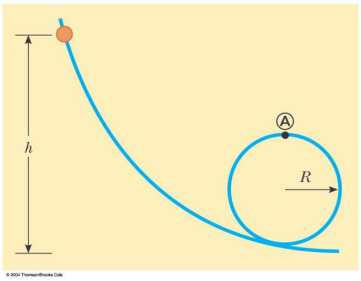
Assignment 10 Energy Due Nov 27

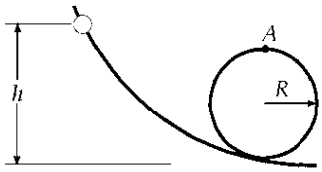
1. A bead slides without friction around a loop-the-loop (Fig. P8.5). The bead is released from a height $h = 3.50R$. (a) What is its speed at point A? (b) How large is the normal force on it if its mass is 5.00 g?



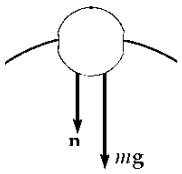
$$U_i + K_i = U_f + K_f: \qquad mgh + 0 = mg(2R) + \frac{1}{2}mv^2$$

$$g(3.50R) = 2g(R) + \frac{1}{2}v^2$$

$$\boxed{v = \sqrt{3.00gR}}$$



$$\sum F = m\frac{v^2}{R}: \qquad n + mg = m\frac{v^2}{R}$$

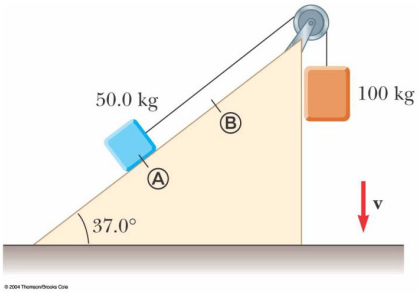


$$n = m\left[\frac{v^2}{R} - g\right] = m\left[\frac{3.00gR}{R} - g\right] = 2.00mg$$

$$n = 2.00\left(5.00 \times 10^{-3}\ \text{kg}\right)\left(9.80\ \text{m/s}^2\right)$$

$$= \boxed{0.098\,0\ \text{N downward}}$$

2. A 50.0-kg block and 100-kg block are connected by a string as in Figure P8.36. The pulley is frictionless and of negligible mass. The coefficient of kinetic friction between the 50-kg block and incline is 0.250. Determine the change in the kinetic energy of the 50-kg block as it moves from A to B, a distance of 20.0 m



$$\sum F_y = n - mg\cos 37.0° = 0$$

$$\therefore n = mg\cos 37.0° = 400\ \text{N}$$

$$f = \mu n = 0.250(400\ \text{N}) = 100\ \text{N}$$

$$-f\Delta x = \Delta E_{\text{mech}}$$

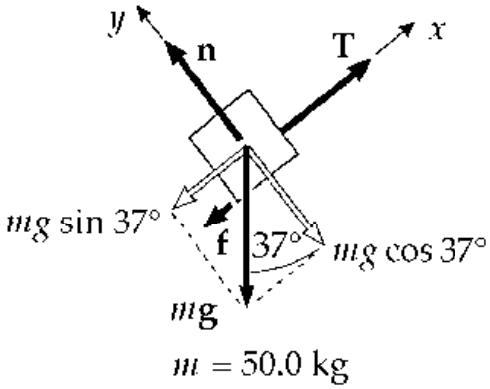
$$(-100)(20.0) = \Delta U_A + \Delta U_B + \Delta K_A + \Delta K_B$$

$$\Delta U_A = m_A g\left(h_f - h_i\right) = (50.0)(9.80)(20.0\sin 37.0°) = 5.90 \times 10^3$$

$$\Delta U_B = m_B g\left(h_f - h_i\right) = (100)(9.80)(-20.0) = -1.96 \times 10^4$$

$$\Delta K_A = \frac{1}{2}m_A\left(v_f^2 - v_i^2\right)$$

$$\Delta K_B = \frac{1}{2}m_B\left(v_f^2 - v_i^2\right) = \frac{m_B}{m_A}\Delta K_A = 2\Delta K_A$$

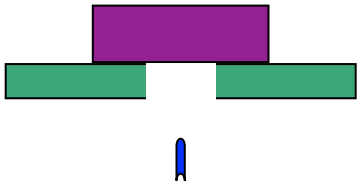


Adding and solving, $\Delta K_A = \boxed{3.92\ \text{kJ}}$.

3 1 On Oct 31 2015massive asteroid TB145 nicknamed "Spooky" passed near the Earth vicinity. Given the measured diameter of the asteroid (500meters) and its speed relative to the Sun:125000km/h, find the total maximum and minimum energy released in the completely inelastic collision of this object with Earth.. Treat the asteroid as spherical object with the density of between 2g/ cm^3 to 5g/cm^3. Earth orbit around the sun has radius =150x10^6 km. State your answers in Jules and
I n megatonnes of TNT T
ANS:

Maximum			Minimum
High density Highest relative Velocity		Low density	Min Relative velocity
Kinetic Energy	**1305929 Mt TNT**	**Kinetic energy**	**2927Mt TNT**

4 In a set up presented on the diagram a 20 g bullet moving at 500m/s hits the 1kg block of soft clay resting on a frictionless surface. The bullet emerges from the block with velocity of 100m/s. Find y_{max} the highest position of the block.

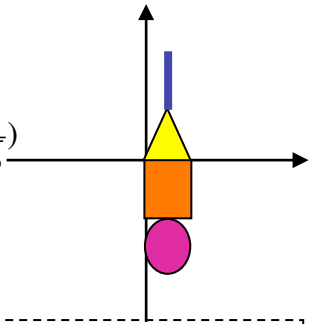


$$mv_b^i = Mv_2 + mv_b^f \quad and \quad \frac{1}{2}Mv_2^2 = Mgh$$

$$v_2 = \frac{mv_b^i - mv_b^f}{M} = \frac{400 \cdot 0.02}{1} = 8\frac{m}{s} \quad and \quad y_{\max} = \frac{v_2^{\ 2}}{2g} = \frac{64}{19.6} = 3.265$$

ANS: the block will reach maximum height of 3.27m

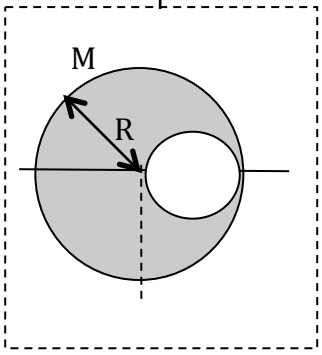
5 A 4.0-kg equilateral triangle, a 2.0-kg circle, a 6.0-kg square and a 1.0-kg rod form a system shown on the diagram on a side. What is the center of mass of this system? /L_{rod}=D_{circle}=$W_{triangle}$=W_{square}=2m/



$$m_{rod} = 1kg \ ; CMrod = (1.0, \frac{1}{2\sqrt{3}} + 1) \ldots m_{triangle} = 4kg; CM_{triangle} = (1.0, \frac{1}{2\sqrt{3}})$$

$$m_{circle} = 2kg; CM_{circle} = (1.0, -3) \ldots m_{square} = 6kg; CM_{square} = (1.0, -1)$$

6 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.



ANSWER;

$$x_{system} = \frac{0M - \frac{R}{2}m}{M - m} = -\frac{m}{M - m}\frac{R}{2} = -\frac{\frac{4}{3}\pi\left(\frac{R}{2}\right)^3 \cdot \frac{M}{\frac{4}{3}\pi R^3}}{M - m}\frac{R}{2} = -\frac{\frac{M}{8}}{\frac{7}{8}M}\frac{R}{2} = -\frac{1}{7}\frac{R}{2} = -\frac{R}{14}$$