Oxford Cambridge and RSA

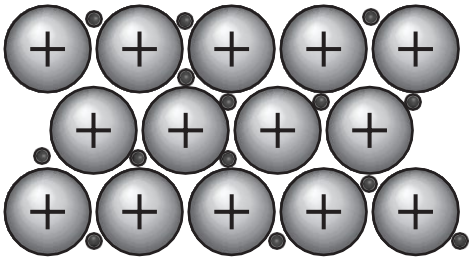
GCSE Chemistry B (Twenty First Century Science)

J258/03 Breadth in chemistry (Higher Tier)

Question Set 35

1 Titanium is used for hip replacements.

(a) Titanium's strength comes from its metallic structure as shown in **Fig. 11.1**.



Use **Fig. 1.1** to explain why the metallic bonds in titanium are very strong.

[2]

(b) Titanium is a transition metal. Calcium is **not** a transition metal.

Which **two** statements are correct about both calcium and titanium?

Tick (✓) **two** boxes.

They both conduct electricity. ☐

They both form cations. ☐

They both form coloured ions in solution. ☐

They both form ions with several different charges. ☐

They both react with cold water. ☐

[2]

(c) Titanium can be made from titanium oxide by two methods.

Method 1 uses magnesium reacting with titanium oxide:
$2Mg + TiO_2 \rightarrow Ti + 2MgO$

Method 2 uses the electrolysis of titanium oxide:
$TiO_2 \rightarrow Ti + O_2$

The atom economies of the two methods can be compared using this equation:

$$\text{atom economy} = \frac{\text{mass of atoms in desired product}}{\text{Total mass of atoms in react}} \times 100\%$$

(i) What does atom economy tell us about a reaction? **[1]**

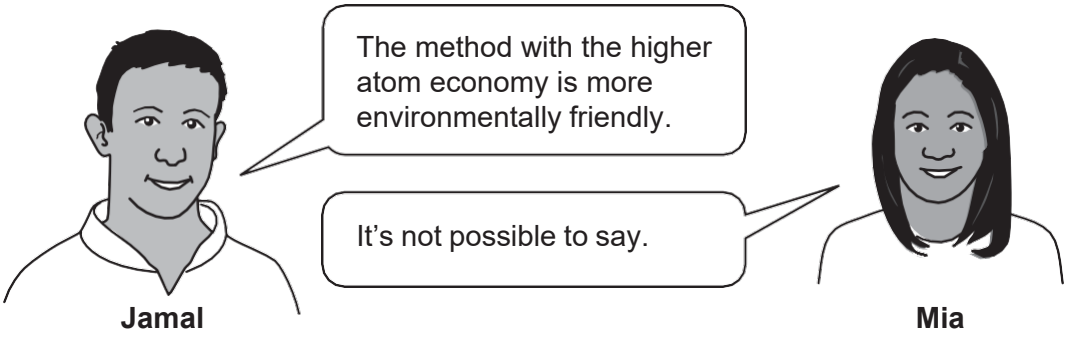
(ii) Calculate the atom economy of **Method 2**.

Give your answer to **2** significant figures.

Atom economy = ... % **[3]**

(iii) Explain, **without further calculation**, which method has the higher atom economy. **[1]**

(iv) Jamal and Mia discuss atom economy.



Evaluate Jamal and Mia's comments.

[3]

(d) Magnesium oxide (MgO) is formed in **Method 1**.

Complete **Fig. 1.2** to show the 'dot and cross' diagrams for an Mg^{2+} ion and an O^{2-} ion.

Show all the electrons.

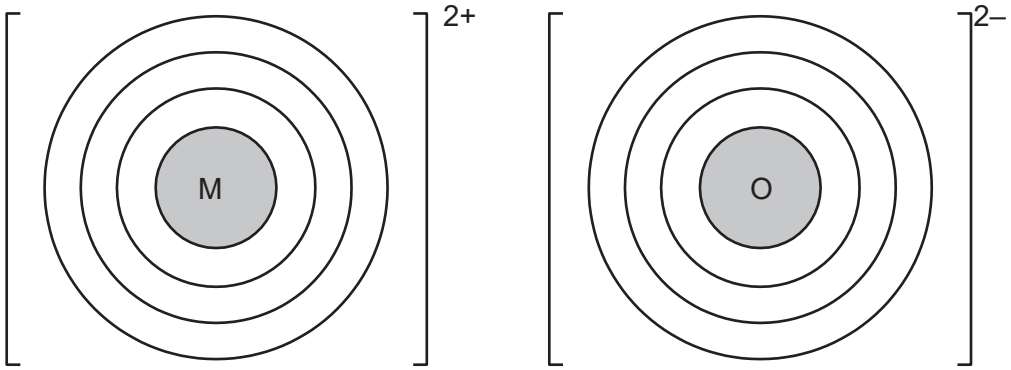


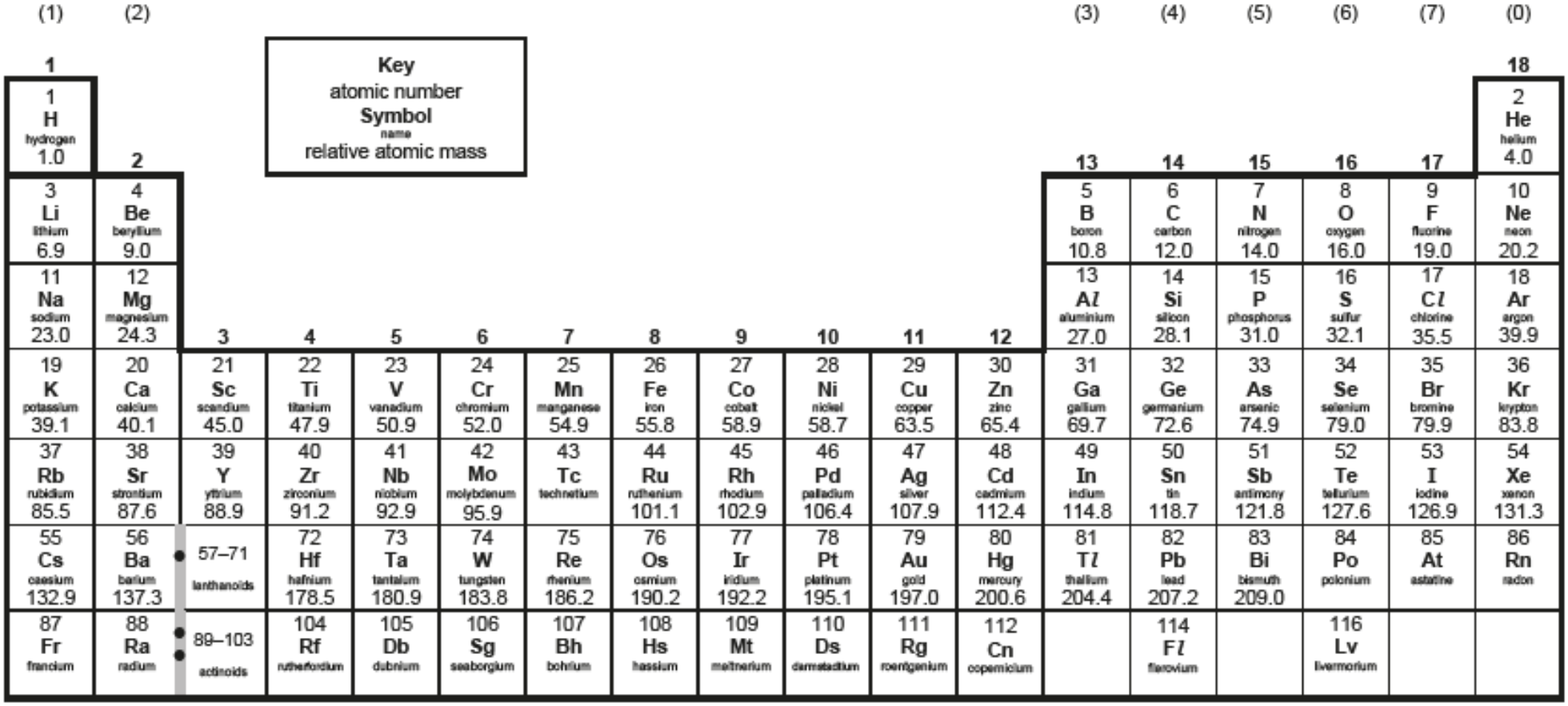
Fig. 1.2

[2]

Total Marks for Question Set 35 : 14

Resource Materials

The Periodic Table of the Elements



(1)	(2)											(3)	(4)	(5)	(6)	(7)	(0)
1																	18
1 H hydrogen 1.0	2											13	14	15	16	17	2 He helium 4.0
3 Li lithium 6.9	4 Be beryllium 9.0											5 B boron 10.8	6 C carbon 12.0	7 N nitrogen 14.0	8 O oxygen 16.0	9 F fluorine 19.0	10 Ne neon 20.2
11 Na sodium 23.0	12 Mg magnesium 24.3	3	4	5	6	7	8	9	10	11	12	13 Al aluminium 27.0	14 Si silicon 28.1	15 P phosphorus 31.0	16 S sulfur 32.1	17 Cl chlorine 35.5	18 Ar argon 39.9
19 K potassium 39.1	20 Ca calcium 40.1	21 Sc scandium 45.0	22 Ti titanium 47.9	23 V vanadium 50.9	24 Cr chromium 52.0	25 Mn manganese 54.9	26 Fe iron 55.8	27 Co cobalt 58.9	28 Ni nickel 58.7	29 Cu copper 63.5	30 Zn zinc 65.4	31 Ga gallium 69.7	32 Ge germanium 72.6	33 As arsenic 74.9	34 Se selenium 79.0	35 Br bromine 79.9	36 Kr krypton 83.8
37 Rb rubidium 85.5	38 Sr strontium 87.6	39 Y yttrium 88.9	40 Zr zirconium 91.2	41 Nb niobium 92.9	42 Mo molybdenum 95.9	43 Tc technetium	44 Ru ruthenium 101.1	45 Rh rhodium 102.9	46 Pd palladium 106.4	47 Ag silver 107.9	48 Cd cadmium 112.4	49 In indium 114.8	50 Sn tin 118.7	51 Sb antimony 121.8	52 Te tellurium 127.6	53 I iodine 126.9	54 Xe xenon 131.3
55 Cs caesium 132.9	56 Ba barium 137.3	57–71 lanthanoids	72 Hf hafnium 178.5	73 Ta tantalum 180.9	74 W tungsten 183.8	75 Re rhenium 186.2	76 Os osmium 190.2	77 Ir iridium 192.2	78 Pt platinum 195.1	79 Au gold 197.0	80 Hg mercury 200.6	81 Tl thallium 204.4	82 Pb lead 207.2	83 Bi bismuth 209.0	84 Po polonium	85 At astatine	86 Rn radon
87 Fr francium	88 Ra radium	89–103 actinoids	104 Rf rutherfordium	105 Db dubnium	106 Sg seaborgium	107 Bh bohrium	108 Hs hassium	109 Mt meitnerium	110 Ds darmstadtium	111 Rg roentgenium	112 Cn copernicium		114 Fl flerovium		116 Lv livermorium		

Key
atomic number
Symbol
name
relative atomic mass