Physics 206 – Exam I

Fall 2019 (all UP sections) **September 23rd, 2019**

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

Rules of the exam:

1. You have 90 minutes (1.5 hrs) to complete the exam.
2. Formulae are provided to you with the exam on a separate sheet. Make sure you have one before the exam starts. You may *not* use any other formula sheet.
3. Check to see that there are 8 numbered (4 double-sided) pages in addition to the scantron-like cover page. **Do not remove any pages**.
4. If you run out of space for a given problem, the last two pages have been left blank and may be used for extra space. Be sure to indicate *at the problem under consideration* that the extra space is being utilized (and also on the extra sheets, which problem the work refers to) so the graders know to look at it!
5. Calculators of any type are **not allowed**. In the case of questions with numerical values, the math should be simple enough you will not need a calculator. For purely symbolic questions, ensure that all your answers are in terms of the known variables given in the question.
6. Cell phone use during the exam is strictly prohibited. Please turn off all ringers as calls during an exam can be quite distracting.
7. Be sure to put a box around your final answer(s) and clearly indicate your work. Credit can be given **only** if your work is legible, clearly explained, and labelled.
8. Unless explicitly stated otherwise in the question, all of the free-response problems in this exam require you show your work and reasoning. You do **not** need to show your work for the multiple-choice problems.
9. Have your TAMU ID ready when submitting your exam to the proctor.

Fill out the information below and sign to indicate your understanding of the above rules

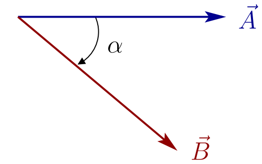
Name: ______________________ UIN: ______________________
(printed *legibly*)

Signature: ______________________ Section Number: ______________

Instructor: Kocharovsky Melconian
(circle one)

Short Problems:

A) Two vectors $\vec{A}$ and $\vec{B}$ have equal magnitues $A = B = 2$ and lay in the x-y plane with vector $\vec{A}$ being parallel to the x-axis. Their scalar product is $\vec{A} \cdot \vec{B} = 2\sqrt{2}$.



(i) What is the angle α between vectors $\vec{A}$ and $\vec{B}$?

Ans: ______________________________

(ii) If this angle α is in the clockwise direction, what is the magnitude of the vector product of these two vectors? What is the direction of the vector product?

Ans: ______________________________

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LO	S	U
2.1		
3.1		
2.2		
2.3		

B) The speed of a particle as the function of time t is described by the equation $\vec{v} = bt^2\hat{j}$, where b is a constant. Find

(i) The particle's displacement over the interval $t_1 = 0$ to $t_2 = t$.

Ans: ______________________________

(ii) The particle's acceleration as a function of time.

LO	S	U
8.1		
14.1		
15.1		
8.2		
14.2		
15.2		

Ans: ______________________________

C) An airplane pilot sets a compass course due north and maintains a constant airspeed $v_{p/a}$ at a constant altitude. After flying for a time t, she finds herself over a town a distance x east and a distance y north of her starting point.

(i) Find the x- and y-components of her average velocity relative to the ground.

Ans: ______________________________

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(ii) Find the x- and y-components of the average wind (air) velocity, assuming that it was constant.

LO	S	U
1.1		
11.1		
11.2		
1.2		
20.1		
20.2		

Ans: ______________________________

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Prob 1 Starting from a moment $t = 0$ s, the position of a train moving in the $\hat{\imath}$ direction is given by the function $x(t) = c_1 + c_2 t + c_3 t^2/2$, where the constants are $c_1 = 10$ m, $c_2 = 50$ m/s, and $c_3 = -10$ m/s^2.

(a) Find the acceleration of the train. Is it constant or not?

Ans: ______________________ ☐ Yes ☐ No

(b) Find the time it takes to reach the turning point, where the train momentarily stops.

Ans: ______________________

(c) What is the velocity train when it *first* reaches a displacement of $\Delta x = 4500$ cm from its initial position?

Ans: ______________________

(d) After passing the position in part (c) above, which of the following best describes the train's subsequent motion? Here "right" means positive $\hat{\imath}$, and "left" means $-\hat{\imath}$. (Check one, you do not need to show your work).

☐ to the right,

☐ to the left,

☐ first to the right, and later to the left, or

☐ first to the left, and later to the right?

LO	S	U
8.3		
12.1		
15.3		
3.2		
6.1		
8.4		
12.2		
3.3		
5.1		
10.1		
14.3		
13.1		

Prob 2 A pilot released a package from rest relative to an airplane. The airplane maintains a constant horizontal velocity of 360 km/hour due east at an altitude of 2 km. Assume that the effect of the air resistance on the package is negligible, and that the acceleration due to gravity is $g = 10$ m/s^2.

(a) Find velocity (direction and magnitude) of the package *relative to the airplane* after 10 s of free fall.

Ans: ____________________

(b) Draw a coordinate system (horizontal distance versus height) and qualitatively sketch the trajectory of the package for each of the following frames of reference:

(i) In the reference frame which is co-moving with the airplane.

(ii) In the ground-based reference frame.

(c) Find the time it takes for the free-falling package to reach the ground.

Ans: ____________________

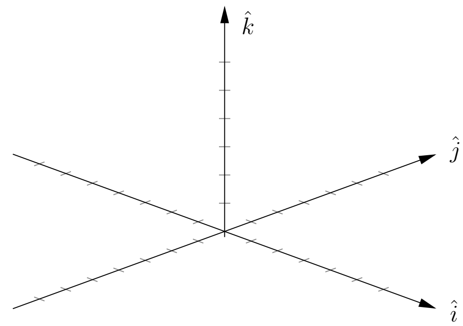
(d) Find the range of flight (the horizontal displacement) of the package in km.

Ans: ____________________

LO	S	U
6.2		
13.2		
14.4		
20.3		
9.1		
9.2		
14.5		
20.4		
3.4		
10.2		
12.3		
14.6		
15.4		
10.3		
10.4		
14.7		
15.5		

Prob 3 An amusement park ride is composed of a horizontal wheel of seats that can be raised or lowered during the ride. The seats are arrayed on a circle of radius R, and the wheel of seats makes one complete revolution about a vertical axis passing through the center of the ride in T seconds. At the start of the ride the wheel is at the ground and is set into rotation about the vertical axis. The wheel of seats is then raised with a constant vertical velocity of v_z while the wheel continues to rotate. Answer the following in terms of the constants given, R, T and v_z.

(a) Using the coordinates drawn to the right, sketch the path of the rider for at least 3 rotations around the central $\hat{k}$ axis.



(b) What is the magnitude of the component of the rider's velocity in the horizontal plane?

Ans: ______________________________

(c) What is the magnitude of the velocity vector of a person sitting in one of the seats of the ride as viewed by someone standing on the ground? What angle does this velocity vector make with respect to the horizontal plane during the ride?

Ans: ______________________________

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(d) Find the acceleration (magnitude and direction) of this rider.

Ans: ______________________________

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LO	S	U
6.3		
16.1		
11.3		
19.1		
1.3		
3.5		
13.3		
16.2		
3.6		
12.4		
13.4		
16.3		
18.1		
19.2		

Extra space:

Extra space (continued):