NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2008

PHYSICAL SCIENCES: PAPER II

MARKING GUIDELINES

Time: 3 hours 150 marks

These marking guidelines are prepared for use by examiners and sub-examiners, all of whom are required to attend a standardisation meeting to ensure that the guidelines are consistently interpreted and applied in the marking of candidates' scripts.

The IEB will not enter into any discussions or correspondence about any marking guidelines. It is acknowledged that there may be different views about some matters of emphasis or detail in the guidelines. It is also recognised that, without the benefit of attendance at a standardisation meeting, there may be different interpretations of the application of the marking guidelines.

QUESTION 1

1.1 **Homologous series** – a family of organic compounds identified by the same functional ✓ group and obeys the same general formula. ✓ (2)

1.2

1.2.1 Alkenes ✓
1.2.2 Alcohols ✓
1.2.3 Esters ✓ (3)

1.3 A – Addition/ Hydration ✓
C – Substitution ✓
D – Elimination ✓
E – Combustion ✓ (4)

1.4

1.4.1 Carboxylic acid ✓ (1)
1.4.2 The alcohol (ethanol) is highly flammable. ✓ The water bath mimimises this as heating will take place without flame close by. ✓ (2)
(The test tube might crack and other relevant answers.)
1.4.3 A catalyst is a substance that increases the rate of a chemical reaction ✓ without itself being chemically used up. ✓ (2)
1.4.4 Used in the perfume industry or as flavourants. ✓ (1)

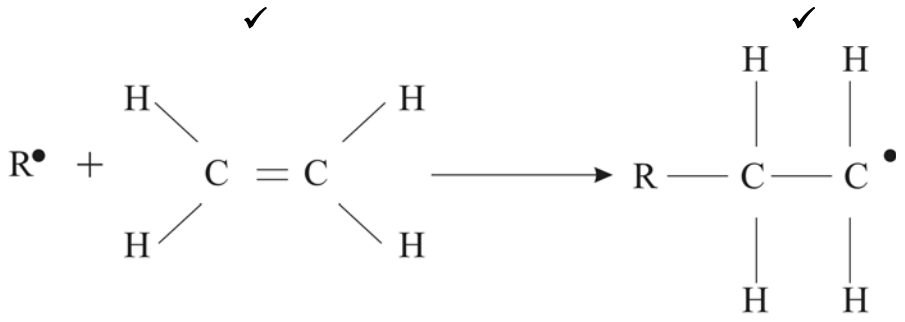
1.5

1.5.1 Same molecular formula, different structural formula. ✓ (1)
1.5.2 Ester ✓, carboxylic acids ✓ (2)
1.5.3 Carboxylic acid ✓ – there is the presence of the OH group ✓ on the molecule which will lead to H-bonding (stronger IM force). ✓ (3)

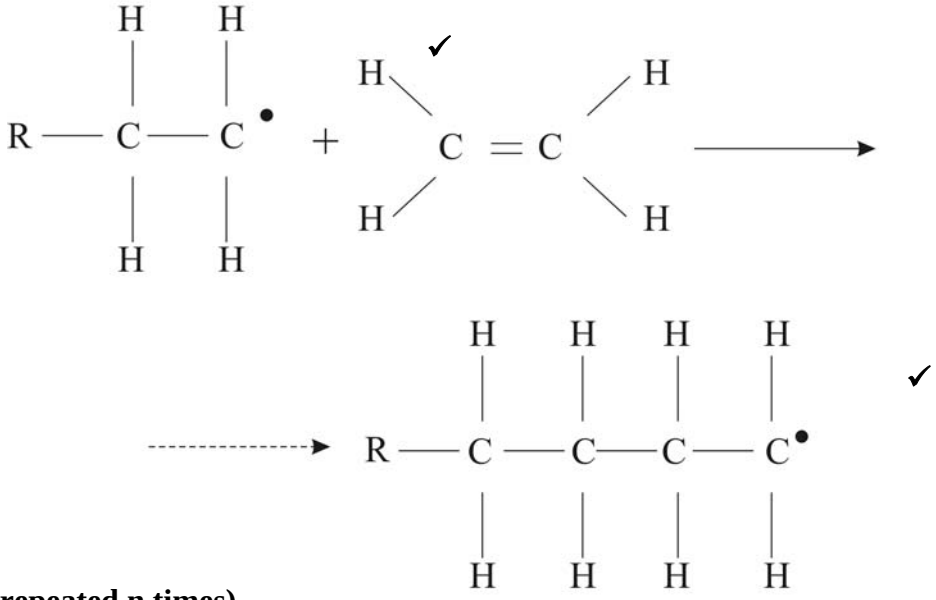
1.6

1.6.1 **Monomer** – identical molecules which can join to make a chain. ✓
Polymer – long chains of monomers covalently bonded together. ✓
Addition Polymerisation – the process where monomers (which have C = C bonds) can be bonded together into very long chains which have C – C bonds. ✓ (3)

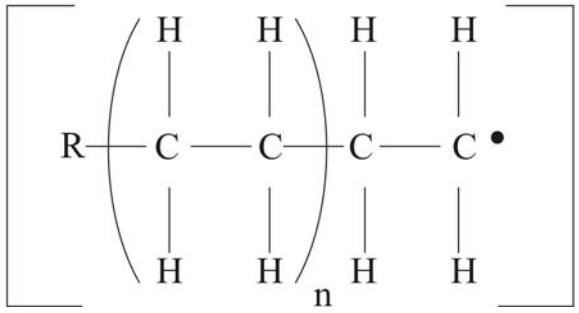
1.6.2 (a) **Initation Step**



(b) **Propagation Step**



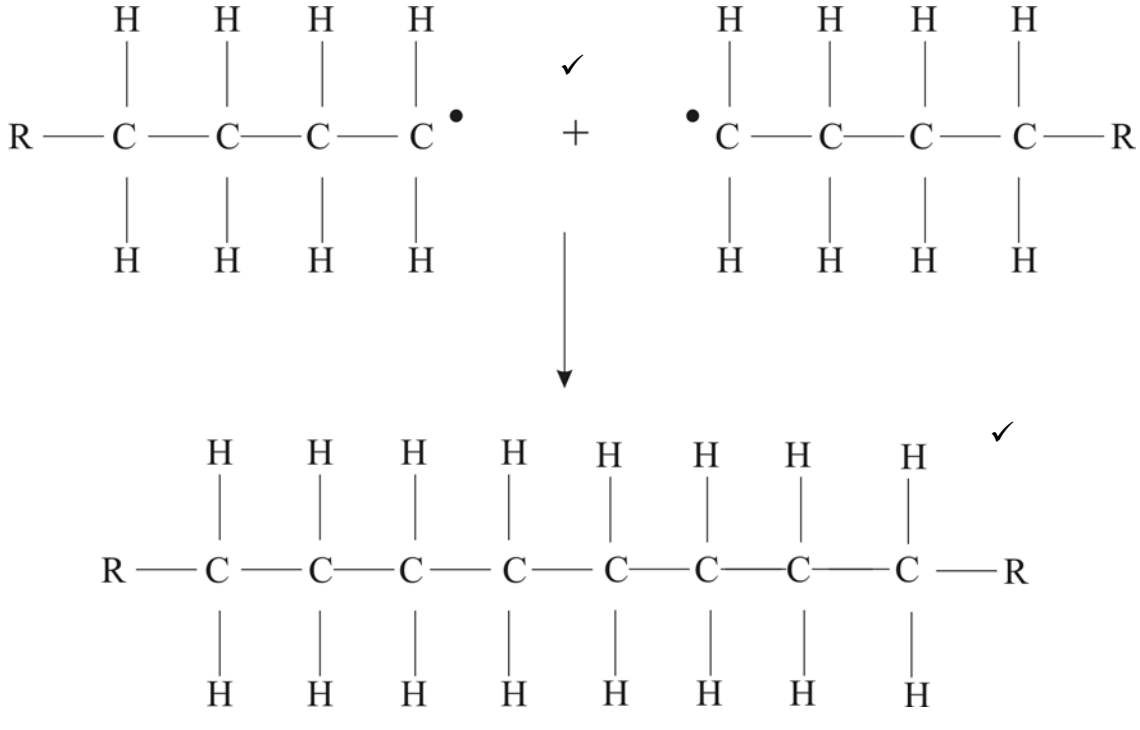
(repeated n times)



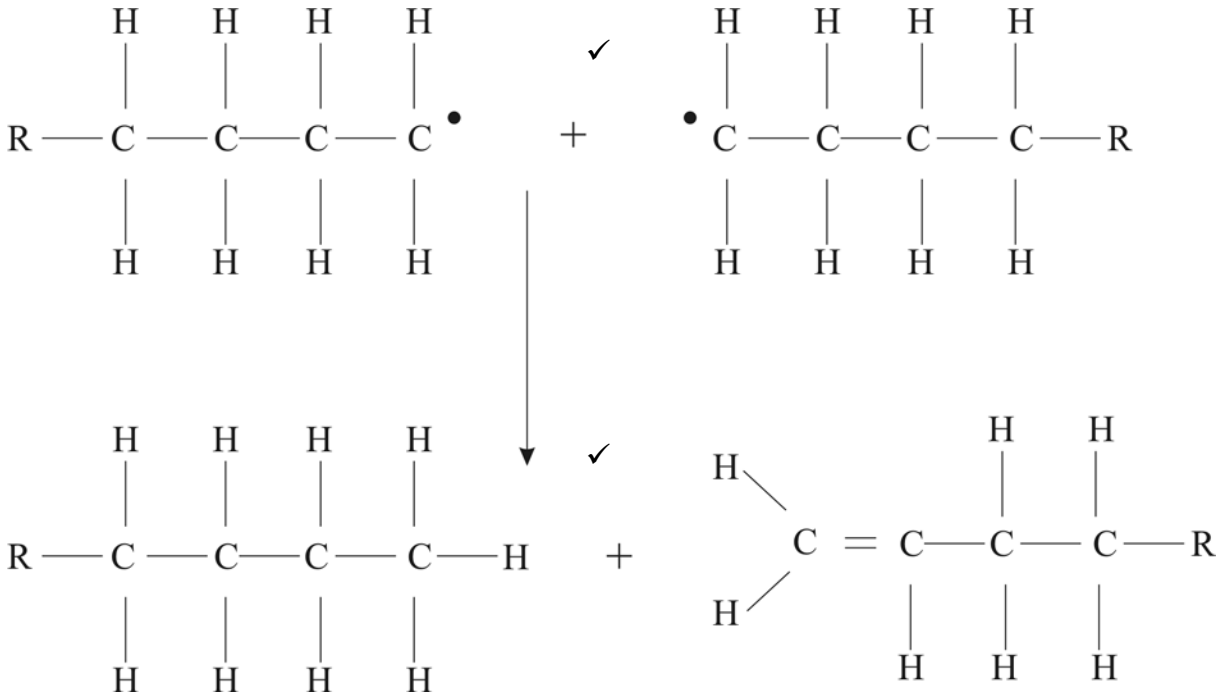
(4)

1.6.3

(i) Radicals join together



(ii) One radical remove H atom from another radical.



(4)

1.7

1.7.1
- The product is versatile and thus used for many things.
- Help economy, thus providing more jobs.
- It is recyclable – environmentally friendly.
- It can be resealed thus preserving the contents, which metal cans cannot.
- There is no tainting of foodstuffs because of chemical leaching.
- Substituting glass bottles, thus much safer.

(three logical and reasonable points plus explanations) (6)

1.7.2

Disadvantages
• Much more plastic in the environment (rubbish). ✓ • Tendency to simply discard without recycling. ✓ • More factories built will cause more pollution. ✓
(three logical and reasonable points)

(3)

1.7.3
- Being much lighter than glass, more product can be transported per container, thus reduce number of big trucks on the road. (POSITIVE)
- Reduce gas emissions from exhausts thus reducing air pollutants and greenhouse effect (global warming). (POSITIVE)
- Can put a greater volume of plastic containers in the environment which can lead to build-up of trash. (NEGATIVE)
- Recyclable, thus can remove much from the environment and reuse. (POSITIVE)
- Increased factories causing more pollution into environment. (NEGATIVE)

(any three will suffice) ✓✓ + ✓✓✓✓ (6)

47 marks

QUESTION 2

2.1 (a) **Experimental hypothesis** – this is a generalization ✓ of an experiment which can be tested. ✓ (It explains a set of observations or gives a possible answer to a question). (2)

OR

A hypothesis is an **assumption** ✓ that can be proved correct or incorrect by doing an experiment. ✓

(b) By decreasing the ✓ concentration of Solution A, it will ✓ make the reaction faster. (2)

OR

A change in concentration ✓ of Solution A will affect ✓ the time taken for reaction to be completed.

2.2 Independent variable – concentration of Solution A ✓
Dependent variable – time taken ✓
Control variable – temperature ✓ (3)

2.3 F all letters correctly sequenced = 4
E 2 letters out of sequence = 3
B 3 letters out of sequence = 2
A 4 letters out of sequence = 1
D 5 letters completely out of sequence = 0
G
C
H (4)

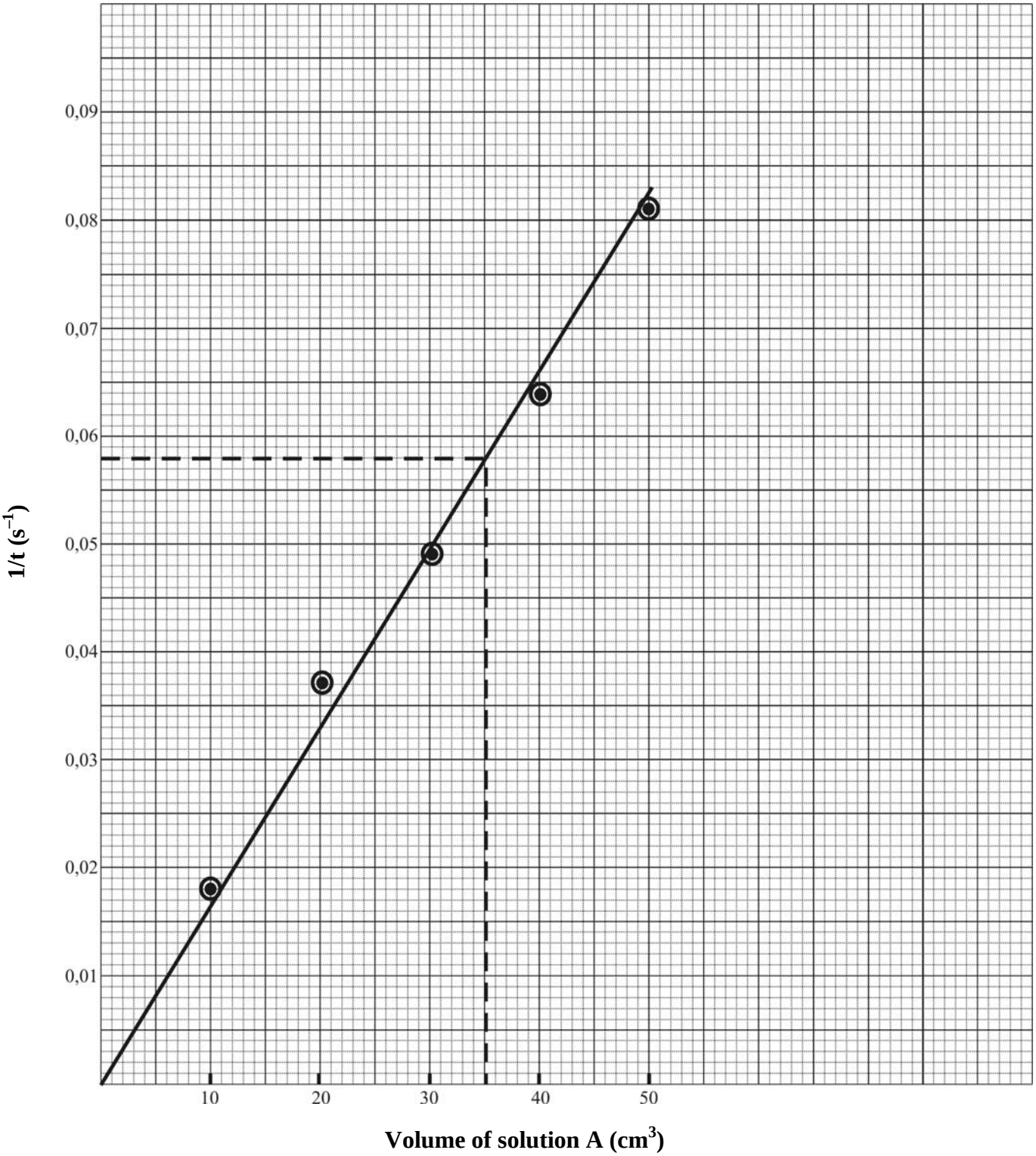
2.4

Volume of solution A ($cm^{3)}$)	Volume of water added (cm^3)	Volume of solution B (cm^3)	Time (t) (s)	1/ time (1/t) (s^{-1})
50	50	50	12,34	0,081
40	60	50	15,53	0,064
30	70	50	20,56	0,049
20	80	50	27,03	0,037
10	90	50	55,55	0,018

– all headings correct and units ✓
– 1/t data calculated correctly ✓✓
– all data placed in table correctly ✓
– table neatly drawn ✓ (5)

2.5

Graph to illustrate the relationship between volume of solution A (cm^3) added and time taken to complete reaction.



- heading of the graph ✓
- labelled axes ✓
- scale ✓
- line of best fit ✓
- through the origin ✓
- points neatly plotted ✓ (6)

2.6 Indicating on graph = 0,058 s^{-1} ✓

$$\frac{1}{t} = 0{,}058$$
$$\therefore t = \frac{1}{0{,}058}$$
$$= \underline{\underline{17{,}24\,s}} \quad ✓$$

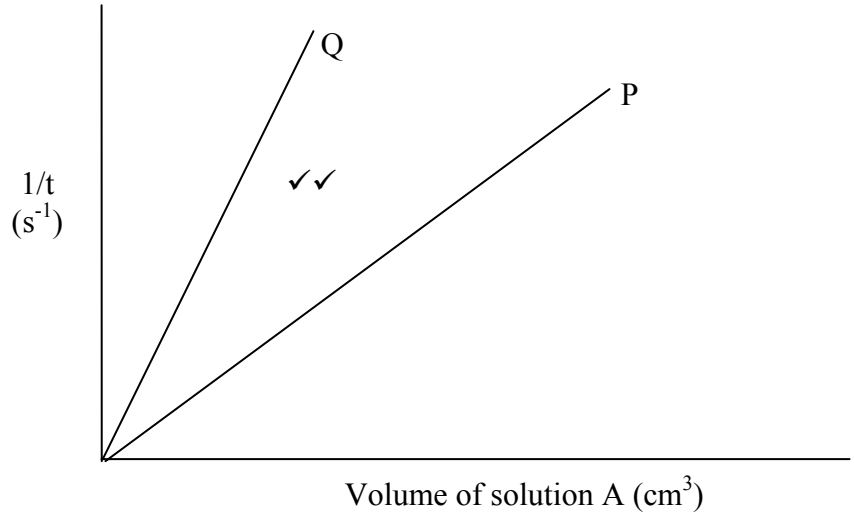
(2)

2.7 Volume of A directly propotional to 1/t. (1 mark only)
i.e. rate of reaction directly proportional to concentration of solution. ✓✓ (2)

2.8 To keep as many variables constant ✓ as possible by keeping surface area, background, mixing areas identical. At a constant volume of 100 cm^3, the same amount (mol) of I_2 will turn the solution deep blue. ✓ (2)

2.9 NO – Tshepiso and Belinda's reaction times on the stopwatch may differ. ✓✓
– Perception of the blue colour and when to stop the stopwatch would be different. ✓✓ (4)

2.10



(2)

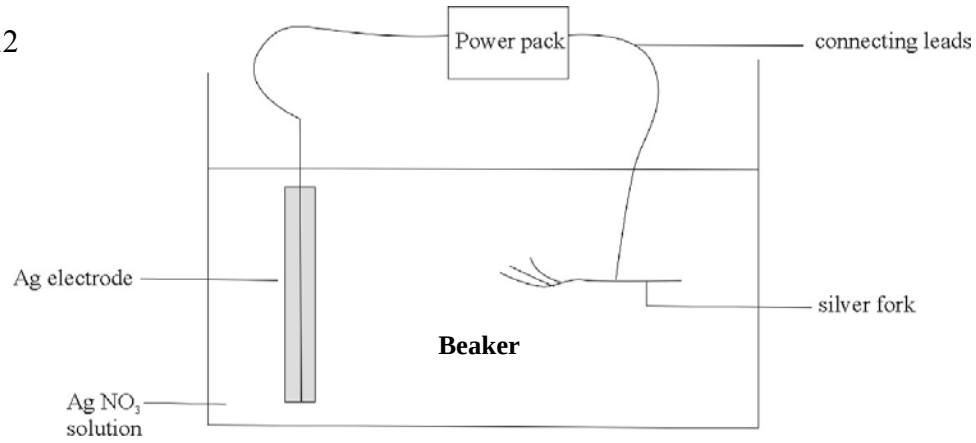
34 marks

QUESTION 3

3.1

3.1.1 Electroplating ✓ (1)

3.1.2



($AgNO_3$ solution obtained from the bottle provided)
All pieces are connected correctly. ✓✓✓✓ (4)

3.1.3

(a) **Cathode** ✓– silver must plate fork therefore must be reduction process. ✓ (2)

(b) $Ag^+ + e^- \rightarrow Ag$ ✓ (1)

3.1.4 If Ag^+ ions are being removed from solution due to reduction at cathode (fork), then Ag^+ must be replaced by the anode. ✓✓
Therefore Anode will oxidise.

$$Ag \rightarrow Ag^+ + e^- \checkmark$$

Hence the other electrode must be made of same metal as cathode to allow for supply of Ag^+ into solution. ✓ (4)

3.2

3.2.1 **Primary cell** – cells that cannot be recharged and can be discarded.
Secondary cell – they can be recharged by reversing the chemical reaction. ✓
Example: Lead-acid accumulator ✓ (2)
rechargeable cell/'battery'

3.2.2 **Anode** – Zn half reaction ($Zn \rightarrow Zn^{2+} + 2e^-$)
Cathode – $2NH_4^+{}_{(aq)} + 2e^- \rightarrow 2NH_{3\,(g)} + H_{2\,(g)}$. } ✓
Zn has more negative E^θ value, making it a much stronger reducing ✓ agent than NH_4^+ reaction. Hence oxidation takes place at Zn electrode (anode). ✓ (3)
(vice versa for NH_4^+ reaction).

3.2.3 Provides medium to allow for mobility of charge i.e. allows charge to move through the cell effectively. ✓✓ (2)

3.2.4 $E^\theta_{cell} = E^\theta$cathode $- E^\theta$ anode
$= 0,74 - \checkmark(-0,76)$
$E\theta_{cell} = 1,50$ V ✓ (2)

21 marks

QUESTION 4

4.1

4.1.1 N = Nitrogen ✓
P = Phosphorus ✓
K = Potassium ✓ (3)

4.1.2 N = Nitrate Salts, e.g. NH_4NO_3 ✓
P = Phosphate Salts, e.g. $(NH_4)_3\ PO_4$ ✓
K = Potassium salts, e.g. Potassium chloride (KC1) (KNO_3) (K_2SO_4) ✓ (3)

4.2

4.2.1 The Haber process ✓ (1)

4.2.2 That the forward and reverse reactions occur simultaneously and continuously. ✓✓ (2)

4.2.3 $c = \frac{n}{V}$

$[N_2]$ $c = \frac{n}{V}$

$= \frac{6\ 000}{1\times10^5}$

$= \underline{0{,}06\ mol\cdot dm^{-3}}$ ✓

$[H_2]$ $c = \frac{n}{V}$

$= \frac{29\ 000}{1\times10^5}$

$= \underline{0{,}29\ mol\cdot dm^{-3}}$ ✓

$[NH_3]$ $c = \frac{18\ 000}{1\times10^5}$

$= \underline{0{,}18\ mol\cdot dm^{-3}}$ ✓ (3)

4.2.4 $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$ ✓✓ (2)

4.2.5 $K_c = \frac{(0{,}18)^2}{(0{,}06)(0{,}29)^3}$

$= \frac{0{,}0324}{0{,}00146}$ ✓

$K_c = \underline{\underline{22{,}2}}$ ✓ (2)

4.2.6 Original conc. of $NH_3 = 0{,}18\ mol\cdot dm^{-3}$

New concentration $= 0{,}24\ mol\cdot dm^{-3}$
therefore increase $= 0{,}24 - 0{,}18$ ✓
$= 0{,}06\ mol\cdot dm^{-3}$ ✓ (2)

4.2.7 Increase ✓ in concentration of reactants ✓
Pressure ✓ increase ✓ (4)

4.3

4.3.1 **Fazul is correct** ✓ – according to Le Chatelier's Principle, decreasing the temperature would favour the forward reaction to ✓ relieve the stress ✓ hence increase concentration of NH_3.
Holly has made the mistake by thinking that increasing reaction rate will increase yield. This is incorrect as increasing ✓ reaction rate only produces products ✓ faster, not more. (5)

4.3.2 Catalysts do not increase production of ammonia, ✓ they only allow the reaction to proceed faster ✓ thus producing ammonia more quickly. (2)

4.3.3 'I think we should also use a catalyst ✓ because then we will get ammonia being produced quicker.' ✓ (2)

4.4

4.4.1 Ammonium nitrate is water soluble. ✓ This will cause the dissolved salt to 'leach' through the soil. ✓ (3)

$$NH_4NO_3 \rightarrow NH_4^+(aq) + NO_3^-(aq)$$ ✓

4.4.2 It will solve the problem in the short term, ✓ but continued rains will cause leaching once again and thus will have to keep adding ✓ fertiliser on a continuous basis. (2)

4.4.3 Organic fertilisers slowly release nitrates (nutrients) ✓ into the soil. Farmer will not have to keep adding fertiliser. ✓ (2)

4.4.4 Bonemeal, Manure, Compost (guano) ✓✓ Any two. (2)

4.4.5 **Inorganic**

Advantages
- Easily obtainable and in plentiful supply.
- Convenient in plastic bags.
- Release nutrients quickly and quick benefit. ✓✓

Disadvantages
- Factories required to produce (pollution).
- Can leach away quickly.
- Can overfertilise and damage plants.
- Have to keep on adding – time consuming.
- May become expensive if have to continually do it in the long run. ✓✓

Candidates must list **at least** two advantages and disadvantages for each. (4)

4.4.6 **Organic**

Advantages
- Naturally available. ✓✓
- Allow for continuous supplementation of soil with nutrients. ✓✓
- No factories needed to produce item therefore no pollution. ✓✓
- Environmentally friendly. ✓✓

Any two possible reasons. (4)

48 marks

Total: 150 marks