PHY205-H1S
"The Physics of Everyday Life"

Test 1

5pm – January 30, 2013 – **Version 4**

Solutions.

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Last Name: _____ First Name: _____.

Student Number: _____ Tutorial (circle) M6 W6 F10 F12 T.A.: _____.

This test has 5 pages and should take no longer than 50 minutes. You may use a calculator and one 5"×3" index card with your own hand-written notes, if you wish. Assume that the acceleration due to gravity in all problems is $g = 10$ m/s^2. Neglect air resistance in all questions, unless otherwise indicated. Good luck!

Written Answer Part

Please answer the following questions. Show all your reasoning and work legibly in the blank space provided, and write your final numerical answers in the boxes provided. For final numerical answers be sure to include units, and direction if the quantity is a vector. You may use the back of the page for rough work which will not be graded.

Written A:	/4
Written B:	/4
Written C:	/4
+ 12 multiple choice worth 2 points each. Test total possible is 36.	

A. Jon is driving in his car at a velocity of 30 m/s to the East. The mass of Jon and his car is 1000 kg. Suddenly Jon sees a cat jump in front of him. He slams on the brakes, locking all the wheels, and skids 15 m East before stopping. He does not hit the cat.

i. How much kinetic energy did Jon and his car have before he slammed on the brakes?

$K = \frac{1}{2} m v^2 = \frac{1}{2}(1000)(30)^2$

$= 450{,}000$ J

450 kJ

ii. What happened to all that kinetic energy when Jon and the car stopped?

It was transformed into thermal energy.

iii. If Jon had been driving at 60 m/s, and then slammed on the brakes locking all the wheels, how far would he have skid?

2× speed ⇒ 4× kinetic energy.

$Fd = \Delta K$, F is the same.

therefore d increases by 4×

4× 15 m

60 m

B. Susan tosses a 0.4 kg ball straight up. It leaves her hand with a speed of 30 m/s, and later she catches it at the same height. Neglect air resistance.

i. When the ball reaches its maximum height, what is its velocity?

0

ii. When the ball reaches its maximum height, what is its acceleration?

For all projectiles, the acceleration is g, down.

$10 \frac{m}{s^2}$, down

iii. What is the maximum height of the ball above the point where it left Susan's hand?

Use $v_f = v_i + at$ to solve for time: $t = \frac{v_f - v_i}{a} = \frac{0-30}{-10}$

$t = 3\ s$

Use $d = v_i t + \frac{1}{2} a t^2$

$= 30(3) + \frac{1}{2}(-10)3^2 = 90 - 45$

45 m

iv. How long does the ball spend in the air before Susan catches it again?

3 s up

+ 3 s down ← by symmetry

$= 6\ s$

6 s

C. Amy is in the airport, and she pushes her wheeled suitcase toward the gate. The friction between the floor and the suitcase is very small. With her push, she brings the suitcase from rest up to a speed of 15 m/s in 1.5 seconds.

v. What is the magnitude of the acceleration of the suitcase while Amy is pushing it?

Use $v_f = v_i + at$ to find a.

$$a = \frac{v_f - v_i}{t} = \frac{15 - 0}{1.5} = 10$$

$10 \frac{m}{s^2}$

vi. If the mass of the suitcase is 20 kg, what is the magnitude of the force Amy exerts on it?

F_{Net} = force of Amy on suitcase: F_{AS}

$F_{Net} = ma = (20\ kg)\left(10 \frac{m}{s^2}\right) = 200$

200 N

vii. What is the magnitude of the force that the suitcase exerts on Amy while she is pushing on it?

Newton's 3rd Law

$F_{S\ on\ A} = -F_{A\ on\ S}$

$|F_{S\ on\ A}| = |F_{A\ on\ S}|$

$= 200\ N$

200 N

Multiple Choice Part (2 points per question)

Please fill your answers in on the provided answer-sheet. Be sure to fill in the identifying information on the top of your answer sheet. You may use pen or pencil when filling in the circles. IMPORTANT: There are multiple versions of this test. On your bubble sheet, please fill in **4** for version.

1. A man leans over the edge of a cliff and throws a rock upward at 5 m/s. Neglecting air resistance, what is the speed of the rock two seconds later?
   A. 5 m/s
   B. 15 m/s
   C. 25 m/s
   D. zero
   E. 10 m/s

$v_f = v_i + at = (5 + (-10)2)$

$= 5 - 20 = -15\ m/s$

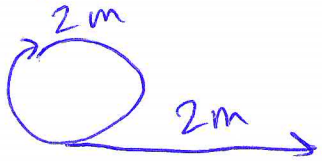
speed $= |v_f| = 15\ m/s$

2. A 10 kg rock and a 0.5 kg apple are dropped from the roof of a tall building. Which of the following statements is true for the two objects as they fall?
   A. The forces of gravity on the rock and the apple are the same.
   B. The force of gravity on the apple is slightly larger than the force of gravity on the rock.
   C. The force of gravity is 20 times greater on the apple than the rock.
   D. The force of gravity is 20 times greater on the rock than the apple.
   E. The force of gravity on the rock is slightly larger than the force of gravity on the apple.

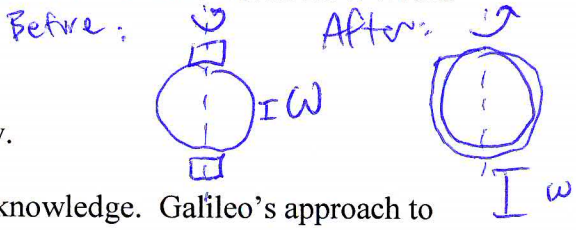
3. A pitcher throws a baseball. While the baseball is flying through the air, consider the action force to be the force of gravity pulling on the ball. What is the reaction to this force?
   A. Air resistance against the ball.
   B. The force of the pitcher's hand upon the ball.
   C. The force of gravity of the ball pulling upward on the earth.
   D. The combined weight of the ball and the pitcher's hand.
   E. Friction of the ground acting on the pitcher's feet.

4. In a head-on collision in a car, your body may impact upon the plastic dashboard of the car. If the car is equipped with air-bags, they will inflate so that your body impacts on the air-bag instead. What is the reason that impacting the air-bag is considered safer?
   A. The air-bag increases the time of impact.
   B. The air-bag increases the force you experience.
   C. The air-bag increases the momentum you experience.
   D. The air-bag decreases the time of impact.
   E. The air-bag decreases the impulse you experience.

5. Suppose the circumference of a bicycle wheel is 2 meters. If it rotates at 1 revolution per second when you are riding the bicycle, what is your speed?
   A. 2 m/s
   B. 3.14 m/s
   C. 6.28 m/s
   D. 1 m/s
   E. 3 m/s



6. If the polar icecaps melted, the resulting water would spread over the entire Earth. How would this new mass distribution affect the length of a day?
   A. It would make the day slightly shorter.
   B. It would make the day slightly longer.
   C. It would make no difference to the length of the day.



7. Aristotle mainly relied on logic to explain nature and gain knowledge. Galileo's approach to explaining nature and gaining knowledge mainly involved
   A. doing experiments.
   B. logic also.
   C. using mathematics.
   D. identifying patterns.
   E. guesswork.

8. A truck is moving forward at constant velocity. Inside the storage compartment, a rock is dropped from the midpoint of the ceiling and strikes the floor below. Within the storage compartment, where does the rock hit the floor?
   A. ahead of the midpoint of the ceiling, toward the front of the truck.
   B. exactly below the midpoint of the ceiling.
   C. behind the midpoint of the ceiling, toward the back of the truck.

9. A large, light beach ball is thrown straight upward and takes 10 seconds to go up and return back to its original height. In this case, you can NOT neglect air resistance. What is the time taken for the ball to go up to its maximum height?
   A. more than 5 s
   B. 5 s
   C. less than 5 s
   D. Nothing about the time can be known without knowing the initial velocity.

10. Two balls of the same mass and the same speed collide with a block of wood. One ball is made of putty, and stops when it hits the block of wood. One ball is made of hard rubber, and bounces backward elastically when it hits the block of wood. How do the impulses of each ball upon the block of wood compare?
   A. The putty ball exerts an impulse about 2 times larger than the rubber ball.
   B. The rubber ball exerts an impulse about 2 times larger than the putty ball.
   C. The rubber ball exerts an impulse about 4 times larger than the putty ball.
   D. The putty ball exerts an impulse about 4 times larger than the rubber ball.
   E. The putty ball and rubber ball exert equal impulses.

11. Your hair-dryer consumes 1500 Watts of power when it is running on high heat. You accidentally leave your hair-dryer running on high-heat when you leave for work in the morning, and when you return you discover that it has been on for 10 hours. The cost of electricity is $0.10 per kWh. How much did it cost to leave that hair dryer running?
   A. $0.54
   B. $15.00
   C. $5400.00
   D. $0.15
   E. $1.50

$1.5\ kW \times 10\ h = 15\ kWh \times \frac{\$0.1}{kWh} = \$1.50$

12. A car travels in a circle with constant speed. What is the direction of the net force on the car?
   A. toward the centre of the circle
   B. backward, opposite the direction of the car's velocity
   C. forward, in the direction of the car's velocity
   D. away from the centre of the circle
   E. The net force on the car is zero because the car is not accelerating.