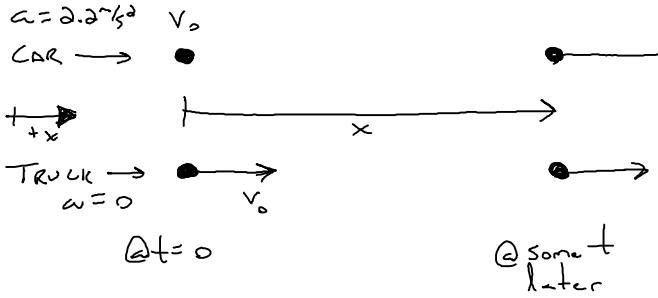
08 SEP 10

- HW ✓ (see solutions online)
- ☆ PRINCETON REVIEW BOOKS
- LAB: Introduction to Motion
- HW ASSIGNMENT

☆ end of page

71 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 automobile be traveling at that instant?



equation describing position of car

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

$x = \frac{1}{2}(2.2\ m/s^2) t^2$

equation describing position of truck

$x = v_0 t + \cancel{\frac{1}{2} a t^2}^{0}$ since $(a = 0)$

$x = (9.5\ m/s)\, t \qquad v = \frac{x}{t}$

when the car and truck meet again, the will be at the same position.

$t = 0$ is a solution $\longrightarrow$ $\frac{1}{2}(2.2\ m/s^2) t^2 = (9.5\ m/s)\, t$

$t = 8.636\ s$

then, use this time to find x in either equation

(a) $x = \frac{1}{2}(2.2\ m/s^2)(8.636\ s)^2 = \boxed{82.039\ m}$

(b) $a = \frac{v - \cancel{v_0}^{0}}{t} \Rightarrow v = a t = (2.2\ m/s^2)(8.636\ s) = \boxed{18.999\ m/s}$

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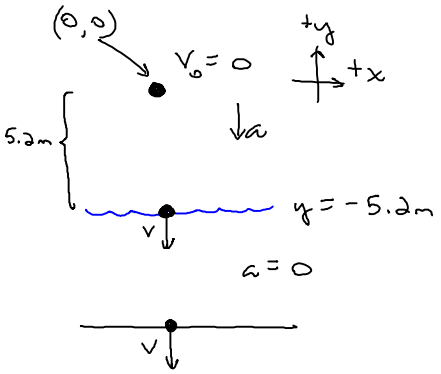
74 A lead ball is dropped in a lake from a diving board 5.20 m above the water. It hits the water with a certain velocity and then sinks to the bottom with this same constant velocity. It reaches the bottom 4.80 s after it is dropped. (a) How deep is the lake? What are the (b) magnitude and (c) direction (up or down) of the average velocity of the ball for the entire fall? Suppose that all the water is drained from the lake. The ball is now thrown from the diving board so that it again reaches the bottom in 4.80 s. What are the (d) magnitude and (e) direction of the initial velocity of the ball?



(a) find t to fall 5.2m : $y = \cancel{v_0 t}^{0} + \frac{1}{2} a t^2 \Rightarrow -5.2\text{m} = \frac{1}{2}(-9.8\text{m/s}^2)\, t^2$

$t = 1.030\text{s}$

so, it must sink for $4.8\text{s} - 1.030\text{s} = 3.77\text{s}$

find the velocity at impact with the water

$y = \frac{v^2 - \cancel{v_0^2}^{0}}{2a} \Rightarrow v = \pm\sqrt{2ay} = -\sqrt{2(-9.8\text{m/s}^2)(-5.2\text{m})}$

$= -10.096\text{ m/s}$ ← this is the velocity at which the ball sinks over a time of 3.77s

find the displacement : $v = \frac{y}{t} \Rightarrow y = vt = (-10.096\text{m/s})(3.77\text{s})$ ($a = 0$)

$= -38.062\text{m}$

the lake is 38.062m deep

(b) distance traveled : $5.2\text{m} + 38.062\text{m} = 43.262\text{m}$

total time : 4.8s

magnitude of average velocity $\|\vec{v}\| = \frac{|x|}{t} = \frac{43.262\text{m}}{4.8\text{s}} = \boxed{9.013\text{ m/s}}$

(c) the direction is **down**

(d) need to free-fall 43.262m in 4.8s with $v_0 \neq 0$

$y = v_0 t + \frac{1}{2} a t^2 \Rightarrow v_0 = \frac{y - \frac{1}{2} a t^2}{t}$

$= \frac{-43.262\text{m} - \frac{1}{2}(-9.8\text{m/s}^2)(4.8\text{s})^2}{4.8\text{s}}$

$= +14.507\text{ m/s}$

magnitude of the initial velocity is **14.507 m/s**

(e) the direction of the initial velocity is **up**

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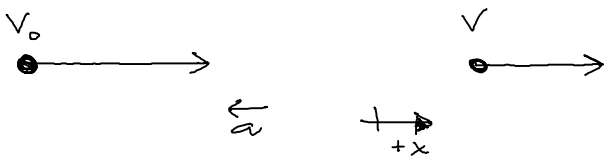
79 A motorcycle is moving at 30 m/s when the rider applies the brakes, giving the motorcycle a constant deceleration. During the 3.0 s interval immediately after braking begins, the speed decreases to 15 m/s. What distance does the motorcycle travel from the instant braking begins until the motorcycle stops?



$v_o = 30\ m/s$

$v = 15\ m/s$

$t = 3\ s$

$x = ?$

find a : $a = \frac{v - v_o}{t} = \frac{15\ m/s - 30\ m/s}{3\ s}$

$= -5\ m/s^2$

then, $x = \frac{0^2 - v_o^2}{2a} = -\frac{(30\ m/s)^2}{2(-5\ m/s^2)}$

$= \boxed{90\ m}$

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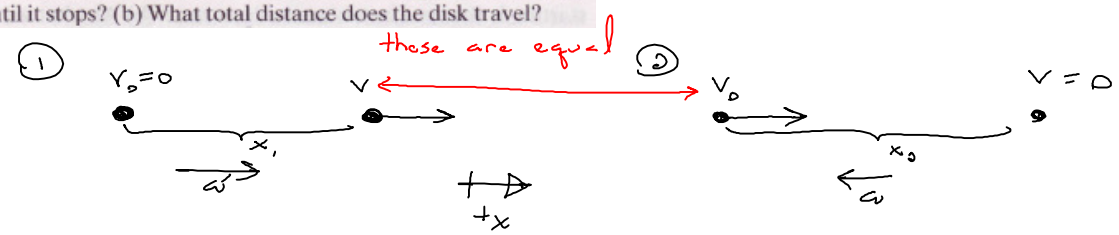
81 A shuffleboard disk is accelerated at a constant rate from rest to a speed of 6.0 m/s over a 1.8 m distance by a player using a cue. At this point the disk loses contact with the cue and slows at a constant rate of 2.5 m/s^2 until it stops. (a) How much time elapses from when the disk begins to accelerate until it stops? (b) What total distance does the disk travel?



for ①: $x = \frac{v^2 - \cancel{v_0^2}^{0}}{2a} \Rightarrow a = \frac{v^2}{2x} = \frac{(6\ m/s)^2}{2(1.8\ m)} = 10\ m/s^2$

$a = \frac{v - \cancel{v_0}^{0}}{t} \Rightarrow t = \frac{v}{a} = \frac{6\ m/s}{10\ m/s^2} = 0.6\ s$

or $x = \frac{1}{2}(v + v_0)t$

$t = \frac{2x}{v + \cancel{v_0}^{0}} = \frac{2(1.8\ m)}{6\ m/s} = 0.6\ s$

for ②: $v_0 = 6\ m/s$

$a = \frac{v - v_0}{t} \Rightarrow t = \frac{-v_0}{a} = \frac{-6\ m/s}{-2.5\ m/s^2} = 2.4\ s$

$x = v_0 t + \frac{1}{2} a t^2 = (6\ m/s)(2.4\ s) + \frac{1}{2}(-2.5\ m/s^2)(2.4\ s)^2 = 7.2\ m$

So... (a) $0.6\ s + 2.4\ s = \boxed{3\ s}$

(b) $1.8\ m + 7.2\ m = \boxed{9\ m}$

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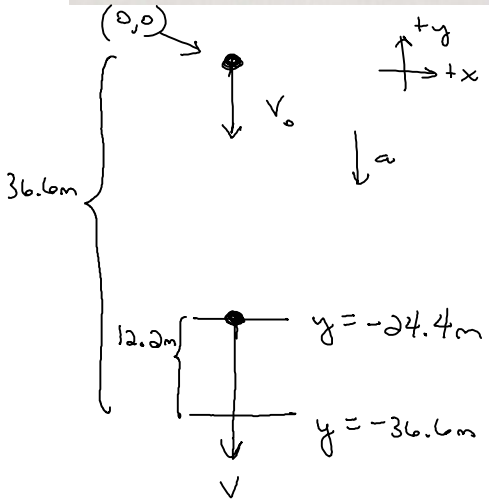
108 A ball is thrown vertically downward from the top of a 36.6-m-tall building. The ball passes the top of a window that is 12.2 m above the ground 2.00 s after being thrown. What is the speed of the ball as it passes the top of the window?



$$x = vt - \frac{1}{2}at^2$$

$$v = \frac{x + \frac{1}{2}at^2}{t}$$

$$= \frac{-24.4\,m + \frac{1}{2}(-9.8\,m/s^2)(2s)^2}{2s}$$

$$= -22\,m/s$$

the speed is $\boxed{22\,m/s}$

☆ end of page

Homework

- HRW Chapter 2
  problems 59, 97, 101, 106

- Scan due Monday 13 Sep 10
- Quiz Friday

☆ end of page