2013 Chemistry

Advanced Higher

Finalised Marking Instructions

Part One: General Marking Principles for Chemistry Advanced Higher

This information is provided to help you understand the general principles you must apply when marking candidate responses to questions in this Paper. These principles must be read in conjunction with the specific Marking Instructions for each question.

(a) Marks for each candidate response must always be assigned in line with these general marking principles and the specific Marking Instructions for the relevant question. If a specific candidate response does not seem to be covered by either the principles or detailed Marking Instructions, and you are uncertain how to assess it, you must seek guidance from your Team Leader/Principal Assessor.

(b) Marking should always be positive ie, marks should be awarded for what is correct and not deducted for errors or omissions.

GENERAL MARKING ADVICE: Chemistry Advanced Higher

The marking schemes are written to assist in determining the "minimal acceptable answer" rather than listing every possible correct and incorrect answer. The following notes are offered to support Markers in making judgements on candidates' evidence, and apply to marking both end of unit assessments and course assessments.

General information for markers

The general comments given below should be considered during all marking.

1 Marks should **not** be deducted for incorrect spelling or loose language as long as the meaning of the word(s) is conveyed.

Example: Answers like 'distilling' (for 'distillation') and 'it gets hotter' (for 'the temperature rises') should be accepted.

2 A right answer followed by a wrong answer should be treated as a cancelling error and no marks should be given.

Example: What is the colour of universal indicator in acid solution?

The answer 'red, blue' gains no marks.

3 If a right answer is followed by additional information which does not conflict, the additional information should be ignored, whether correct or not.

Example: Why can the tube not be made of copper?

If the correct answer is related to a low melting point, and the candidate's answer is 'It has a low melting point and is coloured grey' this would **not** be treated as a cancelling error.

4 Full marks should be awarded for the correct answer to a calculation on its own whether or not the various steps are shown **unless the question is structured or working is specifically asked for.**

5 A mark should be deducted in a calculation for each arithmetic slip **unless stated otherwise in the marking scheme.** No marks should be deducted for incorrect or missing units at intermediate stages in a calculation.

6 A mark should be deducted for incorrect or missing units **unless stated otherwise in the marking scheme**. Please note, for example, that KJ mol^{-1} is not acceptable for kJ mol^{-1} and a mark should be deducted.

7 Where a wrong numerical answer (already penalised) is carried forward to another step, no further penalty is incurred provided the result is used correctly.

8 No mark is given for the solution of an equation which is based on a wrong principle.

Example: Use the information in the table to calculate the standard entropy change for the reaction:

$$C_2H_2 + 2HCl \longrightarrow CH_2ClCH_2Cl$$

Compound	**S^o/J K^{-1} mol^{-1}**
C_2H_2	201
HCl	187
CH_2ClCH_2Cl	208

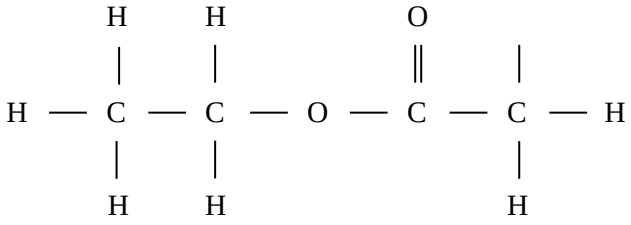
Using $\Delta S^o = S^o_{\text{reactants}} - S^o_{\text{products}}$ would gain zero marks.

9 No marks are given for the description of the wrong experiment.

10 Full marks should be given for correct information conveyed by a sketch or diagram in place of a written description or explanation.

11 In a structural formula, if one hydrogen atom is missing but the bond is shown, no marks are deducted.

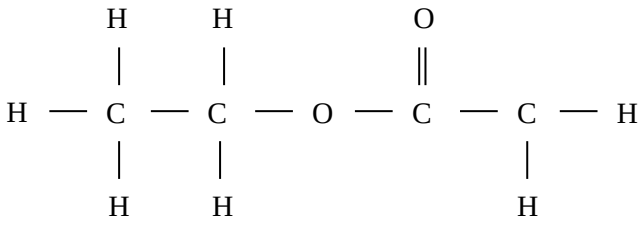
Examples:



Would not be penalised as the structural formula for ethyl ethanoate.

If the bond is also missing, then zero marks should be awarded.

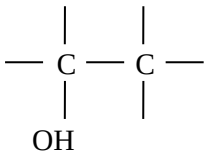
Example:



12 If a structural formula is asked for, CH_3- and CH_3CH_2- are acceptable as methyl and ethyl groups respectively.

13 With structures involving an –OH or an $–NH_2$ group, no mark should be awarded if the 'O' or 'N' are not bonded to a carbon, ie $OH–CH_2$ and $NH_2–CH_2$.

14 When drawing structural formulae, no mark should be awarded if the bond points to the 'wrong' atom, eg



15 A symbol or correct formula should be accepted in place of a name **unless stated otherwise in the marking scheme**.

16 When formulae of ionic compounds are given as answers it will only be necessary to show ion charges if these have been specifically asked for. However, if ion charges are shown, they must be correct. If incorrect charges are shown, no marks should be awarded.

17 If an answer comes directly from the text of the question, no marks should be given.

Example: A student found that 0·05 mol of propane, C_3H_8 burned to give 82·4 kJ of energy.

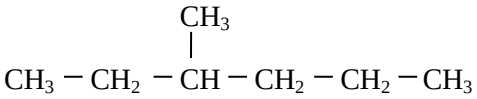
$$C_3H_8(g) + 5O_2(g) \longrightarrow 3CO_2(g) + 4H_2O(\ell)$$

Name the kind of enthalpy change which the student measured.

No marks should be given for 'burning' since the word 'burned' appears in the text.

18 A guiding principle in marking is to give credit for (partially) correct chemistry rather than to look for reasons not to give marks.

Example 1: The structure of a hydrocarbon found in petrol is shown below.



Name the hydrocarbon.

Although not completely correct, the answer, '3, methyl-hexane' would gain the full mark ie wrong use of commas and dashes.

Example 2: A student measured the pH of four carboxylic acids to find out how their strength is related to the number of chlorine atoms in the molecule. The results are shown.

Structural formula	**pH**
CH_3COOH	1·65
$CH_2ClCOOH$	1·27
$CHCl_2COOH$	0·90
CCl_3COOH	0·51

How is the strength of the acids related to the number of chlorine atoms in the molecule?

Again, although not completely correct, an answer like 'the more Cl_2, the stronger the acid' should gain the full mark.

Example 3: Why does the (catalytic) converter have a honeycomb structure?

A response like 'to make it work' may be correct but it is not a chemical answer and the mark should not be given.

Part Two: Marking Instructions for each Question

Section A

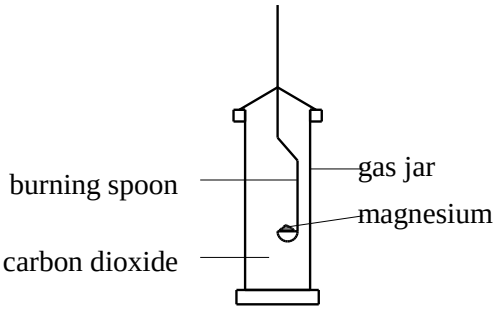
Question			Acceptable Answer/s
1			**C**
2			**B**
3			**A**
4			**D**
5			**D**
6			**A**
7			**C**
8			**A**
9			**C**
10			**B**
11			**C**
12			**C**
13			**D**
14			**B**
15			**A**

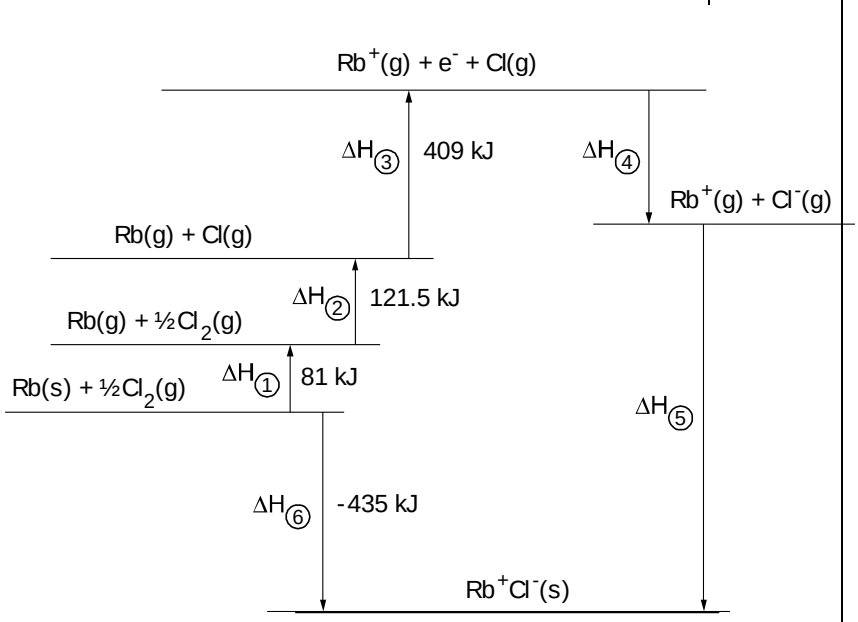
Question			Acceptable Answer/s
16			**C**
17			**B**
18			**C**
19			**A**
20			**D**
21			**B**
22			**D**
23			**A**
24			**B**
25			**B**
26			**C**
27			**B**
28			**D**
29			**D**
30			**A**

Question			Acceptable Answer/s
31			**D**
32			**A**
33			**B**
34			**D**
35			**D**
36			**C**
37			**D**
38			**B**
39			**A**
40			**D**

Section B

Question			Acceptable Answer	Mark	Unacceptable answer
1	**a**		Name a dopant which could be added to germanium to make a p-type semiconductor. Any group 3 element, or boron, aluminium, gallium, indium or thallium or **correct** symbol	**1**	Correct name and wrong symbol Wrong name and correct symbol (cancelling errors) Group 3
1	**b**		What is the charge carrier in a p-type semiconductor? Positive hole(s) + holes +ve holes Electron deficient holes	**1** **(2)**	Positive or + or +ve (cancelling errors apply) Hole(s) Electron(s)

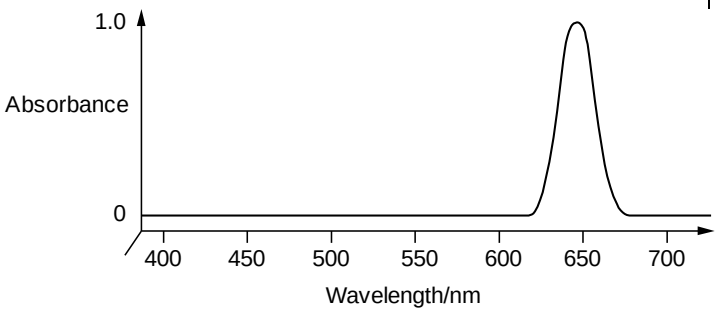
Question			Acceptable Answer	Mark	Unacceptable answer
2			Burning magnesium continues to burn when placed in a gas jar of carbon dioxide according to the equation. $2Mg(s) + CO_2(g) \rightarrow 2MgO(s) + C(s)$  Substance / $S^o/JK^{-1}\ mol^{-1}$: Mg(s) 33·0 $CO_2(g)$ 214 MgO(s) 27·0 C(s) 5·70		
2	**a**		Using the values from the table above, calculate ΔS^o for the reaction. $-220{\cdot}3\ J\ K^{-1}\ (mol^{-1})$ or $-0{\cdot}2203\ kJ\ K^{-1}\ (mol^{-1})$ $-220\ J\ K^{-1}\ (mol^{-1})$ or $-0{\cdot}220\ kJ\ K^{-1}\ (mol^{-1})$ or $-0{\cdot}22\ kJ\ K^{-1}\ (mol^{-1})$ Max of 5 sig figs	**1**	No units $J\ k^{-1}\ mol^{-1}$ or $j\ K^{-1}\ mol^{-1}$ (but give candidates benefit of the doubt if unsure) negative sign missing
2	**b**		Using the information below and your answer to (a), calculate ΔG^o for the burning of magnesium in carbon dioxide. $Mg(s) + ½\ O_2(g) \rightarrow MgO(s)$ $\Delta H^o = -493\ kJ\ mol^{-1}$ $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H^o = -394\ kJ\ mol^{-1}$ **Correct follow through from wrong answer in (a) can get 3 marks in (b)** $\Delta H^o = -592\ (kJ\ mol^{-1})$ or $-296\ (kJ\ mol^{-1})$ **1** $\Delta G^o = \Delta H^o - T\Delta S^o$ **1** $= -\mathbf{526{\cdot}35}\ kJ\ (mol^{-1})$ or kJ) (Accept $-526\ (kJ\ mol^{-1})$, $-526{\cdot}4\ kJ\ mol^{-1}$) **1** (Also accept, −263, −263·2, −263·18 with correct units as final answer) Accept final answer in Joules if correct and allow 6 sig figs in this case (526350 or 526351 J)	**3** **(4)**	$\Delta G^o = \Delta H^o + T\Delta S^o$ or any incorrect relationship (lose 2 marks) 6 sig figs – lose 1 mark $-526{\cdot}00$ or $526{\cdot}3$

Question			Acceptable Answer	Mark	Unacceptable answer
3			The Born-Haber cycle diagram shows the theoretical process involved in the formation of rubidium chloride from the elements rubidium and chlorine.  		
3	**a**		Write the equation which represents the standard enthalpy of formation of rubidium chloride. Rb(s) + ½ Cl_2(g) → Rb^+Cl^-(s) or RbCl(s)	**1**	Multiple of equation. Equation without state symbols.
3	**b**		Use the Data Booklet to find the value for enthalpy change $\Delta H_④$ −349 kJ mol^{-1} or −349 kJ	**1**	Answer without units.

Question			Acceptable Answer	Mark	Unacceptable answer
3	**c**		What name is given to the enthalpy change represented by $\Delta H_{⑤}$? Lattice (formation) (enthalpy) Lattice Lattice energy Crystal lattice	**1**	Lattice breaking
3	**d**		Calculate the value for enthalpy change $\Delta H_{⑤}$ $-697{\cdot}5$ kJ (mol^{-1}) Follow through from wrong answer in (b) by −value for(b) – 1046·5 = gives correct follow through answer.	**1** **(4)**	+697·5

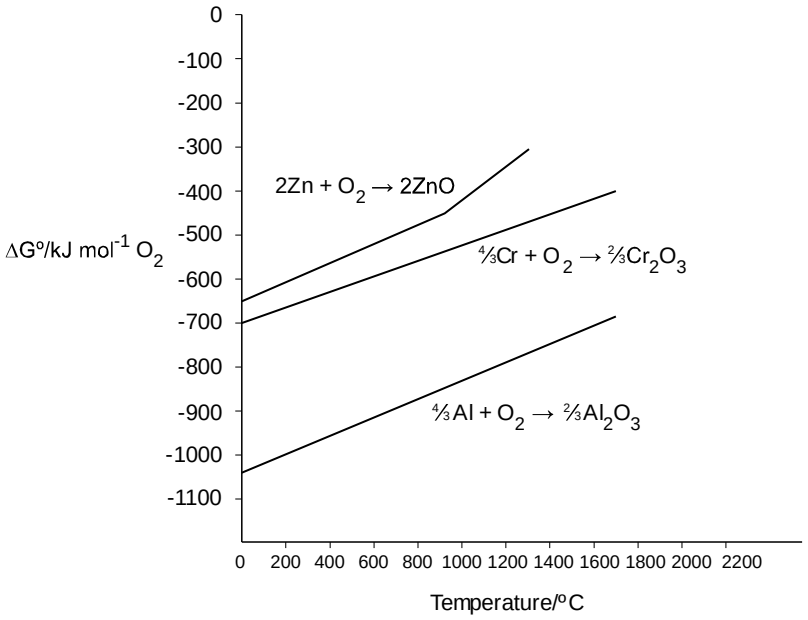
Question			Acceptable Answer	Mark	Unacceptable answer
4			In a PPA the manganese content of a steel paper clip is determined by converting the manganese into purple permanganate ions, the concentration of which is measured using colorimetry. At the start of the activity, a calibration graph has to be drawn.		
4	**a**		What data must be collected to allow the calibration graph to be drawn? A series of standard solutions of different concentrations of $KMnO_4$ is made up and their absorbances measured. Absorbances of permanganate solution**s** of known concentration**s**/variety of concentration**s** (must mention permanganate or manganate or purple solutions) Accept absorbancy/absorption/transmittance/transmission	**1**	Intensity of radiation/adsorption Measure absorbance of solutions of known concentration (must mention permanganate or manganate)
4	**b**		Which colour of filter or wavelength of light should be used in this procedure? Green or 500 to 560 nm (Accept blue-green or green-yellow) Green followed by incorrect wavelength would not be cancelling error	**1**	Complementary colour If wavelength given then units are required Correct wavelength followed by an incorrect colour such as red
4	**c**		A weighed sample of the paper clip is dissolved in 2 mol l^{-1} nitric acid in a beaker covered with a watch glass which is placed in a fume cupboard because a toxic gas is produced. Name this toxic gas. Nitrogen dioxide/dinitrogen tetroxide/nitrogen monoxide/ nitric oxide or mixture. Correct formulae eg NO, NO_2, N_2O_4	**1**	Nitrous oxide, N_2O Nitrogen oxide or oxides of nitrogen (on its own)

Question			Acceptable Answer	Mark	Unacceptable answer
4	**d**		Colorimetry is not used to determine potassium content because potassium ions are not coloured. The concentration of potassium ions in a compound can be determined using atomic absorption spectroscopy at a wavelength of 405 nm. Calculate the energy, in kJ mol^{-1}, of this radiation. E = $\frac{Lhc}{\lambda}$ or E = $\frac{Lhc}{1000\lambda}$ **1** = 296 or 295·6 or 295·64 or 295·65 (kJ mol^{-1}) **1**	**2** **(5)**	295 or 296·3 6 sig figs

Question			Acceptable Answer	Mark	Unacceptable answer
5			 The absorption spectrum of a solution of sodium tetrachlorocobaltate(II) is shown above.		
5	a		Predict the most likely colour of the solution. Blue or green or blue/green or cyan or turquoise	**1**	Red etc
5	b		Write the electronic configuration for a cobalt(II) ion in terms of s, p and d orbitals. $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^7$ or [Ne] $3s^2\ 3p^6\ 3d^7$ or correct answer in terms of orbital box notation with all the orbitals labelled correctly Accept $4s^o$ with otherwise correct answer	**1**	[Ar] $3d^7$
5	c		Write the formula for the tetrachlorocobaltate(II) ion. $[Co(Cl)_4]^{2-}$ or $[CoCl_4]^{2-}$ or $CoCl_4^{2-}$ $Co(Cl)_4^{2-}$ or $[(Cl)_4Co]^{2-}$ Shape of brackets unimportant $^{-2}$ in place of $^{2-}$	**1** **(3)**	$[Co^{2+}(Cl^-)_4]^{2-}$ (II) given in formula Overall charge 2+ $(Cl)_4Co^{2-}$

Question			Acceptable Answer	Mark	Unacceptable answer
6 6	a		Propanoic acid is a weak acid. Sodium propanoate is a salt which can be formed from it. Both propanoic acid and sodium propanoate can be used as mould inhibitors. Calculate the pH of 0·10 mol l^{-1} propanoic acid solution. $pH = ½\ pK_a - ½ \log c$ **1** = 2·935 or 2·94 or 2·9 **1** Max of 4 sig figs	**2**	Wrong relationship = 0 marks 2·93
6	b		0·20 moles of sodium propanoate are added to 100 cm^3 of the 0·10 mol l^{-1} solution of propanoic acid. Calculate the pH of the buffer solution formed. $pH = pK_a - \log \frac{[acid]}{[salt]}$ **1** = 6·171 or 6·17 or 6·2 **1**	**2** **(4)**	Wrong relationship = 0 marks

Question			Acceptable Answer	Mark	Unacceptable answer
7	a		Calculate the emf of a $Cr(s)|Cr^{3+}(aq)||Fe^{2+}(aq)|Fe(s)$ cell operating under standard conditions. Emf = 0·74 − 0·44 = 0·30 V or 0·3 V	**1**	No units −0·3V
7	b		Calculate the free energy change, ΔG^o, in kJ per mole of chromium, for this cell reaction. $\Delta G^o = -nFE^o$ **1** $= -3 \times 96500 \times 0{\cdot}3$ (J per mole Cr) **1** (follow through from incorrect answer in (a)) = −86·9 (kJ per mole Cr) **1** (or −87 kJ or −86·85 **but not −86·8**) (−57·9 = 2/3 using n = 2) (−28·95 = 2/3 using n = 1) (−173·7 = 2/3 using n = 6) **[These answers assume correct answer to (a)]** (Accept $\Delta G^o = -n\ F\ e$ for 1 mark unless candidate goes on to substitute charge on an electron for e)	**3**	$\Delta G^o = nFE^o$ (deduct 1 mark)

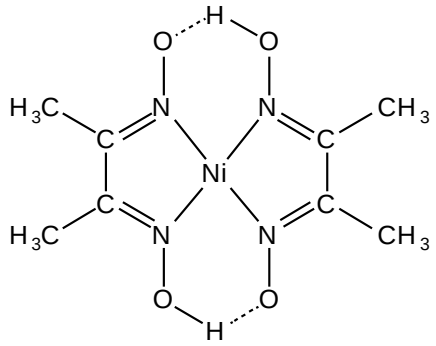
Question			Acceptable Answer	Mark	Unacceptable answer
7	c		Use the Ellingham diagram below to **explain** whether zinc or aluminium should be chosen to extract chromium from chromium oxide.  		
7	c		Aluminium because $\Sigma\Delta G^o$ is negative for the reactions $2/3\ Cr_2O_3 \rightarrow 4/3Cr + O_2$ $+ 4/3Al + O_2 \rightarrow 2/3Al_2O_3$ or Overall ΔG^o is negative for the (redox) reaction: $2/3Cr_2O_3 + 4/3Al \rightarrow 4/3Cr + 2/3Al_2O_3$ Correct answer in terms of overall free energy change for the reaction	**1** **(5)**	Aluminium is more reactive than chromium. Aluminium is above chromium in the ecs. "the lower one always extracts the higher one" "lower graph stays as written and higher graph is reversed." "anti-clockwise rule" applies in Ellingham diagram.?

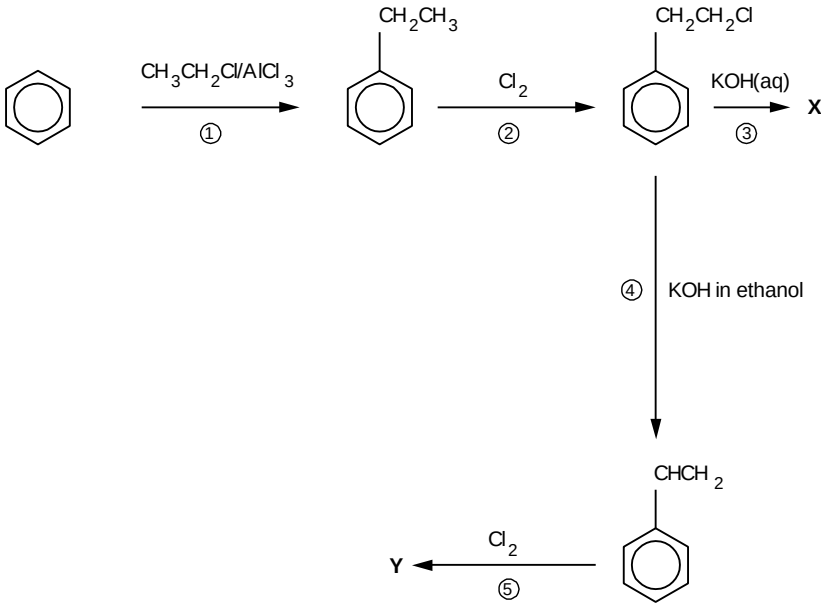
Question			Acceptable Answer	Mark	Unacceptable answer
8			A kinetics study was carried out on the reaction between a halogenoalkane, C_4H_9Br, and aqueous sodium hydroxide. $C_4H_9Br + NaOH \rightarrow C_4H_9OH + NaBr$ The following results were obtained.		

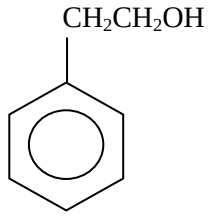
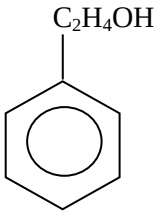
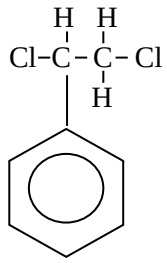
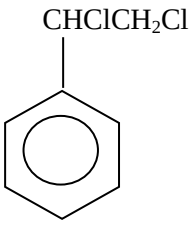
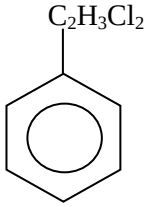
$[C_4H_9Br]$/mol l^{-1}	[NaOH]/mol l^{-1}	Initial Rate/mol $l^{-1}s^{-1}$
$8{\cdot}0 \times 10^{-4}$	0·10	0·15
$1{\cdot}6 \times 10^{-3}$	0·10	0·30
$1{\cdot}6 \times 10^{-3}$	0·20	0·30
$3{\cdot}2 \times 10^{-3}$	0·40	0·60

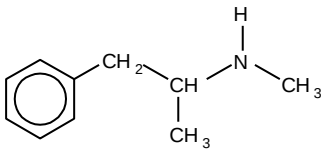
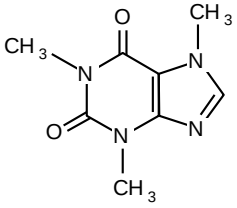
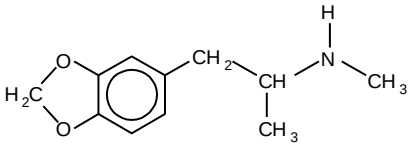
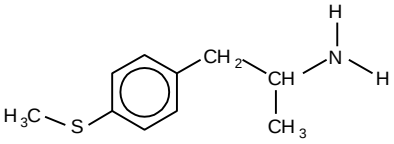
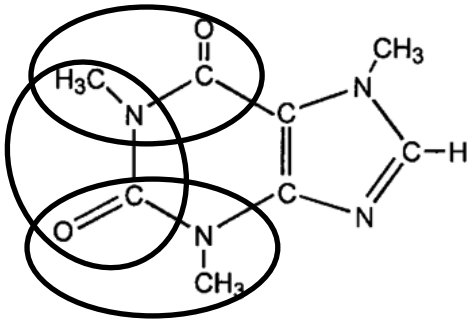
8	**a**		What is the order of reaction with respect to		
8	**a**	**i**	the halogenoalkane First or 1		
		ii	the sodium hydroxide? Zero or 0 or no order	**1**	
8	**b**		Write the rate equation for the reaction. Rate = $k[C_4H_9Br]$ or Rate = $k[C_4H_9Br]^1\,[NaOH]^o$ (accept correct follow on from wrong answers in (a)	**1**	Round brackets (0) No marks if K used in place of k

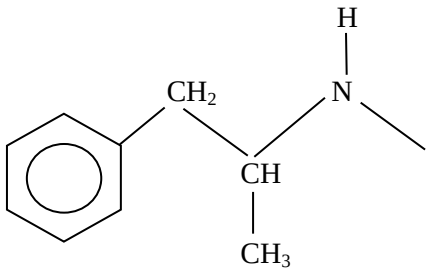
Question			Acceptable Answer	Mark	Unacceptable answer
8	**c**		Calculate a value for the rate constant, k, including the appropriate units. k =Rate/[C_4H_9Br] = 0·15/8·0 × 10^{-4} = 187·5 s^{-1} **1** 1 mark for correct units. Accept 188 and 190 s^{-1} **1** (Don't penalise for K in place of k) **Units must follow on from relationship used in (a) and/or (b)** s^{-1} = 1 mark no matter answer given to (a) or (b) Correct follow through from (a) or (b)	**2**	Any wrong units, deduct 1 mark even if already lost 2 marks for units previously – except if correct due to follow through.
8 **8**	**d** **d**	 **i**	There are four structural isomers of C_4H_9Br. From the above results, which isomer is most likely to have been used? 2-bromomethylpropane or 2-bromo-2-methylpropane Accept 2-methyl-2-bromopropane (ignore dashes and commas) Any correct structural formula would be acceptable Accept "the tertiary isomer"/the tertiary one/tertiary structure	**1**	Cancelling errors apply if correct structure and wrong name or vice-versa but accept "methy" as a slip if the structure is correct But if only the name is given then do not accept errors such as "brom" or "methy" 2-methylbromopropane
8	**d**	**ii**	Explain your answer to (d)(i). Correct explanation in terms of Stability of carbocation or Steric hindrance	**1** **(6)**	

Question			Acceptable Answer	Mark	Unacceptable answer
9			Nickel(II) ions react quantitatively with dimethylglyoxime ($C_4H_8O_2N_2$) forming a complex which precipitates out as a red solid. The equation for the reaction and the structure of the complex are shown below. $Ni^{2+} + 2C_4H_8O_2N_2 \rightarrow Ni(C_4H_7O_2N_2)_2 + 2H^+$  Relative formula mass = 288·7		
9	**a**		What is the coordination number of nickel in the complex? 4 or four or iv or IV	**1**	
9	**b**		When 0·968 g of an impure sample of nickel(II) sulphate, $NiSO_4.7H_2O$, was dissolved in water and reacted with dimethylglyoxime, 0·942 g of the red precipitate was formed. Calculate the percentage, by mass, of nickel in the impure sample of nickel(II) sulphate. Mass of nickel in DMG complex = 0·942 × (58·7/288·7) = 0·1915 g or 0·192 g **1** % Ni in impure salt = (0·1915/0·968) × 100 = 19·8 (%) **1** (Accept 19·79 % and 19·786 % and 19·835 % or 19·83 %) (Deduct 1 mark per error up to a maximum of 2 marks) (19·73 = 1 mark only – rounded 0·1915 to 0·191)	**2** **(3)**	20·9 % (% Ni in pure salt) 20·3 % use of 0·968 instead of 0·942 in first line Use of AN in place of RAM (0)

Question			Acceptable Answer	Mark	Unacceptable answer
10			A student devised the following reaction sequence.  		
10	**a**		What type of reaction is taking place in step ① ? Electrophilic substitution or Alkylation	**1**	Nucleophilic substitution substitution Electrophilic Friedel – Crafts
10	**b**		What experimental condition would be required in step step ② ? Light/UV radiation/radiation of correct wavelength/UV/ visible light/camera flash	**1**	Electromagnetic radiation

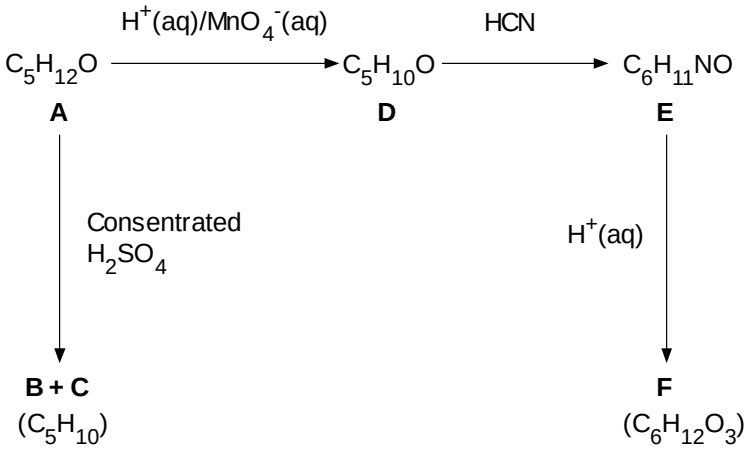
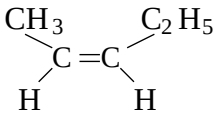
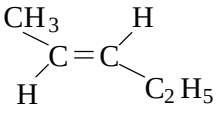
Question			Acceptable Answer	Mark	Unacceptable answer
10	**c**		Draw a structural formula for product **X**.  Accept Kekule structure for the phenyl group Accept $C_6H_5CH_2CH_2OH$/benzene ring showing H's	**1**	 Ring missing or no alternate double/single bonds
10	**d**		What type of reaction is taking place in step ④ ? (base induced) elimination,	**1**	Acid induced elimination
10	**e**		Draw a structural formula for product **Y**.  or  or $C_6H_5CHClCH_2Cl$	**1** **(5)**	 Ring missing or no alternate double/single bonds (0) marks unless already penalised in (c) $C_6H_5CCl_2CH_3$

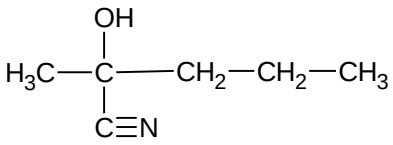
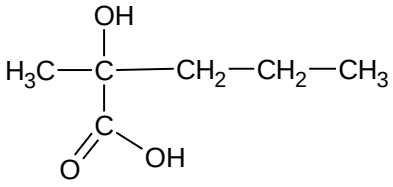
Question			Acceptable Answer	Mark	Unacceptable answer
11			Methylamphetamine (also known as "speed") and caffeine are stimulants. A "designer drug" with a structure related to methylamphetamine is ecstasy. Ecstasy tablets are sometimes contaminated with a substance called 4-MTA.  Methylamphetamine  caffeine  ecstasy  4-MTA		
11	**a**		Caffeine contains more than one "amide" functional group. Draw the structure of caffeine and circle **one** of the "amide" functional groups. Allow minor slip in the structure of caffeine  Caffeine Any one of the three amide functional group shown **1** Not necessary for CH_3 to be included in the circle but there must be a bond coming from the N and part of that bond must be within the circle		

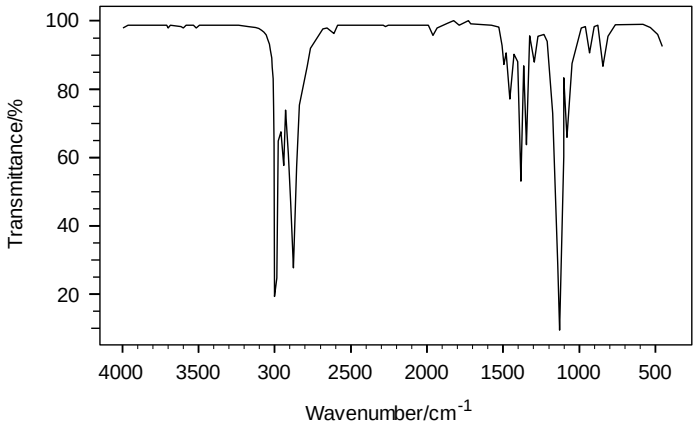
Question			Acceptable Answer	Mark	Unacceptable answer
11	**b**		Which of the four molecules contains a primary amine functional group? 4-MTA	**1**	
11	**c**		Draw the structure of the pharmacaphore common to methylamphetamine, ecstasy and 4-MTA.  	**1**	

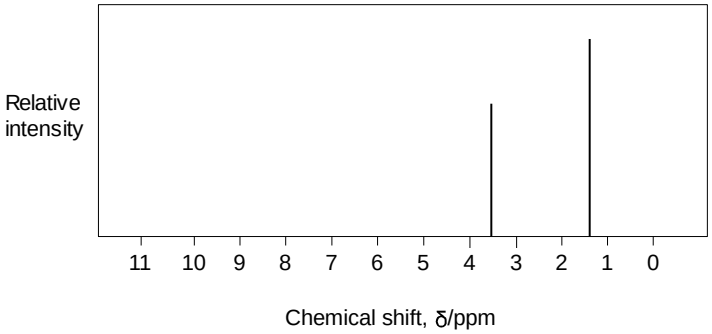
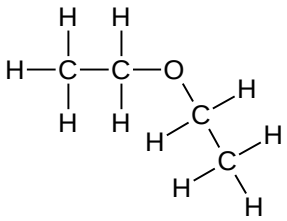
Question			Acceptable Answer	Mark	Unacceptable answer
12 12	a		In a PPA, cyclohexene is prepared from cyclohexanol using a dehydrating agent. Which dehydrating agent is used in the PPA? (Concentrated) phosphoric acid/orthophosphoric acid	 **1**	
12	b	i	When the reactants have been heated gently for about 15 to 20 minutes, the mixture is allowed to cool. Separation of the product is carried out by adding saturated sodium chloride solution to the reaction mixture and vigorously shaking them together for about a minute allowing them to settle and form two layers. Why is saturated sodium chloride solution used rather than water? It is denser than water. The layers separate more quickly. The layers separate better. The layers settle more quickly. The aqueous solution is more polar (than water) To get a better separation	 **1**	It works better Get a better yield
12	b	ii	Which piece of apparatus is used **in this part of the procedure**? Separating funnel/separatory funnel/separation funnel	 **1**	Diagram

Question			Acceptable Answer	Mark	Unacceptable answer
12	**c**		The identity of the product can be verified by using infra-red spectroscopy. Predict **one** difference that would be observed between the infra-red spectra of cyclohexene and cyclohexanol. Presence of: C=C stretch or peak or absorbance/1620 to 1680 cm^{-1} **in cyclohexene**. C–H stretch or peak or absorbance/3095 to 3010 cm^{-1} in **cyclohexene**. O–H stretch/3200 to 3650 cm^{-1} in **cyclohexanol**. Accept the absence of these in the other compound.	**1**	Units must be given with values except for those who have already been penalised twice for wrong/incorrect/ missing units

Question			Acceptable Answer	Mark	Unacceptable answer
13			The diagram below shows a reaction sequence starting from compound **A** which is pentan-2-ol ($C_5H_{12}O$).  		
13	**a**		Compound **B** can exist as two geometric isomers. Compound **C** is pent-l-ene. Compound **D** is the oxidation product of compound **A**. Name **and** draw the structural formulae for the two geometric isomers of compound **B**.  *cis*-pent-2-ene **1**  *trans*-pent-2-ene **1** Two correct structures, no names = 1 Two correct names, no structures = 1 Don't penalise for bonds at 90° rather than 120° and accept CH_3 in place of H_3C	**2**	One only given but with correct structure and wrong name = 0 Both structures correct but names wrong way round = 1 out of 2 Only one structure given but with wrong name (0)

Question			Acceptable Answer	Mark	Unacceptable answer
13	**b**		Name compound **D**. Pentan-2-one.	**1**	Pent-2-one Penta-2-one
13	**c**		Compound **E** is a cyanohydrin.		
13	**c**	**i**	Name the type of reaction occurring when **D** is converted into **E**. (nucleophilic) addition.	**1**	Electrophilic addition
13	**c**	**ii**	Draw a structural formula for compound **E**.  or shortened SF with CN and $(CH_2)_2CH_3$ but not with C_3H_7 (Accept correct follow through from incorrect answer to (b)	**1**	
13	**d**		Name **or** draw a structural formula for compound **F**. 2-hydroxy-2-methylpentanoic acid or  Accept COOH or CO_2H and $(CH_2)_2CH_3$ but not C_3H_7 nor $(C_2H_4)CH_3$ (Accept correct follow through from incorrect answer to (c)	**1** **(6)**	

Question			Acceptable Answer	Mark	Unacceptable answer
14			5·00 g of an organic compound **A** was burned completely producing 11·89 g of CO_2 and 6·08 g of H_2O as the only products.		
14	**a**		**Using the information above**, calculate the empirical formula for compound **A**. Mass of C = (12/44 × 11·89) = 3·243 g Mass of H = (2/18 × 6·08) = 0·676 g So mass of O = 5·00 −3·243 −0·676 = 1·081 g **1** C : H : O 3·243 : 0·676 : 1·081 Ratio of moles 0·270 : 0·676 : 0·0676 4 : 10 : 1 **1** Empirical formula $C_4H_{10}O$ **1**	**3**	Correct answer, no working = 1 mark
14	**b**		The infra-red spectrum of compound **A** is shown below.  Which bond is responsible for the peak at 1140 cm^{-1}? C-O (stretch)	**1**	

Question			Acceptable Answer	Mark	Unacceptable answer
14	**c**		The mass spectrum of compound **A** shows the molecular ion to have a mass/charge ratio of 74. Deduce the molecular formula of compound **A**. $C_4H_{10}O$ (elements can be in any order)	**1**	
14	**d**		The proton nmr spectrum of compound **A** is shown below.  Using all the above information, deduce the structural formula for compound **A**.  (accept shortened structural formula of ethoxyethane) Accept $C_2H_5OC_2H_5$	**1** **(6)**	

[END OF MARKING INSTRUCTIONS]