AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.2.2 HOW BONDING AND STRUCTURE ARE RELATED TO THE PROPERTIES OF SUBSTANCES (PACK 1)

SCORE	PERCENTAGE
/377	%

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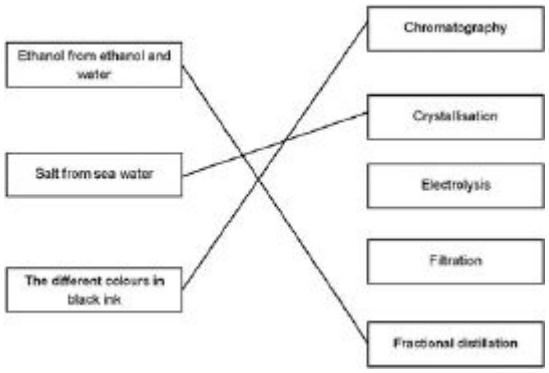
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Q1.

(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]

Q2.

(a) potassium chloride **and** iodine

either order
allow KCl for potassium chloride and I_2 for iodine

1

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(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)

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(**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]

Q3.

(a) gas

1

(b) the gas escapes

allow carbon dioxide escapes

*do **not** accept references to evaporation*

1

(c) 5.12 (g)

1

(d) 4.00 (g) trial 1

allow 2.89 written in either space, or ringed in the table, unless contradicted by mass of copper carbonate or trial number

1

(e) reheat

1

(and reweigh) until constant mass

1

*an answer of heat to constant mass scores **2** marks*

*if no other mark scored allow for **1** mark*
heat for longer
or
(heat at a) higher temperature

alternative approach:

(1) continue heating and pass gas through limewater

(1) until the (lime)water stops bubbling
or
until the limewater no longer turns cloudy

(f) straight line of best fit

must touch at least 5 of the 6 plots

1

(g) correct value read from line of best fit in the graph

allow tolerance of ±½ small square

1

(h) (mass =)

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$168 \times \frac{\text{answer from question (g)}}{8.4}$

*allow (mass =) answer from part **(g)** × 20*

1

correctly calculated value (g)

1

*a correctly calculated value from their answer to part **(g)** scores **2** marks*

[10]

Q4.

(a) bar to 0.3 g

1

bar labelled copper

allow Cu

1

(b) (£) 57

allow (£) 57.00

1

(c) $\frac{22}{9} \times 1.9$

1

= 4.6 (g)

allow an answer of 4.6(4444) (g)

1

*an answer of 4.6(4444) (g) scores **2** marks*

(d) (9 carat gold is)

any **two** from:

- harder

  allow stronger or more durable or less malleable
- less expensive

  allow cheaper
- aesthetic reasons

  allow references to colour

  allow converse arguments about 24 carat or pure gold

  ignore references to finite resources

2

(e) any **three** from:

- copper ores will run out

  allow copper ores scarce
- landfill sites running out

  allow reduces waste

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- less energy used

  allow produces less carbon dioxide or an implication e.g. global warming

- mining causes pollution

  allow a specific pollution resulting from mining, e.g. noise, eyesore, damage to environment

- copper from copper ore more expensive

  allow recycled copper is cheaper

3

[10]

Q5.

(a) chlorine is toxic

allow carbon monoxide is toxic

allow poisonous for toxic
ignore harmful / deadly / dangerous

allow a poisonous gas is used / produced

allow titanium chloride is corrosive

1

(b) any **one** from:

- very exothermic reaction

  allow explosive
  allow violent reaction
  ignore vigorous reaction
  ignore sodium is very reactive

- produces a corrosive solution

  allow caustic for corrosive
  ignore alkaline

- produces hydrogen, which is explosive / flammable

  allow flames produced
  ignore sodium burns

1

(c) argon is unreactive / inert

allow argon will not react (with reactants / products / elements)

1

oxygen (from air) would react with sodium / titanium
or
water vapour (from air) would react with sodium / titanium

allow elements / reactants / products for sodium / titanium

1

(d) metal chlorides are usually ionic

allow titanium chloride is ionic

1

(so)(metal chlorides) are solid at room temperature

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or

(so)(metal chlorides) have high melting points

allow titanium chloride for metal chlorides

1

(because) they have strong (electrostatic) forces between the ions

ignore strong ionic bonds

or

(but) must be a small molecule or covalent

allow molecular

1

allow alternative approach:

*titanium chloride must be covalent **or** has small molecules (1)*

with weak forces between molecules
*do **not** accept bonds unless intermolecular bonds(1)*

(but) metal chlorides are usually ionic (1)

(e) sodium (atoms) lose electrons

*do **not** accept references to oxygen*

1

(f) $Na \longrightarrow Na^+ + e^-$

*do **not** accept e for e^-*

1

(g) (M_r of $TiCl_4$ =) 190

$$(\text{moles Na} = \frac{20\,000}{23} =) \ 870 \text{ (mol) *}$$

1

$$(\text{moles } TiCl_4 = \frac{40\,000}{190} =) \ 211 \text{ (mol) *}$$

1

allow **1 mark for 0.870 mol Na **and** 0.211 mol $TiCl_4$*

allow use of incorrectly calculated M_r from step 1

either

(sodium is in excess because) 870 mol Na is more than the 844 mol needed

or

(because) 211 mol $TiCl_4$ is less than the 217.5 mol needed

the mark is for correct application of the factor of 4

other correct reasoning showing, with values of moles or mass, an excess of sodium or insufficient $TiCl_4$ is acceptable

allow use of incorrect number of moles from steps 2 and / or 3

1

alternative approaches:

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approach 1:

(M_r of $TiCl_4$ =) 190(1)

(40 kg $TiCl_r$ needs)

$\frac{40}{190} \times 4 \times 23$ *(kg Na) (1)*

(=) 19.4 (kg) (1)

so 20 kg is an excess (1)

approach 2:

(M_r of $TiCl_4$ =) 190(1)

(20 kg Na needs)

$\frac{20}{4 \times 23} \times 190$ *(kg $TiCl_4$) (1)*

(=) 41.3 (kg) (1)

so 40 kg is not enough (1)

(h) (actual mass =) $\frac{92.3}{100} \times 13.5$

or

(actual mass =) 0.923 × 13.5

1

= 12.5 (kg)

allow 12 / 12.46 / 12.461 / 12.4605 (kg)

1

*an answer 12.5 (kg) scores **2** marks*

[15]

Q6.

(a) sulfur (formed)

allow S / S_8 (formed)

1

(which is a) precipitate

allow (which is a) solid
allow (which is) insoluble

1

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

5–6

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

3–4

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

1–2

No relevant content

0

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Indicative content

method

- measure (indicated) volume of sodium thiosulfate
- place sodium thiosulfate in (conical) flask
- measure (indicated) volume of hydrochloric acid
- place on cross or between light sensor
  or
  connect to a gas syringe
  or
  other suitable method for timing a change
- add hydrochloric acid to (conical) flask
- swirl
- start stopclock / stopwatch
- measure time for cross to become no longer visible
  or
  log light transmission over time
  or
  measure time for fixed volume of gas to be produced
- repeat and find mean
- repeat for different concentrations of sodium thiosulfate
  or change ratio of sodium thiosulfate volume : water volume

control variables

- concentration of hydrochloric acid
- volume of hydrochloric acid
- (total) volume of sodium thiosulfate solution

[8]

Q7.

(a) **A**

1

(b) **D**

1

(c) **C**

1

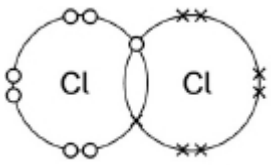
(d) **E**

1

(e) bonding pair of electrons drawn

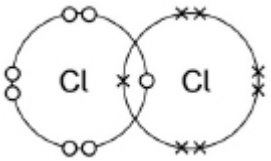
electrons can be dots, crosses or $e^{(-)}$ in any combination

eg

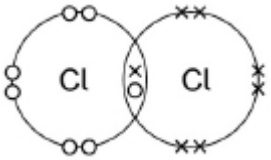


or

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or



*do **not** accept if electrons added to outer shells outside overlap*

1

(f) weak forces between molecules

1

(g) MnO

1

(h) ions move around in the liquid

1

[8]

Q8.

(a) precipitate / solid formed

allow colour change

1

(b) total mass before = 257.68 g
total mass after = 257.68 g

1

so the mass of products equals
the mass of the reactants

1

(c) 0.01 g

1

(d) 207 + (2 × 14) + (6 × 16)
or
207 + 2 × [14 + (3 × 16)]

1

= 331

1

*an answer of 331 scores **2** marks*

(e) CrO_4^{2-}

1

(f) carbon dioxide is a gas

allow a gas is produced

1

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the gas escapes during the reaction

1

(so) the mass at the end is less than expected

1

[10]

Q9.

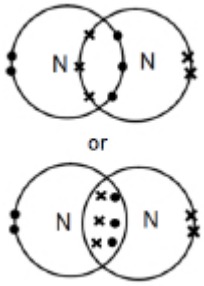
(a) six electrons in the overlap

allow dots, crosses or $e^{(-)}$ for electrons

1

2 non-bonding electrons on each nitrogen atom

***2** marks for an answer of:*



1

(b) weak forces

1

between molecules
or
intermolecular

do not allow references to covalent bonding between molecules

1

(which) need little energy to overcome

1

(c) each (carbon) atom forms three covalent bonds

1

forming layers (of hexagonal rings)

1

(soft)
(because) layers can slide over each other

1

(conducts electricity)
(because of) delocalised electrons

1

(d) molecules are spherical

1

(so molecules) will roll

1

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(e) surface area (= 20 × 20 × 6) = 2400 (nm^2)

1

volume (= 20^3) = 8000 (nm^3)

1

ratio = 0.3 (nm^3): 1 (nm^3)
ratio = 0.3 (nm^3): 1 (nm^3)
or
1 (nm^3): 3.33 (nm^3)

1

(f) (nanoparticles) have a larger surface area to volume ratio

1

so less can be used for the same effect

1

[16]

Q10.

(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]

Q11.

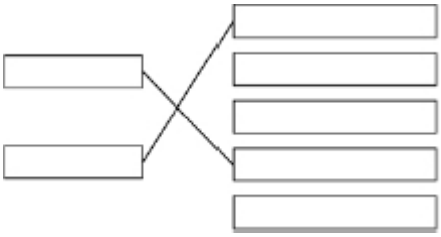
(a) S(s)

1

(b) measuring cylinder

1

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(c) 

1

*allow for **1** mark an answer of dependent variable --- concentration of sodium thiosulfate solution and independent variable --- time for cross to become no longer visible*

1

(d) cross might be darker or paler

allow cross may not be the same size / shape

1

(e) $\frac{43 + 41}{2}$

*an answer of 42 (s) scores **2** marks*

1

= 42 (s)

*an answer of 54 (s) scores **1** mark*

1

(f) smooth curve through all points

must touch all crosses

*do **not** allow straight lines between points*

*ignore attempt to plot **X***

1

(g) reproducible

1

(h) particles collide more frequently

1

there are more particles in a fixed volume

1

[11]

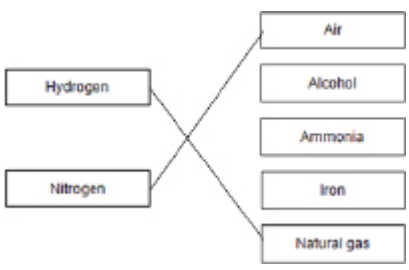
Q12.

(a) 4

1

(b) reversible (reaction)

1

(c) 

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1
1

(d) −40 °C

1

(e) recycled to the reactor

1

(f) ionic

1

(g) nitrogen

1

phosphorus

1

(h) 0.24 × 50 × 5

allow £87.50

1

= £60

1

*an answer of £60 scores **2** marks*

(i) may need to use nitrogen, phosphorus and potassium

allow neither fertiliser has all the elements / nutrients needed.

[12]

Q13.

(a) sulfur

1

precipitate

allow solid

1

(b) any **one** from:
- (volumetric) pipette
- burette

1

(c) any **one** from:
- concentration of hydrochloric acid
- volume of hydrochloric acid
- volume of sodium thiosulfate solution
- temperature (of solution)
- darkness of cross

allow same cross

- same stirring / swirling

1

(d) 7 points plotted correctly

allow tolerance of ± half a small square

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*allow 5 or 6 points plotted correctly for **1** mark*

2

line of best fit

must avoid anomalous point

1

(e) repeatable

*do **not** accept reproducible*

1

(f) discard any anomalous results

1

calculate a mean

1

(g) **conclusion:**
the higher the concentration, the higher the rate of reaction

1

explanation:
(at higher concentrations) there are more particles in a fixed volume

1

(therefore the) collisions are more frequent

1

allow converse

(h) 120 (s)

1

0.18 / 120

allow 0.0015

1

$= 1.5 \times 10^{-3}$ (g / s)

*an answer of 9×10^{-2} scores **2** marks*
*allow an answer of 0.09 for **1** mark*

1

*an answer of 1.5×10^{-3} (g / s) scores **3** marks*

[16]

Q14.

(a) cool

1

to −34 °C

allow temperatures below −34 °C but above −196 °C

1

(b) recycled (to the reactor)

1

(c) $825 \times \frac{2}{3}$

1

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= 550 (dm^3)

1

*an answer of 550 (dm^3) scores **2** marks*

(d) a lower pressure would decrease the equilibrium yield

1

a lower temperature would make the reaction too slow

1

(e) nitrogen / N

1

(f) **B** and **C**

1

contain nitrogen, phosphorus and potassium

1

(g) (**B**)

any **two** from:
- more stages
- uses more energy
- uses more raw materials
- takes longer

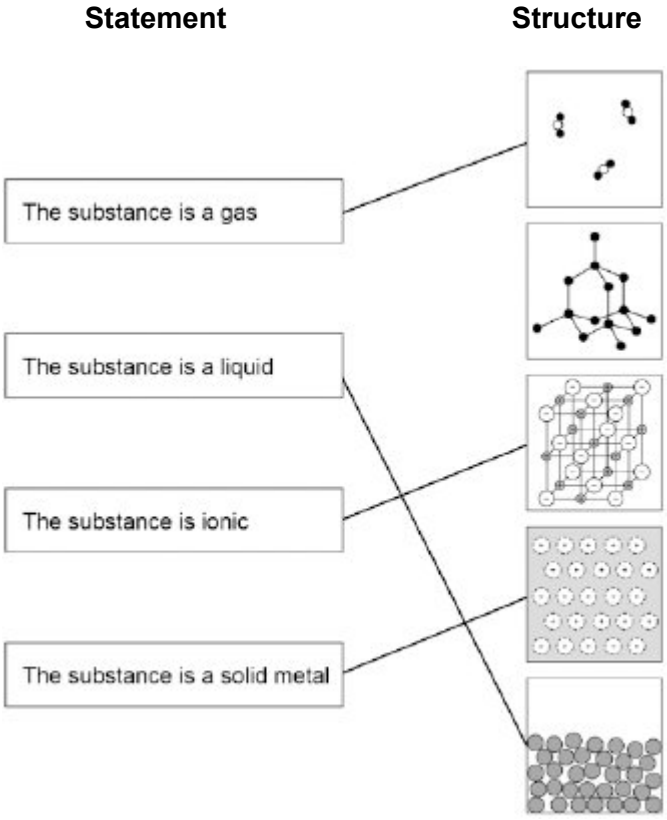
*allow converse for **C***

2

[12]

Q15.

(a)



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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]

Q16.

(a) s

1

l

*Answers **must** be in the correct order.*

1

(b) A gas was lost from the flask

1

(c) **Level 3 (5–6 marks):**
A coherent method is described with relevant detail, and in correct sequence which demonstrates a broad understanding of the relevant scientific techniques and procedures. The steps in the method are logically ordered. The method would lead to the production of valid results.

Level 2 (3–4 marks):
The bulk of the method is described with mostly relevant detail, which demonstrates a reasonable understanding of the relevant scientific techniques and procedures. The method may not be in a completely logical sequence and may be missing some detail.

Level 1 (1–2 marks):
Simple statements are made which demonstrate some understanding of some of the relevant scientific techniques and procedures. The response may lack a logical structure and would not lead to the production of valid results.

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0 marks:
No relevant content.

Indicative content

- sulfuric acid in beaker (or similar)
- add copper carbonate one spatula at a time
- until copper carbonate is in excess or until no more effervescence occurs *
- filter using filter paper and funnel
- filter excess copper carbonate
- pour solution into evaporating basin / dish
- heat using Bunsen burner
- leave to crystallise / leave for water to evaporate / boil off water
- decant solution
- pat dry (using filter paper)
- wear safety spectacles / goggles

*Students. may choose to use a named indicator until it turns a neutral colour, record the number of spatulas of copper carbonate added then repeat without the indicator.

6

(d) Total mass of reactants = 221.5

1

159.5

221.5

allow ecf from step 1

1

72.0 (%)

1

*allow 72.0 with no working shown for **3** marks*

(e) any **one** from:

- Important for sustainable development
- Economic reasons
- Waste products may be pollutants / greenhouse gases

1

[13]

Q17.

(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

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(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

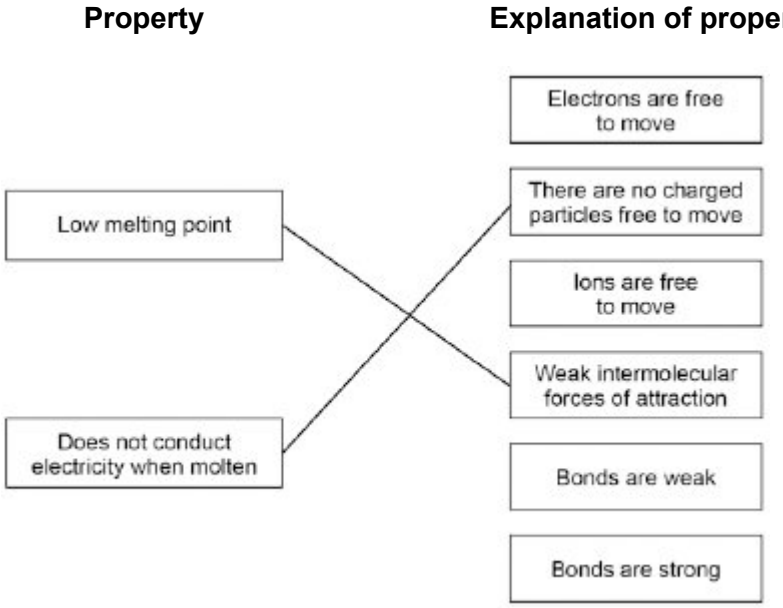
1

(d) 342

2

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

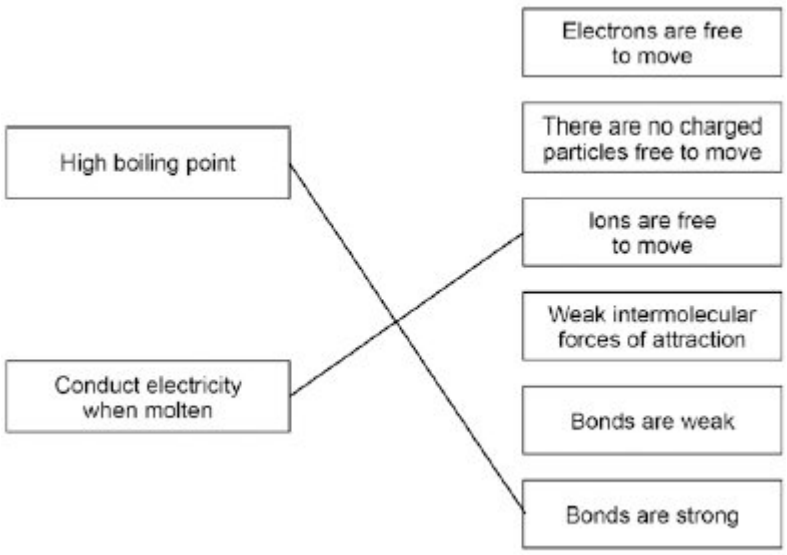
(e)



more than one line drawn from a variable negates the mark

2

(f)



more than one line drawn from a variable negates the mark

2

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[14]

Q18.

(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]

Q19.

(a) The forces between iodine molecules are stronger

1

(b) anything in range +30 to +120

1

(c) Brown

1

(d) $2\ I^- + Cl_2 \rightarrow I_2 + 2\ Cl^-$

1

(e) It contains ions which can move

1

(f) hydrogen iodine

1

[6]

Q20.

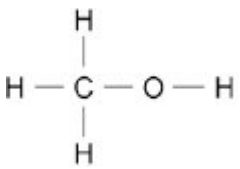
(a) Propanol

1

(b) Butanol has the highest boiling point

1

(c)



1

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(d) ethene + water (→ ethanol)

allow answers in either order

allow steam for water

1

(e) goes back to reactor

allow is recycled

1

(f) air contains oxygen

1

which oxidises ethanol

allow ethanol reacted with oxygen

1

to produce ethanoic acid

1

[8]

Q21.

(a) because it is a good conductor of electricity.

1

(b) (i) 2.1 (%)

1

(ii) correct bar for calcium at 3.6 %

1

allow error of +/– 0.05%

correct bar for iron at 5.0 %

1

allow error of +/– 0.05%

(c) (i) decomposition

1

(ii) carbon dioxide

1

(iii) carbon = 1

allow one

1

oxygen = 3

allow three

1

(iv) 44 (g)

allow forty four

1

(d) (i) to make alloys for specific uses.

1

(ii) any **three** from:

- to conserve resources of iron or iron ore

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allow steel instead of iron or iron ore
allow limited resource or non-renewable

- to avoid the need for quarrying/mining
- to conserve energy resources or fossil fuels
- to limit the amount of carbon dioxide produced or to reduce global warming
- to reduce the amount of landfill

"it" = steel

ignore cost and reuse and time and waste

3

[13]

Q22.

(a) both water vapour and ethanol will condense

allow steam for water vapour
allow they both become liquids
allow ethane condenses at a lower temperature
allow some of the steam hasn't reacted
allow it is a reversible reaction / equilibrium

1

(b) amount will decrease

1

because the equilibrium will move to the left

1

(c) more ethanol will be produced

1

because system moves to least / fewer molecules

1

[5]

Q23.

(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

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*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]

Q24.

(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]

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Q25.

(a) magnesium loses two electrons **and** chlorine gains one electron

*accept magnesium loses electrons **and** chlorine gains electrons for 1 mark*

ignore oxidation and reduction

2

one magnesium and two chlorines

accept $MgCl_2$

1

noble gas structure

or

eight electrons in the outer shell

accept full outer shell (of electrons)

or

(electrostatic) attraction between ions

or

forms ionic bonds

*do **not** accept covalent bonds*

1

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 3***

(b) (i) because ions can move

ignore ions attracted

*do **not** accept molecules / atoms moving*

*do **not** accept incorrect reference to electrons moving*

1

(and ions move) to the electrodes

or

(and ions) carry charge

1

accept converse for solid

(ii) magnesium (ions) attracted (to the electrode)

1

so magnesium ions gain electrons

accept magnesium ions are reduced

ignore oxidised

1

2 electrons

*accept a correct half equation for 2nd **and** 3rd marking points*

1

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(iii) hydrogen

allow H_2

1

(iv) magnesium is more reactive than hydrogen

accept converse

*allow magnesium is high in the reactivity series **or** magnesium is very/too reactive.*

*do **not** accept magnesium ions are more reactive than hydrogen ions*

1

(v) **2** $Cl^- \rightarrow Cl_2 + \mathbf{2e^-}$

must be completely correct

1

(c) layers (of particles/atoms/ions)

1

(particles/atoms/ions/layers) can slide

1

*any mention of intermolecular / weak bonds/forces = **max 1***

[14]

Q26.

(a) has delocalised electrons

accept free (moving) electrons

1

(so electrons) can move through the structure/metal

accept (so electrons) can carry charge through the structure/metal

accept (so electrons) can form a current

1

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = **max 1***

(b) giant structure

accept lattice

accept each atom forms four bonds (with other carbon atoms)

ignore macromolecular

1

strong bonds

accept covalent

*do **not** accept ionic*

1

*reference to intermolecular forces/bonds **or** incorrect particles = **max 1***

(c) thermosetting polymers do not melt (when heated)

accept thermosetting polymers do not change shape (when heated)

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accept thermosetting polymers have high(er) melting points
ignore thermosetting polymers do not soften (when heated)

1

due to cross-links (between chains)

accept due to bonds between chains

1

*reference to smart polymers = **max 1***
accept converse argument

[6]

Q27.

(a) (i) C

1

(ii) B

1

(iii) A

1

(iv) D

1

(b) (i) SO_2

1

(ii) shared

1

(iii) covalent

1

[7]

Q28.

(a) because sulfur dioxide causes <u>acid rain</u>

1

which kills fish / aquatic life **or** dissolves / damages statues / stonework **or** kills / stunts growth of trees

if no other mark awarded then award 1 mark for sulfur dioxide is toxic or causes breathing difficulties.

1

(b) (i) <u>electrons</u> are lost

1

(ii) $Cu^{2+} + 2e^- \rightarrow Cu$

allow $Cu^{2+} \rightarrow Cu - 2e^-$
ignore state symbols

1

(iii) copper sulfate

allow any ionic copper compound

1

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(c) (lattice of) positive ions

1

delocalised electrons

accept sea of electrons

1

(electrostatic) attraction between the positive ions and the electrons

1

electrons can move through the metal / structure **or** can flow

allow electrons can carry charge through the metal / structure

if wrong bonding named or described or attraction between oppositely charged ions then do not award M1 or M3 − MAX 2

1

(d) (copper compounds are absorbed / taken up by) plants

allow crops

1

which are burned

1

the ash contains the copper compounds

do not award M3 if the ash contains copper (metal)

1

(e)

/ A_r	55.6 / 63.5	16.4 / 56	28.0 / 32
moles	0.876	0.293	0.875
ratio	3	1	3
formula	Cu_3FeS_3		

*award **4** marks for Cu_3FeS_3 with some correct working*

*award **3** marks for Cu_3FeS_3 with **no** working*

*if the answer is not Cu_3FeS_3 award up to **3** marks for correct steps from the table apply ecf*

*if the student has inverted the fractions award **3** marks for an answer of $CuFe_3S$*

4

[16]

Q29.

(a) (i) the products are at a lower energy level than the reactants

accept products have less energy / less energy at the end than the beginning

1

(ii) because a catalyst provides an alternative / different pathway / mechanism / reaction route

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accept adsorption or 'increases concentration at the surface'

ignore absorption

1

(that has) <u>lower activation energy</u>

allow weakens bonds

allow idea of increased successful collisions.

DO NOT ALLOW answers stating catalysts provide energy for M1 and M2

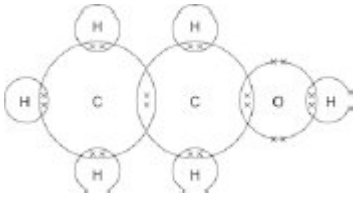
1

(b) one pair of electrons in each overlap (8 pairs in total)

allow any combination of dots, crosses or other symbols

1

the rest of the diagram correct with four non-bonding electrons on the oxygen giving a total of eight electrons in oxygen outer energy level.



*gains **2** marks*

1

(c) (i) ±3024 (J)

*correct answer with or without working gains **3** marks*

*if the answer is incorrect, award up to **2** marks for the following steps:*

- *ΔT = 14.4(°C)*
- *50 x 4.2 x 14.4*

allow ecf for incorrect ΔT

3

(ii) 0.015(2173913)

*correct answer with or without working gains **3** marks*

if answer is incorrect, allow 1 mark each for any of the following steps up to a max of 2.

- *0.70g*
- *M_r of ethanol = 46*
- *0.70 / 46*

allow ecf in final answer for arithmetical errors

3

(iii) ±198 720(J / mole)

c(i) ÷ c(ii)

*allow ecf from **(c)(i)** and **(c)(ii)***

0.015 gives 201600

0.0152 gives 198947

0.01522 gives 198686

1

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(d) (as the molecules get bigger **or** the number of carbon atoms increases) the intermolecular forces

allow intermolecular bonds

1

(intermolecular forces) increase

allow more / stronger (intermolecular forces)

1

and therefore require more (heat) energy to overcome

*breaking covalent bonds or unspecified bonds max **1** mark (M3)*

1

[15]

Q30.

(a) sodium loses (electron)

sharing / covalent / metallic = max 2

1

chlorine gains (electron)

1

1 **or** an (electron)

1

(b) (i) Have no overall electric charge

1

(ii) Should iodine be added to salt?

1

reason
any **one** from:

- cannot be done by experiment
  accept difficult to get / not enough evidence
- based on opinion / view
  allow must be done by survey
- ethical **or** economic issue.

1

(c) (i) nitric (acid)

1

(ii) an alkali

1

(iii) indicator

accept any named acid base indicator

1

(d) (i) Crystallisation

1

(ii) fertiliser

allow to help crops grow

1

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(iii) any **one** from:
- pressure
  allow concentration
- temperature
  ignore heat
- catalyst.

1

[12]

Q31.

(a) any **one** from:
- protection / improve lifespan
- improve appearance.

1

(b) (i) Bleach

1

(ii) Hydrogen is less reactive than sodium

1

(iii) 1 bonding pair of electrons 6 unbonded electrons on Cl
accept dot, cross or e or − or any combination

1

(iv) Covalent

1

(v) Hydrogen chloride has a low boiling point.

1

Hydrogen chloride is made of simple molecules.

1

(c) (i) oxygen
accept carbon dioxide

1

(ii) aluminium ions are positive

1

so are attracted (to the negative electrode)
allow opposites attract

1

(iii) Reduction

1

(iv) slide
allow move

1

(d) (i) C

1

(ii) strong covalent bonds

1

[14]

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Q32.

(a) giant structure / lattice / layers / close packed

first 3 marks can be obtained from a suitably labelled diagram

incorrect structure or bonding or particle = max 3

1

made up of atoms / <u>positive</u> ions

1

with delocalized / free electrons

1

so electrons can move / flow through the metal

accept so electrons can carry charge through the metal

accept so electrons can form a current

1

(b) an alloy (is a metal which) has different types / sizes of atoms

accept converse for pure metal throughout

both marks can be obtained from suitable diagrams

allow made of different metals

allow mixture of metals / atoms / elements

ignore particles

ignore properties

*do **not** accept compound*

1

alloy has distorted layers

allow layers are unable to slide

1

(c) (i) can return to its original shape

accept shape memory alloy

accept smart alloy

ignore other properties

1

(ii) (pure copper is too) soft

accept converse

accept malleable or bends

accept copper is running out

ignore references to strength and weakness

1

(iii) aluminium oxide

accept alumina

accept Al_2O_3

ignore bauxite / aluminium ore

1

(iv) any **one** from:

- different conditions

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- different catalyst
- different pressure

  allow different concentration
- different temperature.

  *do **not** accept different monomers*

1

(d) any **two** from:
- accurate
- sensitive
- rapid
- small sample.

both needed for 1 mark

1

[11]

Q33.

(a) lattice / giant structure

*max **3** if incorrect structure or bonding or particles*

1

ionic **or** (contains) ions

1

Na^+ **and** Cl^-

accept in words or dot and cross diagram: must include type and magnitude of charge for each ion

1

electrostatic attraction

allow attraction between opposite charges

1

(b) hydrogen

allow H_2

1

sodium hydroxide

allow NaOH

1

(c) any **one** from, eg:
- people should have the right to choose
- insufficient evidence of effect on individuals
- individuals may need different amounts.

allow too much could be harmful

ignore religious reasons

ignore cost

ignore reference to allergies

1

(d) (i) one bonding pair of electrons

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accept dot, cross or e or − or any combination, eg



1

6 unbonded electrons on each atom

1

(ii) simple molecules

*max **2** if incorrect structure or bonding or particles*

accept small molecules

accept simple / small molecular structure

1

with intermolecular forces

accept forces between molecules

must be no contradictory particles

1

which are weak **or** which require little energy to overcome − must be linked to second marking point

reference to weak covalent bonds negates second and third marking points

1

(iii) iodine has no delocalised / free / mobile electrons or ions

1

so cannot carry charge

*if no mark awarded iodine molecules have no charge gains **1** mark*

1

[14]

Q34.

(a) (i) silver nitrate

allow $AgNO_3$

1

(ii) potassium carbonate **or**

allow K_2CO_3

sodium carbonate

allow Na_2CO_3

1

(b) base

allow ionic

ignore insoluble or soluble

ignore alkali

1

(c) (i) evaporate

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or

crystallise

allow heat or boil or leave (to evaporate)

allow cool

ignore filtration unless given as an alternative

*do **not** accept freeze or solidify*

1

(ii) 2 (HNO_3)

accept multiples

1

(iii) 9

accept nine

1

(d) 6.21 / 207 0.72 / 16

***1** mark for dividing mass by A_r*

1

= 0.03 = 0.045

***1** mark for correct proportions (allow multiples)*

1

2 3

***1** mark for correct whole number ratio (allow multiples). Can be awarded from formula.*

1

Pb_2O_3

allow O_3Pb_2

***ecf** allowed throughout if sensible attempt at step 1*

*correct formula with no working gains **1** mark*

1

[10]

Q35.

(a) (i) iron

either order

1

carbon dioxide

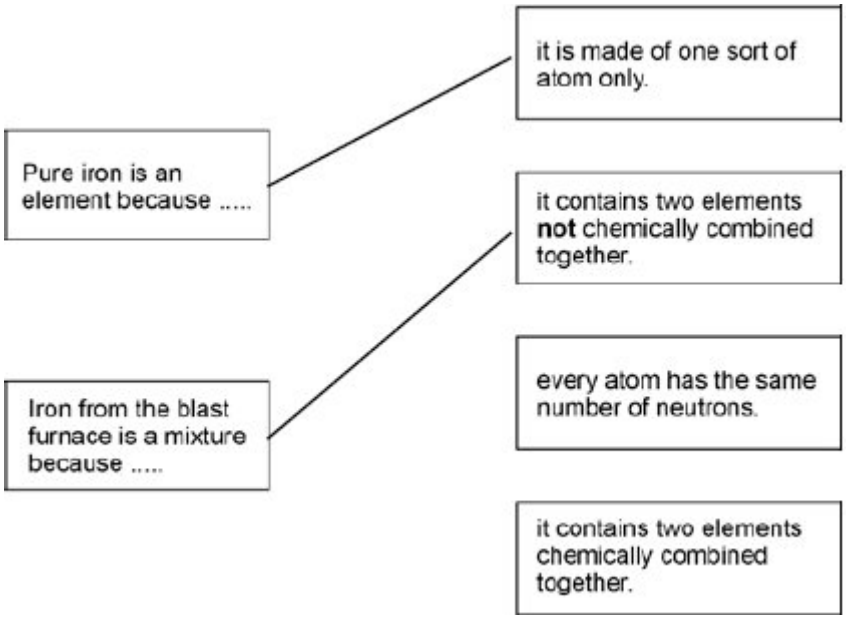
1

(ii) reduced

1

(b) (i) **Statemant** **Explanation**

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*each correct line gains **1** mark*

extra lines from statement negate the mark

max. 2

(ii) the layers / rows are distorted / disrupted **or** it doesn't occur in layers **or** the atoms are different

1

so cannot **slide** over one another **or slide** less easily

1

[7]

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