

Printed Name

Nine-digit GT ID

signature

Summer 2019

PHYS 2211 M

Test 03

- 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 your test, 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.
- 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.

Test Form:

3A

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

1 (a) (b) (c) (d) (e)

2 (a) (b) (c) (d) (e)

3 (a) (b) (c) (d) (e)

4 (a) (b) (c) (d) (e)

5 (a) (b) (c) (d) (e)

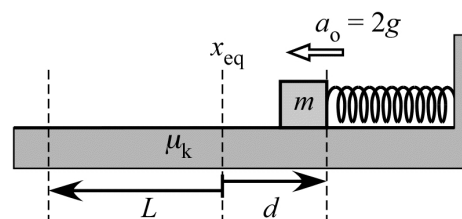
6 (a) (b) (c) (d) (e)

Form 3A

Extra workspace:

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

- [I] (20 points) A horizontal spring with an unknown spring constant is compressed a distance d , and then used to launch a block of mass m across the floor. The coefficient of kinetic friction between the block and the floor is $\mu = 0.25$. The initial acceleration of the block, at the moment it is released, is $a_o = 2g$. How far beyond the spring's equilibrium position (L in the figure at right) will the block slide before coming to a stop? Express your answer as a numerical multiple of d .



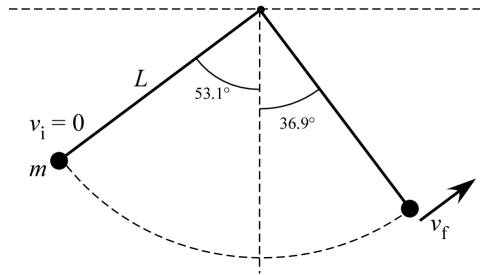
Hint: Start by finding an expression for the spring constant k , in terms of m , g and d

Form 3A

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

- [III] (20 points) Jane (mass m) is swinging through the jungle from vine to vine, pursuing villains in an attempt to rescue Tarzan. Standing at rest on a high tree branch, she grabs a long vine that is inclined at an angle $\theta_o = 53.1^\circ$ from the vertical and swings downward. She swings through the lowest point in her arc, and then upward again until the vine makes an angle $\theta_1 = 36.9^\circ$ from the vertical. At that moment she lets go of the vine, to grab another and continue her pursuit.

Determine the tension in the first vine, just before Jane lets go of it. Express your answer as a multiple of her true weight, mg .

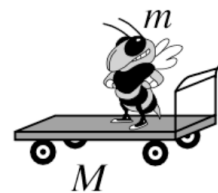


$$\sin(53.1^\circ) = \frac{4}{5} \quad \cos(53.1^\circ) = \frac{3}{5}$$

$$\sin(36.9^\circ) = \frac{3}{5} \quad \cos(36.9^\circ) = \frac{4}{5}$$

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

- [III]** (20 points) Buzz (mass m) stands on a large, flat pushcart (mass M) that is initially stationary. He leaps off horizontally with a speed v_0 measured relative to the cart (not relative to the ground). Determine (1) the velocity of the cart relative to the ground, as it recoils away from Buzz's leap; and (2) the velocity of Buzz relative to the ground while he is airborne. Express each answer as a 1D-vector, in terms of the parameters m , M , and v_0 .

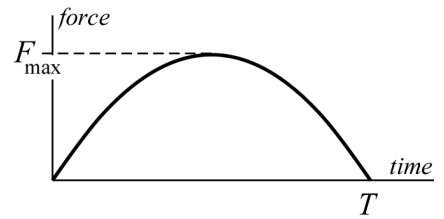


Form 3A

The next two questions involve the following situation:

A rubber ball of mass m is traveling horizontally at speed v when it strikes a wall. It rebounds from the wall traveling in the opposite direction, at the same speed v . While in contact with the wall, the ball experiences a time-dependent force with a magnitude given by the expression:

$$F(t) = 4F_{max} \left(\frac{t}{T} - \frac{t^2}{T^2} \right) \text{ for } 0 \leq t \leq T$$



Question value 4 points

(1) What is the magnitude of the peak force F_{max} experienced by the ball while in contact with the wall?

- (a) $F_{max} = \frac{mv}{T}$
- (b) $F_{max} = \frac{2mv}{T}$
- (c) $F_{max} = \frac{3mv}{T}$
- (d) $F_{max} = \frac{mv}{2T}$
- (e) $F_{max} = \frac{mv}{3T}$

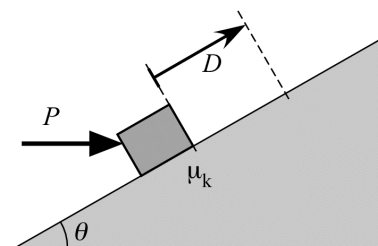
Question value 4 points

(2) What is the magnitude of the average force F_{avg} experienced by the ball while in contact with the wall?

- (a) $F_{avg} = \frac{2}{3}F_{max}$
- (b) $F_{avg} = \frac{4}{3}F_{max}$
- (c) $F_{avg} = 0$
- (d) $F_{avg} = \frac{3}{4}F_{max}$
- (e) $F_{avg} = \frac{1}{2}F_{max}$

Question value 8 points

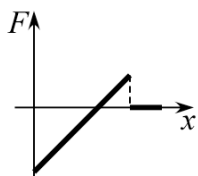
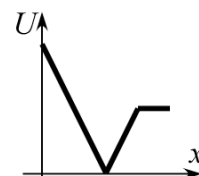
- (3) A crate is pushed up a loading ramp that is inclined at an angle θ above the horizontal, by a pushing force P that is itself *horizontal*. The ramp is rough, with a coefficient of kinetic friction $\mu_k = 0.20$. How much work is done by the pushing force, as the crate moves a distance D up the ramp?



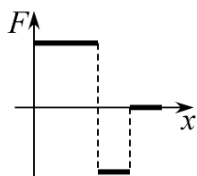
- (a) $W_p = +0.8 PD \sin \theta$
- (b) $W_p = +0.8 PD \cos \theta$
- (c) $W_p = +PD \cos \theta$
- (d) $W_p = +PD$
- (e) $W_p = +PD \sin \theta$

Question value 8 points

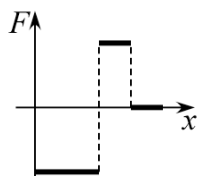
- (4) A particle moves along the x -axis subject to a conservative force $F(x)$. The potential energy function for this force is shown in the figure. Which of the graphs below best characterizes the force F as a function of position?



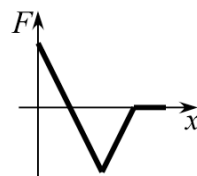
(a)



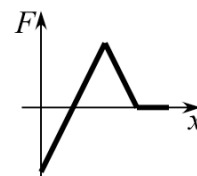
(b)



(c)



(d)



(e)

Form 3A

Question value 8 points

- (5) What is the difference between a *stable equilibrium point* and an *unstable equilibrium point*?
- (a) A stable equilibrium point is a place where the PE graph has a *local maximum*; an unstable equilibrium point is a place where the graph has a *local minimum*.
 - (b) A stable equilibrium point is a place where the slope of the PE graph is *zero*; an unstable equilibrium point is a place where the slope is *non-zero*.
 - (c) A stable equilibrium point is a place where the slope of the PE graph is *positive*; an unstable equilibrium point is a place where the slope is *negative*.
 - (d) A stable equilibrium point is a place where the PE graph has a *local minimum*; an unstable equilibrium point is a place where the graph has a *local maximum*.
 - (e) A stable equilibrium point is a place where the slope of the PE graph is *negative*; an unstable equilibrium point is a place where the slope is *positive*.

Question value 8 points

- (6) A car having mass m is on the interstate traveling due east with speed $4v$. It slows down while entering a broad curve, and exits the curve traveling due south with speed $3v$. What is the magnitude of the impulse delivered to the car during the turn?
- (a) $3mv$
 - (b) $2mv$
 - (c) $1mv$
 - (d) $4mv$
 - (e) $5mv$