learnt those very conventions which were being dismantled. This was because no other professional body of knowledge existed to be taught.

Thus, the extreme of abstract art demonstrates, as an epilogue, the original [uncertainty] of professional art: an art in reality concerned with a selective, very reduced area of experience, which nevertheless claims to be universal.

Material used in this test passage has been adapted from the following source:
J. Berger, *About Looking.* ©1980 by J. Berger.

63. The main argument of the passage is that:

A) the relationship between artists and the ruling classes throughout history has been complex and difficult to understand.

B) artists of the past required strong professional training in order to do work that would appeal to the ruling classes.

C) the professional training of artists has served to limit the areas of experience from which they draw their subjects.

D) artists who attempt to abandon conventional methods must confront a great deal of opposition from the ruling classes.

64. In the context of the passage, the term *tradition* refers primarily to the:

A) best way to record and preserve eternal artistic truths.

B) set of artistic conventions that correspond to the social manners of a ruling elite.

C) system of applying mythological or symbolic elements to realistic subjects.

D) expansion of the area of artistic experience to include the unconscious.

65. The passage implies that art is at its best when it:

A) transcends conventions.

B) records eternal truths.

C) reflects social manners.

D) treats religious themes.

66. According to the passage, why did past artistic conventions most likely correspond so closely to the social manners of the ruling classes?

A) Artists were interested in the narrowness and isolation of the ruling classes as a historical phenomenon.

B) Artists felt that the experiences of the ruling classes were the only kinds of activity worth recording.

C) Artists aspired to the wealth and power of the ruling classes.

D) Artists looked to the members of the ruling classes for financial support.

67. The discussion of Ford Madox Brown's painting *Work* shows primarily that:

A) the process of expanding the subject matter of professional art is complex and extremely difficult to achieve.

B) art that deals with realistic subjects is more powerful than abstract art.

C) the problems inherent in expanding the subject matter of art are still with us today.

D) the relationship between the professional artist and the ruling classes is complicated and should not be simplified.

Passage IV

The interior of the earth retains the memory of the planet's fiery beginning some 4.5 billion years ago. As material from the disk of gas and dust surrounding the early sun coalesced under gravity to form the earth, enough gravitational energy was released to melt much or all of the early earth. In the process, most of the earth's dense, metallic constituents collected at the center, and the lighter silicate minerals that became the mantle and the crust floated to the top. As the heavier materials separated from the lighter ones, additional energy was released, adding to the earth's internal heat. The interior of the planet has been cooling slowly ever since, at a rate of tens of degrees every billion years.

In addition to shedding its primordial heat, the earth casts off the heat generated by the decay of radioactive elements trapped in its interior. All told, about forty-two terawatts (forty-two trillion watts) continuously escapes from the earth's surface. That is only about a thousandth of the heat provided by the sun, but it is still a palpable quantity, as volcanoes, hot springs and the warmth in any deep mine attest. Most of the heat originates in the mantle (the 2,000-mile-thick shell of rock that lies between the earth's crust and its metallic core). By driving mantle convection and plate motions, this heat accounts for most of the geological activity at the earth's surface….

The core is a sphere some 4,000 miles across, made up mostly of iron and perhaps some nickel, alloyed with several light nonmetals such as oxygen or sulfur. Although the energy liberated by the formation of the core probably left it completely molten, by now its inner third is solid. The inner core is hundreds of degrees hotter than the outer core – as hot as 4,500 to 6,000 degrees Celsius – but it is under higher pressure, which keeps it solid.

The existence of the earth's magnetic field is the clearest evidence that the core is cooling. The earth's magnetic field, like any other, is a by-product of electric currents. (Even the magnetism of an ordinary bar magnet can be attributed to moving electric charges.) But currents ordinarily do not persist without the input of energy. Any currents in the core would decay in tens of thousands of years if they were not regenerated somehow. Because magnetized rocks show that the earth has had a magnetic field for at least three billion years, some source of energy within the core must be sustaining the currents continuously. The only theory that can explain the persistence of the field and its propensity for reversing itself is the dynamo theory, which holds that the magnetic field results from fluid motions in the outer core. What sustains the motions, ultimately, is heat loss from the core.

A dynamo – the same device that lies at the heart of an electric generator – converts mechanical energy into electric current by moving a conductive material through a magnetic field. By the laws of electromagnetism the induced electric current generates its own magnetic field; the magnetic fields interact with the current to produce a force that resists the movement of the conductor. All these interactions must be working together smoothly in the outer core, for otherwise the dynamo would have long since ceased to function.

Material used in this test passage has been adapted from the following source:
D. E. Loper, *Scorched Earth: How Heat from the Core Triggers Surface Upheaval*. ©1990 by The New York Academy of Sciences.

68. According to the passage, the internal heat of earth is considered a result of all of the following factors EXCEPT:

A) fluid motions in the outer core.

B) primordial gravitational processes.

C) decay of trapped radioactive elements.

D) primordial separation of heavier from lighter materials.

69. According to the information given in the passage, the amount of heat provided by the sun, in terawatts, is roughly:

A) 42

B) 4,200

C) 42,000

D) 42 trillion

70. According to the passage, earth's core is predominantly:

A) solid and radioactive.

B) gaseous and magnetic.

C) fluid and metallic.

D) solid and magnetic.

71. According to the passage, the continuous existence of earth's magnetic field is best shown by analysis of the:

A) geological activity at the earth's surface.

B) magnetic data obtained from rocks.

C) electrical conductivity of rocks from the earth's mantle.

D) conversion of mechanical into electrical energy by rocks.

72. According to the passage, the dynamo theory derives much of its credibility from the fact that it alone can account for the:

A) periodic reversals of the earth's persisting magnetic field.

B) weakness of the earth's magnetic field.

C) intense heat of the earth's core.

D) electrical conductivity of the earth's inner core.

73. According to the passage, magnetic fields are primarily by-products of:

A) fluid motion.

B) the rotation of the earth.

C) mechanical energy.

D) electrical currents.

74. The synthesis of geology, physics, chemistry, mathematics, and other disciplines required to develop theories such as the one described would be most similar to the study of:

A) historical and contemporary styles of painting to get artistic inspiration.

B) the art, history, and technology of antiquity to develop theories about ancient civilizations.

C) child, adolescent, and adult problem-solving styles to develop a theory of intelligence.

D) the effects of different anesthetics to develop a theory of pain.

Passage V

Television is not the "dream factory" which Hollywood was once said to be by dour sociologists: it is a reality factory. It is truer to life than life is. Television convinces us by immediacy and by repetition, not by structured argument or oratorical exposition. A lack of articulacy is the badge of sincerity; grammar smacks of premeditation. "Series" dominate all program planning. What has been said before – "characters" we have seen before, advertisements we "love" – may well be the evidence that originality (what has never been said before) has scant future on the box. Malcolm Muggeridge has spoken of the numbing effect of the plethora of news. …By hosing us with "information" the networks affect to keep us fully up-to-date with the world, yet the segmentation and "personalization" of the "news" actually confuse us with their discontinuous gush, so that we are less set free by the "truth" than addicted to it, not least because it seems always about to tell us something. Frustration accompanies even our most emotional responses: the eyes fill with tears, the lump engorges the throat, as victims or survivors appear on our screens, but catharsis does not follow, nor (in almost all cases) does any active response, in political or social terms. The reward of being a viewer depends on staying passive – if we are moved to leave the viewing chair we may miss the next program. Such movement then is rarely any part of a newscaster's program: "stay tuned" is the eleventh and commanding commandment.

…What is the language of television?... The truth is that it cannot be isolated, for if I am right, television is a voracious recycler and mixer of a confluence of concepts. "Basic television" has no *distinct* vocabulary: it eavesdrops and cadges with relentless parasitism, but… it has no specific dictionary, merely a character, or characters….

…Being true to life will soon be better (more authentic) than life itself. Television, in fact, suggests that it is already: even television drama, with its almost inescapable naturalism, is more quotidian, so to say, than everyday life. The regularity of its series provides a clock and a monitor by which reality itself is calibrated. "Time for Kojak" becomes a normal way of announcing where we are in the day, while Kojak himself, at the peak of his powers and popularity, gave police officers–as do and did other realistic programs – an indication of how they should behave (and how the public would expect them to behave) if they were to maintain credibility. "As seen on TV" thus becomes a guarantee of quality, not only in advertised products, but in human behavior at large.

Mass communication communicates massively: its language lacks precise articulation and avoids demanding terms; it argues for the kind of behavior in life which will make a "good program."…Television writes our scripts and it thus gives us back our language in a verisimilitudinous revision, docked of amateurish or embarrassing passions or obsessions which might cause our audience to switch off.

Material used in this test passage has been adapted from the following souces:
F. Raphael, *The Language of Television*.

75. The passage suggests that television newscasters attempt to do which of the following to their viewers?

A) Encourage them to stay passive

B) Help them achieve emotional catharsis

C) Move them to leave the viewing chair

D) Confuse them by compartmentalizing information

76. The passage suggests that a real-life argument between two people would probably not make for good television because the people would be:

A) less convincing than professional television actors.

B) incapable of articulating their emotions precisely enough.

C) more passive than the characters in typical television drama series.

D) too passionate to fit in with the prevailing language of television.

77. The overfamiliarity of certain television characters or advertisements is cited by the author as evidence for the claim that:

A) there is little place for originality on television.

B) news is not the only programming that has a numbing effect on viewers.

C) television is truer to life than life is.

D) television convinces through immediacy and repetition.

78. The existence of which of the following phenomena would most strongly *challenge* the information in the passage?

A) A critic who enjoys television drama series

B) A news show that employs fast-paced images and simple language

C) A sympathetic television character who speaks passionately and articulately

D) A television series that mixes and recycles plots from a variety of sources

79. According to the passage, a "good program" would best be described as one that:

A) forces viewers to feel the full impact of their emotions.

B) involves viewers just enough to keep them from leaving their chairs.

C) features passionate and articulate characters.

D) shows interesting and unusual aspects of everyday life.

Passage VI

Confucius saw… that the truly, distinctively human powers have, characteristically, a magical quality. His task, therefore, required, in effect, that he reveal what is already so familiar and universal as to be unnoticed. What is necessary in such cases is that one come upon this "obvious" dimension of our existence in a new way, in the right way…. Confucius found the path: we go by way of the notion of *li*.

One has to labor long and hard to learn *li*. The word in its root meaning is close to "holy ritual," "sacred ceremony." Characteristic of Confucius's teaching is the use of the language and imagery of *li* as a medium within which to talk about the entire body of the… authentic tradition and reasonable conventions of society. Confucius taught that the ability to act according to *li* and the will to submit to *li* are essential to that perfect and peculiarly human virtue or power which can be one's own….

Confucius characteristically and sharply contrasts the ruler who uses *li* with the ruler who seeks to attain… ends by means of commands, threats, regulations, punishments and force. The force of coercion is manifest and tangible, whereas the vast (and sacred) forces at work in *li* are invisible and intangible. *Li* works through spontaneous coordination rooted in reverent dignity. The perfection in Holy Rite is esthetic as well as spiritual….

The effortless power of *li* can also be used to accomplish physical ends, though we usually do not think of it this way. Let us suppose I wish to bring a book from my office to my classroom. If I have no magic powers, I must literally take steps – walk to my office, et cetera. But there is also magic – the proper ritual expression of my wish which will accomplish my wish with no such effort on my part. I turn politely, i.e., ceremonially, to one of my students in class and merely express in an appropriate and polite (ritual) formula my wish…. In almost no time the book is in my hands, as I wished!...

The notion that we can use speech only to talk *about* action or indirectly to *evoke* action has dominated modern Western thought. Yet contemporary "linguistic" analysis in philosophy has revealed increasingly how much the ritual word is itself the critical act rather than a report of, or stimulus to, action. The philosopher J. L. Austin… brought the reality and pervasiveness of this phenomenon to a focus in his analyses of what he called the "performative utterance." These are the innumerable statements we make which function somewhat like the "operative" clause in a legal instrument…. They are the very execution of the act itself.

"I give and bequeath my watch to my brother," duly said or written is not a report of what I have already done but is the very act of bequeathal itself…. It is by words, and by the ceremony of which the words form a part, that I bind myself in a way which, for someone "ever turning to *li*," is more powerful, more inescapable than strategies or force….

…The central lesson of Professor Austin's new philosophical insights is not so much a lesson about language as it is about ceremony. What we have come to see, in our own way, is how vast is the area of human existence in which the substance of that existence *is* the ceremony. Promises, commitments, excuses, pleas, compliments, pacts – these and so much more are ceremonies or they are nothing.

Material used in this test passage has been adapted from the following source:
H. Fingarette, *Confucius–The Secular as Sacred*. ©1972 by H. Fingarette.

80. The author's central thesis is that:

A) promises, commitments, excuses, pleas, and pacts are verbal conventions.

B) *li* is effective in controlling the behavior of others.

C) performative utterances are more honest than are stated intentions.

D) the powers that are uniquely human are revealed in traditional ceremonies.

81. The passage suggests that Confucius would be most likely to endorse which of the following reasons to use *li*?

A) It acknowledges the dignity of others.

B) It works invisibly through magical powers.

C) It does not require the expenditure of effort.

D) It avoids the risks involved in using force.

82. The powers discussed by Confucius are described as "magical." What is the most likely reason for the choice of this word?

A) The word directs attention to the power behind ordinary social conventions.

B) The rituals involved in *li* harness supernatural phenomena.

C) These powers can be learned only from Confucian masters of the occult.

D) Those with these powers can move physical objects through the use of words alone.

83. According to the passage, which of the following sentences is(are) performative utterances?

I. Please help me.
II. I promise to help.
III. May I help you?

A) I only

B) II only

C) I and III only

D) II and III only

84. The author suggests that Confucius considered the ceremonies of society to be "holy" because they are:

A) expressions of respect.

B) divinely sanctioned laws.

C) customary in refined society.

D) performed by holy persons.

85. The author argues that people bind themselves more inescapably through words or ceremony than through strategies or force. Which of the following claims, if true, would most *weaken* the argument?

A) People rarely try to meet their moral obligations.

B) People rarely act ceremoniously.

C) People often respond to force or strategies.

D) People often avoid making promises.

Passage VII

The Greeks were traditionally a religious people. Yet there had always been a tendency, at the same time, to treat the gods with a certain familiar flippancy – this is already very apparent in the *Iliad* and the *Homeric Hymns*. The rationalist movements of the later fifth century had subjected the reputation of the divine personages to a further battering. The inquisitive spirit of Euripides, when not (as in the *Bacchae*) interpreting the gods as profound psychological forces, was capable of presenting them as shady seducers or discredited figures of fun. And at the same time Socrates was questioning the whole traditional fabric so indefatigably that his prosecutors, who secured his death sentence, were hardly wrong to accuse him of "not believing in the gods in whom the city believes."

Then the early Hellenistic age that followed produced numerous slighting references to the Olympian powers. Many people had come to regard them as merely symbolic, and even the Stoics, for all their belief in divine Providence, reinterpreted and accommodated many individual deities as merely allegorical explanations of natural phenomena. Like Hellenistic sculptors, who began to represent some of these gods… in much less idealistic forms than those their predecessors had favoured, the poets Callimachus and Theocritus showed that they were living in an age when the old gods were no longer a matter of belief or serious concern.

Other writers were even more specific. Thus the idea of Euhemerus that the gods Uranus, Cronus, and Zeus had once been great human kings upon the earth may have been a flattering gesture in favour of worshipping living monarchs as their equals… but it was also, in another sense… little more than a rationalization of atheism; and his younger contemporary Strato of Lampsacus… declared that he did not need the help of the gods at all in order to construct an understandable world. Meanwhile, an Athenian's hymn to Demetrius I Poliorcetes had asserted that the gods of the city, if not non-existent, were at least indifferent: and both Menander (in passing) and Epicurus (in an elaborate series of philosophical arguments) found this latter conclusion an obviously correct one, since the traditional gods seemed able to do nothing to ease people's daily encounters with the vicissitudes of Hellenistic life. St. Paul, after such ideas had been going round for three or four centuries, understandably saw pagan Hellenism as a "world without hope – and without God."

All the same, his impression was misleading. Pagan religion was not already dying or dead when Christianity overtook it; it had remained very lively indeed. But it had deviated, and continued to deviate throughout the Hellenistic age, from the traditional mainstream of the classical Olympian cults. They continued, it is true, to receive impressive ceremonial worship, but a person of this epoch no longer pinned his or her faith on those gods, but on a number of Divine Saviours. These Saviours were relied on, passionately, for two quite distinct miraculous gifts, of which their various cults held out hopes in varying proportions: the conferment of strength and holiness to endure our present life upon this earth, and the gift of immortality and happiness after death. And so religion was not moribund at all, but turned out to be one of the most vital elements in the Hellenistic world.

Material used in this test passage has been adapted from the following source:
M. Grant, *From Alexander to Cleopatra: The Hellenistic World.* ©1982 by M. Grant Publications Ltd.

86. The passage suggests that the most favorable portrayal that Euripides gave of the Olympian gods was to interpret them as:

A) psychological forces.

B) Divine Saviours.

C) inquisitive spirits.

D) figures of fun.

87. Suppose that Socrates had said to his prosecutors, "I will obey my god rather than you." How would this information affect the claim that the prosecutors were correct to accuse Socrates of not believing in the city gods?

A) It would refute the claim.

B) It would support the claim.

C) It would support the claim if it could be shown that the god to whom Socrates referred was an Olympian figure.

D) It would support the claim if it could be shown that the god to whom Socrates referred was not an Olympian figure.

88. Suppose it is discovered that a Stoic philosopher originated the traditional portrayal of the Olympian god Zeus as the source of thunder. How would this information affect the author's claims about the Stoics?

A) It would support the claim that the Stoics reinterpreted individual deities as explanations of natural phenomena.

B) It would support the claim that the Stoics came to regard the Olympian gods as merely symbolic.

C) It would weaken the claim that the Stoics believed in divine Providence.

D) It would weaken the claim that the Stoics produced numerous slighting references to the Olympian gods.

89. The claim that religion was one of the most vital elements in the Hellenistic world is based mainly on the:

A) comments of St. Paul regarding pagan Hellenism.

B) existence of cults devoted to Divine Saviours.

C) writings of Menander and Epicurus.

D) idea that Olympian gods had once been human kings.

90. The *Iliad* and the *Homeric Hymns* are cited in the passage as evidence for the claim that:

A) the rationalist movements of the fifth century diminished the reputations of the Olympian gods.

B) poets believed that the old gods were no longer a matter of serious concern.

C) Greeks had a tendency to treat the Olympian gods irreverently.

D) some Greeks believed that the gods of the city were indifferent.

91. The passage suggests that, before Callimachus and Theocritus, Greek poets presented portraits of the Olympian gods that were:

A) similar to sculpture.

B) flippant and unflattering.

C) virtually atheistic.

D) highly idealized.

92. The passage as a whole suggests that in order for a religion to retain its vitality, it must:

A) abandon the search for miraculous gifts.

B) respond in some way to people's needs.

C) answer the challenges set forth by rationalists.

D) be attractive to poets and other artists.

Writing Sample

Time: 60 minutes
2 Prompts, separately timed:
30 minutes each

This is a test of your writing skills. The test consists of two parts. You will have 30 minutes to complete each part. Use your time efficiently. Before you begin writing each of your responses, read the assignment carefully to understand exactly what you are being asked to do. Because this is a test of your writing skills, your response to each part should be an essay of complete sentences and paragraphs, as well organized and clearly written as you can make it in the time allotted.

93. Consider this statement:

An understanding of the past is necessary for solving the problems of the present.

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 solving a current problem might not require an understanding of the past. Discuss what you think determines whether or not the past should be considered in solving the problems of the present.

94. Consider this statement:

Politicians too often base their decisions on what will please the voters, not on what is best for the country.

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 a politician might make an unpopular decision for the good of the country. Discuss the principles you think should determine whether political decisions should be made to please the voters or to serve the nation.

Biological Sciences

Time: 70 minutes
Questions: 95 – 146

Most questions in the Biological Sciences test are organized into groups, each containing a descriptive passage. After studying the passage, select the one best answer to each question in the group. Some questions are not based on a descriptive passage and are also independent of each other. If you are not certain of an answer, eliminate the alternatives that you know to be incorrect and then select an answer from the remaining alternatives. Indicate your selected answer by marking the corresponding answer on your answer sheet. A periodic table is provided for your use. You may consult it whenever you wish.

Periodic Table of the Elements

1 H 1.0																	2 He 4.0
3 Li 6.9	4 Be 9.0											5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3											13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.5	18 Ar 39.9
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.4	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc (98)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.9	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac† (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (281)	111 Uuu (272)	112 Uub (285)		114 Uuq (289)		116 Uuh (289)		

*	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
†	90 Th 232.0	91 Pa (231)	92 U 238.0	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (260)

Passage I

Approximately 100 years ago, two biologists performed separate experiments to study the process by which a fertilized egg differentiates into the many cell types found in a complete organism.

Biologist 1: The Mosaic Hypothesis

Biologist 1 worked with two-celled frog embryos, killing one cell of each embryo with a hot needle, but leaving the dead cell attached. The surviving cell formed only half of an embryo, and the biologist concluded that cells of the developing embryo were independent; that is, they acted as individual pieces of a *mosaic.* The biologist assumed that "determinants" (i.e., genes) were portioned out qualitatively as the egg divided, until each cell contained only the substances needed for its own development. Biologist 1 concluded that the fate of developing cells is determined by the cells' unequal content of determinants, and that cell lineage is unaffected by external conditions or by the position of a cell in the embryo.

Biologist 2: The Regulative Hypothesis

Biologist 2 worked with sea urchin embryos. When a tube of seawater containing embryos was shaken, the two cells of each embryo separated, and each cell later developed into a complete but slightly smaller embryo. This suggested that each cell retained a complete set of determinants. Biologist 2 viewed the embryo not as a mosaic, but as a *harmonious equipotential system;* that is, each cell is capable of developing into a complete organism, and the cells interact to regulate development. Thus, Biologist 2 concluded that the fate of developing cells depends mainly on environmental factors and on their position in the embryo.

95. Which of the following pieces of experimental evidence best supports the Mosaic Hypothesis?

A) Identical twins or triplets are derived from a single fertilized egg.

B) In some developmental accidents, embryos with two normal-sized heads are produced.

C) Separated cells of two-celled embryos continue to divide, producing partial embryos.

D) Nuclei of dividing eggs in a single organism all contain the same genetic information.

96. The nucleus of a frog egg is destroyed by radiation and replaced by a nucleus from a differentiated gut cell of a tadpole. The resulting egg is activated and develops into an adult frog. Are the results of this experiment more consistent with the Regulative Hypothesis or the Mosaic Hypothesis?

A) The Regulative Hypothesis, because an environmental factor (radiation) activated the fertilized egg to develop into a frog

B) The Regulative Hypothesis, because the activated egg resulting from the experiment developed into a complete organism

C) The Mosaic Hypothesis, because some genes were retained in the nucleus of the frog egg cell after the radiation treatment

D) The Mosaic Hypothesis, because the frog egg was unable to develop into an adult frog until genes from another cell were added

97. The validity of the Regulative Hypothesis could best be demonstrated in an organism by showing that:

A) incomplete embryos develop from separated cells.

B) cell fate is dependent on factors within the cell.

C) transplanted embryonic cells show position-dependent development.

D) genes determining cell development are distributed asymmetrically.

98. Which of the two hypotheses in the passage most closely fits the present-day understanding of human differentiation?

A) The Mosaic Hypothesis, because each germ cell loses half of its genetic material during meiosis

B) The Mosaic Hypothesis, because only specific genes are activated during the differentiation of each cell type

C) The Regulative Hypothesis, because each embryonic cell receives a complete set of genes, and cell position is unrelated to differentiation

D) The Regulative Hypothesis, because each embryonic cell receives a complete set of genes, and cell position helps to determine differentiation

99. The cell nucleus below contains the chromosomes of a sea urchin embryo at the two-cell stage.

Which of the diagrams below best represents the nucleus of an embryo at the 64-cell stage grown from this cell?

A)

B)

C)

D)

100. The validity of the Mosaic Hypothesis could best be demonstrated in an organism by showing that:

A) all embryonic cells have the same developmental potential.

B) interactions occur among all embryonic cells.

C) the fate of all cells depends on external conditions.

D) the fate of transplanted embryonic cells is independent of their new position in the embryo.

Passage II

Cholesterol is a structural component of plasma membranes and a precursor of steroid hormones. The typical blood cholesterol level of healthy humans is about 1.8 mg/mL.

Familial hypercholesterolemia (HC) is a disease associated with high cholesterol levels; HC affects 1 in 500 people. The cholesterol level of moderately affected individuals is about 3.0 mg/mL. Severely affected individuals have cholesterol levels around 7.0 mg/mL.

HC is relatively common in some families and absent from others. Research shows no significant difference between the dietary habits of individuals in affected and unaffected families.

Biologists believe that HC is caused by a malfunction at the plasma membrane. The cells of healthy individuals have cholesterol-containing endocytotic vesicles, whereas the cells of individuals with HC do not. A comparison of the homogenized cells reveals that individuals with HC lack a membrane protein that normally binds to a particular cholesterol-containing particle (LDL). This same protein is found in the membrane of cholesterol-containing vesicles.

101. Cholesterol is a precursor of which of the following hormones?

A) Insulin

B) Gastrin

C) Thyroxin

D) Estrogen

102. Is it reasonable to conclude that HC is caused by a genetic disorder?

A) Yes, because HC is common in certain families, regardless of the type of diet they consume

B) Yes, because HC is common in families that consume low-cholesterol diets

C) No, because individuals in families that consume high levels of cholesterol are more likely to acquire the disease

D) No, because HC appears to be caused by a defective protein and not a defective DNA sequence

103. Researchers can most effectively mimic the symptoms of HC in a healthy person if they give that person a drug that:

A) enhances the absorption of lipids from the small intestine.

B) binds to the plasma membrane proteins that normally bind LDL.

C) inhibits both the production and the secretion of bile.

D) prevents the synthesis of all plasma membrane proteins.

104. A man and a woman, each with a cholesterol level of about 3.0 mg/mL, have a child with a cholesterol level of 7.0 mg/mL. Assuming that HC is determined by alleles at a single locus, does this observation provide evidence that the HC allele is dominant to the normal allele?

A) No; HC is recessive, because the disease is expressed in the child but is not expressed in the parents.

B) No; HC is codominant, because the heterozygous parents have a less severe form of the disease than does the homozygous child.

C) Yes; HC is completely dominant, because the child inherited the most severe form of the disease.

D) Yes; HC is completely dominant, because both parents carry the allele and have the disease.

105. Vasoconstriction of which of the following vessels will most effectively reduce fat absorption from the small intestine into the bloodstream?

A) Lacteals inside intestinal villi of the small intestine

B) Capillaries in the smooth muscle of the small intestine

C) Lacteals in the peritoneum around the small intestine

D) Capillaries in the peritoneum around the small intestine

106. Which of the following statements provides the *strongest* support for the hypothesis that HC is a genetic disease rather than a disease caused by environmental factors?

A) HC is relatively common in some families and absent from others.

B) There is no significant difference in the dietary habits of individuals in affected families versus individuals in unaffected families.

C) HC appears to be caused by a malfunction at the plasma membrane.

D) The cells of healthy individuals have cholesterol-containing endocytotic vesicles, whereas the cells of individuals with HC do not.

These questions are not based on a descriptive passage and are independent of each other.

107. A researcher crossed pea plants heterozygous for genes for the recessive "short" trait and the dominant "tall" trait. In the next generation, 787 plants were tall. Which of the following answers represents an approximate prediction of the number of short plants in that generation?

A) 0

B) 277

C) 787

D) 2361

108. Glucose is labeled with ^{14}C and followed as it is broken down to produce CO_2, H_2O, and ATP in a mammalian liver cell. In theory, during this process the label will be detectable:

A) in the mitochondria only.

B) first in the nucleus, then in the mitochondria.

C) first in the mitochondria, then on the ribosomes.

D) first in the cytoplasm, then in the mitochondria.

109. A resident of a famine area who appears undernourished and extremely emaciated has eaten only starches for the past 3 months. A urine analysis shows that a large amount of nitrogen is being excreted. This is most likely evidence of:

A) an abnormally high rate of glycogen breakdown in the liver.

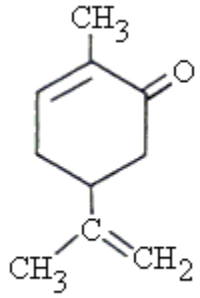
B) breakdown of the body's own structural proteins to provide energy.

C) utilization of the last remaining fat reserves to provide energy.

D) incomplete reabsorption of nitrogenous products due to kidney failure.

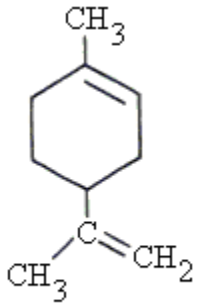
Passage III

Carvone (shown below) can exist as either of two enantiomers. One of them, (+)-carvone, provides the characteristic odor in caraway seed oil, whereas (-)-carvone is responsible for the fragrance of spearmint oil.



carvone

A chemist attempted to isolate (+)-carvone from caraway seed oil, which consists almost entirely of (+)-carvone and limonene (shown below).



limonene

Because the two compounds have very different boiling points, the chemist decided to separate them by *vacuum fractional distillation.* The apparatus in Figure 1 was assembled, and a sample of caraway seed oil was placed in the distillation flask. An *ebulliator* was lowered into the distillation flask to introduce small air bubbles into the system. The fractionating column and distillation head were wrapped with glass wool, and the apparatus was connected with thick tubing to a vacuum source. The contents of the distillation flask were heated, and two fractions were collected in the receiving flask.

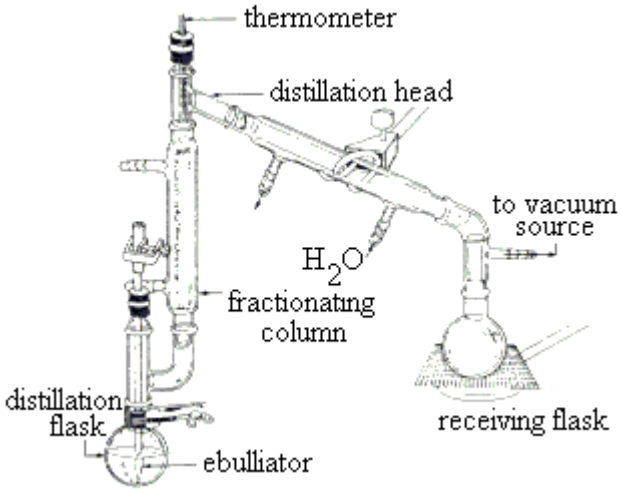


Figure 1 Vacuum fractional distillation apparatus

110. When the caraway seed oil is heated, which of the two components will most likely distill first?

A) Limonene, because it has the lower boiling point

B) Limonene, because it has the higher boiling point

C) (+)-Carvone, because it has the lower boiling point

D) (+)-Carvone, because it has the higher boiling point

111. The most likely function of the ebulliator is to:

A) keep the condensed vapors cool in the receiving flask.

B) promote the establishment of a high vacuum in the system.

C) prevent superheating of the liquid to be distilled.

D) provide an outlet when the pressure inside the system becomes too high.

112. Which of the following experimental modifications will most likely improve the degree of separation between limonene and (+)-carvone?

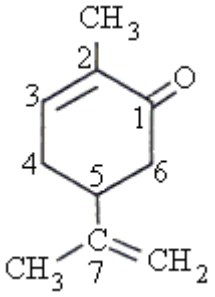
A) Heating the distillation flask at a slower rate

B) Using a vacuum source that can achieve a lower pressure inside the distillation apparatus

C) Cooling the condenser with ice water

D) Using a shorter fractionating column

113. Carvone is shown below with certain carbon atoms labeled.



(+)-Carvone and (–)-carvone differ in the orientations of the substituents around which of the following carbon atoms?

A) Carbon 2 only

B) Carbon 5 only

C) Carbons 2 and 5 only

D) Carbons 2, 5, and 7 only

114. If a leak develops in the vacuum distillation apparatus, the boiling points of the two components of caraway seed oil will:

A) both increase.

B) both decrease.

C) both remain the same.

D) become more similar.

Passage IV

In humans, Hormone X is a protein that induces normal cells to admit more Ca^{2+}. To examine the mode of action of Hormone X, a biologist screened thousands of families for inherited Hormone X deficiencies. The screen turned up two (unrelated) families in which many males but no females had a defect in their ability to respond to Hormone X.

The biologist performed a series of experiments on cells isolated from females and the affected males in the two families to determine: (1) the pathway between hormone binding and Ca^{2+} entry in a normal cell, and (2) the point in the pathway where the defect occurs in the males. The following results were obtained:

1. In both families, none of the isolated cells from affected males had an elevated influx of Ca^{2+} after treatment with Hormone X.
2. Hormone X bound to Protein R of all cells examined.
3. Protein R was smaller than normal in cells from affected males of Family 1, but its size was absolutely normal in all other cells examined.
4. In intact cells, Protein R phosphorylated Protein P in the cells from females only.
5. When activated Protein R was isolated from females, it could phosphorylate Protein P isolated from affected males of Family 1, but not Family 2.
6. Phosphorylated Protein P was necessary and sufficient to increase the rate of Ca^{2+} entry in cells from females.

115. Assuming defective Hormone X response is X-linked, which children of an affected male will most likely be unable to respond to Hormone X?

A) All of the males and all of the females

B) Half of the males and half of the females

C) None of the males and half of the females

D) None of the males and none of the females

116. Which of the following protein(s) is most likely to utilize ATP for its action?

A) Hormone X only

B) Protein R only

C) Protein P only

D) Both Hormone X and Protein P

117. Among the following choices, the most likely function of phosphorylated Protein P is as a:

A) Na^+/K^+ pump.

B) phosphatase.

C) membrane channel.

D) hormone receptor.

118. In the normal cellular response to Hormone X, the influx of Ca^{2+} should stop immediately when:

A) Hormone X no longer binds to Protein R.

B) the complex of Hormone X and Protein R undergoes endocytosis.

C) synthesis of Protein P is terminated.

D) Protein P is dephosphorylated.

119. Based on the passage, the mutation in the DNA in affected males from Family 2 most likely results in:

A) the replacement of a single amino acid in Protein R.

B) the replacement of a single amino acid in Protein P.

C) the introduction of a premature stop codon in Protein R.

D) the introduction of a premature stop codon in Hormone X.

These questions are not based on a descriptive passage and are independent of each other.

120. An intravenous infusion causes a sharp rise in the serum level of albumin (the major osmoregulatory protein in the blood). This will most likely cause an:

A) increase in the immune response.

B) increase in tissue albumin levels.

C) outflow of blood fluid to the tissues.

D) influx of tissue fluid to the bloodstream.

121. Two animals would be considered to be closely related if they were in the same:

A) class.

B) genus.

C) order.

D) family.

122. Ducklings will tend to follow any large moving object they encounter during a critical period after hatching. This type of behavior is termed:

A) imprinting.

B) habituation.

C) conditioning.

D) discrimination.

123. Which of the following alkanes has the lowest heat of combustion per CH_2 group?

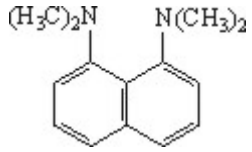
A) Cyclopropane

B) Cyclobutane

C) Cyclohexane

D) Cycloheptane

124. The compound below is sold under the name Proton-Sponge®. Is this compound likely to be a good nucleophile?



A) Yes, because it is a strong base

B) Yes, because the nitrogens have high electron density

C) No, because it is aromatic

D) No, because the nitrogens are sterically hindered

Passage V

Plasma clearance refers to the capacity of the kidney to remove a substance from the plasma. It is determined by comparing the concentrations of the substance in the plasma and the urine, and then calculating the rate at which the substance appears in the urine.

Plasma clearance is affected by the *tubular transport maximum* (T_m) of a substance. The T_m is the maximum rate of transport (mg/min) at which a substance can be reabsorbed by the kidney. That is, if the filtration rate of a substance exceeds its T_m, the substance will begin to appear in the urine. The T_m for glucose averages 320 mg/min in an adult human.

Two experiments were done to study the plasma clearance of Substance A, a hexose that readily enters the glomerular filtrate.

Experiment 1

First, researchers measured the concentrations of Substance A in the plasma and urine of a volunteer. Later, they determined the concentrations of glucose in the volunteer's plasma and urine. In each trial, the test substance was injected intravenously and continuously during measurement. Results are shown in Figure 1.

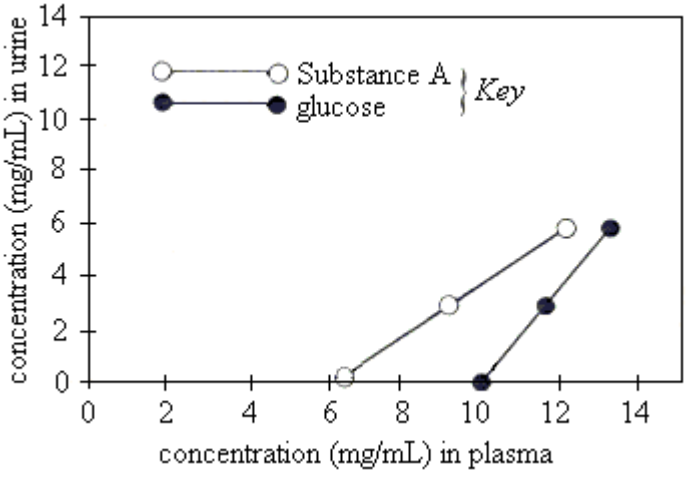


Figure 1 Plasma clearance of Substance A and glucose

Experiment 2

The effect of *antidiuretic hormone* (ADH) on the plasma clearance of Substance A was tested. The volunteer was given two dosages of ADH during two separate trials. The first dosage was within the normal physiological range of concentrations and affected the renal reabsorption of water. The second dosage, which was much higher than the normal physiological concentration, affected urine output by increasing blood pressure.

125. According to the passage, the T_m represents the rate of plasma filtration that just exceeds the:

A) rate of concentration of the substance in the glomerular filtrate.

B) rate of concentration of the substance in the urine.

C) capacity of the kidney tubules to reabsorb the substance.

D) capacity of the bladder to store and excrete the substance.

126. Under normal conditions, the *tubular load* of glucose (the amount/min that filters into the kidney tubules) is approximately 125 mg/min. The amount of glucose in the urine under these conditions is approximately:

A) 0 mg/min.

B) 125 mg/min.

C) 195 mg/min.

D) 515 mg/min.

127. A lower-than-normal blood pressure will cause which of the following effects on the rate of plasma clearance of Substance A?

A) An increase, because the concentration of Substance A in the urine will increase

B) An increase, because the ADH levels will be very low

C) A decrease, because the decreased rate of urine output will allow more reabsorption by the kidney

D) A decrease, because ADH levels will be very high

128. Equal concentrations of 8 mg/mL of Substance A and glucose are found in a volunteer's plasma. Based on Figure 1, which substance will the kidney clear from the plasma more rapidly?

A) Substance A, because the slope of the clearance line for Substance A is higher than that for glucose

B) Substance A, because Substance A reaches its T_m at a lower plasma concentration than does glucose

C) Glucose, because glucose reaches its T_m at a higher plasma concentration than does Substance A

D) Glucose, because the slope of the clearance line for glucose is lower than that for Substance A

129. According to Figure 1, at approximately what plasma concentration of glucose is the T_m (320 mg/min) reached?

A) 6.5 mg/mL

B) 10.0 mg/mL

C) 11.5 mg/mL

D) 12.5 mg/mL

130. In Experiment 2, the increased blood pressure resulting from the higher-than-normal concentration of ADH most likely affected the urinary output of Substance A by increasing the:

A) glomerular filtration rate.

B) T_m of solutes.

C) water reabsorption from the tubules.

D) concentrating ability of the loop of Henle.

Passage VI

Osteoporosis is a pathological decrease of 35 to 50% in a person's bone mass, which may increase the likelihood of pelvic and wrist fractures and result in back pain or "dowager's hump" due to compression and fracture of the vertebrae. Although all individuals (male and female) steadily lose 0.5 to 1.0% of their bone mass per year after the age of 40, this decline is accelerated in postmenopausal women, who show a loss of 2 to 3% per year for the 8 to 10 years immediately following menopause. They then revert to the slower rate of loss.

Aging-related abnormalities in parathyroid hormone and calcitonin secretion contribute to the slow decline of bone mass in both men and women, as does decreased production of active vitamin D by the kidney. The accelerated postmenopausal bone loss in women appears to be directly linked to estrogen deficiency, although the exact mechanism of this linkage is unknown.

Currently, hormone replacement therapies and dietary calcium supplementation are used in the prevention of osteoporosis in women. Because estrogen therapy may increase the risk of developing uterine and breast cancer, patients on estrogens usually also receive low doses of progesterone analogues, which appear to substantially diminish this risk. Recently, calcitonin analogues have also been developed for the treatment and prevention of osteoporosis.

131. In addition to the effects of estrogen deficiency, the most likely reason that more women than men suffer from osteoporosis is that women, compared to men, have:

A) lower bone density.

B) fewer vertebrae.

C) less efficient mechanisms for calcium uptake.

D) less efficient vitamin D production.

132. Postmenopausal women receiving estrogen and progesterone therapy will most likely experience which of the following side effects?

A) Breast tissue will atrophy.

B) Vaginal tissue will dry out.

C) Periodic menstruation will resume.

D) Lactation will be induced.

133. Production of which of the following hormones will be inhibited by the administration of dietary calcium to prevent osteoporosis?

A) Growth hormone

B) Calcitonin

C) Thyroid hormone

D) Parathyroid hormone

134. A man is treated with low doses of an estrogen analogue to destroy an estrogen-responsive adrenal tumor. Compared to an age-matched control (no estrogen treatment), this patient's chances of developing osteoporosis will most likely be:

A) increased.

B) decreased.

C) approximately the same.

D) approximately the same, but the disease will appear at an earlier age.

135. Osteoblasts, which form bone, and osteoclasts, which resorb it, work together to cause continuous bone remodeling. In a person suffering from osteoporosis, which of the following combinations of changes in the activity of these cell types will most likely occur?

A) Increased osteoblast and decreased osteoclast activity

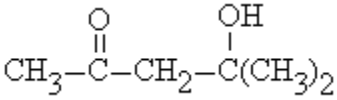
B) Increased osteoblast and increased osteoclast activity

C) Decreased osteoblast and decreased osteoclast activity

D) Decreased osteoblast and increased osteoclast activity

Passage VII

During an experimental workup procedure, a chemist treated a starting material with NaOH in the solvent acetone [$(CH_3)_2C{=}O$]; however, the starting material was recovered unreacted. Instead, the chemist isolated a small amount of Product A (shown below).



Product A

The chemist determined that Product A resulted from the aldol self-condensation of acetone. Product A was identified based on the following observations.

Observations about Product A

1. Elemental analysis of Product A indicated that it consisted only of carbon, hydrogen, and oxygen.
2. Product A had a molecular weight of 116 g/mole.
3. Characteristic signals in the infrared spectrum of Product A included a broad band at 3400 cm^{-1} and an intense signal at 1720 cm^{-1}.
4. Product A was a methyl ketone because it gave a positive iodoform test.
5. When Product A was treated with Br_2 in CCl_4, the red bromine color persisted, because no carbon-carbon double bonds were present to react with the bromine.

The structure of Product A was further confirmed when treatment with hot sulfuric acid resulted in the corresponding dehydration product, Product B.

136. What is the molecular weight of a compound that undergoes an aldol self-condensation reaction to result in a β-hydroxy ketone with a molecular weight of 144?

A) 70 g/mole

B) 72 g/mole

C) 74 g/mole

D) 76 g/mole

137. The aldol self-condensation of acetone is an equilibrium that favors acetone over its condensation product. Which of the following experimental modifications is most likely to shift the position of equilibrium toward Product A?

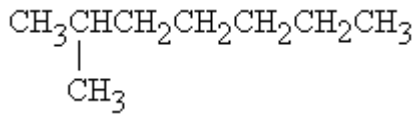
A) Using only a catalytic amount of NaOH

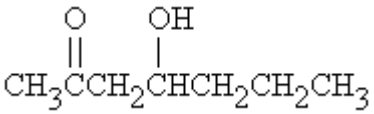
B) Using only a catalytic amount of acetone

C) Removing Product A as it is formed

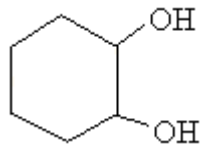
D) Increasing the reaction temperature to the boiling point of acetone

138. Based *only* on Observations 1 and 2, which of the following compounds could have been Product A?

A) 

B) 

C) $CH_2{=}CHCH_2{-}O{-}CH_2CH_2CH_3$

D) 

139. When a drop of Br_2 in CCl_4 is added to Product B, the resulting solution will be:

A) colorless, because Product B does not contain a carbon-carbon double bond.

B) colorless, because Product B contains a carbon-carbon double bond.

C) red, because Product B does not contain a carbon-carbon double bond.

D) red, because Product B contains a carbon-carbon double bond.

140. The chemist obtained a proton NMR spectrum of a sample of the isolated Product A. If the sample were contaminated with acetone, how many extra signals corresponding to the acetone would be present in the spectrum?

A) 1

B) 2

C) 3

D) 6

141. Which of the following compounds from the passage will give a positive iodoform test?

A) Product A only

B) Product A and Product B only

C) Product A and acetone only

D) Product A, Product B, and acetone

These questions are not based on a descriptive passage and are independent of each other.

142. In eukaryotes, oxidative phosphorylation occurs in the mitochondrion. The analogous structure used by bacteria to carry out oxidative phosphorylation is the:

A) cell wall.

B) ribosome.

C) nuclear membrane.

D) plasma membrane.

143. In which organelle of a eukaryotic cell is the pyrimidine uracil, as part of uridine triphosphate (UTP), incorporated into nucleic acid?

A) The nucleus

B) The Golgi bodies

C) The ribosomes

D) The endoplasmic reticulum

144. The enzyme pepsin, which catalyzes the hydrolysis of proteins in the stomach, has a pH optimum of 1.5. Under conditions of excess stomach acidity (pH of 1.0 or less), pepsin catalysis occurs very slowly. The most likely reason for this is that below a pH of 1.0:

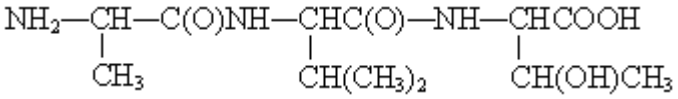
A) pepsin is feedback-inhibited.

B) pepsin synthesis is reduced.

C) the peptide bonds in pepsin are more stable.

D) the three-dimensional structure of pepsin is changed.

145. Ignoring stereochemistry, how many different tripeptides may exist that contain the same three amino acids as the molecule shown below?



A) 1

B) 3

C) 6

D) 9

146. A drug that binds to tubulin molecules of plant cells and prevents the cells from assembling spindle microtubules would most likely cause the resulting plants or plant cells to have:

A) greater genetic variability than the parent plants.

B) more than two sets of chromosomes.

C) a stronger cell wall because of excess tubulin.

D) independent movement because of excess tubulin.

Physical Sciences

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Verbal Reasoning

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Biological Sciences

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