MARK SCHEME

GCSE

CHEMISTRY

AQA - COMBINED SCIENCE

C2 - TEST 5

BONDING, STRUCTURE AND PROPERTIES OF MATTER

Advanced

Mark schemes

1.

(a) (i) sodium..... positive **or +**

both *required*

1

chloride... negative **or –**

both *required*

do not credit chlorine

1

(ii) ions not free (to move) in solid crystal / lattice

ions are free to move when sodium chloride is molten

1

or ions are mobile

do not credit when ions are molten

allow 'particles' for ions (1) mark

do not credit electrons etc

1

(iii) dissolved in water

or *in aqueous solution*

accept in solution

accept in water

or *when a gas/ vapour* ***or*** *solid it will not*

1

(b) (i) 40

1

(ii) (total) number of protons **and** neutrons (in the nucleus)

1

(c) (i) $2Ca + O_2 \text{ -+ } 2CaO$

accept any 2n : n : 2n ratio

do not credit if any other change has been made

1

(ii) any **two** from

electron(s) is / are lost

from the outer shell / orbit / ring

or *from the shell furthest the nucleus*

or *from the 4th shell*

two / both (electrons are lost)

accept two electrons are lost for (2)marks

accept both electrons are lost from the atom for (1) mark

2

[10]

2. (a) gas

for 1 mark

1

(b) AlX_3

for 1 mark

1

(c) 7 / halogens

for 1 mark

1

[3]

3. (a) nanotubes can slide (over each other)

allow nanotubes can roll (over each other)

1

because no (covalent) bonds between the nanotubes

*accept weak forces between the nanotubes **or** weak intermolecular forces*

allow layers for nanotubes throughout

1

(b) delocalised electrons

accept free electrons

1

so (delocalised) electrons can move <u>through the graphite</u>

accept so (delocalised) electrons can carry charge <u>through the graphite</u>

1

[4]

4. (a) **Graphite:**

because the layers (of carbon atoms) in graphite can move / slide

it = graphite

1

this is because there are only weak intermolecular forces **or** weak forces between layers

accept Van der Waals' forces allow no covalent bonds between layers

1

Diamond:

however, in diamond, each carbon atom is (strongly / covalently) bonded to 4 others

allow diamond has three dimensional / tetrahedral structure

1

so no carbon / atoms able to move / slide

*allow so no layers to slide **or** so diamond is rigid*

1

(b) because graphite has delocalised electrons / sea of electrons

allow free / mobile / roaming electrons

1

which can carry charge / current **or** move through the structure

1

however, diamond has no delocalised electrons

accept however, diamond has all (outer) electrons used in bonding

1

[7]

5. (a) *Idea that*
the electrons do not belong to specific atoms/delocalised electrons
[credit if done on appropriate diagram]
metal atoms form positive ions
the attraction which exists between particles with opposite charges, holds the metal together
no specific bonds exist between adjacent atoms/ions
atoms/ions can slide over each other so allowing metals to bend

each for 1 mark

5

(b) some electrons in the structure are delocalised/free to move

for 1 mark

these free electrons carry the electric current

for 1 mark

from left to right across the period, atoms of elements have more free electrons

gains 1 mark

but from left to right across the period, atoms of elements have more free electrons because they have more electrons in the outer shells

gains 2 marks

4

[9]

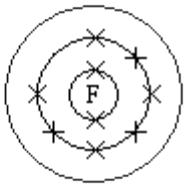
6. (a) 2, 8, 8, 1

for 1 mark

1

(b)

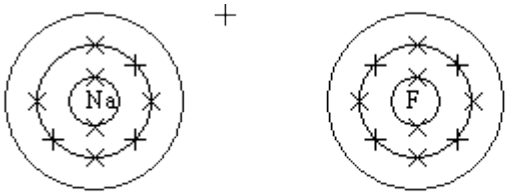
(i)



for 1 mark

Ignore symbol in middle but structure must be drawn NOT 2,7

(ii)



(1) for charges

(1) for each structure

If covalent; can score mark for changes but not for diagram
Arrow showing electron transfer from metal atom to non-metal atom = 2 marks
If the ions are not identified then cannot score mark for changes

4

[5]

7. (a) covalent/description of covalent

for 1 mark

1

(b) forces/bonds between the molecules/particles (<u>not</u> atoms) are weak

for 1 mark each

2

(c) non-flammable so it will not burn etc.
extremely unreactive so it will not react with materials in the transformer,
does not conduct electricity so it can insulate the transformer
gas so it has freedom to move and insulate whole area

for 1 mark each

3

[6]

8.

(a) made of layers
of carbon atoms
weak forces of attraction between layers (owtte) / weak
vertical bonds i.e.
candidate refers to the diagram
layers can slide over each other
layers peel off

each for 1 mark

(b) because there are electrons
which are free (to move)
reason for free electrons / each carbon atom has 3 covalent bonds

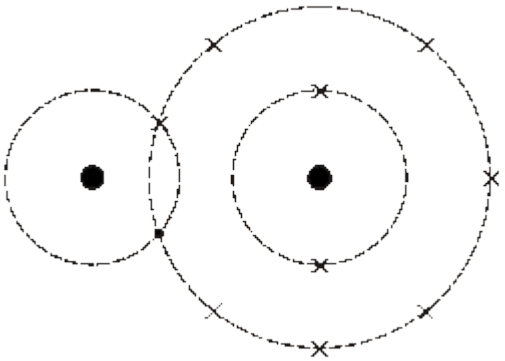
each for 1 mark

to max 5

[5]

9.

(i) 1



(ii) weak forces

accept weak bonds

1

between <u>molecules</u> / intermolecular

reject intramolecular

1

[3]

10.

Level 3 (5–6 marks):
A detailed and coherent explanation applying knowledge of the properties of nanotubes, with clear and logical links to reasons why carbon nanotubes have these properties

Level 2 (3–4 marks):
Description contains relevant statements that demonstrate clear knowledge of the properties of nanotubes. Attempt made to link properties to explanation of why these properties occur, but logic may be unclear

Level 1 (1–2 marks):
Simple relevant statements of the properties of nanotubes, demonstrating knowledge, but no linking to an explanation of why these properties occur.

0 marks:
No relevant content.

Indicative content

properties:

- high tensile strength
- high electrical / thermal conductivity
- high melting point

explanations:

- nanotubes are fullerenes based on hexagonal rings of carbon atoms
- which means that each carbon forms three covalent bonds with three other carbon atoms
- covalent bonds are strong **or** need a lot of energy to break them
- so nanotubes are strong / have high tensile strength
- and have a high melting point
- the structure means that one electron from each carbon atom is delocalised
- as in metals and graphite, the delocalised electrons can move throughout the structure
- allowing the carbon nanotube / fullerene to conduct thermal energy and electricity

[6]

11.

(a) Quality of written communication: All scientific words used correctly (covalent, bonds, atoms)

1

any **two** from

- large numbers of covalent bonds

  allow giant lattice / structure

- between <u>atoms</u>

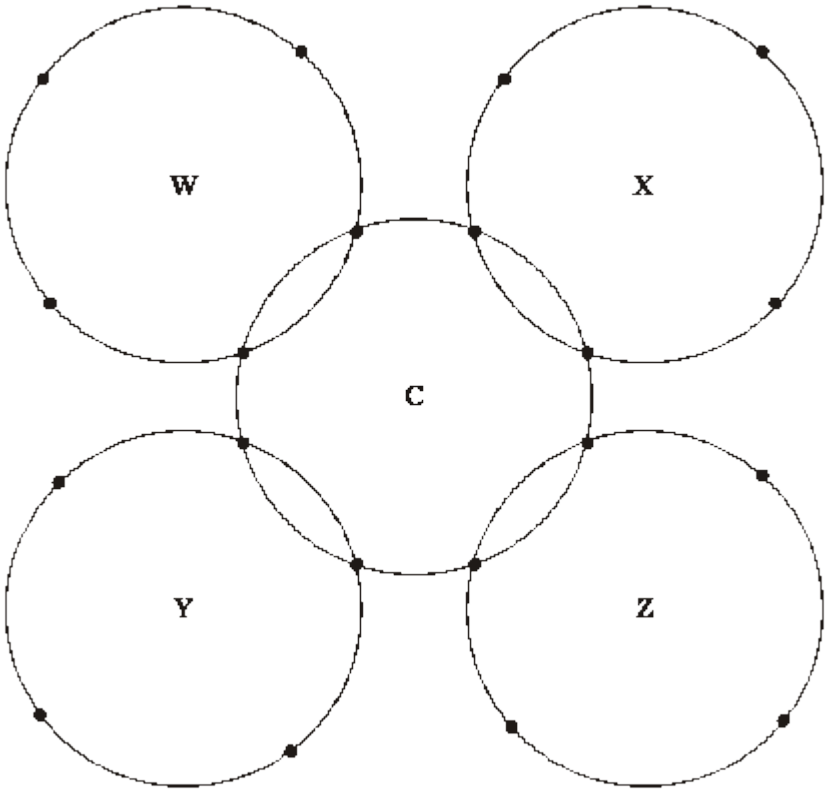
  do not accept between molecules

- (covalent) bonds strong

  accept need much energy to break

2

(b)



each carbon has 4 electrons

1

one shared pair

1

four shared pairs

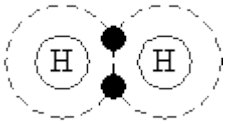
1

[6]

12. (a) correct representation of 1 atom of hydrogen e.g.

gains 1 mark

but correct representation of 1 molecule of hydrogen e.g. or H-H



gains 2 marks

2

(b) *idea that:*
hydrogen/metals form positive ions/lose electrons

gains 1 mark

but hydrogen and the metals form positive ions/lose electrons

gains 2 marks

hydrogen/non-metals form covalent bonds/share electrons

gains 1 mark

but hydrogen and the non-metals form covalent bonds/share electrons

gains 2 marks

4

[6]