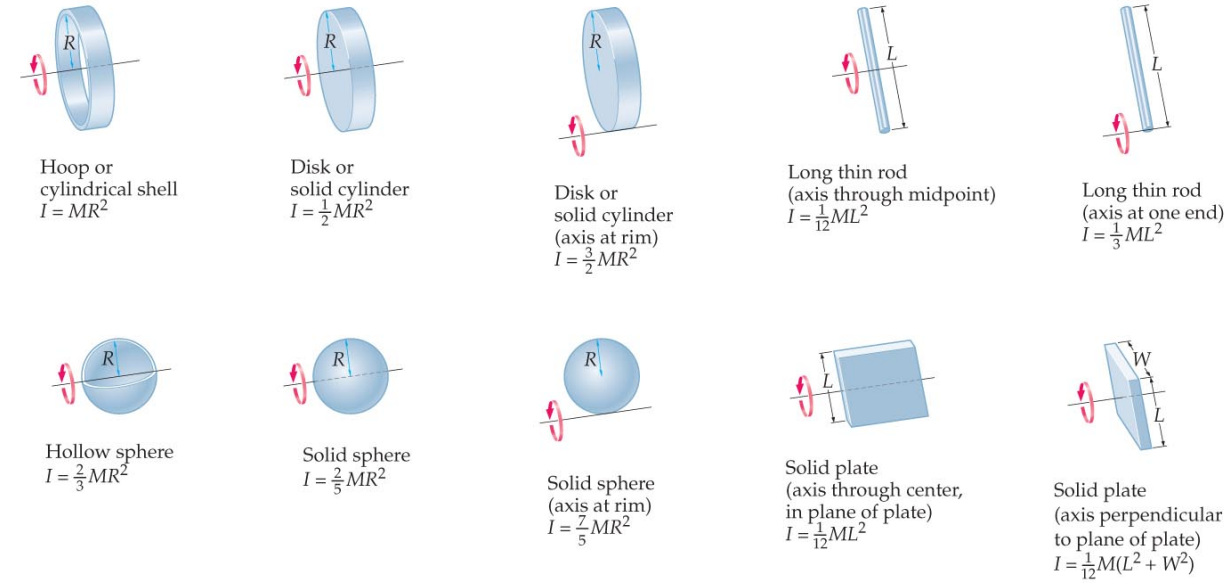
Physics 6A TR Section
Winter 2012 Final

- Enter the answer to the multiple choice questions on the pink scantron sheet. Use a pencil, not a pen.
- There is no penalty for the wrong answer
- Write your name and perm number on the scantron sheet
- The scantron sheet has an entry box labeled "TEST FORM". There are 4 slightly different sets of multiple choice questions, different students get questions in different orders. Make sure to enter the appropriate "TEST FORM" (A, B, C, or D) on your scantron sheet.
- Take your test home with you. You may want to mark your answers so that you can check your score once the solutions are posted.

YOUR "TEST FORM" IS A

DO NOT TURN THIS SHEET OVER UNTIL YOU ARE INSTRUCTED TO DO SO

TABLE 10–1 Moments of Inertia for Uniform, Rigid Objects of Various Shapes and Total Mass M



Question 1

A hockey puck slides off the edge of a table with an initial velocity of 28.0 m/s. The height of the table above the ground is 2.00 m. What is the angle below the horizontal of the velocity of the puck just before it hits the ground?

A) 77.2°
B) 72.6°
C) 12.8°
D) 12.6°
E) 31.8°

Question 2

A 1000-kg barge is being towed by means of two horizontal cables. One cable is pulling with a force of 80.0 N in a direction 30.0° west of north. In what direction should the second cable pull so that the barge will accelerate northward, if the force exerted by the cable is 120 N?

A) 19.5° east of north
B) 21.1° east of north
C) 39.0° east of north
D) 47.5° east of north
E) 54.7° east of north

Question 3

Three boxes rest side-by-side on a smooth, horizontal floor. Their masses are 5.0 kg, 3.0 kg, and 2.0 kg, with the 3.0-kg mass in the center. A force of 50 N pushes on the 5.0-kg mass, which pushes against the other two masses. What is the contact force between the 5.0-kg mass and the 3.0-kg mass?

A) 0 N
B) 10 N
C) 25 N
D) 40 N
E) 50 N

Question 4

In a lab experiment, a student brings up the rotational speed of a rotational motion apparatus to 30.0 rpm. She then allows the apparatus to slow down on its own, and counts 240 revolutions before the apparatus comes to a stop. The moment of inertia of the flywheel is 0.0850 $kg \cdot m^2$. What is the retarding torque on the flywheel?

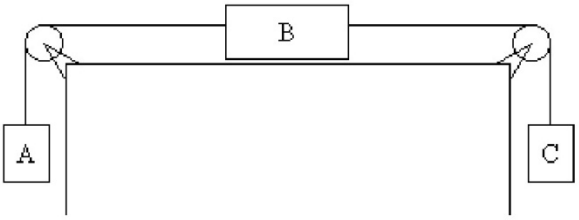
A) 0.0425 Nm
B) 0.159 Nm
C) 0.0787Nm
D) 0.000278 Nm
E) 0.0000136 Nm

Question 5

A 2-kg ball is moving with a constant speed of 5 m/s in a horizontal circle whose radius is 50 cm. What is the magnitude of the net force on the ball?

A) 0 N
B) 20 N
C) 40 N
D) 50 N
E) 100 N

Question 6



Refer to the Figure above. Block A has a mass of 3.00 kg, block B has a mass of 5.00 kg and block C has a mass of 2.00 kg. The pulleys are ideal and there is no friction between block B and the table. What is the acceleration of the masses?

A) 0.981 m/s^2
B) 1.86 m/s^2
C) 2.94 m/s^2
D) 4.20 m/s^2
E) 4.71 m/s^2

Question 7

A child pulls a 3.00-kg sled across level ground at constant velocity with a light rope that makes an angle 30.0° above horizontal. The tension in the rope is 5.00 N. Assuming the acceleration of gravity is 9.81 m/s^2, what is the coefficient of friction between the sled and the ground?

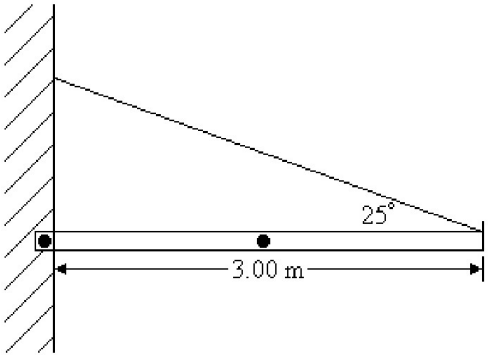
A) 0.161
B) 0.188
C) 0.0441
D) 0.0851
E) 0.103

Question 8

A compact disk rotates at 210 revolutions per minute. What is its angular speed in rad/s?

A) 11.0 rad/s
B) 22.0 rad/s
C) 45.3 rad/s
D) 69.1 rad/s
E) 660 rad/s

Question 9



A store's sign, with a mass of 20.0 kg and 3.00 m long, has its center of gravity at the center of the sign. It is supported by a loose bolt attached to the wall at one end and by a wire at the other end, as shown in the Figure. The wire makes an angle of 25.0° with the horizontal. What is the tension in the wire?
A) 464 N
B) 232 N
C) 116 N
D) 196 N
E) 297 N

Question 10
Consider a solid sphere of radius *R* and mass *M* rolling without slipping. Which form of kinetic energy is larger, translational or rotational?
A) Translational kinetic energy is larger.
B) Rotational kinetic energy is larger.
C) Both are equal.
D) You need to know the speed of the sphere to tell.
E) You need to know the acceleration of the sphere to tell.

Question 11
An experiment that can be used to measure the velocity of a bullet is to have two cardboard disks attached to a rotating shaft some distance apart and to measure the angular separation of the holes made by the bullet. In such an experiment, two cardboard disks are placed 0.534 m apart on a shaft that is rotating at 3000 rpm. The bullet is fired parallel to the axis and the angular separation of the holes is measured to be 22.0°. What is the speed of the bullet?
A) 72.8 m/s
B) 139 m/s
C) 219 m/s
D) 437 m/s
E) 1380 m/s

Question 12

A car traveling with velocity v is decelerated by a constant acceleration of magnitude a. It takes a time t to come to rest. If its initial velocity were doubled, the time required to stop would

A) double as well.
B) decrease by a factor of two.
C) stay the same.
D) quadruple.
E) decrease by a factor of four.

Question 13

A string is wrapped tightly around a fixed pulley that has a moment of inertia of 0.0352 kg m^2 and a radius of 12.5 cm. The string is pulled away from the pulley with a constant force of 5.00 N. As the string unwinds the pulley begins to rotate. What is the speed of the string after it has unwound 1.25 m?

A) 2.09 m/s
B) 2.36 m/s
C) 1.18m/s
D) 3.18 m/s
E) 4.95 m/s

Question 14

An ant walks down the surface of a ball. If the ant begins to slip when the normal force is less than one-third of the ant's weight, at what angle, measured from the top of the ball, does the ant begin to slip?

A) 70.5°
B) 19.5°
C) 55.0°
D) 18.4°
E) 35.2°

Question 15

Three masses are located in the x-y plane as follows: a mass of 6 kg is located at (0 m, 0 m), a mass of 4 kg is located at (3 m, 0 m), and a mass of 2 kg is located at (0 m, 3 m). Where is the center of mass of the system?

A) (1 m, 2 m)
B) (2 m, 1 m)
C) (1 m, 1 m)
D) (1 m, 0.5 m)
E) (0.5 m, 1 m)

Question 16
A car accelerates from rest to a speed of 19.0 m/s in 6.00 seconds. If the car weighs 16,000 N, what average power must the motor produce to cause this acceleration? Use g = 10 m/s^2.
A) 128 kW
B) 15.0 kW
C) 48.1 kW
D) 219 kW
E) 393 kW

Question 17
When a parachutist jumps from an airplane, he eventually reaches a constant speed, called the terminal velocity. This means that
A) the acceleration is equal to *g*.
B) the force of air resistance is equal to zero.
C) the effect of gravity has died down.
D) the effect of gravity increases as he becomes closer to the ground.
E) the force of air resistance is equal to the weight of the parachutist.

Question 18
Two children are riding on a merry-go-round. Child A is at a greater distance from the axis of rotation than child B. Which child has the larger tangential speed?
A) Child A
B) Child B
C) They have the same zero tangential speed.
D) They have the same non-zero tangential speed.
E) There is not enough information given to answer the question.

Question 19
Identical forces act for the same length of time on two different masses. The change in momentum of the smaller mass is
A) smaller than the change in momentum of the larger mass, but not zero.
B) larger than the change in momentum of the larger mass.
C) equal to the change in momentum of the larger mass.
D) zero.
E) There is not enough information to answer the question.

Question 20
The eastward component of vector $\vec{\mathbf{A}}$ is equal to the westward component of vector $\vec{\mathbf{B}}$ and their northward components are equal. Which one of the following statements is correct for these two vectors?
A) Vector $\vec{\mathbf{A}}$ is parallel to vector $\vec{\mathbf{B}}$.
B) Vector $\vec{\mathbf{A}}$ is anti-parallel to vector $\vec{\mathbf{B}}$.
C) Vector $\vec{\mathbf{A}}$ is perpendicular to vector $\vec{\mathbf{B}}$.
D) Magnitude of vector $\vec{\mathbf{A}}$ is equal to the magnitude of vector $\vec{\mathbf{B}}$.
E) Magnitude of vector $\vec{\mathbf{A}}$ is twice the magnitude of vector $\vec{\mathbf{B}}$.

Question 21

A potter's wheel is rotating at 1.00 rpm. What centripetal force is required to hold a 1.00 g lump of clay in place, 10.0 cm from the axis of rotation?

A) 1.10×10^{-6} N

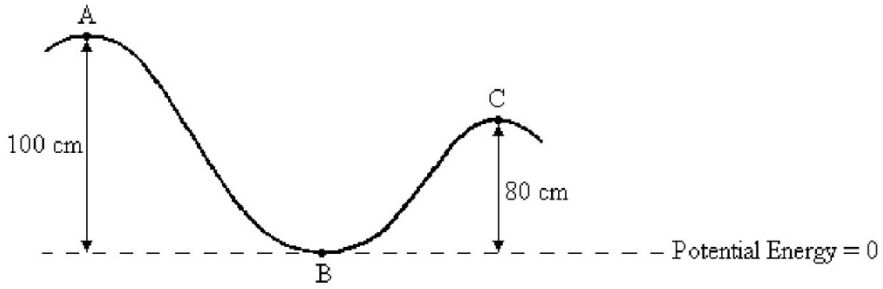
B) 1.20×10^{-6} N

C) 1.30×10^{-6} N

D) 1.40×10^{-6} N

E) 1.50×10^{-6} N

Question 22



A 2.0-g bead slides along a wire, as shown in the Figure. At point A, the bead is at rest. Neglect friction and use $g = 10$ m/s^2. What is the speed of the bead at point B?

A) 10 m/s

B) 4.9 m/s

C) 0 m/s

D) 4.5 m/s

E) There is not enough information to solve this problem.

Question 23

A 900-kg car traveling east at 15.0 m/s collides with a 750-kg car traveling north at 20.0 m/s. The cars stick together. What is the speed of the wreckage just after the collision?

A) 6.10 m/s

B) 12.2 m/s

C) 25.0 m/s

D) 35.0 m/s

E) 17.3 m/s

Question 24

A truck is towing a car whose mass is one quarter that of the truck. The force exerted by the truck on the car is 6000 N. The force exerted by the car on the truck is

A) 1500 N.

B) 24000 N.

C) 3000 N.

D) 6000 N.

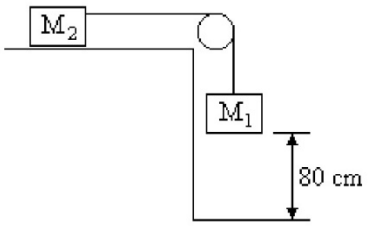
E) 12000 N.

Question 25
A pencil, 15.7 cm long, is released from a vertical position with the eraser end resting on a table. The eraser does not slip. Treat the pencil like a uniform rod. What is the angular speed of the pencil just before it hits the table?
A) 17.2 rad/s
B) 7.23 rad/s
C) 3.70 rad/s
D) 24.5 rad/s
E) 13.7 rad/s

Question 26
A weight of 200 N is hung from a spring with a spring constant of 2500 N/m and lowered slowly. How much will the spring stretch?
A) 4.00 cm
B) 6.00 cm
C) 8.00 cm
D) 10.0 cm
E) 12.0 cm

Question 27
How much energy is needed to change the speed of a 1600 kg sport utility vehicle from 15.0 m/s to 40.0 m/s?
A) 1.10 MJ
B) 10.0 kJ
C) 20.0 kJ
D) 40.0 kJ
E) 0.960 MJ

Question 28



Two masses M_1 = 2.0 kg and M_2 = 4.0 kg are attached by a string as shown in Figure 8-7. M_1 falls vertically down and M_2 moves on a frictionless surface. Initially the system is at rest. Use g = 10 m/s^2. What is the speed of mass M_1 just before it touches the ground?
A) 2.3 m/s
B) 2.9 m/s
C) 3.8 m/s
D) 4.6 m/s
E) 5.8 m/s

Question 29
Which of the following is a vector quantity?
A) time
B) mass
C) volume
D) displacement
E) speed

Question 30
An object of mass *m* is held at a vertical height *h* from ground level. It is then released and falls under the influence of gravity. Which of the following statements is true in this situation? (Neglect air resistance.)
A) The total energy of the object is decreasing.
B) The kinetic energy of the object is decreasing.
C) The potential energy of the object is increasing.
D) The total energy of the object is increasing.
E) The potential energy of the object is decreasing and the kinetic energy is increasing.

Question 31
A 15.0-kg child is sitting on a playground teeter-totter, 1.50 m from the pivot. What is the minimum distance, on the other side of the pivot, such that a 220-N force will make the child lift off the ground?
A) 1.00 m
B) 1.50 m
C) 0.102 m
D) 9.78 m
E) 2.35 m

Question 32
If the acceleration vector of an object is directed perpendicular to the velocity vector,
A) the object is turning.
B) the object is speeding up.
C) the object is slowing down.
D) the object is not moving.
E) this situation would not be physically possible

Question 33

A croquet mallet balances when suspended from its center of mass, as shown in the Figure. If you cut the mallet in two at its center of mass, as shown, how do the masses of the two pieces compare?
A) The masses are equal.
B) The piece with the head of the mallet has the greater mass.
C) The piece with the head of the mallet has the smaller mass.
D) It is impossible to tell.

Question 34

A locomotive is pulling three wagons along a level track with a force of 100,000 N. The wagon next to the locomotive has a mass of 80,000 kg, the next one, 50,000 kg, and the last one, 70,000 kg. Neglect friction. What is the force between the 80,000-kg and 50,000-kg wagons?
A) 35,000 N
B) 40,000 N
C) 50,000 N
D) 60,000 N
E) 65,000 N