Mark schemes

Q1.

(a) non-metallic element

1

(b) compound

1

(c) noble gases

1

(d) the boiling points increase down the group

1

(e) atoms

1

(f) XO_2

1

(g) $(2.8)^2 \times 6$

1

= 47.04

1

= 47 (nm^2)

allow an answer correct to 2 significant figures resulting from an incorrect attempt at the calculation

1

(h) the surface area to volume ratio of the fine particle is 10 times greater

1

[10]

Q2.

(a) all seven points plotted correctly

allow a tolerance of ±½ small square

*allow **1** mark for five or six points plotted correctly*

2

line of best fit

1

(b) 0.0038 **and** 0.0014

1

$$\frac{0.0038 - 0.0014}{105 - 20}$$

allow correct use of incorrectly

determined mole value(s)

1

= 0.000028
or
= 2.8×10^{-5}

1

mol/s

allow moles per second

1

(c) (for large lumps) a smaller number of moles of gas is collected in the same time
or
(for large lumps) more time is needed to collect the same number of moles of gas
or
the line (of best fit for large lumps) is less steep

allow converse statement for small lumps

allow the line (of best fit for large lumps) takes more time to become horizontal

1

(d) (surface area = 6 x 0.5 x 0.5) = 1.5 (cm^2)

1

(volume = 0.5 x 0.5 x 0.5) = 0.125 (cm^3)

1

(surface area : volume =) 12 : 1

allow correctly calculated ratio using incorrectly calculated values for surface area and/or volume

1

(e) decreases by a factor of 10

allow 10 times smaller

allow one tenth

allow 1/10

allow 1 : 10 (large cube to small cube)

1

[12]

Q3.

(a) contain delocalised electrons

allow contain free electrons

1

(so) electrons can move through the structure / nanotube

allow (so) electrons can carry charge through the structure / nanotube

ignore throughout for through
ignore current / electricity for charge

1

(b) **Level 2:** Some logically linked reasons are given. There may also be a simple judgement.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

0

Indicative content

- wood is the least dense so lightest to use
- aluminium is the most dense so will make the racket too heavy

- carbon nanotube is the strongest so least likely to break
- wood / aluminium are too weak so the racket will break more easily

- carbon nanotube is the stiffest so least likely to bend out of shape
- wood / aluminium are not very stiff so could bend out of shape

- justified conclusion

(c)

*an answer of 4.0 x 10^4 (nm^2) scores **3** marks*
*an answer of 40344 (nm^2) scores **2** marks*

(822 =) 6724 (nm^2)

1

(6 x 6724 =) 40344 (nm^2)

allow 40344 (nm^2) correctly rounded to any number of significant figures
allow correct calculation using incorrectly calculated value of area of one face from step1

1

= 4.0 x 10^4 (nm^2)

allow 4.0344 x 10^4 (nm^2) correctly rounded to 1 or more significant figures
allow a correctly calculated and rounded conversion to standard form of an incorrect calculation of surface area

1

(d)

allow converse statements about fine particles

any **one** from:
- less can be used (for the same effect)
  ignore nanoparticles are smaller
- greater surface area (to volume ratio)

1

[10]

Q4.

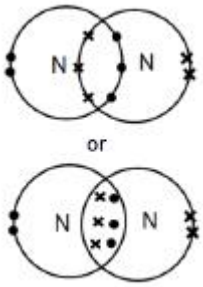
(a) six electrons in the overlap

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]

Q5.

(a) any **one** from:

- there was a flame
- energy was given out
- a new substance was formed
- the magnesium turned into a (white) powder

answers must be from the figure

1

(b) Magnesium oxide

1

(c) The reaction has a high activation energy

1

(d) 9

1

(e) They have a high surface area to volume ratio

1

(f) any **one** from:

- Better coverage
- More protection from the Sun's ultraviolet rays

1

(g) any **one** from:

- Potential cell damage to the body
- Harmful effects on the environment

1

(h) indication of $\frac{1}{1.6}$ = 0.625
and
use of indices $10^{-9} - 10^{-6} = 10^{3}$

Both steps must be seen to score first mark

1

0.625 × 1000 = 625 (times bigger)

1

[9]

Q6.

(a) (i) (mass number = 16) because there are 8 protons and 8 neutrons (in the nucleus)

*accept mass number is total number of protons and neutrons for **1** mark*

2

(ii) same number of protons **or** both have 6 protons

accept same atomic number

1

^{12}C has 6 neutrons

1

^{14}C has 8 neutrons

1

*accept different number of neutrons for **1** mark*
numbers, if given, must be correct
*incorrect reference to electrons = **max 2** marks*

(b) (i) 2 bonding pairs

1

additional unbonded electrons negates this mark

4 unbonded electrons around oxygen

1

accept dot, cross or e or – or any combination

(ii) covalent

1

(iii) any **one** from:
- no delocalised / free electrons
  ignore mobile electrons
- no overall electric charge
  accept no charge (carriers)
- no ions

1

*do **not** accept any implications of the presence of ions*

(c) (i) larger

accept the size of a few hundred atoms

accept atoms are smaller (than nanoparticles)
allow up to 1000 atoms)

1

(ii) (nanoparticles have) large(r) surface area

1

[11]