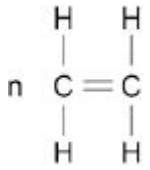
Mark schemes

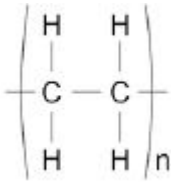
1

(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 wheareas 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]

2

(a) any **one** from:

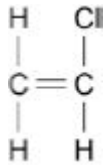
- disposal or does not decompose (in landfill sites) or collection or sorting for recycling

  ignore non-biodegradable alone
- lack of space or more landfill sites
- other specified problems with waste (eg. litter **or** eyesore **or** harm to animals **or** destroys habitats)

  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]

3 (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

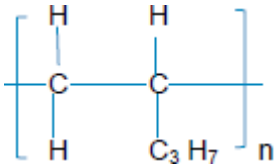
(c) (i) C_2H_4

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]

4

(a) colourless

ignore clear

1

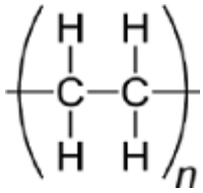
(b) (i) decomposition

1

(ii) C_8H_{18}

1

(c) (i)



two single trailing bonds extending from the carbons (through the brackets) ***1*** *mark*

five single bonds (1 C–C bond and 4 C–H bonds) ***1*** *mark*

2

(ii) any **two** from:

- (polymers made from) cornstarch are biodegradable
- less space needed in landfill sites
- polymers from cornstarch come from a renewable source.

allow converse for poly(ethene)

2

[7]

5 (a) hydrocarbons **or** hydrocarbon

1

(b) (i) distillation

1

(ii) evaporation

1

(iii) condensation

1

(c) (i) bond

1

(ii) $(C_6H)_{14}$

1

(iii) cracking

1

(d) (i) poly(butene)

allow with or without brackets

1

(ii) Advantage = energy is released

do ***not*** *accept more than one tick in the advantage column*

1

Disadvantage = carbon dioxide is produced

do ***not*** *accept more than one tick in the disadvantage column*

1

[10]

6 (a) (i) A **and** 3

*accept A **and** 39*

1

anomalous result

independent mark
*accept not close to other two volumes **or** correct comparison using the results*
ignore does not fit the pattern

1

(ii) any **one** from:

- volume of water (used)
  allow amount of water (used)
- time (for water to run through)
  accept rate / speed (at which water runs through)
- temperature
- mass / surface area of pad
  accept amount / size / volume / thickness of pad
- same filter funnel
  ignore other equipment

1

(iii) any **one** from:

ignore human error unqualified

- incorrect / volume / amount of water added
- reading / volume / amount of water collected
- some water does not go through the pad
  allow spillage / poorly placed pad
- not enough time allowed for water to drain through
  accept rate / speed at which water is added
- pads (from one company) not identical / faulty

1

(b) (i) any **two** from:

- it was not the best (at absorbing the water)
  accept correct descriptions of 'not the best' / third best ***or*** *only better than B*
- (needed) to absorb more (water)
  allow not absorbing enough (water)
- to improve their image / sales
  accept (needs) to absorb more (water) than A and C for ***2*** *marks*

2

(ii) any **one** from:

- cost (more)
- use (more) resources
- use (more) energy
  must relate to the company

1

[7]

7 (a) (i) many ethene / molecules / monomers
accept double bonds open / break
accept addition polymerisation

1

join to form a long hydrocarbon / chain / large molecule
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
it = PEX throughout
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

1

(b) any **four** from:

ignore costs / sustainability / non-renewable

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

4

[10]

8 (a) any **one** advantage from:

- conserves resources (of crude oil / metal ores)
  ignore can be made into other items
  allow the materials (in the pen) are non-renewable
  allow less expensive than producing from the raw material
- reduces use of landfill
  ignore less waste
- less use of fuels/energy
- less carbon dioxide produced
  ignore global warming unqualified

1

any **one** disadvantage from:

- made of different polymers / alloys / materials
- difficulty / cost of separating the different materials
  allow not all the materials can be recycled

1

(b) hard / strong / durable

1

resistant to corrosion **or** unreactive

allow do not rust

*do **not** allow corrosive*

1

(c) (i) vapours (of decane)

ignore pressure / hot / heat

allow high temperature (≥150 °C)

1

passed over a catalyst **or** porous pot **or** aluminium oxide

allow catalyst even if incorrectly named

1

or

mixed with steam (1)

at a (very) high temperature (1)

if temperature quoted, must be ≥ 500 °C

(ii) many monomers **or** many ethene molecules

1

join / bond

allow addition polymerisation for second mark

1

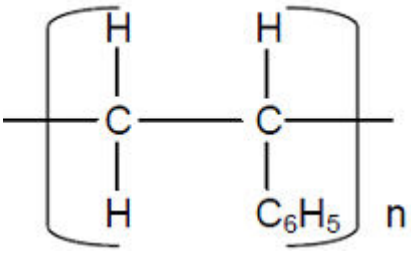
OR

monomers / ethene molecules (1)

form chains **or** very large molecules (1)

*if no other mark awarded allow double bond breaks / opens up **or** double bond forms a single bond for **1** mark*

(d)



allow bonds that do not extend through brackets

7 single bonds are used and are in the correct places with no additional atoms (1)

the brackets and the n are in the correct place (1)

2

[10]

9 (a) (i) (1)

5

3

(6)

4

2

all numbers in the correct order gains both marks
*any two numbers in the correct position gains **1** mark*

2

(ii) Water

ignore formula if correct name given
accept hydrogen oxide
allow H_2O

1

carbon dioxide

allow CO_2
*accept carbon monoxide / CO **or** carbon / C*

1

(b) Marks awarded for this answer will be determined by the Quality of Written Communication (QWC) as well as the standard of the scientific response. Examiners should also apply a 'best-fit' approach to the marking.

0 marks
No relevant content.

Level 1 (1-2 marks)
There is a **basic** description of at least one advantage **or** one disadvantage caused by using plastic shopping bags made from poly(ethene)

Level 2 (3-4 marks)
There is a **clear** description of both an advantage **and** a disadvantage, caused by using plastic shopping bags made from poly(ethene).

Level 3 (5-6 marks)
There is a **detailed** description of both advantages **and** disadvantages caused by using plastic shopping bags made from poly(ethene)

examples of the chemistry/social points made in the response:
ignore cost unqualified

Advantages:

- Simple properties eg strong / low density / water resistant
- Bags can be reused (for shopping) **or** another specified use eg bin liners
- Money charged for bags can go to good causes **or** encourage reuse
- Poly(ethene) bags can be recycled eg made into milk bottle crates
- Poly(ethene) bags can be burned to provide heat for buildings/generation of electricity
- New bags are now made that can biodegrade

Disadvantages:

- (Older) bags can take many years to biodegrade
- There is a shortage of landfill space
- Bags are made from (crude) oil which is a non-renewable resource/running out
- Large amounts of energy/fuel are used for the production of poly(ethene)
- Production of poly(ethene) releases carbon dioxide/causes global warming
- Specified issue caused by litter eg visual pollution or effect on wildlife
- Burning bags release carbon dioxide / causes global warming

6

[10]

10

(a) (i) hydrocarbons

accept alkanes

1

(ii) distillation

1

(b) (i) vaporising

1

(ii) cracking

1

(c) B

1

(d) (i) new plastic products are made from the used plastic bags

1

(ii) not biodegradable

accept does not decompose

allow does not rot

1

(iii) advantage – energy is released

1

disadvantage – carbon dioxide is produced

1

[9]

11

(a) (i) carbon

1

hydrogen

accept in either order

ignore number eg 2 carbons

4 hydrogens

1

(ii) (a carbon carbon) double (bond)

1

(b) poly(ethene)

1

(c) any **two** from:

ignore pollution / cost / global warming / harms environment / recycling

- made from crude oil
- non-renewable resources

  accept resources are running out
- litter

  accept go to landfill
- not biodegradable
- use energy to make
- when burned or biodegraded carbon dioxide is released
- encourage customers to reuse bags / use their own bags

  accept reduces carbon emissions / footprint

2

[6]

12 (a) (i) *if (fractional) distillation / hydrogenation mentioned as the method = max 1*

heat / high temperature / hot / vaporise

allow thermal decomposition

ignore evaporation

*do **not** accept 'burns'*

*do **not** accept temperature < 100*

1

catalyst **or** silica / alumina / porous pot

ignore other named catalyst

or steam

*allow heat (the vapour) to a very high temperature / >800°C for **2** marks*

1

(ii) C_2H_3Cl

ignore attempts to balance equation

1

(iii) single bonds between C – H, C – Cl **and** C – C

*do **not** accept symbols outside the bracket*

1

(b) (i) so that the amount of plasticiser / (sample of) PVC is the independent / only variable that affects the bending / flexibility of the samples

allow because different sizes would give different results

accept because size is a control variable

ignore references to reliability / precision etc

1

(ii) to improve the <u>reliability</u> (of the investigation)

accept to calculate a mean

*accept to check for anomalous results **or** to check the range of results*

ignore accuracy / precision etc

1

(iii) 23

*correct answer with or without working = **2** marks*

if answer is incorrect

allow $\frac{22+23+24}{3}$

***or** 21 for **1** mark*

2

(iv) (PVC) sample had been stretched / used / tested in first three tests

accept higher temperature

*allow worn **or** become weaker*

ignore (human) error

ignore more flexible / softer

ignore intermolecular forces

1

(c) does not bend (easily / much)

ignore non-biodegradable / low maintenance

or it is <u>not</u> flexible **or** it is rigid

ignore sturdy / stronger / harder

1

[10]

13

(a) (i) any **one** from:

- bond / join (together)

  ignore polymerisation / heat

- double bond opens

1

(ii) any **one** from:

- heat / energy
  ignore many processes / distillation / cracking / polymerisation
- cost of fuels / the crude oil
- construction of the factory / plant
- wages / salaries

1

(iii) any **two** from:

ignore gases released / burning / habitats

- non-biodegradable
  accept remains a long time
- landfill sites are filling up / limited
  accept land / space used up
- waste of a resource / could be recycled / reused
  accept crude oil is running out

2

(b) any **two** from:

- renewable / sustainable
  ignore recycling
  ignore crude oil is running out
- less fuel burned
  accept less energy / heat needed
- biodegradable
- natural resource
- plants absorb carbon dioxide

2

[6]

14

(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_2H_4)

accept +C_4H_8

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

– C - C –

1

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

*NB any double bonds = **0** marks*

1

[9]

15 (a) (i) polyethene / poly(ethene)

accept polythene / polyethylene

1

(ii) needs heat / energy / high temperature / fuel (for cracking)

ignore other processes

1

produces carbon dioxide / CO_2

ignore use of CO_2 ***or*** *'produces carbon'*

1

(b) any **three** from:

- use water from local sources **or** water from close to home
- recycle bottles in the UK / close to home

  accept do not recycle in other countries / Asia
- (reduction in distance travelled) would reduce CO_2 emitted by transport

  accept use of transport with low / no carbon dioxide emissions
- use tap water
- use glass bottles / waxed cartons / metal bottles

  do ***not*** *accept 'do not use plastic bottles' without an alternative material*
- do not put in landfill **or** recycle <u>more</u>
- reuse / refill plastic bottles
- <u>tax</u> imported water / plastic bottles (to offset carbon cost)
- make more / all plastic bottles in UK

  answers must be about the reduction of carbon cost

3

[6]

16 (a) (i) C_2H_4

1

(ii) poly(ethene)

1

(b) (i) is not biodegradable

1

(ii) not enough landfill sites / space

*accept landfill sites are filling up **or** plastics remain for <u>years</u> **or** plastics not broken down*

ignore cost / waste of resources / not biodegradable / wildlife

1

(iii) less (crude) oil / fuels / energy used

accept (crude) <u>oil</u> is a non-renewable resource

1

[5]

17 (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]

18 (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) $C_{10}H_{22} \rightarrow C_6H_{14} + \mathbf{2}C_2H_4$
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*

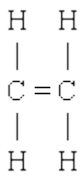
1

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_2 / CO / SO_2 / NO_x / 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]

19 (a) (i) hydrogen

must be name

1

(ii) a line of four or more ethene molecules joined to the original two with single bonds

*at least two other ethene molecules joined to the original two in a chain gains **1** mark*

2

(b) (i) any **two** from:

- non-biodegradable

  accept remains a long time
- landfill sites are filling up / limited

  accept land / space used up
- <u>waste of a resource</u> / could be recycled / reused

  ignore references to tablets / animals

2

(ii) any **one** from:

- (two) different polymers / plastics / materials
- need to be separated
- limited collection points / many need to be collected
- tablets may still be present

1

[6]

20 (a) any **two** from:

asks for cause therefore no marks for just describing the change
must link reason to a correct change in a gas

carbon dioxide has <u>decreased</u> due to:

accept idea of 'used' to indicate a decrease

- plants / micro organisms / bacteria / vegetation / trees
- photosynthesis
  ignore respiration
- 'locked up' in (sedimentary) rocks / carbonates / fossil <u>fuels</u>
- dissolved in oceans
  ignore volcanoes

oxygen has <u>increased</u> due to:

accept idea of 'given out / produced'

- plants / bacteria / micro organisms / vegetation / trees
- photosynthesis
  ignore respiration

nitrogen <u>increased</u> due to:

accept idea of 'given out / produced'

- ammonia reacted with oxygen
- bacteria / micro organisms
  ignore (increase in) use of fossil fuels / deforestation

2

(b) (because methane's) boiling point is greater than the average / surface temperature **or** Titan's (average / surface) temperature is below methane's boiling point

*ignore references to nitrogen **or** water*

1

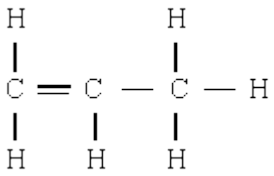
any methane that evaporates will condense

accept boils for evaporates

accept cooling and produce rain for condensing

1

(c) (i)



bonds must be displayed correctly

ignore bond angles

1

(ii) poly(propene) / polypropene / polypropylene

*do **not** allow polypropane*

any **two** from:

- double bonds open up / break / become single(*)
- propene molecules / monomers / they join / undergo addition polymerisation(*)

1

- form chains / long molecules(*)

*(*)correct chemical equation gains **2** marks*

ignore large

*using monomer incorrectly max **2** marks*

2

[8]

21 (a) (i) poly(ethene)

accept polythene

1

(ii) cracking

1

(iii) hydrogen

1

(b) (i) bar labelled 9

1

bar drawn to correct height

1

(ii) (boiling point) increases

1

(iii) heat / evaporate (the crude oil)

accept separate by boiling point

1

cool / condense (hydrocarbons at different temperatures)

accept smaller molecules go to top / larger molecules stay at bottom

*accept fractional distillation for two marks **or** distillation / fractionation for **one** mark*

1

(c) **yes**

any **two** from:

- because plastic does not biodegrade **or** running out of space for landfills **or** land cannot be used for a long time
- it provides heat energy
- which can be used to generate electricity / heat homes or greenhouses
- any other advantage of burning
- any other disadvantage of landfill

or

no

- burning plastic produces carbon dioxide / carbon emissions / toxic gases

accept landfill does not produce carbon dioxide / carbon emissions

- causes global warming / climate change / increase greenhouse effect / global dimming / acid rain
- any other disadvantage of burning
- any other advantage of landfill

2

[10]

22 (a) not broken down by microorganisms **or** not bio-degradable

accept alternative answers such as:
do not rot / corrode / fade / react with atmosphere etc
any answers which imply the inertness or non-biodegradability of this plastic
accept they don't react, they are 'inert'
ignore rusting
*do **not** accept weathering*

1

(b) (i) (have a) double bond **or** do not have maximum number of (hydrogen) atoms attached

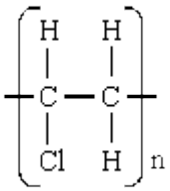
accept can add / react with hydrogen
accept can take part addition reactions
*do **not** accept it is a double bond*
*do **not** accept additional reactions*
*do **not** accept has 'spare' / 'free' bond*
*do **not** accept alkene alone*

1

(ii) single bond between carbon atoms

1

all atoms correct + 2 'linking' bonds
(linking bonds need not go through bracket)



1

n moved to bottom right of bracket i.e. is below $\frac{1}{2}$ way on the right

first 2 marks are possible for chain structures
accept $[– CHCl–CH_2–]_n$

1

(iii) many molecules **or** many monomers

1

joined / bonded / linked **or** form long chain molecules / large molecules **or** to form a long chain polymer

*accept many alkenes **or** many (ethene) molecules*
*do **not** accept many ethene alone etc.*
to form a long polymer is not enough for 2nd mark

1

(iv) no other substances formed
(A + B → C)

allow because double bond breaks so other atoms can add
allow one product only

*do **not** accept saturation occurs*

1

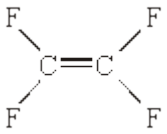
[8]

23 (a) poly(tetrafluoroethene) **or** polytetrafluoroethene

accept PTFE or Teflon

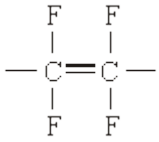
1

(b) double bond

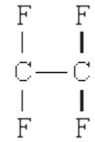


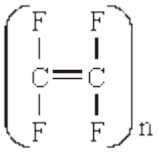
1

all other atoms and bonds correct including F for fluorine



ignore n in front

or  ***= 1** mark*

 *= **1** mark*

$CF_2 = CF_2$ *= **1** mark*

*do **not** accept structures with more than 2 C atoms*

1

(c) any **three** from:

- 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

3

[6]

24 (a) (i) by heating
pressure is neutral

using a catalyst/pot/ceramic/porcelain/aluminium oxide

1

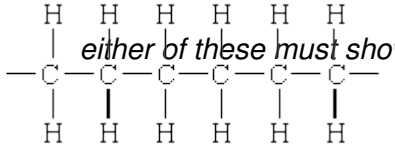
(ii) use bromine water/(alkaline) permanganate
accept bromine

1

alkene makes bromine go colourless or lose its colour
accept alkane does not change the red/orange colour of bromine
***not** change colour/goes clear*

1

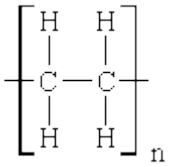
(b) (i)



either of these must show bonds at end

1

or



not *H on ends*

allow 3 instead of n ***not*** *any other number*

(ii) poly(ethene) – brackets not essential

accept polythene

1

(iii) **large amount** of waste polymer/poly(ethene)/polythene/litter

accept large amount of crude oil ***or*** *finite resource used*

1

it is not biodegradable

accept it does not

decompose/decay/break down

it causes pollution/it creates toxic

fumes when burnt are neutral

not *it is not recyclable*

2

[8]

25 (a) catalyst

1

(b) (i) made up of **only** carbon and hydrogen

1

(ii) C_8H_{18}

1

(c) (i) ethene

1

(ii) polymerisation

1

[5]

26 (a) (i) heat

accept increase temperature ignore pressure

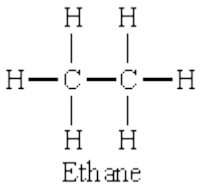
1

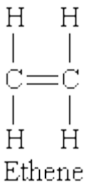
with a catalyst

1

(ii)

1





accept displayed formulae only

1

(iii) O_2

1

$CO_2 + H_2O$

ignore state symbols

1

correct balancing
$2 + 7 \rightarrow 4 + 6$

accept $1 + 3\frac{1}{2} \rightarrow 2 + 3$ *only if reactants and products correct*

1

(b) double bond breaks

1

many (ethene) molecules

accept many monomers

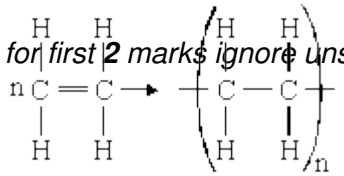
1

bond together

*accept join **or** combine for bond*

accept

*for first **2** marks ignore unsaturated becomes saturated*



1

[10]

27 (a) organic

1

sediment

1

(b) (i) gases

1

(ii) bitumen

1

(c) (i) cracking

accept thermal decomposition

*do **not** accept endothermic*

1

(ii) many **or** short **or** small (ethene) molecules

accept monomer

*accept double bonds open up **or** break*

1

join to make larger molecules

accept polymer

accept polymerisation

*accept short chain to long chain (**or** molecules)*

*do **not** accept unsaturated to saturated*

1

(d) poor ventilation

accept limited air supply

accept insufficient oxygen

1

causes incomplete combustion

accept produces CO

1

(fumes contain) carbon monoxide which dangerous

*toxic is **not** awarded a mark*

*do **not** accept harmful or poisonous*

1

[10]

28 (a) C_2H_4

1

```
  H H H
H C C C H
  H H H
```

Accept even if in wrong columns

1

(c) (i) polythene or poly(ethene)

1

(ii) addition

1

[4]

29 (a) (fractional) distillation/fractionation

for 1 mark

1

(b) (i) cracking/decomposition

for 1 mark

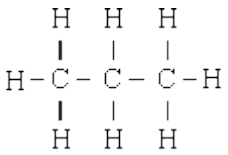
1

(ii) polymerisation/addition reaction

for 1 mark

1

(c)



(Must have H atoms)

for 1 mark

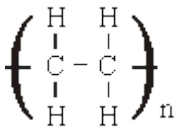
1

(d) contains <u>only/all</u> single bonds
no double bonds
contains maximum number of H atoms
carbon atoms bonded to 4 other atoms (not 4 H atoms)
will not undergo addition reactions

any 1 for 1 mark

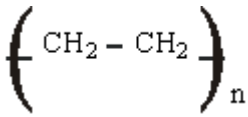
1

(e)



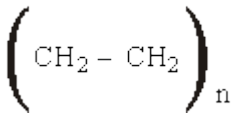
(n must be on (right))

= 2 marks

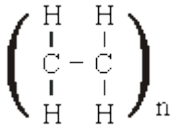


(n on left = 1 mark)

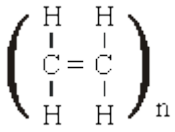
= 2 marks



= 1 mark



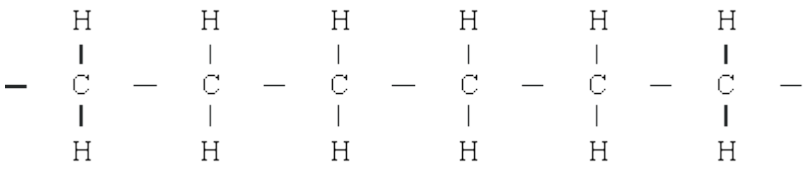
= 1 mark



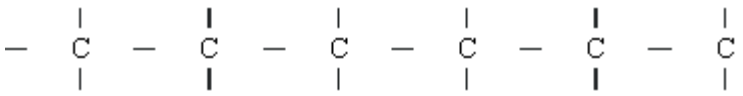
(Double bond loses both marks)

= 0 marks

OR



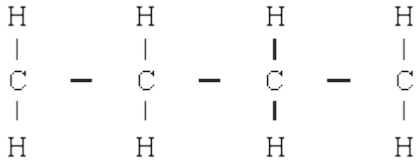
= 2 marks



(for both a minimum of 4 carbon atoms)

= 1 mark

= 2 marks



= 1 mark

= 1 mark

2

[7]

30 (a) (i) bonds / pair of electrons / shared electrons

for one mark

1

(ii) saturated since it has single bonds / no double bonds / no multiple bonds / maximum number of atoms attached

for one mark

1

(iii) sensible answer (e.g. it is harmful)
or better solvent could be used on expanded polystyrene or foam

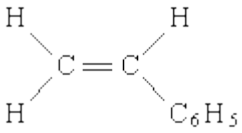
for one mark

1

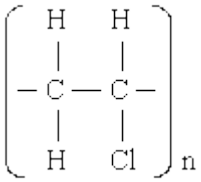
(b) (i) simply writing monomers form / react to form polymers gains no mark
monomers join / bond / combine / link to form polymers = 1 mark
the mark is for the idea of joining
to gain the second mark the idea of the relative size of monomer and polymer is required
small molecules join to form a polymer (2 marks)
many monomers join to form a polymer (2 marks)
monomers join to form a large molecule / long chain (2 marks)
many molecules join together (2 marks)
for 1 mark each

2

(ii) polyethene / poly(ethene) / polythene



don't worry too much about the exact positioning of the C_6H_5 at the end of the bond



placement of linking bonds inside / outside brackets is not important
must have n
for 1 mark each

[8]

31 (a) any **three** from

carbon (atom) spine / chain
accept idea of 'backbone' of carbon (atoms)

surrounded by hydrogen (atoms)
accept idea of only bonded to hydrogen (atoms)

3

single (covalent) bonds between carbon atoms
accept no double bonds

saturated (hydrocarbons)

(general formula) C_nH_{2n+2}

(b) many small molecules/ monomers

*accept many unsaturated molecules **or** alkenes*

1

join together to form a large / long molecule / polymer

1

[5]

32 (a) C=C

do not accept C_2H_4

1

four Hs only, two attached to each carbon

credit CH_2CH_2 for two marks

1

(b) $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$

two correct formulae LHS

1

can be in either order

two correct formulae RHS

1

can be in either order

correctly balanced, consequential

marking allowed for 10 O

1

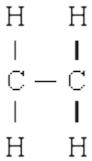
[5]

33 (a) smaller, more useful molecules more reactive (molecules)/(molecules) used to make plastics more easily ignited/better fuels produces unsaturated compounds/alkenes

any two for 1 mark each

2

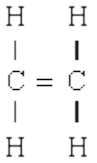
(b)



gains 1 mark

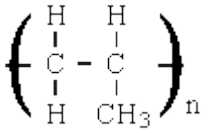
2

but



gains 2 marks

(c) (i)



for 1 mark

1

(ii) poly(propene)
(N.B. brackets not required; *allow* "polypropylene")

for 1 mark

1

[6]