

- | | | |
|-------------|-------------|-------------|
| 1. A ● C D | 17. ● B C D | 33. A ● C D |
| 2. A B ● D | 18. A B C ● | 34. A ● C D |
| 3. A ● C D | 19. A B C ● | 35. A B ● D |
| 4. A ● C D | 20. A ● C D | 36. A B ● D |
| 5. A B ● D | 21. A B ● D | 37. A ● C D |
| 6. A B C ● | 22. A B C ● | 38. A B ● D |
| 7. ● B C D | 23. A ● C D | 39. ● B C D |
| 8. A B C ● | 24. A B ● D | 40. A B ● D |
| 9. A B ● D | 25. A B ● D | |
| 10. A B C ● | 26. A B ● D | |
| 11. A ● C D | 27. A B ● D | |
| 12. ● B C D | 28. A B ● D | |
| 13. A B C ● | 29. ● B C D | |
| 14. ● B C D | 30. ● B C D | |
| 15. A B C ● | 31. A ● C D | |
| 16. A B C ● | 32. A B C ● | |

S.A = 40

L:A = 60
100

Part 'B'

show work where possible , all answers should be in scientific notation whenever possible . MARKS will be given for all questions attempted which are partially correct (60 marks)

- 1) Given the following information about water being heated from 50°C. to 120 °C

Heat of Vaporization	9.7 Kcal / mole
Specific Heat of liquid water	1 cal / gram°C
Specific Heat of gaseous water	0.5 cal / gram°C
Mass of water	36.0 grams

Find the total number of calories needed to heat the 36 grams of water from liquid water at 50°C. to gaseous water at 120 °C (3)

STEP 1 50°C - 100°C	STEP 2 BOILING	STEP 3 100°C - 120°C
$\begin{aligned} \text{Cal} &= SH \cdot M(g) \cdot \Delta t \\ &= 1.0 \cdot 36 \cdot 50 \\ &\approx 1800 \text{ cal} \end{aligned}$	$\begin{aligned} K\text{Cal} &= \frac{9.7 \text{ Kcal}}{2} \cdot \Delta H_2O \\ &= 9.7 \cdot 2 \\ &= 19.4 \text{ Kcal} \\ &= 19400 \text{ cal} \end{aligned}$	$\begin{aligned} \text{Cal} &= SH \cdot m(g) \cdot \Delta t \\ &= 0.5 \cdot 36 \cdot 20 \\ &\approx 360 \text{ cal} \\ &2,1560 \times 10^4 \text{ cal} \\ 1800 + 19400 + 360 &= \underline{\underline{2,1560 \text{ Calories}}} \end{aligned}$

- 2) WHY DO FARMERS SPRAY WATER ON THEIR CROPS WHEN THERE IS A CHANCE OF FROST ? (1)

Because the water will moderate the effect of the drop in temperature by giving off heat as it cools, so the crops will take in this heat and not freeze.

- 3) How much KCl will be precipitated from a 350 ml saturated solution of KCl at 90°C. if the temperature is lowered to 10 °C (2)

$$\text{at } 90^\circ\text{C} = 54 \text{ g KCl / 100 mL of water}$$

$$\therefore \text{at } 90^\circ\text{C} = 189 \text{ g KCl / 350 mL of water}$$

~~$$\text{at } 10^\circ\text{C} = 29 \text{ g KCl / 100 mL of water}$$~~

~~$$\text{at } 10^\circ\text{C} = 101.5 \text{ g KCl / 350 mL of water}$$~~

$$189 \text{ g} - 101.5 \text{ g} = \underline{\underline{87.5 \text{ g ppt.}}}$$

$$8.75 \times 10^{-1} \text{ g ppt.}$$

4) GIVE CORRECT CHEMICAL FORMULAS FOR EACH OF THE FOLLOWING :

- a) Aluminum perchlorate $\text{Al}(\text{ClO}_4)_3$
b) Hypophosphorous acid H_3PO_2
c) Ammonia NH_3
d) Tetrabromine pentaoxide Br_4O_5
e) Hydrotelluric acid H_2Te
f) Zirconium(V)nitrite $\text{Zr}(\text{NO}_2)_5$
g) Chlorous acid HClO_2
h) Chromium(III)dichromate $\text{Cr}_2(\text{Cr}_2\text{O}_7)_3$

(8 x 1/2)

5) EXPLAIN WITH AN EXAMPLE OF EACH THE DIFFERENCE BETWEEN AN IONIC AND MOLECULAR (COVALENT) BOND .

(2)

In an ionic bond, the non-metal ~~atom~~ gives electrons to the non-metal, until each fulfills its outer shell. A covalent bond involves 2 non-octet that share electrons in order to fill their outer shells.
Ionic bond = NaCl
Covalent bond = Cl_2O

6) FIND THE VOLUME OF THE FOLLOWING AT S.T.P. ;

(2)

a) 2.24×10^{24} MOLECULES OF CARBON DIOXIDE

$$2.24 \times 10^{24} \left(\frac{22.4}{6.02 \times 10^{23}} \right) = 83.349 \text{ L} = 8.33 \times 10^1 \text{ L}$$

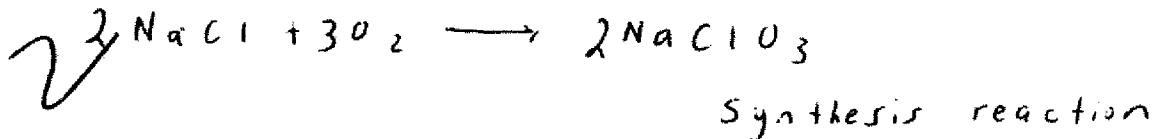
b) 8.25 GRAMS OF OXYGEN GAS

$$8.25 \text{ g } \text{O}_2 \left(\frac{22.4 \text{ L}}{32 \text{ g } \text{O}_2} \right) = 5.775 \text{ L}$$

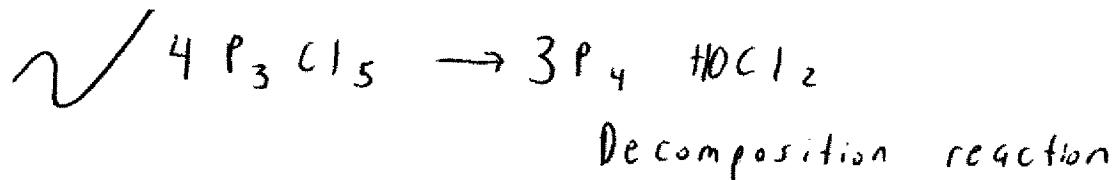
7) BALANCE THE FOLLOWING COMPLETELY. TELL WHAT TYPE OF REACTION EACH IS.

(3 x 2)

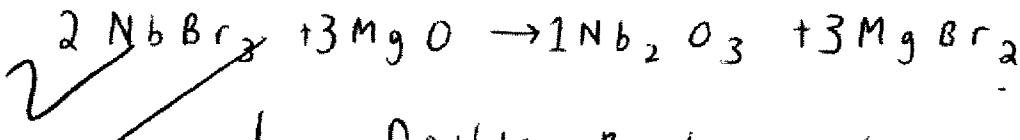
a) SODIUM CHLORIDE + OXYGEN =====> SODIUM CHLORATE



b) TRIPHOSPHOROUS PENTACHLORIDE =====> PHOSPHOROUS + CHLORINE



c) NIOBIUM (III)BROMIDE + MAGNESIUM OXIDE=====>
NIOBIUM (III) OXIDE + MAGNESIUM BROMIDE



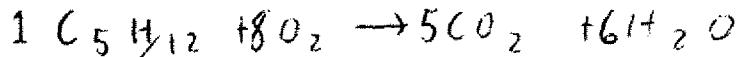
Double Replacement reaction

8) FOR THE COMPLETE COMBUSTION OF 3.5 Kg. of PENTANE (C_5H_{12})

FIND THE FOLLOWING:

a) BALANCE THE EQUATION

(1)



b) NUMBER OF MOLES PENTANE PRESENT

(1)

$$\checkmark 3500 \text{ g} \left(\frac{1 \text{ mol}}{12 \text{ g}} \right) = 26.515 \text{ mol} \quad C_5H_{12} = 5 \cdot 12 + 12 \cdot 1 \\ 7.2 \text{ g mol}^{-1}$$

c) MOLES OXYGEN REQUIRED BY THE COMBUSTION OF 3.5 Kg. of PENTANE (C_5H_{12})

(1)

$$= \text{mol } C_5H_{12} \cdot 8 = 212.12 \text{ mol} = 2.12 \times 10^2 \text{ mol}$$

d) VOLUME OF OXYGEN AT S.T.P. NEEDED BY THE COMBUSTION OF 3.5 Kg. of PENTANE (C_5H_{12})

(1)

$$212.12 \text{ mol} \left(\frac{22.4 \text{ L}}{1 \text{ mol}} \right) = 4751.515 \text{ L} \\ = 4.75 \times 10^3 \text{ L}$$

e) MOLES CARBON DIOXIDE PRODUCED BY THE COMBUSTION OF 3.5 Kg. of PENTANE (C_5H_{12})

(1)

$$= \text{mol } C_5H_{12} \cdot 5 = 132.576 \text{ mol}$$

$$= 1.33 \times 10^2 \text{ mol}$$

f) MOLECULES OF CARBON DIOXIDE PRODUCED BY THE COMBUSTION OF 3.5 Kg. of PENTANE (C_5H_{12})

(1)

$$132.576 \text{ mol} \left(\frac{6.02 \times 10^{23}}{1 \text{ mol}} \right) = 7.98 \times 10^{25} \text{ molecules}$$

9) What mass of Aluminum Nitrate { $Al(NO_3)_3$ } is needed to produce 2 dm^3 of a

0.58 M. solution?

(1)

$$0.58 \text{ M} = \frac{\text{mol}}{2 \text{ L}}$$

$$Al(NO_3)_3 = 26.98 + 42.03 + 144 \\ = 213.01$$

$$1.16 \text{ mol} = \text{mol } Al(NO_3)_3$$

$$6.2 \cdot 1.16 \text{ mol} \left(\frac{213.01}{1 \text{ mol}} \right) = 247.08 \text{ g}$$

$$= 2.47 \times 10^2 \text{ g}$$

10) IF 5 grams of SODIUM is allowed to react with 10 grams of CHLORINE to form SODIUM CHLORIDE

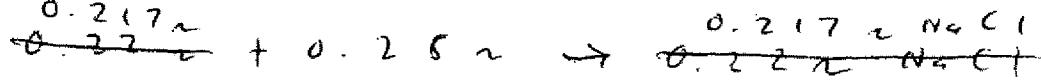
a) BALANCE EQUATION

(1)



b) FIND MASS OF SODIUM CHLORIDE PRODUCED { CHECK FOR LIMITING FACTOR }

$$5 \left(\frac{23}{23} \right) = 0.217 \text{ mol} \quad 10 \left(\frac{35.5}{35.5} \right) = 0.28 \text{ mol}$$

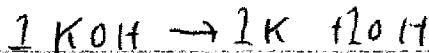
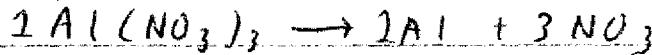


$$0.217 \text{ mol} \left(\frac{58.44}{1} \right) = 12.71 \text{ g} = 1.27 \times 10^4 \text{ g}$$

11) IF WE REACTED 0.250 dm^3 OF A 0.20 M $Al(NO_3)_3$ SOLUTION WITH 0.35 dm^3 OF A 0.50 M KOH SOLUTION, COMPLETE THE FOLLOWING;

a) GIVE BOTH IONIC (DISSOLVING) EQUATIONS

(1)



b) NAME THE PRECIPITATE $Al(OH)_3$ = Aluminum hydroxide (1)

c) GIVE THE COMBINED IONIC EQUATION.

(1)



d) GIVE THE NET IONIC (PREDOMINANT REACTING SPECIES) EQUATION.



e) FIND THE FINAL CONCENTRATION OF IONS.

(2)

$$[K^+] = \frac{0.175 \text{ mol}}{0.6 \text{ L}} = 0.292 \text{ M} \quad 0.05 \text{ mol} Al^{3+} + 0.175 \text{ mol} OH^- = 0.05 \text{ mol} Al(OH)_3$$

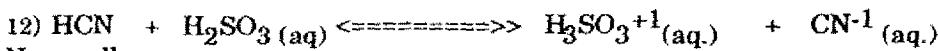
$$[NO_3^-] = \frac{0.15 \text{ mol}}{0.6 \text{ L}} = 0.25 \text{ M} \quad [Al^{3+}] = \text{negligible} \quad [OH^-] = \frac{0.025 \text{ mol}}{0.6 \text{ L}} = 0.042 \text{ M}$$

FIND THE MASS OF PRECIPITATE.

(1)

$$0.05 \text{ mol} Al(OH)_3 \left(\frac{77.98}{1} \right) = 3.90 \text{ g ppt}$$

$$Al(OH)_3 = 26.98 + 3(16) + 3 \\ = 77.98$$



(3)

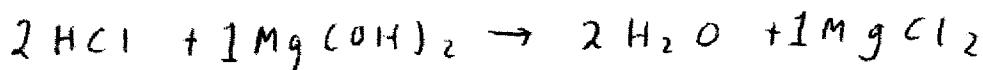
Name all :

- a) Arrhenius acids
- b) Arrhenius bases
- c) Bronsted - Lowry acids
- d) Bronsted - Lowry bases
- e) Conjugate acids
- f) Conjugate bases

<u>HCN</u>	<u>H_2SO_3</u>	<u>H_3SO_3^+</u>
<u>NONE</u>		
<u>HCN</u>		
<u>H_2SO_3</u>		
<u>H_3SO_3^+</u>		
<u>CN^-</u>		

13) If 125 mL OF A 0.55 M. HYDROCHLORIC ACID IS NEUTRALIZED BY 50 mL OF Magnesium hydroxide , WHAT IS THE CONCENTRATION OF THE BASE ?

(3)



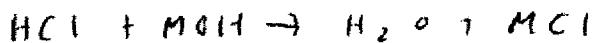
$$\begin{cases} 2 \text{ HCl} = 0.125 \text{ L} \cdot 0.55 \text{ M} \\ = 0.06875 \text{ mol} \end{cases}$$

$$\text{Mg(OH)}_2 = 0.034375 \text{ mol}$$

$$[\text{Mg(OH)}_2] = \frac{0.034375}{0.05} = \underline{\underline{0.6875 \text{ M}}}$$

14) IF 125 mL OF A 0.65 M. hydrochloric acid is neutralized by 6.75 g. of a BASE MOH , WHAT IS THE MOLAR MASS OF THE BASE ?

(3)



$$\begin{cases} 2 \text{ HCl} = 0.125 \text{ L} \cdot 0.65 \text{ M} \\ = 0.08125 \text{ mol} \end{cases}$$

$$\frac{6.75 \text{ g}}{0.08125 \text{ mol}} = \frac{x}{1 \text{ mol}}$$

$$2 \text{ MOH} = 0.08125 \text{ mol}$$

$$83.08 \text{ g/mol} = \text{molar mass}$$

15) a) A strong acid is 0.00425 mol/L HCl , find the $[\text{H}_3\text{O}^{+1}]$, $[\text{OH}^{-1}]$, pH and pOH .

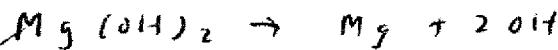
(2)



$$\begin{aligned} [\text{H}^+] &= 0.00425 \text{ M} & \text{pH} &= -\log [\text{H}^+] = 2.37 & \text{pOH} &= -\log [\text{OH}^-] \\ [\text{H}_3\text{O}^+] &= 0.00425 \text{ M} & \text{pOH} &= 11.63 & -11.63 &= \log [\text{OH}^-] \\ & & & & [\text{OH}^-] &= 2.35 \times 10^{-12} \text{ M} \end{aligned}$$

b) Find the $[\text{H}_3\text{O}^{+1}]$, $[\text{OH}^{-1}]$, pH and pOH FOR A 0.00022 mol/L $\text{Mg}(\text{OH})_2$ solution .

(2)



$$\begin{aligned} [\text{OH}^-] &= 1.4 \times 10^{-4} \text{ M} \\ \text{pOH} &= -\log [\text{OH}^-] \\ &\approx 3.36 \end{aligned}$$

$$\text{pH} = -\log [\text{H}^+]$$

$$[\text{Mg}^{2+}] = 10.64 = \log [\text{H}^+]$$

$$\text{pH} = 0.64$$

$$[\text{H}_3\text{O}^+] = 2.27 \times 10^{-11} \text{ M}$$

16) If we have 3.25 mol/L solution of HCl, what volume of this acid solution would we need to make 325 cm³ of a 0.500 mol/L solution? (1)

$$n = 0.325 \text{ L} \cdot 0.5 \text{ M}$$

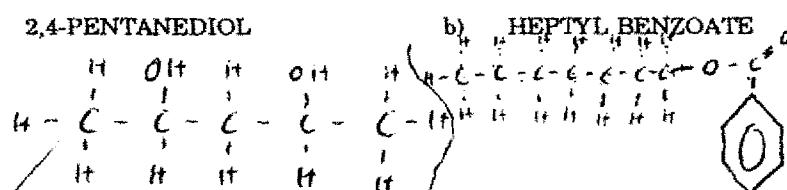
$$= 0.1625 \text{ mol}$$

$$325 \text{ M} = \frac{0.1625 \text{ mol}}{\text{L}}$$

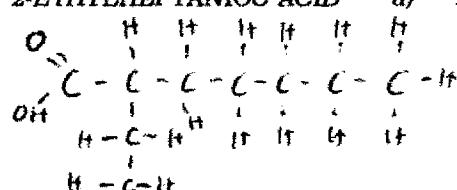
$$\text{L} = \frac{0.05 \text{ L}}{\text{mol}} = 5 \times 10^{-2} \text{ L}$$

17) DRAW STRUCTURAL FORMULAS FOR THE FOLLOWING: (4 x 1/2)

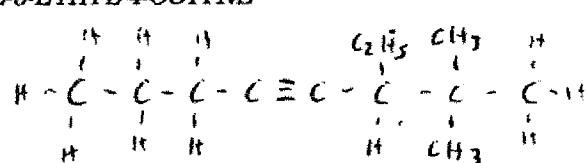
a) 2,4-PENTANEDIOL



c) 2-ETHYLHEPTANOIC ACID



d) 2,2-DIMETHYL-3-ETHYL-4-OCTYNE



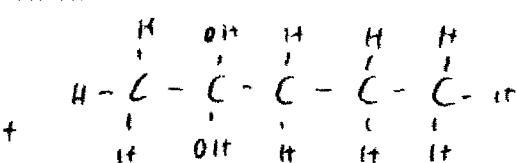
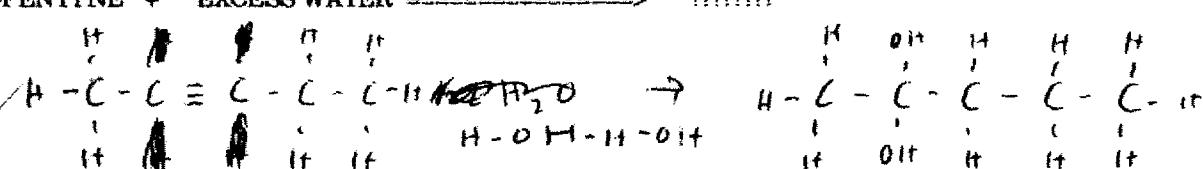
18) GIVE THE STRUCTURAL FORMULAS FOR BOTH THE REACTANTS AND PRODUCTS, THEN NAME THE PRODUCTS ACCORDING TO I.U.P.A.C. RULES: (3 x 2)

a) BENZOIC ACID + 1-HEPTANOL → ??????

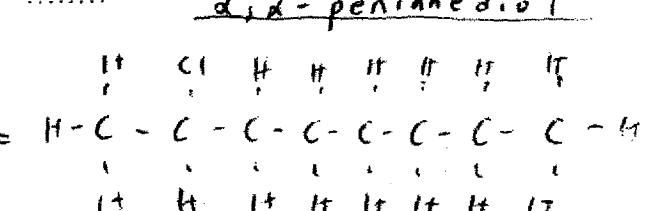
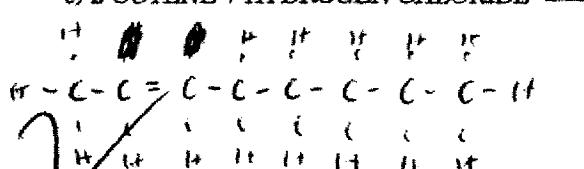


Heptyl Benzoate

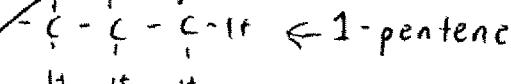
b) 2-PENTYNE + EXCESS WATER → ??????



c) 2-OCTENE + HYDROGEN CHLORIDE → ?????? 2,2-pentanediol



19) Draw and name 4 isomers of C₅H₁₀



2-chlorooctane (4 x 1/2)

