RYERSON UNIVERSITY

Bubble A in question 100

Department of Physics
PCS 211 - PHYSICS II
Final Exam
April 22, 2005

Please Print:

Student: _____
Last Name *First Name*

Student Number: _____

Circle your section: 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16

Instructions - Read them attentively

- **Duration of the EXAM: 2.5 hours.**
- **Formula sheets are not permitted.**
- **Only non-programmable calculators are allowed.**
- **The exam consists of 23 multiple choice questions. All questions are of equal value.**
- **Very important! Solve the quantitative problems in the spaces provided in this booklet. Transfer your answers to the bubble sheet when you are sure they do not change.**
- **Some answers are rounded off a bit so don't panic!**
- **Whenever needed use the value g=9.8 m/s^2**
- **In principle, only the answers on the bubble sheet will be marked but we reserve the right to make a spot check of exam answers in this booklet.**
- **If the correct answer is "*none of these*" or if it is not one of the options given, then this question will be marked manually in this booklet.**
- **Pagers and cellphones must be silenced and placed in the bags at the front of the gym. Earphones are not allowed.**
- **Talking to another student or glancing over another student's paper is not permitted and it may result in a charge of academic misconduct.**
- **Check the box corresponding to your instructor's name**

M. J.Carvalho ☐ **T. Antimirova** ☐ **R.Szmidt** ☐

Sing here after you read these instructions _____

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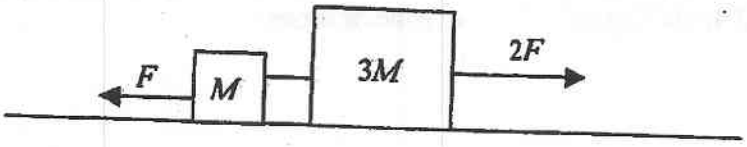
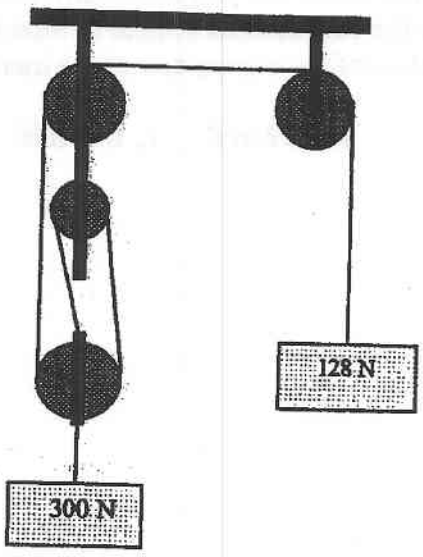
5. Two blocks, connected by a string, move together on a frictionless surface. Two forces of magnitudes F and $2F$ are applied in opposite directions, as shown. If F=6.0 N and M=1.0 kg, what is the tension in the connecting string?

a. 4.5 N **b.** 1.5 N **c.** 6.3 N **d.** 7.5 N **e.** none of these



6. Two masses are connected by a string that passes around 4 pulleys (massless and frictionless) as shown. What is the magnitude of the acceleration of the 128 N block?

a. 1.7 m/s^2 **b.** 0.57 m/s^2 **c.** 3.6 m/s^2 **d.** 1.2 m/s^2 **e.** none of these



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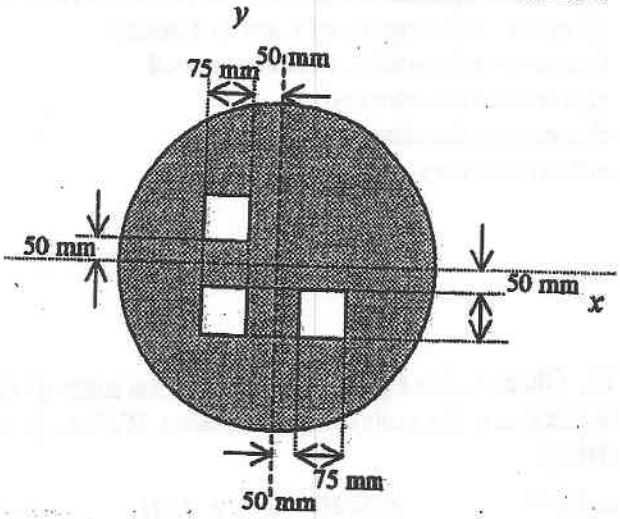
7. A circular plate of radius 250 mm has three square holes, as shown. What is the x-coordinate of the center of mass of this object as referred to the center of the circle?
a. 1.43 mm b. 2.34 mm c. 2.74 mm d. 1.34 mm
e. none of these



8. The vector sum of two co-planar forces
a. must be zero
b. must be perpendicular to one of the two
c. must be parallel to one of the two
d. must be perpendicular to the plane
e. may have any direction in the plane

9. A juggler throws two balls to the same height so that one is at the halfway point going up when the other is at the halfway point coming down. At that point:
a. Their accelerations are equal and their velocities are equal in magnitude but opposite in direction
b. Their velocities are equal and their accelerations are equal in magnitude but opposite in direction
c. Their velocities are equal in magnitude but opposite in direction and their accelerations are also equal in magnitude and opposite in direction
d. Their accelerations are equal and their velocities are equal
e. Their accelerations are equal to their velocities

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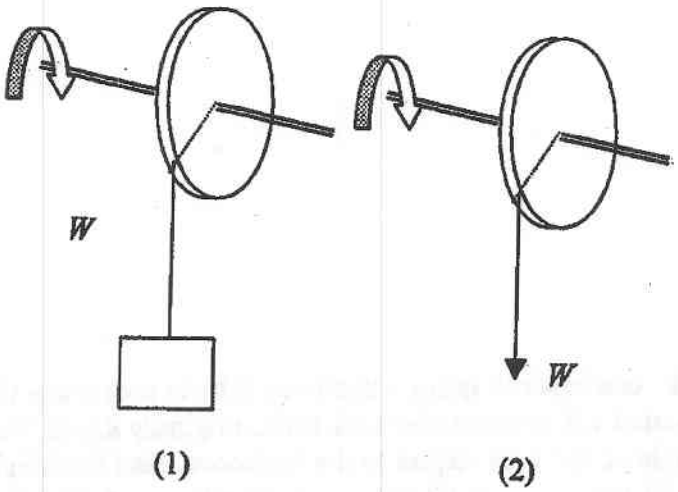
13. A rock attached to a string swings in a vertical circle. Neglect air resistance. Choose the appropriate option, from those given below, to complete the sentence: "**At the lowest point in the rock's motion....**

a. ... two forces act on the rock and their resultant is zero
b. ... only one force acts on the rock
c. ... two forces act on the rock and their resultant is not zero
d. ... three forces act on the rock
e. ... no forces act on the rock

14. A wheel of mass M, radius R and moment of inertia I is mounted on a frictionless horizontal axle. In figure (1) a light cord wrapped around the wheel supports a weight W. The angular acceleration of the wheel in this case is α_1. In figure (2) the same light cord is subjected to a force of magnitude W. The angular acceleration of the wheel in this case is α_2. What is the ratio α_1 / α_2 ?



a. $\dfrac{gI}{gI - WR^2}$

b. $\dfrac{WR^2 - gI}{gI}$

c. $\dfrac{gI}{WR^2 + gI}$

d. 1

e. None of these

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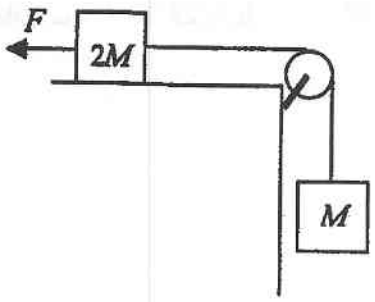
17. A physics student (70 kg) decides to find out what is the maximum acceleration rate reached by an elevator in one of the tall buildings of Toronto. Standing on a bathroom scale he rides from the ground floor to the 60th floor without intermediate stops and records the scale readings at various times of the ride. Examine the data shown in the table and determine the magnitude of the maximum acceleration of the elevator, given that it occurs at one of the given moments displayed in the table.

Time reading (s)	0	3	5	7	10	40	80	108	110	120
Scale reading (kg)	70	71.5	72	71.5	70	70	70	70	68	70

a. 0.31 m/s^2 **b.** 0.28 m/s^2 **c.** 0.48 m/s^2 **d.** 0.21 m/s^2 **e.** None of these

18. The figure represents two blocks (M=3.0 kg) connected by a light string that passes over a pulley of radius 20 cm and moment of inertia 40.0 g.m^2. If a force of magnitude F=50 N is applied as indicated, determine the angular displacement of the pulley during the first 10 seconds (after starting its motion from rest).

a. 82 rev **b.** 102 rev **c.** 10.3 rev **d.** 515 rev **e.** None of these



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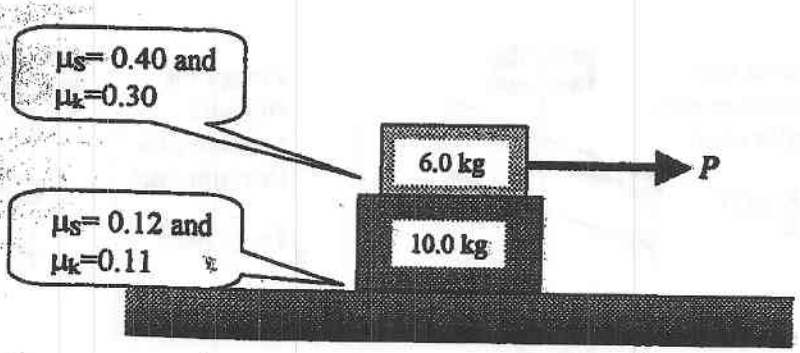
22. A body of mass m_1 makes an elastic collision with a body of mass m_2 at rest and continues to move in the original direction but with $1/n$ of its original speed. Express m_2 in terms of m_1 and n.

a. $m_2 = \dfrac{m_1(n-1)}{n}$ b. $m_2 = \dfrac{m_1(n-1)}{n+1}$ c. $m_2 = \dfrac{m_1(n+1)}{n-1}$ d. $m_2 = \dfrac{m_1 n}{n+1}$ e. None of these

23. A force P=30.0 N is applied to a 6.0 kg block which sits on top of a 10.0 kg block as shown. Given the data shown in the picture, what is the magnitude of the acceleration of the 10.0 kg block?

a. 7.2 m/s^2 b. 2.07 m/s^2 c. 1.2 m/s^2 d. 0 m/s^2 e. none of these



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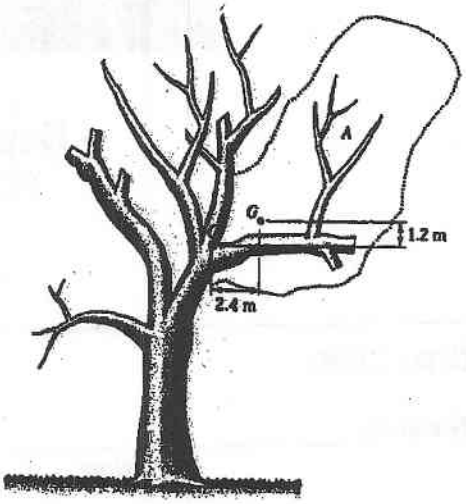
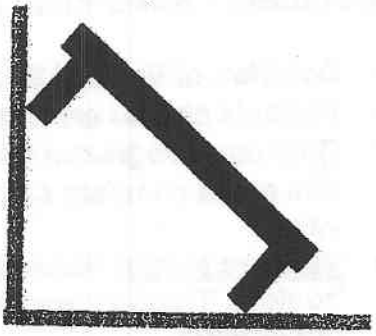
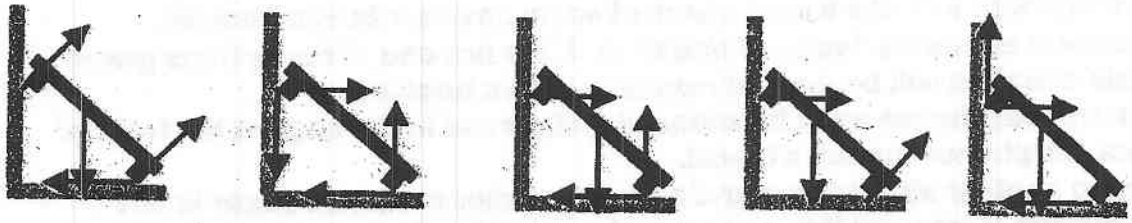
1. The branch OA (singled out by the dotted line) of the tree shown has center of mass at G and a mass of 230 kg. What is the moment of the weight of this branch about point O?



a. 2705 N.m b. 6586 N.m c. 3293 N.m d. 5410 N.m
e. none of these

2. Consider a table with two legs only (each leg as wide as the table top). As represented in the figure, one of its legs rests on a horizontal surface (which is rough) and the other leans against a smooth wall. Which of the following free-body diagrams is correct?





a. b. c. d. e.

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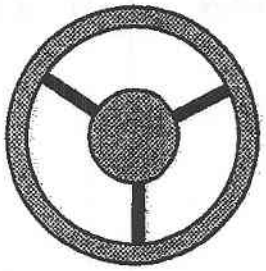
3. The wheel shown below is made of a ring of mass 200 grams (inner radius 30 cm and outer radius 35 cm) and a solid disk of mass 200 grams (20 cm in diameter) connected by three wires, each of mass 50 grams. What is the moment of inertia of this wheel with respect to the wheel axis?

a. 2.9×10^{-2} kg.m^2 b. 2.1×10^{-2} kg.m^2 c. 2.2×10^{-2} kg.m^2
d. 2.4×10^{-2} kg.m^2 e. none of these



4. A train slows down as it rounds a sharp horizontal curve, slowing uniformly from 90.0 km/h to 50.0 km/h in the 15.0 seconds it takes to round the curve. The radius of the curve is 150 metres. What is the magnitude of the acceleration of the train at the moment when the speed of the train is 60 km/h?

a. 0.74 m/s^2 b. 1.99 m/s^2 c. 1.58 m/s^2 d. 1.85 m/s^2 e. None of these

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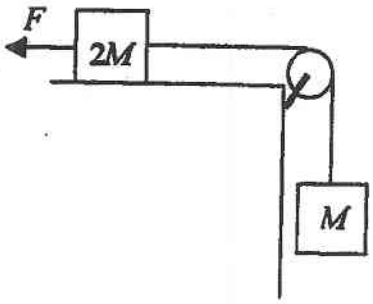
10. The apparent weight of a fish in an elevator is least when the elevator
a. moves downward at constant speed
b. moves upward at constant speed
c. accelerates upward
d. accelerates downward
e. is stationary

11. Observe the figure. Assume that the mass of the pulley is negligible and that both the horizontal surface and the pulley are frictionless. If F=40 N and M=2.0 kg, what is the tension in the connecting string?

a. 18 N **b. 26 N** **c. 33 N** **d. 56 N** **e. none of these**



12. A student is seated in a school bus facing the front of the bus. It is well known that the force of gravity acts downwards on the student while the normal force, from the seat, acts upwards. If the student stays in place (i.e. does not slide on the seat) when the bus makes a right turn, we then conclude that
a. no other force acts on the student
b. a force parallel to the seat directed forward also acts on the student
c. a force parallel to the seat directed to the left also acts on the student
d. a force parallel to the seat directed to the right also acts on the student
e. a force parallel to the seat directed backward also acts on the student
(*Note that the above mentioned directions, forward, right left, etc. are relative to the direction of motion the bus*)

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15. A 3000 kg truck approaches an icy intersection from the north at 10 m/s. A 1000 kg car approaching from the west collides with the truck. The truck and car, locked together, leave marks on the snow that make an angle of 30° east of south. How fast was the car moving before the collision?
a. 17.3 m/s **b.** 8.7 m/s **c.** 25.1 m/s **d.** 19 m/s **e.** none of these

16. In a baseball game, a home run is hit in such a way that the baseball just clears a 21 m high wall, located 130 m from where the ball is originally struck. The ball is struck 1 m above the ground at an angle of 25° with respect to the horizontal. Find the initial speed of the ball.
a. 31 m/s **b.** 92 m/s **c.** 50 m/s **d.** 10 m/s **e. none of these**

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19. Which of the following is the only true statement?

a. The force of static friction between an object of mass M and a horizontal surface on which it is resting must have a magnitude equal to $\mu_S Mg$.

b. According to Newton's third law, the tension in a cord from which a mass is suspended is not the reaction to the gravitational force the earth exerts on the mass.

c. The torque vector is obtained by calculating the cross product between the position and momentum vectors.

d. The tangential acceleration is due to the variation of the velocity with time.

e. If an object is in uniform circular motion, then its acceleration is zero.

20. A playground merry-go-round of radius 2.00 m has a moment of inertia of 250 kg.m^2 and is rotating at 10.0 rev/min about a frictionless vertical axle. A 35.0 kg child steps onto the merry-go-round and stays standing at its edge. What is the new angular speed of the merry-go-round with the child on it?

a. 0.67 rad/s **b.** 0.75 rad/s **c.** 1.75 rad/s **d.** 2.56 rad/s **e.** none of these

21. A wheel has a moment of inertia of 0.32 kg.m^2. It is mounted on a fixed axle and driven by an electric motor that supplies a constant torque when the motor is on. It takes 1.5 seconds for the wheel to reach an angular speed of 2.5 rad/s, starting from rest, after the motor is turned on. After the motor is turned off, it then takes 30 seconds for the wheel to come to rest, due to friction. Assume the friction torque is also constant. What is the average power of the motor?

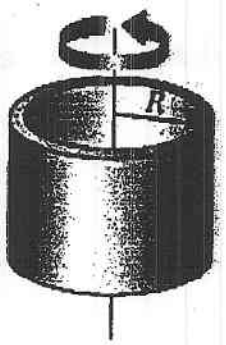
a. 0.67 W **b.** 0.23 W **c.** 0.48 W **d.** 0.70 W **e.** none of these

Table 10.2

Moments of Inertia of Homogeneous Rigid Objects with Different Geometries

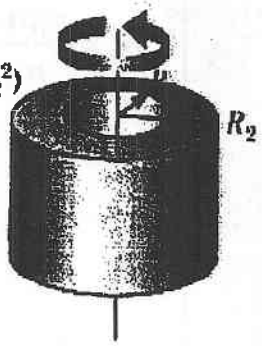
Hoop or thin cylindrical shell

$I_{CM} = MR^2$



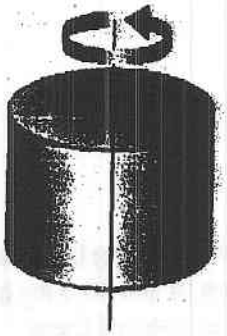
Hollow cylinder

$I_{CM} = \frac{1}{2}M(R_1^2 + R_2^2)$



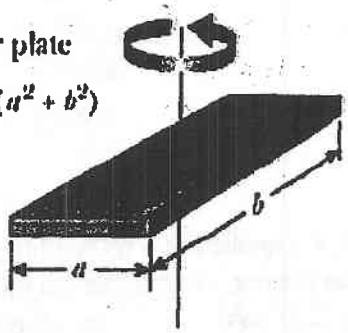
Solid cylinder or disk

$I_{CM} = \frac{1}{2}MR^2$



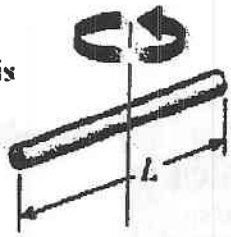
Rectangular plate

$I_{CM} = \frac{1}{12}M(a^2 + b^2)$



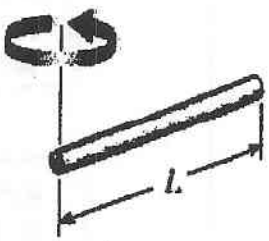
Long thin rod with rotation axis through center

$I_{CM} = \frac{1}{12}ML^2$



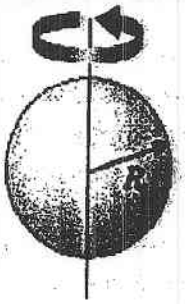
Long thin rod with rotation axis through end

$I = \frac{1}{3}ML^2$



Solid sphere

$I_{CM} = \frac{2}{5}MR^2$



Thin spherical shell

$I_{CM} = \frac{2}{3}MR^2$