PHY203 EXAM-III THURSDAY 11/17/05

YOUR NAME: SOLUTION

STUDENT ID: _____

CIRCLE YOUR LECTURE TIME:

9AM 1PM 2PM 3PM HONORS

YOUR SCORE:

QUESTIONS 1-10: _____ OUT OF 40

QUESTION 11: _____ OUT OF 30

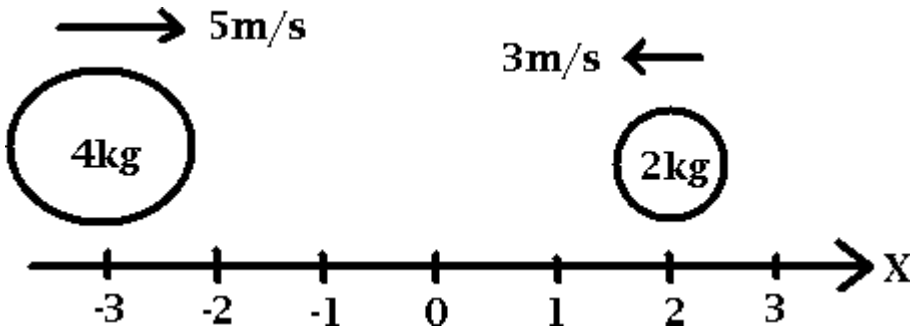
QUESTION 12: _____ OUT OF 30

TOTAL : _____ OUT OF 100

YOUR NAME: _____

	1	2	3	4	5	6	7	8	9	10
A										
B										
C										
D										
E										

For questions 1-10:
An object of mass 2kg is moving with a velocity of 3m/s in the negative x direction. A second object of mass 4kg is moving in the positive x direction with a velocity of 5m/s. At t=0, the 2kg object passes the position x=2m, and the 4kg object passes the position x=-3m. Answer the following 10 questions. Indicate your answers in the table provided above. There is only one correct answer for each question. No credit will be given for work shown elsewhere.

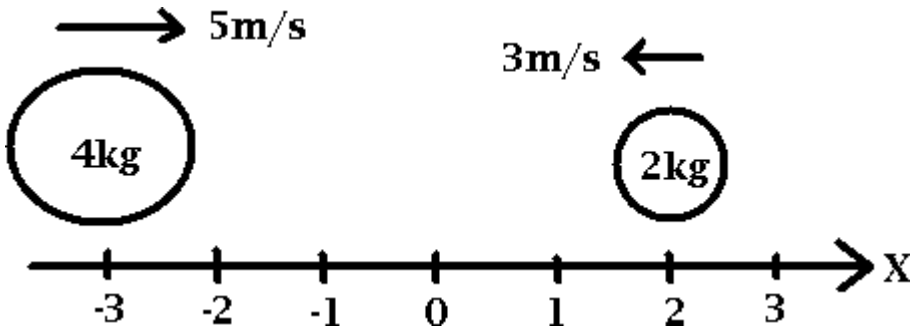


1) What is the SI unit of momentum?
A) kg m^2 B) kg m^2/s C) Joule D Newton E) kg m/s

2) What is the magnitude of the 2kg object's momentum in the SI unit?
A) 3 B) 1.5 C) 14 D) 6 E) 9
2kg x 3m/s = 6 kg m/s

3) Where is the center of mass of the two objects at t=0?
A) -0.75m B) 0.75m C) -1.33m D) 2.33m E) -0.5m
[2kg x 2m + 4kg x (-3m)] / (2kg + 4kg) = -1.33 m

4) What is the kinetic energy of the 4kg object?
A) 20 J B) 50J C) 9J D) 100J E) 6J
½ 4kg x $(5m/s)^2$ = 50 J



5) At a later time, they collide. After their collision, the 4kg object moves with a velocity of 0.333m/s in the negative x direction. How much impulse does the 2kg object exert on the 4kg object during the collision?
A) 21.3kg m/s B) 18.7kg m/s C) 1.33kg m/s D) 20kg m/s E) 0
$\Delta P = (-4kg \times 0.333m/s) - (4kg \times 5m/s) = -21.3\ kg\ m/s$

6) If the duration of the collision is 1 milli-second, what is the average force exerted on the 4kg object during the collision?
A) 0N B) 1332N C) 21kN D) 19kN E) 20N
$F_{ave} = \Delta P/\Delta t = (21.3\ kg\ m/s) / 0.001s = 21.3 \times 10^3\ N$

7) What average force is exerted on the 2kg object by the 4kg object during the collision?
A) Same magnitude and same direction as the force of question 6).
B) Same magnitude and opposite direction. (Newton's 3rd Law)
C) Zero
D) Greater magnitude than the force of question 6).
E) Smaller magnitude than the force of question 6).

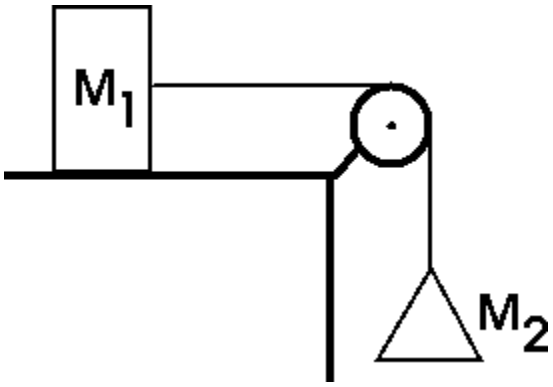
8) After the collision, which way does the 2kg object move?
A) +x direction B) -x direction C) It does not move.

9) What is the speed of the 2kg object after the collision?
A) 7.67m/s B) 2.33m/s C) 0m/s D) 0.333m/s E) 4.67m/s
$(4kg \times 5m/s) + (-2kg \times 3m/s) = (-4kg \times 0.333m/s) + (2kg \times V)$
$V = (14 + 1.33) / 2 = 7.67\ m/s$

10) What kind of collision is this?
A) Perfectly inelastic collision
B) Inelastic collision
C) Elastic collision
D) Collision in which the total momentum is not conserved
E) None of the above
$K_i = \frac{1}{2}\ 4x5^2 + \frac{1}{2}\ 2x(-3)^2 = 59J$
$K_f = \frac{1}{2}\ 4x(-0.333)^2 + \frac{1}{2}\ 2x(7.67)^2 = 59J$

YOUR NAME: _____

11) Two objects M_1=3kg and M_2=4kg are connected by a string that goes around a pulley as shown below. The pulley's mass is 6kg, and its radius is 2m. The pulley can be thought of as a uniform circular disk. The table surface is frictionless. Calculate the angular acceleration of the pulley. Write your final answer in the box provided below. To receive a full credit, you must show all your work on this page.



For M_1

$T_1 = M_1 a = M_1 \alpha R$ -------- (1)

For M_2

$M_2 g - T_2 = M_2 a = M_2 \alpha R$

$T_2 = M_2 g - M_2 \alpha R$ -——— (2)

For the pulley

$T_2 R - T_1 R = (\frac{1}{2} M R^2) \alpha$

$T_2 - T_1 = \frac{1}{2} M R \alpha$ ——— (3)

Substitute (1) and (2) into (3):

$M_2 g - M_2 \alpha R - M_1 \alpha R = \frac{1}{2} M R \alpha$

$\alpha = M_2 g / [(M_2 + M_1 + \frac{1}{2} M) R]$

$= 4 \times 9.81 / [(4+3+3) \times 2]$

$= 1.96 \text{ rad/s}^2$

Answer: 1.96 rad/s^2

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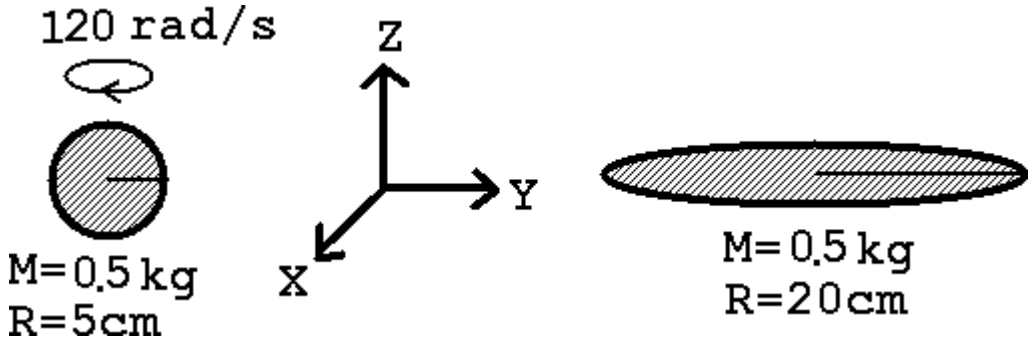
12) A spherical pizza dough of mass 0.5kg and radius 0.05m is tossed high up into the air with an initial angular velocity of 120rad/s in the clock-wise direction. By the time it comes back down to the hands of the chef, it has flattened out to a radius of 0.2m. What is its final angular velocity? Write your answer in the box provided below in the vector notation. To receive a full credit, you must show all your work on this page.



$L_i = L_f$

$I_i \omega_i = I_f \omega_f$

$\omega_f = I_i \omega_i / I_f$

$= \frac{2/5 \times 0.5\text{kg} \times (0.05\text{m})^2 \times 120 \text{ rad/s}}{\frac{1}{2} \times 0.5\text{kg} \times (0.2\text{m})^2}$

$= 6$ rad/s

Direction is along **-k** from the right hand rule.

Answer: **- 6 rad/s k**

PHY203 EXAM-III CRIB SHEET

$X_{cm} = \Sigma M_i X_i / \Sigma M_i$

$P = M v$

$\Delta P = F_{ave} * \Delta t$ (for impulse)

$P_{1i} + P_{2i} = P_{1f} + P_{2f}$

$V_{2i} - V_{1i} = V_{1f} - V_{2f}$ (for elastic collision)

$K = \frac{1}{2} M v^2$

$I = \Sigma M_i R_i^2$

$I = \frac{1}{2} M R^2$ (for a circular disk rotating around its center axis)

$I = M R^2$ (for a ring rotating around its center axis)

$I = 2/5 M R^2$ (for a solid sphere rotating around its diameter)

$\theta = \theta_0 + \omega t + \frac{1}{2} \alpha t^2$

$\omega = \omega_0 + \alpha t$

$\omega^2 = \omega_0^2 + 2\alpha (\theta - \theta_0)$

$\Sigma \tau = I \alpha$

$\tau = r F \sin\theta$

$\tau = r \times F$

$L = I \omega$

$L = r P \sin\theta$

$L = r \times P$

$\Delta L = \tau_{ext} * \Delta t$

$K = \frac{1}{2} I \omega^2$