General Physics
Physics 101
Test #3 – Fall 2016
Friday 11/11/16
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.

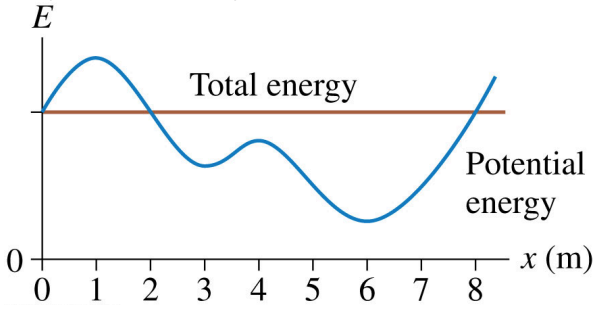
Signature:_____

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. A 2.0 kg mass glides over a friction free track and experiences the potential energy versus position graph shown. Which of the following statements is false? Assume it starts at 7.0 m.

(a) The particles speed is a maximum at 6.0 m.

(b) The particle has zero velocity at 2.0 m.

(c) By lowering the total energy it is not possible to have the particle remain at rest.

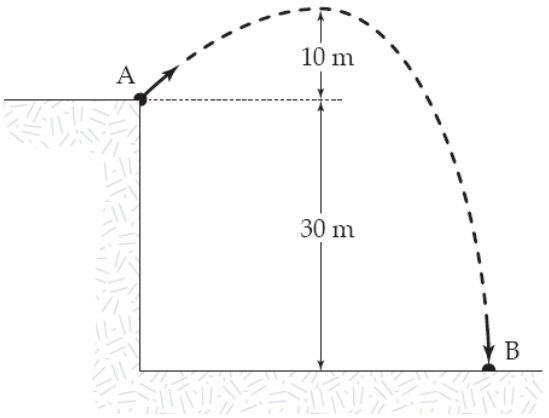
(d) The particle can travel to the left or right between 2.0 m and 8.0 m.

2. Dan (50 kg) is gliding on his 5.0 kg skateboard at 4.0 m/s. He suddenly jumps backward off the skateboard, kicking it forward at 8.0 m/s. How fast is Dan going as his feet hit the ground?

(a) 3.6 m/s
(b) 5.2 m/s
(c) 3.3 m/s
(d) 36 m/s

3. A Jedi fighter flies her craft near the Death Star where gravity is the same as that near Earth. Her craft moves 240 m/s as it travels around a vertical circular loop, which has a 2.0-km radius. What is the magnitude of the centripetal force on the 70-kg pilot at the bottom of the loop?

(a) 0.69 kN
(b) 2.016 N
(c) 8.0 kN
(d) 2.0×10^3 N



4. A 40 g ball is thrown from a 30-m tall building (point A) at an unknown angle above the horizontal. As shown, the ball attains a maximum height of 10 m above the top of the building before striking the ground at point B. If air resistance is negligible, what is the change in kinetic energy of the ball at B compared to that at the launch?

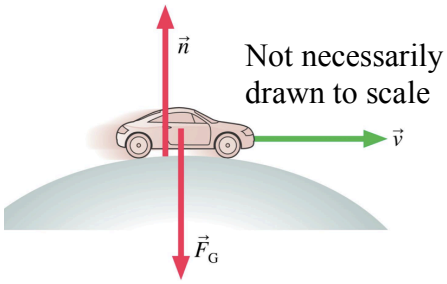
(a) 12 Nm
(b) – 12 J
(c) 16 kg m^2/s^2
(d) -16 J

5. In an amusement park ride, passengers stand inside a 5.0-m-diameter hollow steel cylinder with their backs against the wall. If all goes well, the passengers will "stick" to the wall and not slide down as the ride spins. If clothing has a minimum static coefficient of friction against steel of 0.60, what is the centripetal force required to keep a 30 kg child from falling?

(a) 176.4 N
(b) 4.9×10^2 N
(c) 2.9×10^2 N
(d) Need more information

6. A spring with spring constant k is compressed by Δx, and launches a block across a horizontal, frictionless surface with a speed v_0. A second identical spring is compressed four times as much ($4\Delta x$). If the same block is launched across the frictionless surface, what is the velocity of block following the launch?

(a) $\sqrt{2}v_0$
(b) $2v_0$
(c) $4v_0$
(d) $v_0/\sqrt{2}$



7. An out-of-gas car is rolling over the top of a hill at speed v. At this instant,

(a) $n > F_G$
(b) $n = F_G$
(c) $n < F_G$
(d) Impossible to tell without knowing v.

8. A 1.0 kg toy car to the left traveling at 1.0 m/s approaches a 2.0 kg toy car traveling to the right at 2.0 m/s. Assuming they collide elastically, what is the speed of the 2.0 kg car post-collision?

(a) 3.0 m/s
(b) 1.3 m/s
(c) 1.0 m/s
(d) 0.0 m/s

9. A space station orbits 300 km above the surface of the earth. What is the gravitational force on a 2.0 kg sphere inside the space station?

(a) 20 N
(b) 9.0 N
(c) 8.9 kN
(d) 18 N

10. A 10.0 cm long spring is attached to the ceiling. When a 2.00 kg mass is hung from it, the spring stretches to a length of 15.0cm. What is the spring constant?

(a) 196 N/m
(b) 0.137 kNm
(c) 780 N/m
(d) 392 N/m

11. Two boxes, one heavier than the other, are traveling with the same initial momentum. They experience the same constant force from a wind that causes them to slow over the same amount of time. Which box has less momentum after experiencing the wind?

(a) the heavier one
(b) they are the same
(c) the lighter one
(d) not possible to tell with the information given

12. A 0.50 kg roller coaster car travels down a frictionless ramp at a speed of 10 m/s. If a few moments later the car has fallen 2.0 m vertically, how fast is it traveling?

(a) 16 m/s
(b) 12 m/s
(c) 11 m/s
(d) 7.8 m/s

Part II. Short answer problems (12 pts each)

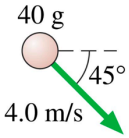
Instructions:

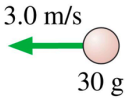
Solve three of the following four problems. If you try to solve all four problems, please clearly indicate which problems you wish to have graded. If you do not indicate this, I will assume you want me to grade problems one, two and three.

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)**

Two balls of clay are traveling as shown and hit simultaneously and stick together.





(a) What is the velocity in the y-direction post collision?

(b) What is the momentum in the x-direction post 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 combined ball traveling post-collision?

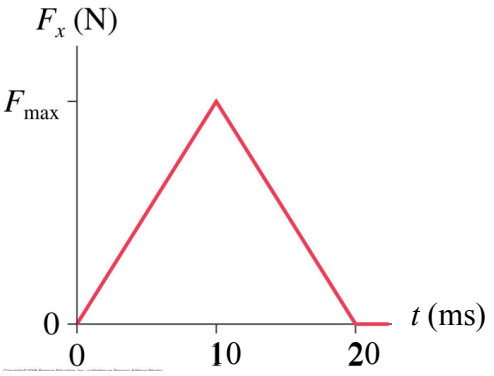
Question 2. **Grade this problem? Yes or No (circle one)**

Trying to determine the mass of a cow, you decide to drop it on a large spring. The cow falls a vertical distance of 1.00 m before it hits the spring.

(a) Just before the cow hits the spring, what is the velocity of the cow?

(b) If the spring constant of the spring is 5.29 kN/m and the spring is compressed by 1.00 m, what is the mass of the cow?

(c) The nimble cow jumps off the spring and kicks a 20 kg milk jug in celebration. The jug is stationary initially and achieves a velocity of 1.0 m/s post kick. If the jug experiences the force versus time graph shown, what is the max force it experiences?



(d) During the kick, does the cow or the jug experience the larger impulse? Explain.

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

A 2.0 kg ball is spun vertically in uniform circular motion at 4.0 rad/s, and the tension in the string is 40 N at the top of the motion.

(a) What is the net force acting on the ball at the top of the loop?
Be sure to specifically state the direction the net force is acting.

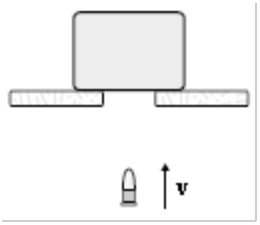
(b) What is the radius of the loop?

(c) What is the tension in the string at the bottom of the loop?

(d) Explain why a minimum speed exists for the ball to spin in a vertical loop. No calculations are necessary, but you do need to explain what is happening in terms of the forces acting on the ball at the top of the loop.

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

A 10-g bullet moving 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.



(a) What is the velocity of the block post-collision?

(b) To what maximum height will the block rise above its initial position?

(c) As the block flies up in the air, what happens to the total mechanical, gravitational and kinetic energy? Do they increase, decrease or stay the same? Explain.

(d) If a rubber bullet was used instead, at what velocity would it bounce off the block?