Answer Key Multiple Choice (PART I)

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

Part II
Total Value : 60%

41. a. A compound is found to have a % composition of 72.71% oxygen and 27.29% carbon. Determine the empirical formula of the compound.

$72.71\%O \rightarrow 72.71g\ O\}$ 0.5%

$27.29\%C \rightarrow 27.29g\ C\}$ 0.5%

$n(O) = \frac{m}{M} = \frac{72.71g}{16.00g/mol} = 4.54\ mol$ 0.5%

$n(C) = \frac{m}{M} = \frac{27.29g}{12.01g/mol} = 2.27mol$ 0.5%

$\frac{4.54mol\ O : 2.27\ mol\ C}{2.27}$ 1%

$2\ mol\ O : 1\ mol\ C$

$EF = CO_2$ 1%

b. i. What mass of potassium sulfate, K_2SO_4, is required to produce 2.50 L of 1.25 mol/L solution?

$M_{(K_2SO_4)} = 2 \times 39.10\frac{g}{mol} + 1 \times 32.07\frac{g}{mol} + 4 \times 16.00\frac{g}{mol} = 174.27\ g/mol$ 1%

$n = C \times V = 1.25\ \frac{mol}{L} \times 2.50\ L = 3.13\ mol$ 1%

$m = n \times M = 3.13\ mol \times 174.27\frac{g}{mol} = 545\ g$ 1%

ii. With reference to appropriate equipment, outline the steps you would use to make the potassium sulfate solution described above. **2%**

1. Using scales, obtain 545 g of potassium sulfate in a 4.00 L beaker.
2. Add water to the dissolved compound.
3. Transfer to a 2.50 L volumetric flask.
4. Add water to exactly 2.50 L.
5. Stopper and invert the volumetric flask to thoroughly mix the solution.

(OR other appropriate answer)

c. What is the mass of 4.00 L of ammonia gas ($NH_{3(g)}$) at STP ?

$n_{(NH_3)} = \frac{v}{V} = \frac{4.00L}{22.4L/mol} = 0.17857\ mol$ 1%

$M_{(NH_3)} = 1 \times 14.01 + 3 \times 1.01 = 17.04g/mol$ 1%

$m_{(NH_3)} = n \times M = 0.17857\ mol \times \frac{17.04g}{mol} = 3.04\ g$ 1%

d. **Given a reaction between 80.0 g of tin (II) fluoride (SnF_2) and excess hydrochloric acid, what mass of tin (II) chloride would be obtained from the chemical reaction below?**

$$\boldsymbol{SnF_2 + 2HCl_{(aq)} \rightarrow SnCl_2 + 2HF_{(aq)}}$$

$M_{(SnF_2)} = 1 \times 118.69\,\frac{g}{mol} + 2 \times 19.00\,\frac{g}{mol} = 156.69\ g/mol$ 1%

$n_{(SnF_2)} = \frac{m}{M} = \frac{80.0 g/mol}{156.69 g/mol} = 0.51056\ mol$ 1%

$M_{(SnCl_2)} = 1 \times 118.69\,\frac{g}{mol} + 2 \times 35.45\,\frac{g}{mol} = 189.59\ g/mol$ 1%

$m_{(SnCl_2)} = n \times M = 0.51056 mol \times 189.59\,\frac{g}{mol} = 96.8\ g$ 1%

e. **In the laboratory, a student reacts 0.179 mol of solid iron with 50.0 mL of 1.50 mol/L copper (II) chloride solution,**

$$\boldsymbol{2\,Fe_{(s)} + 3\,CuCl_{2(aq)} \rightarrow 2\,FeCl_{3(aq)} + 3\,Cu_{(s)}}$$

Using appropriate calculations, identify the limiting reagent and predict the amount of solid copper that would be produced.

$n_{CuCl_2} = 1.50\,\frac{mol}{L} \times 0.0500\ L = 0.0750\ mol\ CuCl_2$ 1%

Using Fe

$n_{Cu} = 0.179\ mol\ Fe \times \frac{3\ mol\ Cu}{2\ mol\ Fe} = 0.269$ mol Cu produced. 1%

Using $CuCl_2$

$n_{Cu} = 0.0750\ mol\ CuCl_2 \times \frac{3\ mol\ Cu}{3\ mol\ CuCl_2} = 0.0750$ mol Cu produced. 1%

Because less copper is produced using $CuCl_2$, $CuCl_2$ is the limiting reagent. 1%

(Other suitable calculations accepted as well).

f.

4 f. Calcium ion, Ca^{2+}, is one of the ions in human blood. Using the solubility table, determine which substances below, if swallowed, would result in a significant decrease in calcium ion concentration in the blood. Give reasons for choices in the space provided.

Substance	Decrease in Ca^{2+} (Yes/No)	Reason
sodium acetate ($NaCH_3COOH$)	No	The concentration of Ca^{2+} ions will not change because Ca^{2+} ions will not form a precipitate with acetate CH_3COO^- ions because, if formed, $Ca(CH_3COOH)_2$has a high solubility.
sodium chloride (NaCl)	No	The concentration of Ca^{2+} ions will not change because Ca^{2+} ions will not form a precipitate with chloride Cl^- ions because, if formed, $CaCl_2$ has a high solubility.

sodium nitrate ($NaNO_3$)	No	The concentration of Ca^{2+} ions will not change because Ca^{2+} ions will not form a precipitate with nitrate NO_3^{2-} ions because, if formed, $CaNO_3$ has a high solubility.
sodium sulfate (Na_2SO_4)	No	The concentration of Ca^{2+} ions will decrease as the Ca^{2+} ions combine with sulfate ions to produce calcium sulfate. $CaSO_4$ has a low solubility in water and will form a precipitate.

g. **Copper exists as two naturally occurring isotopes. One isotope has an atomic mass of 62.93 amu and a relative abundance of 69.1%. The percent abundance of the other isotope is 30.9%. If the average atomic mass of copper is 63.55 amu, calculate the atomic mass of the other isotope.**

$(62.93amu)(0.691) + (X)(0.309) = 63.55$ 1%

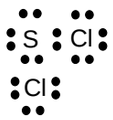
$43.4846 + (X)(0.309) = 63.55$

$(X)(0.309) = 20.0654$ 1%

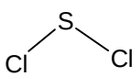
$X = 64.94amu$ 1%

42. **a. For the molecule SCl_2,**

(i) **Draw the electron dot diagram.** 2%

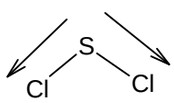


(ii) **Name and draw the VSEPR shape diagram.** 2%

V-Shaped 

(iii) **Explain why SCl_2 is a polar molecule.** 2%

Bond dipoles occur from sulfur to each chlorine atom:



Because the bond dipoles DO NOT cancel the molecule is POLAR.

b. Explain why diamond has a higher melting point than graphite, yet both are made up of only carbon atoms.

Diamond has network covalent bonding. 1%

Graphite has only covalent bonding. 1%

Network covalent solids are extremely hard and have higher melting points than covalent compounds. 1%

c. **For the 2 compounds CH_3OH and CH_3F, list the intermolecular forces present in each compound and identify which has the higher boiling point.**

	$\underline{CH_3OH}$	$\underline{CH_3F}$,	
LDF	18 electrons	18 electrons	1%
Dipole-Dipole	Yes	Yes	1%
Hydrogen Bonding	Yes	No	1%

CH_3OH has greater intermolecular forces and is thus expected to have a higher boiling point. 1%

d. Consider the following data for four different substances:

Use the information provided in the table to identify and explain which substance has:

(i) Network Covalent Bonding

Compound - X 1%

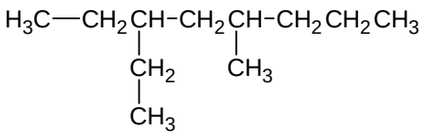
Reasons - Very high MP and BP
- Does NOT conduct in solid phase or in water 1%

(ii) Ionic Bonding

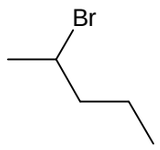
Compound - W: 1%

Reasons - MP and BP are relatively high 1%
- Conducts in solution but not as a solid

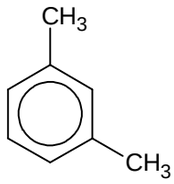
43. a. Name each of the following compounds using the IUPAC naming system.

(i).  2%

3-ethyl-5methyloctane

(ii). 

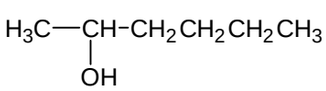
2-bromopentane 2%

(iii). 

1,3-dimethylbenzene 2%

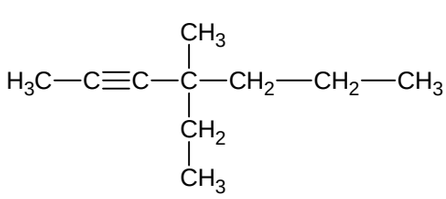
b. Draw structural diagrams for each of the following compounds:

(i). 2-hexanol



2%

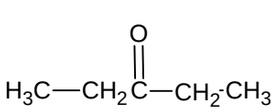
(ii). 4-ethyl-4-methyl-2-heptyne



2%

(iii). 3-pentanone

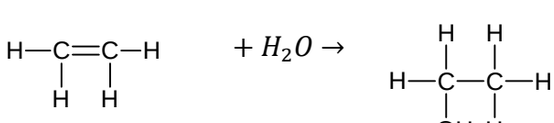
2%



c. A reaction between ethene and water produces Compound A. Compound A is further reacted with ethanoic acid to produce Compound B.

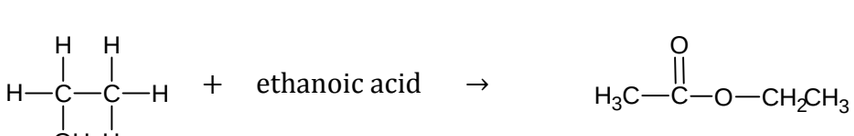
Use structural diagrams to show Compound A and Compound B.

Compound A

1. 

2%

2%

2. 

Compound B