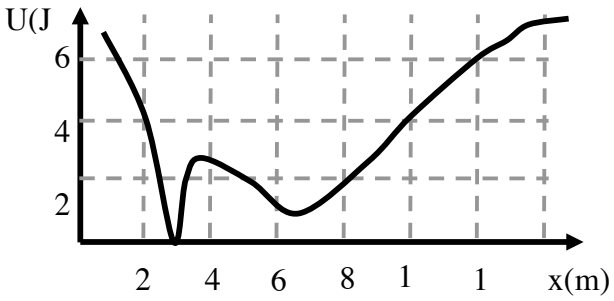
PHY1124 Winter 2017
Dr. Andrzej Czajkowski

STUDENT NAME:_____ STUDENT NUMBER:_____

ASSIGNEMNT 3 Due: Mon Feb 27 6:00PM

1 A 1kg particle moves under influence of conservative force whose potential energy is shown in the diagram. At t=0 particle has K=4J at x= 8m.



a What is the kinetic energy of the particle at x=3m?

b) What is the direction of the force at x=2m

c) What is the right turning point?

d) What is the left turning point?

Ans A: 6J **B: to the right**

C: x=12 **D: x=1m**

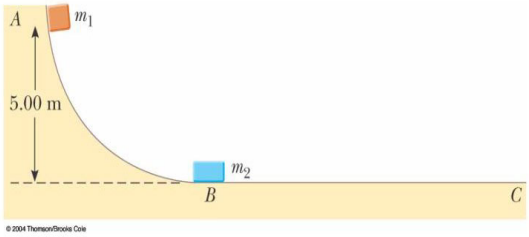
2 Two blocks are free to slide along the frictionless wooden track *ABC* shown. A block of mass m_1 = 5.00 kg is released from *A.* Protruding from its front end is the north pole of a strong magnet, repelling the north pole of an identical magnet embedded in the back end of the block of mass m_2 = 10.0 kg, initially at rest. The two blocks never touch. Calculate the maximum height to which m_1 rises after the elastic collision.

v_1, speed of m_1 at B before collision.

$$\frac{1}{2}m_1v_1^2 = m_1gh$$

$$v_1 = \sqrt{2(9.80)(5.00)} = 9.90 \text{ m/s}$$

v_{1f}, speed of m_1 at B just after collision.



$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2}v_1 = -\frac{1}{3}(9.90) \text{ m/s} = -3.30 \text{ m/s}$$

At the highest point (after collision)

$$m_1gh_{\max} = \frac{1}{2}m_1(-3.30)^2 \qquad h_{\max} = \frac{(-3.30 \text{ m/s})^2}{2(9.80 \text{ m/s}^2)} = \boxed{0.556 \text{ m}}$$

3A A 4.1 kg rifle is suspended by strings and fires a 0.0030 kg bullet at a speed of 1500 m/s. What is its recoil speed in m/s?

c. 1.1

3B An explosion in a rigid pipe shoots out three pieces. A 6 g piece comes out the right end. A 4 g piece comes out the left end with twice the speed of the 6 g piece. From which end does the third piece emerge?

A. Right end

B. Left end

C Not enough information to answer this question

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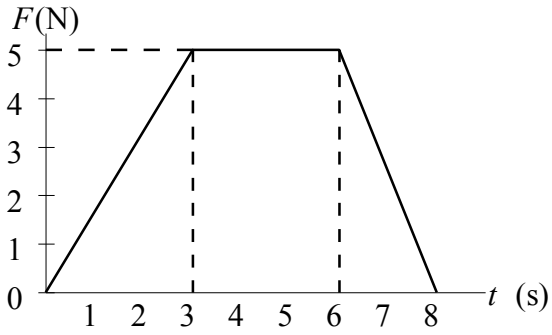
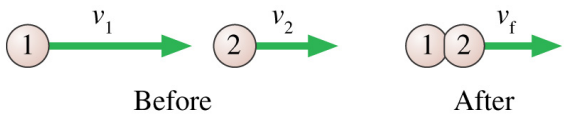
4 A 2.5 kg body moving horizontally with speed v= 1m/s is acted on by a horizontal force as shown in the graph. What is the body speed at x=3s?

a) 1m/s
b) 2m/s
c) 3m/s
d) 4m/s
e) 5m/s



5 The two particles are both moving to the right. Particle 1 catches up with particle 2 and collides with it. The particles stick together and continue on with velocity vf. Which of these statements is true?



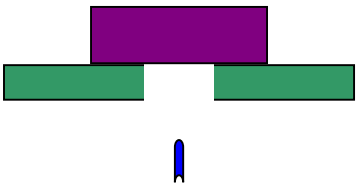
A. vf = v2.
B. vf is less than v2.
C. vf is greater than v2, but less than v1.
D. vf = v1.
E. vf is greater than v1.

6 A 12-g bullet moving horizontally strikes and remains in a 3.0-kg block initially at rest on the edge of a table. The block, which is initially 80 cm above the floor, strikes the floor a horizontal distance of 120 cm from its initial position. What was the initial speed of the bullet?

b. 0.75 km/s

7 A 10-g bullet moving 1000 m/s strikes and passes through a 2.0-kg block initially at rest, as shown. The bullet emerges from the block with a speed of 400 m/s. To what maximum height will the block rise above its initial position?

d. 46 cm



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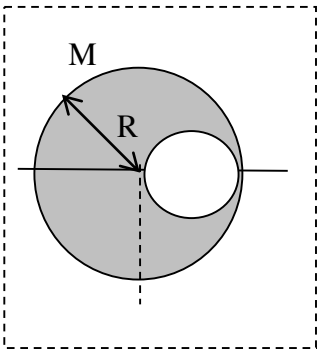
8a. A 4.0-kg particle is moving horizontally with a speed of 5.0 m/s when it strikes a vertical wall. The particle rebounds with a speed of 3.0 m/s. What is the magnitude of the impulse delivered to the particle?

b. 32 N

8b A 2.0-kg object moving 5.0 m/s collides with and sticks to an 8.0-kg object initially at rest. Determine the kinetic energy lost by the system as a result of this collision.

a.20 J

9 *A sphere of radius R and mass M uniformly distributed over its whole volume, has a smaller sphere of radius R/2 removed from it as shown on the cross section diagram. Find the x coordinate of the CM of the sphere.*

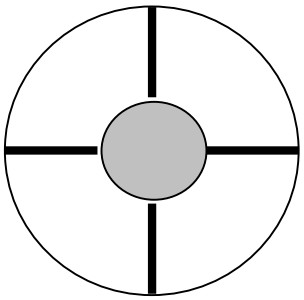


$$x_{CM}(system) = \frac{M(fullsphere)\times 0 + (-m(smallspehere)x_{cm}}{M-m}$$

$$\rho = \frac{M}{\frac{4}{3}\pi R^3} = \frac{3}{4}\frac{M}{\pi R^3} \quad \Rightarrow \quad m = \rho\frac{4}{3}\pi\left(\frac{R}{2}\right)^3 = \frac{M}{R^3}\left(\frac{R}{2}\right)^3 = \frac{1}{8}M$$

$$x_{CM}(system) = \frac{M\times 0 + (-\frac{M}{8})\frac{R}{2}}{M-\frac{M}{8}} = -\frac{\frac{1}{16}M}{\frac{7}{8}M} = -\frac{1}{14}$$

10 The wheel shown on diagram has a central hub of radius 2m and a mass of 4kg, outside rim of radius 6m and a mass 1kg. Each of the four spokes is 4 m long and has a mass of 2kg.



a)Find the moment of inertia about an axis through the centre. Treat the hub as a disk.
b) find the moment of inertia about the axis through the point where the spoke is attached to the outer rim.
Both axes are perpendicular to the plane of the wheel.

A)

$$I_{CM} = 4I(rod) + I(hub) + I(rim)$$

$$I_{CM} = 4[\frac{1}{12}M_{rod}L^2 + M_{rod}(R_{hub} + \frac{L}{2})^2] + \frac{1}{2}M_{hub}R_{hub}^2 + M_{rim}r_{rim}^2$$

$$I_{CM} = 4[\frac{1}{12}(2)4^2 + (2)(6)^2] + \frac{1}{2}4(2)^2 + (1)(6)^2 = 4[\frac{8}{3} + 72] + 8 + 36 = \frac{32}{3} + 288 + 8 + 36 = 342.66(kgm^2)$$

B) $I = I_{CM} + M_{total}(r)^2 = 342.66 + (4+8+1)6^2 = 342.66 + (13)36 = 810.66 = 811(kgm^2)$

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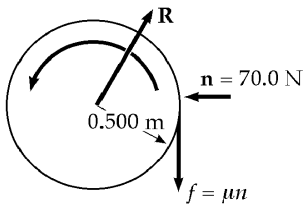
11 A potter's wheel—a thick stone disk of radius 0.500 m and mass 100 kg—is freely rotating at 50.0 rev/min. The potter can stop the wheel in 6.00 s by pressing a wet rag against the rim and exerting a radially inward force of 70.0 N. Find the effective coefficient of kinetic friction between wheel and rag.

$$I = \frac{1}{2}mR^2 = \frac{1}{2}(100\ \text{kg})(0.500\ \text{m})^2 = 12.5\ \text{kg}\cdot\text{m}^2$$

$$\omega_i = 50.0\ \text{rev/min} = 5.24\ \text{rad/s}$$

$$\alpha = \frac{\omega_f - \omega_i}{t} = \frac{0 - 5.24\ \text{rad/s}}{6.00\ \text{s}} = -0.873\ \text{rad/s}^2$$

$$\tau = I\alpha = 12.5\ \text{kg}\cdot\text{m}^2(-0.873\ \text{rad/s}^2) = -10.9\ \text{N}\cdot\text{m}$$



The magnitude of the torque is given by $fR = 10.9\ \text{N}\cdot\text{m}$, where f is the force of friction.

Therefore, $f = \dfrac{10.9\ \text{N}\cdot\text{m}}{0.500\ \text{m}}$ and $f = \mu_k n$

yields $\mu_k = \dfrac{f}{n} = \dfrac{21.8\ \text{N}}{70.0\ \text{N}} = \boxed{0.312}$

12 An explosion in a rigid pipe shoots out three pieces. A 6 g piece comes out the right end. A 4 g piece comes out the left end with twice the speed of the 6 g piece. From which end does the third piece emerge?

A. Right end
B. Left end
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