EXAM-1

PHYS 201 (Spring 2008), 02/15/08

Name: Solution Key

Lab-Sect. no.:

Signature:

Duration: 50 minutes
Show all your work for full/partial credit!
Include the correct units in your final answers for full credit!
Unless otherwise stated, quote your results in SI units!

students: 52

517	518	519
18	12	22

1.) *Multiple Choice* *(25 pts.)*

For each statement below, circle the correct answer (TRUE or FALSE, no reasoning required).

(a) Adding physical quantities is only meaningful if those quantities carry the same units.
TRUE FALSE

(b) In a 2-dimensional, multi-step trip, the magnitude of the net displacement can be larger than the total distance traveled.
TRUE FALSE

(c) In projectile motion, the vertical component of the velocity is zero at the highest point of the trajectory.
TRUE FALSE

(d) Inertia and Gravity are the same concept because both are quantified in terms of mass.
TRUE FALSE

(e) If an object slides down an inclined plane at constant velocity, the net force on that object is zero.
TRUE FALSE

No.	Points
1	KD
2	SD
3	RR
4	HQ
5	KD
Sum	

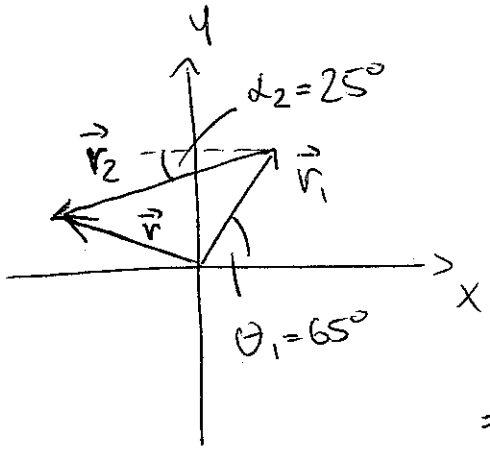
2.) *Vector Addition and Kinematics* *(20 pts.)*

On a hiking trip, a person first walks for $2.3mi$ in a direction of 65° North of East, and then for $4.0mi$ in a direction of 25° South of West.

(a) Calculate the magnitude (in mi) and direction (relative to due West) of the net displacement for the entire trip. Start by drawing a vector diagram.

(b) If the hike took 2 hours and thirty minutes, calculate the average speed and the average velocity for the entire trip (both in mi/h).

(a)



$$\vec{r}_1 = \begin{pmatrix} r_1 \cos\theta_1 \\ r_1 \sin\theta_1 \end{pmatrix} = \begin{pmatrix} 0.972\,mi \\ 2.085\,mi \end{pmatrix}$$

$$\vec{r}_2 = \begin{pmatrix} -r_2 \cos\alpha_2 \\ -r_2 \sin\alpha_2 \end{pmatrix} = \begin{pmatrix} -3.625\,mi \\ -1.690\,mi \end{pmatrix}$$

$$\Rightarrow \vec{r} = \vec{r}_1 + \vec{r}_2 = \begin{pmatrix} -2.653\,mi \\ 0.395\,mi \end{pmatrix}$$

$$\Rightarrow \boxed{r = \sqrt{r_x^2 + r_y^2} = 2.68\,mi}$$

$$\tan\beta = \frac{|r_y|}{|r_x|} \Rightarrow \boxed{\beta = \tan^{-1}\left(\frac{0.395}{2.653}\right) = 8.5°} \text{ North of West}$$

(b) average speed: $\bar{v} = \frac{d}{\Delta t}$, $d = d_1 + d_2 = |\vec{r}_1| + |\vec{r}_2| = 6.3\,mi$

$$\Rightarrow \boxed{\bar{v} = \frac{6.3}{2.5} = 2.52\ mi/h}$$

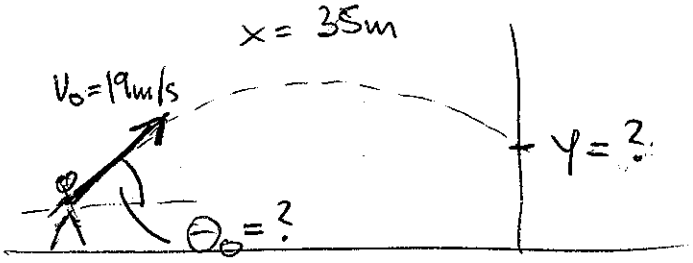
average velocity: $\boxed{\vec{\bar{v}} = \frac{\Delta\vec{x}}{\Delta t} = \frac{\vec{r}}{\Delta t} = \begin{pmatrix} -1.06\ mi/h \\ +0.16\ mi/h \end{pmatrix}}$

3.) *Projectile Motion* *(20 pts.)*

A child is throwing a tennis ball with initial speed of $19m/s$ toward a tall building which is a horizontal distance of $35m$ away. The ball hits the vertical building wall after $2.8s$.

(a) Find the launch angle of the ball (relative to the horizontal).

(b) How high above the launch point does the ball hit the building?



(a) $x = v_{ox}\,t = v_0 \cos\theta_0\, t$

$\Rightarrow \boxed{\theta_0 = \cos^{-1}\left(\frac{x}{v_0 t}\right) = 48.9^\circ}$

(b) $\boxed{y = y_0 + v_{oy}t - \frac{1}{2}gt^2 = v_0 \sin\theta_0\, t - \frac{1}{2}gt^2 = 1.65m}$

4.) *1-D Kinematics with Friction* *(20 pts.)*

A block of wood is sliding on a horizontal ice surface with an initial speed of $6.9 m/s$. The block is slowed down by a kinetic friction force and comes to rest after a displacement of $12 m$.

(a) What is the acceleration of the block?

(b) Calculate the kinetic friction coefficient between the block and the ice.

(a) $v^2 = v_0^2 - 2a\Delta x$

$$a = +\frac{v^2 - v_0^2}{2\Delta x} = -\frac{v_0^2}{2\Delta x} = -1.98\ m/s^2$$

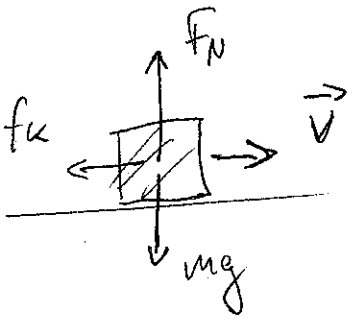
(b) $\Sigma F = ma$

$-f_k = ma$

$-\mu_k F_N = ma$

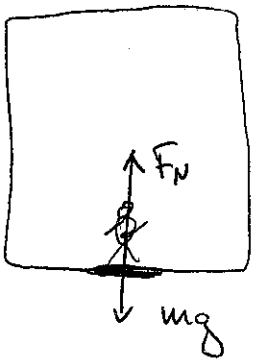
$-\mu_k mg = ma$

$$\mu_k = \frac{-a}{g} = 0.202$$



5.) *Newton's 2. Law in an Elevator* *(15 pts.)*

An elevator cabin has a scales implemented into its floor. A person of mass $84kg$ steps onto the scales. The elevator door closes, and the elevator starts to move vertically. If the reading on the scales is showing $710N$, what is the magnitude and direction of the elevator's acceleration?



$$\sum F = ma$$

$$F_N - mg = ma$$

$$\boxed{a = \frac{F_N - mg}{m} = \frac{F_N}{m} - g = -1.34 \frac{m}{s^2}}$$