Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P2 (CHEMISTRY)

PREPARATORY EXAMINATION

MEMORANDUM

SEPTEMBER 2017

NATIONAL SENIOR CERTIFICATE

GRADE 12

TIME: 3 hours

MARKS: 150

This memorandum consists of 9 pages.

QUESTION 1: MULTIPLE CHOICE

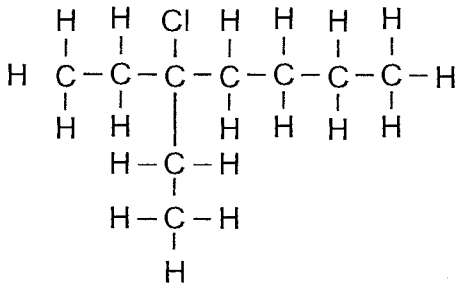
1.1 D ✓✓ (2)
1.2 B ✓✓ (2)
1.3 A ✓✓ OR C (2)
1.4 D ✓✓ (2)
1.5 C ✓✓ (2)
1.6 B ✓✓ (2)
1.7 A ✓✓ (2)
1.8 D ✓✓ (2)
1.9 A ✓✓ (2)
1.10 C ✓✓ (2)
[20]

QUESTION 2

2.1 2-bromo-5-chloro-2,5-dimethyl✓heptane ✓ (2)

2.2 C_nH_{2n} ✓ (1)

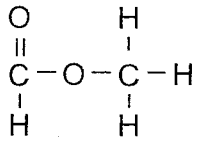
2.3 (3)



✓ correct structural formula
✓ Cl in correct position
✓ ethyl group in correct position

2.4 Triple bond✓/ Accept Alkynes (1)

2.5 (2)



✓✓

Accept any correct formula except the molecular

2.6 Ketones ✓ (1)
[10]

QUESTION 3

3.1 C ✓ OR Ethanoic acid (1)

3.2 Ethanoic acid has the strongest intermolecular forces ✓
More energy is required to overcome the intermolecular forces ✓
least amount will evaporate ✓ (3)

3.3 B ✓ (1)

3.4 Ethanal has the weakest intermolecular forces ✓ (3)
Least energy is required to overcome the intermolecular forces ✓
Ethanal has the lowest boiling point and therefore the highest vapour pressure✓

[8]

QUESTION 4

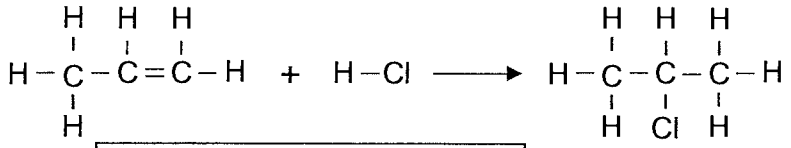
4.1 H_2SO_4 / H_3PO_4/Heat✓ (1)

4.2 Pt / Pd / Ni ✓ (1)

4.3 $C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$ (3)

If any structural formulae used $\frac{2}{3}$

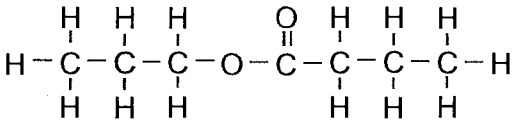
✓ reactants/left hand side
✓ products/right hand side
✓ balancing

4.4  (3)

If condensed formulae used $\frac{2}{3}$

✓ reactants/left hand side
✓ products/right hand side
✓ structural formulae

4.5 Sulphuric acid ✓ (1)

4.6  (2)

✓ correct functional group
✓ whole structure correct

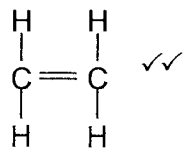
4.7. Propyl butanoate ✓✓ Any correct name given for 4.6 (2)

[13]

QUESTION 5

5.1 A molecule that consists of a large number of atoms. ✓✓ (2)

5.2 Polymerisation ✓ (1)

5.3  ✓✓ (2)

[5]

QUESTION 6

6.1 How does the rate of a reaction change with time? ✓✓ (2)

Any given investigative question

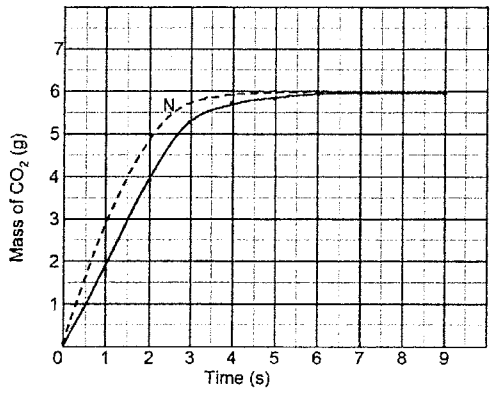
6.2 Time ✓ Mark based on given investigative question. (1)

6.3 (2)

Time (s)	0	1	2	3	4	5	6	7	8	9
Mass of flask and its contents (g)	178	176,2	174,1	172,7	172,3	172,2	172,1	172,1	172,1	172,1
Mass of CO_2 (g) produced (g)	0	1,8	3,9	5,3	5,7	5,8	5,9	5,9	5,9	5,9

✓✓

6.4



✓ Correct shape
✓✓ plotting of all points
✓Appropriate scale and labels on both axes
✓ Correct heading

But plotting 5 or less points subtract one mark.

(5)

6.5 The reaction has reached completion. ✓ (1)

OR

One of the reactants is finished. ✓

6.6

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

$$= \frac{5,9}{44} \checkmark$$

$$= 0,13 \text{ mol}$$

1 mol occupies 24,46 dm^3

0,13 mol will occupy 3,18 dm^3 ✓

Accept range 3.18 – 3.28

(3)

6.7 Graph N has a steeper gradient ✓and finishes at the same point as the original graph✓ (2)

6.8 Higher temperature, molecules have greater kinetic energy ✓ (3)

More effective collisions per unit time ✓

Reaction rate increases ✓

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QUESTION 7

7.1

CALCULATIONS USING NUMBER OF MOLES
BEREKENINGE WAT GETAL MOL GEBRUIK

Mark allocation/*Puntetoekenning:*

- Calculating number of moles of H_2, Cl_2 and HCl. ✓
- Molar ratio. ✓
- Number of moles at Equilibrium. ✓
- Dividing by 0,5 to get the concentration. ✓
- K_c expression. ✓
- Substitution in the K_c expression ✓
- Calculating concentration of Cl_2 ✓
- Substitution in n= cV.✓
- Substitution in m=nM ✓
- Final answer✓

7.1 (10)

H_2 + Cl_2 ⇌ 2HCl

Initial mass	10g	355g	0g
Initial n	5	5	0
React/Prod	x	x	2x
n at equilibrium	5 - x	5 - x	2x
Conc. at equilibrium	$\frac{5-x}{0,5}$	$\frac{5-x}{0,5}$	$\frac{2x}{0,5}$

Calc no. of
✓ mol
✓ Ratio
✓
✓dividing by 0,5

$$K_c = \frac{[HI]^2}{[H_2][I_2]} \checkmark$$

$$\checkmark\ 60 = \frac{(\frac{2x}{0,5})^2}{(\frac{5-x}{0,5})(\frac{5-x}{0,5})} \checkmark$$

$$x = 3,97$$

$$\text{Conc.}Cl_2 \text{ at equilibrium} = \frac{5-3,97}{0,5} \checkmark$$

$$n = C \cdot V$$
$$= \frac{5-3,97}{0,5} \cdot 0,5$$
$$= 1,03 \text{ mol}$$
$$m = n \cdot M$$
$$= 1,03 \cdot 71 \checkmark$$
$$= 73,13 \text{ g} \checkmark$$

No K_c expression, correct substitution max $\frac{9}{10}$
Wrong KC expression max $\frac{4}{10}$

7.2 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)

7.3

7.3.1 Decrease ✓ (1)

7.3.2 Increase ✓ (1)

7.4 The temperature of the system was increased, according to Le Chatelier's principle, the system reacts by favouring the endothermic reaction.✓ Hence, the reverse reaction is favoured.✓

(2)
[16]

QUESTION 8

8.1 8.1.1 Strong acid ✓ (1)

8.1.2 (5)

Vol. of conc.HCl required

n =CV ✓
= 0,25 x 0,5✓
= 0,0125 ✓

$$C = \frac{n}{V}$$
$$10 \checkmark = \frac{0,0125}{V}$$
$$V = 0,0125 \checkmark dm^3$$
$$= 12,5\ cm^3$$

OR

$$c_1V_1 = c_2V_2 \checkmark$$
$$(10)(x) = (0,25)(0,5) \checkmark$$
$$x = 0,0125 dm^3$$
$$= 12,5 cm^3 \checkmark$$

8.1.3

$$HCl \xrightarrow{H_2O} H_3O^+ + Cl^-$$

0,25 mol.dm^{-3} 0,25 mol.dm^{-3}

$pH = -\log [H_3O^+]$ ✓
$= -\log (0,25)$ ✓
$= 0,60$ ✓

(3)

8.2 8.2.1 **Option 1**

$$n(HCl) = cV = (0,25)(0,5) = 0,125\,mol$$

$$n(NaOH) = cV = (0,2)(0,14) = 0,028\,mol$$

$$n(HCl)\ reacted\ with\ (NaOH) = 0,028\,mol$$

$$n(HCl)\ reacted\ with\ (CaCO_3) = 0,125 - 0,028$$
$$= 0,097\,mol$$

$$n(CaCO_3) = \frac{1}{2} \times 0,097$$
$$= 0,0485\,mol$$

$$mass\ of\ CaCO_3 = nM$$
$$= 0,0485 \times 100$$
$$= 4,85\,g$$

Option 2

Volume of HCl reacted with NaOH

$$\frac{C_a V_a}{C_b V_b} = \frac{n_a}{n_b}$$

$$\frac{(0,25)V_a}{(0,2)(140} = \frac{1}{1}$$

$$V_a = 112\ cm^3$$

Volume of HCl reacted with $CaCO_3$

$$V_{HCl} = 500 - 112$$
$$= 388\ cm^3$$
$$= 0,388\ dm^3$$

No. of mol of HCl reacted with $CaCO_3$

$$C = \frac{n}{V}$$

$$0,25 = \frac{n}{0,388}$$

$$n = 0,097\ mol$$

No. of mol of $CaCO_3$ reacted with HCl

$$n_{HCl} : n_{CaCO_3} = 2 : 1$$

$$n_{CaCO_3} = \frac{0,097}{2}$$
$$= 0,0485\ mol$$

Mass of mol of $CaCO_3$ reacted with HCl

$$m = n \cdot M$$
$$= 0,0485 \cdot 100$$
$$= 4,85\ g$$

(8)

8.2.2 (3)

$$\%\ \text{purity} = \frac{\text{mass of } CaCO_3}{\text{mass of sample}} \cdot 100$$

$$= \frac{4,85}{5} \cdot 100 \quad \checkmark\checkmark$$

$$= 97\% \quad \checkmark$$

[20]

QUESTION 9

9.1 9.1.1 cathode ✓ (1)

9.1.2 P to silver medal ✓ (1)

9.1.3 Electrode P is made of silver. Rate of oxidation is equal to the rate of reduction.✓✓ (2)

9.1.4 Ag ✓ (1)

9.2 9.2.1 Temp = 25 °C ✓
Concentration of the electrolyte solution = 1 mol.dm^{-3}✓ (2)

9.2.2 Chemical energy to electrical energy ✓ (1)

9.2.3 Maintain electrical neutrality between the two half cells ✓ (2)
Completes the circuit ✓

9.2.4 $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ ✓
$2,70^{\checkmark} = 0,34^{\checkmark} - E^{\theta}_{anode}$
$E^{\theta}_{anode} = -2,36\ V^{\checkmark}$
The anode must be magnesium ✓ (5)

+ marking

9.2.5 $Mg \rightarrow Mg^{2+} + 2e^{-}$ ✓✓ OR (2)

9.2.6 ✓ ✓ ✓ (3)
$Mg/Mg^{2+}//Cu^{2+}/Cu$ OR $Y/Y^{2+}//Cu^{2+}/Cu$

9.2.7 Remain the same✓ (1)

9.2.8 Ag^{+} will form a precipitate with the Cl^{-}. This decreases the concentration of the Cl^{-} in solution, but not the concentration of Cu^{2+}✓✓
The reading on the voltmeter can only be affected by a change of concentrations of either Cu^{2+} or Mg^{2+}/ Y^{2+}.✓ (3)

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QUESTION 10

10.1 10.1.1 Haber process ✓ (1)

10.1.2 Fractional distillation of air ✓ (1)

10.1.3 Ostwald process ✓ (1)

10.1.4 Platinum ✓ (1)

10.1.5 H_2O ✓ OR ($H_2O + O_2$) (1)

10.1.6 Enables plants to grow better and faster ✓ (2)
Increases food production ✓

10.1.7 Ammonium nitrate ✓ (1)

10.2 10.2.1 The ratio of N:P:K or primary nutrients in the bag ✓
Amount of fertilizer in the bag ✓ (2)

10.2.2 $\%N = \frac{22}{50} \times 22 = 9{,}68\%$ ✓

$\%P = \frac{10}{50} \times 22 = 4{,}40\%$ ✓

$\%N = \frac{18}{50} \times 22 = 7{,}92\%$ ✓ (3)

OR

22% ✓✓✓

10.2.3 Potassium✓
Shortage of potassium causes poor quality flowers and fruit (colour and taste) and make leaves have brown or yellow edges. ✓ (2)

[15]

TOTAL MARKS: [150]