2.20 Moles, Formulae and Equations: Test Pack

AQA 8464 · Calculator allowed · about 35 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 This question checks three key terms and values used throughout this topic.

(a) Define the term 'mole' as used in chemistry. **(1)**

(b) State the value of the Avogadro constant, including its unit. **(1)**

(c) Define the term 'empirical formula'. **(1)**

(Total for Question 1 is 3 marks)

2 Sodium reacts with excess chlorine gas to form sodium chloride: $2Na + Cl_2 \rightarrow 2NaCl$. Relative atomic masses: Na = 23, Cl = 35.5. 4.6 g of sodium reacts completely.

(a) State the mole ratio of sodium to sodium chloride shown by the balanced equation. **(1)**

(b) Calculate the number of moles of sodium in 4.6 g of sodium. **(1)**

(c) Calculate the mass of sodium chloride, NaCl (Mr = 58.5), produced. Show your working. **(3)**

(Total for Question 2 is 5 marks)

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3 Zinc carbonate decomposes on heating: $ZnCO_3$ -> $ZnO + CO_2$. Relative formula masses: $ZnCO_3$ = 125, ZnO = 81. 25.0 g of zinc carbonate is completely decomposed.

(a) Calculate the mass of zinc oxide produced. **(3)**

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(b) Use conservation of mass, rather than a separate mole calculation, to calculate the mass of carbon dioxide released. **(2)**

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(Total for Question 3 is 5 marks)

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4 Iron reacts with chlorine gas to form iron(III) chloride: $Fe + Cl_2$ -> $FeCl_3$ (unbalanced).

(a) Balance the equation by writing the correct number in front of each formula where needed. **(2)**

(b) Use the balanced equation to calculate the number of moles of chlorine gas needed to react completely with 2.0 mol of iron. **(2)**

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(Total for Question 4 is 4 marks)

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5 At room temperature and pressure (RTP), one mole of any gas occupies 24 dm^3. Carbon dioxide has Mr = 44.

(a) Calculate the number of moles in 4.4 g of carbon dioxide. **(1)**

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(b) Calculate the volume, in dm^3, that this carbon dioxide would occupy at RTP. **(2)**

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(c) State one condition that is assumed by using the value 24 dm^3 per mole. **(1)**

(Total for Question 5 is 4 marks)

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6 Required practical: Noah carries out the empirical formula of magnesium oxide practical. His results are: mass of empty crucible + lid = 22.35 g; mass of crucible + lid + magnesium (before heating) = 22.83 g; mass of crucible + lid + magnesium oxide (after heating and cooling) = 23.19 g.

(a) Calculate the mass of magnesium used, and the mass of oxygen gained by the magnesium during the reaction. **(3)**

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(b) Noah did not lift the crucible lid periodically during heating to let more air in. Suggest the effect this would have on his calculated mass of oxygen gained, and explain why. **(2)**

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(Total for Question 6 is 5 marks)

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Mark scheme · 2.20 Moles, Formulae and Equations: Test Pack

Question 1

(a) the amount of substance that contains 6.02 x 10^{23} particles (atoms, molecules or ions) of that substance, oe **B1**

(a) Answer: The amount of substance that contains 6.02 x 10^{23} particles of that substance.

(b) 6.02 x 10^{23} per mole (mol^{-1}) cao **B1**

(b) Answer: 6.02 x 10^{23} per mole.

(c) the simplest whole-number ratio of atoms of each element present in a compound, oe **B1**

(c) Answer: The simplest whole-number ratio of atoms of each element in a compound.

Question 2

(a) 1 : 1 cao **B1**

(a) Answer: 1 : 1

(b) 0.2 mol (4.6 / 23) cao **B1**

(b) Answer: 0.2 mol

(c) uses the 1:1 mole ratio to state moles of NaCl = 0.2 mol, ecf from (b) **M1**

(c) substitutes: mass = 0.2 x 58.5 **M1**

(c) 11.7 g cao **A1**

(c) Answer: 11.7 g

Question 3

(a) calculates moles of $ZnCO_3$: 25.0 / 125 = 0.2 mol **M1**

(a) uses the 1:1 mole ratio and substitutes: mass ZnO = 0.2 x 81 **M1**

(a) 16.2 g cao **A1**

(a) Answer: 16.2 g

(b) mass of CO_2 = mass of $ZnCO_3$ - mass of ZnO = 25.0 - 16.2, ecf from (a) **M1**

(b) 8.8 g cao **A1**

(b) Answer: 8.8 g

Question 4

(a) balances at least one of the two formulae that need a coefficient ($3Cl_2$ or $2FeCl_3$), oe **M1**

(a) fully balanced: $2Fe + 3Cl_2 \rightarrow 2FeCl_3$ cao **A1**

(a) Answer: $2Fe + 3Cl_2 \rightarrow 2FeCl_3$

(b) uses the mole ratio Fe : Cl_2 = 2 : 3, ecf from (a) **M1**

(b) 3.0 mol cao (2.0 x 3/2) **A1**

(b) Answer: 3.0 mol

Question 5

(a) 0.1 mol (4.4 / 44) cao **B1**

(a) Answer: 0.1 mol

(b) substitutes: 0.1 x 24, ecf from (a) **M1**

(b) 2.4 dm^3 cao **A1**

(b) Answer: 2.4 dm^3

(c) the gas is at room temperature (about 20°C) and atmospheric pressure (1 atmosphere), oe **B1**

(c) Answer: The gas is at room temperature and atmospheric pressure.

Question 6

(a) mass of magnesium = 22.83 - 22.35 = 0.48 g **M1**

(a) mass of magnesium oxide formed = 23.19 - 22.35 = 0.84 g **M1**

(a) mass of oxygen gained = 0.84 - 0.48 = 0.36 g cao **A1**

(a) Answer: Mass of magnesium = 0.48 g; mass of oxygen gained = 0.36 g

(b) not enough air (oxygen) could enter the crucible for all of the magnesium to fully react (oxidise), oe **M1**

(b) so the mass of oxygen gained calculated would be lower than the true value (an underestimate), oe **A1**

(b) Answer: Too little air could enter the crucible for all the magnesium to fully react, so the calculated mass of oxygen gained would be an underestimate.

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