

Answers to examination-style questions

Answers	Marks	Examiner's tips
1 a) order with respect to A = 1 order with respect to B = 2	2	
b) i) $\text{rate} = k [\text{C}][\text{D}]^2$	1	
ii) $k = \frac{1.45 \times 10^{-4}}{(2.5 \times 10^{-2})(6.65 \times 10^{-2})^2}$ Rate = $1.31 \text{ mol}^{-2} \text{ dm}^6 \text{ s}^{-1}$	3	If you place the units in the equation and cancel them out as you would with numbers, your answer will have the correct units.
2 a) i) electrophilic addition	1	
ii) $\text{CH}_3\text{-CH=CH-CH}_3$	1	The structure must show the C=C bond to which the HBr has added.
b) nucleophilic substitution	1	Three marks are for the curly arrows and one is for the structure with the N^+ .
	4	If you do not show the lone pair on the N of ammonia you will lose the mark for the curly arrow drawn from the ammonia molecule.
c) i) $\text{C}_4\text{H}_9\text{Br} \rightarrow \text{C}_4\text{H}_{11}\text{N}$ $M_r = 137$ and $M_r = 73$ $0.0730 \times 73 = 5.33$ $53.4\% = 0.534 \times 5.33 = 2.85 \text{ g}$	3	If you achieve the correct answer of 2.85g, you should be awarded full marks.
ii) Further substitution can happen.	1	Hint: you can say 'G reacts with F' or 'there is a further reaction to form secondary and tertiary amines'. 'Other products formed' does not merit a mark.
d) 4 peaks, a = doublet, b = triplet	3	
e) i)	1	

Answers to examination-style questions

Answers	Marks	Examiner's tips
F HCOOCH ₂ CH ₃	1	This can be written as HCO ₂ CH ₂ CH ₃ .
iv) G Any of the following are answers: CH ₃ CH=CHCH ₂ CH ₂ CH ₃ CH ₃ CH=CHCH(CH ₃) ₂ CH ₃ CH ₂ CH=CHCH ₂ CH ₃	1	You must show C=C in alkenes.
$ \begin{array}{c} \text{CH}_3 \quad \text{CH}_3 \\ \diagdown \quad \diagup \\ \text{C} = \text{C} \\ \diagup \quad \diagdown \\ \text{H} \quad \text{CH}_2\text{CH}_3 \end{array} $		
H	1	There must be 4 different groups around the C.
$ \begin{array}{c} \text{H} \quad \text{CH} = \text{CH}_2 \\ \diagdown \quad \diagup \\ \text{C} \\ \diagup \quad \diagdown \\ \text{H}_3\text{C} \quad \text{CH}_2\text{CH}_3 \end{array} $		
v) I	1	
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C} - \text{C} - \text{CH}_2\text{CH}_3 \\ \\ \text{OH} \end{array} $		
v) J	1	
$ \begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C} - \text{C} - \text{CH}_2\text{OH} \\ \\ \text{CH}_3 \end{array} $		
b) i)	5	Each H must be in a completely different environment.
ii)	2	
a) singlet		
b) triplet		

Answers to examination-style questions

Answers	Marks	Examiner's tips
<p>4 a) i) <i>N</i>-methylpropanamide nucleophilic addition-elimination</p>	2	
	4	Each curly arrow gives one mark (M1, M2, M3 and M4).
<p>ii)</p>	1	You could put C ₂ H ₅ so the minimum formula you could write would be (C ₂ H ₅ CO) ₂ O.
<p>iii) [CH₃CH₂CONHCH₃⁺] → CH₃CH₂CO⁺ + CH₃NH⁺</p>	3	You can put C ₄ H ₉ NO ⁺ as the first species. There is one mark for each correct species.
<p>b) nucleophilic addition</p> <p>reagent: H₂/Ni type of reaction: hydrogenation or reduction</p>	4	You could have Na/ethanol or LiAlH ₄ as the reagent in a reduction reaction.
<p>5 a) i) proton donor</p>	1	
<p>ii) completely dissociated in solution</p>	1	
<p>b) i) $7.05 \times 10^{-3} \times \frac{105}{50} = 0.141$</p>	1	
<p>ii) $-\log [H^+]$</p>	1	This is a definition that is often asked for.

Answers to examination-style questions

Answers	Marks	Examiner's tips
iii) 0.85	1	You can obtain this from your answer to i).
iv) $\text{pH} = 1$, so $[\text{H}^+] = 0.10 \text{ mol dm}^{-3}$ $\text{vol} = \frac{(7.05 \times 10^{-3})}{0.10}$ $= 7.05 \times 10^{-2} \text{ dm}^3$ or 70.5 cm^3	3	You must put the correct units. They are necessary for the correct answer.
c) i) $K_a = \frac{[\text{H}^+][\text{X}^-]}{[\text{HX}]}$	1	You cannot have $\frac{[\text{H}^+]^2}{[\text{HX}]}$
ii) $K_a = \frac{[\text{H}^+]^2}{\text{HX}}$ $[\text{H}^+] = \sqrt{6.10 \times 10^{-5} \times 0.255}$ $= 3.94 \times 10^{-3}$ $\text{pH} = 2.40$	3	If your K_a expression is wrong you can score a max of 1 in this part ii) for correct calculation of pH from your $[\text{H}^+]$. If you write $\sqrt{\quad}$ but forget to take the square root this gives $\text{pH} = 4.81$ which can get a maximum of two marks in this part ii).
d) i) $[\text{H}^+] = 1.66 \times 10^{-4}$ $K_a = \frac{[\text{H}^+][\text{NaY}]}{[\text{HY}]}$ $K_a = 7.22 \times 10^{-5}$ $\text{p}K_a = 4.14$	4	If you use the wrong method you can get no further marks in d i).
ii) effect = none or negligible or a very small decrease	1	You cannot just say 'pH goes down' – it must be a very small decrease.
Salt or Y^- reacts with extra H^+ .	1	Any one of these three answers is allowed for the first explanation mark here.
Equilibrium $\text{HY} \rightleftharpoons \text{H}^+ + \text{Y}^-$ shifts to LHS.		
H^+ is removed as equilibrium shifts to LHS.		
$[\text{H}^+]$ or ratio $\frac{[\text{HY}]}{[\text{Y}^-]}$ or ratio $\frac{[\text{Y}^-]}{[\text{HY}]}$ remains almost constant.	1	This mark can only be scored if the first explanation mark is correct.

Answers to examination-style questions

Answers	Marks	Examiner's tips
6 a) i)	1	Si(CH ₃) ₄ is allowed.
		$\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{Si}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array}$
ii)	2	Do not allow 'cheap'.
		inert /non toxic/volatile/low boiling point/single intense peak/signal upfield of others/protons/very shielded
b) 2	1	The molecule is symmetrical.
c) i)	1	
		<i>a</i> = quartet or 4 <i>b</i> = triplet or 3
ii)	1	Use Table 1 in the data section.
		3230–3550 cm ⁻¹
d) i)	1	
		butane-1,4-diol
ii)	3	The ester group and the (CH ₂) ₃ are worth one mark each. You must have both carbon chains and ester group to gain any marks.
		$\text{—O—(CH}_2\text{)}_4\text{—C(=O)—(CH}_2\text{)}_3\text{—C(=O)—}$
e) i)	1	Accept 2 × CH ₃ groups.
		6H present
ii)	1	
		ROCH ₃
iii)	1	
		CH ₃ CH ₂ —
iv)	1	
		$\begin{array}{c} \text{H} \\ \\ \text{H}_3\text{C}-\text{C}-\text{OCH}_3 \\ \\ \text{OCH}_3 \end{array}$

Answers to examination-style questions

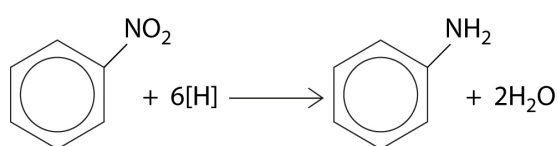
Answers	Marks	Examiner's tips
---------	-------	-----------------

7 a) see tables below. 6

a i)	You could have any of the following reagents	Na ₂ CO ₃ / NaHCO ₃	UI litmus	PCl ₅ PCl ₃ SOCl ₂	Suitable metal	K ₂ Cr ₂ O ₇ /H ⁺	KMnO ₄ /H ⁺
	P	no reaction	no reaction	no reaction	no reaction	turns green	colourless or brown
	Q	effervescence or CO ₂ or dissolves	red	fumes	effervescence or H ₂ or dissolves	no reaction stays orange	no reaction stays purple

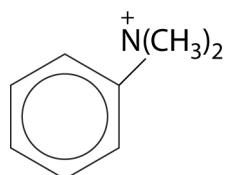
ii)	You could have any of the following reagents	H ₂ O	AgNO ₃	Na ₂ CO ₃ / NaHCO ₃ both should be aqueous	Named alcohol	Named amine or ammonia	UI litmus
	R	misty fumes	white ppt	effervescence	smell or fumes	fumes	red
	S	no reaction	no ppt	no reaction	no reaction	no reaction	no reaction

b) i) One of any of the following reducing agents 1
 Sn or Fe/HCl
 Sn or Fe/H₂SO₄
 H₂/Ni



2 You can have 3H₂ instead of 6[H].
 The organic species gives one mark and
 the balanced equation gives one mark.

nucleophilic substitution 2



You do not need to show Br⁻.