Physics 218 – Exam I

Fall 2018 (all UP sections) **September 26$^{\text{th}}$, 2018**

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 (four 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 page has 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 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 problems in this exam require you show your work and reasoning.
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) Each of the following equations was given by a student during an examination:

(a) $\frac{1}{2}Mv^2 = \frac{1}{2}Mv_\circ^2 + \sqrt{Mgh}$ (b) $v = v_\circ + at^2$ (c) $Ma = v^2$,

where M is a mass, v is a speed, g is the magnitude of the acceleration due to gravity, t is time, and a is an acceleration. Determine the SI units of each term in each equation, and briefly explain whether the equation can be correct or not based soley on the consistency of the units.

(a)

(b)

(c)

LO	S	U
10.1		
12.1		
10.2		
12.2		
10.3		
12.3		

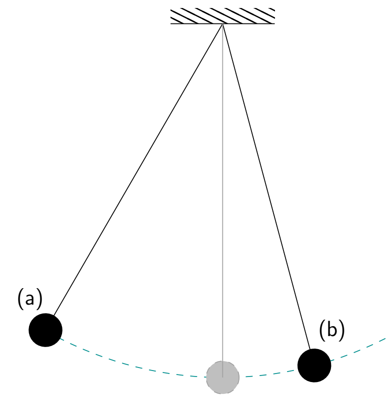
B) Given $\vec{A} = 2\hat{\imath} - 3\hat{k}$ and $\vec{B} = -\hat{\imath} + \hat{\jmath} + 2\hat{k}$, find:

(a) the product $\vec{A} \cdot \vec{B}$

(b) the product $\vec{A} \times \vec{B}$

LO	S	U
2.1		
2.2		

C) A simple pendulum (a mass swinging at the end of a string) swings back and forth in a circular arc as shown. For each of the labelled points, determine the direction of the acceleration of the mass and draw the approximate direction on the figure.



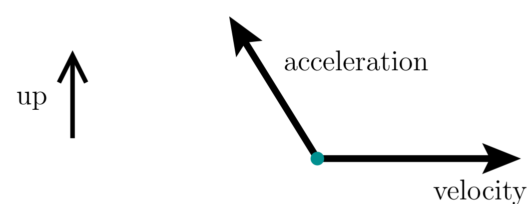
(a) At its maximum height

(b) Partway up the right side

LO	S	U
13.1		
16.1		
17.1		
18.1		
13.2		
16.2		
17.2		
18.2		

D) At a certain instance of time, the acceleration and velocity vectors of an object are as shown below. Which statement most correctly describes the motion of this object at that time? (You do not need to explain your reasoning for this question).

(a) it is slowing down and turning upwards
(b) it is speeding up and turning upwards
(c) it is maintaining its speed but turning upwards
(d) it is slowing down and turning downwards
(e) it is speeding up and turning downwards
(f) it is maintaining its speed but turning downwards



LO	S	U
1.1		
2.3		
13.3		

Prob 1 An antelope moving with constant acceleration covers the distance between two points 70.0 m apart in 7.00 s. Its speed as it passes the second point is 15.0 m/s.

(a) What was its speed at the first point?

Ans: ______________________________

(b) What acceleration did the antelope have between the two points?

Ans: ______________________________

(c) Using the same values you got above for the antelope, imagine now that a lion, able to accelerate at 3.00 m/s^2, was hiding in the grass at the first point. It misses the antelope when it first passes by, but immediately starts giving chase from rest at the same time the antelope passes it. How far does the antelope travel before the lion catches up to it?

LO	S	U
3.1		
14.1		
3.2		
14.2		
3.3		
14.3		
20.1		

Ans: ______________________________

Prob 2 At the instant a traffic light turns green, a car that has been waiting at an intersection starts ahead with a constant acceleration of 3.20 m/s^2. At the same instant a truck, traveling with a constant speed of 32 m/s, overtakes and passes the car.

(a) How far beyond its starting point does the car overtake the truck?

Ans: ______________________________

(b) How fast is the car traveling when it overtakes the truck?

Ans: ______________________________

LO	S	U
3.4		
14.4		
20.2		
14.5		
20.3		

Prob 3 The radius of the Earth's orbit around the sun (assumed to be circular) is 1.5×10^8 km, and the Earth travels around this orbit in a year, which is approximately $\pi \cdot 10^7$ s. *Note*: your answers to all parts of this question may include π without evaluating it numerically.

(a) What is the magnitude of the orbital velocity of the Earth, in m/s?

Ans: ______________ m/s

(b) What is the radial acceleration of the Earth towards the sun, in m/s^2?

Ans: ______________ m/s^2

(c) If I inform you that the Moon's radial acceleration is 2.5×10^{-3} m/s^2 as it orbits the Earth, and remind you that a lunar month (it's orbital period) is approximately 2.5×10^6 s, calculate how far the moon is from the Earth, in km. *Note*: $(2.5)^2 \approx 2\pi$.

LO	S	U
10.4		
16.3		
19.1		
10.5		
16.4		
18.3		
19.2		
16.5		
18.4		
19.3		

Ans: ______________ km

Prob 4 You are told that the velocity of a plane is given by $\vec{v}(t) = \left[7.30\ \text{m/s} + \left(0.0260\ \text{m/s}^3\right) t^2\right]\hat{\imath} - \left[\left(4\ \text{m/s}^2\right) t\right]\hat{\jmath}$, where $\hat{\imath}$ is the horizontal direction pointing north and $\hat{\jmath}$ is vertically upwards. You note that at a particular time, say $t = 0$, it is 5.00 km above the ground and 450.0 m south of you.

(a) Determine the horizontal and vertical components of the plane's acceleration as a function of time.

Ans: ______________________________

(b) Determine the horizontal and vertical components of the plane's position vector relative to you as a function of time.

Ans: ______________________________

(c) How long before the plane reaches ground level?

Ans: ______________________________

LO	S	U
1.2		
8.1		
12.4		
1.3		
8.2		
14.6		
3.5		
14.7		

Extra space: