A Level OCR Chemistry

Chapter 3 – answers

Question	Answers	Extra information	Mark	AO Spec reference
1(a)	Moles = $\frac{C \times V}{1000} = \frac{0.600 \times 62.0}{1000} = 0.0372$		1	2.1.4 MS0.0 AO2
1(b)	Moles = $\frac{C \times V}{1000} = \frac{0.500 \times 19.6}{1000} = 0.0098$		1	2.1.4 MS0.0 AO2
1(c)	0.0372 – 0.0098 = 0.0274	Allow e.c.f. from either **1(a)** or **1(b)**	1	2.1.4 AO2
1(d)	Moles of $MgCO_3$: HCl = 1:2 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 = (1.15491/1.25) × 100 = 92.4%	 E.c.f. from **1(c)** Accept from 92.0% to 92.4%	 1 1 1 1	2.1.3,2.1.4 MS0.2 AO2
2(a)	• Rinse equipment with reagent • 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 to conical flask • Add sodium hydroxide from burette while stirring until the pink colour appears • (Credit 1 mark to reference to rinsing flask with distilled water) • Repeat until concordant results	Do not allow distilled water Allow inverse reactants Do not accept 'colour change'	1 1 1 1 1 1	2.1.4 AO3
2(b)(i)	23.62		1	2.1.4 MS1.2 AO1

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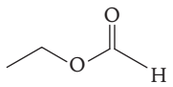
Question	Answers	Extra information	Mark	AO Spec reference
2(b)(ii)	Moles $NaOH = \frac{C \times V}{1000} = \frac{0.100 \times 23.62}{1000} = 0.00236$ Moles ethanoic acid = 0.002362 Concentration = 0.002362/0.025 = 0.0945 mol dm^{-3}	Allow e.c.f. from **2(b)(i)** and throughout	1 1 1	2.1.4 AO2
2(c)	Random error	Do not accept human error.	1	2.1.4 AO3
2(d)	Titration 4 Because the volume is too big.		1 1	2.1.4 AO3
2(e)	$\frac{0.3 \times 2}{23.75} \times 100 = 2.53\%$		1	2.1.4 MS1.3 AO2
2(f)	Carboxylic acid		1	6.1.3 AO1
2(g)			1	6.1.3 AO1
3(a)	$Cl_2(g) + 2I^-(aq) \rightarrow 2Cl^-(aq) + I_2(aq)$	**1** mark for equation **1** mark state symbols	1 1	2.1.5 2.1.3 AO1
3(b)	Oxidising agent		1	2.1.5 AO1

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Question	Answers	Extra information	Mark	AO Spec reference
3(c)	$\frac{0.1 \times 26.0}{1000}$ = 0.0026 moles thiosulfate Moles I_2 = 0.0026/2 = 0.0013 moles in 25 cm^3 0.013 moles in 250 cm^3 0.013 moles Cl_2	 Correct answer scores **4** marks	1 1 1 1	2.1.3 AO2 MS 0.2
3(d)	$V = \frac{nRT}{P}$ $V = \frac{0.013 \times 8.31 \times 298}{101\,000}$ $= 3.19 \times 10^{-4}\ (m^3)$	Recall of equation scores **1** Allow e.c.f. from **3(c)**	1 1 1	2.1.3 AO2 MS 2.2, 2.3, 2.4
3(e)	$(3.19 \times 10^{-4}/0.060) \times 100 = 0.532\%$	5.32×10^{-4} % scores **1** mark	2	2.1.3 AO2 MS 0.2
3(f)	0.013 × 71 = 0.923 g Cl_2 in 0.06 m^3 which is much higher than safety limits	Allow valid calculation of Cl_2 concentration in mg m^{-3} = 15 383 mg m^{-3}	1 1	2.1.3 AO3
4(a)(i)	$Cu + 4HNO_3 \rightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$		1	2.1.2 MS 0.2
4(a)(ii)	HNO_3 (+) 5 NO_2 (+) 4		1 1	2.1.5 AO1
4(a)(iii)	$HNO_3 + H^+ + e^- \rightarrow NO_2 + H_2O$ or $NO_3^- + 2H^+ + e^- \rightarrow NO_2 + H_2O$		1	3.2.3 AO3

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Question	Answers	Extra information	Mark	AO Spec reference
4(b)(i)	The forwards and reverse reactions have the same **rate** The **concentrations** remain constant		1 1	3.2.3 AO1
4(b)(ii)	The (forward) reaction / to the right is endothermic or takes in / absorbs heat The equilibrium shifts / moves left to right to oppose the increase in temperature	Allow converse	1 1	3.2.3 AO3
4(b)(iii)	Amount of NO_2 decreases Equilibrium shifts to the left to reduce the pressure		1 1 1	3.2.3 AO3
4(c)	Moles at equilibrium $NO_2 = 3.0$ Mole fractions $NO_2 = 3 / 4 = 0.75$. $N_2O_4 = 1 / 4 = 0.25$ Partial pressure $NO_2 = 0.75 \times 200 = 150$ kPa Partial pressure of $N_2O_4 = 0.25 \times 200 = 50$ kPa $K_p = \frac{p(NO_2)^2}{p(N_2O_4)} = \frac{150^2}{50} = 450$ kPa	Allow e.c.f. Correct workings scores both marks for K_p equation	1 1 1 1 1 1	5.1.2 AO2 MS 2.2 2.3
5(a)	(+)5/ V/ five		1	2.1.5 AO1
5(b)	Reducing agent		1	2.1.5 AO1

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Question	Answers	Extra information	Mark	AO Spec reference
5(c)	Enthalpy/Energy change when 1 mole of substance is formed from its elements, under standard conditions		1 1 1	3.2.1 AO1
5(d)	$\Delta H = \Sigma\Delta_f H$ **(products)** $-$ $\Sigma\Delta_f H$ **(reactants)** = 5(−635) − (−1560) = − 3175 + 1560 = −1615 (kJ mol^{-1})	Or correct Cycle. Can be shown in calculation	1 1 1	3.2.1 AO”
5(e)	$VCl_2 + H_2 \rightarrow V + 2HCl$		1	2.1.2 AO1
5(f)	HCl is a gas so will escape into the atmosphere	Allow removed/lost/separated	1	2.1.2 AO3
6(a)	Propanol + sulfuric acid in (round bottom) flask Anti-bumping granules Reflux condenser attached Heat gently Add potassium dichromate dropwise	Allow heart shaped/ quick fit Allow gently/slowly etc.	1 1 1 1 1	4.2.1 AO1
6(b)	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	Allow multiples	1	2.1.5 AO1
6(c)	Orange to green colour change	Allow it would turn green	1	4.2.1 AO1

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<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td>6(d)</td><td>
<table>
<tr><td colspan="2">Marks awarded for this answer will be determined by the quality of written communication as well as the standard of the scientific response. Examiners should apply a ‘best-fit’ approach to the marking.

Additional tests limits to lower mark within a level. This would include, for example, adding silver nitrate to the already identified propanoic acid.</td></tr>
<tr><td>Level 3
5–6 marks</td><td>All stages are covered and each stage is generally correct and virtually complete.

Answer is communicated coherently and shows a logical progression from Stage 1 to Stages 2 and 3 to identify all three compounds in a logical sequence with results and equations for all compounds stated.

Covers 2 tests with matching observations, conclusions and equations</td></tr>
</table>
</td><td>Virtually complete mean ⅔ criteria met</td><td>6</td><td>6.1.2
6.3.1
3.1.4
AO3</td></tr>
</table>

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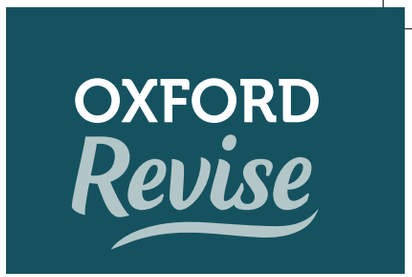
Chapter 3 – answers



<table>
<tr><th>Question</th><th>Answers</th><th>Extra information</th><th>Mark</th><th>AO
Spec reference</th></tr>
<tr><td></td><td>
<table>
<tr><td>Level 2
3–4 marks</td><td>All stages are covered but stage(s) may be incomplete or may contain inaccuracies

OR two stages are covered and are generally correct and virtually complete.

Answer is communicated mainly coherently and shows a logical progression from Stage 1 to Stages 2 and 3.

Covers 2 compounds
Isolated tests on named compounds – max LEVEL 2</td></tr>
<tr><td>Level 1
1–2 marks</td><td>Two stages are covered but stage(s) may be incomplete or may contain inaccuracies OR only one stage is covered but is generally correct and virtually complete.

Answer includes isolated statements but these are not presented in a logical order.</td></tr>
</table>
</td><td>Indicative Chemistry Content
identification of Acid
1a) Add named carbonate
1b) effervescence/bubbles/ fizzing
Identification of aldehyde
2a) Add tollens reagent/ Fehlings A+B
2b) warm/ water bath
2c) silver mirror/brick red precipitate
Identification of alcohol (after aldehyde identified)
3a) add acidified potassium dichromate
3b) heat
3c) orange to green colour change</td><td></td><td></td></tr>
</table>

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Question	Answers	Extra information	Mark	AO Spec reference
7(a)(i)	+ 7/VII/seven		1	2.1.5 AO1
7(a)(ii)	$16H^+ + 2MnO_4^- + 10Cl^- \rightarrow 2Mn^{2+} + 8H_2O + 5Cl_2$	allow multiples **1** mark for reversing chlorine half equation	2	2.1.5 AO1
7(b)(i)	$Cl_2 + 2Br^- \rightarrow 2Cl^- + Br_2$		1	2.1.2 AO1
7(b)(ii)	Chlorine		1	2.1.5 AO1
7(b)(iii)	Gains electrons/removes electrons	Allow specific references to this example to illustrate and half equation	1	2.1.5 AO1
7(c)	Bromine had more electrons So stronger van der Waals forces More energy needed to overcome the forces	 Ignore break bonds unless specifically van der Waals bonds	1 1 1	2.2.2 AO1
8(a)(i)	$Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$		1	2.1.5 AO1
8(a)(ii)	$6e^- + 14H^+(aq) + Cr_2O_7^{2-}(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$		1	2.1.5 AO1
8(a)(iii)	$6Fe^{2+}(aq) + 14H^+(aq) + Cr_2O_7^{2-}(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l) + 6Fe^{3+}(aq)$		1	2.1.5 AO1

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Question	Answers	Extra information	Mark	AO Spec reference
8(b)	Moles of $Cr_2O_7^{2-}$ per titration = 21.0 × 0.0160 / 1000 = $\underline{3.36\times10^{-4}}$ Moles of Fe^{2+} = 6 × 3.36×10^{-4} = 2.016×10^{-3} Original moles in 250 cm^3 = 2.016×10^{-3} × 10 = 2.016×10^{-2} Mass of $FeSO_4.7H_2O$ = 2.016×10^{-2} × 277.9 = 5.60 (g)		1 1 1 1	2.1.5 AO2
8(c)	(5.60/5.78) × 100 = 96.9%	Allow e.c.f.	1	2.1.3 AO2

Skills box answers:

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

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

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

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

Most accurate = volumetric flask > balance > pipette > burette

b) (i) The titre will be less because there is less $NaOH$, so less HCl needed to neutralise it

(ii) No effect. The number of moles of $NaOH$ in the flask does not change OR the water is not added to the pipette