



KWAZULU-NATAL PROVINCE

EDUCATION
REPUBLIC OF SOUTH AFRICA

**PROVINCIAL STANDARDISED
ASSESSMENT**

GRADE 11

**PHYSICAL SCIENCES
MARKING GUIDELINES
SEPTEMBER 2026**

MARKS: 100

DURATION: 2 hours

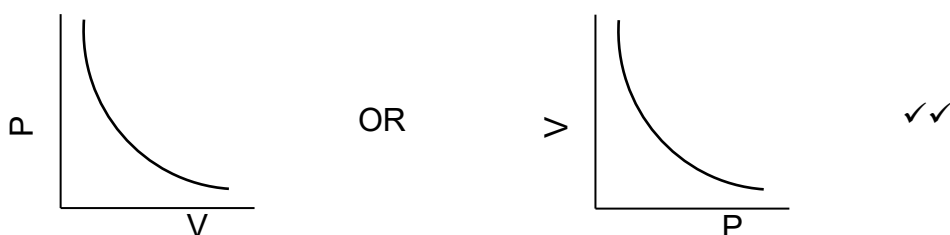
This marking guidelines consists of 8 pages.

QUESTION 1:

- | | | |
|-----|------|-------------|
| 1.1 | B ✓✓ | (2) |
| 1.2 | A ✓✓ | (2) |
| 1.3 | C ✓✓ | (2) |
| 1.4 | B ✓✓ | (2) |
| 1.5 | B ✓✓ | (2) |
| 1.6 | C ✓✓ | (2) |
| | | [12] |

QUESTION 2

- 2.1 The pressure of an enclosed gas is inversely proportional to the volume it occupies ✓ at a constant temperature. ✓ (2)
- 2.2 As the balloon rises, the pressure exerted by the water decreases. ✓
Therefore the pressure exerted by the gas decreases ✓ (2)
- 2.3 Helium atoms are smaller and occupy a negligible volume ✓ compared with the particles in air.
At higher pressures, further increases in pressure will decrease the volume more for helium gas than for atmospheric gas ✓
Therefore helium behaves more like an ideal gas ✓ compared to the gases in air (so its pressure-volume relationship more closely follows Boyle's law) (3)
- 2.4



- 2.5.1 The pressure exerted by the gas in the balloon is equal to the pressure exerted by surrounding water/ The pressure exerted by the gas in the balloon is directly proportional to the pressure exerted by surrounding water/ The gradient of the graph is 1. ✓✓ (2)
- 2.5.2 $p_1V_1 = p_2V_2$ ✓
 $420 \times 4 = 120 \times V_2$ ✓
 $V_2 = 14 \text{ dm}^3$ ✓ (4)

2.5.3

OPTION 1 The balloon will burst. ✓ $p_1V_1 = p_2V_2$ $420 \times 4 \checkmark = p_2 \times 16 \checkmark$ $p_2 = 105 \text{ kPa}$ $p_2 \text{ (or 105 kPa)} > 100 \text{ kPa} \checkmark$	OPTION 2 The balloon will burst. ✓ $p_1V_1 = p_2V_2$ $420 \times 4 \checkmark = 100 \times V_2 \checkmark$ $V_2 = 16,8 \text{ dm}^3$ $V_2 \text{ (16,8)} > 16 \text{ dm}^3 \checkmark$
OPTION 3 (POSITIVE MARKING FROM 2.5.1) The balloon will burst. ✓ $p_1V_1 = p_2V_2$ $120 \times 14 \checkmark = p_2 \times 16 \checkmark$ $p_2 = 105 \text{ kPa}$ $p_2 \text{ (or 105 kPa)} > 100 \text{ kPa} \checkmark$	OPTION 4 (POSITIVE MARKING FROM 2.5.1) The balloon will burst. ✓ $p_1V_1 = p_2V_2$ $120 \times 14 \checkmark = 100 \times V_2 \checkmark$ $V_2 = 16,8 \text{ dm}^3$ $V_2 \text{ (16,8)} > 16 \text{ dm}^3 \checkmark$

(4)

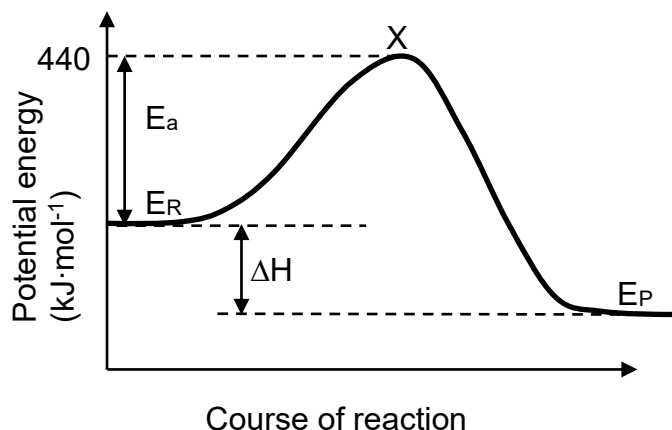
[19]**QUESTION 3**

3.1 The energy absorbed or released per mole ✓✓ (in a chemical reaction) (2 or 0) (2)

3.2 $\Delta H = E_P - E_R$
 $= \underline{40 - 260} \checkmark$
 $= \underline{-220 \text{ kJ} \cdot \text{mol}^{-1}} \checkmark$ (2)

3.3 Less than ✓ (1)

3.4



NOTE: If the graph of an endothermic reaction is drawn, award a maximum of 3 marks (bullets 3, 4 and 5 if correctly indicated).

Marking criteria:

- Shape of curve (must be for exothermic reaction) ✓
- E_R , E_P and ΔH correctly labelled ✓
- E_a correctly labelled ✓
- Activated complex correctly labelled as X on the peak ✓
- Energy of activated complex = $440 \text{ kJ} \cdot \text{mol}^{-1}$ ✓

(5)

3.5 Exothermic ✓ (1)

3.6.1 A spark/heat energy is required to provide the activation energy ✓ needed to initiate the reaction. (1)

3.6.2 The combustion reaction is exothermic / energy is released ✓ when products are formed.
Part of the energy released provides the activation energy for more particles to react ✓ **OR** The heat produced by the reaction continues the reaction. (2)

[14]**QUESTION 4**

4.1.1

Marking criteria:

- Substitute into formula to find mass of sorbitol ✓
- Subtract mass of C and H from mass of sorbitol to obtain mass of O ✓
- Calculate the number of moles of all 3 elements ✓
- Determine the simplest ratio of all elements ✓
- Final answer: $\text{C}_3\text{H}_7\text{O}_3$ ✓

$$n = \frac{m}{M}$$

$$0,25 = \frac{m}{182} \quad \checkmark$$

$$m(\text{sorbitol}) = 45,5 \text{ g}$$

$$m(\text{O}) = 45,5 - (18 + 3,5) \quad \checkmark$$

$$= 24 \text{ g}$$

Element	mass (g)	$n = \frac{m}{M}$	Simplest Ratio		
C	18	$\frac{18}{12} = 1,5$	1,5	$\times 2 \text{ OR}$ $\times \frac{3}{1,5}$ $\checkmark$	3
H	3,5	$\frac{3,5}{1} = 3,5 \quad \checkmark$	3,5		7
O	24	$\frac{24}{16} = 1,5$	1,5		3

Empirical Formula: $\text{C}_3\text{H}_7\text{O}_3$ ✓

(5)

4.1.2 $M(C_3H_7O_3) = 3 \times 12 + 1 \times 7 + 3 \times 16 \checkmark$
 $= 91 \text{ g} \cdot \text{mol}^{-1}$

$$\frac{182}{91} \checkmark = 2$$

Molecular formula : $C_6H_{14}O_6 \checkmark$

(3)

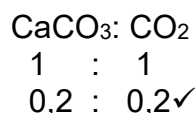
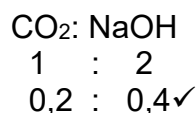
4.2.1 The amount of solute/ dissolved substance/ mole per litre/dm³ of solution. $\checkmark \checkmark$
(2 OR 0)

(2)

4.2.2 $c = \frac{n}{V} \checkmark$
 $2 = \frac{n}{0,2} \checkmark$
 $n = 0,4 \text{ mol} \checkmark$

(3)

4.2.3 **POSITIVE MARKING FROM QUESTION 4.2.2**



NOTE:

Ratios may be shown
in s table. Mark
accordingly

$m(CaCO_3) = nM$
 $= 0,2 \times 100 \checkmark$
 $= 20 \text{ g}$

$\% \text{ purity} = \frac{\text{pure mass}}{\text{total sample mass}} \times 100$
 $= \frac{20}{25} \times 100 \checkmark$
 $= 80 \% \checkmark$

(5)

[18]

QUESTION 5

5.1 The reactant that is completely consumed in a chemical reaction OR The reactant that is used up first in a chemical reaction OR The reactant that limits/determine the amount of product formed. $\checkmark \checkmark$ **(2 OR 0)**

(2)

NOTE:

For Questions 5.2, 5.3 and 5.4, calculations may be done in a single table. Award marks if the calculations (ratios for Q5.2 and Q5.4, and the subtraction for Q5.3) are correct in the table.

5.2

$n(\text{NH}_3) = \frac{N}{N_A} \checkmark$ $= \frac{1,81 \times 10^{24}}{6,02 \times 10^{23}} \checkmark$ $= 3,01 \text{ mol}$ $n(\text{O}_2) = \frac{m}{M}$ $= \frac{108,8}{32} \checkmark$ $= 3,4 \text{ mol}$		
<u>OPTION 1</u>	<u>OPTION 2</u>	<u>OPTION 3</u>
$\text{NH}_3 : \text{O}_2$ $4 : 5$ $3,01 : 3,76 \checkmark$	$\text{NH}_3 : \text{O}_2$ $4 : 5$ $2,72 : 3,4 \checkmark$	$\frac{3,01}{4} > \frac{3,4}{5} \checkmark$
O ₂ / Oxygen is the limiting reagent ✓		

(5)

5.3

POSTIVE MARKING FROM QUESTION 5.2

$$n(\text{NH}_3)_{\text{excess}} = 3,01 - 2,72 \checkmark$$

$$= 0,29 \text{ mol}$$

$$n = \frac{V}{V_{m}} \checkmark$$

$$0,29 = \frac{V}{24,5} \checkmark$$

$$V(\text{NH}_3)_{\text{excess}} = 7,11 \text{ dm}^3 (7,105 \text{ dm}^3) \checkmark$$

(4)

5.4

POSTIVE MARKING FROM QUESTION 5.2

$$\text{O}_2 : \text{NO}$$

$$5 : 4$$

$$3,4 : 2,72 \checkmark$$

OR

$$\text{NH}_3 : \text{NO}$$

$$4 : 4 \text{ (OR 1:1)}$$

$$2,72 : 2,72 \checkmark$$

OPTION 1

$$n = \frac{V}{V_{m}}$$

$$2,72 = \frac{V}{24,5} \checkmark$$

$$V = 66,64 \text{ dm}^3$$

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$= \frac{56,6}{66,64} \times 100 \checkmark$$

$$= 84,93 \% \checkmark$$

OPTION 2

$$n = \frac{V}{V_{m}}$$

$$= \frac{56,6}{24,5} \checkmark$$

$$= 2,31 \text{ mol}$$

$$\% \text{ yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

$$= \frac{2,31}{2,72} \times 100 \checkmark$$

$$= 84,93 \% \checkmark$$

(4)

[15]

QUESTION 6

6.1 An acid is a proton/ H^+ donor ✓✓(2 OR 0) (2)

6.2.1 Hydrogen sulphate / Sulphuric acid ✓ (1)

6.2.2 $H_2SO_4 + 2H_2O \checkmark \rightarrow 2H_3O^+ + SO_4^{2-} \checkmark$ Balancing ✓ (3)

6.2.3 $HSO_4^- \checkmark$ (1)

6.3.1 A diprotic acid is an acid that can donate two hydrogen ions/ H^+ /protons per molecule in aqueous solution. ✓✓ (2)

6.3.2

$H_2X + H_2O \rightarrow H_3O^+ + HX^-$ If complete ionization took place: $[H_3O^+] = [H_2X]$ $= (0,1) \text{ mol}\cdot\text{dm}^{-3} \checkmark$ $pH = -\log[H_3O^+] \checkmark$ $0,9 = -\log[H_3O^+] \checkmark$ $[H_3O^+] = 0,13 \text{ mol}\cdot\text{dm}^{-3}$ • H_2X ionized completely in water ✓. • Therefore, H_2X is a strong acid ✓	
<u>ACCEPT:</u> [Assume H_2X ionises completely to produce $2H_3O^+$] $H_2X + 2H_2O \rightarrow 2H_3O^+ + X^{2-}$ If complete ionization took place: $[H_3O^+] = 2 [H_2X]$ $= 2(0,1) \checkmark$ $= 0,2 \text{ mol}\cdot\text{dm}^{-3}$	
$pH = -\log[H_3O^+] \checkmark$ $0,9 = -\log[H_3O^+] \checkmark$ $[H_3O^+] = 0,13 \text{ mol}\cdot\text{dm}^{-3}$ • H_2X ionized partially/ incompletely in water ✓. • Therefore, H_2X is a weak acid ✓	$pH = -\log[H_3O^+] \checkmark$ $= -\log[0,2] \checkmark$ $= 0,7$ • H_2X ionized partially/ incompletely in water ✓. • Therefore, H_2X is a weak acid ✓

NB: Credit for *Strong Acid* or *Weak Acid* will only be given when a suitable calculation is performed. (5)

6.4.1 **OPTION 1**

$$\begin{aligned} n(\text{HCl}) &= cV \\ &= 0,6 \times 0,02 \checkmark \\ &= 0,012 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Na}_2\text{CO}_3) &= \frac{1}{2} n(\text{HCl}) \\ &= 0,5(0,012) \checkmark \\ &= 0,006 \text{ mol in } 25 \text{ cm}^3 \end{aligned}$$

$$\begin{aligned} n(\text{Na}_2\text{CO}_3) \text{ in } 250 \text{ cm}^3 &= \frac{250}{25} \times 0,006 \checkmark \\ &= 0,06 \text{ mol} \end{aligned}$$

$$\begin{aligned} m(\text{Na}_2\text{CO}_3) &= nM \\ &= 0,06 \times 106 \checkmark \\ &= 6,36 \text{ g} \checkmark \end{aligned}$$

OPTION 2

$$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$$

$$\frac{0,6 \times 20 \checkmark}{c_b \times 25 \checkmark} = \frac{2}{1} \checkmark$$

$$c(\text{Na}_2\text{CO}_3) = 0,24 \text{ mol} \cdot \text{dm}^{-3}$$

$$c(\text{Na}_2\text{CO}_3) = \frac{m}{MV}$$

$$0,24 = \frac{m}{106 \times 0,25} \checkmark$$

$$m = 6,36 \text{ g} \checkmark$$

OPTION 3

$$\begin{aligned} n(\text{HCl}) &= cV \\ &= 0,6 \times 0,02 \checkmark \\ &= 0,012 \text{ mol} \end{aligned}$$

$$\begin{aligned} n(\text{Na}_2\text{CO}_3) &= \frac{1}{2} n(\text{HCl}) \\ &= 0,5(0,012) \checkmark \\ &= 0,006 \text{ mol} \end{aligned}$$

$$\begin{aligned} c(\text{Na}_2\text{CO}_3) &= \frac{n}{V} \\ &= \frac{0,006}{0,025} \checkmark \\ &= 0,24 \text{ mol} \cdot \text{dm}^{-3} \end{aligned}$$

$$c(\text{Na}_2\text{CO}_3) = \frac{m}{MV}$$

$$0,24 = \frac{m}{106 \times 0,25} \checkmark$$

$$m = 6,36 \text{ g} \checkmark$$

(5)

$$\begin{aligned} 6.4.2 \quad C_1 V_1 &= C_2 V_2 \\ 0,6 \times 50 \checkmark &= C_2 \times 250 \checkmark \\ C_2 &= 0,12 \text{ mol} \cdot \text{dm}^{-3} \checkmark \end{aligned}$$

(3)

[22]**TOTAL: 100**