Mark schemes

Q1.

(a) (thermal) energy is transferred

allow heat is transferred

1

by delocalised electrons

1

(b) (the alloy / mixture has) different sized atoms

1

(so the) layers are distorted

1

(so the) layers cannot easily slide

allow (positive / metal) ions for atoms throughout

allow (so the) atoms cannot slide over each other

1

(c) $2\ Fe + 3\ Cl_2 \rightarrow 2\ FeCl_3$

1

(d) $1\ Fe^{2+} : 2\ Fe^{3+} : 4\ O^{2-}$

1

(e) ($M_r\ Fe_3O_4$ =) 232

1

$(\%\ Fe =) \frac{3 \times 56}{232} \times 100$

allow $\frac{168}{232} \times 100$

allow correct use of an incorrectly determined M_r using the values of A_r given in the question

1

= 72.4 (%)

allow 72.41379 correctly rounded to at least 2 significant figures

1

(f) (40.0 kg =) 40 000 (g)

*a maximum of **4** marks can be awarded for a method which determines and uses the volume of iron oxide as a gas*

1

(moles $Fe_2O_3 = \frac{40\,000}{160}$ =) 250

allow correct use of an incorrectly converted or unconverted mass

1

(moles $CO_2 = 250 \times \frac{3}{2}$ =) 375

allow correct use of an incorrectly determined number of moles of Fe_2O_3

1

(volume of CO_2 =) 375 × 24

allow correct use of an incorrectly determined number of moles of CO_2

1

= 9000 (dm^3)

1

[15]

Q2.

(a) giant structure

allow macromolecular

allow (giant) lattice

1

covalent (bonds)

1

four bonds per carbon / atom

1

(b) (covalent) bonds are strong

1

(and many covalent) bonds must be broken

1

(so) a lot of energy is required

1

(c) fullerene

1

(d) any **one** from:

- (C_{70} is) hollow

  allow (C_{70}) acts as a cage

  allow (C_{70}) traps the drug
- (C_{70} is) unreactive
- (C_{70} is) not toxic
- (C_{70} has) a large surface area to volume ratio

  ignore references to ease of movement around the body

1

(e) $\left(\text{moles of } C_{70} \text{ molecules} = \frac{1}{70} =\right) 0.0\dot{1}42857\dot{}$

1

(molecules =) $0.0\dot{1}42857\dot{}$ × 6.02 × 10^{23}

allow correct use of an incorrect attempt at the calculation of the number of moles of C_{70} molecules

1

= 8.6 × 10^{21}

1

[11]

Q3.

(a) silicon is less reactive than carbon

allow converse

allow silicon is below carbon (in the reactivity series)

1

(because) carbon displaces silicon (from silicon dioxide)

ignore (because) carbon reduces silicon dioxide

1

ignore references to hydrogen

(b) more energy is needed (to obtain aluminium)

ignore references to electricity

1

(because) aluminium is obtained (from aluminium oxide) by electrolysis

1

(c) both products are solid

1

(d) (M_r of SiO_2 = 28 + (2 × 16)) = 60

1

(conversion 1.2 kg =) 1200 (g)

1

(number of moles of SiO_2 = $\frac{1200}{60}$) = 20

allow correct use of an incorrectly converted or unconverted mass of SiO_2

allow correct use of an incorrectly calculated M_r of SiO_2

1

(number of moles of Mg = 20 × 2) = 40

allow correct use of an incorrectly calculated number of moles of SiO_2

1

(mass of Mg = 40 × 24) = 960 (g)

allow correct use of an incorrectly calculated number of moles of Mg

1

alternative approach:

(M_r of SiO_2 = 28 + (2 × 16)) = 60 (1)

48 g Mg reacts with 60 g SiO_2 (1)

allow correct use of an incorrectly calculated M_r of SiO_2

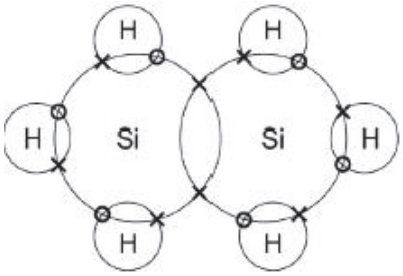
(conversion 1.2 kg =) 1200 (g) (1)

$48 \times \frac{1200}{60}$ (g Mg reacts with 1200 g SiO_2) (1)

allow correct use of an incorrectly calculated mass of Mg and / or incorrectly converted or unconverted mass of SiO_2

= 960 (g) (1)

(e)



allow any combination of x, •, o, $e^{(-)}$ for electrons

1

(f) (volume of oxygen for 30 cm^3 Si_2H_6 = 3.5 × 30) = 105 (cm^3)

1

(volume of excess oxygen = 150 – 105) = 45 (cm^3)

allow correct use of an incorrectly calculated volume of oxygen for 30 cm^3 Si_2H_6

1

(volume of water (vapour) = 3 × 30) = 90 (cm^3)

1

(volume of gases = 45 + 90) = 135 (cm^3)

allow correct use of incorrectly calculated volumes of excess oxygen and / or water vapour

1

allowed alternative approach:

(moles S_2H_6 = $\frac{0.03}{24}$) 0.00125 (1)

(moles water vapour formed = 3 × 0.00125 =) 0.00375
and
(moles oxygen used = 3.5 × 0.00125 =) 0.004375 (1)

allow correct use of an incorrectly calculated number of moles of Si_2H_6

(moles excess oxygen = $\frac{0.15}{24}$ − 0.004375 =) 0.001875 (1)

allow correct use of an incorrectly calculated number of moles of oxygen used

(volume of gases = 24 × (0.00375 + 0.001875) = 0.135 dm^3 =) 135 (cm^3) (1)

allow correct use of an incorrectly calculated number of moles of excess oxygen and / or moles of water vapour formed

[15]