



233/1 –

CHEMISTRY
(THEORY)

– Paper 1

Nov. 2017 – 2 hours

Name Index Number

Candidate's Signature Date

Instructions to candidates

- (a) Write your name and index number in the spaces provided above.
- (b) Sign and write the date of examination in the spaces provided above.
- (c) Answer **ALL** the questions in the spaces provided in the question paper.
- (d) KNEC mathematical tables and silent non-programmable electronic calculators may be used.
- (e) All working **MUST** be clearly shown where necessary.
- (f) **This paper consists of 15 printed pages.**
- (g) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
- (h) **Candidates should answer the questions in English.**

For Examiner's Use Only

Question	Maximum Score	Candidate's Score
1 – 28	80	



1. **Table 1** shows the atomic numbers and the first ionisation energies of three elements. The letters are not actual symbols of the elements. Use it to answer the questions that follow.

Table 1

Element	Atomic number	First ionisation energy kJmol ⁻¹
A	3	519
B	11	494
C	19	418

- (a) Explain the trend in first ionisation energy from A to C. (2 marks)

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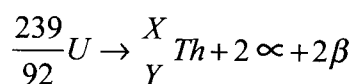
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- (b) Write the electronic configuration for the ion of C. (1 mark)

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2. Calculate the values of X and Y in the following nuclear equation. (2 marks)



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3. The diagram in **Figure 1** shows a section of a dry cell. Study it and answer the questions that follow.

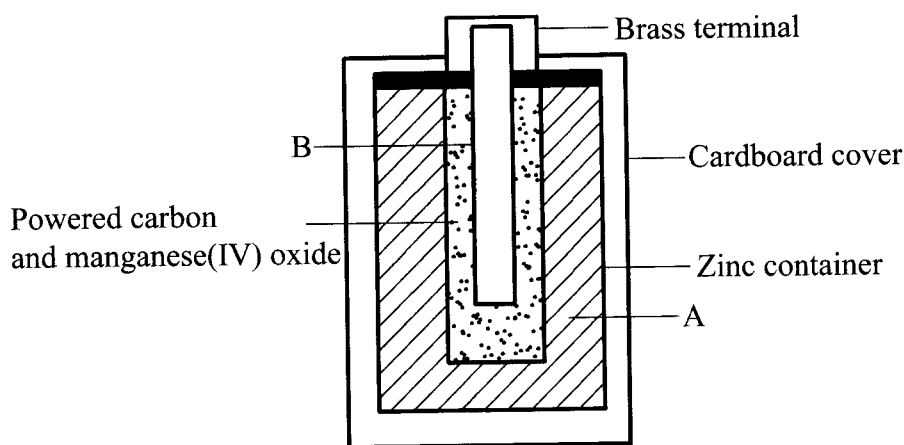


Figure 1

- (a) Name the part labelled **B**. (1 mark)
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- (b) The part labelled **A** is a paste. Give a reason why it is not used in dry form. (1 mark)
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- (c) What is the purpose of the zinc container? (1 mark)
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4. The empirical formula of lead(II) oxide was determined by passing excess dry hydrogen gas over 6.69 g of heated lead(II) oxide.

- (a) What was the purpose of using excess dry hydrogen gas? (2 marks)

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- (b) The mass of lead was found to be 6.21g. Determine the empirical formula of the oxide.
(Pb = 207.0 ; O = 16.0) (2 marks)

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5. The set-up in **Figure 2** was used to prepare a sample of ethane gas. Study it and answer the questions that follow.

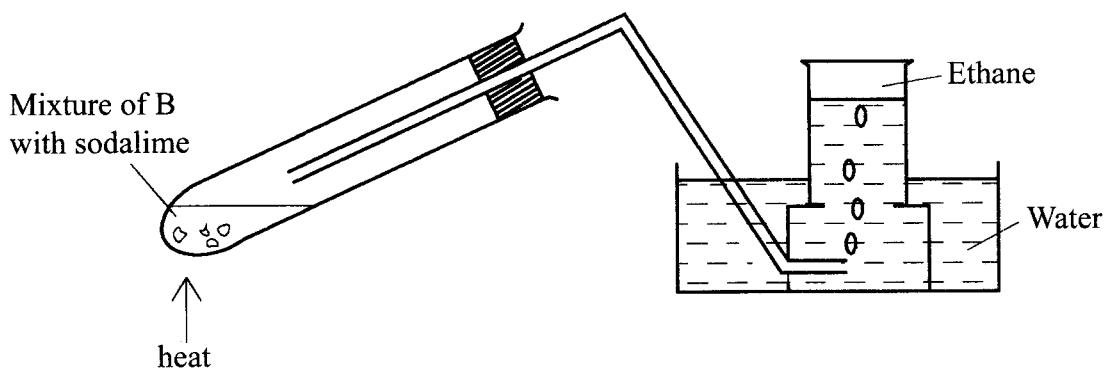


Figure 2

- (a) Name **B** (1 mark)
- (b) Write an equation for the complete combustion of ethane. (1 mark)
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-
- (c) State **one** use of ethane. (1 mark)
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6. (a) State Charles' Law. (1 mark)

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(b) Explain why the pressure of a fixed mass of a gas increases, when the volume of the gas is reduced at constant temperature. (2 marks)

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7. A sample of water is suspected to contain sulphate ions. Describe an experiment that can be carried out to determine the presence of sulphate ions. (3 marks)

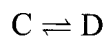
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8. (a) State **one** characteristic of a reaction where equilibrium has been attained. (1 mark)

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- (b) The following equation is in a state of equilibrium:



Use it to sketch a graphical representation of concentration against time in seconds for the equilibrium. (2 marks)

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9. Copper(II) ions react with excess aqueous ammonia to form a complex ion.

- (a) (i) Write an equation for the reaction that forms the complex ion. (1 mark)

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- (ii) Name the complex ion. (1 mark)

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- (b) Explain why CH_4 is not acidic while HCl is acidic yet both compounds contain hydrogen. (1 mark)

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10. 20 cm^3 of ethanoic acid was diluted to 400 cm^3 of solution. Calculate the concentration of the solution in moles per litre. (C = 12.0 ; H = 1.0 ; O = 16.0)
(Density of ethanoic acid = 1.05 g/cm^3) (3 marks)

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11. An oxide of element **K** has the formula K_2O_5 .
- (a) Determine the oxidation number of **K**. (1 mark)
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- (b) To which group of the periodic table does **K** belong? (1 mark)
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12. Potassium nitrate liberates oxygen gas when heated. Draw a diagram of a set-up that shows heating of potassium nitrate and collection of oxygen gas. (3 marks)
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13. Explain the observation made when chlorine gas is passed through a solution of potassium iodide. (3 marks)
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14. Using the elements chlorine, calcium and phosphorus:

(a) Select elements that will form an oxide whose aqueous solution has a pH less than 7. (1 mark)

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(b) Write an equation for the reaction between calcium oxide and dilute hydrochloric acid. (1 mark)

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(c) Give **one** use of calcium oxide. (1 mark)

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15. Starting with copper, describe how a pure sample of copper(II) carbonate can be prepared. (3 marks)

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16. In an experiment, concentrated nitric(V) acid was reacted with iron(II) sulphate. State and explain the observations made. (2 marks)

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17. The flow chart in **Figure 3** shows the process of obtaining a sample of nitrogen gas. Study it and answer the questions that follow.

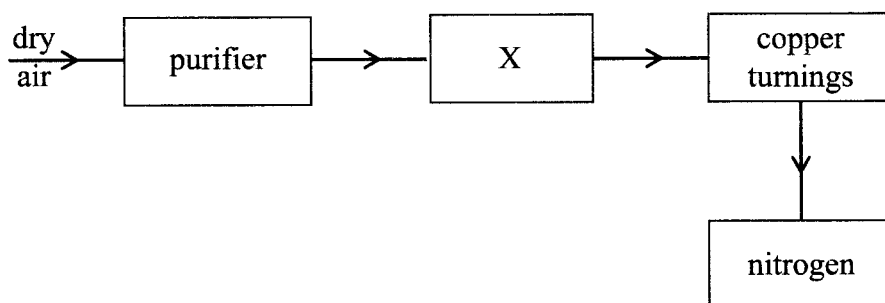


Figure 3

- (a) Identify X (1 mark)
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- (b) Write an equation for the reaction with heated copper turnings. (1 mark)
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- (c) Name an impurity in the sample of nitrogen gas. (1 mark)
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18. The set-up in **Figure 4** can be used to prepare nitrogen(II) oxide. Use it to answer the questions that follow.

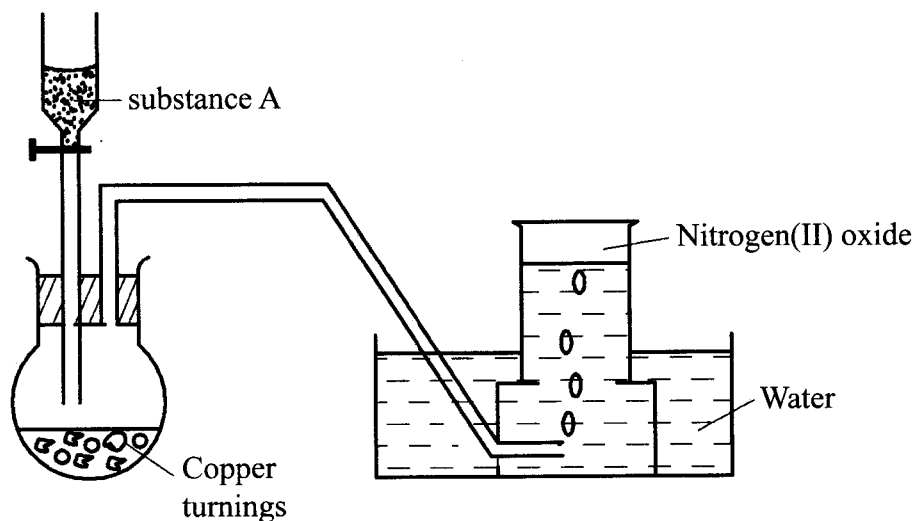


Figure 4

- (a) Name substance A. (1 mark)

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- (b) When the gas jar containing nitrogen(II) oxide is exposed to air, a brown colour is observed. Explain. (1 mark)

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- (c) Write an equation for the reaction which occurred in the flask. (1 mark)

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19. The following procedure was used to investigate the temperature changes that occur when sodium hydroxide solution is added to dilute hydrochloric acid.

- (i) Place the acid in a glass beaker and record its temperature.
- (ii) Add a known volume of sodium hydroxide solution.
- (iii) Stir the mixture and record the highest temperature reached.
- (iv) Repeat steps (ii) and (iii) with different volumes of sodium hydroxide solution.

- (a) State **two** factors that must be kept constant in this experiment (1 mark)

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- (b) Explain how the use of a polystyrene cup will affect the results. (1 mark)

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20. Study the flow chart in **Figure 5** and answer the questions that follow.

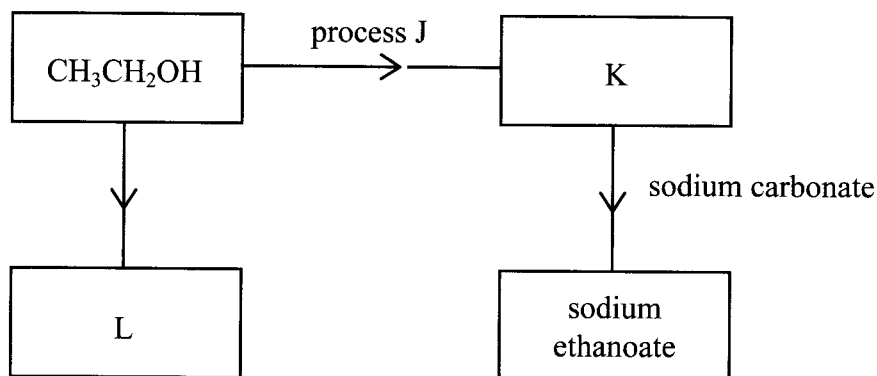


Figure 5

- (a) Identify substances **K** and **L**.

K: (1 mark)

L: (1 mark)

- (b) Name **one** reagent that can be used to carry out process **J**. (1 mark)

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21. The atomic numbers of some elements **P**, **Q**, **R** and **S** are 6, 8, 12 and 17 respectively.

- (a) Draw the dot (•) and cross (X) diagrams for the compounds formed when:

- (i) **R** and **Q** react (1 mark)

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(ii) **P** and **S** react. (1 mark)

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(b) Explain why the melting point of the compound formed by **P** and **S** is lower than that formed by **R** and **Q**. (1 mark)

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22. (a) What is an inert electrode? (1 mark)

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(b) State the products formed when brine is electrolysed using inert electrodes.

Anode: (1 mark)

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Cathode: (1 mark)

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23. Explain how a student can establish whether a liquid sample extracted from a plant is pure. (2 marks)

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24. **Figure 6** shows part of the periodic table. The letters are not the actual symbols of the elements. Study it and answer the questions that follow.

H					K		
			L				
M				N		P	

Figure 6

- (a) Write an equation for the reaction between **M** and **K**. (1 mark)
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- (b) Select the element which can form an ion with a charge of +3. (1 mark)
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- (c) An element **J** has atomic number 15. Indicate with a tick (✓), on the part of the periodic table the position of **J**. (1 mark)
25. In terms of structure and bonding, explain why graphite is used as a lubricant in machines. (3 marks)

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26. (a) What is meant by the term bleaching? (1 mark)

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(b) Write the formula of the bleaching agent formed when chlorine gas reacts with aqueous sodium hydroxide. (1 mark)

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(c) State the role of chlorine in water treatment. (1 mark)

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27. (a) Name **two** ores in which sodium occurs. (1 mark)

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(b) During extraction of sodium using the down's process, calcium chloride is added to the ore. Give a reason for the addition of calcium chloride. (1 mark)

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(c) State **two** uses of sodium. (1 mark)

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28. When an aqueous solution of compound X was mixed with a few drops of bromine water, the colour of the mixture remained yellow. When another portion of solution X was reacted with acidified potassium dichromate(VI), the colour of the mixture changed from orange to green.

(a) What conclusion can be made from the use of:

(i) bromine water? (1 mark)

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(ii) acidified potassium dichromate(VI)? (1 mark)

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(b) Solution X was reacted with a piece of a metal and a colourless gas was produced. Describe a simple experiment to identify the gas. (1 mark)

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