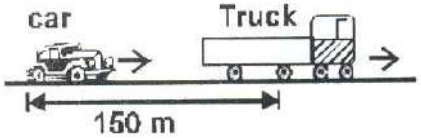
Example 8 A truck starts from rest with an acceleration of 1.5 ms^{-2} while a car 150 metre behind starts from rest with an acceleration of 2 ms^{-2}. (a) How long will it take before both the truck and car are side by side and (b) How much distance is travelled by each.



Solution. **(a)** $s_T = \frac{1}{2}at^2$

$$s_T = \frac{1}{2}(1.5)t^2 \quad .... (1)$$

Distance covered by car when car one overtakes the truck

$$s_c = \frac{1}{2}(2)t^2$$

$$(s_T + 150) = \frac{1}{2}(2)t^2 \quad .... (2)$$

Divide equation (2) by equation (1) $\frac{s_T + 150}{s_T} = \frac{2}{1.5}$ Or $1 + \frac{150}{s_T} = \frac{20}{15} = \frac{4}{3}$

$\Rightarrow \quad \frac{150}{s_T} = \frac{4}{3} - 1 = \frac{1}{3}$ or $s_T = 450$

Distance travelled by car = 450 + 150 = 600 metre

(b) Now by equation (1) $s_T = \frac{1}{2}at^2$

$$450 = \frac{1}{2} \times 1.5 \times t^2$$

$t^2 = \frac{450 \times 2}{1.5} \quad \Rightarrow \quad t = \sqrt{300 \times 2} = 24.5 \sec$

Therefore car will overtake the truck after 24.5 second.

Example 9. A police inspector in a jeep is chasing a pickpocket on a straight road. The jeep is going at its maximum speed v (assumed uniform). The pickpocket rides on the motorcycle of a waiting friend when the jeep is at a distance d away, and the motorcycle starts with a constant acceleration a. Show that the pick pocket will be caught if $v \geq \sqrt{2ad}$.

Solution. Suppose the pickpocket is caught at a time t after motorcycle starts. The distance travelled by the motorcycle during this interval is

$$s = \frac{1}{2}at^2 \qquad \text{____ (1)}$$

During this interval the jeep travels a distance

$$s + d = vt \qquad \text{____ (2)}$$

By (1) and (2), $\frac{1}{2}at^2 + d = vt$