General Physics
Physics 101
Test #3 – Spring 2020
Friday 4/17/20
10 AM Section
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:_____

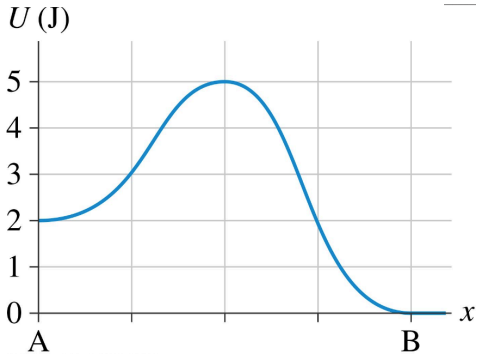
Part I. Multiple Choice (3 pts each)

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



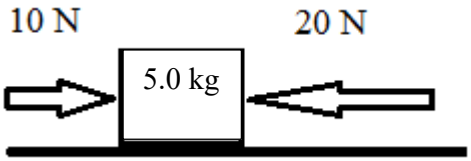
(a) 5.5 m/s
(b) 4.5 m/s
(c) 7.1 m/s
(d) It never makes it to point B.

2. In a ballistics test, a 25 g bullet traveling horizontally at 1200 m/s goes through a 30-cm-thick 350 kg stationary target and emerges with a speed of 900 m/s. The target is free to slide on a smooth horizontal surface. What is the target's speed just after the bullet emerges?

(a) 21 m/s
(b) 0.15 m/s
(c) 0.021 m/s
(d) 0.17 m/s

3. A process occurs in which a system's potential energy increase while the environment does work on the system. Does the system's kinetic energy…
Ignore Thermal Energy.

(a) Increase
(b) Decrease
(c) Stay the same
(d) Not enough information to tell.



4. A box travels 2.0 m to the left on a "frictionless" level surface. With the forces illustrated, what is the change in work done on the box?

(a) -20 Nm
(b) 60 J
(c) 20 Nm
(d) 10 J

5. You are whirling a bucket of water in a vertical circle at a speed and at a radius of 0.75 m. If the normal force exerted on the 170 g of water is 2.0 N when it is at the top of its motion, what is the speed of the bucket?

(a) 5.4 m/s
(b) 4.0 m/s
(c) 3.0 m/s
(d) 2.7 m/s

6. A 2.0 kg ball traveling to the left at a speed of 2.0 m/s collides elastically with a 1.0 kg ball traveling to the right at a speed of 3.0 m/s. What is the speed of the 2.0 kg ball after the collision?

(a) 2.6 m/s
(b) 3.6 m/s
(c) 4.7 m/s
(d) 1.3 m/s

7. You want to ride your mountain bike up a steep hill. Two paths lead from the base to the top, one twice as long as the other. If you exert 1.0×10^3 N of force on average on the shorter path, the average force you exert along the longer path is…

(a) 5.0×10^2 N
(b) 2.5×10^2 N
(c) 1.0×10^3 N
(d) Need more information

8. Which of the following statements is true?

(a) Two objects colliding with each other can have different impulses.

(b) 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.

(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 in equilibrium.

9. When a 65 kg cheerleader stands on a vertical spring, the spring compresses by 5.5 cm ($k = 1.16 \times 10^4$ N/m). When a second cheerleader stands on the shoulders of the first, the spring compresses an additional 4.5 cm. What is the mass of the second cheerleader?

(a) 5.0 kg
(b) 1.2×10^2 kg
(c) 27 kg
(d) 53 kg

10. 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

11. A 10-m long glider with mass of 680 kg (including the passengers) is gliding horizontally through the air at 30 m/s when a 60 kg skydiver drops out by releasing his grip on the glider (the glider + passengers remaining are 620 kg). What is the glider's velocity just after the skydiver lets go?

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

12. A "2m" block slides down a frictionless ramp and collides with a block "m". The blocks collide and stick together, what is the speed of the blocks after the collision?

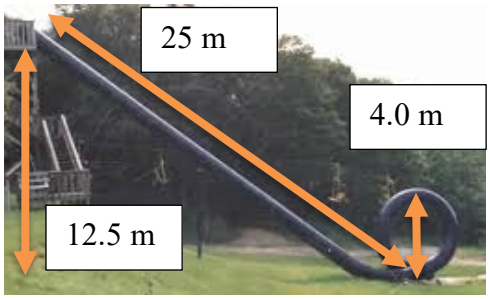
(a) 2.6 m/s
(b) 7.7 m/s
(c) 5.1 m/s
(d) 3.9 m/s

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)
In Fall 2019, we explored an "Action Park" waterslide with a loop at the end. We determined the critical speed to keep a rider moving in the circle at the top of the loop to be 4.4 m/s.

(a) Using energy conservation (ignore friction), determine the kinetic energy of a 75 kg rider at the bottom of the loop. Assume, they are on the outside of the loop at the top of the loop and that the vertical displacement is 4.0 m (as shown).

(b) If we assume a friction-free environment, explain what happens to the total energy, kinetic energy and potential energy as a rider goes from the bottom to the top of the loop Do they increase, decrease or stay the same? Explain your answer in words.

Now look at friction along the ramp – which is super awesome. Assume the answer for (a) is correct. The distance traveled along the ramp is 25 m, which is 12.5 m vertically.
(c) Determine the work done by friction along the ramp, assuming initial velocity is zero.

(d) What is the friction force along the ramp (state a direction along the ramp)

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

Riding a Ferris wheel, you (75 kg) estimate the radius of the big wheel to be 15 m and each loop around takes 25 s when traveling at a constant angular speed (0.25 rad/s).

(a) What net force do you experience at the top of the wheel?
Please state a direction in words.

(b) As the wheel spins, explain whether or not the magnitude of the net force, normal force and gravity acting on a rider change. Words and possibly force diagrams are necessary in your justification.

(c) At the bottom of the motion, what normal force do you experience?
Assume you are right side up at the top of the motion.

(d) At the top of the motion, the person sitting next to you indicates indicates they experience a normal force that is ½ of your value found in (c). What is their mass? How they know this is up for debate, but you don't have time to question them.

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

A two-car inelastic collision occurred intersection of State Street and Union Avenue. The car driven by Jim (1200 kg) was proceeding north on Union while the car driven by Dan (1600 kg) was moving west on State. Immediately after the collision, it was determined the combined system was traveling at 6.46 m/s, 53º NW (-3.89 m/s, 5.16 m/s).

(a) What is the velocity of Jim prior to the accident?

(b) What is the momentum of Dan prior to the accident?

(c) During the collision, explain whether momentum AND kinetic energy are conserved. Be sure to answer both and explain why (or why not) this is the case.

(d) If Dan would have stopped prior to the collision with Jim moving at the velocity from (a), what would the speed of Dan be post collision if this collision were elastic? Assume all 1D.

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

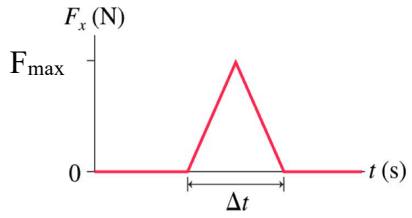
As a social distancing birthday gift Dr. Tritico gave my son, Charlie, a 3-person slingshot. So, we fired water balloons at each other from across the street. As a test, we loaded a 50g water balloon into the slingshot, stretched it by 1.5 m and fired it horizontally. By estimate, the balloon left with a velocity 10 m/s.

(a) What is the spring constant of the slingshot?

(b) Another 50 g balloon is launched at an unknown angle after a stretch of 1.5 m, and impacts on Dr. Tritico who is standing on a hill 2.0 m above the launch point. What was the impact velocity of the balloon?

The balloon collides with Dr. Tritico and explodes.

(c) Dr. Trticio experienced the approximate force versus time shown in the diagram with the impact lasting 10 ms and the maximum force experienced of 1.0 kN. What impulse did he experience?



(d) During the collision was the momentum change experienced by the balloon, bigger, smaller or the same as Dr. Tritico's? Please justify with words & theory. No calculations are required.