Mark schemes

Q1.

(a) limestone

1

sodium carbonate

1

(b) (advantage) stronger

1

(reason) less easily damaged

1

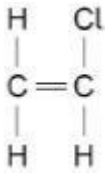
(c) (advantage) lower density

1

(reason) lighter (to install)

1

(d)



1

(e) (add damp) litmus paper

1

(litmus paper) is bleached
or
(litmus paper) turns white

ignore (litmus paper) turns red

1

(f) (polymers)
last a long time

ignore references to cost
allow break down slowly

1

(wood)
renewable

allow trees can be replanted
allow aesthetic reasons

1

(g) (percentage of aluminium =)

$$\frac{5.94}{6.00} \times 100$$

1

= 99 (%)

1

(h) (alloy is) harder (than pure aluminium)

allow (alloy is) stronger (than pure aluminium)

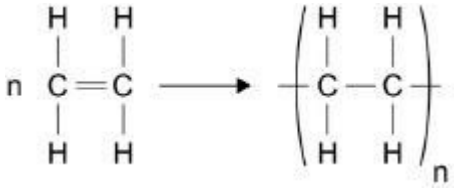
ignore references to cost

1

[14]

Q2.

(a)



if equation incorrect

allow 1 mark for 5 single bonds

or

allow 1 mark for n

2

(b) (poly(ethene)) melts

allow converse statements about thermosetting polymers

allow thermosoftening polymers melt

1

(so) can be reshaped (into new products)

1

(c) use different (reaction) conditions

allow use different temperatures / pressures

1

(d) (in HDPE) polymer chains / molecules are closer together

allow converse statements about LDPE

allow (HDPE has) unbranched polymer chains / molecules

1

(so) more atoms per unit volume

allow (so) more molecules per unit volume

1

(e) circle around HO– or –OH on monomer A

1

(f) H2O

and
HCl

must be in this order

1

[9]

Q3.

(a) (lead is) toxic / poisonous

allow (lead is) harmful

ignore (lead is) dangerous / deadly / lethal

1

(b) the proportions (of metals) are different

1

(c) any three from:

- recycling conserves copper ores
- recycling uses less energy
- recycling reduces waste

ignore references to cost

allow copper ores are finite

allow recycling reduces use of landfill

- mining / quarrying cause environmental impacts

allow description of environmental impact caused by mining / quarrying

3

(d) grow plants (on land containing copper ores)

allow named plant

1

plants are burnt (to produce ash)

1

ash dissolved in acid (to produce a solution of a copper compound)

1

electrolysis of solution (containing a copper compound)
or
displacement (of copper) from solution (containing a copper compound)

allow addition of scrap iron to the solution (of a copper compound)

1

(e) any two from:

- high grade ores still available
- land not available
- phytomining takes a long time
- new technology

allow demand not high enough

2

[11]

Q4.

(a) tin

1

(b) any one from:

- ornaments
- musical instruments
- hinges / knobs / screws

allow any correct use of brass

1

(c) (A) 12 (carat)

1

(B) 3 (grams)

1

(d) any two from:

- (alloy of gold is) harder
- (alloy of gold is) cheaper
- aesthetic reasons

allow converse statements about pure gold

2

(e) any one from:

- does not corrode

allow will not rust

- does not react with water
- is hard

1

(f) low carbon steel

1

[8]

Q5.

(a) disposal at the end of useful life

1

(b) heating in a furnace

1

shaping wet clay

1

(c) polymers

1

propene

allow (a) monomer

1

(d) cracking

1

fractional distillation

1

(e) covalent

1

(f) thermosetting

1

(g) polymer A has crosslinks (between polymer molecules)
or
polymer B has no crosslinks (between polymer molecules)

1

[10]

Q6.

(a) any two from:

energy used in:
- extraction of raw materials
- processing raw materials

allow energy used to make food plate materials

- manufacturing
- transportation
- cleaning non-disposable plates
- disposal
- recycling

2

(b) Level 2: A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

3–4

Level 1: Some logically linked reasons are given. There may also be a simple judgement.

1–2

No relevant content

0

Indicative content

Raw materials
- Trees are renewable
- Crude oil and clay are finite

Manufacturing and packaging
- Paper plates use the least packaging so conserve raw materials
- Paper plates need less transportation overall as more plates in a 10 dm3 cardboard box

Use and operation
- Paper plates are single use so must be replaced most often
- Ceramic plates last longer than polymer plates so must be replaced less often

Disposal
- Polymer / ceramic plates take up landfill which is running out
- Paper / polymer plates can be used to make new products
- Recycling conserves raw materials

Reasoned judgement

(c) (wet) clay is shaped

1

(and) heated in a furnace

allow (and) heated in a kiln / oven
allow (and) fired

1

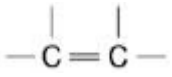
[8]

Q7.

(a) covalent

1

(b)



1

(c) composite

1

(d) limestone

1

sand

1

either order

(e)

ignore corrosion / erosion / rotting / rusting

any two from:
(makes the board)
- strong
- hard
- tough

- waterproof
- durable
  allow long lasting
- aesthetic reasons
- rigid
- less friction
  allow streamlined / smooth
- protection
  allow prevents damage

2

(f) (advantages of addition polymers)
low(er) cost
allow cheap(er)

1

low(er) density
allow light(er)

1

(disadvantages of addition polymers)
weak(er)
allow (more) likely to break

1

hard(er) to dispose of
ignore references to recycling or use as a fuel

1

(g)
an answer of 0.035 (m3) scores 3 marks.
allow 2 marks for an answer of 0.105 (m3) (addition polymer)

$150 = \frac{5.25}{\text{volume}}$

1

$\text{(volume =)}\ \frac{5.25}{150}$

1

(volume =) 0.035 (m3)

1

[14]

Q8.

(a) Level 3: The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

5–6

Level 2: The design/plan would not necessarily lead to a valid outcome. Most steps are identified, but the plan is not fully logically

sequenced.

3–4

Level 1: The design/plan would not lead to a valid outcome. Some relevant steps are identified, but links are not made clear.

1–2

No relevant content

0

Indicative content

Plan – allow diagrams to indicate content

- three test tubes containing nails
- test tube 1 – open test tube with water
- test tube 2 – stoppered test tube with drying agent
- test tube 3 – test tube with boiled water
- test tube 3 – sealed with oil
- leave for several days
- observe results

Results

- test tube 1 – nail rusts test
- tube 2 – nail does not rust test
- tube 3 – nail does not rust

(b) 0.11 (g)

1

(c)

$$\left(\frac{0.08 + \mathbf{X} + 0.09}{3}\right)$$

= 0.09 (g)

allow 0.09(3333....)
allow ecf from part (b)

1

[9]

Q9.

(a) C=C bond in correct position

1

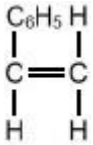
3× C-H and 1× C-C bond in correct positions

do not accept any additional bonds or atoms

ignore brackets and n before and after displayed structural formula

an answer of

1



scores 2 marks

(b) carboxylic acid (group)

allow carboxyl (group)

1

(c) water

allow H2O

1

(d) (polyester is) thermosoftening

allow (polyester is) thermoplastic

ignore thermoforming

1

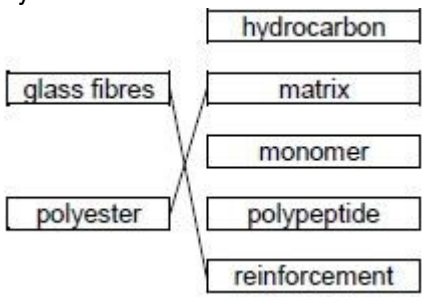
(polyester has) no cross-links

allow intermolecular forces are weak

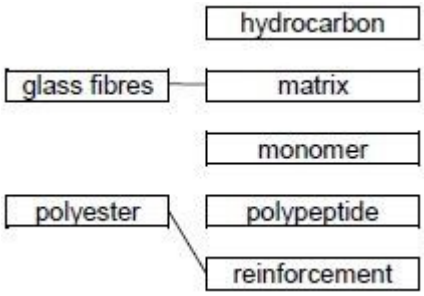
do not accept references to breaking covalent bonds or breaking chains

1

(e) hydrocarbon



allow for 1 mark:



2

(f) any two from:

(to make the board)

- harder
- stronger
- tougher
- more rigid

must be implied comparative

statements

- waterproof

2

[10]

Q10.

(a) Tube 1: (nail) rusts because air / oxygen and water present

1

Tube 2: (nail) does not rust because no water

allow Tube 2: (nail) does not rust because only air / oxygen

1

Tube 3: (nail) does not rust because no air / oxygen

allow Tube 3: (nail) does not rust because only water

1

Tube 4: (nail) does not rust because paint is a barrier (to water / air / oxygen)

allow Tube 4: (nail) does not rust because paint is a protective layer / coating (against water / air / oxygen)
or
allow Tube 4: (nail) does not rust because paint protects it from water / air / oxygen

1

Tube 5: (nail) does not rust because stainless steel resistant to corrosion

allow Tube 5: (nail) does not rust because stainless steel does not corrode
allow Tube 5: (nail) does not rust because stainless steel contains nickel / chromium

If no other mark awarded allow 1 mark for correct rusting pattern in all 5 tubes

1

(b)

allow converse

magnesium is more reactive (than iron)

allow magnesium is more reactive (than steel)

1

(so magnesium) provides sacrificial protection

allow (so magnesium) corrodes / reacts instead of iron / steel
allow (so magnesium) corrodes / reacts before iron / steel

ignore references to protective layers
ignore references to magnesium rusting

1

(c) (aluminium has a coating of) aluminium oxide

1

(so the aluminium oxide) protects the metal (from further corrosion)

allow (so aluminium oxide) prevents water / air / oxygen from reaching the metal

1

[9]

Q11.

(a)

property	J	K
density in g/cm3		
melting point in °C		✓
flame resistance		✓
water absorption	✓	

three correct = 2 marks
one or two correct = 1 mark

2

(b) $\frac{1.4 \times 6.0}{0.90}$

1

= 9.3 (kg)

allow 9.3(333...)(kg)

1

an answer of 9.3(333...)(kg) scores 2 marks

(c) polymer L will not melt

1

(d) polymers are more hard-wearing

1

(e) any two from:

- (wool / sheep) renewable

  allow wool grows back, etc.

- (wool) will not run out

ignore (wool is) readily available

- (crude oil) non-renewable
  allow finite
- (crude oil) will run out
  ignore references to cost
  ignore properties from tables 1 and 2

2

[8]

Q12.

(a) tin

1

(b) 70 (%)

1

(c) $\frac{90}{100} \times 1100$

1

= 990 (g)

1

(d) mixture of metals

1

(e) (red brass) contains more copper
allow converse

1

(so) layers slide more easily
or
layers are less distorted

1

(f) 24

1

[8]

Q13.

(a) 50

1

(b) 5%

1

(c) any two from:

- cost (9 carat is cheaper)
- pure gold is soft
  or
  24 carat gold is soft

or
9 carat gold is harder
allow 9 carat gold is stronger
allow gold is an alloy in 9 carat gold

- can change the colour

2

[4]

Q14.

(a) $1 \times 10{-}2$ g

1

(b) $\frac{0.46}{8.45} \times 100$

1

(test tube 1) 5.44 %
and
(test tube 2) 0.854 %

1

4.586

1

4.59

1

allow ecf answer correctly calculated to 3 significant figures
allow 4.59 with no working for 4 marks
allow 4.586 with no working for 3 marks

(c) Level 3 (5–6 marks):
Detailed and coherent conclusions based on the evidence together with an evaluation
are given in a response that is coherent and well-structured. A range of relevant points is made demonstrating a broad understanding of the key scientific ideas.
Level 2 (3–4 marks):

An attempt to relate relevant points and draw conclusions or to make an evaluation. The logic may be inconsistent at times but builds towards a coherent argument.
Level 1 (1–2 marks):

Simple descriptive statements are made. The logic may be unclear and any conclusions,
if present, may not be consistent with the reasoning.
0 marks:

No relevant content.
Indicative content

Simple statements

- nail rusted in test tubes 1 and 5
- test tubes 1 and 4 contained air / oxygen and water
- nail did not rust in test tubes 2, 3 and 4
- test tube 2 no water present
- test tube 3 no air / oxygen present
- test tube 4 paint stopped rusting
- test tube 6 scratched galvanised iron did not rust
- test tube 6 galvanising stopped rusting

Conclusions

- both water and oxygen are required for rusting
- coatings that prevent water and oxygen reaching the metal
- prevent rusting
- when paint is scratched, iron comes into contact with water and
- oxygen and the iron rusts
- in test tube 5 less iron exposed so less rusting than in test tube 1

galvanising is better at resisting rusting than paint when scratched

zinc is more reactive than iron, so when galvanised metal is scratched, zinc reacts with water and oxygen first / sacrificially

Evaluation

oil and paint are effective at preventing rusting when the coating is intact

- galvanising is the most effective coating because it prevents rusting even when scratched.

6

(d) iron + oxygen + water

all three needed for 2 marks

2 correct = 1 mark

ignore air

2

[13]

Q15.

(a) all points correct

±1 small square

allow 1 mark for 6 or 7 plots

2

Year	Percentage (%) of bottles made from other materials
1975	5
1980	10
1985	22
1990	42
1995	70
2000	72
2005	90
2010	95

1

(b) Level 3 (5–6 marks):
A detailed and coherent argument is provided which considers a range of issues and comes to a conclusion consistent with the reasoning.
Level 2 (3–4 marks):
An attempt to describe the advantages and disadvantages of the production and uses is made, which comes to a conclusion. The logic may be inconsistent at times but builds towards a coherent argument.
Level 1 (1–2 marks):
Simple statements made. The logic may be unclear and the conclusion, if present, may not be consistent with the reasoning.
0 marks:

No relevant content.
Indicative content

- glass – 2 stages in production of soda-lime glass glass –
- second stage, heating sand, limestone and sodium carbonate
- HDPE – 3 stages in production HDPE – second stage, cracking
- of naphtha to obtain ethene HDPE – third stage,
- polymerisation of ethene fewer stages in glass production,
- may be quicker higher temperature in glass manufacture,
- therefore maybe higher energy requirement glass bottle can
- be reused consideration of collection / cleaning costs to
- reuse glass bottles other glass products can be made from
- recycled glass plastic has greater range of sizes both
- produced from limited raw materials higher percentage
- recycled materials in glass conserves raw materials
-

This indicative content is not exhaustive, other creditworthy responses should be awarded marks as appropriate.

6

[9]

Q16.

(a) (i) hard

ignore strong

1

(ii) hundred

1

(b) (i) Covalent

1

(ii) 3

1

(iii) Soft and slippery

1

(c) (i) cross-links

allow bonds
ignore links
do not accept intermolecular

1

(ii) melt

1

(iii) any two from:

- temperature
  allow heat(ing)
- pressure
- catalyst

2

(d) (i) CH_4

1

(ii) Small molecules

1

[11]