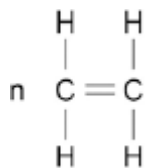
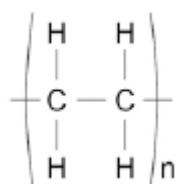


M1.(a) (ethene)



1

(polyethene)



1

(b) any **four** from:

- poly(ethene) produced by addition polymerisation whereas polyester by condensation polymerisation
- poly(ethene) produced from one monomer whereas polyester produced from two different monomers
- poly(ethene) produced from ethene / alkene whereas polyester from a (di)carboxylic acid and a diol / alcohol
- poly(ethene) is the only product formed whereas polyester water also produced
- poly(ethene) repeating unit is a hydrocarbon whereas polyester has an ester linkage

4

[6]

M2.(a) any **one** from:

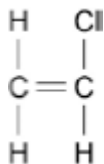
- disposal or does not decompose (in landfill sites) or collection or sorting for recycling
- lack of space or more landfill sites
- other specified problems with waste (eg. litter **or** eyesore **or** harm to animals **or** destroys habitats)

*ignore non-biodegradable alone*

*ignore pollution unqualified.*

1

(b)



*if 2 marks not awarded, award 1 mark for **one** of the following:*

- a double bond between the two carbons and no additional trailing bonds
- two C atoms bonded together with three single bonds to hydrogen atoms and one single bond to a chlorine atom. no additional Cl or H.

2

(c) intermolecular forces **or** forces between the chains

*allow intermolecular bonds*

1

(intermolecular forces are) weak

*ignore references to no cross links between chains.*

*allow 1 mark for weak forces between layers.*

1

which are easily overcome (by heat) **or** need little energy to overcome **or** chains / molecules can slide over one another (when heated)

*if weak bonds **or** breaking covalent bonds mentioned only the third marking point is available.*

1

(d) Monomer **A** – carboxylic acid

*do not allow carbolic*

1

Polymer C - ester (linkage)

1

[8]

M3.(a) any four from:

- (crude oil is) heated
- to evaporate / vaporise / boil (the substances / hydrocarbons)
- the column is hotter at the bottom or is cooler at the top
- (vapours / fractions) condense
- at their boiling points or at different levels.

*marks can be taken from a diagram*

*max 3 marks for reference to cracking*

*allow fractional distillation allow vapours (enter the column)*

*allow temperature gradient or (vapours) cool as they rise*

*allow description e.g. vapour turns to liquid)*

*allow they have different boiling points*

4

(b) acid rain is caused by

*allow consequences of acid rain*

1

sulfur dioxide or oxides of nitrogen

*second marking point is dependent on first marking point*

1

they react with / are neutralised by calcium carbonate or limestone

**OR**

global warming is caused by

carbon dioxide

carbon dioxide will react or dissolve in suspension of limestone

*allow greenhouse effect is caused by or allow consequences of global warming*

1

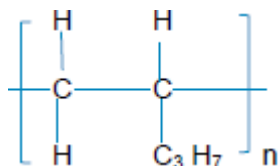
(c) (i)  $C_2H_4$

*must be formula*

*ignore any name*

1

(ii) a single bond between carbon atoms



would score 3 marks

1

other four bonds linking hydrogen atoms and  $C_3H_7$  group plus two trailing / connecting bonds

1

n at the bottom right hand corner of the bracket

1

(iii) has a shape memory

**or**

(a smart polymer) can return to original shape (when conditions change)

1

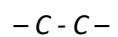
[12]

- M4.** (a) vaporise / evaporate  
*allow boil for vaporise* 1
- different condensing points / temperatures  
*accept condense at different levels*  
*ignore different size molecules or different densities*  
*mention of cracking = max 1*  
*allow boils at different temperatures and condenses for 2 marks*  
*if no other marks awarded allow*  
*fractional distillation for 1 mark* 1
- (b) (i) 3 (C<sub>2</sub>H<sub>4</sub>)  
*accept +C<sub>4</sub>H<sub>8</sub>* 1
- (ii) (decane / naphtha / hydrocarbon) vaporise / evaporate  
*allow crude oil*  
*allow boil for vaporise* 1
- (passed over) a catalyst / alumina / porous pot  
*ignore other names of catalysts* 1
- (c) any **two** from:  
*'they' must be clarified*
- alkanes / butane (molecules) do not have a (carbon carbon) double bond / are saturated / have (carbon carbon) single bonds
  - alkenes / ethene (molecules) have (carbon carbon) double bonds
- or**  
are unsaturated

- alkenes / ethene molecules are able to bond to other molecules

2

(d) single bonds between carbon atoms



1

the  $-CH_3$  group appears on each pair of carbons on the 'chain'

*NB any double bonds = 0 marks*

1

[9]

- M5.** (a) (i) many ethene / molecules / monomers  
*accept double bonds open / break* 1
- join to form a long hydrocarbon / chain / large molecule  
*accept addition polymerisation*  
*ignore references to ethane*  
*correct equation gains 2 marks* 1
- (ii) (can be deformed but) return to their original shape (when heated or cooled)  
*ignore 'it remembers its shape'* 1
- (iii) cross links / extra bonds in PEX  
*accept inter-molecular bonds*  
*ignore inter-molecular forces* 1
- molecules / chains in PEX are held in position  
*accept rigid structure* 1
- molecules / chains in PEX unable to slide past each other / move  
*it = PEX throughout* 1
- (b) any **four** from:
- less (hydrocarbon) fuels used  
*allow less energy*
  - less / no electrical energy used  
*allow no electrolysis*
  - reduce carbon / carbon dioxide emissions  
*allow less global warming*
  - reduce / no pollution by sulfur dioxide / acid rain



- continuous process  
*allow less / no transportation*
- conserve copper which is running out or only low-grade ores available
- reduce the amount of solid waste rock that needs to be disposed  
*allow less waste*
- reduce the need to dig large holes (to extract copper ores)  
*allow less mining*  
*ignore costs / sustainability / non-renewable*

4

[10]

**M6.** (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)  $C_{10}H_{22} \rightarrow C_6H_{14} + 2C_2H_4$   
*allow multiples*

1

(ii) (hydrocarbon) heated / vapours

1

(passed over a) catalyst / alumina / porous pot  
*ignore other catalysts*

1

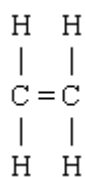
(iii) it / ethene is unsaturated **or** decane and hexane / they are saturated  
*accept decane and hexane are alkanes /  $C_nH_{2n+2}$*   
*or ethene is an alkene /  $C_nH_{2n}$*   
*or different homologous series / general formula*

1

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*

1

(c) all bonds drawn correctly



1

(d) **economic argument** against recycling

any **one** from:

- poly(ethene) / plastic must be collected / transported / sorted / washed
- this uses (fossil) fuels which are expensive

1

**environmental argument** against recycling

any **one** from:

- 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

1

**counter arguments**

any **two** from:

- 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

2

[12]