

Crude oil, fuels and other useful substances from crude oil

Mark scheme

1. (a) (i) the greater the number (of carbon atoms), the higher its boiling point 1
do not accept hydrocarbons for carbon atoms
allow converse
allow melting point
- (ii) accept answers in the range 344 to 350 1
- (iii) 216 1
- (b) (i) **EITHER**
 shortage of petrol **or** demand for petrol is higher than supply 1
 diesel is in excess **or** supply of diesel is higher than demand 1
OR
 petrol low supply **and** diesel high supply (1)
 petrol high demand **and** diesel low demand (1)
petrol / diesel not specified = max 1
- (ii) any **one** from: 1
- use diesel to make petrol
accept crack diesel or description of cracking
 - make diesel cheap(er) (than petrol) **or** make petrol more expensive
accept lobby the government to reduce the tax on diesel / increase tax on petrol
 - mix ethanol with petrol
ignore biodiesel
- [6]
2. (a) any **two** environmental problems with linked explanations
- global warming (1)
accept effects of global warming
 caused by (formation of) carbon dioxide / greenhouse gas (1)
ignore greenhouse effect
 - acid rain (1)
accept effects of acid rain; ignore respiratory problems
 caused by (formation of) sulfur dioxide (1)
accept sulfur oxide; ignore sulfuric acid
 - global dimming (1)
ignore respiratory problems
 caused by (formation of) particles / particulates / fires / smoke / carbon / pm 10 (1)
 - scarring of landscape (1)
 caused by mining / quarrying of coal (1) max 4
ignore ozone layer
- (b) any **three** from:
- replant the trees / renewable / sustainable
ignore reusable
 - carbon dioxide is used by the trees / photosynthesis
accept trees absorb carbon dioxide as they grow

- do **not** allow respiration
- it's a (continuous carbon) cycle
accept 'carbon dioxide goes back into the air'
accept trees use CO₂ which is released when trees are burnt
- no 'new' carbon (dioxide) is produced
or no locked up carbon (dioxide) is released
accept no carbon (dioxide) from fossil fuels is produced

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[7]

3. (a) any **two** from:
- naphtha has a different / low(er) boiling point
accept different volatility
 - condenses at a different temperature / height / place in the column /when it reaches it's boiling point
 - different size of molecules
- (b) (i) C₁₀H₂₂ → C₆H₁₄ + 2C₂H₄
allow multiples
- (ii) (hydrocarbon) heated / vapours
(passed over a) catalyst / alumina / porous pot
ignore other catalysts
- (iii) it / ethene is unsaturated or decane and hexane / they are saturated
accept decane and hexane are alkanes / C_nH_{2n+2}
or ethene is an alkene / C_nH_{2n}
or different homologous series / general formula
- ethene has a double (carbon carbon) bond
or decane and hexane have only single (carbon carbon) bonds
accept ethene has a reactive double (carbon carbon) bond for 2 marks
- (c) all bonds drawn correctly
- $$\begin{array}{cc} \text{H} & \text{H} \\ | & | \\ \text{C} = & \text{C} \\ | & | \\ \text{H} & \text{H} \end{array}$$
- (d) **economic argument** against recycling
- any **one** from:
- poly(ethene) / plastic must be collected / transported / sorted / washed
 - this uses (fossil) fuels which are expensive
- environmental argument against recycling
- any **one** from:
- uses (fossil) fuels that are non-renewable / form CO₂ / CO / SO₂ / NO_x / particulates
ignore pollution / harmful gases / etc
 - washing uses / pollutes water
- counter arguments**
- any **two** from:
- collect / transport alongside other waste
 - use biofuels (instead of fossil)
 - landfill is running out

2

1

1

1

1

1

1

1

1

2

- landfill destroys habitats
- incinerators are expensive to build
- saves raw materials / crude oil
- saves energy needed to make new plastic
- incinerators may produce harmful substances
- incinerator ash goes to landfill
- poly(ethene) is non-biodegradable
- poly(ethene) can be made into other useful items
- more jobs / employment for people

[12]

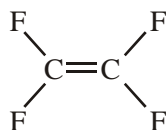
4. (a) (i) by (fractional) distillation 1
accept a description of the distillation process (heat and how separation works)
*eg heat **and** condense; accept boil / vapourise etc for heat*
- or**
- fractionation
- (ii) CO₂ 1
note the order of these products must be correct
- H₂O 1
wrong way round = 1 mark
- (b) (i) (hexane) has been broken down (into smaller hydrocarbons / molecules) 1
accept (thermal) decomposition / cracked / split / broken up owtte
- (ii)
$$\begin{array}{c} \text{H} \\ | \\ \text{C} \\ | \\ \text{H} \end{array} = \begin{array}{c} \text{H} \\ | \\ \text{C} \\ | \\ \text{H} \end{array}$$
 1
accept CH₂ = CH₂
- (iii) water / hydrogen oxide / steam 1
accept H₂O
- (c) candidates must include both sugar cane and crude oil in their evaluation **and** both an advantage and a disadvantage to gain full marks. If they do not then the maximum mark is three
- any **four** from: 4
- advantages of using sugar
- country has no wealth to buy (large quantities of) crude oil
not 'expensive' alone
 - country has limited technological development **or** underdeveloped / third world country
 - able / suitable climate to grow sugar cane
 - enough land to grow sugar cane / land cannot be used to grow food / deforestation
 - sugar is a renewable source **or** crude oil is a non-renewable resource / finite resource / limited resources
 - CO₂ / carbon neutral
- advantages of using alkanes:
- economic costs are low

- continuous process
- country has large oil resources
- country has oil refineries / cracking plants
- very pure product
- faster process

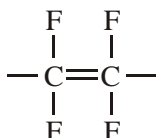
[10]

5. (a) poly(tetrafluoroethene) **or** polytetrafluoroethene 1
accept PTFE or Teflon

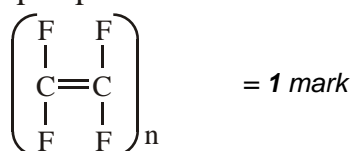
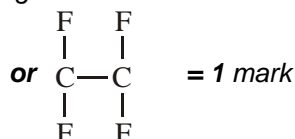
(b) double bond 1



all other atoms and bonds correct including F for fluorine 1



ignore n in front



do not accept structures with more than 2 C atoms

(c) any **three** from: 3

- many monomers / (small) molecules / tetrafluoroethene molecules
allow many tetrafluoroethenes
many particles alone is insufficient
do not accept many polymers
- (monomers, molecules etc.) join / bond / link / combine / attach
allow many particles join
allow many atoms join
do not accept collide / add ignore polymerise
do not accept many polymers join
- to form one molecule **or** to form a long-chain **or** to form a large molecule
- no other substances are produced / one substance formed (definition of addition)
- idea of double bond breaking / opening / opens / bond being used to join to another molecule **or** the double bond becomes a single bond

[6]