

EXAM-1 – v1

PHYS 201 (Spring 2006), 02/14/06

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 vector is characterized by both magnitude and direction.  
TRUE                      FALSE
- (b) Newton's 2. Law of Motion implies that the acceleration of an object is always opposite to the net force acting upon that object.  
TRUE                      FALSE
- (c) In projectile motion, the acceleration becomes zero at the highest point of the trajectory.  
TRUE                      FALSE
- (d) If a net force is acting on an object, the velocity of that object is changing.  
TRUE                      FALSE
- (e) In uniform circular motion, the direction of the centripetal acceleration does not change.  
TRUE                      FALSE
- (f) The gravitational mass of an object is a scalar quantity.  
TRUE                      FALSE

No.	Points
1	
2	
3	
4	
5	
6	
Sum	

2.) *Projectile Motion*

(18 pts.)

A person stands on the ground 12meters in front of the vertical wall of a 8meter-high building with horizontal roof. He throws a baseball with an initial speed of 16m/s and at an initial angle of 60degrees with respect to the horizontal toward the building.

- (a) What maximal height does the ball reach?
- (b) What is the flight time of the ball before landing on the roof of the building?
- (c) How far behind the wall does the ball hit the roof?

3.) *Newton's 2. and 3. Laws*

(14 pts.)

A roller skater (total mass  $m=62\text{kg}$ ) stands on a horizontal surface close to a vertical wall. She then decides to push at the wall in horizontal direction with a force of  $55\text{N}$  for a duration of  $0.7\text{s}$ .

- (a) With what speed does the skater recede from the wall (neglect any friction effects)?
- (b) Using the speed calculated in part (a), and accounting for a kinetic (rolling) friction coefficient of  $0.005$  between the roller skates and the ground, after how many meters does the skater come to a stop?

4.) *Relative Velocity*

(18 pts.)

A river boat, which has a speed of  $11\text{mph}$  in still water, crosses a  $450\text{meter}$ -wide river which has a current of  $1.8\text{m/s}$ . The captain of the boat chooses an angle of  $115\text{degrees}$  between the Boat's velocity and the river current. ( $1\text{m/s}=2.25\text{mph}$ )

- (a) How many seconds does it take the boat to arrive at the opposite shore?
- (b) How far up- or downstream does the boat arrive at the opposite shore?
- (c) Now the captain wants to minimize the crossing time. At what angle does he have to aim the boat relative to the current, and what is the minimal crossing time?

5.) *Friction Forces*

(20 pts.)

A box of mass  $m=25\text{kg}$  is resting on a horizontal surface. Using an ideal rope, a person applies a force to the box so that the rope encloses an angle of  $38\text{degrees}$  with the horizontal. The static and kinetic friction coefficients between the box and ground surfaces are  $\mu_s=0.6$  and  $\mu_k=0.35$ .

- (a) Draw a free-body diagram including all the forces acting on the box.
- (b) What is the minimal force that the person has to apply to overcome the static friction and get the box moving?
- (c) Using the force found in part (a), what is the normal force acting on the box?
- (d) Still using the force found in part (a), but with the box now moving, what is the acceleration of the box?

6.) *Circular Motion*

(12 pts.)

A car is driving over a crest which can be approximated by a segment of a circle of radius 135meters. ( $1m/s=2.25mph$ )

- (a) What is the maximal value of the speed (in *mph*) with which the car can pass over the top of the crest without losing contact with the ground?
- (b) What is the normal force (apparent weight) experienced by a person (mass 80kg) in the car when passing over the top of the crest at a speed of 75*mph*? By how many percent is it reduced compared to the usual weight?