

Multiple Choice Answers

Q1: B
Q7: D
Q9: B
Q11: C
Q12: A
Q15: A
Q16: C
Q19: D
Q40: D

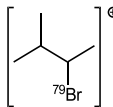
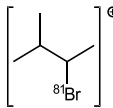
Multiple Choice Answers

Q38: D

Multiple Choice Answers

Q3: B
Q5: A

1(a)(i)	24 protons 28 neutrons 24 electrons
1(a)(ii)	(⁵⁴ Cr has two) more neutrons (than ⁵² Cr)
1(a)(iii)	(relative) abundance (of each isotope)
1(a)(iv)	The fourth isotope has any value of RIM less than 51.996
1(b)(i)	1s ² 2s ² 2p ⁶ 3s ² 3p ⁶ (3d ⁵ 4s ¹)
1(b)(ii)	6
1(c)(i)	Cr / Cr ₂ O ₇ ²⁻ AND it gains electrons
1(c)(ii)	(+) ₄
1(c)(iii)	<i>Due to an issue with question 1(c)(iii), the question has been removed from the question paper.</i>
1(c)(iv)	M1 CO ₂ has only instantaneous / temporary dipole–induced dipole forces AND methanal has permanent dipole–permanent dipole (and id-id) forces M2 IMF's in methanal are stronger than IMF's in CO ₂
1(d)(i)	rate of forward and backward (reaction) are the same / equal OR concentrations of reactants and products are constant
1(d)(ii)	closed system
1(d)(iii)	M1 (mixture becomes more) orange M2 forward reaction is endothermic M3 (mixture becomes more) orange M4 equilibrium moves (forwards/right) to compensate for extra acid / H ⁺
1(e)	M1 hydrolysis M2 CrF ₄ + 2H ₂ O → CrO ₂ + 4HF

2(a)	M1 Al ₂ O ₃ is ionic M2 P ₄ O ₁₀ is a (simple) molecule M3 ionic bonds are stronger than intermolecular forces								
2(b)(i)	mol ⁻² dm ⁶								
2(b)(ii)	M1 at equilibrium: moles of CO = 0.120 AND moles of H ₂ = 0.240 M2 [CH ₃ OH] = 0.056 AND [CO] = 0.024 AND [H ₂] = 0.048 M3 use of K _c with correct evaluation = 1.01 × 10 ³								
2(b)(iii)	no effect AND K _c is not affected by pressure								
2(c)(i)	increases rate by providing a different mechanism with a lower activation energy								
2(c)(ii)	2CH ₃ OH → CH ₃ OCH ₃ + H ₂ O								
2(c)(iii)	P ₄ O ₁₀ + 6H ₂ O → 4H ₃ PO ₄								
4(a)(i)	M1 (molecules with the) same molecular formula / same number of atoms of each element M2 different structural formulae/structures								
4(a)(ii)	M1  M2 restricted / lack of / no rotation about C=C								
4(a)(iii)	electrophilic addition								
4(a)(iv)	M1 CH ₃ COCH ₃ + CH ₃ COOH as products M2 (CH ₃) ₂ C = CHCH ₃ + 3[O] → CH ₃ COCH ₃ + CH ₃ COOH								
4(a)(v)	M1 (reaction proceeds via a) more stable intermediate / carbocation M2 because of greater positive inductive effect of more alkyl groups								
4(a)(vi)	M1  M2 								
4(b)(i)	KCN in ethanol (and heat)								
4(b)(ii)	(C ₂ H ₅) ₂ CHCN + 2H ₂ O + HCl → (C ₂ H ₅) ₂ CHCOOH + NH ₄ Cl								
4(b)(iii)	<table><tr><td></td><td>reaction of V with propan-2-ol</td></tr><tr><td>type of reaction</td><td>M1 condensation</td></tr><tr><td>functional group formed</td><td>M2 ester</td></tr><tr><td>molecular formula of organic product W</td><td>M3 C₉H₁₈O₂</td></tr></table>		reaction of V with propan-2-ol	type of reaction	M1 condensation	functional group formed	M2 ester	molecular formula of organic product W	M3 C ₉ H ₁₈ O ₂
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2(a)	I Six correct headings with units in results space • (Mass) crucible + lid / g • (Mass) crucible + lid + FA 4 / g • (Mass) crucible + lid + residue / contents after first heating / g • (Mass) crucible + lid + residue after second heating / g • (Mass) FA 4 (used) / g • (Mass) residue / g Display of units: / g, (g), in g, in gram(me)s or in (column) heading covering all entries II Four readings in space provided • All four weighings recorded to same decimal places (either to two or to three) • Reading after 2nd heating within + 0.02 and – 0.05 of reading after 1st heating II Correct subtractions • Correct calculations of mass FA 4 and residue AND • Mass of FA 4 is between 2.90 and 3.40 g. IV and V Accuracy Theoretical value = 1.78 Calculate and record candidate's mass ratio = mass FA 4 / mass of residue. Award IV if $1.51 \leq \text{candidate's mass ratio} \leq 2.05$ Award V if $1.60 \leq \text{candidate's mass ratio} \leq 1.96$
2(b)(i)	Correctly uses M1 Amount $\text{ZnSO}_4 = \text{mass residue} / 161.5 \text{ mol}$ AND answer given to 2 – 4 sf Correctly calculates M2 Amount $\text{H}_2\text{O} = \text{mass water lost} / 18 \text{ mol}$ AND answer given to 2–4 sf
2(b)(ii)	M1 $y = \text{moles H}_2\text{O} / \text{moles ZnSO}_4$ M2 Expression evaluated and y correctly calculated quoted as integer
2(c)	The (anhydrous ethanedioic) acid would decompose (on heating) / is flammable

2(a)	To ensure no air / other gas remains in the syringe																	
2(b)(i)	<table><tr><td>$\sqrt{\frac{1}{Mr}}$</td><td>0.707</td><td>0.500</td><td>0.222</td><td>0.158</td><td>0.109</td></tr><tr><td>Rate of effusion /cm³s⁻¹</td><td>4.63</td><td>3.27</td><td>1.45</td><td>1.26</td><td>0.71</td></tr></table>						$\sqrt{\frac{1}{Mr}}$	0.707	0.500	0.222	0.158	0.109	Rate of effusion /cm ³ s ⁻¹	4.63	3.27	1.45	1.26	0.71
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2(b)(ii)	Time (taken).																	
2(b)(iii)	size of hole																	
2(c)	M1 all 5 points plotted correctly. M2 Straight line of best fit drawn																	
2(d)	Point most anomalous to the plotted line of best fit circled. AND If point above LOBF (Measured rate of effusion is higher than the true rate predicted by LOBF.) for this point ... measured / recorded (effusion) time < true / actual time OR If point below LOBF (Measured rate of effusion is lower than the true rate predicted by LOBF.) for this point ... measured / recorded (effusion) time > true / actual time																	
2(e)	Yes AND The graph / LOBF... is a straight-line AND it goes through the origin.																	
2(f)	The results are not reliable as there is an anomalous result.																	
2(g)(i)	M1 Effusion rate = 50/31.6 = (1.58) Correct value for $\sqrt{\frac{1}{Mr}}$ read from x-axis M2 Value correctly converted to <i>M</i> .																	
2(g)(ii)	If calculated M > 16 (The average) <i>M</i> (of the other components) is greater than 16 / calculated value for g(i).																	
2(h)	(Rate of effusion) increases AND (At higher temperature) gas particles move more quickly.																	