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ST BENEDICT'S

SUBJECT	CHEMISTRY EXAMINATION
GRADE	12
EXAMINER	Mr McCoy
MODERATOR	Mr Hilder
DATE	26 July 2024
MARKS	200
DURATION	3 hours

%

MARKING GUIDELINES**PLEASE READ THE FOLLOWING INSTRUCTIONS CAREFULLY**

1. This question paper consists of 12 pages and a separate Data Sheet and Periodic Table. Please check that your question paper is complete.
2. Read the questions carefully.
3. Answer **ALL** the questions on the question paper and hand it in at the end of the assessment. Remember to write your name and surname in the space provided above.
4. Use the data and formulae sheet whenever necessary.
5. Show your working in all calculations.
6. Units need not be included in the working of calculations, but appropriate units should be shown in the answer.
7. Answers must be expressed in decimal format, not left as proper fractions.
8. Where appropriate, express answers to TWO decimal places.
9. It is in your own interest to write legibly and to present your work neatly.
10. A Blank page is included at the end of the paper. If you run out of space for a question, use this space. Clearly indicate the question number of your answer should you use this extra space.

FOR OFFICE USE ONLY: MARKER TO ENTER MARKS

Question	1	2	3	4	5	6	7	8	9	10	Total
Mark											
Moderated Mark											
Question Total	20	17	17	14	13	27	29	16	25	22	200

Comment:

QUESTION 1**MS. RAMOTSHO****20 MARKS**

- 1.1 B ✓✓
1.2 C ✓✓
1.3 D ✓✓
1.4 D ✓✓
1.5 B ✓✓
1.6 D ✓✓
1.7 C ✓✓
1.8 C ✓✓
1.9 C ✓✓
1.10 D ✓✓

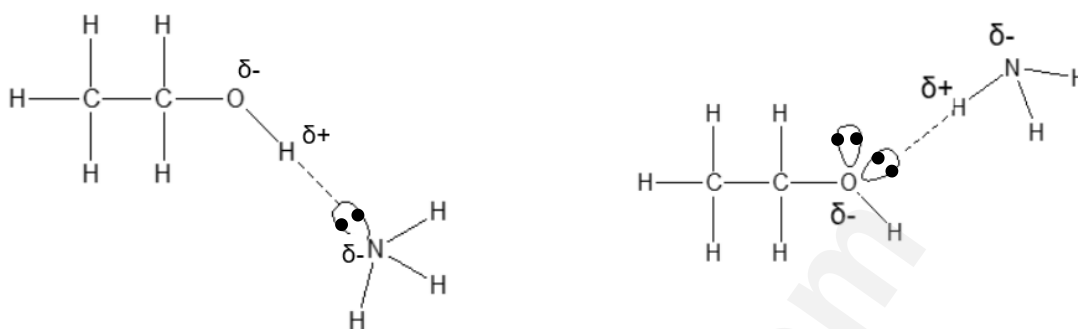
QUESTION 2

MR MOHLOBA

17 MARKS

2.1

(4)



- ✓ lone pairs and ✓ partial charges (δ^- , δ^+ , δ^-) on atoms involved in the hydrogen bond
- ✓ dotted line between lone pair on N/O to correct H
- ✓ linear O-H...N / linear N-H...O

2.2

2.2.1 A measure ✓ of the tendency of an atom to attract a bonding pair of electrons ✓. (2)

2.2.2 H and O ✓ OR O-H (1)

2.2.3 The molecule is (completely) symmetrical ✓ due to the tetrahedral shape ✓ (there is an even distribution of electron density) (2)

2.2.4 CBr₄ has London forces between molecules ✓CHBr₃ has (London forces) and dipole-dipole intermolecular forces ✓London forces between CBr₄ molecules are stronger than the dipole-dipole and London forces between CHBr₃, ✓

BUT because it has a larger mass/more electrons/larger electron cloud ✓

The intermolecular forces between CBr₄ molecules are stronger than the intermolecular forces between CHBr₃ ✓ (5)

2.2.5 Graphite ✓ (1)

2.2.6 Graphite has delocalised electrons due to only 3 out of the 4 carbon-carbon bonds being utilised ✓.

these electrons are free to move ✓ (when a potential difference is applied) (2)

QUESTION 3

MR HILDER

17 MARKS

3.1 .

3.1.1 Lower yield at higher temperature✓

So, equilibrium favours the reverse reaction, (the endothermic) to oppose the increase in temperature✓

(Allow converse arguments: Higher yield at lower temperature. So, equilibrium the forward reaction, the exothermic, to oppose the decrease in temperature. IGNORE REFERENCE TO PRESSURE (2)

3.1.2 **INCREASE**✓

(1)

3.1.3 Lower yield at higher pressure✓

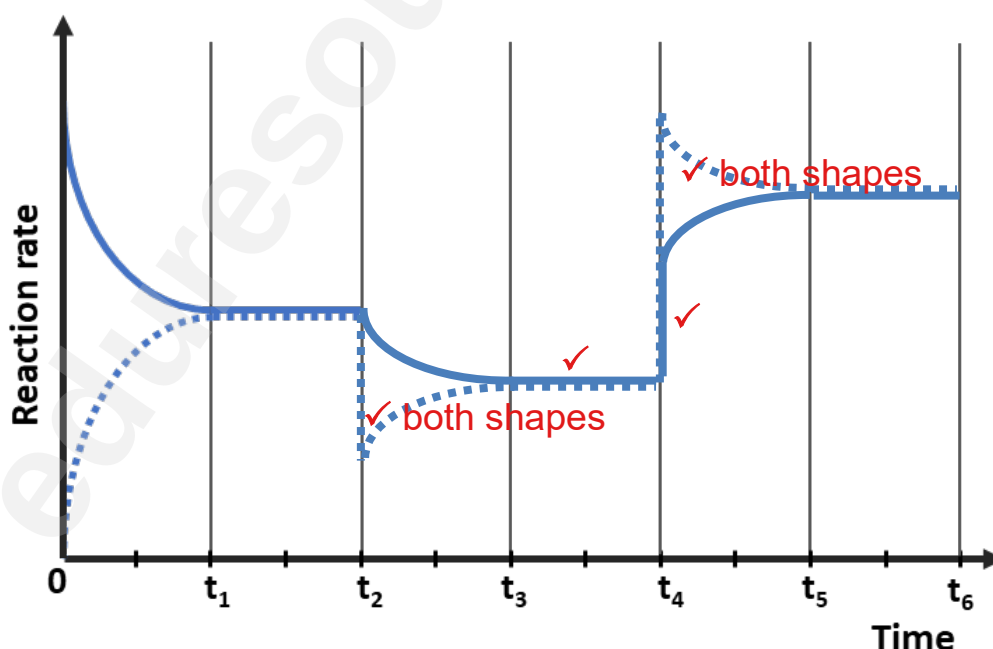
So, the reverse reaction is favoured to the side with fewest number of moles to oppose the increase in pressure✓

(Higher yield at lower pressure So, the forwards is favoured to the side with highest number of moles to oppose the decrease in pressure. IGNORE REFERENCE TO TEMPERATURE (2)

3.1.4 Increases the rate of forwards and reverse reactions equally✓

(1)

3.2 .



3.3

3.3.1

$$K_c = \frac{[NH_3]^2}{[H_2]^3[N_2]}$$

$$0.118 = \frac{[NH_3]^2}{\left[0.0285/0.150\right]^3 \left[0.0870/0.150\right]}$$

✓ skill, dividing by 0,15

$$0.118 = \frac{[NH_3]^2}{[0.190]^3 [0.580]}$$

$$[NH_3]^2 = 4.69 \times 10^{-4}$$

$$[NH_3] = 0.0217 \text{ mol dm}^{-3}$$

$$n(NH_3) = 0.0217 \times 0.150 = 3.25 \times 10^{-3} \text{ mol}$$

(5)

$$3.3.2 \quad K_c = \frac{1}{0.118} = 8.47$$

(2)

QUESTION 4

MRS GOVENDER

14 MARKS

4.1 .

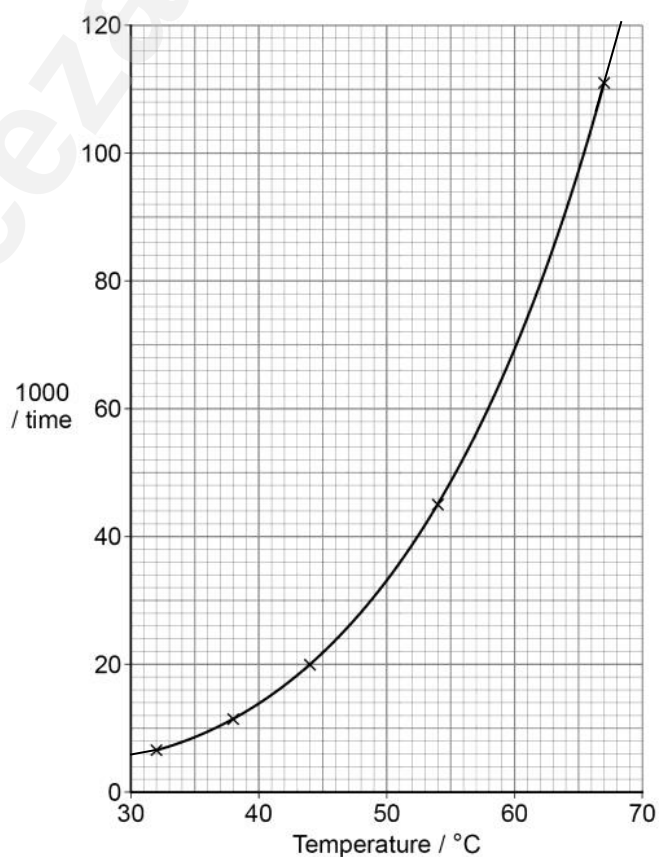
4.1.1 111,1✓. (1)

4.1.2 Temperature of the solution. ✓ (1)

4.1.3 Measure the temperature at the start and end of the reaction✓ and find the mean/average✓ (2)

4.1.4 Increase the average kinetic energy of **all** particles✓
More particles will have kinetic energy equal too or greater than the activation energy✓
 The number of collisions will increase per unit time✓
 the number of effective collisions will increase, per unit time✓ (4)

4.1.5 suitable vertical scale✓
 points plotted correctly ($\pm \frac{1}{2}$ small square per point) ✓
 best fit line drawn
Must go beyond the last point
 (within one small square of each point and should be a smooth curve) ✓
should use more than half the axis to cover the four points given and the point for 67°C (3)



4.1.6 Graph value +-78✓

$$Time = \frac{1000}{\text{value from graph at } 60^{\circ}\text{C}}$$

$$= \pm 12,8 \text{ s} \checkmark$$

(3)

QUESTION 5

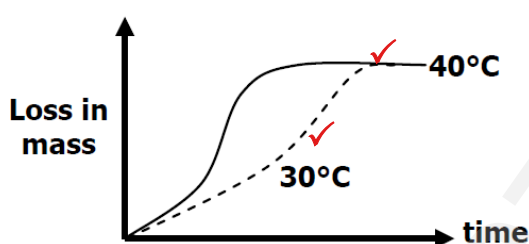
MR NTOMBELA

13 MARKS

5.1 .

5.1.1 The reaction is exothermic ✓ thus the extra heat given off allows for more effective collisions per second ✓ and ∴ a greater reaction rate (as shown by the steeper curve.) (2)

5.1.2 This is an indication that one (or both) of the reactants has 'run out' by being used up to make product. ✓
Thus, there will be fewer collisions per second ✓ and the reaction rate will decrease or stop (reaction has reached completion). (2)



5.1.3 (2)

5.1.4 Greater reaction rate. ✓ (1)

5.1.5 HCl Zn

$$n = c \times V = 3,6 \times 0,1 \checkmark = 0,36 \text{ mol} \checkmark \quad n = \frac{m}{M} = \frac{10 \checkmark}{65,4} = 0,15 \text{ mol} \checkmark$$

Mol ratio

Zn : HCl

1 : 2

0,15 : 0,3 ✓

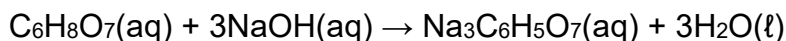
Zn is the limiting reagent, ∴ increasing the concentration of HCl will have no effect on the loss in mass of the system. ✓ (6)

QUESTION 6

MR MCCOY

27 MARKS

6.1 Citric acid reacts with sodium hydroxide.



6.1.1 Place watch glass on a balance and zero the balance ✓

Add the solid to a beaker (or other suitable container), rinse out watch glass and transfer washing to the beaker. ✓ (2)

$$6.1.2 \quad c = \frac{m}{VM}, \quad c = \frac{0,834}{0,5 \times (192)} = 0,00869 \text{ mol. dm}^{-3} \quad (3)$$

6.1.3 Calculates the titres for each of 1,2,3 as ✓

	Rough	Run 1	Run 2	Run 3
Final reading (cm ³)	23,65	22,95	46,05	26,30
Start reading (cm ³)	0,00	0,00	22,95	3,40
Titre (cm ³)	23,65	22,95	23,10	22,90

Averages:

$$(22,95 + 23,10 + 22,90) \div 3 = 23,15 \text{ cm}^3 \quad (2)$$

$$6.1.4 \quad \frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}, \quad \frac{0,00869 \times 0,025}{c_b \times 0,02315} = \frac{1}{3}, \quad c_b = 0,0282 \text{ mol. dm}^{-3} \text{. cannot round to 0,03} \quad (3)$$

6.2 The acid is TRI ✓✓ PROTIC. (2)

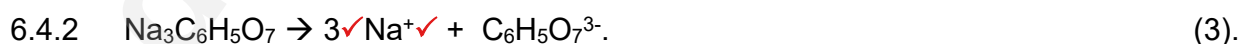
6.3 .

$$6.3.1 \quad K_a = 7,1 \times 10^{-4} \quad (1)$$

6.3.2 BASE ✓ (1)

6.4 .

6.4.1 the splitting of an ionic compound ✓ into its ions ✓ (2)



6.4.3 Na^+ and NaOH ✓ $\text{C}_6\text{H}_5\text{O}_7^{3-}$ and $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$. ✓ (COE from 3Na^+) (2)

6.4.4 A reaction of an ion with water ✓✓ . (2)

6.4.5 BASIC ✓ (1)

$\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$ is (an ACIDIC / a) salt.

6.4.6 $\text{C}_6\text{H}_5\text{O}_7^{3-}$ is the strong conjugate of the weak acid $\text{H}_3\text{C}_6\text{H}_5\text{O}_7$ 

The salt is basic as more OH^- ions will be present. (3)

QUESTION 7

MRS GOVENDER

29 MARKS

7.1 .

7.1.1 a substance that donates electrons.✓✓ (2)

7.1.2 $\text{Pb}(\text{NO}_3)_2$ ✓✓ (2)

7.1.3 .

a) there is not enough information to place Cobalt and Magnesium in order✓ or there has been no comparison between cobalt and magnesium.

b) Place cobalt into magnesium nitrate solution✓✓
OR place magnesium into a cobalt nitrate solution. (2)c) Result must correspond with (b) suggestion.
Cobalt would not react with magnesium nitrate✓ OR
A shiny grey solid deposits on the magnesium✓
As magnesium is a stronger reducing agent than cobalt✓ (or converse) (2)7.1.4 $\text{Pb} + 2\text{Ag}^+ \rightarrow 2\text{Ag} + \text{Pb}^{2+}$ $\text{Ag}^+ \rightarrow \text{Ag}$ ✓ $\text{Pb} \rightarrow \text{Pb}^{2+}$ ✓ bal✓
(-1 if double arrow given) (3)

7.2 .

7.2.1 Chemical to electrical✓✓ (2)

7.2.2 $E = -0,76 - (-1,66)$ ✓ = 0,9 V✓ (2)7.2.3 $\text{Al}_{(s)}|\text{Al}_{(aq)}^{3+}||\text{Zn}_{(aq)}^{2+}|\text{Zn}_{(s)}$ each half cell✓✓ states✓? (3)

7.2.4 As the reaction progresses:

(a) Aluminium electrode will corrode/dissolve/ get eaten away ✓ (1)

b) TO THE RIGHT.✓ (1)

c) the solution around the copper electrode will become negatively charged✓
as positively charged/ Zn^{2+} ions are reduced✓
The potassium ions are positively charged✓
So will be attracted into the negative solution✓ (4)

d) FROM A TO B✓✓ (2)

7.2.5 GREATER THAN✓✓ (2)

QUESTION 8

MR MOHLOBA

16 MARKS

- 8.1 a substance that can conduct electricity due to the presence of free (mobile) ions ✓ when molten or dissolved in solution ✓ (2)
- 8.2 copper sulphate OR copper nitrate. ✓ Do not accept copper chloride. (1)
- 8.3 idea that teapot is connected to the incorrect electrical pole OR idea that in the picture the teapot would in fact be the anode ✓
The teapot needs to be negative ✓
To attract the copper ions to it OR for the copper ions to reduce there ✓ (3)
- Mihir corrects the error.
- 8.4 $m = n \times M = 0,01 \times 63,5 \checkmark = 0,635 \text{ g} \checkmark$ (2)
- 8.5 ratio Cu : e⁻ is 1 : 2 so 0,02 mol electrons must be transferred ✓
.Q = nF = 0,02 x 96500 ✓ **skill mark**
= 1930 C ✓ transferred
t = Q/I = 1930/0,5 ✓ **skill mark**
= 3860 00\ s ✓ (5)
- 8.6 Each mole of silver ions requires only 1 mole of electrons while each mole of copper ions requires 2 mole of electrons ✓
accept a meaningful ratio equation here e.g. Cu:Ag 1 : 2
as the current is the same ✓
this would take a shorter time ✓ (3)

QUESTION 9

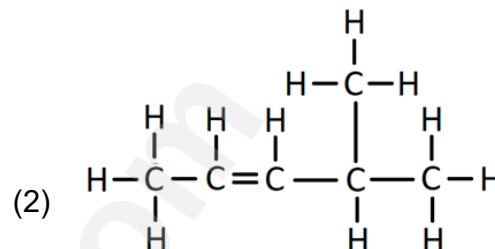
MR NTOMBELA

25 MARKS

9.1

9.1.1 compounds having the same molecular formula✓ but different structural formulae✓. (2)

9.1.2 any 5 chain carbon with the double bond between carbon 2 and 3✓
methyl group must be on carbon 2,3 or 4✓.



9.1.3 $\text{CH}_2\text{CH}(\text{CH}_2)_3\text{CH}_3$ ✓✓ **MINUS 1 IF NOT CONDENSED** (2)

9.1.4 Hex-2-ene will have London forces between its molecules✓
Hexanol will have hydrogen bonds between its molecules✓
Hydrogen forces are stronger than London forces✓
Hexanol will have the higher boiling point as more energy is needed to overcome the stronger intermolecular force.✓ (4)

9.2

9.2.1 Water/ H_2O . ✓ (1)

9.2.2 1-chlorohexane✓. (1)

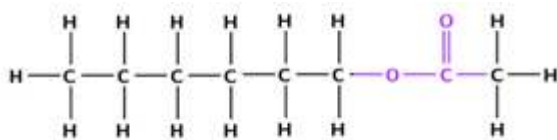
9.2.3 a) Hydration ✓ b) hydrolysis✓ (2)

9.2.4 LOW.✓ (1)

9.2.5 The organic compounds may have low boiling points✓ and escape from the reaction vessel.✓ (2)

9.3

9.3.1 Correct functional group✓ correct hexyl✓ correct ethanoate✓
Condensed formula (-1) missing H's (-1). (3)



9.3.2 ester. ✓ (1)

9.3.3 ethanoic✓ acid.✓ (2)

9.3.4 Water/ H_2O . ✓ (1)

9.3.5 H_2SO_4 **Downloaded from eduresourceza.com** (1)

QUESTION 10

MR HILDER

22 MARKS

10.1 .

10.1.1 The colour in heptane will remain/or fade slowly/nothing will happen✓

The colour in hept-1-ene will disappear✓ faster/✓ quickly/immediately (3)

10.1.2 $CH_3(CH_2)_5CH_3 + Br_2 \xrightarrow{UV/heat} CH_3(CH_2)_4CHBrCH_3 + HBr$ ✓ **condensed** ✓ (4)

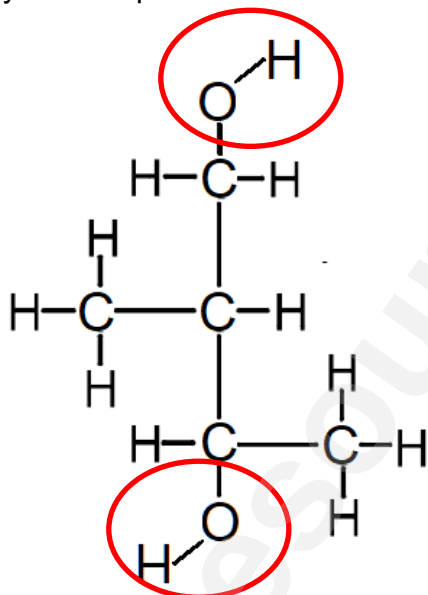
10.1.3 Halogenation✓ (1)

10.2 Consider the reaction equation: $C_{13}H_{28} \xrightarrow{heat} \text{heptane} + 2X$

10.2.1 Thermal cracking ✓ (1)

10.2.2 prop✓ene ✓✓ (3)

10.3 Study the compound below:



10.3.1 No✓ (1)

10.3.2 SATURATED✓ (1)

10.3.3 BOTH functional groups circled ✓ (1)

10.3.4 2-methyl✓butane✓-1,3-diol.✓ (3)

10.3.5 $C_5H_{12}O_2 + 7O_2 \rightarrow 5CO_2 + 6H_2O$ ✓
balancing if all correct✓ (4)