FORM TP 2013153

TEST CODE **02112020**

MAY/JUNE 2013

CARIBBEAN EXAMINATIONS COUNCIL

CARIBBEAN ADVANCED PROFICIENCY EXAMINATION®

CHEMISTRY

UNIT 1 – Paper 02

2 hours 30 minutes

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. ALL working MUST be shown.
5. You may use a silent, non-programmable calculator to answer questions.
6. A data booklet is provided.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.

SECTION A

Answer ALL questions in this section.

Write your answers in the spaces provided in this booklet.

MODULE 1

FUNDAMENTALS IN CHEMISTRY

1. (a) Defin the terms

(i) oxidation _____

_____

(ii) reduction . _____

_____

[2 marks]

(b) When an acidifie solution of potassium manganate(VII) is added to hydrogen peroxide a redox reaction occurs and the observations include effervescence and a colour change.

(i) State the colour change observed.

_____

[1 mark]

(ii) Write the TWO half equations for the reaction, indicating the changes in oxidation number.

_____

_____

_____

_____

[6 marks]

(iii) State the roles of the two reagents, potassium manganate(VII) and hydrogen peroxide.

_____

_____

[2 marks]

(c) Describe an experiment, **including observations**, that can be used to compare the oxidizing ability of the elements chlorine, bromine and iodine.

_____

_____

_____

_____

_____

_____

[4 marks]

Total 15 marks

MODULE 2

KINETICS AND EQUILIBRIA

2. (a) Defin the term 'buffer solution'.

_____

_____

_____

_____

[2 marks]

(b) Explain, using relevant equations, how a buffer solution containing ammonia and ammonium chloride reacts in the following circumstances:

(i) Contamination of the buffer with a small quantity of base

_____

_____

_____

_____

_____

[2 marks]

(ii) Contamination of the buffer with a small quantity of acid

_____

_____

_____

_____

_____

[2 marks]

(c) Calculate the pH of a buffer solution made from 20.00 cm^3 of 0.10 mol dm^{-3} propanoic acid (CH_3CH_2COOH) and 40.00 cm^3 of 0.050 mol dm^{-3} sodium propanoate (CH_3CH_2COONa).

(The acid dissociation constant, K_a, for propanoic acid is 1.22×10^{-5}.)

[5 marks]

(d) The experimental determination of the pH of the buffer solution in 2 (c) was carried out by a group of students.

(i) List TWO relevant pieces of apparatus and/or materials that may have been used to carry out the experiment.

_____

_____

_____

[2 marks]

(ii) Describe TWO relevant steps taken by the students to determine the pH of the buffer.

_____

_____

_____

_____

_____

_____

[2 marks]

Total 15 marks

MODULE 3

CHEMISTRY OF THE ELEMENTS

3. (a) (i) Outline TWO reasons why aqueous hydroxide ions, OH^- (aq), are used in the identificatio of cations.

_____

_____

_____

_____

[2 marks]

(ii) Table 1 shows an incomplete list of a number of cations with the expected results of their respective flam tests.

Complete the table.

TABLE 1: FLAME TEST RESULTS

Element	**Na^+**	**K^+**	**Ca^{2+}**	**Ba^{2+}**	**Cu^{2+}**
Colour of Flame					Green

[2 marks]

(b) M is a mixture of a soluble and an insoluble salt. Table 2 is an incomplete laboratory report of tests carried out on M.

Complete Table 2 by writing the relevant observations.

TABLE 2: LABORATORY REPORT

No.	Tests	Observations	Inferences
(i)	Add dil. HCl to M and warm.	• •	SO_2 evolved
(ii)	Shake M with water and then filte . To the colourless filtrate, add acidifie $Cr_2O_7^{2-}$ (aq).	•	SO_3^{2-} (aq) present
(iii)	Dissolve residue from (ii) in dil. HNO_3. Add a) KI (aq) and b) boil for 1 minute.	• •	Pb^{2+} present PbI_2 formed

[5 marks]

(c) (i) Write half equations to explain the observation in test (b) (ii).

_____

_____

_____

[4 marks]

(ii) Identify the salts in mixture M.

_____

_____

[2 marks]

Total 15 marks

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SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

MODULE 1

FUNDAMENTALS IN CHEMISTRY

4. Calcium oxide, quicklime, is produced by roasting limestone. Quicklime is used to neutralize the acidity of soils.

(a) Defin the term 'standard enthalpy of formation'. **[2 marks]**

(b) Write a balanced equation for formation of CaO(s). **[1 mark]**

(c) Construct a Born-Haber cycle for the formation of CaO(s) showing clearly, **using equations**, the steps of the enthalpy changes involved. **[6 marks]**

(d) Distinguish between 'exothermic enthalpy change' and 'endothermic enthalpy change', citing enthalpy changes from your Born-Haber cycle in (c) to support your answer. **[4 marks]**

(e) Explain, by writing an equation, how the data from the Born-Haber cycle can be used to calculate the lattice energy of CaO(s). **[2 marks]**

Total 15 marks

Write the answer to Question 4 here.

Write the answer to Question 4 here.

Write the answer to Question 4 here.

MODULE 2

KINETICS AND EQUILIBRIA

5. (a) With the aid of appropriate Boltzmann distribution curves, **(using the axes provided on page 12)** describe the effect of EACH of the following on reaction rates:

(i) Temperature **[4 marks]**

(ii) Catalyst **[3 marks]**

(b) The values of initial rates measured for the reaction below are recorded in Table 3.

$$S_2O_8^{2-} + 2I^- \longrightarrow 2SO_4^{2-} + I_2$$

TABLE 3: INITIAL RATES DATA

Experiment	**$[S_2O_8^{2-}]$ (mol dm^{-3})**	**$[I^-]$ (mol dm^{-3})**	**Initial Rate (mol dm^{-3} min^{-1})**
1	0.15	0.25	1.4×10^{-5}
2	0.15	0.50	5.6×10^{-5}
3	0.075	0.50	2.8×10^{-5}
4	0.075	0.25	7.0×10^{-6}

(i) Use the information from the table to deduce the rate equation and calculate the overall order of the reaction. **[5 marks]**

(ii) Calculate the

a) rate constant **[2 marks]**

b) initial rate of the reaction when $[S_2O_8^{2-}]_0 = 0.13$ mol dm^{-3} and $[I^-]_0 = 0.32$ mol dm^{-3}. **[1 mark]**

Total 15 marks

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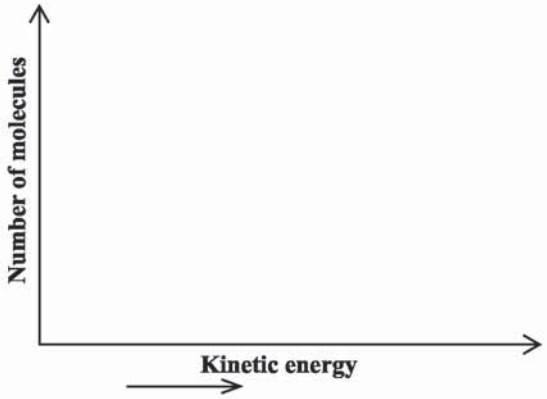
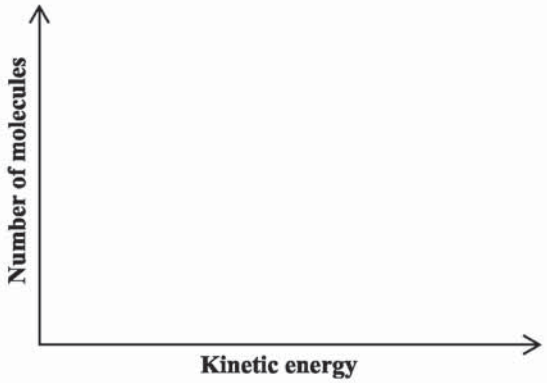
Write the answer to Question 5 here.

(a) (i) Temperature



(ii) Catalyst



Write the answer to Question 5 here.

Write the answer to Question 5 here.

MODULE 3

CHEMISTRY OF THE ELEMENTS

6. (a) The atomic radii across the firs row of transition elements show a gradual decrease.

Outline the reasons for this trend. **[2 marks]**

(b) (i) State the FULL electronic configuratio for the ions, Ti^{3+}; Fe^{2+}; Cr^{3+}. **[3 marks]**

(ii) Explain, in terms of electronic configuration why iron(II) is readily converted to iron(III). **[2 marks]**

(c) When aqueous copper ions are treated separately with aqueous ammonia and concentrated hydrochloric acid, the complex ions $[Cu(NH_3)_4(H_2O)_2]^{2+}$ and $[CuCl_4]^{2-}$ are formed.

State the name of the shape for

(i) EACH of the complex ions **[2 marks]**

(ii) a complex ion of the formula $[ML_4]^{n-}$ where M is the central metal and L represents the ligand. **[1 mark]**

(d) When titanium(III) chloride is dissolved in water, a purple solution is formed.

Explain carefully how the colour is produced. **[5 marks]**

Total 15 marks

Write the answer to Question 6 here.

GO ON TO THE NEXT PAGE

Write the answer to Question 6 here.

Write the answer to Question 6 here.

END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.