Education
KwaZulu-Natal Department of Education
REPUBLIC OF SOUTH AFRICA

PHYSICAL SCIENCES P2 (CHEMISTRY)

COMMON TEST

SEPTEMBER 2016

NATIONAL SENIOR CERTIFICATE

GRADE 11

MARKS: 50

TIME: 1 hour

This question paper consists of 5 pages, and 1 data sheet.

INSTRUCTIONS AND INFORMATION

1. Write your name in the appropriate space on the ANSWER BOOK.
2. This question paper consists of 3 questions. Answer ALL the questions in the ANSWER BOOK.
3. You may use a non-programmable calculator.
4. You may use appropriate mathematical instruments.
5. YOU ARE ADVISED TO USE THE ATTACHED DATA SHEET.
6. Number the answers correctly according to the numbering system used in this question paper.
7. Write neatly and legibly.

QUESTION 1

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 (1.1–1.3) in the ANSWER BOOK, for example 1.3 D.

1.1 In a reaction that is slow, the addition of a catalyst will...

A provide an alternate pathway for the reaction.
B increase the activation energy of the activated complex.
C change the average kinetic energy of the reacting species.
D lead to a decrease in the frequency of collisions between the reactants. (2)

1.2 Which one of the following substances cannot act as an ampholyte?

A H_2O
B HNO_3
C HCO_3^-
D HSO_4^- (2)

1.3 Consider the following reversible reaction:

$HSO_3^-(aq) + H_2O(\ell) \rightleftharpoons H_2SO_3(aq) + OH^-(aq)$

The compounds HSO_3^- and OH^- in this reaction can be described as...

A a conjugate acid – base pair
B Lowry – Brönsted bases
C Lowry – Brönsted acids
D polyprotic acids (2)
[6]

QUESTION 2

2.1 Consider the hypothetical reaction below and the data given.

$$X_2\,(g) + Y_2\,(g) \rightarrow 2XY\,(g)$$

Energy of reactants = 15 kJ.mol^{-1}
Energy of products = 40 kJ.mol^{-1}
Energy of activated complex = 65 kJ.mol^{-1}

2.1.1 What is activation energy? (1)

2.1.2 Calculate the activation energy for this reaction. (2)

2.1.3 Calculate the heat of reaction (enthalpy change). (2)

2.2 When methane gas (CH_4) and chlorine gas ($C\ell_2$) are mixed they do not react in the absence of sunlight. In the presence of sunlight however, an explosive reaction takes place.

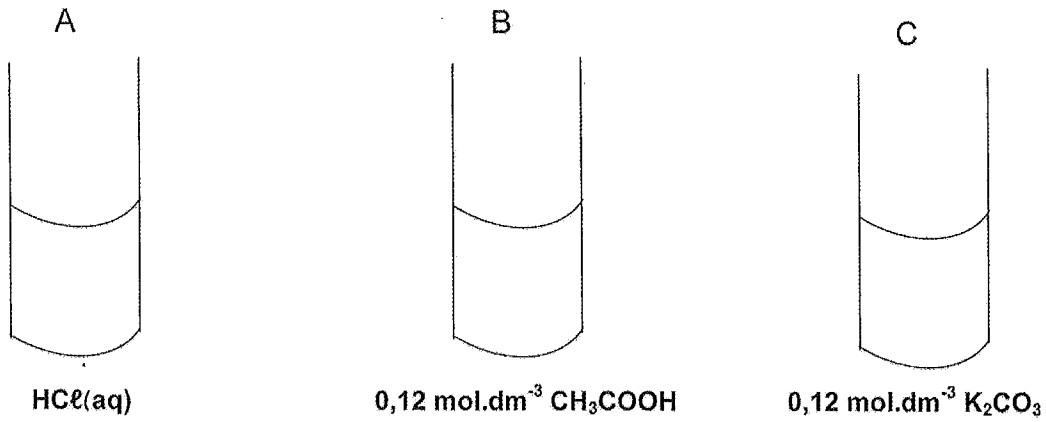
2.2.1 What purpose does sunlight serve in this reaction? (2)

2.2.2 Sketch a possible energy profile diagram for this reaction. (2)

[9]

QUESTION 3

Three test tubes, A, B and C contain three solutions: $HC\ell$ (aq), 0,12 mol.dm^{-3} CH_3COOH and 0,12 mol.dm^{-3} K_2CO_3 respectively as indicated below:



3.1 Which of these solutions:

3.1.1 Is a strong acid. (1)

3.1.2 Is an organic acid. (1)

3.1.3 Will turn red litmus paper blue. (1)

3.2 The Arrhenius Theory of acids and bases was an attempt to explain the chemistry of acids and bases.

3.2.1 Define an acid according to this theory. (2)

3.2.2 How does the Arrhenius definition of an acid differ from the Bronsted- Lowry definition of an acid? (2)

3.3 Solution A is formed when hydrogen chloride gas is added to water.

3.3.1 Write down the balanced equation for the reaction taking place here. (3)

3.3.2 Identify the conjugate base in this reaction. (1)

3.4 You are required to prepare 200 cm^3 of solution C.
Calculate the mass of solute that must be used. (4)

3.5 In a titration, 25,10 cm^3 of solution B is neutralised by an unknown volume of solution C in the presence of an indicator.
The following reaction takes place.

$$K_2CO_3\ (aq) + 2CH_3COOH\ (aq) \rightarrow 2CH_3COOK\ (aq) + H_2O\ (\ell) + CO_2\ (g)$$

3.5.1 What is an indicator? (1)

3.5.2 Calculate the volume of solution C that was neutralised. (4)

3.6 Write down balanced equations for each of the following reactions using appropriate chemical formulae.

3.6.1 Magnesium + solution A (4)

3.6.2 Calcium oxide + solution A. (4)

3.6.3 $MgO + H_2O$ (2)

3.7 You are required to prepare some sodium sulphate in the laboratory using an acid and a base.

3.7.1 Name the acid and the base that you would use. (2)

3.7.2 Write down the balanced equation for the reaction that will take place. (3)

[35]

TOTAL MARKS: [50]

DATA SHEET

FORMULAE	RELATIVE ATOMIC MASS
$n = \frac{m}{M}$	C = 12
$c = \frac{n}{V}$	H = 1
$c = \frac{m}{MV}$	O = 16
	K = 39
	Na = 23

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MEMORANDUM

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This memorandum consists of 3 pages.

QUESTION 1

1.1 A ✓✓ (2)

1.2 B ✓✓ (2)

1.3 B ✓✓ (2)

[6]

QUESTION 2

2.1.1 minimum energy needed for a reaction to take place. ✓ (1)

2.1.2 65 – 15 ✓ = 50 kJ.mol^{-1} ✓ (2)

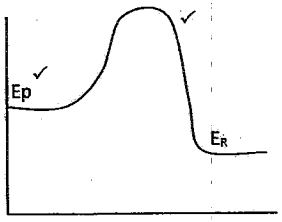
2.1.3 $\Delta H = Hp - H_R$

$= 40 - 15$ ✓

$= 25$ kJ.mol^{-1}✓ (2)

2.2.1 catalyst. ✓✓ (2)

2.2.2



1 mark = shape
1 mark = Ep below E_R

(2)

[9]

3.1.1 A ✓ (1)

3.1.2 B ✓ (1)

3.1.3 C ✓ (1)

3.2.1 Substance that produces H_3O^+ ions in aqueous solutions.✓✓ (2)

3.2.2 Arrhenius acids produces H_3O^+ in aqueous solutions. Lowry Bronsted acids produce protons (H^+). ✓✓ (2)

3.3.1 $HCl(g) + H_2O^+ \rightarrow H_3O^+ + Cl^-$

LHS ✓
RHS✓
BAL ✓

(3)

3.3.2 chloride ion / Cl^- ✓ (1)

3.4 m = C x RM x V✓

= 0,12 x 138 ✓x 0,2 ✓

= 3.312 g ✓ (4)

3.5.1 organic dye with a specific colour in acid and base.✓ (1)

3.5.2

$$\frac{n_b}{n_c} = \frac{2}{1} \quad ✓$$

$$\frac{C_bV_b}{C_cV_c} = \frac{2}{1}$$

$$\frac{25{,}10 \times 0{,}12✓}{0{,}12 \times V_c ✓} = \frac{2}{1}$$

$V_c = 12.55$ cm^3 ✓

(4)

3.6.1 Mg ✓ + 2 HCl → $MgCl_2$ ✓ + H_2 ✓ bal ✓ (4)

3.6.2 CaO ✓ + 2HCl → $CaCl_2$ ✓ + H_2O✓ bal✓ (4)

3.6.3 MgO + H_2O → $Mg(OH)_2$✓ bal ✓ (2)

3.7.1 Acid = sulphuric acid ✓ (1)

Base = sodium hydroxide✓ (1)

3.7.2 $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

LHS ✓
RHS✓
BAL ✓

(3)

[35]

TOTAL MARKS [50]