Solutionbank M1

Heinemann Modular Maths for Edexcel AS and A-level

5 Newton's laws of motion

Exercise B, Question 15

Question:

A car moves along a straight road. When it passes a set of traffic lights, the car is travelling at a speed of 8 m s^{-1}. The car then moves with constant acceleration for 10 seconds and travels 200 metres.

(a) Show that the acceleration of the car is 2.4 m s^{-2}.

(b) Find the speed of the car at the end of the 10 seconds.

(c) The road is horizontal and the car has mass 1200 kg. A constant resistance force of 1800 N acts on the car while it is moving.
(i) Find the magnitude of the driving force that acts on the car while it is accelerating.
(ii) At the end of the 10 second period the driving force is removed. The car then moves subject to the resistance force of 1800 N until it stops. Find the distance that the car travels while it is slowing down. [A]

Solution:

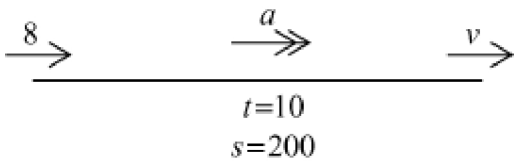
$$s = ut + \frac{1}{2}at^2$$

$$200 = 8 \times 10 + \frac{1}{2} \times a \times 10^2$$

(a) $\therefore 200 - 80 = 50 \times a$

$$\frac{120}{50} = a$$

$$\therefore a = 2.4 \text{ m } s^{-2}$$



(b) $v = u + at$ $v = 8 + 2.4 \times 10$

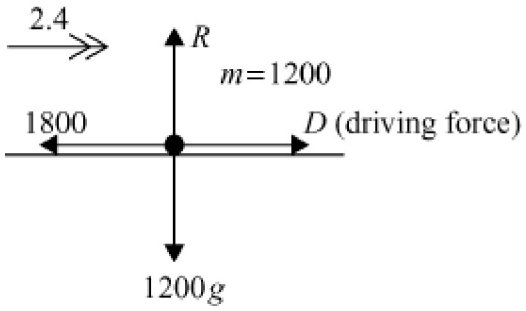
$v = 32 \text{ m } s^{-1}$

(c) (i) Newton's 2nd Law, →

$D - 1800 = 1200 \times 2.4$

$\therefore D = 1800 + 1200 \times 2.4$

$D = 4680 \text{ N}$



(ii) Newton's 2nd Law, ←

$1800 = 1200 \times r$

$\therefore r = \frac{1800}{1200}$

$r = 1.5 \text{ m s}^{-2}$

then $v^2 = u^2 + 2as$

$0^2 = 32^2 + 2(-1.5) \times s$

$3s = 32^2$

$\therefore s = \frac{32^2}{3}$

$s = 341\frac{1}{3}$ metres