Physics 160 Name ____KEY______

Exam 1 – Kinematics

September 17, 2010

- This is a closed book examination.
- You may use a 3x5 index card that you have made with any information on it that you would like. You must have your name, lab section and the date on your index card.
- There is extra scratch paper available.
- Your explanation/work for the worked problems is worth ¾ of the points. You must use a "Problem Solving Sheet" for each problem. Please make sure to fill out your name etc. on each "Problem Solving Sheet"
- Please fill out the Scantron sheet completely – do not neglect your test code.
- Explain your answers – even on multiple choice questions!

A general reminder about problem solving:

1. Visualize - draw a picture
2. Pick a coordinate frame
3. Create a simplified picture – schematic with vectors describing motion
   a. 2D Motion: separate vectors into components
   b. Force Problem: create a simplified free body diagram
   c. Energy Problem: create energy level diagram(s)
4. Write down what you know – create separate columns for different directions
5. Write down what you don't know and/or what you want to know
6. List mathematical relationships
7. Combine mathematical formulas, Simplify and Solve
8. Check your answer – Is it reasonable? Are the units correct?

- Show all work!

You throw a heavy small blue ball as fast as you can straight up into the air. Use a coordinate system where up is in the positive direction. The next six questions refer to this ball after it has left your hand but before you catch it again. Please explain your answers.

1. The acceleration of the ball on the way up is
   a) $9.81\ m/s^2$ in the downward direction.
   b) zero (no acceleration).
   c) $9.81\ m/s^2$ in the upward direction.
   d) Can not tell. It depends on how high it was thrown.
   e) Can not tell. It depends on the initial velocity.

2. The velocity of the ball on the way up is
   a) negative (in the downward direction).
   b) zero.
   c) positive (in the upward direction).
   d) Can not tell. It depends on the initial position.
   e) Can not tell. It depends on the initial acceleration.

3. The acceleration of the ball at the very top of its throw (just before it starts back down) is
   a) $9.81\ m/s^2$ in the downward direction.
   b) zero (no acceleration).
   c) $9.81\ m/s^2$ in the upward direction.
   d) Can not tell. It depends on how high it was thrown.
   e) Can not tell. It depends on the initial velocity.

4. The velocity of the ball at the very top of its throw (just before it starts back down) is
   a) negative (in the downward direction).
   b) zero.
   c) positive (in the upward direction).
   d) Can not tell. It depends on the initial position.
   e) Can not tell. It depends on the initial acceleration.

5. The acceleration of the ball on the way down is
   a) $9.81\ m/s^2$ in the downward direction.
   b) zero (no acceleration).
   c) $9.81\ m/s^2$ in the upward direction.
   d) Can not tell. It depends on how high it was thrown.
   e) Can not tell. It depends on where you catch it.

6. The velocity of the ball on the way down is
   a) negative (in the downward direction).
   b) zero.
   c) positive (in the upward direction).
   d) Can not tell. It depends on the initial position.
   e) Can not tell. It depends on the initial acceleration.

Use the graphs below to best match the motion described in the following questions.

7. Which graph could represent the velocity of a biker whose is traveling at a constant speed and doesn't change direction? **B**

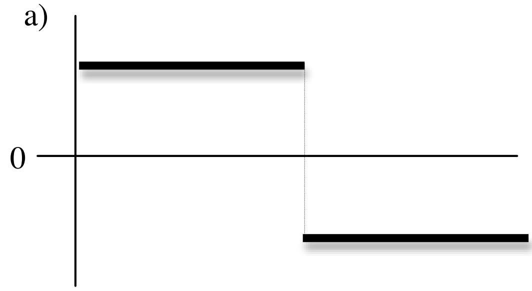
8. Which graph could represent the acceleration of a soccer ball kicked straight up into the air after it leaves your foot? **B**

9. Which graph could represent the velocity of a motorist approaching a stop sign? **D**

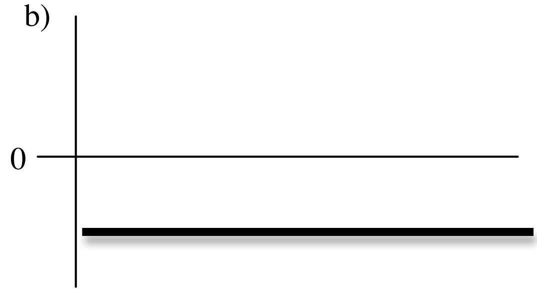
10. Which graph could represent the position of a rabbit that is sleeping? **B**

11. Which graph could represent the position of a rabbit that is running at constant velocity? **D**

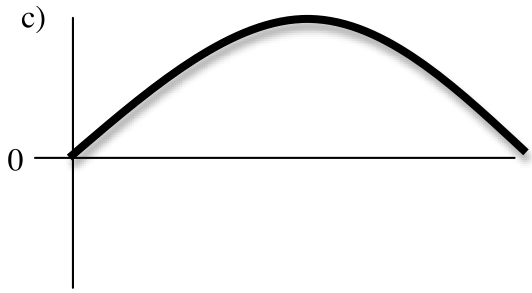
a)



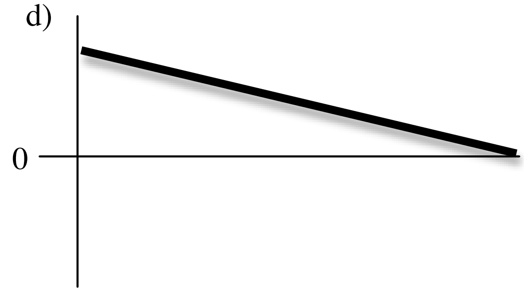
b)



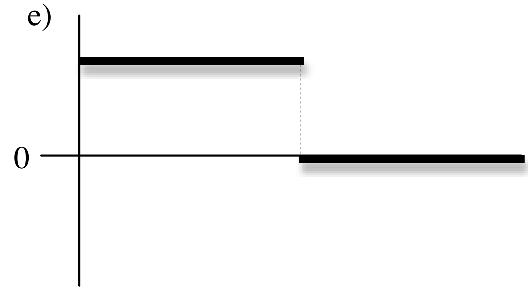
c)



d)



e)



12. A car is traveling in a circle with a constant speed.
   a) The car has a net acceleration normal to the surface of the circle (pointing radially out).
   b) The car has zero net acceleration.
   c) The car has a net acceleration towards the center of the circle (pointing radially inwards).
   d) The car has a net acceleration pointing tangential to the circle (pointing in the direction of travel).

13. An airplane flies straight back and forth between Fargo and Minneapolis, always at the same airspeed. If it encounters a mild steady tailwind going, and the same steady headwind returning, will the round trip take more, less or the same time as with no wind?
   a) The round trip takes more time with the wind.
   b) The round trip takes the same time with the wind.
   c) The round trip takes less time with the wind.

14. A sports car has an average acceleration of 13.1 $\frac{\text{miles}}{\text{hour}\cdot\text{sec}}$. How long does it take for the car to reach 60.0 mi/h, if it starts from rest?
   a) 0.22 s
   b) 3.1 s
   c) 4.6 s
   d) 5.5 s
   e) 8.8 s

15. You are taking a turn at 23.0 m/s on a ramp of radius 39.0 m. What is your acceleration?
   a) 0.0737 m/s^2
   b) 13.6 m/s^2
   c) 0.590 m/s^2
   d) 66.1 m/s^2
   e) 1.70 m/s^2

Answer the following TRUE or FALSE questions.

16. Acceleration is zero if the change in velocity is zero.
    a) TRUE
    b) FALSE

17. Your acceleration can be zero even if the velocity is not zero.
    a) TRUE
    b) FALSE

18. Velocity and acceleration are always in the same direction.
    a) TRUE
    b) FALSE

19. The velocity is the slope of the position vs time graph.
    a) TRUE
    b) FALSE

20. The area under the acceleration vs time graph is the change in velocity.
    a) TRUE
    b) FALSE

Do the next two problems using separate problem solving sheets. There are extra problems solving sheets available if you need one.

21. A motorist makes a trip of 180 miles. For the first 90 miles she drives at a constant speed of 30 mph. At what constant speed must she drive the remaining distance if her average speed for the total trip is to be 40 mph? **60 mph**

22. You are a working as a "reality check" consultant on a movie production. A stunt requires a biker to pedal horizontally off of the roof of one building and land on the roof of a second (shorter) building. The buildings are 40 meters apart and the second building is 30 meters shorter. How fast would the biker need to be moving to make this "jump"? Is this realistic? **16.2 m/s**