RECITATION 3

Ch. 4

•22 A small ball rolls horizontally off the edge of a tabletop that is 1.20 m high. It strikes the floor at a point 1.52 m horizontally from the table edge. (a) How long is the ball in the air? (b) What is its speed at the instant it leaves the table?

a)

$$y - y_0 = v_{0y}t - \frac{1}{2}gt^2$$

With $y = v_0 = 0$,

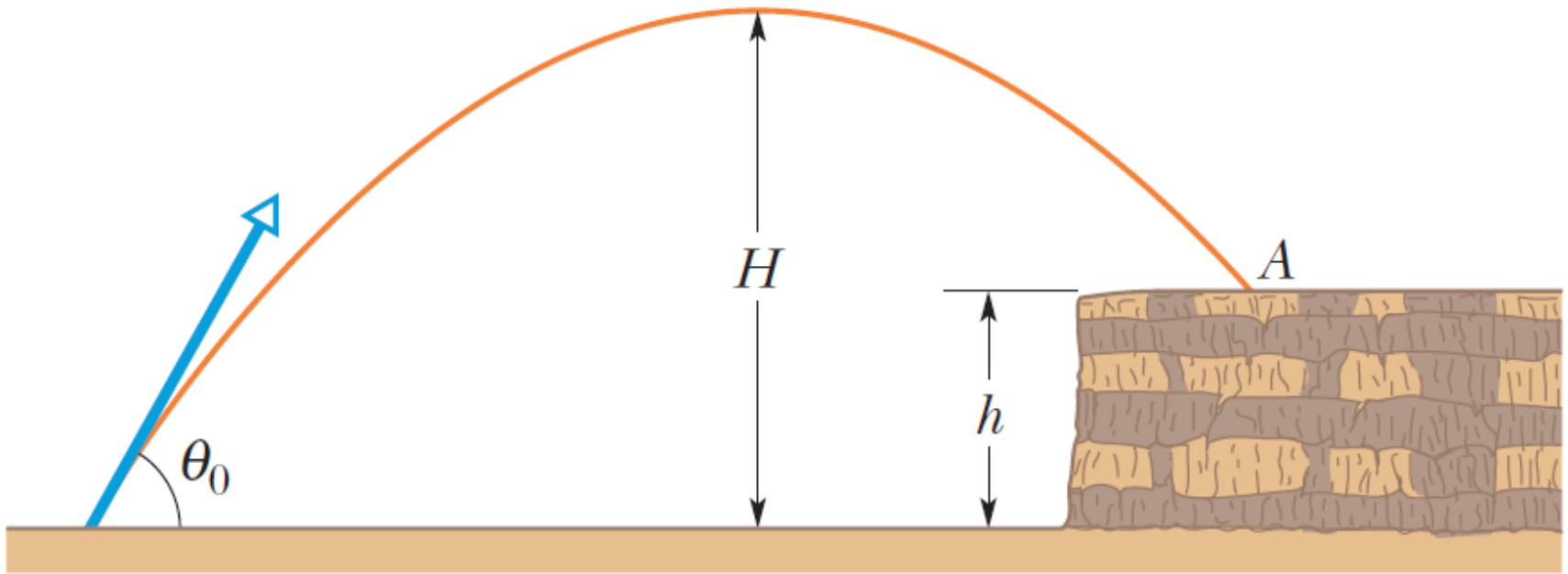
$$t = \sqrt{2y_0/g} = \sqrt{2(1.20)/9.81} = 0.495 \text{ s}.$$

b)

$$v_{x0} = \frac{\Delta x}{\Delta t} = \frac{1.20}{0.495} = 2.43 \frac{\text{m}}{\text{s}}.$$

$$v = \sqrt{v_{0x}^2 + v_{0y}^2} = \sqrt{(2.43)^2 + 0} = 2.43 \frac{\text{m}}{\text{s}}.$$

••28 In Fig. 4-34, a stone is projected at a cliff of height with an initial speed of 42.0 m/s directed at angle $\theta_0 = 60.0°$ above the horizontal. The stone strikes at A, 5.50 s after launching. Find (a) the height h of the cliff, (b) the speed of the stone just before impact at A, and (c) the maximum height H reached above the ground.



a)

$$y - y_0 = v_{0y}t - \frac{1}{2}gt^2$$

With $y_0 = 0$ and $y = h$,

$$h = v_{0y}t - \frac{1}{2}gt^2 = (42.0 \sin 60.0°)(5.50) - \frac{1}{2}(9.81)(5.50)^2$$

$$= 51.8 \text{ m}.$$

b)

$$v_y = v_{0y} - gt = 42.0 \sin 60.0° - (9.81)(5.50) = -17.6 \text{ m/s}$$

$$v_x = v_{0x} = 42.0 \cos 60.0° = 21.0 \text{ m/s}.$$

$$v = \sqrt{v_x^2 + v_y^2} = 27.4 \text{ m/s}.$$

c)

$$v_y^2 = v_{0y}^2 - 2g\Delta y$$

For $v_y = 0$, $y_0 = 0$ and $y = H$

$$0 = v_{0y}^2 - 2gH$$

$$H = \frac{v_{0y}^2}{2g} = \frac{(42.0 \sin 60.0°)^2}{2(9.81)} = 67.5 \text{ m.}$$

•56 An Earth satellite moves in a circular orbit 640 km above Earth's surface with a period of 98.0 min. What are the (a) speed and (b) magnitude of the centripetal acceleration of the satellite?

a)

$$r = 6.40 \times 10^5 \text{m} + 6.37 \times 10^6 \text{m} = 7.01 \times 10^6 \text{m}$$

$$v = \frac{2\pi r}{T} = \frac{2\pi(7.01 \times 10^6)}{(98.0)(60)} = 7.49 \times 10^3 \text{m/s}.$$

b)

$$a = \frac{v^2}{r} = \frac{(7.49 \times 10^3)^2}{7.01 \times 10^6} = 8.00 \text{ m/s}.$$

••77 SSM Snow is falling vertically at a constant speed of 8.0 m/s. At what angle from the vertical do the snowflakes appear to be falling as viewed by the driver of a car traveling on a straight, level road with a speed of 50 km/h?

Fame A is ground and frame B is the car.

$$\vec{v}_{PA} = \vec{v}_{PB} + \vec{v}_{BA}$$

$$\vec{v}_{PB} = \vec{v}_{PA} - \vec{v}_{BA} = \left(-8.0\frac{\text{m}}{\text{s}}\right)\hat{\text{j}} - \left(14\frac{\text{m}}{\text{s}}\right)\hat{\text{i}} =$$

$$\theta = \tan^{-1}\frac{-8.0}{-14} = 30° + 180° = 210°.$$

The view angle from the vertical is then 60°.