CAPE WINELANDS EDUCATION DISTRICT

CAPS

GRADE 12

PHYSICAL SCIENCES: CHEMISTRY (P2)

MEMORANDUM SEPTEMBER 2015

MARKS 150

TIME 3 hours

This question paper consists of 9 pages.

QUESTION 1 [START ON A NEW PAGE]

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

QUESTION 2 [START ON A NEW PAGE]

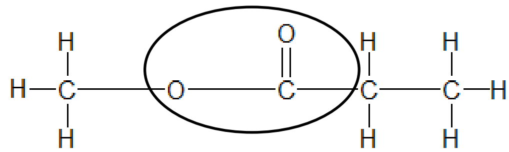
2.1	Organic compounds that consist of hydrogen and carbon only. ✓✓	(2)
2.1.1	B ✓	(1)
2.2.2	C ✓.	(1)
2.2.3	E ✓	(1)
2.3	Organic molecules with the same molecular formula, but different structural formulae✓✓	(2)

2.4 2-methylprop-1-ene ✓✓ or methylpropene
(Double bond correctly named ✓ side chain correctly named ✓) (2)

Marking criteria
IF/*INDIEN*:
2 methylprop1 ene / *2 metielpropeen 1 een (1 mark out of two)*

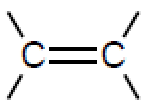
2.5 C_4H_8 ✓ (1)

2.6

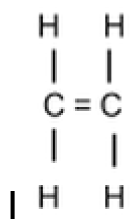


functional group✓ rest of molecule ✓. (2)

2.7 (1)



✓ if



no marks

2.8 Butanoic acid ✓ / butanoesuur (1)

2.9 unsaturated ✓ Compounds with one or more multiple bonds between C atoms✓✓ in their hydrocarbon chains. (3)

ANY ONE/*ENIGE EEN*:

- It does not <u>ONLY have single bonds</u>.
- It does not have <u>single bonds between all C atoms.</u>
- It has double bonds between C atoms.
- It does not contain the <u>maximum number of H atoms bonded to C atoms</u>.
- Each C atom in B is not bonded to four other atoms.

2.10 alkenes ✓ (1)

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QUESTION 3 [START ON A NEW PAGE]

3.1.1 Different functional group/homologous series✓
Verskillende funksionele groepe/homoloe reeks (1)

3.1.2 Boiling point/Kookpunt ✓ (1)

3.2 Higher✓ Between the particles of propan-1-ol there are hydrogen bonds and between the particles of propanal there are London forces (induced dipole forces) (momentele dipool kragte) ✓ .Hydrogen bonds are stronger than London forces✓ Hydrogen bonds require more energy to overcome than London forces. ✓ (4)

3.3.1 A propanal ✓ (1)

3.3.2 B - propan-1-ol ✓ (1)

3.3.3 C ethanoic acid ✓ (1)

3.4 HIGHER, ✓the van der Waals forces increases with increasing molecular mass✓ or the longer the carbon chain/greater the surface area, the greater stronger the London forces will become. (2)

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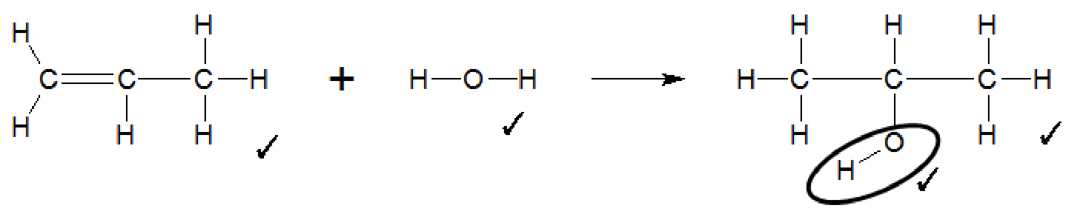
QUESTION 4 [START ON A NEW PAGE]

4.1.1



(4)

4.1.2 propan-2-ol/2-propanol (1)

4.1.3 a. substitution / hydrolysis ✓ (1)
b. heat ✓
dilute NaOH or KOH (under reflux)✓ (2)

4.2.1 esterfication ✓ (1)

4.2.2 hydrogen sulfate / H_2SO_4✓ (1)

4.2.3 $M[C_3H_6O_2] = 74$

$n = \frac{m}{M_r}$ ✓ $= \frac{68,88}{74}$ ✓ $= 0,93$ mol

0,93 mol ester was delivered by 0,93 mol methanol✓

$M[CH_4O] = 32$

0,93 x 32✓ = 29,78 g

% purity: $\frac{29,79}{50} \times 100 = 59,57\%$✓

- One mark for formula
- One mark for correct substitution of M
- One mark for the USE of the molar relationship
- One mark for calculating the mass of methanol formed.
- One mark for calculating percentage purity. (5)

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QUESTION 5 [START ON A NEW PAGE]

5.1 The zinc becomes smaller✓
or gas bubbles forms✓
or the test tube heats up
(any two) (2)

5.2 The change in concentration of reactants or products per unit time.✓✓
also except change in mol/volume/mass of reactants /products per unit time (2)

5.3 rate = $-\frac{\Delta c}{\Delta t}$.✓ $= -(\frac{0,77-2 ✓}{45-0 ✓})$= 0,027 $mol.dm^{-3}.s^{-1}$✓ (4)

5.4

5.4.1 increase ✓ (1)

5.4.2 stay the same ✓ (1)

5.4.3 increase ✓ (1)

[11]

QUESTION 6 [START ON A NEW PAGE]

6.1 It is an equilibrium where the rate of the forward reaction equals the rate of the reverse reaction✓✓ (2)

6.2 Between t_1 and t_2 ✓and between t_3 and t_4✓ (2)

6.3 reverse ✓ (1)

6.4 EXOTHERMIC✓ (1)

6.5
- [CO] and [O_2] decrease and [CO_2] increases✓
- This means the forward reaction is favoured.✓
- decrease in temperature, favours exothermic reaction, therefore reaction is exothermic.✓

(3)

6.6 The concentration of CO_2 was suddenly increased (by adding more CO_2 gas)✓
OR [CO_2] increases / CO_2 is added. (1)

6.7 Remains the same ✓ (1)

6.8 **Option 1**

n(CO) initially: $n = \frac{m}{M} = \frac{63}{28} = 2{,}25$mol
n(O_2) initially $n = \frac{m}{M} = \frac{9{,}11}{32} = 0{,}28$mol $\quad$ *one mark for both values*✓

At equilibrium:
[CO_2] is 0,15 mol·dm^{-3} (given), therefore
n(CO_2) formed: n = cV = 0,15 x 2 = 0,3 mol ✓
n(O_2) reacted: 0,15 ✓
n(CO) reacted: 0,3✓
n(CO) at equilibrium: 2,25 - 0,3 = 1,95✓
n(O_2) at equilibrium: 0,28 - 0,15 = 0,13 ✓
Calculate concentration:✓

$K_c = \frac{[CO_2]^2}{[CO]^2[O_2]}$✓

$= \frac{(0{,}15)^2}{(0{,}975)^2(0{,}065)}$✓

= 0,36✓

OPTION 2:

	2CO	**O_2**	**$2CO_2$**
Initial	2,25	0,28	0 (✓one mark for all values in row)
Reacted/ formed	0,3✓	0,15✓	0,3
At equilibrium	1,95✓	0,13✓	0,3✓
Equilibrium concentration	0,975	0,065	0,15 (✓one mark for all values in row)

$K_c = \frac{[CO_2]^2}{[CO]^2[O_2]}$✓

$= \frac{(0,15)^2}{(0,975)^2(0,065)}$✓

= 0,36✓

(10)

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QUESTION 7

7.1.1 The point where the indicator changes colour..✓✓ (2)

7.1.2 An acid that is able to donate two protons (H^+) per unit ✓ (1)

7.1.3 H_2SO_4 ionises completely in water to form a high concentration of H_3O^+ ions. ✓✓ (2)

7.1.4 20 cm^3✓ (1)

7.1.5 n = cV✓

= 0,2 x 0,05 ✓

= 0,01 mole

0,01 mol NaOH reacts with 0,005 mole H_2SO_4 ✓

$c = \frac{n}{v}$

$= \frac{0,005}{0,02}$✓

= 0,25 $mol{\cdot}dm^{-3}$ ✓ (5)

7.2.1 It can act as either an acid or a base.✓✓ (2)

7.2.2 10^{-7} mol·dm^{-3} ✓ (1)

7.2.3 $K_w = [H_3O^+][OH^-]$ ✓✓ (2)

7.3.1 Decrease✓ (1)

7.3.2 According to Le Chatelier, an increase in temperature will favour the forward reaction. ✓,. That means the $[H_3O^+]$ increases and therefore the pH will decrease.✓ (2)

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QUESTION 8 [START ON A NEW PAGE]

8.1.1 chemical (potential) energy ✓ to electrical energy ✓ (2)

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

8.1.3 B ✓ (1)

8.1.4 $Ni^{2+} + 2e^- \rightarrow Ni$✓✓ (if double arrow only one mark)

Notes

$Ni \leftarrow Ni^{2+} + 2e^-$ $(\frac{2}{2})$ $Ni^{2+} + 2e^- \rightleftharpoons Ni$ $(\frac{1}{2})$

$Ni \rightleftharpoons Ni^{2+} + 2e^-$ $(\frac{0}{2})$ $Ni^{2+} + 2e \leftarrow Ni$ $(\frac{0}{2})$ (2)

8.1.5 $E^o_{cell} = E^o_{cathode} - E^o_{anode}$ ✓

$= -0,27$✓ $- (-2,36)$✓

$= 2,09$ V ✓

Notes

Accept any other correct formula from the data sheet

Any other formula using unconventional abbreviations, e.g. $E°_{cell} = E°_{OA} - E°_{RA}$ followed by correct substitutions:$(\frac{3}{4})$

Option 2

$Ni^{2+}(aq) + 2e^- \rightarrow Ni(s)$ $E° = -0,27$ ✓

$Mg(s) \rightarrow Mg^{2+}(aq) + 2e^-$ $E° = +2,36$✓ ✓

$Ni^{2+}(aq) + Mg(s) \rightarrow Ni(s) + Mg^{2+}(aq)$ $E° = +2,09$ V ✓

(4)

8.1.6 From B to A ✓ (1)

8.1.7 Anions moves to Ni-half cell (A) ✓
Cations moves to mg-half cell (B) ✓
Ensures electrical neutrality to ensure flow of electrons in the external circuit ✓ (3)

8.1.8 $Mg(s)|Mg^{2+}(aq)||Ni^{2+}(aq)|Ni(s)$ oxidation half cell correct ✓
reduction half cell correct ✓
saltbridge ✓
If phases not included, do not subtract marks. (3)

8.2.1 $Al^{3+} + 3e^- \rightarrow Al$ ✓✓(if double arrow only one mark)
Notes
$Al \leftarrow Al^{3+} + 3e^-$ $(\frac{2}{2})$ $Al^{3+} + 3e^- \rightleftharpoons Al$ $(\frac{1}{2})$

$Al \rightleftharpoons Al^{3+} + 3e^-$ $(\frac{0}{2})$ $Al^{3+} + 3e \leftarrow Al$ $(\frac{0}{2})$ (2)

8.2.2 Electrode B (carbon) ✓ (1)

8.2.3 Al^{3+} ✓ or/of Al_2O_3 (1)

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QUESTION 9 [START ON A NEW PAGE]

9.1 Nitrogen/stikstof (N_2) ✓ (Not N) (1)

9.2 $N_2 + 3H_2$ ✓ $\Leftrightarrow$ $2NH_3$ ✓ balancing ✓ (Ignore arrow) (3)

9.3 Ammonia/ammoniak ✓ (1)

9.4 $4\ NH_3\ (g) + 5\ O_2\ (g)$✓ $\rightarrow 4\ NO\ (g) + 6\ H_2O\ (g)$✓ balancing ✓ (3)

9.5 ammonium nitrate/ammoniumnitraat ✓ (1)

9.6 Eutrophication/eutrifikasie (1)

9.7 40/100 (or 0,4) x 1,5✓ = 0,6 kg✓ fertilizer in bag.
1/1 x 0,6 ✓ = 0,6 kg ✓ (600 g) Nitrogen is present in fertilizer
(OR only nitrogen/no other fertilizer present, 0,6 kg nitrogen) (4)

[14]

TOTAL 150