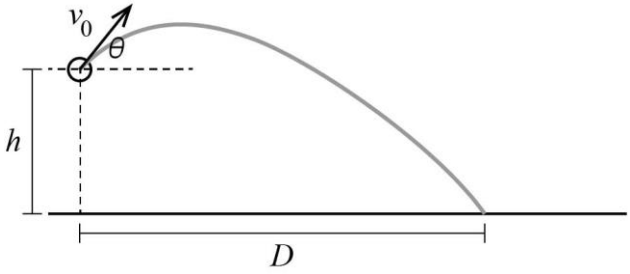
Name: _____

PHYS 1110-02 Exam 1

You may use an 8.5"×11" note sheet written on both sides and a calculator. Please write your answers in the boxes provided. Show your work outside the boxes. If you need to change the answer you wrote in a box, erase it and write your intended answer. This is easiest if you write in pencil. You have 110 minutes.

1. In physics lab, Percival fires a steel ball from a spring-powered launcher from a lab table onto the floor. The ball is launched at an initial speed of $v_0 = 4.00$ meters per second at an angle of $\theta = 42$ degrees above horizontal, from a height of $h = 1.100$ meters above the floor.



A. (2 points) What are the horizontal (v_{0x}) and vertical (v_{0y}) components of the ball's velocity at launch?

$v_{0x} =$ ____ $v_{0y} =$ ____

B. At the highest point of the ball's trajectory, is the ball's speed faster or slower than at launch? Select one choice by filling its bubble.

○ a. faster ○ b. slower ○ c. same speed

C. (2 points) At the top of the ball's trajectory, what are the horizontal (v_x) and vertical (v_y) components of its velocity?

$v_x =$ ____ $v_y =$ ____

D. If the ball were fired at a steeper (closer to vertical) angle, would it take more or less time to reach the floor? Select one choice by filling its bubble.

○ a. more time ○ b. less time ○ c. same time

E. When the ball returns to its launch height (on its way back down), what is its speed?

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F. When the ball returns to its launch height, what is the direction of its velocity? Express as an angle, positive if the angle is above horizontal and negative if the angle is below horizontal.

G. (2 points) At what horizontal distance *D* does the ball land on the floor?

2. What type of quantity is *force*? Select one choice by filling its bubble.

○ a. Force is a scalar. ○ b. Force is a vector.

3. What defines the *net force* acting on a body? Select one choice by filling its bubble.

○ a. Net force is the largest force acting on the body.

○ b. Net force is the sum of the magnitudes of the forces acting on the body.

○ c. Net force is the vector sum of all the forces acting on the body.

○ d. Net force is the force exerted by a net in contact with the body.

4. The SI unit of force is the *newton*. What is a newton, expressed in the fundamental SI units of meter, kilogram, and second?

5. Riding her bicycle, Ada coasts down a hill with a 5-degree downhill grade. When she reaches a speed of 10.0 meters per second, the force of the wind pushing her backward exactly cancels the component of the force of gravity that pushes her downhill. If this cancellation persists, how far downhill does she travel in the next 5.0 seconds?

6. The Sun's gravity pulls the Earth toward the Sun, keeping it in its annual orbit. Newton's third law states that there exists a "reaction" to this pull.

   A. What body exerts this reaction force?

   B. On what body does this reaction force act?

   C. What is the direction of this reaction force?

   D. Compared to the magnitude of the Sun's gravitational pull on the Earth, what is the magnitude of this reaction force? Select one choice by filling its bubble.

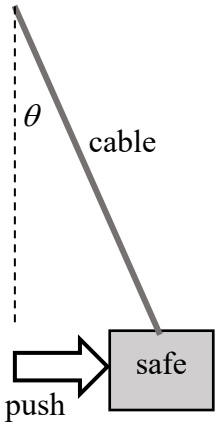
   ○ a. The reaction force is weaker.

   ○ b. The reaction force is stronger.

   ○ c. The reaction force has the same magnitude.

7. A 53.0-kg safe carried by a crane hangs from a cable. A worker installing the safe pushes the safe horizontally, so that the safe is motionless with the cable at an angle of $\theta = 16°$ from vertical.

   A. Draw a labeled free body diagram for the safe.



B. What is the weight of the safe?

C. What is the direction of the force of tension that the cable exerts on the safe? Give a number in degrees from a reference.

D. What is the vertical component of the tension force exerted on the safe by the cable?

E. What is the horizontal component of the tension force exerted on the safe by the cable?

8. In a game of baseball, a 44.0-kg base runner avoiding a tag slides into third base. Before beginning his slide, he was running at 6.50 m/s. He slides to a stop in 3.40 meters.

   A. What is the magnitude of the net force on the runner during his slide?

   B. What is the magnitude of the normal force on the runner during his slide?

C. What is the coefficient of kinetic friction between the runner and the ground?

9. A wrecker tows a disabled 1720-kg car up a 10-degree ice-covered embankment back onto the road. There is no friction between the embankment and the car.

A. What is the magnitude of the normal force between the car and the embankment?

B. What is the magnitude of the smallest force that will pull the car up the embankment?

10. A cart of mass $m_1 = 0.500$ kg on a level track is tied by a light cord to a battery-powered cart of mass $m_2 = 0.200$ kg on the same track. The lighter cart's motor turns the drive wheels, pulling both carts to the right. The drive wheels have a coefficient of static friction against the track of $\mu = 0.55$; rolling friction is negligible. What is the greatest possible acceleration of the two carts, limited by the traction of the drive wheels on the track? (Assume the motor can provide plenty of power to the drive wheels.)