higher education & training

Department:
Higher Education and Training
REPUBLIC OF SOUTH AFRICA

MARKING GUIDELINE

NATIONAL CERTIFICATE (VOCATIONAL)

PHYSICAL SCIENCE
(Second paper)
NQF LEVEL 4

24 November 2022

This marking guideline consists of 10 pages.

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INSTRUCTIONS TO MARKERS

1. Mark all the questions.

2. Follow the answers according to the numbering system used in this question paper.

3. Use only a red pen.

4. Put your ticks and crosses neatly and legibly.

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SECTION A

QUESTION 1

1.1 Becquerel
1.2 Saturated
1.3 Gamma (rays)
1.4 Boiling point
1.5 Pascal

(5 × 1) **[5]**

QUESTION 2

2.1 K
2.2 F
2.3 H
2.4 A
2.5 J

(5 × 1) **[5]**

QUESTION 3

Marking guide: 2 marks for True.
NO MARKS for False.
NO MARKS if the statement is written in the NEGATIVE.
2 marks for CORRECT statement.

3.1 False
Butanoic acid is a weak acid because it ionises partially.✓✓

3.2 True

3.3 True

3.4 False
The intermolecular forces in methanoic acid are stronger than the intermolecular forces in methanol.✓✓

or

The intermolecular forces in methanol are weaker than the intermolecular forces in methanoic acid.✓✓ (Any 1 × 2)

3.5 True

(5 × 2) **[10]**

QUESTION 4

4.1 D
4.2 C
4.3 C
4.4 B
4.5 A

(5 × 3) **[15]**

TOTAL SECTION A: 35

SECTION B

QUESTION 5

5.1 5.1.1 $P = \frac{F}{A}$✓

$24 = \frac{F}{14}$✓

$F = 336\ N$✓ (3)

5.1.2 $P = \sigma\ g\ h$✓
$24 = \sigma(9{,}8)(3{,}06)$✓
$\sigma = 0{,}8\ kg \cdot m^{-3}$✓ (3)

5.2 5.2.1 Greater than

5.2.2 The atmosphere will also exert pressure on the liquid/base.
(2 × 1) (2)

5.3 5.3.1 Remain the same

5.3.2 Decreases
(2 × 1) (2)
[10]

QUESTION 6

6.1 6.1.1 (a) B (1)

(b) E (1)

6.1.2 (a) Alcohol (1)

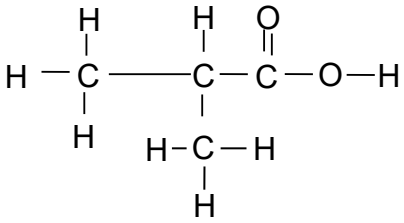
(b) Hydroxyl (1)

(c) 2-methy✓ propan-2-ol✓ (2)

6.1.3 (a) Alcohol;✓ carboxylic acid✓ (2)

(b) methyl✓ butanoate✓ (2)

6.1.4 (a)



Marks allocated for: Long chain with 3 carbons and correct number of hydrogens✓
Correct position of methyl and functional group✓ (2)

(b) 2-methyl✓ propanoic acid✓

Accept: methyl propanoic acid (2)

6.2 6.2.1 (a) Volume, temperature, position of the hydroxyl/the functional group (Any 1 × 1) (1)

(b) Vapour pressure (1)

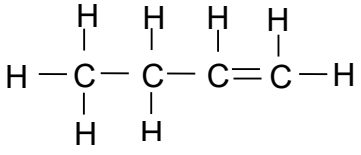
6.2.2
- The vapour pressure decreases when the chain length (of the alcohol) increases.
- The vapour pressure increases when the chain length (of the alcohol) decreases.
- When the chain length (of the alcohol) increases, the vapour pressure decreases.
- When the chain length (of the alcohol) decreases, the vapour pressure increases. (Any 1 × 2)

NB: NO marks if the answer includes 'directly proportional' or 'inversely proportional'. (2)

6.2.3
- The intermolecular forces are London forces/Van der Waals forces and hydrogen bonding.
- The strength of the London forces/Van der Waals forces increase when the chain length increases.
- More energy is required to break the strong intermolecular forces. Therefore, few molecules escape into the vapour phase. (3)

6.3 6.3.1 Dehydration (1)

6.3.2



Marks allocated for: Long chain with 4 carbons and correct number of hydrogens✓ and correct position of double bond.✓ (2)

6.3.3
- Concentrated strong base
- Concentrated NaOH
- Concentrated KOH (Any 1 × 1) (1)

[25]

QUESTION 7

7.1 7.1.1 90 (cm^3) (1)

7.1.2 POSITIVE MARKING FROM Q7.1 TO Q7.2

OPTION 1

$n = \frac{V}{V_M} = \frac{90\ x\ 10^{-3}}{24,5} = 3,67\ x\ 10^{-3}\ mol$ ✓

$Rate_{ave} = \frac{\Delta n}{\Delta t}$ ✓ $= \frac{3,67\ x\ 10^{-3}}{180}$ ✓ $= 2,04\ x\ 10^{-5} mol \cdot s^{-1}$ ✓

OPTION 2

$Rate_{ave} = \frac{\Delta n}{\Delta t}$ ✓

$Rate_{ave} = \frac{V}{V_M \Delta t} = \frac{90\ x\ 10^{-3}}{24,5\ (180)}$ ✓ $= 2,04\ x\ 10^{-5} mol \cdot s^{-1}$ ✓ (4)

7.1.3 POSITIVE MARKING FROM Q7.2.1 TO Q7.2.2

OPTION 1

$c\ (HCl) = \frac{n}{V}$ ✓

$= \frac{2(3,67x10^{-3})}{0,2}$ ✓

$= 0,0367\ mol \cdot dm^{-3}$ ✓

OPTION 2

$n = cV$ ✓

$\Delta n = (c_f - c_i)V$

$-2(3,67x10^{-3})$ ✓ $= (0 - c_i)(0,2)$ ✓

$c_i = 0,0367\ mol \cdot dm^{-3}$ ✓ (4)

7.2 A (1)

7.3
- A catalyst lowers/reduces the activation energy. A catalyst provides an alternate pathway for the reaction.
- The number of effective collisions per second increases.
- The rate of formation of the activated complex increases. (3)

[13]

QUESTION 8

8.1 8.1.1 Blue (1)

8.1.2
- According to Le Chatelier's principle, some of the added chloride ions must be used up.
- The forward reaction is favoured/The equilibrium shifts to the right.
- The concentration of $CoC\ell_4^{2-}(aq)$ increases. (3)

8.2 8.2.1 <u>OPTION 1</u>

$$n(S) = \frac{m}{M} = \frac{76,8}{32} = 2,4\ mol\checkmark$$

	S	:	H_2O
Mole ratio	3	:	2
	2,4	:	x

$$x = \frac{(2)(2,4)}{3} = 1,6\ mol$$

$$c\ (H_2O) = \frac{n}{V}\checkmark$$
$$= \frac{1,6}{10}\checkmark$$
$$= 0,16\ mol \cdot dm^{-3}\checkmark$$

<u>OPTION 2</u>

	S	:	H_2O
Mass ratio	3(32)	:	2(18)
	76,8	:	x

$$x = \frac{2(18)(76,8)}{3(32)} = 28,8\ g\checkmark$$

$$c\ (H_2O) = \frac{m}{MV}\checkmark$$
$$= \frac{28,8}{(18)10}\checkmark$$
$$= 0,16\ mol \cdot dm^{-3}\checkmark$$

<u>OPTION 3</u>

$$n(S) = \frac{m}{M} = \frac{76,8}{32} = 2,4\ mol\checkmark$$

	S	:	H_2O
Mole ratio	3	:	2
	2,4	:	x

$$x = \frac{(2)(2,4)}{3} = 1,6\ mol$$

$$n\ (H_2O) = \frac{m}{M}$$
$$1,6 = \frac{m}{18}$$
$$m = 28,8\ g$$
$$c\ (H_2O) = \frac{m}{MV}\checkmark$$
$$= \frac{28,8}{(18)10}\checkmark$$
$$= 0,16\ mol \cdot dm^{-3}\checkmark$$ (4)

8.2.2 POSITIVE MARKING FROM Q8.2.1 TO Q8.2.2
OPTION 1

	$2H_2S$	SO_2	$3S$	$2H_2O$
Ratio	2	1	3	2
I_{mol}	3,6	2,8	0	0
C_{mol}	-1,6	-0,8	+2,4	+1,6
E_{mol}	2	2	2,4	1,6
E_{conc}	0,2✓	0,2✓		0,16

$$K_c = \frac{[H_2O]^2}{[H_2S]^2[SO_2]}✓ = \frac{(0,16)^2}{(0,2)^2(0,2)}✓ = 3,2✓$$

POSITIVE MARKING FROM Q8.2.1 TO Q8.2.2
OPTION 2

	$2H_2S$	SO_2	$3S$	$2H_2O$
Ratio	2	1	3	2
I_{conc}	0,36	0,28	0	0
C_{conc}	-0,16	-0,08	+0,24	+0,16
E_{conc}	0,2✓	0,2✓		0,16

$$K_c = \frac{[H_2O]^2}{[H_2S]^2[SO_2]}✓ = \frac{(0,16)^2}{(0,2)^2(0,2)}✓ = 3,2✓$$

(5)

8.2.3 Increases (1)

8.3 8.3.1 Contact (process)
8.3.2 Ammonia
8.3.3 $(NH_4)_2SO_4$

(3 × 1) (3)
[17]

QUESTION 9

9.1 9.1.1
- Gain of electrons
- Reduction in the oxidation number (Any 1 × 2) (2)

9.1.2
- The chemical reaction is exothermic in a galvanic cell and endothermic in an electrolytic cell.
- The anode is negative in a galvanic cell and positive in an electrolytic cell.
- An emf/current is produced in a galvanic cell and required in an electrolytic cell. (Any 1 × 2) (2)

9.1.3
$$E^0_{cell} = E^0_{cathode} - E^0_{Anode}✓$$
$$= (0,34✓) - (-0,74)✓$$
$$= 1,08\,V✓$$
(4)

9.1.4 (a) Increases (1)

(b) Decreases (1)

9.1.5 $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$
Reactants✓ Products✓ (2)

9.1.6 $2Cr(s) + 3Cu^{2+}(aq) \rightarrow 2Cr^{3+}(aq) + 3Cu(s)$

Reactants✓ Products✓ Balancing✓ (3)

9.2 9.2.1 B (1)

9.2.2 $Cu(s) \rightarrow Cu^{2+}(aq) + 2e^-$
Reactants✓ Products✓ (2)

9.2.3
- The impure copper electrode must be replaced with a silver electrode.
- The electrolyte must be replaced with a soluble silver salt, e.g., $AgNO_3$ (2)

[20]

QUESTION 10

10.1 10.1.1 R✓ (nitric acid) and Q✓ (sodium hydrogen carbonate) (2)

10.1.2 T (potassium hydroxide) (1)

10.2 10.2.1 Strong electrolyte (1)

10.2.2 It ionises completely.✓✓ (To produce a high concentration of ions) (2)

10.2.3 A base is a proton acceptor. (2)

10.2.4 $n(NaOH) = cV$✓
$= (0{,}8)(0{,}2)$✓
$= 0{,}16\ mol$✓ (3)

POSITIVE MARKING FROM Q10.2.4 TO Q10.2.5

10.2.5 $n(H_2SO_4) = 0{,}08\ mol$✓✓ (2)

POSITIVE MARKING FROM Q10.2.4 and Q10.2.5 TO Q10.2.6

10.2.6 $n_i(H_2SO_4) = cV = 1{,}6x$
$n(H_2SO_4)\ in\ excess = 1{,}6x - 0{,}08$✓

$c = \frac{n}{V}$✓

$0{,}8$✓ $= \frac{1{,}6x-0{,}08}{x+0{,}2}$✓
$x = 0{,}3\ dm^3\ OR\ 300\ cm^3$✓ (5)

[18]

QUESTION 11

11.1 11.1.1 Isotopes (1)

11.1.2 They have different numbers of neutrons✓ and different atomic mass✓ numbers. (2)

11.2 11.2.1 T
11.2.2 Q
11.2.3 R
(3 × 1) (3)

11.3 11.3.1 (a)
- Alpha particles will not pass through the cardboard.
- Alpha particles are stopped by paper. (Any 1 × 1) (1)

(b)
- Gamma rays will pass through both cardboard and washing powder.
- Gamma rays are highly penetrating. (Any 1 × 1) (1)

11.3.2
- The beta rays will be blocked from reaching the detector.✓
- An electric circuit will be closed/triggered.✓
- An electric signal will be sent to close✓ the hopper and then move✓ the conveyor belt forward. (4)

[12]

TOTAL SECTION B: 115
GRAND TOTAL: 150

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