Phy 2A 6/19

Monday, June 19, 2017 9:53 AM

Goals for the Lecture:

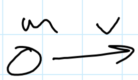
1) Know how to calculate the angular momentum of objects moving in a straight lines
2) Know how to calculate the angular momentum of rotating rigid objects
3) Be able to use conservation of angular momentum to solve rotational collision problems
4) Understand Newton's Universal Law of Gravity and how to use it to solve problems
5) Understand gravitational potential energy when objects are not close to the earth's surface
6) Understand escape speed and be able to calculate it

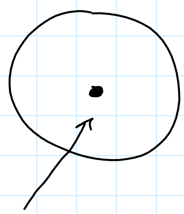
Review

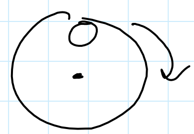
if $\Sigma \vec{F} = 0$ → use linear momentum $\vec{P}_i = \vec{P}_f$

if $\Sigma \vec{\tau} = 0$ → use angular momentum $\vec{L}_i = \vec{L}_f$

} Independent

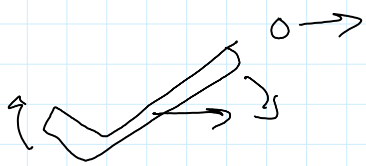






since the wheel is attached to the earth at the axis of rotation, cannot use linear momentum.

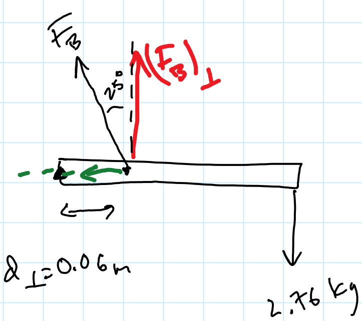
but, you can use angular momentum



can use both linear and angular momentum

on a sheet of ice

HW #10

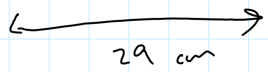


$\Sigma \vec{\tau} = 0$

$\vec{\tau}_B + \vec{\tau}_{weight} = 0$

$F_B \cos 25° \, (0.06) - (2.76)(9.8)(0.29) = 0$

$(2.76)(9.8)(0.29)$

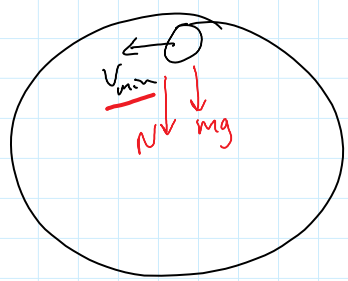


$$F_B = \frac{\quad}{(\cos 25^\circ)(0.06)}$$

$$= 144.2 \text{ N}$$

HW #15

1st find v_{min} at top of loop so that it doesn't fall off track:



$$\sum \vec{F}_{radial} = m\,\vec{a}_{cp} \quad \downarrow +$$

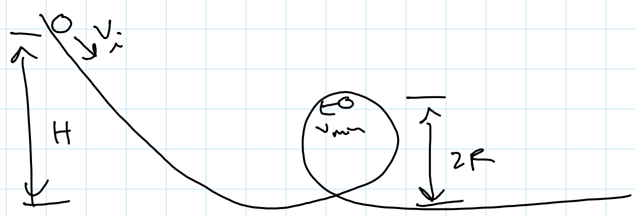
$$mg + \cancel{N}^{\,0} = m\frac{v^2}{R}$$

when $N = 0$, $v = v_{min}$

$$\cancel{m}g = \cancel{m}\frac{v_{min}^2}{R}$$

$$v_{min} = \sqrt{gR}$$

2nd) use energy



$$E_i = E_{top\ of\ loop}$$

$$(K + K_R + U_g)_i = (K + K_R + U_g)_{top\ of\ loop}$$

$(\ldots)_i = (\ldots)_{\text{top of loop}}$

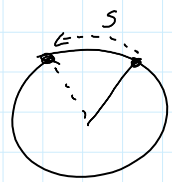
$$\frac{1}{2}mv_i^2 + \frac{1}{2}I\omega_i^2 + mgH = \frac{1}{2}mV_{min}^2 + \frac{1}{2}I\omega_{min}^2 + mg2R$$

$$\frac{1}{2}mv_i^2 + \frac{1}{2}\left(\frac{2}{5}m\cancel{r^2}\right)\left(\frac{V_i}{\cancel{r}}\right)^2 + mgH = \frac{1}{2}mV_{min}^2 + \frac{1}{2}\left(\frac{2}{5}m\cancel{r^2}\right)\left(\frac{V_{min}}{\cancel{r}}\right)^2 + 2mgR$$

radius of the ball

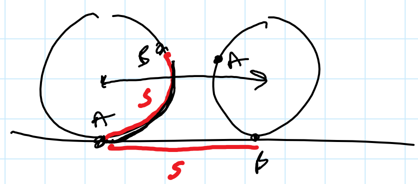
Radius of Loop

Solve for V_i



$s = R\theta$

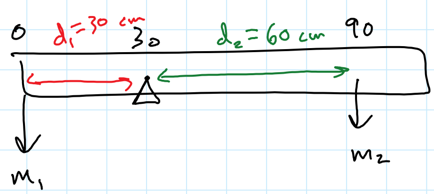
$V = R\omega$



$V_{cm} = R\omega$

worksheet p. 103

1)



$\tau_1 = m_1 g d_1 = (0.8)(9.8)(0.3) = 2.35$ N m

$\tau_2 = m_2 g d_2 = (0.4)(9.8)(0.6) = 2.35$ N m

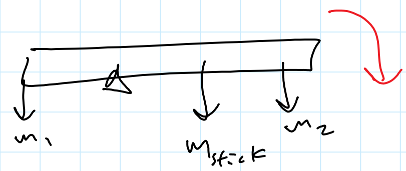
$|\vec{\tau}_1| = |\vec{\tau}_2|$

2) same

3) remain stationary

3) remain stationary

4) Clockwise



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p.104 a) $I_1 = m_1 r_1^2 = (0.8)(0.3)^2 = 0.072 \text{ kg m}^2$

$I_2 = M_2 r_2^2 = (0.4)(0.6)^2 = 0.144 \text{ kg m}^2$

$I_2 > I_1$

b) same

c) $L_1 = I_1 \omega$

$L_2 = I_2 \omega$ same ω for both

$L_2 > L_1$ since $I_2 > I_1$

d) $K_1 = \frac{1}{2} I_1 \omega^2$

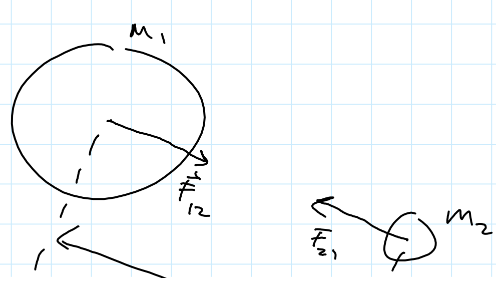
$K_2 = \frac{1}{2} I_2 \omega^2$ same ω for both

$K_2 > K_1$ since $I_2 > I_1$

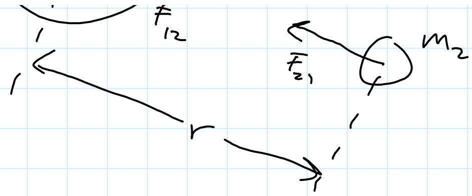
Gravity

Force of gravity: $F = mg$ works on the surface of the Earth

Universal Law of Gravity: $F = G \frac{M_1 M_2}{r^2}$



$G = 6.67 \times 10^{-11} \text{ N } \frac{m^2}{kg^2}$



$$|\vec{F}_{12}| = |\vec{F}_{21}|$$

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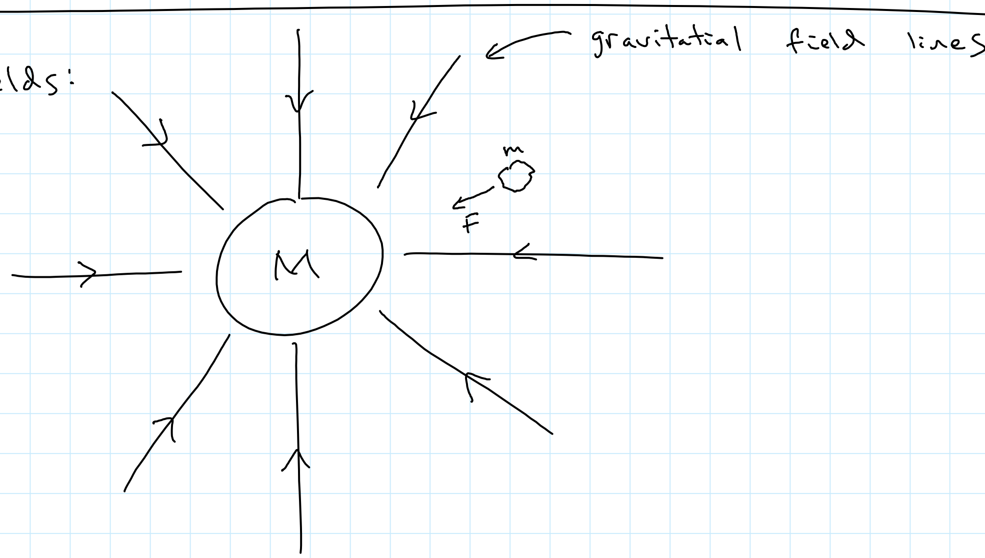
if $\quad F = \dfrac{G m_1 m_2}{r^2} \quad$ and $\quad F = mg$

then on the earth's surface:

$$\frac{G m M_E}{R_E^2} = mg$$

$$g = \frac{G M_E}{R_E^2} = 9.8 \ \frac{m}{s^2}$$

Fields:



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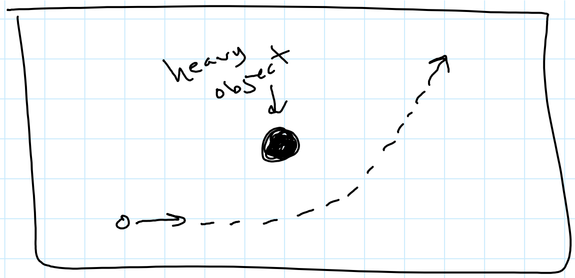
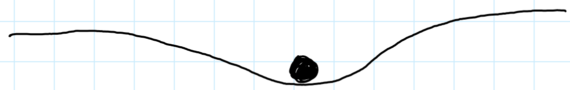
top view:

sheet pulled tight

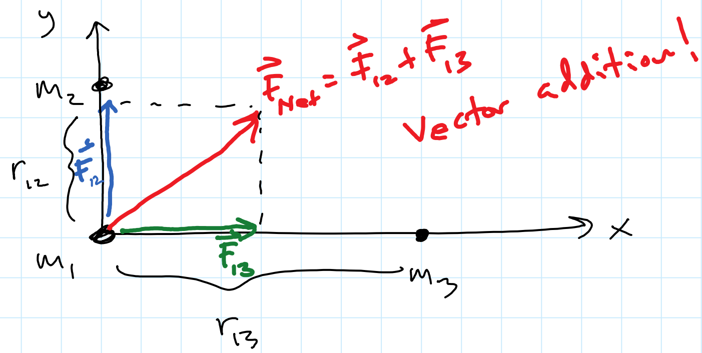


side view:



problem: Find the force on m_1 due to m_2 and m_3

given: m_1, m_2, m_3, and their locations



$$F_{12} = G \frac{m_1 m_2}{r_{12}^2} \uparrow$$

$$F_{13} = G \frac{m_1 m_3}{r_{13}^2} \longrightarrow$$