PHY205-H1S
"The Physics of Everyday Life"

Test 1

5pm – January 30, 2013 – **Version 3**

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 box 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. 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 any projectile, acceleration is always 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 $d = v_i t + \frac{1}{2}at^2$ to find d.

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

45 m

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

3 s on the way up
+ 3 s on the way down.
6 s

6 s

B. 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?

$K = \frac{1}{2}mv^2$

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

$= 450{,}000\ J$

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?

speed is 2× greater ⇒ K is 4× greater.

$Fd = \Delta K \Rightarrow Fd$ is 4× greater.

Assume same friction force F.

⇒ d is 4× greater. $4 \times 15 = 60$

60 m

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.

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

$a = \frac{v_f - v_i}{t} = \frac{15 - 0}{1.5} = 10\ \frac{m}{s^2}$

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

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

$F_{Net} = ma = (20)(10) = 200N$

200 N

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

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

by Newton's 3rd Law.

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 **3** for version.

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

2. 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. zero
   B. 5 m/s
   C. 10 m/s
   D. 15 m/s
   E. 20 m/s

$v_f = v_i + at = +5 - 10(2)$
$= +5 - 20$
$= -15$ m/s
speed $= |v_f| = 15$

3. A truck is moving forwards 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. exactly below the midpoint of the ceiling.
   B. ahead of the midpoint of the ceiling, toward the front of the truck.
   C. behind the midpoint of the ceiling, toward the back of the truck.

4. 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 force of gravity is 20 times greater on the rock than the apple.
   B. The forces of gravity on the rock and the apple are the same.
   C. The force of gravity on the rock is slightly larger than the force of gravity on the apple.
   D. The force of gravity on the apple is slightly larger than the force of gravity on the rock.
   E. The force of gravity is 20 times greater on the apple than the rock.

5. 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 just to go up to its maximum height?
   A. less than 5 s
   B. more than 5 s
   C. 5 s
   D. Nothing about the time can be known without knowing the initial velocity.

6. 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. The combined weight of the ball and the pitcher's hand.
   B. Air resistance against the ball.
   C. Friction of the ground acting on the pitcher's feet.
   D. The force of the pitcher's hand upon the ball.
   E. The force of gravity of the ball pulling upward on the earth.

7. 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 which is about 4 times larger than the rubber ball.
   B. The putty ball exerts an impulse which is about 2 times larger than the rubber ball.
   C. The putty ball and rubber ball exert equal impulses.
   D. The rubber ball exerts an impulse which is about 2 times larger than the putty ball.
   E. The rubber ball exerts an impulse which is about 4 times larger than the putty ball.

8. 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 decreases the time of impact.
   B. The air-bag increases the time of impact. ← thereby decreasing the force, as $F \cdot d = \Delta p$ is fixed.
   C. The air-bag decreases the impulse you experience.
   D. The air-bag increases the force you experience.
   E. The air-bag increases the momentum you experience.

9. 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. \$0.15
   B. \$0.54
   C. \$1.50
   D. \$15.00
   E. \$5400.00

$1500\,W = 1.5\,kW$

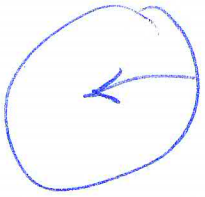
$E = P \cdot t = 1.5\,kW \cdot 10\,h = 15\,kWh$

$cost = E \times rate = 15\,kWh \cdot \frac{\$.10}{kWh} = \$1.50$

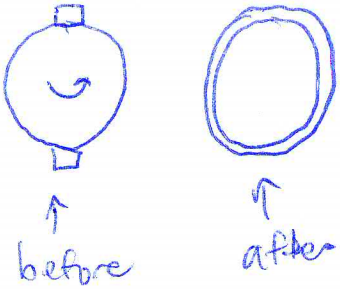
10. Suppose the circumference of a bicycle wheel is 2 meters. If it rotates at 1 revolution per second when you are riding the bicycle, what is your speed?
   A. 1 m/s
   B. 2 m/s
   C. 3 m/s
   D. 3.14 m/s
   E. 6.28 m/s

$v = \frac{circ.}{period.} = \frac{2m}{1s} = 2\,\frac{m}{s}$

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



12. 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 longer.
    B. It would make the day slightly shorter.
    C. It would make no difference to the length of the day.



I increases.

⇒ ω decreases.

⇒ Period increases.

→ longer day.