# Physics 218: Exam 1

**February** 10th, 2016

Please read the instructions below, but **do not open the exam until told to do so**.

**Rules of the Exam:**

1. You have 75 minutes to complete the exam.
2. Formulae are provided on a separate colored sheet. You may NOT use any other formula sheet.
3. You may use SAT approved handheld calculator. However, you MUST show your work. If you do not show HOW you integrated or HOW you took the derivative or HOW you solved a quadratic or system of equations, etc you will NOT get credit.
4. Cell phone and any other internet connected device use during the exam is strictly prohibited.
5. Be sure to put a box around your final answers and clearly indicate your work.
6. Partial credit can be given ONLY if your work is clearly explained and labeled. No credit will be given unless we can determine which answer you are choosing, or which answer you wish us to consider. If the answer marked does not follow from the work shown, even if the answer is correct, you will not get credit for the answer.
7. You do not need to show work for the multiple choice questions.
8. Have your TAMU ID ready when submitting your exam to the proctor.
9. Check to see that there are a total of 5 problems (5 multiple choice questions count as one).
10. **If you need extra space**, use the reverse side to complete your work and indicate/ mark on the main page of the problem that you are continuing on the reverse side. You may ask for extra space (scratch paper).
11. **DO NOT REMOVE ANY PAGES FROM THIS BOOKLET.**

**Sign below to indicate your understanding of the above rules.**

Name (in CAPS) : _____ Section Number: _____

UIN: _____

Instructor's Name:_____ Your Signature: _____

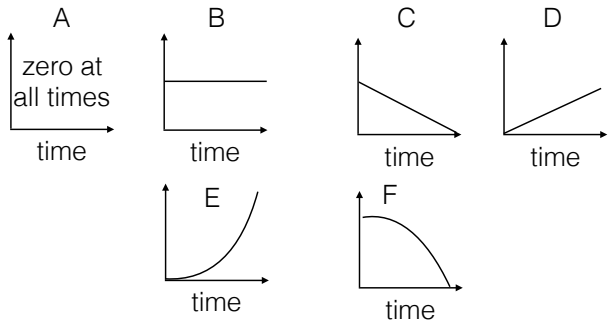
| | |
|---|---|
| **Short Problems (20)** | _____ |
| **Problem 2 (20)** | _____ |
| **Problem 3 (20)** | _____ |
| **Problem 4 (20)** | _____ |
| **Problem 5 (20)** | _____ |
| **Total Score (100)** | _____ |

## Short Problems (<u>Circle</u> the correct option) [<u>NO Partial Credit</u>] [20 Points]

| | |
|---|---|
| **A) [4 points]** The speed of light in vacuum is known to be $3.0 \times 10^{10}$ cm/s. What is its value in mph (miles per hour) units? (1 mi = 1609 m) | i) $6.7 \times 10^{8}$ mph<br>ii) $1.3 \times 10^{8}$ mph<br>iii) $6.7 \times 10^{10}$ mph<br>iv) $1.3 \times 10^{10}$ mph<br>v) $1.1 \times 10^{9}$ mph<br>vi) None of the above |

| | |
|---|---|
| B) **[4 points]** Vector $\vec{A}$ has magnitude **5** and vector $\vec{B}$ has magnitude **20**. The scalar product $\vec{A} \bullet \vec{B}$ is **-100**. What is the magnitude of the vector sum between these two vectors. | i) 5<br>ii) 10<br>iii) 15<br>iv) 20<br>v) 25<br>vi) 30<br>vii) None of the above |

C) **[4 points]** A stone is thrown horizontally from a window of a tall building. Choose from the graphs below those that best describe magnitudes of x and y components of velocity vector as a function of time. (For example, if your answer is "A,B" then this would mean that graphs A and B correspond to x and y components of a velocity vector as a function of time respectively.)




i) A,F

ii) B,F

iii) C,E

iv) C,B

v) D,A

vi) A,D

vii) B,D

viii) D,F

ix) E,F

x) B,E

D) **[4 points]** To practice for the driving test exam at DPS a high school student decides to practice on an empty Walmart parking lot. He is driving with constant speed along a circular trajectory of constant radius. What can we say about his acceleration? (1 mi = 1609 m)

i) there is no acceleration - his speed is constant!

ii) there is an acceleration in the direction away from the center of the circle.

iii) there is radial acceleration in the direction toward the center of the circle.

iv) the direction of acceleration is not known, it depends on actual speed of the car and radius of the trajectory

v) acceleration is in the direction of motion - always tangential to the trajectory

| | |
|---|---|
| E) **[4 points]** A boat sailed 10 miles north, then 5 miles 45$^{o}$ west from north and then 25 miles south. What is the magnitude of the displacement in miles for this trip? | i) 8<br>ii) 10<br>iii) 12<br>iv) 14<br>v) 15<br>vi) 20<br>vii) 30<br>viii) 35<br>ix) 40<br>x) 42 |

## **Problem 2** (20 points)

A point particle is moving at a straight line in positive x-direction and has a velocity that is given by the following equation $\mathbf{v(t) = 0.30*t^2 + 4.0}$ m/s.

A. What is the instantaneous acceleration at time t=5.0 s?

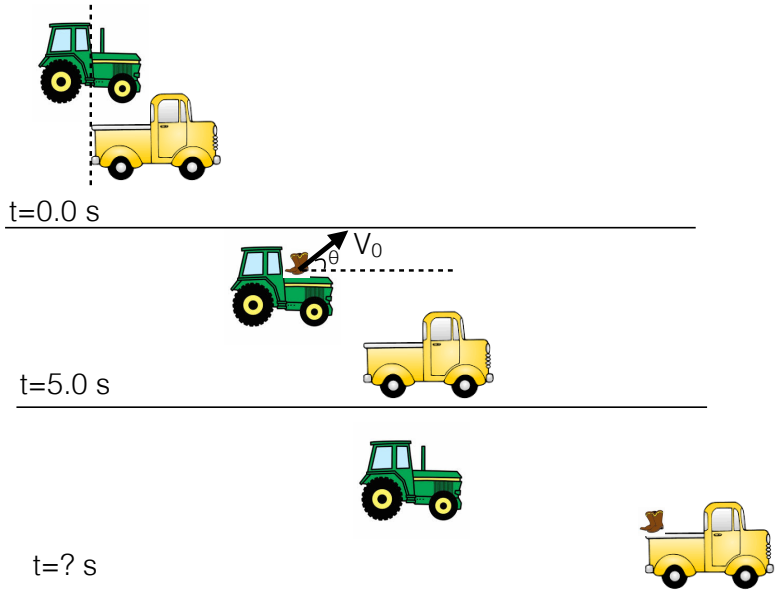
B. What is the average acceleration for the time interval from 0.0 to 5.0 s?

C. What is the displacement of the point particle in the time interval from 0.0 s to 5.0 s?

Extra Space

## **Problem 3** (20 points)

On a rural Navasota road a truck overtakes a tractor. The tractor runs with a constant speed of 20.0 m/s. The truck moves with an acceleration of 0.5 m/s$^2$ and a speed of 25.0 m/s at the moment when it overtakes the tractor (the truck's bed just clears the driver/passenger seats of the tractor). To have some fun the passenger in the tractor throws his cowboy boots into the truck's bed. However, the boots were thrown 5.0 s after the tractor was overtaken (the passenger needed some time to take the shoes off). The initial velocity of the boots makes 30 degrees angle with respect to the horizontal surface of the road. (*Consider the tractor, the truck and the boots as point particles in this problem and ignore air resistance.*)




A. What is the distance covered by the tractor and the truck **after** the tractor was overtaken by the truck and **just before** the boots were thrown? (*Make sure to provide two answers - one for the **truck** and one for the **tractor.***)

B. What is the minimum magnitude of the initial boots's velocity **with respect to the road's surface** required for successful (boots land on a truck bed) throw? (Assume that the release point of the boots and the truck's bed are at the same height.)

C. What is the magnitude of the initial velocity of the boots **with respect to the tractor**?

**Problem 4** (20 points)

A group of girl-scouts had followed a forest trail until they reached the Brazos river. Unfortunately, a bridge across the river was damaged by the recent flood and they had to use an inflatable boat to cross the river which has width ***L*** at this location. The girls have not had physics classes in school yet so they tried to cross the river by rowing across the river directing the boat perpendicular to the shoreline. However, due to the strong stream that has speed $V_s$, they get to the other side of the river at a distance ***D*** downstream from the desired destination.

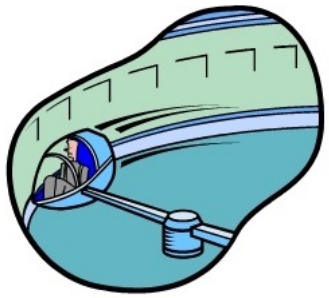
**A.** What is the speed of the boat with respect to the water? (express your answer in terms of known values ***L, D,*** $V_s$)

**B.** On the return trip they corrected the mistake (smart girls!) and directed the boat at the correct angle with respect to the shoreline - such that the boat moved straight (perpendicular to the shoreline). How much time does it take them to cross the river back if the speed of the boat with respect to water is the same as in part **A**? (express your answer in terms of known values ***L, D,*** $V_s$)

Extra Space

**Problem 5** (20 points)

As part of a training program astronauts are required to experience effects of strong g-force in centrifuges. If an astronaut passes out during such exercise emergency brakes are applied that quickly bring a centrifuge to a complete stop. Assume that the astronaut is placed at the end of the centrifuge at a radius of 10.0 m.



A) What is the magnitude of acceleration of the astronaut during steady rotation of the centrifuge if it makes 30 revolutions per minute.

B) The centrifuge comes to a complete stop in 5.0 seconds after the emergency brakes are applied. Deceleration proceeds at a uniform rate (constant negative tangential acceleration). What is the magnitude of tangential and radial accelerations of the astronaut exactly 2.0 seconds **after** application of the brakes.

Extra space