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Closed book exam - Calculators are allowed.

Only the official formula sheet downloaded from the course web page can be used. You are allowed to write notes on the back of the formula sheet.

Use the scantron forms (pencil only!) for the multiple choice problems. Circle the ansers on the examination sheet as well, and return it together with the scantron form. Use the back of these page, or attache your own pages with solutions for the problems which require calcuations.

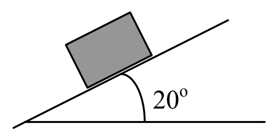
The multiple-choice problems are 1 point each. Work out problems are 4 points each. Passing of the exam requires at least 50% of the maximum number of points.

Clearly print your last name and indicate your section number on both the scantron form and the examination sheet. Also indicate your name and ID on each of the two sheets with work-out problems since they will be graded separately. Failure to do any of these will result in a penalty of 2 points.

Problem 1: What is the work done by a force **F** = (2 N)**i** + (-4 N)**j** that causes a displacement **d** = (-3 m)**i** + (2 m)**j**?

A) 2 J
B) 14 J
C) -14 J
D) -2 J
E) 16 J

Problem 2: A man pushes a 2-kg block 5 m along a frictionless incline at an angle of 20^o with the horizontal at constant speed. What is the work done by his force?

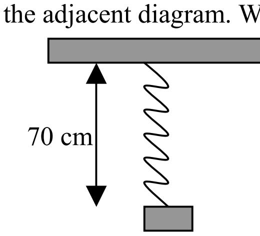


A) 0 J
B) 98 J
C) 34 J
D) 92 J
E) 100 J

Problem 3: Starting from rest, it takes 8.00 s to lower with constant acceleration an 80.0-kg couch from a 16.0-m high rooftop of a building all the way to the ground with a single vertical rope tied to its body. What is the work done by the tension in the rope?

A) 1.57 kJ
B) –1.28 kJ
C) –12.5 kJ
D) 12.5 kJ
E) –11.9 kJ

Problem 4: A 10-kg mass is attached to one end of a 50-cm-long unstretched spring. When the other end of the spring is attached to the ceiling the mass reaches a stable stationary position as shown in the adjacent diagram. What is the spring constant of the spring?



A) 490 N/m
B) 245 N/m
C) 980 N/m
D) 140 N/m
E) 196 N/m

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Problem 5: A dog must apply its full power of 100 W in order to move a 5-kg sled by a distance of 10 m in 4 s. What average force does the dog exert on the sled?

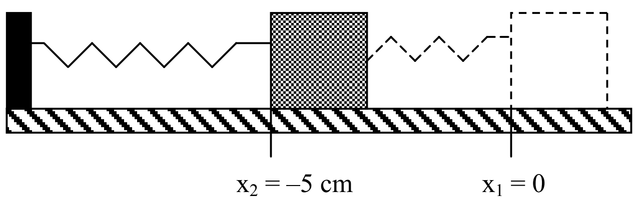
A) 49 N
B) 250 N
C) 8 N
D) 40 N
E) 200 N

Problem 6. A bicyclist is traveling on a horizontal track at a speed of 20.0 m/s as he approaches the bottom of a hill. He decides to coast up the hill and stops upon reaching the top. Determine the vertical height of the hill.

A) 28.5 m
B) 3.70 m
C) 11.2 m
D) 40.8 m
E) 20.4 m

Problem 7. A mass m = 2.5 kg is sliding left along a frictionless table with initial speed *v*. It strikes a coiled spring that has a force constant k = 500 N/m and compresses it a distance 5.0 cm before coming to a momentary rest. The initial speed *v* of the block was

A) 0.71 m/s
B) 1.0 m/s
C) 1.4 m/s
D) 0.50 m/s
E) 1.7 m/s

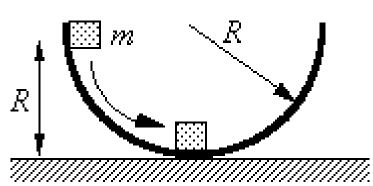


Problem 8. Two skiers start from rest at the same place and finish at the same place. Skier A takes a straight, smooth route to finish whereas skier B takes a curvy, bumpy route to the finish. If you assume that friction is negligible, which of the following statements is true?

A) Skier A has the same speed as skier B at the finish.
B) Skier B has greater speed at the finish.
C) Skier A has greater speed at the finish because the route is straight.
D) Skier B has greater speed at the finish because the route is smooth.
E) Skier A has greater speed at the finish because the route is both straight and smooth.

Problem 9. A block of mass *m* is released from rest at a height *R* above a horizontal surface. The acceleration due to gravity is *g*. The block slides along the inside of a frictionless circular hoop of radius *R*. Which one of the following expressions gives the speed of the mass at the bottom of the hoop?

A) zero m/s
B) $v = mgR$
C) $v = mg/2R$
D) $v^2 = g^2/R$
E) $v^2 = 2gR$



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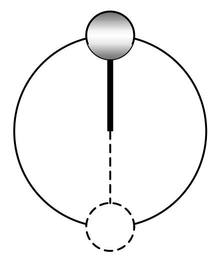
Problem 10. A 60-kg skier starts from rest from the top of a 50-m high slope. If the work done by friction is -6.0×10^3 J, what is the speed of the skier on reaching the bottom of the slope?

A) 17 m/s
B) 24 m/s
C) 28 m/s
D) 31 m/s
E) 42 m/s

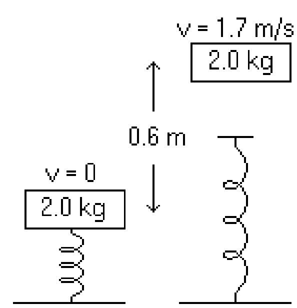
Problem 11. A 2.0-kg ball is attached to a light rod that is 1.2 m long. The other end of the rod is loosely pinned at a frictionless pivot. The rod is raised until it is inverted, with the ball above the pivot. The rod is released and the ball moves in a vertical circle. The tension in the rod as the ball moves through the bottom of the circle is closest to:

A) 40 N
B) 100 N
C) 20 N
D) 60 N
E) 80 N



Problem 12. A block of mass 2.0 kg is placed on a vertical spring, which is kept compressed 0.050 m by a clamp (The clamp is not shown in the diagram). The spring and the block are not attached. When the clamp is removed, the spring propels the block vertically upward. When the block has risen 0.60 m above its initial position its velocity is 1.7 m/s. How much potential energy was originally stored in the spring?

A) 5.5 J
B) 8.2 J
C) 11 J
D) 15 J
E) 26 J



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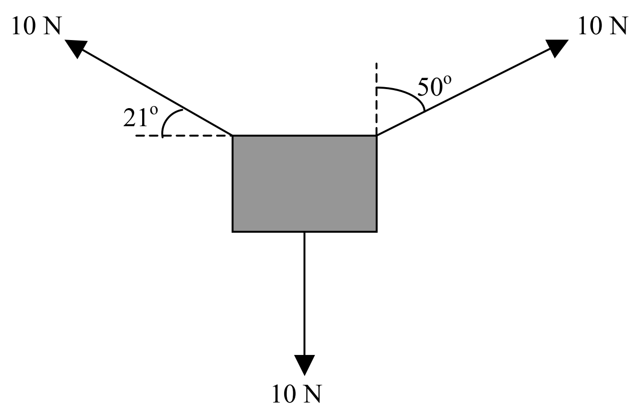
WORKOUT PROBLEM 1:

An object of mass 2 kg, initially at rest on a frictionless floor, experiences three horizontal forces as shown in an overhead view. It then travels 5 m to the left.



(a) **[2 points]** Calculate the total work done on the object by all of the forces.

(b) **[2 points]** Find the speed of the object after its 4 m travel.

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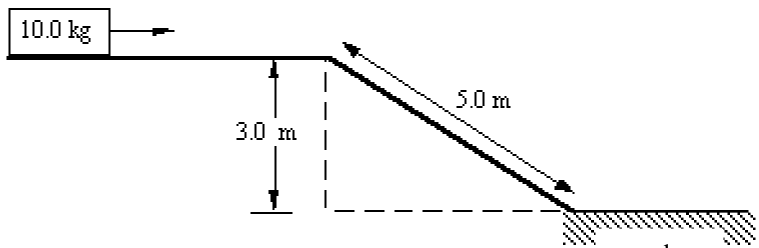
WORKOUT PROBLEM 2:

Important Note!! You have to use Work-Energy concepts to get credit for this problem.

A 10.0-kg crate slides along a horizontal frictionless surface at a constant speed of 4.0 m/s. The crate then slides down a frictionless incline and across a second rough horizontal surface as shown in the figure.



(a) **[2 points]** What is the speed of the crate when it arrives at the lower surface?

(b) **[2 points]** What minimum coefficient of kinetic friction μ_k is required to bring the crate to a stop over a distance of 5.0 m along the *lower* surface?