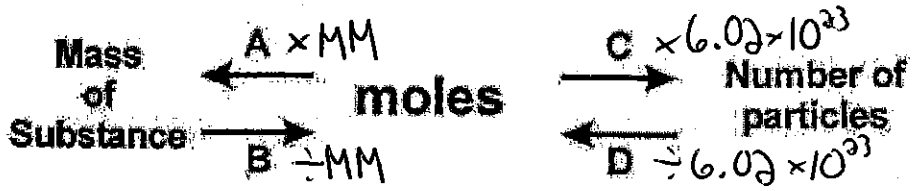
Key

CP Chemistry Final Exam Practice Problems

Short Answer

1. Label the conversion factors that best fit in the space labeled "A, B, C, D" in this diagram?



2. Given:

Mass of solid = 20.0 g
Volume of water in graduated cylinder = 10.00 ml
Volume of water + solid = 38.0 ml

Vol solid = 38 - 10 = 28 mL

What is the volume of the solid? What is the density of the object?

V = 28 mL $D = \frac{M}{V} = \frac{20\,g}{28\,mL} = 0.714\,g/mL$

3. Consider this equilibrium system at constant volume and temperature.

$$CO(s) + H_2O(g) \longleftrightarrow CO_2(g) + H_2(g)$$

What factors cause equilibrium to shift left? What factors cause equilibrium to shift right?

Shift Left
Add CO_2, Add H_2, Remove CO, Remove H_2O, ~~Increase~~ Decrease Pressure

Shift Right
Add CO, Add H_2O, Remove CO_2, Remove H_2, Increase Pressure

4. Describe a saturated solution. Describe an unsaturated solution. Describe a supersaturated solution.

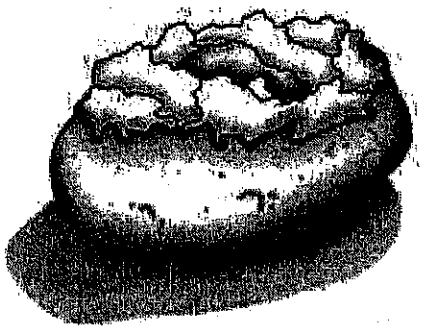
Saturated - A solution that contains the max. amount of solute.

Unsaturated - A solution that contains LESS than the maximum amount of solute.

Supersaturated - A heated solution that contains MORE than the max amount of solute

5. Calculate the energy in joules.

245 Calories



$$245\ \text{Calories}\left(\frac{1000\ \text{cal}}{1\ \text{Cal}}\right)\left(\frac{4.184\,J}{1\ \text{cal}}\right) = 1{,}025{,}080\,J$$

1025.08 kJ

6. The oxidation number of K(s) is: 0 (A neutral element).

7. Consider the following reaction:

$$P_4 + 10\ Cl_2 \rightarrow 4\ PCl_5$$

How many moles of P_4 reacts with...
2.0 mol of Cl_2?
50 grams of Cl_2?
25 liters of Cl_2at STP?

$2.0 \text{ mol } Cl_2 \left(\frac{1 \text{ mol } P_4}{10 \text{ mol } Cl_2}\right) = 5.0 \text{ mol } P_4$

$50 \text{ g } Cl_2 \left(\frac{1 \text{ mol } Cl_2}{71 \text{ g } Cl_2}\right)\left(\frac{1 \text{ mol } P_4}{10 \text{ mol } Cl_2}\right) = .0704 \text{ mol } P_4$

$25 \text{ L } Cl_2 \left(\frac{1 \text{ mol } Cl_2}{22.4 \text{ L}}\right)\left(\frac{1 \text{ mol } P_4}{10 \text{ mol } Cl_2}\right) = .112 \text{ mol } P_4$

8. What factors will in crease the rate of a chemical reaction?
Increase temp, smaller particle size, higher concentration, use of a catalyst

9. Which family of elements contains the most reactive nonmetals?
Halogens

10. How does molar mass affect the rate of diffusion in gases?
Heavier MM, the slower the gas.

11. How does Collision Theory explain the rates of chemical reactions?
Particles react when they collide, as long as they have enough energy.

12. What is the molarity of a solution containing 68.0 grams of KBr dissolved in 80 milliliters of water?
80mL = .08L

$M = \frac{\text{moles}}{L} = \frac{.571 \text{ mol}}{.08 \text{ L}} = 7.14 \text{ M}$ $\quad 68 \text{ g KBr} \div 119 \text{ g/mol} = .571 \text{ moles KBr}$

13. What volume does .0594 mol of gas occupy
at STP?
at 423K and 3.5 atm?

STP
$.0594 \text{ mol}\left(\frac{22.4 \text{ L}}{1 \text{ mol}}\right) = 1.33 \text{ L}$

@ 423K + 3.5 atm
$PV = nRT$
$(3.5 \text{ L})(V) = (.0594 \text{ mol})(.0821)(423)$
$V = .589 \text{ L}$

14. How are acids and bases defined according to...
the Arrhenius Theory?
the Bronsted Lowry Theory? → Acids H donor, Bases H acceptor
the Lewis theory?

15. What is the pH of a solutions with...
a hydrogen ion concentration is 1.0×10^{-9} M? $[H^+] = 1 \times 10^{-9}$ $pH = 9$
a hydroxide ion concentration is 1.0×10^{-10} M?
$[OH^-] = 1 \times 10^{-10}$ $pOH = 10$ $pH = 4$

16. The specific heat of water is 4.18 J/g°C. What mass of water can be heated from 40.0 °C to 75.0 °C with 1550 J?
$Q = mc\Delta t$ $\quad m = \frac{Q}{c\Delta t} = \frac{1550 \text{ J}}{(4.18 \text{ J/g°C})(35 \text{°C})} = 10.6 \text{ g}$ $\quad \Delta t = 75 - 40 = 35 \text{°C}$

17. Classify the following solutions as acid, base, or neutral..
pH=7 - Neutral
pH=2 - Acidic

pOH=7 · Neutral
pOH=2 - Basic
↳ pH= 12

18. When the expression is balanced, what is the coefficient of Mg?

$$\underset{3}{?}\ MgSO_4 + \underset{2}{?}\ Al \longrightarrow ?\ Al_2(SO_4)_3 + \underset{3}{?}\ Mg$$

19. Calculate the following to the correct number of significant figures

6.732m x 2.00m = 13.5 m^2
(4) (3) 13.464 (round to 3 sig figs)

20. How many total atoms are in $5Al_2(SO_4)_3$?

$5(2+3+12)=(17)5 = 85$ total atoms

21. Two neutral isotopes of the same element have the same number of P and E but a different number of N

22. Place these intermolecular forces in order of increasing strength:
dipole attractions Middle
dispersion forces Lowest
hydrogen bonding Greatest

23. What are the key assumptions of kinetic molecular theory?
molecules of gases - (1) Size - molecules are very small - they are very far apart - lots of empty space
(2) Particle Motion - Gas molecules are in constant, random motion.

24. Which type of reaction can be recognized by the general pattern
$A + X \rightarrow AX$? Synthesis
$AX \rightarrow A + X$? Decomposition
$A + BX \rightarrow AX + B$? Single Displacement
$AX + BY \rightarrow AY + BX$? Double Displacement
$A + O_2 \rightarrow X$? Combustion

25. What is the percent composition of sodium in NaSCN?

$$\%Na = \frac{\text{mass Na}}{\text{mass NaSCN}} \times 100 \quad \frac{23\ g/mole}{81\ g/mole} \times 100 = 28.4\%\ Na$$

26. Which are the product(s) of these chemical reactions?
$FeCl_3 + Al \rightarrow AlCl_3 + Fe$
$Fe + Cl_2 \rightarrow FeCl_3$
$FeCl_3 \rightarrow Fe + Cl_2$
$FeCl_3 + Al(NO_3)_3 \rightarrow Fe(NO_3)_3 + AlCl_3$

27. Reactants are favored at equilibrium when K_{eq} < 1
Products are favored at equilibrium when K_{eq} > 1

28. Which element has the electron configuration $1s^2 2s^2 2p^6 3s^2 3p^6$?

Argon

29. What is the unit of energy used in the...
metric system? - calorie
SI system? - Joule

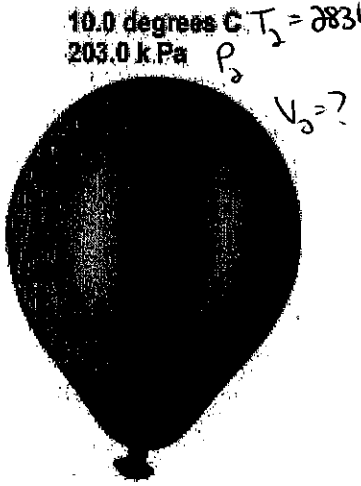
1 calorie = 4.184 J

30. What is the formula for *manganese (II) chlorite*?

Mn^{+2} ClO_2^{-1} $Mn(ClO_2)_2$

31. What is the concentration of hydroxide ions ([OH^-]) and hydrogen ions ([H+]) of a solution with...
pH = 4? $[H^+] = 1\times10^{-4}$ $[OH^-] = 1\times10^{-10}$
pOH = 4? $[OH^-] = 1\times10^{-4}$ $[H^+] = 1\times10^{-10}$

32. The volume of a sample of helium is 6.8 mL at 45.0°C and 302.0 kPa. What will its volume be in the figure?



T_2 = 283K V_1 T_1 P_1
45+273=318K P_2

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\frac{(302\,kPa)(6.8\,mL)}{318K} = \frac{(203kPa)(V_2)}{283K}$$

$V_2 = 9.00\,mL$

33. What is the oxidation number of bromine in KBr?

Br - ox # (-1)

34. Compare & contrast suspensions, solutions, and colloids.
solutions - small particles, homogeneous mixture.
colloids - medium particles, heterogeneous mixtures - scatter light
suspension - large particles that settle down when not stirred. (Heterogeneous)

35. A colligative property is a property that varies with...

Concentration of solution.

36. What are the common properties of acids? What are the common properties of bases?

Acids
- sour taste clear when phenolphthalein added
- pH < 7
- forms H_2 when mixed w/ metal
- forms CO_2 when mixed w/ carbonates.

Bases
- Bitter taste
- pH > 7
- no reaction w/ metals or carbonates
- pink w/ phenolphthalein.

37. What effect will a catalyst have on the rate of a chemical reaction? What effect will an inhibitor have on the rate of a chemical reaction?

A catalyst will lower the activation energy barrier and speed up a reaction. An inhibitor slows down a reaction.

38. What are the relationships described in the gas laws of Boyle, Charles, and Gay-Lussac?

Boyle: P↑ V↓ or P↓ V↑ Charles: V↑ T↑ or V↓ T↓ Gay-Lussac P↑ T↑ or P↓ T↓

39. Which is the name of the solid substance formed in an aqueous chemical reaction?

A Precipitate.

40. A _____ reaction is a chemical reaction that can occur in both the forward and reverse directions.

Reversible

42. Oxidation involves the _____ of electrons while reduction involves the _____ of electrons.

Loss Gain

43. An acid that can donate one hydrogen ion is called a _____ acid while an acid that can donate more than one hydrogen is called a _____ acid.

monoprotic diprotic

44. The combined gas law is represented by the equation: $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

What must remain constant for this to be true?

# of moles of a gas.

45. What volume of 0.3*M* HCl is required to neutralize 90mL of 0.5*M* NaOH?

$M_AV_A = M_BV_B$ $(.3M)(V_A) = (.5M)(90mL)$ $V_A = 150mL$

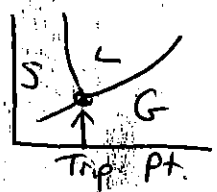
46. What are the periodic trends for atomic radius, electronegativity, and first ionization energy?

Atomic radius ↓ larger → smaller Electronegativity ↑ Ionization Energy ↓ smaller → larger

47. A solid substance that dissolves in a solvent is said to be_____ while a liquid substance that dissolves in a liquid solvent is said to be _____. A solid substance that does not dissolve in a solvent is said to be_____ while a liquid substance that does not dissolve in a liquid solvent is said to be _____.

soluble; miscible; insoluble; immiscible.

48. Draw a phase diagram for a substance and label the three phases and the triple point.



49. The erratic movement of colloid particles is called _____

Tyndall Effect.

50. Identify the acid and conjugate base pair in the following equation: $HCl + OH^- <-> H_2O + Cl^-$

Acid: HCl - Conj. Base Cl^-

51. Which is the formula for a compound that contains 129.5g nitrogen and 370.5 g oxygen.

	N	O
Mass	129.5g	370.5g
MM	14	16
moles	9.25	23.156
	9.25	9.25

N : O
(1 : 2.5) ×2
2 : 5

N_2O_5