

Mark Scheme - 2.5 Crude Oil, Fuels and Organic Chemistry

1.

Mark	Guidance
6	<p>Indicative content: This method of separation is called fractional distillation. Crude oil is a mixture of hydrocarbons. The crude oil is heated and vaporised before entering the column. Smaller/lower boiling hydrocarbons will rise in the column and condense higher up the column. Hydrocarbons with similar boiling points condense at the same level in the column. (Boiling point depends on the size of the molecule – larger molecules have higher boiling points.)</p> <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

2.		Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)			2	remains of sea / marine organisms / small sea animals / small plants (1) from millions of years ago / under the effect of heat/pressure / no oxygen (1)			
(b)	(i)		1	evaporated / vaporised	boiled		
	(ii)		1	different boiling points			
(c)			2	nitrogen (1) it has the lowest boiling point (1) do not award second mark if incorrect gas named			

3.		Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)			2	fractions have different length of hydrocarbon / chains / relative mass / M_r (1) must be correct to award second mark which have different boiling points (1)			
(b)			4	conditions – heat / catalyst (1) explanation <ul style="list-style-type: none"> breaks down large / less useful fractions into smaller more useful ones increases amount of fuels obtained from the crude oil produces raw materials or monomers for use in making plastics less waste / more profit any three for (1) each up to max 3	break bonds between C atoms products more useful than reactants		

4.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		2	over millions of years (1) remains of marine organisms (1)	missing 'marine' reference if pressure / heat mentioned		
(b)	(i)	2	as the molecule size increases - the boiling point (range) increases / (colour) darkens / becomes more viscous / more difficult to burn / flame becomes more smoky any two for (1) each	inverse statement		
	(ii)	2	temperature lower during the winter (1) propane easier to ignite (1) butane becomes liquid at low temperature / difficult or problems for the butane to flow (1) any two for (1) each			

5.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		1	a compound containing hydrogen and carbon only			mixture
(b)		1	each fraction collected across a range of temperatures / several compounds have similar boiling points		melting points	
(c)	(i)	1	(catalytic) cracking			
	(ii)	1	polymerisation			
(d)		2	double bond breaks / turns in to single bond (1) molecules join together to form (long) chains (1)			
(e)		1	non-biodegradable / increased use of landfill / depletion of raw materials produce toxic / harmful gases when burned	can harm wildlife	'harmful' – unless linked to burning	

6.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	1	compound that contains hydrogen and carbon only			mixture
	(ii)	2	decaying / remains of / dead (marine) organisms (1) heat / pressure over millions of years (1) must have reference to organisms/correct context to award second mark			
(b)	(i)	1	bitumen and naphtha	recalled knowledge e.g. wax		
	(ii)	2	22% (2) award (1) for 156 or 44 ecf possible for incorrect addition (must divide by 2)			
	(iii)	I	1	cracking		
		II	1	polymerisation		

7.

Mark	Answer
6	<p>Indicative content Many fossil fuels contain impurities including sulfur. The sulfur produces sulfur dioxide during combustion which can eventually produce sulfuric acid resulting in acid rain. Lakes can then become acidic damaging aquatic life. Forests and vegetation gets damaged. Limestone buildings are badly affected. Acid rain also attack metal structures such as bridges.</p> <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

8.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	1	carbon, sulfur and hydrogen	C, S and H	H ₂ oxygen	
	(ii)	1	(fuels that) cannot be replaced (when they are used up) / (fuels that) will run out		'limited amount' needs qualification	
(b)	(i)	1	$2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$			
	(ii)	1	produces a '(squeaky) pop' noise when tested with a lighted splint		'pop test'	
	(iii)	2	(large amount of) electricity required to produce hydrogen (1) (storage problem due to its) explosive nature (1)	availability of hydrogen e.g. lack of service stations for vehicles	highly flammable / unsafe / unstable / expensive	

9.

Mark	Answer
6	<p>Indicative content Many fossil fuels contain impurities including sulfur. The sulfur produces sulfur dioxide during combustion which can eventually produce sulfuric acid resulting in acid rain. Lakes can then become acidic damaging aquatic life. Forests and vegetation gets damaged. Limestone buildings are badly affected. Acid rain also attack metal structures such as bridges.</p> <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

10.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		3	mass carbon and hydrogen divided by respective A_r values e.g. carbon 9/12 and hydrogen 2/1 (1) ratio of 3:8 (1) C_3H_8 (1) ecf possible if formula given is an alkane award (1) mark only for correct answer with no working			
(b)		2	$M_r(C_4H_{10}) = 58$ (1) $(48/58) \times 100 = 82.76$ (1) consequential marking	82.8 / 83		

11.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	2	<p>increased (fossil) fuel consumption / burning more (fossil) fuels causes (1)</p> <p>increased carbon dioxide emissions / more carbon dioxide formed (1)</p> <p>[Credit (1) for 'burning (fossil) fuels forms carbon dioxide' when no reference made to increase]</p>	accept named fossil fuel	deforestation	reference to 'ozone layer' or 'acid rain'
(b)	1	<p>Any one from:</p> <p>sea level rises / flooding</p> <p>destruction of habitats / kills wildlife</p>	accept named animal e.g. polar bears decrease in number / nowhere for polar bears to live		
(c)	2	<p>Any two sensible disadvantages, e.g.</p> <p>separation issues: cost (of separation)</p> <p>transport issues: road – burns fuels pipeline – cost, hazards</p> <p>storage issues: leakage back into the atmosphere / dissolves into the sea / increases acidity</p> <p>unproven</p> <p>only power stations – other sources not addressed</p> <p>other options available</p>			

12.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		3	<p>coal contains sulfur impurities (1)</p> <p>(impurities burn to produce sulfur dioxide) which dissolves in rainwater to produce acid rain (1)</p> <p>acid rain kills fish / trees / erodes limestone statues or buildings / causes metals to rust quicker (1)</p>		kills marine life	ozone layer global warming
(b)	(i)	2	<p>as the amount of coal burnt increases the emission of sulfur dioxide decreases / more coal used as time goes on but less sulfur dioxide released (1)</p> <p>would expect more sulfur dioxide to be released as more coal is burnt (1)</p>			
	(ii)	1	<p>(introduction of techniques to remove sulfur dioxide from smoke) e.g. sulfur scrubbing coal burnt has lower sulfur content</p>	sulfur dioxide neutralised / reacted with limestone	new technology	carbon capture and storage

13.



Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	1	2×10^6	2000000 2 million		2
	(ii)	2	(1) for a reason and (1) for linked explanation sulfur scrubbing / react with lime / with sea waterremoves sulfur dioxide / neutralises sulfur dioxide use cleaner fuelsremove sulfur from oil / gas / fuel use coal / fuel containing less sulfur use less coalgreater use of alternative energy sources which do not produce sulfur dioxide			
	(iii)	1	$2\text{SO}_2 + 2\text{H}_2\text{O} + \text{O}_2 \longrightarrow 2\text{H}_2\text{SO}_4$			
(b)	(i)	1	neutralisation		exothermic	
	(ii)	2	(adding limestone) increases the pH (1) (higher the pH the) lower the acidity (1) <i>i.e. relationship between pH and acidity</i>	goes from 3.4 → 4.3 'weaker' the acidity		
	(iii)	1	increased lake acidity / decreased pH of lakes increased soil acidity / decreased pH of soil destruction of trees / fish killed / destruction of food chains / destruction of food webs increased metal corrosion (e.g. bridges)	lakes = reservoirs / ponds / rivers	'harmful to nature' 'marine life'	drinking water

14.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		1	$C_nH_{2n+1}OH$	$C_nH_{2n+2}O$		
(b)		2	$ \begin{array}{ccccccc} & H & H & H & & & \\ & & & & & & \\ H & -C & -C & -C & -O & -H & \\ & & & & & & \\ & H & H & H & & & \end{array} $ (1)	$CH_3CH_2CH_2OH$		
			$ \begin{array}{ccccccc} & H & H & H & & & \\ & & & & & & \\ H & -C & -C & -C & -H & & \\ & & & & & & \\ & H & OH & H & & & \end{array} $ (1)	$ \begin{array}{c} CH_3CH_2CH_3 \\ \\ OH \end{array} $		
(c)		2	propene	(1)		
			$ \begin{array}{ccccccc} & H & H & H & & & \\ & & & & & & \\ H & -C & =C & -C & -H & & \\ & & & & & & \\ & & & H & & & \end{array} $ (1)			

15.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		3	methane (1)			
			C_3H_8 (1)			
			$ \begin{array}{cccc} H & H & H & H \\ & & & \\ H-C & -C & -C & -C-H \\ & & & \\ H & H & H & H \end{array} $ (1)			
(b)	(i)	1	A			
	(ii)	1	E			

16.		Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		1	 atoms must be touching			
	(ii)		1	NH ₃	H ₃ N		
(b)	(i)		1	O ₂ / He / Ne <i>any two</i>	oxygen / helium / neon		O
	(ii)		1	CO ₂ / CH ₄ / SO ₂ <i>any two</i>	carbon dioxide / methane / sulfur dioxide		
(c)	(i)		1	1			
	(ii)		1	5			
(d)	(i)		1	Mg ²⁺ Cl ⁻ <i>both ions needed (including charges)</i>	2Cl ⁻		Cl ₂ ⁻
	(ii)		1	NaOH	Na ⁺ OH ⁻		

17.		Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	(three) factors needed for a fire to burn / fire goes out if any one factor is removed	heat, oxygen and fuel are needed		
(b)			3	removes air / oxygen (1) removes heat (1) removes fuel (1)			
(c)			1	water			

18.

Mark	Guidance
6	<p>Indicative content: Reference to <i>principle</i> of fire triangle – fuel, heat and air (oxygen) are needed, removing any one factor will put fire out</p> <p>Types of fire fighting methods related to examples</p> <ul style="list-style-type: none">• heat removed by water e.g. house fires, bonfires• air removed:<ul style="list-style-type: none">○ fire blanket e.g. chip pan fire, person on fire○ CO₂ / powder e.g. indoor fires, chemical fire, electrical fire○ foam e.g. aeroplane fire• fuel removed:<ul style="list-style-type: none">○ fire-break e.g. forest fire○ gas supply switched off e.g. natural gas fire <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

19.	Mark	Answer	Accept	Neutral answer	Do not accept
	6	<p>three different methods needed award max (2) for each method</p> <p>use water (1) remove heat (1)</p> <p>'beat' (1) remove air/oxygen (1)</p> <p>bulldoze/back burn / backfire / making a firebreak (1) remove fuel (1)</p> <p>method must be correct for second mark to be awarded</p>			CO ₂ extinguisher / fire blanket as a method of removing oxygen in this context

20.	Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
	(a)	1	C ₃ H ₆		CH ₂ CHCH ₃	
	(b)	1	$ \begin{array}{ccccc} & \text{H} & \text{H} & \text{H} & \\ & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & \\ & \text{H} & \text{H} & \text{H} & \end{array} $			
	(c)	3	<ul style="list-style-type: none"> double bond opens (1) R ethene molecules join together long chain / single chain formed / polymer formed addition reaction/ addition polymerisation <p>any two for (1) each</p>		<p>becomes single bond loses double bond</p> <p>'additional'</p>	

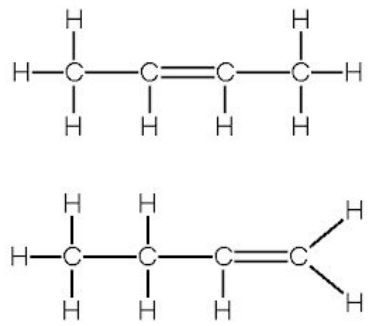
21.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		3	$ \begin{array}{ccccc} & \text{H} & \text{H} & \text{H} & \\ & & & & \\ \text{H} & - \text{C} & - \text{C} & - \text{C} & - \text{H} \\ & & & & \\ & \text{H} & \text{H} & \text{H} & \end{array} $ (1) C_6H_{14} (1) methane (1)			
(b)	(i)	1	ethene	C_2H_4		polyethene
	(ii)	1	monomers		unsaturated	
(c)	(i)	1	polytetrafluoroethene	PTFE		
	(ii)	1	$ \begin{array}{cc} \text{F} & \text{F} \\ & \\ - \text{C} & - \text{C} - \\ & \\ \text{F} & \text{F} \end{array} $		ignore brackets	

22.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	4	<p><i>Name</i> propene (1)</p> <p><i>Molecular formula</i> CH₄ (1)</p> <p><i>Structural formula</i></p> $ \begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ & & & \\ \text{H}-\text{C} & -\text{C} & -\text{C} & -\text{C}-\text{H} \\ & & & \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array} $ <p>(1)</p> <p><i>Family of hydrocarbons – both needed</i> (1)</p> <p>alkane</p> <p>alkene</p>			
(b)	2	<p>double bond breaks / changes to single bond (1)</p> <p>many ethene molecules join together / form long chain or polymer (1)</p>			
(c)	1	$ \begin{array}{cc} \text{F} & \text{F} \\ & \\ \text{C} & =\text{C} \\ & \\ \text{F} & \text{F} \end{array} $ <p>ignore 'n' and any brackets used</p>			

23.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	1	either of following 	correct structure for 2-methylpropene		
(b)	4	double bonds open (1R) Reserved mark <ul style="list-style-type: none"> propene molecules join together / form chains (1) (addition) polymerisation (1) repeat unit $\left[\text{C}_3\text{H}_6 \right]_n$ (1) any 2 of high temp / high pressure / catalyst (1) any 3 up to 3 max			condensation polymerisation

24.		Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)			1	C_4H_{10}			
(b)			2	propane (1) $ \begin{array}{ccccccc} & H & & H & & H & \\ & & & & & & \\ H & - C & - & C & - & C & - H \\ & & & & & & \\ & H & & H & & H & \end{array} $ (1)			
(c)			1	C_3H_6			

25.		Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)		2	$ \begin{array}{c} H \\ \\ H - C - H \\ \\ H \end{array} $ (1) C_2H_6 (1)			
	(ii)		1	C_8H_{18}			
(b)	(i)		1	ethanol		alcohol	
	(ii)		1	C			
	(iii)		1	wine / beer / alcoholic drinks fuels / biofuels solvents antibacterial gels perfumes / aftershaves any one for (1)		alcohol / drinking / drinks / medicine / cleaning	

26.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a) (i)	2	A and C - both needed (1) B and D - both needed (1)	correct formulae/names for both correct formulae/names for both		
(ii)	1	E	propene		
(b)	1	$C_{10}H_{22}$	$H_{22}C_{10}$		

27.

Sub-section	Mark	Answer	Accept	Neutral answer	Do not accept
(a) (i)	1	C_8H_{18}			
(ii)	2	$\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{CH}_2-\text{CH}-\text{CH}_3 \end{array} \quad (1)$ $\begin{array}{c} \text{CH}_3 \\ \\ \text{CH}_3-\text{C}-\text{CH}_3 \\ \\ \text{CH}_3 \end{array} \quad (1)$			
(b) (i)	1	C_nH_{2n}			
(ii)	1	$\begin{array}{c} \text{H} \quad \text{H} \quad \text{H} \\ \quad \quad \\ \text{H}-\text{C}=\text{C}-\text{C}-\text{H} \\ \\ \text{H} \end{array}$			
(c)	1	B contains C=C peak both needed for (1)			

28.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		2	alcohols (1) alkenes (1)			
(b)		2	add bromine water (1) stays brown/orange/no reaction with C and E turns from brown/orange to colourless (1)	add bromine		red
(c)	(i)	1	same molecular formula but different structure	same type and number of atoms but arranged differently	same atoms	same compound
	(ii)	1	$ \begin{array}{ccccc} & \text{H} & & \text{H} & & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & & & & \text{H} \\ & & & & & \\ & & & \text{H} - \text{C} - \text{H} & & \\ & & & & & \\ & & & \text{H} & & \end{array} $			
(d)		2	D (1)			
			$ \begin{array}{ccccc} & \text{H} & & \text{OH} & & \text{H} \\ & & & & & \\ \text{H} & - \text{C} & - & \text{C} & - & \text{C} & - \text{H} \\ & & & & & \\ & \text{H} & & \text{H} & & \text{H} \\ & & & & & \\ & & & & & (1) \end{array} $	ether isomer of B or D		

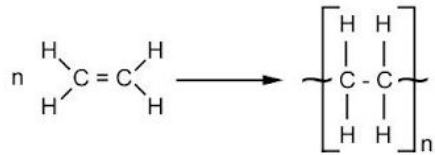
29.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	1	polytetrafluoroethene / PTFE		Teflon	
	(ii)	I	1			
		II	1			additional
(b)		2	<p>both have long or large molecules / long chains of carbon atoms / polymer chains (1)</p> <p>(only) thermosets have crosslinking / strong bonds between chains (1)</p>			reference to layers

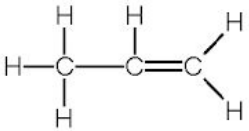
30.

Mark	Answer
6 QWC	<p>Indicative content</p> <ul style="list-style-type: none">• ethene (monomer) contains a C=C bond/ ethene (monomer) is unsaturated• double bonds in ethene molecules 'open'• ethene molecules join together• long chain molecule formed/ polymer formed/ single molecule formed• balanced symbol equation, showing repeating unit• monomer & repeating unit, for example, for polypropene from propene/ PVC from chloroethene / polytetrafluoroethene from tetrafluoroethene <p>5-6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar.</p> <p>3-4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar.</p> <p>1-2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar.</p> <p>0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.</p>

31.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	2	$C_2H_4 + Br_2$ (1) $C_2H_4Br_2$ (1)			
	(ii)	1	orange solution turns colourless			ethene goes colourless
(b)	(i)	3	 <p>(3) for correct equation</p> <p>otherwise double bond breaks in ethene (1) large number of molecules join together (1) to form a long chain polymer (1)</p>			
	(ii)	2	speeds up the rate of the reaction (1) reduces energy required (for collision to be successful) (1)	reduces activation energy		
(c)		4	A = thermoplastic / thermosoftening plastic B = thermoset both needed for (1) weak or no bonds between chains in A (1) bonds formed between chains in B (1) allowing chains of A to move over each other / chains of B cannot move over each other (1)	crosslinks		award (2) max for explanation if any reference to layers

32.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		1	shape memory polymer → regains original shape when heated thermoplastic → softens when heated thermoset → does not change when heated			
(b)	(i)	1	ethene		C ₂ H ₄ alkene	
	(ii)	2	D (1) fluorine atoms present / hydrocarbons include carbon and hydrogen atoms only / doesn't contain hydrogen atoms (1)			
	(iii)	2	B (1) it has a double bond (1)	ethene it is unsaturated		
(c)		1				

33.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)	(i)	1	flexible / low density / water proof		non-toxic light	unreactive
	(ii)	1	rigid / non-toxic / low density / good insulator		unreactive	easily squashed
(b)		3	they are non-biodegradable / don't rot (1) build up in landfill (1) burning produces toxic / harmful fumes (1) can harm wildlife (1) - up to (2) max recycling / reusing / use biodegradable plastics (1)	reference to oil being finite resource	litter ‘bags for life’	
(c)		4	reactive (1) monomer (1) polymerisation (1) polymer (1)			

34.

Sub-section		Mark	Answer	Accept	Neutral answer	Do not accept
(a)		2	$100 \times 4.2 \times 30$ (1) 12600 (1) award (2) for cao			
(b)		1	same height between flame and can same can/same wick/ same spirit burner same stirring (or not) not using a lid for all alcohols changing the water each time / using cold water each time any one for (1)		same room temperature / conditions	
(c)		3	theoretical values greater (than experimental values) (1) both values increase down alcohol group (1) loss of heat to the surroundings / can (1)	rank order the same		
(d)		2	two linked points required e.g. biofuels have a lower energy output than traditional fuels (1) and therefore require greater quantities to be consumed (in order to produce the same amount of energy) (1) credit sensible alternatives uses land that would otherwise be used to grow food crops (1) leading to food shortage/price increase (1) growth requires large amounts of water (1) which is therefore not available for other uses (1)			