1 **(a)** Fig. 3.1 shows the path taken by an aircraft as it flies from **A** to

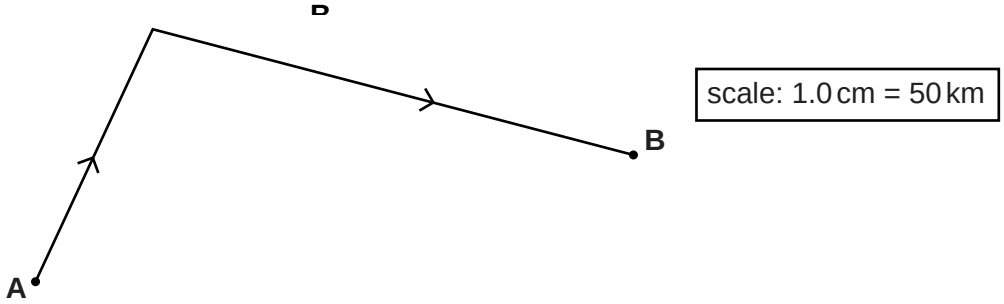


Fig. 3.1

On Fig. 3.1, a distance of 1.0 cm represents a distance of 50 km travelled by the aircraft. The aircraft takes 25 minutes to travel from **A** to **B**.

(i) Use Fig. 3.1 to determine the magnitude of the average velocity of the aircraft as it travels from **A** to **B**.

average velocity = ... $m\,s^{-1}$ **[3]**

(ii) Without doing any calculations, explain why the average speed of the aircraft is not the same as the magnitude of its average velocity.

.....

.....

..... **[1]**

(b) Io is one of the many moons of Jupiter. It travels at constant speed around Jupiter in a circular orbit of radius 4.2×10^8 m. Io takes 1.5×10^5 s to orbit once around Jupiter.

(i) Calculate the speed of Io in its orbit.

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

(ii) Io has several active volcanoes on its surface. One of these volcanoes produces jets of sulphur with a velocity of 1.3 $km\,s^{-1}$ that rise to 470 km above the volcano.

Calculate the constant acceleration of free fall on the surface of Io.

acceleration = ... $m\,s^{-2}$ **[3]**

2 **(a)** Fig. 7.1 shows several forces acting on an object that is free to move.

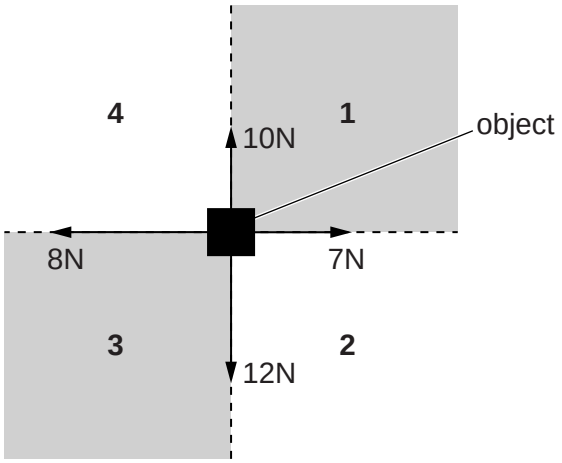


Fig. 7.1

Using simple calculations, deduce whether the object will move into region **1**, **2**, **3** or **4**. Briefly explain your reasoning.

.....

.....

..... **[2]**

(b) State the *principle of moments*.

.....

.....

..... **[1]**

(c) Fig. 7.2 shows the forces acting on a suitcase with wheels as it is held stationary.

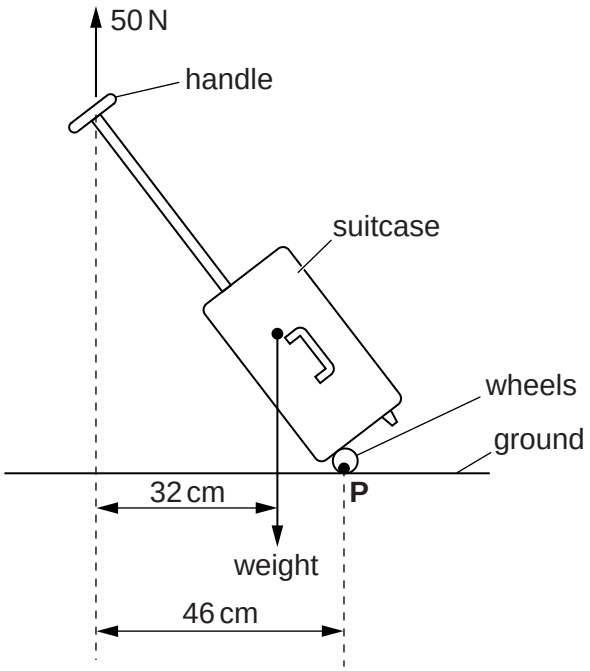


Fig. 7.2

A vertical force of 50 N is applied to the top of the handle in order to keep the suitcase stationary in the position shown in Fig. 7.2. The line of action of this force acts at a perpendicular distance of 46 cm from **P**, the point of contact with the ground. The line of action of the weight of the suitcase acts at a perpendicular distance of 32 cm from the top of the handle.

By taking moments about **P**, calculate the mass *m* of the suitcase.

m = ... kg **[3]**

[Total: 6]

3 **(a)** Define a *vector quantity*.

.....

..... **[1]**

(b) Circle all the vector quantities in the list below.

acceleration speed eight **[1]**

(c) Fig. 1.1 shows graphs of velocity v against time t for two cars **A** and **B** travelling along a straight level road in the same direction.

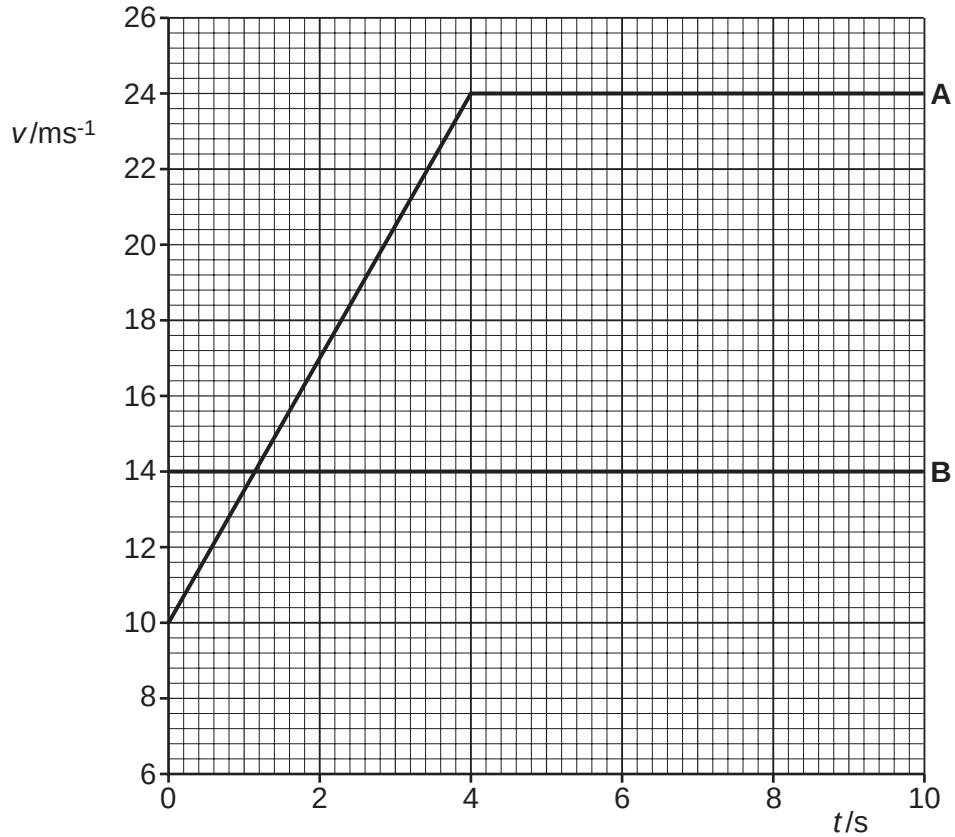


Fig. 1.1

At time $t = 0$, both cars are side-by-side.

(i) Describe the motion of car **A** from $t = 0$ to $t = 10$ s.

.....

.....

..... **[2]**

(ii) Calculate the distance travelled by car **A** in the first 4.0 s.

distance = ... m **[2]**

(iii) Use Fig. 1.1 to find

1 the time at which both cars have the same velocity

time = ... s **[1]**

2 the time *t* at which car **A** overtakes car **B**.

t = ... s **[2]**

[Total: 9]

4 **(a)** Fig. 5.1 shows a 20 N force acting at an angle of 38° to the horizontal.

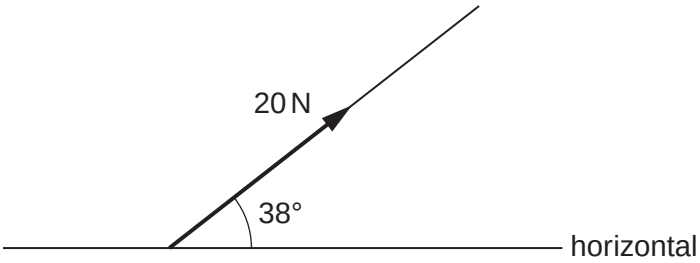


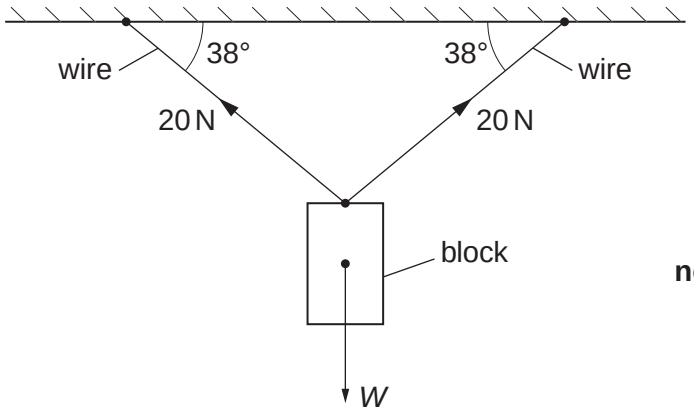
Fig. 5.1

Determine the horizontal and vertical components of this force.

horizontal component = ... N **[1]**

vertical component = ... N **[1]**

(b) Fig. 5.2 shows a metal block held in equilibrium by two wires.



not to scale

Fig. 5.2

The tension in each wire is 20 N.

(i) Show that the weight *W* of the metal block is about 25 N.

(ii) The metal block has a volume of $2.9 \times 10^{-4}\,m^3$. Calculate the density of the metal.

density = ... $kg\,m^{-3}$ **[3]**

[Total: 7]