Solutions

Marking: **M1** a correct method, **A1** the correct answer, **B1** an independent mark.

Each answer shows the steps, then the **result**.

2.1

a species with an unpaired electron; the bond breaks and each atom takes one of the two electrons

2.2

$Cl_2 \rightarrow 2Cl^{\bullet}$; UV light; it provides the energy to break the Cl–Cl bond

2.3

$Cl^{\bullet} + CH_4 \rightarrow CH_3^{\bullet} + HCl$; $CH_3^{\bullet} + Cl_2 \rightarrow CH_3Cl + Cl^{\bullet}$; the $Cl^{\bullet}$ used is made again, so the cycle repeats many times

2.4

any two: $Cl^{\bullet} + Cl^{\bullet} \rightarrow Cl_2$; $CH_3^{\bullet} + Cl^{\bullet} \rightarrow CH_3Cl$; $CH_3^{\bullet} + CH_3^{\bullet} \rightarrow C_2H_6$; two radicals are used up and no new radical forms

2.5

$Cl^{\bullet}$ can also remove H from chloromethane, so further substitution happens; e.g. CH_2Cl_2 / $CHCl_3$ / CCl_4

3.1

(a) $C_2H_6 + Br_2 \rightarrow C_2H_5Br + HBr$

(b) (radical) substitution

(c) $Br_2 \rightarrow 2Br^{\bullet}$; $Br^{\bullet} + C_2H_6 \rightarrow C_2H_5^{\bullet} + HBr$; $C_2H_5^{\bullet} + Br_2 \rightarrow C_2H_5Br + Br^{\bullet}$

(d) UV light is needed to break the Br–Br bond and make radicals

(e) termination: two ethyl radicals join, $C_2H_5^{\bullet} + C_2H_5^{\bullet} \rightarrow C_4H_{10}$