InkChemistry

QUESTION WORKBOOK

The mole, the Avogadro constant and molar mass

Amount of substance · Unit C02

AQA 3.1.2.1, 3.1.2.2 · OCR A 2.1.3; PAG 1

17 questions · 54 marks

NAVY SCREEN EDITION

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SECTION A · Short, 1 to 2 marks

A1 MAC-Q1

State what is meant by one mole of a substance, and state the value of the Avogadro constant with its unit. [2]

A2 MAC-Q11

Suggest why hydrated iron(II) sulfate cannot be analysed by heating it in an open crucible to constant mass in the same way as hydrated copper(II) sulfate. [2]

A3 MAC-Q20

Suggest why washing soda crystals, $Na_2CO_3 \cdot 10H_2O$, left in an open dish for several weeks give a value of x below 10 when analysed by heating to constant mass. [2]

SECTION B · Standard, 3 to 5 marks

B1 MAC-Q3

Calculate the total number of ions in solution when a student dissolves 8.55 g of aluminium sulfate, $Al_2(SO_4)_3$, in water and it dissociates completely into its ions. Use Al 27.0, S 32.1, O 16.0 and $L = 6.022 \times 10^{23}$ mol^{-1}. [4]

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B2 MAC-Q10 Calculate the value of x in hydrated sodium carbonate, $Na_2CO_3 \cdot xH_2O$, given that 2.86 g of the crystals leaves 1.06 g of anhydrous Na_2CO_3 after heating to constant mass. Use Na 23.0, C 12.0, O 16.0, H 1.0. [4]

B3 MAC-Q13 Evaluate this conclusion. A student heats 0.50 g of $CuSO_4 \cdot xH_2O$ once for two minutes, weighs it once on a two-decimal-place balance, calculates x = 4.2, and concludes that the formula is $CuSO_4 \cdot 4H_2O$. [4]

B4 MAC-Q2 Calculate the mass of washing soda, $Na_2CO_3 \cdot 10H_2O$, that a student must weigh out to obtain 0.0150 mol of sodium carbonate, and the mass of water that this washing soda contains. Use Na 23.0, C 12.0, O 16.0, H 1.0. [3]

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B5 MAC-Q4 Calculate the total number of atoms in 4.40 g of carbon dioxide. L = 6.022×10^{23} mol^{-1}. [3]

B6 MAC-Q6 Calculate the mass of magnesium oxide formed when 1.20 g of magnesium burns completely: $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$. Use Mg 24.3, O 16.0. [3]

B7 MAC-Q7 Compare the relative molecular mass of water, H_2O, with its molar mass, and say why the relative mass of sodium chloride is called a relative formula mass instead. [3]

B8 MAC-Q8 Explain why a hydrated salt is heated to constant mass, rather than heated once for a fixed time, when finding its water of crystallisation. [3]

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B9 MAC-Q9 Explain why one mole of water and one mole of carbon dioxide contain the same number of molecules but have different masses. [3]

B10 MAC-Q12 Suggest why some of the white solid turns black when a student heats hydrated copper(II) sulfate very strongly, and the effect this has on the value of x the student calculates. [3]

B11 MAC-Q16 Calculate the number of chloride ions in 2.22 g of calcium chloride, $CaCl_2$. Use Ca 40.1, Cl 35.5 and L = 6.022×10^{23} mol^{-1}. [3]

B12 MAC-Q18 Calculate the value of x in hydrated zinc sulfate, $ZnSO_4 \cdot xH_2O$, given that the crystals are 43.8% water by mass. M($ZnSO_4$) = 161.5 g mol^{-1}; H_2O = 18.0 g mol^{-1}. [3]

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B13 MAC-Q19 Explain why a car that burns 1.00 kg of octane, C_8H_{18}, gives off about three kilograms of carbon dioxide: $2C_8H_{18}(l) + 25O_2(g) \rightarrow 16CO_2(g) + 18H_2O(l)$. [3]

SECTION C · Long, 6 marks or more

C1 MAC-Q15 Describe how a student could determine the value of x in a hydrated metal sulfate, $MSO_4 \cdot xH_2O$, whose anhydrous molar mass is known. Include how x is calculated and how the method shows that the result can be relied on. [6]

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