Part II
Practice Test 1

AP® Chemistry Exam

SECTION I: Multiple-Choice Questions

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO.

At a Glance

Total Time
1 hour and 30 minutes
Number of Questions
60
Percent of Total Grade
50%
Writing Instrument
Pencil required

Instructions

Section I of this examination contains 60 multiple-choice questions. Fill in only the ovals for numbers 1 through 60 on your answer sheet.

CALCULATORS MAY NOT BE USED IN THIS PART OF THE EXAMINATION.

Indicate all of your answers to the multiple-choice questions on the answer sheet. No credit will be given for anything written in this exam booklet, but you may use the booklet for notes or scratch work. After you have decided which of the suggested answers is best, completely fill in the corresponding oval on the answer sheet. Give only one answer to each question. If you change an answer, be sure that the previous mark is erased completely. Here is a sample question and answer.

Sample Question

Chicago is a
(A) state
(B) city
(C) country
(D) continent

Sample Answer

Use your time effectively, working as quickly as you can without losing accuracy. Do not spend too much time on any one question. Go on to other questions and come back to the ones you have not answered if you have time. It is not expected that everyone will know the answers to all the multiple-choice questions.

About Guessing

Many candidates wonder whether or not to guess the answers to questions about which they are not certain. Multiple-choice scores are based on the number of questions answered correctly. Points are not deducted for incorrect answers, and no points are awarded for unanswered questions. Because points are not deducted for incorrect answers, you are encouraged to answer all multiple-choice questions. On any questions you do not know the answer to, you should eliminate as many choices as you can, and then select the best answer among the remaining choices.

CHEMISTRY
SECTION I
Time—1 hour and 30 minutes

INFORMATION IN THE TABLE BELOW AND ON THE FOLLOWING PAGES MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)							

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	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** (262)

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ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

Throughout the test the following symbols have the definitions specified unless otherwise noted.

L, mL	= liter(s), milliliter(s)	mm Hg	= millimeters of mercury
g	= gram(s)	J, kJ	= joule(s), kilojoule(s)
nm	= nanometer(s)	V	= volt(s)
atm	= atmosphere(s)	mol	= mole(s)

ATOMIC STRUCTURE

$E = h\nu$

$c = \lambda\nu$

E = energy
ν = frequency
λ = wavelength

Planck's constant, $h = 6.626 \times 10^{-34}$ J s

Speed of light, $c = 2.998 \times 10^{8}$ m s^{-1}

Avogadro's number = 6.022×10^{23} mol^{-1}

Electron charge, $e = -1.602 \times 10^{-19}$ coulomb

EQUILIBRIUM

$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$, where $a\,A + b\,B \rightleftarrows c\,C + d\,D$

$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$

$K_a = \frac{[H^+][A^-]}{[HA]}$

$K_b = \frac{[OH^-][HB^+]}{[B]}$

$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ at 25°C

$= K_a \times K_b$

$pH = -\log[H^+]$, $pOH = -\log[OH^-]$

$14 = pH + pOH$

$pH = pK_a + \log\frac{[A^-]}{[HA]}$

$pK_a = -\log K_a$, $pK_b = -\log K_b$

Equilibrium Constants

K_c (molar concentrations)
K_p (gas pressures)
K_a (weak acid)
K_b (weak base)
K_w (water)

KINETICS

$\ln[A]_t - \ln[A]_0 = -kt$

$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$

$t_{1/2} = \frac{0.693}{k}$

k = rate constant
t = time
$t_{1/2}$ = half-life

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GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$P_A = P_{\text{total}} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{M}$$

$$K = °C + 273$$

$$D = \frac{m}{V}$$

$$KE \text{ per molecule} = \frac{1}{2}mv^2$$

Molarity, M = moles of solute per liter of solution

$$A = abc$$

P = pressure
V = volume
T = temperature
n = number of moles
m = mass
M = molar mass
D = density
KE = kinetic energy
v = velocity
A = absorbance
a = molar absorptivity
b = path length
c = concentration

Gas constant, $R = 8.314 \text{ J mol}^{-1}\text{K}^{-1}$
$= 0.08206 \text{ L atm mol}^{-1}\text{K}^{-1}$
$= 62.36 \text{ L torr mol}^{-1}\text{K}^{-1}$
1 atm = 760 mm Hg
= 760 torr
STP = 0.00 °C and 1.000 atm

THERMOCHEMISTRY/ ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta S° = \sum S° \text{ products} - \sum S° \text{ reactants}$$

$$\Delta H° = \sum \Delta H_f° \text{ products} - \sum \Delta H_f° \text{ reactants}$$

$$\Delta G° = \sum \Delta G_f° \text{ products} - \sum \Delta G_f° \text{ reactants}$$

$$\Delta G° = \Delta H° - T\Delta S°$$
$$= -RT \ln K$$
$$= -nFE°$$

$$I = \frac{q}{t}$$

q = heat
m = mass
c = specific heat capacity
T = temperature
$S°$ = standard entropy
$H°$ = standard enthalpy
$G°$ = standard free energy
n = number of moles
$E°$ = standard reduction potential
I = current (amperes)
q = charge (coulombs)
t = time (seconds)

Faraday's constant, F = 96,485 coulombs per mole of electrons

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

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1. In a saturated solution of Na_3PO_4, $[Na^+] = 0.30$ M. What is the molar solubility of Na_3PO_4?

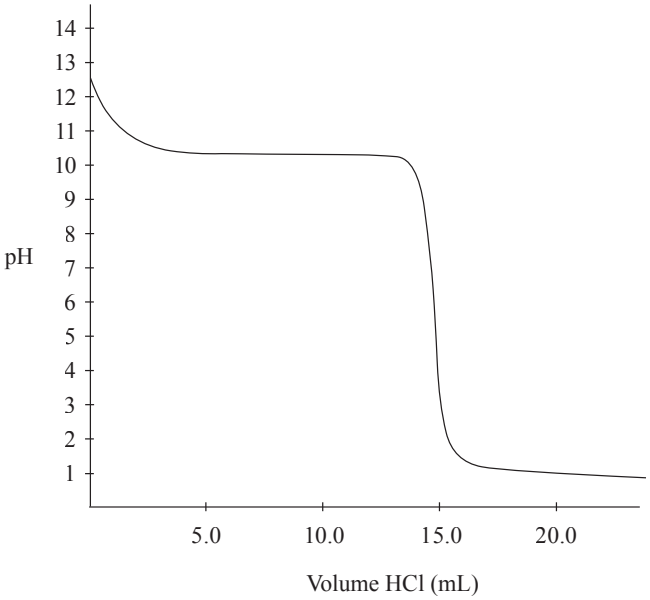
   (A) 0.10 *M*
   (B) 0.30 *M*
   (C) 0.60 *M*
   (D) 0.90 *M*

2. When some LiCl is dissolved in water, the temperature of the water increases. This means that:

   (A) the strength of the intermolecular forces between the water molecules is stronger than the bond energy within the LiCl lattice
   (B) the attraction of the lithium ions to the negative dipoles of the water molecules is weaker than the attraction of the chloride ions to the positive dipoles of the water molecules
   (C) breaking the bonds between the lithium and chloride ions is an exothermic process
   (D) the strength of the ion-dipole attractions that are formed exceeds the lattice energy in LiCl

Use the following information to answer questions 3-6

A student titrates some 1.0 M HCl into 20.0 mL of methylamine (CH_3NH_2), a weak base which only accepts a single proton. The following titration curve results:



3. What is the concentration of the methylamine?

   (A) 0.50 *M*
   (B) 0.75 *M*
   (C) 1.0 *M*
   (D) 1.25 *M*

4. What is the approximate pK_b for methylamine?

   (A) 3.5
   (B) 5.5
   (C) 10.5
   (D) 12.5

5. The buffer region of this titration is located:

   (A) Below 3.0 mL
   (B) Between 3.0 mL and 14.0 mL
   (C) Between 14.0 mL and 16.0 mL
   (D) Above 16.0 mL

6. The methylamine is replaced by 20.0 mL of sodium hydroxide of an identical concentration. If the sodium hydroxide is titrated with the 1.0 M HCl, which of the following options accurately describes the pH levels at various points during the titration when compared to the pH levels at the same point in the HCl/methylamine titration?

	Initial pH	**Equivalence pH**	**Ending pH**
(A)	lower	same	higher
(B)	higher	higher	same
(C)	same	higher	same
(D)	higher	lower	lower

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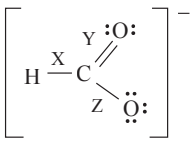
7. The formate ion, HCO_2^-, is best represented by the Lewis diagram below. Each bond is labeled with a different letter.



What is the bond order for each bond?

	X	**Y**	**Z**
(A)	1	1	2
(B)	2	2	1
(C)	1	1.5	1.5
(D)	1.33	1.33	1.33

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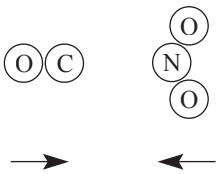
$$Ag^{+}(aq) + 2\ NH_3\ (aq) \rightleftharpoons Ag(NH_3)_2^{+}(aq)$$

8. The reaction above is at equilibrium in a closed system. Which of the following will happen immediately when water is added?

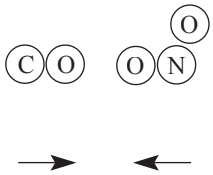
   (A) The rate of the reverse reaction will increase.
   (B) Both ions will increase in concentration, while the NH_3 decreases in concentration.
   (C) The reaction will shift to the right.
   (D) Nothing will happen; adding water does not cause any changes to the equilibrium system.

9. The two products above are created from a reaction involving CO and NO_2, as drawn in the answer options below. Which of the following options indicates a viable orientation of both reactant molecules prior to the collision? (Note: the arrows indicate the direction each molecules is moving prior to the collision)

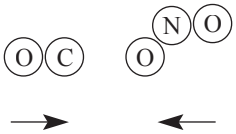
(A)



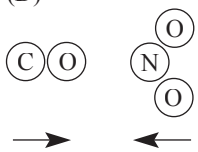
(B)



(C)



(D)



$$C_XH_Y\ (g) + O_2\ (g) \rightarrow CO_2\ (g) + H_2O\ (g)$$

10. When the above <u>unbalanced</u> reaction occurs at STP, 1.5 L of CO_2 and 1.0 L of H_2O are created. What is the empirical formula of the hydrocarbon?

    (A) CH_2
    (B) C_2H_3
    (C) C_2H_5
    (D) C_3H_4

$$2\ H_2O_2\ (aq) \rightarrow 2\ H_2O\ (l) + O_2\ (g)$$

11. For the decomposition of hydrogen peroxide, which element (if any) is being reduced, and which is being oxidized?

	Oxidized	**Reduced**
(A)	Hydrogen	Oxygen
(B)	Oxygen	None
(C)	None	Hydrogen
(D)	Oxygen	Oxygen

12. Identical amounts of the four gases listed below are present in four separate balloons. At STP, which balloon size experiences the greatest deviation from the volume calculated using the Ideal Gas Law?

    (A) H_2
    (B) O_2
    (C) N_2
    (D) F_2

13. Which of the following reasons correctly explains one reason that increasing the temperature of a reaction increases its speed?

    (A) All reactant molecules will have more kinetic energy.
    (B) A larger percentage of reactant molecules will exceed the activation energy barrier.
    (C) A higher percentage of molecular collisions will have the correct orientation to cause a reaction.
    (D) The order of each reactant will increase.

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Use the following information to answer questions 14-16

The radius of atoms and ions is typically measured in Angstroms (Å), which is equivalent to $1 * 10^{-10}$ m. Below is a table of information for three different elements.

Element	Atomic Radius (Å)	Ionic Radius (Å)
Ne	0.38	N/A
P	0.98	1.00
Zn	1.42	1.35

14. The phosphorus ion is larger than a neutral phosphorus atom, yet a zinc ion is smaller than a neutral zinc atom. Which of the following statements best explains why?

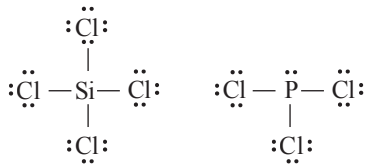
(A) The zinc atom has more protons than the phosphorus atom.
(B) The phosphorus atom is paramagnetic, but the zinc atom is diamagnetic.
(C) Phosphorus gains electrons when forming an ion, but zinc loses them.
(D) The valence electrons in zinc are further from the nucleus than those in phosphorus.

15. Neon has a smaller atomic radius than phosphorus because:

(A) Unlike neon, phosphorus has electrons present in its third energy level.
(B) Phosphorus has more protons than neon, which increases the repulsive forces in the atom.
(C) The electrons in a neon atom are all found in a single energy level.
(D) Phosphorus can form anions, while neon is unable to form any ions.

16. Which of the following represents the correct electron configuration for the zinc ion, Zn^{2+}?

(A) $[Ar]3d^{10}$
(B) $[Ar]4s^{2}3d^{8}$
(C) $[Ar]4s^{2}4d^{8}$
(D) $[Kr]4s^{2}3d^{8}$



17. The Lewis diagrams for $SiCl_4$ and PCl_3 are drawn above. What are the approximate bond angles between the terminal chlorine atoms in each structure?

	$SiCl_4$	PCl_3
(A)	90°	90°
(B)	109.5°	< 109.5°
(C)	90°	109.5°
(D)	< 109.5°	> 90°

$$2\ CrO_4^{2-}\ (aq) + 2\ H^+\ (aq) \rightleftharpoons Cr_2O_7^{2-}\ (aq) + H_2O\ (l)$$

18. The above reaction is present at equilibrium in a beaker. A student stirs the mixture. What effect will this have on the reaction rates?

(A) It will increase both the forward and reverse reaction rates.
(B) It will increase the forward rate, but decrease the reverse rate.
(C) It will have no effect on the forward rate, but decrease the reverse rate.
(D) It will have no effect on either rate.

19. A sample of water originally at 25°C is heated to 75°C. As the temperature increases, the vapor pressure of the water is also observed to increase. Why?

(A) Water molecules are more likely to have enough energy to break free of the intermolecular forces holding them together.
(B) The covalent bonds between the hydrogen and oxygen atoms within individual water molecules are more likely to be broken.
(C) The strength of the hydrogen bonding between different water molecules will increase until it exceeds the covalent bond energy within individual water molecules.
(D) The electron clouds surrounding each water molecule are becoming less polarizable, weakening the intermolecular forces between them.

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20. The enthalpy change for which of the following reactions would be equal to the enthalpy of formation for ethanol (CH_3CH_2OH)?

(A) $CH_3 + CH_2 + OH \rightarrow CH_3CH_2OH$
(B) $2\ C + 5\ H + O \rightarrow CH_3CH_2OH$
(C) $4\ C + 6\ H_2 + O_2 \rightarrow 2\ CH_3CH_2OH$
(D) $2\ C + 3\ H_2 + \frac{1}{2}O_2 \rightarrow CH_3CH_2OH$

21. A chemist wants to plate out 1.00 g of solid lead from a solution containing aqueous Pb^{2+} ions. Which of the following expressions will equal the amount of time, in seconds, it takes if a current of 5.00 A is applied?

(A) $\frac{(2)(55.85)(5.00)}{96500}$
(B) $\frac{(2)(96500)}{(55.85)(5.00)}$
(C) $\frac{(55.85)(96500)}{(2)(5.00)}$
(D) $\frac{(2)(55.85)(96500)}{(5.00)}$

Use the following information to answer questions 22-24

10.0 g each of three different gases are present in three glass containers of identical volume, as shown below. The temperature of all three flasks is held constant at 298 K.

22. The container with which gas would have the greatest pressure?

(A) SO_2
(B) CH_4
(C) NCl_3
(D) All four containers would have the same pressure.

23. Which of the gases would have the greatest density?

(A) SO_2
(B) CH_4
(C) NCl_3
(D) All three gases would have the same density.

24. If a small, pinhole-size leak were to be drilled into each container, the container with which gas would experience the fastest pressure decrease?

(A) SO_2
(B) CH_4
(C) NCl_3
(D) All three containers would decrease pressure at the same rate.

$CO_2\ (g) + H_2\ (g) \rightleftharpoons CO\ (g) + H_2O\ (g) \quad K_c = 1.4$
$CO\ (g) + 2\ H_2\ (g) \rightleftharpoons CH_3OH\ (g) \quad K_c = 14.5$

25. Given the above information, what would the equilibrium constant for the below reaction be?

$$3\ CO\ (g) + 2\ H_2O\ (g) \rightleftharpoons 2\ CO_2\ (g) + CH_3OH\ (g)$$

(A) $(2)(1.4)(14.5)$
(B) $\frac{(1.4)(14.5)}{2}$
(C) $\frac{14.5}{(1.4)^2}$
(D) $14.5 - 1.4^2$

$$2\ H_2\ (g) + O_2\ (g) \rightarrow 2\ H_2O\ (g)$$

26. When 1.0 mole of H_2 is combined with 1.0 mol of O_2 in a sealed flask, the reaction above occurs to completion at a constant temperature. After the reaction, the pressure in the container will have:

(A) Increased by 25%
(B) Increased by 50%
(C) Decreased by 25%
(D) Decreased by 50%

27. A strong acid/strong base titration is completed using an indicator which changes color at the exact equivalence point of the titration. The protonated form of the indicator is HIn, and the deprotonated form is In^-. At the equivalence point of the reaction:

(A) $[HIn] = [In^-]$
(B) $[HIn] = 1/[In^-]$
(C) $[HIn] = 2[In^-]$
(D) $[HIn] = [In^-]^2$

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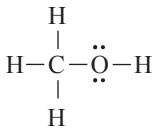
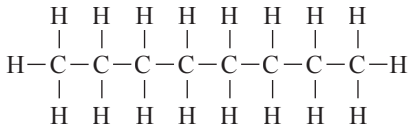


Ethanol



Octane

28. The Lewis diagrams for both ethanol and octane are drawn above. Ethanol's boiling point is 78°C, while octane's is 125°C. This is best explained by the fact that:

(A) Octane has hydrogen bonding, while ethanol does not.
(B) Octane has a significantly higher molar mass than ethanol.
(C) Octane's temporary dipoles are stronger than those in ethanol.
(D) Octane is more symmetrical than ethanol.

29. Which compound, $CaCl_2$ or CaO, would you expect to have a high melting point? Why?

(A) $CaCl_2$, because there are more ions per lattice unit
(B) $CaCl_2$, because a chlorine ion is smaller than an oxygen ion
(C) CaO, because the charge of oxygen ion exceeds that of chlorine ion
(D) CaO, because the common charges of calcium and oxygen ions are identical in magnitude

30. Even though it is a noble gas, xenon is known to form bonds with other elements. Which element from the options below would xenon most likely be able to bond with?

(A) Lithium
(B) Argon
(C) Fluorine
(D) Carbon

31. A sealed, rigid container contains three gases: 28.0 g of nitrogen, 40.0 g of argon, and 36.0 g of water vapor. If the total pressure exerted by the gases is 2.0 atm, what is the partial pressure of the nitrogen?

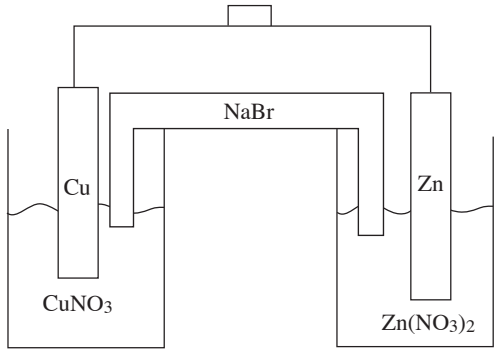
(A) 0.33 atm
(B) 0.40 atm
(C) 0.50 atm
(D) 2.0 atm

Questions 32-36 refer to the following.

Two half-cells are set up as follows:

Half-Cell A: Strip of Cu(*s*) in $CuNO_3(aq)$
Half-Cell B: Strip of Zn(*s*) in $Zn(NO_3)_2(aq)$

When the cells are connected according to the diagram below, the following reaction occurs:



$2Cu^+(aq) + Zn(s) \rightarrow 2Cu(s) + Zn^{2+}(aq)$ $E° = +1.28$ V

32. Correctly identify the anode and cathode in this reaction as well as where oxidation and reduction are taking place.

(A) Cu is the anode where oxidation occurs, and Zn is the cathode where reduction occurs.
(B) Cu is the anode where reduction occurs, and Zn is the cathode where oxidation occurs.
(C) Zn is the anode where oxidation occurs, and Cu is the cathode where reduction occurs.
(D) Zn is the anode where reduction occurs, and Cu is the cathode where oxidation occurs.

33. How many moles of electrons must be transferred to create 127 g of copper?

(A) 1 mole of electrons
(B) 2 moles of electrons
(C) 3 moles of electrons
(D) 4 moles of electrons

34. If the $Cu^+ + e^- \rightarrow Cu(s)$ half-reaction has a standard reduction potential of +0.52 V, what is the standard reduction potential for the $Zn^{2+} + 2e^- \rightarrow Zn(s)$ half-reaction?

(A) +0.76 V
(B) –0.76 V
(C) +0.24 V
(D) –0.24 V

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35. As the reaction progresses, what will happen to the overall voltage of the cell?

(A) It will increase as $[Zn^{2+}]$ increases.
(B) It will increase as $[Cu^{+}]$ increases.
(C) It will decrease as $[Zn^{2+}]$ increases.
(D) The voltage will remain constant.

36. What will happen in the salt bridge as the reaction progresses?

(A) The Na^{+} ions will flow to the Cu/Cu^{+} half-cell.
(B) The Br^{-} ions will flow to the Cu/Cu^{+} half-cell.
(C) Electrons will transfer from the Cu/Cu^{+} half-cell to the Zn/Zn^{2+} half-cell.
(D) Electrons will transfer from the Zn/Zn^{2+} half-cell to the Cu/Cu^{+} half-cell.

---

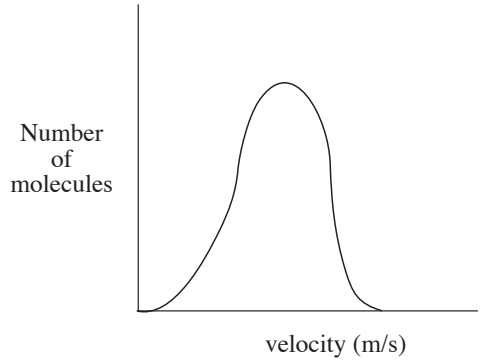
37. For a reaction involving nitrogen monoxide inside a sealed flask, the value for the reaction quotient (Q) was found to be 1.1×10^{2} at a given point. If, after this point, the amount of NO gas in the flask increased, which reaction is most likely taking place in the flask?

(A) $NOBr(g) \leftrightarrow NO(g) + \frac{1}{2}Br_2(g)$ $\quad K_c = 3.4 \times 10^{-2}$
(B) $2NOCl(g) \leftrightarrow 2NO(g) + Cl_2(g)$ $\quad K_c = 1.6 \times 10^{-5}$
(C) $2NO(g) + 2H_2(g) \leftrightarrow N_2(g) + 2H_2O(g)$ $\quad K_c = 4.0 \times 10^{6}$
(D) $N_2(g) + O_2(g) \leftrightarrow 2NO(g)$ $\quad K_c = 4.2 \times 10^{2}$

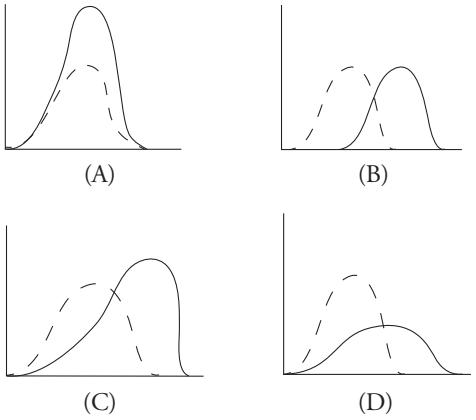
38. Which of the following substances has an asymmetrical molecular structure?

(A) SF_4
(B) PCl_5
(C) BF_3
(D) CO_2

39.



The diagram above shows the speed distribution of molecules in a gas held at 200 K. Which of the following representations would best represent the gas at a higher temperature? (Note: The original line is shown as a dashed line in the answer options.)

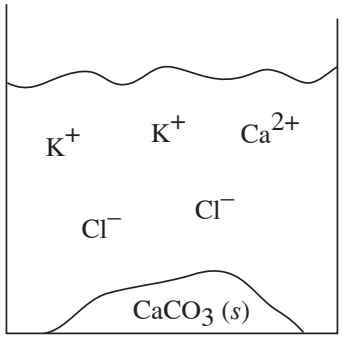


40. Nitrogen's electronegativity value is between those of phosphorus and oxygen. Which of the following correctly describes the relationship between the three values?

(A) The value for nitrogen is less than that of phosphorus because nitrogen is larger, but greater than that of oxygen because nitrogen has a greater effective nuclear charge.
(B) The value for nitrogen is less than that of phosphorus because nitrogen has fewer protons, but greater than that of oxygen because nitrogen has fewer valence electrons.
(C) The value for nitrogen is greater than that of phosphorus because nitrogen has fewer electrons, but less than that of oxygen because nitrogen is smaller.
(D) The value for nitrogen is greater than that of phosphorus because nitrogen is smaller, but less than that of oxygen because nitrogen has a smaller effective nuclear charge.

GO ON TO THE NEXT PAGE.

41. Solutions of potassium carbonate and calcium chloride are mixed, and the particulate representation below shows which are present in significant amounts after the reaction has gone to completion.



Which of the two original solutions is the limiting reagent and why?

(A) The potassium carbonate, because of the polyatomic anion
(B) The potassium carbonate, because there is no carbonate left after the reaction
(C) The calcium chloride, because there is an excess of calcium ions post-reaction
(D) The calcium chloride, because the component ions are smaller than those in potassium carbonate

42. In which of the following circumstances is the value for K_{eq} always greater than 1?

	ΔH	ΔS
(A)	Positive	Positive
(B)	Positive	Negative
(C)	Negative	Negative
(D)	Negative	Positive

43. The structure of two oxoacids is shown below:

Which would be a stronger acid, and why?

(A) HOCl, because the H–O bond is weaker than in HOF as chlorine is larger than fluorine
(B) HOCl, because the H–O bond is stronger than in HOF as chlorine has a higher electronegativity than fluorine
(C) HOF, because the H–O bond is stronger than in HOCl as fluorine has a higher electronegativity than chlorine
(D) HOF, because the H–O bond is weaker than in HOCl as fluorine is smaller than chlorine

44. Which of the following pairs of substances would make a good buffer solution?

(A) $HC_2H_3O_2(aq)$ and $NaC_2H_3O_2(aq)$
(B) $H_2SO_4(aq)$ and $LiOH(aq)$
(C) $HCl(aq)$ and $KCl(aq)$
(D) $HF(aq)$ and $NH_3(aq)$

Questions 45-48 refer to the following.

Inside a calorimeter, 100.0 mL of 1.0 *M* hydrocyanic acid (HCN), a weak acid, and 100.0 mL of 0.50 *M* sodium hydroxide are mixed. The temperature of the mixture rises from 21.5°C to 28.5°C. The specific heat of the mixture is approximately 4.2 J/g°C, and the density is identical to that of water.

45. Identify the correct net ionic equation for the reaction that takes place.

(A) $HCN(aq) + OH^-(aq) \leftrightarrow CN^-(aq) + H_2O(l)$
(B) $HCN(aq) + NaOH(aq) \leftrightarrow NaCN(aq) + H_2O(l)$
(C) $H^+(aq) + OH^-(aq) \leftrightarrow H_2O(l)$
(D) $H^+(aq) + CN^-(aq) + Na^+(aq) + OH^-(aq) \leftrightarrow H_2O(l) + CN^-(aq) + Na^+(aq)$

46. What is the approximate amount of heat released during the reaction?

(A) 1.5 kJ
(B) 2.9 kJ
(C) 5.9 kJ
(D) 11.8 kJ

47. As ΔT increases, what happens to the equilibrium constant and why?

(A) The equilibrium constant increases because more products are created.
(B) The equilibrium constant increases because the rate of the forward reaction increases.
(C) The equilibrium constant decreases because the equilibrium shifts to the left.
(D) The value for the equilibrium constant is unaffected by temperature and will not change.

GO ON TO THE NEXT PAGE.

48. If the experiment is repeated with 200.0 mL of 1.0 *M* HCN and 100. mL of 0.50 *M* NaOH, what would happen to the values for ΔT and ΔH_{rxn}?

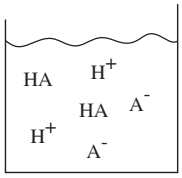
	ΔT	ΔH_{rxn}
(A)	Increase	Increase
(B)	Stay the same	Stay the same
(C)	Decrease	Stay the same
(D)	Stay the same	Increase

49. $PCl_3(g) + Cl_2(g) \leftrightarrow PCl_5(g) \quad \Delta H = -92.5$ kJ/mol

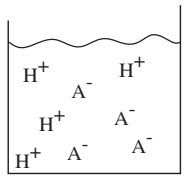
In which of the following ways could the reaction above be manipulated to create more product?

(A) Decreasing the concentration of PCl_3
(B) Increasing the pressure
(C) Increasing the temperature
(D) None of the above

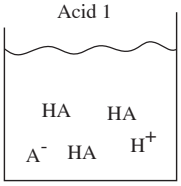
50. Four different acids are added to beakers of water, and the following diagrams represent the species present in each solution at equilibrium. Which acid has the highest pH?



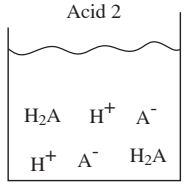
Acid 1



Acid 2



Acid 3



Acid 4

(A) Acid 1
(B) Acid 2
(C) Acid 3
(D) Acid 4

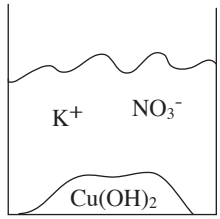
51. A 2.0 L flask holds 0.40 g of helium gas. If the helium is evacuated into a larger container while the temperature is held constant, what will the effect on the entropy of the helium be?

(A) It will remain constant because the number of helium molecules does not change.
(B) It will decrease because the gas will be more ordered in the larger flask.
(C) It will decrease because the molecules will collide with the sides of the larger flask less often than they did in the smaller flask.
(D) It will increase because the gas molecules will be more dispersed in the larger flask.

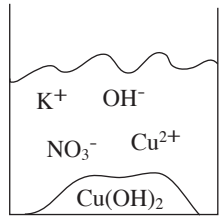
52. Starting with a stock solution of 18.0 *M* H_2SO_4, what is the proper procedure to create a 1.00 L sample of a 3.0 *M* solution of H_2SO_4 in a volumetric flask?

(A) Add 167 mL of the stock solution to the flask, then fill the flask the rest of the way with distilled water while swirling the solution.
(B) Add 600 mL of the stock solution to the flask, then fill the flask the rest of the way with distilled water while swirling the solution.
(C) Fill the flask partway with water, then add 167 mL of the stock solution, swirling to mix it. Last, fill the flask the rest of the way with distilled water.
(D) Fill the flask partway with water, then add 600 mL of the stock solution, swirling to mix it. Last, fill the flask the rest of the way with distilled water.

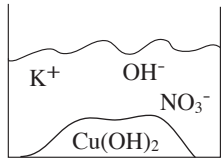
53. A student mixes equimolar amounts of KOH and $Cu(NO_3)_2$ in a beaker. Which of the following particulate diagrams correctly shows all species present after the reaction occurs?



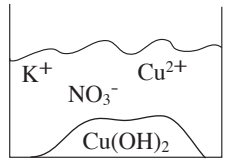
(A)



(B)



(C)



(D)

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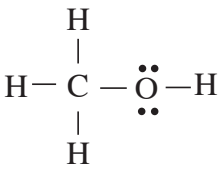
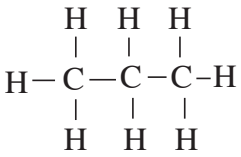
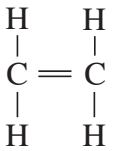
Questions 54-56 refer to the following.



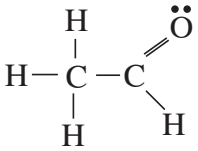
Methanol



Propane



Ethene



Ethanal

54. Based on the strength of the intermolecular forces in each substance, estimate from greatest to smallest the vapor pressures of each substance in liquid state at the same temperature.

(A) Propane > Ethanal > Ethene > Methanol
(B) Ethene > Propane > Ethanal > Methanol
(C) Ethanal > Methanol > Ethene > Propane
(D) Methanol > Ethanal > Propane > Ethene

55. When in liquid state, which two substances are most likely to be miscible with water?

(A) Propane and ethene
(B) Methanol and propane
(C) Ethene and ethanal
(D) Methanol and ethanal

56. Between propane and ethene, which will likely have the higher boiling point and why?

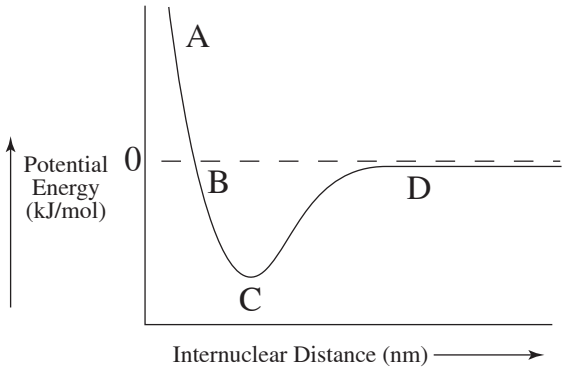
(A) Propane, because it has a greater molar mass
(B) Propane, because it has a more polarizable electron cloud
(C) Ethene, because of the double bond
(D) Ethene, because it is smaller in size

57. $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$

The above reaction will experience a rate increase by the addition of a catalyst such as platinum. Which of the following best explains why?

(A) The catalyst causes the value for ΔG to become more negative.
(B) The catalyst increases the percentage of collisions that occur at the proper orientation in the reactant molecules.
(C) The catalyst introduces a new reaction mechanism for the reaction.
(D) The catalyst increases the activation energy for the reaction.

58. The graph below shows the amount of potential energy between two hydrogen atoms as the distance between them changes. At which point in the graph would a molecule of H_2 be the most stable?



(A) Point A
(B) Point B
(C) Point C
(D) Point D

59. $N_2(g) + O_2(g) + Cl_2(g) \leftrightarrow 2NOCl(g)$ $\Delta G° = 132.6$ kJ/mol

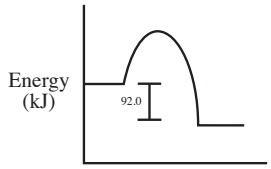
For the equilibrium above, what would happen to the value of $\Delta G°$ if the concentration of N_2 were to increase and why?

(A) It would increase because the reaction would become more thermodynamically favored.
(B) It would increase because the reaction would shift right and create more products.
(C) It would decrease because there are more reactants present.
(D) It would stay the same because the value of K_{eq} would not change.

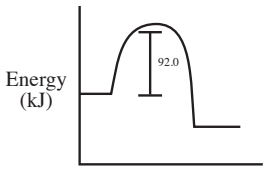
GO ON TO THE NEXT PAGE.

60. $C(s) + 2S(s) \rightarrow CS_2(l)$ $\Delta H = +92.0$ kJ/mol

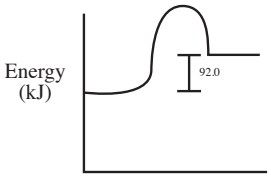
Which of the following energy level diagrams gives an accurate representation of the above reaction?



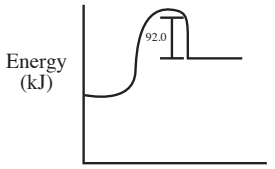
(A)



(B)



(C)



(D)

END OF SECTION I

INFORMATION IN THE TABLE BELOW AND ON THE FOLLOWING PAGES MAY BE USEFUL IN ANSWERING THE QUESTIONS IN THIS SECTION OF THE EXAMINATION.

DO NOT DETACH FROM BOOK.

PERIODIC TABLE OF THE ELEMENTS

1 **H** 1.008																	2 **He** 4.00
3 **Li** 6.94	4 **Be** 9.01											5 **B** 10.81	6 **C** 12.01	7 **N** 14.01	8 **O** 16.00	9 **F** 19.00	10 **Ne** 20.18
11 **Na** 22.99	12 **Mg** 24.30											13 **Al** 26.98	14 **Si** 28.09	15 **P** 30.97	16 **S** 32.06	17 **Cl** 35.45	18 **Ar** 39.95
19 **K** 39.10	20 **Ca** 40.08	21 **Sc** 44.96	22 **Ti** 47.90	23 **V** 50.94	24 **Cr** 52.00	25 **Mn** 54.94	26 **Fe** 55.85	27 **Co** 58.93	28 **Ni** 58.69	29 **Cu** 63.55	30 **Zn** 65.39	31 **Ga** 69.72	32 **Ge** 72.59	33 **As** 74.92	34 **Se** 78.96	35 **Br** 79.90	36 **Kr** 83.80
37 **Rb** 85.47	38 **Sr** 87.62	39 **Y** 88.91	40 **Zr** 91.22	41 **Nb** 92.91	42 **Mo** 95.94	43 **Tc** (98)	44 **Ru** 101.1	45 **Rh** 102.91	46 **Pd** 106.42	47 **Ag** 107.87	48 **Cd** 112.41	49 **In** 114.82	50 **Sn** 118.71	51 **Sb** 121.75	52 **Te** 127.60	53 **I** 126.91	54 **Xe** 131.29
55 **Cs** 132.91	56 **Ba** 137.33	57 ***La** 138.91	72 **Hf** 178.49	73 **Ta** 180.95	74 **W** 183.85	75 **Re** 186.21	76 **Os** 190.2	77 **Ir** 192.2	78 **Pt** 195.08	79 **Au** 196.97	80 **Hg** 200.59	81 **Tl** 204.38	82 **Pb** 207.2	83 **Bi** 208.98	84 **Po** (209)	85 **At** (210)	86 **Rn** (222)
87 **Fr** (223)	88 **Ra** 226.02	89 **†Ac** 227.03	104 **Rf** (261)	105 **Db** (262)	106 **Sg** (266)	107 **Bh** (264)	108 **Hs** (277)	109 **Mt** (268)	110 **Ds** (271)	111 **Rg** (272)							

*Lanthanide Series	58 **Ce** 140.12	59 **Pr** 140.91	60 **Nd** 144.24	61 **Pm** (145)	62 **Sm** 150.4	63 **Eu** 151.97	64 **Gd** 157.25	65 **Tb** 158.93	66 **Dy** 162.50	67 **Ho** 164.93	68 **Er** 167.26	69 **Tm** 168.93	70 **Yb** 173.04	71 **Lu** 174.97
†Actinide Series	90 **Th** 232.04	91 **Pa** 231.04	92 **U** 238.03	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** (262)

GO ON TO THE NEXT PAGE.

ADVANCED PLACEMENT CHEMISTRY EQUATIONS AND CONSTANTS

Throughout the test the following symbols have the definitions specified unless otherwise noted.

L, mL	= liter(s), milliliter(s)	mm Hg	= millimeters of mercury
g	= gram(s)	J, kJ	= joule(s), kilojoule(s)
nm	= nanometer(s)	V	= volt(s)
atm	= atmosphere(s)	mol	= mole(s)

ATOMIC STRUCTURE

$E = h\nu$

$c = \lambda\nu$

E = energy
ν = frequency
λ = wavelength

Planck's constant, $h = 6.626 \times 10^{-34}$ J s

Speed of light, $c = 2.998 \times 10^{8}$ m s^{-1}

Avogadro's number = 6.022×10^{23} mol^{-1}

Electron charge, $e = -1.602 \times 10^{-19}$ coulomb

EQUILIBRIUM

$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$, where $a\,A + b\,B \rightleftarrows c\,C + d\,D$

$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$

$K_a = \frac{[H^+][A^-]}{[HA]}$

$K_b = \frac{[OH^-][HB^+]}{[B]}$

$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ at 25°C

$= K_a \times K_b$

$pH = -\log[H^+]$, $pOH = -\log[OH^-]$

$14 = pH + pOH$

$pH = pK_a + \log\frac{[A^-]}{[HA]}$

$pK_a = -\log K_a$, $pK_b = -\log K_b$

Equilibrium Constants

K_c (molar concentrations)
K_p (gas pressures)
K_a (weak acid)
K_b (weak base)
K_w (water)

KINETICS

$\ln[A]_t - \ln[A]_0 = -kt$

$\frac{1}{[A]_t} - \frac{1}{[A]_0} = kt$

$t_{1/2} = \frac{0.693}{k}$

k = rate constant
t = time
$t_{1/2}$ = half-life

GO ON TO THE NEXT PAGE.

GASES, LIQUIDS, AND SOLUTIONS

$$PV = nRT$$

$$P_A = P_{\text{total}} \times X_A, \text{ where } X_A = \frac{\text{moles A}}{\text{total moles}}$$

$$P_{total} = P_A + P_B + P_C + \ldots$$

$$n = \frac{m}{M}$$

$$K = {}^\circ C + 273$$

$$D = \frac{m}{V}$$

$$KE \text{ per molecule} = \frac{1}{2}mv^2$$

Molarity, M = moles of solute per liter of solution

$$A = abc$$

P = pressure
V = volume
T = temperature
n = number of moles
m = mass
M = molar mass
D = density
KE = kinetic energy
v = velocity
A = absorbance
a = molar absorptivity
b = path length
c = concentration

Gas constant, R = 8.314 J mol^{-1} K^{-1}
= 0.08206 L atm mol^{-1} K^{-1}
= 62.36 L torr mol^{-1} K^{-1}
1 atm = 760 mm Hg
= 760 torr
STP = 0.00 °C and 1.000 atm

THERMOCHEMISTRY/ ELECTROCHEMISTRY

$$q = mc\Delta T$$

$$\Delta S^\circ = \sum S^\circ \text{ products} - \sum S^\circ \text{ reactants}$$

$$\Delta H^\circ = \sum \Delta H_f^\circ \text{ products} - \sum \Delta H_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \sum \Delta G_f^\circ \text{ products} - \sum \Delta G_f^\circ \text{ reactants}$$

$$\Delta G^\circ = \Delta H^\circ - T\Delta S^\circ$$
$$= -RT \ln K$$
$$= -n F E^\circ$$

$$I = \frac{q}{t}$$

q = heat
m = mass
c = specific heat capacity
T = temperature
S° = standard entropy
H° = standard enthalpy
G° = standard free energy
n = number of moles
E° = standard reduction potential
I = current (amperes)
q = charge (coulombs)
t = time (seconds)

Faraday's constant, F = 96,485 coulombs per mole of electrons

$$1 \text{ volt} = \frac{1 \text{ joule}}{1 \text{ coulomb}}$$

GO ON TO THE NEXT PAGE.

CHEMISTRY

Section II

7 Questions

(Total time—105 minutes)

YOU MAY USE YOUR CALCULATOR FOR THIS SECTION

Directions: Questions 1-3 are long free-response questions that require about 23 minutes each to answer and are worth 10 points each. Questions 4-7 are short free-response questions that require about 9 minutes each to answer and are worth 4 points each.

Write your response in the space provided following each question. Examples and equations may be included in your responses where appropriate. For calculations, clearly show the method used and the steps involved in arriving at your answers. You must show your work to receive credit for your answer. Pay attention to significant figures.

1. A student is tasked with determining the identity of an unknown carbonate compound with a mass of 1.89 g. The compound is first placed in water, where it dissolves completely. The K_{sp} value for several carbonate-containing compounds are given below.

Compound	K_{sp}
Lithium carbonate	8.15×10^{-4}
Nickel (II) carbonate	1.42×10^{-7}
Strontium carbonate	5.60×10^{-10}

   (a) In order to precipitate the maximum amount of the carbonate ions from solution, which of the following should be added to the carbonate solution: $LiNO_3$, $Ni(NO_3)_2$, or $Sr(NO_3)_2$? Justify your answer.
   (b) For the carbonate compound that contains the cation chosen in part (a), determine the concentration of each ion of that compound in solution at equilibrium.
   (c) When mixing the solution, should the student ensure the carbonate solution or the nitrate solution is in excess? Justify your answer.
   (d) After titrating sufficient solution to precipitate out all of the carbonate ions, the student filters the solution before placing it in a crucible and heating it to drive off the water. After several heatings, the final mass of the precipitate remains constant and is determined to be 2.02 g.
      (i) Determine the number of moles of precipitate.
      (ii) Determine the mass of carbonate present in the precipitate.
   (e) Determine the percent, by mass, of carbonate in the original sample.
   (f) Is the original compound most likely lithium carbonate, sodium carbonate, or potassium carbonate? Justify your answer.

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2. The **unbalanced** reaction between potassium permanganate and acidified iron (II) sulfate is a redox reaction that proceeds as follows:

$$H^+(aq) + Fe^{2+}(aq) + MnO_4^-(aq) \rightarrow Mn^{2+}(aq) + Fe^{3+}(aq) + H_2O(l)$$

(a) Provide the equations for both half-reactions that occur below:
   (i) Oxidation half-reaction
   (ii) Reduction half-reaction

(b) What is the balanced net ionic equation?

A solution of 0.150 *M* potassium permanganate is placed in a buret before being titrated into a flask containing 50.00 mL of iron (II) sulfate solution of unknown concentration. The following data describes the colors of the various ions in solution:

Ion	Color in solution
H^+	Colorless
Fe^{2+}	Pale Green
MnO_4^-	Dark Purple
Mn^{2+}	Colorless
Fe^{3+}	Yellow
K^+	Colorless
SO_4^{2-}	Colorless

(c) Describe the color of the solution in the flask at the following points:
   (i) Before titration begins
   (ii) During titration prior to the endpoint
   (iii) At the endpoint of the titration

(d) (i) If 15.55 mL of permanganate are added to reach the endpoint, what is the initial concentration of the iron (II) sulfate?
   (ii) The actual concentration of the $FeSO_4$ is 0.250 *M*. Calculate the percent error.

(e) Could the following errors have led to the experimental result deviating in the direction that it did? You must justify your answers quantitatively.
   (i) 55.0 mL of $FeSO_4$ was added to the flask prior to titration instead of 50.0 mL.
   (ii) The concentration of the potassium permanganate was actually 0.160 *M* instead of 0.150 *M*.

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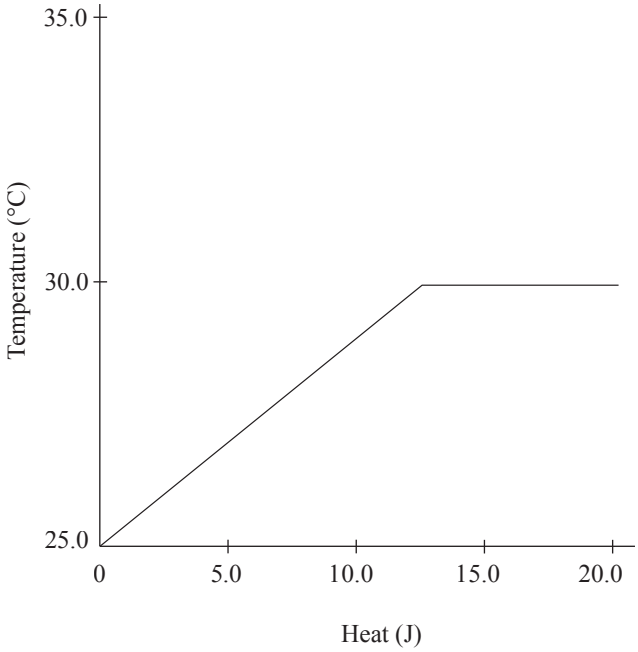
3.



0.10 mol of solid gallium initially at room temperature is heated at a constant rate, and its temperature is tracked, leading to the above graph.

(a) As heat is added, what is happening to the total entropy of the system? Justify your answer.
(b) The horizontal portion of the graph indicates a phase change. Explain on a particulate level why the temperature is constant during a phase change.
(c) (i) Calculate the specific heat capacity of solid gallium in J g^{-1} $^oC^{-1}$
(ii) If the specific heat of the solid gallium were greater than what you calculated in (c)(ii), how would the slope of the temperature versus heat line change during gallium's solid phase?

The gallium continues to be heated until it fully boils. Assume ideal behavior for the gallium gas.

$$Ga\ (l) \rightarrow Ga\ (g)$$

Substance	ΔH°_f (kJ mol^{-1})
Ga (*l*)	5.60
Ga (*g*)	277.1

(d) (i) Calculate the enthalpy of vaporization for gallium given the above data.
(ii) The enthalpy of vaporization for gallium is greater than its enthalpy of fusion. Explain why in terms of intermolecular forces.

(e) Given your answer to (d)(i) and that ΔS° = 128.0 J $mol^{-1}$$^oC^{-1}$ for the boiling of gallium, what is the boiling point of the gallium?
(f) After the gallium is fully converted to a gas, it continues to be heated. What would you expect to be true about the velocity distribution of the gaseous gallium atoms as the temperature increases?

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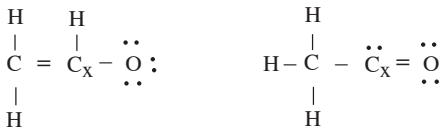
4. The acetyl ion has a formula of $C_2H_3O^-$ and two possible Lewis electron-dot diagram representations:



(a) Using formal charge, determine which structure is the most likely correct structure.
(b) For carbon atom "x" in the structure you chose:
  (i) What is the hybridization around the atom?
  (ii) How many sigma and pi bonds has the atom formed?
(c) A hydrogen ion attaches itself to the acetyl ion, creating C_2H_4O. Draw the Lewis diagram of the new molecule.

5. Hyprobromous acid, HBrO, is a weak monoprotic acid with a K_a value of 2.0×10^{-9} at 25°C.

(a) Write out the equilibrium reaction of hyprobromous acid with water, identifying any conjugate acid/based pairs present.
(b) (i) What would be the percent dissociation of a 0.50 *M* solution of hyprobromous acid?
  (ii) If the 0.50 *M* solution were diluted, what would happen to the percent dissociation of the HBrO? Why?

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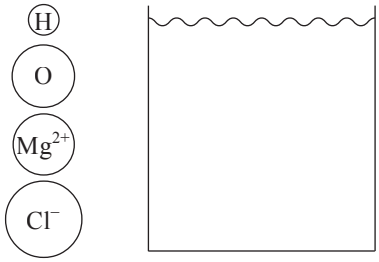
6. Chlorofluorocarbons are byproducts of many different processes that are known to be dangerous to the environment as both as a greenhouse gas, as well as an agent for ozone (O_3) depletion. The accepted mechanism for the latter is:

$$\text{Step 1: } Cl\,(g) + O_3\,(g) \rightarrow ClO\,(g) + O_2\,(g)$$
$$\text{Step 2: } O\,(g) + ClO\,(g) \rightarrow Cl\,(g) + O_2\,(g)$$

(a) Write out the full reaction with the above elementary steps, and identify all catalysts and intermediates.
(b) Describe two ways by which a catalyst can reduce the activation energy of a reaction.
(c) Both elementary steps in the reaction above are exothermic. On the axes provided, draw a potential reaction mechanism which supports this.

7. A stock solution of 2.0 *M* $MgCl_2$ is dissolved in water.

(a) (i) In the beaker below, draw a particulate diagram that represents $MgCl_2$ dissolved in water. The approximate sizes of each atom/ion are provided for you. Your diagram should include at least four water molecules, which should be correctly oriented compared to the ions dissolved in solution.



(ii) Why are the chloride ions from (a)(i) larger than the magnesium ions?
(b) (i) A student wishes to make up 500 mL of 0.50 *M* $MgCl_2$ for an experiment. Explain the best method of doing so utilizing a graduated cylinder and a volumetric flask. Assume $MgCl_2$ is fully soluble.
(ii) What are the concentrations of the Mg^{2+} and Cl^- ions in the new solution?

STOP

END OF EXAM

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Completely darken bubbles with a No. 2 pencil. If you make a mistake, be sure to erase mark completely. Erase all stray marks.

1.

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(Print) Last First M.I.

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(Print) Number and Street

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City State Zip Code

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IMPORTANT: Please fill in these boxes exactly as shown on the back cover of your test book.

2. TEST FORM

3. TEST CODE

4. REGISTRATION NUMBER

3. TEST CODE					4. REGISTRATION NUMBER					
0	A	J	0	0	0	0	0	0	0	0
1	B	K	1	1	1	1	1	1	1	1
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4	E	N	4	4	4	4	4	4	4	4
5	F	O	5	5	5	5	5	5	5	5
6	G	P	6	6	6	6	6	6	6	6
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5. YOUR NAME

First 4 letters of last name					FIRST INIT	MID INIT
A	A	A	A		A	A
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K	K	K	K		K	K
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V	V	V	V		V	V
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6. DATE OF BIRTH

Month	Day		Year	
JAN				
FEB	0	0	0	0
MAR	1	1	1	1
APR	2	2	2	2
MAY	3	3	3	3
JUN		4	4	4
JUL		5	5	5
AUG		6	6	6
SEP		7	7	7
OCT		8	8	8
NOV		9	9	9
DEC				

7. GENDER

MALE
FEMALE

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1.	A	B	C	D	21.	A	B	C	D	41.	A	B	C	D
2.	A	B	C	D	22.	A	B	C	D	42.	A	B	C	D
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4.	A	B	C	D	24.	A	B	C	D	44.	A	B	C	D
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6.	A	B	C	D	26.	A	B	C	D	46.	A	B	C	D
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9.	A	B	C	D	29.	A	B	C	D	49.	A	B	C	D
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14.	A	B	C	D	34.	A	B	C	D	54.	A	B	C	D
15.	A	B	C	D	35.	A	B	C	D	55.	A	B	C	D
16.	A	B	C	D	36.	A	B	C	D	56.	A	B	C	D
17.	A	B	C	D	37.	A	B	C	D	57.	A	B	C	D
18.	A	B	C	D	38.	A	B	C	D	58.	A	B	C	D
19.	A	B	C	D	39.	A	B	C	D	59.	A	B	C	D
20.	A	B	C	D	40.	A	B	C	D	60	A	B	C	D