University of California – Santa Barbara
Winter 2005 Physics 6A Final

Enter all of your answers in your blue-book. Make sure to write your name and PERM number on the cover of the blue-book.

<u>For the multiple choice questions (1-12), you do not need to show your work.</u>

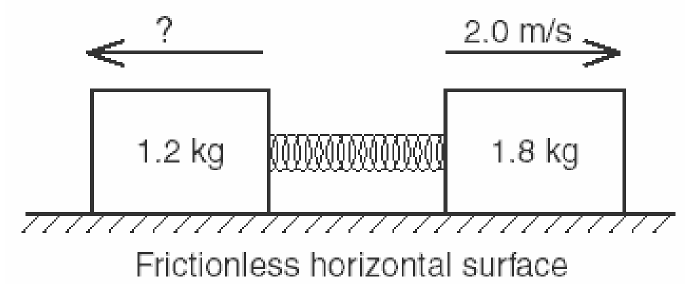
<u>For questions 13,14,15, and 16, show all of your work.</u>

SCORING

Question 1-12	4 points each
Question 13	15 points
Question 14	11 points
Question 15	11 points
Question 16	15 points

DO NOT TURN THE PAGE UNTIL YOU ARE INSTRUCTED TO DO SO

Question 1



A 1.2-kilogram block and a 1.8-kilogram block are initially at rest on a frictionless, horizontal surface. When a compressed spring between the blocks is released, the 1.8-kilogram block moves to the right at 2.0 meters per second, as shown. What is the speed of the 1.2-kilogram block after the spring is released?

A: 1.4 m/sec
B: 2.4 m/sec
C: 3.0 m/sec
D: 3.6 m/sec
E: not enough information

Question 2

A projectile is fired straight up into the air and 12.6 seconds later hits the ground. With what speed was the projectile fired? (Neglect air resistance).

A: 97.5 m/sec
B: 14.6 m/sec
C: 61.7 m/sec
D: 38.6 m/sec

Question 3

A high-jumper, having just cleared the bar, lands on an air mattress and comes to rest. Had she landed directly on the hard ground, her stopping time would have been much shorter. Which of the following statements is correct?

A: The air mattress exerts a greater impulse, and a greater net average force, on the high-jumper than does the hard ground.

B: The air mattress exerts a greater impulse, but a smaller net average force, on the high-jumper than does the hard ground.

C: The air mattress exerts the same impulse, but a smaller net average force, on the high-jumper than does the hard ground.

D: The air mattress exerts a smaller impulse, and a smaller net average force, on the high-jumper than does the hard ground.

Question 4

A rotating wheel has a constant angular acceleration. It has an angular velocity of 5.0 rad/s at time t = 0 s, and 3.0 s later has an angular velocity of 9.0 rad/s. What is the angular displacement of the wheel during the 3.0-s interval?

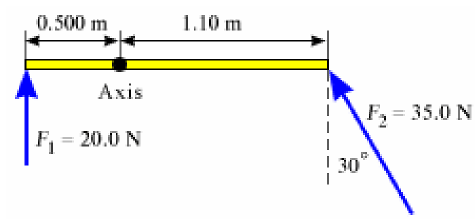
A: 15 rad C: 27 rad
B: 21 rad D: Not enough information to determine the angular displacement

Question 5

A merry-go-round at a playground is a circular platform that is mounted parallel to the ground and can rotate about an axis that is perpendicular to the platform at its center. The angular speed of the merry-go-round is constant, and a child at a distance of 1.4 m from the axis has a tangential speed of 2.2 m/s. What is the tangential speed of another child, who is located at a distance of 2.1 m from the axis?

A: 1.5 m/sec D: 5.0 m/sec
B: 3.3 m/sec E: 0.98 m/sec
C: 2.2 m/sec

Question 6



The drawing shows a top view of a door that is free to rotate about an axis of rotation that is perpendicular to the paper. Find the net torque (magnitude and direction) produced by the forces $\mathbf{F_1}$ and $\mathbf{F_2}$ about the axis.

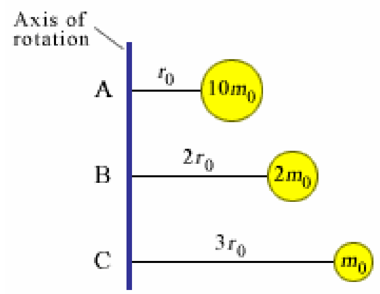
A: 28.5 Nm, counterclockwise D: 23.3 Nm, clockwise
B: 23.3 Nm, counterclockwise E: 9.3 Nm, clockwise
C: 9.3 Nm, counterclockwise F: none of the above

Question 7

An ice skater is spinning on frictionless ice with her arms extended outward. She then pulls her arms in toward her body, reducing her moment of inertia. Her angular momentum is conserved, so as she reduces her moment of inertia, her angular velocity increases and she spins faster. Compared to her initial rotational kinetic energy, her final rotational kinetic energy is ………

A: the same
B: larger, because her final angular speed is larger
C: smaller, because her final moment of inertia is smaller
D: depends on the detailed values of initial and final angular velocity

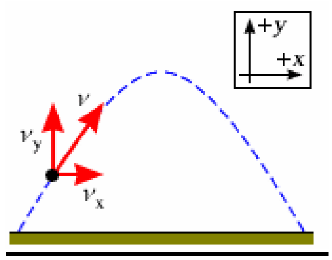
Question 8



The figure shows three objects rotating about a vertical axis. The mass of each object is given in terms of m_0, and its perpendicular distance from the axis is specified in terms of r_0. Rank the three objects according to their moments of inertia, **largest to smallest.**

A: A,B,C
B: A,C,B
C: B,A,C
D: B,C,A
E: C,A,B

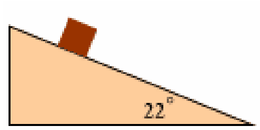
Question 9



At a certain point along the path in projectile motion, the projectile has a velocity **v** whose components are v_x = +30 m/s and v_y = +40 m/s. As the projectile moves along the path, what would be its *minimum* speed?

A: 0 m/sec
B: 10 m/sec
C: 30 m/sec
D: 40 m/sec
E: 50 m/sec
F: 70 m/sec

Question 10



The drawing shows a block at rest on an incline. The mass of the block is 8.0 kg. What is the static frictional force that acts on the block?

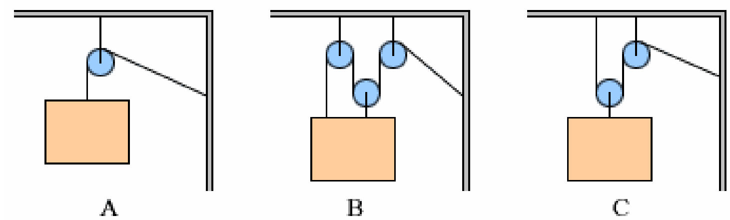
A: 73 N
B: 32 N
C: 78 N
D: 29 N
E: 0 N
F: Not enough information

Question 11

A 12000 kg railroad car traveling at 10 m/s strikes and couples with a 6000 kg caboose at rest. What is the speed of the final combination?

A: 3.3 m/sec
B: 5.0 m/sec
C: 6.7 m/sec
D: 10 m/sec

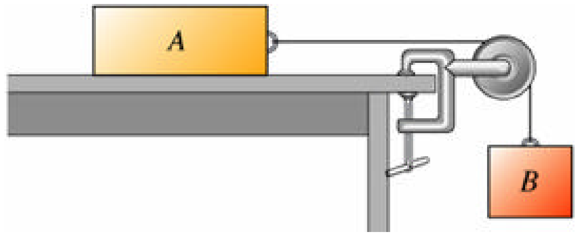
Question 12



A heavy block is suspended from a ceiling using pulleys in three different ways, as shown in the drawings. Rank the tension in the rope that passes over the pulleys in **ascending order (smallest first)**.

A: B, A, C
B: C, B, A
C: A, B, C
D: C, A, B
E: B, C, A

Question 13



Consider the system shown in the figure. Block *A* has weight W_A and block *B* has weight W_B. Once block *B* is set into downward motion, it descends at a constant speed.

(a) Find the tension of the rope.
(b) Find the coefficient of kinetic friction between block *A* and the table top.
(a) A cat, also of weight W_A, falls asleep on top of block *A*. If block *B* is now set into downward motion, what is the magnitude of its acceleration? (Make sure to indicate the direction of the acceleration)

You can ignore the mass of the pulley and the mass of the rope.

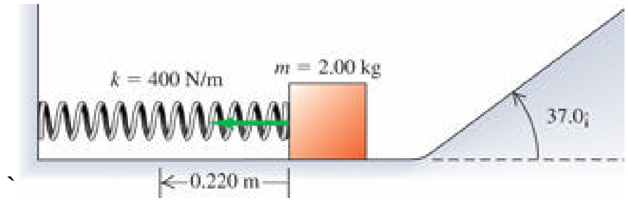
Question 14

You and your bicycle have a combined mass of 80.0 Kg. When you reach the base of a bridge, you are traveling along the road at 5.0 m/sec. By the time you have climbed to the top of the bridge, you have traveled a vertical distance of 5.2 m and you have slowed to 1.5 m/sec.

(a) What is the total work done on you and your bicycle in going from the base of the bridge to the top of the bridge.
(b) How much work have you done with the force you have applied to the pedals?

Ignore friction and any inefficiency in the bike or your legs.

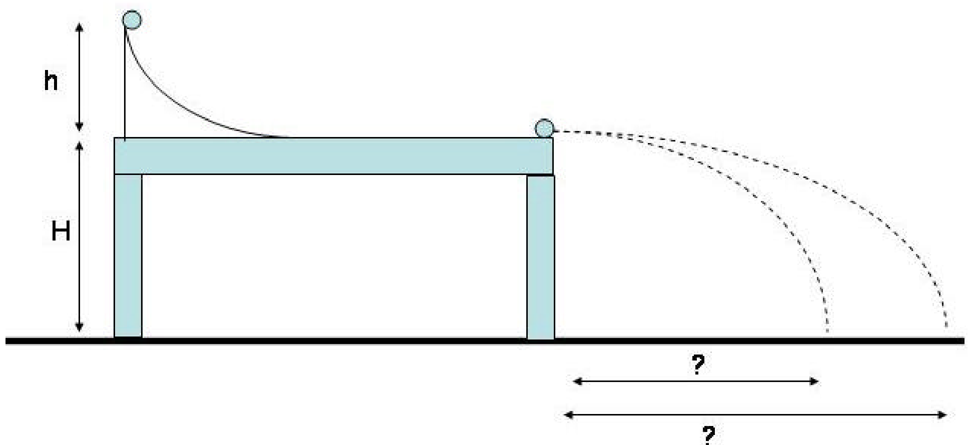
Question 15



A 2.00-kg block is pushed against a spring with negligible mass and force constant k = 400 N/m, compressing it 0.220 m. When the block is released, it moves along a frictionless, horizontal surface and then up a frictionless incline with slope 37^{o}.

(a) What is the speed of the block as it slides along the horizontal surface after having left the spring?
(b) How far does the block travel up the incline before starting to slide back down?

Question 16



A marble of mass 2m slides down a frictionless incline which is placed on a table as shown in the figure. This marble then strikes a second marble of mass m. The two marbles then hit the floor below.

(a) What is the velocity of the first marble just before the collision
(b) What are the velocities of the two marbles after the collision
(c) At what distances from the edge of the table will the two marbles hit the floor.

To avoid confusion in your answers, label the first marble (the one of mass = 2m which rolls down the incline) as marble 1, and the other one (mass m) as marble 2.
Assume that the collision between the two marbles is elastic. Ignore friction and air resistance. Neglect any effects associated with the moments of inertia of the two marbles.