

Question	Expected answers	Marks
1 (a) (i)	Volatile/gas (1); toxic (to humans)/causes respiratory diseases/choking gas (1).	2
1 (a) (ii)	Green colour (1). Allow (pale) greenish yellow/ yellowish green & all shades in between.	1
1 (b) (i)	Hydrogen ions/ H ⁺ /protons are present (1).	1
1 (b) (ii)	1 mark for point in bold and 3 from 4 other points: NaCl contains chloride ions/ chloride added/ sodium chloride dissolves AW (1); Increase in (chloride ion) (1); concentration (1); will cause equilibrium (position) to move to the left AW (1); (molecular) chlorine/Cl ₂ (concentration) increases (1).	4
1 (b) (iii)	QWC 1 mark for two sentences / 2 bullet points including correct use of two of the following words: <i>ion, molecule, equilibrium, counteract/oppose.</i> For example	3
	correct sized ions for Cl ⁻ and Na ⁺ (1); correct charges for Cl ⁻ and Na ⁺ (1); 4 oppositely charged ions or atoms around each type of ion/atom (1).	
1 (c) (i)	Cl ₂ = 0 (1); HOCJ = +1 (1).	2
1 (c) (ii)	Oxidation/ redox (1) NOT ecf	1
1 (c) (iii)	Oxidation state of Cl has increased or Cl has lost electron(s), (1) ecf.	1
1 (d)	2HOCJ → O ₂ + 2Cl ⁻ + 2H ⁺ or 2HCl in equation formulae correct (1); correct formulae balanced (1); hv above → (1).	3
Total mark		19

Question	Expected answers	Marks
2 (a) (i)	allow -COCH ₃ (1) 	1
2 (a) (ii)	Softens/flows/melts (1); when heated/warmed (1).	2
2 (a) (iii)	Addition accept additional (1).	1
2 (b) (i)	M _r of monomer = 86 (1); n = 43,000 / 86 = 500 ecf (1).	2
2 (b) (ii)	More intermolecular forces/attractions between chains / chains get tangled /entwined (1); chains/molecules can not move as easily AW (1).	2
2 (c) (i)	Hydrogen bonding (1).	1
2 (c) (ii)	 or accept non-linearity of the O-H...O atoms; bond (1); correct partial charges (1). (Shake with/add) bromine (in solvent) (1) orange/brown (1); turns colourless (1) do not accept clear. C=C restricts bond rotation AW (1); substituent groups mean two different arrangements possible AW (1).	3
2 (d) (i)		3
2 (d) (ii)		2
Total mark		17

Question	Expected answers	Marks
3 (a) (i)	$O_2 \rightarrow 2O(1)$; $O + O_2 \rightarrow O_3(1)$	2
3 (a) (ii)	High frequency radiation only present in stratosphere AW (1); bonds are broken by this radiation AW (1).	2
3 (a) (iii)	(Intense) high frequency radiation/uv given off by firework reactions/(intense) heat/energy released (1).	1
3 (b) (i)	Increase its temperature/warm up the atmosphere (1).	1
3 (b) (ii)	Infrared (1) do not allow heat.	1
3 (b) (iii)	Makes it vibrate (faster)/increases its (kinetic) energy (1).	1
3 (c) (i)	Photodissociate / break down (to form oxygen molecules and atoms) (1).	1
3 (c) (ii)	E for 1 bond = $302 \times 1000(1) / 6.02 \times 10^{23}(1) J = 5.02 \times 10^{-19} J$ ecf (1).	3
3 (c) (iii)	$v = 5.02 \times 10^{-19} / 6.63 \times 10^{-34}(1) = 7.57 \times 10^{14} Hz$ ecf. 1 mark for 3 sig. figs.	2
Total mark		14

Question	Expected answers	Marks
4 (a) (i)	$(3 / 1 \times 10^6) \times 100(1) = 3 \times 10^{-4} \%$.	1
4 (a) (ii)	Froth flotation (1); Any 2 points from 4: grains are given water repellent coating (1); (air & detergent cause) the solution to froth (1); ore grains/metal are concentrated/AW in the froth (1); ore grains scooped/AW off with froth (1).	3
4 (b) (i)	$Cu_2S(1)$.	1
4 (b) (ii)	$2p^6, 3s^2, 3p^4$ 12 electrons added (1); correct orbitals (1).	2
4 (b) (iii)	$Cu_2S + O_2 \rightarrow 2Cu + SO_2$ formulae correct, allow ecf from b(i) for copper(I) sulphide (1); balanced (1).	2
4 (b) (iii)	SO_2 reacts in the atmosphere to form sulphuric/sulphurous acid / with water to form an acid (1); causes acid rain (1)	2
4 (c) (i)	hydrogen ions /protons (1).	1
4 (c) (ii)	$S^{2-}(1)$.	1
4 (d) (ii)	Enthalpy of products lower than reactants in both cases (1); correct shape curve for reaction, single 'hump' (1); correct shape curve for catalysed reaction, two 'humps' (1); enthalpy change of reaction correct (1); both enthalpy changes of activation correct (1).	5
Total mark		18

Question	Expected answers	Marks
5 (a) (i)	C_6H_6 (1).	1
5 (a) (ii)	2-chloro-2-methylpropane name (1); number for chlorine/methyl (1).	2
5 (a) (iii)	room temperature (1) accept heat (under reflux) alone.	1
5 (b) (i)	OH^- (1); must be ion.	1
5 (b) (ii)	Cl and C have different electronegativities AW/ C-Cl bond is polar (1); the C is electron deficient/ slightly positive/ δ^+ (1).	2
5 (c) (i)	(Concentration x volume) $2.0 \times 100/1000$ (1); $= 0.2$ mol (1)	2
5 (c) (ii)	$M_r(NaOH) = 40$ (1); mass $= 0.2 \times 40 = 8$ g (1). ecf for 5 (b) (i) and incorrect M_r .	2
5 (d) (i)	Tertiary (1); no H atoms on C connected to OH (1) only alkyl groups on C connected to OH / three carbon atoms bonded to C-OH (1).	2
5 (d) (ii)	$ \begin{array}{c} CH_3 \\ \\ H_2C=C \\ \\ CH_3 \end{array} $	2
5 (d) (iii)	C=C bond present (1); rest of molecule correct (1). Elimination (1).	1
5 (e) (i)	X in distillation head opposite condenser (1).	1
5 (e) (ii)	2 defects from 3 Water connections need to be reversed (1); condenser water jacket will not be filled/ product will not condense (1); Delivery tube and distillate flask sealed (1); closed system is dangerous/pressure builds up on heating (1); No anti-bumping granules (1); liquid will boil over into condenser AW (1).	4
	QWC At least two readable and clear sentences with no more than one spelling, punctuation or grammatical error (1).	1
	Total mark	22