Section 3 Organic chemistry 1
Answers to practice questions

Question number	Answer	Marks	Guidance
1 (a) (i)	**M1 Initiation** $Cl_2 \rightarrow 2Cl\bullet$ **M2 First propagation** $Cl\bullet + CHF_3 \rightarrow CF_3\bullet + HCl$ **M3 Second propagation** $Cl_2 + CF_3\bullet \rightarrow CClF_3 + Cl\bullet$ **M4 Termination (must make C2F6)** $2\ CF_3\bullet \rightarrow C_2F_6$ or CF_3CF_3	4	Penalise absence of dot once only. Penalise + or – charges <u>every time</u> Credit CF3 • with the radical dot above / below / to either side. Mark independently.
1 (a) (ii)	ultra-violet / uv / sun light **OR** (very) high temperature **OR** 500 °C ≤ T ≤ 1000 °C **OR** 773 K ≤ T ≤ 1273 K	1	
1 (b)	M_r of $CClF_3$ = 104.5 Moles of $CClF_3$ = $\frac{2.09\times10^{-4}\times10^{8}}{104.5} = 0.002$ Number of molecules = $0.002 \times 6.03 \times 10^{23} = 1.20 \times 10^{21}$ Molecules in 500 cm^3 = $\frac{(1.20\times10^{21}\times500\times10^{-6})}{200} = 3.00\times10^{15}$	1 1 1	Allow answers 3.00×10^{15} to 3.01×10^{15}
2 (a)	Crude oil **OR** petroleum Fractional distillation / fractionation	1 1	Not petrol. Not distillation alone.
2 (b)	$C_{12}H_{26} + 12.5O_2 \rightarrow 12CO + 13H_2O$	1	Allow balanced equations that produce CO_2 in addition to CO Accept multiples.
2 (c) (i)	M1 Nitrogen and oxygen (from air) react / combine / allow a correct equation M2 at high temperatures	1 1	If nitrogen from petrol / paraffin / impurities CE=0/2 Allow temperatures above 1000 °C or spark. Not just heat or hot. M2 dependent on M1 But allow 1 mark for nitrogen and oxygen together at high

			temperatures.
2 (c) (ii)	$2NO + O_2 \rightarrow 2NO_2$	1	Allow multiples.
2 (c) (iii)	$4NO_2 + 2H_2O + O_2 \rightarrow 4HNO_3$	1	Allow multiples.
2 (d) (i)	C_nH_{2n+2} C_nH_{2n+2}	1	Allow C_xH_{2x+2} Allow C_xH_{2x+2}
2 (d) (ii)	$C_{12}H_{26} \rightarrow C_6H_{14} + C_6H_{12}$ C_3H_7 Zeolite / aluminosilicate(s)	1 1 1	Only. Only. Ignore aluminium oxide.
2 (d) (iii)	Larger molecule / longer carbon chain / more electrons / larger surface area More / stronger van der Waals' forces between molecules	1 1	 Allow dispersion forces / London forces / temporary induced dipole-dipole forces between molecules. If breaking bonds, CE = 0/2
2 (e)	2,2,3,3,4,4-hexamethylhexane Chain	1 1	Only. Ignore punctuation. Ignore branch(ed).
2 (f)	Cl_2 Cl–Cl	1	Only. Not CL_2 or Cl2 or CL2 or Cl^2 or CL^2 Ignore Chlorine.
3 (a)	Fractional distillation / fractionation / GLC / gas liquid chromatography	1	
3 (b)	C_4H_{10} Because it has a higher bp / has stronger IMF / larger molecule / longer chain / larger surface (area)	1	Need C_4H_{10} **and** the reason for the mark
3 (c)	$C_4H_{10} + 6½\ O_2 \rightarrow 4CO_2 + 5H_2O$	1	Accept multiples Ignore state symbols
3 (d)	CO_2 or H_2O evolved is a greenhouse gas / CO_2 or H_2O evolved contribute to global warming / the products are greenhouse gases	1	Ignore climate change
3 (e)	$CH_3CH_2CH_2CH_3 + 3.5O_2 \rightarrow C_2H_2(CO)_2O + 4H_2O$	1	Accept multiples Allow with or without a number 1

			before the organic molecules
3 (f) (i)	$C_2H_5SH + 4.5O_2 \rightarrow 2CO_2 + 3H_2O + SO_2$	1	Accept multiples
3 (f) (ii)	Calcium oxide / calcium carbonate Neutralises the SO_2 / acid base reaction / it is a base	1 1	Allow any base or alkali Allow correct formulae Can only score M2 if base or alkali used in M1 Allow M2 if blank in M1
3 (f) (iii)	Ethanol contains Hydrogen bonding Which is stronger than IMF (VDW / dipole-dipole forces) in ethanethiol/ (H bonding) is the strongest IMF	1 1	Breaking covalent bonds CE = 0/2 Only award M2 if M1 given, but allow IMF in ethanol are stronger than in ethanethiol for maximum 1 mark
3 (g) (i)	(2,2-)dimethylpropane	1	Ignore punctuation
3 (g) (ii)	Because molecule is smaller / less polarisable / has less surface (area)/ is more spherical / molecules can't get as close to one another (to feel the vdW forces) vdW intermolecular forces or vdW force between molecules are weaker or fewer	1 1	Allow converse answers referring to straight chain isomers CE = 0/2 if breaking bonds Need vdW rather than just IMF
3 (g) (iii)	1 or one	1	
3 (h) (i)	C_9H_{20}	1	$H_{20}C_9$
3 (h) (ii)	Thermal (cracking) High pressure AND high temperature ***OR*** Pressure of ≥ 10 atm, ≥ 1 MPa ≥ 1000 kPa AND temp of 400 °C ≤ T ≤ 1000 °C or 650 K ≤ T≤ 1300 K	1 1	If not thermal cracking CE = 0/2 If blank mark on Allow high P and T Do not allow high heat If no units for T, then range must be 650-1000