M1.(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]

M2. (a) (i) reduction

accept redox / smelting

1

(ii) 3 4 3

1

(b) (i) 55

ignore other units

(ii) Water

accept sodium hydroxide

accept correct formulae H_2O or NaOH

1

(iii) any **one** from:

- save energy / fuel for transporting the ore

  accept less (cost of) transport allow transported quickly

- (old) quarries nearby for waste/red mud

1

(c) **Environmental**

any **one** from:

- less mining / quarrying (of bauxite)

  allow loss of habitat / less qualified noise pollution

- less landfill space needed / used

  allow less red mud / waste

- less use of fossil fuels / energy

- less carbon dioxide produced

1

Ethical or social

any **one** from:

- saves resources

  allow using resources more than once

- creates (local) employment

  *if answers reversed and both correct award **1** mark*

- more people aware of the need for recycling

  allow less qualified noise pollution if not given in environmental

1

[7]

M3. (a) (i) low percentage / very little of metal (in the ore)

*accept <u>only</u> 0.5% metal in the ore **or** over 99% waste in the ore **or** nearly 100% waste in the ore*

*ignore reference to percentage of metal in the Earth's crust **or** energy used or pollution*

1

(ii) any **one** from

(it = iron)

- iron uses less energy / fuel for extraction

  ignore electrolysis / uses electricity / reactivity
- iron has more uses
- more demand for iron

  ignore high abundance in the Earth's crust / high percentage of metal in ore
- iron is stronger

  ignore harder
- cheaper / costs less
- easier to extract

1

(b) (i) has <u>mel</u>ting point lower than 950°C

(it = aluminium)

allow has a low <u>mel</u>ting point

ignore boiling point

1

(ii) electrode(s) made of carbon

1

oxygen reacts with electrode(s) / carbon

accept C + O_2 (→ CO_2)

*NB oxygen reacts with the carbon electrode(s) = **2** marks*

1

*(iii) any **two** from:*

- *saves resources / non-renewable*
  *accept aluminium / ore will run out **or** conserves aluminium*
- *landfill problem*
  accept aluminium does not corrode
- *saves energy / fuel / electricity*
  ignore global warming
- *less carbon dioxide / carbon emissions **or** reduces carbon footprint*
  ignore consequences of quarrying / mining
- *less quarrying / mining*
  ignore pollution / harms environment / costs / easy to recycle

2

[7]

M4. *(a)* *(i)* *C*

must be correct symbol

*do **not** accept carbon*

any balancing must be correct

1

(ii) *$Fe + CO_2$*

correct formulae

1

2... . + 3... .

correct balancing

allow $Fe_2 + 3CO_2$ for this mark

1

(iii) *layers / atoms in pure iron are able to slide over each other*

it = pure iron

accept ions for atoms

ignore molecules / particles

or

layers / atoms in cast iron are unable to slide over each other (easily)

1

(b) *any **three** from:*

*mention of ozone = max **2***

- *less iron ore used*

  accept the idea that ores would be conserved but not unspecified conservation

- *less other metals extracted / used to make different steels*

  accept the idea that ores would be conserved but not unspecified conservation

- *<u>less fuel</u> used*

  accept the idea that fuels would be conserved

ignore reduces energy requirements

- *less <u>specified</u> pollution*

  accept global warming / greenhouse effect / CO_2 / CO / carbon emissions / acid rain / SO_2 / global dimming /

  *do **not** accept ozone layer*

- *less / no landfill space needed*

  ignore reduces waste

- *less / no mining needed **or** fewer specified effects of mining*

  accept effect such as eyesore / loss of habitat

  *eg 'less mining iron ore' = **2** marks*

3

[7]

M5. *(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]

M6. *(a)* *(i)* *reacts with carbon / C*

accept burns / oxidises carbon

1

carbon dioxide / CO_2 / gas is formed / given off

accept carbon monoxide / CO

*accept correctly balanced equation for **2** marks*

ignore state symbols

1

(ii) *change / improve properties*

accept any specific property

accept to make alloys / special steels

ignore brittle

1

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

- *to conserve ores / iron*

  accept ores / iron are non-renewable / non-sustainable
  allow less quarrying / mining

- *to prevent the use of landfills*

  allow reduce waste

- *to conserve energy / fuel*

  accept fossil fuels are non-renewable

- *to reduce carbon / carbon dioxide emissions*

- *to meet EU / International targets*

  ignore costs / demand

2

[5]

M7. *(a) any **three** from:*

- *resources / aluminium / ores are conserved*
  accept converse argument
- *less / no mining **or** less associated environmental problems*
  eg quarrying / eyesore / dust / traffic / noise / loss of land / habitat
  ignore just pollution
- *less / no waste (rock) / landfill*
  *do **not** accept 'wastes 50% of the ore'*
- *no purification / separation (of aluminium oxide)*
- *(aluminium extraction / production) has high energy / electricity / heat / temperature requirements*
- *less carbon dioxide produced*
  accept no carbon dioxide produced
  ignore references to cost

3

(b) statement

ignore density

1

linked reason

eg
(pure) Al / it is weak / soft (1)
as layers / rows can slide (over each other) (1)
or
alloy / other metals / they make it stronger / harder (1)
stops layers / rows sliding over each other (1)
accept disrupts the structure owtte if no other mark awarded
*accept to form an alloy **or** to change properties for **1** mark*

1

[5]

M8. *(a) (i) contain enough metal to make it economical / worth while to extract*

1

(ii) reduction

accept displacement

accept redox

1

(iii) $Fe + CO_2$

*do **not** accept Fe_2 / Fe_4*

1

correct balancing

accept multiples and halves

2Fe_2O_3 + ***3***$C \rightarrow$ ***4***Fe + ***3***CO_2

allow Fe_2 / Fe_4 as ecf

1

(b) ***Pure Iron***

(in pure metal all the atoms are the same size and) able to slip / slide over each other – (property soft)

OWTTE

ignore references to molecules / particles

*if they say 'move' both times, allow **one** mark but 'crack' or 'split' is wrong..*

1

Cast iron

*(in cast iron) different sized atoms / larger atoms **or** structure is distorted / disrupted*

OWTTE

1

so it is difficult for layers of atoms to slip / slide over each other

OWTTE

1

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

- *conserves / saves resources / metal ores*
- *saves energy resources (used for extraction / processing)*

accept cheaper / saves money

- *decreases waste materials*
- *decreases a named pollution*
  *do **not** accept acid rain*

3

[10]