2.7 Moles, Formulae and Reacting Mass Calculations: 30-minute Pack

Total Marks

EDEXCEL 4CH1 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 In the balanced equation $2Mg + O_2 \rightarrow 2MgO$, magnesium reacts with oxygen to form magnesium oxide. Calculate the amount of MgO formed from 0.35 mol of Mg when oxygen is in excess.

(Total for Question 1 is 1 mark)

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2 A chemist writes the formula $C_2H_4Cl_2$ for a chlorinated compound. Calculate its relative formula mass, Mr, using Ar: C = 12, H = 1 and Cl = 35.5.

(Total for Question 2 is 2 marks)

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3 A technician measures 4.90 g of sulfuric acid, H_2SO_4, for a preparation. Calculate the amount in moles. Use Ar: H = 1, S = 32 and O = 16.

(Total for Question 3 is 2 marks)

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4 Calculate the Mr of aluminium sulfate, $Al_2(SO_4)_3$. Use Ar: Al = 27, S = 32, O = 16 and show your working.

(Total for Question 4 is 2 marks)

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5 A student has 5.00 g of ethanol, C_2H_5OH, and burns it completely. Calculate the number of moles of ethanol used. Use Ar: C = 12, H = 1, O = 16 and show your working.

(Total for Question 5 is 2 marks)

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6 Calculate the relative formula mass, Mr, of potassium dichromate, $K_2Cr_2O_7$, using Ar: K = 39, Cr = 52, O = 16. Then calculate the number of moles present in a 10.0 g sample. Show your working.

(Total for Question 6 is 3 marks)

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7 A hydrocarbon sample contains 2.4 g of carbon and 0.4 g of hydrogen. Determine its empirical formula using Ar: C = 12 and H = 1.

(Total for Question 7 is 2 marks)

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8 A magnesium ribbon sample reacts completely with excess oxygen: $2Mg + O_2 \rightarrow 2MgO$. Calculate the mass of magnesium oxide formed from 12.0 g of magnesium. Use Ar: Mg = 24 and O = 16.

(Total for Question 8 is 2 marks)

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9 Calcium carbonate decomposes when heated: $CaCO_3$ -> $CaO + CO_2$. Calculate the mass of calcium oxide made from 25.0 g of pure calcium carbonate. Use Ar: Ca = 40, C = 12 and O = 16.

(Total for Question 9 is 3 marks)

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10 Methane burns completely in oxygen: $CH_4 + 2O_2$ -> $CO_2 + 2H_2O$. Calculate the mass of carbon dioxide produced by burning 16.0 g of methane in excess oxygen. Use Ar: C = 12, H = 1 and O = 16.

(Total for Question 10 is 3 marks)

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11 Hydrogen gas reacts with nitrogen to form ammonia according to the balanced equation: $N_2 + 3\ H_2$ -> $2\ NH_3$. Calculate the mass of ammonia produced when 28 g of nitrogen reacts with excess hydrogen. Use Ar: N = 14, H = 1 and show your working.

(Total for Question 11 is 3 marks)

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12 Copper(II) oxide, CuO, reacts with hydrogen gas to produce copper and water: $CuO + H_2$ -> $Cu + H_2O$. If 7.95 g of CuO are reduced and hydrogen is in excess, calculate the mass of copper produced. Use Ar: Cu = 63.5, O = 16 and show your working.

(Total for Question 12 is 3 marks)

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Mark scheme · 2.7 Moles, Formulae and Reacting Mass Calculations: 30-minute Pack

Question 1

2:2 ratio gives 0.35 mol MgO cao **B1**

Answer: 0.35 mol MgO

Question 2

substitutes atom counts and Ar values: (2 x 12) + (4 x 1) + (2 x 35.5) **M1**

Mr = 24 + 4 + 71 = 99 cao **A1**

Answer: Mr($C_2H_4Cl_2$) = 99

Question 3

calculates Mr(H_2SO_4) = (2 x 1) + 32 + (4 x 16) = 98 **M1**

amount = mass / Mr = 4.90 / 98 = 0.0500 mol cao **A1**

Answer: 0.0500 mol H_2SO_4

Question 4

calculates contribution: 2 x 27 for Al = 54; 3 x (32 + 4 x 16) for $(SO_4)_3$ = 3 x (32 + 64) = 3 x 96 = 288 **M1**

Mr = 54 + 288 = 342 cao **A1**

Answer: Mr($Al_2(SO_4)_3$) = 342

Question 5

calculates Mr(C_2H_5OH) = 2x12 + 6x1 + 16 = 24 + 6 + 16 = 46 **M1**

moles = 5.00 / 46 = 0.1087 mol, cao (allow 0.109 mol) **A1**

Answer: 0.109 mol (to 3 s.f.)

Question 6

calculates Mr = 2x39 + 2x52 + 7x16 = 78 + 104 + 112 = 294 **M1**

sets up moles = mass / Mr = 10.0 / 294 **M1**

gives moles = 0.0340 mol cao **A1**

Answer: Mr = 294; moles = 10.0 / 294 = 0.0340 mol

Question 7

calculates amounts: C = 2.4 / 12 = 0.20 mol and H = 0.4 / 1 = 0.40 mol **M1**

ratio C:H = 1:2, so empirical formula is CH_2 cao **A1**

Answer: Empirical formula CH_2

Question 8

amount Mg = 12.0 / 24 = 0.500 mol; 2:2 ratio gives 0.500 mol MgO **M1**

Mr(MgO) = 24 + 16 = 40; mass MgO = 0.500 x 40 = 20.0 g cao **A1**

Answer: 20.0 g MgO

Question 9

calculates Mr($CaCO_3$) = 40 + 12 + (3 x 16) = 100 and amount $CaCO_3$ = 25.0 / 100 = 0.250 mol **M1**

uses 1:1 equation ratio to give 0.250 mol CaO **M1**

Mr(CaO) = 40 + 16 = 56; mass = 0.250 x 56 = 14.0 g cao **A1**

Answer: 14.0 g CaO

Question 10

calculates Mr(CH_4) = 12 + (4 x 1) = 16 and amount CH_4 = 16.0 / 16 = 1.00 mol **M1**

uses 1:1 equation ratio to give 1.00 mol CO_2 **M1**

Mr(CO_2) = 12 + (2 x 16) = 44; mass = 1.00 x 44 = 44.0 g cao **A1**

Answer: 44.0 g CO_2

Question 11

calculates moles of N_2: Mr(N_2) = 28 so moles = 28 / 28 = 1.0 mol **M1**

uses mole ratio: 1 mol N_2 produces 2 mol NH_3, so moles NH_3 = 2 x 1.0 = 2.0 mol **M1**

mass NH_3 = moles x Mr(NH_3) = 2.0 x (14 + 3 x 1) = 2.0 x 17 = 34 g cao **A1**

Answer: 34 g NH_3

Question 12

calculates Mr(CuO) = 63.5 + 16 = 79.5 and moles CuO = 7.95 / 79.5 **M1**

uses mole ratio 1:1 so moles Cu = moles CuO = 7.95 / 79.5 = 0.1000 mol ecf **M1**

mass Cu = moles x Ar(Cu) = 0.1000 x 63.5 = 6.35 g cao **A1**

Answer: 6.35 g Cu

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