Printed Name

Nine-digit GT ID

*signature*

**Spring 2019** **PHYS 2211 ABC** **Test 02**

Test Form:

**2A**

- Put nothing other than your name and nine-digit GT ID in the blocks above. Print clearly so that OCR software can properly identify you. Sign your name on the line immediately below your printed name.
- Free-response problems are numbered I–III. Show all your work clearly, including all steps and logic. Write darkly. Blue or black ink is recommended. Do not make any erasures in your free-response work. Cross out anything you do not want evaluated. Box your answer.
- Multiple-choice questions are numbered 1–6. For each, select the answer most nearly correct, circle it on yourtest, and fill the bubble for your answer on this front page.
- Initial the odd pages in the top margin, in case the pages of your quiz get separated.
- The standard formula sheet is on the back of this page, which may be removed from the quiz form if you wish, but it must be submitted.
- If the page for a free-response problem has insufficient space for your work, ask a proctor for an additional sheet. If you wish this work to be evaluated, put your name on the sheet and make a note on the problem page, so graders know where to find your work. Place any added pages at the **back** of your test, when submitting your exam.
- You may use a calculator that cannot store letters, but no other aids or electronic devices.
- Scores will be posted when your test has been graded. Test grades become final when the next is given.

*Fill in bubbles for your Multiple Choice answers darkly and neatly.*

1 ⓐ ⓑ ⓒ ⓓ ⓔ

2 ⓐ ⓑ ⓒ ⓓ ⓔ

3 ⓐ ⓑ ⓒ ⓓ ⓔ

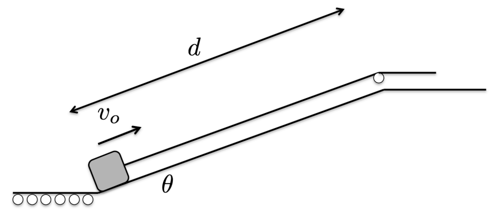
4 ⓐ ⓑ ⓒ ⓓ ⓔ

5 ⓐ ⓑ ⓒ ⓓ ⓔ

6 ⓐ ⓑ ⓒ ⓓ ⓔ

*The following problem will be hand-graded.* *Show all supporting work for this problem.*

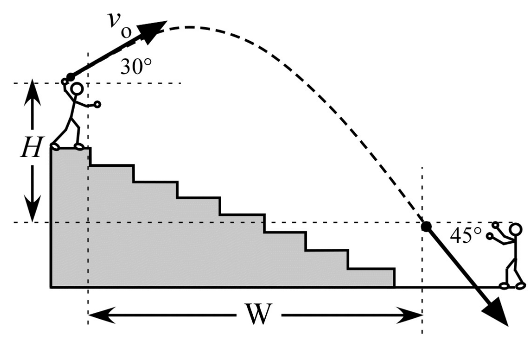
**[I]** *(20 points)* A miner gets stones out of a quarry by pulling them up a ramp of length $d$ inclined at an angle $\theta$ above the horizontal. At time $t = 0$, a conveyor belt delivers a stone to the bottom of the ramp with speed $v_o$. At that moment, the miner begins pulling with a rope so that the rock, under uniform acceleration, arrives at the top of the ramp with speed with $v = 0$. The rope that pulls the stone uphill is rated for a maximum tension $T_m$. That is, the rope will break if the tension is larger than this value. The static/kinetic coefficients for friction are $\mu_s$ and $\mu_k$ respectively.




1. Draw a free body diagram, select a coordinate system, write down Newton's second law as a vectorial equation, and decompose these equations along the axes of the chosen coordinate system.
2. What's the maximum rock mass that the person will be able to pull? Express your answer in terms of the quantities defined in the statement and physical or mathematical constants.

*The following problem will be hand-graded. Show all supporting work for this problem.*

**[II]** *(20 points)* You are standing at the top of a stairwell of height $H$ while your friend is standing at the bottom, a horizontal distance $W$ away from you. You throw a tennis ball with speed $v_o$ at an angle $\theta = 30°$ above the horizontal. When your friend catches the ball it is traveling in a direction $\phi = 45°$ below the horizontal.

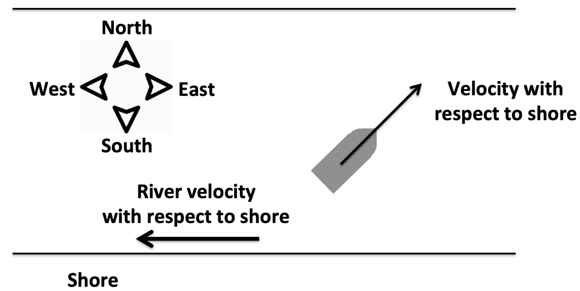



Find expressions for the height $H$ and width $W$ of the stairwell. Express each answer in terms of the parameters $g$ and $v_o$.

*Hint: start by finding an expression for the landing speed as a multiple of the launch speed. What kinematic quantity is constant as the tennis ball travels?*

*The following problem will be hand-graded. Show all supporting work for this problem.*

**[III]** *(20 points)* Relative to the shore, a canoe has a speed $v_B$ and is moving in a direction $\theta$ = 30° east of north. The canoe is in a river that flows with speed $v_R$ due west with respect to the shore. Calculate the velocity of the canoe with respect to the river, including expressions for the speed and an angle measured relative to the northward direction. Provide an answer in termes of the quantities defined in the statement.



*Question value 4 points*

(01) A courier is in an express elevator, riding down from the $105^{th}$ floor of a high-rise building. The elevator is descending rapidly, and must undergo a long period of deceleration as it nears the ground floor. While this is happening, how do the values for the courier's apparent mass and apparent weight compare to the normal values for mass and weight when standing on the Earth?

(a) $m_{app} > m_{norm}$ and $W_{app} > W_{norm}$

(b) $m_{app} = m_{norm}$ and $W_{app} = W_{norm}$

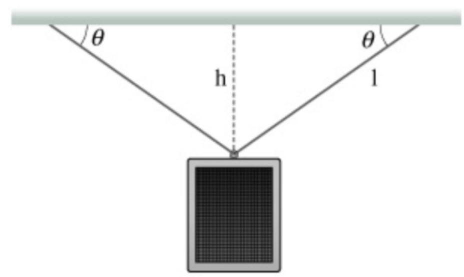
(c) $m_{app} = m_{norm}$ and $W_{app} < W_{norm}$

(d) $m_{app} < m_{norm}$ and $W_{app} = W_{norm}$

(e) $m_{app} = m_{norm}$ and $W_{app} > W_{norm}$

*Question value 8 points*

(02) A box of mass m = 10.0 kg is suspended a distance $h$ = 0.50 m below the ceiling by two cables that make equal angles with the ceiling. Each cable has a length of $l$ = 1.0 m. What is the tension $T$ in each of the cables? Use $g$ = 10 m/s$^2$.




(a) 87 N

(b) 200 N

(c) 100 N

(d) 173 N

(e) 43.3 N

*Question value 8 points*

(03) A race car is on a circular track of radius 100 m. Starting from rest the car has an initial acceleration of magnitude 1.0 m/s$^2$. Assuming the tangential acceleration remains constant, what speed will the car have when the magnitude of the total accelearation on the car is 2.0 m/s$^2$?

(a) 7.60 m/s

(b) 10.0 m/s

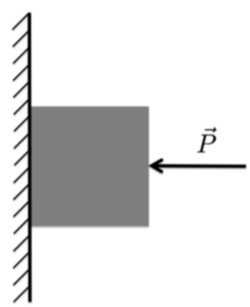
(c) 22.2 m/s

(d) 14.1 m/s

(e) 13.2 m/s

*Question value 8 points*

(04) A block of mass $m$ has a force $\vec{P}$ applied to it, holding it stationary against a rough wall as shown at right. State the magnitude and direction of the friction force that the wall exerts on the block.




(a) $\mu_s|\vec{P}|$, upward

(b) $\mu_s mg$, upward

(c) $mg$, downward

(d) $mg$, upward

(e) $\mu_s|\vec{P}|$, downward

*Question value 4 points*

(05) The Earth orbits around the Sun in a circular orbit of $R = 1.5 \times 10^{11}$ m. What is the Earth's acceleration, as it orbits? Assume Erth's orbit is perfectly circular, and that a year lasts exactly $T = 365$ days.

(a) $\vec{a} = 1.5 \times 10^{-4}$ m/s$^2$ toward the Sun

(b) $\vec{a} = 6.1 \times 10^{-3}$ m/s$^2$ toward the Sun

(c) $\vec{a} = 1.5 \times 10^{-4}$ m/s$^2$ away from the Sun

(d) $\vec{a} = 1.0 \times 10^{-2}$ m/s$^2$ toward the Sun

(e) $\vec{a} = 0$ because the Earth orbits at constant speed

*Question value 8 points*

(06) A disk is rotating counter-clockwise with some angular speed ω, when it begins to slow down. Which of the following figures *best* depicts the acceleration vector for a point of the rim of the disk, as it is slowing?