Physics 1050-01,02 - Exam 3 **Name______________________**

Allowed: calculators, pens, pencils, 1 page of equations and notes.
Not allowed: books, additional notes, smart phones, etc.
The exam will end at 1:40 (total time is 65 minutes). 100 total points.

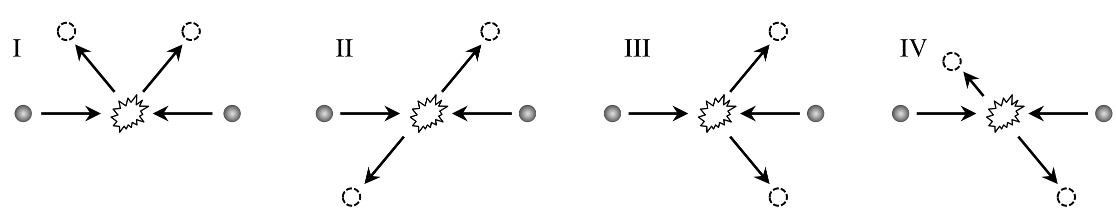
A. Multiple choice: circle the most appropriate answer (4 points each)

1. You push hard on a desk but it does not move. What work is done?
   a. you do *not* do work on the desk, and it does *not* do work on you
   b. you do *not* do work on the desk, but it *does* do work on you
   c. you *do* work on the desk, but it does *not* do work on you
   d. you *do* work on the desk, and it *does* do work on you
   e. it depends on which direction you are pushing

2. From a top of a cliff, you throw one ball up and another down with the same speed, at the same time. Ignore air resistance. Which is true?
   a. the ball thrown upward lands first
   b. the two balls land at exactly the same time
   c. the ball thrown downward hits the ground harder
   d. the two balls hit the ground with the same velocity
   e. the ball thrown upward has a greater total energy

3. A car accelerates from rest using constant power. Which takes longer?
   a. going from 0 to 30 mph
   b. going from 30 to 60 mph
   c. it takes the same amount of time
   d. it depends on the car's mass
   e. cannot be solved; the work-energy principle does not apply in this case

4. Two balls that have the same mass move towards each other with the same speed. Which of the below diagrams is a possible outcome of an inelastic collision? There are no other forces. Note that it does not matter which ball goes in which direction.
   a. diagram II only
   b. diagrams II and IV
   c. diagrams II, III, and IV
   d. diagrams I, III, and IV
   e. all are possible



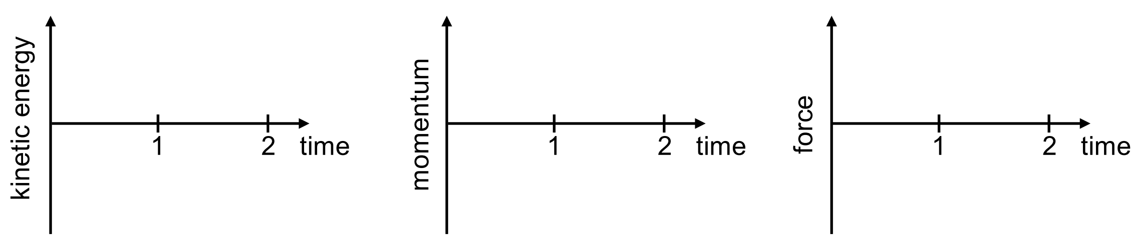
5. An apple falls off a tree. Assume air resistance is negligible. As it falls,
   a. only its kinetic energy is conserved
   b. only its momentum is conserved
   c. both its kinetic energy and momentum are conserved
   d. only its mechanical energy is conserved
   e. both its mechanical energy and momentum are conserved

6. If a quantity has units of $kg\cdot m^2/s^2$, what type of quantity could it be?
   a. momentum
   b. potential energy
   c. impulse
   d. force
   e. power

7. Two friends are standing on opposite ends of a canoe that is initially at rest. The person in the front throws a watermelon toward the back, and the person in the back catches it. After the watermelon is caught, the canoe is
   a. moving backward
   b. moving forward
   c. stationary and in the original place
   d. stationary and forward of where it was
   e. stationary and behind where it was

Short answer (6 points each)

8. A superball is dropped on a hard floor and bounces. It is dropped at time 0 and hits the floor at 1 second. Taking up as the positive direction, sketch (a) kinetic energy of the superball, (b) momentum of the superball, and (c) force of the floor on the superball as a function of time, from 0 to 2 s.



9. A ball is thrown up into the air and then falls to the ground. Is the ball's momentum in the vertical direction conserved? Explain how this agrees with the law of the conservation of momentum.

Longer answer (10 points each)
Give all answers with 3 significant figures and don't forget the units.

10. In the winter, a 20 kg girl runs up to a frozen puddle, and then stops running and slides across the puddle. Assume the coefficient of kinetic friction between her shoes and ice is 0.15 and she slides for 3 meters before coming to a stop. (a) How much work did the puddle do on her? (b) What was her initial speed?

(a)

(b)

11. During takeoff, a 65,000 kg passenger jet accelerates from rest to 70 m/s in 30 s. (a) How much impulse do the jet engines deliver to the plane during takeoff? (b) What is the average force that they exert on the plane?

(a)

(b)

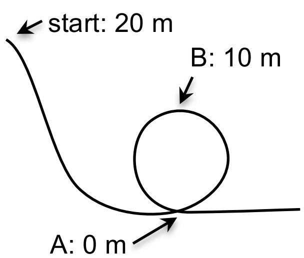
12. A 55 kg man jumps out of a 2nd story window and falls onto a trampoline that can be modeled as a simple spring, with spring constant $5x10^4$ N/m. Assume he jumps from 8 m above the initial trampoline level, with negligible initial speed. (a) How far down does he depress the trampoline as he lands? (b) After he stops bouncing and is simply standing on the trampoline, how much is it depressed?

(a)

(b)

13. A 14,000-kg train boxcar is coasting at 1.50 m/s along a horizontal track when it hits and couples with a stationary 8,000-kg boxcar. What is the speed of the cars just after the collision?

14. A frictionless roller-coaster starts from a standstill at 15 m above the ground. It goes down to point A, at ground level, and then in a loop through point B, 10 m above the ground, and then on around the loop. What are the speeds at points A and B?



(a)

(b)

15. The Space Needle can be modeled as two masses that are connected by a light connecting rod. One mass is the foundation, which weighs 5850 tons and has its center at 15 feet underground. The other mass is the observation deck, which is 520 feet above ground. The center of mass of the whole Space Needle is 5 feet above ground. What does the observation deck weigh in tons?