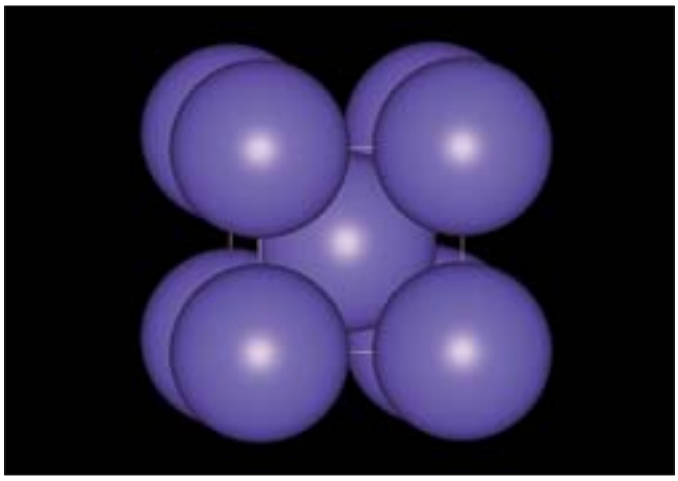
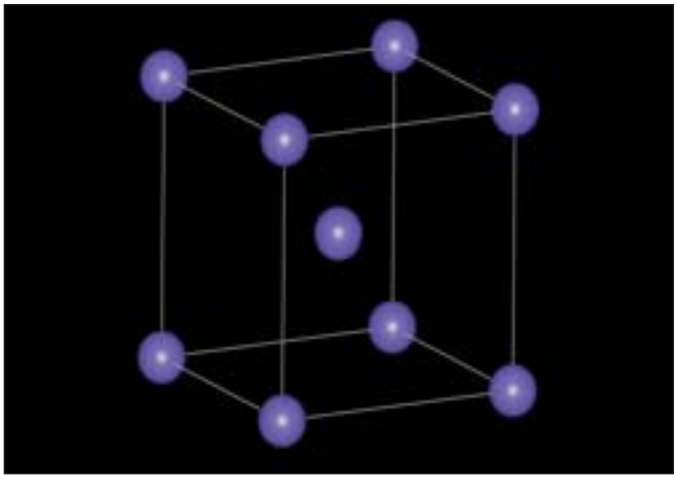
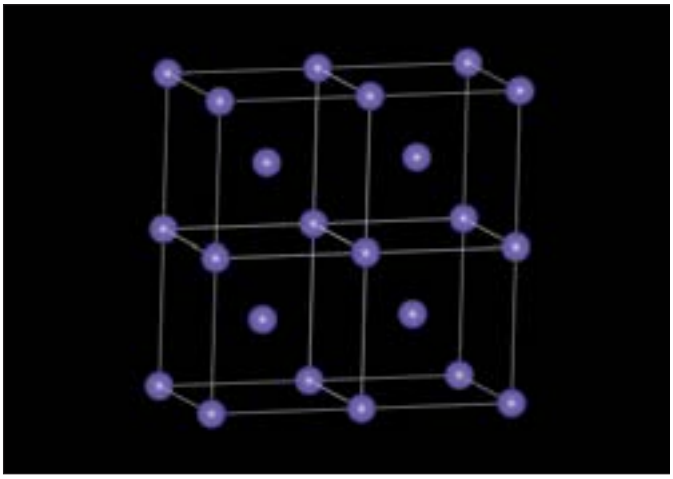


(a)



(b)



(c)

Figure 2.14 A body-centred cubic array, as adopted by sodium, potassium, etc.: (a) one cube, space-filling representation; (b) one cube, ball-and-stick model; (c) four cubes, ball-and-stick model.

In the *bcc* structure, each atom is surrounded by eight atoms at the corners of the cube, but it has six other atoms only slightly more remote at the body-centres of the adjacent cubes (Figure 2.15). This means that the packing efficiency in *bcc* is not very different from that in close-packed structures: 68% of the volume is occupied, compared with the 74% of volume occupied in close-packing, regardless of the atom sizes.

QUESTION 2.3

If the length of a side of the cube in Figure 2.14b is *a*, what is the shortest distance from the atom at the cube centre to (a) an atom at a corner of the cube, and (b) the equivalent position in an adjacent cube? (See the Maths Help overleaf.)

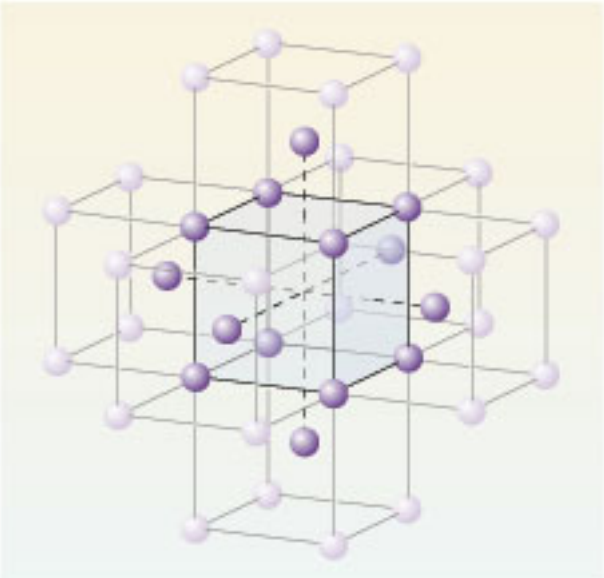


Figure 2.15 Body-centred cube, showing the six next-nearest neighbours at the body-centres of the adjoining cubes.

MATHS HELP: THE PYTHAGORAS THEOREM

This states that for any right-angled triangle, the square on the hypotenuse (side facing the right-angle) is equal to the sum of the squares on the other two sides. Thus, for the triangle shown in Figure 2.16:

$$a^2 + b^2 = c^2$$

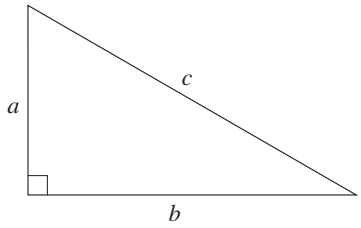


Figure 2.16
A right-angled triangle with sides a and b, and hypotenuse, c.

QUESTION 2.4

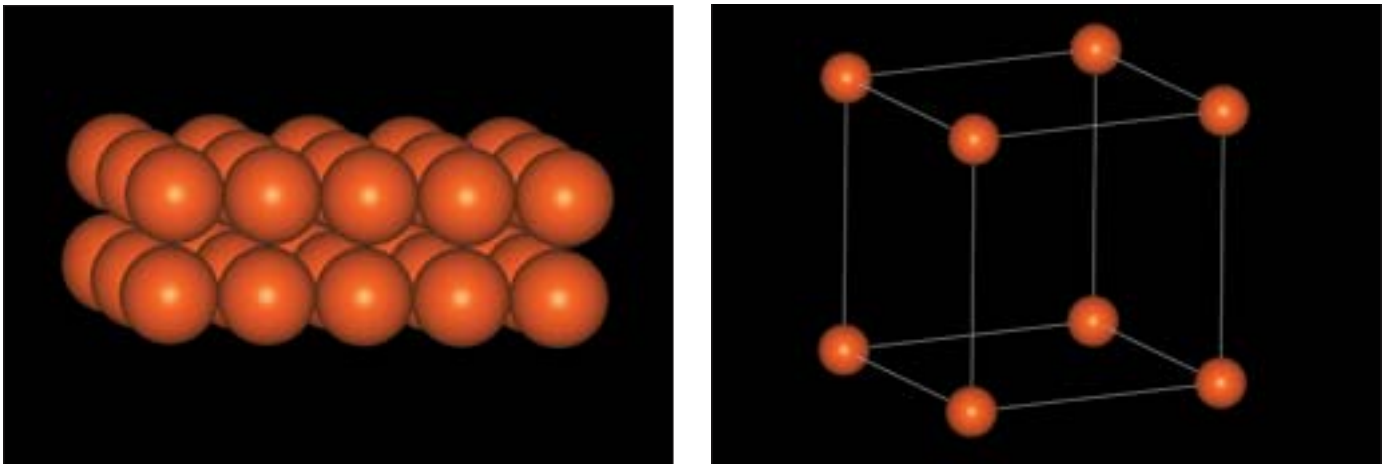
In a right-angled triangle with a hypotenuse of 5 cm, and one side of 3 cm, what is the length of the third side?

STUDY NOTE

More maths help is available in *The Sciences Good Study Guide*[1] (see the Further Reading list on p.118) .

Another cubic structure, and the simplest, is the so-called **primitive cubic structure**. There is only one metal that adopts this structure — polonium.

Figure 2.17a shows how a primitive cubic structure is built from spheres by forming a square array, with a second layer directly over the first layer, and so on. Figure 2.17b uses a ball-and-stick representation to show how each atom in such a structure sits at the corner of a cube.



(a) (b)

Figure 2.17 (a) Two layers of a primitive cubic array; (b) a cube of atoms from a primitive cubic array.

MODEL EXERCISE 2.1
Build a model of a primitive cubic structure

You will spend much time making molecular models in Part 2 *Molecular Shape*. The rationale for using models is explained in Box 1.2 of Part 2, p. 125. We have based our model diagrams like Figure 2.18 on the Orbit kit, but the principles involved are the same in other model systems.

Use your model kit to build a model of the primitive cubic structure, with octahedral atom centres (Figure 2.18).