



education

Department:
Education
PROVINCE OF KWAZULU-NATAL

PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY EXAMINATION

SEPTEMBER 2019

MEMORANDUM

**NATIONAL
SENIOR CERTIFICATE**

GRADE 12

MARKS : 150

This marking guideline consists of 8 pages.

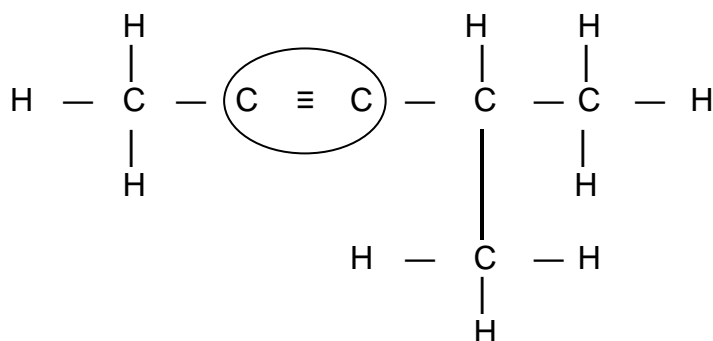
QUESTION 1

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

QUESTION 2

- 2.1.1 hexan-3-one ✓✓ (2)
- 2.1.2 carboxyl (group) ✓ (1)

2.1.3



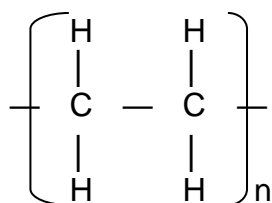
- | | |
|----------------------------------|-----|
| • Whole structure correct: | 2/2 |
| • Only functional group correct | 1/2 |
| • More than one functional group | 0/2 |

(2)

2.1.4 addition polymerisation ✓

(1)

2.1.5



polyethene ✓

- | | |
|---------------------------|----|
| • Whole structure correct | ✓✓ |
| • Name | ✓ |

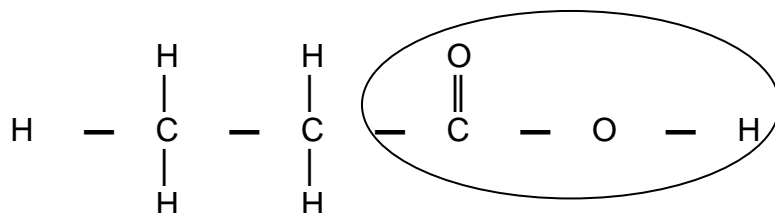
(3)

2.1.6 G✓ (1)

2.2.1 esters/alkyl alkanoate✓ (1)

2.2.2 ethyl✓ propanoate✓ (2)

2.2.3



- | | |
|-----------------------------------|-----|
| • Whole structure correct: | 2/2 |
| • Only functional group correct: | 1/2 |
| • More than one functional group: | 0/2 |

(2)

2.2.4 acts as a catalyst/speeds up the reaction. ✓ or acts as a dehydrating agent. ✓ (1)

2.3.1 Compounds that have the same molecular formula but different functional groups✓✓ (2)

2.3.2 pentanoic acid✓ (2)

[20]

QUESTION 3

3.1 the pressure exerted by a vapour at equilibrium with its liquid in a closed system. ✓✓ (2 or 0) (2)

3.2.1 length of carbon chain/surface area/branching✓ (1)

3.2.2 number of carbon atoms/molecular mass✓ (1)

3.3.1 GREATER THAN✓ (1)

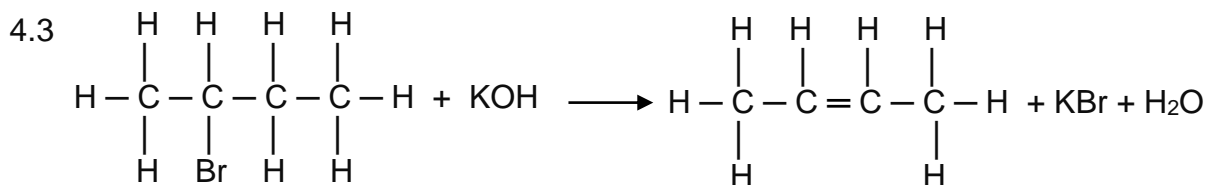
3.3.2 M has a longer carbon chain/greater surface area than N/ M has more sites for intermolecular forces✓
Intermolecular forces between molecules of M are stronger than between molecules of N✓
More energy is required to overcome the intermolecular forces between molecules of M✓ (3)

3.4 N✓ (1)

[9]

QUESTION 44.1.1 warm/mild heat ✓ dilute KOH ✓ / warm ✓ dilute strong base ✓ (2)4.1.2 hot KOH ✓ concentrated ✓ Base(KOH) (2)

4.2 substitution ✓ (1)



- | | |
|---|-----|
| <ul style="list-style-type: none"> • ✓ left hand side • ✓✓ for organic product • ✓ balancing | (4) |
|---|-----|

4.4 unsaturated ✓
contains a double bond/multiple bond ✓ between atoms of carbon ✓ (3)

4.5 hydration ✓✓ (2)

[14]**QUESTION 5**5.1 calcium carbonate ✓ there is some unreacted CaCO₃ at the end of the reaction (time 60s) ✓ (2)**5.2.1 ANY ONE**

- The change in concentration ✓ of reactants/products per unit time. ✓
- Rate of change in concentration of reactants or products. ✓✓
- Change in amount/number of moles/volume/mass of reactants/products per (unit) time.
- Amount/number of moles/volume/mass of products formed OR reactants used per (unit) time. (2)

5.2.2 $\text{rate} = - \frac{\text{change in mass of CaCO}_3}{\Delta t}$ ✓

$$\begin{aligned}
 1,07 &= - \frac{54 - X}{30 - 0} \checkmark \\
 &= 86,10 \text{ g } \checkmark
 \end{aligned}$$

(if answer is negative minus

1 mark)

(5)

Marking criteria

- Equation ✓ (accept if negative sign is omitted)
- Substitute 54 - X in equation ✓
- Substitute 30 - 0 in equation ✓
- Substitute 1,07 ✓ for rate
- Final answer: X = 86,10 g ✓

5.3 0 (cm³). ✓ (1)

5.4 A decrease in concentration of reactants decreases the number of molecules per unit volume. ✓
Fewer number of collisions per unit time ✓
A fewer number of effective collisions occur per unit time/lower frequency of effective collisions. ✓ (3)

5.5 REMAINS THE SAME ✓ (1)
[14]

QUESTION 6

6.1 When the equilibrium in a closed system is disturbed, the system will re-instate a new equilibrium by favouring the reaction that will oppose the disturbance. ✓✓ (2 or 0) (2)

6.2 the reaction has reached a state of (dynamic) equilibrium/the rate of the forward reaction is equal to the rate of the reverse reaction. ✓✓ (2 or 0) (2)

6.3

Marking criteria:

- Indicating that the number of mols of CO equilibrium is 0,6 ✓
- Correct mol ratio ✓
- Calculating the quantity(mol) at equilibrium of all three substances ✓
- Substitute $V = 2 \text{ dm}^3$ in $c = \frac{n}{V}$ to determine concentration at equilibrium of all the substances. ✓
- K_c expression ✓
- Substitution of concentrations in K_c expression ✓
- Final answer: 0,456 ✓

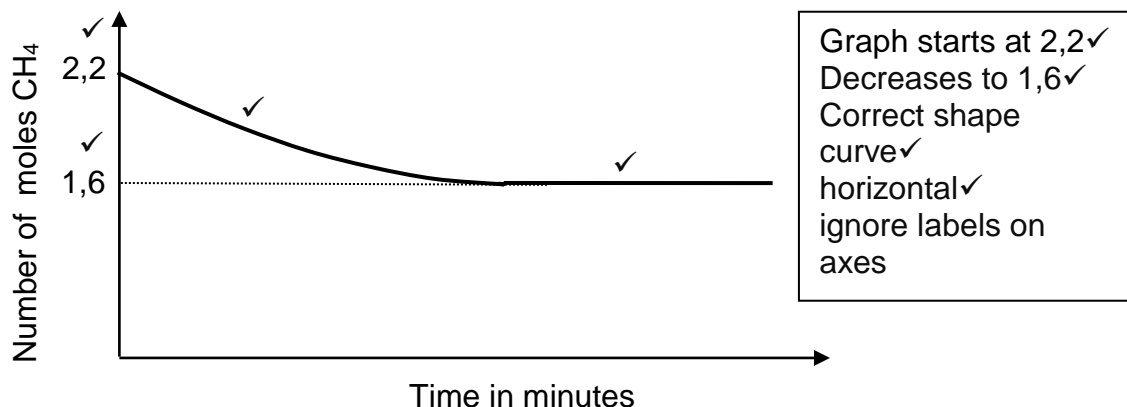
No K_c expression, correct substitution: Max. $\frac{6}{7}$

Wrong K_c expression : Max. $\frac{4}{7}$

| | CH ₄ | H ₂ O | CO | H ₂ | |
|--|-----------------|------------------|-------|----------------|---------------|
| Initial quantity(mol) | 2,2 | 1,8 | 0 | 0 | |
| Change(mol) | -0,6 | -0,6 | +0,6 | + 1,8 | Ratio ✓ |
| Quantity at equilibrium(mol) | 1,6 | 1,2 | 0,6 ✓ | 1,8 ✓ | |
| Equilibrium concentration(mol.dm ⁻³) | 0,8 | 0,6 | 0,3 | 0,9 | Divide by 2 ✓ |

$$K_c = \frac{[\text{CO}] [\text{H}_2]^3}{[\text{CH}_4] [\text{H}_2\text{O}]} \checkmark = \frac{(0,3) (0,9)^3}{(0,8) (0,6)} \checkmark = 0,456 \checkmark \quad (7)$$

6.4



(4)

6.5.1 INCREASES ✓

(1)

6.5.2 REMAINS THE SAME ✓

(1)

6.6 An increase in the number of moles of CH₄ increases the concentration of CH₄(reactant).According to Le Chateliers Principle an increase in the concentration of the reactants ✓
favours the reaction that decreases the concentration of the reactants ✓In this case the forward reaction is favoured ✓

(3)

[20]**QUESTION 7**7.1.1 An acid is a substance that produces hydrogen ions(H⁺)/hydronium ions(H₃O⁺) ✓
when it dissolves in water. ✓

(2)

7.1.2 strong ✓
it ionises completely in water ✓ ✓

(ACCEPT: dissociates)

(3)

7.2.1

$$\begin{aligned} \text{pH} &= -\log [\text{H}_3\text{O}^+] \quad \checkmark \\ 0,65 \checkmark &= -\log [\text{H}_3\text{O}^+] \\ \therefore [\text{H}_3\text{O}^+] &= 0,224 \text{ mol.dm}^{-3} \\ c(\text{H}_2\text{SO}_4) &= \frac{1}{2}c(\text{H}_3\text{O}^+) \quad \checkmark \\ &= \frac{1}{2}(0,224) \quad \checkmark \\ &= 0,112 \text{ mol.dm}^{-3} \quad \checkmark \end{aligned}$$

- Formula pH = - log [H₃O⁺] ✓
- Substitute 0,65 for pH ✓
- c((H₂SO₄) = ½c(H₃O⁺) ✓
- c((H₂SO₄) = 0,112 mol.dm⁻³ ✓

(4)

7.2.2 POSITIVE MARKING FROM QUESTION 7.2.1: concentration of H₂SO₄**Marking guidelines/Nasienriglyne:**

- Formulae: $c = \frac{n}{V}/n = cV/$ ✓
- Calculate initial number of moles of H₂SO₄ ✓
- Calculate number of moles of H₂SO₄ that reacted ✓
- Calculate number of moles of H₂SO₄ in excess ✓
- Calculate number of moles of NaOH that reacted ✓
- Ratio of NaOH to H₂SO₄ ✓
- Final answer cm³ or dm³ ✓

$$\begin{aligned} n(\text{H}_2\text{SO}_4)_{\text{initial}} &= cV \checkmark \\ &= (0,25)(0,024) \checkmark \\ &= 6 \times 10^{-3} \text{ mols} \end{aligned}$$

$$\begin{aligned} n(\text{H}_2\text{SO}_4)_{\text{excess}} &= cV \\ &= (0,112)\frac{(X+24)}{1000} \checkmark \end{aligned}$$

$$n(\text{H}_2\text{SO}_4)_{\text{reacted}} = 6 \times 10^{-3} - \frac{(0,112)(X+24)}{1000} \checkmark$$

$$\begin{aligned} n(\text{NaOH})_{\text{reacted}} &= cV \\ &= \frac{0,15(X)}{1000} \checkmark \end{aligned}$$

$$n(\text{NaOH})_{\text{reacted}} = 2 (n(\text{H}_2\text{SO}_4)_{\text{reacted}}) \checkmark$$

$$\begin{aligned} \frac{0,15(X)}{1000} &= 2 \left(6 \times 10^{-3} - \frac{(0,112)(X+24)}{1000} \right) \\ X &= 17,71 \text{ cm}^3 \checkmark \quad 0,01771 \text{ dm}^3 \end{aligned}$$

(7)
[16]**QUESTION 8**

8.1 a solution/liquid/dissolved substance ✓ that conducts electricity through the movement of ions. ✓ (2)

8.2 Zn(s) → Zn²⁺(aq) + 2e⁻

Notes

- Zn²⁺ + 2e⁻ ← Zn (2/2) Zn²⁺ + 2e⁻ ⇌ Zn (0/2)
- Zn ⇌ Zn²⁺ + 2e⁻ (1/2) Zn²⁺ + 2e⁻ → Zn (0/2)

- Ignore if charge on electron is omitted.

- If a charge of an ion is omitted e.g. Zn → Zn²⁺ + 2e⁻ Max.: 1/2

(2)

8.3.1 Temperature of 25 °C/298K ✓
Concentration of the electrolytes equals 1 mol.dm⁻³. ✓

(2)

$$8.3.2 \quad E^{\ominus}_{\text{cell}} = E^{\ominus}_{\text{cathode}} - E^{\ominus}_{\text{anode}} \checkmark$$

$$0,63 \checkmark = E^{\ominus}_{\text{cathode}} - (-0,76) \checkmark$$

$$E^{\ominus}_{\text{cathode}} = -0,13 \text{ V} \checkmark$$

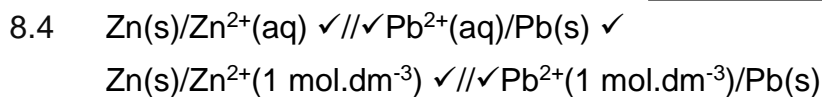
X is lead(Pb) \checkmark

Notes

- Accept any other correct formula from the data sheet.
- Any other formula using unconventional abbreviations, e.g. $E^{\ominus}_{\text{cell}} = E^{\ominus}_{\text{OA}} - E^{\ominus}_{\text{RA}}$ followed by correct substitutions:

$$E^{\ominus}_{\text{sel}} = E^{\ominus}_{\text{OM}} - E^{\ominus}_{\text{RM}} \quad \text{Max: } \frac{4}{5}$$

(5)

Accept $\text{Zn}/\text{Zn}^{2+} // \text{Pb}^{2+}/\text{Pb}$

(3)

8.5 $0(\text{V}) \checkmark$

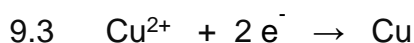
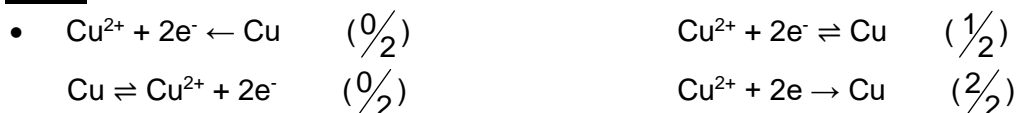
(1)

[15]**QUESTION 9**9.1 from electrical energy to chemical energy \checkmark

(1)

9.2 P \checkmark

(1)

**Notes**

- Ignore if charge on electron is omitted.

- If a charge of an ion is omitted e.g. $\text{Cu} \rightarrow \text{Cu}^2 + 2\text{e}^{-}$

Max.: $\frac{1}{2}$

(2)

9.4.1 Q will break down/become eroded/surface becomes rough and eroded $\checkmark \checkmark$
ACCEPT Q will be oxidised. $\checkmark \checkmark$

(2)

9.4.2 Cu/electrode Q is a stronger reducing agent \checkmark than the Cl^{-} ions \checkmark .
Cu/Q will be oxidised/loses electrons \checkmark resulting in the electrode becoming eroded
ORThe Cl^{-} ion is a weaker reducing agent \checkmark than Cu(Q) \checkmark and will therefore not be oxidised. \checkmark

(3)

9.4.3 P \checkmark

(1)

[10]**QUESTION 10**10.1.1 Haber process \checkmark

(1)

10.1.2 nitric oxide \checkmark NO \checkmark

(1)

10.1.3 platinum \checkmark

(1)

**Notes:**

- Reactants \checkmark Products \checkmark Balancing \checkmark
- Ignore double arrows.
- Marking rule 6.3.10.

(3)

10.2

$$\text{Mass P} = 31 \checkmark / 149 \checkmark \times 11,95 \checkmark = 2,486 \text{ kg}$$

$$2/8 \times Z/100 \times 20 \checkmark = 2,486 \checkmark$$

$$Z = 49,72\% \checkmark$$

(6)

TOTAL MARKS: 150