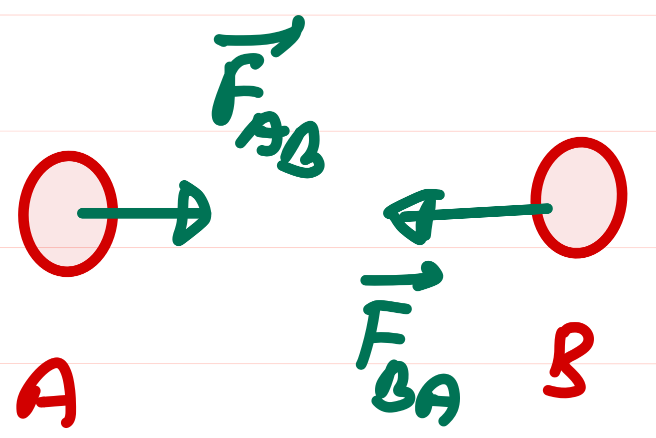
The Third Law :→

SL AL

Force is always a two-body interaction. The first law describes qualitatively and the second law describes quantitatively what happens to a body if a force acts on it, but do not reveal anything about what happens to the other body participating in the interaction responsible for the force.

The third law accounts for this aspect of the force and states that every action on a body has equal and opposite reaction on the other body participating in the interaction.



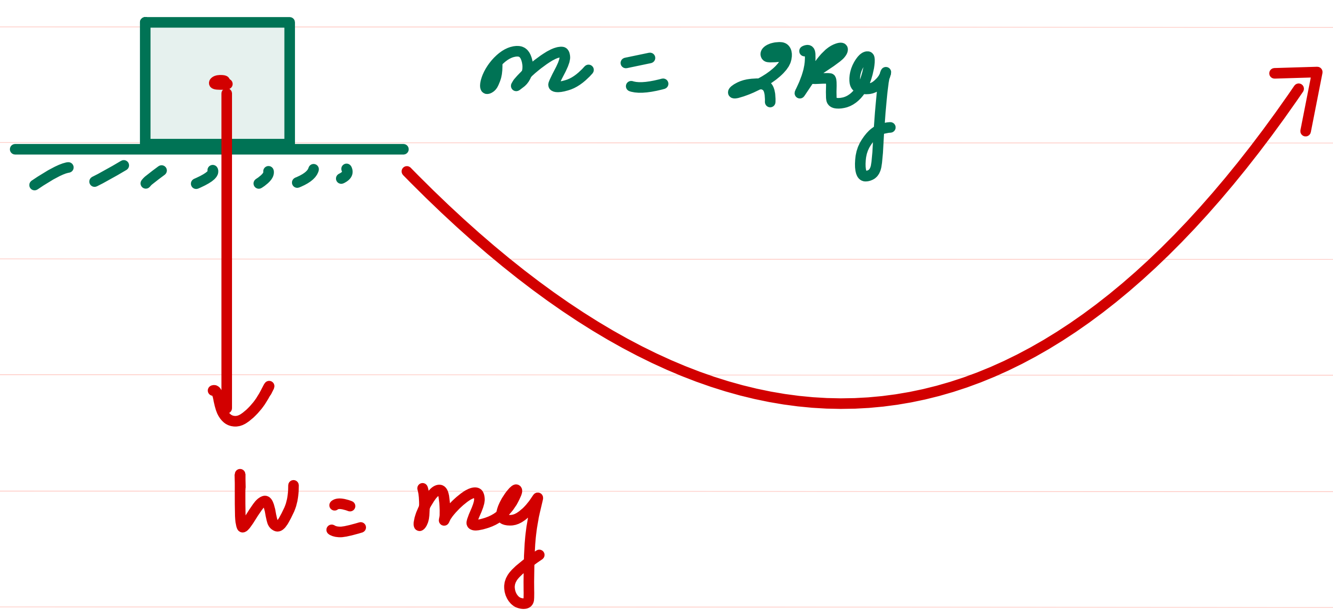
$$\boxed{\vec{F}_{AB} = -\vec{F}_{BA}}$$

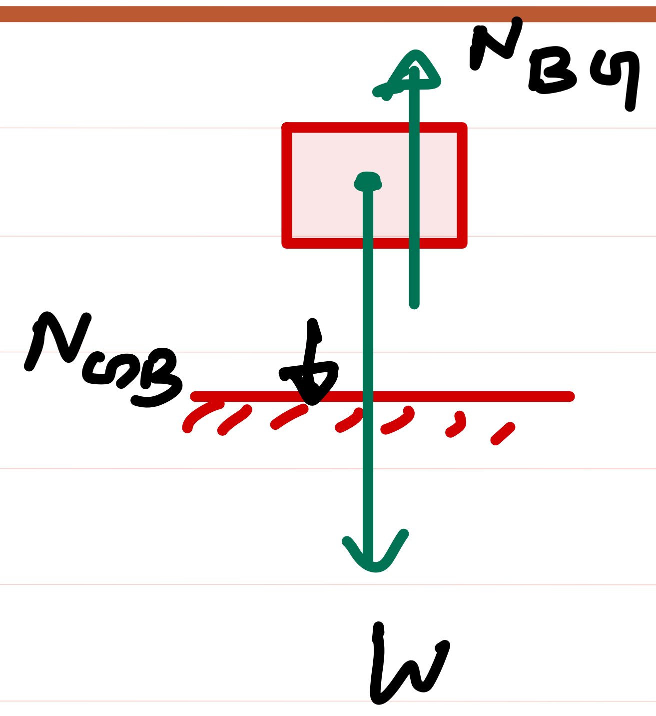
Net force on System of body-A and body-B

$$\boxed{\vec{F}_{net} = 0}$$

$$\boxed{\vec{F}_{AB} + \vec{F}_{BA} = 0}$$

Ex





Box at Rest so

$F_{net} = 0$

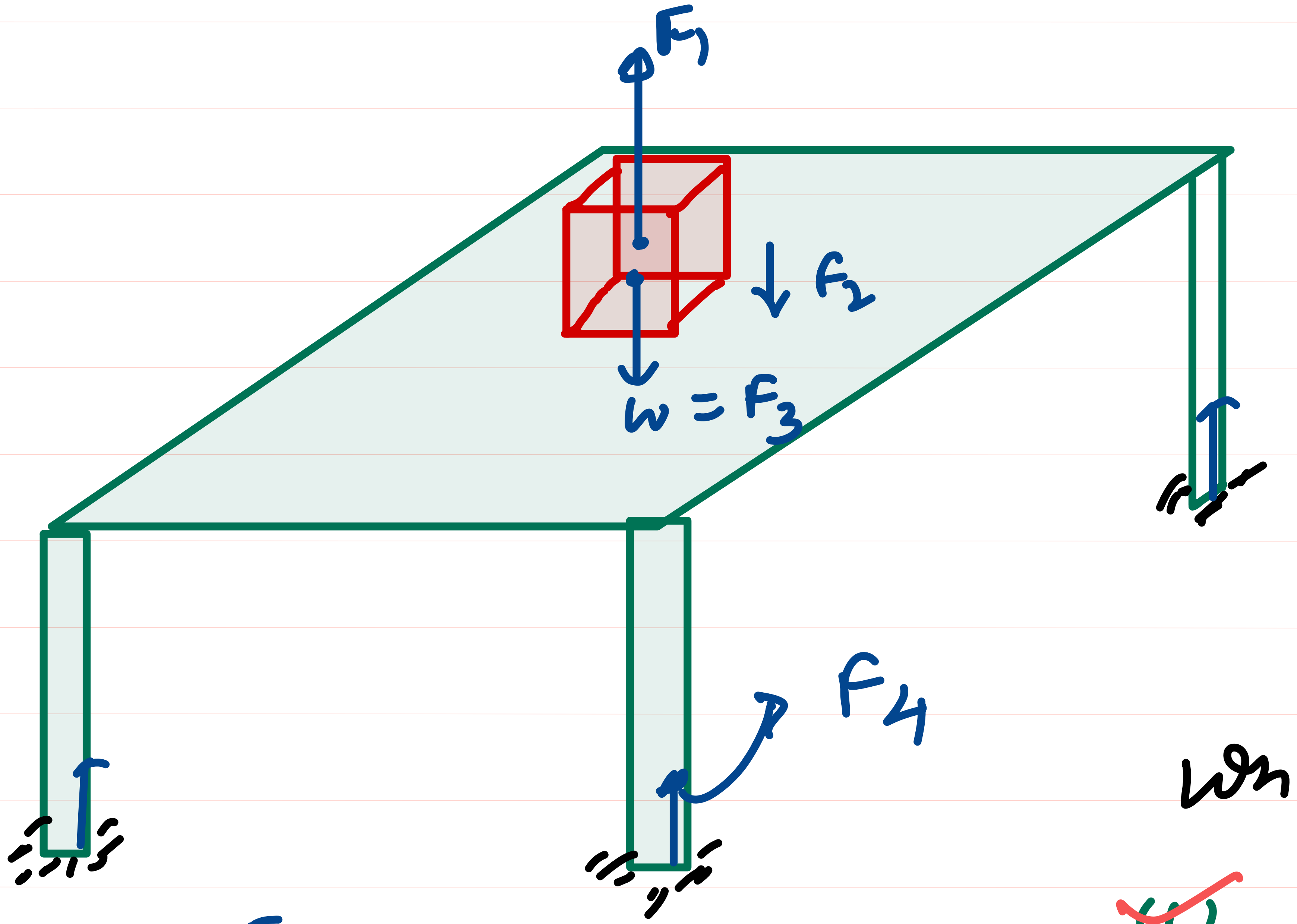
$$\boxed{\vec{N}_{BG} = -\vec{W}}$$

does not follow Newton's III^{rd} law

According Newton's III^{rd} law

$$\boxed{\vec{N}_{BG} = -\vec{N}_{GB}}$$

Ex



F_1 = Force on Box due to Table

F_2 = Force on table due to Box

F_3 = Force on Box due to Gravitational pull

F_4 = Force on Table due to Ground

Which of the following option(s) are correct

(i) $F_1 = F_2$

(ii) $F_1 = F_3$

(iii) $F_2 = F_3$

(iv) $F_1 = F_2 = F_3$

(v) $F_1 = F_4$

(vi) F_1 & F_3 follow III^{rd} law

(vii) F_1 & F_2 follow III^{rd} law

① $F_1 = F_3$

② $F_1 = F_2$

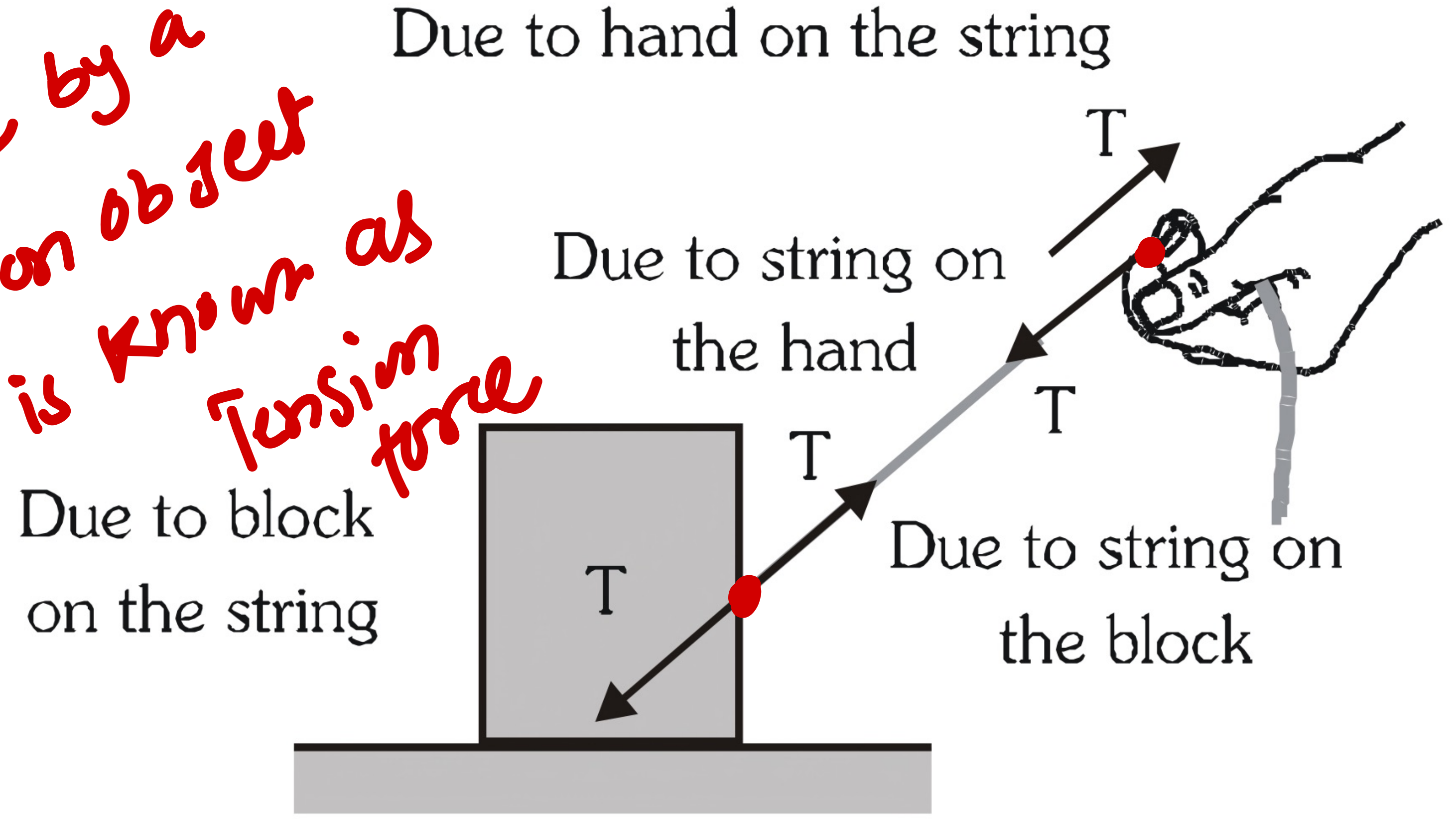
Various Field Forces

Field forces include the gravitational force (weight) electrostatic forces and magnetic forces, which can easily be identified. At present, we consider only gravitational pull from the earth i.e. weight of the body.

Various Contact Forces :→

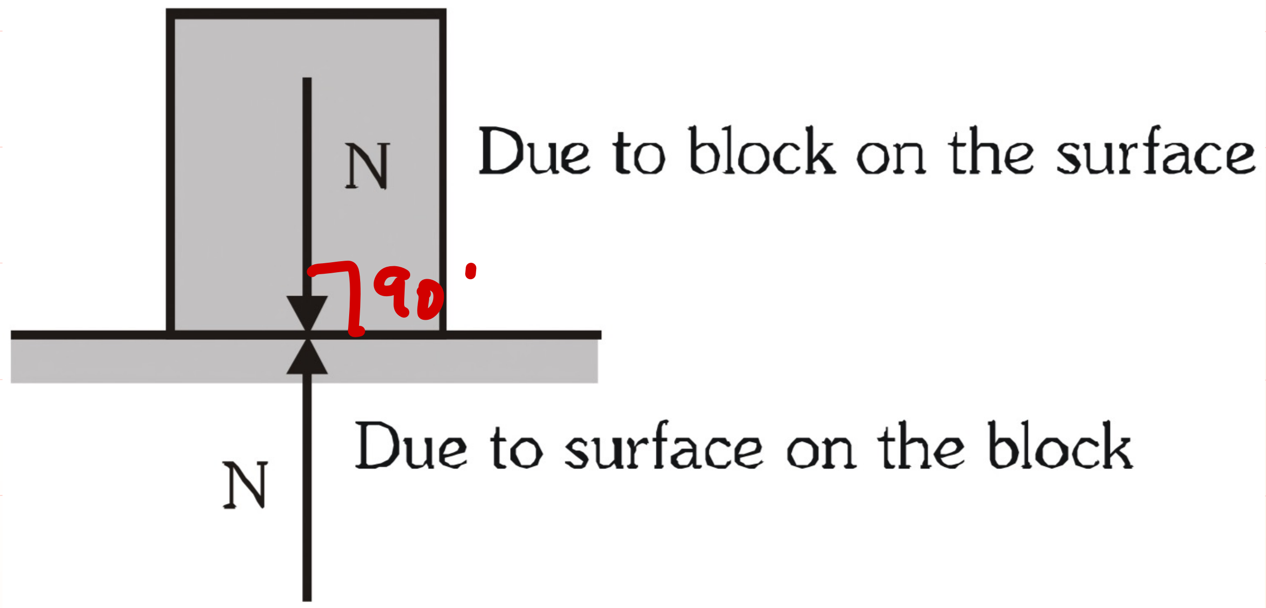
① Tension Force of Strings :→

Force by a String on object is known as Tension force

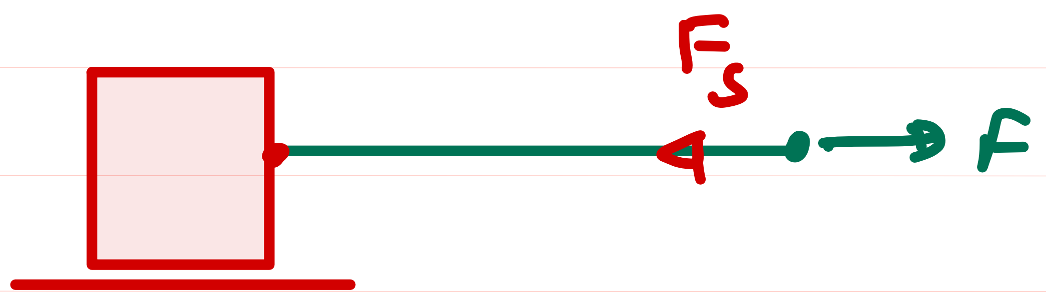


② Normal Reaction :→

Two bodies in contact, when press each other, must apply equal and opposite forces on each other. These forces constitute a third law action-reaction pair. If surfaces of the bodies in contact are frictionless, this force acts along normal to the surface at the point of contact. Therefore, it is known as normal reaction.

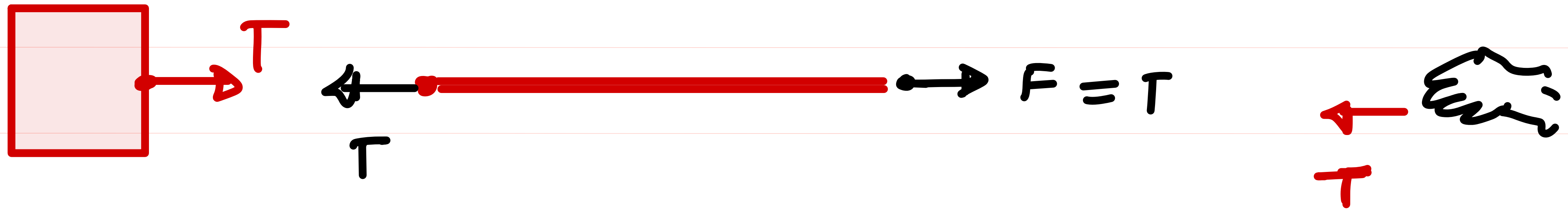


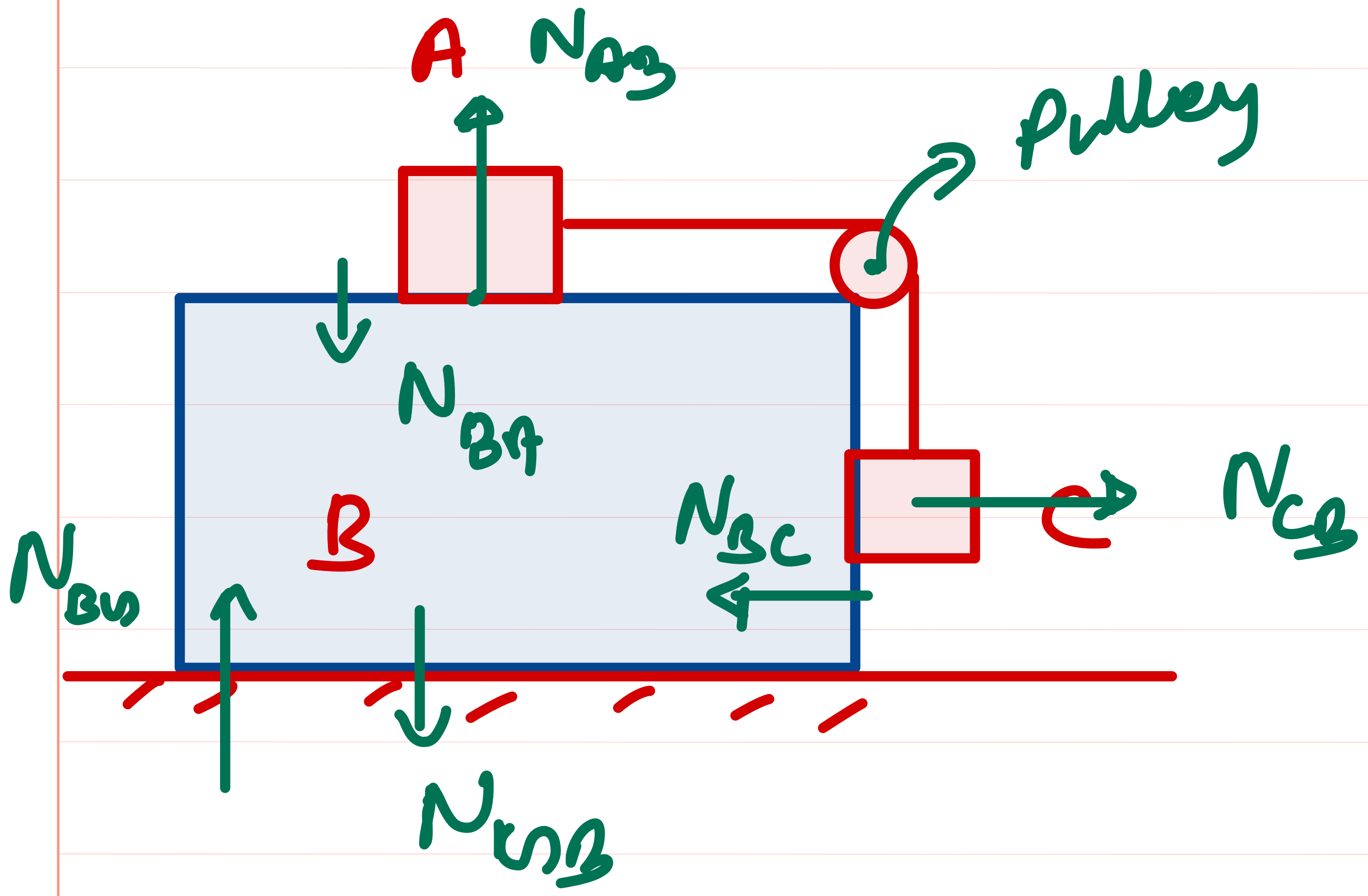
Normal contact forces on every contact point are represented by their resultant N



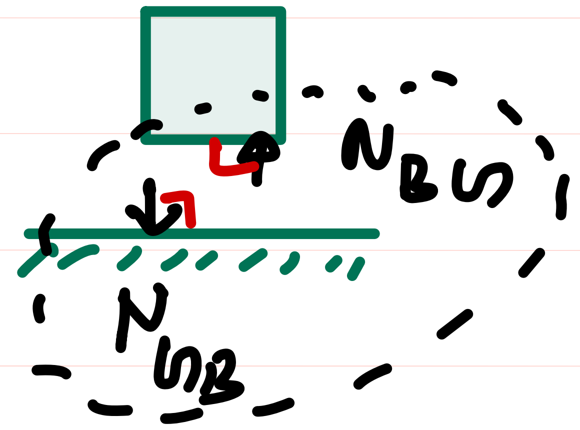
F_s = Tension (T)

$F_s = F = T$



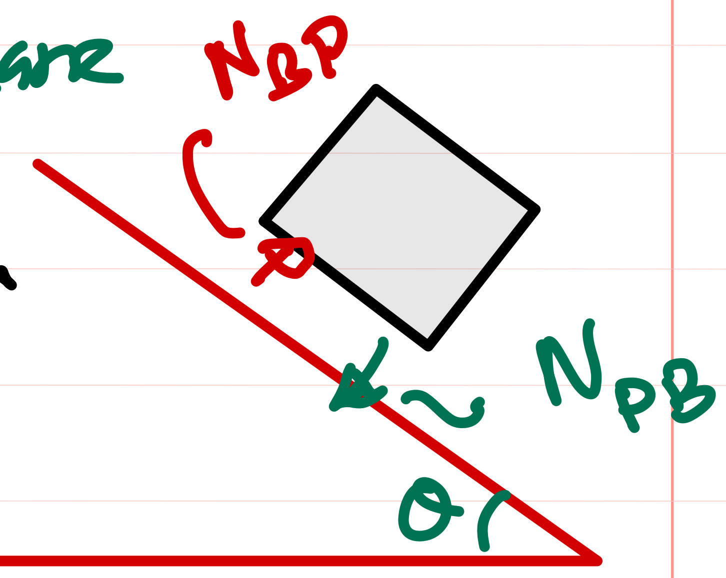


Ex



plane

Ex



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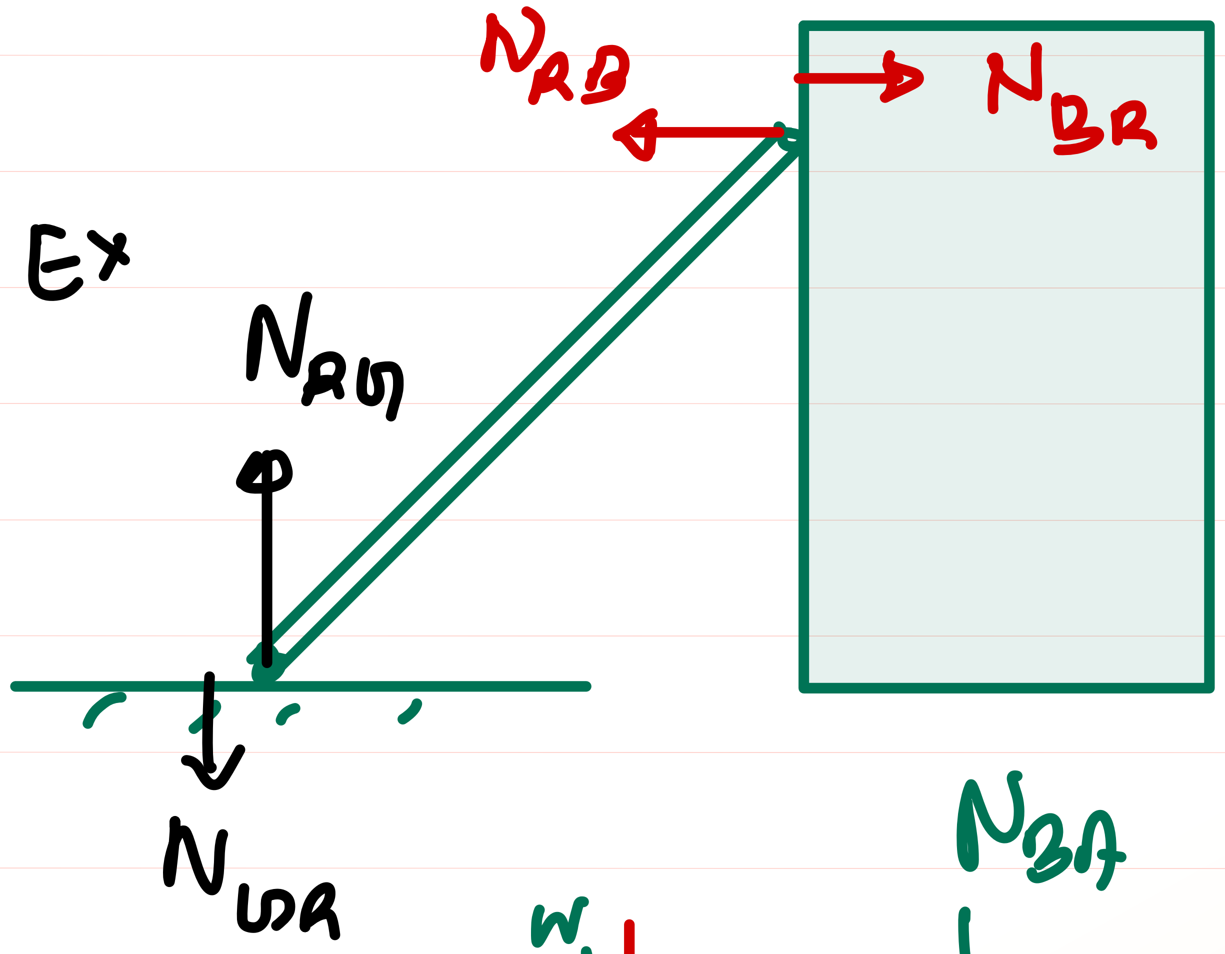

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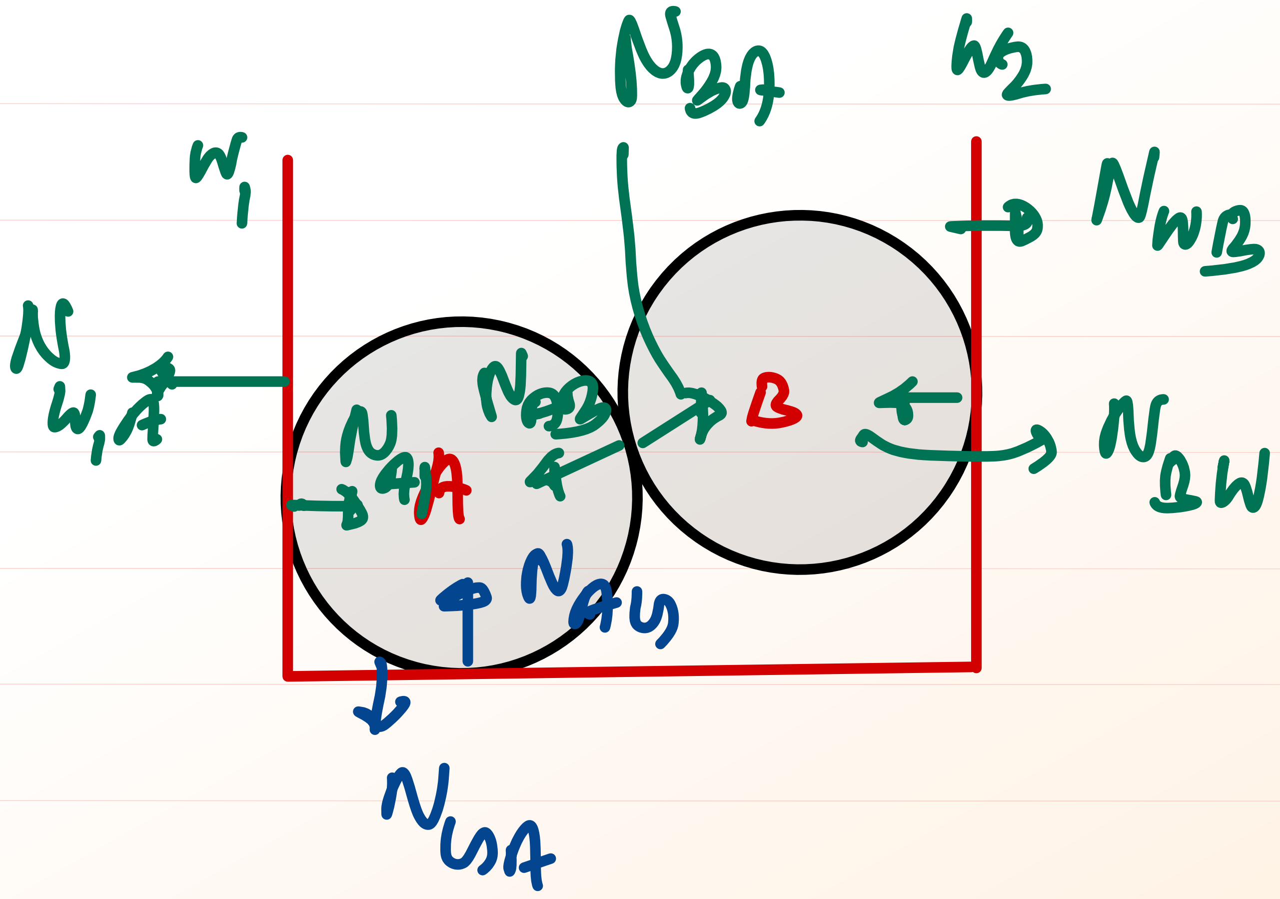
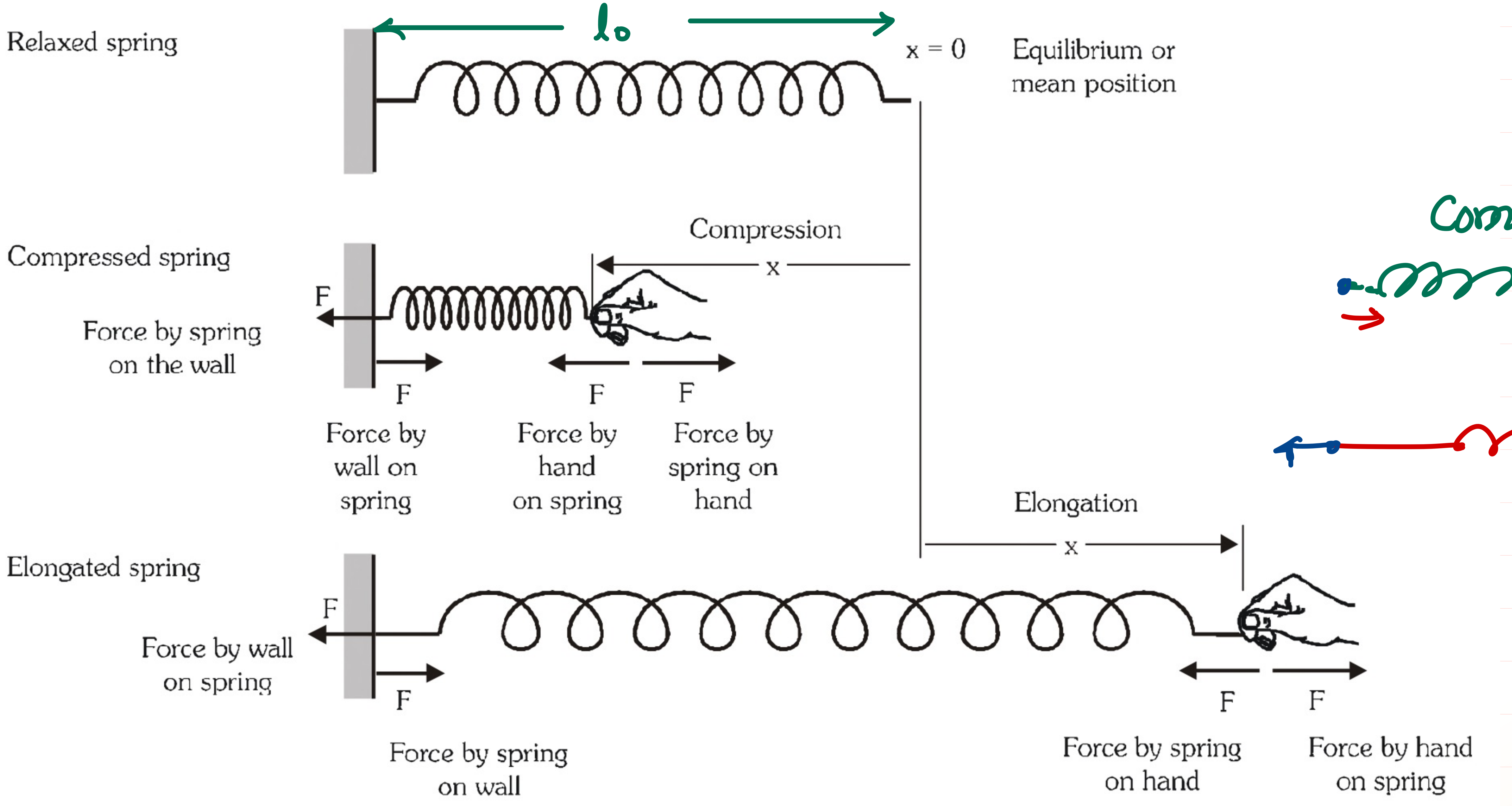
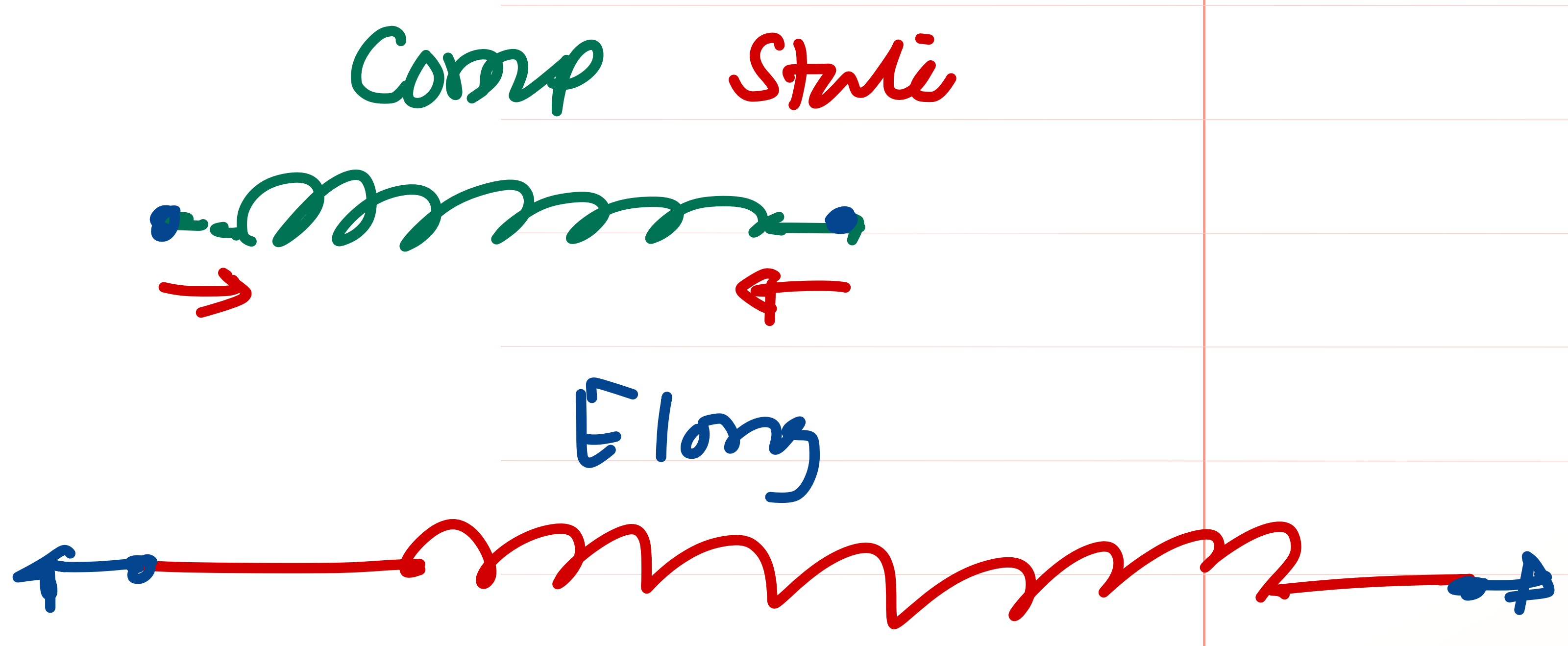


③ Spring Force :→

Natural length



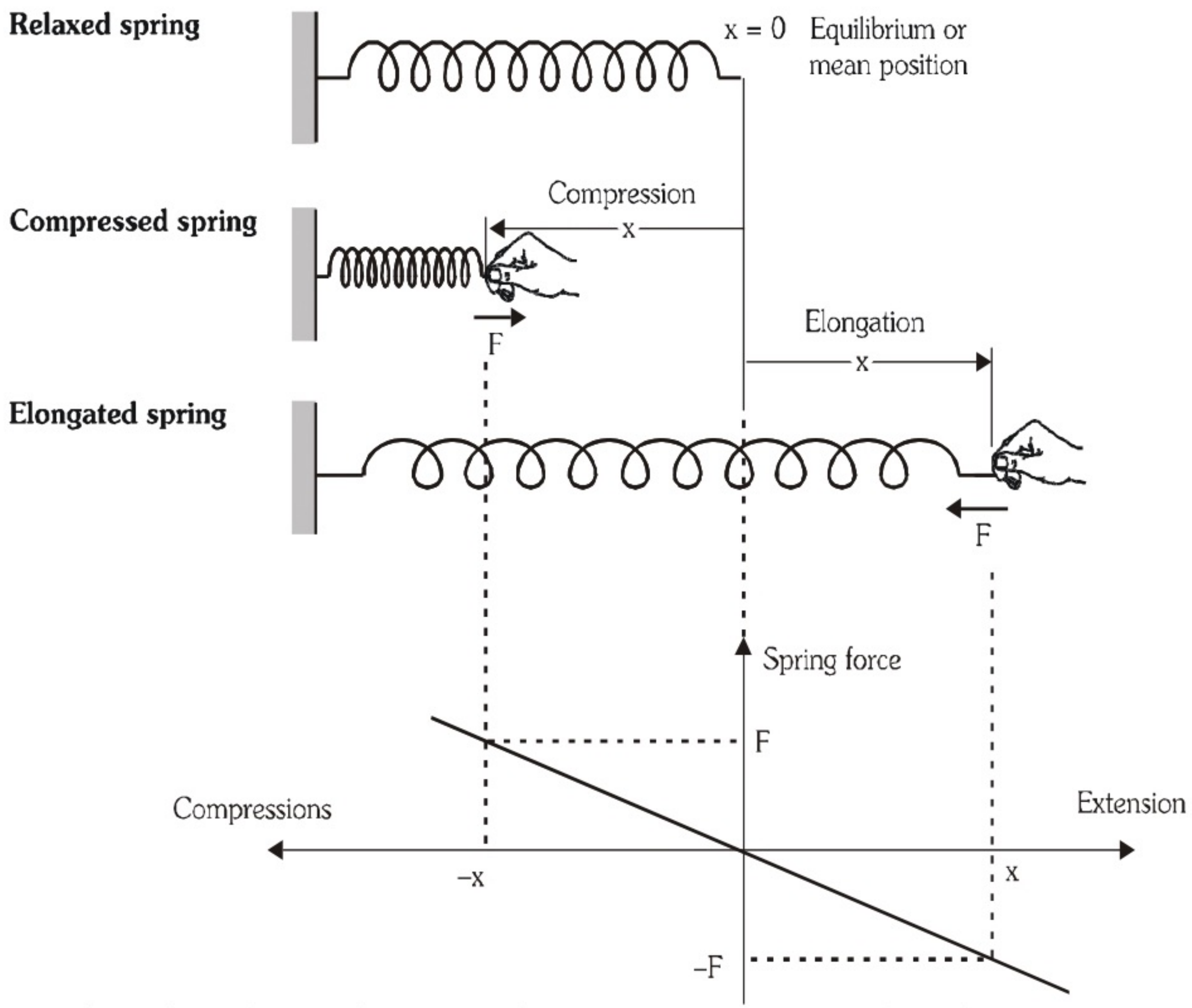


Hooke's Law :→

How spring force varies with deformation in length x of the spring is also shown in the following figure.

$K =$ Spring constant

$\boxed{K \propto \frac{1}{l_0}}$ depends on Natural length.



The force F varies linearly with x and acts in a direction opposite to x. Therefore, it is expressed by the following equation

$$\boxed{F = -kx}$$ → this is force by spring on contact object

CONCEPT OF FREE BODY DIAGRAM (FBD) :→

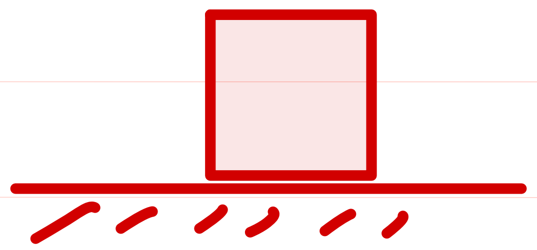
A free body diagram is a pictorial representation in which the body under study is assumed free from rest of the system i.e. assumed separated from rest of the interacting bodies and is drawn in its actual shape and orientation and all the forces acting on the body are shown.

How to draw a Free Body Diagram (FBD) :→

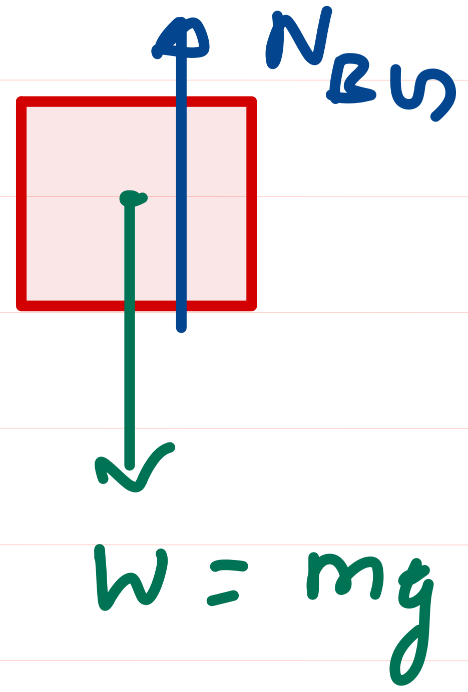
- Separate the body under consideration from the rest of the system and draw it separately in actual shape and orientation.
- Show all the forces whether known or unknown acting on the body at their respective points of application.

  For the purpose count every contact where we separate the body under study from other bodies. At every such point, there may be a contact force. After showing, all the contact forces show all the field forces.

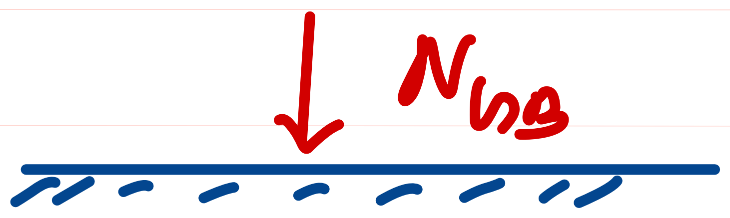
Ex



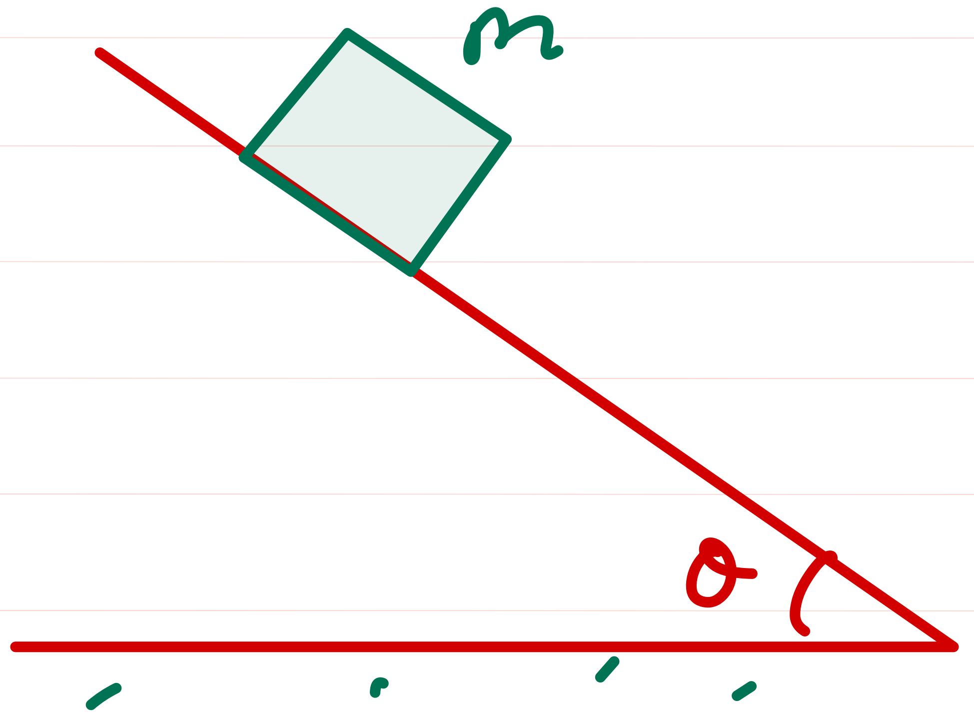
F.B.D of Box



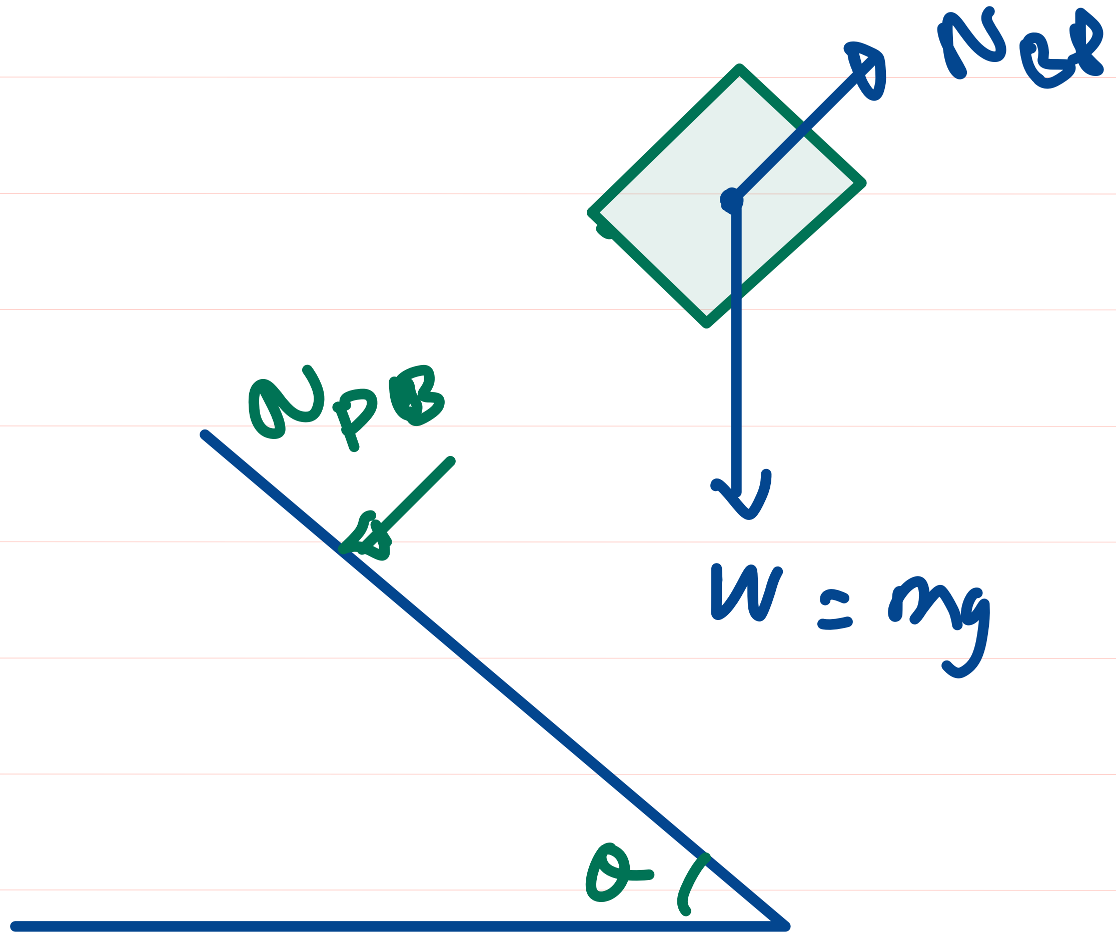
FBD of Surface



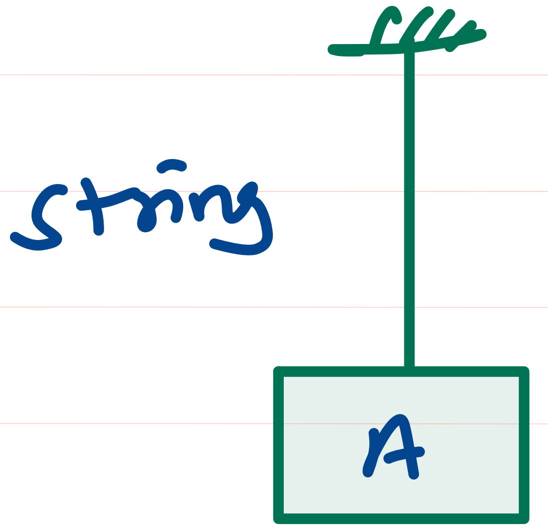
Ex



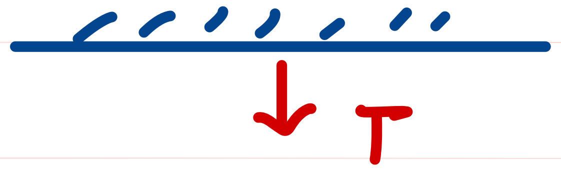
F.B.D of Box



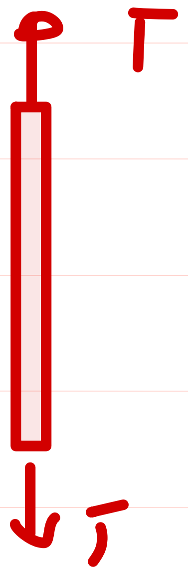
Ex



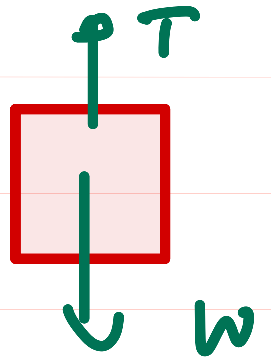
⇒ F.B.D of Top



F.B.D of String

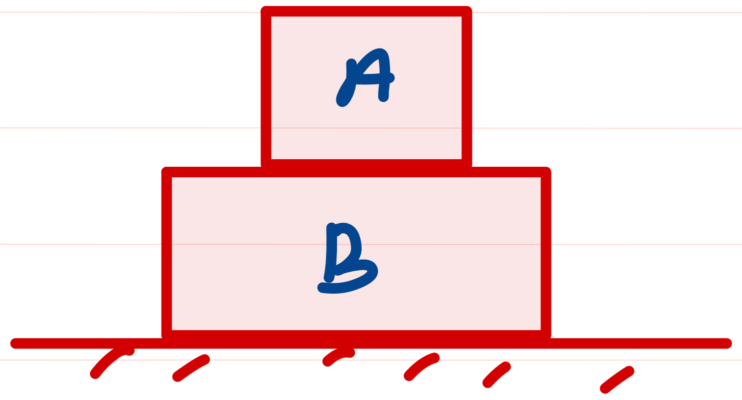


F.B.D of Box

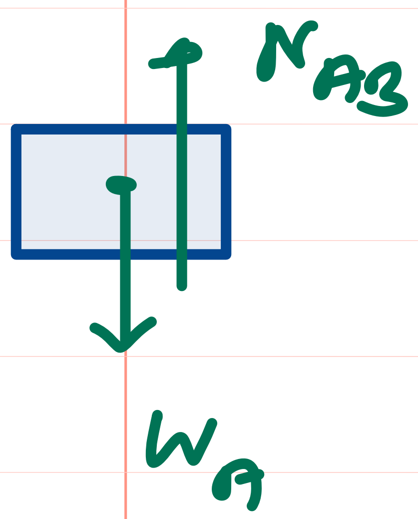


Ex

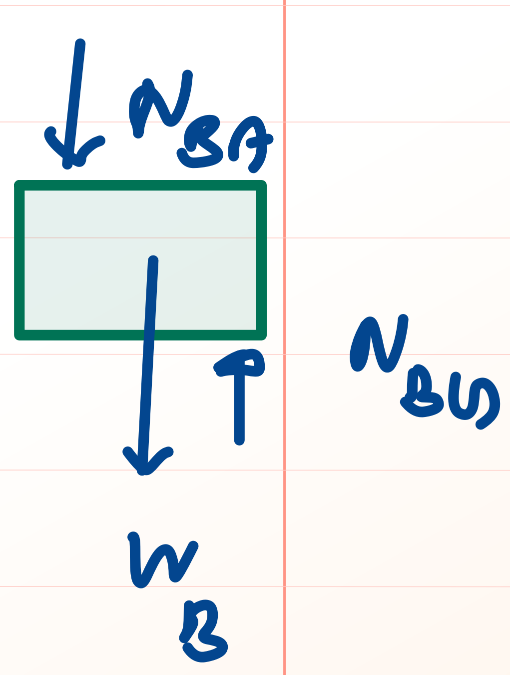
Ex.



F.B.D of A



F.B.D of B



F.B.D of Ground