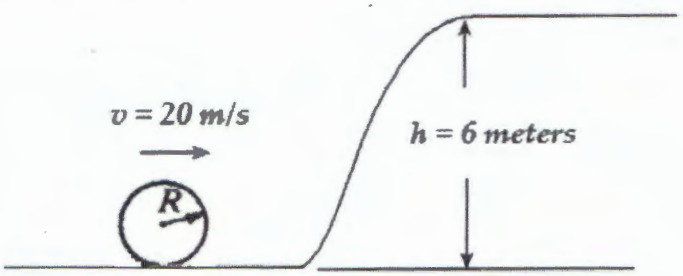
Miami-Dade College – Wolfson Campus

PHY1025 – Fall 2012 - Final Exam

Name: KEY (25)

SECTION II – FREE-RESPONSE

Directions: Read each question carefully and write your responses on the space provided after each question. You MUST show all your work. **(Use g = 10 m/s² for the acceleration of gravity)**



1. A large cylinder or radius $R = 4.0\ m$, mass $M = 4\ kg$ and moment of inertia $I = \frac{1}{2}MR^2$ rolls without slipping across a horizontal surface with a translational speed of 20 m/s. The cylinder approaches a 6 meters high incline plane and rolls up without slipping. See figure above. When the cylinder is on the top of the incline plane:

   a) Determine its translational speed v.

$ME_{(I)} = KE_{(T)} + KE_{ROT\,I} = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 = \frac{1}{2}(4)(20)^2 + \frac{1}{4}(4)(20)^2$

$= 800 + 400 = \boxed{1200\ J}$

$ME_{(F)} = KE_F + KE_{ROT\,F} + mgh_{(F)}$

$= \frac{1}{2}(4)v^2 + \frac{1}{4}(4)v^2 + 4(10)(6)$

$ME_F = ME_i$

$3v^2 + 240 = 1200$

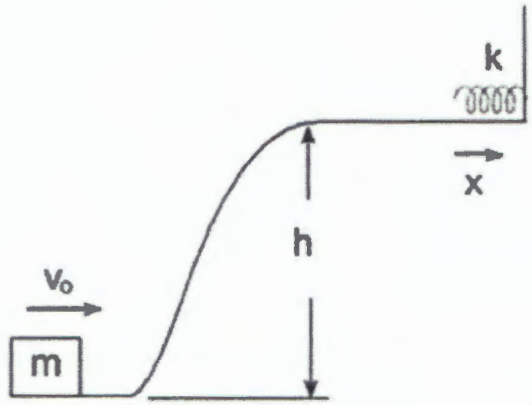
$v = \sqrt{320} = \boxed{17.9\ m/s}$

   b) Determine the angular speed ω.

(3) $\omega = v/R = 17.9/4 = \boxed{4.5\ R/s}$

   c) Determine the rotational energy KE_{rot}

(3) $KE_{ROT} = \frac{1}{2}I\omega^2 = v^2 = \boxed{320\ J}$



2. The diagram above (not drawn to scale) shows a block of mass m = 4 kg moving to the right with an initial speed of v_0 = 20m/s. The height of the inclined is h = 4m. All surfaces are smooth. The block is stopped by a spring of force constant k = 100 N/m.

A) Determine the Kinetic energy of the block at the bottom of the inclined.

(3) $K = \frac{1}{2}mv^2 = \frac{1}{2}(4)(20)^2 = \boxed{800\ J}$

B) Use energy considerations to determine the compression of the spring **X**.

$ME_I = KE_i = 800J$

$ME_f = mgh + \frac{1}{2}kx^2$

$= (4)(10)(4) + \frac{1}{2}(100)(x)^2$

(6) $= 160 + 50x^2$

$ME_f = ME_i$

$160 + 50x^2 = 800$

$x^2 = \frac{64}{5}$ $\quad x = \sqrt{12.8} = \boxed{3.6\ m}$

C) Determine the energy stored by the spring when it is compressed the distance you obtained in part B.

(3) $PE_S = \frac{1}{2}kx^2 = \frac{1}{2}(100)(12.8) = \boxed{640\ J}$

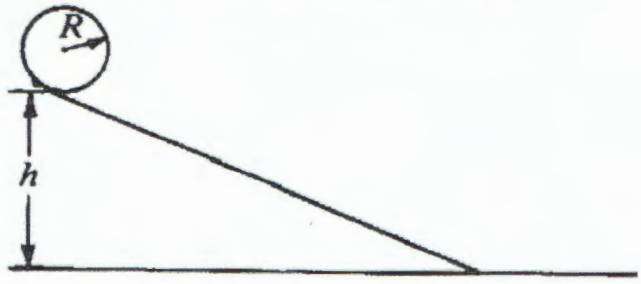
Miami-Dade College – Wolfson Campus

PHY1025 – Fall 2014 - Final Exam

Name: Key (25)

SECTION I – FREE-RESPONSE

Directions: Read each question carefully and write your responses on the space provided after each question. You MUST show all your work. **(Use g = 10 m/s² for the acceleration of gravity)**



1. A solid sphere of radius $R = 2.0\ m$, mass $M = 4kg$ and moment of inertia $I = \frac{2}{5}MR^2$ initially at rest in the position shown, with $h = 8\ m$, is released and rolls down the plane without slipping. When the sphere reaches the bottom of the inclined plane:

   a) Determine its translational speed v.

(6)

$$ME_i = K_i^{\circ} + PE_i = Mgh = (4)(10)(8) = 320\,J$$

$$ME_f = K_{ROT} + K = \frac{1}{2}I\omega^2 + \frac{1}{2}Mv^2 = \frac{1}{2}\left(\frac{2}{5}MR^2\right)\left(\frac{v^2}{R^2}\right) + \frac{1}{2}Mv^2$$

$$= \frac{1}{5}Mv^2 + \frac{1}{2}Mv^2$$

$$= \frac{7}{10}Mv^2 = \frac{7}{10}(4)v^2$$

$$ME_i = ME_f$$

$$320 = 2.8v^2$$

$$v = \sqrt{\frac{320}{2.8}} = \sqrt{114.29} = \boxed{10.7\ m/s}$$

   b) Determine its angular speed ω.

(3)

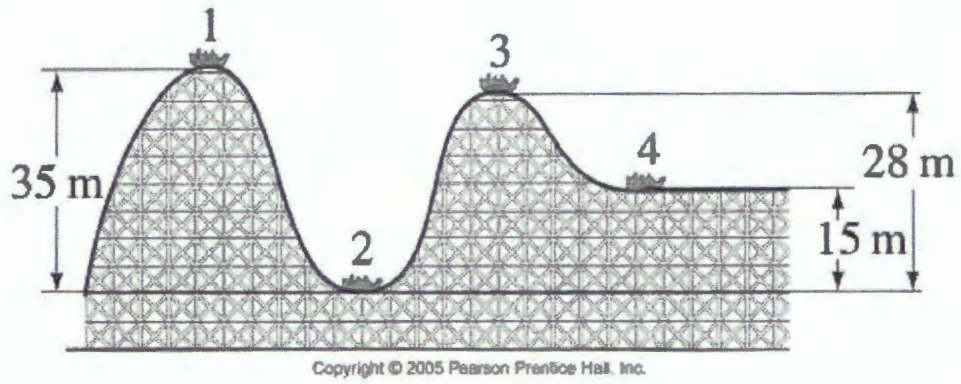
$$\omega = \frac{v}{R} = \frac{10.7}{2} = 5.3\ rad/s$$

   c) Determine its rotational kinetic energy KE_{rot}.

(3)

$$KE_{ROT} = \frac{1}{2}I\omega^2 = \frac{1}{2}\left(\frac{2}{5}(4)(2)^2\right)(5.3)^2$$

$$= \boxed{89.9\,J}$$



USE POINT 2 AS GROUND LEVEL

1. The roller-coaster car shown in the figure above (mass m = 200kg) has a velocity of 4 m/s at point **1**. Assuming no friction:

a) Calculate the speed at point **4**.

$ME_1 = KE_1 + PE_1$

$= \frac{1}{2}mv_1^2 + mgh_1 = \frac{1}{2}(200)(4)^2 + (200)(10)(35)$

$= 1600 + 70000 = 71600$

(7)

$ME_4 = KE_4 + PE_4$

$= \frac{1}{2}(200)v_4^2 + (200)(10)(15) = 100v_4^2 + 30000$

$ME_1 = ME_4$

$71600 = 100v_4^2 + 30000$

$v_4 = \sqrt{71600 - 300} = \sqrt{416} = \boxed{20.4\ m/s}$

b) Calculate the kinetic energy at point **4**.

$KE_4 = \frac{1}{2}mv_4^2 = \frac{1}{2}(200)(416) = \boxed{41600\ J}$

(3)

c) Calculate the potential energy at point **3**.

(3) $PE_{(3)} = mgh_{(3)} = (200)(10)(28) = \boxed{56000\ J}$