Your Name: _____ **PHY203**

Final Exam
5/6/10

Part 3

Solutions

For problems1-3,
Masses are placed as follows along the x-axis: 1kg at x=0, 2kg at x=1m, and 3kg at x=2m, all connected by a 5kg rod of length 3m starting at x=0.

1. Find the x position of the center of mass:
a. 0.73m x_{cm}=[(2kg)(1m) + (3kg)(2.0m) + (5kg)(1.5m)]/(11kg)
b. 1.41m
c. 1.50m
d. 1.55m
e.2.1 m

2. Find the moment of inertia about the x-axis:
a. 0 all mass on x-axis
b. 12.5 kgm^2
c. 17.0 kgm^2
d. 25.2 kgm^2
e. 29.0 kgm^2

3. Find the moment of inertia about the y-axis:
a. 0 $I=(1kg)(0) + (2kg)(1m)^2 + (3kg)(2m)^2 + 1/3(5kg)(3m)^2$
b. 12.5 kgm^2
c. 17.0 kgm^2
d. 25.2 kgm^2
e. 29.0 kgm^2

For problems 4 and 5,
A 0.25kg ball traveling at a speed of 3.5m/s in the positive x-direction strikes a wall and rebounds in the negative x-direction with a speed of 2.5m/s.

4. Find the magnitude of the impulse.
a. 0.25Ns I=(0.25kg)(6m/s)
b. 1.0Ns
c. 1.5Ns
d. 6.0Ns
e. 24.0Ns

5. Assuming the collision time is $1.0x10^{-3}$s, find the magnitude of the average force during the

collision.

a. $2.5x10^{-4}N$ $I = 1.5\ Ns = F_{av}Dt = F_{av}\ (1x10^{-3}s)$

b. $1.5x10^{-3}N$

c. $2.5x10^{+2}N$

d. $1.0x10^{+3}N$

e. $1.5x10^{+3}N$

6. Young Albert Einstein is playing with a model train set. He gets the train (mass 3kg) going at a speed of 4m/s along a straight section of track. As the train passes by him, he drops a stone (mass 0.5kg) which lands on the train and stays there. Find the speed of the train after the stone has landed:

a. 3.4m/s $p = mv = (3kg)(4m/s) = 12kgm/s$

b. 4.0m/s. $v = p/m_{tot} = (12kgm/s)/(3.5kg)$

c. 4.8m/s

d. 8.0m/s

e. None of the above

7. Young Albert Einstein is playing with a model train set. He gets the train (mass 3kg) going at a speed of 4m/s along a straight section of track. He runs along the side of the train, matching his speed to the speed of the train. He drops a stone (mass 0.5kg) which lands on the train and stays there. Find the speed of the train after the stone has landed:

a. 3.4m/s $p = mv = (3kg)(4m/s) + (0.5kg)(4m/s) = 14kgm/s$

b. 4.0m/s $v = p/m_{tot} = (14kgm/s)/(3.5kg)$

c. 4.8m/s

d. 8.0m/s

e. None of the above

8. In an inelastic collision, of momentum, kinetic energy, and total energy which are conserved?

a. momentum only K.E. is not conserved in an inelastic collision

b. momentum and kinetic energy only

c. momentum and total energy only

d. kinetic energy and total energy only

e. all three

For problems 9 and 10:

A solid sphere of mass 10 kg and radius 0.5 m is at rest. A force of 10 N is applied at the edge of the sphere in a direction perpendicular to the radius.

9. Find the moment of inertia about the axis of the sphere:

a. 0.25 kgm^2 $I = 2/5mr^2 = 2/5(10kg)(0.5m)^2$

b. 0.5 kgm^2

c. 0.75 kgm^2

d. 0.67 kgm^2

e.1.0 kgm^2

10. Find the angular speed of the sphere after the torque has been applied for 10s.

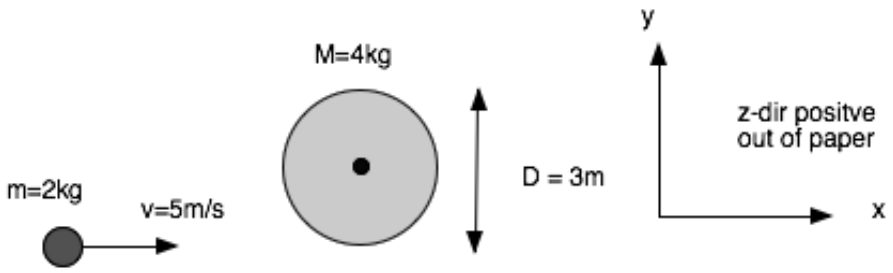
a. 0.25 rad/s $t = rFsinq = (0.5m)(10N)(sin90^o) = 5Nm$

b. 0.5 rad/s $a = t/I = 5Nm/1.0\ kgm^2 = 5.0\ rad/s^2$

c. 5.0 rad/s $w = w_o + at = 0 + (5.0rad/s^2)(10)$

d. 25.0 rad/s

e. 50.0 rad/s



11. A ball of mass 2kg traveling at a speed of 5m/s as shown above strikes a solid disk of diameter 3m and mass 4kg and sticks to its edge. The disk pivots about an axis at its center.

a. Calculate the linear momentum of the ball before the collision and express it in vector notation, using the coordinate system given above.

$\mathbf{p_i} = (2kg)(5m/s\mathbf{i}) = 10kgm/s\mathbf{i}$

b. Calculate the angular momentum of the system about the center of the disk just before the collision and express it in vector notation, assuming out-of-the-paper is the positive z-direction.

$\mathbf{L} = \mathbf{r} \times \mathbf{p} = (1.5m)(10kgm/s)(\sin 90) = 15kgm^2/s\mathbf{k}$

c. Find the angular momentum of the system after the collision and write it as a vector.

same: $\mathbf{L} = 15kgm^2/s\mathbf{k}$

d. Calculate the moment of inertia of the disk about its center before the collision.

$I = (1/2)MR^2 = (1/2)(4kg)(1.5m)^2 = 4.5kgm^2$

e. Calculate the moment of inertia of the ball+disk system after the collision.

$I = I_{disk} + mr^2 = 4.5kgm^2 + (2kg)(1.5m)^2 = 9.0kgm^2$

f. Calculate the angular speed of the ball+disk system after the collision.

$L = 15kgm^2/s = Iw = (9.0kgm^2)w$
$w = 1.67rad/s$