

Crude oil, fuels and other useful substances from crude oil

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 CO<sub>2</sub> which is released when trees are burnt*
- no 'new' carbon (dioxide) is produced  
**or** no locked up carbon (dioxide) is released 3  
*accept no carbon (dioxide) from fossil fuels is produced*

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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 2
- (b) (i)  $C_{10}H_{22} \rightarrow C_6H_{14} + 2C_2H_4$  1  
*allow multiples*
- (ii) (hydrocarbon) heated / vapours 1  
(passed over a) catalyst / alumina / porous pot 1  
*ignore other catalysts*
- (iii) it / ethene is unsaturated **or** decane and hexane / they are saturated 1  
*accept decane and hexane are alkanes / C<sub>n</sub>H<sub>2n+2</sub>*  
*or ethene is an alkene / C<sub>n</sub>H<sub>2n</sub>*  
*or different homologous series / general formula*
- ethene has a double (carbon carbon) bond 1  
**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 1
- $$\begin{array}{cc} \text{H} & \text{H} \\ | & | \\ \text{C} = & \text{C} \\ | & | \\ \text{H} & \text{H} \end{array}$$
- (d) **economic argument** against recycling
- any **one** from: 1
- poly(ethene) / plastic must be collected / transported / sorted / washed
  - this uses (fossil) fuels which are expensive
- environmental argument against recycling
- any **one** from: 1
- uses (fossil) fuels that are non-renewable / form CO<sub>2</sub> / CO / SO<sub>2</sub> / NO<sub>x</sub> / particulates  
*ignore pollution / harmful gases / etc*
  - washing uses / pollutes water
- counter arguments**
- any **two** from: 2
- collect / transport alongside other waste
  - use biofuels (instead of fossil)
  - landfill is running out
  - 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]

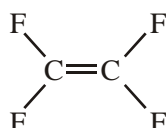
4. (a) (i) by (fractional) distillation 1  
*accept a description of the distillation process (heat and how separation works)*  
*eg heat **and** condense; accept boil / vapourise etc for heat*
- or**  
 fractionation
- (ii) CO<sub>2</sub> 1  
*note the order of these products must be correct*
- H<sub>2</sub>O 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 CH<sub>2</sub> = CH<sub>2</sub>*
- (iii) water / hydrogen oxide / steam 1  
*accept H<sub>2</sub>O*
- (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
  - CO<sub>2</sub> / 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

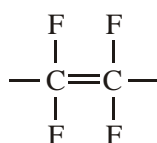
[10]

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

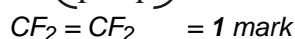
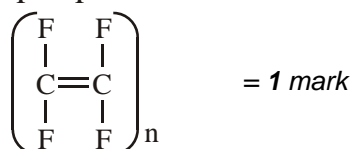
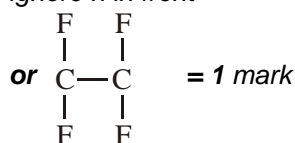
(b) double bond 1



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]