2.7 Moles, Formulae and Reacting Mass Calculations: Test Pack

Total Marks

EDEXCEL 4CH1 · Calculator allowed · about 15 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Calculate the relative formula mass, Mr, of calcium carbonate, $CaCO_3$, using relative atomic masses Ar: Ca = 40, C = 12, O = 16. Show your working.

(Total for Question 1 is 2 marks)

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2 A mineral compound has a mole ratio of magnesium atoms to oxygen atoms of 1:1. State its empirical formula using the symbols Mg and O.

(Total for Question 2 is 1 mark)

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3 A sample of magnesium oxide, MgO, has a mass of 40 g. Calculate the number of moles of MgO present. Use Ar: Mg = 24, O = 16 and show your working.

(Total for Question 3 is 2 marks)

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4 A compound is analysed and found to contain 60.0% magnesium and 40.0% oxygen by mass. Determine the empirical formula of the compound. Use Ar: Mg = 24, O = 16 and show your working.

(Total for Question 4 is 2 marks)

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5 A sample of aluminium oxide contains 5.4 g of aluminium and 4.8 g of oxygen. Deduce its empirical formula. Use Ar: Al = 27 and O = 16.

(Total for Question 5 is 3 marks)

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6 10.0 g of aluminium react with 5.00 g of oxygen according to the balanced equation: $4\ Al + 3\ O_2 \rightarrow 2\ Al_2O_3$. Determine the mass of aluminium oxide, Al_2O_3, that can be produced. Use Ar: Al = 27, O = 16 and show your working. Indicate which reactant is limiting.

(Total for Question 6 is 4 marks)

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Mark scheme · 2.7 Moles, Formulae and Reacting Mass Calculations: Test Pack

Question 1

adds Ar values correctly: 40 + 12 + (3 x 16) **M1**

Mr = 100 cao **A1**

Answer: Mr($CaCO_3$) = 100

Question 2

MgO cao **B1**

Answer: MgO

Question 3

calculates Mr(MgO) = 24 + 16 = 40 **M1**

moles = mass / Mr = 40 / 40 = 1.0 mol cao **A1**

Answer: 1.0 mol

Question 4

converts percentages to moles using a convenient 100 g sample: n(Mg) = 60.0 / 24 = 2.5; n(O) = 40.0 / 16 = 2.5 **M1**

ratio Mg:O = 2.5:2.5 = 1:1 so empirical formula = MgO cao **A1**

Answer: Empirical formula MgO

Question 5

calculates amounts: Al = 5.4 / 27 = 0.20 mol and O = 4.8 / 16 = 0.30 mol **M1**

divides by the smaller amount to get Al:O = 1:1.5, then scales both by 2 to 2:3 **M1**

empirical formula Al_2O_3 cao **A1**

Answer: Empirical formula Al_2O_3

Question 6

calculates moles Al = 10.0 / 27 = 0.37037 mol and moles O_2 = 5.00 / 32 = 0.15625 mol **M1**

uses stoichiometry to find limiting reactant: for 0.37037 mol Al requires 0.37037 x (3/4) = 0.27778 mol O_2 but only 0.15625 mol O_2 is available, so O_2 is limiting **M1**

finds moles Al_2O_3 from limiting O_2: 3 mol O_2 -> 2 mol Al_2O_3 so moles Al_2O_3 = 0.15625 x (2/3) = 0.104167 mol **M1**

mass Al_2O_3 = moles x Mr = 0.104167 x (2x27 + 3x16) = 0.104167 x 102 = 10.625 g, cao (allow 10.6 g) **A1**

Answer: 10.6 g Al_2O_3 (to 3 s.f.), oxygen is limiting

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