



eduresourceza.com



HILTON COLLEGE
GRADE 12 TRIAL EXAMINATIONS
SEPTEMBER 2020

PHYSICAL SCIENCES: PAPER II
MEMORANDUM

Examiner: Mr MJ van Wyk
Time: 3 hours

Moderator: Mr NC Robert
200 Marks

QUESTION 1 MULTIPLE CHOICE

- 1.1 C ✓✓
- 1.2 A or C ✓✓
- 1.3 C ✓✓
- 1.4 A ✓✓
- 1.5 B ✓✓
- 1.6 A ✓✓
- 1.7 D ✓✓
- 1.8 B ✓✓
- 1.9 D ✓✓
- 1.10 D ✓✓

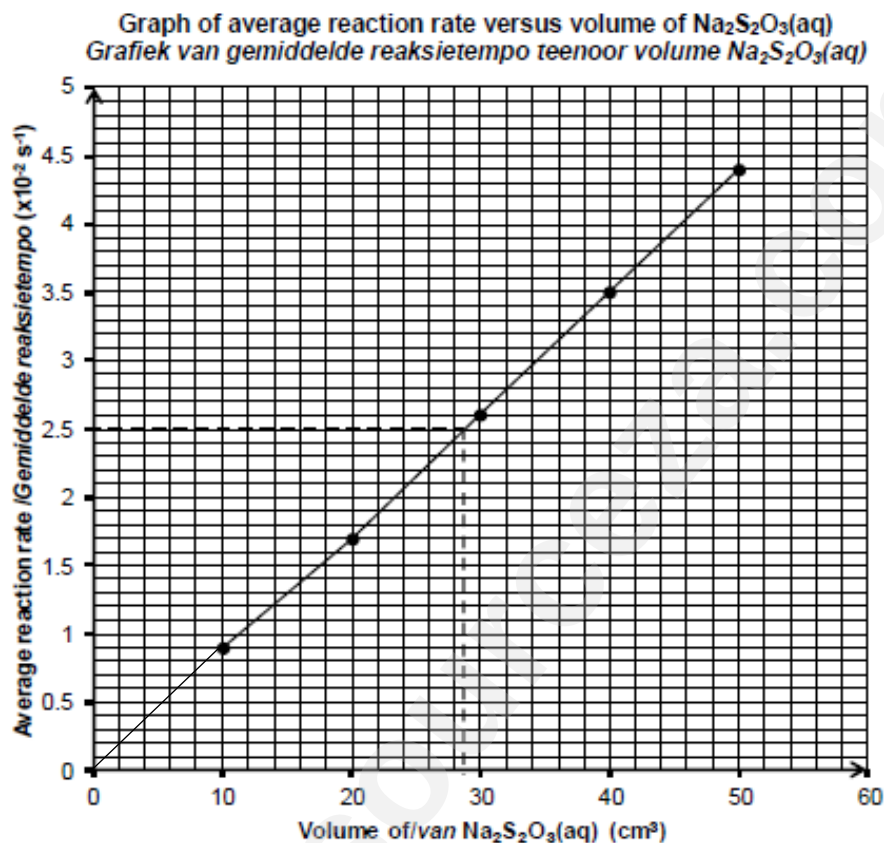
[20]

QUESTION 2

2.1 The change in concentration ✓ per unit time of either reactant or product. ✓ (2)

2.2 Greater than ✓ (1)

2.3



Mark allocation	
Description	
• Heading	✓
• Axes correctly labelled	✓
• Scale	✓
• Points plotted correctly	✓✓
• LOBF straight line	✓

Note: -1 if not through origin.

(6)

2.4

2.4.1

Marking criteria:
y axis: $2,5 \times 10^{-2} \text{ s}^{-1}$ ✓
Dotted line drawn from the y-axis to the x-axis as shown. ✓
$V = 28 \text{ to } 30 \text{ cm}^3$ ✓

(3)

2.4.2

Criteria for conclusion:	
Dependent and independent variables correctly identified.	✓
Relationship between the independent and dependent variables correctly stated.	✓

Examples:

☐ Reaction rate of reaction increases with an increase in concentration/volume of sodium thiosulphate.

☐ Reaction rate decreases with a decrease in concentration/volume of sodium thiosulphate.

☐ Reaction rate is (directly) proportional to concentration/volume of sodium thiosulphate.

(2)

2.5 ☐ More($\text{Na}_2\text{S}_2\text{O}_3$) particles (per unit volume). ✓ **No mark if () not stated**

☐ More collision per unit time, ✓ **(2 marks if per unit time mentioned once)**

☐ Thus, more effective collisions per unit time./Higher frequency of effective collisions. ✓ **(One mark for both collision statements without any mention to time)**

(4)

☐ Increase in reaction rate. ✓

2.6

OPTION 1/OPSIE 1	Marking criteria/Nasienriglyne:
$n(\text{S})_{\text{produced/gevorm}} = \frac{m}{M}$ $= \frac{1,62}{32}$ $= 0,0506 \text{ mol}$	Substitute correct formula ✓ Answer n(S) ✓ Ratio ✓ Mr (158) ✓ Mass ✓
$n(\text{Na}_2\text{S}_2\text{O}_3) = n(\text{S}) = 0,0506 \text{ mol}$	
$n(\text{Na}_2\text{S}_2\text{O}_3) = \frac{m}{M}$ $0,0506 = \frac{m}{158}$ $\therefore m(\text{Na}_2\text{S}_2\text{O}_3) = 7,99 \text{ g}$ [Range/Gebied: 7,90 to 8,06]	OPTION 2/OPSIE 2 $158 \text{ g } \checkmark \text{Na}_2\text{S}_2\text{O}_3 \longrightarrow 32 \text{ g } \checkmark \text{S}$ $\therefore x \longrightarrow 1,62 \text{ g S } \checkmark$ $x = \frac{158 \times 1,62}{32} = 7,99 \text{ g } \checkmark$ [Range/Gebied: 7,90 to 8,06]

(5)

2.7

2.7.1 SiO_2 ✓

(1)

2.7.2 a bond which occurs (between atoms) ✓ (within molecules). ✓

(2)

2.7.3 $\Delta \text{electronegativity} = 3,5 - 1,8 = 1,7$ ✓

The difference is > 0 so the bonds are **polar**. ✓

(2)

- 2.7.4 In silicon dioxide, which is a giant structure the melting point is high due to the large amount of energy needed to break the:
- **many** ✓
 - **strong covalent bonds.** ✓

Carbon dioxide is a **non-polar molecule** ✓ and in the solid state the molecules are held together **by weak London forces.** ✓

(4)
[32]

QUESTION 33.1.1 **CaCO₃:**

$$\begin{aligned}
 n(\text{CaCO}_3)_{\text{formed}} &= \frac{m}{M_r} \\
 &= \frac{40}{100} \checkmark \\
 &= 0,4 \text{ mol } \checkmark
 \end{aligned}$$

HCl:

$$\begin{aligned}
 n(\text{HCl})_{\text{formed}} &= \frac{m}{M} \\
 &= \frac{1,2}{0,5} \checkmark \text{ (0,5 conversion)} \\
 &= 0,6 \text{ mol } \checkmark
 \end{aligned}
 \tag{4}$$

3.1.2 mol ratio

$$\begin{array}{ccc}
 \text{CaCO}_3 & : & \text{HCl} \\
 1 & : & 2 \\
 0,3 & : & 0,6
 \end{array}
 \left. \vphantom{\begin{array}{ccc} \text{CaCO}_3 & : & \text{HCl} \\ 1 & : & 2 \\ 0,3 & : & 0,6 \end{array}} \right\} \checkmark \text{ (any appropriate calculation)}$$

Therefore, HCl $\checkmark$ will be used up completely. (2)

3.1.3 Excess CaCO₃ = 0,4 – 0,3
= 0,1 mol $\checkmark$

$$\begin{aligned}
 M &= n \times M_r \checkmark \\
 &= 0,1 \times 100 \\
 &= 10 \text{ g } \checkmark
 \end{aligned}
 \tag{3}$$

3.2

$$\begin{aligned}
 n(\text{O}_2) &= \frac{V}{V_m} \\
 &= \frac{336}{22,4} \checkmark \\
 &= 15 \text{ mol } \checkmark
 \end{aligned}$$

$$\begin{array}{ccc}
 \text{(mol ratio)} & \text{oxygen} & : \text{ magnesium oxide} \\
 1 & : & 2 \\
 15 & : & 30
 \end{array}$$

Theoretical mass of 30 mol $\checkmark$ MgO.

$$\begin{aligned}
 M &= n \times M_r \\
 &= 30 \times (24,3 + 16) \\
 &= 1209 \text{ g } \checkmark
 \end{aligned}$$

$$\begin{aligned}
 \text{Yield} &= \frac{\text{Actual}}{\text{Theoretical}} \times 100 \\
 &= \frac{875}{1209} \times 100 \checkmark \\
 &= 72,37\% \checkmark
 \end{aligned}
 \tag{6}$$

[15]

QUESTION 4

4.1

4.1.1 One in which mass is conserved inside the system ✓ but energy energy can enter or leave the system freely. ✓ (2)

4.1.2 When an external stress is applied to a system in dynamic chemical equilibrium ✓, the equilibrium point will change in such a way as to counteract the stress. ✓ (2)

4.1.3 (a) The particles became more spread out and the density of the mixture decreased (as the volume increased) ✓
OR
 the concentration decreased ✓ (thus fewer moles of NO₂ per unit volume.) (1)

(b) Stress: Volume increased, hence decrease of pressure. ✓
Response: The reverse reaction is favoured (Eq. shifts left) ✓
Reason: Produce more moles of gas (to increase P again) ✓
Observation: Thus, more dark brown particles are made. ✓ (4)

NOTE: If they say increase volume without mentioning the decrease in pressure then no marks for explanation.

NOTE: Give mark for correct inverse relationship between volume and pressure.

4.1.4

(a) DECREASED (accept Increase) ✓ (1)

(b) EXOTHERMIC. ✓ (1)

4.2

4.2.1 $K_C = \frac{[AB_3]^2}{[A_2] \cdot [B_2]^3}$ ✓✓ **NOTE:** Round brackets subtract 1 mark. (2)

4.2.2

Equation	1 A ₂	3 B ₂	2 AB ₃
Initial (mol) (GIVEN) no marks	6	6	1
Change (mol)	-1,5	-4,5	+3 ✓ (ratio ✓)
Equilibrium (mol)	4,5	1,5 ✓ sub	4 ✓ (Calc.)
Equilibrium concentration	2,25	0,75 ✓ (÷2)	2 (given)

OR At equilibrium:

[A₂] = 2,25 mol•dm⁻³ ✓✓

[B₂] = 0,75 mol•dm⁻³ ✓✓✓

([AB₃] = 2 mol•dm⁻³ No marks – given)

(5)

4.2.3 C.O.E from 4.2.2 and 4.2.1

$$K_c = \frac{(2)^2}{(2,25) \cdot (0,75)^3} \quad \checkmark \text{ for correct substitutions}$$

$$= 4,21 \quad \checkmark \text{ accuracy; no units.}$$

(2)

4.2.4 Increase in pressure. ✓

(1)

4.2.5

(a) STAYS THE SAME ✓

(1)

(b) DECREASE ✓

(1)

[23]

QUESTION 5

5.1

5.1.1 An acid that can donate two protons. ✓✓ (2)

5.1.2 H_2O ✓ $(\text{COO})_2^{2-}$ ✓ (2)

5.1.3 A substance that can (act as either) ✓ an (acid or a base) ✓ (2)

5.1.4 $\text{H}(\text{COO})_2^-$ ✓ (1)

5.2

5.2.1 No. ✓ (1)

5.2.2 A weak acid does not ionise completely ✓
 (or and forms a low concentration of H_3O^+ ions)
 while a dilute solution contains a small amount of moles acid per
 volume water ✓ and does not depend on whether the acid is strong
 or weak. (2)

5.3

5.3.1 A solution of known concentration. ✓✓ (2)

5.3.2 $c = \frac{m}{MV}$ ✓
 $0,2 = \frac{m}{(126)(0,25)}$ (126) ✓ (0,25) ✓
 $= 6,3 \text{ g}$ ✓ (4)

5.4

5.4.1 End point – the point where the indicator changes colour. ✓ (1)

5.4.2 Phenolphthalein ✓ (1)

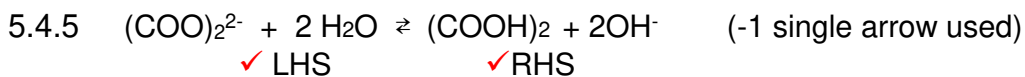
5.4.3 $n(\text{acid})_{\text{formed}} = cV(\text{acid})$
 $= (0,2)(0,025)$ ✓ Correct Volume
 $= 0,005 \text{ mol acid}$ ✓ n of acid

(C.O.E) Ratio: acid : base $\therefore n(\text{base}) = 0,01 \text{ mol base}$ ✓ method
 1 : 2

Conc. (base) = $\frac{n(\text{base})}{V}$
 $= \frac{0,01}{0,036}$ ✓ Substitution and $V = 0,036 \text{ dm}^3$ ✓
 $= 0,27 \text{ mol.dm}^{-3}$ ✓ (accept 0,28) (6)

5.4.4 GREATER THAN 7 ✓

(1)

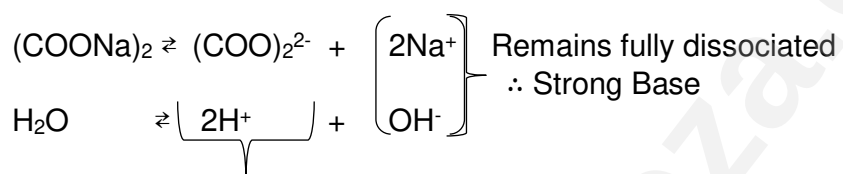


- $(\text{COO})_2^{2-}$ comes from a weak acid. ✓
- Equation above.
- This leads to an excess OH^- . ✓
- (Therefore, solution is a weak base with pH greater than 7).
- (Accepted spectator ions (Na^+))

(4)

NOTE: Accept single protonation; accept $(\text{COONa})_2 + \dots \rightarrow \text{NaOH} + \dots$

OR



Combine

 $\therefore$ Removal of H^+ Forward reaction is favoured and excess OH^- producedSolution is a weak base, $\text{pH} > 7$.

[29]

QUESTION 6

6.1

6.1.1 Salt bridge ✓ (1)

6.1.2 Galvanic / Voltaic cell ✓ (1)

6.2

6.2.1 Decreases ✓ (1)

6.2.2 Increases ✓ (1)

6.3

6.3.1 $Y(s) \rightarrow Y^{2+} + 2e^-$ ✓✓ **OR/OF** $Mg(s) \rightarrow Mg^{2+} + 2e^-$ (2)

6.3.2 $Y(s) | Y^{2+}(aq) || Al^{3+}(aq) | Al(s)$
 ✓ anode ✓ salt bridge ✓ cathode ✓ phases

OR/OF $Mg(s) | Mg^{2+}(aq) || Al^{3+}(aq) | Al(s)$ (4)

6.4

OPTION 1/OPSIE 1	Notes/Aantekeninge
$E^\circ_{cell} = E^\circ_{reduction} - E^\circ_{oxidation}$ ✓ $0,7 \checkmark = -1,66 \checkmark - E^\circ_{oxidation}$ $E^\circ_{oxidation} = -2,36 (V)$ ✓ Y is Mg ✓	- Accept any other correct formula from the data sheet./Aanvaar enige ander korrekte formule vanaf gegewensblad. - Any other formula using unconventional abbreviations, e.g. $E^\circ_{cell} = E^\circ_{OA} - E^\circ_{RA}$ followed by correct substitutions:/Enige ander formule wat onkonvensionele afkortings gebruik bv. $E^\circ_{sel} = E^\circ_{OM} - E^\circ_{RM}$ gevolg deur korrekte vervangings: $\frac{4}{5}$
OPTION 2/OPSIE 2	
$Al^{3+}(aq) + 3e^- \rightarrow Al(s)$ ✓	$E^\circ = -1,66 V$ ✓
$Y(s) \rightarrow Y^{2+}(aq) + 2e^-$	$E^\circ = +2,36 V$ ✓
$Y(s) + Al^{3+}(aq) \rightarrow Y^{2+}(aq) + Al(s)$	$E^\circ = +0,7 V$ ✓
Y is Mg ✓	

(4)

6.5 Conversion of electrical energy into chemical energy. ✓ (1)

6.6 Anode ✓ $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$ ✓ (2)

6.7 $CuSO_4$ solution /any soluble copper salt. ✓ (1)

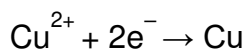
- 6.8 Cu^{2+} ions accept electrons more readily (stronger OA, undergo reduction) than example Zn^{2+} ions (above it on the SEP table). ✓✓
Therefore, Cu^{2+} ions discharges (more readily) first on Cathode. (2)

6.9

6.9.1 $n = \frac{m}{M}$
 $n = \frac{3,2}{63,5}$ ✓ Substitution
 $= 0,05 \text{ mol copper}$ ✓ (2)

6.9.2 $Q = I\Delta t$ ✓
 $= (8)(1\,200)$ OR $n = \frac{q}{F}$
 $= 9\,600 \text{ C}$ ✓ $= \frac{9600}{96500}$
 $= 0,1 \text{ mol}$
 $n_e = \frac{Q}{q}$ $N = n \cdot N_A$
 $= \frac{9600}{1,6 \times 10^{-19}}$ ✓ $= (0,1)(6,02 \times 10^{23})$
 $= 6 \times 10^{22} \text{ electrons}$ ✓ $= 6 \times 10^{22} \text{ electrons}$ (4)

OR



Ratio: Copper : electrons

$$\begin{array}{ccc} 1 & : & 2 \\ \therefore & 0,05 & : & 0,1 \end{array}$$
 ✓

C.O.E Q.6.9.1

No. of mol of $e^- = 1 \text{ mol}$ 1 mol of e^- requires 96 500 C

$$\therefore \text{charge required} = 0,1 \times 96\,500$$

$$= 9\,650 \text{ C}$$
 ✓

$$\text{No. of electrons} = \frac{9650}{1,6 \times 10^{-19}}$$
 ✓

$$\therefore \text{no. of electrons} = 6,03 \times 10^{22} \text{ electrons}$$
 ✓

[26]

QUESTION 7

7.1 The ions ✓ are free to move ✓ and current can flow through electrolyte. (2)

7.2 It is an ion-selective membrane. ✓ Meaning, usually only allowing the passage of positive ions although negative ions might pass through. (1)

7.3 Negative ✓ (1)

7.4

7.4.1 $\text{Na}^+ + \text{e}^- \rightarrow \text{Na}$ ✓✓ (2)

7.4.2 $2\text{H}_2\text{O} + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-$ ✓✓ (2)

7.4.3 In **Cell 2** water is a stronger oxidising agent ✓ than the Na^+ ions ✓ (or converse) thus H_2O reduces in preference to the Na^+ ions. ✓✓ (4)

[12]

QUESTION 8

8.1

8.1.1 *An atom or a group of atoms ✓ that form the centre of chemical activity in the molecule. ✓* (2)

8.1.2 Double (covalent) bond ✓ between carbon atoms. ✓ (2)

8.1.3 As the size of the molecule increases / as the length of the carbon chain increases / as the molecular mass increases/ as the surface area increases as you go down the group ✓

The London forces/ dispersion forces / induced / temporary / Momentary dipole forces found between the molecules increase in strength / there are **more** induced/ temporary/ momentary dipole forces or London forces or dispersion forces. ✓

More energy is needed to overcome the stronger / more London forces or to separate the molecules, ✓

therefore, a higher boiling point ✓ (4)

OR

The intermolecular forces experienced are London forces or dispersion forces or induced/temporary/momentary dipole forces/ Therefore, **more** induced/ temporary/ momentary dipole forces or London forces or dispersion forces. ✓

Bigger molecules have (more atoms and hence) more electrons
OR a greater surface area ✓

More energy is needed to overcome the stronger intermolecular forces (**NOT bonds**) or to separate the molecules ✓

therefore, a higher boiling point. ✓

8.1.4 For molecules with the same number of carbon atoms ✓ the boiling points of the alkenes are lower than those of the alkanes. ✓ (2)

OR

For molecules with the same number of carbon atoms ✓ the alkanes have a higher boiling point than the alkenes. ✓

8.2

8.2.1 A compound in which (all of the bonds between carbon atoms) are (single bonds). (2)

8.2.2 Water has relatively strong hydrogen bonding between its molecules.

While the hydrocarbon has weaker London forces between its Molecules.

Thus, the intermolecular forces are not of similar strength. (and so the hydrocarbon is not miscible in water.) (3)

names of IMF

comparison

not of similar strength

OR

Water is polar and the hydrocarbon is non-polar.

Their IMFs are not of similar strength.

The hydrogen bond forces between water particles are so strong that the hydrocarbon particles are pushed out.

8.2.3 **Condition:** Heat or Sunlight or UV light
Products: CH_3F and HF (3)

[18]

QUESTION 9

9.1

9.1.1 High pressures ✓ and temperatures ✓ without a catalyst. ✓ (3)

9.1.2 Chemical process. ✓
New products are formed **OR** bonds are broken. ✓ (2)9.1.3 $C_{18}H_{38} \rightarrow C_{12}H_{26} + 3C_2H_4$ (nothing else must be changed) ✓ (2)

9.2

9.2.1 Combustion **OR** oxidation ✓ (1)9.2.2 $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$ ✓ (2)

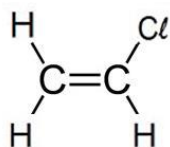
9.3

9.3.1 Chlorine (gas) ✓ (reject the formula) (1)

9.3.2 1,2-dichloroethane.

1,2 - ✓ dichloro ✓ ethane ✓
(- 1 for convention error e.g. gaps, no commas etc) CH_2ClCH_2Cl ✓ (4)

9.3.3

✓ double bond between two carbons
✓ whole molecule

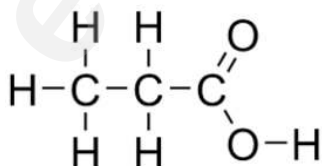
(2)

9.4

9.4.1 **General:** Addition ✓
Specific: Hydration ✓ (2)

9.4.2 Methanoic acid ✓✓ (2)

9.4.3 Propanoic acid ✓

✓✓ If given structural isomer
✓ Correct structure

(4)

[25]**Total: 200 marks**