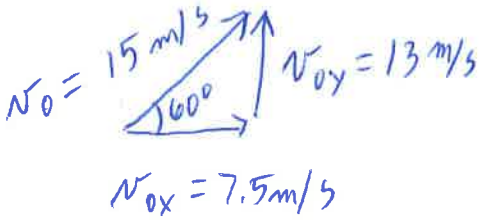
Name: Solutions

PHYS 141 - Written Homework #03

1. (8 points) Solve problem 3.52 in your text (13th ed. 3.56). In the end-of-chapter problems, the blue dots are supposed to indicate the difficulty level. However, in the case of three blue dots, sometimes the problem is truly difficult, and other times it is merely long (and still other times, it would involve concepts from multiple chapters). In this problem, the 3 dots seem to indicate 3 steps: first find time for the package to fall to the water-level, then find its range, and finally determine how far the boat moves in that time.



$$y(t) = y_0 + v_{0y}t + \tfrac{1}{2}\left(-9.8\tfrac{m}{s^2}\right)t^2$$

$$-8.75\,m = 0 + \left(13\tfrac{m}{s}\right)t - \left(4.9\tfrac{m}{s^2}\right)t^2$$

$$\left(4.9\tfrac{m}{s^2}\right)t^2 - \left(13\tfrac{m}{s}\right)t - 8.75\,m = 0$$

$$t = 3.21\,s$$

$$x(t) = x_0 + v_{0x}t$$

$$= 0 + \left(7.5\tfrac{m}{s}\right)t$$

$$= \left(7.5\tfrac{m}{s}\right)(3.21\,s) = 24.1\,m$$

$$\Delta x_{BOAT} = \left(0.45\tfrac{m}{s}\right)(3.21\,s) = 1.44\,m$$

$$D = 25.5\,m$$

2. (6 points) Consider problem 3.71:

3.71 •• An airplane pilot sets a compass course due west and maintains an airspeed of 220 km/h. After flying for 0.500 h, she finds herself over a town 120 km west and 20 km south of her starting position. Helpful information: "…sets a compass course due west…" is yet another way to say "…the airplane points due west…."

2.a. (2 pts) Write the general equation that relates the 3 velocity vectors to each other.

$$\vec{v}_{P/E} = \vec{v}_{P/A} + \vec{v}_{A/E}$$

2.b. (4 pts) Fill-in the blank cells of this table, taking N as $+\hat{y}$ and E as $+\hat{x}$ as usual:

Name	Magnitude	Direction	x-component	y-component
v P/E	don't do this one	don't do this one	-240 km/hr	-40 km/hr
v P/A	220 km/hr	West or $-\hat{x}$	-220 km/hr	0
v A/E	unknown	unknown	unknown	unknown

Note: you are not solving for anything. You are only doing these important setup steps.

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3. (6 points) A car drives on a circular road or radius R. The distance driven by the car is given by $d(t) = \frac{1}{3}at^3 + bt$ [where a and b are constants, and t in seconds will give d in meters]. In terms of a, b, and R, and when $t = 2$ *seconds*, find an expression for the magnitudes of (i) the tangential acceleration a_{TAN}, and (ii) the radial acceleration a_{RAD}.

$$d(t) = \frac{1}{3}at^3 + bt$$

$$v(t) = at^2 + b$$

$$a(t) = a_{TAN}(t) = 2at$$

$$a_{TAN}(2s) = \boxed{4a}$$

$$a_{RAD}(t) = \frac{v^2(t)}{R} = \frac{(at^2+b)^2}{R}$$

$$= \frac{(a^2t^4 + b^2 + 2abt^2)}{R}$$

$$a_{RAD}(2s) = \boxed{\frac{16a^2 + b^2 + 8ab}{R}}$$