Education

KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

NATIONAL SENIOR CERTIFICATE

GRADE 12

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

JUNE 2017

TIME: 2 hours

MARKS: 100

This question paper consists of 13 pages including 4 data sheets.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate spaces on the ANSWER BOOK.
2. This question paper consists of EIGHT questions. Answer ALL the questions in the ANSWER BOOK.
3. Start EACH question on a NEW page in the ANSWER BOOK.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Leave ONE line between two subquestions, for example between QUESTION 2.1 and QUESTION 2.2.
6. You may use a non-programmable calculator.
7. You may use appropriate mathematical instruments.
8. You are advised to use the attached DATA SHEETS.
9. Show ALL formulae and substitutions in ALL calculations.
10. Round off your **FINAL** numerical answers to a minimum of TWO decimal places.
11. Give brief motivations, discussions et cetera where required.
12. Write neatly and legibly.

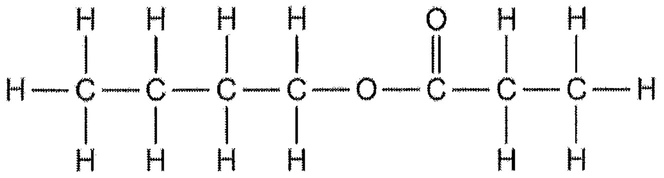
QUESTION 1: MULTIPLE CHOICE

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Write only the letter (A - D) next to the question number (1.1 – 1.7) in the ANSWER BOOK, for example 1.8 D.

1.1 Which ONE of the following homologous series does NOT contain a CARBONYL group?

A Aldehydes
B Alcohols
C Carboxylic acids
D Esters (2)

1.2 The structural formula of an ester is shown below.



$$\begin{array}{cccccccccc} & H & H & H & H & & O & H & H & \\ & | & | & | & | & & \| & | & | & \\ H- & C- & C- & C- & C- & O- & C- & C- & C & -H \\ & | & | & | & | & & & | & | & \\ & H & H & H & H & & & H & H & \end{array}$$

Which ONE of the following pairs of compounds can be used to prepare the above ester?

A Butanoic acid and propan-1-ol
B Butanoic acid and propan-2-ol
C Propanoic acid and butan-1-ol
D Propanoic acid and butan-2-ol (2)

1.3 If $Q = \frac{\text{change in concentrafon of products}}{\text{change in time}}$, then Q represents the ...

A Yield of products.
B Equilibrium constant.
C Rate of reaction.
D Quantity of reactants used. (2)

1.4 100 cm^3 of a 0,1 $mol.dm^{-3}$ solution of hydrochloric acid is poured on to a 0,5 g piece of zinc in a glass beaker at room temperature. Which one of the following factors WILL NOT increase the rate of this reaction?

A Using 200 cm^3 of a 0,1 mol. dm^{-3} solution of hydrochloric acid at room temperature.

B Increasing the temperature of the acid solution to 50 °C.

C Using zinc powder.

D Using 100 cm^3 of a 0,2 mol. dm^{-3} hydrochloric acid at room temperature. (2)

1.5 Consider the following hypothetical reaction in a closed container:

$$A(s) + B(g) \rightleftharpoons C(g) + H_2O(\ell) \quad ; \quad \Delta H = - 150 \text{ kJ}$$

Which ONE of the following changes will increase the yield of C?

A Add water to the reaction

B Add more A(s) to the reaction if B is in excess

C Increase the pressure in the container

D Increase the temperature of the reaction. (2)

1.6 The following statements refer to a catalyst.

I It changes the heat of the reaction.

II It is not consumed in a reaction.

III It increases the kinetic energy of the reactants.

IV It increases the initial mass of products formed.

Which of the above statement/s is/are TRUE?

A II

B I, II and IV

C II, III and IV

D All are true. (2)

1.7 0,1 $mol.dm^{-3}$ solutions of the four substances below are prepared. Which ONE will have the highest pH?

A KOH

B NH_4OH

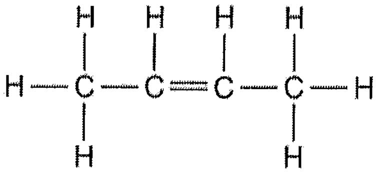
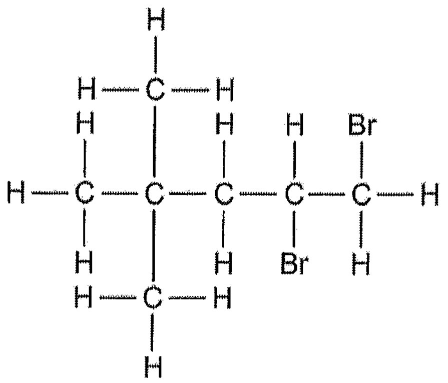
C NH_4NO_3

D KNO_3 (2)

[14]

QUESTION 2 (START ON A NEW PAGE)

The letters **A** to **F** in the table below represent six organic compounds.

A		**B**	
C	Methyl propanoate	**D**	3–Methylbutan–2–ol
E	$CH_3CH_2\ CH_2CO_2H$	**F**	$CH_3CH_2CH_2CH_2CH_2CHO$

2.1 Write down the LETTER(S) that represent(s) the following:

2.1.1 A carboxylic acid (1)

2.1.2 An aldehyde (1)

2.1.3 A compound with a general formula C_nH_{2n} (1)

2.1.4 Two compounds that are functional isomers of each other. (2)

2.2 Write down the IUPAC name of compound B. (2)

2.3 Write down the structural formula of compound D. (2)

[9]

QUESTION 3 (START ON A NEW PAGE)

The table below shows data collected for three organic compounds, represented by the letters A – C, during a practical investigation.

	Organic Compound	Relative Molecular Mass	Boiling Point °C
A	$CH_3CH_2CH_3$	44	-42
B	CH_3CHO	44	21
C	CH_3CH_2OH	46	78

3.1 Which variable except atmospheric pressure was controlled during this investigation? (1)

3.2 Identify the following for this investigation:

3.2.1 The dependent variable (1)

3.2.2 The independent variable (1)

3.3 Explain the difference in boiling points between compounds A and C. (3)

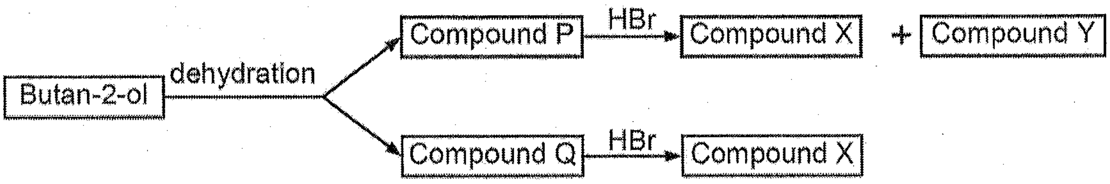
3.4 Which ONE, compound B or C, will have a higher vapour pressure at 15 °C? Give a reason. (2)

3.5 Predict which of methanoic acid or compound C will have a higher boiling point? (1)

[9]

QUESTION 4 (START ON A NEW PAGE)

The flow diagram below shows the conversion of an alcohol into haloalkanes, X and Y.



4.1 Name the type of organic reaction of which dehydration is an example. (1)

4.2 What type of reaction takes place when compound P is converted to compounds X and Y as illustrated above? (1)

4.3 Use condensed structural formulae to write a balanced equation for the preparation of compound Q as illustrated above. (3)

4.4 Butan-2-ol can be convert directly into compound X.

4.4.1 Name the type of reaction that will take place during this direct conversion. (1)

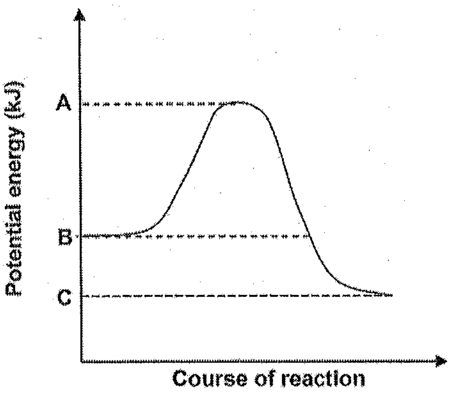
4.4.2 Use structural formulae to write a balanced equation for the reaction that takes place. (4)

4.5 Write down the IUPAC name of compound Y. (2)

[12]

QUESTION 5 (START ON A NEW PAGE)

5.1 The graph below shows changes in the potential energy for the reaction between zinc and hydrochloric acid.



5.1.1 Is this reaction endothermic or exothermic? Give a reason for the answer. (2)

5.1.2 Use the relevant energy values, A, B and C, to write down the energy of the activated complex. (1)

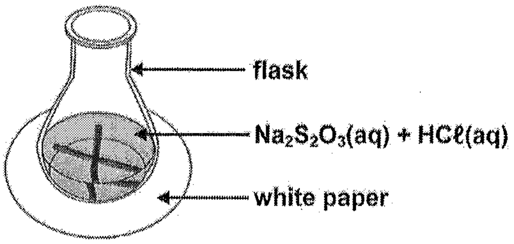
5.1.3 Use the relevant energy values, A, B and C, to write down ΔH for the reaction. (1)

5.1.4 Copy the given graph in your answer book. On the same graph, draw the graph for the catalysed reaction. (2)

5.2 Learners use dilute hydrochloric acid and a sodium thiosulphate ($Na_2S_2O_3$) solution to investigate the relationship between rate of reaction and temperature. The reaction that takes place is represented by the following equation:

$$Na_2S_2O_3\,(aq) + 2HC\ell(aq) \rightarrow 2NaC\ell(aq) + S(s) + H_2O(\ell) + SO_2(g)$$

They add 5 cm^3 dilute hydrochloric acid solution to 50 cm^3 sodium thiosulphate solution in a flask placed over a cross drawn on a sheet of white paper, as shown in the diagram below. The temperature of the mixture is 30 °C.



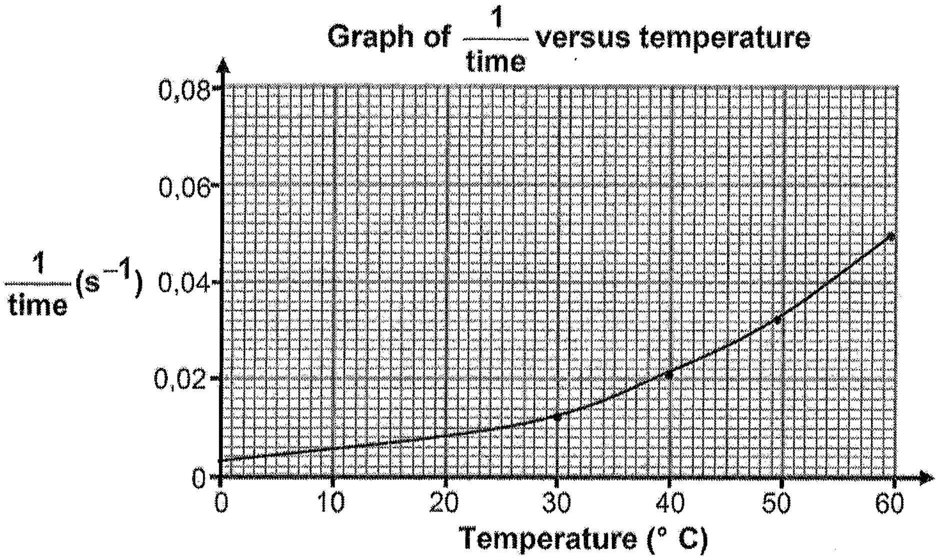
They measure the time it takes for the cross to become invisible. The experiment is repeated with the temperature of the mixture at 40 °C, 50 °C and 60 °C respectively.

5.2.1 Write down a possible hypothesis for this investigation. (2)

5.2.2 Apart from the volume of the reactants used, state ONE other variable that must be kept constant during this investigation. (1)

5.2.3 Write down the NAME or FORMULA of the product that causes the cross to become invisible. (1)

The graph shown below is obtained from the results.



5.2.4 What is represented by $\frac{1}{\text{time}}$ on the vertical axis? (1)

5.2.5 What conclusion can be drawn from the results obtained? (2)

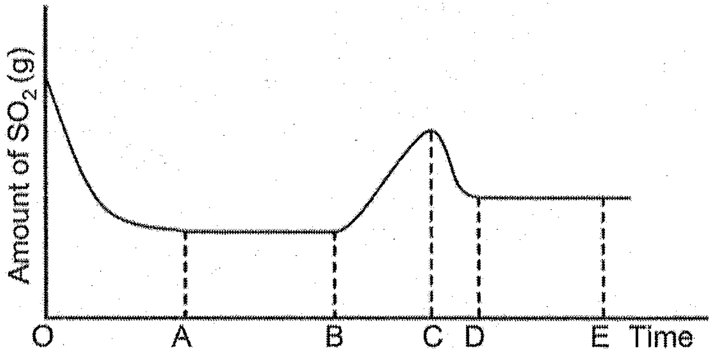
[13]

QUESTION 6 (START ON A NEW PAGE)

Consider the following reaction:

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g) \quad ; \quad \Delta H < 0$$

A graph of the AMOUNT of SO_2 (g) was plotted against time as shown below:



6.1 Which reaction has greater rate during each of the following intervals? (Choose from FORWARD REACTION, REVERSE REACTION or NEITHER REACTION.)

6.1.1 OA (1)

6.1.2 BC (1)

6.1.3 DE (1)

6.2. If the changes in the graph from B to D are due to changes in the TEMPERATURE, at which points (B, C or D) will the temperature be the lowest? Explain. (3)

6.3 If the changes in the graph from B to D are due to PRESSURE changes, at which point (B, C or D) will the pressure be the lowest? Explain. (3)

[9]

QUESTION 7 (START ON A NEW PAGE)

Seven (7,0) moles of nitrogen gas (N_2) and 2,0 moles of oxygen gas (O_2) are placed in an empty container of volume 2 dm^3 . The container is sealed and the following equilibrium is established:

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

The K_c value for this reaction at 250 °C is $4,8 \times 10^{-31}$.

7.1 What information does this value of K_c indicate with regards to the amount of NO(g) in the equilibrium mixture at 250 °C? (2)

The container is heated and the system reaches a new equilibrium at 500 °C. At this temperature it is found that there are 0,4 moles of NO(g) present.

7.2 Determine the K_c value at 500 °C. (8)

7.3 Is this reaction exothermic or endothermic? (1)

[11]

QUESTION 8 (START ON A NEW PAGE)

8.1 Write down:

8.1.1 The definition of an acid according to the Arrhenius theory. (2)

8.1.2 What is meant by a strong acid. (2)

8.2 Magnesium hydroxide ,$Mg(OH)_2$, is often used as medicine to relieve an upset stomach. The pH of the $HC\ell(aq)$ in a person's stomach is 1.

8.2.1 Calculate the concentration of the hydrochloric acid in the person's stomach. (3)

8.2.2 Will the pH in the stomach **INCREASE**, **DECREASE** or **STAY THE SAME** after taking in a dose of $Mg(OH)_2$? (1)

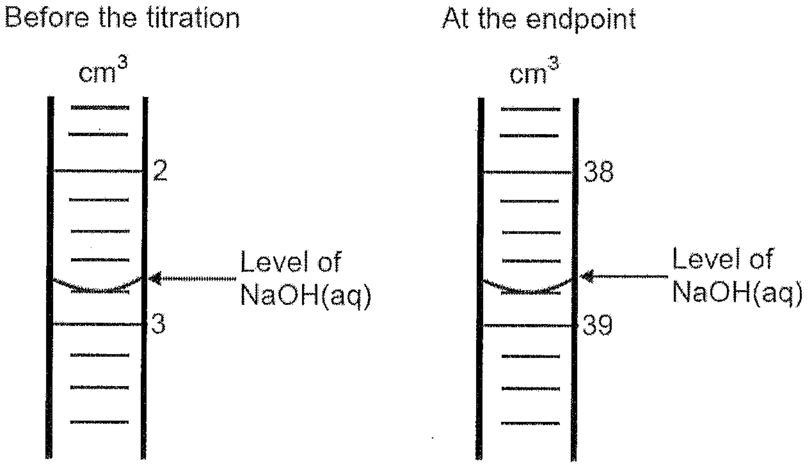
8.2.3 A person takes in a dose of $Mg(OH)_2$.
Write down the balanced equation for the acid-base reaction that takes place in the stomach. (3)

8.3 A standard solution of oxalic acid, $(COOH)_2$, of concentration 0,20 $mol{\cdot}dm^{-3}$ is prepared by dissolving a certain amount of $(COOH)_2{\bullet}2H_2O$ in water and made up to 250 cm^3 in a volumetric flask. Calculate the mass of $(COOH)_2{\bullet}2H_2O$ needed to prepare the standard solution. (4)

8.4 During a titration 25 cm^3 of the standard solution of oxalic acid prepared in **QUESTION 8.3** is neutralised by a sodium hydroxide solution from a burette. The balanced equation for the reaction is:

$$(COOH)_2\ (aq) + 2NaOH\ (aq) \rightleftharpoons (COONa)_2\ (aq) + 2H_2O\ (\ell)$$

The diagrams below show the burette readings before the titration commenced and at the endpoint respectively.



8.4.1 Calculate the concentration of the sodium hydroxide solution. (5)

8.4.2 Write down a balanced equation that explains why the solution has a pH greater than 7 at the endpoint. (3)

[23]

TOTAL : 100

DATA FOR PHYSICAL SCIENCES GRADE 12
PAPER 2 (CHEMISTRY)

GEGEWENS VIR FISIESE WETENSKAPPE GRAAD 12
VRAESTEL 2 (CHEMIE)

TABLE 1: PHYSICAL CONSTANTS/*TABEL 1: FISIESE KONSTANTES*

NAME/*NAAM*	SYMBOL/*SIMBOOL*	VALUE/*WAARDE*
Standard pressure *Standaarddruk*	p^{θ}	$1,013 \times 10^5$ Pa
Molar gas volume at STP *Molêre gasvolume by STD*	V_m	$22,4\ dm^3 \cdot mol^{-1}$
Standard temperature *Standaardtemperatuur*	T^{θ}	273 K
Charge on electron *Lading op elektron*	e	$-1,6 \times 10^{-19}$ C
Avogadro's constant *Avogadro-konstante*	N_A	$6,02 \times 10^{23}\ mol^{-1}$

TABLE 2: FORMULAE/*TABEL 2: FORMULES*

$n = \frac{m}{M}$	$n = \frac{N}{N_A}$
$c = \frac{n}{V}$ or/*of* $c = \frac{m}{MV}$	$n = \frac{V}{V_m}$
$\frac{c_a V_a}{c_b V_b} = \frac{n_a}{n_b}$	$pH = -\log[H_3O^+]$
$K_w = [H_3O^+][OH^-] = 1 \times 10^{-14}$ at/*by* 298 K	
$E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$ / $E^{\theta}_{sel} = E^{\theta}_{katode} - E^{\theta}_{anode}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{reduction} - E^{\theta}_{oxidation}$ / $E^{\theta}_{sel} = E^{\theta}_{reduksie} - E^{\theta}_{oksidasie}$ or/*of* $E^{\theta}_{cell} = E^{\theta}_{oxidising\ agent} - E^{\theta}_{reducing\ agent}$ / $E^{\theta}_{sel} = E^{\theta}_{oksideermiddel} - E^{\theta}_{reduseermiddel}$	

TABLE 3: THE PERIODIC TABLE OF ELEMENTS
TABEL 3: DIE PERIODIEKE TABEL VAN ELEMEN

KEY/*SLEUTEL*

Atomic number / *Atoomgetal* → 29

Electronegativity / *Elektronegatiwiteit* → 1,9

Symbol / *Simbool* → **Cu**

Approximate relative atomic mass / *Benaderde relatiewe atoommassa* → 63,5

1 (I)	2 (II)	3	4	5	6	7	8	9	10	11	12	13 (III)	14 (IV)	15 (V)	16 (VI)	17 (VII)	18 (VIII)
1 2,1 **H** 1																	2 **He** 4
3 1,0 **Li** 7	4 1,5 **Be** 9											5 2,0 **B** 11	6 2,5 **C** 12	7 3,0 **N** 14	8 3,5 **O** 16	9 4,0 **F** 19	10 **Ne** 20
11 0,9 **Na** 23	12 1,2 **Mg** 24											13 1,5 **Aℓ** 27	14 1,8 **Si** 28	15 2,1 **P** 31	16 2,5 **S** 32	17 3,0 **Cℓ** 35,5	18 **Ar** 40
19 0,8 **K** 39	20 1,0 **Ca** 40	21 1,3 **Sc** 45	22 1,5 **Ti** 48	23 1,6 **V** 51	24 1,6 **Cr** 52	25 1,5 **Mn** 55	26 1,8 **Fe** 56	27 1,8 **Co** 59	28 1,8 **Ni** 59	29 1,9 **Cu** 63,5	30 1,6 **Zn** 65	31 1,6 **Ga** 70	32 1,8 **Ge** 73	33 2,0 **As** 75	34 2,4 **Se** 79	35 2,8 **Br** 80	36 **Kr** 84
37 0,8 **Rb** 86	38 1,0 **Sr** 88	39 1,2 **Y** 89	40 1,4 **Zr** 91	41 **Nb** 92	42 1,8 **Mo** 96	43 1,9 **Tc**	44 2,2 **Ru** 101	45 2,2 **Rh** 103	46 2,2 **Pd** 106	47 1,9 **Ag** 108	48 1,7 **Cd** 112	49 1,7 **In** 115	50 1,8 **Sn** 119	51 1,9 **Sb** 122	52 2,1 **Te** 128	53 2,5 **I** 127	54 **Xe** 131
55 0,7 **Cs** 133	56 0,9 **Ba** 137	57 **La** 139	72 1,6 **Hf** 179	73 **Ta** 181	74 **W** 184	75 **Re** 186	76 **Os** 190	77 **Ir** 192	78 **Pt** 195	79 **Au** 197	80 **Hg** 201	81 1,8 **Tℓ** 204	82 1,8 **Pb** 207	83 1,9 **Bi** 209	84 2,0 **Po**	85 2,5 **At**	86 **Rn**
87 0,7 **Fr**	88 0,9 **Ra** 226	89 **Ac**															

58 **Ce** 140	59 **Pr** 141	60 **Nd** 144	61 **Pm**	62 **Sm** 150	63 **Eu** 152	64 **Gd** 157	65 **Tb** 159	66 **Dy** 163	67 **Ho** 165	68 **Er** 167	69 **Tm** 169	70 **Yb** 173	71 **Lu** 175
90 **Th** 232	91 **Pa**	92 **U** 238	93 **Np**	94 **Pu**	95 **Am**	96 **Cm**	97 **Bk**	98 **Cf**	99 **Es**	100 **Fm**	101 **Md**	102 **No**	103 **Lr**

TABLE 4A: STANDARD REDUCTION POTENTIALS
TABEL 4A: STANDAARD-REDUKSIEPOTENSIALE

Increasing oxidising ability/*Toenemende oksiderende vermoë* ↑

Half-reactions/*Halfreaksies*			E^θ (V)
$F_2(g) + 2e^-$	⇌	$2F^-$	+ 2,87
$Co^{3+} + e^-$	⇌	Co^{2+}	+ 1,81
$H_2O_2 + 2H^+ + 2e^-$	⇌	$2H_2O$	+1,77
$MnO_4^- + 8H^+ + 5e^-$	⇌	$Mn^{2+} + 4H_2O$	+ 1,51
$C\ell_2(g) + 2e^-$	⇌	$2C\ell^-$	+ 1,36
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	⇌	$2Cr^{3+} + 7H_2O$	+ 1,33
$O_2(g) + 4H^+ + 4e^-$	⇌	$2H_2O$	+ 1,23
$MnO_2 + 4H^+ + 2e^-$	⇌	$Mn^{2+} + 2H_2O$	+ 1,23
$Pt^{2+} + 2e^-$	⇌	Pt	+ 1,20
$Br_2(\ell) + 2e^-$	⇌	$2Br^-$	+ 1,07
$NO_3^- + 4H^+ + 3e^-$	⇌	$NO(g) + 2H_2O$	+ 0,96
$Hg^{2+} + 2e^-$	⇌	$Hg(\ell)$	+ 0,85
$Ag^+ + e^-$	⇌	Ag	+ 0,80
$NO_3^- + 2H^+ + e^-$	⇌	$NO_2(g) + H_2O$	+ 0,80
$Fe^{3+} + e^-$	⇌	Fe^{2+}	+ 0,77
$O_2(g) + 2H^+ + 2e^-$	⇌	H_2O_2	+ 0,68
$I_2 + 2e^-$	⇌	$2I^-$	+ 0,54
$Cu^+ + e^-$	⇌	Cu	+ 0,52
$SO_2 + 4H^+ + 4e^-$	⇌	$S + 2H_2O$	+ 0,45
$2H_2O + O_2 + 4e^-$	⇌	$4OH^-$	+ 0,40
$Cu^{2+} + 2e^-$	⇌	Cu	+ 0,34
$SO_4^{2-} + 4H^+ + 2e^-$	⇌	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + e^-$	⇌	Cu^+	+ 0,16
$Sn^{4+} + 2e^-$	⇌	Sn^{2+}	+ 0,15
$S + 2H^+ + 2e^-$	⇌	$H_2S(g)$	+ 0,14
$2H^+ + 2e^-$	⇌	**$H_2(g)$**	**0,00**
$Fe^{3+} + 3e^-$	⇌	Fe	− 0,06
$Pb^{2+} + 2e^-$	⇌	Pb	− 0,13
$Sn^{2+} + 2e^-$	⇌	Sn	− 0,14
$Ni^{2+} + 2e^-$	⇌	Ni	− 0,27
$Co^{2+} + 2e^-$	⇌	Co	− 0,28
$Cd^{2+} + 2e^-$	⇌	Cd	− 0,40
$Cr^{3+} + e^-$	⇌	Cr^{2+}	− 0,41
$Fe^{2+} + 2e^-$	⇌	Fe	− 0,44
$Cr^{3+} + 3e^-$	⇌	Cr	− 0,74
$Zn^{2+} + 2e^-$	⇌	Zn	− 0,76
$2H_2O + 2e^-$	⇌	$H_2(g) + 2OH^-$	− 0,83
$Cr^{2+} + 2e^-$	⇌	Cr	− 0,91
$Mn^{2+} + 2e^-$	⇌	Mn	− 1,18
$A\ell^{3+} + 3e^-$	⇌	$A\ell$	− 1,66
$Mg^{2+} + 2e^-$	⇌	Mg	− 2,36
$Na^+ + e^-$	⇌	Na	− 2,71
$Ca^{2+} + 2e^-$	⇌	Ca	− 2,87
$Sr^{2+} + 2e^-$	⇌	Sr	− 2,89
$Ba^{2+} + 2e^-$	⇌	Ba	− 2,90
$Cs^+ + e^-$	⇌	Cs	- 2,92
$K^+ + e^-$	⇌	K	− 2,93
$Li^+ + e^-$	⇌	Li	− 3,05

Increasing reducing ability/*Toenemende reduserende vermoë* ↓

TABLE 4B: STANDARD REDUCTION POTENTIALS
TABEL 4B: STANDAARD-REDUKSIEPOTENSIALE

Increasing reducing ability/*Toenemende reduserende vermoë*

Half-reactions/*Halfreaksies*			**E^{θ} (V)**
$Li^+ + e^-$	$\rightleftharpoons$	Li	− 3,05
$K^+ + e^-$	$\rightleftharpoons$	K	− 2,93
$Cs^+ + e^-$	$\rightleftharpoons$	Cs	− 2,92
$Ba^{2+} + 2e^-$	$\rightleftharpoons$	Ba	− 2,90
$Sr^{2+} + 2e^-$	$\rightleftharpoons$	Sr	− 2,89
$Ca^{2+} + 2e^-$	$\rightleftharpoons$	Ca	− 2,87
$Na^+ + e^-$	$\rightleftharpoons$	Na	− 2,71
$Mg^{2+} + 2e^-$	$\rightleftharpoons$	Mg	− 2,36
$A\ell^{3+} + 3e^-$	$\rightleftharpoons$	$A\ell$	− 1,66
$Mn^{2+} + 2e^-$	$\rightleftharpoons$	Mn	− 1,18
$Cr^{2+} + 2e^-$	$\rightleftharpoons$	Cr	− 0,91
$2H_2O + 2e^-$	$\rightleftharpoons$	$H_2(g) + 2OH^-$	− 0,83
$Zn^{2+} + 2e^-$	$\rightleftharpoons$	Zn	− 0,76
$Cr^{3+} + 3e^-$	$\rightleftharpoons$	Cr	− 0,74
$Fe^{2+} + 2e^-$	$\rightleftharpoons$	Fe	− 0,44
$Cr^{3+} + e^-$	$\rightleftharpoons$	Cr^{2+}	− 0,41
$Cd^{2+} + 2e^-$	$\rightleftharpoons$	Cd	− 0,40
$Co^{2+} + 2e^-$	$\rightleftharpoons$	Co	− 0,28
$Ni^{2+} + 2e^-$	$\rightleftharpoons$	Ni	− 0,27
$Sn^{2+} + 2e^-$	$\rightleftharpoons$	Sn	− 0,14
$Pb^{2+} + 2e^-$	$\rightleftharpoons$	Pb	− 0,13
$Fe^{3+} + 3e^-$	$\rightleftharpoons$	Fe	− 0,06
$2H^+ + 2e^-$	$\rightleftharpoons$	**$H_2(g)$**	**0,00**
$S + 2H^+ + 2e^-$	$\rightleftharpoons$	$H_2S(g)$	+ 0,14
$Sn^{4+} + 2e^-$	$\rightleftharpoons$	Sn^{2+}	+ 0,15
$Cu^{2+} + e^-$	$\rightleftharpoons$	Cu^+	+ 0,16
$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons$	$SO_2(g) + 2H_2O$	+ 0,17
$Cu^{2+} + 2e^-$	$\rightleftharpoons$	Cu	+ 0,34
$2H_2O + O_2 + 4e^-$	$\rightleftharpoons$	$4OH^-$	+ 0,40
$SO_2 + 4H^+ + 4e^-$	$\rightleftharpoons$	$S + 2H_2O$	+ 0,45
$Cu^+ + e^-$	$\rightleftharpoons$	Cu	+ 0,52
$I_2 + 2e^-$	$\rightleftharpoons$	$2I^-$	+ 0,54
$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons$	H_2O_2	+ 0,68
$Fe^{3+} + e^-$	$\rightleftharpoons$	Fe^{2+}	+ 0,77
$NO_3^- + 2H^+ + e^-$	$\rightleftharpoons$	$NO_2(g) + H_2O$	+ 0,80
$Ag^+ + e^-$	$\rightleftharpoons$	Ag	+ 0,80
$Hg^{2+} + 2e^-$	$\rightleftharpoons$	$Hg(\ell)$	+ 0,85
$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons$	$NO(g) + 2H_2O$	+ 0,96
$Br_2(\ell) + 2e^-$	$\rightleftharpoons$	$2Br^-$	+ 1,07
$Pt^{2+} + 2\ e^-$	$\rightleftharpoons$	Pt	+ 1,20
$MnO_2 + 4H^+ + 2e^-$	$\rightleftharpoons$	$Mn^{2+} + 2H_2O$	+ 1,23
$O_2(g) + 4H^+ + 4e^-$	$\rightleftharpoons$	$2H_2O$	+ 1,23
$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons$	$2Cr^{3+} + 7H_2O$	+ 1,33
$C\ell_2(g) + 2e^-$	$\rightleftharpoons$	$2C\ell^-$	+ 1,36
$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons$	$Mn^{2+} + 4H_2O$	+ 1,51
$H_2O_2 + 2H^+ + 2\ e^-$	$\rightleftharpoons$	$2H_2O$	+1,77
$Co^{3+} + e^-$	$\rightleftharpoons$	Co^{2+}	+ 1,81
$F_2(g) + 2e^-$	$\rightleftharpoons$	$2F^-$	+ 2,87

Increasing oxidising ability/*Toenemende oksiderende vermoë*

Education
KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P2 (CHEMISTRY)
COMMON TEST
MARKING GUIDELINE
JUNE 2017

NATIONAL SENIOR CERTIFICATE

GRADE 12

TIME: 2 hour

MARKS: 100

This marking guideline consists of **5 pages.**

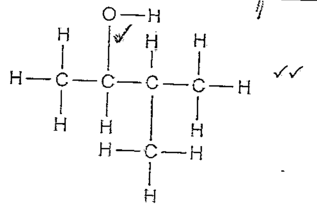
QUESTION 1: MULTIPLE CHOICE

1.1 B ✓✓ BC
1.2 C ✓✓ CA (2)
1.3 C ✓✓ (2)
1.4 A ✓✓ BA (2)
1.5 B ✓✓ A (2)
1.6 A ✓✓ (2)
1.7 A ✓✓ (2)
(2)
[14]

QUESTION 2

2.1.1 E ✓
2.1.2 F ✓ (1)
2.1.3 A ✓ (1)
2.1.4 C and E ✓✓ (1)
(2)

2.2 1,2–dibromo–4,4–dimethyl✓pentane ✓
2.3 (2)



- 1 mark for OH
- 1 mark for rest of the structure
- Penalise for one mark for extra hydrogen or less hydrogen in the carbon

(2)
[9]

QUESTION 3

3.1 Relative molecular mass/molecular size ✓
3.2.1 Boiling point ✓ (1)
3.2.2 Type of organic compound/type of homologous series/type of functional group ✓ (1)
3.3 Between alkane molecules/molecules of compound A/propane molecules are London forces ✓ (1)
Between alcohol molecules/molecules of compound C/ethanol molecules are (weak Van der Waals forces as well as) strong hydrogen bonds ✓
Hydrogen bonds are stronger than London forces and less energy needed to overcome intermolecular forces between alkane molecules/molecules of compound A/propane molecules ✓

3.4 Compound B ✓ (3)
Lower boiling point/weaker intermolecular forces ✓
3.5 Methanoic acid ✓ (2)
(1)
[9]

QUESTION 4

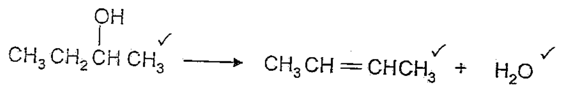
4.1 Elimination ✓

4.2 Addition / hydrohalogenation / hydrobromination ✓ (1)

4.3 **Marking Criteria** (1)

- Drawing condensed formula of butan-2-ol ✓
- molecular formula of water ✓
- Drawing condensed formula of but – 2- ene ✓

If structural formula used max: ⅔



$$CH_3CH_2\overset{OH}{CH}CH_3 \checkmark \longrightarrow CH_3CH{=}CHCH_3 \checkmark + H_2O \checkmark$$

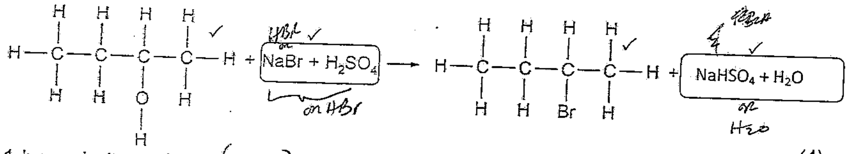
(3)

4.4.1 Substitution ✓ (1)

4.4.2 **Marking Criteria**

- Drawing structural formula of butan-2-ol ✓
- Both inorganic reactants ✓
- Drawing structural formula of 2-bromobutane ✓
- Both inorganic products ✓

If condensed/molecular formula used max: ⅔



(4)

4.5 1-bromobutane ✓✓ (2 or 0) (2)

[12]

QUESTION 5

5.1.1 Exothermic✓

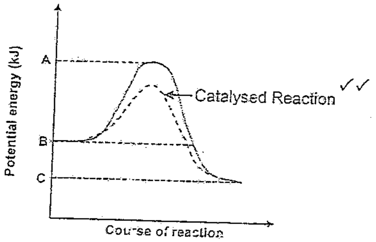
or

Reactants at higher energy than products / $\Delta H < 0$✓ (2)

5.1.2 A✓ (1)

5.1.3 C – B✓ (1)←

5.1.4



(2)

5.2.1 The rate of the reaction is directly/inversely proportional to the temperature.✓✓ (2)

5.2.2 Concentration ✓(of acid and sodium thiosulphate) mass ? (1)

5.2.3 Sulphur / S✓ (1)

5.2.4 Reaction rate✓ (1)

5.2.5 As temperature increases the rate of the reaction increases.✓✓ (2)

r.r. ∝ ΔT [X] - from the graph

[13]

QUESTION 6

6.1.1 Forward reaction ✓ (1)

6.1.2 Reverse reaction ✓ (1)

6.1.3 Neither reaction ✓ (1)

6.2 ⊖ B ✓

For the amount of SO_2 to increase the reverse reaction must be favoured. ✓ Hence the system must be heated.✓ Therefore B will represent the point of lowest temperature.

OR

The forward reaction is exothermic. ✓
Therefore the temperature is lowest where the amount of SO_2 is lowest. ✓

OR

The reverse reaction is endothermic. ✓
Therefore the temperature is lowest where the amount of SO_2 is lowest. ✓ (3)

6.3 ⊖ C ✓

An increase in pressure will favour the forward reaction. ✓
Therefore the pressure is lowest where the amount of SO_2 is highest. ✓ (3)

[9]

QUESTION 7

7.1 Low concentration of NO (g). ✓✓ OR Small amount of NO (g). ✓✓
OR Low yield of of NO (g). ✓✓ (2)

7.2

	N_2	O_2	NO
Initial no. of moles	7	2	0
No. of moles formed			0,4 ✓
No. of moles reacted	0,2 ✓	0,2 ✓	
No. moles at equilibrium	6,8	1,8	0,4✓
Concentration at equilibrium	3,4	0,9✓	0,2

Very small Kc's

If 2 cases Mark from 2nd table

$$K_c = \frac{[NO]^2}{[N_2][O_2]} \checkmark$$

$$= \frac{(0,2)^2}{(3,4)(0,9)} \checkmark$$

$$= 1,3 \times 10^{-2} \checkmark (0,013) \text{ or } 0,01$$

Give marks if substituted incorrect value [incorrectly]

Note: Kc for first equilibrium is too small to change the initial concentrations for the second equilibrium.

(8)

7.3 Endothermic✓ (1)

* Can a accept exothermic? Explain why? If K_c < 4,8 × 10⁻³¹

[11]

QUESTION 8

8.1.1 An acid is a substance ✓ that produces hydrogen ions ✓ (H^+)/hydronium ions (H_3O^+) when it dissolves in water. ✓✗ , in solution ✗

8.1.2 Strong acids ionise completely in water to form a high concentration of H_3O^+ ions. ✓✓ (2)

8.2.1 $pH = -\log[H_3O^+]$ ✓ (2)

$1 = -\log[H_3O^+]$ ✓

$[H_3O^+] = 0{,}1\ mol \cdot dm^{-3}$ ✓ (3)

8.2.2 Increase ✓ (1)

8.2.3 $Mg(OH)_2 + 2\,HCl \rightarrow MgCl_2 + 2\,H_2O$ (3)

✓ Correct reactants
✓ Correct products
✓ Balancing

8.3

$m = cMV$ ✓
$= 0{,}2 \times 126 \times 0{,}25$ ✓ ✓
$= 6{,}3\ g$ ✓

OR

$n = cV$
$= 0{,}2 \times 0{,}25$ ✓
$= 0{,}05\ mol$

$m = nM$ ✓
$= 0{,}05 \times 126$ ✓
$= 6{,}3\ g$ ✓

(4)

8.4.1 No. of mol $(COOH)_2$ ✓ reacted with NaOH

$n = cV$ ✓
$= 0{,}2 \times 0{,}025$ ✓
$= 0{,}005\ mol$

$n((COOH)_2) : n(NaOH) = 1 : 2$ ✓
$n(NaOH) = 0{,}01\ mol$

Concentration of NaOH

$c = \frac{n}{V}$
$= \frac{0{,}01}{0{,}036}$ ✓
$= 0{,}278\ mol.dm^{-3}$ ✓

OR

$\frac{c_aV_a}{c_bV_b} = \frac{n_a}{n_b}$ ✓
$\frac{0{,}2 \times 25}{c_b \times 36} = \frac{1}{2}$ ✓ ✓ ✓
$c_b = 0{,}278\ mol.dm^{-3}$ ✓

(5)

8.4.2 $(COO)_2^{2-} \overset{✓}{+} H_2O \rightleftharpoons H(COO)_2^- \overset{✓}{+} OH^-$ ✓ balancing

✗ ~~$H(COO)_2$ ✓ + $H_2O \rightleftharpoons H_2CO_2$ + ✓ H_3O^+ ✓balancing~~

✓ Correct reactants
✓ Correct products
✓ balancing

(3)

$C_2O_4^{2-} + 2H_2O \rightleftharpoons 2OH^- + H_2C_2O_4$ ✓✓

[23]

TOTAL MARKS: [100]