(iii) Given that this power is suddenly increased by 12 kW, find the instantaneous acceleration of the car. [3]

New power = 12 + 45 = 57 kW , DF = $\frac{P}{v}$

F = ma

R(→) : $\frac{57000}{36}$ - 1250 = 1400 a

a = $\frac{5}{21}$ ms^{-2}

a = 0.238 ms^{-2} (3s.f)

(b) The car now travels at a constant speed of 32 m s^{-1} up a section of the road inclined at $\theta°$ to the horizontal, with the engine working at 64 kW.

Find the value of θ. [2]

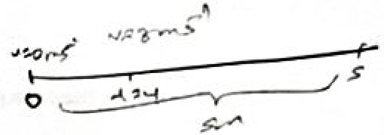
F = ma a = 0 , F = 0

R(↗) : DF - 1250 - W sin θ = 0

$\frac{64000}{32}$ - 1250 = 14000 sin θ

θ = 3.07

θ = 3.1° (1d.p)



5 A particle P moves in a straight line, starting from rest at a point O on the line. At time t s after leaving O the acceleration of P is $k(16-t^2)$ m s^{-2}, where k is a positive constant, and the displacement from O is s m. The velocity of P is 8 m s^{-1} when $t = 4$.

D V A

(a) Show that $s = \frac{1}{64}t^2(96-t^2)$. [5]

$a = k(16-t^2)$

$v = k\int 16 - t^2 \, dt$

$v = k\left[16t - \frac{t^3}{3}\right] + c$

→ t = 0 , v = 0 so c = 0 → t = 4 , v = 8

$8 = k\left[64 - \frac{64}{3}\right]$

$k = \frac{3}{16}$

$s = \frac{3}{16}\int 16t - \frac{t^3}{3} \, dt$

$s = \frac{3}{16}\left[\frac{16t^2}{2} - \frac{t^4}{12}\right] + d$

→ t = 0 , s = 0 so d = 0

$s = \frac{3}{16}\left[8t^2 - \frac{t^4}{12}\right]$

$s = \frac{3}{16}t^2\left(8 - \frac{t^2}{12}\right)$

$s = \left(\frac{3}{16} \div 12\right)t^2 \left((8\times 12) - \left(\frac{t^2}{12}\times 12\right)\right)$

$s = \frac{1}{64}t^2(96 - t^2)$

(shown)