1 **(a)** The spacing between two atoms in a crystal is $3.8 \times 10^{-10}$ m. State this distance in pm.

spacing = ..... pm [1]

**(b)** Calculate the time of one day in Ms.

time = ..... Ms [1]

**(c)** The distance from the Earth to the Sun is 0.15 Tm. Calculate the time in minutes for light to travel from the Sun to the Earth.

time = ..... min [2]

**(d)** Underline all the vector quantities in the list below.

distance energy momentum weight work [1]

**(e)** The velocity vector diagram for an aircraft heading due north is shown to scale in Fig. 1.1. There is a wind blowing from the north-west.


**Fig. 1.1**

The speed of the wind is 36 m s$^{-1}$ and the speed of the aircraft is 250 m s$^{-1}$.

**(i)** Draw an arrow on Fig. 1.1 to show the direction of the resultant velocity of the aircraft. [1]

**(ii)** Determine the magnitude of the resultant velocity of the aircraft.

resultant velocity = ..... m s$^{-1}$ [2]

**2** Two planks of wood AB and BC are inclined at an angle of 15° to the horizontal. The two wooden planks are joined at point B, as shown in Fig. 2.1.

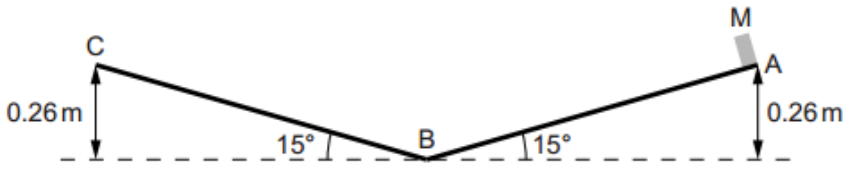



**Fig. 2.1**

A small block of metal M is released from rest at point A. It slides down the slope to B and up the opposite side to C. Points A and C are 0.26 m above B. Assume frictional forces are negligible.

**(a) (i)** Describe and explain the acceleration of M as it travels from A to B and from B to C.

.....

.....

.....

..... [3]

**(ii)** Calculate the time taken for M to travel from A to B.

time = ..... s [3]

**(iii)** Calculate the speed of M at B.

speed = ..... $m\,s^{-1}$ [2]

**(b)** The plank BC is adjusted so that the angle it makes with the horizontal is 30°. M is released from rest at point A and slides down the slope to B. It then slides a distance along the plank from B towards C.

Use the law of conservation of energy to calculate this distance. Explain your working.

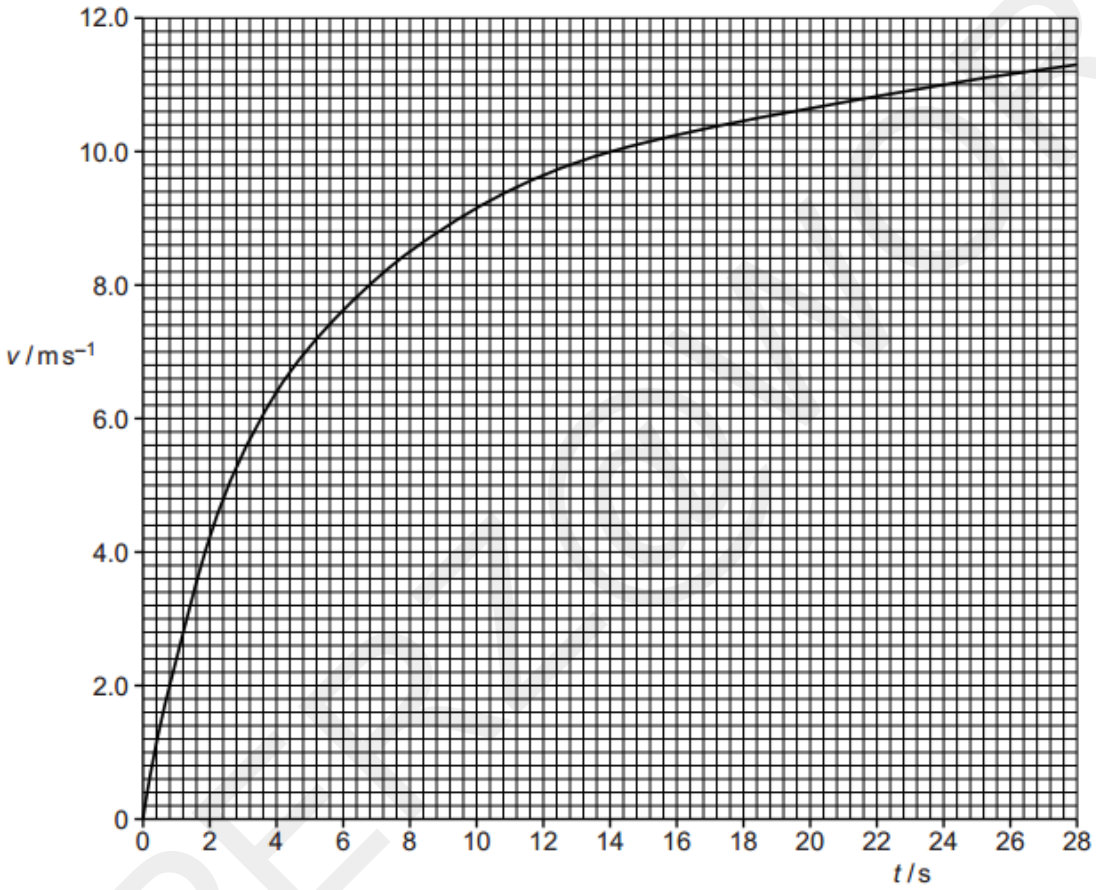
distance = ..... m [2]

3 **(a)** Define *power*.

.....

..... [1]

**(b)** A cyclist travels along a horizontal road. The variation with time $t$ of speed $v$ is shown in Fig. 3.1.




The cyclist maintains a constant power and after some time reaches a constant speed of $12\,m\,s^{-1}$.

**(i)** Describe and explain the motion of the cyclist.

.....

.....

.....

.....

..... [3]