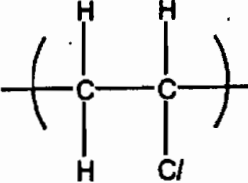



~~MINERALS TO MEDICINES CHEMISTRY OF NATURAL RESOURCES~~

| Question          | Expected answers   | Marks     |
|-------------------|--|-----------|
| 1 (a)(i)          | <p><i>For infrared:</i><br/>bond (1);<br/>vibrates (1); more (or faster) (1);<br/>or moves to higher (1) vibrational level (1);<br/><i>If IR not specified first two marks only (note marks are linked).</i></p> <p><i>For ultraviolet: three points max</i><br/>electron(s) (1);<br/>excited (1) or move to higher energy level (1);<br/>bonds are broken/form radicals (1);<br/>molecules are ionized (1).<br/><i>If UV not specified, one mark only for any effect (5) max.</i><br/>QWC<br/><i>At least two readable and clear sentences with no more than one spelling, punctuation or grammatical error.</i><br/>(1).</p> | 6         |
| (ii)              | Both peaks at same frequency (1);<br>Winter peak smaller than summer peak (1).   | 2         |
| (b)(i)            | Atom or molecule (accept a chemical species, particle or ion) having at least one unpaired/spare/one (NOT free, unshared, single) electron (1).  | 1         |
| (ii)              | <p>Any 3 points from 4:<br/>Absorption/<math>h\nu</math> (1); of ultraviolet/high frequency radiation/light/energy (1);<br/>causes <u>bonds</u> to break or photodissociation (may be shown by an equation) (1);<br/>homolytically (AW)(1).</p>  | 3         |
| (iii)             | Bond enthalpy (1); of C-Cl is smaller than C-F (1).<br>or C-Cl bond is weaker/longer (1) and bond breaks more easily, or a (1).  | 2         |
| (iv)              | $Cl + O_3 \rightarrow ClO + O_2$ (1)<br>$ClO + O \rightarrow O_2 + Cl$ / $ClO + O_3 \rightarrow O_2 + Cl$ (1)<br>Overall: $O + O_3 \rightarrow 2O_2$ / $2O_3 \rightarrow 3O_2$ (1)   | 3         |
| (c)(i)            | Non-linear or bent triatomic molecule drawn (1);<br>order of atoms is ClOCl (1).   | 2         |
| (ii)              | <p>Compares electronegativity (1);<br/>C-O <u>bonds</u> are polar/shown as correct partial charges (1);<br/>Dipoles of bonds do not cancel therefore molecule polar/has similar shape to water/molecule has a dipole (1)</p> <p>OR electronegativity difference is very small (1);<br/><u>bonds</u> are not polar /do not have a dipole (1);<br/>therefore molecule is not polar (1);<br/><i>ect for linear molecule in (c) (i) and stating that dipoles cancel.</i></p>   | 3         |
| <b>Total mark</b> |  | <b>22</b> |
| 3 (a)             | One from polythene (any version), light emitting polymers, conducting polymers, or 'bakelite' (1).   | 1         |
| (b)               | Addition (allow additional/adding polymerisation) (1).   | 1         |
| (c)               | <p>Any 3 points from following 4:<br/>The initiator produces radicals (1);<br/>which cause a chain reaction/cycle of reactions (1);<br/>in which radicals are reformed/propagated/regenerated/reproduced (1);<br/>until terminated (1).</p>  | 3         |

|                   |  |           |
|-------------------|--|-----------|
| (d)               | <p>Particles/molecules <u>collide</u> (1);<br/> with energy (1);<br/> lower/greater than activation enthalpy/energy, AW (1);<br/> fewer/greater number of collisions are successful, AW (1).</p> <p><b>QWC</b><br/> 1 mark for two sentences / 2 bullet points including correct use of two of the following words:<br/> <i>activation enthalpy (energy), collisions/collide, (kinetic) energy, particles/molecules.</i></p> | 5         |
| (e)               |  <p>(1) <i>brackets not essential but spare bonds are.</i></p>  | 1         |
| (f)               | <p>PTFE more flexible because polymer chains can slide over each other more easily (1);<br/> chains don't tangle/are stereoregular (1).</p>  | 2         |
| (g)(i)            |  <p>1 mark for each structure.</p>  | 2         |
| (ii)              | (Thin layer) chromatography/(fractional) distillation (1).   | 1         |
| <b>Total mark</b> |  | <b>16</b> |
| 4 (a)(i)          | $5 \text{ ppm in } 5 \times 10^5 \text{ dm}^3 = 5 \times 5 \times 10^5 / 10^8 = 2.5 \text{ dm}^3$ (1).   | 1         |
| (ii)              | <p>molecules = <math>(2.5 / 24.0 \times 6.02 \times 10^{23}) = 6.27 \times 10^{22}</math> (1)<br/> 1 mark for ratio of volumes (2.5/ 24.0)</p>   | 2         |
| (b)               | (Permanent) dipole-(permanent) dipole forces (1) ( <i>accept pd-pd</i> ).  | 1         |
| (c)(i)            | <p>1 mark for both full structural formulae (<math>\text{CH}_3\text{OH}</math> and <math>\text{CH}_3\text{Br}</math>) <i>accept</i> <math>-\text{OH}</math> group;<br/> 1 mark for rest correct: <math>\text{CH}_3\text{OH} + \text{HBr} \rightarrow \text{CH}_3\text{Br} + \text{H}_2\text{O}</math></p>  | 2         |
| (ii)              | nucleophilic (1); substitution (1).  | 2         |
| (d)(i)            | Iodomethane because it is a liquid. (1).   | 1         |
| (ii)              | Iodomethane is a bigger molecule/has a higher boiling point/higher mass or it has more electrons (1).  | 1         |
| (e)(i)            | <p>Any 3 points from 4:<br/> Ppt (1);<br/> yellowish-(green) for <math>\text{CH}_3\text{I}</math> (1);<br/> creamy/off-white for <math>\text{CH}_3\text{Br}</math> (1);<br/> yellow ppt appears before cream ppt (AW) (1).</p>   | 3         |
| (ii)              | Ethanol is a solvent (1)<br>allows reactants to mix (1);   | 2         |
| (iii)             | <p><math>\text{Ag}^+(\text{aq}) + \text{I}^-(\text{aq}) \rightarrow \text{AgI}(\text{s})</math><br/> 1 mark for iodide ion, 1 mark for correct balanced equation, 1 mark for state symbols.</p>  | 3         |
| (iv)              | <p>Carbon-halogen bond is broken in the reaction (<i>may be implied</i>) (1);<br/> C-Br bond is stronger than a C-I bond or C-I is easier to break than C-Br bond (<i>a comparison mark</i>) (1).</p>  | 2         |
| <b>Total mark</b> |  | <b>20</b> |