3. A 3.0 kg ball is dropped from a height of 10. m. How fast is it going when it hits the ground? Assume an average air resistance force of 20. N acts on the ball as it falls.

ground $= \varnothing$ m

F_f

$|PE_{g_T}| = |KE_B| + |Q_B|$ $\qquad W_f = F_f \cdot d \cdot \cos\theta$

$mgh = \frac{1}{2}mv^2 + F_f d \cos\theta$

$|3\,Kg(9.8\,m/s^2)(10.\,m)| - |\frac{1}{2}3\,Kg(v^2)| + |20.\,N(10\,m)(\cos 180°)|$

$\boxed{V = 7.9\,m/s}$

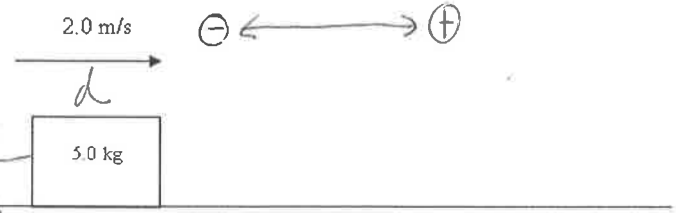
4. A 5.0 kg box is sliding across a rough surface at 2.0 m/s and is brought to rest in 0.40 m. How much work is done by friction in stopping the box? Calculate the force of friction.

$|KE| = |Q|$ $\qquad d = 0.40\,m$

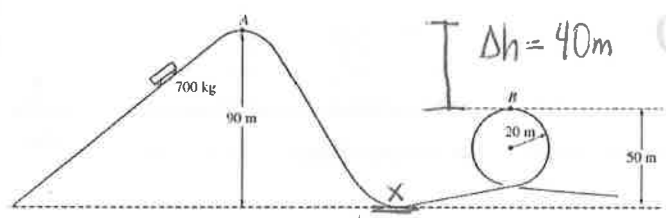
$\frac{1}{2}(5\,Kg)(2.0\,\frac{m}{s})^2 = 10\,J$

$\frac{1}{2}mv^2 =$

$\frac{10\,J}{d\cos\theta} = \frac{F\,\cancel{d\cos\theta}}{\cancel{d\cos\theta}} = -25\,N = F_f \qquad \theta = 180°$



1. A roller coaster ride at an amusement park lifts a car of mass 700 kg to point A at a height of 90 m above the lowest point on the track, as shown above. The car starts from rest at point A, rolls with negligible friction down the incline and follows the track around a loop of radius 20 m. Point B, the highest point on the loop, is at a height of 50 m above the lowest point on the track.



$\Delta h = 40\,m$

$h = \varnothing\,m$

a) Determine the speed of the car at the bottom of the first hill.

$mgh_T = \frac{1}{2}mv_B^2 \qquad V = \sqrt{2g\Delta h}$

$PE_{g_T} = KE_B \qquad \Delta h = 90\,m - \varnothing\,m$

$\boxed{V = 42\,m/s}$

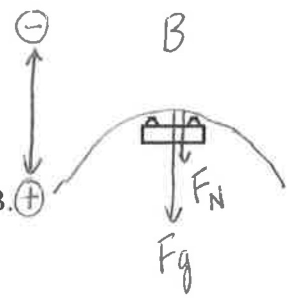
b) Calculate the speed of the car at point B.

$V = \sqrt{2g\Delta h}$

$\Delta h = 90\,m - 50\,m = 40\,m$

$\boxed{V = 28\,m/s}$

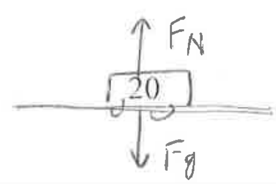
c) Calculate the force the track exerts on the car when it is upside down at point B.



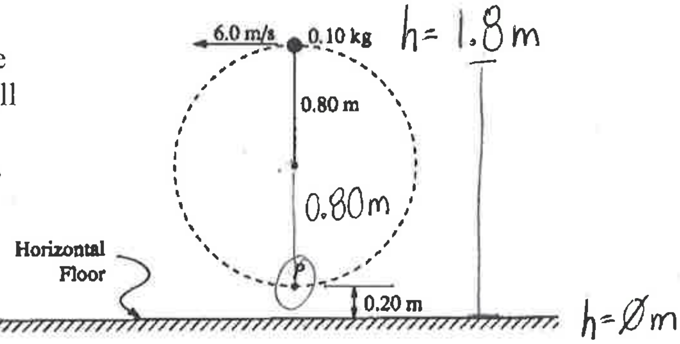
$\Sigma F_{in} = \frac{mv^2}{r} = F_N + F_g$

$F_N = \frac{mv^2}{r} - F_g$

$\boxed{F_N = 2.1 \times 10^4\,N}$



2. A 0.10-kilogram solid rubber ball is attached to the end of a 0.80-meter length of light thread. The ball is swung in a vertical circle, as shown in the diagram. Point ***P***, the lowest point of the circle, is 0.20 meter above the floor. The speed of the ball at the top of the circle is 6.0 meters per second, and the total energy of the ball is kept constant.



* neglect air resistance

a) Determine the total energy of the ball, using the floor as the zero point for gravitational potential energy.

$$\frac{1}{2}mv_T^2 + mgh_T = \text{Energy Total at Top}$$

$$v_T = 6.0\frac{m}{s} \quad h_T = 1.8m \qquad \boxed{E_T \text{ at top} = 3.6J}$$

b) Determine the speed of the ball at point ***P***, the lowest point of the circle.

$$E_T = E_B$$

$$E_T = mgh_B + \frac{1}{2}mv_B^2 \qquad \boxed{v_B = 8.2\frac{m}{s}}$$

$$h_B = 0.20m$$

$F_{NET} = ma$

$F_T + F_g = ma$

For circular motion,

$$\vec{a} = \frac{v^2}{r}$$

so,

$$F_T + F_g = \frac{mv^2}{r}$$

c) Determine the tension in the thread at

⊕ ⊖ F_T F_g

i) the top of the circle.

$v = 6.0 m/s$

$$\Sigma F_{in} = \frac{mv^2}{r} = F_T + F_g$$

$r = 0.80m$

$$F_T = \frac{mv^2}{r} - F_g$$

$$\boxed{F_T = -3.5N}$$

ii) the bottom of the circle.

$v = 8.2 m/s$

F_T F_g ⊕ ⊖

$$\Sigma F_{in} = \frac{mv^2}{r} = F_T + F_g$$

$$\boxed{F_T = 9.4N}$$

designate +/- directions for forces