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

KOÇ UNIVERSITY

College of Sciences
PHYS 101 General Physics 1
Fall Semester 2018
Midterm I Exam
October 23, 2018 Tuesday, 19:00-20:40

Please read.

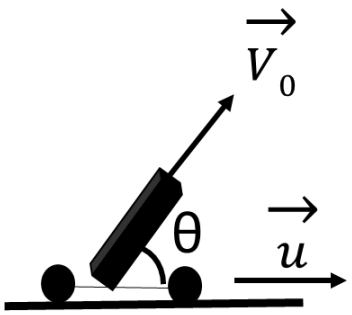
- Count to make sure that there are 5 pages in this question booklet
- Check your **name, number, on front page, and student ID on each page.**.
- This examination is conducted with closed books and notes.
- Put all your personal belongings underneath your seat and make sure that pages of books or notebooks 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.
- Make sure that you include units in your results.
- Make sure that you label the axis and have units in your plots.
- You are not allowed to use calculators during this exam.
- Turn off your mobile phones, and put away.
- 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.

P101_Index:

1	2	3	4	Total

Exam Room:	P101_Index:
Student ID Number:	Signature:

Q1-(25 pts) A cannon on a train is travelling with velocity u = 5 m/s to the right. At a point, the cannon fires at an angle θ with the horizontal. The cannonball leaves the cannon with a speed v_0 = 25 m/s with respect to the cannon. (Gravitational acceleration is g = $10 m/s^2$, the height of the train car and the cannon is negligible, and sin θ = 3/5.)



a) What is the velocity of the cannonball with respect to the ground?

b) How far away from firing point does the cannonball hit the ground?

c) Assume that the train has stopped, and cannon is ready for a second fire. Derive the general expression for horizontal range. What value of θ gives maximum horizontal range?

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

Exam Room:	P101_Index:
Student ID Number:	Signature:

Q2-(25 pts) A racing car starts from rest and speeds up on a circular track according to $v(t) = A + 2B\,t$, where A and B are positive constants and t is time in seconds. While it takes 2 seconds for it to complete its first cycle, the second cycle takes only 1 second.

Using a coordinate system whose origin is located at the center of the track, and assuming that the car is initially positioned at $\vec{r} = 1\text{m}\,\hat{\imath}$.

a) Find the position $\vec{r}$ of the car at $t = 1s$.

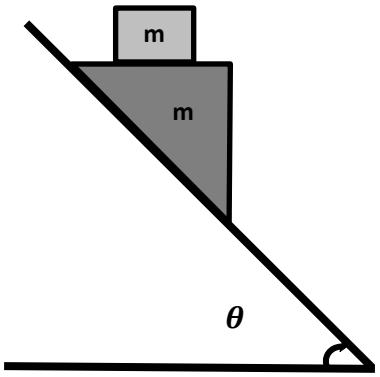
b) Find the velocity $\vec{v}$ of the car at $t = 1s$.

c) Find the acceleration $\vec{a}$ of the car at $t = 1s$.

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

Exam Room:	P101_Index:
Student ID Number:	Signature:

Q3-(25 pts) A triangular block with an exactly horizontal upper surface can slide down an inclined plane. There is a rectangular block on top of the triangular one as shown in the figure. There is no friction between the two blocks, but the coefficient of kinetic and static friction between the triangular block and the inclined plane is μ. Both blocks have mass m, and the inclination angle of the plane is θ.



a) Draw the free body diagrams of the blocks.

b) How is the magnitude of the acceleration of the rectangular block (a_r) related to the magnitude of the acceleration of the triangular block (a_t)?

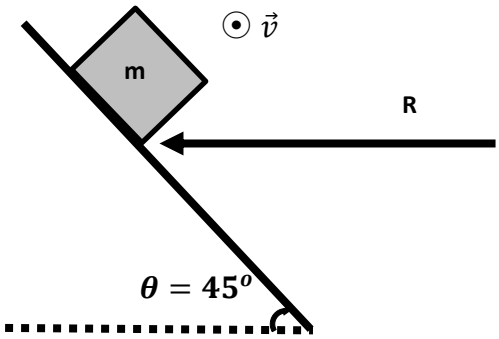
c) Find a_t and a_r.

d) For what values of μ blocks do not move at all?

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

Exam Room:	P101_Index:
Student ID Number:	Signature:

Q4-(25 pts) A car of mass m is going around a circular turn of radius R over a wet concrete road, that is banked at an angle of θ=45° with respect to the ground (cross section of the road is in the figure). The coefficient of static friction between the rubber tires and the road can be taken as μ=0.5. You may neglect the kinetic friction.



a) Sketch the free body diagram of the car if it just starts to slip down.

b) Sketch the free body diagram of the car if it just starts to slip up.

c) If the car does not want to slip, what are the minimum and maximum allowed speeds?

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