General Physics
Physics 101
Test #3 – Fall 2019
Friday 11/15/19
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.

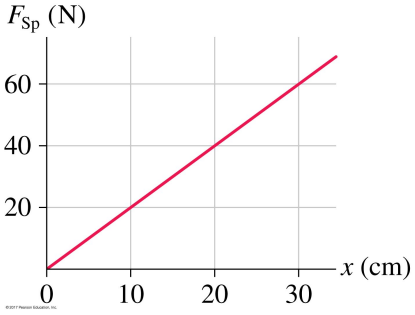
Signature:_____

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:

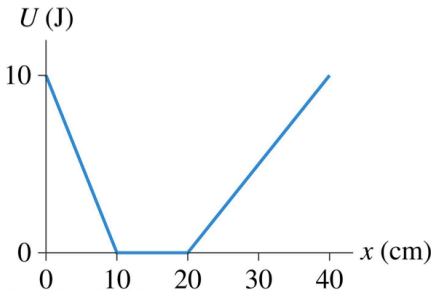


1. A 50 g rock is placed in a slingshot and the rubber band is stretched. The magnitude of the force of the rubber band on the rock is shown. The rubber band is stretched 30 cm and then released. What is the velocity of the rock as it leaves the rubber band?

(a) 19 m/s
(b) 17 m/s
(c) 9 m/s
(d) 27 m/s

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 particle has the potential energy shown. What is the x-component of the force on the particle at x=30 cm?

(a) 17 N
(b) -50 kg m/s^2
(c) 100 N
(d) -17 kg m/s

4. A 2.0 kg block slides down a frictionless ramp and collides with a 4.0 kg block. What is the momentum of the system post-collision?

(a) 7.7 Ns
(b) 2.6 kg m/s
(c) 15 kg m/s
(d) Need to know the type of collision

5. If you spin a 0.50 kg ball on the end of a 50 cm long string in a vertical circle with an angular speed of 5.0 rad/s. What is the tension in the string at the bottom of the motion?

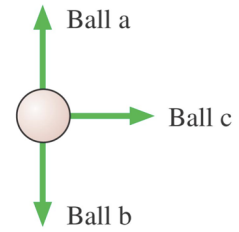
(a) 6.3 N
(b) 11 N
(c) 1.4 N
(d) 30 N

6. Ingenious movers drop a 1000 kg piano from a second floor balcony onto a large spring 2.0 m below. As the piano impacts the spring it slows to rest as the spring is compressed by 50 cm. What is the spring constant of the spring?

(a) 9.8×10^5 Nm
(b) 1.6×10^5 N/m
(c) 2.0×10^4 N/m
(d) 2.0×10^5 N/m

7. A crane lowers a steel girder into place. The girder moves with constant speed. Consider the work done by gravity (W_G) and the work done by the tension in the cable (W_T). Which of the following are correct?

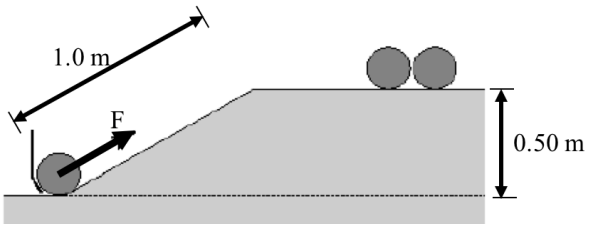
(a) W_G is positive and W_T is negative
(b) W_G is negative and W_T is positive
(c) W_G is positive and W_T is positive
(d) W_G is negative and W_T is negative



8.The three balls shown have equal masses and are fired with equal speeds from the same height above the ground. What is the rank in order from largest to smallest their speeds, v_a, v_b and v_c as they hit the ground below?

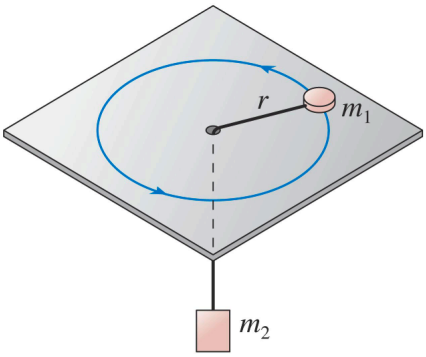
(a) $v_a > v_c > v_b$
(b) $v_a = v_b > v_c$
(c) $v_a = v_b = v_c$
(d) $v_b > v_c > v_a$

9. At the bowling alley, the ball-feeder mechanism must exert a force to push the bowling balls up a 1.0-m long ramp. The ramp leads the balls to a chute 0.50 m above the base of the ramp. Approximately how much force must be exerted on a 5.0-kg bowling ball?



(a) 10 N
(b) 25 N
(c) 50 N
(d) 200 N

10. Mass m_1 on the frictionless table shown is connected by a string through a hole in the table to a hanging mass m_2. For m_2 to remain motionless, while m_1 spins with a speed v at radius r, which of the following is true?



(a) The net force on m_2 is non-zero
(b) The tension in the string supplies a radially outward force on m_1
(c) The system is not in equilibrium
(d) The net force acting on m_1 is zero

11. Three blobs of equal mass of 1.0 kg are traveling towards each other each with a speed of 1.0 m/s. The first mass is traveling to the north, the second to the south and the third to the west, and they stick together post-collision. What is the system's magnitude of speed after the collision?

(a) 1.0 m/s
(b) 3.0 m/s
(c) 0.50 m/s
(d) 0.33 m/s

12. A newly discovered spherical planet has a radius twice as large as earth's and a mass five times as large. What is the free-fall acceleration on its surface?

(a) 3.9 m/s^2
(b) 7.8 m/s^2
(c) 25 m/s^2
(d) 12 m/s^2

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)

One billiard ball is shot east at 2.0 m/s. A second identical billiard ball is shot west at 1.0 m/s. The balls have a glancing collision, not a head-on collision, deflecting the second ball by 90º and sending it north at 1.41 m/s. Assume the mass of each ball is 0.16 kg.

(a) What is the velocity of the first ball in the x-direction post collision?

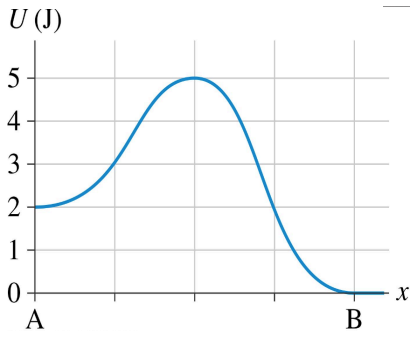
(b) What is the velocity of the first ball in the y-direction post collision?

(c) What is the magnitude of momentum and angle of the first ball post collision?

(d) 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.

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

A 200 g mass glides over a friction free track and experiences the potential energy versus position graph shown.

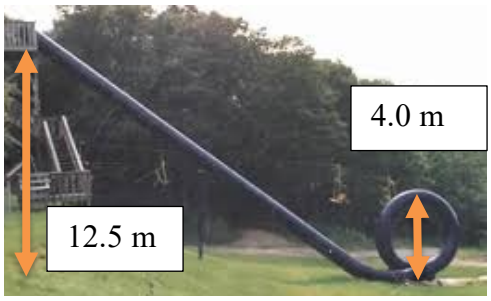


(a) If the velocity of the mass was 10 m/s at point B, what is its Kinetic Energy at point A?

At point B the 200g particle collides elastically with a 100 g particle traveling in the opposite direction as the 200 g particle with a speed of 5.0 m/s. Assume all 1D.
(b) What is the velocity of the 100 g particle after the collision?

(c) In this collision explain which particle receives the larger impulse?
Explain your answer with words and possibly theory/equations.

(d) If the collision in (b) were inelastic instead of elastic, what would the final velocity of the 200g particle be?



Question 3. Grade this problem? Yes or No (circle one)
There was an amusement park in New Jersey called "Action Park" that had a waterslide with a loop-da-loop at the end. This unfortunately caused many injuries. Let's look at the physics. For (a) – (c) assume this is friction free; which clearly is a lie, but we'll go with it.

(a) Using energy conservation, determine the velocity of a 75 kg rider at the top of the loop. If it works, they are on the outside of the loop at this point (if not, ouch).

(b) What centripetal force do they experience at the top of the loop? Be sure to state a direction.

(c) What normal force do they experience at the top of the loop?

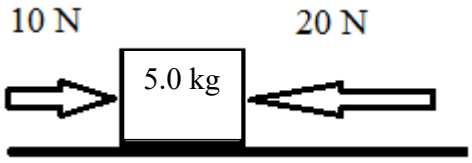
(d) Explain what minimum speed they would need at the top of the loop to keep them moving in a circle and what is physically happening to forces acting on the person at this moment. Equations and words are necessary in your answer. If/when we include friction this is relevant.

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

A 5.0 kg box is launched up a 1.0 m high ramp by a spring that was initially compressed 10 cm. The box is moving to the left during the motion and of course we ignore friction.
(a) If the kinetic energy at the top of the ramp is 25 J, what is the spring constant of the spring?

(d) As the block climbs the ramp, what happens to the total mechanical, gravitational and kinetic energy? Do they increase, decrease or stay the same? Explain with words and possibly equations.

(c) Once at the top of the ramp the box travels 2.0 m to the left on a "frictionless" level surface. With the forces illustrated, what is the total work done on the object on the level surface?



(d) What is the speed of the box after it moves 2.0 m?