



NATIONAL SENIOR CERTIFICATE EXAMINATION
NOVEMBER 2009

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.

Please note that learners who provided alternate correct responses to those given in the marking guidelines will have been given full credit.

QUESTION 1**1.1**

- 1.1.1 Gas (1)
- 1.1.2 Van der Waal's Forces/London/Momentary dipole (2)
- 1.1.3 As the number of atoms increases in the molecule/as the chain gets longer/as the molar mass increases then the boiling point increases. (2)
- 1.1.4
- The molecules are non-polar (They have no permanent dipoles to produce strong intermolecular attraction).
 - The molecules therefore are held together by weak forces.
 - As the number of electrons in the molecule increases the likelihood (probability) of temporary (statistical) dipoles forming increases.
 - Thus the boiling point increases with more atoms in the structure. (5)

1.2

- 1.2.1
- | | | | | | |
|------|----|----|----|----|----|
| H | Cl | H | H | H | |
| | | | | | |
| Cl—C | —C | —C | —C | —C | —H |
| | | | | | |
| H | Cl | H | H | H | |
- all bonds shown
- position of 3 C atoms
- 5 carbons in the chain (3)
- 1.2.2 Substitution reaction
- Same number of substituent atoms before and after
- Different type of substituent atoms before and after (3)
- 1.2.3 $C_5H_{12} + 3Cl_2 \rightarrow C_5H_9Cl_3 + 3HCl$ (4)
- 1.2.4 A reactive species with an unpaired electron (2)
- 1.2.5 No – substitution of an alkane **requires UV light or heat**, i.e. will not happen on its own (2)
- 1.2.6 (a) Yes (1)
- (b) The carbon undergoes a change in oxidation number.

OR

The carbon gains oxygen, i.e. oxidation occurs.

ORO₂ is reduced to O²⁻ (2)

1.3

- 1.3.1 No – it is easily collected – a soluble gas will not bubble through the water /the alkenes formed are only slightly soluble in water/non-polar. (2)
- 1.3.2 (a) Yes (1)
 (b) A saturated compound has only single bonds. (2)
- 1.3.3 Weaker; shorter chains $\therefore$ Induced dipoles (London type forces) are weaker/ product is a gas. (3)
- 1.3.4 (a) The brown bromine solution would begin to decolourise immediately and become colourless (lighter)./Change colour (1) (2)
 (b) The test confirms that a compound is unsaturated. (2)
 (c) The addition reaction of bromine with unsaturated compounds is spontaneous and fast whilst the substitution reaction with saturated compounds is slow and needs UV light to take place. (4)

43 marks

QUESTION 2

- 2.1 Cheap quick to produce/Availability of material seasonal/Any reasonable answers (2)
- 2.2 No – ethanol is a compound with a specific chemical formula so identical
 Yes – by-products can be present/different/more concentrated implied concentration (3)
- 2.3 Ethanol is carbon neutral in Brazil – all transport is ethanol based.
 Ethanol is cleaner burning. It does not generate pollutants such as SO₂.
 Sugar cane is a renewable energy source. (4)
- 2.4 2.4.1 D (2)
 2.4.2 C (2)
 2.4.3 An oily liquid (less dense colourless liquid) floating on the water layer
 A sweet smell is produced (2)
 2.4.4 Yes – you can smell it easily, therefore, it becomes gas easily (2)

17 marks

QUESTION 3

$$3.1 \quad A \quad (2)$$

3.2 Mass of the (open) reaction vessel.

OR

Volume of gas released after x time. (2)

- 3.3
 - Measure a set volume of H_2O_2 (control).
 - Measure equal volumes of each powder (control).
 - Place the reaction vessel with H_2O_2 on a balance.
 - Add the powder and record the mass of the vessel.
 - Record the mass every 10 seconds, etc.
 - Repeat the experiment.

OR

- Measure a set volume of H_2O_2 (control).
- Measure equal volumes of each powder (control).
- Set up the apparatus to collect the gas.
- Add the powder and close the vessel.
- Record the time to fill the gas syringe.
- Repeat the experiment.

(6)

3.4 Balance and beaker + stopwatch

OR

Gas syringe and flask with delivery tube + stopwatch (2)

3.5 C (2)

3.6 Suitable table structure
Headings with units
Order and correctly matched values to headings
Average of readings
-1 if units next to each value (5)

3.7 There is a huge increase in the amount of bubbles formed.
(Rapid effervescence) (2)

3.8 The correct order in catalysing ability is MnO_2 , PbO_2 , Fe_2O_3
best } (3)

24 marks

QUESTION 4

4.1

4.1.1 Galvanic. The cell produces electrical energy from chemical potential energy. (3)

4.1.2 $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}$ (0 if) 1 if Ag identified (2)

4.1.3 $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$ (0 if) 1 if Zn identified (2)

4.1.4 $2\text{Ag}^+ + 2\text{e}^- \rightarrow 2\text{Ag}$ (x2)
 $\text{Zn} \rightarrow \text{Zn}^{2+} + 2\text{e}^-$

Overall $2\text{Ag}^+ + \text{Zn} \rightarrow 2\text{Ag} + \text{Zn}^{2+}$ (4)

4.2

4.2.1 No (1)

4.2.2 The Ag is the cathode. OR Zn is the anode
 Ag will be deposited, Zn will dissolve
 so it will grow (2)

4.3

4.3.1 No (1)

4.3.2 Electrolyte ions do not move through the salt bridge.
 The salt bridge releases positive ions into the silver half cell and negative ions into the zinc half cell. (4)

4.3.3 • Completes the circuit.
 • Maintains electrical neutrality of solutions. (3)

4.4

4.4.1 Cadmium is a heavy metal so they are heavy, and cadmium is toxic. Memory effect. (2)

4.4.2 NiMH batteries are rechargeable so not disposed of into the environment as often. Less raw materials used to make them; less energy input any 2 (2)

4.4.3 Rechargeable – secondary; non-rechargeable – primary (2)

4.4.4 Its capacity/stored charged (2)

4.4.5 $Q = I\Delta t$
 $\Delta t = Q/I$
 $= 2,5/0,1$
 $= 25 \text{ h}$ (4)

4.4.6 The electrodes are close together. (2)

4.4.7 $\text{M} + \text{Ni(OH)}_2 \rightarrow \text{MH} + \text{NiO(OH)}$
 -2 if wrong way round (3)

38 marks

QUESTION 5

- 5.1 Salt water/sea water/NaCl solution (1)
- 5.2 A – Chlorine gas (Cl_2)
 B – Hydrogen gas (H_2)
 C – Sodium hydroxide (NaOH) (3)
- 5.3 Allows the ions to migrate
 Prevents bulk mixing (keeps the liquids separate)
 Maximises yield / enables production of NaOH (3)
- 5.4 Keeps the liquid flowing so to increase the throughput of product (2)
 Pressure is higher so helps the ions to move through the diaphragm.
 Stops backflow of OH^- ions.
- 5.5 No (1)
- 5.6 $2 \text{H}_2\text{O} + 2 \text{e}^- \rightarrow \text{H}_2 + 2 \text{OH}^-$ (2)
- 5.7 The water reduces in preference to Na^+ ions. (1 if Na) (2)
- 5.8 (Gas leaking/poisonous)
 Hydrogen gas explosion OR Release of NaOH into the environment. (Any 2) (2)
- 5.9 Positives negative other logical conclusion
 For example:
 Yes – Is used for water purification
 – Improves health (reduces risk)
 – Transport costs would increase
 – Risk of leak not high whilst risk of infection is high (poorest most vulnerable) therefore would not want to not have chlorine.
 No – The risk of leak too high
 – Gas able to travel relatively large distance therefore make too many people ill if leaks (4)

20 marks**QUESTION 6**

- 6.1
 6.1.1 $\text{Cu} \rightarrow \text{Cu}^{2+} + 2\text{e}^-$ (2)
 6.1.2 Yes (1)
- 6.2
 6.2.1 It dissolves and loses mass (oxidised). (2)
 6.2.2 They sink into the solution (remain behind insoluble solid). (2)
 6.2.3 $\text{Ag} + \text{Au}$ are weaker reducing agents than Cu and are therefore not oxidised. Less reactive than upper. (2)

9 marks

QUESTION 7

- 7.1 Sulphur dioxide/Sulphur(IV) oxide (1)
- 7.2 No (1)
- 7.3
- 7.3.1 $K_c = \frac{[\text{SO}_3]^2}{[\text{O}_2][\text{SO}_2]^2}$ (3)
- 7.3.2 The equilibrium will lie towards the reactants, (i.e. a greater proportion of reactants than products)./Low yield. (2)
- 7.3.3 Decrease the temperature (3)
- 7.3.4
- Increase the temperature
 - Add a catalyst
 - Increase the pressure/concentration
- (5)
- 7.3.5 $V = 10 \text{ m}^3 = 10\,000 \text{ dm}^3$ $n = c \times V$
 $= 5 \times 10\,000$
 $= 50\,000 \text{ mol}$ (4)
- 7.4
- 7.4.1 Oleum or pyrosulphuric acid (2)
- 7.4.2 Process is too exothermic (difficult to control heat dissipation/rate of rxn). A large number of acid droplets is formed which is difficult to condense. (2)
- 7.5
- 7.5.1 $\text{Ca}_3(\text{PO}_4)_2$ (3)
- 7.5.2 CaSO_4 $\text{Ca}(\text{H}_2\text{PO}_4)_2$ (2)
- 7.5.3 No (1)
- 7.6
- 7.6.1 Need to replenish lost nutrients./Increase yield; grow faster; increase quality. (2)
- 7.6.2 Poisoning soil with trace impurities with long term use.
 Burning the plants with poor application techniques. (2)
- 7.6.3 Use small amounts of inorganic fertiliser./Switch to organic. (2)

7.7

7.7.1 Fertiliser usually nitrates + phosphates contaminates rivers and waterways causing excessive plant growth. Oxygen is used up by decaying plant material depletes oxygen in the water and destroys life. (4)

7.7.2 Fertiliser washes (leaches) from the soil with rain and irrigation runoff. (2)

- 7.7.3
- Inorganic fertiliser adds micronutrients as well as macronutrients.
 - Modern farming techniques are very demanding on soil minerals.
 - Organic fertiliser not able to replace enough nutrients fast enough (need huge quantity).
 - Food shortages may arise $\therefore$ risk hunger.

1 mark eutrophication solved

2 marks large scale farming 2 reasons

1 mark conclusion

(4)

- 7.7.4
- Would cause farmers to use fertiliser more sparingly.
 - Would reduce waste (and thereby eutrophication).
 - Would switch to less soluble fertiliser (allow to leach slowly into soil, i.e. would last longer).
 - May increase cost of food.

Again argument needs to be carefully reasoned.

Approximately 1 mark per reason (max 3 marks) 1 mark conclusion.

(4)

49 marks

Total: 200 marks