COMMONWEALTH SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2018
CHEMISTRY
MARK SCHEME

PAPER 1

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

PAPER 2
Section A (50 marks)

A1 **(a)** N / nitrogen [1]
(b) K / potassium [1]
(c) C / Carbon [1]
(d) Ca, Zn / Calcium, Zinc [1]

[Total: 4]

A2 **(a)** It means that they exist as **single atom**.[1]

(b) Their **outermost/valence shell** is **completely filled with electrons**. [1]

(c) **(i)**

Elements	xenon	oxygen	fluorine
Mass /g	0.549	0.134	0.317
Ar	131	16	19
Mole/ mol	0.549/131 = 0.004191	0.134/16 = 0.008375	0.317/19 = 0.01668
Ratio	0.004191/0.004191= 1	0.008375/0.004195 = 2	0.01668 / 0.004191 = 4

Correct no of moles with workings[1]

empirical formula: XeO_2F_4[1]

(ii) The relative molecular mass of the compound / molar mass / relative formula mass/mass of one mole of the substance [1]

(d) Use **liquid mixture** / liquefy the mixture [1]
Heat or boil the mixture (and collect fractions) [1]
Idea that each fraction or gas **condenses at different boiling point** / lower boiling point collect first [1]

[Total: 8]

A3 **(a)** **Giant molecular structure**

Small amount of energy is required to **overcome** the **weak intermolecular forces of attraction between the layers of atoms**.

These **layers are able to slide over each other easily** thus it is slippery.

3 points – 2m
2 points – 1m

(b) number of protons: 5
number of neutrons: 5
1m for both ans

(c) Graphite has a **giant molecular structure.[1]**

Lots of energy is required to **break the strong covalent bonds between the carbon atoms**[1], thus graphite has a high melting point.

[Total: 5]

A4 **(a)** **(i)** O_2 [1]
(ii) $2Cu(NO_3)_2 \rightarrow 2CuO + 4NO_2 + O_2$ [1]

(b) **C** is Ammonia[1]
D is Copper(II) hydroxide[1]

(c) name of reagent **X:**
Sodium carbonate / ammonium carbonate / carbonic acid / sodium hydrogen carbonate / any soluble carbonate / carbon dioxide [1]

ionic equation
$Cu^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CuCO_3(s)$
$2HCO_3^-(aq) + Cu^{2+}(aq) \rightarrow CuCO_3(s) + H_2O(l) + CO_2(g)$

1m – correct formula + balance equation
1m – correct state symbols + correct formulas

[Total: 7]

A5 **(a)** **(i)** **Energy absorbed** in **bond breaking** of O_2 is **less** than the **energy released in the bond forming** of O_3. [2]

1m – Bond breaking absorbs energy and bond making releases energy
1m - Less energy absorbed than released/more energy released than absorbed

(ii) No of moles of oxygen = $\frac{48}{16\times2}$ = 1.5 mol [1]
Energy released = 1.5 x 392 = 588 kJ [1]

energy released = ……588……kJ

(b) Chlorofluorocarbons / oxides of nitrogen(nitrogen monoxide, nitrous oxide) / chlorine radicals [1]

[Total: 5]

A6 **(a)** **(i)** Zinc, as it is more reactive than silver, hence oxidises more readily / giving out electrons. [1]

(ii) *Checking drawing and label*
Tube X: contains oxygen, Tube Y: contains hydrogen.
Volume of hydrogen is approximately double of the volume of oxygen

(iii) For every 4 moles of electrons transferred, 1 mole of oxygen gas and 2 moles of hydrogen gas will be formed. [1]

Since the number of moles of gas is proportional to the volume of gas, the volume of hydrogen gas obtained will be twice the volume of oxygen gas.[1]

(b) **(i)** Cu^{2+}, SO_4^{2-}, OH^-, H^+ [1]

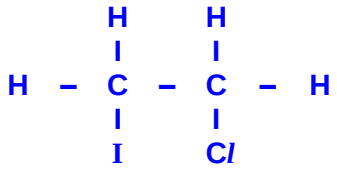
(ii) As **hydroxide ions are oxidized/discharged** at the anode [1], the **concentration of hydrogen ions** in the solution **increases / more hydrogen ions than hydroxide ions.**[1] This causes the solution to become acidic.

(iii) As **copper(II) ions are reduced/discharged** at the cathode, the **concentration of copper(II) ions decreases[1]**. This cause the blue colour of the solution to fade.

[Total: 8]

A7 **(a)** $2Na + ICl \rightarrow NaI + NaCl$ [1]

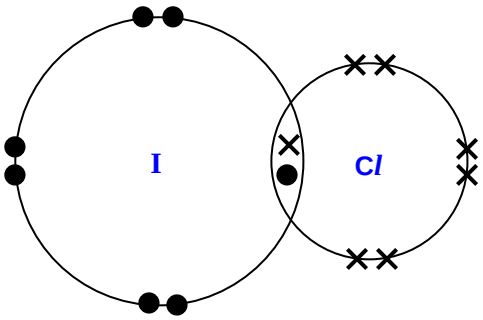
(b)



[1]

(c) Type of reaction: Substitution [1]
Equation
$C_2H_6 + ICl \rightarrow C_2H_5Cl + HI$ /
$C_2H_6 + ICl \rightarrow C_2H_5I + HCl$ [1] [2]

(d)



Minus 1m for every mistake [2]
[Total: 6]

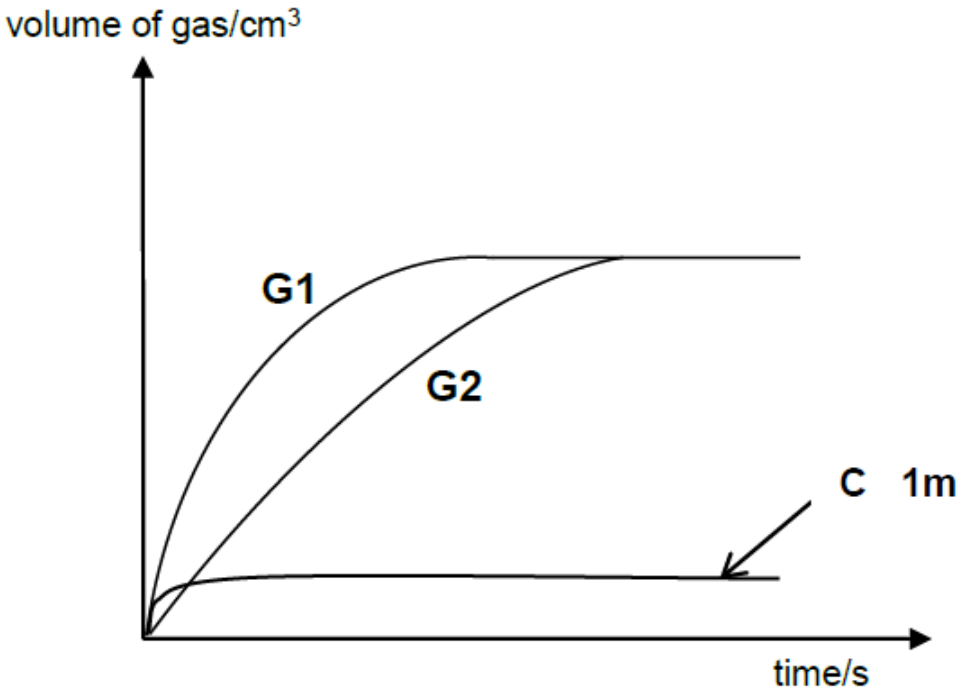
A8 **(a)** Graph: Graph G**2**

Explanation :
Sulfuric acid is dibasic while hydrochloric acid is monobasic acid, **concentration of hydrogen ions in HC*l* is half** that of H_2SO_4 / sulfuric acid produces 2 hydrogen ions per molecule while hydrochloric acid produces 1 hydrogen ions per molecule **[1]**

frequency of collisions is lower and hence **frequency of effective collision /number of effective collisions per unit time is less in HC*l*** compared to H_2SO_4; **[1]**

rate of reaction is slower **[1]**,
gradient is less steep **[1]** [4]

(b)



Initial speed as fast as G1 → same acid
Volume of gas formed very little (less than ¼ of the volume formed) → calcium sulfate is insoluble **[1]**

(c) The **initial speed is the same as G1** as the **same acid** is used. [1]
The final volume of gas formed is very little as calcium carbonate reacts with sulfuric acid to form an **insoluble layer of calcium sulfate** which **prevents further reaction** with the acid [1] [2]

[Total: 7]

PAPER 2
Section B (30 marks)

B9 **(a)** **(i)** **Transition elements** like iron and osmium produce a **higher % yield** of ammonia than **main group metals** aluminium and calcium after 3h / 24h. for example, at 400 ^{o}C, iron achieves a yield of 15% more than calcium.[1]

Comparing and listing data between transition and main group element [**1**]
Quote the **difference in %** yield of transition elements and main group [**1**]

(ii) Yes
Speed: Comparing experiment 1 & 7, the **% yield of ammonia after 3h**, is **16% more**. With catalyst, there is an apparent increase in yield, thus catalyst speed up the reaction. [1]

Yield: Comparing experiment 2 & 4/6/8/10, the **% yield of ammonia after 30 days is the same at 17 %, with or without catalyst.** Catalyst does not affect the final yield. [1]

[1] – speed up reaction
[1] – yield not affected

(b) **(i)**
- At lower temperature, particles **possess lesser amount of energy**, resulting in **lower frequency of effective collision** between the reactant particles.
  OR
  At lower temperature, **lesser particles have energy** equal or **higher than that of the activation energy**, resulting in **lower frequency of effective collision** between the reactant particles. [1] [2]

- Rate of reaction is slower. [1]

(ii)
- At a lower temperature, the **yield of ammonia is higher**.[1]

- There will be more ammonia produced, hence
- There will be **more ammonia(product) formed and lesser nitrogen(reactants) and hydrogen(reactants)** leaving the main reactor [1] [2]

(iii)
- At a lower temperature, there is no change to the **final amount of ammonia**. [1]
- Final amount of ammonia is **determined by the amount of nitrogen and hydrogen** added into the reactor/
- As the **unreacted gases are constantly being recycled** in the reactor, the final amount of ammonia remains unchanged. [1] [2]

[Total: 10]

B10 (a) (i)

	aqueous zinc nitrate	aqueous copper(II) nitrate
nickel	No visible reaction	**Blue solution** turned **green** Silver / grey metal coated with **pink/ reddish-brown** solid

[2]

3 points – 2m; 2 points – 1m;

(ii) $Zn + Cu^{2+} \rightarrow Zn^{2+} + Cu$ [1] [1]

(iii) **Zn has been oxidised** as its **oxidation state of Zn** has **increased from 0 in Zn to +2 in Zn^{2+}**. [1]
Cu^{2+} has been reduced as its **oxidation state of Cu** has **decreased from +2 in Cu^{2+} to 0 in Cu**. [1]

Alt: 1m – stating substance oxidized & reduced
1m – stating the change in oxidation state for both elements & direction of change [2]

(b) (i) Excess nickel(II) carbonate is added to ensure that the dilute nitric **acid reacts completely** [1] and pure nickel(II) nitrate is obtained as filtrate. [1]

(ii) If the solution is heated to dryness**, anhydrous nickel(II) nitrate will be obtained / nickel(II) nitrate will decompose. [1]** [1]

(iii) No. of moles of HNO_3 added = 25/1000 ×1.00 = 0.0250 mol [1]

No. of moles of nickel(II) nitrate produced = 0.0250 × 2 = 0.0125 mol
Mass of nickel(II) nitrate = 0.0125 x [59 + 2(14) +6(16) + 6(18)] = 3.6375 g [1]

Percentage yield = 2/3.6375 ×100 = 54.98% = 55.0% (3sf) [1] [3]

Max 1m if the mass of nickel(II) nitrate is wrong.

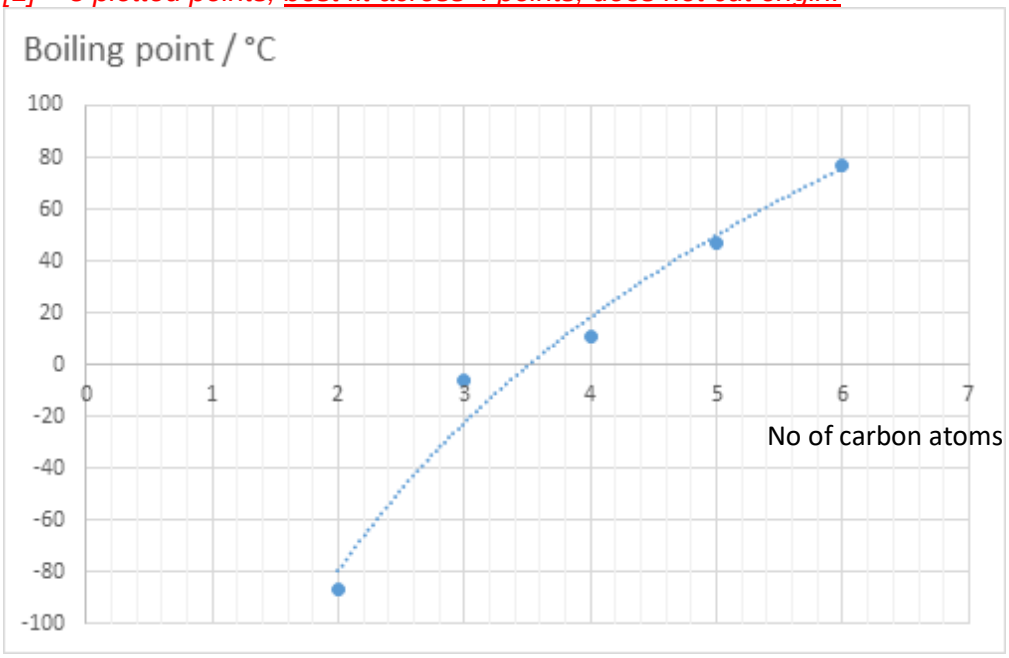
[Total: 10]

Either

B11 (a) (i) Homologous series refers to a group of organic molecules/compound/hydrocarbons with the **same functional group** / shows similar chemical properties. [1]
They show a gradual change in physical properties as the number of carbon atom increases. [1]
Consecutive members in the homologous series differ by a $–CH_2$ group / Mr of 14. [1]
They have the **same general formula**. [1] [1]

Any 1 points

(ii) *[1] – appropriate scale, well-labelled axes with units*
[1] – 5 plotted points, best fit across 4 points, does not cut origin.



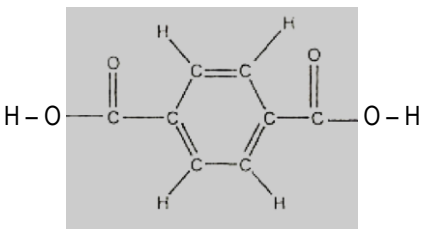
[2]

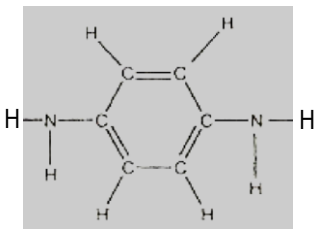
(iii) B [1] [1]

(iv) The **boiling point increases** as the number of carbon atoms increases.[1]
As the number of carbon atoms increases, the **molecular size increases**.
This **increases the intermolecular forces** between the molecules. [1]
More energy is required to overcome the forces, thus the boiling point increases. [1] [3]

(b) **(i)** **Condensation polymerization** [1] [1]

(ii) [2]





[1m each]

[Total: 10]

OR

B11 **(a)** **(i)** $2C_8H_{18} + 25O_2 \rightarrow 16CO_2 + 18H_2O$;[1] [1]

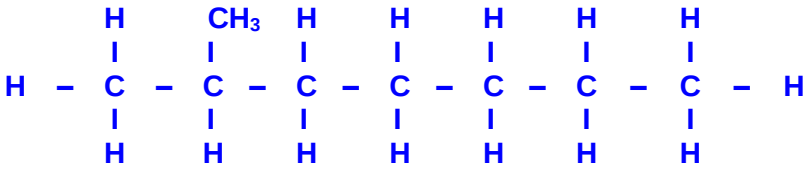
(ii) The **total** amount of **energy taken in/absorbed** to break the bonds in **isooctane and octane** is the same.[1]

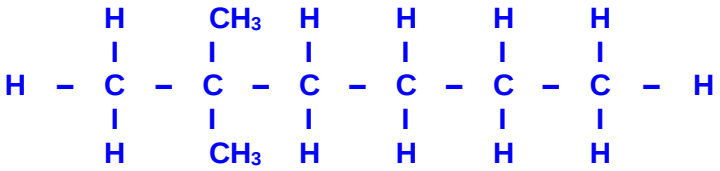
The **total** amount of **energy given out/released** to form bonds in **carbon dioxide and water** is the same. [1]

Thus the enthalpy change of combustion for isooctane and octane are the same.

R: same number of bonds/same bonds are broken and formed [2]

(iii)

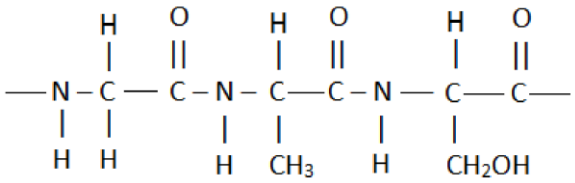




1m for each possible isomer

[2]

(b) **(i)**



[1]: 2 proper amide linkages

[1]: consists of 1 glycine, 1 alanine, 1 serine

[2]

(ii) Mr of repeat unit = 215; [1]
Number of repeat units = 600 000/215; [1]
Number of amino acids = 2790.7 x 3 or 2791 x 3
= 8372.1
= 8372; [1] =8373[1]

8370 [3sf] – accept [3]

[Total: 10]