| Name: | Student ID Number: |
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| Surname: | Exam Room: |

# KOÇ UNIVERSITY
## College of Sciences
## PHYS 101 General Physics 1
## Spring Semester 2022
## Midterm 1 Exam
## March 27, 2022 Sunday, 11:45-13:45

**Please read.**

- Count to make sure that there are 5 pages in this question booklet
- Check your **name, number, on front page, and student ID on each page.**.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks are not open.
- Absolutely no talking or exchanging anything (like rulers, erasers) during the exam.
- You must show all your work to get credit; you will not be given any points unless you show the details of your work (this applies even if your final answer is correct).
- Write neatly and clearly; unreadable answers will not be given any credit.
- If you need more writing space, use the backs of the question pages and put down the appropriate pointer marks.
- You are not allowed to use calculators during this exam.
- You are not allowed to leave the class during the first 15 minutes, and last 15 minutes.
- Write your final answers into the boxes. No points will be given to unjustified answers. Incomplete calculations will not be graded.

***I hereby certify that I have completed this exam on my own without any help from anyone else.***

***Signature***

**P101_Index:**

| 1 | 2 | 3 | 4 | Total |
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**Q1-(25 pts)** The acceleration of a particle in a laboratory experiment is given by $\vec{a} = -a_0\,\hat{\imath} - a_0\,\hat{\jmath}$. It is thrown from the origin with initial velocity $\vec{v} = v_0\,\hat{\imath} + 2v_0\,\hat{\jmath}$ at $t = 0$.

a) What is the maximum value of the $y$ coordinate the particle reaches? (10pts)

b) What is the $y$ coordinate of the particle when its position satisfies $x = 0$ (after $t = 0$)? (7 pts)

c) Sketch the particle's trajectory on the $x - y$ plane until the time $t = 4v_0/a_0$. (8 pts)



Solution continues on the back side of the page **Yes** □ **No** □

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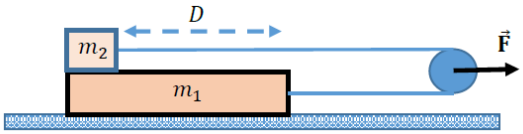
**Q2-(25 pts)** A mass $m_2$ is on top of a platform with mass $m_1$ (assume $m_2 < m_1$). There is no friction between the mass and the platform, or between the platform and the horizontal floor. The two masses are connected by an ideal massless string going over a massless pulley. Initially $m_2$ is a distance $D$ away from the right edge of the platform and all masses are at rest. Starting at time $t$=0, a force $F$ is applied to the pulley horizontally, as shown in the figure.




a) Draw free-body diagrams of the blocks and the pulley for $t > 0$. (6pts)

b) What is the tension on the string? (4 pts)

c) Find how long it would take for the mass $m_2$ to cover the distance $D$ to reach the edge of the platform. (8 pts)

d) Find the acceleration of the pulley with respect to the ground. (7 pts)



Solution continues on the back side of the page **Yes** □ **No** □

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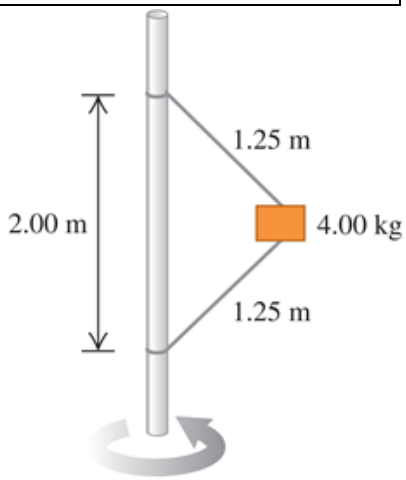
**Q3-(25 pts)** A block of mass M is attached to a vertical rod by means of two strings. The lengths are shown in the figure. When the system rotates about the axis of the rod with angular velocity ω, the strings are extended as shown in the figure.




a) Draw a free body diagram for the mass M. (5 pts)

b) If the tension in the upper string is twice the tension in the lower string, find the angular velocity ω of the system in terms of the other parameters. (10 pts)

c) Find the angular velocity at which the tension in the lower string becomes zero. (10 pts)



Solution continues on the back side of the page **Yes** □ **No** □

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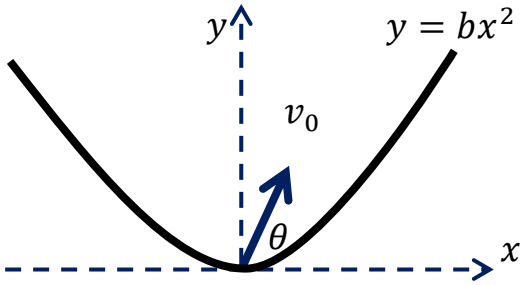
**Q4-(25 pts)** There is a cannon at the bottom of a valley whose shape is given by $y = bx^2$ (see figure). The cannon fires a projectile with initial velocity $v_0 = \sqrt{\frac{g}{2b}}$ at an angle $\theta$ from the horizontal. The gravitational acceleration is $-g\hat{j}$.




a) (5 pts) What is the SI unit for $b$?

b) (10 pts) When does the projectile hit the side of the valley after launch?

c) (10 pts) Find the coordinates $(x_f, y_f)$ where the projectile hits.



Solution continues on the back side of the page **Yes** □ **No** □