Mark schemes

1 (a) (i) giant lattice

allow each carbon atom is joined to three others

1

atoms in graphene are covalently bonded

*max. **2** marks if any reference to wrong type of bonding*

1

and covalent bonds are strong **or** need a lot of energy to be broken

allow difficult to break

1

(ii) because graphene has delocalised electrons

allow each carbon atom has one free electron

1

which can move throughout the structure

*do **not** accept just electrons can move.*

1

(b) because there are weak forces between molecules

allow no bonds between the layers

1

so layers / molecules can slip / slide.

1

[7]

2 (a) (i) high

1

(ii) hundred

1

(b) hard

1

(c) (i) carbon

1

(ii) four

1

(iii) covalent

1

(iv) all

1

[7]

3 (a) layers

which have weak forces / attractions / bonds between them

second mark must be linked to layers

1

or

which can slide over each other **or** separate

ignore references to rubbing

1

(b) covalent

1

[3]

4 (a) carbon

allow C

1

(b) (i) (atoms are in) layers (that) can slide over each other

1

because between the layers there are only weak forces

accept because there are no (covalent) bonds between the layers

accept Van der Waals forces between the layers

*do **not** allow intermolecular bonds between the layers*

*if no other marks are awarded allow weak intermolecular forces for **1** mark*

1

(ii) because each atom forms four (covalent) bonds **or** (diamond is a) giant (covalent) structure **or** lattice **or** macromolecular

*any reference to ionic / metallic bonding or intermolecular forces scores a maximum of **1** mark*

accept carbon forms a tetrahedral shape

1

(and) covalent bonds are strong

accept covalent bonds need a lot of energy / difficult to break

1

(iii) because graphite has delocalised electrons

allow sea of electrons

allow each carbon atom has one free electron

1

which can move through the whole structure (and carry the current / charge / electricity)

1

[7]

5 (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

(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]

6 (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]

7 (a) (i) *ionic / molecules / metallic / (inter)molecular = max **2***

because graphene / it has a giant structure / lattice / macromolecular

accept <u>all</u> / <u>every</u> / <u>each</u> atom is <u>bonded to</u> 3 other atoms

1

because graphene / it has covalent bonds / is covalent

1

because in graphene / the bonds are strong **or**
a lot of energy needed / hard to break the bonds

1

(ii) there are delocalised / free electrons

1

because one (delocalised / free) electron <u>per atom</u> linked to first marking point

accept because three <u>electrons per atom</u> used (in bonding)

accept because one electron <u>per atom</u> not used (in bonding)

1

(b) opaque (owtte)

eg could not see through them

or layers slide
or layers not aligned

ignore thick

1

[6]

8 (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]

9 (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 <u>covalent</u> 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 <u>through the structure</u>

1

however, diamond has no delocalised electrons

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

1

[7]

10 (a) carbon

1

(b) each atom is joined to four other atoms

1

It has a giant structure

1

(c) very small

1

[4]

11 any **three** from:

any reference to incorrect bonding = max 2

- giant structure / lattice / macromolecule
- covalent (bonds)
- bonds are (very) strong

  allow bonds difficult to break

  ***or** takes a lot of energy to break bonds*
- each atom / carbon joined to four others

  accept each atom / carbon forms four bonds

3

[3]

12 (a) carbon

1

(b) layers

1

have weak forces / attractions / bonds between them **or** are only held together weakly

second mark must be linked to layers

or

can slide over each other **or** separate (1)

1

(c) covalent

1

[4]

13

(a) the diameter of the tube is very small

1

(b) (i) three

1

(ii) covalent

1

(iii) bonds

1

[4]

14 (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]

15

(a) carbon

1

(b) all

1

(c) covalent

1

(d) four

1

(e) hard

1

[5]

16

(a) 2,4 (drawn as crosses) on shells

accept dots / e / - etc.

1

(b) (i) hard

allow rigid / high melting point

*do **not** allow references to bonding*

ignore strong

ignore unreactive

ignore structure

1

(ii) any **three** from

*max **2** if ionic / metallic / molecule / intermolecular bonds **or** incorrect number of bonds*

- giant structure / lattice / macromolecular

  allow many bonds

- covalent (bonds)

- (covalent) bonds are strong

  accept needs lots of energy to break bonds (owtte)

- (each) carbon / atom forms four bonds

  or

  (each) carbon / atom bonded to four other atoms

3

(c) any **three** from:

*max **2** if ionic / ions / metallic / molecule*

'it' needs to be qualified

graphite

- has delocalised / free electrons

  *do **not** accept the electrons move unless qualified (around structure etc)*

  or

  electrons that can move through / around the structure

- each carbon is joined to three other carbon atoms

  allow graphite has three bonds

  or

  one electron from each atom is free / delocalised

diamond

- has no free / delocalised electrons

  *do **not** accept the electrons do not move*

  or

  no electrons that move around the structure

- all the electrons are used for bonding

  allow diamond has 4 bonds

  or

  each carbon joined to four other carbon atoms

3

[8]

17 (a) reduce wear of metal ie don't get damaged

or other sensible answer

or

stop / reduce friction

accept stop metal heating up

accept move more smoothly

ignore make it slippery / rub more smoothly

or

prevent seizing

accept can move freely

1

(b) (i) carbon

1

(ii) layers (of atoms)

1

can slide / slip over each other

allow slip off

or

weak forces of attraction / weak bonds (between layers)

allow no bonds

accept there are weak forces of attraction for ***1*** *mark even when there is no reference to layers*

accept atoms slide over each other (for ***1*** *mark)*

an answer which ***only*** *states there are weak bonds would gain* ***0*** *mark when there is no reference to layers*

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

1

[4]

18 (a) any **two** from:

- conducts electricity
- soft
- slippery
- high melting point

ignore hardwearing / does not stick

apply list principle

2

(b) (i) three

1

covalent

1

(ii) it is made of layers of atoms

1

[5]

19 **five** ideas from the following for one mark each

- each carbon / atom joined / bonded to three other carbon / atoms
  or each carbon forms 3 bonds
- in layers
- only weak forces (of attraction) / bonds between layers
  allow weak electrostatic / intermolecular forces /bonds between layers
- layers / atoms can slide over each other
- one electron on each carbon is not used for bonding
- electrons delocalised **or** electrons free
  allow 'sea' of electrons
- electrons carry the charge / current
- giant structure / lattice
- covalent (bonds)
- strong bonds **or** a lot of energy needed to break bonds

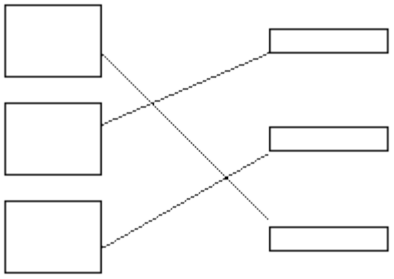
*reference to ionic bonding = **max 4***

diagrams could be used:

- *to show layered structure*
- *to show that each carbon is bonded to three other carbon atoms*
- *to show giant structure (at least 3 rings required)*

[5]

20 (a)



*all three lines correct gains **2** marks*

*one or two correct gains **1** mark*

if there are more than 3 lines then lose mark for each extra line

2

(b) (i) covalent

1

(ii) four

1

(iii) hard

1

(iv) three

1

(v) soft

1

(c) carbon

accept C

1

[8]

21 (a) electric current / electricity

1

plus **one** from:

- is passed through <u>ionic</u> compound / substance / electrolyte
- passed through molten/aqueous <u>compound</u> / <u>substance</u>
  must be linked to electricity
  allow liquid compound / substance
  *do **not** allow solution / liquid alone*
- causing decomposition
  accept split up / breakdown / breaking up owtte
  ignore separated
  accept elements are formed
  ignore new substances form

1

(b) hydrogen

accept H_2

*do **not** accept H / H^2*

1

(c) one electron from each atom

accept each carbon is bonded to three other carbon atoms leaving one (unbonded) electron owtte

1

is delocalised / free (to move)

must be linked to electrons

*answers of delocalised / free electrons only, gains **1** mark*

*accept each carbon is bonded to three other carbon atoms leaving delocalised / free electrons = **2** marks*

***maximum 1** mark if graphite described as a metal / giant ionic lattice*

1

[5]

22 (a) M_r (SiO_2) = 60

if M_r incorrect ecf for max 2

1

60 g SiO_2 → 28 g Si

*correct answer for **3** marks*

1

2.14 g SiO_2 → 1 g Si

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

a unit is not required but an incorrect unit loses the third mark

OR M_r (SiO_2) = 60 (1)

moles if silicon needed = $\frac{1}{28}$ = 0.0357

mass of SiO_2 needed = 0.0357 × 60 (1)

= 2.14 g (1)

allow 2, 2.1, 2.14 (or anything rounding to 2.14), 2.16 or 2.2

OR M_r (SiO_2) = 60 (1)

mass SiO_2 = 1 × $\left(\frac{60}{28}\right)$ (1)

= 2.14 g (1)

allow 2, 2.1, 2.4 (or anything rounding to 2.14), 2.16 or 2.2

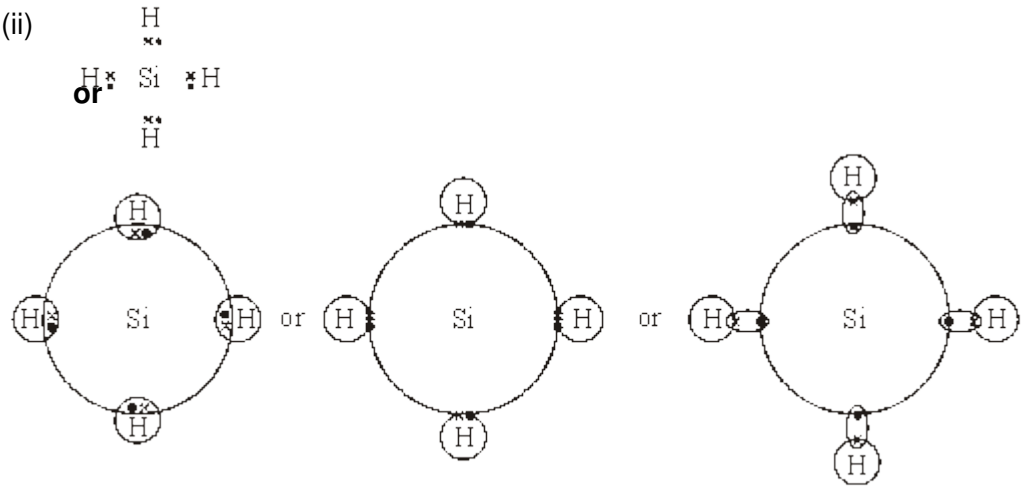
3

(b) (i) $MgO(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l)$

*penalise incorrect symbols correctly balanced equation for **1** mark*
*state symbols for **1** mark*
allow correct multiples / fractions

2

(ii)



ignore inner shell electrons of silicon
allow correct drawings without symbols
must clearly indicate four shared pairs of electrons with one electron from each atom

(iii)

Si	**H**
$\frac{1.4}{28}$	$\frac{0.15}{1}$

1

= 0.05 = 0.15

1

1 3

for whole number ratio can be implied

1

SiH_3

*accept H_3Si **or** any correct formula with 1:3 ratio*

if in step 1 they get either of ratios incorrect they lose first 2 marks but can be ecf for 3rd and 4th mark

evidence of mass / A_r ***1*** *mark*

proportions of each ***1*** *mark*

whole number ratio ***1*** *mark*

correct formula ***1*** *mark*

1

(iv) **C**

accept c

1

(c) any **four** from:

- giant structure / macromolecule / lattice / giant molecule

  allow giant molecular / giant atomic structure

- each silicon atom joined to four other atoms

  (or diagram)

- covalent bonds

- bonds are strong **or** large amount of energy needed to break bonds

  accept hard to break bonds

- large number of bonds to be broken

  *mention of giant **ionic** structure **or** intermolecular forces **or** intermolecular bonds max **1** mark*

  *diamond **or** carbon discussion max **3** marks unless clearly linked to silicon*

4

[15]

23 (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]

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

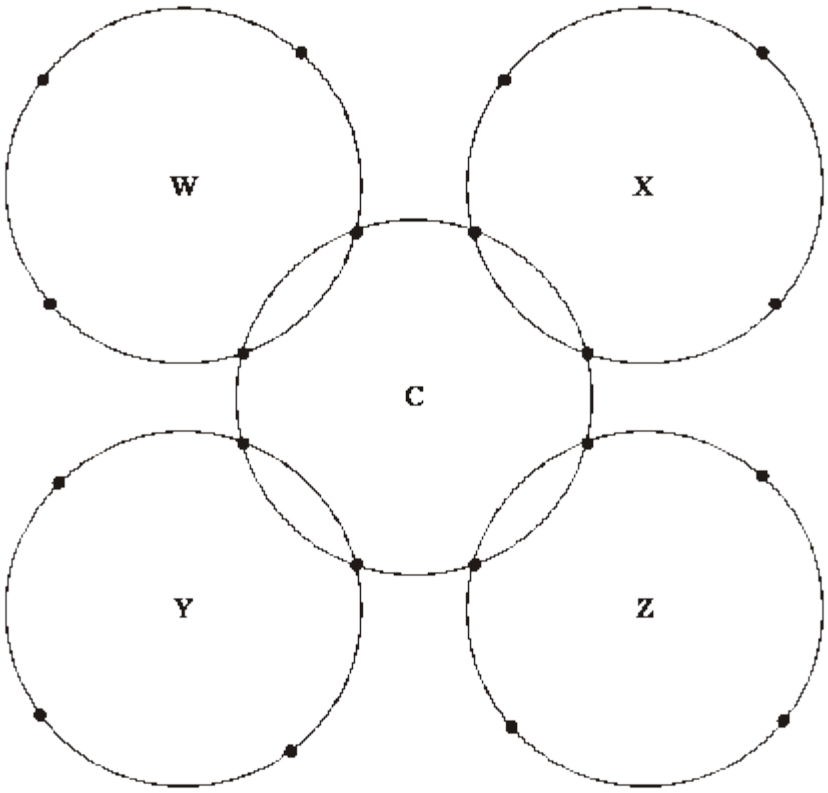
1

any **two** from

- large numbers of covalent bonds
  allow giant lattice / structure
- between atoms
  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]

25 (a) $\underline{2}$ Na + Cl_2 → 2 NaCl

allow 2 Na^+ Cl^- for 1 mark

(allow Na + ½Cl_2 → Na Cl)

1

(b) (i) *idea that*

- it has strong (attractive) forces/bonds between ions / charged particles

for 1 mark

(not '..it has a rigid structure'- this defines a solid or '...particles close together' – they are in a liquid)

1

(ii) *ideas that*

- there is increased vibration of ions / particles on heating
- ions have sufficient energy to overcome attractive forces / to break out of the
- rigid structure / to move about

(must be in terms of increased energy of particles lions)

each for 1 mark

2

(iii) • ions can go to electrodes / ions are free to move

for 1 mark

[do not credit 'ions carry charges']

1

(c) *ideas that*

- it has stronger attractive forces between atoms/particles *(not 'ions')*
- each carbon atom forms covalent bonds with neighbouring atoms

each for 1 mark

2

[7]

26 (a) *idea that*

- copper has free electrons / electrons that move throughout the structure

  gains 1 mark

but

- in copper, electrons from the highest (occupied) energy level /outer shell, are free / can move throughout the structure

  gains 2 marks

2

(b) *idea that*

- in graphite, only three bonds are formed by each carbon atom

  for 1 mark

- one outer electron (per atom), free to move

  for 1 mark

- an electric current is a flow of (free) electrons*

  for 1 mark

(this mark to be given in **either** (a) **or** (b) but not in both)*

3

[5]