1989 Advanced Placement Exam Part I Multiple Choice

Note: For all questions referring to solutions, assume that the solvent is water unless otherwise stated.

Directions: Each set of lettered choices below refers to the numbered statements immediately following it. Select the one lettered choice that best fits each statement and then blacken the corresponding space on the answer sheet. A choice may be used once, more than once, or not at all in each set.

Questions 1–3

a. O
b. La
c. Rb
d. Mg
e. N

1. What is the most electronegative element?
2. Which element exhibits the greatest number of different oxidation states?
3. Which of the elements above has the smallest ionic radius for its most commonly found ion?

Questions 4–7

a. $1s^2\ 2s^2 2p^5\ 3s^2 3p^5$
b. $1s^2\ 2s^2 2p^6\ 3s^2 3p^6$
c. $1s^2\ 2s^2 2p^6 2d^{10}\ 3s^2 3p^6$
d. $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^5$
e. $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^3\ 4s^2$

4. An impossible electronic configuration
5. The ground–state configuration for the atoms of a transition element
6. The ground–state configuration of a negative ion of a halogen
7. The ground–state configuration of a common ion of an alkaline earth element

Questions 8–10

a. a solution with a pH less than 7 that is not a buffer solution
b. a buffer solution with a pH between 4 and 7
c. a buffer solution with a pH between 7 and 10
d. a solution with a pH greater than 7 that is not a buffer solution
e. a solution with a pH of 7

(Ionization constants:

$CH_3COOH = 1.8\times10^{-5}$;
$NH_3 = 1.8\times10^{-5}$;
H_2CO_3: $K_1 = 4\times10^{-7}$;
$K_2 = 4\times10^{-11}$;)

8. A solution prepared to be initially 1 M in NaCl and 1 M in HCl.
9. A solution prepared to be initially 1 M in Na_2CO_3 and 1 M in CH_3COONa
10. A solution prepared to be initially 0.5 M in CH_3COOH and 1 M in CH_3COONa

Questions 11–14

a. hydrogen bonding
b. hybridization
c. ionic bonding
d. resonance
e. van der Waals forces (London dispersion forces)

11. Is used to explain why iodine molecules are held together in the solid state
12. Is used to explain why the boiling point of HF is greater than the boiling point of HBr
13. Is used to explain the fact that the four bonds in methane are equivalent
14. Is used to explain the fact that the carbon-to-carbon bonds in benzene, C_6H_6, are identical

Directions: Each of the questions or incomplete statements below is followed by five suggested answers or compilations. Select the one that is best in each case and then blacken the corresponding space on the answer sheet.

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15. The weight of H_2SO_4 (molecular weight 98.1) in 50.0 milliliters of a 6.00-molar solution is
a. 3.10 grams
b. 12.0 grams
c. 29.4 grams
d. 294 grams
e. 300. grams

16. A gaseous mixture containing 7.0 moles of nitrogen, 2.5 moles of oxygen, and 0.50 mole of helium exerts a total pressure of 0.90 atmosphere. What is the partial pressure of the nitrogen?
a. 0.13 atm
b. 0.27 atm
c. 0.63 atm
d. 0.90 atm
e. 6.3 atm

17. The Lewis dot structure of which of the following molecules shows only one unshared pair of valence electrons?
a. Cl_2
b. N_2
c. NH_3
d. CCl_4
e. H_2O_2

18. For the types of radiation given, which of the following is the correct order of <u>increasing</u> ability to penetrate a piece of lead?
a. Alpha particles < gamma rays < beta particles
b. Alpha particles < beta particles < gamma rays
c. Beta particles < alpha particles < gamma rays
d. Beta particles < gamma rays < alpha particles
e. Gamma rays < alpha particles < beta particles

19. In the titration of a weak acid of unknown concentration with a standard solution of a strong base, a pH meter was used to follow the progress of the titration. Which of the following is true for this experiment?
a. The pH is 7 at the equivalence point.
b. The pH at the equivalence point depends on the indicator used.
c. The graph of pH *versus* volume of base added rises gradually at first and then much more rapidly.
d. The graph of pH *versus* volume of base added shows no sharp rise.
e. The $[H^+]$ at the equivalence point equals the ionization constant of the acid.

20. $6I^- + 2MnO_4^- + 4H_2O_{(l)} \rightarrow 3I_{2(s)} + 2MnO_{2(s)} + OH^-$
Which of the following statements regarding the reaction represented by the equation above is correct?
a. Iodide ion is oxidized by hydroxide ion.
b. MnO_4^- is oxidized by iodide ion.

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c. The oxidation number of manganese changes from +7 to +2.
d. The oxidation number of manganese remains the same.
e. The oxidation number of iodine changes from –1 to 0.

21. Which of the following is true at the triple point of a pure substance?
a. The vapor pressure of the solid phase always equal the vapor pressure of the liquid phase.
b. The temperature is always 0.01 K lower that the normal melting point.
c. The liquid and gas phases of the substance always have the same density and are therefore indistinguishable.
d. The solid phase always melts if the pressure increases at constant temperature.
e. The liquid phase always vaporizes if the pressure increases at constant temperature.

22. $__Cr_2O_7^{2-} + __e^- + __H^+ \rightarrow __Cr^{3+} + __H_2O_{(l)}$
When the equation for the half reaction above is balanced with the lowest whole–number coefficients, the coefficient for H_2O is
a. 2 c. 6 e. 14
b. 4 d. 7

23. How many grams of calcium nitrate, $Ca(NO_3)_2$, contains 24 grams of oxygen atoms?
a. 164 grams c. 62 grams e. 41 grams
b. 96 grams d. 50. grams

24. The mass of element Q found in 1.00 mole of each of four different compounds is 38.0 grams, 57.0 grams, 76.0 grams, and 114 grams, respectively. A possible atomic weight of Q is
a. 12.7 c. 27.5 e. 57.0
b. 19.0 d. 38.0

25. The simplest formula for an oxide of nitrogen that is 36.8 percent nitrogen by weight is
a. N_2O c. NO_2 e. N_2O_5
b. NO d. N_2O_3

26. How many milliliters of 11.6-molar HCl must be diluted to obtain 1.0 liter of 3.0-molar HCl?
a. 3.9 mL c. 260 mL e. 3,900 mL
b. 35 mL d. 1,000 mL

27. I. Difference in temperature between freezing point of solvent and freezing point of solvent and freezing point of solution
II. Molal freezing point depression constant, K_f, for solvent

In addition to the information above, which of the following gives the minimum data required to determine the molecular mass of a nonionic substance by the freezing point depression technique?
a. No further information is necessary.
b. Mass of solute
c. Mass of solute and mass of solvent
d. Mass of solute and volume of solvent
e. Mass of solute, mass of solvent, and vapor pressure of solvent

28. Which of the following is probably true for a solid solute with a highly endothermic heat of solution when dissolved in water?
a. The solid has a low lattice energy.
b. As the solute dissolves, the temperature of the solution increases.
c. The resulting solution is ideal.
d. The solid is more soluble at higher temperatures.
e. The solid has a high energy of hydration.

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29. In which of the following systems would the number of moles of the substances present at equilibrium NOT be shifted by a change in the volume of the system at constant temperature?
a. $CO_{(g)} + NO_{(g)} / CO_{2(g)} + {}^{1}/_{2}\, N_{2(g)}$
b. $N_{2(g)} + 3\, H_{2(g)} / 2\, NH_{3(g)}$
c. $N_{2(g)} + 2\, O_{2(g)} / 2\, NO_{2(g)}$
d. $N_2O_{4(g)} / 2\, NO_{2(g)}$
e. $NO_{(g)} + O_{3(g)} / NO_{2(g)} + O_{2(g)}$

30. Hydrogen gas is collected over water at 24°C. The total pressure of the sample is 755 millimeters of mercury. At 24°C, the vapor pressure of water is 22 millimeters of mercury. What is the partial pressure of the hydrogen gas?
a. 22 mm Hg
b. 733 mm Hg
c. 755 mm Hg
d. 760 mm Hg
e. 777 mm Hg

31. The structural isomers C_2H_5OH and CH_3OCH_3 would be expected to have the same values for which of the following? (Assume ideal behavior.)
a. Gaseous densities at the same temperature and pressure
b. Vapor pressures at the same temperature
c. Boiling points
d. Melting points
e. Heats of vaporization

32. A 2.00–liter sample of nitrogen gas at 27°C and 600. millimeters of mercury is heated until it occupies a volume of 5.00 liters. If the pressure remains unchanged, the final temperature of the gas is
a. 68°C
b. 120°C
c. 477°C
d. 677°C
e. 950°C

33. Which of the following conclusions can be drawn from J. J. Thomson's cathode ray experiments?
a. Atoms contain electrons.
b. Practically all the mass of an atom is contained in its nucleus.
c. Atoms contain protons, neutrons, and electrons.
d. Atoms have a positively charged nucleus surrounded by an electron cloud.
e. No two electrons in one atom can have the same four quantum numbers.

34. All of the following species can function as Brönsted–Lowry bases in solution EXCEPT
a. H_2O
b. NH_3
c. S^{2-}
d. NH_4^+
e. HCO_3^-

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35. When phenolphthalein is used as the indicator in a titration of an HCl solution with a solution of NaOH, the indicator undergoes a color change from clear to red at the end point of the titration. This color change occurs abruptly because
   a. phenolphthalein is a very strong acid that is capable of rapid dissociation
   b. the solution being titrated undergoes a large pH change near the end point of the titration
   c. phenolphthalein undergoes an irreversible reaction in basic solution
   d. OH^- acts as a catalyst for the decomposition of phenolphthalein
   e. phenolphthalein is involved in the rate–determining step of the reaction between H_3O^+ and OH^-

36. Appropriate laboratory procedures include which of the following?
   I. Rinsing a buret with distilled water just before filling it with the titrant for the first titration
   II. Lubricating glass tubing before inserting it into a stopper
   III. For accurate results, waiting until warm or hot objects have reached room temperature before weighing them
   a. II only
   b. I and II only
   c. I and III only
   d. II and III only
   e. I, II, and III

37. $__\ CH_3CH_2COOH_{(l)} + __\ O_{2(g)} \rightarrow __\ CO_{2(g)} + __\ H_2O_{(l)}$
   How many moles of O_2 are required to oxidize 1 mole of CH_3CH_2COOH according to the reaction represented above?
   a. 2 moles
   b. $^5/_2$ moles
   c. 3 moles
   d. $^7/_2$ moles
   e. $^9/_2$ moles

38. $^{251}_{98}Cf \rightarrow 2\ n + ^{131}_{54}Xe + \underline{?}$
   What is the missing product in the nuclear reaction represented above?
   a. $^{114}_{42}Mo$
   b. $^{118}_{44}Ru$
   c. $^{120}_{42}Mo$
   d. $^{120}_{44}Ru$
   e. $^{122}_{46}Pd$

39. When a hydrate of Na_2CO_3 is heated until all the water is removed, it loses 54.3 percent of its mass. The formula of the hydrate is
   a. $Na_2CO_3 \cdot 10\ H_2O$
   b. $Na_2CO_3 \cdot 7\ H_2O$
   c. $Na_2CO_3 \cdot 5\ H_2O$
   d. $Na_2CO_3 \cdot 3\ H_2O$
   e. $Na_2CO_3 \cdot H_2O$

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40. $2\ K + 2\ H_2O \rightarrow 2K^+ + 2\ OH^- + H_2$
When 0.400 mole of potassium reacts with excess water at standard temperature and pressure as shown in the equation above, the volume of hydrogen gas produced is
a. 1.12 liters
b. 2.24 liters
c. 3.36 liters
d. 4.48 liters
e. 6.72 liters

41. Which of the following reactions has the largest positive value of ΔS per mole of Cl_2
a. $H_{2(g)} + Cl_{2(g)} \rightarrow 2\ HCl_{(g)}$
b. $C1_{2(g)} + ¤\ O_{2(g)} \rightarrow Cl_2O_{(g)}$
c. $Mg_{(s)} + Cl_{2(g)} \rightarrow MgCl_{2(s)}$
d. $2\ NH_4Cl_{(s)} \rightarrow 4\ H_{2(g)} + Cl_{2(g)}$
e. $Cl_{2(g)} \rightarrow 2\ Cl_{(g)}$

42. The $SbCl_5$ molecule has trigonal bipyramid structure. Therefore, the hybridization of Sb orbitals should be
a. sp^2
b. sp^3
c. dsp^2
d. dsp^3
e. d^2sp^3

43. Which of the following does NOT behave as an electrolyte when it is dissolved in water?
a. CH_3OH
b. K_2CO_3
c. NH_4Br
d. HI
e. Sodium acetate, CH_3COONa

44. The metal calcium reacts with molecular hydrogen to form a compound. All of the following statements concerning this compound are true EXCEPT:
a. Its formula is CaH_2.
b. It is ionic.
c. It is solid at room temperature.
d. When added to water, it reacts to produce H_2 gas.
e. When added to water, it forms an acidic solution.

45. A measured mass of an unreactive metal was dropped into a small graduated cylinder half filled with water. The following measurements were made.
Mass of metal =..... 19.611 grams
Volume of water before addition of metal =..... 12.4 milliliters
Volume of water after addition of metal =..... 14.9 milliliters
The density of the metal should be reported as
a. 7.8444 grams per mL
b. 7.844 grams per mL
c. 7.84 grams per mL
d. 7.8 grams per mL
e. 8 grams per mL

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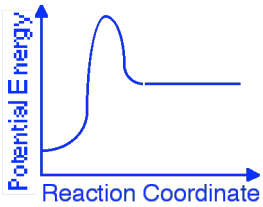
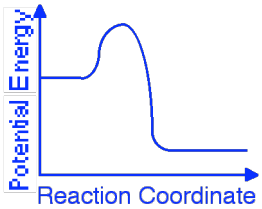
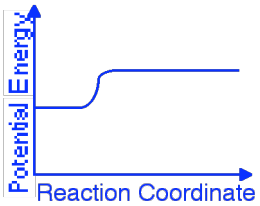
46. As the number of oxygen atoms increases in any series of oxygen acids, such as HXO, HXO_2, HXO_3, … which of the following is generally true?
   a. The acid strength varies unpredictably.
   b. The acid strength decreases only if X is a nonmetal.
   c. The acid strength decreases only if X is a metal.
   d. The acid strength decreases whether X is a nonmetal or a metal.
   e. The acid strength increases.

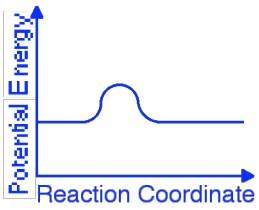
47. CCl_4, CO_2, PCl_3, PCl_5, SF_6
   Which of the following does not describe any of the molecules above?
   a. Linear
   b. Octahedral
   c. Square planar
   d. Tetrahedral
   e. Trigonal pyramidal

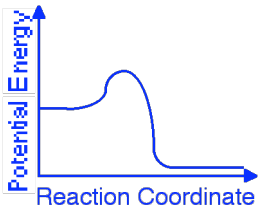
48. Which of the following is a graph that describes the pathway of reaction that is endothermic and has high activation energy?

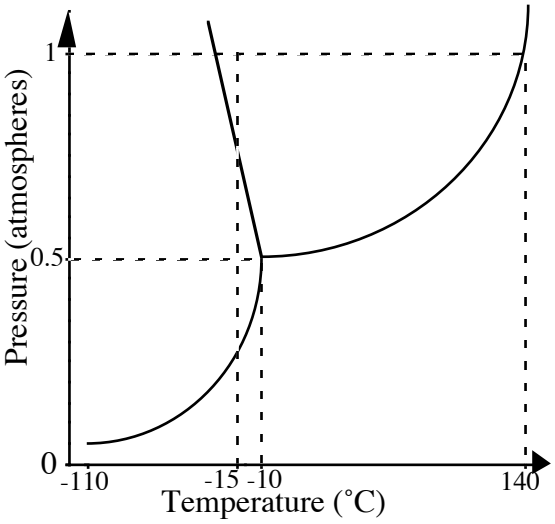
a.


b.


c.


d.


e.




49. The normal boiling point of the substance represented by the phase diagram above is
   a. –15˚C
   b. –10˚C
   c. 140˚C
   d. greater than 140˚C
   e. not determinable from the diagram

50. The phase diagram above provides sufficient information for determining the
   a. entropy change on vaporization
   b. conditions necessary for sublimation
   c. deviations from ideal gas behavior of the gas phase
   d. latent heat of vaporization
   e. latent heat of fusion

51. For the substance represented in the diagram, which of the phases is most dense and which is least dense at –15 degrees C.

Most Dense	Least Dense
a. Solid	Gas
b. Solid	Liquid
c. Liquid	Solid
d. Liquid	Gas

   e. The diagram gives no information about densities.

52. The test for the presence of Ag+ in an unknown solution involves the treatment of the silver–ammonia complex with dilute hydrochloric acid. The appearance of a white precipitate at this point indicates the presence of silver ion in the original sample. The net ionic equation that represents this test is
   a. $Ag(NH_4)_4^+ + 4\ H^+ / Ag_{(s)} + 4\ NH_4^+$

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b. $Ag(NH_4)_4^+ + Cl^- / AgCl_{(s)} + 4\ NH_4^+$
c. $Ag(NH_3)_4^+ + 4HCl / AgCl_{(s)} + 4NH_4^+ + 3Cl^-$
d. $Ag(NH_3)_2^+ + Cl^- / Ag(NH_3)_2Cl_{(s)}$
e. $Ag(NH_3)_2^+ + 2\,H^+ + Cl^- / AgCl_{(s)} + 2\,NH_4^+$

53. Which of the following must be true for a reaction that proceeds spontaneously from initial standard state conditions?
a. $\Delta G^\circ > 0$ and $K_{eq} > 1$
b. $\Delta G^\circ > 0$ and $K_{eq} < 1$
c. $\Delta G^\circ < 0$ and $K_{eq} > 1$
d. $\Delta G^\circ < 0$ and $K_{eq} < 1$
e. $\Delta G^\circ = 0$ and $K_{eq} = 1$

54. Which of the following is the correct equilibrium expression for the hydrolysis of CO_3^{2-} ?

a. $K = \dfrac{[HCO_3^-]}{[CO_3^{2-}][H_3O^+]}$

b. $K = \dfrac{[HCO_3^-][OH^-]}{[CO_3^{2-}]}$

c. $K = \dfrac{[CO_3^{2-}][OH^-]}{[HCO_3^-]}$

d. $K = \dfrac{[CO_3^{2-}]}{[CO_2][OH^-]^2}$

e. $K = \dfrac{[CO_3^{2-}][H_3O^+]}{[HCO_3^-]}$

55. $H_2PO_4^- + HBO_3^{2-} / HPO_4^{2-} + H_2BO_3^-$
The equilibrium constant for the reaction represented by the equation above is greater than 1.0. Which of the following gives the correct relative strengths of the acids and bases in the reaction?

	Acids	Bases
a.	$H_2PO_4^- > H_2BO_3^-$	$HBO_3^{2-} > HPO_4^{2-}$
b.	$H_2BO_3^- > H_2PO_4^-$	$HBO_3^{2-} > HPO_4^{2-}$
c.	$H_2PO_4^- > H_2BO_3^-$	$HPO_4^{2-} > HBO_3^{2-}$
d.	$H_2BO_3^- > H_2PO_4^-$	$HPO_4^{2-} > HBO_3^{2-}$
e.	$H_2PO_4^- = H_2BO_3^-$	$HPO_4^{2-} = HBO_3^{2-}$

56. A 0.20–molar solution of a weak monoprotic acid, HA, has a pH of 3.00. The ionization constant of this acid is
a. 5.0×10^{-7}
b. 2.0×10^{-7}
c. 5.0×10^{-6}
d. 5.0×10^{-3}
e. 2.0×10^{-3}

57. rate = k[X]
For the reaction whose rate law is given above, a plot of which of the following is a straight line?
a. [X] *versus* time
b. log [X] *versus* time
c. $^1/_{[X]}$ *versus* time
d. [X] *versus* $^1/_{time}$
e. log [X] *versus* $^1/_{time}$

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58. $(CH_3)_3CCl_{(aq)} + OH^- \rightarrow (CH_3)_3COH_{(aq)} + Cl^-$

For the reaction represented above, the experimental rate law is given as follows.

$$\text{Rate} = k[(CH_3)_3CCl]$$

If some solid sodium solid hydroxide is added to a solution that is 0.010–molar in $(CH_3)_3CCl$ and 0.10–molar in NaOH, which of the following is true? (Assume the temperature and volume remain constant.)

a. Both the reaction rate and *k* increase.
b. Both the reaction rate and *k* decrease.
c. Both the reaction rate and *k* remain the same.
d. The reaction rate increases but *k* remains the same.
e. The reaction rate decreases but *k* remains the same.

59. Which of the following compounds is ionic and contains both sigma and pi covalent bonds?

a. $Fe(OH)_3$ c. H_2S e. NaCN
b. HClO d. NO_2

60. $Fe^{2+} + 2e- \rightarrow Fe_{(s)}$ $E^\circ = -0.44$ volt
$Ni^{2+} + 2e- \rightarrow Ni_{(s)}$ $E^\circ = -0.23$ volt

The standard reduction potentials for two half reactions are given above. The Nernst equation for a galvanic cell at 25°C in which $Fe_{(s)}$ reduces Ni^{2+} is the following.

$$E = E^\circ - \frac{0.059}{2}\log\frac{[Fe^{2+}]}{[Ni^{2+}]}$$

What is the equilibrium constant for the reaction below?

$$Fe_{(s)} + Ni^{2+} \rightarrow Fe^{2+} + Ni_{(s)}$$

a. 1.9×10^{-23} c. $3.6\times10^{+3}$ e. $5.2\times10^{+22}$
b. 7.6×10^{-8} d. $1.3\times10^{+7}$

61. When acidified $K_2Cr_2O_7$ solution is added to Na_2S solution, green Cr^{3+} ions and free S are formed. When acidified $K_2Cr_2O_7$ solution is added to NaCl, No change occurs. Of the substances involved in these reactions, which is the best reducing agent?

a. $K_2Cr_2O_7$ c. Cr^{3+} e. NaCl
b. Na_2S d. S

62. As the temperature is raised from 20°C to 40°C, the average kinetic energy of neon atoms changes by a factor of

a. $\frac{1}{2}$ c. $\frac{313}{293}$ e. 4
b. $\sqrt{\frac{313}{293}}$ d. 2

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63. Which of the following characteristics is common to elemental sulfur, chlorine, nitrogen, and carbon?
   a. They are gaseous elements at room temperature.
   b. They have oxides that are acid anhydrides.
   c. They have perceptible color at room temperature.
   d. They form ionic oxides.
   e. They react readily with hydrogen at room temperature.

64. A solution is known to contain an inorganic salt of one of the following elements. The solution is colorless. The solution contains a salt of
   a. Cu c. Fe e. Zn
   b. Mn d. Ni

65. The solubility of CuI is 2×10^{-6} molar. What is the solubility product constant, K_{sp}, for CuI?
   a. 1.4×10^{-3} c. 4×10^{-12} e. 8×10^{-18}
   b. 2×10^{-6} d. 2×10^{-12}

66. $MnS_{(s)} + 2\ H^+ / Mn^{2+} + H_2S_{(g)}$
   At 25°C the solubility product constant, K_{sp}, for MnS in 5×10^{-15} and the acid dissociation constants K_1 and K_2 for H_2S are 1×10^{-7} and 1×10^{-13}, respectively. What is the equilibrium constant for the reaction represented by the equation above at 25°C?
   a. $\frac{1\times10^{-13}}{5\times10^{-15}}$ d. $\frac{5\times10^{-15}}{1\times10^{-20}}$
   b. $\frac{5\times10^{-15}}{1\times10^{-7}}$ e. $\frac{1\times10^{-20}}{5\times10^{-15}}$
   c. $\frac{1\times10^{-7}}{5\times10^{-20}}$

67. $BrO_3^- + 5\ Br^- + 6\ H^+ / 3\ Br_2 + 3\ H_2O$
   If 25.0 milliliters of 0.200 molar BrO_3^- is mixed with 30.0 milliliters of 0.450 molar Br^- solution that contains a large excess of H^+, the amount of Br_2 formed, according to the equation above, is
   a. 5.00×10^{-3} mole d. 1.50×10^{-2} mole
   b. 8.10×10^{-3} mole e. 1.62×10^{-2} mole
   c. 1.35×10^{-2} mole

68. The specific rate constant k for radioactive element X is 0.023 min^{-1}. What weight of X was originally present in a sample if 40. grams is left after 60. minutes?
   a. 10. grams c. 80. grams e. 160 grams
   b. 20. grams d. 120 grams

69. A white solid is observed to be insoluble in water, insoluble in excess ammonia solution, and soluble in dilute HCl. Which of the following compounds could the solid be?
   a. $CaCO_3$ c. $Pb(NO_3)_2$ e. $Zn(OH)_2$
   b. $BaSO_4$ d. AgCl

70. $H_2O_{(s)} \rightarrow H_2O_{(l)}$
   When ice melts at its normal melting point, 273.16 K and 1 atmosphere, which of the following is true for the process shown above?
   a. $\Delta H < 0, \Delta S > 0, \Delta V > 0$
   b. $\Delta H < 0, \Delta S < 0, \Delta V > 0$
   c. $\Delta H > 0, \Delta S < 0, \Delta V < 0$
   d. $\Delta H > 0, \Delta S > 0, \Delta V > 0$
   e. $\Delta H > 0, \Delta S > 0, \Delta V < 0$

71. A solution of toluene (molecular weight 92.1) in benzene (molecular weight 78.1) is prepared. The mole fraction of toluene in the solution is 0.100. What is the molality of the solution?
   a. 0.100 *m* c. 0.921 *m* e. 1.42 *m*
   b. 0.703 *m* d. 1.28 *m*

72. How many moles of solid $Ba(NO_3)_2$ should be added to 300. milliliters of 0.20–molar $Fe(NO_3)_3$ to increase the concentration of the NO_3^- ion to 1.0–molar? (Assume that the volume of the solution remains constant.)
   a. 0.060 mole c. 0.24 mole e. 0.40 mole
   b. 0.12 mole d. 0.30 mole

73. Adding water to some chemicals can be dangerous because large amounts of heat are liberated. Which of the following does NOT liberate heat when water is added to it?
   a. KNO_3 c. CaO e. Na
   b. NaOH d. H_2SO_4

74. Equal volumes of 0.10–molar H_3PO_4 and 0.20–molar KOH are mixed. After equilibrium is established, the type of ion an solution in largest concentration, other than the K^+ ion, is
   a. $H_2PO_4^-$ c. PO_4^{3-} e. H_3O^+
   b. HPO_4^{2-} d. OH^-

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75. If a copper sample containing some zinc impurity is to be purified by electrolysis, the anode and the cathode must be which of the following?

Anode	Cathode
a. Pure copper	Pure zinc
b. Pure zinc	Pure copper
c. Pure copper	Impure copper sample
d. Impure copper sample	Pure copper
e. Impure copper sample	Pure zinc

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1989 AP Chemistry Exam – Multiple Choice Answers								
Question #	Answer	% Correct	Question #	Answer	% Correct	Question #	Answer	% Correct
1	A	81	26	C	65	51	D	29
2	E	41	27	C	38	52	E	47
3	D	33	28	D	58	53	C	54
4	C	79	29	E	69	54	B	49
5	E	42	30	B	82	55	A	34
6	B	62	31	A	62	56	C	42
7	B	40	32	C	55	57	B	32
8	A	40	33	A	34	58	C	31
9	D	26	34	D	58	59	E	38
10	B	36	35	B	66	60	D	24
11	E	57	36	D	32	61	B	41
12	A	72	37	D	57	62	C	18
13	B	44	38	B	45	63	B	41
14	D	55	39	B	51	64	E	37
15	C	88	40	D	71	65	C	41
16	C	81	41	D	49	66	D	23
17	C	76	42	D	54	67	B	39
18	B	57	43	A	46	68	E	20
19	C	50	44	E	40	69	A	19
20	E	82	45	D	30	70	E	26
21	A	49	46	E	40	71	E	16
22	D	82	47	C	50	72	A	20
23	E	75	48	A	65	73	A	18
24	B	64	49	C	50	74	B	15
25	D	74	50	B	65	75	D	22

Average % correct = 47.92 ± 19.03

VERY EASY (80–100% correct), 8.0%
1 15 16 20 22 30
EASY (60–79% correct), 18.7%
4 6 12 17 23 24 25 26 29 31 35 40 48 50
MEDIUM DIFFICULTY (40–59% correct), 40.0%
2 5 7 8 11 13 14 18 19 21 28 32 34 37 38
39 41 42 43 44 46 47 49 52 53 54 56 61 63 65
HARD (20–39% correct), 26.7%
3 9 10 27 33 36 45 51 55 57 58 59 60 64 66
67 68 70 72 75
VERY HARD (0–19% correct), 6.7%
62 69 71 73 74

[$^1/_4$ of wrong answers subtracted from # correct]

Multiple–Choice Score	AP Grade (%)					Total (%)
	1	**2**	**3**	**4**	**5**	
47–75	0.0	0.0	0.8	20.8	78.4	13.1

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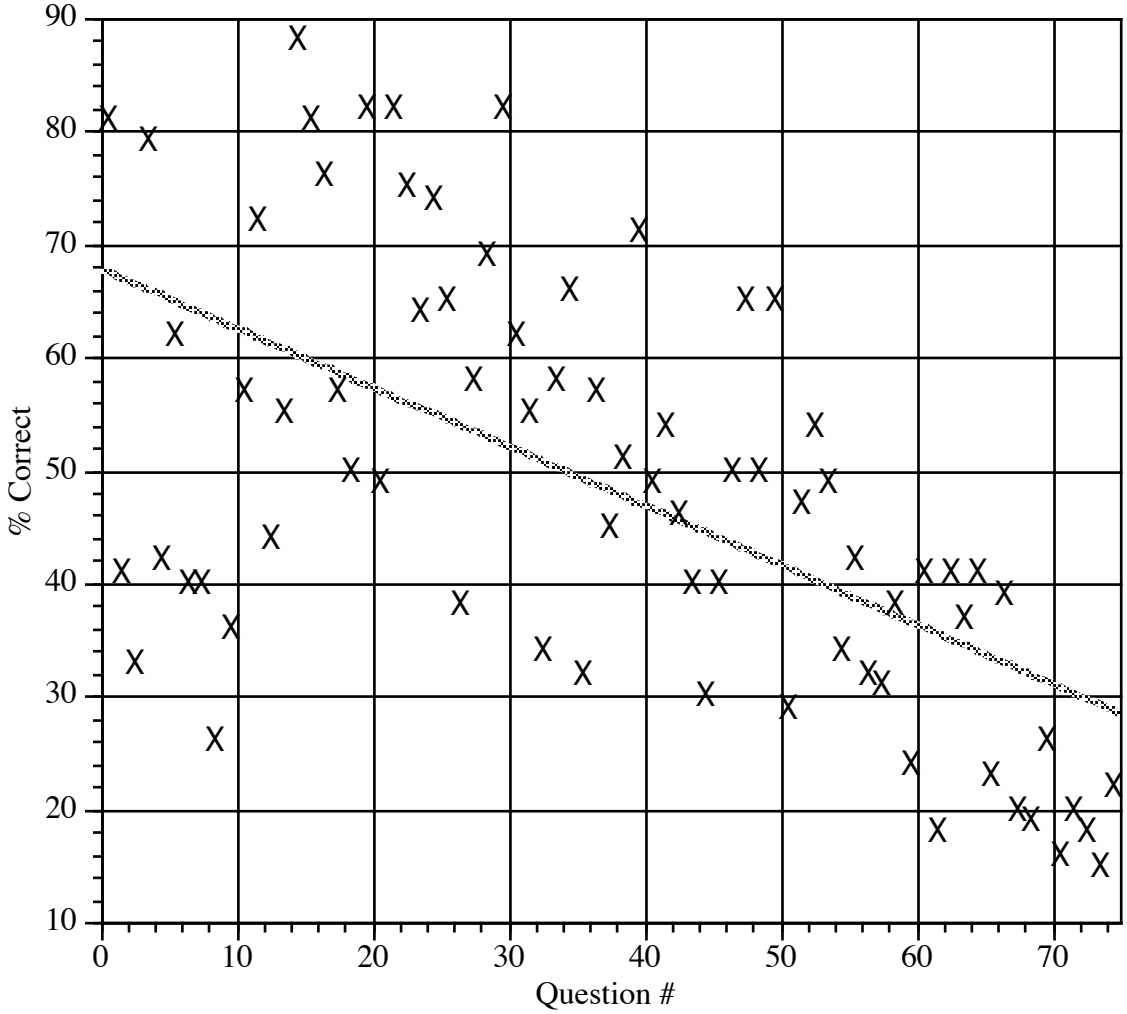
37–46	0.0	0.1	25.0	62.8	12.0	16.8
24–36	0.1	18.7	69.4	11.7	0.1	30.9
13–23	15.0	69.7	15.2	0.0	0.0	25.6
0–12	85.5	14.4	0.1	0.0	0.0	13.7
Total	15.6	25.6	29.6	16.9	12.3	100

1989 Multiple Choice Questions of the Advanced Placement Chemistry Exam



Notes:

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