

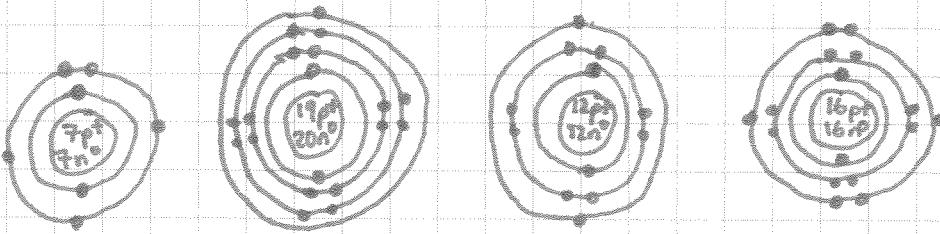
# SCH 3UI EXAM REVIEW #2

①

## UNIT 1: MATTER & BONDING

1. a)  $\cdot \ddot{\text{Br}} \cdot$  b)  $\cdot \ddot{\text{N}} \cdot$  c)  $\dot{\text{K}}$  d)  $\ddot{\text{Mg}}$  e)  $\cdot \ddot{\text{S}} \cdot$

B-R not appropriate



2. a)  $\text{ClO}_3^-$  (aq) b)  $\text{NH}_4^+$  (aq) c)  $\text{HCO}_3^-$  (aq) d)  $\text{ClO}_4^-$  (aq) e)  $\text{Cr}_2\text{O}_7^{2-}$  (aq)

3. a) Mg, Br, Se, Zn, Ca, I  
 b) I, Ca, Zn, Se, Br, Mg  
 c) I, Ca, Zn, Se, Br, Mg

4. a) sodium bromide, b) magnesium sulphide, c) copper(I) hydroxide  
 d) tin(II) chloride e) potassium sulphite f) sulphur trioxide  
 g) arsenic trichloride h) nitrogen monoxide i) carbon tetrachloride  
 j) diphosphorus pentoxide k) hydrogen chloride l) nitric acid m) sulphurous acid  
 n) lead(IV) hydroxide

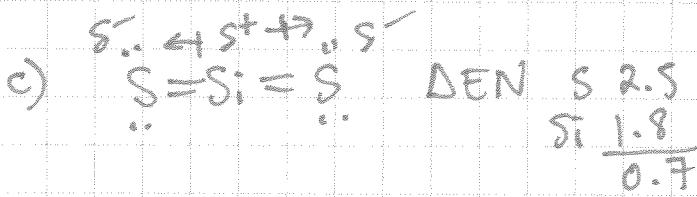
5. a)  $\text{NaF}$  b)  $\text{CaCl}_2$  c)  $\text{Hg}_2\text{O}$  d)  $\text{KCN}$  e)  $\text{Ni}(\text{ClO}_4)_2$  f)  $(\text{NH}_4)_2\text{SO}_4$   
 g)  $\text{Ba}_3(\text{PO}_4)_2$  h)  $\text{Mg}_3\text{S}_2$  i)  $\text{HBr}$  (aq) j)  $\text{H}_3\text{PO}_3$  (aq) k)  $\text{KClO}_4$  (aq)  
 l)  $\text{Cu}(\text{OH})_2$  (aq)



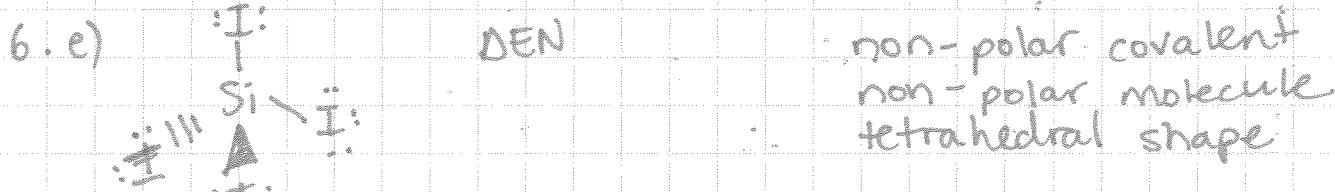
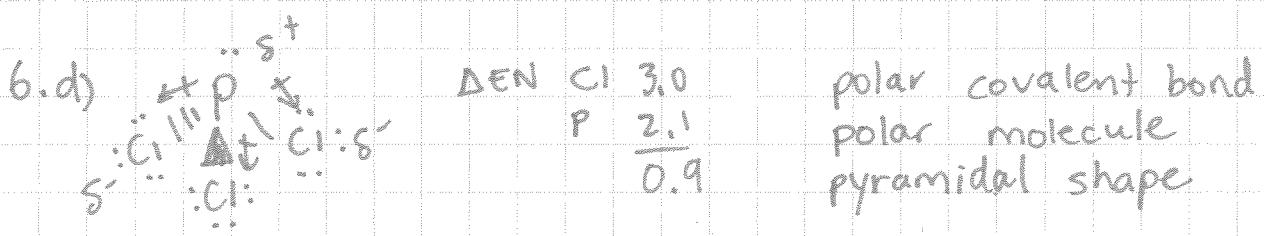
polar-bond  
 non-polar molecule  
 bent shape



pure covalent bond  
 non-polar molecule  
 linear



polar bond  
 non-polar molecule  
 linear



7.a) dispersion forces

b) dipole-dipole

c) H-bonding

(3)

## UNIT 2: CHEMICAL REACTIONS

8. Balance the following equations and identify the type of reaction.

TYPE:

synthesis

double displacement

single displacement

double displacement

single displacement

s.

s. .

s.

d.d.

d.d.

d.d.

s.

s.

d.d.

s.

s.

s.

s.

s.

c.c.

d.d.

c.c.

c. c. c/s

c.c.

s.d.

9. What are the three clues that a double displacement reaction has occurred?

→ precipitate forms

→ gas forms

→ water is made

10. a) What is the relationship between reactivity of metals and EN values?  $\downarrow \text{EN} = \uparrow \text{reactivity}$ b) What is the relationship between reactivity of non-metals and EN values?  $\uparrow \text{EN} = \uparrow \text{reactivity}$

## UNIT 3: QUANTITIES IN CHEMICAL REACTIONS

(4)

11. let  $x$  represent the amount of U-235  
 let  $1-x$  represent the amount of U-239

$$\text{avg. atomic mass} = \frac{(\text{amt U-235})(\text{mass U-235}) + (\text{amt U-239})(\text{mass U-239})}{\text{mass}}$$

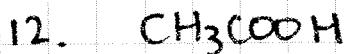
$$238.05 = (x)(235) + (1-x)(239)$$

$$238.05 = 235x + 239 - 239x$$

$$4x = 0.95$$

$$x = 0.2375$$

$\therefore$  23.75% is U-235 & 76.25% is U-239



$$\begin{aligned} n &= \frac{m}{M} \\ &= \frac{400\text{g}}{60.06\text{g/mol}} \\ &= 6.66 \text{ mol CH}_3\text{COOH} \end{aligned}$$

$$\begin{aligned} N &= n N_A \\ &= (6.66\text{mol})(6.02 \times 10^{23}) \\ &\approx 4.01 \times 10^{24} \text{ molecules} \end{aligned}$$

$$\begin{aligned} \text{Atoms} &= n N_A \times 8 \\ &= (4.01 \times 10^{24}) / (8) \\ &\approx 3.21 \times 10^{25} \text{ atoms} \end{aligned}$$

$\therefore$  there are 6.66 mol,  $4.01 \times 10^{24}$  molecules, &  $3.21 \times 10^{25}$  atoms in the sample.

13. Assume a 1 mol sample

$$\begin{aligned} \% \text{Fe} &= \frac{m_{\text{Fe}}}{m_{\text{Fe}_2\text{O}_3}} \times 100 \\ &= \frac{111.7\text{g}}{159.7\text{g}} \times 100 \\ &= 69.94\% \text{ Fe} \end{aligned}$$

$$\begin{aligned} \% \text{O} &= \frac{m_{\text{O}}}{m_{\text{Fe}_2\text{O}_3}} \times 100 \\ &= \frac{48.2}{159.7\text{g}} \times 100 \\ &= 30.06\% \text{ O} \end{aligned}$$

$\therefore \text{Fe}_2\text{O}_3$  is 69.94% Fe & 30.06% O by mass.

$$14. m_{Sn} = \frac{m_{\text{sample}} \times \% \text{ Sn}}{100} \quad m_{Sb} = \frac{m_{\text{sample}} \times \% \text{ Sb}}{100} \quad m_{Pb} = \frac{m_{\text{sample}} \times \% \text{ Pb}}{100}$$

$$= \frac{(500g)(10)}{100} \quad = \frac{(500g)(16\%)}{100} \quad = \frac{(500g)(74)}{100}$$

$$= 50 \text{ g Sn} \quad = 80 \text{ g Sb} \quad = 370 \text{ g Pb}$$

$\therefore$  the 500g sample would contain 50g Sn, 80g Sb, & 370g Pb.

15. Assume a 100g sample

$$n_C = \frac{m_C}{M}$$

$$= \frac{80 \text{ g}}{12.01 \text{ g/mol}}$$

$$\therefore \frac{6.667 \text{ mol C}}{6.667 \text{ mol}}$$

$$\therefore 1 : 3$$

$\therefore$  the EF is  $\text{CH}_3$

$$n_H = \frac{m_H}{M}$$

$$= \frac{20 \text{ g}}{1.01 \text{ g/mol}}$$

$$= \frac{19.801 \text{ mol H}}{6.667 \text{ mol}}$$

$$\rightarrow \text{multiple} = \frac{M_{MF}}{M_{EF}}$$

$$= \frac{60 \text{ g/mol}}{15.04 \text{ g/mol}}$$

$$\therefore 4$$

$\therefore$  the MF is  $\text{C}_4\text{H}_{12}$

$$16. m_{\text{CuCl}_2} = 2.69 \text{ g}$$

$$n_{\text{CuCl}_2} = \frac{m}{M}$$

$$= \frac{(2.69 \text{ g})}{(134.45 \text{ g/mol})}$$

$$= \frac{0.020 \text{ mol CuCl}_2}{0.020}$$

$$1 : 2$$

$$m_{\text{H}_2\text{O}} = m_{\text{hydrate}} - m_{\text{anhydrous}}$$

$$= 3.41 \text{ g} - 2.69 \text{ g}$$

$$= 0.72 \text{ g}$$

$$n_{\text{H}_2\text{O}} = \frac{m}{M}$$

$$= \frac{0.72 \text{ g}}{18.02 \text{ g/mol}}$$

$$\therefore \frac{0.03996 \text{ mol H}_2\text{O}}{0.020}$$

$\therefore$  the hydrate is  $\text{CuCl}_2 \cdot 2\text{H}_2\text{O}$



(6)

$$\begin{aligned} n_{\text{C}_2\text{H}_4\text{O}} &= \frac{m}{M} \\ &= \frac{890\text{ 000 g}}{44.06\text{ g/mol}} \\ &\approx 20 181 \text{ mol C}_2\text{H}_4\text{O} \end{aligned}$$

$$\begin{aligned} n_{\text{H}_2\text{O}} &= \frac{m}{M} \\ &= \frac{400\text{ 000 kg}}{18.02\text{ g/mol}} \\ &\approx 22 198 \text{ mol H}_2\text{O} \end{aligned}$$

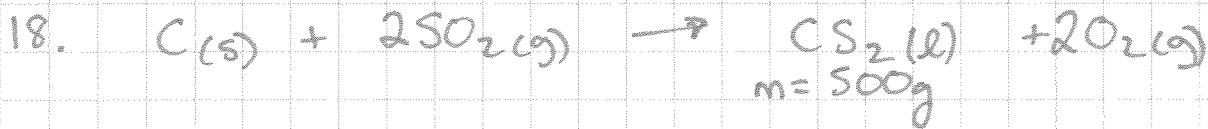
$$\frac{1 \text{ mol C}_2\text{H}_4\text{O}}{383142 \text{ mol}} = \frac{1 \text{ mol HOCH}_2\text{CH}_2\text{OH}}{x}$$

$$x = 383142 \text{ mol HOCH}_2\text{CH}_2\text{OH}$$

$$\frac{1 \text{ mol H}_2\text{O}}{22198 \text{ mol}} = \frac{1 \text{ mol HOCH}_2\text{CH}_2\text{OH}}{x}$$

$$x = 22198 \text{ mol H}_2\text{O}$$

∴ water is the limiting reagent.



$$\begin{aligned} \text{TY} &= \frac{(\text{AY})(\text{PY})}{100} \\ &= \frac{(500\text{ g})(86\%)}{100} \\ &= 430\text{ g} \end{aligned}$$

∴ the theoretical yield of  $\text{CS}_2$  would be 430g.

#### UNIT 4: SOLUTIONS & SOLUBILITY

19. ① - break intra molecular forces of ions or intermolecular forces of sugar (SOLUTE) requires energy
- ② - break intermolecular forces of water (SOLVENT) requires energy
- ③ - attract solute & solvent releases energy

(7)

$$20. \frac{m}{M} = \frac{n}{V}$$

$$= \frac{(1.00g)}{(85g/mol)}$$

$$= \frac{(0.011764)}{(0.315)}$$

$$\checkmark = 0.037M$$

$$\therefore [NaNO_3] \text{ is } 0.037M$$

$$21. C_2 = \frac{C_1 V_1}{V_2}$$

$$= \frac{(4.00)(0.080)}{(0.400)}$$

$$= 0.800M$$

$$\therefore [H_2SO_4] \text{ is } 0.8M$$

$$22. \textcircled{A} V_{room} = l \times w \times h$$

$$= (5)(4)(3)$$

$$= 60m^3$$

$$\textcircled{B} m_{air} = DV$$

$$= (1.22\text{kg/m}^3)(60\text{m}^3)$$

$$= 73.2\text{kg}$$

$$\textcircled{C} m_{solute} = \frac{(ppm)(m_{sol})}{10^6}$$

$$= \frac{(0.12)(73200)}{10^6}$$

$$= 8.78 \times 10^{-3} \text{ g}$$

$$\textcircled{D} n_{O_3} = \frac{m}{M}$$

$$= \frac{(8.78 \times 10^{-3})}{(48)}$$

$$= 1.83 \times 10^{-4} \text{ mol O}_3$$

$$\textcircled{E} V = \frac{nRT}{P}$$

$$= \frac{(1.83 \times 10^{-4})(8.314)(298)}{(100)}$$

$$= 0.0045 \text{ L}$$

$\therefore 0.0045 \text{ L}$  of ozone are in the room.



$$24. \quad [\text{H}_3\text{O}^+] = 10^{-\text{pH}} \\ = 1.0 \times 10^{-5} \text{ M}$$

$$\Rightarrow [\text{OH}^-] = 10^{-\text{pOH}}$$

$$= 10^{-9}$$

$$= 1.0 \times 10^{-9} \text{ M}$$

(8)

$$\text{pOH} = 14 - \text{pH}$$

$$= 14 - 5$$

$$= 9$$

$\therefore [\text{H}_3\text{O}^+]$  is  $1 \times 10^{-5} \text{ M}$ ;  $[\text{OH}^-]$  is  $1 \times 10^{-9} \text{ M}$  in a solution with a pH of 5



26. Volume added

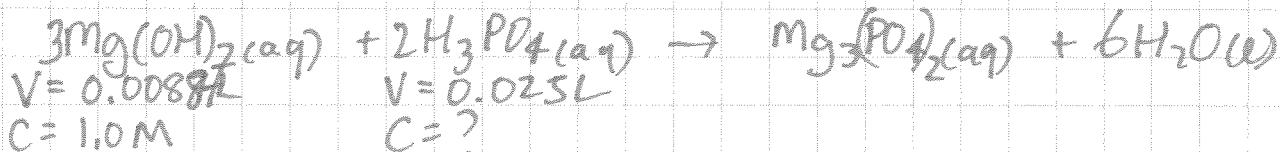
$$\#1 \quad 12.1 - 3.2 = 8.9 \text{ mL}$$

$$V_{\text{av}} = \frac{\text{trial 1} + 2 + 3}{3}$$

$$\#2 \quad 20.9 - 12.1 = 8.8 \text{ mL}$$

$$= 8.87 \text{ mL}$$

$$\#3 \quad 29.8 - 20.9 = 8.9 \text{ mL}$$



$$\begin{aligned} n \text{ Mg}(\text{OH})_2 &= CV \\ &= (1.0 \text{ M})(0.0087 \text{ L}) \\ &= 0.0087 \text{ mol Mg}(\text{OH})_2 \end{aligned}$$

$$\Rightarrow C = \frac{n}{V} \\ = \frac{(5.913 \times 10^{-3} \text{ mol})}{(0.025 \text{ L})}$$

$$= 0.24 \text{ M}$$

$$\underline{3 \text{ mol Mg}(\text{OH})_2} = \underline{2 \text{ mol H}_3\text{PO}_4}$$

$0.0087 \text{ mol}$        $x$

$$\therefore [\text{H}_3\text{PO}_4] \text{ is } 0.24 \text{ M}$$

$$x = 5.913 \times 10^{-3} \text{ mol H}_3\text{PO}_4$$

## UNIT 5 : GASES & ATMOSPHERES

$$27. \quad \frac{V_1}{T_1} = \frac{V_2}{T_2}$$

$$T = 273 + 27^\circ\text{C}$$

$$T_1 = 300 \text{ K}$$

$$T_2 = \frac{V_2 T_1}{V}$$

$\therefore$  the temp must be 200K.

$$= \frac{2/3(300)}{11}$$

$$= 200 \text{ K} = -73^\circ\text{C}$$

$$28. \frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

$$\begin{aligned} V_2 &= \frac{P_1V_1T_2}{T_1P_2} \\ &= \frac{(55\text{cm}^3)(780\text{mmHg})(303\text{K})}{(298\text{K})(750\text{mmHg})} \\ &\approx 58.2\text{cm}^3 \end{aligned}$$

$\therefore$  its volume will be  $58.2\text{cm}^3$

$$29. n = \frac{PV}{RT}$$

$$= \frac{(100\text{kPa})(1\text{L})}{(8.314)(298\text{K})}$$

$$= 0.0404\text{ mol}$$

$$\begin{aligned} M &= \frac{m}{n} \\ &= \frac{2.05\text{g}}{0.0404\text{mol}} \\ &= 50.79\text{g/mol} \end{aligned}$$

$\therefore$  the molar mass is  $50.79\text{g/mol}$



$$\begin{aligned} n_{\text{H}_2} &= \frac{m}{M} \\ &= \frac{(1\text{g})}{(2.02\text{g/mol})} \\ &\approx 0.495\text{ mol H}_2 \end{aligned}$$

$$\begin{aligned} \frac{2\text{ mol H}_2}{0.495\text{ mol}} &= \frac{1\text{ mol O}_2}{x} \\ x &\approx 0.248\text{ mol O}_2 \\ m &= n M \\ &= (0.248)(32\text{g/mol}) \\ &= 7.92\text{ g O}_2(\text{g}) \end{aligned}$$

$\therefore 7.92\text{ g of O}_2$  would be required.

(9)

31.  $P_{O_2} = P_{\text{total}} - P_{H_2O}$

$$= 100.2 \text{ kPa} - 2.2 \text{ kPa}$$

$$= 98 \text{ kPa}$$

$n = \frac{PV}{RT}$

$$= \frac{(98 \text{ kPa})(0.375 \text{ L})}{(8.314)(292 \text{ K})}$$

$$= 0.01514 \text{ mol O}_2$$

$T = 19^\circ\text{C} + 273$

$$=$$

$m = nM$

$$= (0.01514 \text{ mol})(32 \text{ g/mol})$$

$$= 0.48 \text{ g}$$

$\therefore$  the mass of  $O_2$  is 0.48 g



$$\frac{1 \text{ L } C_7H_{16}}{10 \text{ L}} = \frac{11 \text{ L } O_2}{x}$$

$$x = 110 \text{ L } O_2$$

$\therefore 110 \text{ L}$  of  $O_2$  is required

b)  $n_{CO_2} = \frac{m}{M}$

$$= \frac{200 \text{ g}}{44.01 \text{ g/mol}}$$

$$= 4.544 \text{ mol CO}_2$$

$\therefore 65.07 \text{ g}$  of  $C_7H_{16}$  was burned.

$$\frac{7 \text{ mol } CO_2}{4.544 \text{ mol}} = \frac{1 \text{ mol } C_7H_{16}}{x}$$

$$x = 0.6492 \text{ mol } C_7H_{16}$$

$$m = nM$$

$$= (0.6492 \text{ mol})(100.23 \text{ g/mol})$$

$$= 65.07 \text{ g } C_7H_{16}$$

c)  ~~$n_{H_2O} = \frac{PV}{RT}$~~

 ~~$\frac{n_1}{V_1} = \frac{n_2}{V_2}$~~ 
 ~~$\frac{101.3}{25} = \frac{18.41}{V_2}$~~ 
 ~~$V_2 = \frac{18.41 \times 25}{101.3} = 4.52 \text{ L}$~~

$$n_{H_2O} = \frac{PV}{RT}$$

$$= \frac{(101.3)(300)}{(8.314)(273)}$$

$$= 13.39 \text{ mol H}_2O$$

$$\frac{8 \text{ mol } H_2O}{13.39 \text{ mol}} = \frac{11 \text{ mol } O_2}{x}$$

$$x = 18.41 \text{ mol O}_2$$

$$m = nM$$

$$= (18.41 \text{ mol})(32 \text{ g/mol})$$

$$= 589 \text{ g of O}_2$$

$\therefore 589 \text{ g}$  of  $O_2$  is required

(10)

$$33. \quad 0.43 \text{ atm} \times \frac{101.3 \text{ kPa}}{1 \text{ atm}}$$

$$= 43.56 \text{ kPa}$$

$$0.43 \text{ atm} \times 760 \text{ mmHg}$$

$$= 326.8 \text{ mmHg}$$

(1)

$$0.43 \text{ atm} \times 760 \text{ torr}$$

$$= 326.8 \text{ torr}$$

∴ 0.43 atm is equivalent to 43.56 kPa, 326.8 mmHg & torr.