

## EXAM-1

PHYS 201 (Fall 2010), 09/23/10

Name:

Lab-Sect. no.:

Signature:

*Duration: 75 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!*

1.) *Multiple Choice* (18 pts.)

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

- (a) A scalar quantity is characterized by a magnitude and a direction.

TRUE                  FALSE

- (b) If a runner on a circular track completes precisely one lap, his net displacement over this lap is zero.

TRUE                  FALSE

- (c) In projectile motion, the acceleration at the highest point of the trajectory is zero.

TRUE                  FALSE

- (d) A change in velocity,  $\vec{v}$ , always requires a change in speed,  $v$ .

TRUE                  FALSE

- (e) The normal force between an object and a surface is parallel to that surface.

TRUE                  FALSE

- (f) A friction force between an object and a surface is parallel to that surface.

TRUE                  FALSE

No.	Points
1	
2	
3	
4	
5	
6	
Sum	

2.) *Free Fall*

(20 pts.)

A kid throws a tennis ball straight up (neglect air drag and friction forces), with a launch speed of  $12m/s$ , and catches it upon return at the original launch point. ( $g = 9.8m/s^2$ )

- (a) What is the *velocity* of the ball when it reaches its maximal height, and when the kid catches it again? (*no calculation necessary!*)
- (b) Calculate the maximal height reached by the ball.
- (c) Calculate the total flight time of the ball (until the kid catches it again).
- (d) Sketch the velocity as a function of time in a  $v_y(t)$  plot.

3.) *Projectile Motion* (18 pts.)

A supply plane is flying low, just  $185m$  above ground, at a speed of  $280\text{mph}$  in horizontal direction. The rescue worker in the plane drops a package of food supply for a snowed-in farm which is on the ground a horizontal distance of  $1.0\text{km}$  straight ahead. Neglect any air drag and friction forces. ( $1\text{m/s} = 2.25\text{mph}$ )

- (a) How long is the package in the air when dropped from rest relative to the plane?
- (b) At what horizontal distance from the farm does the package hit the ground?
- (c) What is the package's speed when it hits the ground?

4.) *Relative Velocity* (14 pts.)

A plane is traveling straight north in still air at its cruising speed of  $520\text{mph}$ , expected to reach its destination in  $90\text{min}$ . Suddenly, it encounters an unexpected strong wind from the west blowing at  $60\text{mph}$ .

- (a) By how many degrees relative to north does the captain have to counter-steer to maintain the plane's course straight north? Start by sketching a velocity diagram.
- (b) By how many minutes will the arrival at the destination be delayed if the wind keeps blowing steadily?

5.) *Newton's Law and Friction* *(15 pts.)*

A factory worker is pulling a box (mass  $45kg$ ) which is sliding behind him on a horizontal surface. He is applying a force of  $170N$  at an angle of  $25^\circ$  above the horizontal. The kinetic friction coefficient between box and floor surface is  $\mu_k = 0.15$ .

- (a) Draw a free-body diagram of the box including all forces acting on it.
- (b) Calculate the normal force on the box.
- (c) Calculate the horizontal acceleration of the box.

6.) *Equilibrium and Tension* *(15 pts.)*

A heavy cement block is suspended via three steel cables as shown in the diagram below. The left (horizontal) cable is under its maximally allowed tension,  $T_1 = 12000N$ .

- (a) Draw a free-body diagram for the connecting ring (where all 3 cables attach).
- (b) Calculate the tension  $T_2$  in the inclined cable 2.
- (c) Calculate the mass of the cement block.