Class 9 Academic Program-2020

PHYSICS

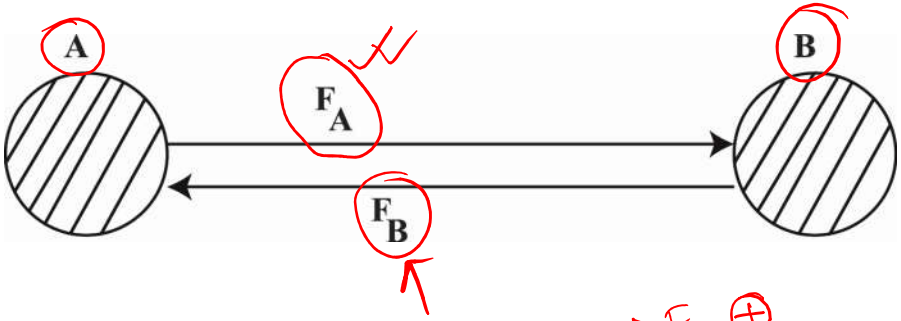
Lecture : P-08

Chapter 3 : Force

Newton's Third Law

- Definition: When an object applies a force on another object, then that object also applies a force of equal magnitude on the first object but in the opposite direction.

Newton's Third Law



Here, $F_A = F_B$

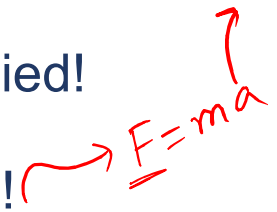
Here, A and B are 2 different object.

Object A applies F_A to object B & then as reaction, Object B applies F_B to object A.

So, two opposite forces act on different object; not on a single object.

Newton's Law

- Newton's 1st Law denotes→ What happens when No Force is applied!
- Newton's 2nd Law denotes→ What happens when Force is applied!
- Newton's 3rd Law denotes→ What happens when an objects applies force on another object. (Reaction Force)



Newton's 3rd Law

Apple also attracts Earth towards itself! Then, why does Earth not move towards apple?

a_a → acceleration of apple

★ Hints: Think about Mass of Earth & Apple!

$$F = G\frac{mM}{R^2}$$

Gravitational force, Gravitational constant, mass of apple, mass of earth 3rd, Radius of earth

Apple ⇒ $F_a = \frac{GmM}{R^2} \rightarrow F_a = ma_a \rightarrow \frac{GmM}{R^2} = ma_a \Rightarrow a_a = \frac{GM}{R^2}$

Earth ⇒ $F_e = \frac{GmM}{R^2} \rightarrow F_e = Ma_e \rightarrow \frac{GmM}{R^2} = Ma_e \Rightarrow a_e = \frac{Gm}{R^2}$

F_e, F_a

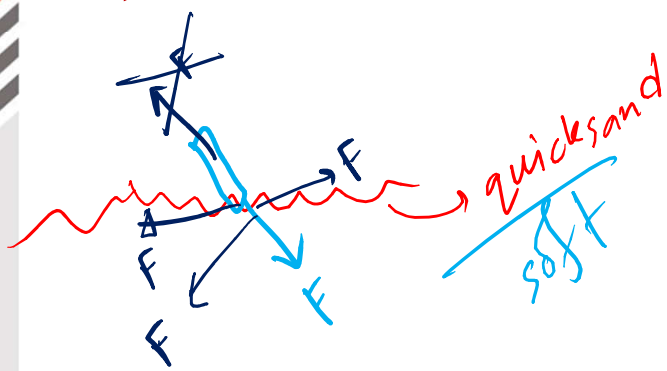
6×10^{24} kg (M), a_a ↑↑↑↑

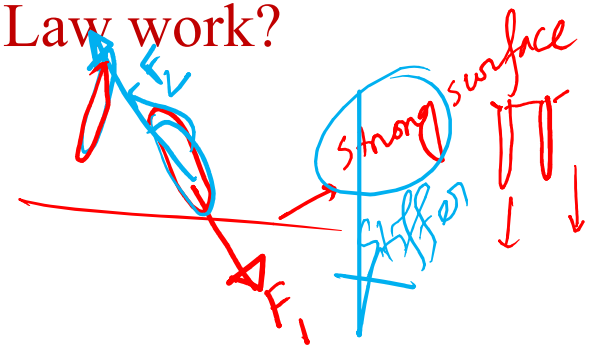
m → ↓↓↓↓, 1/2 kg

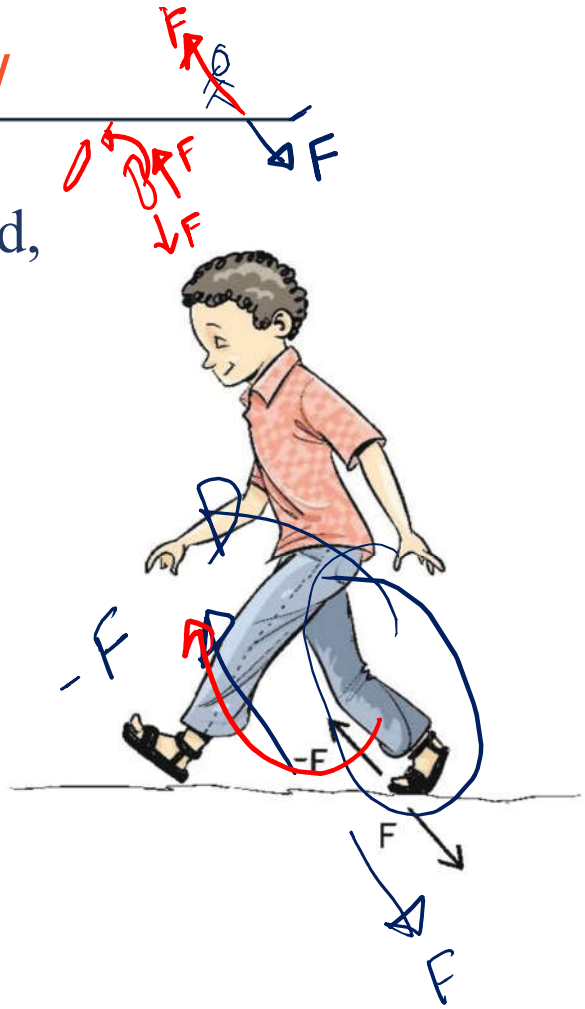
Application of Newton's 3rd Law

During walking when a person applies force on the ground, then the ground also applies force on him in contrary!

Suppose, you are trapped in a Quicksand and drowning!
So, will there Newton's 3rd Law work?





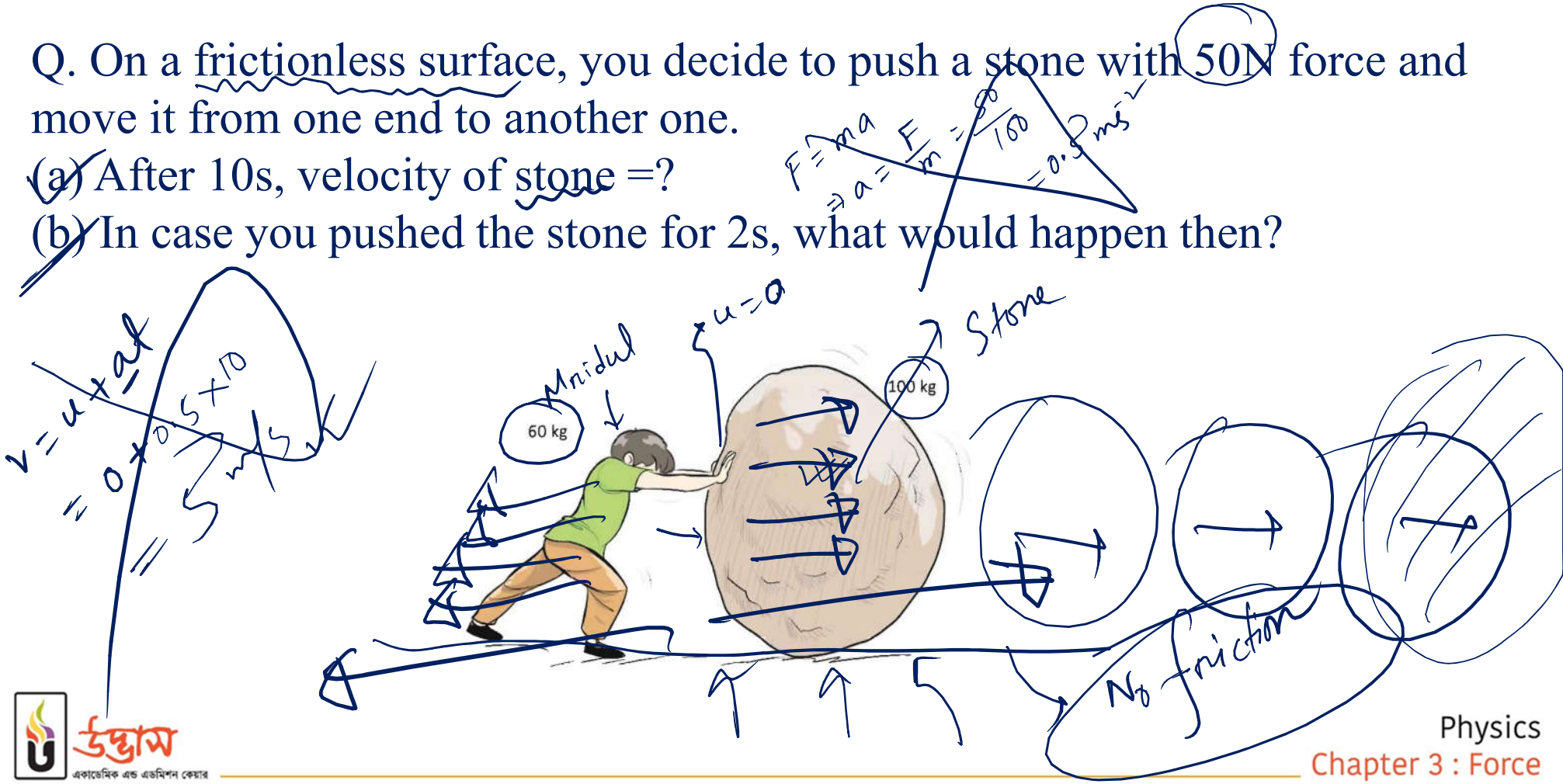


Application of Newton's 3rd Law

Q. On a frictionless surface, you decide to push a stone with 50N force and move it from one end to another one.

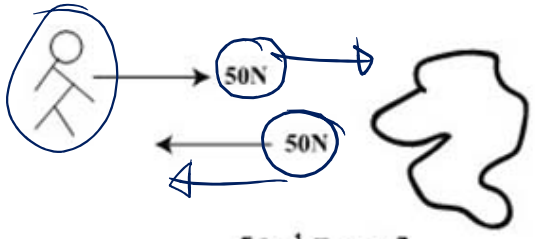
(a) After 10s, velocity of stone =?

(b) In case you pushed the stone for 2s, what would happen then?



Solution:

(a) Not possible:



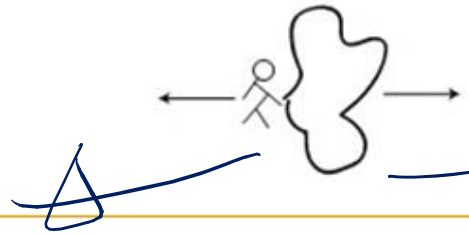
[3rd Law]

So,

For $\Rightarrow a = \frac{F}{m} = \frac{50}{60} = 0.833 ms^{-2}$ &

For $\Rightarrow a = \frac{F}{m} = \frac{50}{100} = 0.5 ms^{-2}$

So, Not possible to push the stone for 10s as ⇒



Solution:

b) After 2 sec.

$\rightarrow v = u + at$

$\Rightarrow v = (0.5 \times 2) m/s$

$= 1$ m/s

Constant velocity 1m/s

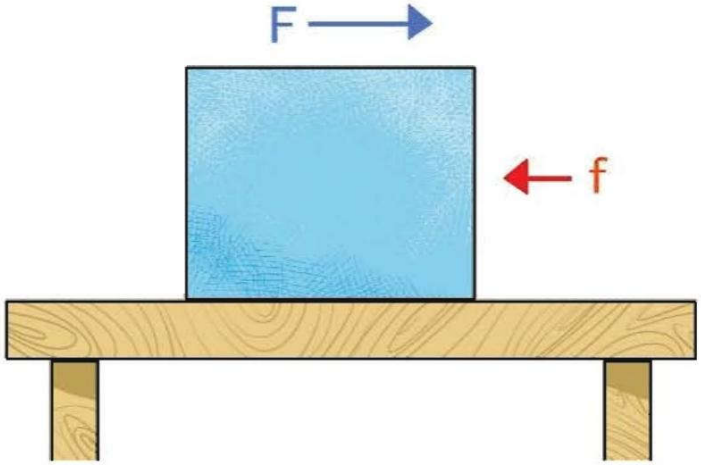
After 2 sec.

$\rightarrow v = u + at$

$\Rightarrow v = (0.833 \times 2) m/s = 1.67$ m/s

Constant velocity 1.67m/s (Ans.)

Frictional Force

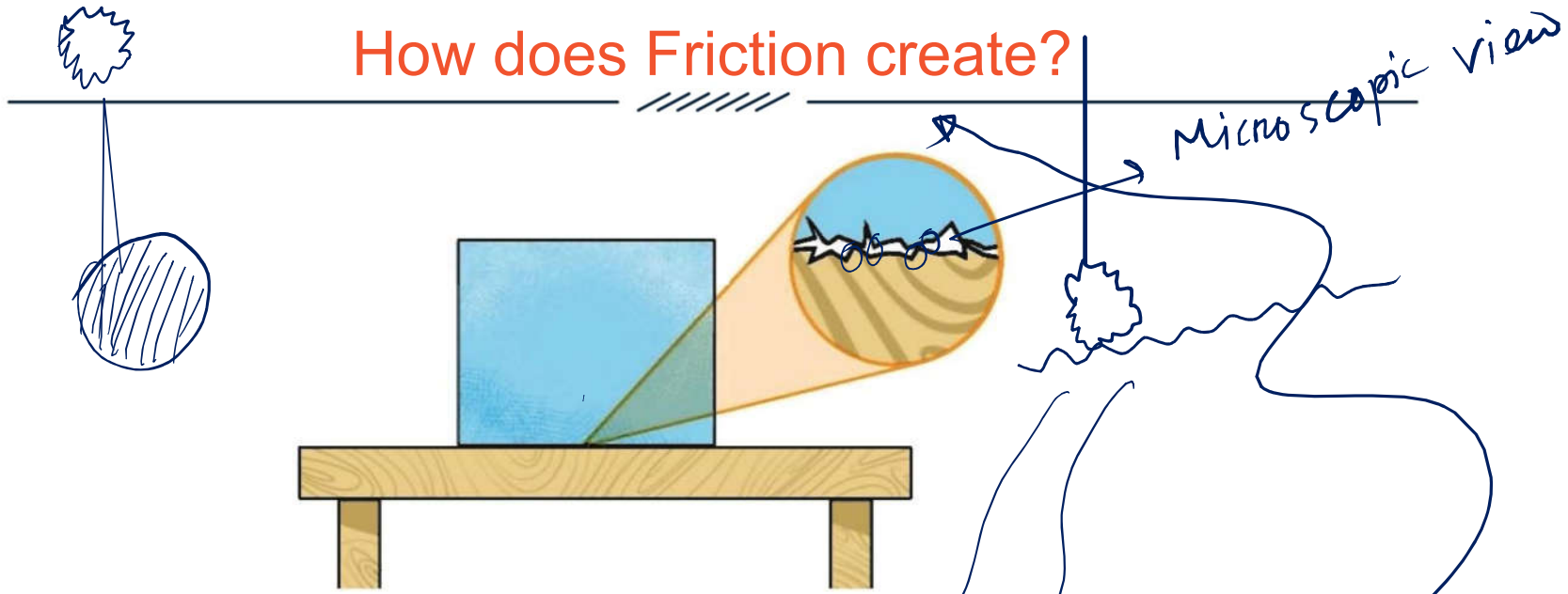


→ Resistive Force that acts in the reverse direction of the object moving!

** f is frictional force…..

How does Friction create?

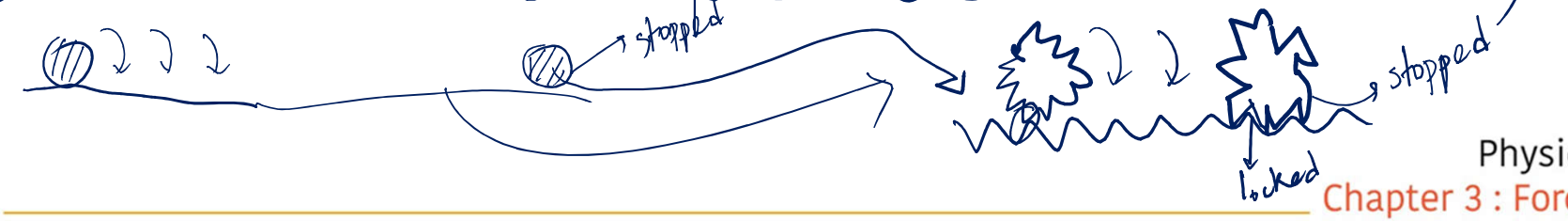
Soln:



→ The surfaces are mainly scratched & they contain grooves….

→ So……☺☺

Roll a ball on the floor! Notice & you will see the ball stops after sometime! Why? ☺☺



Static Friction force

$f_{s(max)} = \mu_s R$; $R = mg$ [For straight surface]

Here,

f_s = Static frictional force

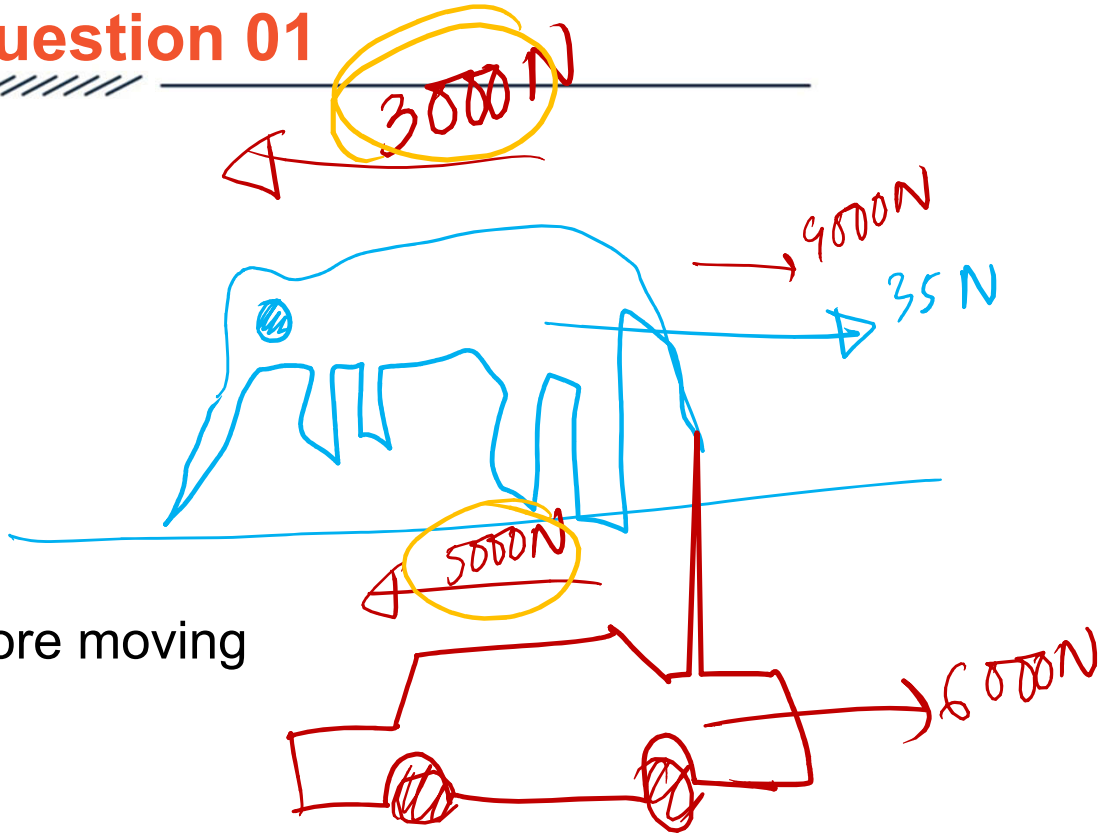
μ_s = Co-efficient of static force

R = Reaction force

Poll Question 01

The value of static friction –

(a) Always remain same
(b) Variable
(c) Equal to the horizontal force before moving
(d) Both a and c



Sliding Friction

$f_k = \mu_s R$; $R = mg$ [For straight surface]

Here,

f_k = Sliding frictional force

μ_k = Co-efficient of sliding force

R = Reaction force

Poll Question 02

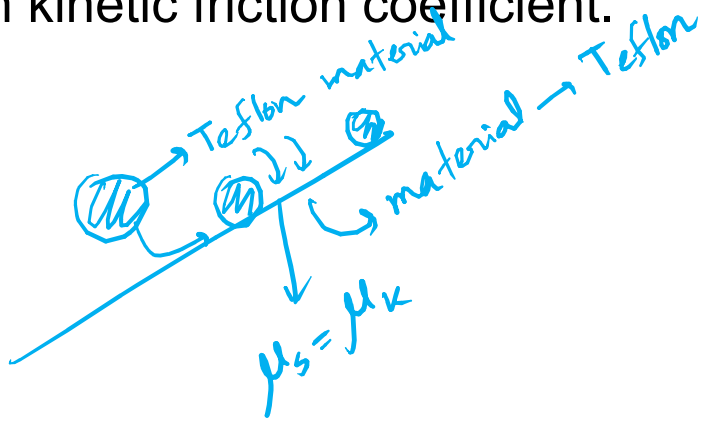
What is the relation between static and kinetic friction coefficient? Static friction coefficient is ____ than kinetic friction coefficient.

(a) Bigger

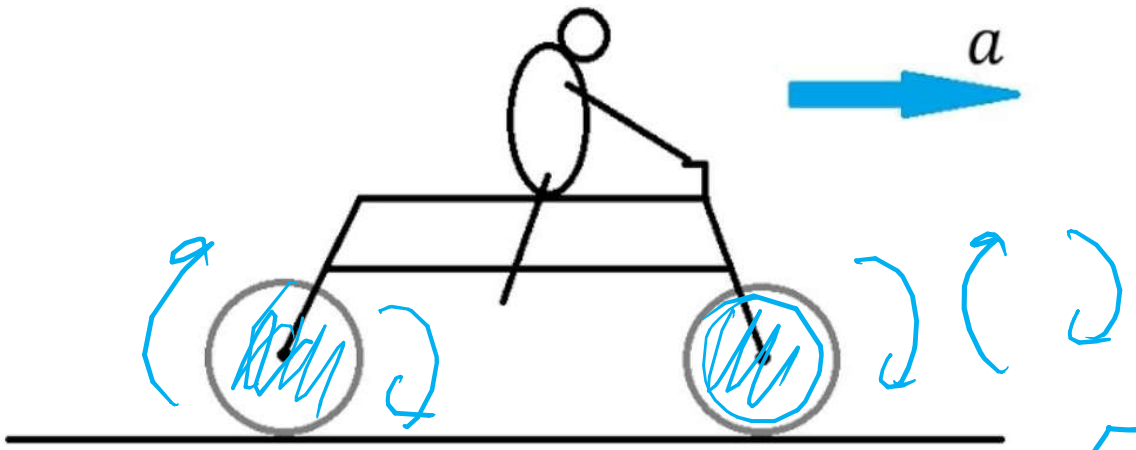
(b) smaller

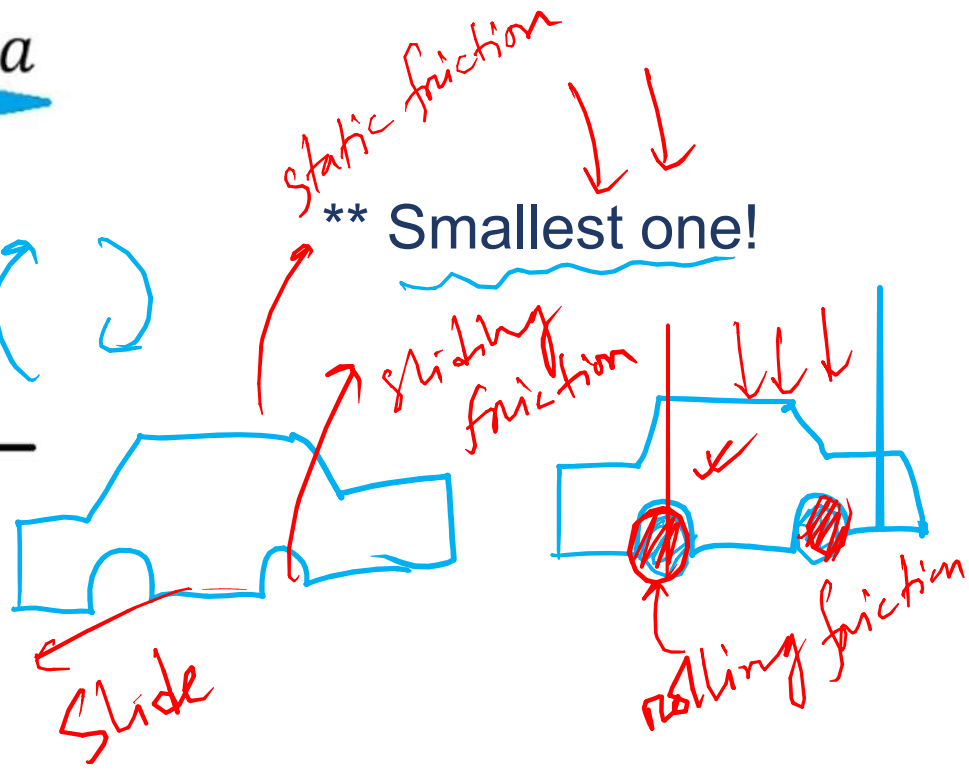
(c) Both bigger and equal

(d) None

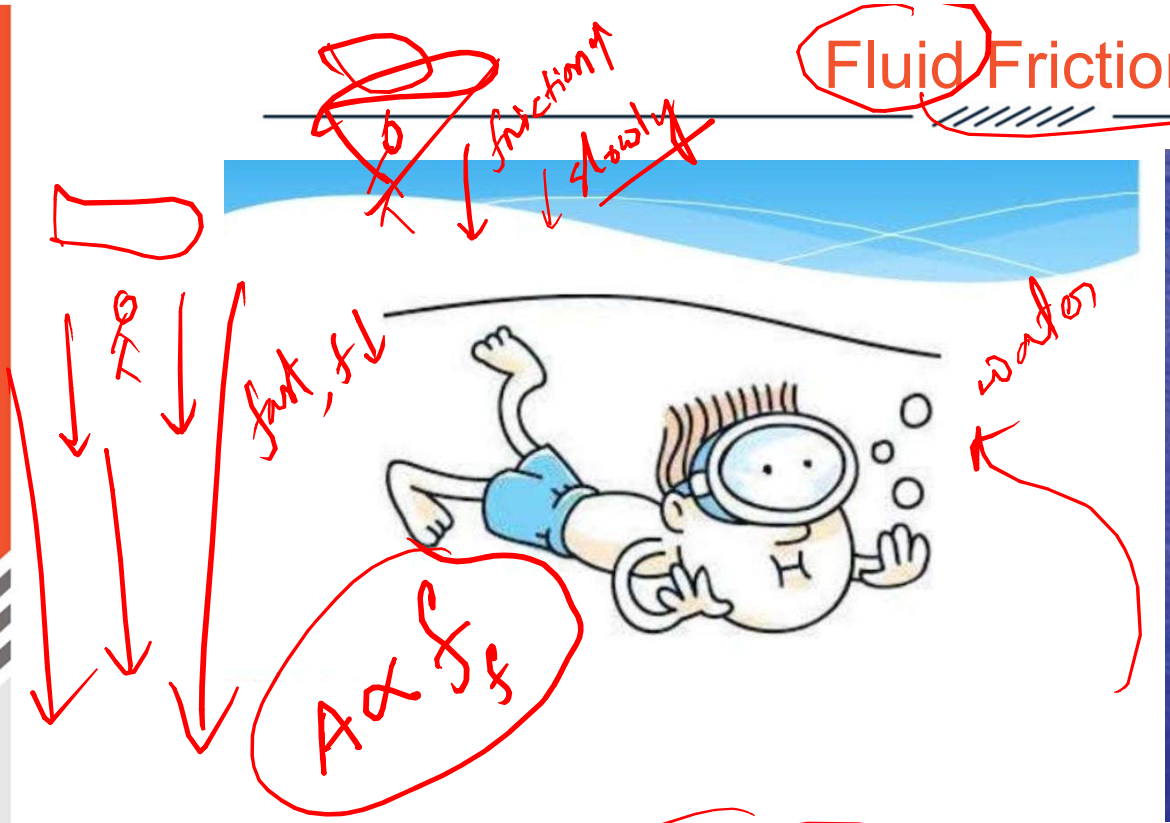


Rolling Friction





Fluid Friction



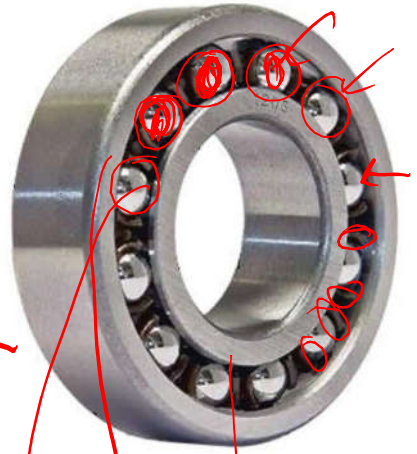
** Area and Fluid Friction are proportional to each other!

Effect of Friction on Motion

1. Tyre's Surface
2. Smoothness of Road
3. Controlling Motion & Breaking Force:

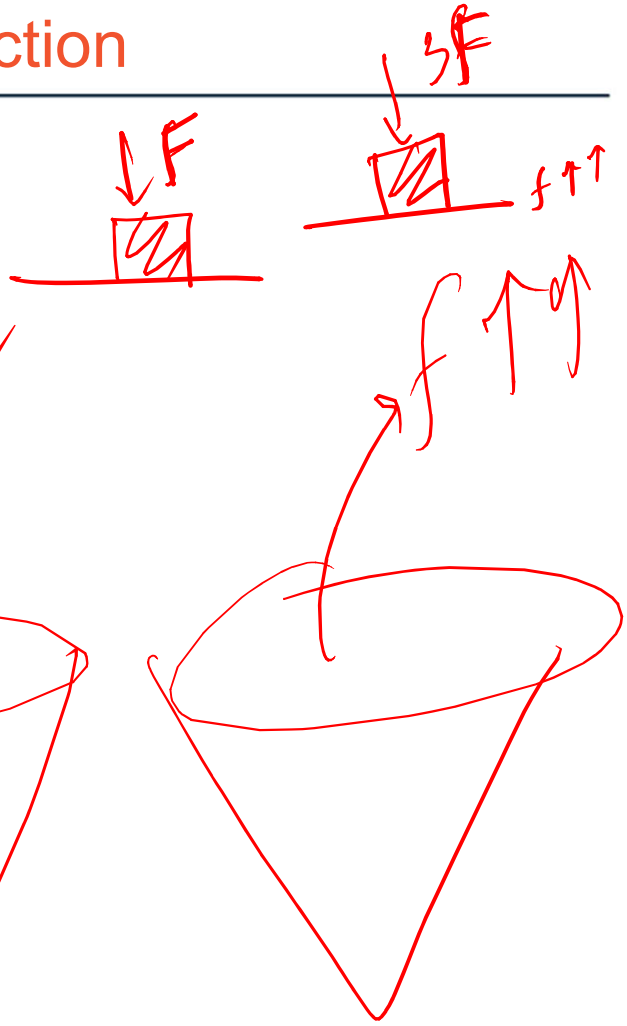
Decreasing Friction

1. Smoothness of Surface.
2. Usage of Wheel.
3. Usage of Lubricants.
4. Reduction of Vertically applied Force.
5. Proper design of Plane & Car
6. Ball Bearings Use……..

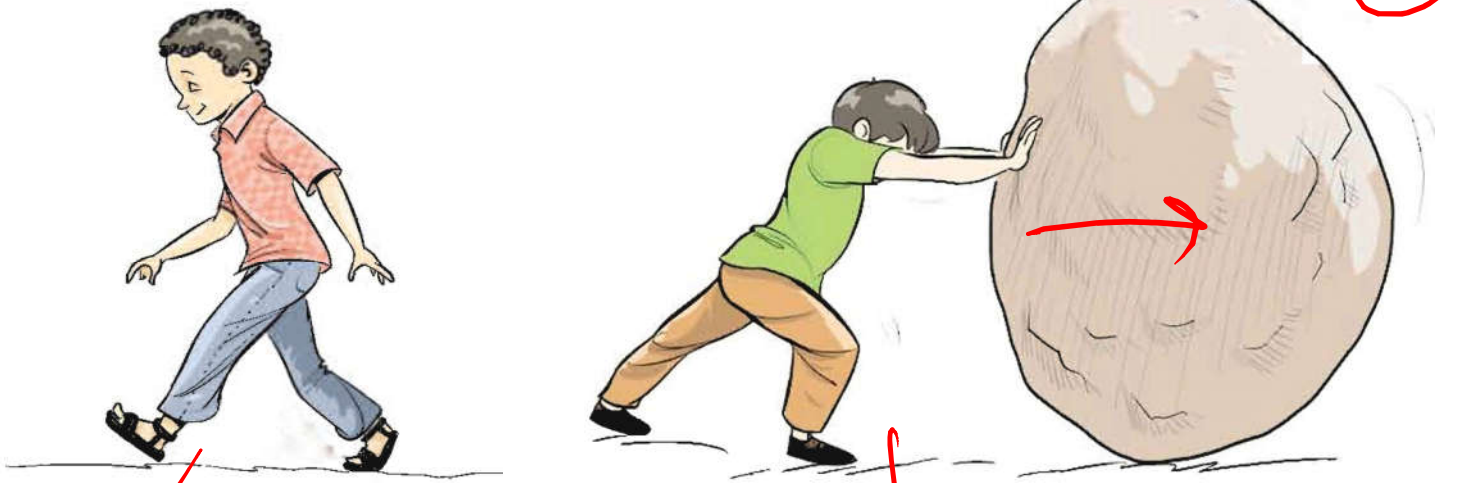


Increasing Friction

1. Roughening Surface.
2. Pressing the two surfaces more tightly.
3. Remove Wheel.
4. Remove Ball Bearings.
5. Increasing Frictional Area……..



Friction: A Necessary Evil



Poll Question 03

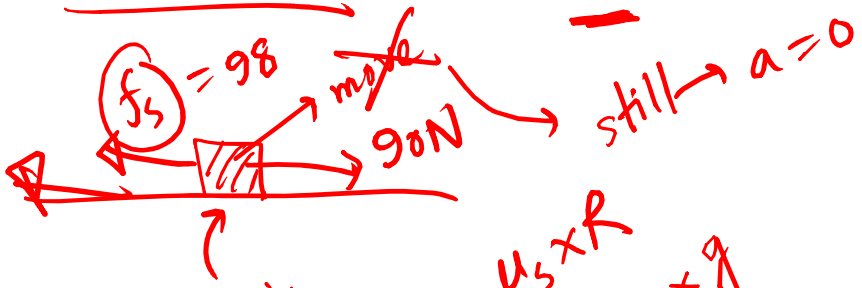
A horizontal force of 90N is applied on a block of 20kg mass. What is the acceleration of body? [Static friction coefficient: 0.5 and kinetic friction coefficient: 0.4]

(a) 2

(b) 1

(c) 0

(d) The body will be at rest



$f_s = \mu_s \times R$

$= 0.5 \times m \times g$

$= 0.5 \times 20 \times 9.8$

$= \frac{196}{2} N$

$= 98N$

motion

না বুঝে মুখস্থ করার অভ্যাস প্রতিভাকে ধ্বংস করে।