Physics 218: Exam 1

Sections: 201-203, 520-529,534-538, 544, 546-555, 557,569, 572

September 28th, 2016

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

Rules of the Exam:

1. You have 90 minutes to complete the exam.

2. Formulae are provided on the last page. You may NOT use any other formula sheet.

3. You may use any type of 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 use during the exam is strictly prohibited.

5. Be sure to put a box around your final answers and clearly indicate your work.

6. 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 are required to show work for the short answer questions.

8. Have your TAMU ID ready when submitting your exam to the proctor.

9. Check to see that there are 8 numbered pages.

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.

Sign below to indicate your understanding of the above rules.

11. DO NOT REMOVE ANY PAGES FROM THIS BOOKLET (except the formula sheet).

Name (printed): ____________________________ Section Number: _________________________

Instructor's Name:___________________________ Your Signature:_________________________

Blank page for work

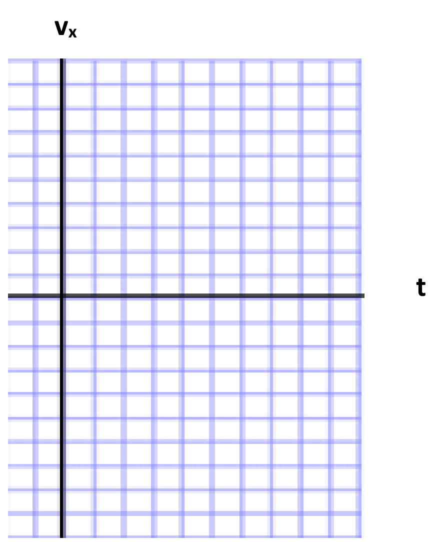
Short answer questions:

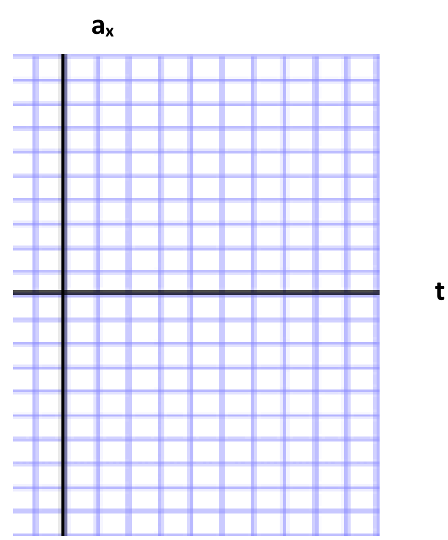
1. Find the angle between two vectors if ratio of the magnitude of their vector product to their scalar product is 0.2.

2. You throw a ball straight up and catch it at the same point on its return. During the ball's flight it reaches a maximum height, H, above the release point. In terms of H, at what height above the release point will the instantaneous velocity be the same as the average velocity over the entire path?

3. A block is pushed up a frictionless ramp with an initial velocity and released at *t=0*. The incline makes a 30 degree angle to the horizontal. After reaching some distance up the ramp, the block slides back down. Sketch *qualitatively* the v_x-t and a_x-t graphs, **assuming x-axis is along the ramp pointing down**. Be sure to show these quantities for the entire round trip of the block.

	LO	Pass	Fail
1	2.1		
	3.1		
2	11.1		
	12.1		
	13.1		
3	12.2		
	13.2		





4. A typical garden hose attached to a faucet has a water flow rate of 100 liters per minute. What is the flow rate of this hose in SI units? (1 liter is a volume of a cube with 10 cm sides).

5. A typical DVD player spins its disk at a constant 1600 rpm (revolutions per minute). If the diameter of a typical disk is 12.0 cm, find the acceleration of a point on the rim during this rotation. (Be sure to give both magnitude and direction.)

	LO	Pass	Fail
4	10.1		
5	18.1		
	19.1		
	20.1		

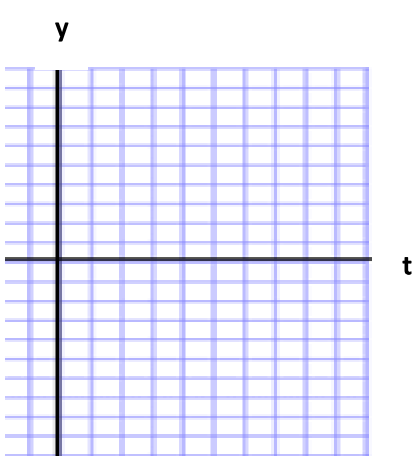
Problem 1. A 5000 lb. SpaceX rocket blasts off vertically from the launch pad at Cape Kennedy Space Center with a net constant upward acceleration of 2 m/s^2. Unfortunately, the engine suddenly and completely fails when the rocket is at a height of 500 m, at which point the rocket continues its flight now unpowered. Ignoring air resistance, answer the following:

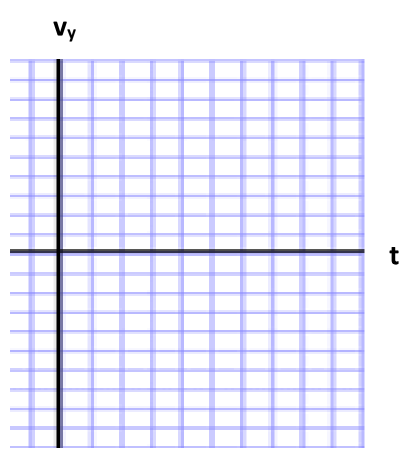
a. What is the maximum height this rocket will reach?

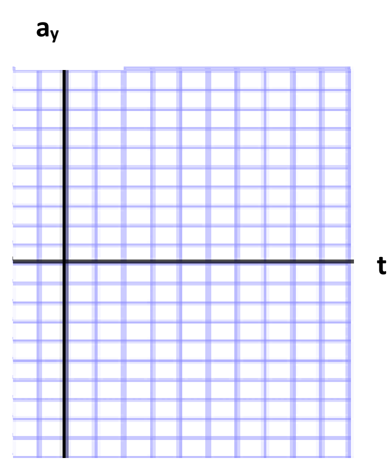
b. How long is the rocket's flight from lift off to just before it crashes back on earth?

c. Sketch y-t, v_y-t and a_y-t graphs of the rocket's motion from the instant of blast-off to the instant just before it strikes the launch pad.

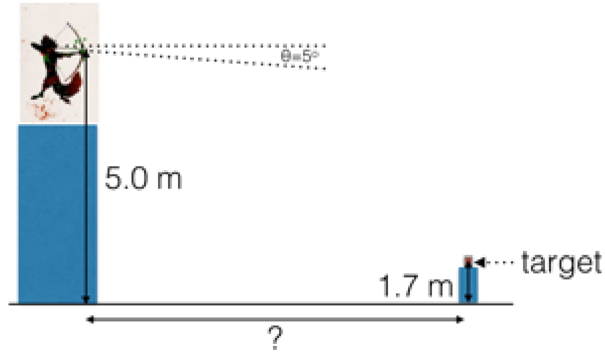
	LO	Pass	Fail
a	3.2		
	12.3		
	14.1		
b	5.1		
	14.2		
c	12.4		
	13.3		
	13.4		







Problem 2. Robin Hood is sitting on a tree and wishes to hit a small target (consider it a point target) that is below him at 1.7 meters above the ground. An arrow released from Robin Hood's bow has velocity of 65 m/s and initially makes a 5 degree angle below the horizontal. The arrow is released at a height of 5 m above the ground. Ignore effects of wind and air resistance.



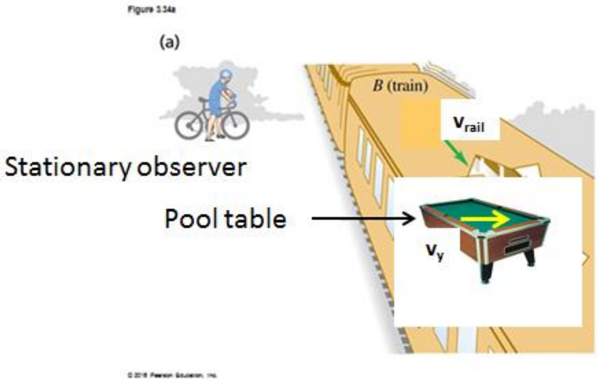
a. How far away, in the horizontal direction, must the target be if the shot is successful?

b. Find the angle that the arrow makes with the horizontal when it hits the target.

c. What is the average velocity of the arrow during this flight (make sure to provide both direction and magnitude)?

	LO	Pass	Fail
a	1.1		
	3.3		
	5.2		
	14.3		
	15.1		
b	13.5		
c	11.2		

Problem 3. A railcar is moving along in the x-direction at a constant velocity, $v_{rail} = 0.5\ m/s$, relative to a bicyclist standing on the side of the railroad tracks. At t=0 the origins of both reference frames coincide. In the railcar frame the coordinate reference frame is sitting on a pool table.



At $t=0$ a pool ball is rolled along the surface of the pool table with a constant velocity, $v_y = 1.0\ m/s$ in the direction perpendicular to the railcar's motion.

a) Find the **velocity** (magnitude and direction) of this rolling ball in the frame of the bicyclist standing on the ground outside the moving railcar.

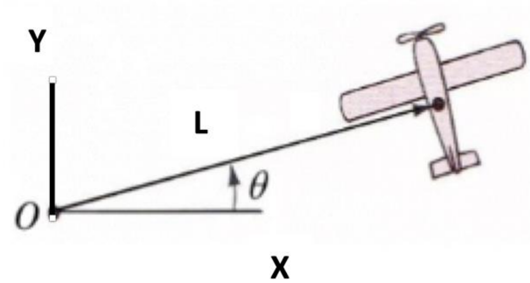
b) Find the **displacement** (magnitude and direction) of the ball measured **in each of the two frames** after the ball has been rolling for 5 seconds. (displacement in railcar frame and displacement in stationary bicyclist frame)

c) In what direction must we roll the ball relative to the pool table *with this same speed*, for the stationary bicyclist to see the ball roll only in the y-direction of their reference frame?

	LO	Pass	Fail
a	1.2		
	2.2		
	21.1		
b	12.5		
c	7.1		
	21.2		

Problem 4. We tie a small model airplane to the end of a wire and tie to other end of the wire to a post, allowing the airplane to move in a horizontal circle of constant radius L. The airplane is initially at rest when the motor is turned on at $t=0$. The airplane experiences a time-dependent tangential acceleration while the motor is spinning, $a(t) = a_o + b\,t^{1/2}$, where a_o and b are positive constants. In terms of the quantities given, $\boldsymbol{a_o}$**, *b, t, and L,*** answer the following:

View from above



a) Find an expression for the speed of the airplane for any time t after the motor is fired.

b) What distance along this circular path will the airplane have traveled in this same time, t?

c) Find the angle that the total acceleration vector makes with the tangent to the path of the airplane at this time, t.

	LO	Pass	Fail
a	8.1		
	14.4		
	15.2		
b	8.2		
	14.5		
c	1.3		
	18.2		