General Physics
Physics 101
Test #3 – Spring 2015
Friday 4/10/15
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 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?

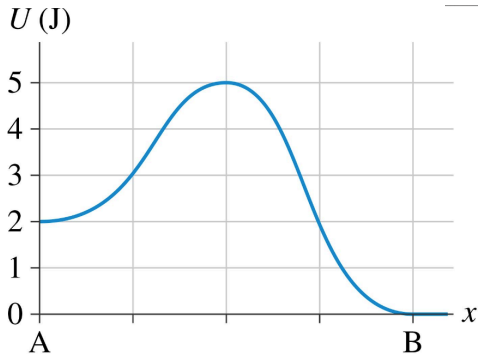
(a) 3.1×10^2 J
(b) 62 Nm
(c) 6.3×10^2 J
(d) Need more information

2. A truck traveling at 100 mph crashes into a solid concrete wall. Which experiences the larger change in momentum (magnitude)?

(a) Truck
(b) Wall
(c) They are the same
(d) Need more information

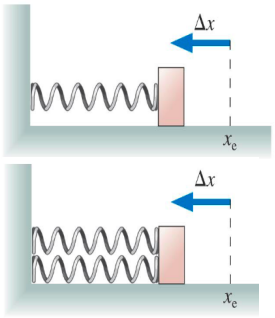
3. You are spinning 1.0 kg of water vertically in a bucket. Your arm has a radius of 0.75 m, and the bucket spins at a constant 5.0 rad/s. What is the normal force exerted on the water by the bucket when the bucket is at the top of its motion?

(a) 24 N
(b) 9.0 N
(c) 29 N
(d) 19 N



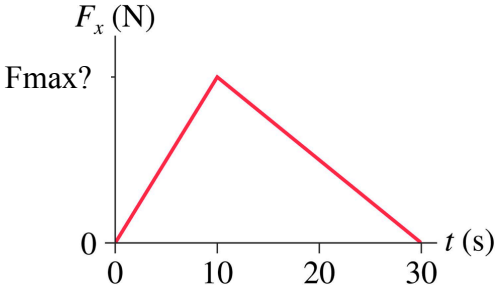
4. For the potential energy versus position graph shown, what minimum speed must a 200g particle need at point A to reach point B?

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



5. A single spring is compressed by Δx, and launches a block across a frictionless surface with a speed v_0. A second identical spring is added in parallel to the first spring. If the springs are compressed by the same Δx, what is the velocity of block following the launch?

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



6. Far in space, where gravity is negligible, a 425 kg rocket traveling at 75 m/s fires its engines and experiences a 1.5×10^4 Ns impulse. The graphs shows the force the rocket experiences as a function of a time. Assume the mass of the ship is constant. Calculate the maximum thrust force.

(a) 1000 N
(b) 2.0×10^3 N
(c) 5.0×10^2 N
(d) 1.0 kN

7. A 2.0 kg cart is traveling with -10 Ns of momentum.
What is the kinetic energy of the cart?

(a) 5.0 Ns
(b) 25 Nm
(c) 1.0×10^2 J
(d) -25 J

8. A 6.0 kg ball traveling at 2.0 m/s collides elastically with a 3.0 kg ball that is traveling at 1.0 m/s. What is the velocity of the 3.0 kg ball after the collision?

(a) 1.3 m/s
(b) 0.67 m/s
(c) 2.0 m/s
(d) 2.3 m/s

9. A ball thrown horizontally at 25 m/s has a velocity of 35 m/s at an angle of 30º below the horizontal right before it strikes the ground. From what height was the ball thrown?

(a) 94 m
(b) 31 m
(c) 16 m
(d) 5.102 m

10. Which of the following statements is false?

(a) An object moving in uniform circular motion is not in equilibrium.

(b) An object in free-fall can have a non-zero kinetic energy at its max height.

(c) It is possible for momentum to always be conserved.

(d) If the total momentum of a system is zero, the system is motionless.

11. A 620 g bird 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 bird releases the 60 g stick, what is the bird's velocity just after the stick leaves the bird's mouth.

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

12. A ball is spun in a vertical circle with constant angular velocity, as the ball spins in the circle, which of the following forces change magnitude?

(a) Force of Gravity
(b) Net Force
(c) Tension Force
(d) Centripetal Force

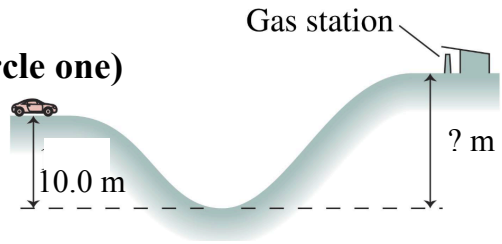
Part II. Short answer problems (12 pts each)

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 1500 kg car suddenly runs out of gas while approaching the valley shown. Ignore friction.

(a) If the speed at the bottom of the hill is 18 m/s, what was the kinetic energy of the car when it ran out of gas?

(b) At the bottom of the hill, draw to scale a force diagram showing all forces acting on the car including net force. These do not need to be exact, but a larger force should have a larger length. Also explain the direction of the net force using your diagram.

(c) If the car coasts into the station with a speed of 5.5 m/s, what is the vertical height from the bottom of the valley to the gas station?

(d) The car unfortunately collides with a 50 kg gas pump, which flies off at a velocity of 10 m/s. What is the velocity of the car after this collision?

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

A roller coaster car approachs a vertical loop-da-loop. The loop has a diameter of 20.0 m and the roller coaster car (and rider) has a mass of 500 kg.

(a) If the net force on the car at the top of the loop is 10.0 kN, what is the speed of the car at the top of the loop? The car is upside down at the top of the loop.

(b) Using energy conservation, determine the speed of the car at the bottom of the loop.

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

(d) Explain why a minimum speed exists for the car 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 car at the top of the loop.

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

Two cars collided at the intersection of State Street and Union Avenue. The automobile driven by Jim was proceeding north on Union while the automobile driven by Dan was moving west on State. Following the impact the combined wreckage was observed to travel at 6.8 m/s in a direction 37.0° west of north. A representative of the wrecking company estimated that Dan and Jim's automobiles had masses of 1600 kg and 1200 kg respectively.

(a) What are the x and y components of the total momentum of the cars post-collision?

(b) What was the velocity of the Dan's car prior to the collision?

(c) What was the velocity of the Jim's car prior to the 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 4. **Grade this problem? Yes or No (circle one)**

A 1000 kg safe is 2.0 m above a heavy-duty spring when the rope holding the safe breaks. The safe hits the spring and compresses it by 50 cm as it comes to rest.

(a) What is the velocity of the safe right before it hits the spring?

(b) What is the spring constant of the spring?

(c) When the spring is compressed to 50 cm is the safe in equilibrium? Explain your answer using words and possibly diagrams or equations. No calculations are required.

(d) To remove the safe from the spring you slowly pull vertically upwards on it so the safe moves with a constant velocity. If the spring is compressed by 2.0 cm, how much force are you pulling with at that instance?