Answers to examination-style questions

Answers	Marks	Examiner's tips
1 (a) heat energy change	**1**	This is in the spec but not so well known.
at constant pressure	**1**	Learn it.
(b) $N_2(g) + \frac{1}{2}O_2(g) \rightarrow N_2O(g)$	**1**	Always check balancing. Don't forget formation means to make 1 mole.
(c) (i) $\Delta H = \sum$(bonds broken) − $\sum$(bonds made)	**1**	Write the first line out so you will always
$= \frac{1}{2}(945) + (3/2)(159) - 3(278)$	**1**	get that mark even if you go wrong with
$= -123$ kJ mol^{-1}	**1**	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) $\Delta H = \sum \Delta H_f$ (products) − $\sum \Delta H_f$ (reactants) (or correct cycle)	**1**	Write the first line out so you will always get that mark even if you go wrong with
$= -114 + 3(-467) - 4(-46) - 0$	**1**	the arithmetic.
$= -1331$ kJ mol^{-1}	**1**	
2 (a) rate of forward reaction = rate of backward reaction	**1**	
concentrations of reactants and products are constant	**1**	Learn both these statements
(b) increases	**1**	
more moles on the left-hand side of equation	**1**	
equilibrium moves to reduce pressure / oppose the change	**1**	If you get the trend wrong you lose all the marks.
(c) decreases	**1**	
reaction is exothermic (in the forward direction)	**1**	
equilibrium moves to absorb heat / lower the temperature / oppose the change	**1**	If you get the trend wrong you lose all the marks.
(d) (+)5	**1**	You do not need to put the + sign in.
(+)5	**1**	
3 (a) (i) decreases from fluorine to iodine	**1**	Accept ionic equations.
(ii) $Cl_2 + 2KBr \rightarrow Br_2 + 2KCl$	**1**	
(iii) toxic	**1**	A How Science Works answer. Think!
(b) J: NaF	**1**	accept F^- or correct name
K: NaI	**1**	accept I^- or correct name
L: NaBr	**1**	accept Br^- or correct name
M: Br_2 / bromine	**1**	
N and **Q:** HBr / hydrogen bromide	**1**	In all these cases it says 'identify' so you
SO_2 / sulfur dioxide	**1**	can put a name or formula.

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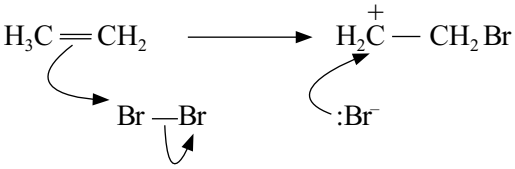
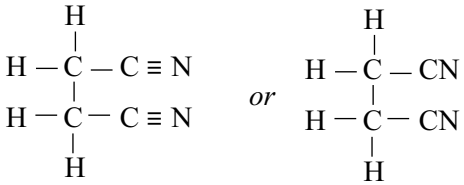
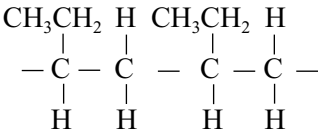
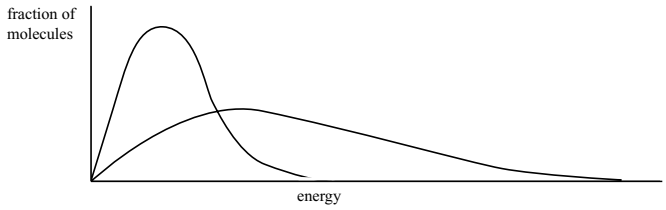
4 (a) least soluble hydroxide = $Mg(OH)_2$	**1**	
(b) (i) $BaCl_2$ / any soluble barium compound	**1**	This work on Group 2 is learning so make sure you do this.
(ii) *observation with NaCl:* no change / no reaction	**1**	
observation with Na_2SO_4*:* white ppt / solid	**1**	
$Ba^{2+} + SO_4^{2-} \rightarrow BaSO_4$	**1**	This ionic equation is much easier than a molecular equation.
5 (a) (i) reduction is the gain of electrons	**1**	
a reducing agent donates electrons	**1**	This is not pairs of electrons.
(ii) C *or* CO	**1**	
$Fe_2O_3 + 3C \rightarrow 2Fe + 3CO$ *or* $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$ *or* $2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$	**1**	
(iii) high temperature needed	**1**	You can put a temperature anywhere in the range 700 °C to 2000 °C.
(b) *any two from:* • might get too hot • solution of alkali is corrosive • alkaline / corrosive solution may splash etc	**2**	How Science Works question so think carefully about a sensible answer.
so the carbon is oxidised	**1**	You can use the equation, e.g. $C + O_2 \rightarrow CO_2$
(c) (i) $TiO_2 + 2C + 2Cl_2 \rightarrow TiCl_4 + 2CO$ *or* $TiO_2 + C + 2Cl_2 \rightarrow TiCl_4 + CO_2$	**1**	
$TiCl_4 + 4Na \rightarrow Ti + 4NaCl$ *or* $TiCl_4 + 2Mg \rightarrow Ti + 2MgCl_2$	**1**	Learn these two equations well.
(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 *or* prevent Na / Mg reacting with oxygen, nitrogen, water, air *or* prevent $TiCl_4$ hydrolysing / reacting with water	**1**	
(d) *any two from:* • Mg / Na / Cl_2 have to be made first (by electrolysis) • batch process • argon atmosphere needed • high temperatures needed in both stages	**2**	This often comes up so learn them.

Answers to examination-style questions

Answers	Marks	Examiner's tips
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) *Isomer 1:* but-1-ene	**1**	
Isomer 2: 2-methylpropene	**1**	Number the C chain first then add the substituent groups.
(b) (i) compounds with the same structural formula	**1**	
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_2OH or H–OSO_3H	**1**	
curly arrow from H–O bond towards side of O atom on H–OSO_2OH	**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.

Answers to examination-style questions

Answers	Marks	Examiner's tips
sulfuric acid is corrosive so wash spills up / wash hands after contact	1	
(d) (i) 	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'		
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	1	
and is flatter / lower	1	
(b) the change in concentration per unit of time	1	
y-axis labelled 'conc. NO_2' and *x*-axis 'time'		Both axes must be labelled to gain marks for graph.
curve starts at origin	1	
and levels off		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) $2SO_2 + O_2 \rightarrow 2SO_3$	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	1	
of lower activation energy	1	This is recall of catalysts.

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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 *or* 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 electron pair donor	**1**	You could say it is a molecule that uses a pair of electrons to form a covalent or co-ordinate bond *or* say it uses an electron pair to attack a partially positive carbon atom.
nucleophile: hydroxide ion	**1**	You can say OH^-
feature: polar C—Cl (bond)	**1**	You could say δ+ is on the C atom of C—Cl (bond) *or* you could put $\overset{\delta+}{C} — \overset{(\delta-)}{Cl}$
change the reaction conditions to: alcohol *or* ethanol solvent	**1**	Or you could refer to a higher temperature or more concentrated KOH
(c) type of reaction: oxidation	**1**	You could put redox reaction.
acidified potassium dichromate(VI)	**1**	You could also have $K_2Cr_2O_7 / H_2SO_4$ *or* acidified potassium manganate(VII) *or* $KMnO_4 / H_2SO_4$
heat under reflux	**1**	You could use excess oxidising agent *or* use a more concentrated oxidising agent.
test with Tollens' (reagent)	**1**	
silver mirror	**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) $CH_3CH_2CH_2CH_2CH=CH_2$ *or* $CH_3CH_2CH_2CH=CHCH_3$ *or* $CH_3CH_2CH=CHCH_2CH_3$	**1**	You can have a displayed formula for either hex-1-ene or hex-2-ene or hex-3-ene, clearly showing the double bond.