Honors Physics - Chapter 3 Practice Answers

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1) $\Delta t_x = 7.95\text{ s}$

$\Delta y = 161\text{ m}$

$d = 226\text{ m}$

$$d^2 = \Delta x^2 + \Delta y^2$$

$$\Delta x = \sqrt{d^2 - \Delta y^2} = \sqrt{(226\text{ m})^2 - (161\text{ m})^2} = \sqrt{5.11 \times 10^4\text{ m}^2 - 2.59 \times 10^4\text{ m}^2}$$

$$\Delta x = \sqrt{2.52 \times 10^4\text{ m}^2} = 159\text{ m}$$

$$\Delta x = \boxed{159\text{ m}}$$

$$v = \frac{\Delta x}{\Delta t_x} = \frac{159\text{ m}}{7.95\text{ s}} = \boxed{20.0\text{ m/s}}$$

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2) $\Delta x = 5\text{ jumps}$

$1\text{ jump} = 8.0\text{ m}$

$d = 68\text{ m}$

$$d^2 = \Delta x^2 + \Delta y^2$$

$$\Delta y = \sqrt{d^2 - \Delta x^2} = \sqrt{(68\text{ m})^2 - [(5)(8.0\text{ m})]^2} = \sqrt{4.6 \times 10^3\text{ m}^2 - 1.6 \times 10^3\text{ m}^2}$$

$$\Delta y = \sqrt{3.0 \times 10^3\text{ m}} = 55\text{ m}$$

$$\text{number of jumps northward} = \frac{55\text{ m}}{8.0\text{ m/jump}} = 6.9\text{ jumps} = \boxed{7\text{ jumps}}$$

$$\theta = \tan^{-1}\left(\frac{\Delta x}{\Delta y}\right) = \tan^{-1}\left[\frac{(5)(8.0\text{ m})}{55\text{ m}}\right] = \boxed{36^\circ\text{ west of north}}$$

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3) $v = 347\text{ km/h}$

$\theta = 15.0^\circ$

$$v_x = v(\cos\theta) = (347\text{ km/h})(\cos 15.0^\circ) = \boxed{335\text{ km/h}}$$

$$v_y = v(\sin\theta) = (347\text{ km/h})(\sin 15.0^\circ) = \boxed{89.8\text{ km/h}}$$

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4) $d = 14\,890\text{ km}$

$\theta = 25.0^\circ$

$\Delta t = 18.5\text{ h}$

$$v_{avg} = \frac{d}{\Delta t} = \frac{1.489 \times 10^4\text{ km}}{18.45\text{ h}} = \boxed{805\text{ km/h}}$$

$$v_x = v_{avg}(\cos\theta) = (805\text{ km/h})(\cos 25.0^\circ) = \boxed{730\text{ km/h east}}$$

$$v_y = v_{avg}(\sin\theta) = (805\text{ km/h})(\sin 25.0^\circ) = \boxed{340\text{ km/h south}}$$

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5)

$v = 925$ km/h

$\Delta t_1 = 1.50$ h

$\Delta t_2 = 2.00$ h

$\theta_2 = 135°$

$$d_1 = v\Delta t_1 = (925 \text{ km/h})(10^3 \text{ m/km})(1.50 \text{ h}) = 1.39 \times 10^6 \text{ m}$$

$$d_2 = v\Delta t_2 = (925 \text{ km/h})(10^3 \text{ m/km})(2.00 \text{ h}) = 1.85 \times 10^6 \text{ m}$$

$$\Delta x_1 = d_1 = 1.39 \times 10^6 \text{ m}$$

$$\Delta y_1 = 0 \text{ m}$$

$$\Delta x_2 = d_2(\cos\theta_2) = (1.85 \times 10^6 \text{ m})(\cos 135°) = -1.31 \times 10^6 \text{ m}$$

$$\Delta y_2 = d_2(\sin\theta_2) = (1.85 \times 10^6 \text{ m})(\sin 135°) = 1.31 \times 10^6 \text{ m}$$

$$\Delta x_{tot} = \Delta x_1 + \Delta x_2 = 1.39 \times 10^6 \text{ m} + (-1.31 \times 10^6 \text{ m}) = 0.08 \times 10^6 \text{ m}$$

$$\Delta y_{tot} = \Delta y_1 + \Delta y_2 = 0 \text{ m} + 1.31 \times 10^6 \text{ m} = 1.31 \times 10^6 \text{ m}$$

$$d = \sqrt{(\Delta x_{tot})^2 + (\Delta y_{tot})^2} = \sqrt{(0.08 \times 10^6 \text{ m})^2 + (1.31 \times 10^6 \text{ m})^2}$$

$$d = \sqrt{6 \times 10^9 \text{ m}^2 + 1.72 \times 10^{12} \text{ m}^2} = \sqrt{1.73 \times 10^{12} \text{ m}^2}$$

$$d = \boxed{1.32 \times 10^6 \text{ m} = 1.32 \times 10^3 \text{ km}}$$

$$\theta = \tan^{-1}\left(\frac{\Delta y_{tot}}{\Delta x_{tot}}\right) = \tan^{-1}\left(\frac{1.31 \times 10^6 \text{ m}}{0.08 \times 10^6 \text{ m}}\right) = 86.5° = 90.0° - 3.5°$$

$$\theta = \boxed{3.5° \text{ east of north}}$$

6)

$v_x = 9.37$ m/s

$\Delta y = -2.00$ m

$a_y = -g = -9.81$ m/s^2

$$\Delta t = \sqrt{\frac{2\Delta y}{a_y}} = \frac{\Delta x}{v_x}$$

$$\Delta x = v_x\sqrt{\frac{2\Delta y}{a_y}} = (9.37 \text{ m/s})\sqrt{\frac{(2)(-2.00 \text{ m})}{(-9.81 \text{ m/s}^2)}} = 5.98 \text{ m}$$

$$\boxed{\text{The river is 5.98 m wide.}}$$

7)

$\Delta x = 25$ m

$v_x = 15$ m/s

$a_y = -g = -9.81$ m/s^2

$h = 25$ m

$$\Delta t = \frac{\Delta x}{v_x}$$

$$\Delta y = \frac{1}{2}a_y(\Delta t)^2 = \frac{a_y(\Delta x)^2}{2v_x^2} = \frac{(-9.81 \text{ m/s}^2)(25 \text{ m})^2}{(2)(15 \text{ m/s})^2}$$

$$\Delta y = h - h' = -14 \text{ m}$$

$$h' = h - \Delta y = 25 \text{ m} - (-14 \text{ m})$$

$$= \boxed{39 \text{ m}}$$

8)

$\Delta x = 76.5$ m

$\theta = 12.0°$

$a_y = -g = -9.81$ m/s^2

At maximum height, $v_{y,f} = 0$ m/s.

$$v_{y,f}^2 = v_{y,i}^2 + 2a_y\Delta y_{max} = 0$$

$$y_{max} = \frac{-v_{y,i}^2}{2a_y} = \frac{-v_i^2(\sin\theta)^2}{2a_y}$$

Using the derivation for v_i^2 from problem 1,

$$\Delta y_{max} = \left[\frac{-a_y\Delta x}{2(\sin\theta)(\cos\theta)}\right]\frac{-(\sin\theta)^2}{2a_y} = \frac{\Delta x(\sin\theta)}{4(\cos\theta)} = \frac{\Delta x(\tan\theta)}{4}$$

$$\Delta y_{max} = \frac{(76.5 \text{ m})(\tan 12.0°)}{4} = \boxed{4.07 \text{ m}}$$