PRACTICE!

KEY

AP CHEMISTRY – SEMESTER 2 FINAL EXAM

Multiple Choice

1. A flask contains 0.25 mol of $SO_{2\,(g)}$, 0.50 mole of $CH_{4\,(g)}$, and 0.50 mole of $O_{2\,(g)}$. The total pressure of the gases in the flask is 800 mm Hg. What is the partial pressure of the $SO_{2\,(g)}$ in the flask?

   A. 800 mm Hg
   B. 600 mm Hg
   C. 250 mm Hg
   D. 200 mm Hg
   E. 160 mm Hg

2. Under the same conditions of pressure, sulfur dioxide liquefies at a much higher temperature than carbon dioxide. Which best accounts for this difference?

   A. Each sulfur dioxide molecule has a greater absolute volume than a carbon dioxide molecule.
   B. Stronger forces of attraction exist between sulfur dioxide molecules than between carbon dioxide molecules.
   C. S-O bonds illustrate resonance; C-O bonds do not.
   D. Each carbon dioxide molecule has a greater molecular mass than a sulfur dioxide molecule.
   E. At the same conditions of temperature and pressure, a sulfur dioxide molecule has greater density than a carbon dioxide molecule.

3. The synthesis of nitrogen dioxide is represented by: $\mathbf{2\ NO_{(g)} + O_{2\,(g)} \rightarrow 2\ NO_{2\,(g)}}$

   A possible mechanism for the overall reaction represented above is the following:

   (1) $NO(g) + NO(g) \rightarrow N_2O_2(g)$ slow
   (2) $N_2O_2(g) + O_2(g) \rightarrow 2\ NO_2(g)$ fast

   Which of the following rate expressions agrees best with this possible mechanism?

   A. Rate = $k[NO]^2$
   B. Rate = $k[NO]^2[O_2]$
   C. Rate = $\dfrac{k[NO]}{[O_2]}$
   D. Rate = $k[N_2O_2][O_2]$
   E. Rate = $\dfrac{k[NO]^2}{[O_2]}$

4. For which of the following processes would ΔS have a negative value?

   I. $\mathbf{2\ Fe_2O_{3\,(s)} \rightarrow 4\ Fe_{(s)} + 3\ O_{2\,(g)}}$
   II. $\mathbf{Mg^{2+}_{(aq)} + 2\ OH^-_{(aq)} \rightarrow Mg(OH)_{2\,(s)}}$
   III. $\mathbf{H_{2\,(g)} + C_2H_{4\,(g)} \rightarrow 3\ C_2H_{6\,(g)}}$

   A. I only
   B. I and II only
   C. I and III only
   D. II only
   E. I, II, and III

5. The ground-state configuration of a negative ion of a halogen is represented by:

   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. $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^8$
   E. $1s^2\ 2s^2 2p^6\ 3s^2 3p^6 3d^3\ 4s^2$

$$\left(P + \frac{n^2 a}{V^2}\right)(V - nb) = nRT$$

6. At certain conditions, the molar volume of a real gas may be less than the value predicted by the ideal gas law. Which property accounts for this deviation?
   A. Each gas molecule occupies an absolute volume.
   B. Forces of attraction exist between the gas molecules.
   C. Resonance bonds exist between the atoms in the molecules of the gas.
   D. The average velocity of the gas molecules is less than the value predicted by Graham's Law.
   E. The kinetic energy of the gas molecules is less than the value predicted by the $KE = 1/2mv^2$.

7. Appropriate uses of a visible-light spectrophotometer include which of the following?
   I. Determining the concentration of a solution of $Cu(NO_3)_2$
   II. Measuring the electrical conductivity of a solution of $KMnO_4$
   III. Determining which ions are present in a solution that may contain Na^+, Mg^{2+}, Al^{3+}
   A. I only
   B. II only
   C. III only
   D. I and II only
   E. I and III only

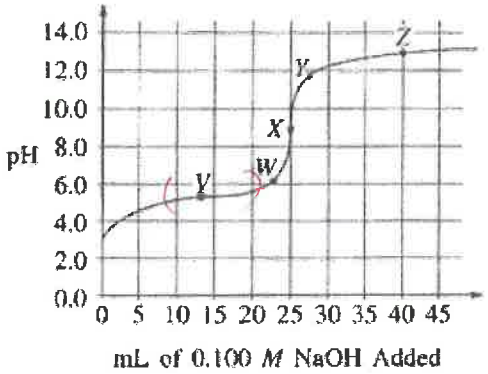
8. When a 1.25-gram sample of limestone was dissolved in acid, 0.44 gram of CO_2 was generated. If the limestone contained no carbonate other than $CaCO_3$, what was the percent of $CaCO_3$ by mass in the limestone?
   A. 35%
   B. 44%
   C. 67%
   D. 80%
   E. 100%

9. Refer to the reaction equation: $\mathbf{HgO_{(s)} + 4\ I^-_{(aq)} + H_2O_{(l)} \rightleftarrows HgI_4^{2-}{}_{(aq)} + 2\ OH^-_{(aq)} \quad \Delta H < 0}$

   Consider the equilibrium above. Which of the following will increase the concentration of $HgI_4^{2-}{}_{(aq)}$?
   A. Increasing the concentration of $OH^-_{(aq)}$
   B. Adding 6 M HNO_3
   C. Increasing the mass of $HgO_{(s)}$ present
   D. Increasing the temperature
   E. Adding a catalyst

10. For the underlined species in the reaction:
    $\mathbf{2\ KMnO_{4\,(aq)} + 3\ H_2SO_{4\,(aq)} + \underline{5\ H_2S}_{(aq)} \rightarrow \underline{5\ S}_{(s)} + 2\ MnSO_{4\,(aq)} + K_2SO_{4\,(aq)} + 8\ H_2O_{(l)}}$
    the oxidation number of sulfur changes from...
    A. 0 to -2
    B. +5 to -5
    C. -2 to 0
    D. -5 to 5
    E. +6 to +4

11. The graph below shows the titration curve that results when 100. mL of 0.0250 M acetic acid is titrated with 0.100 M NaOH.



What part of the curve corresponds to the optimum buffer action for the acetic acid/acetate pair?

A. Point V
B. Point X
C. Point Z
D. Along all of section WY
E. Along all of section YZ

12. Mixtures that would be considered buffers include which of the following?

I. 0.10 M HCl + 0.10 M NaCl
II. 0.10 M HF + 0.10 M NaF
III. 0.10 M HBr + 0.10 M HNO_3

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

13. One version of the First Law of Thermodynamics is expressed as $\Delta E = q + w$.
Which gives the sign convention for this relationship that is usually used in chemistry?

Choices	heat, q, transferred to the system	heat, q, transferred to the surroundings	work, w done on the system	work, w done on the surroundings
A.	-	+	-	-
B.	+	+	+	+
C.	+	+	+	-
D.	+	-	+	-
E.	+	-	-	-

14. The molecule of the following that has trigonal pyramidal geometry is:

A. CO_2
B. H_2O
C. CH_4
D. C_2H_4
E. PH_3

15. 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

Big Jump after 2nd IE (change in E.C.)

16. **Ionization Energies for element X (kJ mol^{-1})**

First	Second	Third	Fourth	Five
580	1815	2740	11600	14800

The ionization energies for element X are listed in the table above. On the basis of the data, element X is most likely to be:

A. Na B. Mg C. Al D. Si E. P

17. A sample of 0.010 moles of oxygen gas is confined at 127 °C and 0.80 atmospheres. What would be the pressure of this same sample at 27 °C and the same volume?

A. 0.10 atm
B. 0.20 atm
C. 0.60 atm
D. 0.80 atm
E. 1.1 atm

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$ $\frac{0.8}{400} = \frac{x}{300}$ $\frac{3}{4}(0.8) = 0.6$

18. When used to prepare a standard solution of acid with specified molarity, which apparatus provides the greatest precision for measuring the specified volume of solution to be prepared?

A. Eye dropper
B. Centigram balance
C. Dewar flask
D. Erlenmeyer flask
E. Volumetric flask

HNO_2 NaOH

19. The net ionic equation for the reaction that occurs during the titration of nitrous acid with sodium hydroxide is:

A. $HNO_{2\,(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightarrow NaNO_{2\,(aq)} + H_2O_{(l)}$
B. $HNO_{2\,(aq)} + NaOH_{(aq)} \rightarrow Na^+_{(aq)} + NO_2^-{}_{(aq)} + H_2O_{(l)}$
C. $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
D. $HNO_{2\,(aq)} + H_2O_{(l)} \rightarrow NO_2^-{}_{(aq)} + H_3O^+_{(aq)}$
E. $HNO_{2\,(aq)} + OH^-_{(aq)} \rightarrow NO_2^-{}_{(aq)} + H_2O_{(l)}$

$HNO_2 + OH^- \rightarrow H_2O + NO_2^-$

20. Refer to the balanced chemical reaction: $2\,A_{(g)} + B_{(g)} \rightleftarrows 2\,C_{(g)}$

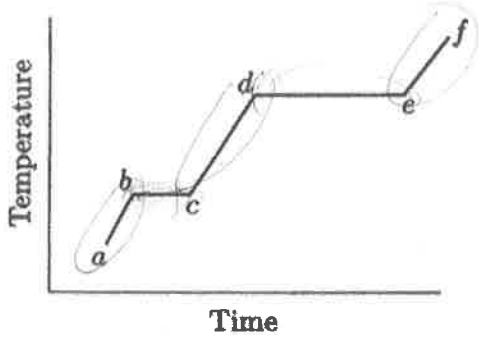
When the concentration of substance B in the reaction above is doubled, all other factors being held constant, it is found that the rate of the reaction remains unchanged. The most probable explanation for this observation is that...

A. the order of the reaction with respect to substance B is 1.
B. substance B is not involved in any of the steps in the mechanism of the reaction.
C. substance B is not involved in the rate-determining step of the mechanism, but is involved in subsequent steps.
D. substance B is probably a catalyst, and as such, its effect on the rate of the reaction does not depend on its concentration.
E. the reactant with the smallest coefficient in the balanced equation generally has little or no effect on the rate of the reaction.

21. The isomerization of cyclopropane to propylene is a first-order process with a half-life of 19 minutes at 500 °C. The time it takes for the partial pressure of cyclopropane to decrease from 1.0 atmosphere to 0.125 atmospheres at 500 °C is closest to...

A. 38 minutes
B. 57 minutes
C. 76 minutes
D. 152 minutes
E. 190 minutes

22. Energy is added to a system containing a pure substance at a constant rate as shown in the heating curve below:



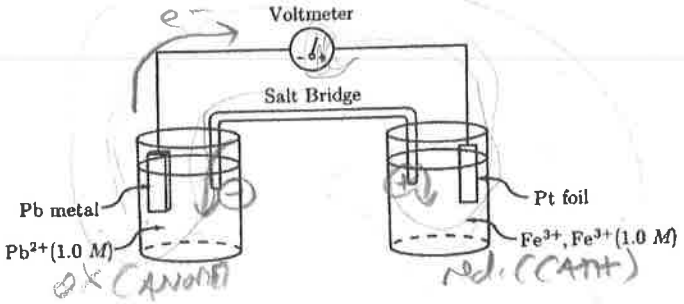
Which accounts for the difference in length of the line segments b - c and d - e?

A. The heat of fusion is less than the heat of vaporization.
B. The heat of fusion is greater than the heat of vaporization.
C. The solid has a greater specific heat capacity than the liquid.
D. The liquid has a greater specific heat capacity than the solid.
E. The heat of sublimation is equal to the sum of the heats of fusion and vaporization.

For questions 23-26 please refer to the electrochemical cell represented below using the following reduction half-reactions and their E° values:

$Fe^{3+} + e^- \rightarrow Fe^{2+}$ $\quad E° = 0.77$ volts

$Pb^{2+} + 2e^- \rightarrow Pb^0$ $\quad E° = -0.13$ volts



23. Which describes change in concentration for Pb^{2+} and the movement of charge in this electrochemical cell as the cell undergoes discharge?

	movement of electrons in the external circuit	movement of positive ions in the salt bridge	change in $[Pb^{2+}]$
A.	toward the cathode	toward the cathode	increases
B.	toward the anode	toward the anode	increases
C.	toward the cathode	toward the anode	decreases
D.	toward the anode	toward the cathode	decreases
E.	toward the cathode	toward the anode	increases

24. Which expression gives the change in mass expected at the lead electrode after this cell has produced 150 milli-amps for 2.0 hours?

A. $\dfrac{3{,}600 \times 207}{0.150 \times 96{,}500}$

B. $\dfrac{0.150 \times 3{,}600 \times 207}{2 \times 96{,}500}$

C. $\dfrac{2 \times 0.150 \times 207}{96{,}500}$

D. $\dfrac{3{,}600 \times 0.150 \times 207}{96{,}500}$

E. $\dfrac{2 \times 0.150 \times 3{,}600 \times 207}{96{,}500}$

25. Which expression gives the voltage for this standard chemical cell?

A. 0.13 + 0.77 volts
B. -0.13 + 0.77 volts
C. 0.13 + (2 x 0.77) volts
D. (2 x 0.13) + (2 x 0.77) volts
E. (2 x (-0.13)) + (2 x 0.77) volts

26. A similar electrochemical cell is assembled using standard electrodes except that the concentration of Pb^{2+} is changed to 0.010 M. Which is the best comparison of the voltage of the original standard cell to this non-standard cell?

A. No difference is expected.
B. The voltage of the non-standard cell is greater than that of the standard cell.
C. The voltage of the non-standard cell is less than that of the standard cell.
D. The voltage of the non-standard cell drops to zero.
E. It is impossible to determine the effect of changing concentration on voltage.

"Under"

27. Which is an example of a p-type semiconductor; that is, a semiconductor; that is, a semiconductor in which a transport of charge is produced by moving spaces that accommodate valence electrons?
    - A. arsenic with some silicon added
    - B. germanium with some silicon added
    - C. silicon with some gallium added
    - D. silicon with some germanium added
    - E. germanium with some arsenic added

28. Resonance helps to account for all of the following properties EXCEPT
    - A. the equal S-O bond energies in SO_2
    - B. the bond order of 1.5 for ozone (O_3)
    - C. the charge of 3+ on the aluminum ion, Al^{3+}
    - D. the equal bond strengths in the nitrate ion, NO_3^{1-}
    - E. the equal bond lengths in the carbonate ion, CO_3^{2-}

29. At 298 K, as the salt MX dissolves spontaneously to form an aqueous solution, ΔS and ΔH are positive. Which describes the value of ΔG and the absolute values of its components, $T\Delta S$ and ΔH?
    - A. $\Delta G < 0$; $|T\Delta S| > |\Delta H|$
    - B. $\Delta G < 0$; $|T\Delta S| < |\Delta H|$
    - C. $\Delta G > 0$; $|T\Delta S| > |\Delta H|$
    - D. $\Delta G > 0$; $|T\Delta S| < |\Delta H|$
    - E. $\Delta G = 0$; $|T\Delta S| = |\Delta H|$

$\Delta G = \Delta H - T\Delta S$

$-$ $+$ $+$

"bond" "Gain"

30. The molar solubility of $Ag_2CrO_{4\,(s)}$ is 1.3×10^{-4} mol L^{-1} for: $\mathbf{Ag_2CrO_{4\,(s)} \leftrightarrows 2\,Ag^{+}_{(aq)} + CrO_4^{2-}{}_{(aq)}}$
Which expression gives the value for K_{sp}, the solubility product constant?
    - A. $(1.3 \times 10^{-4})(1.3 \times 10^{-4})^2$
    - B. $(2.6 \times 10^{-4})^2 (1.3 \times 10^{-4})$
    - C. $(2.6 \times 10^{-4})(1.3 \times 10^{-4})$
    - D. $\dfrac{(2.6 \times 10^{-4})^2}{1.3 \times 10^{-4}}$
    - E. $\dfrac{1.3 \times 10^{-4}}{(2.6 \times 10^{-4})^2}$

$(2.6 \times 10^{-4})^2 (1.3 \times 10^{-4})$

$4x^3$

$(2x)^2 x$

31. Four trials of the reaction below were carried out in order to determine its rate law.

2 A + B + C → Products

The following data were collected:

Trial	[A]	[B]	[C]	Initial Rate M sec^{1-}
1	0.02	0.02	0.02	1.6×10^{-3}
2	0.01	0.02	0.02	8.0×10^{-4}
3	0.01	0.04	0.02	1.6×10^{-3}
4	0.01	0.04	0.03	1.6×10^{-3}

Based on these observations, what is the rate law?

a. Rate = $k[A]^2$
b. Rate = $k[B][C]$
c. Rate = $k[A][B]$
d. Rate = $k[A]^2[B]^2$
e. Rate = $k[A]^2[B][C]$

$[A]^1 [B]^1 [C]^0$

32. Which properties must be known in order to use a constant-pressure ("coffee cup") calorimeter to investigate heats of reaction?

i. The initial temperature of the solution
ii. Heat capacity of the solution, $C_{sol'n}$
iii. Mass of solution

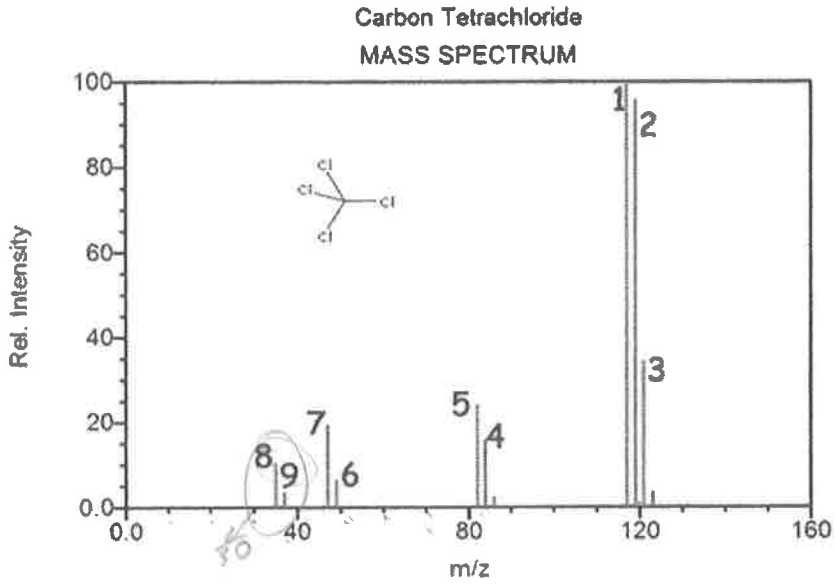
$q = m C \Delta T$

A. I only
B. II only
C. III only
D. I and III only
E. I, II, and III

33. According to the Kinetic Molecular Theory, all of the following apply to a mixture of gases EXCEPT

A. All gas molecules travel at the same speed
B. The collisions of the gas molecules are perfectly elastic
C. The forces of attraction between the gas molecules are negligibly small
D. The gas molecules exert pressure on the wall of the container of the system
E. Compared to the volume of the system, the absolute volume of the gas molecules is negligibly small.

34. Refer to the mass spectrometry diagram below:



Peaks 8 and 9 are representative of...

A. chlorine's electron configuration
B. two isotopes of carbon
C. chlorine's existence as a diatomic molecule
D. two isotopes of chlorine

35. Use the thermochemical equations shown below to determine the enthalpy for the reaction:

$$P_{4\,(s)} + 10\ Cl_{2\,(g)} \rightarrow 4\ PCl_{5\,(g)}$$

$4\ PCl_{3\,(g)} \rightarrow P_{4\,(s)} + 6\ Cl_{2\,(g)}$ $\quad \Delta H = 1626.0$ kJ

$PCl_{3\,(g)} + Cl_{2\,(g)} \rightarrow PCl_{5\,(g)}$ $\quad \Delta H = -166.5$ KJ

The enthalpy for the reaction (in kJ) is...

A. - 2292.0 kJ
B. - 1792.5 kJ
C. 1459.5 kJ
D. 1792.5 kJ
E. 2292.0 kJ

$P_4 + 6Cl_2 \rightarrow 4PCl_3$ $\quad -1626$

$4(PCl_3 + Cl_2 \rightarrow PCl_5)$ $\quad -666$

-2292

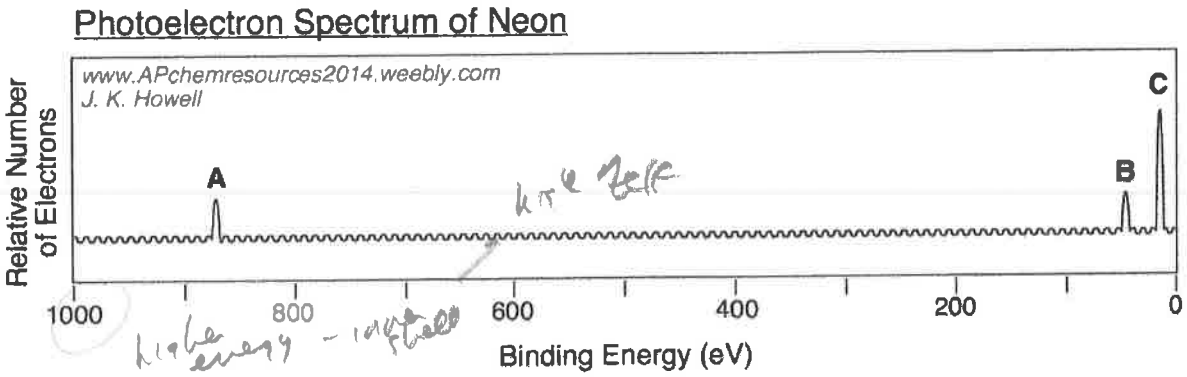
$2\,28$

166.5

4

666.0

36. Refer to the PES spectrum below for the following question:



Which of the following statements best accounts for peak A being far to the left of peaks B and C:

A. the electron configuration of neon is $1s^2 2s^2 2p^4$
B. neon has 8 electrons located in its valence shell
C. core electrons of an atom experience a much higher effective nuclear charge than valence electrons
D. peaks B and C show first ionization energies of electrons in neon, whereas peak A shows the second ionization energy of neon electrons
E. peak A is the only peak that truly applies to neon

37. A compound consists of the following elements by percent by mass:
sulfur - 50%
oxygen - 50%

The ratio of sulfur : oxygen : ~~hydrogen~~ in the empirical formula is:

A. 1 : 1 b. 1 : 2 c. 2 : 1 d. 2 : 3 e. 3 : 2

38. Refer to the statements below:

i. Electrons follow distinct pathways around the nucleus.
ii. The location of electrons cannot readily be determined.
iii. The atom is an overall positively charged mass with negative particles randomly dispersed throughout it.

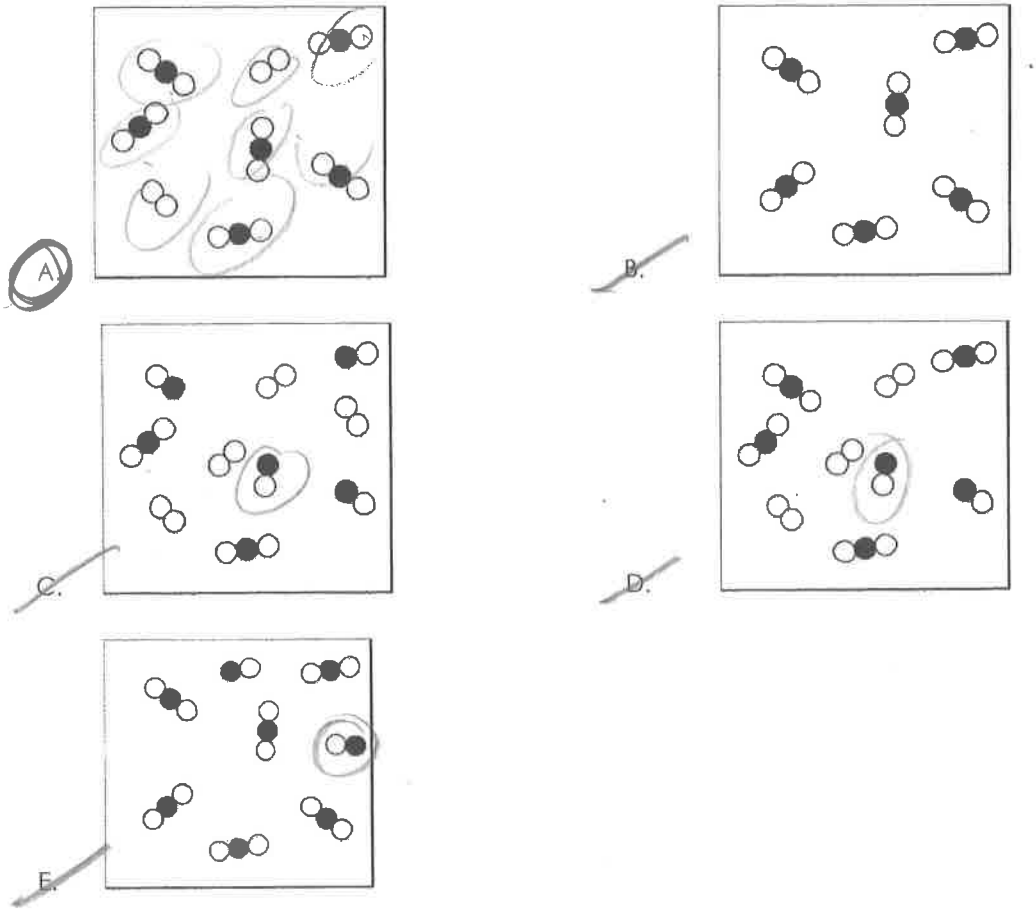
Which of the statements listed above best applies to the Bohr Model of the atom?

A. i only
B. ii only
C. i and iii
D. ii and iii
E. i, ii, and iii

39. The synthesis of nitrogen dioxide follows the reaction:

$$2\ NO_{(g)} + O_{2(g)} \rightarrow 2\ NO_{2(g)}$$

A sealed rigid container initially holds 6 mol of $NO_{(g)}$ and 5 mol $O_{2(g)}$. Assuming 1 particle represents 1 mole of a substance, which picture correctly depicts the interior of the container once the reaction has gone to completion? (dark circles represent nitrogen atoms, light circles represent oxygen atoms)



40. The melting point of magnesium sulfide is 2000 °C, whereas the melting point of sodium bromide is 747 °C. This can be explained by the fact that...

i. Mg has a charge of 2+, wheres Na has a charge of 1+
ii. Mg^{2+} has a smaller radius than Na^{1+}
iii. S^{2-} has a larger radius than Cl^{1-}

A. i only
B. ii only
C. i and ii
D. i and iii
E. i, ii, and iii

not room T ?

Poorly worded question !

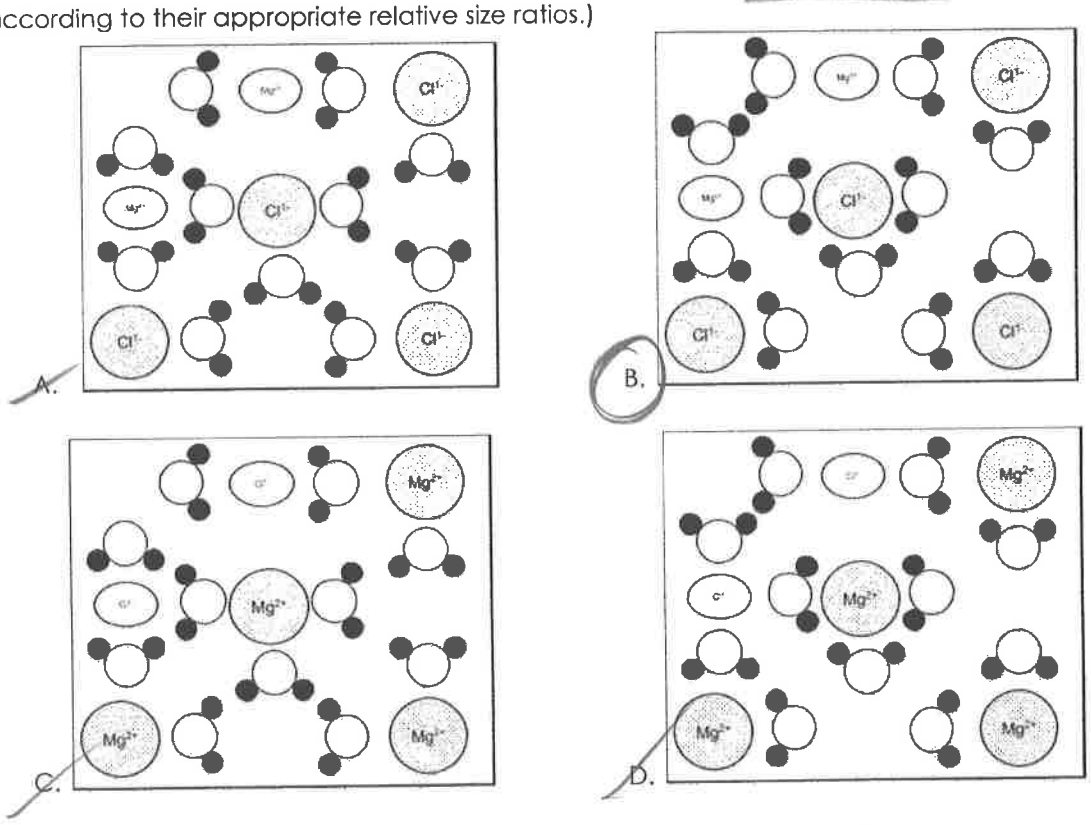
41. For the reaction: $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$ the $\Delta H = -393.5$ kJ/mol; however, this reaction does not occur spontaneously. What statement best explains this?

$\Delta S = +$

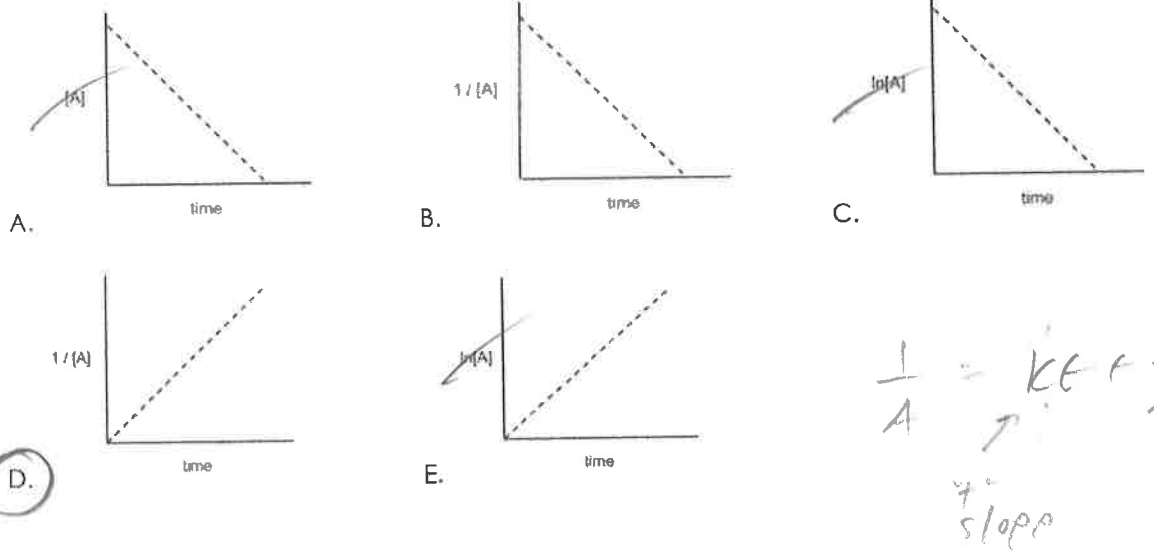
A. The reaction has a positive entropy value.
B. The reaction has a low activation energy.
C. The reaction has a high activation energy.
D. The reaction involves an inert solid.
E. The reaction has a negative ΔG.

$MgCl_2$

42. Which of the pictures below best displays the hydrolysis of magnesium chloride? (Ions are drawn according to their appropriate relative size ratios.)



43. A chemical reaction is determined to be second order. Which of the following graphs would validate this conclusion?



$\frac{1}{A} = kt + \frac{1}{A_0}$

↑ slope

$pH = pK_a + \log \frac{[B]}{[HB]}$

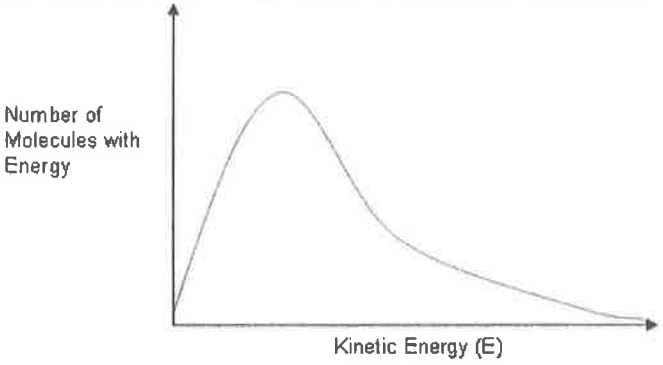
44. A solution should be prepared to buffer at a pH of 2.4. Which of the acid / salt pairs should be used to prepare a buffer for this system?

A.	$CH_2ClCOOH$ / $NaCH_2ClCOO$	($k_a = 1.4 \times 10^{-3}$)
B.	C_6H_5COOH / KC_6H_5COO	($k_a = 6.5 \times 10^{-5}$)
C.	$HClO$ / $NaClO$	($k_a = 3.5 \times 10^{-8}$)
D.	H_2O_2 / $NaHO_2$	($k_a = 2.4 \times 10^{-12}$)

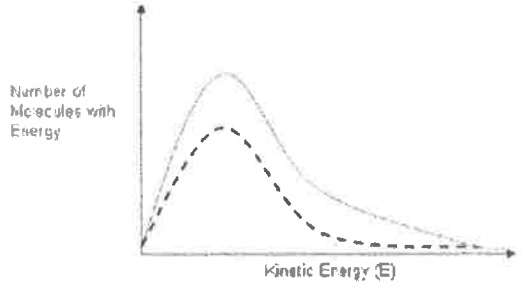
$pK_a \approx 2.4$

$10^{-2} - 10^{-3}$

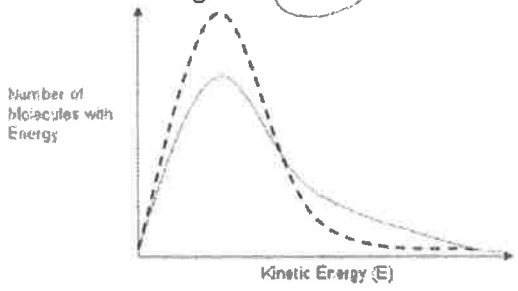
45. The diagram below represents a Boltzmann distribution for Argon at 300 K:



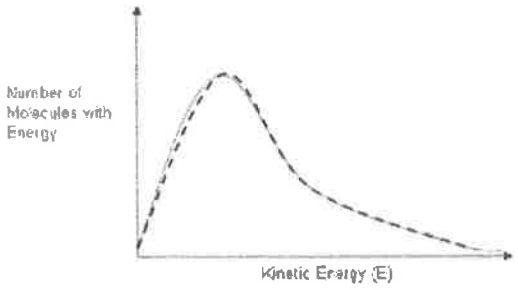
Which of the dotted line spectra would represent the distribution for Argon at 400 K? higher T



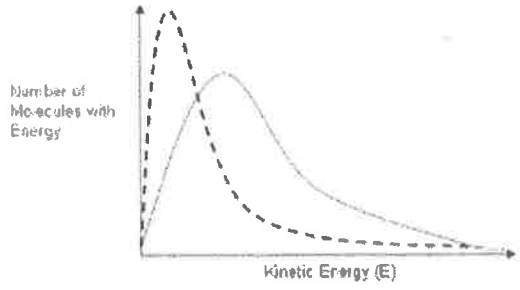
A.



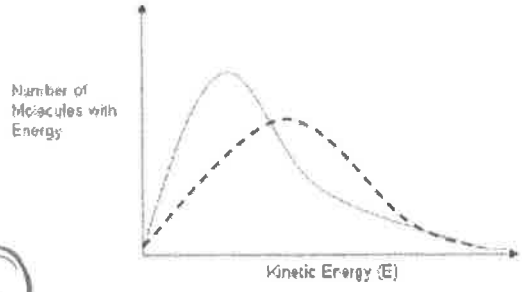
b.



c.

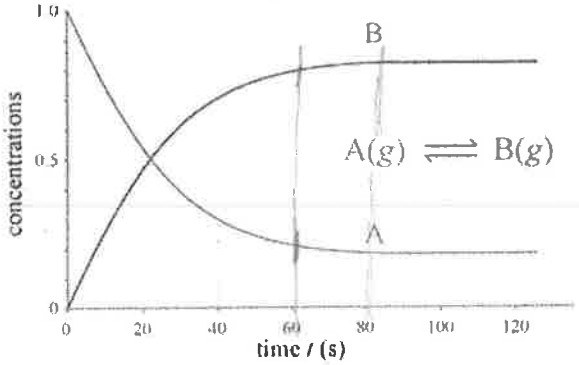


d.



e.

46. Refer to the graph below for the reaction: $A_{(g)} \Leftrightarrow B_{(g)}$



At what time does the reaction first reach equilibrium?

A. 20 seconds
B. 40 seconds
C. 60 seconds
D. 80 seconds
E. 100 seconds

units ?

47. For a given reaction, ΔH = -60.0 kJ/mol and ΔS = -20.0 J/K-mol. The reaction will have $\Delta G = 0$ at _____ K. (Assume that ΔH and ΔS do not vary with temperature.)

A. 0.003 B. 3 C. 300 D. 333 E. 3000

$\Delta G = \Delta H - T\Delta S$

$T = \frac{\Delta H}{\Delta S} = \frac{60}{.02}$

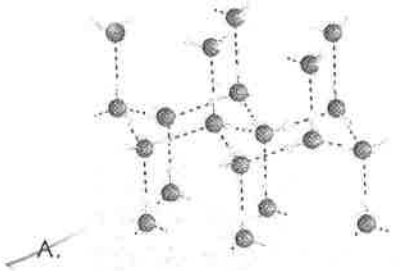
48. Which pair of solutions, when mixed, will produce a white precipitate?

A. $AgNO_{3\,(aq)} + NaCl_{(aq)}$
B. $AgNO_{3\,(aq)} + K_2CrO_{4\,(aq)}$
C. $AgNO_{3\,(aq)} + KMnO_{4\,(aq)}$
D. $Mn(NO_3)_{2\,(aq)} + Na_2S_{(aq)}$
E. $AgNO_{3\,(aq)} + Na_2S_{(aq)}$

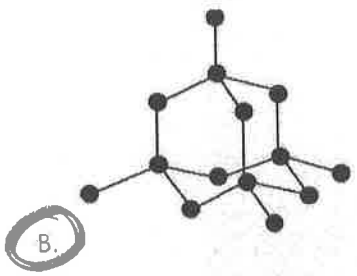
CrO_4^{2-} - yellow
MnO_4^- - purple
S^{-2} - black

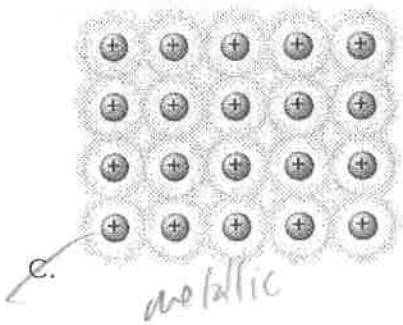
49. A sample of SiC is viewed at the molecular level. Which of the following pictures would look most like the sample of SiC?

network solid

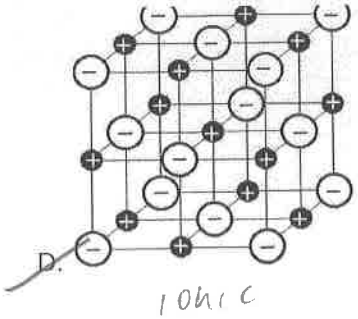


molecular





metallic



ionic

50. Refer to the following substances:

least middle most

X = CH_3-CH_2-CH_2-CH_2-CH_3 **Y = CH_3-CH_2-CH_2-CH_2-OH** **Z = HO-CH_2-CH_2-CH_2-OH**

Based on concepts of polarity and hydrogen bonding, which of the following sequences correctly lists the compounds above in the order of their increasing solubility in water?

A. Z < Y < X b. Y < Z < X c. Y < X < Z d. X < Z < Y e. X < Y < Z

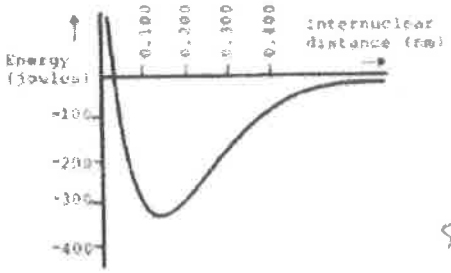
51. Which of the following must be true for a reaction that proceeds spontaneously to form products from initial standard state conditions?

A. $\Delta G° > 0$ and $K_{eq} > 1$
B. $\Delta G° > 0$ and $K_{eq} < 1$
C. $\Delta G° < 0$ and $K_{eq} > 1$
D. $\Delta G° < 0$ and $K_{eq} < 1$
E. $\Delta G° = 0$ and $K_{eq} = 1$

$\Delta G° = -RT \ln K$ $K = e^{-\frac{\Delta G}{RT}}$ when $\Delta G = -$, $K > 1$

$\Delta G = \Delta G° + RT \ln Q$

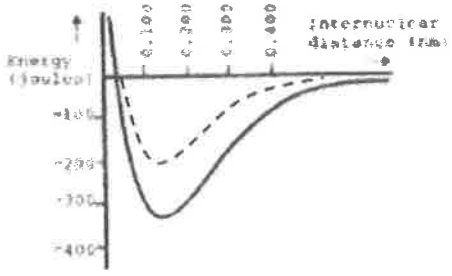
52. Refer to the bond length diagram for ethene: $H_2C=C_2H$



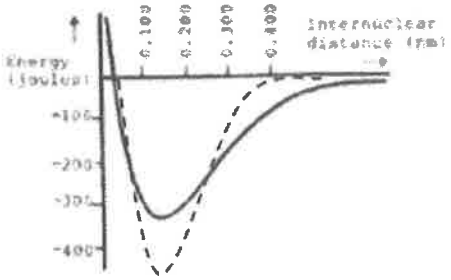
stronger = deeper & shorter

Which of the following diagrams (dotted line) would apply to ethyne (triple-bonded carbons)?

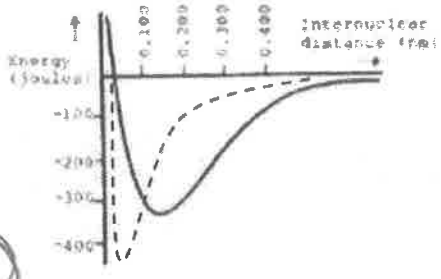
A.



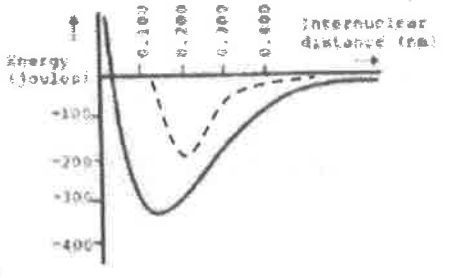
B.



C.



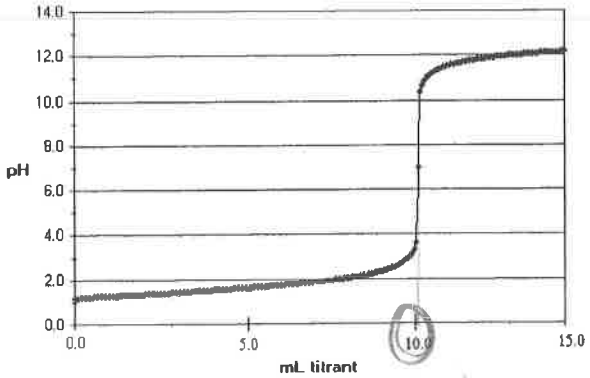
D.



53. Which of the following bonds is most polar?

A. N - Cl B. C - N C. S - S D. Br - Br E. S - O

54. A 30.0 mL aliquot of HCl is titrated using 0.15 M NaOH.The titration curve provided by the reaction and a pH probe yielded the graph below. What would be the molarity of the HCl solution?



0.15 M × 10 mL = 1.5 mmol

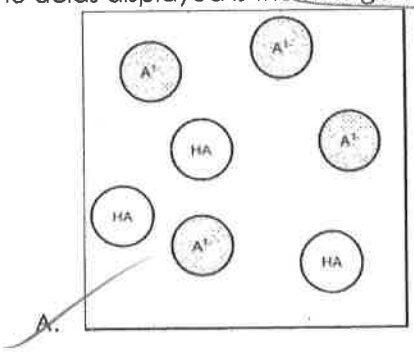
$\frac{1.5 \text{ mmol}}{30 \text{ mL}} = 0.05 \text{ M}$

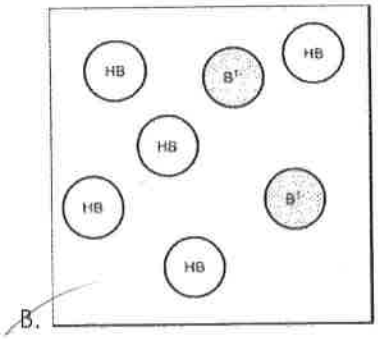
3 × volume = 1/3 conc.

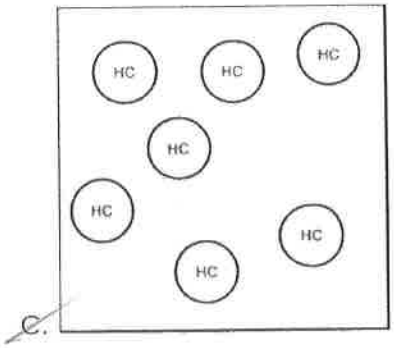
1/3 (0.15) = 0.05

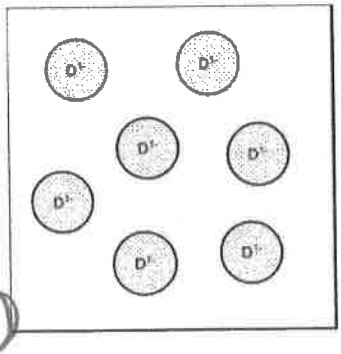
A. 0.050 M HCl
B. 0.10 M HCl
C. 0.15 M HCl
D. 0.30 M HCl
E. 0.45 M HCl

55. The following pictures represent acids: HA, HB, HC, HD. Based on the dissociation shown below, which of the acids displayed is the strongest acid?



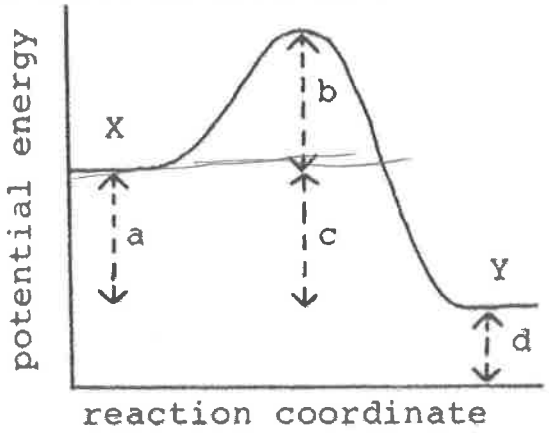






All dissociated

56. What distance corresponds to the activation energy for the reaction of X to Y?



A. a (B) b C. c D. d E. e

57. Which k expression best describes the hydrolysis of NaCN?

A. $\frac{[HCN][NaOH]}{[NaCN][H_2O]}$

B. $\frac{[HCN][OH^-]}{[CN^-][H_2O]}$

C. $\frac{[HCN][OH^-]}{[CN^-]}$

D. $\frac{[H^+][OH^-]}{[H_2O]}$

E. $\frac{[HNa^+][H_3O^+]}{[H_2O]}$

$CN^- + H_2O \rightleftharpoons HCN + OH^-$

$PbI_2 \rightleftharpoons Pb^{+2} + 2I^-$

58. The Ksp of lead (II) iodide is 7.1×10^{-9}. The concentration of the $[Pb^{2+}]$ and $[I^-]$ are both 2.0×10^{-3} M. Which direction will the reaction shift and will a precipitate form?

A. The reaction will shift left and a precipitate will form.
B. The reaction will shift left and a precipitate will not form.
C. The reaction will shift right and a precipitate will form.
D. The reaction will shift right and a precipitate will not form.
E. The reaction will NOT shift because it is at equilibrium.

$Q = (2\times10^{-3})(4\times10^{-3})^2$

$32\times10^{-9} > 7.1\times10^{-9}$

$Q > K$

Precipitate forms

59. Why does atomic radius decrease as you move across a period of the periodic table from left to right as it goes from one element to the next?

A. because the increasing number of protons and decreasing number of electrons creates an attractive force which causes the atom to expand
B. because the increasing number of protons and increasing number of electrons creates an attractive force which causes the atom to shrink in on itself
C. because the decreasing number of protons and decreasing number of electrons creates an attractive force which causes the atom to shrink in on itself
D. because the decreasing number of protons and increasing number of electrons creates an attractive force which causes the atom to shrink in on itself
E. None of the above

does not correspond to "shrinkage"

60. Thin layer chromatography was used to separate unknowns in a liquid mixture. The mobile phase was a nonpolar liquid. Their respective retention factors are listed in the table below:

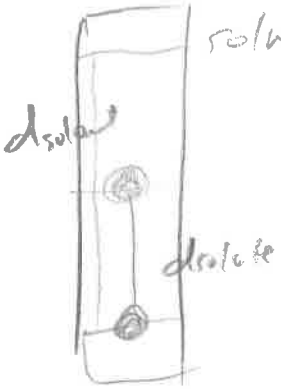
Unknown	Retention Factor (R_f)
U_1	0.45
U_2	0.77
U_3	0.12
U_4	0.64

most polar

Which of the substances was the most polar?

A. U_1
B. U_2
C. U_3
D. U_4
E. All of the substances had the same degree of polarity.

least time in mobile phase

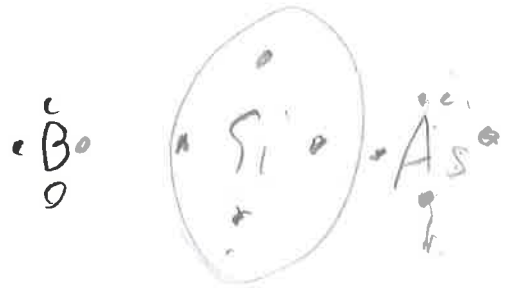


$$R_f = \frac{d_{solute}}{d_{solvent}}$$

MULTIPLE CHOICE RESPONSES

1	E
2	B
3	A
4	D
5	B
6	B
7	A
8	D
9	B
10	C
11	A
12	B
13	D
14	E
15	C
16	C
17	C
18	E
19	E
20	C
21	B
22	A
23	A
24	D
25	A
26	B
27	C
28	C
29	A
30	B

31	C
32	E
33	A
34	D
35	A
36	C
37	B
38	A
39	A
40	C
41	C
42	B
43	D
44	A
45	E
46	D
47	E
48	A
49	B
50	E
51	C
52	C
53	E
54	A
55	D
56	B
57	C
58	A
59	E
60	C



$PV = nRT$

$\frac{P_1}{T_1} = \frac{P_2}{T_2}$

$0.150\ C/s \times \frac{2\ hrs}{1} \times \frac{3600\ s}{1\ hrs} \times \frac{1\ mol\ e^-}{96,500\ C} \times \frac{1\ mol\ Pb}{2e^-}$