



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2010

PHYSICAL SCIENCES: PAPER II

MARKING GUIDELINES

Time: 3 hours

200 marks

These marking guidelines were used as the basis for the official IEB marking session. They were prepared for use by examiners and sub-examiners, all of whom were required to attend a rigorous standardisation meeting to ensure that the guidelines were consistently and fairly interpreted and applied in the marking of candidates' scripts.

At standardisation meetings, decisions are taken regarding the allocation of marks in the interests of fairness to all candidates in the context of an entirely summative assessment.

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, and different interpretations of the application thereof. Hence, the specific mark allocations have been omitted.

Carry-over marking will occur where the error is carried from 1 question to the next – as appropriate.

QUESTION 1

- | | | |
|------|-----|-------------|
| 1.1 | C | (2) |
| 1.2 | B/C | (2) |
| 1.3 | D | (2) |
| 1.4 | D | (2) |
| 1.5 | A | (2) |
| 1.6 | D | (2) |
| 1.7 | D | (2) |
| 1.8 | C | (2) |
| 1.9 | D/C | (2) |
| 1.10 | C | (2) |
| | | [20] |

QUESTION 2

- | | | |
|-----|--|-----|
| 2.1 | Ester
Alcohol
Alkene (ene) (arene) | (6) |
| 2.2 | Alcohol and carboxylic acid | (4) |

- 2.3 Either:
No – as it contains a carbon-carbon chain and no polar group to dissolve into polar water i.e. the whole molecule is non-polar

OR

Yes – although it contains a carbon-carbon backbone, the O-H group is polar and this will make it (partially) water soluble in the polar water. (Part of the molecule is polar like water). (4)

- | | | |
|-----|---|-----|
| 2.4 | To speed up the reaction | (2) |
| 2.5 | The catalyst reduces the activation energy for a reaction | |

OR

It provides an alternative reaction pathway

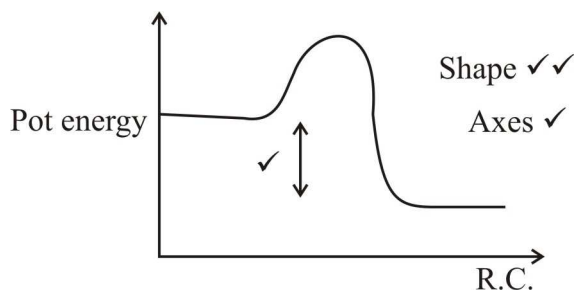
OR

It increases the likelihood of a collision being successful

OR

Site for reaction	(2)
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2.6

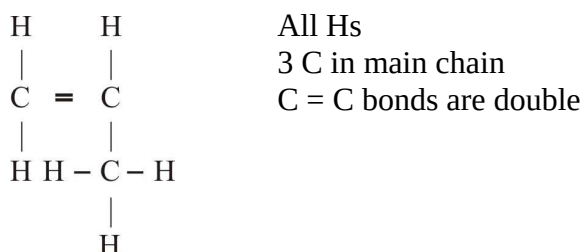


(4)

- 2.7 Yes – it does not change permanently and the definition of a catalyst assumes that the catalyst will remain unchanged.

(3)
[25]**QUESTION 3**

3.1



(4)

3.2

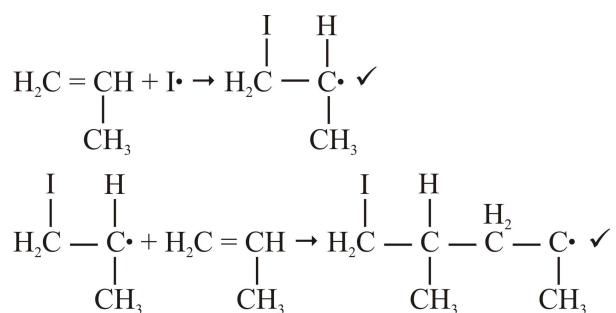
Initiation and Termination

(4)

3.3

- Propagation occurs by the free radical formed at initiation joining a propene molecule
- This reaction opens the double bond
- This new molecule is a new free radical that will join to another propene molecule

Diagrams to aid explanation



This grows 'infinitely' long until terminated.

(6)

3.4

Thermoplastic

The propylene is easily moulded and extruded which is a characteristic of a thermoplastic. Fewer crosslinks/flexible ??? when heated recyclable thermo plastic

(3)

3.5

Advantages	Disadvantages
Cheap Flexible	Not heat resistant Can be used to warm food only
Difficult to break Any 2	Any 2

Table

(5)
[22]**Advantages:**

Non-toxic/inert/unreactive
easily coloured
easily moulded/shapes last in use
strong/light/re-useable/airtight

Disadvantages:

Non-toxic/inert/unreactive
easily coloured
easily moulded/shapes last in use
strong/light/re-useable/airtight

QUESTION 4

- 4.1 The relative reactivity of the metals (or types of metals) (2)
- 4.2 Potential difference (2)
- 4.3 Temperature
Concentration of solutions Some equipment/liquid level/surface area of electrode/
sufficient electrode.
Salts that dissolve must have the same ions, i.e. all nitrates, etc.
(specific & reasonable) (3)
- 4.4 Only the independent and dependent variables are allowed to vary. (The
experimenter will decide by how much the independent variable may change)
- As relationships are being measured, the other variables must be controlled so that
they do not cause the dependent variable to change and thus give a different
relationship. This would ensure that the data is reliable and repeatable. (4)
- 4.5 $\text{Cr} > \text{Ag} > \text{Zn}$ wrt reduction potential (Ranking of metals and nature of property
being ranked) rank; 3 metals; ref to red pot/voltage.
- Any order acceptable but comparison must be present. (3)
- 4.6 No – Metal A should be dipped into a solution of its ions, i.e. Ag should be dipped
into silver ions (each metal in solution of its ions)
- Metal B should be dipped into its own ions – therefore the solutions should be
different. Ions linked to solution (4)
- 4.7
- | Anode | Cathode | Voltage/V | (heading with unit) |
|-------|---------|-----------|----------------------|
| Cr | Ag | 0,3 | |
| Zn | Ag | -0,7 | correct voltage |
| Zn | Cr | 0,4 | |
- Correct Anode (4)
- 4.8 Zn is a stronger reducing agent than Cr which is a stronger reducing agent than Ag (3)
- 4.9 Keeping the liquids from mixing
Allowing ion movement
Behaves as a salt bridge (Any 2) (2)
- 4.10 4.10.1 $E^\theta_{\text{cell}} = E^\theta_{\text{cat}} - E^\theta_{\text{anode}}$
 $= 0,8 - (-0,76)$
 $= 1,56 \text{ V}$ (3)
- 4.10.2 Not performed under std conditions
 i.e. not $1 \text{ mol} \cdot \text{dm}^{-3}$ concentrations
 not 25°C / Terminals may have been the other way around
 internal resistance
 non-ideal salt bridge (3)

[33]

QUESTION 5

- 5.1 Electrolytic – as energy is being put into the system → electrical to chemical (3)
- 5.2 5.2.1 The higher the mpt the higher the cost (2)
 5.2.2 AlF_3 added// Mixed with cryolite (2)
- 5.3 $\text{Al}^{3+} + 3 \text{e}^- \rightarrow \text{Al}$ (2)
- 5.4 Conducts electricity | does not reactive with aluminium
 Cheap (3)
- 5.5 Interface between chemical and electrical system // (negative or positive) terminal → site of chemical rxn // solid conductor – site of ??? (2)
- 5.6 They get used up (undergo chemical reaction) because the carbon combines with the O_2 produced in the cell to form CO_2 . (3)
- 5.7 Yes – it is a strong reducing agent because it has a large and negative E^θ value. (higher on redox table) (3)
- 5.8 Agree
 Produces high amounts of CO_2 at electrode and at powerstation
 Uses large amounts of electricity – where SA has little capacity
 Bauxite imported therefore easy to do elsewhere
 Pumps fluoride into the air.

 However – moving production elsewhere:
 Jobs at stake (7)
- Disagree
 Even though it pollutes the environment through fluoride, CO_2 and red dust it provides valuable jobs and earns valuable foreign exchange.

[27]

QUESTION 6

6.1 Dynamic equilibrium is when the (forward and reverse reactions) are occurring at the (same rate) (2)

6.2 $K_c = [\text{NO}]^2 \cdot [\text{O}_2] / [\text{NO}_2]^2$ (2)

6.3 Closed system/products must remain in the system so they can form reactants. (Reaction rates must be measurable; fwd rate = reverse rate) (2)

6.4 6.4.1 Endothermic (1)

6.4.2 If the temperature increases, the endothermic reaction is promoted. This is the forward reaction so more products are formed. (3)

6.5 No Less No Stress/LC interpret $\therefore$ result

An increase in pressure favours the reaction that produces fewer particles.

This is the reverse reaction.

The reverse reaction is favoured.

OR

Le Chatelier states that a reaction in equilibrium will shift to counter the effect of a change.

An increase in pressure favours the reaction that reduces the pressure.

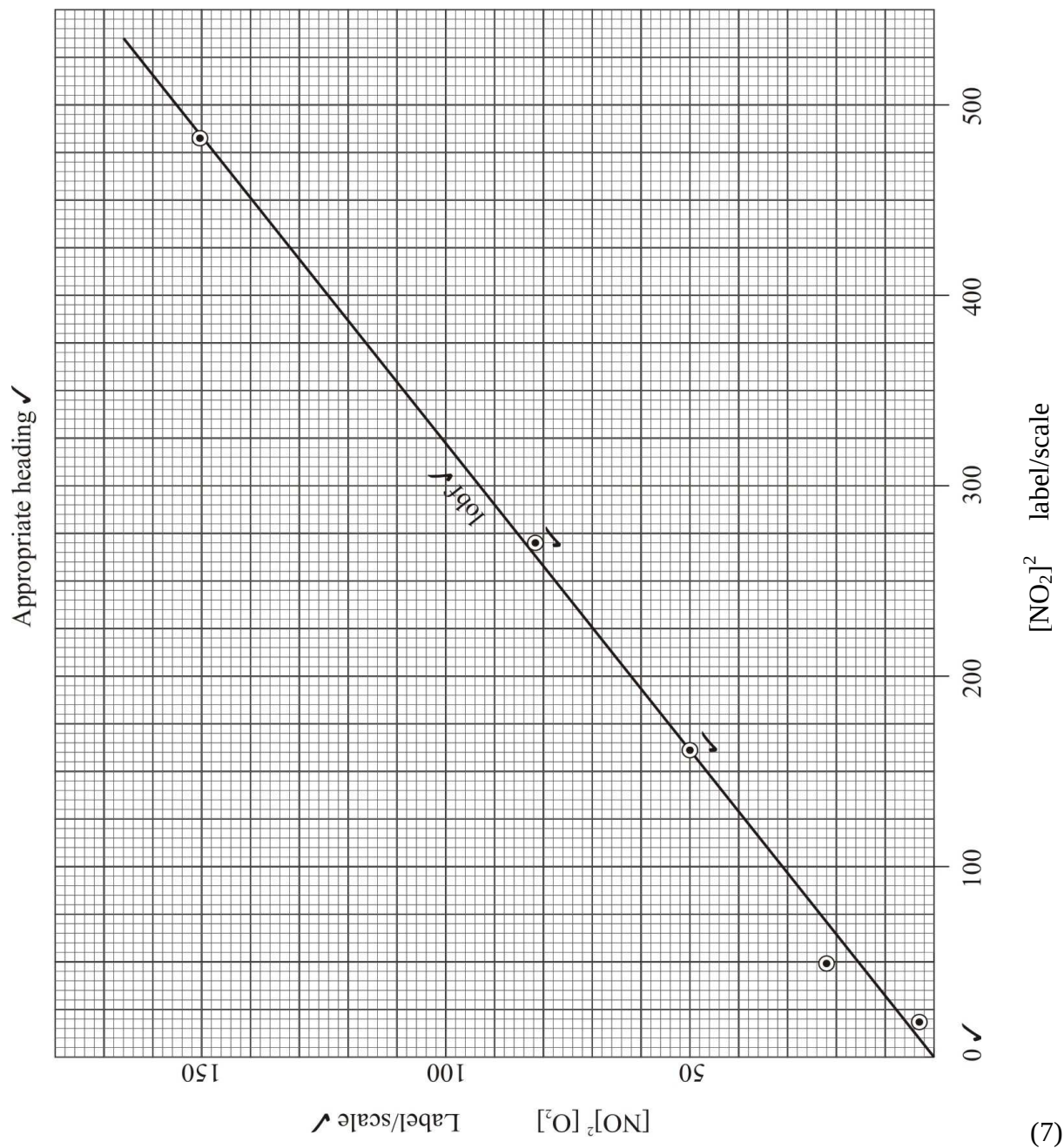
The reverse reaction produces fewer particles than the forward reaction therefore less NO formed. (4)

6.6 Table

Sample Number	$[\text{NO}_2]$ (mol.dm ⁻³)	$[\text{NO}]$ (mol.dm ⁻³)	$[\text{O}_2]$ (mol.dm ⁻³)	$[\text{NO}]^2 \cdot [\text{O}_2]$
1	4,2	2,3	1,1	6
2	7	3,4	1,8	20,8 /21
3	13	4,7	2,2	48,6 /49
4	17	5,4	2,8	81
5	23	7,2	2,9	150

(2)

6.7 heading/axes/zero/2 points/best fit



QUESTION 7

7.1 Solution of ions/ solution that conducts electricity (2)

7.2 $2 \text{PbSO}_4 + 2 \text{H}_2\text{O} \rightarrow \text{Pb} + \text{PbO}_2 + 2 \text{SO}_4^{2-} + 4 \text{H}^+ (2\text{H}_2\text{SO}_4)$ (3)

7.3 **From the overall rxn:**

As the battery discharges; more H_2O is produced. $\rightarrow$ increasing V; decreasing mass/unit volume.

OR

The amount of SO_4^{2-} ion is reduced (removed) from solution reducing mass/unit volume. (3)

7.4 $\text{Pb}^{2+} + 2 \text{e}^- \rightarrow \text{Pb}$

Therefore 2 mol of electrons needed per mole of lead deposited

1 mol of electrons is equivalent to 96 500 C

2 mol of electrons = 193 000 C

For 10 minutes at 1 V : $Q = 1 \times (60 \times 10) = 600 \text{ C}$

Therefore $600 / 193\,000 = 0,0031 \text{ mol of Pb}$

Mass = $0,0031 \times 207 = 0,64 \text{ g}$ (6)

7.5 Recharging does not replace Pb on the electrode perfectly/evenly eventually leading to breakdown. /crystallisation/rational for change ??? (2)

7.6 Disagree

Li-ion batteries are expensive

While they do not pollute, a car would need a large battery to produce enough energy to start the vehicle

Li-ion batteries would still find their way into landfill

Pb acid batteries are currently recycled.

Or Agree

Pb is hazardous to health

Mining and processing is also problematic

Pb batteries are heavy, and Li-ion may require less mass therefore save fuel

Recycling of lead-acid batteries is not making a significant enough impact (6)

[22]

QUESTION 8

8.1 There remains a risk of (mercury poisoning) and pollution – especially to water resources. dangerous costly to maintain escape environmental/ human (4)

8.2 Product is impure and NaCl is wasted Diaphragm cell has one outlet → so product and unreacted NaCl flow out together. Product is thus impure.

Membrane cell has two outlets → dilute NaCl solution which is topped up ∴ more cost effective. Pure product is produced → better able to sell. (4)

8.3 Diaphragm is non-selective membrane (often simple barrier like asbestos) → slows throughput.

Membrane only allows certain ions through to the other half-cell
Membrane needs replacement (2)

8.4 Na cannot be produced because water is reduced before the Na^+ ion. Therefore H_2 is a product and not Na metal

OR

Na is a strong reducing agent/+ will not accept electrons, i.e. water is more reactive. (3)

[13]

QUESTION 9

9.1 Gases have spaces between particles that allows an increase in pressure to reduce volume as pressure increases. This causes an increase in the number of collisions per unit time increasing the rate. (3)

9.2 Yes

Increase of temperature increases the average kinetic energy of the particles.

A greater proportion of collisions will have sufficient energy to react.

This causes more collisions per unit time

And thus there are more effective collisions per unit time

Increasing the rate of reaction (5)

[8]

Total: 200 marks