Mark schemes

Q1.

(a) spherical

allow ball-shaped

ignore round / circular

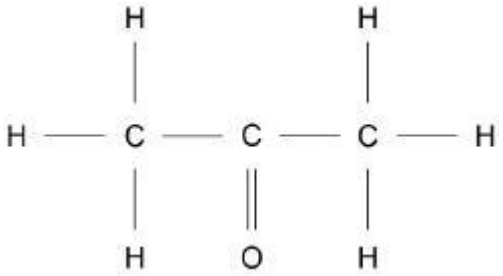
1

(b) any **one** from:

- drug delivery (round the body)
- hydrogen storage
- anti-oxidants
- reduction of bacterial growth
- catalysts
- (cylindrical fullerenes for) strengthening materials
- (spherical fullerenes for) lubricants

1

(c)



1

(d) C_3H_6O

allow CH_3COCH_3

allow elements in any order

1

(e) the intermolecular forces are weak

1

(f) **Level 3**: Relevant points (reasons/causes) are identified, given in detail and logically linked to form a clear account.

5–6

Level 2: Relevant points (reasons/causes) are identified, and there are attempts at logical linking. The resulting account is not fully clear.

3–4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1–2

No relevant content

0

Indicative content

- bonds are covalent
- giant / macromolecular structure

- three (covalent) bonds per carbon atom
  or
  only three electrons per carbon atom used in (covalent) bonds
- so one electron per carbon atom (is delocalised)
- these delocalised electrons
- can move through the structure
- carrying (electrical) charge
- so graphite conducts electricity

- layered structure
- of (interlocking) hexagonal rings
- with weak (intermolecular) forces between layers
  or
  no (covalent) bonds between layers
- so the layers can slide over each other
- so graphite is soft and slippery

[11]

Q2.

(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

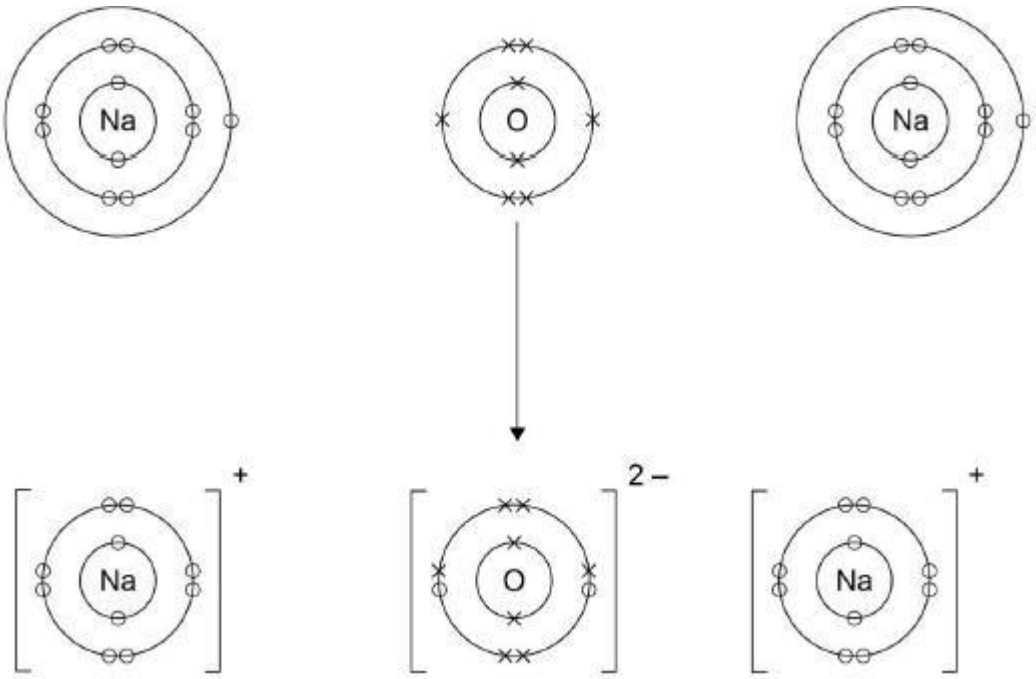
1

(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]

Q3.

(a) $C_6H_8O_7$

1

(b) covalent

1

(c) shows (single and) double bonds

1

shows which atoms are which element

1

(d) temperature decreases (during the reaction)

allow (the solution) gets colder

1

(e) all six points plotted correctly

allow a tolerance of ± ½ small square
*allow **1** mark for four / five points plotted correctly*

2

line of best fit

1

extrapolation to meet the printed line

1

(f) 22.6 – 20.2

*allow ecf from question **(e)***

1

= 2.4 (°C)

ignore sign
*if no other mark awarded allow **1** mark for 2.2 (°C)*

1

(g) temperature of solution

1

[12]

Q4.

(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]

Q5.

(a) H_2O_2

1

(b) covalent

1

(c) transition metals

1

(d) B

1

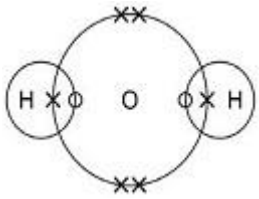
(e) A

1

(f) exothermic

1

(g)



*scores **2** marks*

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

1 bonding pair of electrons in the right hand overlap

*do **not** accept any change to the number of electrons in the left hand overlap*

1

4 non-bonding electrons on oxygen

*do **not** accept non-bonding electrons on hydrogen*
ignore inner shell electrons drawn on oxygen

1

[8]

Q6.

(a) **A**

1

(b) **D**

1

(c) **C**

1

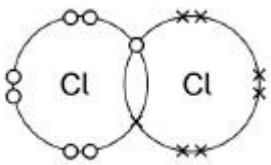
(d) **E**

1

(e) bonding pair of electrons drawn

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

eg



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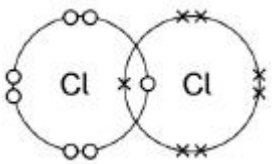

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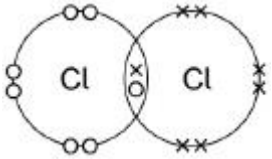


*do **not** accept if electrons added to outer shells outside overlap*

1

(f) weak forces between molecules

1

(g) MnO

1

(h) ions move around in the liquid

1

[8]

Q7.

(a) lithium (atom) loses (one) electron(s)

1

chlorine (atom) gains (one) electron(s)

1

reference to transfer of one electron

1

to form positive and negative ions

allow to form noble gas electronic structures
or
allow to form stable electron arrangements
or
allow to form full outer shells
or
allow reference to ionic bonding

1

(b) $\frac{161}{81+98} \times 100$

1

= 89.944134

1

= 89.9 (%)

1

*an answer of 89.9 (%) scores **3** marks*

(c) more sustainable **or** less waste

allow any sensible economic or environmental reason but not 'cheaper' without qualification

1

(d) 50 / 1000 (dm^3) or 0.05 dm^3
or
80 / 1000 (g / cm^3) or 0.08 g / cm^3

1

= 4(.00) (g)

1

*an answer of 4(.00) (g) scores **2** marks*

[10]

Q8.

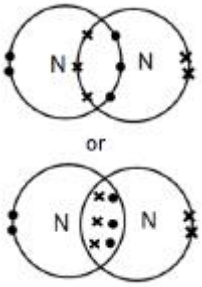
(a) six electrons in the overlap

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

(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]

Q9.

(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)

Property	Explanation of property
Low melting point	Weak intermolecular forces of attraction
Does not conduct electricity when molten	There are no charged particles free to move

Electrons are free to move
Ions are free to move
Bonds are weak
Bonds are strong

more than one line drawn from a variable negates the mark

2

(f)

Property	Explanation of property
High boiling point	Weak intermolecular forces of attraction
Conduct electricity when molten	Ions are free to move

Electrons are free to move
There are no charged particles free to move
Bonds are weak
Bonds are strong

more than one line drawn from a variable negates the mark

2

[14]

Q10.

(a) (i) 7 / seven

1

(ii) 1

*do **not** accept –1*

1

Electron

1

(iii) isotopes

1

(b) (i) (sodium +) fluorine → sodium fluoride

1

(ii) compounds

1

(iii) mole

1

(iv) sodium (atom) loses

1

fluorine (atom) gains

1

one electron

1

ions formed

1

*allow sodium forms positive (ion) **or** fluorine forms negative (ion)*

allow form ionic bond

allow to gain a full outer shell of electrons

allow forms noble gas structure

***max 3** if reference to incorrect particle / bonding*

(v) Dissolve in water

1

High melting point

1

[13]