General Physics
Physics 101
Test #3 – Spring 2019
Friday 4/17/19
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 1000 kg elevator accelerates upward at 1.0 m/s^2 for 10 m, starting from rest. How much work does the tension in the elevator cable do on the elevator?

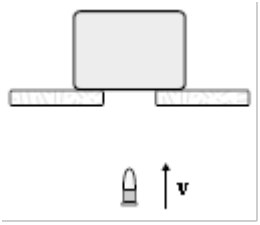
(a) 1.0 x 10^4 N
(b) -9.8 x 10^4 Nm
(c) 1.1 x 10^5 J
(d) 88 kJ

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 x 10^2 m/s
(d) 27 m/s

3. 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 x 10^2 N
(c) 2.9 x 10^2 N
(d) Need more information



4. 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

5. A student is asleep on the top bunk, which is 2.20 m from the floor. If he rolls off the bed with an initial horizontal velocity of 1.10 m/s, what is his impact speed when he reaches the floor?

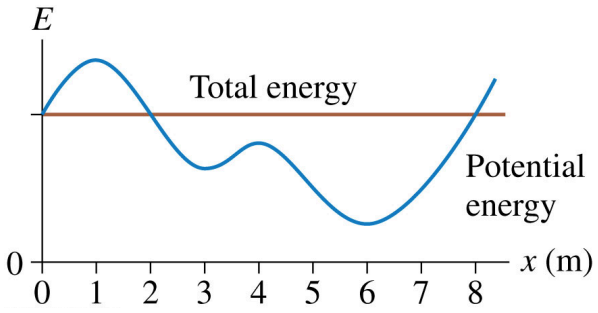
(a) 6.66 m/s
(b) 6.56 m/s
(c) 6.47 m/s
(d) 4.77 m/s

6. 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 centripetal force is 25N?

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

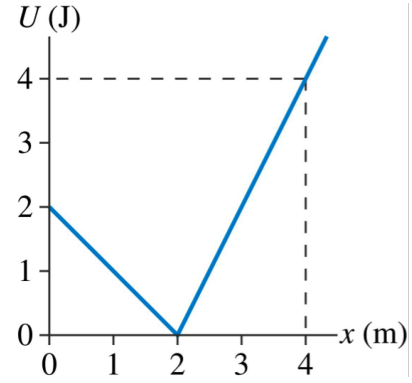
7. A process occurs in which a system's potential energy decreases while the environment does work on the system ($\Delta E_{th} = 0$). Does the system's kinetic energy…

(a) Increase
(b) Decrease
(c) Stay the same
(d) Can't tell



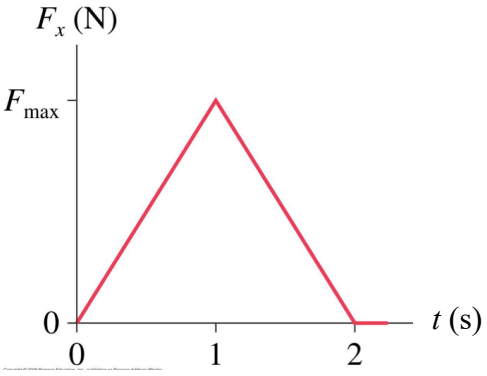
8. A 2.0 kg mass glides over a friction free track and experiences the potential energy versus position graph shown. Which of the following statements is false? Assume it starts at 7.0 m.

(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.



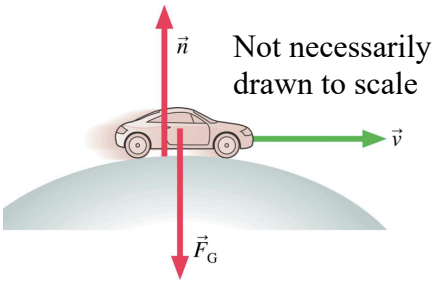
9. A particle moves along the x-axis with potential energy shown. The x-component of the force on the particle when it is at x=4 m is?

(a) 8.0 N
(b) 1.0 N
(c) -1.0 N
(d) -2.0 N



10. A 500 g particle moving along the x-axis experiences the force shown. If the particle goes from $v_x = 2.0$ m/s at $t = 0$ s to $v_x = 6.0$ m/s at $t = 2.0$ s, what is F_{max}?

(a) 8.0 N
(b) 4.0 J/m
(c) 2.0 kg m/s^2
(d) 1.0 N



11. 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.

12. Which of the following statements is true?

(a) An object rotating in uniform circular motion is in equilibrium.

(b) It is not 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) 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.

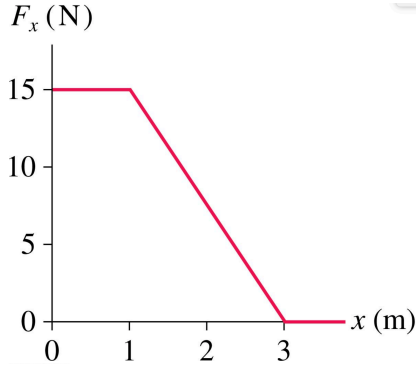
Part II. Short answer problems (12 pts each)

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 500 g particle moving along the x-axis experiences the force shown in the figure. The particles velocity is 2.0 m/s at x=0m.

(a) How much work is done on the particle from 0 to 3.0 m?

(b) What is the particle's velocity at 3.0 m?

(c) The particle now collides elastically with a 100 g object traveling at -5.0 m/s. What is the velocity of the object post collision?

(d) Explain whether the particle or the object experience a larger impulse during the collision. Be sure to include words and equation(s) in your justification/explanation.

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

Three balls, 1.0 kg, 2.0 kg and 3.0 kg collide and stick together and are at rest post collision. The 1.0 kg ball is traveling at 5.0 m/s to the north-west, with components of 4.0 m/s to the west and 3.0 m/s to the north. The 2.0 kg ball is traveling at 2.0 m/s to the south, and the 3.0 kg ball velocity is unknown.

(a) What is the momentum in the y-direction for the 3.0 kg ball pre-collision?

(b) What is the velocity in the x-direction for the 3.0 kg ball pre-collision?

(c) At what angle is the 3.0 kg ball traveling pre-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 3. **Grade this problem? Yes or No (circle one)**

Training for the "Sisyphus Boulder Express" challenge. You have pushed a 200 kg boulder up a hill, which falls down a hill and goes through a 20 m diamater loop-da-loop. We'll ignore the effects of the rotation of the boulder, as we have not learned that yet.

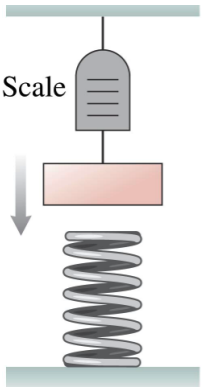
(a) If the net force on the boulder at the top of the loop is 10.0 kN, what is its speed at the top of the loop?

(b) Using energy conservation, determine the speed of the boulder at the bottom of the loop. Note: Boulder falls 20 m vertically.

`

(c) Calculate the normal force acting on the boulder at the bottom of the loop.

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



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

A scale measures the mass of an object to be 10.0 kg (98.0N).
(a) In your first experiment, you gently lower the object onto a spring (k=500 N/m) and read the scale. What is the reading on the scale in Newtons, when the spring is gently compressed by 10.0 cm?

You now setup for another experiment, but right before you touch the object to the spring, the object comes loose from the scale. You decide to watch what happens.
(b) What is the maximum compression of the spring as the object falls onto it?

For the third experiment, you turn the spring horizontally and launch the object, by compressing the spring by 50 cm.
(c) How fast is the object traveling when the spring is compressed by only 10 cm?

(d) If you compress the spring by twice as much as in (c) by what factor did the spring potential energy increase? Words and an equation are necessary, but no new calculations are required in your answer.