Physics 10154 – Summer 2013 – Exam #1B

Instructions: Be sure to <u>SHOW ALL WORK</u> and clearly indicate your answers. I will not give full credit if I cannot logically follow how you got your answer, even if the answer is correct. Partial credit will be given provided you are solving parts of the problem correctly. <u>Clearly indicate your final answer</u>, including correct units and significant figures.

1. (35 pts) Alan is walking North along University Drive starting at 3.3 miles/hour from a location 2.0 miles South of University Drive. Ben is 3.0 miles North of I-30, walking South along University Drive at 3.8 miles/hour.

Do they meet North or South of I-30? How far away from I-30 do they meet, in miles?

From Alan's perspective, Ben is moving 7.1 $^{mi}/_{hr}$ from 5.0 miles away.

$$t = \frac{5.0 \, mi}{7.1 \, ^{mi}/_{hr}} = 0.704 \, hr$$

Alan moves $\Delta x_A = (3.3)(.704) = 2.32 \, mi$, North

Ben moves $\Delta x_B = (3.8)(.704) = 2.68 \, mi$, South

$\qquad\qquad\qquad\qquad\qquad\qquad 5.0 \, mi \checkmark$
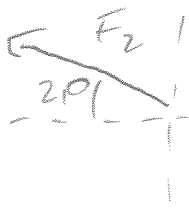
They meet 0.32 miles North of I-30.

2. (30 pts) Three forces are acting on a block. Force #1 is 46 Newtons directed due South. Force #2 is ⬛ Newtons directed 21° North of West. Force #3 is 65 Newtons directed 27° East of North. What is the magnitude and direction of the net force acting on the block?
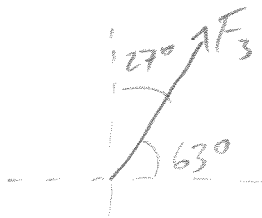
F_1 ↓

$F_{1x} = 0$

$F_{1y} = -46 N$

F_2 20

$F_{2x} = -54 \cos 21° = -50.41$

$F_{2y} = 54 \sin 21° = 19.35$

27° F_3 63°
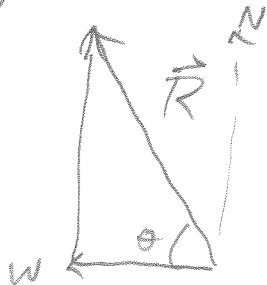
$F_{3x} = 65 \cos 63° = 29.51$

$F_{3y} = 65 \sin 63° = 57.92$

$R_x = 0 - 50.41 + 29.51 = -20.90$

$R_y = -46 + 19.35 + 57.92 = 31.27$
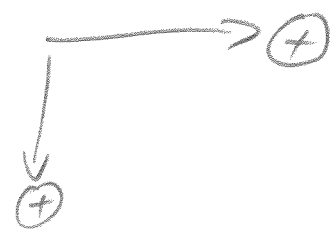
$|\vec{R}| = \sqrt{(-20.90)^2 + (31.27)^2}$

$= 37.61$

$\theta = \tan^{-1}\left(\frac{31.27}{20.90}\right) = 56.24$

$\boxed{\vec{F}_{TOT} = 38 N, \ 56° \ N \ of \ W}$

3. (35 pts) A rock is thrown from the top of a 55 meter building with an initial speed of 33 meters/sec directed 22° below the horizontal. There is a 12 meter high wall located 45 meters from the base of the building. Does the rock hit the wall, pass over the wall or fall short of the wall? Justify your answer mathematically.

x	y
$\Delta x = 45m$	$\Delta y = ?$
$v_{ox} = 33\cos 22°$	$v_{oy} = 33\sin 22°$
$= 30.60$	$= 12.36$
$v_x = 30.60$	$v_y = ?$
$a_x = 0$	$a_y = 9.8 \, m/s^2$
$t = ?$	$t = ?$

$$\Delta x = v_{ox}t + \tfrac{1}{2}a_x t^2 =$$

$$45 = (30.60)t + 0 \qquad \boxed{t = 1.47s}$$

$$\Delta y = v_{oy}t + \tfrac{1}{2}a_y t^2$$

$$= (12.36)(1.47) + \tfrac{1}{2}(9.8)(1.47)^2$$

$$= 18.17 + 10.59 = 28.76m$$

Rock starts at 55 m, ends at 26.24 m, above the 12m high wall.

Passes over.