General Physics
Physics 101
Test #3 – Fall 2017
Friday 11/10/17
Prof. Bob Ekey

Name (print):_____

I hereby declare upon my word of honor that I have neither given nor received unauthorized help on this work.

Signature:_____

Part I. Multiple Choice (3 pts each)

Instructions:

Please clearly circle one and only one answer for each of the following.
Show all of your work. Partial credit may be given if you include your work.

Questions:

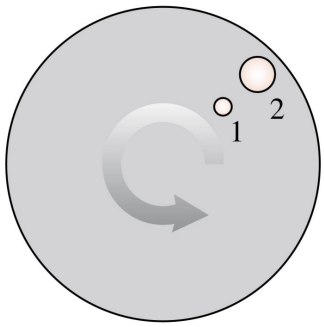
1. Hannah is standing at the edge of a cliff and throws a 20 g ball straight up and another 20 g ball at an angle of 30º below the horizontal. Both balls are thrown with the same initial speed. Neglecting air resistance, which ball has the largest change in gravitational potential energy as it impacts the ground?

(a) upward
(b) 30º below the horizontal
(c) both are the same
(d) not enough information given

2. A 620 g hawk has a 60 g stick in its mouth (680 g total) that is coasting in the air horizontal to the ground at 30 m/s. If the hawk releases the 60 g stick, what is the hawk's velocity just after the stick leaves the hawk's mouth?

(a) 33 m/s
(b) 30 m/s
(c) 3.4×10^2 m/s
(d) 27 m/s

3. Two coins are on a turntable that steadily speeds up, starting from rest, with a ccw rotation. Which coin flies off the turntable first? Assume the coefficients of friction are the same for each coin.



(a) Coin 1
(b) Coin 2
(c) Both coins fly off at the same time
(d) Need more information

4. In the week 8 lab, the roller on the record player made 10 revolutions in 7.8 seconds, what is the magnitude of the centripetal force acting on the 0.454 kg roller if the radius is 0.12 m?

(a) 3.5 kg m/s^2
(b) 245.5 N
(c) 0.44 N
(d) 0.25 kN

5.Suppose a bus and a compact car are traveling towards the HULK with the same momentum. The HULK stops each in the same amount of time. Which has a larger force applied?

(a) The bus
(b) The car
(c) They are the same
(d) Impossible to determine

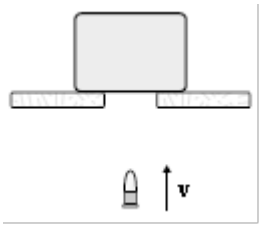
6. A 5.0 kg block is launched up ramp with a 50 N/m spring. The block has a velocity of 5.0 m/s when it is climbed a vertical distance of 5.0 m from the launch point, what is the spring potential energy before launch?

(a) 3.1×10^2 J
(b) 62 Nm
(c) 6.3×10^2 J
(d) Need more information

7. A 1.0 kg ball is spinning on a 1.0 m long string in a circle in uniform circular motion. What is the tension in the string when the ball is at the top of its motion, if the net force is 25N?

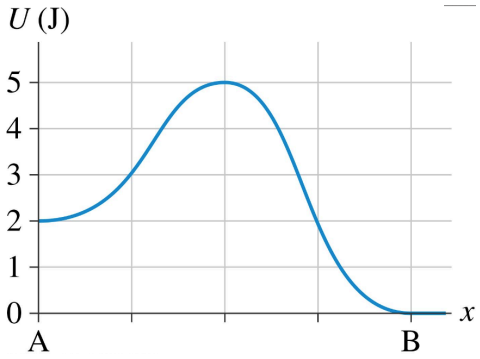
(a) 35 N
(b) 245 N
(c) 25 N
(d) 15 N

8. A 10-g bullet moving at 1000 m/s strikes and passes through a 2.0-kg block initially at rest, as shown. The bullet emerges from the block with a speed of 400 m/s. What is the velocity of the block post-collision?



(a) 1.0 m/s
(b) 3.0 m/s
(c) 7.0 m/s
(d) 6.0 m/s

9. For the potential energy versus position graph shown, what minimum speed must a 200g particle need at point A to reach point B?



(a) 5.5 m/s
(b) 4.5 m/s
(c) 7.1 m/s
(d) It never makes it to point B.

10. Which of the following statements is false?

(a) If two different massed objects sitting on a frictionless surface explode apart, it is not possible for them to have the same velocity post explosion.

(b) It is possible for a horizontal spring to have the same potential energy if it is compressed or stretched from equilibrium.

(c) Astronauts on the International Space Station appear weightless because g is very small, although not zero.

(d) An object rotating in uniform circular motion is not in equilibrium.

11. A spring-loaded gun shoots a plastic ball with a speed v. If you use the same spring-loaded gun compressed the same distance to shot a ball that is twice as massive, the speed will now be...

(a) 0.5v
(b) $\sqrt{2}$ v
(c) v
(d) v/$\sqrt{2}$

12. Planet Z is 10,000 km in diameter. The free-fall acceleration on Planet Z is 8.0 m/s^2. What is the mass of planet Z?

(a) 1.2 x 10^{24} kg
(b) 2.998 x 10^{24} kg
(c) 1.2 x 10^{19} kg
(d) 3.0 x 10^{24} kg

Part II. Short answer problems (12 pts each)

Instructions:

Solve three of the following four problems. If you try to solve all four problems, please clearly indicate which problems you wish to have graded. If you do not indicate this, I will assume you want me to grade problems one, two and three.

Please show all of your work, including equations without numbers.
Please provide units with all answers.
Partial credit may be given if you include your work.

Question 1. **Grade this problem? Yes or No (circle one)**

A 1.0 kg, 2.0 kg and 3.0 kg ball approach each other for a collision. The 1.0 kg ball is traveling at 2.0 m/s to the south and the 3.0 kg ball is traveling at 5.0 m/s to the north-west, with components of 3.0 m/s to the west and 4.0 m/s to the north. After the collision, the balls stick together and are at rest.

(a) What is the momentum in the y-direction for the 2.0 kg ball pre-collision?

(b) What is the velocity in the x-direction for the 2.0 kg ball pre-collision?

(c) In this collision are momentum and/or kinetic energy conserved? Explain your answer using words, and be sure to address both momentum and kinetic energy.

(d) At what angle is the 2.0 kg ball traveling pre-collision?

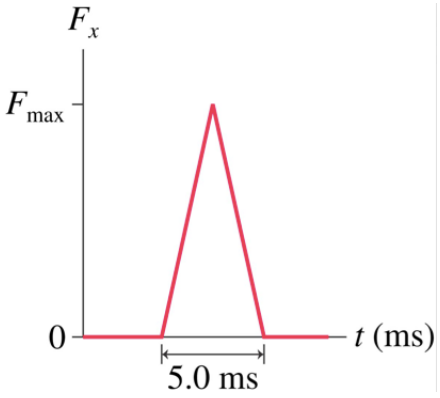
Question 2. **Grade this problem? Yes or No (circle one)**

A 625 g basketball is dropped from a height of 2.0 m, bounces on a hard floor and rebounds with a velocity of 5.0 m/s.

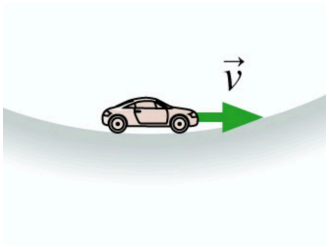
(a) Using energy conservation determine the velocity of the ball just before it hits the floor.

(b) What is the impulse the ball experiences during this impact?

(c) The figure shows the force the ball experiences from the floor. What maximum force does the floor exert on the ball?



(d) As the ball rises back into the air, what is happening to the total mechanical energy, kinetic energy and gravitational potential energy? Are they increasing, decreasing or remaining constant? Words along with equations are required in your justification, calculations are not.



Question 3. **Grade this problem? Yes or No (circle one)**

Bored, you decide to let your car coast down a series of hills (engine off). Air-drag and friction are negligible.

(a) At the bottom of a valley, the car experiences a normal force of 20 kN while experiencing a centripetal acceleration of 2.0 m/s^2. What is the mass of the car if the radius of the valley is 50 m?

(b) At the top of the next hill the car is traveling at 10 m/s, what is the net force acting on the car if the normal force is now 18 kN? Be sure to include the direction.

(c) For the situation in (b) what is the radius of the hill?

(d) The car coasts over the top of another hill that has a radius of 50 m. If the car barely stays on the road at the top, draw a force diagram showing the forces acting on the car, including the net force. Explain what is happening in words, no calculations are necessary.

Question 4. Grade this problem? Yes or No (circle one)

On the left-side we have a 2.0 kg block that has compressed a 500 N/m horizontal spring by 50 cm. On the right-side we have a 1.0 kg block at the top of a tall slide. The hope is that we can launch the blocks towards each other for physics type interactions. Of course this is all friction free, which is nice.

(a) The left-side spring launches the 2.0 kg block to the right, what is the velocity of the 2.0kg block as it leaves the spring?

(b) The right-side block slides down the ramp and at the bottom is traveling at -6.0 m/s. What is the velocity of the block when it is 1.0 m high on the ramp?

(c) If the blocks collide elastically, what is the velocity of the 1.0 kg block post collision?

(d) Explain which block has a greater change in momentum (magnitude).
Words are necessary and equations with calculations may help, but are not required.