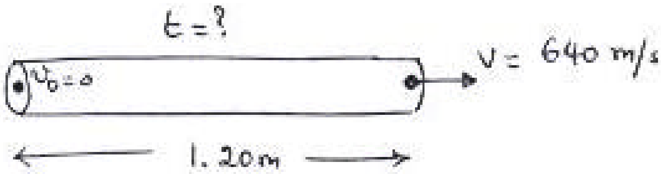
26E. The speed of a bullet is measured to be 640 m/s as the bullet emerges from a barrel of length 1.20 m. Assuming constant acceleration, find the time that the bullet spends in the barrel after it is fired.



assume $a = \text{Const.}$

$$x - x_0 = \cancel{v_0}^{\,0} t + \frac{1}{2} a t^2$$

$$v - \cancel{v_0}^{\,0} = at \Rightarrow a = \frac{v}{t}$$

$$\Rightarrow x - x_0 = \frac{1}{2} \frac{v}{t} t^2 = \frac{1}{2} v t$$

$$\Rightarrow t = \frac{2(x - x_0)}{v} = \frac{2(1.20\ \text{m})}{640\ \text{m/s}} = \boxed{3.8 \times 10^{-3}\ \text{s}}$$

32E. Figure 2-21 depicts the motion of a particle moving along an x axis with a constant acceleration. What are the magnitude and direction of the particle's acceleration?

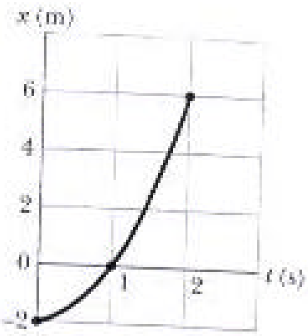


Fig. 2-21 Exercise 32.

Since a = Constant $\quad x - x_0 = \frac{1}{2} a t^2 + v_0 t$

From the graph, at $t = 0$ the slope is horizontal

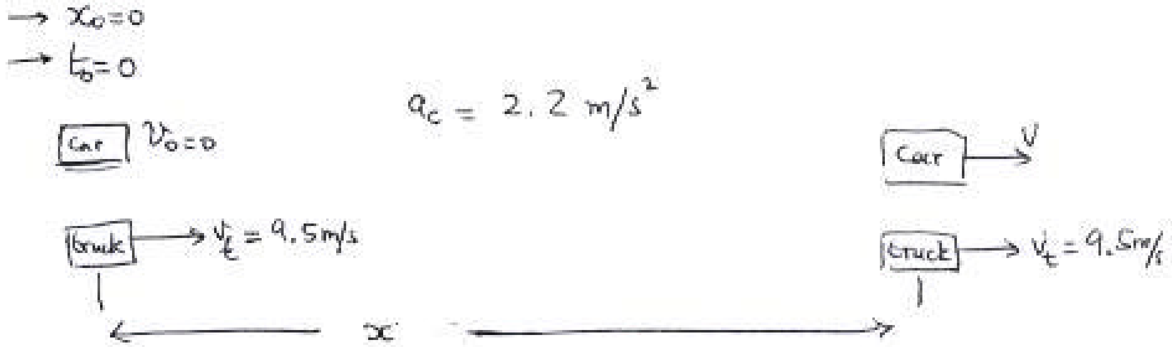
$\Rightarrow \quad v_0 = 0$

Also from the graph $\quad x_0 = -2\,m$

at $\quad t = 2\,s \quad x = 6\,m$

$\Rightarrow \quad 6 - (-2) = \frac{1}{2} a \, (2)^2 \Rightarrow \boxed{a = 4\ m/s^2}$

36P. At the instant the traffic light turns green, an automobile starts with a constant acceleration a of 2.2 m/s^2. At the same instant a truck, traveling with a constant speed of 9.5 m/s, overtakes and passes the automobile. (a) How far beyond the traffic signal will the automobile overtake the truck? (b) How fast will the car be traveling at that instant?



a) truck $= v_t t$

Car $= \frac{1}{2} a_c t^2 + \cancel{v_0}^{\,0} t$

For the car to overtake the truck they both must have the same position.

$$\Rightarrow \quad v_t t = \frac{1}{2} a_c t^2 \Rightarrow t = \frac{2 v_t}{a_c}$$

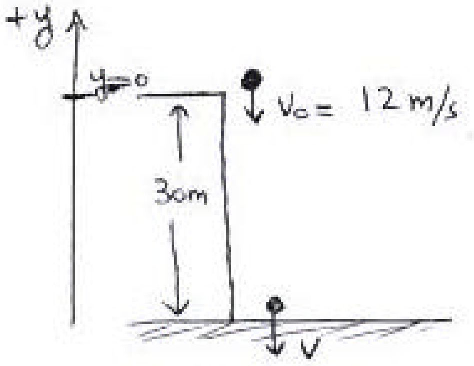
$$t = 8.64\,s$$

$$\Rightarrow \quad x = \frac{1}{2}(2.2)(8.64)^2 = \boxed{82.1\ m}$$

$$= (9.5)(8.64) = 82.1\ m$$

b) $v_c = \cancel{v_0}^{\,0} + a_c t = (2.2)(8.64) = \boxed{19\ m/s}$

42E. A hoodlum throws a stone vertically downward with an initial speed of 12.0 m/s from the roof of a building, 30.0 m above the ground. (a) How long does it take the stone to reach the ground? (b) What is the speed of the stone at impact?



a) $y - \overset{0}{y_0} = -\frac{1}{2} g t^2 + v_0 t$

$-30 = -4.9t^2 - 12t$

$\Rightarrow 4.9t^2 + 12t - 30 = 0$

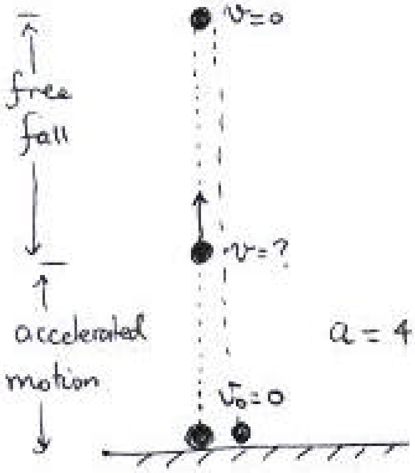
$t = \dfrac{-12 \pm \sqrt{(-12)^2 + 4(4.9)(30)}}{9.8} = \dfrac{-12 \pm 27}{9.8}$

ak the positive answer $\boxed{t = 1.54\text{ s}}$.

b) $v = v_0 - gt = -12 - (9.8)(1.54)$

$= \boxed{-27.1\text{ m/s}}$

52P. A model rocket fired vertically from the ground ascends with a constant vertical acceleration of 4.00 m/s² for 6.00 s. Its fuel is then exhausted, so it continues upward as a free-fall particle and then falls back down. (a) What is the maximum altitude reached? (b) What is the total time elapsed from takeoff until the rocket strikes the ground?



$a = 4\,m/s^2, \quad t = 6s$

a) The rocket starts from rest $v_0 = 0$

$$y_1 - \cancel{y_0}^{0} = \frac{1}{2}at^2 = \frac{1}{2}(4)(6)^2 = 72m$$

$$v = at = (4)(6) = 24\ m/s = v_0 \text{ for free fall}$$

free fall : $\cancel{v^2}^{0} - v_0^2 = -2g(y_2 - \cancel{y_0}^{0}) \Rightarrow y_2 = \frac{v_0^2}{2g} = \frac{(24)^2}{2 \times 9.8}$

$$= 29.4\ m$$

$$y = y_1 + y_2 = \boxed{101\ m}$$

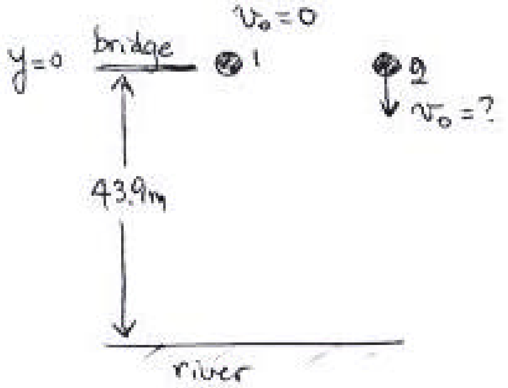
b) $t_1 = 6s$ (accelerated motion)

$t_2 = ?$ (free fall)

$$y - \cancel{y_0}^{0} = -\frac{1}{2}gt_2^2 + v_0 t_2$$

$$-72 = -4.9t_2^2 + 24t_2 \Rightarrow t_2 = 7s$$

60P. A stone is dropped into a river from a bridge 43.9 m above the water. Another stone is thrown vertically down 1.00 s after the first is dropped. Both stones strike the water at the same time. (a) What is the initial speed of the second stone? (b) Plot velocity versus time on a graph for each stone, taking zero time as the instant the first stone is released.



a) Stone #1

$$y = -\frac{1}{2} g t_1^2$$

$$-43.9 = -4.9 t_1^2 \Rightarrow t_1 = 3\,s$$

$$t_2 = 2\,s$$

Stone # 2

$$y = -\frac{1}{2} g t_2^2 + v_0 t_2$$

$$-43.9 = -4.9 (2)^2 + 2 v_0$$

$$\Rightarrow \boxed{v_0 = -12.2\ m/s}$$