Midterm 1 for Algebra-Based Physics 1

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1 Estimation and Unit Conversion

1. Which of the following is most likely the speed of a fast swimmer in a pool?
   - A: 0.001 m/s
   - B: 0.01 m/s
   - C: 1 m/s
   - D: 100 m/s
2. Which of the following is most likely the volume of the bed of a pickup truck?
   - A: 1.5 m
   - B: 150 m^3
   - C: 0.15 m^3
   - D: 1.5 m^3
3. Convert 90 kilometers per hour to meters per second.

4. A glacier moves at 1 cm per year. What is this speed in meters per millenium? (A millenium is 1000 years).

2 Displacement, Velocity, and Constant Acceleration

1. Suppose the position of an object is described by the following equation: $x(t) = 0.1t - 1.0$ m. What is the displacement Δx if the initial time is $t_i = 4.0$ seconds, and the final time is $t_f = 10.0$ seconds?

2. In the previous problem, which of the following is true of the velocity?
   - A: Velocity is positive.
   - B: Velocity is negative.
   - C: Velocity is zero.
   - D: Velocity is undetermined.
3. A submarine sails underwater at 30 knots (15 m/s), to the West. Draw a coordinate system with the submarine at the origin, and draw the velocity vector of the submarine.

4. How far has the sub traveled in 1 hour? Where is it located? *Check your units.*

5. A train slows, aproaching the next station: it changes from 20 m/s to 0 m/s over a span of 40 seconds. What is the acceleration? Should it be positive or negative?

6. A child throws a ball to her father, who stands some distance away. Which of the following is true of the acceleration of the ball?
   - A: Acceleration is positive (up).
   - B: Acceleration is negative (down).
   - C: Acceleration is positive (up), then negative (down).
   - D: Acceleration is negative (down), then positive (up).
7. The child throws the ball such that the inital y-component of the velocity and the initial x-component of the velocity are both 4 m/s. (a) When would it land if it hit the ground? (b) Where would it land?

3 Vectors

1. Let $\vec{x}_1 = (-3.0, -4.0)$ m, and $\vec{x}_2 = (3.0, 4.0)$ m. (a) What is $\vec{x}_1 + \vec{x}_2$? (b) What are the magnitudes of $\vec{x}_1$ and $\vec{x}_2$? (c) What is the dot product of the two vectors?

2. **Jet fighters.** Maverick takes off in his jet fighter, heading 30 degrees North of East at a velocity $\vec{v}$, after an enemy MIG-28 is detected at a range of 200 kilometers, 30 degrees North of East. (a) Draw the coordinate system and mark the locations of both planes. (b) If the speeds of the planes are equal, where will they meet? (*Specify the coordinates*).

3. The two pilots meet! (a) How far has each pilot traveled, from the time Maverick took off? (b) What are the velocity vectors of each plane, if it took 10 minutes for them to reach each other?