Physics 151 Roster No.:_____

Score:_____26 pts. possible_____

SPRING 2004 Midterm Exam #1, Part A

Exam time limit: 50 minutes. You may use calculators and both sides of 1 page of notes, *handwritten only*. Closed book; no collaboration. For multiple choice questions, circle the letter of the one best answer (unless more than one answer is asked for).

1. (2 pts.) A modern computer processor chip requires only 1.5×10^{-9} of a second to perform a single arithmetic operation. How much **time** does it take to perform **100 operations**?

A. 0.15 ms
B. 15 μs
C. 150 ns
D. 150 μs
E. 1.5 μs
F. 0.15 ns

2. a. (1 pt.) The value "0.00600 kg" has how many **significant figures**?

A. 1
B. 3
C. 4
D. 5
E. 6
F. cannot determine — it's ambiguous

b. (2 pts.) Write the value "0.00600 kg" in **scientific notation**: _____kg____
(Write your answer as compactly as possible, i.e., using the fewest digits necessary to write the number.)

3. (2 pts.) We will later learn that the units of power, "watts," are equivalent to the units of **[force] × [velocity]**. Therefore, watts must be equivalent to:

A. kg·m/s
B. kg·m^2/s
C. kg·m^2/s^2
D. kg·m^3/s^2
E. kg·m^2/s^3
F. kg·m^3/s^3

4. (2 pts.) If an object has a non-zero **constant velocity**, then all of the following are true EXCEPT:

A. Its position must be changing at all times.
B. Its speed must have some positive value.
C. Its acceleration must be zero.
D. Its weight must be zero.

5. (2 pts.) If an object constrained to move along the *x*-axis has a **constant positive acceleration**, then which ONE of the following is TRUE?

A. Its velocity must be positive at all times.
B. Its velocity must be changing at all times.
C. Its speed must be increasing at all times.
D. The net force acting on the object must be zero.

6. (2 pts.) If object X has a **greater mass** than object Y, then all of the following are true EXCEPT:

A. X has greater inertia than Y.
B. Near the surface of Earth, X has greater weight than Y.
C. In the absence of all other forces, a 1.0-N force would give X a lesser acceleration than it would give Y.
D. When released from rest and allowed to fall freely, X has greater acceleration than Y.

7. Suppose you are pulling a toy wagon containing your little cousin, which has a total mass of 30. kg. (The wagon has frictionless wheels. Ignore all air resistance.)

a. (2 pts.) If you apply a 24-N force horizontally to the wagon, what is the resulting **acceleration** of your little cousin?

A. 0.67 m/s^2
B. 0.80 m/s^2
C. 1.5 m/s^2
D. 1.8 m/s^2
E. 2.4 m/s^2
F. 3.0 m/s^2

b. (2 pts.) As you pull on the wagon with 24 N to the right in part (a), which ONE of the following is TRUE?

A. The wagon pulls on you with exactly 24 N of force to the left.
B. The wagon pulls on you with less than 24 N, so that the net force accelerates the wagon to the right.
C. The wagon pulls on you with more than 24 N, because your mass is larger than the wagon's, and F is proportional to m.
D. The wagon exerts no force on you; there is only the force of you pulling on the wagon.

8. A standard event in diving competitions involves diving from a rigid platform 10. meters above the surface of the swimming pool. Assume there is no air resistance.

a. (2 pts.) If a diver stands at the edge of the 10.-meter platform and gently steps off, how much **time** will it take him to hit the water below?

A. 0.98 s
B. 1.4 s
C. 2.0 s
D. 2.8 s
E. 3.2 s
F. 4.9 s

b. (3 pts.) If a 10-meter diver wanted to **increase** the amount of **time** it takes him to hit the water, which of the following could he do? ***Circle all that apply:***

A. Run toward the end of the platform, to increase the horizontal component of his initial velocity.
B. Jump upward from the end of the platform, to increase the vertical component of his initial velocity.
C. Lose some weight, so that his mass is less.
D. Use a pool on the surface of Mars or the Moon, where the acceleration due to gravity is less.

9. a. (2 pts.) If vector **A** = (–70. m/s, 45 m/s), its **magnitude** is:

A. 35 m/s
B. 58 m/s
C. 83 m/s
D. 95 m/s
E. 103 m/s
F. 115 m/s

b. (2 pts.) The **direction** of **A** (as measured counterclockwise from the +x direction) is:

A. 103°
B. 117°
C. 123°
D. 138°
E. 147°
F. 155°

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Score: **24 pts. possible**

SPRING 2004 Midterm Exam #1, Part B

Exam time limit: 50 minutes. You may use calculators and both sides of 1 page of notes, *handwritten only*. Closed book; no collaboration. Show your work on free-response questions. Be sure to use **proper units** and **significant figures** in your final answers.

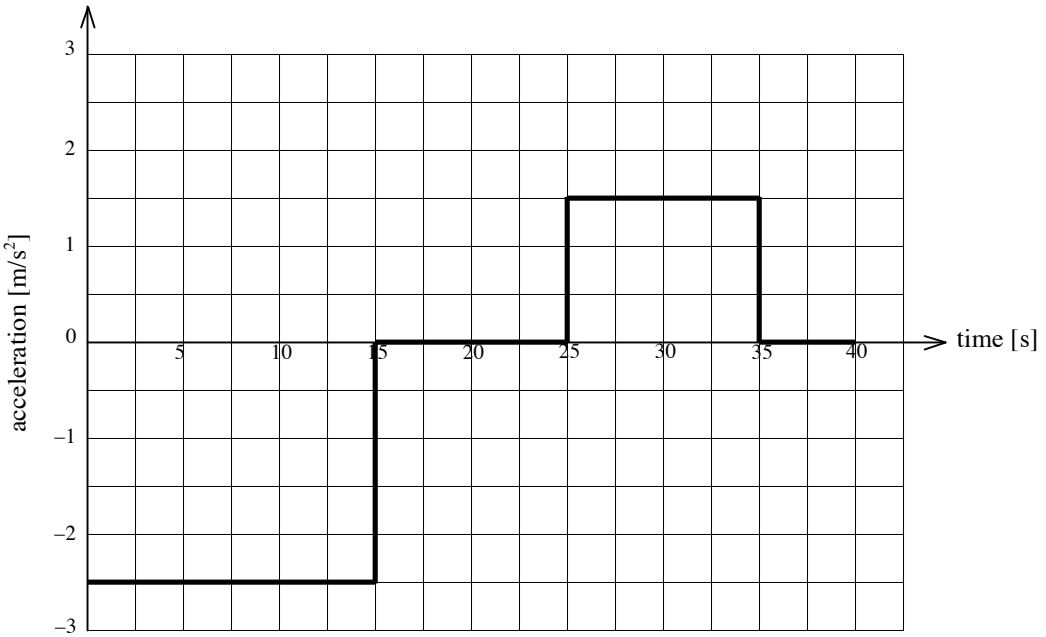
1. A baseball player on the Boston Red Sox team is playing in Boston's Fenway Park stadium. During his turn at bat, he hits a baseball with an initial velocity of 35.0 m/s at an angle of 45.0° above the horizontal. (Assume that the baseball field is level, and that there is no air resistance.)

a. (4 pts.) Calculate the **vertical and horizontal components, v_{0x} and v_{0y}, of the initial velocity** of the baseball. Show your work.

b. (4 pts.) What **maximum vertical displacement** (above the level at which the ball was hit) does the ball reach? Show your work.

c. (6 pts.) Suppose that the player is attempting to hit a "home run" by hitting the baseball over the famous "Green Monster" fence in left field. The ball happens to be aimed toward a point on the fence where the fence is 10.0 meters high (above the level at which the ball was hit) and is located at a horizontal distance of 100. meters away from the player. **Will the ball clear the top of the fence?** Show your work and/or explain your reasoning.

2. A small spacecraft faces in the +*x*-direction, and moves only along the *x*-axis during this problem. The spacecraft has two rocket thrusters that can be used to accelerate it along the *x*-axis: one facing backward, to create positive acceleration, and one facing forward, to create negative acceleration. (Ignore all friction in this entire problem.) The following graph represents the spacecraft's **acceleration** as a function of time:



a. (4 pts.) Suppose that at $t = 15$ s, the spacecraft's velocity is: v = –15 m/s. What was the spacecraft's **initial velocity, $\mathbf{v_0}$** at time $t = 0$? Show your work and/or explain your reasoning.

b. (6 pts.) Using the above acceleration graph and your answer to part (a), graph the spacecraft's **velocity** from $t = 0$ to 40 s below: