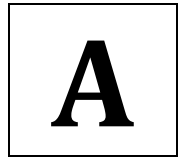


Fall 2017

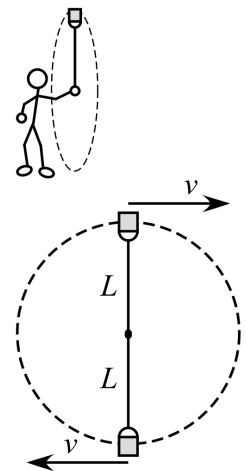
**Test 3**

Recitation Section (see cover page): \_\_\_\_\_

- 1) Print your name, test form number (above), and nine-digit student number in the section of the answer card labeled "STUDENT IDENTIFICATION".
- 2) Bubble your test form number (**ABOVE**) in columns 1-3, skip column 4, then bubble in your student number in columns 5-13.
- 3) For each free-response question, show all relevant work supporting your answer. **Clearly box or underline your final answer.** "Correct" answers which are not supported by adequate calculations and/or reasoning will be counted wrong.
- 4) For each multiple-choice question, select the answer most nearly correct, **circle this answer on your test**, and bubble it in on your answer card. **Show all relevant work on your quiz.**
- 5) Be prepared to present your Buzzcard as you turn in your test. Scores will be posted to WebAssign after they have been graded. **Test grades become final when the next quiz is given.**
- 6) You may use a simple scientific calculator capable of logarithms, exponentials, and trigonometric functions. **Programmable engineering calculators with text or graphical capabilities are not allowed. Wireless devices are prohibited.**



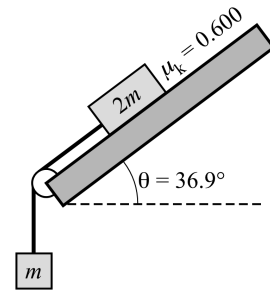
- [1]** (20 points) A water-filled bucket has *true* total weight  $W$ . A physics instructor then spins the bucket in a vertical circle at constant speed  $v$ , using a cord of length  $L$ . When the bucket is inverted at the top of its loop, the instructor feels that the apparent weight of the bucket is  $2W$ . What will be the apparent weight of the bucket when it is at the bottom of the loop? Express your answer as a numerical multiple of  $W$ .



The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

- III** (20 points) In the figure at right, the block  $2m$  on the incline is given a tiny nudge to start it moving downslope. When it is moving freely, what will be the tension in the cord? Express your answer as a numerical multiple of the weight of the hanging block,  $mg$ .

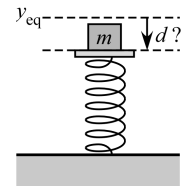
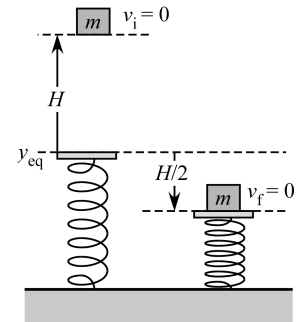
Your free body diagrams will be graded for accuracy and clarity!



The following problem will be hand-graded. Show all your work for this problem. Make no marks and leave no space on your answer card for it.

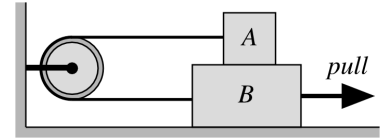
- [III]** (20 points) A block of mass  $m$  is held stationary at a height  $H$  above a vertical spring, and dropped. It is observed to compress the spring by a distance  $H/2$  before momentarily coming to rest (top figure). If, instead, the block had simply been gently placed atop the spring (with the block in equilibrium), by what distance  $d$  would the spring compress (bottom figure)?

*Hint: use the Energy Principle to analyze the drop, in order to learn about the spring constant.*



The next two questions involve the following situation:

Wooden block A is stacked on wooden block B, and an ideal cord passes over a pulley to connect the blocks as shown at right. Block B is then pulled to the right with sufficient force to cause it to slip along the ground.



Question value 4 points

- (1) According to the Third Law, What force is paired with the upward normal force by the ground on the bottom of block B?

- (a) The gravitational force down on block B.
- (b) The weight of *both* blocks A and B, down on block B.
- (c) The downward normal force by block A on block B
- (d) The downward normal force by block B on block A.
- (e) A downward normal force by block B on the ground.

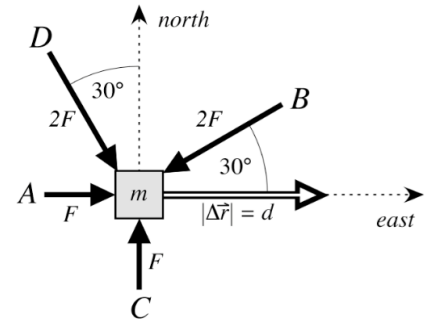
Question value 4 points

- (2) What pair of horizontal "Third Law" forces act on the two blocks?

- (a) Kinetic friction to the right on block B and to the left on block A.
- (b) Tension to the left on block B and Tension to the right on block A.
- (c) Static friction to the right on block B and to the left on block A.
- (d) Kinetic friction to the left on block B and to the right on block A.
- (e) Tension to the left on block B and also to the left on block A.

Question value 8 points

- (3) The figure at right shows a top-down view of a block resting on a frictionless horizontal surface. Four forces (A through D, all horizontal) push the block, with the magnitudes ( $F$  or  $2F$ ) and directions indicated. The block is observed to displace a distance  $d$  in a direction due east (as shown). Rank, from greatest (i.e. most positive) to least (i.e. most negative), the work done by each force.



- (a)  $W_D = W_B > W_A > W_C$   
 (b)  $W_A = W_D > W_C > W_B$   
 (c)  $W_B > W_D = W_A > W_C$   
 (d)  $W_A > W_D > W_B > W_C$   
 (e)  $W_D > W_A > W_C > W_B$

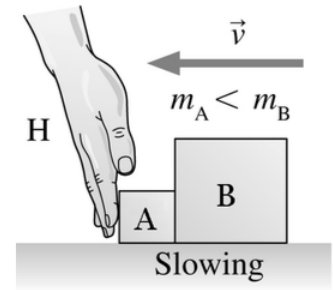
Question value 8 points

- (4) A worker lowers a crate from a shelf at height  $H$  to the ground, with the crate beginning at rest on the shelf, and ending at rest on the ground. If the “system of interest” is defined to be just the crate itself, what work is being done by each of the forces acting on the crate?
- (a) Gravity and the worker are both doing positive work—with the total work being *positive*.  
 (b) Gravity is doing positive work while the worker is doing negative work—with the total work being *negative*.  
 (c) Gravity and the worker are both doing negative work—with the total work being *negative*.  
 (d) Gravity is doing positive work while the worker is doing negative work—with the total work being *zero*.  
 (e) Gravity is doing negative work while the worker is doing positive work—with the total work being *zero*.

*Question value 8 points*

- (5) Boxes A and B are sliding to the left across a frictionless table. The hand H is slowing them down. The mass of A is less than the mass of B. Rank the magnitudes of the horizontal forces on A, B, and H, from greatest to least.

- (a)  $F_{H \text{ on } A} = F_{A \text{ on } H} > F_{B \text{ on } A} = F_{A \text{ on } B}$   
 (b)  $F_{H \text{ on } A} > F_{A \text{ on } B} = F_{A \text{ on } H} > F_{B \text{ on } A}$   
 (c)  $F_{B \text{ on } A} = F_{A \text{ on } B} = F_{H \text{ on } A} = F_{A \text{ on } H}$   
 (d)  $F_{A \text{ on } B} = F_{B \text{ on } A} > F_{H \text{ on } A} = F_{A \text{ on } H}$   
 (e)  $F_{H \text{ on } A} > F_{A \text{ on } H} > F_{A \text{ on } B} > F_{B \text{ on } A}$



*Question value 8 points*

- (6) Two identical coins are placed on a turntable, at distance  $R$  and  $2R$  from the central axis. Starting from rest, the turntable is gradually spun up with a constant (but small) angular acceleration  $a$ . At some angular speed  $\omega_A$ , coin A is “flung off” the turntable, and at some speed  $\omega_B$ , coin B is “flung off” the turntable. Compare these two speeds.

- (a)  $\omega_B = 0.500 \omega_A$   
 (b)  $\omega_B = 0.707 \omega_A$   
 (c)  $\omega_B = 1.414 \omega_A$   
 (d)  $\omega_B = 0.250 \omega_A$   
 (e)  $\omega_B = 2.000 \omega_A$

