KWAZULU-NATAL PROVINCE

EDUCATION

REPUBLIC OF SOUTH AFRICA

GRADE 11

NATIONAL SENIOR CERTIFICATE

PHYSICAL SCIENCES P2 (CHEMISTRY)

MARKING GUIDELINES

NOVEMBER 2024

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MARKS: 150

These marking guidelines consists of 8 pages.

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QUESTION 1: MULTIPLE CHOICE QUESTIONS

1.1 A✓✓ (2)
1.2 D✓✓ (2)
1.3 D✓✓ (2)
1.4 A✓✓ (2)
1.5 B✓✓ (2)
1.6 B✓✓ (2)
1.7 D✓✓ (2)
1.8 C✓✓ (2)
1.9 A✓✓ (2)
1.10 A✓✓ (2)

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QUESTION 2

2.1

2.1.1 B✓ (1)

2.1.2 A✓ (1)

2.1.3 A✓ (1)



2.2 Valence electrons are <u>electrons in the highest / outermost energy level of an atom</u>. ✓✓ (2 OR 0) (2)

2.3

H^{*} ✓ $\quad {}_{\circ}H$ ✓ $\longrightarrow$ $H{}^{*}_{\circ}H$ ✓

(3)

2.4 There <u>are forces of attraction (between unlike charges / protons and electrons)</u> ✓and <u>forces of repulsion (between like charges / protons and protons and electrons and electrons)</u>. ✓ When two H atoms approach each other, there is a distance between their nuclei where <u>the forces of attraction and repulsion are balanced / the resultant force between them is zero.</u> ✓ For this distance the <u>potential energy of the system (the 2 atoms) is at its lowest / a stable bond is formed.</u> ✓ (4)

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2.5 Helium <u>has a completely filled outer energy level consisting of a single electron pair.</u> ✓ The atom is <u>at its lowest energy level.</u>✓ (2)

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QUESTION 3

3.1

Marking criteria
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

The temperature at which the vapour pressure of a substance equals atmospheric pressure. ✓✓ (2)

3.2 For the experiment to be fair / have only one independent variable.✓ (1)

3.3 Intermolecular forces are forces of attraction between molecules. ✓
Interatomic forces (chemical bonds) bond atoms to form molecules. ✓ (2)

3.4.1 H_2S - dipole-dipole forces✓
O_2 - London forces / Dispersion forces✓
CH_3OH - hydrogen bonding✓ (3)

3.4.2 CH_3OH✓ (1)

3.4.3 O_2✓ (1)

3.5 More energy is required to separate molecules✓ with strongest intermolecular forces.✓ (2)

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QUESTION 4

4.1

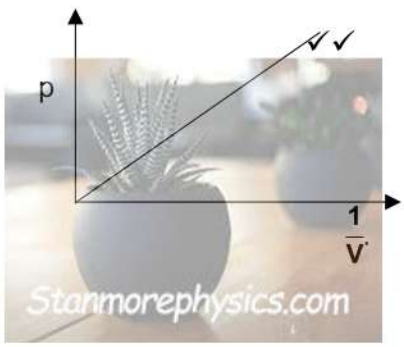
Marking criteria
If any of the underlined key words/phrases in the **correct context** is omitted deduct 1 mark

The pressure of an enclosed gas is inversely proportional to the volume it occupies at constant temperature. ✓✓ (2)

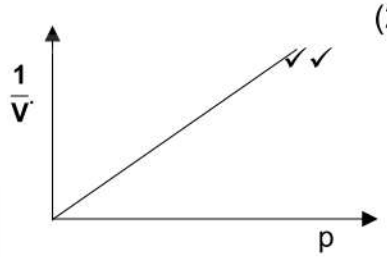
4.2 Temperature✓ and mass✓ (of the gas). (2)

4.3
$p_1V_1 = p_2V_2$✓
$400 \times 12 = 30 \times V_{2G}$ ✓
$V_2 = 160\ dm^3$✓ (3)

4.4 (2)



OR



Straight line through the origin ✓✓

4.5.1 a) x
b) x + 8,6 (2)

4.5.2 **POSITIVE MARKING FROM Q5.5.1:**

$p_1V_1 = p_2V_2$✓
x (5,61) ✓ = (x + 8,6) (5,17)✓
x = 101,5 kPa✓ (4)

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QUESTION 5

5.1 CaO ✓ + CO_2 ✓→ $CaCO_3$ ✓ Balancing ✓ (4)

5.2.1 The total mass in a reaction (the mass of its atoms) stays the same, but because the atoms are re-arranged, ✓the number and type of molecules can change. ✓ (2)

5.2.2 The total mass before a reaction takes place is equal to the total mass after the reaction ✓
OR
In a chemical reaction, the total mass of the reactants and the products remains constant. (1)

5.2.3 Reactant mass: 1 g CaO + 2 g CO_2 = 3 g ✓
Product mass: 1,78 g $CaCO_3$ + 1,22 Unreacted CO_2= 3 g ✓
Therefore, the mass of the reactants and the products is the same, i.e. mass has been conserved in the reaction. ✓ (3)

5.3.1 Empirical formula is the simplest whole number ratio in which the elements combine✓ to form a compound whereas the molecular formula shows the actual numbers of each element✓ in a compound. (2)

5.3.2 Take 100 g of the compound.

	C	H	O
Mass in 100 g	✓ 40 g	6,67 g	53,33 g
$n = \frac{m}{M}$✓	$n = \frac{40}{12}$✓	$n = \frac{6,67}{1}$✓	$n = \frac{53,33}{16}$✓
	n = 3,33	n = 6,67	n = 3,33
Ratio:	✓ 1	2	1

Empirical formula = CH_2O✓ (7)

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5.3.3 $M(CH_2O) = 30\ g \cdot mol^{-1}$✓

$$\frac{\text{Actual molecular mass}}{\text{Empircal formula mass}} = \frac{60}{30}\checkmark = 2$$

∴ Molecular formula = $C_2H_4O_2$✓ (3)

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QUESTION 6

6.1 Exothermic✓
Products have a lower energy than the reactants✓✓
OR energy of products is less than energy of reactants.
OR $\Delta H < 0$ / ΔH is negative. (3)

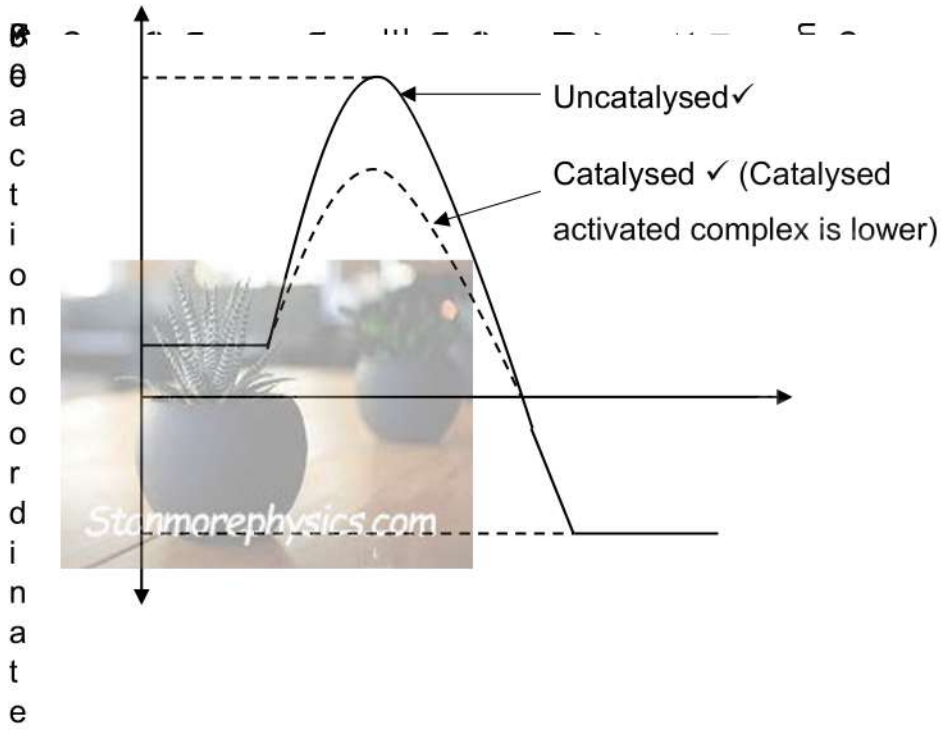
6.2 Heat of reaction (ΔH) is the energy absorbed or released per mole in a chemical reaction. ✓✓ (2)

6.3 $\Delta H = E_P - E_R$ ✓= -57 - 25✓ = -82 $kJ \cdot mol^{-1}$ ✓ (3)

6.4 The high energy / unstable / transition state when the reactants are converted to products. ✓✓ (2)

6.5 $E_a = 80 - (-57)$ ✓ = 1137 $kJ \cdot mol^{-1}$✓ (2)

6.6 (3)



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QUESTION 7

7.1

Cu_2O	C
$n = \frac{m}{M}$ ✓	$n = \frac{m}{M}$
$n = \frac{114,5}{143}$ ✓ = 0,80 mol	$n = \frac{11,5}{12}$ ✓ = 0,96 mol

Hence, the limiting reactant is Cu_2O✓ (4)

7.2 **POSITIVE MARKING FROM Q7.1:**

Marking criteria:

- $m = nM$ / $n = \frac{m}{M}$ ✓
- Correct substitution of 63,5 for M in the above formulae.✓
- Correct application of ratio of $NaHCO_3$ to H_2SO_4 (2:1).✓
- Formula for percentage yield. ✓
- Correct substitution into formula for percent yield. ✓
- Final answer. ✓

OPTION 1:	**OPTION 2:**
Theoretical yield = nM✓ = 0,8 x 2✓ x 63,5 ✓ = 101,6 g Percent Yield = $\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100\%$✓ = $\frac{87,4}{101,6}$ × 100% ✓ = 86,02 %✓	Actual yield = $\frac{m}{M}$✓ = $\frac{87,4}{63,5}$✓ = 1,38 mol Percent Yield = $\frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100\%$ = $\frac{1,38}{2 \times 0,8}$✓× 100%✓ = 86,25 %✓

(6)

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QUESTION 8

8.1 A solution whose concentration is accurately known. ✓✓ (2)

8.2 H_2O✓ and HCO_3^- ✓ [Accept $NaHCO_3$ instead of HCO_3^-] (2)

8.3.1 A substance that ionises completely in solution / water,✓ to form a large concentration of H_3O^+ ions.✓ (2)

8.3.2 HSO_4^-✓ (1)

8.4.1 pH = $-\log[H_3O^+]$✓
= $-\log(0,1)$ ✓
= 1 ✓ (3)

8.4.2

OPTION 1:	**OPTION 2:**
$[H_2SO_4] = ½ [H^+] = ½(0,1)$ ✓ $= 0,05 \text{ mol·dm}^{-3}$ $\frac{C_aV_a}{C_bV_b} = \frac{n_a}{n_b}$ ✓ $\frac{(0,05)(12)}{C_b(20)}$ ✓ $= \frac{1}{2}$ ✓ $C_b = 0,06 \text{ mol·dm}^{-3}$ ✓	$[H_2SO_4] = ½ [H^+] = ½(0,1)$ ✓ $= 0,05 \text{ mol·dm}^{-3}$ $n_a = c_aV_a$ $= (0,05)(0,012)$ $= 6x10^{-4} \text{ mol}$ $n(NaHCO_3) = (2)(6x10^{-4})$ ✓ $n(NaHCO_3) = 12 x10^{-4} \text{ mol}$ $c = \frac{n}{V}$ ✓ $c = \frac{12 \times 10^{-4}}{0,02}$ ✓ $= 0,06 \text{ mol·dm}^{-3}$ ✓

(5)

8.4.3 **POSITIVE MARKING FROM Q 8.4.2:**

OPTION 1:	**OPTION 2:**
$c = \frac{m}{MV}$ ✓ $0,06$ ✓ $= \frac{x}{(84)(0,25)}$ ✓ $x = 1,26 \text{ g}$ ✓	$n = cV$ $= (0,06)(0,25)$ ✓ $= 0,015 \text{ mol}$ $n = \frac{m}{M}$ ✓ $0,015 = \frac{x}{(84)}$ ✓ $x = 1,26 \text{ g}$ ✓

(4)

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QUESTION 9

9.1 The loss of electrons. /An increase in oxidation number. ✓✓ (2)

9.2 +7✓✓ (2)

9.3 MnO_4^- / Mn^{7+}/ permanganate ion. ✓✓ (2)

9.4.1 $H_2S \rightarrow S + 2H^+ + 2e^-$ ✓✓ (2)

9.4.2 $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$ ✓✓ (2)

9.4.3 $(H_2S \rightarrow S + 2H^+ + 2e^-) \times 5$
$(MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O) \times 2$ ✓

$5H_2S + 2MnO_4^-$ ✓ $+ 6H^+$ ✓ $\rightarrow 2 Mn^{2+} + 5S + 8H_2O$ ✓ Balancing ✓ (4)

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QUESTION 10

10.1 $Fe + 2HC\ell$ ✓ $\rightarrow FeC\ell_2 + H_2$ ✓ Balancing✓ (3)

10.2
$$n = \frac{m}{M}$$
$$= \frac{3}{56}\checkmark$$
$$= 0,054 \text{ mol}$$
$$n_e = 2 \times 0,054\checkmark$$
$$= 0,108 \text{ mol}$$
$$N_e = 6,02 \times 10^{23} \times 0,108$$
$$= 6,5 \times 10^{25} \text{ electrons.} \checkmark$$ (3)

10.3 Oxidised. ✓

$Fe^{2+} \rightarrow Fe^{3+} + e^-$✓✓ (3)

[9]



TOTAL: 150