Name:_____ ID:_____ Lab (day/time)_____

Physics 201

Midterm Exam 1

6/28/2016

Collaboration is not allowed. Allowed on your desk are: up to ten 8.5 x 11 inch doubled sided sheets of notes that are bound together, non-communicating/graphing scientific calculator, 1 page of scratch paper, writing utensils, and the exam. You will have 50 minutes to complete this exam.

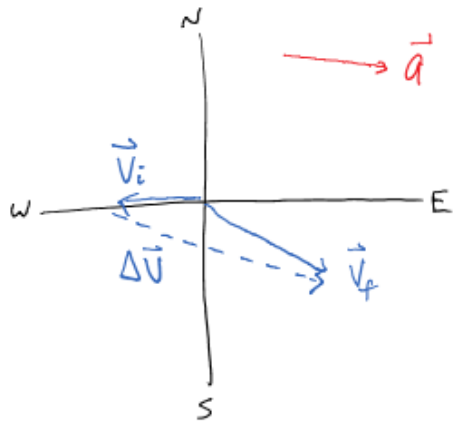
1. (10 points) An unidentified flying object maintains a constant acceleration for 2.50 s. The acceleration during this time is 10 m/s^2 in the eastern direction and 4 m/s^2 in the southern direction. The final velocity of the object is 15 m/s in the eastern direction and 10 m/s in the southern direction. (a) What was the initial velocity of the object? (b) Draw a physical representation of the initial, final, and change in velocity.

a) $\vec{a} = \dfrac{\vec{V}_f - \vec{V}_i}{\Delta t} \Rightarrow \vec{V}_i = \vec{V}_f - \vec{a}\Delta t$

$\vec{V}_i = \langle 15, -10 \rangle \text{ m/s} - \langle 10, -4 \rangle \text{ m/s}^2 \, (2.5\text{ s})$

$= \langle -10, 0 \rangle \text{ m/s}$

b)



Rubric

(a) 2pt - definition $\vec{a}$

1pt - N, S, E, W → Cartesian

3pt - solving V_i

1pt - answer w/ units

(b) 1pt each vector

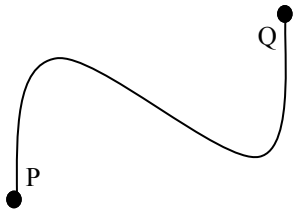
For questions 2 through 4 circle all correct answers, a given problem may have more than one correct answer. Each correctly circled answer will receive two points. There are **5** correct answers in this section and only the first **5** circled answers will be graded. There is no partial credit.

2. An object moving along a straight line has it's velocity pointing in the opposite direction of it's position. Which *one* of the following statements concerning the object is *necessarily* true?

[?] (a) The value of the acceleration is negative.
[?] (b) The direction of the acceleration is in the opposite direction as the displacement.
[?] (c) The direction of the acceleration is in the direction opposite to that of the velocity.
[T] (d) The object is moving towards the origin.
[?] (e) The object is slowing down.

3. An amoeba travels at a constant speed along a curved path as shown. Considering between the points P and Q, which of the following statements are true regarding this situation.

[F] (a) The distance traveled is the same as the magnitude of the displacement.
[F] (b) The magnitude of the average velocity is greater than the amoeba's constant speed.
[T] (c) The magnitude of the average velocity is less than the amoeba's constant speed.
[F] (d) The magnitude of the average velocity is equal to the amoeba's constant speed.
[F] (e) The amoeba experienced zero acceleration the entire trip.
[T] (f) The amoeba experienced both periods of zero and non-zero acceleration.



4. The table lists four variables along with their units. These variables appear in the below equations, along with a few numbers that have no units. Which of the equations are *not* dimensionally valid?

Variable	Units
x	Meters (m)
v	Meters per second (m/s)
t	Seconds (s)
a	Meters per second squared (m/s^2)

(a) $x = vt$
(b) $x = vt + \frac{1}{2}at^2$
(c) $v = at$
(d) $v = at + \frac{1}{2}at^3$
(e) $v^3 = 2ax^2$
(f) $t = \sqrt{\frac{2x}{a}}$

---

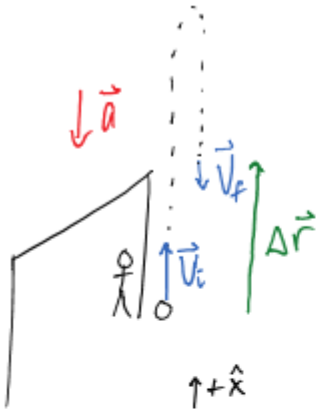
5. (4 points) Pressure is a physical quantity that describes a force per area. The International System of Units (SI) unit for pressure is called a Pascal (Pa), which is equal to a Newton (N) per meter squared. The atmospheric pressure on top of Mt. Everest is 33.7 kilopascals. Knowing that a pound (lb) is equal to 4.45 N and that 1 inch is equal to 2.54×10^{-5} kilometers, determine the pressure on top of Mt. Everest in pounds per square inch (psi).

$P = 33.7 \times 10^3\ Pa$, $Pa = \frac{N}{m^2}$, $1lb = 4.45N$, $1inch = 2.54 \times 10^{-5} km$

$$\frac{33.7 \times 10^3\ N}{m^2} \left| \frac{1lb}{4.45N} \right| \left[\frac{1000m}{1km} \right]^2 \left| \left[\frac{2.54 \times 10^{-5} km}{1inch} \right]^2 = 4.89\ psi \right.$$

Rubric
0.5pt - kilo ... $\times 10^3$
0.5pt - $Pa \rightarrow \frac{N}{m^2}$
1pt - Canceling N
1.5pt - squared conversions
0.5pt - Answer + units

6. (10 points) A goalie kicks a soccer ball straight vertically into the air. It takes 5.00 s for the ball to reach its maximum height *and* come back down to the level of the crossbar. Assume the crossbar of a soccer goal is 2.44 m above the ground. (a) How fast was the ball originally moving when it was kicked. (b) How much longer would it take the ball to reach the ground?



(a)

K	uk	equations
$\Delta t = 5s$	V_i ?	(i) $\Delta x = V_i \Delta t + \frac{1}{2} a \Delta t^2$
$\Delta x = 2.44 m$	V_f	(ii) $V_f = V_i + a\Delta t$
$a_x = -9.8 m/s^2$		(iii) $V_f^2 = V_i^2 + 2a\Delta x$

(i) $\Delta x = V_i \Delta t + \frac{1}{2} a \Delta t^2$

$$V_i = \frac{\Delta x - \frac{1}{2} a \Delta t^2}{\Delta t} = 24.988 s$$

(b) w/ V_i same as (a) but $\Delta x_b = 0$

$\Delta x_b = V_i \Delta t_b + \frac{1}{2} a \Delta t_b^2$

$$\Delta t_b = \frac{2 V_i}{-a} = 5.09959 s$$

so a difference of 0.0996 s

Rubric

(a) 1.5pt - physical representation
1.5pt - knowns + unknowns
1pt - $\Delta x = 2.44 m$
2pt - eq. (i)
0.5pt - Answer w/ units

(b) 1pt - using V_i from (a)
1pt - setting $\Delta x = 0$
1pt - eq. (i)
0.5pt - Answer + units

Scores:

Problems

1	2-4	5	6

Exam Total
