MC, Chem2, Sum17, Test2

KEY

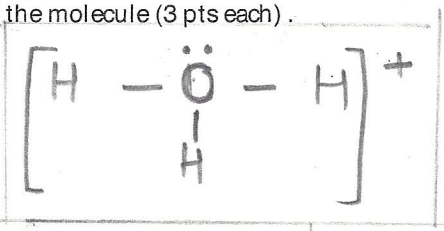
Please read all the questions VERY carefully before answering. If you do not understand any question, please ask. Use the reverse side of the question paper as scratch. Use the periodic table and constant chart in the last page. No outside paper is allowed. Total points = 50+(22x3=)66=116

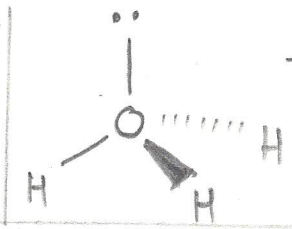
SHORT ANSWER. Please write the set-up equation first, then insert the raw data with units in the equation before doing your calculations. Points will be deducted if your answer is not clear.

1) Draw the Lewis structures (4 pts. each) of the following compounds and predict the electronic geometry of the molecule (3 pts each). 1) _____

(a) H_3O^+

$3 \times 1 + 6 - 1 = 8 - 6 = 2 - 2 = 0$

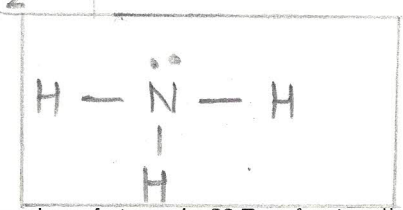


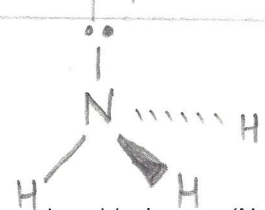


– Tetrahedral Electronic Geometry ✓

(b) NH_3

$1 \times 5 + 3 \times 1 = 8 - 6 = 2 - 2 = 0$





– Tetrahedral Electronic geometry ✓

2) Calculate the number of atoms in 39.7 g of naturally occuring chlorine gas (Note the formula of chlorine). (6 pts.) 2) 6.74×10^{23} Cl atoms

$$39.7 \text{ g } Cl_2 \times \frac{1 \text{ mol } Cl_2}{70.90 \text{ g } Cl_2} \times \frac{2 \text{ mol Cl}}{1 \text{ mol } Cl_2} \times \frac{6.022 \times 10^{23} \text{ Cl atoms}}{1 \text{ mol Cl}}$$ ✓

$= 6.7439 \times 10^{23}$ Cl atoms

$= 6.74 \times 10^{23}$ Cl atoms

∴ There are 6.74×10^{23} atoms of Chlorine in 39.7 g of naturally occuring chlorine gas

3) Calculate the amount (in grams) of potassium in a 42.7 gram sample of potassium nitrate. (10 pts.) 3) 16.5 g K

$$42.7 \text{ g } KNO_3 \times \frac{1 \text{ mol } KNO_3}{101.11 \text{ g } KNO_3} \times \frac{1 \text{ mol K}}{1 \text{ mol } KNO_3} \times \frac{39.10 \text{ g K}}{1 \text{ mol K}}$$ ✓

$= 16.512$ g K

$= 16.5$ g K

∴ There is 16.5 g of potassium in a 42.7 g sample of potassium nitrate

4) Show your calculation to determine the empirical formula of a compound that is composed 40.92% C, 4.58% H, and 54.50% O. (8 pts.)

4) $C_3H_4O_3$ ~~$C_2H_3O_2$~~

Assuming a 100 g sample of the compound

C → 40.92 g

H → 4.58 g

O → 54.50 g

converting grams to moles of elements,

$40.92\ g\ C \times \frac{1\ mol\ C}{12.01\ g\ C} = 3.41\ mol\ C$

$4.58\ g\ H \times \frac{1\ mol\ H}{1\ g\ H} = 4.58\ mol\ H$

$54.50\ g\ O \times \frac{1\ mol\ O}{16\ g\ O} = 3.41\ mol\ O$

Dividing by the least moles,

$C \rightarrow \frac{3.41}{3.41} = 1$, $H = \frac{4.58}{3.41} = 1.34$ ~~1.5~~ $O = \frac{3.41}{3.41} = 1$

Thus, $C_1H_{1.34}O_1 \rightarrow C_3H_4O_3$

∴ The empirical formula of the compound will be ~~$C_2H_3O_2$~~ $C_3H_4O_3$

5) A gas tank is is maintained at 2.20 atm pressure. If the volume of the gas in the tank is 3250.0 m^3, at - 15°C then what is the volume (in m^3) of the same quantity of the gas at 31°C. (6 pts.)

5) 3829.46 m^3

Using combined gas law,

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

But Pressure is maintained at 2.20 atm

∴ $P_1 = P_2$

∴ $\frac{V_1}{T_1} = \frac{V_2}{T_2}$

$V_1 = 3250.0$ $T_1 = -15°C$, $T_2 = 31°C$

∴ $\frac{3250.0}{(273-15)} = \frac{V_2}{(273+31)}$

∴ $\frac{3250.0}{258} \times 304 = V_2$

∴ $V_2 = 3829.46\ m^3$

∴ the volume of the gas will be 3829.46 m^3

6) Calculate the mass in grams of $K_2Cr_2O_7$ needed to make 250.0 mL of a 0.5 M $K_2Cr_2O_7$ solution (6 pts.)

6) 36.8 g $K_2Cr_2O_7$

Moles $K_2Cr_2O_7$ = $0.5\ M\ K_2Cr_2O_7 \times 250.0\ mL \times \frac{1\ L}{1000\ mL}$

$= 0.125$ Mol. $K_2Cr_2O_7$

$0.125\ Mol\ K_2Cr_2O_7 \times \frac{294.2\ g\ K_2Cr_2O_7}{1\ mol\ K_2Cr_2O_7}$

$= 36.775\ g\ K_2Cr_2O_7$

$= 36.8\ g\ K_2Cr_2O_7$

MULTIPLE CHOICE. On scantron, answer the questions starting from number 8. Choose the one alternative that best completes the statement or answers the question. (3 poins each)

7) What is the mass percent of hydrogen in water? 7) B

A) 88.8
B) 11.2
C) 33.3
D) 5.60
E) none of the above

8) What is the formula mass for diboron tetrachloride? 8) B

A) 198.89 amu
B) 163.43 amu
C) 127.98 amu
D) 234.34 amu
E) none of the above

$2 \times 10.81 + 4 \times 35.45$

$= 163.43$ amu

9) You have 10.0 g each of Na, C, Pb, Cu and Ne. Which contains the smallest number of moles? 9) C

A) Ne B) Na C) Pb D) C E) Cu

10) How many moles of carbon are in 3.5 moles of calcium carbonate? 10) B

A) 7
B) 3.5
C) 100.09
D) 10.5
E) none of the above

$3.5 \text{ mol } CaCO_3 \times \frac{1 \text{ mol } C}{1 \text{ mol } CaCO_3} = 3.5 \text{ mol } C$

11) What is the value of n when the empirical formula is C_3H_5 and the molecular mass is 205.4 g/mol? 11) B

A) 140
B) 5
C) 10
D) 0.02
E) none of the above

12) Evaporation is: 12) E

A) an endothermic process.
B) the opposite process as condensation.
C) a cooling process for humans when they sweat.
D) increased by increasing temperature.
E) all of the above

13) What is the heat of vaporization (kJ/mol) if it takes 3,452 J of heat to completely vaporize 2.68 moles of the liquid at its boiling point? 13) C

A) 1288
B) 0.776
C) 1.29
D) 12.2
E) none of the above

$q = \Delta H_{vap} \times \text{moles}$

$\frac{3452}{1000} = \Delta H_{vap} \times 2.68$

$\therefore \Delta H_{vap} = \frac{3452}{2.68 \times 1000}$

$\therefore \Delta H_{vap} = 1.288$ kJ/mol

$= 1.29$ kJ/mol

14) Which intermolecular force increases with increasing molar mass? 14) ~~D~~ C

A) hydrogen bonding
B) X- forces
C) dispersion forces
D) dipole- dipole forces
E) none of the above

15) Which molecule below has hydrogen bonding? 15) B

A) HCl
B) CH_3CH_2OH
C) H_2
D) CH_4
E) all of the above

16) If each of the following gas samples have the same temperature and pressure, which sample has the greatest volume? 16) B

A) 1 gram of O_2
B) 1 gram of H_2
C) all have the same volume
D) 1 gram of Ar
E) not enough information

17) A sample of helium gas initially at 37.0°C, 785 torr and 2.00 L was heated to 58.0°C while the volume expanded to 3.24 L. What is the final pressure in atm? 17) C

A) 517
B) 1.79
C) 0.681
D) 3.21
E) none of the above

18) A 3.76 g sample of a noble gas is stored in a 2.00 L vessel at 874 torr and 25°C. What is the noble gas? (R= 0.0821 L atm/ mol K) 18) C

A) He
B) Ne
C) Ar
D) Kr
E) not enough information

19) Which of these compounds would you expect to be *least* soluble in water? 19) C

A) NaCl
B) CH_3OH
C) N_2
D) NH_3
E) not enough information

20) We dissolve 2.45 g of sugar in 200.0 g water. What is the mass percent of sugar in the solution? 20) C

A) 2.42%
B) 1.23%
C) 1.21%
D) 123%
E) none of the above

21) What is the molarity of a solution prepared by dissolving 10.7 g NaI in 0.250 L? 21) A

A) 0.286
B) 42.8
C) 2.86×10^{-4}
D) 0.0714
E) none of the above

TRUE/FALSE. On scantron, choose "A" for a true answer and "B" for wrong answer. (3 points each)

22) The mole has a value of 6.023×10^{22}. 22) B

23) The mass of 2.0 moles of H_2O is greater than the mass of 1.0 mole of CO_2. 23) B

24) Pressure is calculated by: $P = \frac{\text{Area}}{\text{Force}}$. 24) B

25) Absolute zero refers to 0°C. 25) B

26) The volume of a gas and the number of particles is inversely proportional. 26) B

27) The minor component in a solution is called the solvent. 27) B

28) Ionic solutes typically dissolve in nonpolar solvents. 28) B