Magnitude of the kinetic friction :— Magnitude of kinetic friction is proportional to the normal force acting between two bodies.

$$f_k \propto N \Rightarrow \boxed{f_k = \mu_k N}$$

μ_k = Cofficient of kinetic friction
N = Normal force.

N1 There is a mass of 20 kg and it's pulled on the horizontal surface. The coefficient of kinetic friction is 0.25. Calculate the force of friction exerted by the horizontal surface on the box

$$\boxed{g = 9.8\ m/s^2}$$

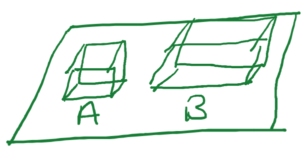
$\Rightarrow F_f = \mu_k N$ $m = 20\,kg \longrightarrow F$ $= 0.25 \times 20 \times 9.8 = 49\,N$

$N = mg = 20 \times 9.8$

(i) $F_f = \mu_k N$ frictional force does not depend on the speed.

(ii)

⇒ Which cube is covering more area on the table
(B)



As long as the normal force is same, the frictional force is independent of the area of surface in contact.

(2) Static friction :→ If the bodies are in contact but not sliding with respect to each other (i.e. motion is not there). The friction working at at contact known as static friction.

Example ~ Pushing a heavy almira ~ Static friction

Magnitude of static friction :— Magnitude of static friction adjust its value according to the applied force. As the applied force increases the static friction also increase.

Static friction adjust magnitude and direction in such a way that together with other forces applied on the body, it maintains relative rest between the two surfaces.

Limiting friction:— When the applied force exceeds maximum, the friction fails to increase its value and slipping starts

Maximum static friction that a body can exert on other body in contact with it, called limiting friction.

Limiting friction $\propto$ Normal force

$$\boxed{f_{max} = \mu_s N}$$

μ_s = Coefficient of static friction

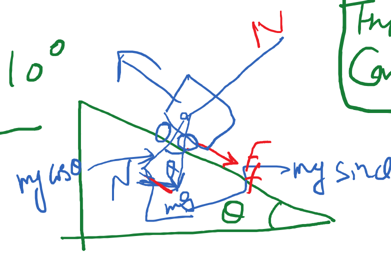
$$\boxed{f \leq f_{max}}$$

Numerical Problem

Friday, February 19, 2021 6:42 PM

$m = 30\,Kg$, $F = 85\,N$ and $\theta = 10^\circ$

This is under Constant speed



Calculate – $\mu_k = ?$

$$\boxed{\mu_k = \frac{F - mg\sin\theta}{mg\cos\theta}} = 0.11 = 0.09$$

Sol.

$$F = F_f + mg\sin\theta$$

$F_f = \mu_k N$

$N = mg\cos\theta$

$$F = \mu_k mg\cos\theta + mg\sin\theta$$

$$\Rightarrow \mu_k mg\cos\theta = F - mg\sin\theta$$

$$\boxed{\mu_k = \frac{F - mg\sin\theta}{mg\cos\theta}}$$

$$= \frac{85 - (30)(10)\sin 10^\circ}{(30)(10)\cos 10^\circ}$$

$$\boxed{\mu_k \simeq 0.11}$$

Gravity: →

Newton's second law of motion

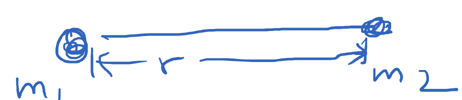
$$\boxed{F = ma}$$

more force = more acceleration

$\boxed{F = ma}$

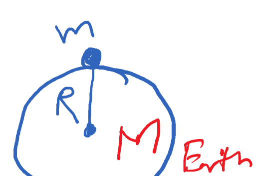
General form of Newton's 2nd law

$$\Rightarrow \boxed{F = mg} \quad \text{—— (1)}$$



$$\Rightarrow \boxed{F = G\frac{m_1 m_2}{r^2}}$$

$$\Rightarrow \boxed{F = G\frac{Mm}{R^2}} \quad \text{—— (2)}$$



$$\Rightarrow \boxed{F = G\frac{Mm}{R^2}} \quad \text{———} \quad (2)$$

$$\cancel{m}g = G\frac{M\cancel{m}}{R^2}$$

$$\boxed{g = \frac{GM}{R^2}}$$

$G = 6.673 \times 10^{-11}\ N\text{-}m^2/kg^2$ $\quad M = 5.98 \times 10^{24}\ kg$

$R = 6.38 \times 10^{6}$ metre

$$\boxed{g \simeq 9.8\ m/sec^2}$$

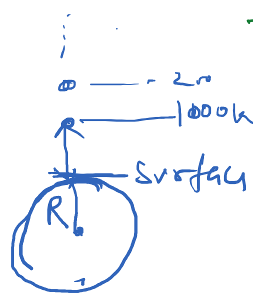
$F = mg$

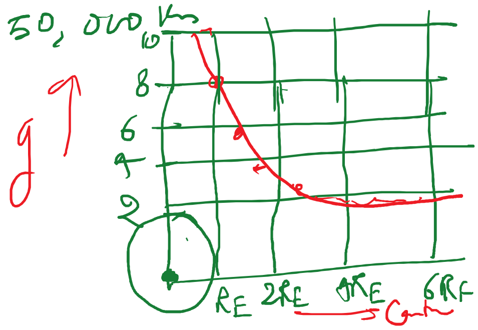
$m = 1$ unit

$$\boxed{F = g}$$

Home Work

Height (from the Surface of Earth)	Estimate g
Surface	9.8 m/sec2
1000 km	
2000 km	
⋮	
10,000 km	
20,000 km	
50,000 km	

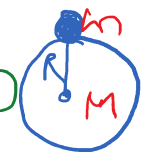




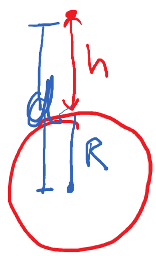
$$\boxed{\text{It follows inverse square law}}$$

Varition of g with height

Case(I) = $\boxed{g = \frac{GM}{R^2}}$ — (1)



Case (II)



$\boxed{d = R+h}$

$$g' = \frac{GM}{(R+h)^2} \quad \text{— (2)}$$

$$\frac{g'}{g} = \frac{\frac{\cancel{GM}}{(R+h)^2}}{\frac{\cancel{GM}}{R^2}} = \frac{R^2}{(R+h)^2} = \frac{1}{\left(1+\frac{h}{R}\right)^2}$$

$$g' = g\left[\frac{1}{\left(1+\frac{h}{R}\right)^2}\right]$$

Apply mathematics $h <<< R$

$$\boxed{g' \approx g\left(1-\frac{2h}{R}\right)}$$

It h will increase g' will decres.