Physics 7A Final Exam WAT Camp 2020

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Instructions: You have 120 minutes to complete the exam. You are allowed one cheat sheet front and back. Please do not open the exam until you are instructed to. Electronics are not allowed at anytime during the duration of the exam. If you have a question please raise your hand and I will come clarify anything that doesn't involve me giving you answers. **Don't leave anything blank**. Even if you completely have no idea how to do a problem, if you can at least articulate what you think you could do or have relevant equation you can still get points. Physics especially is generous with partial credit *believe me*.

Please show all your work. You will be given partial credit if you show understanding of parts of the problem. Pictures and explanations that show understanding will be given credit. There are six questions and the amount of points of each question varies. **You may leave your answer in variables.** This eliminates the need for calculators.

I have been honored to have been your instructor. The road ahead will be rough, but we are no strangers to challenges. I am proud of each and every one of you and I cannot wait to see you all become official scientists, engineers, or whatever you set your heart to become. Good luck!

Name:_____

Major:_____

Problem	—Your Score—	Total points
1	— —	15pts
2	— —	20pts
3	— —	15pts
4	— —	20pts
5	— —	15pts
6	— —	1pts
	— —	85 + 1pts

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1 C-137 Atoms

"Rick and Morty" gets replaced by the new show "Gabriela and Alexander" for their discovery of an exotic new particle. They figure out the horizontal and vertical position of the particles obeys the following equations:
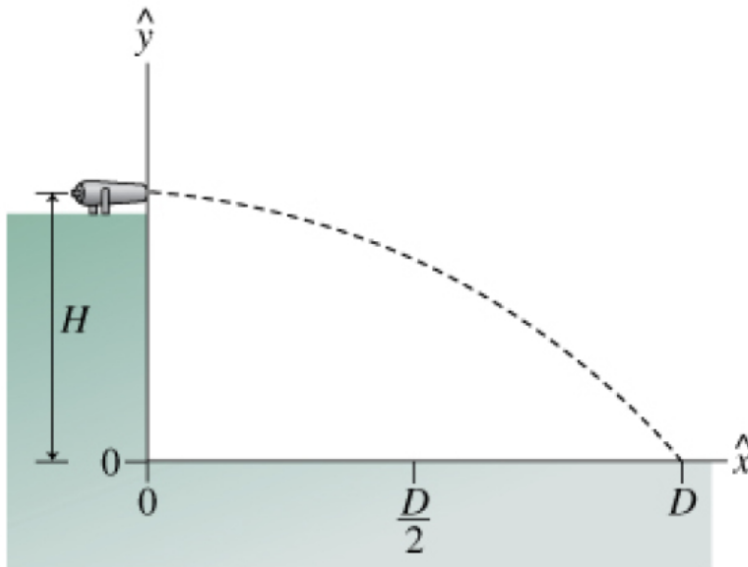
$$x(t) = A_0 cos(\omega t)e^{-i\Omega t} + B_0 ln(t+1) \tag{1}$$

$$y(t) = -4t^2 + 3t + e^{2020} \tag{2}$$

Where A_0, B_0, ω, and Ω are positive constants. You may assume $x(t)$ is the particle's horizontal position and $y(t)$ is the particle's vertical position.

a) (4 points) What are v_x and v_y?

b) (3 points) What is the speed of the particles at time t = 0?

c) (4 points) What is the highest point the particles can reach?

d) (4 points) What is a_x and a_y?

2 Go Bears

Aylin is on a ledge of height H with a cannon. They see someone from stanturd on yonder. You may neglect air resistance for the whole problem.

a) (5 points) Aylin accidentally drops the cannon ball off the cliff. How long does it take for Aylin to hear it crack the floor? Assume speed of sound is v_s

b) (5 points) They readjust and fire again this time successfully. If they land a hit on the stanturd kid a horizontal distance D away from the ledge, what was the initial velocity v of the cannonball?

Suppose now the cannon is tilted upwards at an angle such that the cannonball hits a distance $\frac{D}{2}$ away from the ledge.

c) (8 points) If the maximum height achieved by the ball is h **above the cliff** then at what angle θ did Aylin shoot the cannon?

d) (2 points) Again assuming the cannon is tilted upwards as in the last problem, how long did it take the ball to reach a distance $\frac{D}{2}$?

3   Pull Me Closer

Jonathan creates a device to study mechanics to ensure an A+. He puts together a system of two pulleys with masses as shown in the figure below:
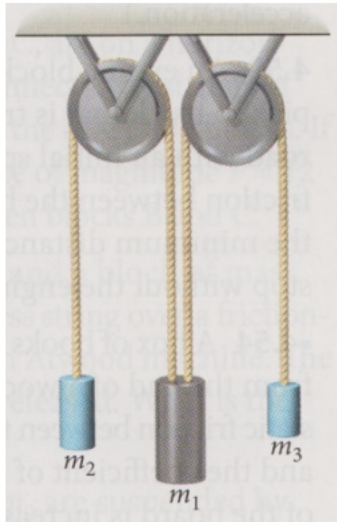

Let $m_1 = 40$kg, $m_2 = 20$kg, and $m_3 = 12$kg. These masses hang on ideal ropes (they don't stretch or compress).

a) (5 points) Draw the force diagrams for each mass

b) (10 points) What is the acceleration of m_1?

4 I'm Blocking You!

Eduardo blocks the instructor on Instagram. To get revenge, the instructor places two blocks M_1 and M_2 shown in the sketch connected by a rope. There is friction between the floor and M_1 with coefficient of friction μ. Now the instructor has blocked Eduardo back.
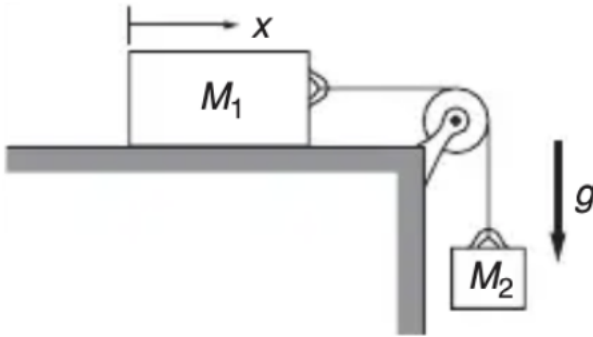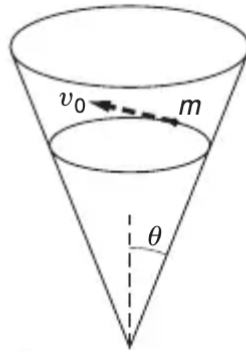

a) (5 points) Draw the force diagram for M_1 and M_2

b) (10 points) Find acceleration of M_1

If the system is released from rest:

c) (5 points) Find how far block M_1 slides in time T

5   What Goes Around Comes Around

Alaska of mass m slides without friction on the inside of a cone. The axis of the cone is vertical and gravity points downward. The apex half-angle of the cone is θ as shown.
The path taken is circle on the horizontal plane. Alaska's speed is v_0.

a) (5 points) Draw the force diagram

b) (10 points) Find the radius of the circular path in terms of v_0, g, and θ.

6 The Final Question...

(1 point) Josselin has called her instructor Javi on several occasions. This warrants an extra problem on the final exam that will hold significant weight. So, your last physics question for winter break is as follows:

What is the name of your physics 7A instructor for WAT Camp 2020?