1 A car of mass 1000 kg is travelling along a straight, level road.

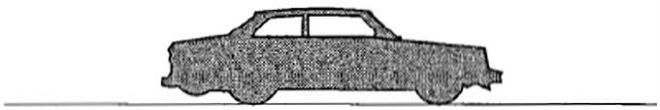

Fig. 6.1

(i) Calculate the acceleration of the car when a resultant force of 2000 N acts on it in the direction of its motion.

How long does it take the car to increase its speed from 5 ms^{-1} to 12.5 ms^{-1}? [3]

The car has an acceleration of 1.4 ms^{-2} when there is a driving force of 2000 N.

(ii) Show that the resistance to motion of the car is 600 N. [2]

A trailer is now atached to the car, as shown in Fig. 6.2. The car still has a driving force of 2000 N and resistance to motion of 600 N. The trailer has a mass of 800 kg. The tow-bar connecting the car and the trailer is light and horizontal. The car and trailer are accelerating at 0.7 ms^{2}.

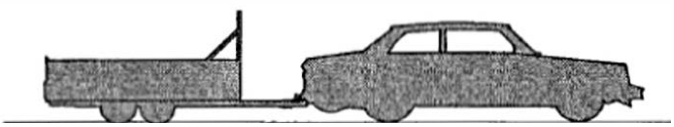

Fig. 6.2

(iii) Show that the resistance to the motion of the trailer is 140 N. [3]

(iv) Calculate the force in the tow bar. [3]

The driving force is now removed and a braking force of 610 N is applied to the car. All the resistances to motion remain as before. The trailer has no brakes.

(v) Calculate the new acceleration. Calculate also the force in the tow-bar, stating whether it is a tension or a thrust (compression). [6]

2 Fig. 3 shows two people, Sam and Tom, pushing a car of mass 1000 kg along a straight line l on level ground.

Sam pushes with a constant horizontal force of 300 N at an angle of 30° to the line l.

Tom pushes with a constant horizontal force of 175 N at an angle of 15° to the line l.

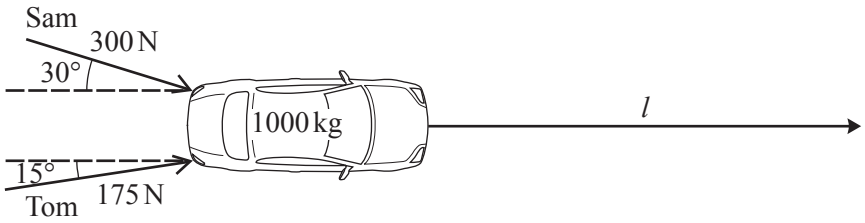

Fig. 3

(i) The car starts at rest and moves with constant acceleration. After 6 seconds it has travelled 7.2 m.

Find its acceleration. **[3]**

(ii) Find the resistance force acting on the car along the line l. **[4]**

(iii) The resultant of the forces exerted by Sam and Tom is not in the direction of the car's acceleration. Explain briefly why. **[1]**

3 A particle is travelling along a straight line with constant acceleration. P, O and Q are points on the line, as illustrated in Fig. 4. The distance from P to O is 5 m and the distance from O to Q is 30 m.

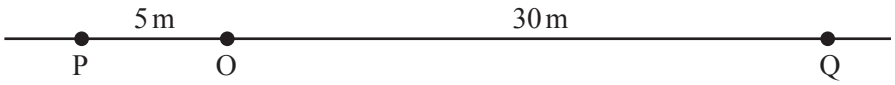

Fig. 4

Initially the particle is at O. After 10 s, it is at Q and its velocity is $9\,\text{m}\,\text{s}^{-1}$ in the direction $\overrightarrow{\text{OQ}}$.

(i) Find the initial velocity and the acceleration of the particle. **[4]**

(ii) Prove that the particle is never at P. **[3]**

4 A car is driven with constant acceleration, a m s $^{-2}$, along a straight road. Its speed when it passes a road sign is u m s $^{-1}$. The car travels 14 m in the 2 seconds after passing the sign; 5 seconds after passing the sign it has a speed of 19 m s $^{-1}$.

(i) Write down two equations connecting a and u. Hence find the values of a and u. [5]

(ii) What distance does the car travel in the 5 seconds after passing the road sign? [2]