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THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/1 — **CHEMISTRY** — **Paper 1**

(THEORY)

Nov. 2019 – 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 16 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

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

17	18	19	20	21	22	23	24	25	26	27	28	29	Grand Total	

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1. An atom of element A has mass number 39 and 19 protons.

(a) Write the electron arrangement of the atom. (1 mark)

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(b) State the period and group to which element A belongs.

Group ..... (½ mark)

Period ..... (½ mark)

(c) State whether the element is a metal or a non-metal. (1 mark)

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2. Describe how an increase in concentration increases the rate of a reaction. (2 marks)

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3. The flow chart in **Figure 1** represents some stages in the extraction of copper metal. Study it and answer the questions that follow.

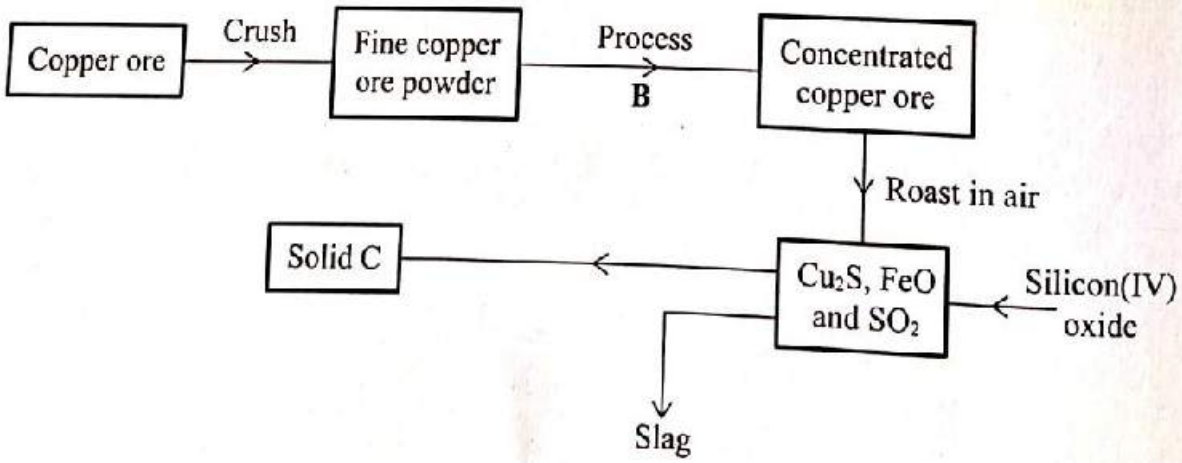

Figure 1

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(a) Identify:

(i) the copper ore ..... (1 mark)

(ii) process B ..... (½ mark)

(iii) solid C ..... (½ mark)

(b) Write an equation for the reaction that forms the slag. (1 mark)

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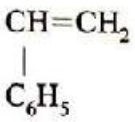
4. A monomer has the following structure.



(a) Draw the structure of its polymer that contains three monomers. (1 mark)

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(b) A sample of the polymer formed from the monomer has a molecular mass of 4992. Determine the number of monomers that formed the polymer (C=12; H=1.0).
(2 marks)

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5. Hydrogen gas can be prepared by passing steam over heated magnesium ribbon as shown in **Figure 2.**

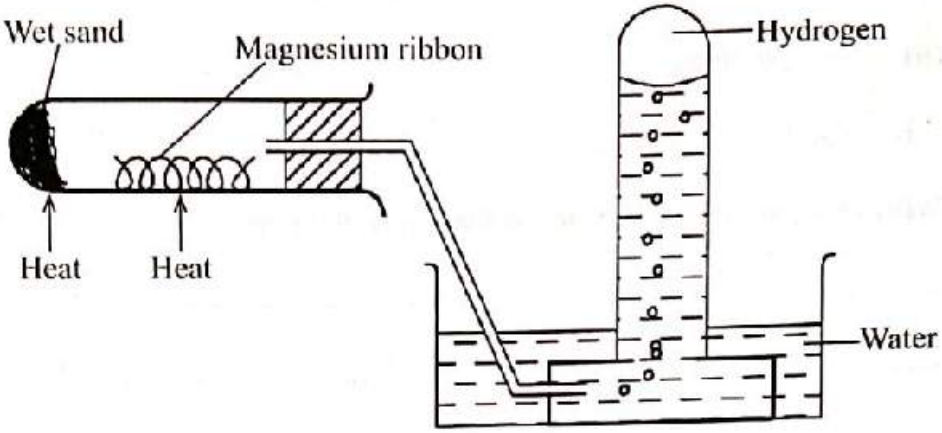

Figure 2

(a) Write an equation for the reaction that produces hydrogen gas. (1 mark)

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(b) Explain why the delivery tube must be removed from beneath the water before heating is stopped. (1 mark)

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(c) Explain why sodium metal is **not** suitable for this experiment. (1 mark)

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6. A farmer intended to plant cabbages in his farm. He first tested the pH of the soil and found it to be 3.0. If cabbages do well in alkaline soils, explain the advice that would be given to the farmer in order to realise a high yield. (2 marks)

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7. A solution contains 40.3 g of substance XOH per litre. 25.0 cm^3 of this solution required 30.0 cm^3 of 0.3 M sulphuric(VI) acid for complete neutralisation.

(a) Calculate the number of moles of XOH that reacted. (½ mark)

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(b) Determine the relative atomic mass of **X**. (1½ marks)

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8. **Table 1** shows the properties of two chlorides, **D** and **E**.

Table 1

Chlorides	Melting points (°C)	Electrical conductivity (liquid)
D	1074	Good
E	203	Poor

(a) State the type of bond present in:

(i) **D** ..... (1 mark)

(ii) **E** ..... (1 mark)

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(b) Explain in terms of structure and bonding, the difference in electrical conductivity of the chlorides **D** and **E**. (1 mark)

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9. Sulphur(IV) oxide is prepared in the laboratory using the set-up in **Figure 3**. Study it and answer the questions that follow.

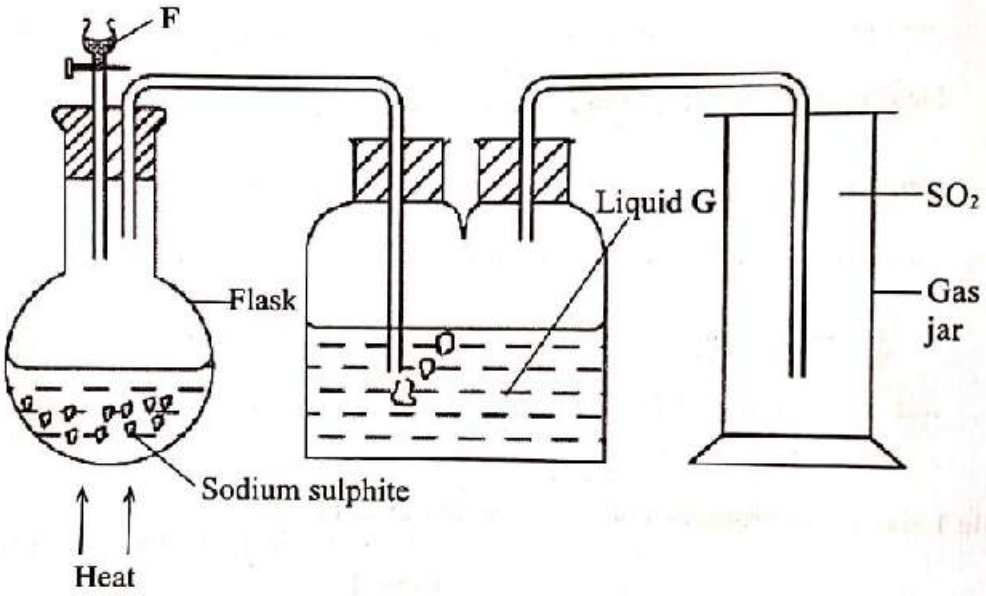

Figure 3

(a) Identify substance **F**. (1 mark)

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(b) Write an equation for the reaction that takes place in the flask. (1 mark)

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(c) State the purpose of liquid **G**. (1 mark)

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10. The graph in **Figure 4** was obtained when a certain substance was heated and its temperature recorded at regular intervals.

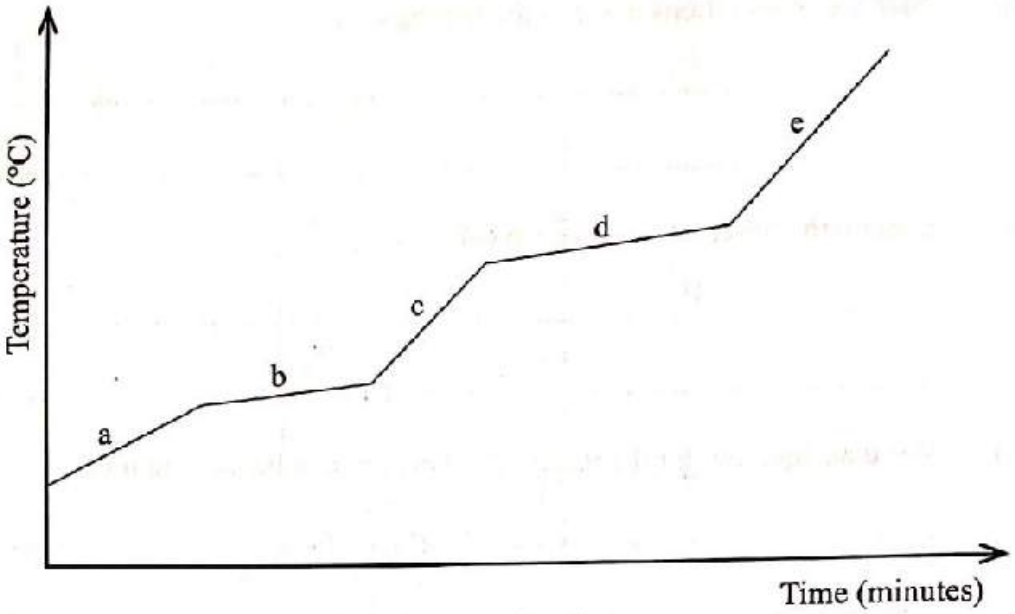

Figure 4

(a) State the purity of the substance. (1 mark)

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(b) Explain the answer in (a). (2 marks)

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11. Ethene is prepared in the laboratory by dehydration of ethanol.

(a) Name a suitable dehydrating agent used in this process. (1 mark)

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(b) State the condition necessary for the reaction to occur. (1 mark)

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(c) Write an equation for the dehydration process. (1 mark)

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12. A boiling tube filled with chlorine water was inverted in a trough containing the same solution and the set-up left in sunlight for about 2 hours.

(a) State the observations made in the boiling tube. (1 mark)

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(b) Explain the observations made in (a). (1 mark)

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(c) Write an equation for the reaction that occurred in the boiling tube. (1 mark)

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13. 5 g of calcium carbonate was strongly heated to a constant mass. Calculate the mass of the solid residue formed (Ca = 40.0; C = 12.0; O = 16.0). (2 marks)

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14. During laboratory preparation of oxygen, manganese(IV) oxide is added to reagent **H**.

(a) Name reagent **H**. (1 mark)

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(b) State the role of manganese(IV) oxide in this experiment. (1 mark)

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(c) Write the equation for the reaction that takes place. (1 mark)

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15. **Figure 5** shows an apparatus used to separate a mixture of water and hexene.

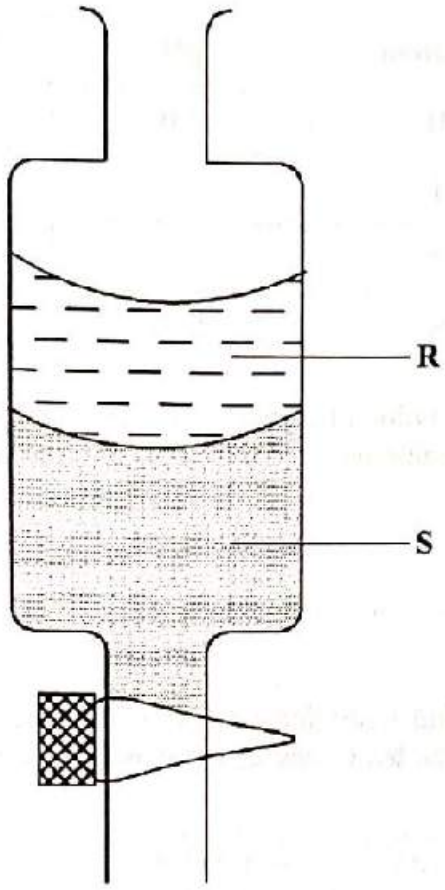

Figure 5

(a) Name the apparatus in **Figure 5**. (1 mark)

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(b) State the principle by which the mixture of the two liquids is separated. (1 mark)

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(c) Identify the liquids, **R** and **S** if the density of hexene is 0.66 g/cm^3.

(i) **R** ..... (½ mark)

(ii) **S** ..... (½ mark)

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16. (a) Complete the following table. (2 marks)

Solution	pH	Nature of solution
H	1.0	
I		Neutral
J		Weak acid
K	13.0	

(b) Explain why a solution of ammonia in methylbenzene has no effects on red litmus paper while in aqueous ammonia red litmus paper turns blue. (1 mark)

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17. The heat of solution and hydration energy of potassium chloride is $-17.2\,kJ$ and $-689\,kJ$ respectively. Calculate the lattice energy of potassium chloride. (2 marks)

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18. Use the information in **Table 2** to answer the questions that follow.

Table 2

Bond	Bond energy ($kJ\ mol^{-1}$)
C−H	412
Cl−Cl	242
C−Cl	338
H−Cl	431

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(a) State what is meant by heat of reaction. (1 mark)

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(b) Calculate the heat change when one mole of methane reacts completely with excess chlorine in the presence of UV light. (2 marks)

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19. Given that the E^{θ} of $Cu(s)/Cu^{2+}(aq)$ is + 0.34 V and that of $Zn(s)/Zn^{2+}(aq)$ is − 0.76 V, draw a labelled diagram of zinc and copper electrochemical cell. (3 marks)

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20. During laboratory preparation of carbon(IV) oxide gas, dilute hydrochloric acid was added to substance L in a conical flask.

(a) Identify substance L. (1 mark)

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(b) Write an equation that produces carbon(IV) oxide. (1 mark)

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(c) State the observations made when the gas produced was bubbled through calcium hydroxide solution for a long time. (1 mark)

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21. Study the information in **Table 3** and use it to answer the questions that follow.

Table 3

Elements	Na	Mg	Al	Si	P	S	Cl
Atomic numbers	11	12	13	14	15	16	17
Atomic radii (nm)	0.157	0.136	0.125	0.117	0.110	0.104	0.099

(a) Explain the trend in atomic radii from sodium to chlorine. (1 mark)

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(b) Explain how the chloride of aluminium differs from those of other metals in the period. (2 marks)

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22. The diagram in **Figure 6** shows radiations emitted by a radioactive sample.

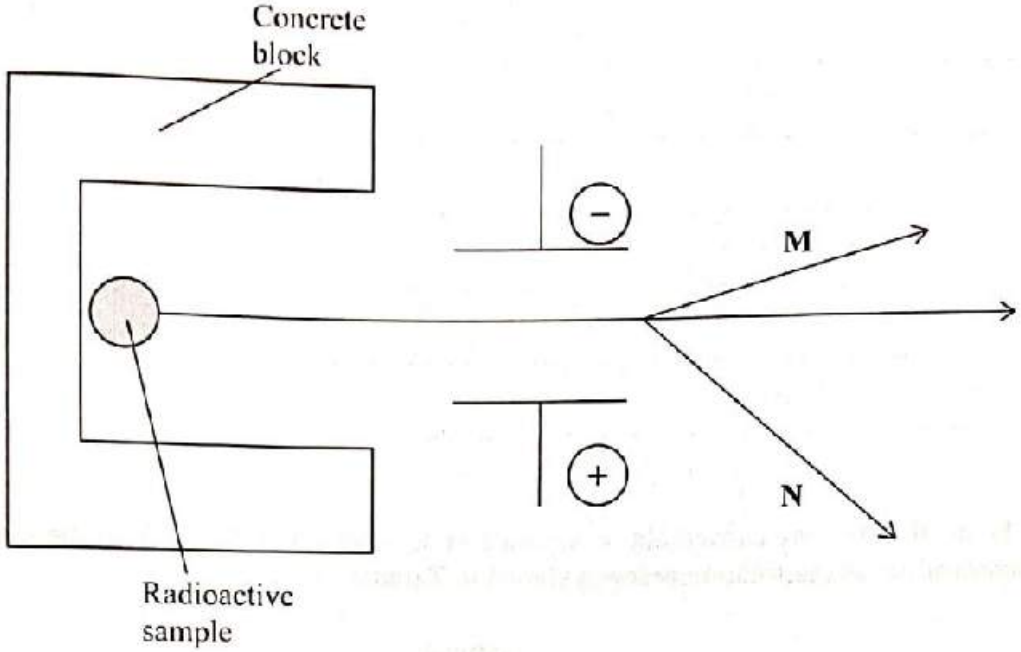

Figure 6

(a) Identify radiations:

(i) **M** ..... (1 mark)

(ii) **N** ..... (1 mark)

(b) Explain what would happen when a sheet of paper is placed in the path of the two radiations. (1 mark)

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23. ${}^{16}_{8}X$ and ${}^{18}_{8}X$ are isotopes of element **X**. They occur naturally in the ratio of 9:1 respectively. Calculate the relative atomic mass of element **X**. (2 marks)

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24. Starting with copper turnings, describe how a sample of copper(II) sulphate crystals can be prepared in the laboratory. (3 marks)

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25. Chemical tests were carried out on separate samples of water drawn from the same source. The observations made were recorded as shown in **Table 4**.

Table 4

Test	Observation
(i) Addition of aqueous calcium chloride	No white precipitate
(ii) Addition of dilute sulphuric(VI) acid	No effervescence, colourless solution
(iii) Addition of a few drops of acidified barium nitrate	No white precipitate
(iv) Addition of aqueous ammonia	White precipitate dissolves

State the inferences made in reactions:

(i) ..... (1 mark)

(ii) ..... (1 mark)

(iii) ..... (1 mark)

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26. $140\,cm^3$ of nitrogen gas diffuses through a membrane in 70 seconds. How long will it take $200\,cm^3$ of carbon(IV) oxide gas to diffuse through the same membrane under the same conditions of temperature and pressure. (3 marks)

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27. When burning magnesium ribbon is introduced into a gas jar full of nitrogen, it continues to burn producing a greenish yellow powder.

(a) Write an equation for the reaction between nitrogen and magnesium. (1 mark)

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(b) Explain why magnesium continues to burn in nitrogen but sulphur does not. (2 marks)

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(c) State **one** use of nitrogen. (1 mark)

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28. Draw in the space provided a labelled diagram of the set-up of the apparatus that can be used to electrolyse molten lead(II) bromide. (3 marks)

29. Name an appropriate apparatus that is used to prepare standard solutions in the laboratory. (1 mark)

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