Physics 206 – Exam I

Spring 2019 (all UP sections) **February 18$^{\text{th}}$, 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 $\boxed{\text{final answer(s)}}$ 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*)

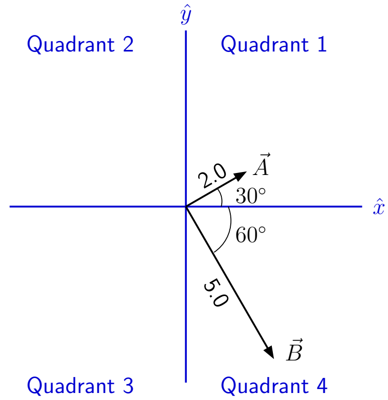
Signature: ______________________________ Section Number: ____________________

Instructor: (circle one)

Allen	Eusebi	Kocharovsky	Kubik
Mahapatra	McIntyre	Saslow	Wu

Short Problems:

A) You are given two vectors $\vec{A}$ and $\vec{B}$ as shown. The magnitude of $\vec{A}$ is 2.0 and its direction is 30° counterclockwise from the $\hat{x}$ axis. The magnitude of $\vec{B}$ is 5.0 and its direction is 60° clockwise from the $\hat{x}$ axis.



(i) In which quadrant does $\vec{A}+\vec{B}$ lie?

Ans: ____________________

(ii) In which quadrant does $\vec{A}-\vec{B}$ lie?

Ans: ____________________

(iii) Calculate the scalar product, $\vec{A}\cdot\vec{B}$.

Ans: ____________________

(iv) In which direction does the vector produce $\vec{A}\times\vec{B}$ point? What is the magnitude of $\vec{A}\times\vec{B}$?

Ans: ____________________

LO	S	U
1.1		
2.1		
1.2		
2.2		
2.3		
2.4		
2.5		

B) Starting from rest at the origin, $x_0 = 0$, a car accelerates in a straight line along the $+x$ direction. For the time interval from $t_0 = 0$ s to $t_1 = 4$ s, its velocity is given by $v(t) = (-10\ \text{m/s}^2)t + (6\ \text{m/s}^3)t^2$. Then from $t_1 = 4$ s to $t_2 = 10$ s, it maintains a constant velocity $v = 56$ m/s in the same direction.

(i) Find the average acceleration for the first time interval, from $t_0 = 0$ s to $t_1 = 4$ s.

Ans: ____________________

(ii) Find the average acceleration for the second time interval, from $t_1 = 4$ s to $t_2 = 10$ s.

Ans: ____________________

(iii) Find the instantaneous acceleration $a(t)$ as a function of time for $0\ \text{s} < t < 4$ s.

Ans: ____________________

(iv) Find the position $x(t)$ as a function of time for $0\ \text{s} < t < 4$ s.

Ans: ____________________

LO	S	U
11.1		
11.2		
8.1		
12.1		
14.1		
8.2		
12.2		
14.2		

C) A hammer is thrown from the ground level of the Moon with a speed $v_0 = 10$ m/s at an angle 45° above the horizontal. Assume that the acceleration due to gravity on the surface of the Moon is one sixth of the acceleration due to gravity on the surface of the Earth (take $g = 10$ m/s^2).

(i) Draw a coordinate system and sketch the hammer's trajectory.

(ii) Find the maximum height of flight of the hammer.

Ans: ______________________________

(iii) Find the component of the hammer's acceleration vector that is perpendicular to the hammer's velocity vector at the highest point.

Ans: ______________________________

(iv) What is the hammer's velocity at the highest point?

Ans: ______________________________

LO	S	U
9.1		
14.3		
1.3		
13.1		
14.4		
13.2		
15.1		
18.1		
12.3		
13.3		

Prob 1 Sarah and Bob depart from the bus stop. Sarah walks north for 10 meters and then east for another 30 meters. Bob walks south at some unknown constant speed, v_B, for $\Delta t = 10$ seconds.

(a) Draw a clear coordinate system, and then on it draw Bob's and Sarah's paths.

(b) Find and plot the displacement vectors for both Sarah and Bob.

Ans: ______________________________

(c) Find the speed, v_B, (in km/hour) with which Bob would need to walk if Sarah and Bob were to end up 50 meters from each other.

LO	S	U
9.2		
1.4		
6.1		
11.3		
2.6		
5.1		
6.2		
10.1		

Ans: ______________________________

Prob 2 Elvis is in a speeding car moving in the trajectory $x(t) = (40 \text{ m/s})t$ along the x axis and t is the time in seconds. An Elvis fan is moving in the trajectory $x(t) = -400 \text{ m} - (20 \text{ m/s})t + (4 \text{ m/s}^2)t^2$.

(a) Sketch the initial positions of Elvis and the fan's car in an appropriate coordinate system.

(b) Find the time at which the fan's car has zero instantaneous velocity, $v(t) = 0$.

Ans: ______________________

(c) Find when Elvis and the fan's car have the same velocity.

Ans: ______________________

(d) Find the time when the fan catches up with Elvis.

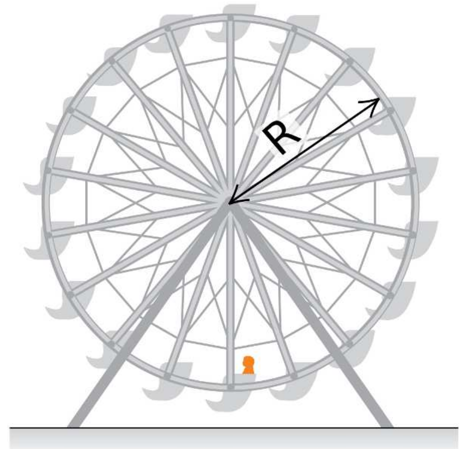
Ans: ______________________

(e) Find how far, in feet, Elvis has moved when the fan catches up to him. Assume 1 m = 3 ft.

Ans: ______________________

LO	S	U
9.3		
3.1		
8.3		
12.4		
3.2		
6.3		
3.3		
5.2		
6.4		
14.5		
6.5		
10.2		
14.6		

Prob 3 A Ferris wheel with radius $R = 1400$ cm is turning clockwise about a horizontal axis through its center as shown. The linear speed of a passenger on the rim is constant and equal to $v = 6$ m/s.



(a) What is the magnitude and direction of the passenger's acceleration as she passes through the lowest point in her circular motion?

Ans: ______________________________

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(b) What is the magnitude and direction of the passenger's acceleration as she passes through the highest point in her circular motion?

Ans: ______________________________

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(c) How much time does it take the Ferris wheel to make one revolution? (Take $\pi \approx 3$ for this question.)

Ans: ______________________________

LO	S	U
10.3		
15.2		
17.1		
18.2		
19.1		
10.4		
15.3		
17.2		
18.3		
19.2		
3.4		
6.6		
10.5		
19.3		

Extra space:

Extra space (continued):