

Answers to examination-style questions

Answers	Marks	Examiner's tips
1 (a) heat energy change at constant pressure	1 1	This is in the spec but not so well known. Learn it.
(b) $\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g}) \rightarrow \text{N}_2\text{O}(\text{g})$	1	Always check balancing. Don't forget formation means to make 1 mole.
(c) (i) $\Delta H = \sum(\text{bonds broken}) - \sum(\text{bonds made})$ $= \frac{1}{2}(945) + (3/2)(159) - 3(278)$ $= -123 \text{ kJ mol}^{-1}$	1 1 1	Write the first line out so you will always get that mark even if you go wrong with the arithmetic.
(ii) the N–F bond energy is an average taken from several compounds	1	Learn this.
(d) (i) it is an element	1	Easy answer!
(ii) $\Delta H = \sum\Delta H_f(\text{products}) - \sum\Delta H_f(\text{reactants})$ (or correct cycle) $= -114 + 3(-467) - 4(-46) - 0$ $= -1331 \text{ kJ mol}^{-1}$	1 1 1 1	Write the first line out so you will always get that mark even if you go wrong with the arithmetic.
2 (a) rate of forward reaction = rate of backward reaction concentrations of reactants and products are constant	1 1	Learn both these statements
(b) increases more moles on the left-hand side of equation equilibrium moves to reduce pressure / oppose the change	1 1 1	If you get the trend wrong you lose all the marks.
(c) decreases reaction is exothermic (in the forward direction) equilibrium moves to absorb heat / lower the temperature / oppose the change	1 1 1	If you get the trend wrong you lose all the marks.
(d) (+)5 (+)5	1 1	You do not need to put the + sign in.
3 (a) (i) decreases from fluorine to iodine (ii) $\text{Cl}_2 + 2\text{KBr} \rightarrow \text{Br}_2 + 2\text{KCl}$ (iii) toxic	1 1 1	Accept ionic equations. A How Science Works answer. Think!
(b) J: NaF K: NaI L: NaBr M: Br ₂ / bromine N and Q: HBr / hydrogen bromide SO ₂ / sulfur dioxide	1 1 1 1 1 1	accept F ⁻ or correct name accept I ⁻ or correct name accept Br ⁻ or correct name In all these cases it says 'identify' so you can put a name or formula.

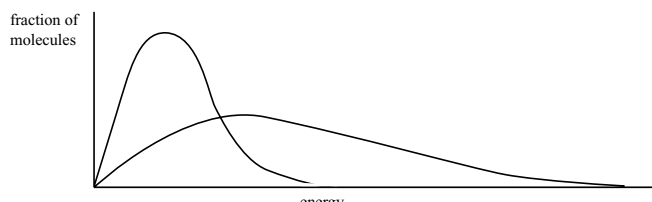
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4 (a) least soluble hydroxide = $\text{Mg}(\text{OH})_2$	1	
(b) (i) BaCl_2 / any <u>soluble</u> barium compound	1	This work on Group 2 is learning so make sure you do this.
(ii) <i>observation with NaCl</i> : no change / no reaction	1	
<i>observation with Na_2SO_4</i> : white ppt / solid	1	
$\text{Ba}^{2+} + \text{SO}_4^{2-} \rightarrow \text{BaSO}_4$	1	This ionic equation is much easier than a molecular equation.
5 (a) (i) reduction is the gain of electrons a reducing agent donates electrons	1	
(ii) C or CO	1	This is not pairs of electrons.
$\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 2\text{Fe} + 3\text{CO}$	1	
or $\text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow 2\text{Fe} + 3\text{CO}_2$		
or $2\text{Fe}_2\text{O}_3 + 3\text{C} \rightarrow 4\text{Fe} + 3\text{CO}_2$		
(iii) high temperature needed	1	You can put a temperature anywhere in the range 700°C to 2000°C .
(b) <i>any two from</i> :	2	
• might get too hot		
• solution of alkali is corrosive		
• alkaline / corrosive solution may splash etc		
so the carbon is oxidised	1	How Science Works question so think carefully about a sensible answer. You can use the equation, e.g. $\text{C} + \text{O}_2 \rightarrow \text{CO}_2$
(c) (i) $\text{TiO}_2 + 2\text{C} + 2\text{Cl}_2 \rightarrow \text{TiCl}_4 + 2\text{CO}$	1	
or $\text{TiO}_2 + \text{C} + 2\text{Cl}_2 \rightarrow \text{TiCl}_4 + \text{CO}_2$		
$\text{TiCl}_4 + 4\text{Na} \rightarrow \text{Ti} + 4\text{NaCl}$	1	Learn these two equations well.
or $\text{TiCl}_4 + 2\text{Mg} \rightarrow \text{Ti} + 2\text{MgCl}_2$		
(ii) argon	1	You cannot put inert gas because that could be nitrogen and Ti reacts with nitrogen.
prevent Ti reacting with oxygen, nitrogen, air	1	
or prevent Na / Mg reacting with oxygen, nitrogen, water, air		
or prevent TiCl_4 hydrolysing / reacting with water		
(d) <i>any two from</i> :	2	
• Mg / Na / Cl_2 have to be made first (by electrolysis)		
• batch process		
• argon atmosphere needed		
• high temperatures needed in both stages		This often comes up so learn them.

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6 (a) (i) <u>fermentation</u>	1	This is the only allowed answer.
(ii) $C_6H_{12}O_6 \rightarrow 2CH_3CH_2OH + 2CO_2$ or $C_6H_{12}O_6 \rightarrow 2C_2H_5OH + 2CO_2$	1	C_2H_6O will be penalised.
(b) elimination	1	You must learn the types of reactions in the organic chemistry.
(c)	4	You will lose a mark if HBr used or wrong alkene used. You will lose a mark if polarity on Br-Br is incorrect or + and - full charges used. You will lose a mark if partial charges are placed on the double bond.
(d) (i) <u>nucleophilic substitution</u>	1	You must have both words.
(ii)	1	
(e) CH_3CH_2OH has an OH alcohol peak at 3230 to 3550 cm^{-1}	1	
ethene has a C=C peak at 1620 to 1750 cm^{-1}	1	You can quote a value in the range given.
7 (a) <i>Isomer 1</i> : but-1-ene	1	
<i>Isomer 2</i> : 2-methylpropene	1	Number the C chain first then add the substituent groups.
(b) (i) compounds with the same structural formula but different arrangements of atoms / bonds / groups in space	1	
(ii) isomer 3 and isomer 4	1	
(c) electrophilic addition	1	
curly arrow from C=C bond towards side of H atom on H-OSO ₂ OH or H-OSO ₃ H	1	
curly arrow from H-O bond towards side of O atom on H-OSO ₂ OH	1	
correct structure of the carbocation	1	
curly arrow from lone pair on an individual oxygen atom of hydrogen sulfate ion towards C atom bearing the positive charge	1	Make sure your curly arrows start and finish at the right place.

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sulfuric acid is corrosive so wash spills up / wash hands after contact	1	
(d) (i) $\begin{array}{cccc} \text{CH}_3\text{CH}_2 & \text{H} & \text{CH}_3\text{CH}_2 & \text{H} \\ & & & \\ -\text{C} & - & \text{C} & - \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$	1	
addition polymerisation	1	This is the only type of polymerisation in Unit 2!
(ii) addition polymers are saturated and do not easily react and so do not break down	1	
8 (a)		
		
y-axis labelled 'number / fraction / % of molecules'	1	Both axes must be correctly labelled to get the mark.
x-axis labelled 'energy'	1	
curve starts at origin	1	
curve skewed to the left and has a decreasing gradient to a maximum	1	
curve after maximum decreases in steepness, never touches x-axis, levels out at <10% of the maximum height	1	
W is displaced to the right and is flatter / lower	1	
(b) the <u>change in concentration</u> per unit of time	1	Both axes must be labelled to gain marks for graph.
y-axis labelled 'conc. NO ₂ ' and x-axis 'time'	1	
curve starts at origin and levels off	1	If graph does not level off then second mark can be scored for a curve with a continuously decreasing gradient.
initial rate can be found by finding the gradient at t = 0	1	Initial means at t = 0
(c) 2SO ₂ + O ₂ → 2SO ₃	1	Accept multiples or halves of this equation.
NO is a catalyst	1	
it is regenerated at the end of the reaction	1	
provides an alternative route of lower activation energy	1	
	1	

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(d) any precautions to avoid releasing toxic gases into the environment	1	
9 (a) (free) radical	1	You must mention radical.
uv light <i>or</i> ultraviolet light	1	
initiation	1	
propagation	1	
termination	1	
$C_4H_{10} + 10Cl_2 \rightarrow C_4Cl_{10} + 10HCl$	1	Don't forget that HCl is formed.
(b) a nucleophile is an <u>electron pair donor</u>	1	You could say it is a molecule that <u>uses a pair of electrons</u> to <u>form a covalent or co-ordinate bond</u> <i>or</i> say it <u>uses an electron pair</u> to attack a partially positive carbon atom.
<i>nucleophile:</i> hydroxide ion	1	You can say OH^-
<i>feature:</i> polar <u>C—Cl</u> (bond)	1	You could say δ^+ is on the C atom of C—Cl (bond) <i>or</i> you could put $C^{\delta+} - Cl^{\delta-}$
<i>change the reaction conditions to:</i> alcohol <i>or</i> ethanol solvent	1	<i>Or</i> you could refer to a higher temperature <i>or</i> <u>more</u> concentrated KOH
(c) type of reaction: oxidation	1	You could put redox reaction.
<u>acidified potassium dichromate(VI)</u>	1	You could also have $K_2Cr_2O_7 / H_2SO_4$ <i>or</i> acidified potassium manganate(VII) <i>or</i> $KMnO_4 / H_2SO_4$
heat under reflux	1	You could use excess oxidising agent <i>or</i> use a more concentrated oxidising agent.
test with Tollens' (reagent)	1	
<u>silver mirror</u>	1	You could get the 2 marks with the answer 'test with Fehling's reagent' and 'red solid / precipitate'. You cannot have acidified potassium dichromate(VI).
10 (a) (i) propan-2-ol	1	
(ii) $CH_3CH_2CH_2OH$	1	A displayed formula for propan-1-ol is okay but the C—O bond must be shown.
(b) (i) (2,3-)dimethylbut-2-ene	1	
(ii) $CH_3CH_2CH_2CH_2CH=CH_2$ <i>or</i> $CH_3CH_2CH_2CH=CHCH_3$ <i>or</i> $CH_3CH_2CH=CHCH_2CH_3$	1	You can have a displayed formula for either hex-1-ene <i>or</i> hex-2-ene <i>or</i> hex-3-ene, clearly showing the double bond.