AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



MARK SCHEME

4.2.2 HOW BONDING AND STRUCTURE ARE RELATED TO THE PROPERTIES OF SUBSTANCES (PACK 2)

SCORE	PERCENTAGE
/231	%

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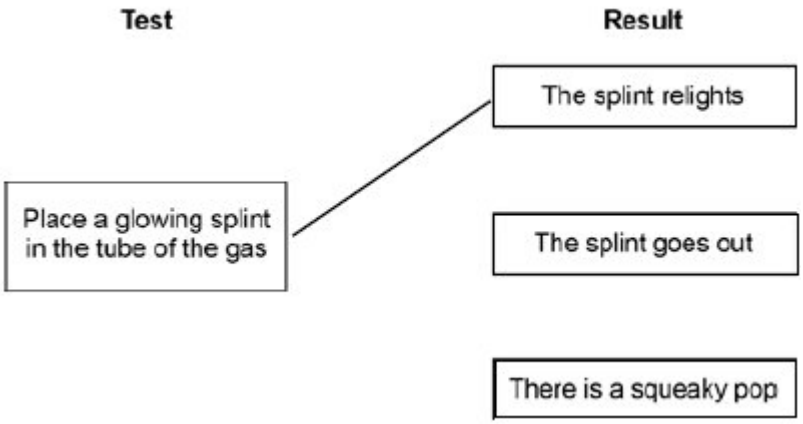
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Q1.

(a)



more than one line from test negates the mark

1

(b) (i) place a lighted splint at the mouth of the tube

1

there is a squeaky pop

dependent on correct test

1

(ii) hydrogen is less reactive than magnesium

accept converse

accept magnesium is too reactive

1

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

- to improve appearance or make it look nice
- to prevent corrosion
- to make it more durable
- cheaper than solid silver

1

(ii) solution must be silver nitrate **or** contain silver ions

1

otherwise copper will be deposited **or** silver will not be deposited

1

spoon must be the negative electrode / cathode

1

because silver ions have a positive charge **or** go to negative electrode **or** are discharged at the negative electrode.

1

(iii) because (plastic is an) insulator **or** does not conduct electricity

accept does not contain mobile electrons

1

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[10]

Q2.

(a) (i) ionic (bonding)

1

(ii) <u>ions</u> cannot move in solid **or** are in fixed positions

*do **not** accept electrons / atoms / molecules*

ignore particles

***must** mention ions*

1

but can move in solution

1

(b) silver chloride formed

1

which is insoluble

1

(c) (i) aluminium

1

calcium

accept other metal ions that also give white precipitates (such as lead and zinc)

1

(ii) add excess sodium hydroxide solution

the second mark of each pair is dependent on the first mark being awarded.

1

precipitate remains

1

carry out a flame test

1

not red / orange

accept any colour that is not orange / red

*give full credit for answers that correctly eliminate other cations in **(c)(i)** that would give white precipitates with a few drops of NaOH*

1

[11]

Q3.

(a) *weaker bonds*

allow (other substances) react with the silicon dioxide

or

fewer bonds

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ignore weaker / fewer forces

or

disruption to lattice

*do **not** accept reference to intermolecular forces / bonds*

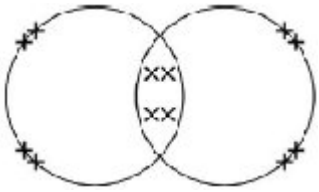
1

(b) (i) Na_2O

*do **not** accept brackets or charges in the formula*

1

(ii)



electrons can be shown as dots, crosses, e or any combination

2 bonding pairs

accept 4 electrons within the overlap

1

2 lone pairs on each oxygen

accept 4 non-bonding electrons on each oxygen

1

(c) *lattice / regular pattern / layers / giant structure / close-packed arrangement*

1

(of) positive ions **or** (of) atoms

1

(with) delocalised / free electrons

*reference to incorrect particles **or** incorrect bonding **or** incorrect structure = max **2***

1

[7]

Q4.

(a) Will kelp last longer than coal as an energy source?

1

(b) any **two** from:

- cannot be determined by experiment

  allow can't predict how long kelp / coal will last

  allow more testing needed

- based on opinion

- ethical **or** environmental **or** economic reason

  allow could damage ecosystem allow reference to cost

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2

(c) (i) 7

1

(ii) sodium (atom) loses (electron) **and** iodine (atom) gains (an electron)

*reference to incorrect bonding **or** incorrectly named particle = max **2***

any or all marks can be obtained from a labelled diagram

ignore inner shell electrons if shown

1

1 electron

1

(electrostatic) attraction **or** forms ionic bond(s)

1

(iii) ions can move (in the solution)

1

(iv) $2\,I^- \rightarrow I_2 + 2\,e^-$

1

(v) hydrogen is formed

1

because sodium is more reactive (than hydrogen)

1

[11]

Q5.

high melting point

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

accept will not melt (at high temperatures)

ignore withstand high temperatures

1

because a lot of energy needed to break bonds

1

because it is covalent **or** has strong bonds

accept bonds are hard to break

1

and because it is a giant structure **or** a macromolecule **or** a lattice

ignore many bonds

1

[4]

Q6.

(a) (Chromium =) 20

in correct order

1

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(Nickel =) 8

accept Chromium = 8 ***and*** *Nickel = 20 for* ***1*** *mark*

1

(b) (i) (because iron is made up of only) one type of atom

1

(ii) not strong

allow too soft ***or*** *too flexible*

accept it rusts / corrodes ***or*** *that it could wear away*

accept could change shape / bend

accept layers / atoms could slide (over each other)

1

(iii) structure is different / distorted / disrupted

accept not in layers ***or*** *not regular*

1

so it is difficult for layers / atoms / particles to slip / slide (over each other)

accept layers cannot slip / slide

1

[6]

Q7.

(a) because atoms / ions / particles in alloy are different (sizes)

do ***not*** *allow reference to molecules*

ignore reference to compounds

1

so layers distorted

(and layers / atoms / ions / particles) don't slide **or** slide less easily

accept all marking points in a suitably labelled or annotated diagram

1

if no other mark awarded accept an alloy is a mixture ***or*** *contains different metals / elements for* ***1*** *mark*

1

(b) giant structure **or** lattice **or** macromolecule

max ***3*** *marks if incorrect bonding*

1

strong bonds (between carbon / atoms)

1

covalent (bonds)

1

each carbon / atom forms 4 bonds

accept tetrahedral

if no other marks awarded, allow carbon (atoms) for ***1*** *mark*

1

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(c) *reference to incorrect bonding = max **3***
*reference to 'weak covalent bonds' = max **2***
allow correctly drawn diagram for first two marking points eg. (tangled) lines with no cross-links

chains **or** large molecules
ignore layers
1

with intermolecular forces **or** forces between chains
allow bonds for forces accept no cross-links
1

that are weak
must relate to 2 nd marking point
1

and are easily overcome/ broken (when heated)
accept molecules / chains can flow / move
1

[11]

Q8.

(a) has simple / small molecules
accept molecular covalent
1

the intermolecular forces / intermolecular bonds (are weak)
*do **not** accept weak covalent bonds **or** reference to incorrect bonding*
1

only need a small amount of energy to be overcome
accept only need a small amount of energy to separate the molecules
*if no other mark awarded, allow it has a low boiling point for **1** mark*
1

(b) (i) any pH value from 0 to 6.9
1

(ii) hydrogen
allow H^+
ignore H / H_2 / H^-
1

(c) any **three** from:

- same number of protons
accept same atomic number
numbers if given must be correct

- ^2H has one neutron

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- ^{1}H has no neutrons

  *accept different mass number **or** different number of neutrons for **1** mark*

  ignore relative atomic mass

- same number of electrons

  numbers if given must be correct

3

[8]

Q9.

(a) (i) C

1

(ii) C **or** D

1

(iii) A

1

(b) covalent

1

(c) layers

1

can slide / move over each other

accept are weakly bonded (owtte)

allow no bonds between layers

ignore slip / rub

1

[6]

Q10.

(a) (i) *mention of molecules / intermolecular / ionic / covalent = **max 2***

atoms / positive ions

1

any **two** from:

- (atoms / positive ions) in regular pattern / lattice / layer / giant structure (or diagram)
- delocalised electrons

  accept electrons move within / through the structure

  allow free (moving) electrons

  allow sea of electrons

- (atoms / positive ions) held together by strong / electrostatic attractions

  allow strong (metallic) bonds

2

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(ii) delocalised electrons

accept electrons move within / through the structure

allow free electrons

1

(b) (i) smaller / very small

accept converse

accept 1 - 100 nanometres in size

accept a few hundred atoms

accept larger surface area ***or***

large surface area for their size

1

(ii) nanoparticles / more can fit into (tiny) gaps

allow nanosize particles have large(r) surface area

1

[6]

Q11.

(a) Aluminium has a low density

1

Aluminium is resistant to corrosion

1

(b) (i) (an alloy) is a mixture of metals

accept (an alloy) can be a metal mixed with another metal ***or*** *iron mixed with carbon / a non-metal*

1

(ii) pure metals are soft

allow weak

or

alloys are hard

allow strong / keep their shape

ignore rust / corrosion

1

(c) (i) crude oil

1

(ii) hydrocarbons

1

(iii) oxygen

1

(d) (i) hydrogen

allow H_2 or H

1

(ii) only water is produced (from the fuel)

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or

no carbon dioxide is produced (from the fuel)

*allow less carbon dioxide produced **or** less global warming*
allow carbon dioxide causes global warming

1

[9]

Q12.

(a) (i) covalent

*two different answers indicated gains **0** marks*

1

(ii) carbon

*two different answers indicated gains **0** marks*

1

(iii) 3

*two different answers indicated gains **0** marks*

1

(b) layers can slide / slip

1

because there are no bonds between layers

accept because weak forces / bonds between layers

or so (pieces of) graphite rubs / breaks off

or graphite left on the paper

1

[5]

Q13.

(a) 118

1

(b) it loses / transfers electrons

it = Au / gold atom

1

three electrons

*sharing / covalency = max **1** mark*

1

(c) (i) O_2

1

2 CO and **2** CO_2
or
correct balancing of equation from O

accept correct multiples / fractions throughout

1

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(ii) *reference to incorrect bonding = **1** mark max*

because carbon dioxide is simple molecular / small molecules

1

there are *intermolecular* forces (between the molecules)

allow intermolecular bonds

1

so a small amount of energy needed (to separate molecules) **or** (*intermolecular forces*) are weak

1

(d) any **three** from:

- gold is the only catalyst for some reactions
- catalysts are not used up
- improves speed of reaction

reduces amount of energy **or** process needs low(er) temperature

*if no mark awarded, allow catalyst reduce costs (of the process) for **1** mark*

- only small quantities (of catalyst) needed

3

[11]

Q14.

(a) gases

1

white

1

solid

1

ammonium chloride

1

(b) reversible

allow phonetic spelling

allow goes both / two / either way(s)

1

[5]

Q15.

(a) (i) *mention of molecules **or** any reference to incorrect bonding = max 2*

giant structure / lattice or particles arranged in a regular pattern

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allow close packed / layers

1

sea of electrons / delocalised electrons

allow free electrons

1

positive ions and electrons attract each other

ignore metallic bonds

appropriately labelled diagrams can gain first two marks

1

(ii) (sea of) electrons can move <u>through the structure</u>

allow free / roaming / mobile electrons

or delocalised electrons

1

(b) (metal) oxide / ionic compound formed

1

ions not free to move

or

electrons cannot move <u>through the structure</u>

allow no / fewer delocalised / free / roaming / mobile electrons

1

[6]

Q16.

(a) (i) conducts electricity

1

(ii) <u>mix</u>ture (of metals)

(it = alloy)

1

(b) any **two** from:

ignore pollution without qualification

- noise
- dust

allow dirt

- traffic
- eyesore

2

[4]

Q17.

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(a) any **two** from

assume it = methanol
allow converse for water

- shorter / quicker soaking time
  allow it is quicker
- takes less time / quicker to dry

  or faster evaporation
- dissolves quicker / better in methanol

2

(b) (i) CH_4O

1

(ii) covalent

1

(c) it is made of small molecules

1

[5]

Q18.

(a) high melting point

1

not flammable

1

(b) (i) all

1

(ii) two

1

(iii) covalent

1

(iv) very strong

1

[6]

Q19.

(a) diagram **A**

1

(b) the atoms can slide over each other.

1

the atoms are in layers

1

(c) (i) sulfuric

1

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(ii) bubbles are produced

1

the magnesium disappears

1

(iii) crystallisation

1

[7]

Q20.

(a) • made of layers / rows (atoms / ions / particles)

ignore free / delocalised electrons

1

• which can slide / slip (over each other)

*reference to incorrect particles / covalency / intermolecular forces = max **1***

or

particles / ions / atoms can slide over each other

ignore malleable / ductile / weak bonds

1

(b) (i) sulfuric

accept sulphuric

ignore formula

ignore hydrogen sulfate

1

(ii) any **two** from:

list principle applies for incorrect observations

• (hydrogen) gas produced (or any indication of a gas such as bubbles etc.)

ignore just hydrogen produced

ignore cloudiness / colour changes

• magnesium / solid disappears / goes into solution

accept magnesium / magnesium sulfate / solid / it dissolves

accept forms a liquid / solution

• gets hot

allow exothermic

ignore floats

2

(iii) crystallisation

accept detailed answers such as: evaporate to half volume and then allow the solution to crystallise.

or

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evaporation / heating / boiling / cooling

ignore any references to filter

1

[6]

Q21.

three from:

*reference to ionic / metallic / intermolecular / (small) molecules = max **2***

structure: (max 2)

- giant structure / macromolecule / all the atoms are joined together

  allow (giant) lattice

  ignore large structure

  ignore diamond structure

- covalent (bonds)

- strong bonds / bonds difficult to break

- each silicon atom forms 4 bond sand / or each oxygen atom forms 2 bonds

explanation: (max 2)

- a lot of energy needed to break the bonds

- high melting point

  *if neither point given accept high temperature needed to break bonds for **1** mark*

- does not burn **or** react with oxygen

3

[3]

Q22.

(a) gives out heat / energy

allow more energy given out in making bonds than is used in breaking bonds

or

energy / heat transferred to surroundings

ignore light

1

(b) activation

allow phonetic spelling

1

(c) (i) 2 crosses on inner circle **and**

8 crosses on outer circle

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accepts dots / e / – for electrons

1

(ii) opposite charges (attract)

allow electrostatic forces (attract)

*do **not** accept intermolecular attraction / shared electrons*

1

[4]

Q23.

(a)

$\frac{6.21}{207}$ $\frac{0.64}{16}$

***1** mark for dividing mass by A_r*
*max **2** if A_r divided by mass*

1

= 0.03 = 0.04

***1** mark for correct proportions*

1

3 4

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

1

Pb_3O_4

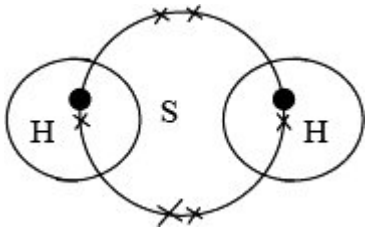
***1** mark for correct formula*

ecf** allowed from **step 2 to step 3** and **step 3 to step 4** if sensible attempt at **step 1

*correct formula with no working gains **2** marks*

1

(b) (i)



*allow all dots **or** all crosses **or** e **or** e^-*

ignore inner shells and any inner electrons

allow 4 non-bonded electrons anywhere on shell as long as not in overlap – need not be paired

1

(ii) forces of attraction / bonds between molecules are weak (owtte)

*do **not** accept intramolecular forces / covalent bonds are weak*

*do **not** accept reference to ions*

or

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intermolecular forces / bonds are weak (owtte)

or

it is made of small molecules with weak forces of attraction

*if **2** marks not awarded*

*made of small molecules / simple molecular gains **1** mark*

*forces of attraction are weak (without specifying between molecules / intermolecular) gains **1** mark*

(accept easily broken / not much energy needed to break instead of weak)

bonds are weak without specifying intermolecular would not gain a mark and would be ignored

2

(iii) 4

1

[8]

Q24.

the atoms are in layers

1

the atoms can slide over each other

1

[2]

Q25.

(a) (i) 48

1

(ii) 3

1

(b) heat / energy

1

given out / transfers to surroundings

the mark for given out / transfers to cannot be awarded without heat / energy

allow given off

1

(c) it has a low boiling point

1

it is made of small molecules

1

[6]

Q26.

(a)

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$^{2}_{1}H$

2 and 1 must be on the left

2 must be above half-way on the H and the 1 below half-way

accept diagram with 2 <u>different</u> particles in centre and 1 particle on circle

1

(b) (i) 18

ignore working

ignore units

1

(ii) forces (of attraction) between molecules **or**
bonding between molecules **or**
intermolecular forces /intermolecular bonds

1

are weak **or** not much energy needed to break them **or** easily overcome

must be linked to first mark

*if no other mark awarded allow <u>small</u> molecules / small M_r for **1** mark*

*allow forces / bonds are weak for **1** mark*

*do **not** allow covalent bonding is weak*

1

(c) *any reference to <u>more</u> protons = **0** marks*

H-2 atoms have 1 proton and 1 neutron

*allow H-2 has more neutrons / particles for **1** mark*

1

H-1 atoms have one proton

*allow H-2 has two particles and H-1 has one particle for **1** mark*

or

H-2 atom has one neutron (1)

*allow H-2 atom has one more neutron for **2** marks*

H-1 atom has no neutrons (1)

***NB** heavy water (molecule) has 2 <u>more</u> neutrons = **2** marks*

*heavy water (molecule) has <u>more</u> neutrons / particles = **1** mark*

*if no other mark awarded then heavy water molecule has **M_r** of 20 = **1** mark*

ignore reference to electrons

1

[6]

Q27.

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(a) any **four** from:

*max **3** marks if any reference made to covalent / ionic bonding / molecules or intermolecular forces **or** graphite / diamond **or** forces of attraction between electrons and then ignore throughout*

- giant structure / lattice
  ignore layers
- positive ions
- sea of electrons **or** delocalised / free electrons
  ignore electrons can move
- awareness of outer shell / highest energy level electrons are involved
- (electrostatic) attractions / bonds between electrons and positive ions
- bonds / attractions (between atoms/ ions) are strong
  allow hard to break for strong
  ignore forces unqualified
- a lot of energy / heat is needed to break these bonds / attractions
  ignore high temperature

4

(b) (i) that they are very small

accept tiny / really small / a lot smaller / any indication of very small
eg microscopic, smaller than the eye can see

or

1–100 nanometres **or** a few (hundred) atoms
ignore incorrect numerical values if very small is given

1

(ii) any **2** from:

- one (non-bonded) electron from each atom
- delocalised / free electrons
  allow sea of electrons
  ignore electrons can move
- electron carry / form / pass current / charge
  ignore carry electricity

2

[7]

Q28.

(a) (i) lead nitrate

accept $Pb(NO_3)_2$
*do **not** accept nitride*

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1

sodium iodide / potassium iodide

accept NaI / KI

accept other correct soluble iodides

*do **not** accept sodium iodine / potassium iodine*

1

(ii) filter / filtration / filtering

accept decant / decanting etc.

accept centrifugation

*ignore evaporation **or** heating if after filtration*

1

(b) *metallic / sharing / covalent **or** molecule = max **3***

magnesium loses **2** electrons

all three underlined ideas must be present

*two underlined ideas = **1** mark*

eg magnesium loses electrons

or

magnesium gains 2 electrons

or

magnesium loses 2 ions

*nb magnesium **ion** loses 2 electrons = **1** mark*

*2 errors = **0** marks*

eg magnesium gains electrons

all four underlined ideas must be present

2

iodine gains **1 / an** electron

*three underlined ideas = **1** mark*

eg iodine gains electron(s)

or

iodine loses 1 / an electron

or

iodine gains 1 / an ion

or

iodide (ion) gains 1 / an electron

*2 errors = **0** marks*

2

(c) any **two** from:

*mention of molecules / intermolecular / covalent / atoms = max **1***

- forces (of attraction) / bonds are strong **or** lot of energy needed to break bonds
- oppositely charged ions attract **or** electrostatic attraction between ions
- giant structure **or** lattice

  allow many bonds

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ignore ionic bonding unqualified

2

[9]

Q29.

(a) atoms

1

(b) mixture

1

metal

1

structure

1

smart

1

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

- saves raw materials / iron ore
- saves energy / fuels
  accept cheaper / saves money
- make new / useful items
- make money / it is economic
- <u>reduces</u> pollution
  allow less harmful for the environment
- decreases cost of steel cans
- reduces carbon dioxide emissions
- decreases waste materials / use of landfill

2

(ii) any **one** from:

- provide information / education of the need to recycle
- legislate against / charge for waste
- reward / pay people to recycle
  accept fine people for not recycling
- put labels on the cans
- provide recycling bags / bins / areas

1

[8]

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Q30.

(a) (Chromium =) 20

1

in correct order

(Nickel =) 8

accept Chromium = 8 ***and*** *Nickel = 20 for* ***1*** *mark*

1

(b) (i) (because iron is made up of only) one type of atom

1

(ii) not strong

ignore soft / corrosive / flexible

accept it rusts / corrodes ***or*** *that it could wear away*

accept could change shape / bend

accept layers / atoms could slide (over each other)

1

(iii) has different sized atoms / particles

or

structure is different/distorted / disrupted

accept not in layers ***or*** *not regular*

1

so it is difficult for layers / atoms / particles to slip / slide (over each other)

accept layers cannot slip / slide

1

[6]

Q31.

(a) C_3H_8

capital letters for symbols numbers must be halfway or lower down the element symbol

allow H_8C_3

do ***not*** *allow 3:8* ***or*** C_3 *and* H_8

1

(b) (i) electron

1

(ii) covalent

1

(c) low **and** small

both for ***1*** *mark*

1

[4]

Q32.

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(a) (i) increase

1

(ii) high melting point

1

(b) (i) decreases

1

increases

1

(ii) it gives the particles more energy

1

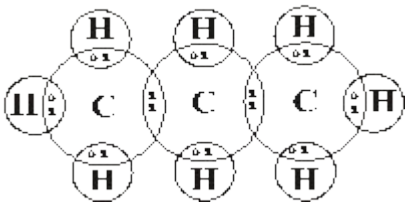
it makes the particles move faster

1

[6]

Q33.

(a)



allow all dots
or
all crosses
or
combination
or
all e / e^-
or –
or *other suitable symbols*
*centre of symbols must be on **or** inside overlapping areas within reason*

1

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

- no change initially **or** stays constant at the beginning
- increase
- slowly at first and then more rapidly

accept converse arguments
*allow vapour pressure is 0 at any temperature <–100°C for **1** mark*
accept positive correlation
accept explanation based on kinetic theory eg particles have more kinetic energy
allow reasonable attempt at using numbers

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2

(ii) –44 (using graph) accept –43 to –45

1

(c) • intermolecular forces / bonds **or** forces / bonds between molecules

1

• bonds / forces are weak

covalent *bonds are weak =* ***0*** *marks*

if they do not gain either of the marks on the left then allow simple covalent / molecular / made of small molecules for ***1*** *mark*

1

[6]

Q34.

(a) any **two** from:

• outer shell electrons / electrons in highest energy level (in metals)

• electrons are delocalised / sea of electrons

• electrons are free **or** electrons move around **or** electrons are free to flow **or** electrons attracted to positive terminal

• electrons carry charge / current **or** electrons form the current / electrons transfer charge / electrons pass charge

ignore electrons carry electricity

ignore reference to positively charged atoms / ions

if they state electrons have +ve charge = max ***1*** *mark*

if they state covalent bonding then max ***1*** *mark*

2

(b) ions can move / are attracted to electrode

accept ions are free

allow 'they' for ions

or

attracted to named electrode

or

ions are charged **or** ions form / carry the current **or** ions form the charge

1

(c) (i) electron gain

ignore hydrogen reduces charge

1

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(ii) sodium hydroxide **or** NaOH **or** caustic soda

*do **not** allow hydroxide alone*

1

(iii) $2Cl^- - 2\ e^- \rightarrow Cl_2$

or

$2Cl^- \rightarrow Cl_2 + 2\ e^-$

*allow fractions **or** multiples*

*allow e **or** e^-*

*do **not** allow e^+*

1

[6]

Q35.

(a) conducts (electricity) **or**

accept flexible

allows electrons / current to flow

ignore conducts heat

1

(b) electron

1

(c) (i) lithium>copper>tungsten **or**

Li>Cu>W

all correct

*allow **1** mark for one metal in the correct position*

2

(ii) has high / highest melting point

accept has high / highest boiling point

or

can withstand the highest temperature

1

(d) unreactive

1

[6]

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