A Level AQA Chemistry

Chapter 2 – answers

Question	Answers	Extra information	Mark	AO Spec reference
01.1	$\frac{184}{1000} = 0.184$ g	Can be found in any place during the process	1	3.1.2.3 MS 0.0, 1.1, 2.2, 2.3, 2.4 AO1, AO2
	102 000 Pa and 5.3×10^{-5} m^3		1	
	$\frac{PV}{RT} = n$ OR $\frac{(102\,000 \times 5.3 \times 10^{-5})}{(8.31 \times 361)} = n$	Can be found within the equation	1	
	$= 1.80 \times 10^{-3}$ moles		1	
	$\frac{\text{mass}}{\text{moles}} = M_r = \frac{0.184}{1.80 \times 10^{-3}} = 102.105$	Accept 102.1–102.3	1	
	102 g mol^{-1}	Accept 102 only	1	
01.2	100 − 90 = 10% Hydrogen		1	3.1.2.4 MS0.2 AO2
	C H			
	$\frac{90}{12} = 7.5$ $\quad$ $\frac{10}{1} = 10$	Allow any method that determines the correct ratio of 3:4	1	
	$\frac{7.5}{7.5} = 1$ $\quad$ $\frac{10}{7.5} = 1.33$			
	3 : 4			
	C_3H_4	Must be written as a formula to score final mark	1	
01.3	M_r $C_3H_4 = 40$			3.1.2.4 AO2
	$\frac{80}{40} = 2$			
	C_6H_8	Mark for formula only	1	

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01.4	The value of n will be <u>smaller</u> This will make the true value of M_r <u>larger</u>	Accept converse. Student must explain how the measurements will impact the calculated. Accept exemplifications using actual numbers	1 1	3.1.2.2 AO3
02.1	Moles = $\frac{C \times V}{1000} = \frac{0.600 \times 62.0}{1000} = 0.0372$		1	3.1.2.5 MS0.0 AO2
02.2	Moles = $\frac{C \times V}{1000} = \frac{0.500 \times 19.6}{1000} = 0.0098$		1	3.1.2.5 MS0.0 AO2
02.3	0.0372 – 0.0098 = 0.0274	Allow e.c.f. from either **02.1** or **02.2**	1	3.1.2.5 AO2
02.4	Moles of $MgCO_3$: HCl = 1:2 $\frac{0.0274}{2}$ = moles $MgCO_3$ = 0.0137 M_r $MgCO_3$ = 24.3 + 12.0 + (3 × 16) = 84.3 g mol^{-1} Mass $MgCO_3$ = 84.3 × 0.0137 = 1.15491 g % purity = $\left(\frac{1.15491}{1.25}\right) \times 100 = 92.4\%$	 Allow e.c.f. from **2.3** Accept from 92.0% to 92.4%	 1 1 1 1	3.1.2.5 2.1.2.2 MS0.2 AO2

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03.1	100 – (36.5 + 25.5) = 38% oxygen Na: $\frac{36.5}{23} = 1.59$; $\frac{1.59}{0.79} = 2.01$ S: $\frac{25.5}{32.1} = 0.79$; $\frac{0.79}{0.79} = 1.00$ O: $\frac{38}{16} = 2.375$; $\frac{2.375}{0.79} = 3.00$ 2 : 1 : 3	Allow Na: $\frac{23.1}{23.1 + 32 + 16 \times 3}$ = 36.5% etc. as an alternative method	1 1	3.1.2.4 MS0.2 AO2
03.2	Mean mass of 1 molecule $\div \frac{1}{12^{th}}$ Carbon 12	Allow average penalise atom/element/ compound	1 1	3.1.2.1 AO1
03.3	$(2 \times 23) + 32.1 + (3 \times 16) = 126.1$ (g mol^{-1})		1	3.1.2.2 AO1
03.4	$Na_2SO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + SO_2(g) + H_2O(l)$	Equation balanced State symbols	1 1	3.1.2.5 MS0.2 AO2
03.5	$\frac{2500}{64.1} = 39.(001$ moles $SO_2)$ Ratio = 1:1 So 39 moles Na_2SO_3 Mass $Na_2SO_3 = 39 \times 126.1 = 4918$ g	First mark for M_r Second for kg $\rightarrow$g Allow any answer equivalent to 4.91 – 4.92 kg	1 1 1 1	3.1.2.5 MS0.2 AO2

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Question	Answers	Extra information	Mark	AO Spec reference
03.6	$\frac{PV}{Rn} = T$ OR $\frac{(101\,000 \times 1.5)}{(8.31 \times 39)} = T$ = 467 K	Allow e.c.f. from 03.5 Award 1 mark for any recall of correct ideal gas equation Allow 194°C but not 194	2 1	3.1.2.3 MS 2.2, 2.3, 2.4 AO1 AO2
04.1	100 – 43.8 = 56.2% $ZnSO_4$ $ZnSO_4$ H_2O $\frac{56.2}{161.5} = 0.348$ $\frac{43.8}{18} = 2.433$ $\frac{0.348}{0.348} = 1$ $\frac{2.433}{0.348} = 6.99$ X = 7	Credit 1 mark for M_r ZSO_4 (161.5)	1 2 1	
04.2	Reaction 2 is more efficient Has a higher atom economy	Allow correctly calculated atom economies	1 1	3.1.2.5 MS0.2 AO2
04.3	No hydrogen produced Hydrogen is explosive/flammable		1 1	3.1.2.5 AO3
04.4	$\frac{6.74}{81.4} = 0.083$ moles ZnO $\frac{1.2 \times 100}{1000} = 0.12$ moles HCl $0.083 \times 136.4 = 11.32$ g	1 mark for each accurate M_r	2 1 2	3.1.2.5 AO2 MS0.2

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04.5	$\frac{5.68}{65.4} = 0.087$ moles Zn Maximum mass $ZnCl_2 = 0.087 \times 136.4 = 11.85$ g % yield $= \frac{\text{actual}}{\text{max}} \times 100$ $= \frac{10.70}{11.85} \times 100 = 90.1\%$		1 1 1 1	3.1.2.5 AO2 MS0.2
04.6	Stable ion with partially filled d sub-shell Zn only forms a 2^+ ion with full d sub-shell		1 1	3.2.5.1 AO1 AO3
04.7	Sulfuric acid/ Named sulfate Zinc chloride = no visible change Barium chloride = white precipitate	'sulfate' in isolation unacceptable but allow $SO_4^{2-}(aq)$	1 1 1	3.2.2 AO1
05.1	Rinse equipment with reagent /$NaOH$ Fill burette with $NaOH$ Take a 25 cm^3 volume of ethanoic acid with a volumetric pipette into a conical flask. Add a few drops of phenolphthalein Add sodium hydroxide while stirring until the pink colour appears Repeat the process	Do not allow distilled water Allow inverse reactants Do not accept 'colour change' Credit 1 mark to reference to rinsing flask with distilled water	1 1 1 1 1 1	3.1.2.5 3.1.2.2 AO3
05.2	23.63		1	3.1.2.5 3.1.2.2 MS1.2 AO1

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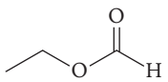
Question	Answers	Extra information	Mark	AO Spec reference
05.3	Moles $NaOH = \frac{C \times V}{1000} = \frac{0.100 \times 23.60}{1000} = 0.00236$ Moles ethanoic acid = 0.00236 Concentration $= \frac{0.00236}{0.025} = 0.0944\ mol\ dm^{-3}$	Allow e.c.f. from **05.2**	1 1 1	3.1.2.5 3.1.2.2 AO2
05.4	Random error	Do not accept human error	1	3.1.2.5 AO3
05.5	Titration 4 Because the volume is too big.		1 1	3.1.2.5 3.1.2.2 AO3
05.6	$\frac{0.3}{25} \times 100 = 1.2\%$		1	3.1.2.5 MS1.3 AO2
05.7	Carboxylic acid		1	3.3.9.1 AO1
05.8	Sodium carbonate Effervescence/fizzing/bubbles	Allow any named metal carbonate Ignore any carbon dioxide/ limewater references	1 1	3.3.9.1 AO1
05.9			1	3.3.9.1 AO1
06.1	Average mass of 1 atom relative to $\left(\frac{1}{12^{th}}\right.$ of carbon 12$\left.\right)$		1	3.1.1.2 AO1

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06.2	Same number of protons / atomic number Different numbers of neutrons / atomic mass		1 1	3.1.1.2 AO1
06.3	No difference Same electronic configuration		1 1	3.1.1.2 AO3
06.4	(Electron gun) Beam of electrons fired at gaseous sample Knocks off outer electron	Reject electrospray ionisation (as mainly used for large organic molecules)	1 1 1	3.1.1.2 AO1
06.5	$Ir(g) \rightarrow Ir^{+}(g) + e^{-}$	Allow $Ir(g) + e^{-} \rightarrow Ir^{+}(g) + 2e^{-}$	1	3.1.1.2 AO1
06.6	To accelerate To detect		1 1	3.1.1.2 AO1
06.7	$\frac{193a + 191(100 - a)}{100} = 192.2$ $2a + 19100 = 19220$ $2a = 120$ $a = 60$ $^{193}Ir = 60\%$ $^{191}Ir = 40\%$	Allow setting up as $\frac{193(100 - a) + 191a}{100} = 192.2$ which would lead to $a = 40$	1 1 1	3.1.2.4 AO2

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Question	Answers	Extra information	Mark	AO Spec reference
06.8	100 – (68.1+6.3) = 25.6% Oxygen Ir: $\frac{68.1}{191.2} = 0.356$ C: $\frac{6.3}{12} = 0.525$ O: $\frac{25.6}{16} = 1.6$ $\frac{0.356}{0.356} = 1$: $\frac{0.525}{0.356} = 1.47$: $\frac{1.6}{0.356} = 4.49$ 2 : 3 : 9 $Ir_2C_3O_9$ or $Ir_2(CO_3)_3$		1 1 1	3.1.2.4 AO2
06.9	$\frac{193}{6.022} \times 10^{23}$ $= 3.20 \times 10^{-22}$ g	Given to 3 s.f.	1	3.1.2.1 AO2
07.1	$\frac{6 \times 14}{130} \times 100 = 64.6\%$		1	3.1.2.5 AO2
07.2	101 000 Pa and 5.6×10^{-2} m^3 $\frac{PV}{RT} = n$ OR $\frac{(101\,000 \times 5.6 \times 10^{-2})}{(8.31 \times 300)} = n$ = 2.27 moles of N_2 moles $(NaN_3) = \frac{2}{3} \times 2.27 = 1.513\ldots$ Mass = $M_r \times$ moles = 65.1 × 1.51233 = 98.5 g	Can be found within the equation	1 1 1	3.1.2.3 AO2 Ms 0.0, 2.2, 2.3, 2.4

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07.3	Ans from $\frac{\textbf{07.2}}{\textbf{0.9}}$ Should be 109 g	Allow e.c.f. from **07.2**	1	3.1.2.5 AO2
08.1	$2\ CH_3NO_2(l) + \frac{3}{2}\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g) + N_2(g)$	Allow multiples e.g. $4\ CH_3NO_2 + 3\ O_2 \rightarrow 4\ CO_2 + 6\ H_2O + 2\ N_2$	1	3.1.2.5 AO1
08.2	$\frac{nRT}{P} = V$ OR $\frac{3 \times 8.31 \times 1000}{10000} = 0.2493\ m^3$	1st mark equation 2nd for 3 and 100000 3rd answer to any precision	3	3.1.2.3 AO2 Ms 0.0, 2.2, 2.3, 2.4
08.3	$\frac{(1.5 \times 8.31 \times 298)}{10000} = 0.0371\ m^3$ OR $3.71 \times 10^{-2}\ m^3$	1st mark for 1.5 moles Allow $\frac{\text{Answer } \textbf{08.2}}{2} \times \frac{298}{1000}$	2	3.1.2.3 AO2 Ms 0.0, 2.2, 2.3, 2.4
08.4	100 – 46.7 = 53.3 % N $\frac{46.7}{14} = 3.34$ NO N_2O_2	O O $\frac{53.3}{16} = 3.33$	1 1 1 1	3.1.2.4 AO2

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Skills box answers:

1. balance: $\%\ \text{error} = \frac{0.01}{5} \times 100 = 0.2\%$

   pipette: $\%\ \text{error} = \frac{0.06}{25} \times 100 = 0.24\%$

   volumetric flask: $\%\ \text{error} = \frac{0.3}{250} \times 100 = 0.12\%$

   burette: $\%\ \text{error} = \frac{2 \times 0.05}{11} \times 100 = 0.91\%$ ($\times$ 2 because two readings on a burette)

   Most accurate = volumetric flask > balance > pipette > burette
2. The titre will be less because there is less $NaOH$, so less HCl needed to neutralise it.
3. The titre will be less because there is less $NaOH$, so less HCl needed to neutralise it.
4. No effect. The number of moles of $NaOH$ in the flask does not change.