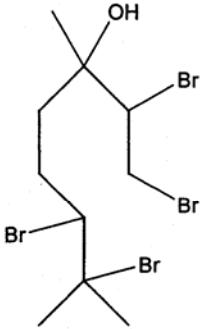


Question	Expected answers	Marks
1 (a) (i)	Addition (<i>allow additional/adding polymerisation</i> (1)).	1
1(a) (ii)	Initiation (1); propagation (1); termination (1).	3
1 (b) (i)	Chains are branched in ldpe(1); chains are (more) linear in hdpe/less branching a <i>comparison mark</i> (1); chains cannot pack closely together / weaker attraction between chains/ more chains can fit in a given space ORA (1).	3
1 (b) (ii)	Areas in polymer <i>may be inferred or show using a diagram</i> (1); ordered / closely packed / chains more aligned / side by side (1).	2
1 (c) (i)	$\text{TiCl}_4 + 2\text{H}_2\text{O} \rightarrow \text{TiO}_2 + 4\text{HCl}$ <i>Formulae correct each side</i> (1); <i>balanced</i> (1).	2
1 (c) (ii)	Covalent (1); liquid at room temperature/ hydrolysed by water (1).	2
1 (d) (i)	d (block) (1).	1
1 (d) (ii)	d = 2 (1); s = 2 (1).	2
Total mark		16

Question	Expected answers	Marks
2 (a)	Nitrogen (1); oxygen (1); argon (1) <i>allow correct formulae.</i>	3
2 (b)	$0.003/10^6$ (1); $\% = 0.003/10^6 \times 100 = 3 \times 10^{-7}$ (1).	2
2 (c) (i)	$2\text{H}_2\text{O} + 2\text{SO}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{SO}_4$ <i>Or half quantities etc.</i> correct formulae each side (1); balanced (1).	2
2 (c) (ii)	NH_4^+ (1); $(\text{NH}_4)_2\text{SO}_4$ (1).	2
2 (c) (iii)	it gains/accepts (1) a proton/ H^+ (ion) (1). <i>1 mark only for 'it neutralises an acid' AW (1).</i>	2
2 (d) (i)	Ultraviolet/high frequency/low wavelength (1).	1
2 (d) (ii)	It has an unpaired/lone electron (1) <i>do not allow 'free'.</i>	1
2 (d) (iii)	$\text{NO}_2 + 4$ (1); $\text{HNO}_3 + 5$ (1). <i>1 mark only if no + sign and numbers correct.</i>	2
2 (d) (iv)	Oxidation/ redox (1); (N) has lost an electron / oxidation state of (N) has increased/changed (<i>watch for con</i>)/ AW (<i>N may be inferred</i>) <i>ecf from d(iii)</i> (1).	2
2 (e)	Pipette NaOH into flask (1); fill burette with rain water (1); add indicator (1); (at end point) add rain water dropwise/slowly (1); repeat to get concordant readings AW (1). <i>If NaOH & rain water reversed then allow 1 mark, hence max of 4.</i> QWC 1 mark for two sentences / 2 bullet points including correct use of two of the following words: <i>pipette, burette, indicator, concordant, end-point.</i>	6
2 (f)	$\text{H}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow \text{H}_2\text{O}(\text{l})$ <i>or</i> $\text{H}_3\text{O}^+(\text{aq}) + \text{OH}^-(\text{aq}) \rightarrow 2\text{H}_2\text{O}(\text{l})$ OH^- (1); rest correct (1); state symbols correct (1).	3
2 (g) (i)	Volume x concentration ($10.0 \times 0.005/1000$) (1); $= 5.0 \times 10^{-5}$ mol (1).	2
2 (g) (ii)	5.0×10^{-5} mol (1).	1
2 (g) (iii)	5.0×10^{-5} /volume (1); $= 5.0 \times 10^{-5} / 24.8/1000 = 2.0 \times 10^{-3}$ mol dm^{-3} (1); 2 sig figs (1).	3
Total mark		32

Question	Expected answers	Marks
3 (a)	Ozone layer filters out/protects Earth from/ absorbs (high energy) radiation that is harmful to life/ damage will allow high energy/harmful radiation through to Earth (1).	1
3 (b) (i)	High energy/UV radiation (1); breaks (covalent) bond in oxygen (molecule)/photodissociation /homolysis of bond occurs (1).	2
3 (b) (ii)	Step 2; reaction is faster, activation enthalpy must be lower (1).	1
3 (c) (i)	Catalyst is in <u>same phase/state</u> as reactants (1).	1
3 (c) (ii)	NO is not used up in the reaction/ NO is reformed /chemically unchanged (1).	1
3 (d)	<i>1 mark for point in bold and any 4 other points from 5:</i> Infrared radiation is absorbed by NO/NO molecule excited by/ NO is given energy (1); NO bond/molecule (1); vibrates (1) <i>more /may answer in terms of higher vibrational energy levels (1); at a specific frequency/wavelength/ allow in terms of 'characteristic absorption' (1); more IR absorbed by higher concentrations of NO / larger peak in IR spectrum/ relationship mark between absorbance and concentration (1).</i> QWC At least two readable and clear sentences with no more than one spelling, punctuation or grammatical error (1).	6
3 (e) (i)	Trichlorofluoromethane (1); <i>allow fluorotrichloromethane and ignore numbers if ones.</i>	1
3 (e) (ii)	C-F bond (is more polar than C- <u>Cl</u> bond) since C-F has greater electronegativity difference (may be given as a number) ORA (1); correct partial charges: $\delta+$ on C & $\delta-$ on one halogen/F is more electronegative/F has the highest electronegativity (1).	2
3 (e) (iii)	CFC ₂ (1); Cl (1).	2
3 (e) (iv)	Bond strength/enthalpy/energy (1).	1
3 (e) (v)	CH ₃ ⁺ and Cl ⁻ ; <i>1 mark for correct charges (if molecules add up to CH₃Cl (1) & 1 mark for correct formulae (1).</i>	2
Total mark		20

Question	Expected answers	Marks
4 (a)	Synthetic fragrances are not seasonal; Much less labour intensive/easier to manufacture; very low yield from natural sources/synthetic (or raw materials for) are more readily available/higher yield; synthetic fragrances are not weather dependant (1).	1
4 (b)	1 mark for each point in bold, 1 mark for any of the other points listed: (Pencil) line near bottom of plate/paper & spot small sample of mixture on line; solvent in beaker below line; plate; cover beaker with lid/film; leave until solvent front nears top of plate; remove and dry plate; use (UV light or iodine) to locate; at least two different spots (5).	5
4 (c)	C ₁₀ O (1); H ₁₈ (1). (1 mark only for C ₁₀ H ₁₇ OH)	2
4 (d) (i)	Linalool: tertiary (1); No H on C to which OH attached/ 3 alkyl groups on C (1); citronellol: primary (1); 2 Hs on C to which OH attached/ 1 alkyl group only on C/at end of chain (1).	4
4 (d) (ii)	Geraniol (1); restricted rotation around C=C /it has different groups which can be arranged in two ways/lack of symmetry around bond AW (1).	2
4 (e)	3 from 4 points: Hydrogen (1); 1 mol H ₂ : 1 mol geraniol (1) unnamed catalyst & heat (and pressure)/Ni cat or Pt/Pd (1); at about 150 °C / room temperature (<i>correct temperature for named catalyst</i>) (1).	3
4 (f) (i)	 <p>May use molecular formula C₁₀H₁₈OBr₄ If MF incorrect in part (c) then ecf. 4 bonded Br atoms (1); rest of molecule correct (1).</p>	2
4 (f) (ii)	addition (1); electrophilic (1).	2
4 (f) (iii)	The C=C bond (1).	1
Total mark		22