Mark schemes

Q1.

(a) any **two** from:
- (potassium) floats
- (potassium) melts
- (potassium) moves around
- potassium becomes smaller

  allow potassium disappears
- (lilac) flame
- effervescence

  allow fizzing

2

(b) $2K + 2H_2O \rightarrow 2KOH + H_2$

allow multiples

*allow **1** mark for KOH **and** H_2*

2

(c) reactivity increases (going down the group)

1

(because) the outer electron / shell is further from the nucleus

allow (because) there are more shells

allow (because) the atoms get larger

1

(so) there is less attraction between the nucleus and the outer electron / shell

allow (so) there is more shielding from the nucleus

*do **not** accept incorrect attractions*

1

(so) the atom loses an electron more easily

1

(d) (dot and cross diagram to show) sodium atom **and** oxygen atom

allow use of outer shells only

1

two sodium atoms to one oxygen atom

allow two sodium ions to one oxide ion

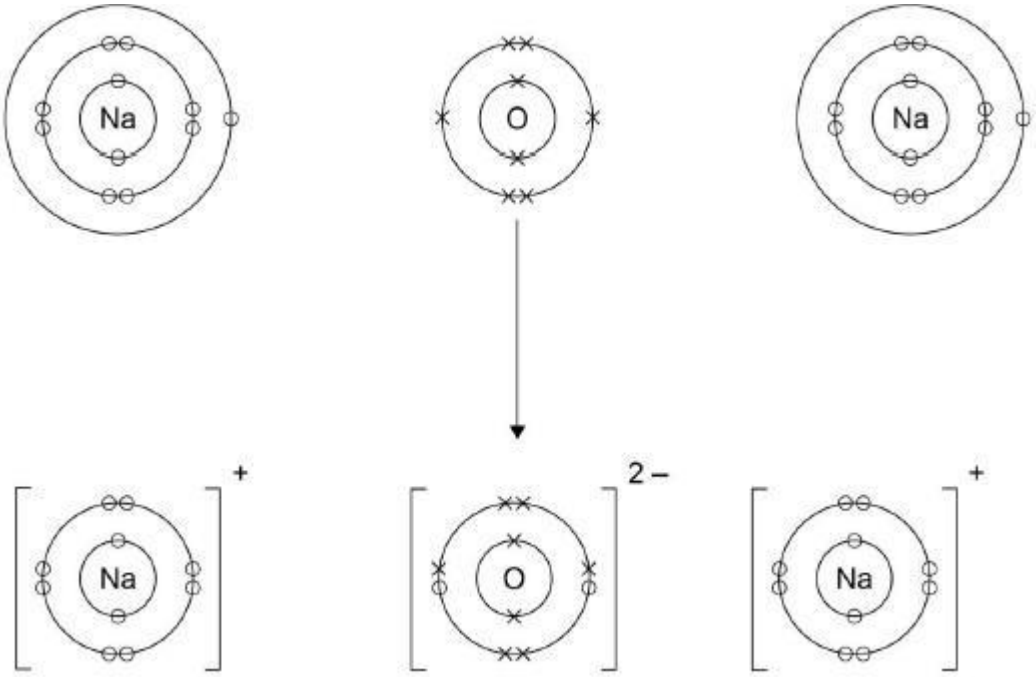
1

(to produce) sodium ion with a + charge

1

(to produce) oxide ion with a 2– charge

1



scores **4** marks

(e) (oxygen) gains electrons

1

(f) giant structure

allow (giant ionic) lattice

1

(with) strong (electrostatic) forces of attraction between (oppositely charged) ions

1

(so) large amounts of energy are needed to break the bonds / forces

allow (so) large amounts of energy are needed to separate the ions

1

[16]

Q2.

(a) C

1

(b) (in an alloy) the atoms are of different sizes

1

(so) the layers (of atoms in an alloy) are distorted

1

(so in an alloy) the layers slide over each other less easily (than in a pure metal)

1

(c) measure temperature change

*allow measure the temperature before **and** after the reaction*

1

when each metal is added to silver nitrate solution

1

same concentration / volume of solution
or
same mass / moles of metal

allow same initial temperature (of silver nitrate solution)

1

the greater the temperature change the more reactive

1

[8]

Q3.

(a) limestone

1

sodium carbonate

1

(b) (advantage) stronger

1

(reason) less easily damaged

1

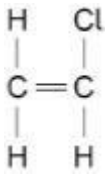
(c) (advantage) lower density

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]

Q4.

(a) gas

1

(b) -35 (°C)

allow any value between -35 °C and -100 °C

1

(c) increase

1

increase

allow become stronger

1

(d) chlorine gas is toxic

1

(e) increased

1

chlorine (atoms) are now part of the solid (iron chloride)
or

the mass of the chlorine (atoms) is now also measured

1

(f) burns very vigorously

allow burns violently
allow brighter (orange) glow
allow (orange) flame
allow explodes

1

(g) $2\ Fe + 3\ Br_2 \rightarrow 2\ FeBr_3$

allow multiples

1

(h) $56 + (3 \times 80)$

1

$= 296$

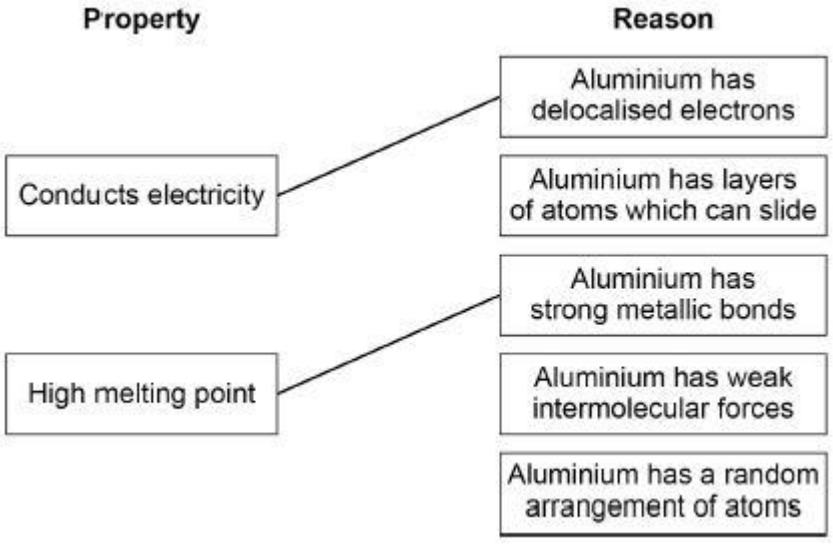
ignore units

1

[11]

Q5.

(a)



1

additional line from a box on the left negates the mark from that box

1

(b) a mixture of metals

allow a mixture of a metal with other elements

1

(c) bauxite contains a variable percentage of aluminium

allow converse argument
allow bauxite does not have a fixed proportion / percentage of aluminium

1

(d) any **two** from:
- danger of dam bursting
  allow the lake (of mud) could overflow
- leakage of toxic substances from mud to environment
- water pollution
- damage to habitats
- visual pollution
- (dam) blocks light
- reduces the value of houses
  allow unpleasant smell

2

(e) 10 / ten

1

(f) to lower the melting point of the mixture

1

(g) oxygen
must be in this order

1

carbon

1

(h)

$\frac{25}{100} \times 300\,000$

1

=75 000

1

$= 7.5 \times 10^4$ (kg)
allow correct conversion to standard form of an incorrectly calculated mass

1

[13]

Q6.

(a) poly(ethene)

1

water

1

(b) **Level 2:** Scientifically relevant features are identified; the way(s) in which they are similar/different is made clear and (where appropriate) the magnitude of the similarity/difference is noted.

4–6

Level 1: Relevant features are identified and differences noted. 1–3

1–3

No relevant content

0

Indicative content

- (both) carbon dioxide and silicon dioxide are made up of atoms
- (but) magnesium oxide is made up of ions

- (both) silicon dioxide and magnesium oxide are giant structures
- (but) carbon dioxide is small molecules
- with weak intermolecular forces

- all three compounds have strong bonds
- (both) carbon dioxide and silicon dioxide are formed from two non-metals
- (so) bonds formed are covalent
- (so) electron (pairs) are shared (between atoms)
- (but) magnesium oxide is formed from a metal and a non-metal
- (so) bonds in magnesium oxide are ionic
- (so) electrons are transferred
- from magnesium to oxygen
- two electrons are transferred

- bonds in silicon dioxide are single bonds
- (where) each silicon forms four bonds
- (and) each oxygen forms two bonds
- (but) in carbon dioxide the bonds are double bonds
- (where) carbon forms two double bonds
- (and) oxygen forms one double bond

ignore properties e.g. melting point, electrical conductivity

[8]

Q7.

(a) liquid gas

1

(b) (boiling point) increases (down the table / group)

1

(because) the relative formula / molecular mass increases
or
(because) the size of the molecule increases

1

(so) the intermolecular forces increase (in strength)

allow (so) the forces between molecules increase (in strength)

1

(so) more energy is needed to overcome the intermolecular forces

allow (so) more energy is needed to separate the molecules

*do **not** accept a reference to breaking bonds unless specifically between*

molecules

1

(c) boiling point is a bulk property

allow boiling point is related to intermolecular forces (so more than one molecule is involved)

1

(d) the gas / halogen is toxic

allow the gas / halogen is poisonous / harmful allow to prevent inhalation of the gas / halogen

ignore deadly / lethal

1

(e) (going down the group) the outer electrons / shell become further from the nucleus

allow energy level for shell throughout

allow the atoms become larger

allow the number of shells increases

ignore the number of outer shells increases

1

(so) the nucleus has less attraction for the outer electrons / shell

allow (so) the nucleus has less attraction for the incoming electron

allow (so) increased shielding between the nucleus and the outer electrons / shell

allow (so) increased shielding between the nucleus and the incoming electron

1

(so) an electron is gained less easily

1

(f) 4.48 (g iron) **and** 8.52 (g chlorine)

1

(moles Fe = $\frac{4.48}{56}$ =) 0.08

allow correct calculation using incorrectly calculated mass of iron

1

(moles Cl = $\frac{8.52}{35.5}$ =) 0.24

allow correct calculation using incorrectly calculated mass of chlorine

allow (moles Cl_2 = $\frac{8.52}{71}$ =) 0.12

1

(Fe : Cl = 0.08 : 0.24 =) 1 : 3

allow correct calculation using incorrectly calculated moles of iron and / or chlorine

$2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$

allow multiples / fractions

allow a correctly balanced equation including Fe and Cl_2 from an incorrect ratio of Fe : Cl

*allow **1** mark for Fe **and** Cl_2 (reactants) **and** $FeCl_3$ (product)*
or
*allow **1** mark for Fe **and** Cl_2 (reactants) **and** a formula for iron chloride correctly derived from an incorrect ratio of Fe : Cl (product)*

2

[16]

Q8.

(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]

Q9.

(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

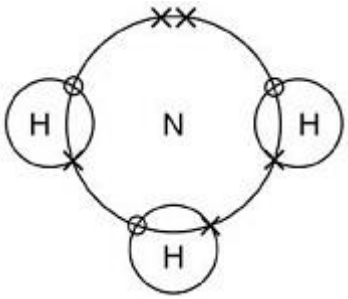
(g) polymer **A** has crosslinks (between polymer molecules)
or
polymer **B** has no crosslinks (between polymer molecules)

1

[10]

Q10.

(a)



*scores **2** marks*
allow dots, crosses, circles or $e^{(-)}$ for electrons

1 bonding pair of electrons in each overlap

1

2 non-bonding electrons on nitrogen

*do **not** accept non-bonding electrons on hydrogen*

ignore inner shell electrons drawn on nitrogen

1

(b) does not show the shape
or
only two-dimensional

allow is not three-dimensional

1

(c) (ammonia has) small molecules

allow (ammonia has) a simple molecular (structure)

1

(ammonia has) weak intermolecular forces

allow (ammonia has) weak intermolecular bonds

*do **not** accept weak covalent bonds*

1

(so) little energy is needed to overcome the intermolecular forces

allow (so) little energy is needed to break the intermolecular bonds
allow (so) little energy is needed to separate the molecules

*do **not** accept references to breaking covalent bonds*

1

(d) Cr_2O_3

1

(e)

*an answer of (-)1272 (kJ) scores **3** marks*

(for bonds broken)
((12 x 391) + (3 x 498) =) 6186

1

(for bonds made)
((2 x 945) + (12 x 464) =) 7458

1

(overall energy change = 6186-7458 =) (-)1272 (kJ)

allow correct calculation using incorrectly calculated values from step 1 and/or step 2

1

(f)

allow ecf from part (e)

7458 (kJ) (released in making bonds) is greater than 6186 (kJ) (used in breaking bonds)
or
the products have 1272 (kJ) less energy than the reactants

allow the (overall) energy change is -1272 (kJ)

1

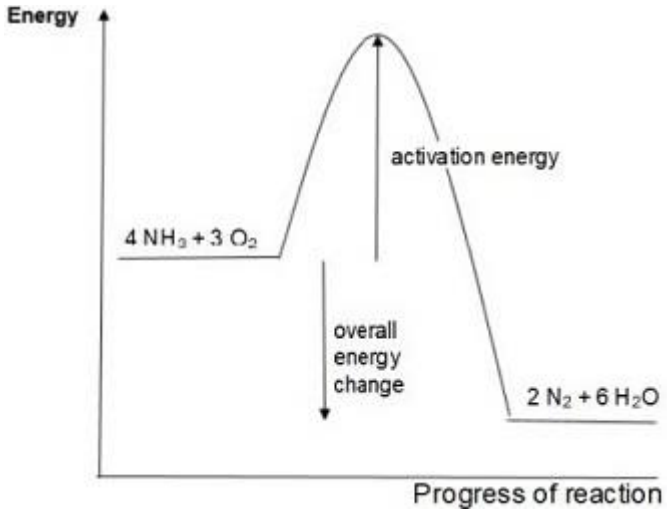
(so) energy is released (to the surroundings)

dependent on MP1 being awarded
allow (so) heat is released (to the surroundings)

*if no values given, allow **1** mark for more energy released in making bonds than used in breaking bonds*

1

(g)



*scores **2** marks*

allow discontinuous lines
ignore arrow heads

activation energy labelled

1

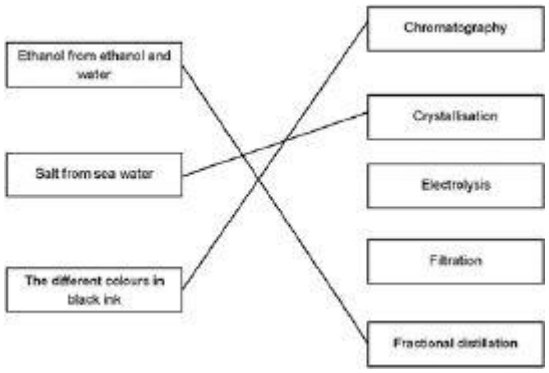
(overall) energy change labelled

1

[14]

Q11.

(a)



1
1
1

(b) include a (filter) funnel

allow funnel drawn on the diagram
ignore clamp stand

1

(c) evaporate

1

condense

1

must be this order

(d) $\frac{2}{20} \times 100$

1

= 10 (%)

1

*an answer of 10 (%) scores **2** marks*
*an answer of 11.1(%) **or** 90 (%) scores **1** mark*

(e) an alloy

1

(f) the layers in the mixture are distorted

1

(g) 8000 nm^3

1

[11]

Q12.

(a) potassium chloride **and** iodine

either order
allow KCl for potassium chloride and I_2 for iodine

1

(b) (chlorine's) outer electrons / shell closer to the nucleus

allow chlorine has fewer shells

allow chlorine atom is smaller than iodine atom

ignore chlorine has fewer outer shells

1

(so) the chlorine nucleus has greater attraction for outer electrons / shell

allow chlorine has less shielding

*do **not** accept incorrect types of attraction*

1

(so) chlorine gains an electron more easily

1

***max 2** marks can be awarded if the answer refers to chloride / iodide instead of chlorine / iodine*

allow converse statements

allow energy levels for shells throughout

(c) hydrogen chloride is made of small molecules

allow hydrogen chloride is simple molecular

1

(so hydrogen chloride) has weak intermolecular forces*

1

(intermolecular forces) require little energy to overcome*

1

do **not accept reference to bonds breaking unless applied to intermolecular bonds*

(d) (bonds broken = 4(412) + 193 =)1841

1

(bonds formed = 3(412) + 366 + **X** =) 1602 + **X**

1

−51 = 1841 − (1602 + **X**)

allow use of incorrectly calculated values of bonds broken and / or bonds formed from steps 1 and 2 for steps 3 and 4

1

(**X** =) 290 (kJ/mol)

allow a correctly calculated answer from use of −51 = bonds formed − bonds broken

1

OR

alternative method ignoring the 3 unchanged C−H bonds

(412 + 193 =) 605 (1)

366 + **X** (1)

−51 = 605 − (366 + **X**) (1)

(**X** =) 290 (kJ/mol) (1)

*an answer of 290 (kJ/mol) scores **4** marks*

*an answer of 188 (kJ/mol) scores **3** marks*

*an incorrect answer for one step does **not** prevent allocation of marks for subsequent steps*

[11]

Q13.

(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

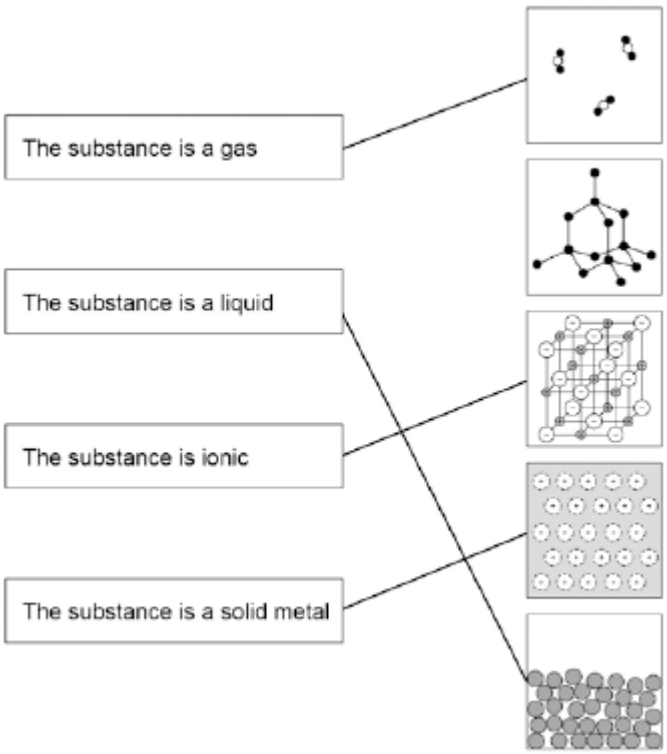
(f) 24

1

[8]

Q14.

(a) **Statement** **Structure**



more than one line drawn from a variable negates the mark

4

(b) Carbon

1

(c) It has delocalised electrons

1

(d) the atoms / particles / ions are different sizes

*do **not** accept molecules*

1

so there are no rows / layers to slide

accept the layers are disrupted

1

(e) $\frac{2}{27} \times 100$

1

7.4%

1

*allow 7.4% with no working shown for **2** marks*

(f) Mixture

1

[11]

Q15.

(a) electrons transferred from potassium to sulfur

1

two potassium atoms each lose one electron

1

forming K^+ / 1+ ions

1

sulfur atoms gain 2 electrons

1

forming S^{2-} / 2− ions

1

(b) there are no gaps / sticks between the potassium ions and sulfide ions

1

(c) (two) shared pairs between H and S

1

rest correct - no additional hydrogen electrons and two non-bonding pairs on sulfur

second mark dependent on first

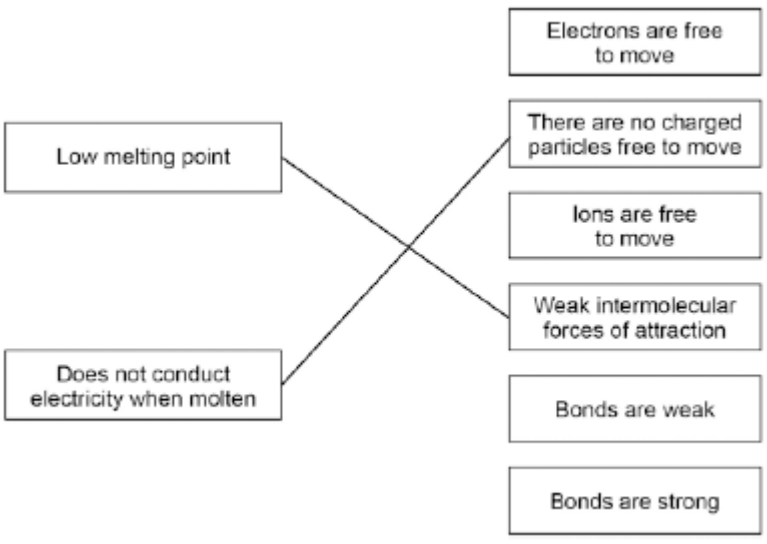
1

(d) 342

2

*allow **1** mark for evidence of (2 × 27) + 3[32 + (16 × 4)]*

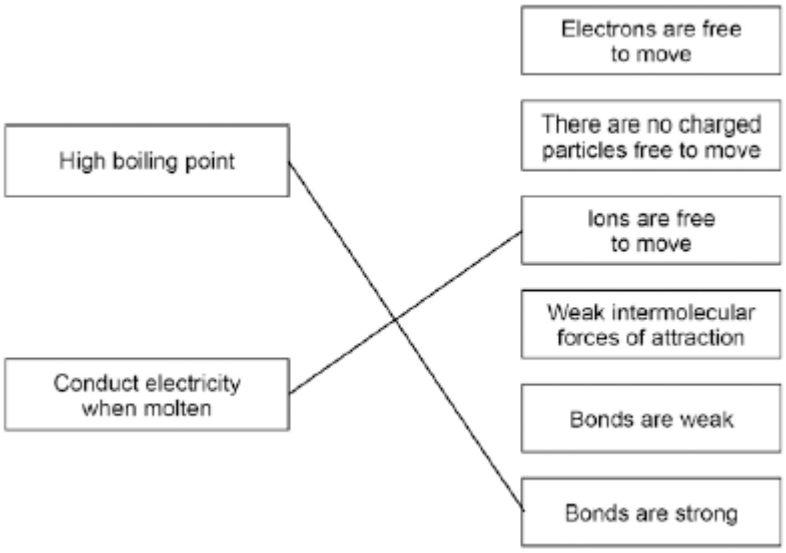
(e)



more than one line drawn from a variable negates the mark

2

(f) **Property** **Explanation of property**



more than one line drawn from a variable negates the mark

2

[14]

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]

Q17.

(a) electricity

allow an electric current

1

(b) (i) chlorine/Cl_2

*do **not** accept chloride*

1

(ii) (zinc ions are) positive

ignore to gain electrons

1

and (opposite charges) attract

1

(iii) reduction

1

(c) (i) in alloy:

accept converse

different sized atoms/particles

or

no layers/rows

accept layers distorted

1

so cannot slide

1

(ii) shape memory (alloys)

accept smart

1

[8]