A Level OCR Chemistry

Chapter 2 – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)(i)	3 peaks At *m/z* of 158,160,162 Peak 160 twice as tall as 158 and 162, which are same heights		1 1 1	AO2 2.1.1
1(a)(ii)	Two bromine atoms in each molecule 79 + 81 twice as likely as 79 + 79 or 81 + 81	Allow diagram that demonstrates relative probability of each mass	1 1	2.1.1 AO2
1(b)(i)	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}4p^6$		1	2.2.1 AO3
1(b)(ii)	Br^{2-} would be $5s^1$ so adding an extra electron to a new shell	Do not allow adding an electron to a negative ion	1	
1(c)	1st mark curly arrow from double bond to Br δ^+ 2nd mark Br—Br bond to δ^- Br atom. 3rd mark structure of haloalkane with C^+ and Br^- 4th mark curly arrow from lone pair on Br^- to C^+ Electrophilic addition		1 1 1 1 1	4.1.3 AO1
2(a)	Average mass of 1 atom (relative to) 1/12th of carbon-12		1 1	2.1.1 AO1
2(b)	$\frac{(40 \times 96.46) + (42 \times 0.70) + (43 \times 0.30) + (44 \times 2.20) + (48 \times 0.34)}{100}$ = 40.14	Allow **1** mark for correct working	2	2.1.1 AO2
2(c)	Second ionisation energy is removing an electron from a positive ion More energy required to overcome stronger attraction	Allow no (mutual) repulsion from other s electron	1 1	3.1.1 AO3
2(d)	Calcium has higher nuclear charge But more shielding So easier to remove electron from outer shell	Allow named charges Allow named outer shells	1 1 1	3.1.1 AO3

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2(e)	$Ca(s) + 2H_2O \rightarrow Ca^{2+}(aq) + 2OH^-(aq) + H_2(g)$	**1** mark for equation **1** mark state symbols	2	2.1.2 AO3
3(a)	Use of $pV = nRT$ in any form Conversion of mg → g <u>and</u> kPa → Pa Conversation of $cm^3 \rightarrow m^3$ $n = \frac{pV}{RT} = \frac{102\times10^3 \times 53\times10^{-6}}{8.31 \times 361} = 1.802\ldots \times 10^{-3}$ $M_r = \frac{m}{n} = \frac{184\times10^{-3}}{1.802\times10^{-3}}$ $= 102\ g\ mol^{-1}$		1 1 1 1 1 1	
3(b)(i)	$C: \frac{90}{12} = 7.5\ H: \frac{10}{1} = 10$ $C:H = 1: 1.3333$ C_3H_4		1 1 1	
3(b)(ii)	$M_r(X) = 12 \times 3 + 4(\times1) = 40$ $\therefore Y = C_6H_8$		1 1	
3(c)	Measured volume of gas will be smaller So calculated M_r will be bigger.		1 1	
4(a)(i)	Different number of neutrons		1	2.1.1 AO1
4(a)(ii)	Same electron configuration		1 1	2.1.1 AO1

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4(b)	$\frac{(24 \times 80) + (25 \times a) + (26 \times (20 - a))}{100} = 24.3$ $\frac{1920 + 25a + 520 - 20a}{100} = 24.3$ $\frac{2440 - a}{100} = 24.3$ $2440 - a = 2430$ $-a = -10$ $a = 10\%$ $20 - 10 = 10\%$	Allow any method that shows 80% 10% 10%	1 1 1	2.1.1 AO2
5(a)	$100 - (36.5 + 25.5) = 38\%$ Oxygen Na: $\frac{36.5}{23} = 1.79$ S: $\frac{25.5}{32.1} = 0.79$ O: $\frac{38}{16} = 2.375$ 1.59/0.79 = 2.01 0.79/0.79 = 1.00 2.375/0.79 = 3.00 2 : 1 : 3		1 1	2.1.3 MS0.2 AO2
5(b)	Mean mass of 1 molecule ÷ 1/12th Carbon 12	Allow average	1 1	2.1.1 AO1
5(c)	$(2 \times 23) + 32.1 + (3 \times 16) = 126.1$		1	2.1.3 AO1
5(d)(i)	$Na_2SO_3(s) + 2HCl(aq) \rightarrow 2NaCl(aq) + SO_2(g) + H_2O(l)$	Equation balanced State symbols	1 1	2.1.2 MS0.2 AO2

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OXFORD Revise

Question	Answers	Extra information	Mark	AO Spec reference
5(d)(ii)	2500 / 64.1 = 39.(001) moles SO_2 Ratio = 1:1 So 39 moles Na_2SO_3 Mass Na_2SO_3 = 39 × 126.1 = 4918 g	First mark for M_r Second for kg → g Allow any answer equivalent to 4.91-4.92 kg	1 1 1 1	2.1.3 MS0.2 AO2
5(d)(iii)	$\frac{PV}{Rn} = T$ OR $\frac{(101\,000 \times 1.5)}{(8.31 \times 39)}$ = 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, mark for unit	2 1	2.1.3 MS 2.2,2.3,2.4 AO1 AO2
6(a)	100 – 43.8 = 56.2% $ZnSO_4$ $ZnSO_4$ $\frac{56.2}{161.5} = 0.348$ H_2O $\frac{43.8}{18} = 2.433$ 0.348/0.348 = 1 2.433/0.348 = 6.99 $X = 7$	Credit **1** mark for M_r ZSO_4 (161.5)	1 2 1	2.1.3
6(b)(i)	Reaction 2 is more efficient Has a higher atom economy	Allow correctly calculated atom economies If no comparison **1** mark only	1 1	2.1.3 MS0.2 AO2
6(b)(ii)	No hydrogen produced Hydrogen is explosive/flammable		1 1	2.1.2 AO3

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Question	Answers	Extra information	Mark	AO Spec reference
6(b)(iii)	$\frac{6.74}{81.4} = 0.083$ 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	2.1.3 AO2 MS0.2
6(b)(iv)	$\frac{5.68}{65.4} = 0.087$ moles Zn Maximum mass $ZnCl_2 = 0.087 \times 136.4 = 11.85$ g % yield = actual/max × 100 = 10.70 /11.85 × 100 = 90.1%	Mark 4 for e.c.f number to 3 s.f.	1 1 1 1	2.1.3 AO2 MS0.2
6(c)	Stable ion with partially filled d sub-shell Zn only forms a 2+ ion with full d sub-shell		1 1	5.3.1 AO1 AO3
6(d)	Sulfuric acid Zinc chloride = no visible change Barium chloride = white precipitate	'Sulfate' in isolation unacceptable	1 1 1	3.1.2 AO1
7(a)	$\frac{6 \times 14}{130} \times 100 = 64.6\%$		1	2.1.3 AO2
7(b)	101 000 Pa and 5.6×10^{-5} m^3 $\frac{PV}{RT} = n$ OR $\frac{(101\,000 \times 5.6 \times 10^{-5})}{(8.31 \times 300)} = n$ $= 2.27 \times 10^{-3}$ moles Mass $= M_r \times n = 65 \times 2.27 \times 10^{-3} = 0.148$ g	Can be found within the equation Accept 0.147	1 1 1	2.1.3 AO2 Ms 0.0, 2.2,2.3, 2.4

Question	Answers	Extra information	Mark	AO Spec reference
7(c)	Ans from **07(b)**/0.9 Should be 0.164 g	E.c.f. from **07(b)**	1	2.1.3 AO2
8(a)(i)	$CH_3NO_2 = 0$ $O_2 = 0.5$ / ½ $CO_2 = 2$ $H_2O = 3$ $N_2 = 1$		1	2.1.2 AO1
8(a)(ii)	$\frac{nRT}{P} = V$ OR $\frac{(6.5 \times 8.31 \times 1000)}{100000} = 0.540\ \text{m}^3$	1st mark equation and converting units 2nd for total moles of gas. Allow e.c.f. 3rd for 3 s.f. and volume unit. Allow $5.40 \times 10^5\ \text{cm}^3$	3	2.1.3 AO2 Ms 0.0, 2.2,2.3, 2.4
8(b)(i)	100 – 46.7 = 53.3 % O N: $\frac{46.7}{14} = 3.34$ O: $\frac{53.3}{16} = 3.33$ NO		1 1 1	2.1.3 AO2
8(b)(ii)	N_2O_2		1	2.1.3 AO2

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OXFORD Revise

Skills box answers:

a) They need to be in excess, but, the exact concentration is not required as the MnO_4 is the limiting reagent.
b) When the solution in the flask stays colourless. MnO_4^- is dark purple it is reduced to Mn^{2+} which is very pale pink but appears colourless at this low concentration. When there is an excess of MnO_4^- the solution in the flask stays purple.
c) Oxidation: $H_2C_2O_2 \rightarrow 2CO_2 + 2H^+ + 2e^-$
a. Reduction: $MnO_4^- + 8H^+ + +5e^- \rightarrow Mn^{2+} + 4H_2O$
b. Overall: (5 × oxidation + 2 × reduction)
$5H_2C_2O_4 + 2MnO_4^- + 6H^+ \rightarrow 10CO_2 + 2Mn^{2+} + 8H_2O$
d) % uncertainty in mass:
% uncertainty in aliquot volume:
e) mol$(KMnO_4)$ = $35.3 \times 10^{-3} \times 20 \times 10^{-3} = 7.06 \times 10^{-4}$ mol