

# Review Sheet - CP/Honors Chemistry Final

## Calculations:

1. A solution has a  $[\text{OH}^-] = 4.7 \times 10^{-4} \text{ M}$ . Calculate the pH, pOH, and  $[\text{H}^+]$ .
2. How much energy is required to melt 40.0 grams of ice at  $0^\circ\text{C}$  to liquid water at  $0^\circ\text{C}$ ?
3. How much energy is required to heat 5.00 grams of water from  $15.7^\circ\text{C}$  to  $46.0^\circ\text{C}$ ?
4. A metal has a density of  $3.87 \text{ g/cm}^3$ . What is the volume of a sample of this metal with a mass of 68.5 grams?
5. Calculate the average atomic mass of a sample of element Q which contains three isotopes as shown in the chart below:

Isotope	% abundance
Q-106	15.0%
Q-108	50.0%
Q-109	35.0%

6. Calculate the percent by mass of chlorine in  $\text{KClO}_2$ .
7. Calculate the percent water in  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .
8. Solve the following using sig figs:
  - a.  $3.50 \text{ g} + 8.4 \text{ g} =$
  - b.  $2.05 \text{ g} / 7.3 \text{ mL} =$
9. A student does a titration to determine the molarity of an unknown acid and collects the following data. The student measured three drops of phenolphthalein indicator and 25.0 mL of the acid into an Erlenmeyer flask then slowly added 0.500 M NaOH from a buret. Calculate the molarity of the acid.

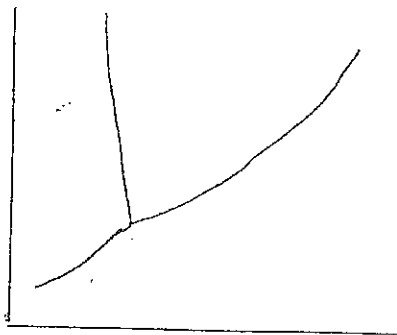
Initial volume of NaOH	15.7 mL
Final volume of NaOH	74.8 mL

10. Find the molar mass of aluminum hydroxide.
11. A sample of gas occupies 500.0 mL at 575.0 kPa and  $40.0^\circ\text{C}$ . What is the pressure if the volume was reduced to 400.0 mL and the temperature was increased to  $45.0^\circ\text{C}$ ?
12. A substance has an empirical formula of  $\text{CH}_2$  and a <sup>molar</sup> ~~molecular~~ mass of 70 ~~amu~~ g/mol. What is the molecular formula of the compound?
13. How many liters does a 50.0 gram sample of nitrogen gas occupy at STP?

## Diagrams:

14. Draw a heating curve for water. Label the phases of matter, the melting point, and the boiling point. In which intervals is the kinetic energy increasing while potential energy remains the same? In which intervals is the potential energy increasing while kinetic energy remains the same?

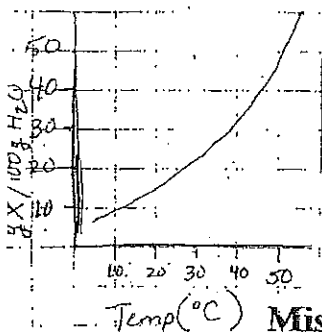
15. The following is a phase diagram.  
Label solid, liquid, gas, and triple point.



16. Draw a potential energy diagram for an endothermic process. Label the reactants, products, activated complex, activation energy, and heat of reaction ( $\Delta H$ ). Draw a dotted line showing the effect of a catalyst on the diagram.

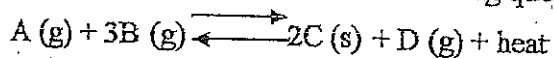
17. Using the solubility curve below, answer the questions:

- a. How many grams of solute X can dissolve in 100 grams of water at 30 °C?
- b. At what temperature can 40 grams of solute X dissolve in 200 grams of water?
- c. If 38 grams of solute X is dissolved in 100 grams of water, <sup>at 50 °C</sup> is the solution saturated, unsaturated, or supersaturated?



### Miscellaneous

18. Use the reaction below to answer the following questions:



- a. Write the equilibrium expression ( $K_{eq}$ ) for the reaction.
- b. If the temperature is increased, what will happen to the concentration of D?
- c. If the pressure is increased, in which direction will the reaction shift?
- d. If the concentration of B is increased, what will happen to the concentration of A?
19. Name two ways to increase the rate of dissolving an effervescent tablet.
20. Are the following chemical or physical changes?

- |                              |  |
|------------------------------|--|
| a. Sublimation of dry ice    | d. Reacting sodium with water                |
| b. Burning of methane        | e. Fermentation of grains to produce alcohol |
| c. Dissolving sugar in water | f. Freezing water                            |

21. For each of the physical changes occurring in #20, write an appropriate chemical equation using phase notation.
22. Is the freezing of water an endothermic or exothermic process? Is the burning of methane an endothermic or exothermic process?
23. Write the dissociation equation for  $\text{Na}_2\text{SO}_3$ .

# CP Chemistry Final Review

1. When a sample of a gas is heated at constant pressure the average kinetic energy of its molecules

- (1) decreases and the volume of the gas increases
- (2) decreases and the volume of the gas decreases
- (3) increases and the volume of the gas increases
- (4) increases and the volume of the gas decreases

2. Equal volumes of all gases at the same temperature and pressure contain an equal number of

- (1) molecules
- (2) atoms
- (3) electrons
- (4) protons

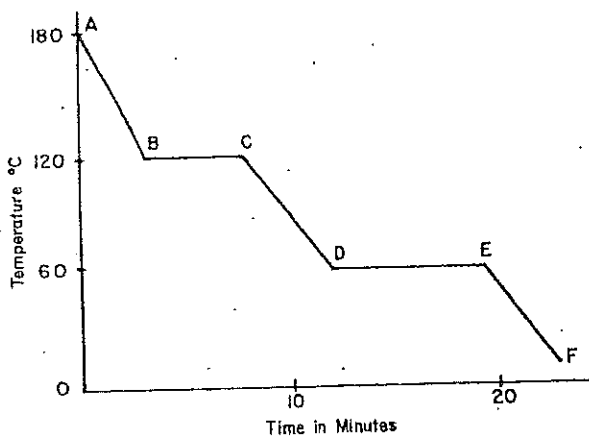
3. A sample of gas has a volume of 2.0 liters at a pressure of 1.0 atmosphere. When the volume increases to 4.0 liters, at constant temperature, the pressure will be

- (1) 1.0 atm
- (2) 2.0 atm
- (3) 0.50 atm
- (4) 0.25 atm

4. When a substance is made up of constantly vibrating particles arranged in a regular geometric pattern, the substance is classified as a

- (1) true solid
- (2) supercooled liquid
- (3) liquid
- (4) gas

5. Base your answer on the graph below, which represents uniform cooling of a sample of a pure substance, starting as a gas.



Solid and liquid phases can exist in equilibrium between points

- (1) E and F
- (2) B and C
- (3) C and D
- (4) D and E

6. Which change of phase is endothermic?

- (1)  $\text{CO}_2(\text{g}) \rightarrow \text{CO}_2(\text{s})$
- (2)  $\text{H}_2\text{O}(\text{l}) \rightarrow \text{H}_2\text{O}(\text{s})$
- (3)  $\text{I}_2(\text{s}) \rightarrow \text{I}_2(\text{g})$
- (4)  $\text{H}_2\text{O}(\text{g}) \rightarrow \text{H}_2\text{O}(\text{l})$

7. As the Group 1 (IA) elements of the Periodic Table are considered from top to bottom, the first ionization energy of each successive element decreases. One reason for this is that the

- (1) distance between the valence electron and the nucleus is increasing
- (2) number of principal energy levels is decreasing
- (3) number of neutrons is increasing
- (4) nuclear charge is decreasing

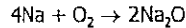
8. How does the size of an aluminum atom change when it becomes an ion with a charge of +3?

- (1) It becomes larger by losing 3 electrons.
- (2) It becomes larger by gaining 3 electrons.
- (3) It becomes smaller by losing 3 electrons.
- (4) It becomes smaller by gaining 3 electrons.

9. A compound has a molecular mass of 54 and an empirical formula of  $\text{C}_2\text{H}_3$ . What is the molecular formula of the compound?

- (1)  $\text{C}_2\text{H}_3$
- (2)  $\text{C}_4\text{H}_6$
- (3)  $\text{C}_5\text{H}_8$
- (4)  $\text{C}_6\text{H}_{10}$

Given the reaction:



How many grams of oxygen are completely consumed in the production of 1.00 mole of  $\text{Na}_2\text{O}$ ?

- (1) 16.0
- (2) 32.0
- (3) 62.0
- (4) 124

10. What is the molarity of an  $\text{H}_2\text{SO}_4$  solution if 0.25 liter of the solution contains 0.75 mole of  $\text{H}_2\text{SO}_4$ ?

- (1) 0.33 M
- (2) 0.75 M
- (3) 3.0 M
- (4) 6.0 M

11. How do the freezing and boiling points of a sample of water change when 1 mole of  $\text{NaCl}$  is dissolved in it?

- (1) The freezing point decreases and the boiling point increases.
- (2) The freezing point increases and the boiling point increases.
- (3) The freezing point decreases and the boiling point decreases.
- (4) The freezing point increases and the boiling point decreases.

12. A sample of gas occupies 15.0 liters at a pressure of 2.00 atmospheres and a temperature of 300. K. If the pressure is lowered to 1.00 atmosphere and the temperature is raised to 400. K, the volume of the gas sample would be

- (1) 5.63 L
- (2) 10.0 L
- (3) 22.5 L
- (4) 40.0 L

13. Given the same conditions of temperature and pressure, which noble gas will diffuse most rapidly?

- (1) He
- (2) Ne
- (3) Ar
- (4) Kr

14. Which quantity of salt will form a saturated solution in 100 grams of water at 45°C?

- (1) 30 g of  $\text{KCl}$
- (2) 35 g of  $\text{NH}_4\text{Cl}$
- (3) 60 g of  $\text{KNO}_3$
- (4) 110 g of  $\text{NaNO}_3$

15. If 75.0% of the isotopes of an element have a mass of 35.0 amu and 25.0% of the isotopes have a mass of 37.0 amu, what is the atomic mass of the element?

- (1) 35.0 amu
- (2) 36.0 amu
- (3) 35.5 amu
- (4) 37.0 amu

16. An atom that contains 8 protons, 8 electrons, and 9 neutrons has

- (1) an atomic number of 9
- (2) an atomic number of 16
- (3) a mass number of 17
- (4) a mass number of 25

17. An atom contains a total of 25 electrons. When the atom is in the ground state, how many different principal energy levels will contain electrons?

- (1) 1
- (2) 2
- (3) 3
- (4) 4

18. The characteristic bright-line spectrum of an element is produced when electrons

- (1) fall back to lower energy levels
- (2) are gained by a neutral atom
- (3) are emitted by the nucleus as beta particles
- (4) move to higher energy levels

20. The table below contains data for compounds A, B, C, and D.

COMPOUND	MELTING POINT (°C)	BOILING POINT (°C)	ELECTRICAL CONDUCTIVITY (state)	SOLUBILITY IN WATER
A	800.4	1413	excellent (liquid)	good
B	1710	2236	very poor (solid)	insoluble
C	42.5	216.3	poor (solid)	poor
D	1083	2542	excellent (solid)	insoluble

Which list identifies the type of bonding characteristic of each compound's solid phase?

- (1) A -ionic  
B -network  
C -metallic  
D -molecular
- (2) A -network  
B -ionic  
C -molecular  
D -metallic
- (3) A -metallic  
B -molecular  
C -network  
D -ionic
- (4) A -ionic  
B -network  
C -molecular  
D -metallic

Types of bonding

4. Which measurement contains three significant figures?

- (1) 0.05 g  
(2) 0.050 g  
(3) 0.056 g  
(4) 0.0563 g

Sig figs

6. A cube has a volume of 8.0 cm<sup>3</sup> and a mass of 21.6 grams.

22 The density of the cube, in grams per cubic centimeter, is best expressed as

- (1) 2.7  
(2) 2.70  
(3) 0.37  
(4) 0.370

density

4. Which statement best compares the atomic radius of a potassium atom and the atomic radius of a calcium atom?

- (1) The radius of the potassium atom is smaller because of its larger nuclear charge.  
(2) The radius of the potassium atom is smaller because of its smaller nuclear charge.  
(3) The radius of the potassium atom is larger because of its larger nuclear charge.  
(4) The radius of the potassium atom is larger because of its smaller nuclear charge.

Periodic trends

4. Which element is malleable and ductile?

- (1) Ge  
(2) Au  
(3) S  
(4) Si

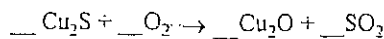
8. The elements in Period 3 all have the same number of

- (1) principal energy levels containing electrons  
(2) sublevels containing electrons  
(3) orbitals containing electrons  
(4) valence electrons

14. Which element requires the *least* amount of energy to remove its most loosely bound electron?

- (1) Li  
(2) Mg  
(3) Ba  
(4) Ca

20. When the equation



is completely balanced using smallest whole numbers the coefficient of the O<sub>2</sub> would be

- (1) 5  
(2) 2  
(3) 3  
(4) 4

balancing eqns

9. In a nonpolar covalent bond, electrons are

- (1) shared unequally by two atoms  
(2) shared equally by two atoms  
(3) located in a mobile "sea" shared by many atoms  
(4) transferred from one atom to another

Bonding

29. Compared to the boiling point of H<sub>2</sub>S, the boiling point of H<sub>2</sub>O is relatively high. Which type of bonding causes this difference?

- (1) network  
(2) ionic  
(3) hydrogen  
(4) covalent

Intermolecular forces

8. What is the correct name for the compound with the formula CrPO<sub>4</sub>?

- (1) chromium (III) phosphide  
(2) chromium (II) phosphide  
(3) chromium (III) phosphate  
(4) chromium (II) phosphate

Naming compounds

31. The total number of pairs of shared electrons in a nitrogen molecule is

- (1) 1  
(2) 2  
(3) 3  
(4) 4

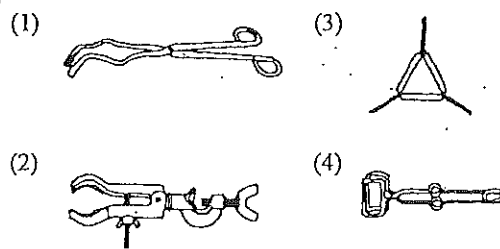
Lewis dot diagram

32. When 418 Joules of heat energy is added to 10 grams of water at 20°C, the final temperature of the water will be

- (1) 10°C  
(2) 30°C  
(3) 40°C  
(4) 100°C

Heat calculations

33. Which piece of laboratory equipment should be used to remove a heated crucible from a ringstand?



Laboratory equipment

29. Which substance is classified as an Arrhenius base?

- (1) HCl  
(2) NaOH  
(3) LiNO<sub>3</sub>  
(4) KHCO<sub>3</sub>

Acids/Bases

35. What is the pH of a 0.001 M solution of HCl?

- (1) 1  
(2) 7  
(3) 3  
(4) 11

pH calc's

36. What is the OH<sup>-</sup> ion concentration of an aqueous solution with a pH of 5?

(1) 1 × 10<sup>-5</sup> M                      (3) 1 × 10<sup>-9</sup> M  
 (2) 1 × 10<sup>-7</sup> M                      (4) 1 × 10<sup>-14</sup> M

*pH calc. at 5*

37. If 50 milliliters (ml) of a 0.01 M HCl solution is required to neutralize exactly 25 milliliters (ml) of NaOH, what is the concentration of the base?

(1) 0.01 M                              (3) 0.0005 M  
 (2) 0.02 M                              (4) 0.04 M

*Titration Calcs.*

38. Given the reaction at equilibrium:

$$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \leftrightarrow 2\text{SO}_3(\text{g}) + 44 \text{ kcal}$$

Which change will drive the reaction in the forward direction?

(1) increasing the temperature  
 (2) increasing the concentration of O<sub>2</sub>(g)  
 (3) decreasing the pressure  
 (4) decreasing the concentration of SO<sub>2</sub>(g)

Given the reaction at equilibrium:

$$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \leftrightarrow 2\text{SO}_3(\text{g}) + \text{heat}$$

Rate of the forward reaction can be increased by adding more SO<sub>2</sub> because the

(1) temperature will increase  
 (2) number of molecular collisions between reactants will increase  
 (3) reaction will shift to the left  
 (4) forward reaction is endothermic

Given the reaction

$$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \leftrightarrow 2\text{HI}(\text{g})$$

What is the correct equilibrium expression for this reaction?

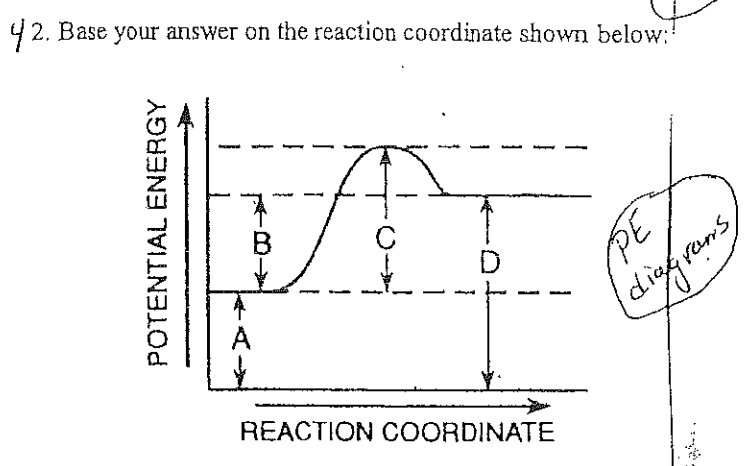
(1)  $K_{eq} = \frac{[\text{HI}]^2}{[2\text{H}] [2\text{I}]}$                       (3)  $K_{eq} = \frac{[\text{HI}]^2}{[\text{H}]^2 [\text{I}]^2}$   
 (2)  $K_{eq} = \frac{[\text{HI}]^2}{[\text{H}_2] [\text{I}_2]}$                       (4)  $K_{eq} = \frac{[\text{H}_2] [\text{I}_2]}{[\text{HI}]}$

*(K<sub>eq</sub>)*

41. Which chemical reaction will always be spontaneous?

(1) an exothermic reaction in which entropy increases  
 (2) an exothermic reaction in which entropy decreases  
 (3) an endothermic reaction in which entropy increases  
 (4) an endothermic reaction in which entropy decreases

*exo/ endo and entropy*



Which interval represents the heat of reaction

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

*LeChatelier's Principle*

43. How many moles of a gas will occupy 2.00L at 4.00atm and 30°C?

*ideal gas Law Calc.*

44. Draw a Lewis dot diagram for PCl<sub>3</sub>. Is this molecule polar or nonpolar?

*Lewis diagrams and polar/nonpolar molecules*