Name, Surname:	Student ID Number:
Exam Room:	Signature:

KOÇ UNIVERSITY

College of Sciences
PHYS 101 General Physics 1
Fall Semester 2021
Midterm1 Exam
November 7, 2021 Sunday, 11:45-13:45

Please read.

- Please turn off mobile phones and stow away your belongings. Have your student ID ready for attendance check. Only exam booklet, pencil and eraser are allowed throughout the exam.
- Check that there are 4 question sheets in this question booklet.
- Use only black pencil for writing.
- Write your **name, number, on front page, and student ID on each page.**.
- Write neatly and clearly; unreadable answers will not be given any credit.
- Any final answer not backed by a reasonable, consistent solution attempt on the exam paper may get no credit even if it coincides with the correct answer.
- The mathematical expressions in the result must be simplified as possible.
- Use the back pages in case you need more blank space. **IMPORTANT: Do not continue the solution of a question on a different question sheet!**
- If applicable, make sure to include units in your final answer.
- In graphing questions, use proper scaling, label the axes and indicate units.
- Using calculators is not allowed.
- Leaving/entering the exam room within the last 10 minutes of the exam session is not allowed. Please wait until the exam session is over.

P101_Index:

1	2	3	4	Total

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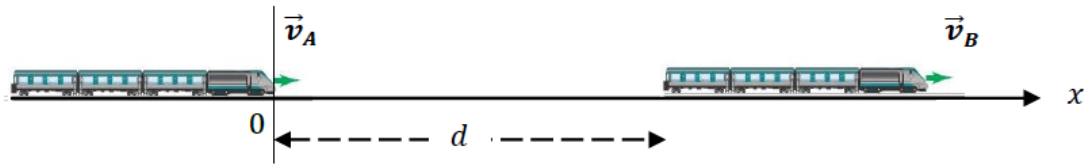
Q1-(25 pts)



Two trains move with constant speeds of v_A and v_B in the same direction as shown in the figure, where $v_A > v_B$. To avoid a collision, train A starts slowing down with a constant acceleration a at time $t = 0$ when the distance between the trains is d. The train A is at $x = 0$ at time $t = 0$.

(a) (8 Pts) Write the position $x_A(t)$ of the train A as a function of time for $t > 0$.

(*b*) (8 Pts) Assuming that the speed of train B does not change, what will be the distance between the two trains as a function of time for $t > 0$?

(*c*) (9 Pts) What must be the minimum acceleration a to avoid collision of the two trains?

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

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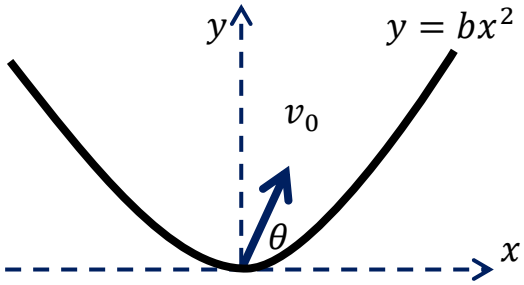
Q2-(25 pts) There is a cannon at the bottom of a valley whose shape is given by $y = bx^2$ (see figure). The cannon fires a projectile with initial velocity $v_0 = \sqrt{\frac{g}{2b}}$ at an angle θ from the horizontal. The gravitational acceleration is $-g\hat{j}$.



a) (5 pts) What is the unit of 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** □

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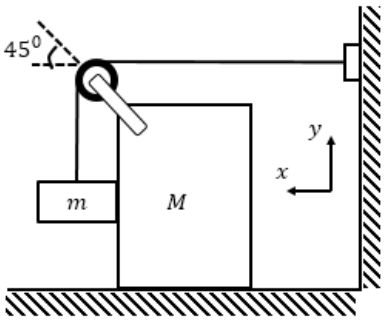
Q3-(25 pts) A large rectangular block of mass M is on flat ground. A small rectangular block of mass m is suspended vertically by a rope on the left side of the large block. The rope passes over a pulley and fixed to the wall, and remains always parallel to the ground. The pulley holder makes an angle 45^0 on the large block as shown. Both rope and pulley are massless. Gravitational acceleration is g. The coordinate system is as given.



a) **(12 pts.)** Due to friction between the large block and the ground, the system is observed to be in static equilibrium. Draw the free body diagrams of the two blocks below. Determine the minimum required value of static friction coefficient μ_s in terms of given parameters and write your answer into the box.

b) **(13 pts.)** In this part, assume there is no friction on any surface. A force $F = 2mg\hat{\imath}$, is applied to the large block. Draw the free body diagrams of the two blocks below. Calculate the tension T in the rope in terms of given parameters and write your answer into the box.

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

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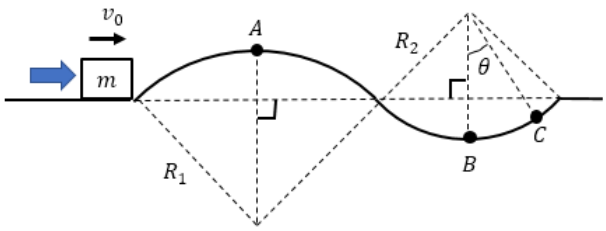
Q4-(25 pts) A block of mass m slides onto an uneven track consisting of two circular segments of radii R_1 and R_2. The track has a kinetic friction coefficient μ_k. Upon entering the track, a varying pushing force is applied to the block to keep its speed constant *all the time*. The pushing force is directed *always horizontal throughout the track*, as shown by the blue arrow. The speed of the block is such that it <u>almost loses contact</u> with the track at point A (Hint: what does the underlined statement imply about some forces acting on the block?)



a) **(8 pts.)** Draw below the free body diagram of the block at point A. Determine the speed of the block and the magnitude of the applied force at A in terms of the given parameters only. Write your answers in the box.

b) **(7 pts.)** Draw below the free body diagram of the block at point B and determine the magnitude of the applied force at B in terms of the given parameters only. Write your answer in the box.

c) **(10 pts.)** Draw below the free body diagram of the block at point C and determine the magnitude of the applied force at C in terms of the given parameters only. Write your answer in the box.

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