



PRACHAND NEET



ONE SHOT



Physics

LAWS OF MOTION



By – Professor Dr. Aayudh

Topics *to be covered*



1 Part 1 – Basic Maths ✓

2 Part 2 – Theory of Force ✓

3 Part 3 – 2nd Law Numericals ✓

4 Part 4 – Normal, Tension, Spring & Friction ✓

5 Part 5 – Constraint Motion ✓

6 Part 6 – Equilibrium ✓



Topics

to be covered



7 Part 7 – Push and Pull ✓

8 Part 8 – Pseudoforce ✓

9 Part 9 – Atwood Machine Pulley ✓

10 Part 10 – Spring Force ✓

11 Part 11 – Variable Mass System ✓

12 Part 18 – Theory and AR Questions

13 Part 19 – Revision and PUPPY POINTS ✓

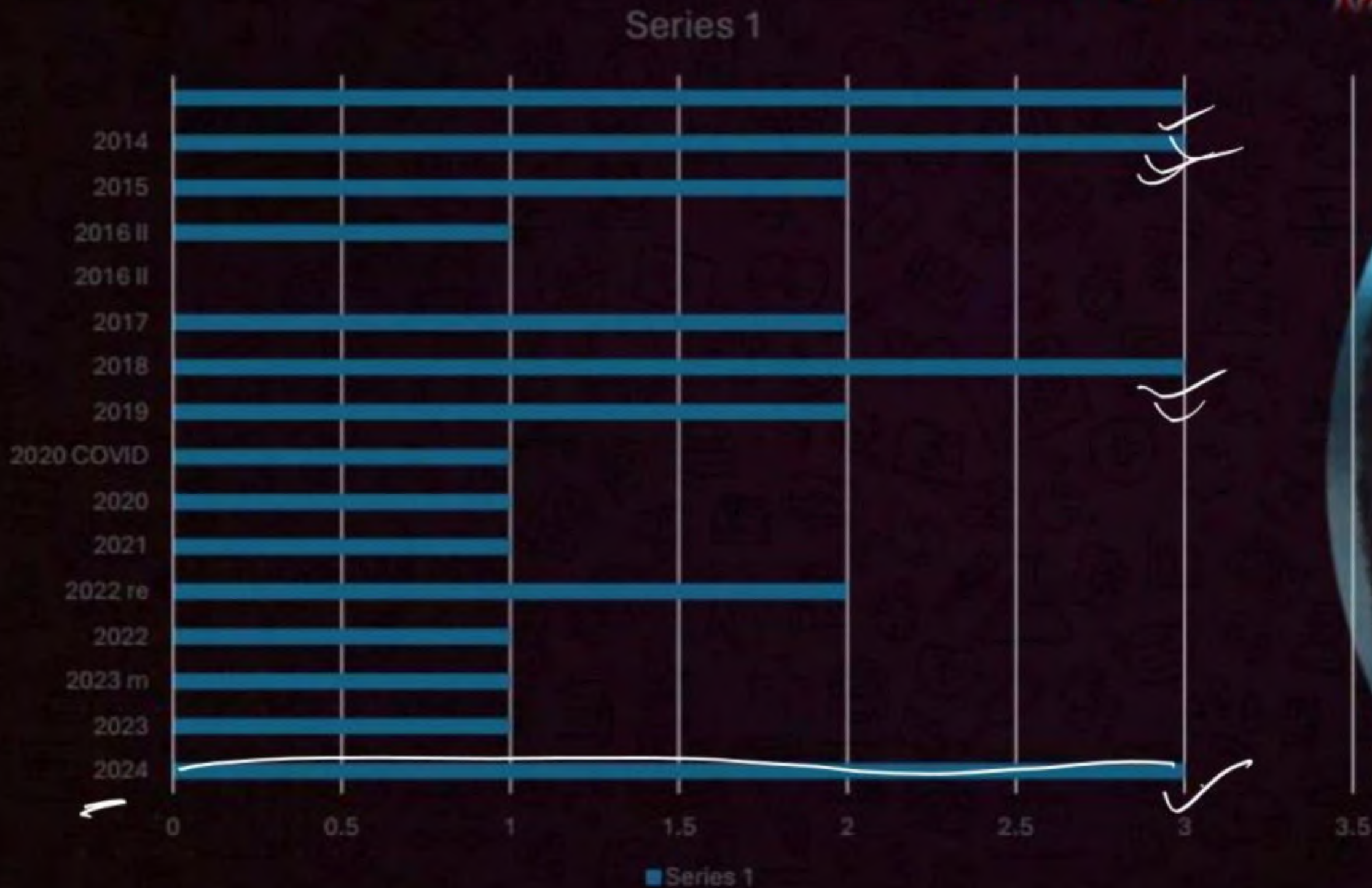
NEET SYLLABUS



- Force and inertia ✓ → Theory
 - Newton's First law of motion ✓
 - Newton's Second Law of motion → Numerical
 - Newton's Third Law of motion ✓
 - Momentum ✓
 - Impulses ✓
 - Equilibrium of concurrent forces ✓
 - Law of conservation of linear momentum and its applications - **Momentum** ✓✓
 - Static and Kinetic friction - **Friction**
 - Laws of friction - **Friction**
 - Rolling friction - **Friction**
- Tuesday ✓✓

PROFESSOR ANALYSIS

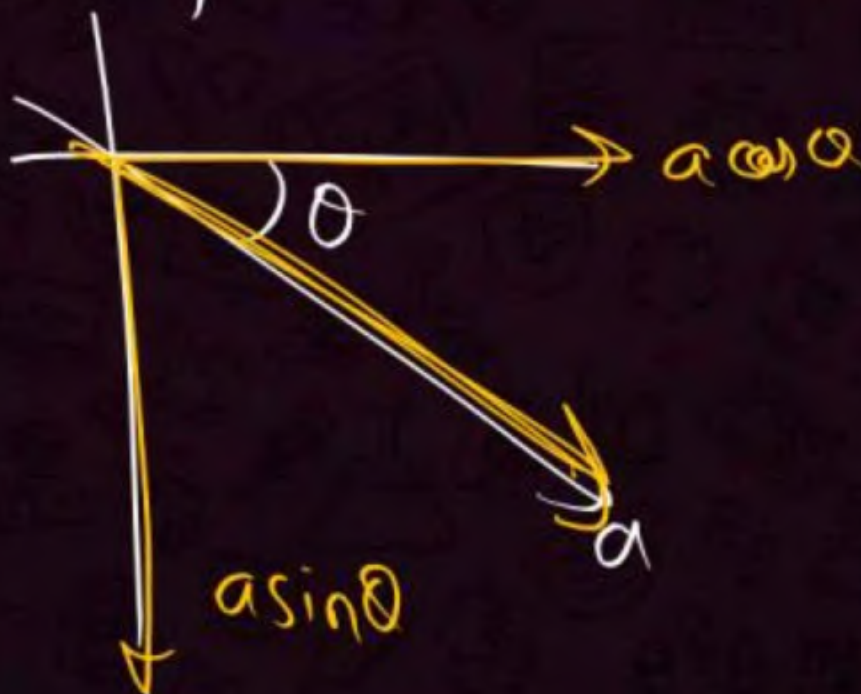
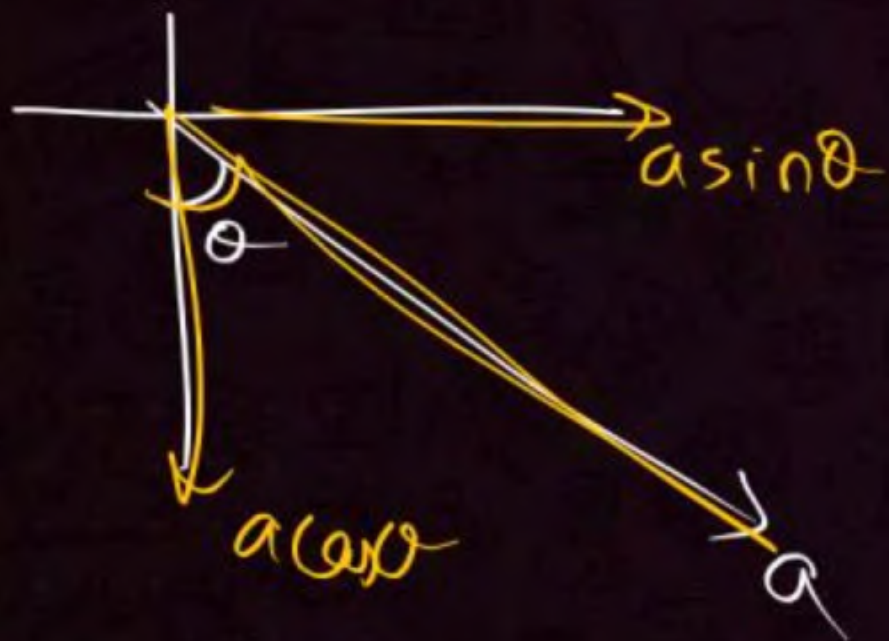
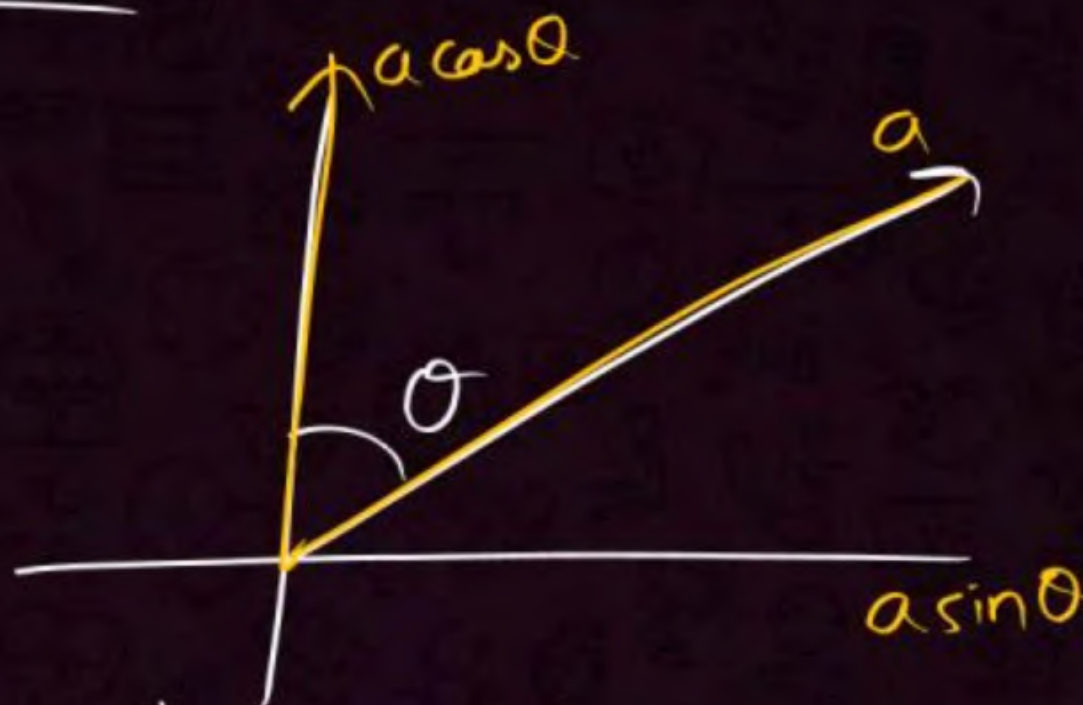
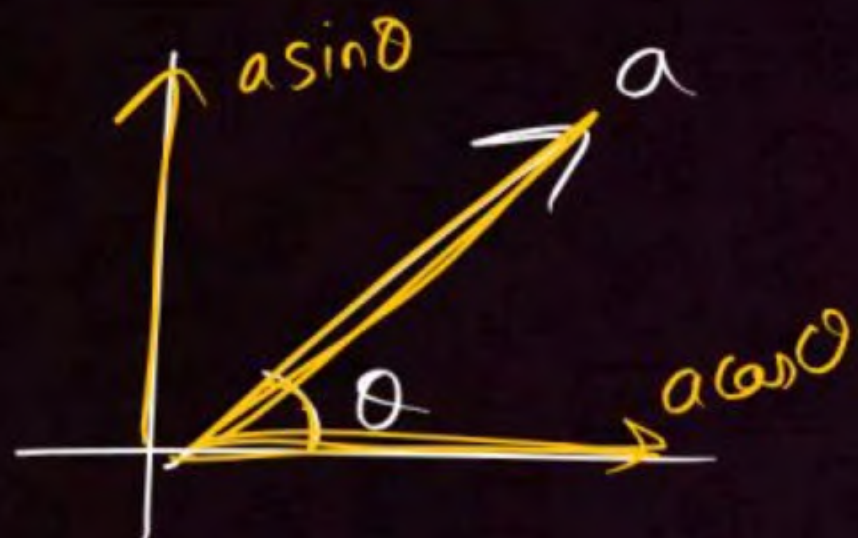
Difficulty Level : EASY
Difficulty Level : MEDIUM
Difficulty Level : HARD
Difficulty Level : YODHA

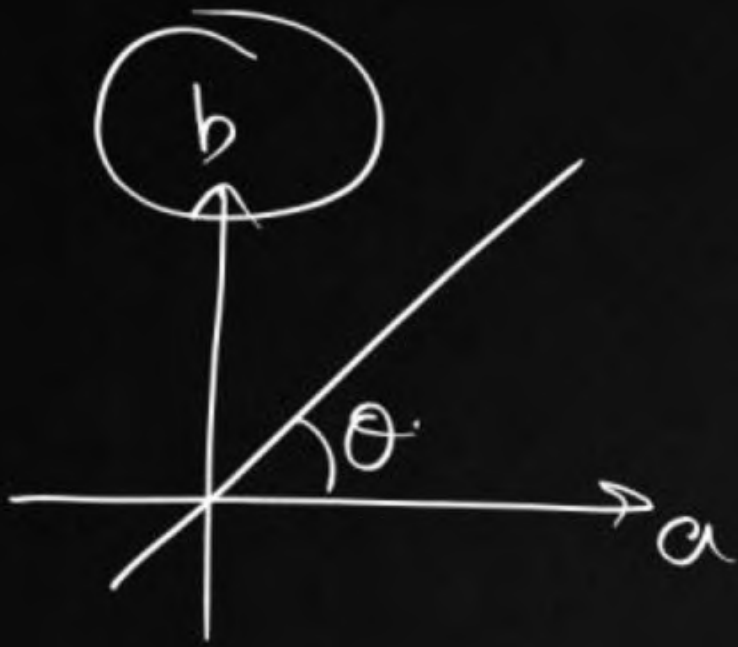


Part 1 – Basic Maths and Vectors

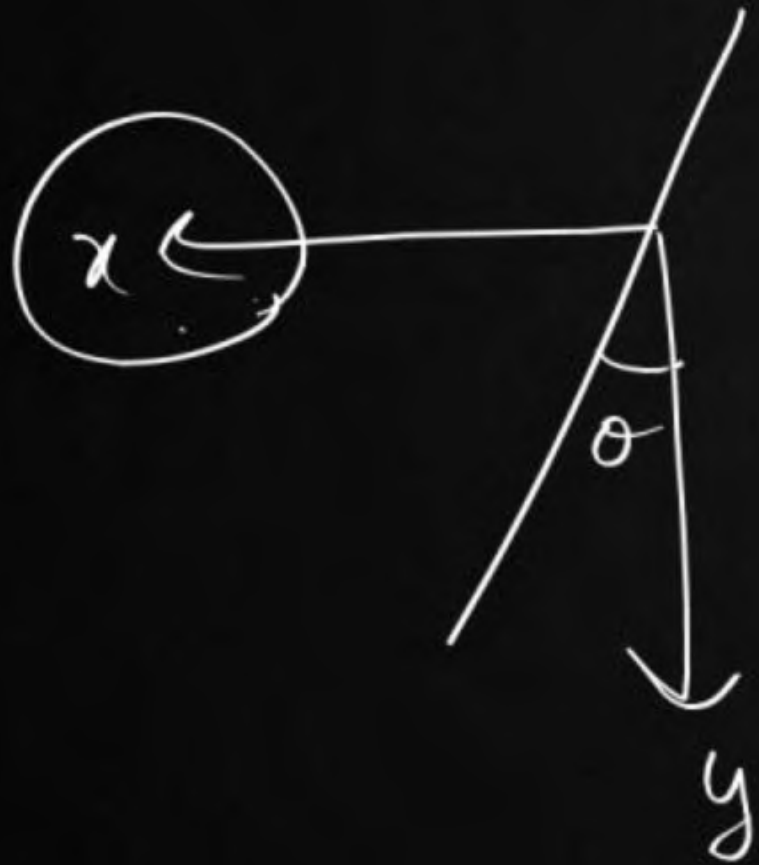


1.1 Components of Vectors





$$\tan \theta = \frac{\text{durr wala}}{\text{pass wala}} = \frac{b}{a}$$



$$\tan \theta = \frac{y}{x} = \frac{\text{durr wala}}{\text{pass wala}} = \frac{x}{y}$$

Hide & Seek



$$\frac{d(mv)}{dt} = m \frac{dv}{dt} + v \frac{dm}{dt}$$

Part 2 – Theory of Force



2.1 Aristotle's Fallacy

♥ Aristotle's fallacy is the idea that an **external force is required to keep an object in motion.**

Aristotle based this conclusion on his observations of practical situations, but it was **later disproved** by Newton's laws of motion



4.2 ARISTOTLE'S FALLACY

The question posed above appears to be simple. However, it took ages to answer it. Indeed, the correct answer to this question given by Galileo in the seventeenth century was the foundation of Newtonian mechanics, which signalled the birth of modern science.

The Greek thinker, Aristotle (384 B.C– 322 B.C.), held the view that if a body is moving, something external is required to keep it moving. According to this view, for example, an arrow shot from a bow keeps flying since the air behind the arrow keeps pushing it. The view was part of an elaborate framework of ideas developed by Aristotle on the motion of bodies in the universe. Most of the Aristotelian ideas on motion are now known to be wrong and need not concern us. For our purpose here, the Aristotelian law of motion may be phrased thus: **An external force is required to keep a body in motion.**

Aristotelian law of motion is flawed, as we shall

Which one of the following options is correct according to Aristotle's Fallacy?

[NCERT Based]

- 1 An external force is necessary to keep a body in uniform motion. ✓
- 2 The state of rest and the state of motion with constant velocity are equivalent in the absence of external forces. ✗
- 3 A force is not necessary to counter the opposing force of friction. ✗
- 4 To keep a body in uniform motion, no external force is needed. ✗

2.2 Galileo's Observation

The state of rest and the state of motion with constant velocity are equivalent in the absence of external forces.

Both Cases there is no net Force on the body

✓ **Inertia – Resist to change**

✓ Inertia is that property of a body by virtue of which the body is **unable to change by itself the state of rest or of uniform motion**

Galileo thus, arrived at a new insight on motion that had eluded Aristotle and those who followed him. The state of rest and the state of uniform linear motion (motion with constant velocity) are equivalent. In both cases, there is no net force acting on the body. It is incorrect to assume that a net force is needed to keep a body in uniform motion. To maintain a body in uniform motion, we need to apply an external force to counter the frictional force, so that the two forces sum up to zero net external force.

To summarise, if the net external force is zero, a body at rest continues to remain at rest and a body in motion continues to move with a uniform velocity. This property of the body is called inertia. **Inertia means 'resistance to change'**. A body does not change its state of rest or uniform motion, unless an external force compels it to change that state.

[NCERT Page 51]



QUESTION-02

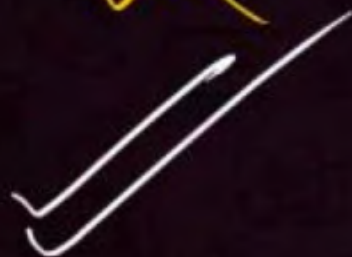
Difficulty Level : Easy



The term inertia was first used by

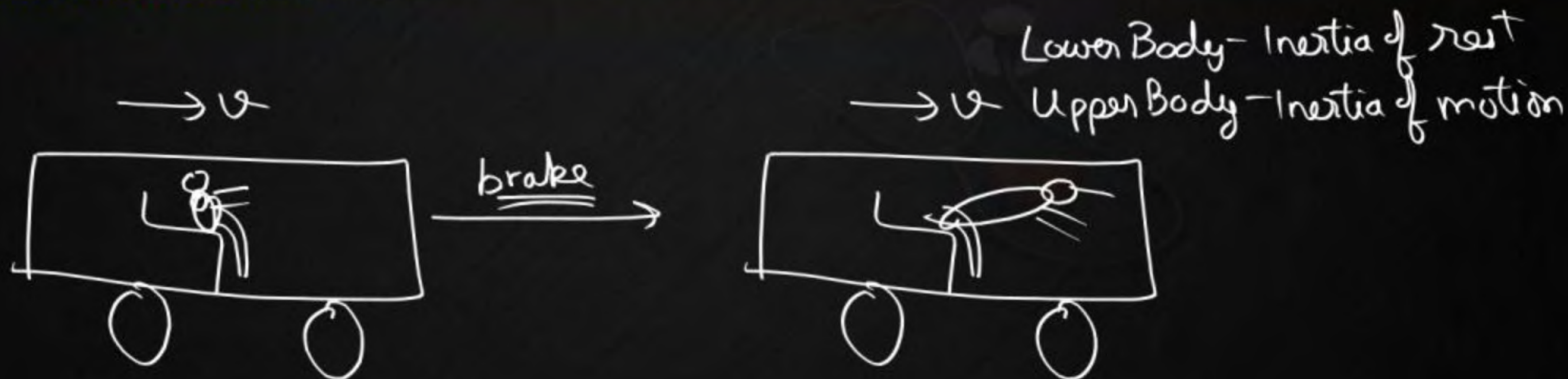
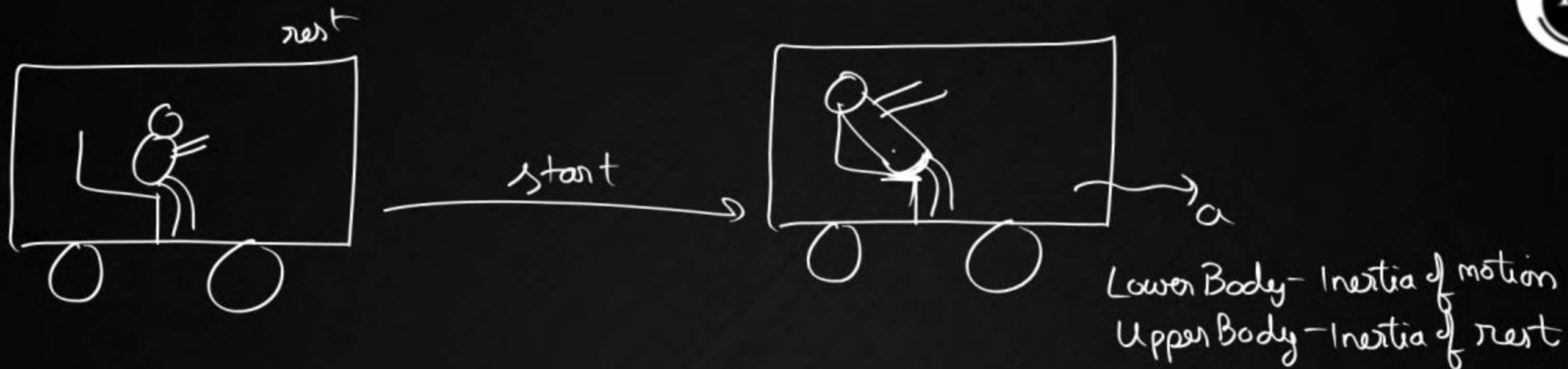
[NCERT Based]

- 1 Newton
- 2 Galileo
- 3 Aristotle
- 4 Kepler



Inertia is that property of a body by virtue of which the body is unable to change by itself the state of rest or of uniform motion [NCERT Based]

- 1 unable to change by itself the state of rest. ✓
- 2 unable to change by itself the state of uniform motion. ✓
- 3 unable to change by itself the direction of motion. ✓
- 4 unable to change by itself the state of rest or of uniform motion ✓



A rider on horse back falls when horse starts running all of a sudden because

- 1** Rider is taken back
- 2** Rider is suddenly afraid of falling
- 3** ✓ Inertia of rest keeps the upper part of body at rest whereas lower part of the body moves forward with the horse
- 4** None of the above

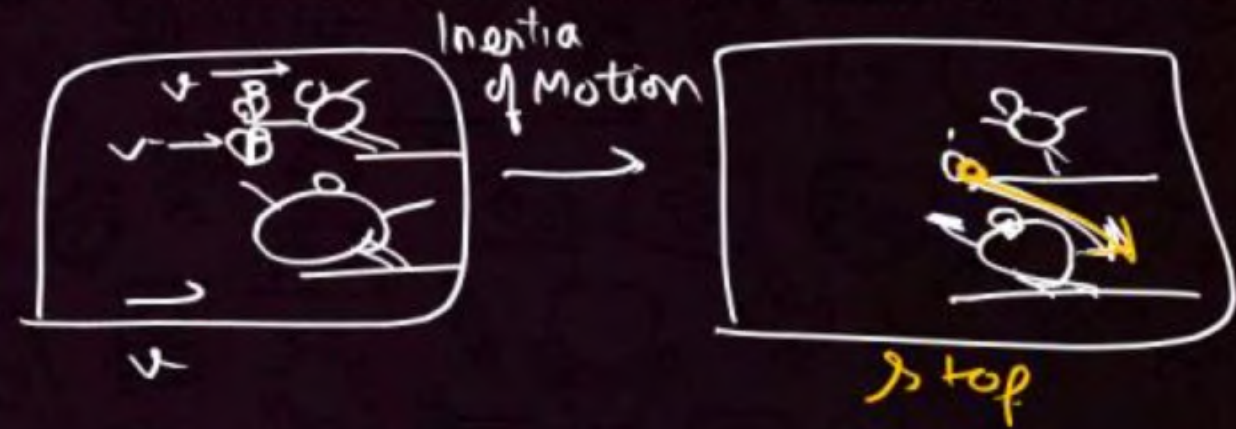
QUESTION-05

Difficulty Level : **HARD**



A boy sitting on the topmost berth in the compartment of a train which is just going to stop on a railway station, drops an apple aiming at the open hand of his brother sitting vertically below his hands at a distance of about 2 meters. The apple will fall

- 1** Precisely on the ~~hand~~ of his brother
- 2** Slightly away from the hand of his brother in the direction of motion of the train
- 3** Slightly away from the hand of his brother in the direction opposite to the direction of motion of the train
- 4** None of the above



QUESTION-06

Difficulty Level : MEDIUM



There are two bodies A and B of same mass body A is at rest while body B is under going uniform motion, which is correct statements?

- 1 Inertia of $A >$ inertia of B
- 2 Inertia of $B >$ inertia of A
- 3 Inertia of $A =$ inertia of B
- 4 either 1st, 2nd, 3rd depending upon the shape of body.

mass same
Inertia same

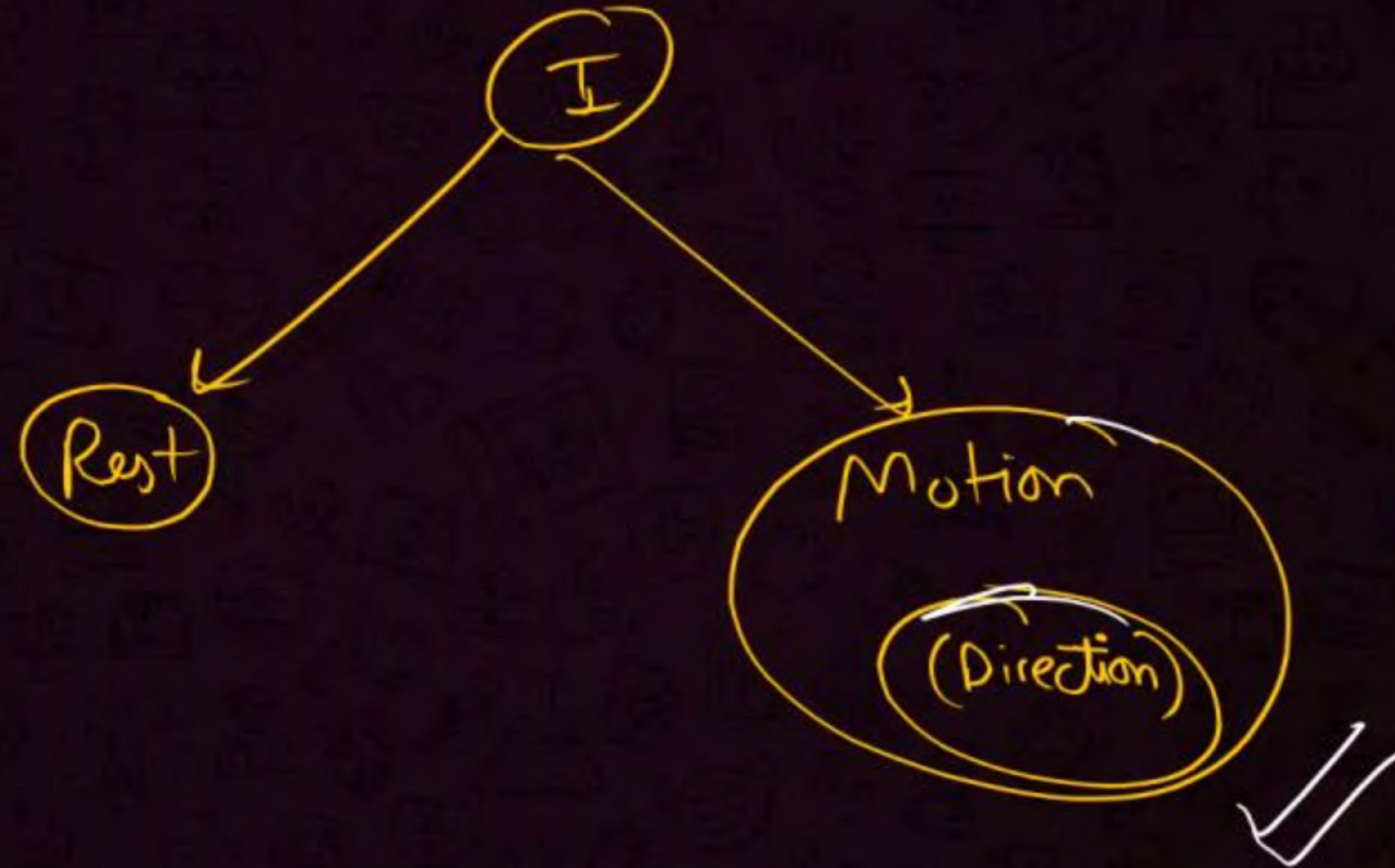
2.3 Types of Inertia



Inertia of Rest

Inertia of Motion

Inertia of Direction





A passenger getting down from a moving bus, falls in the direction of the motion of the bus. This is an example for **[NCERT Based]**

- 1 second law of motion
- 2 third law of motion
- 3 inertia of rest
- 4 inertia of motion



QUESTION-08

Difficulty Level : Easy



boat

HW

When a speeding ~~bus~~ stops suddenly, passengers are thrown forward from their seats because

[NCERT Based]

- 1 the back of seat suddenly pushes the passengers forward.
- 2 inertia of rest stops the bus and takes the body forward.
- 3 upper part of the body continues to be in the state of motion whereas the lower part of the body in contact with seat remains at rest. ✓
- 4 upper part of the body come to rest whereas the lower part of the body in contact with seat begins to move.

2.4 Force



- ♥ Force is a physical cause that ✓
- ♥ changes or may tend to change ✓
- ♥ the state of rest or the state of motion of an object and the shape of the object

SI Unit **Newton** ♥

Dimensions - **$[M^1L^1T^{-2}]$** ♥

1 Newton = 10^5 dyne = 1 lakh dyne (C.G.S.)

1 KGF = 9.8 N = 9 lakh 80 thousand dyne

↓ kg-wt

1 GF = 9.8×10^{-3} N = 980 dyne ✓

↓ g-wt

Force is an interaction between two objects



2.5 Newton's 1st Law of Motion



♥ Galileo's **law of inertia** was his starting point which he formulated as the first law of motion: Every body continues to be in its state of rest or of uniform motion in a straight line unless compelled by some external force to act otherwise. (NCERT Page 51)

♥ If the net external force on a body is zero, its acceleration is zero. $F_{\text{net}} = 0 \rightarrow a = 0$
 $\nearrow$ rest
 $\searrow$ or constant v

♥ Acceleration can be non zero only if there is a net external force on the body.
 $a \neq 0$ $F_{\text{ext}} \neq 0$

♥ If the (vector) sum of all the forces acting on a particle is zero then and only then the particle remains unaccelerated (i.e., remains at rest or moves with constant velocity). (HCV) $F_{\text{net}} = 0$ $a = 0$



2.5 Newton's 1st Law of Motion



♥ If then, on earth, an object is at rest or in uniform linear motion, it is not because there are no forces acting on it, but because the various external forces cancel out i.e. add up to zero net external force.
(NCERT Page 52)

♥ It explains physical independence of force ✓

♥ Rest or constant velocity can have 2 meanings – 1) No Force 2) Net Force = 0
zero

♥ Same Mass means same inertia (rest or constant velocity)

QUESTION-09

Difficulty Level : Easy



An astronaut accidentally gets separated out of his small spaceship accelerating in interstellar space at a constant rate of 10 ms^{-2} . What is the acceleration of the astronaut the instant after he is outside the spaceship?

(Assume that there are no nearby stars to exert gravitational force on him)

[NCERT In Text 4.1]

1 ✓ zero

2 10 ms^{-2}

3 50 ms^{-2}

4 100 ms^{-2}



QUESTION-10

Difficulty Level : Easy



Physical independence of force is a consequence of:

[1991]

- 1 Third law of motion
- 2 Second law of motion
- 3 First law of motion
- 4 All of these laws

QUESTION-11

Difficulty Level : MEDIUM



Which of the following statements is most correct?

[NCERT Based]

- 1 It is possible for an object to have motion in the absence of forces on the object. *Constant v* ✓
- 2 It is possible to have several forces acting on an object in the absence of motion of the object. ✓
- 3 Neither (1) nor (2) is correct.
- 4 ~~Both (1) and (2) are correct.~~



QUESTION-12

Difficulty Level : MEDIUM



$$\begin{aligned} F &= 0 \\ a &= 0 \end{aligned}$$

An object experience no acceleration. What of the following cannot be true for the object?
[NCERT Based]

- 1 A single force acts on the object. ✗
- 2 NO force act on the object. ✓
- 3 Forces act on the object, but they force cancel. ✓
- 4 None of these



QUESTION-13

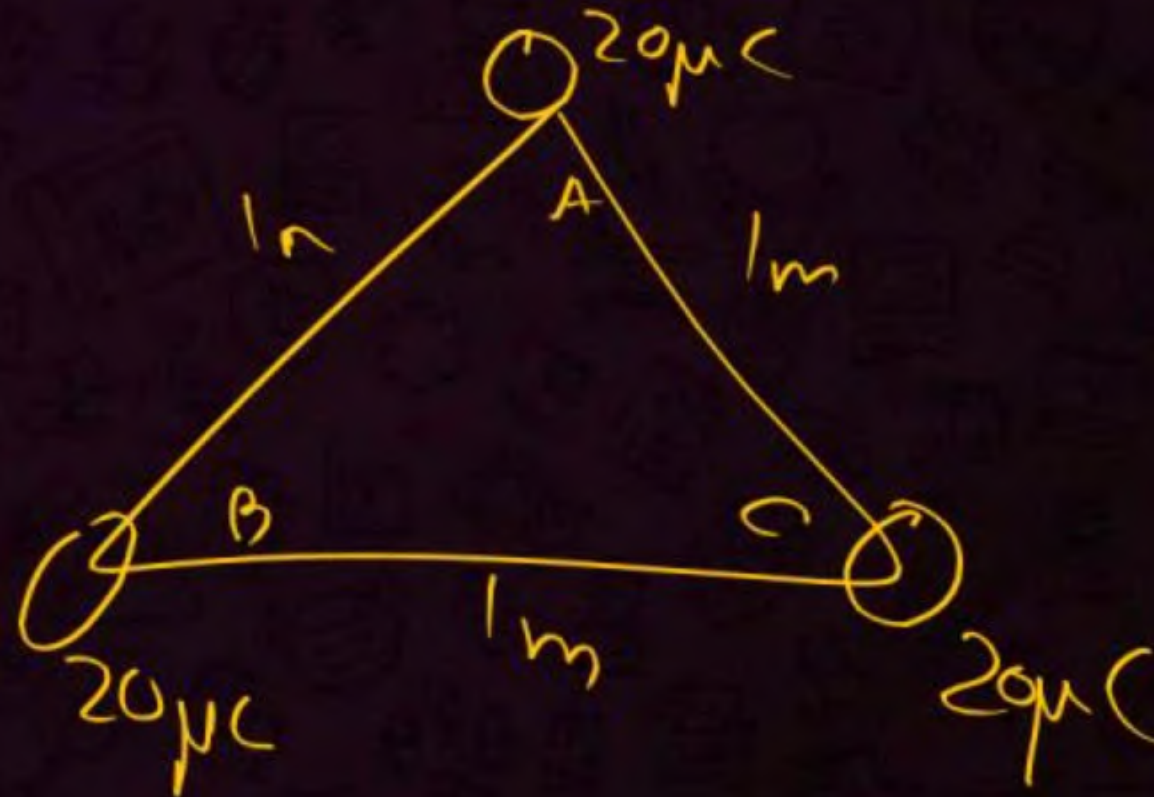
Difficulty Level : HARD



Three rigid rods are joined to form an equilateral triangle ABC of side 1 m. Three particles carrying charges $20\ \mu\text{C}$ each are attached to the vertices of the triangle. The whole system is at rest in an inertial frame. The resultant force on the charged particle at A has the magnitude

[HCV Objective]

- 1 zero
- 2 3.6 N
- 3 $3.6\sqrt{3}\ \text{N}$
- 4 7.2 N



QUESTION-14

Difficulty Level : MEDIUM



Neglect the effect of rotation of the earth. Suppose the earth suddenly stops attracting objects placed near its surface. A person standing on the surface of the earth will

[HCV Objective]

- 1 fly up
- 2 slip along the surface
- 3 fly along a tangent to the earth's surface
- ~~4 remain standing.~~



QUESTION-15

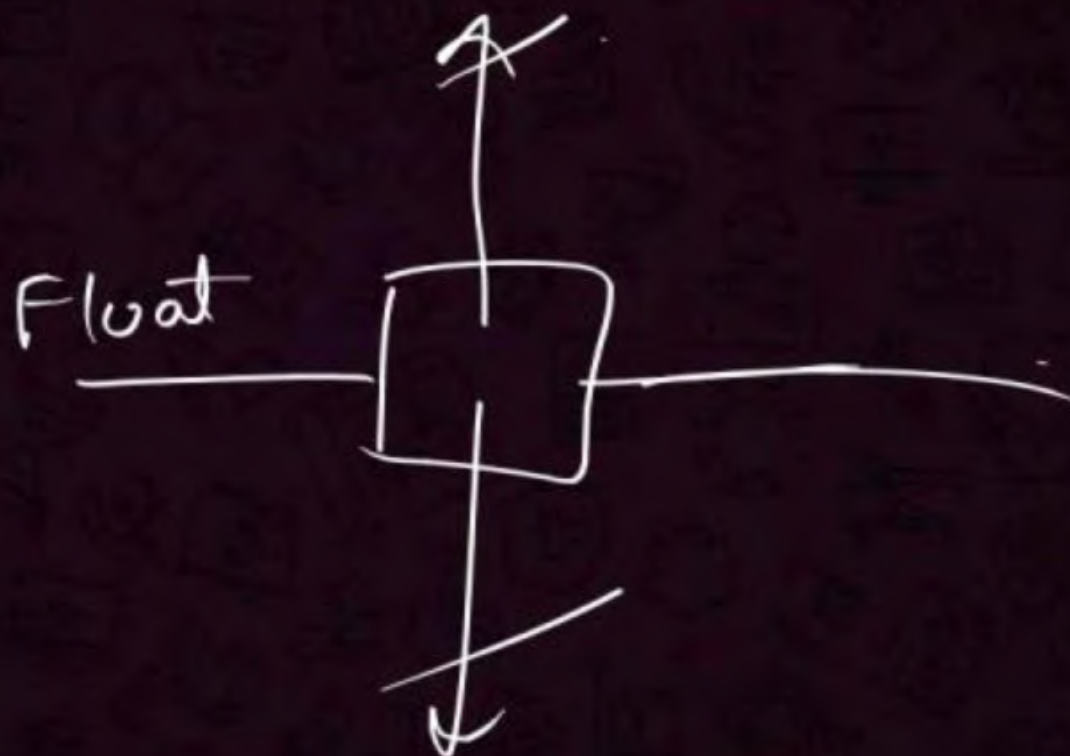
Difficulty Level : Easy



A cork of mass 10 g is floating on water. The net force acting on the cork is

[NCERT Based]

- 1 10 N
- 2 10^{-3} N
- 3 10^{-2} N
- 4 zero ✓✓



QUESTION-16

Difficulty Level : MEDIUM



In which of the following cases the net force is not zero?

hw

- 1 A kite skillfully held stationary in the sky
- 2 A ball freely falling from a height ✓
- 3 An arphlane rising upwards at an angle of 45° with the horizontal with a constant speed
- 4 A cork floating on the surface of water

QUESTION-17

Difficulty Level : MEDIUM



A particles is in a straight-line motion with uniform velocity. A force is not required

- 1 To increase the speed ✗
- 2 To decrease the speed ✗
- 3 To maintain the same speed ()
- 4 To change the direction ✗

QUESTION-18

Difficulty Level : Easy



A body of mass 40 g is moving with a constant velocity of 2 cm/s on a horizontal frictionless table. The force on the body (in dynes) is ^{hw}

- 1 Zero ✓
- 2 39200
- 3 160
- 4 80

QUESTION-19

Difficulty Level : Easy



hw

In a circus of horse rider takes a vertically jump on a moving horse, and falls back on the horse because

- 1 the inertia of motion is present ✓
- 2 the length of the circus horse is large
- 3 the motion is in circular path
- 4 in reality the rider does not jump

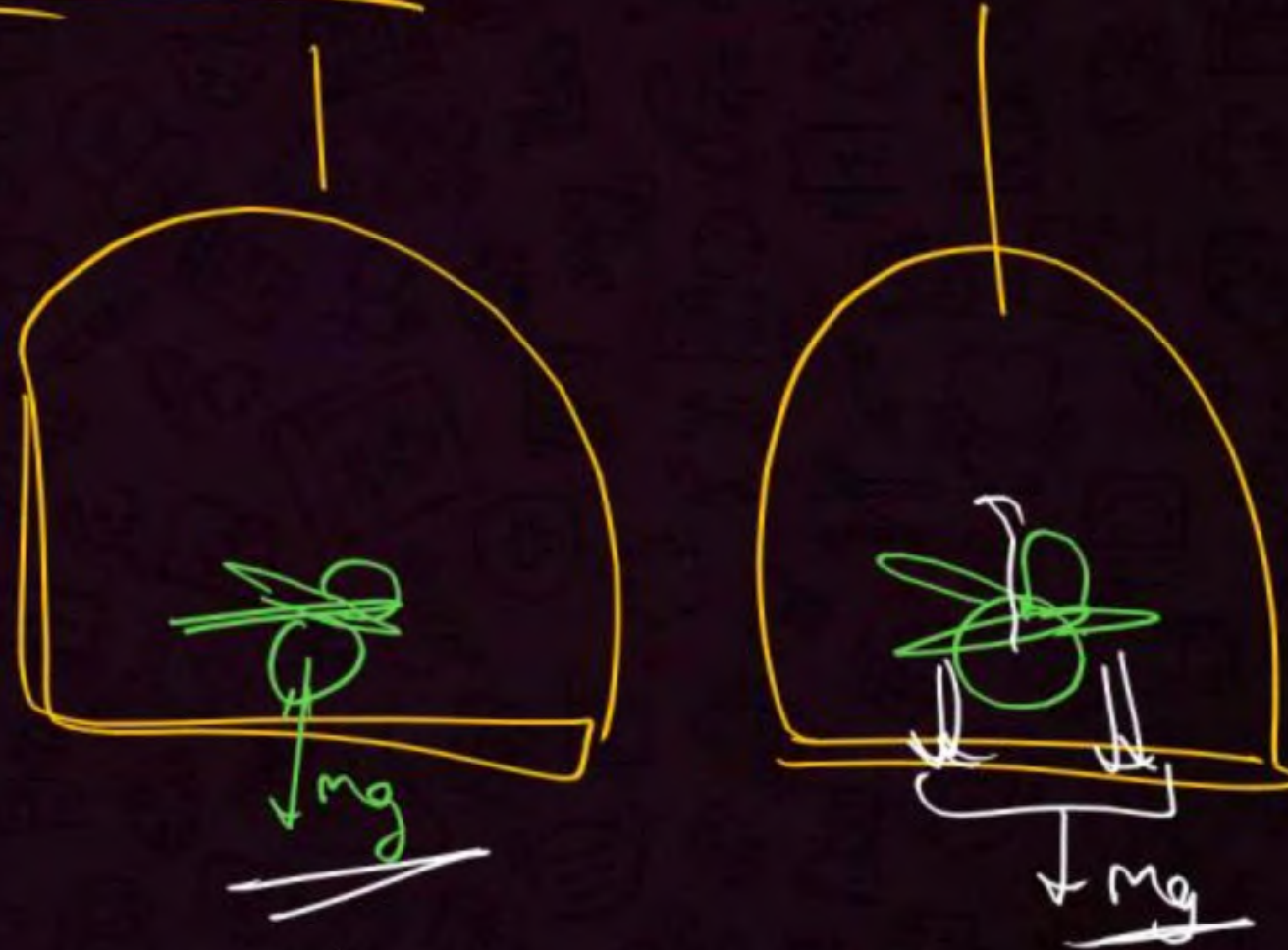
QUESTION-20

Difficulty Level : HARD



A parrot is sitting on the floor of a closed glass cage which is in a boy's hand. If the parrot starts flying with a constant speed, the boy will feel the weight of the cage as

- 1 unchanged ✓
- 2 reduced
- 3 increased
- 4 Nothing can be said



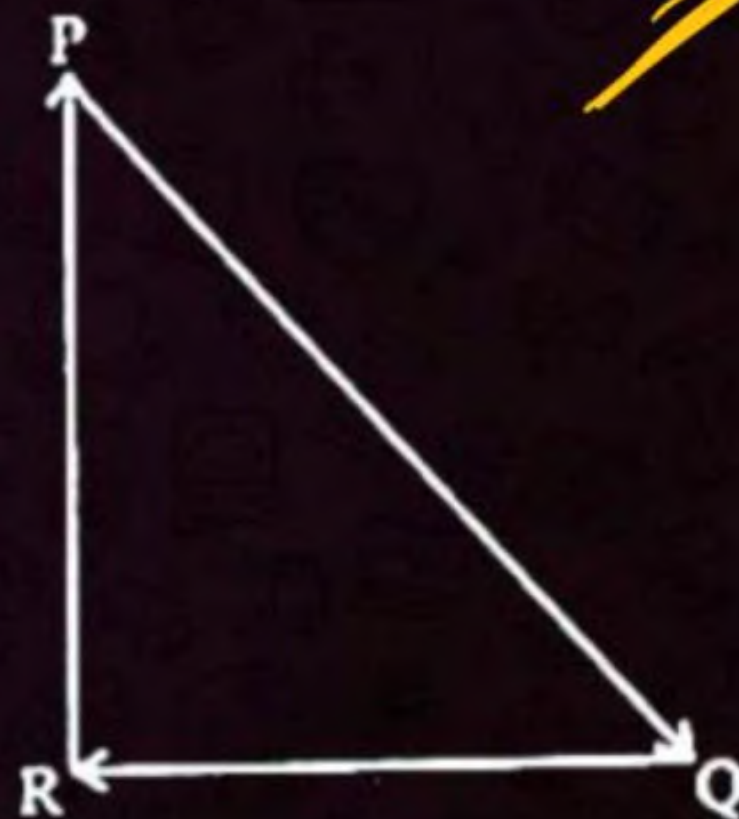
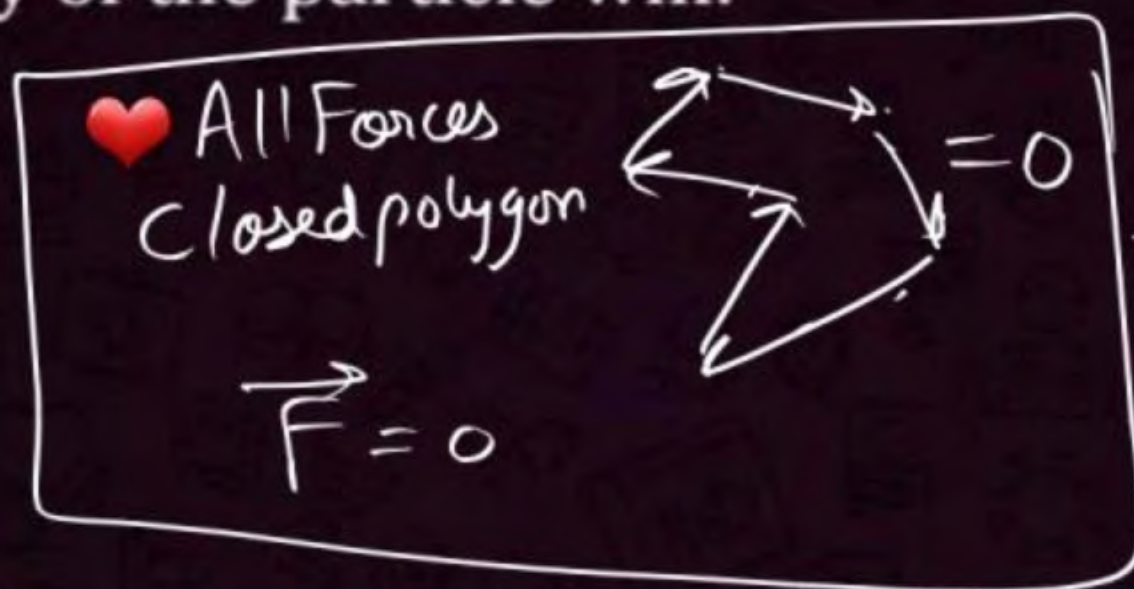
QUESTION-21

Difficulty Level : MEDIUM



A particle moving with velocity $\vec{V}$ is acted by three forces shown by the vector triangle PQR. The velocity of the particle will: [2019]

- 1 Increase
- 2 Decrease
- 3 Remain constant
- 4 Change according to the smallest force



1.5 Newton's 3rd Law of Motion



- ♥ Force is the mutual interaction between two bodies.
- ♥ Forces always occur in pairs.
- ♥ Mutual forces between two bodies are always equal and opposite.

♥ To every action, there is always an equal and opposite reaction.

♥ Action and reaction **cannot act on the same body.**

♥ There is no cause-effect relation between action and reaction.

♥ Action and reaction forces are simultaneous forces.

♥ 3rd Law Explains the creation of force

♥ N and mg are not action/reaction pair



3rd Law



Which of the following statements is not true regarding the Newton's third law of motion?
[NCERT Based]

- 1 To every action there is always an equal and opposite reaction. ✓
- 2 Action and reaction act on the same body. ✗
- 3 There is no cause-effect relation between action and reaction. ✓
- 4 Action and reaction forces are simultaneous forces. ✓

QUESTION-23

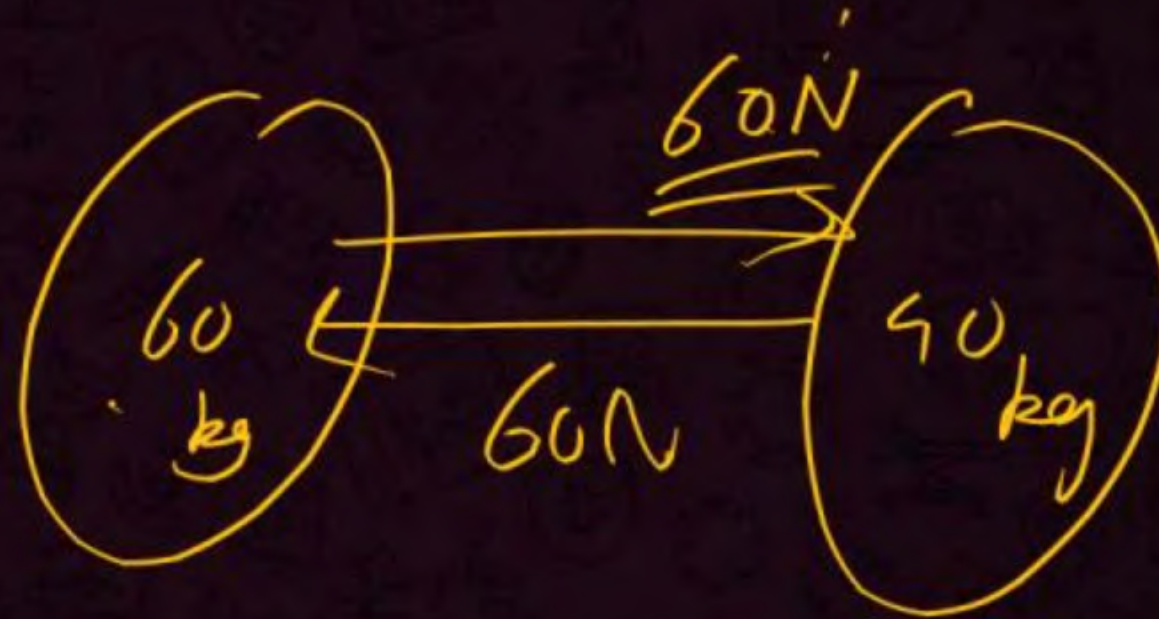
Difficulty Level : Easy



A 60 kg man pushes a 40 kg man by a force of 60. The 40 kg man has pushed the other man with a force of

[HCV Objective]

- 1 40 N
- 2 0
- 3 60 N ✓
- 4 20 N



QUESTION-24

Difficulty Level : MEDIUM



Identify false statement. Action and reaction

HW

[HCV Objective]

- 1** act on same objects
- 2** have equal magnitude
- 3** have opposite directions
- 4** have resultant zero.

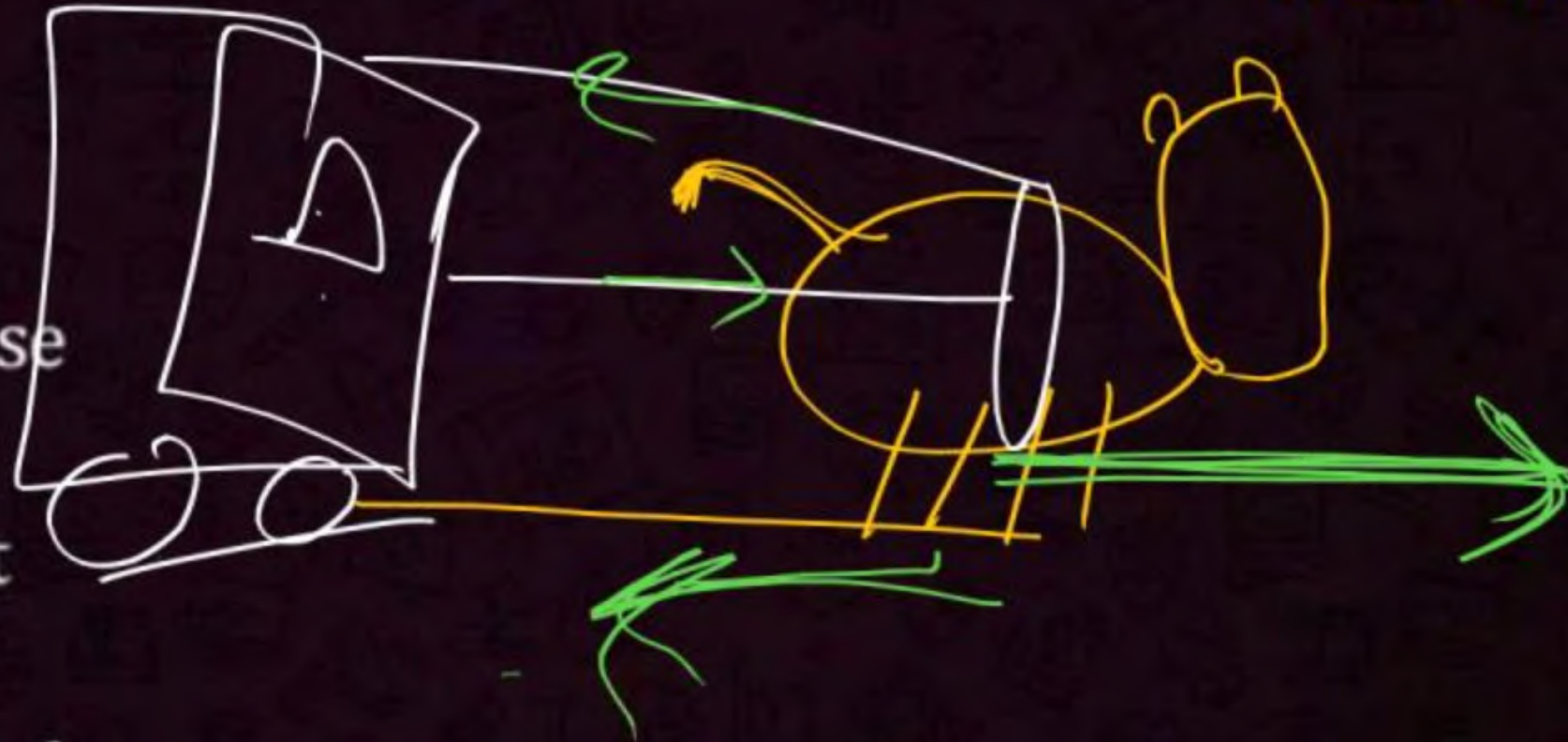
QUESTION-25

Difficulty Level : HARD



When a horse pulls a cart, the force that helps the horse to move forward is the force exerted by **[HCV Objective]**

- 1 the cart on the horse
- 2 the ground on the horse
- 3 the ground on the cart
- 4 the horse on the ground



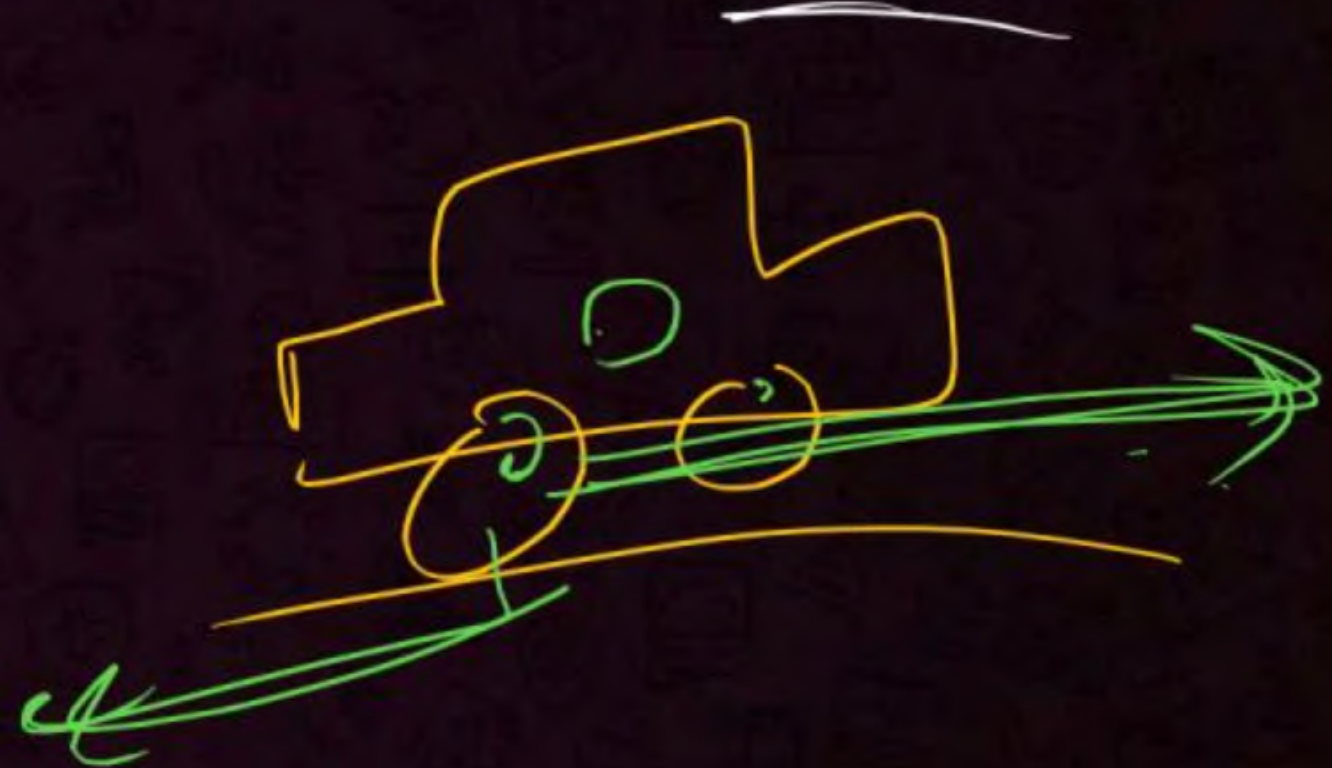
QUESTION-26

Difficulty Level : HARD



A car accelerates on a horizontal road due to the force exerted by **[HCV Objective]**

- 1 the engine of the car ✓
- 2 the driver of the car ✗
- 3 the earth
- 4 the road ✓



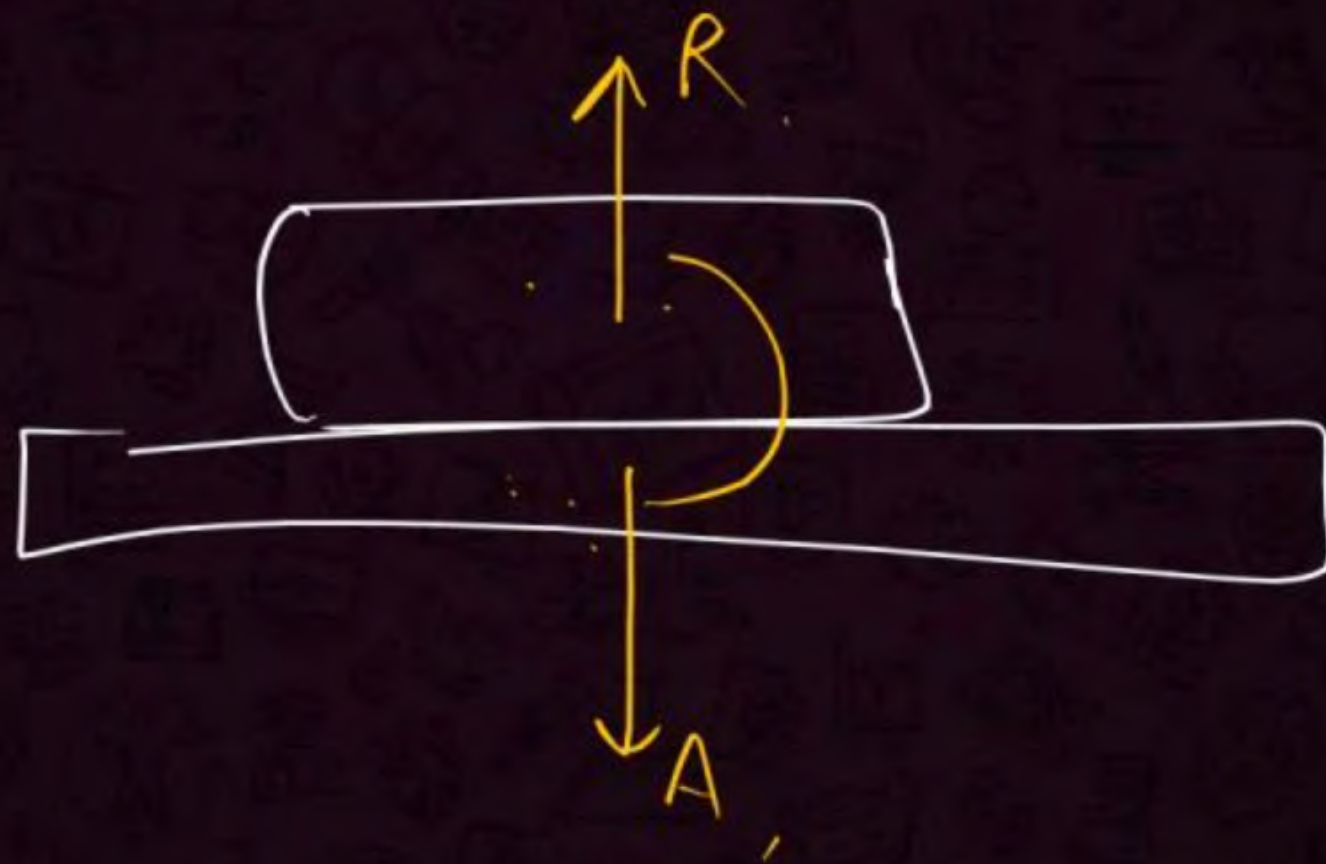
QUESTION-27

Difficulty Level : Easy



A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book? **[NCERT Based]**

- 1 0°
- 2 45°
- 3 90°
- 4 180°



QUESTION-28

Difficulty Level : MEDIUM



A man is at rest in the middle of a pond on perfectly smooth ice. He can get himself to the shore by making use of Newton's

- 1 First law
- 2 Second law
- 3 Third law
- 4 Law of gravitation



QUESTION-29

Difficulty Level : MEDIUM



Newton's third law of motion gives

- 1 definition of force
- 2 magnitude of force
- 3 Explanation of the creation of force ✓✓
- 4 None of these

QUESTION-30

Difficulty Level : Easy



When we kick a stone, we get hurt. due to which of the following properties of stone does it happens?

- 1 Inertia
- 2 Velocity
- 3 Reaction ✓✓
- 4 Momentum

QUESTION-31

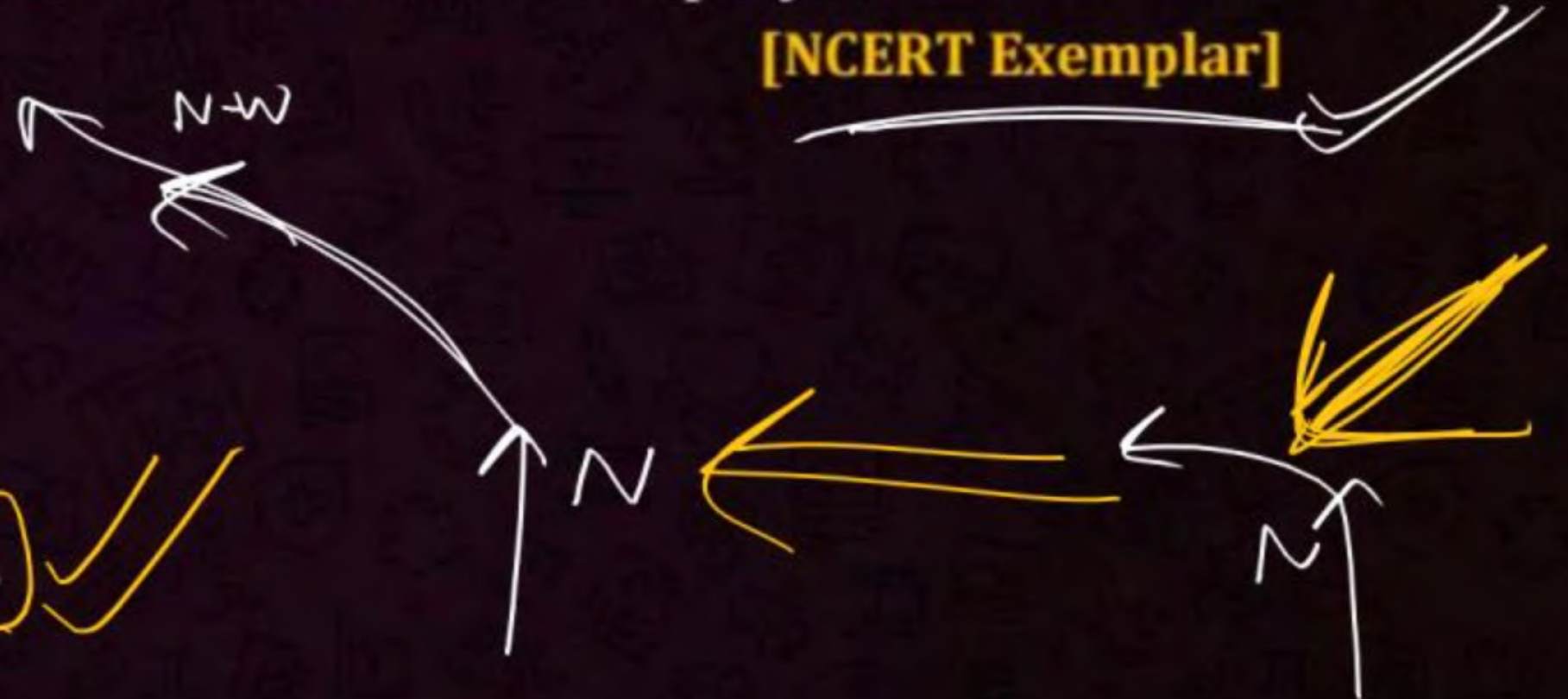
Difficulty Level : YODHA



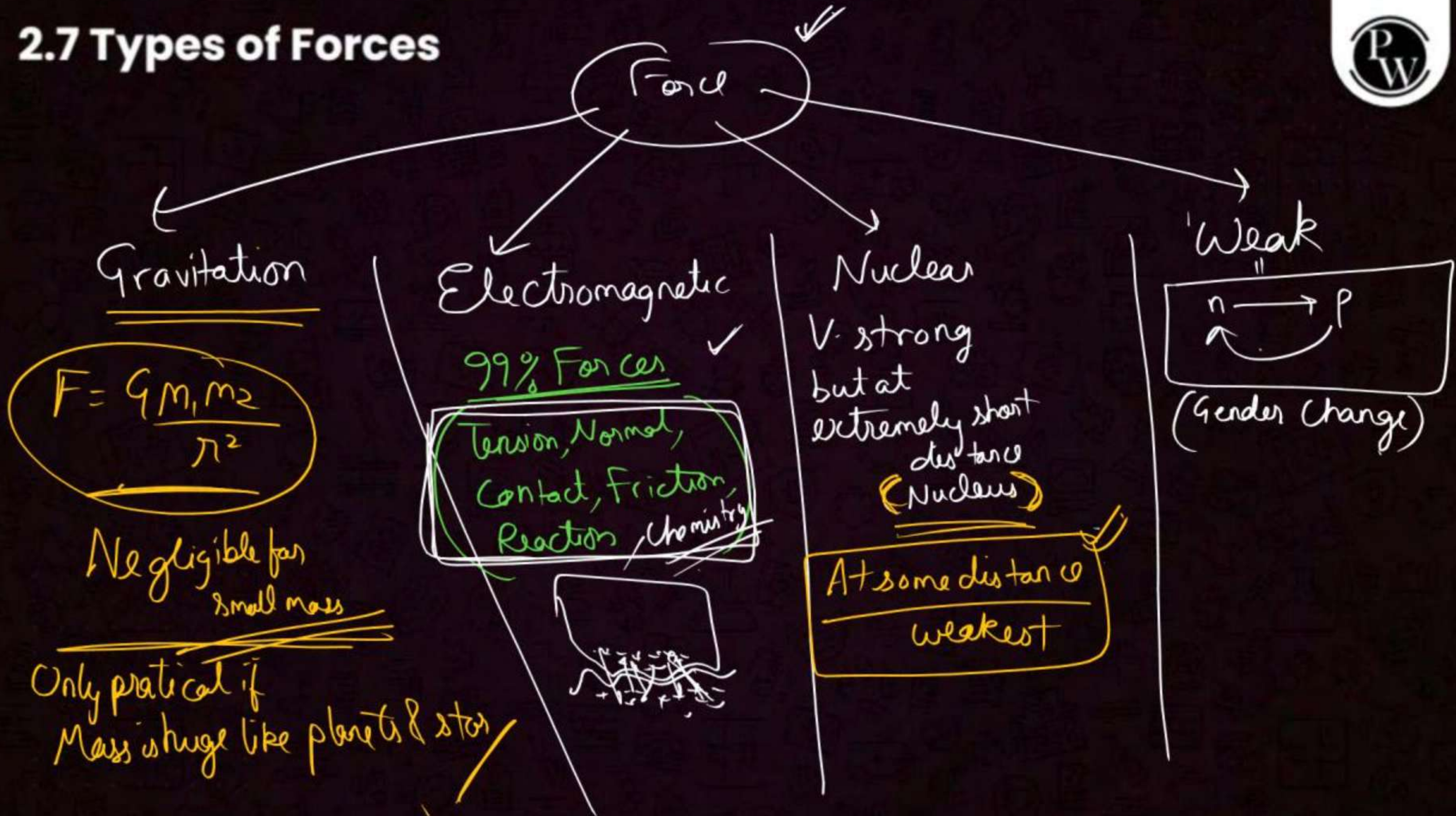
A hockey player is moving northward and suddenly turns westward with the same speed to avoid an opponent. The force that acts on the player is:

[NCERT Exemplar]

- 1 frictional force along westward.
- 2 muscle force along southward.
- 3 frictional force along south-west.
- 4 muscle force along south-west.



2.7 Types of Forces



QUESTION-32

Difficulty Level : Easy



When Neils Bohr shook hand with Werner Heisenberg, what kind of force they exerted?
[HCV Objective]

1 Gravitational

2 Electromagnetic ✓

3 Nuclear

4 Weak.

QUESTION-33

Difficulty Level : Easy



Let E , G and N represent the magnitudes of electromagnetic, gravitational and nuclear forces between two electrons at a given separation. Then [HCV Objective]

1 $N > E > G$

2 $E > N > G$

3 $G > N > E$

4 $E > G > N$

durrr ✓

QUESTION-34

Difficulty Level : MEDIUM



How many forces out of the following neutron exerts a force on a proton which is kept in a nucleus//

[HCV Objective]

☒ **A** gravitational

☐ **B** electromagnetic

☒ **C** Nuclear

☒ **D** weak.

☐ **1**

☒ **2**

☐ **3**

☐ **4**

QUESTION-35

Difficulty Level : MEDIUM



How many forces out of the following proton exerts a force on a proton which is *inside nucleus* **[HCV Objective]**

☒ **A** gravitational ☒ **B** electromagnetic

☒ **C** Nuclear ☒ **D** ~~weak.~~

☐ **1** ☐ **2** ☒ **3** ☐ **4**

QUESTION-36

Difficulty Level : HARD



Identify wrong statement - if all matter were made of electrically neutral particles such as neutrons,
[HCV Objective]

- 1 there would be no force of friction ✓
- 2 there would be no tension in the string ✓
- 3 it would not be possible to sit on a chair ✓
- 4 the earth could not move around the sun. ✗

2.8 Classical vs Quantum vs Relativistic Physics



♥ Classical Mechanics is not valid everywhere ✓✓



QUESTION-37

Difficulty Level : Easy



HW

Which of the following systems may be adequately described by classical physics?
[HCV Objective]

- 1 motion of a cricket ball ✓
- 2 Velocity of proton moving at 90% speed of light
- 3 a hydrogen atom
- 4 a neutron changing to a proton

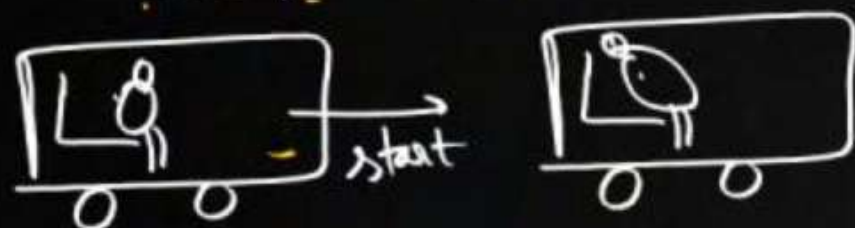
PUPPY POINTS 1

Aristotle's Fallacy - Force for motion $\times$

Galileo - Inertia - resistance to change

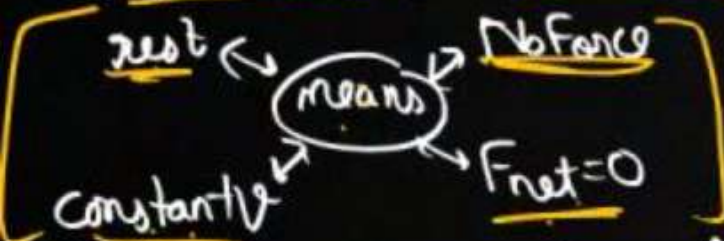
Inertia $\propto$ Mass (same mass, same Inertia)

$\rightarrow$ rest, motion, direction



Force $1\text{N} = 10^5 \text{ dyne}$ $1\text{kGf} = 9.8\text{N}$

$1\text{gF} = 9.8 \times 10^{-3} \text{ N}$ $[\text{MLT}^{-2}]$ ✓



1st Law - Physical Dependence of Force, definition

3rd Law - Force is interaction b/w 2 objects ✓

- Force occurs in pairs ✓

- Action Reaction cannot act on same object ✓

- Equal, opp, No cause effect, simultaneous ✓

- Creation of Force ✓

Force types

EM - T, N, fr, Contact, ... $\xrightarrow{\text{distance}}$

Gravitational - weakest

Nuclear - strong (at very small range)

weak $\times$

Classical mechanics is not valid

$\rightarrow$ v. small (Quantum) ✓

$\rightarrow$ high speed (Relativistic) ✓



Part 3 – Newtons 2nd Law of Motion



3.1 Momentum

Linear //

♥ **Momentum** of a body is defined to be the product of its mass m and velocity v , and is denoted by

$$\text{♥ } \vec{P} = m \vec{v}$$

♥ **Impulse** is the change in an object's momentum when a force acts on it for a period

$$\text{♥ } \vec{I} = m (\vec{v}_2 - \vec{v}_1) = \vec{P}_2 - \vec{P}_1$$

♥ Impulse is the product of the average force and the time interval over which it acts

$$\text{♥ } I = F_{\text{avg}} t_{\text{contact}}$$

Impulsive Force

Thak pat Thakad Khatm

Non Impulsive Force



QUESTION-38**Difficulty Level : Easy**

A particle of mass m is moving with a uniform velocity v_1 . It is given an impulse such that its velocity becomes v_2 . The impulse is equal to: [1990]

1 $m[|\vec{v}_2| - |\vec{v}_1|]$

2 $\frac{1}{2}m[v_2^2 - v_1^2]$

3 $m[\vec{v}_1 + \vec{v}_2]$

4 $m[\vec{v}_2 - \vec{v}_1]$ ✓

$$\begin{aligned}\vec{I} &= \Delta \vec{p} = \vec{p}_2 - \vec{p}_1 \\ &= m\Delta \vec{v} = m(\vec{v}_2 - \vec{v}_1)\end{aligned}$$

3.2 Newton 2nd Law of Motion



♥ The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts (NCERT)

♥ Force refers to the total external force on the system and Any internal forces in ignored in 2nd law

2nd Law

$$\vec{F} = \frac{d\vec{p}}{dt}$$

→ External Force

$$\vec{F}_{\text{avg}} = \frac{\Delta \vec{p}}{\Delta t} = \frac{\vec{J}}{t}$$

$$\Delta \vec{p} = \vec{J} = \vec{F}_{\text{avg}} t_{\text{contact}}$$

$$\text{Impulse} = \vec{I} = \Delta \vec{p}$$

$$\vec{F} = \frac{d\vec{p}}{dt}$$

$$\Delta \vec{p} = \vec{I} = F_{\text{avg}} t_{\text{contact}}$$

QUESTION-39

Difficulty Level : Easy



Newton's second law of motion is

[NCERT Based]

- 1 $F = \frac{dp}{dt}$ ✓
- 2 $F = mv$
- 3 $F = mv^2$
- 4 $F = m^2v$

QUESTION-40

Difficulty Level : MEDIUM



Newton's second law relates the following quantities

- 1 Momentum and acceleration
- 2 Variation in momentum and velocity
- 3 Variation in momentum and external force
- 4 Rate of change of force and momentum

$$F_{\text{ext}} = \frac{dp}{dt}$$

~~$$\frac{dF}{dt}$$~~

Always
valid

$$\vec{p} = m \vec{v}$$

if mass is constant

$$F = \frac{d\vec{p}}{dt} = \frac{d(m\vec{v})}{dt} = m \frac{d\vec{v}}{dt} = m \vec{a}$$

$$F = ma$$

Only
valid if
 m is constant

3.3 Newton 2nd Law of Motion



♥ The acceleration of the body is directly proportional to the net force acting on the body and inversely proportional to the mass of the body $a \propto F$ $a \propto \frac{1}{m}$
(Only when mass is constant)

$$a = \frac{F}{m} \rightarrow \boxed{F = ma}$$

♥ The acceleration of a particle as measured from an inertial frame is given by the (vector) sum of all the forces acting on the particle divided by its mass. (HCV)

♥ Acceleration means that of the system as a whole. (centre of mass of the system)

$$a = \frac{F_{\text{net}}}{\text{mass}}$$

acceleration

QUESTION-41**Difficulty Level : MEDIUM**

Which of the following relations is wrong

MISL

1 $\vec{F} \neq m \frac{d\vec{r}}{dt}$ $F = mv$ X

2 $\vec{F} = m \frac{d^2\vec{r}}{dt^2} = ma$ ✓

3 $\vec{F} = m \frac{d\vec{v}}{dt} = ma$

4 $F = \frac{m(v-u)}{t} = ma$ ✓✓

QUESTION-42

Difficulty Level : **YODHA**



We can derive Newton's

- 1 second and third laws from the first law.
- 2 first and second laws from the third law.
- 3 Third and first laws from the second law.
- 4 All the three laws are independent of each other.

[NCERT Page 54 & 58]

$$\vec{F} = \frac{d\vec{P}}{dt} \quad \text{--- 2nd Law}$$

$$F=0, \Delta P=0$$

$$P_i = P_f$$

$$m_1 v_1 = m_2 v_2$$

μ constant

1st Law



$$F_{\text{net}} = 0$$

$$F_1 + F_2 = 0 \quad \left(F_1 = -F_2 \right)$$

$$\Delta P = 0$$

$$F = \frac{dP}{dt} = 0$$

IIIrd Law

QUESTION-43

Difficulty Level : MEDIUM



The relation $\vec{F} = m\vec{a}$ cannot be deduced from Newton's second law, if

[NCERT Based]

- 1 force depends on time
- 2 momentum depends on time
- 3 acceleration depends on time
- 4 mass depends on time

QUESTION-44

Difficulty Level : HARD



(hw)

Which one of the following statements is not true?

[NCERT Based]

- 1 The same force for the same time causes the same change in momentum for different bodies. ✓ $F = \frac{\Delta p}{\Delta t}$
- 2 The rate of change of momentum of a body is directly proportional to the applied force and takes place in the direction in which the force acts.
- 3 A greater opposing force is needed to stop a heavy body than a light body in the same time, if they are moving with the same speed.
- 4 ✓ The greater the change in the momentum in a given time, the lesser is the force that needs to be applied.

QUESTION-45

Difficulty Level : Easy



Conservation of momentum in a collision between particles can be understood from

[NCERT Exemplar] ★★

- 1 conservation of energy.
- 2 Newton's first law only.
- 3 Newton's second law only. ✓
- 4 both Newton's second and third law.

$$F_{ext} = 0$$

$$\frac{dp}{dt} = 0$$

$p \rightarrow \text{same}$

3.4 Calculus (mass constant)

$a = \frac{F}{m}$	$v = \frac{p}{m}$
$F = ma$	$p = mv$

$$F = \frac{dp}{dt}$$

Multiply $\rightarrow$ Area
Divide $\rightarrow$ Slope



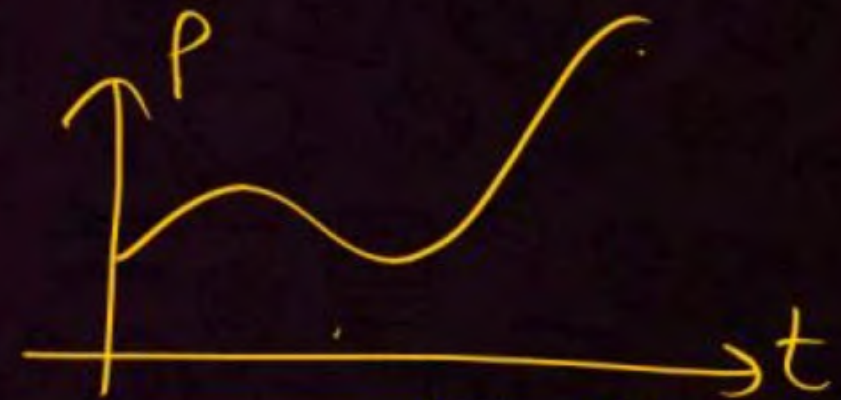
Area $\rightarrow \Delta p$ or I

$$(\Delta p = F \times t)$$



$$\Delta \vec{p} = \vec{I} = m \Delta \text{Area} \quad \checkmark$$

$$m \Delta \text{Area} = m(a \cdot t) = Ft$$



$$F = \text{Slope} = \frac{dp}{dt}$$



$$F = \text{mass} \times \text{slope}$$



QUESTION-46

Multiply — Integrate — Area
Divide — Differentiate — Slope

Difficulty Level : MEDIUM



A particle is acted upon by a force given by $(F = 12t + 3t^2)$ N, where t is in seconds. Find the change in momentum of that particle from $t = 1$ to $t = 3$ sec.

1 70

2 55

3 74 ✓✓

4 51

$$\begin{aligned}\Delta P &= \int F dt \\ &= \int (12t + 3t^2) dt \\ &= 12 \left[\frac{t^2}{2} \right] + 3 \left[\frac{t^3}{3} \right] \\ &= 6[t^2]_1^3 + [t^3]_1^3 \\ &= 6(9-1) + (27-1)\end{aligned}$$

$$\begin{aligned}&6 \times 8 + 26 \\ &= 48 + 26 \\ &\quad \begin{array}{r} 48 \\ + 26 \\ \hline 74 \end{array}\end{aligned}$$

QUESTION-47**Difficulty Level : MEDIUM***HW*

If force $F = 500 - 100t$, then function of impulse with time will be:

[1998]

- 1** $500t - 50t^2$
- 2** $50t - 10$
- 3** $50 - t^2$
- 4** $100t^2$

QUESTION-48(After MISL)**Difficulty Level : HARD**

A body of mass 2 kg travels according to the law $x(t) = pt + qt^2 + rt^3$ where $p = 3 \text{ ms}^{-1}$, $q = 4 \text{ ms}^{-2}$, $r = 5 \text{ ms}^{-3}$. The force acting on the body at $t = 2$ seconds is

[NCERT Exemplar]

1 136 N

2 134 N

3 158 N

4 68 N

$$x = 3t + 4t^2 + 5t^3$$

$$v = \cancel{3} + 8t + 15t^2$$

$$a = 8 + 30t$$

$$t = 2$$

$$a = 8 + 30 \times 2$$

$$a = 68$$

$$F = ma = 2 \times 68 = \underline{136 \text{ N}}$$

3.5 Graphs



QUESTION-49

Difficulty Level : Easy



For the given momentum time ($P-t$) graphs find the ratio of force on particles A and B.

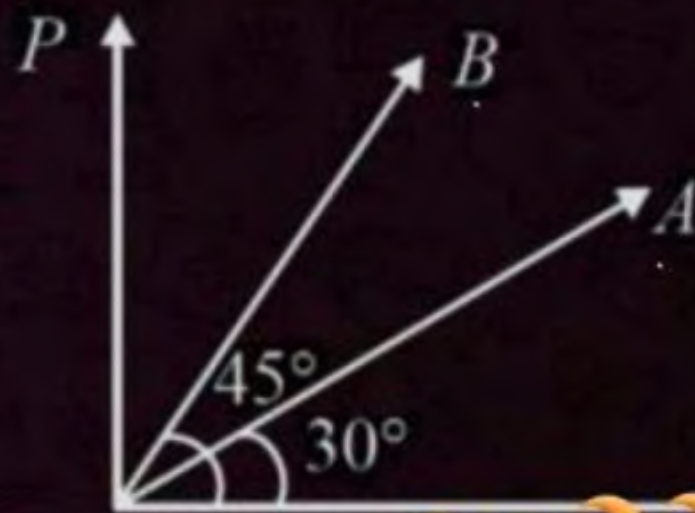
1 $\sqrt{3} : 1$

2 $1 : 1$

3 $1 : \sqrt{3}$

4 $1 : 2$

$$\frac{F_A}{F_B} = \frac{(\text{slope } P-t)_A}{(\text{slope } P-t)_B} = \frac{\tan 30^\circ}{\tan 45^\circ} = \frac{1}{\sqrt{3}}$$



$$\tan 45^\circ = 1$$

$$\tan 30^\circ = \frac{1}{\sqrt{3}}$$

QUESTION-50**Difficulty Level : MEDIUM**

Force-time graph for the motion of a body is shown in fig. Change in linear momentum between 0 to 8 s is:-

1 ✓ Zero

2 4 N-s

3 8 N-s

4 None

$$I = \Delta p = \text{Area}(F-t)$$



QUESTION-51**Difficulty Level : Easy**

For a body of 50 kg mass, the velocity-time graph is shown in figure. The force acting on the body is:

1 25 N

2 50 N

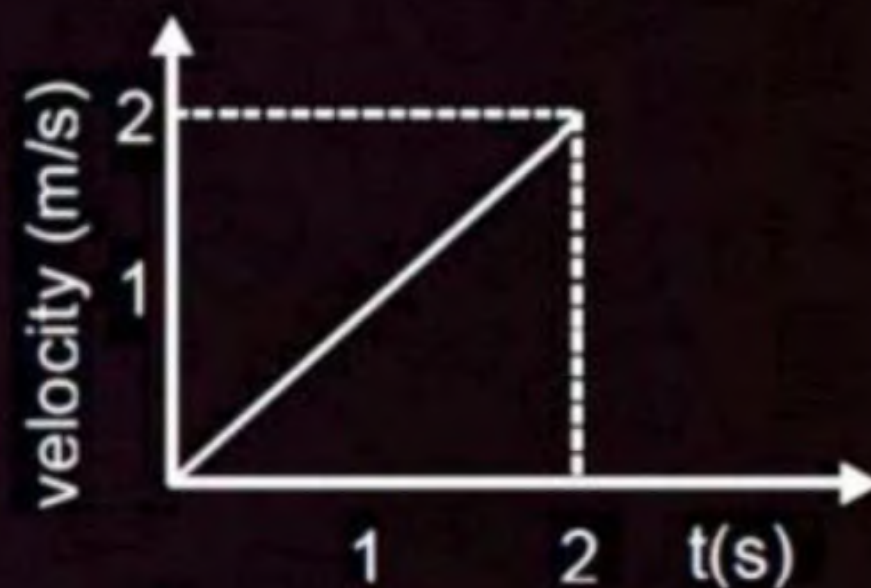
3 12.5 N

4 100 N

$$\text{slope (v-t)} \quad \frac{v}{t}$$

$$a = \frac{2}{2} = 1 \text{ m/s}^2$$

$$F = ma = 50 \times 1$$



QUESTION-52

Difficulty Level : **YODHA**



The position-time graph of a body of mass 2 kg is as shown in figure. What is the impulse on the body at $t = 4$ s ? **[NCERT Based]**

1 $\frac{2}{3} \text{ kg m s}^{-1}$

2 $-\frac{2}{3} \text{ kg m s}^{-1}$

3 $\frac{3}{2} \text{ kg m s}^{-1}$

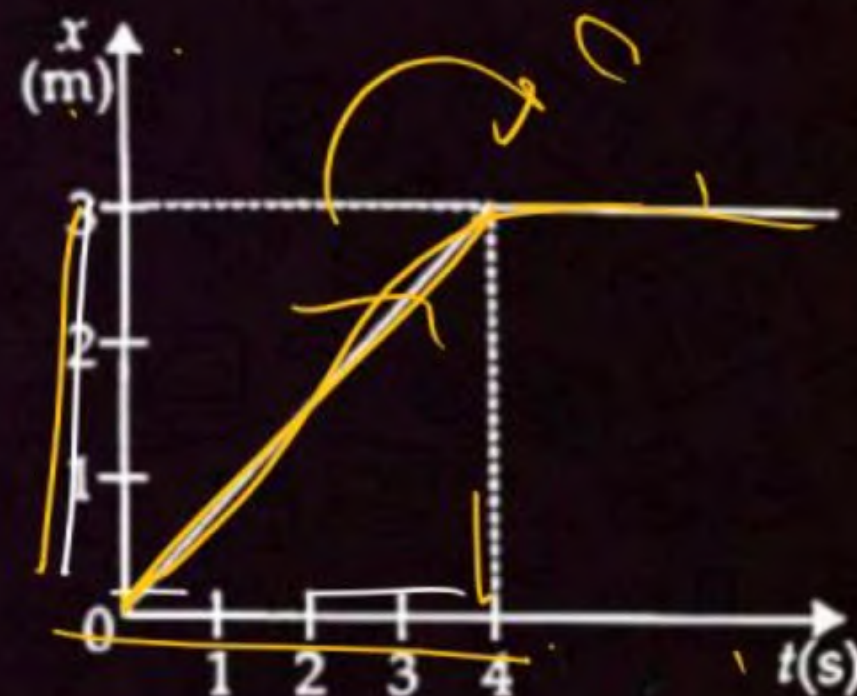
4 $-\frac{3}{2} \text{ kg m s}^{-1}$

$$I = m(v_2 - v_1)$$

$$I = 2\left(0 - \frac{3}{4}\right)$$

$$= 2 \times -\frac{3}{4}$$

$$= -\frac{3}{2}$$



$$V_1 = \text{slope} = \frac{3}{4} \quad V_2 = 0$$

QUESTION-53

Difficulty Level: **YODHA**



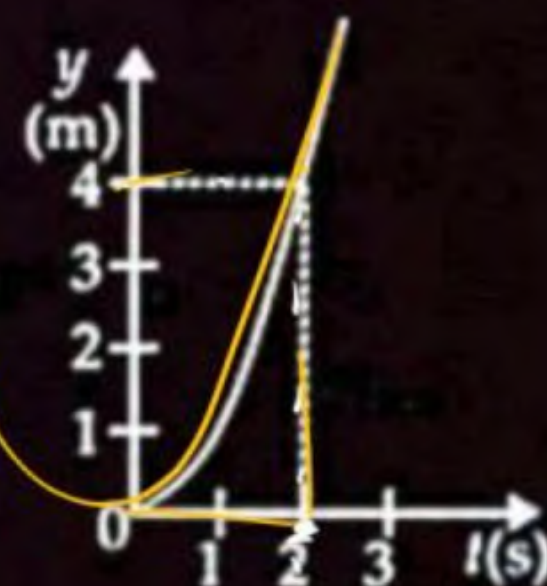
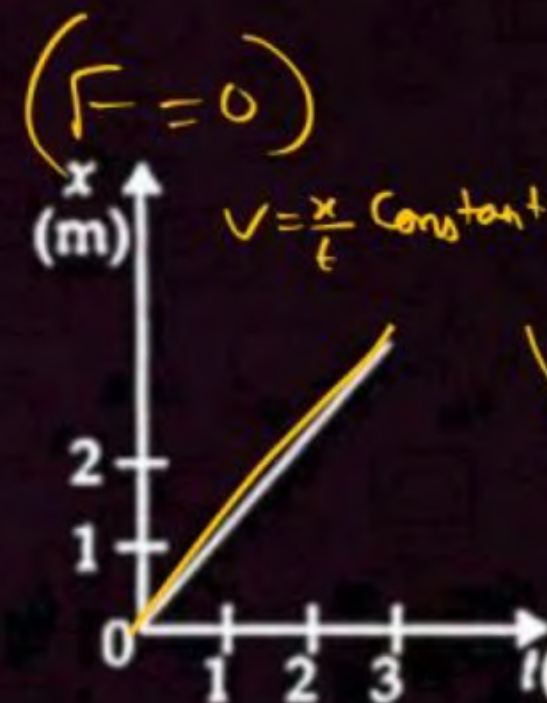
Figure shows (x, t) , (y, t) diagram of a particle moving in 2-dimensions. If the particle has a mass of 500 g, the force acting on the particle is **[NCERT Based]**

- 1** ✓ 1 N along y-axis
- 2** 1 N along x-axis
- 3** 0.5 N along x-axis
- 4** 0.5 N along y-axis

$$\begin{aligned} v_y &= \frac{dy}{dt} = 2t \\ a_y &= \frac{dv}{dt} = 2 \text{ in } y \end{aligned}$$

$$\begin{aligned} F &= ma \\ &= \frac{500 \times 2}{1000} \end{aligned}$$

$$F = 1 \text{ N } y$$



(b)

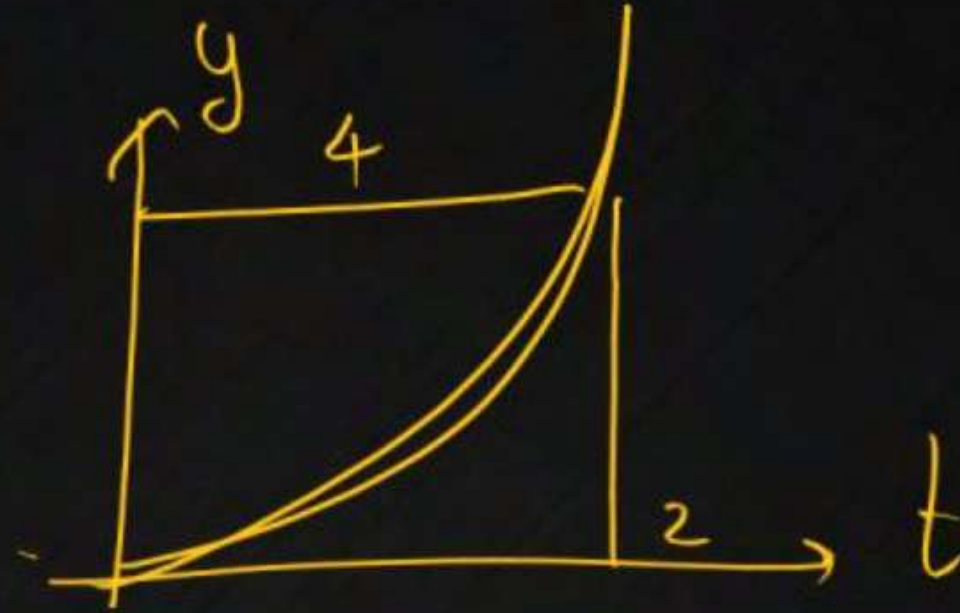
$$\begin{aligned} y &= kt^2 \\ 4 &= k \cdot 2^2 \\ 4 &= k \cdot 4 \end{aligned} \quad \left| \begin{array}{l} k=1 \end{array} \right.$$

MISL praetband



$$a_x = 0$$
$$F_x = 0$$

X



$$y = kt^2$$

$$4 = k \cdot 2^2$$

$$4 = k \cdot 4$$
$$\boxed{k = 1}$$

$$y = t^2$$

$$v_y = \frac{dy}{dt} = 2t$$

$$a_y = \frac{dv}{dt} = 2$$

$$F = ma$$
$$= \frac{1}{2} \times 2 = 1N$$

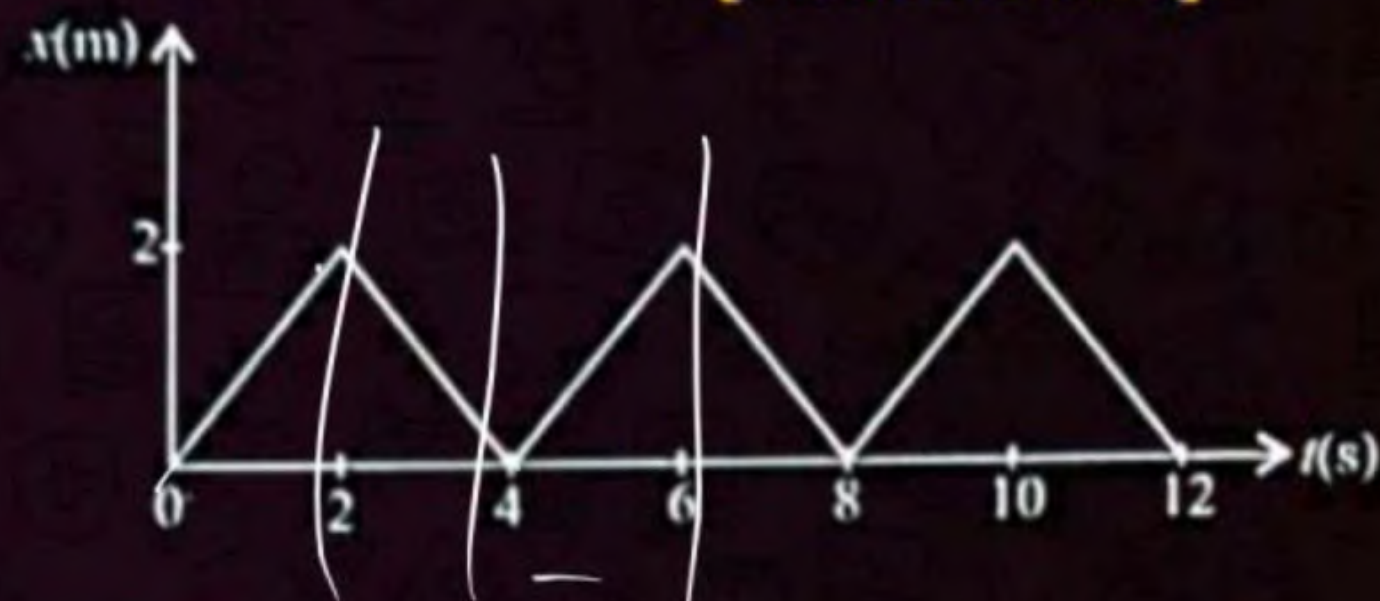
QUESTION-54**Difficulty Level : HARD**

HW
←

Figure shows the position-time ($x - t$) graph of one dimensional motion of a body of mass 500 g. What is the time interval between two consecutive impulses received by the body?

[NCERT Based]

- 1 2 s ✓
- 2 4 s
- 3 6 s
- 4 8 s

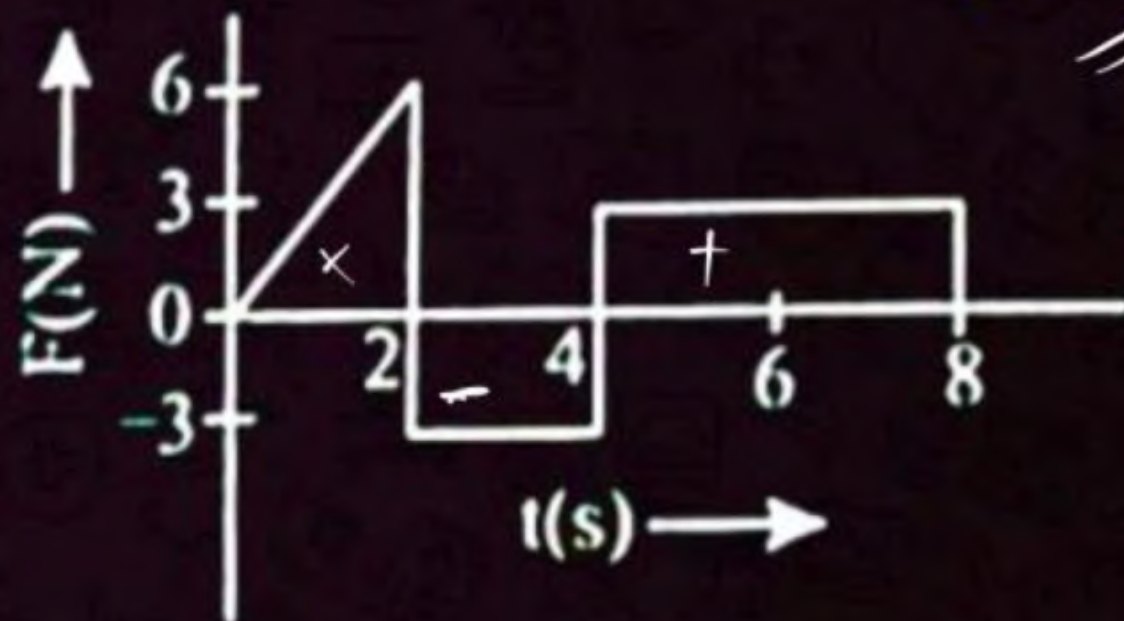


QUESTION-55**Difficulty Level : MEDIUM**

The force F acting on a particle of mass m is indicated by the force-time graph shown. The change in momentum of the particle over the time interval from zero to 8 s is:

[2014]hw

- 1** 24 Ns
- 2** 20 Ns
- 3** 12 Ns
- 4** 6 Ns



3.6 Kinematics mix



$$\begin{aligned}v &= u + at \\ S &= ut + \frac{1}{2}at^2 \\ v^2 &= u^2 + 2as\end{aligned}$$

$$\begin{aligned}S &= V_{avg} t \\ &= \left(\frac{u+v}{2}\right)t\end{aligned}$$

$$a = \frac{F}{m}$$
$$v = \frac{P}{m}$$

QUESTION-56**Difficulty Level : MEDIUM**

A force of 10 N is applied to a mass of 10 gm for 10 seconds. The change of momentum is mkg/sec units will be

1 10

2 100 ✓

3 1000

4 0.01

$$F = \frac{\Delta P}{t}$$

$$10 = \frac{\Delta P}{10}$$

$$\Delta P = 100$$

QUESTION-57

Difficulty Level : HARD



A player catches a ball of 200 g moving with a speed of 20 m/s. If the time taken to complete the catch is 0.5s, the force exerted on the players hand is:

- 1 8 N
- 2 4 N
- 3 2 N
- 4 0

$$v = u + at$$

$$0 = 20 + a \cdot \frac{1}{2}$$

$$-\frac{a}{2} = 20$$

$$a = -40$$

$$F = ma = \frac{200}{1000} \times 40 = -8 \text{ N}$$

QUESTION-58

Difficulty Level : MEDIUM



A constant force acting on a body of mass of 5 kg change its speed from 5 ms^{-1} to 10 ms^{-1} in 10 s without changing the direction of motion. The force acting on the body is

[NCERT Based]

HW
=

1 1.5 N

2 2 N

3 2.5 N

4 5 N

QUESTION-59

Difficulty Level : HARD



A bullet of mass 40 g moving with a speed of 90 ms^{-1} enters heavy wooden block and its stopped after a distance of 60 cm. The average resistive force exerted by the block on the bullet is

[NCERT Based]

1 180 N

2 220 N

3 270 N

4 320 N

QUESTION-60

Difficulty Level : MEDIUM



rw

A constant retarding force of 50 N is applied to a body of mass 10 kg moving initially with a speed of 10 ms^{-1} . The body comes to rest after **[NCERT Based]**

1 2 s

2 4 s

3 6 s

4 8 s

QUESTION-61

Difficulty Level : **YODHA**



hw✓✓

A car of mass m starts from rest and acquires a velocity along east $\vec{v} = v\hat{i}$ ($v > 0$) in two seconds. Assuming the car moves with uniform acceleration, the force exerted on the car is

[NCERT Exemplar]

- 1 $\frac{mv}{2}$ eastward and is exerted by the car engine.
- 2 $\frac{mv}{2}$ eastward and is due to the friction on the tyres exerted by the road.
- 3 more than $\frac{mv}{2}$ eastward exerted due to the engine and overcomes the friction of the road. ✓
- 4 $\frac{mv}{2}$ exerted by the engine.

QUESTION-62

Difficulty Level : HARD



An object of mass 3 kg is at rest. Now a force of $\vec{F} = 6t^2\hat{i} + 4t\hat{j}$ is applied on the object then velocity of object at $t = 3$ second is: [2002]

1 $18\hat{i} + 3\hat{j}$

2 $18\hat{i} + 6\hat{j}$

3 $3\hat{i} + 18\hat{j}$

4 $18\hat{i} + 4\hat{j}$

$$a = \frac{F}{m} = \frac{6t^2}{3}\hat{i} + \frac{4t}{3}\hat{j}$$

$$v = \int a dt = \int \frac{6t^2}{3} dt \hat{i} + \int \frac{4t}{3} dt \hat{j}$$

$$= \frac{2t^3}{3} \hat{i} + \frac{2t^2}{3} \hat{j}$$

$$\vec{v} = \left(\frac{2t^3}{3} \hat{i} + \frac{2t^2}{3} \hat{j} \right)$$

$$= 2 \times 3 \times 3 \times 3 \hat{i} + 2 \times 3 \times 3 \hat{j} = 18\hat{i} + 6\hat{j}$$

NLM

MISL

MISL

Basic Maths

QUESTION-63**Difficulty Level : MEDIUM***h w / /*

A cricketer catches a ball of mass 150 gm in 0.1 second moving with speed 20 ms^{-1} , then the experiences force of: **[2001]**

1 300 N

2 30 N

3 3 N

4 0.3 N

QUESTION-64**Difficulty Level : Easy***h w*

A force of 6 N acts on a body at rest and of mass 1 kg. During this time, the body attains a velocity of 30 m/s. The time for which the force acts on the body is:

[1997]

- 1** 7 seconds
- 2** 5 seconds
- 3** 10 seconds
- 4** 8 seconds

QUESTION-65

Difficulty Level : Easy



A 10 N force is applied on a body produce in it an acceleration of 1 m/s^2 . The mass of the body is: hw//
[1996]

- 1 15 kg
- 2 20 kg
- 3 10 kg
- 4 5 kg

QUESTION-66

Difficulty Level : MEDIUM



The distance covered by a body of mass 5 g having linear momentum ^{nu //} 0.3 kg m/s in 5 s is: [Re-2022]

1 0.3 m

2 300 m

3 30 m

4 3 m

QUESTION-67

Difficulty Level : MEDIUM



A body under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j}$ N acquires an acceleration of 5 ms^{-2} . The mass of the body is **[NCERT Based]**

- 1 2 kg
- 2 5 kg
- 3 4 kg
- 4 6 kg

$$F = |6\hat{i} - 8\hat{j}|$$

$$F = \sqrt{6^2 + 8^2}$$

$$F = \sqrt{10^2}$$

$$F = 10 \text{ N}$$

$$ma = F$$

$$m = \frac{F}{a} = \frac{10}{2} \text{ kg}$$

$$|a\hat{i} + b\hat{j}|$$

$$= \sqrt{a^2 + b^2}$$

QUESTION-68**Difficulty Level : MEDIUM**

hw //

A body, under the action of a force $\vec{F} = 6\hat{i} - 8\hat{j} + 10\hat{k}$ acquires an acceleration of 1 m/s^2 . The mass of this body must be:

[2009, 1996]

- 1 10 kg
- 2 20 kg
- 3 $10\sqrt{2} \text{ kg}$ ✓
- 4 $2\sqrt{10} \text{ kg}$

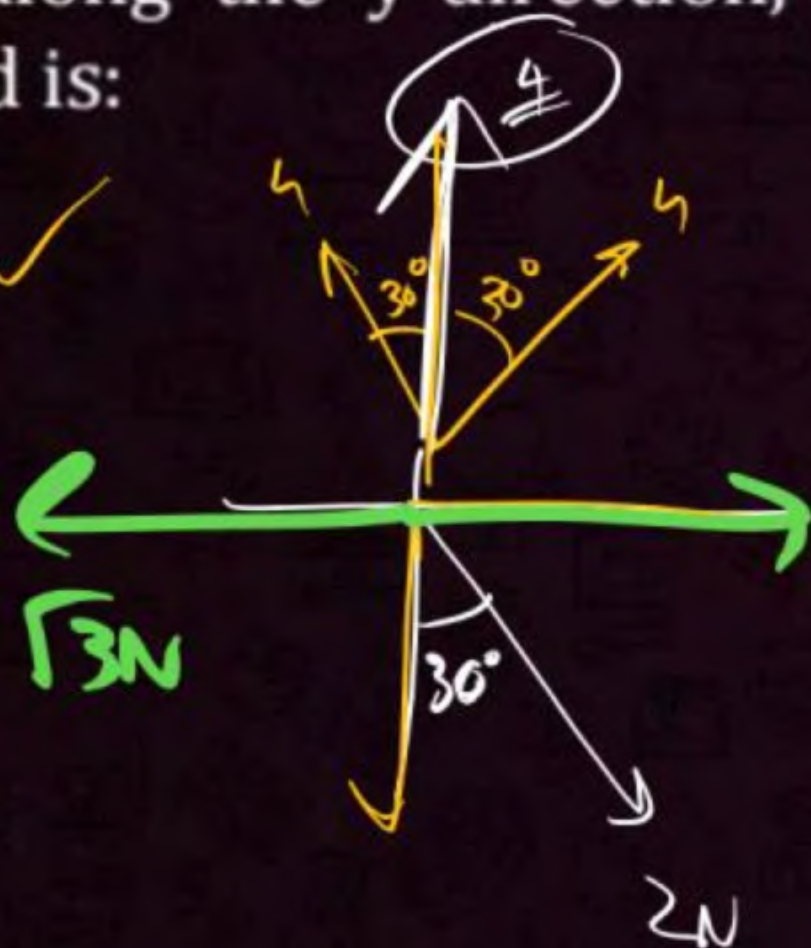
QUESTION-69

Difficulty Level : HARD



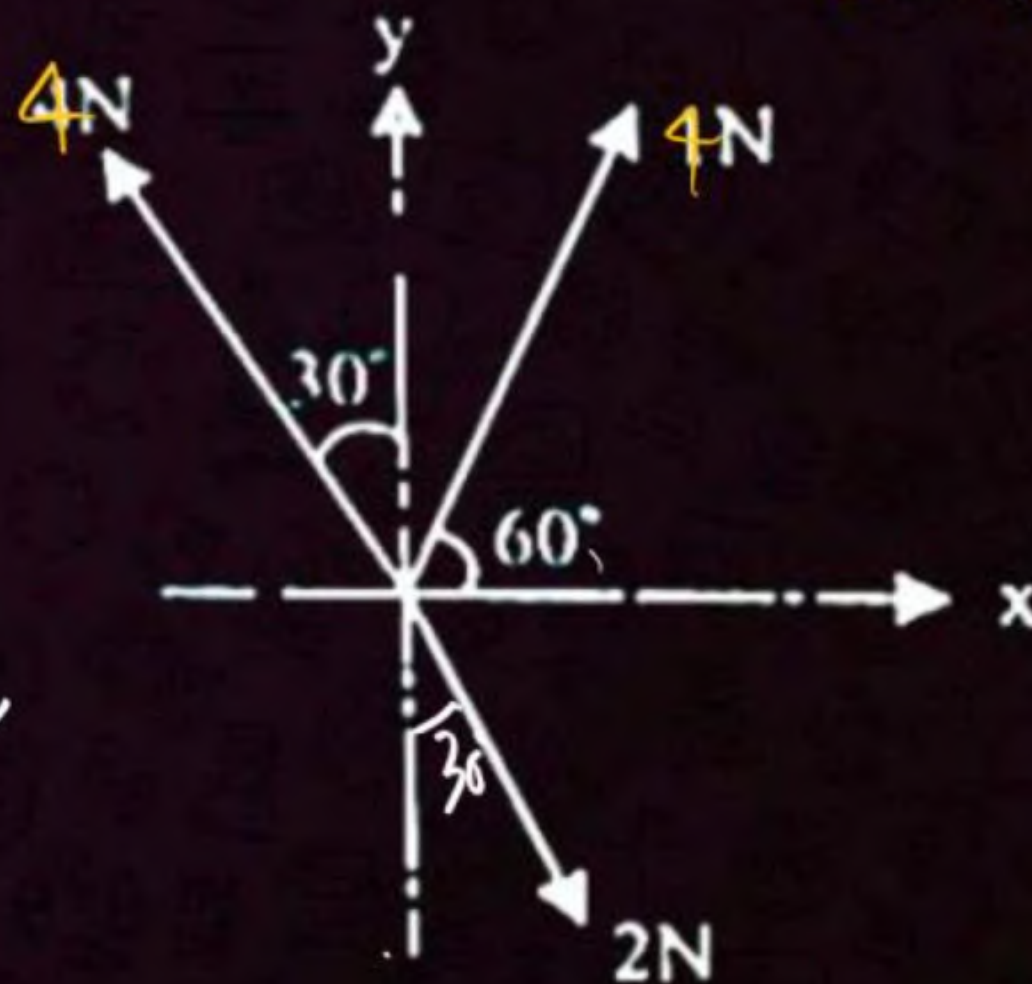
Three forces acting on a body are shown in the figure. To have the resultant force only along the y-direction, the magnitude of the minimum additional force needed is: [2008]

- 1 $\sqrt{3}$ N ✓
- 2 0.5 N
- 3 1.5 N
- 4 $\frac{\sqrt{3}}{4}$ N



$$2 \sin 30^\circ$$

$$2 \times \frac{1}{2} = 1N //$$



QUESTION-70**Difficulty Level : HARD**

Match Column I with column II.

[NCERT Based]**1** ~~A-q~~, B-p, C-r, D-s**2** ~~A-p~~, B-q, C-r, D-s**3** A-s, B-r, C-q, D-p**4** A-s, ~~B-q~~, C-r, D-p

	Column I		Column II
A.	Definition of force	p.	Newton's third law
B.	Measure of force	q.	Impulse
C.	Effect of force	r.	Newton's second law
D.	Recoiling of gun	s.	Newton's first law

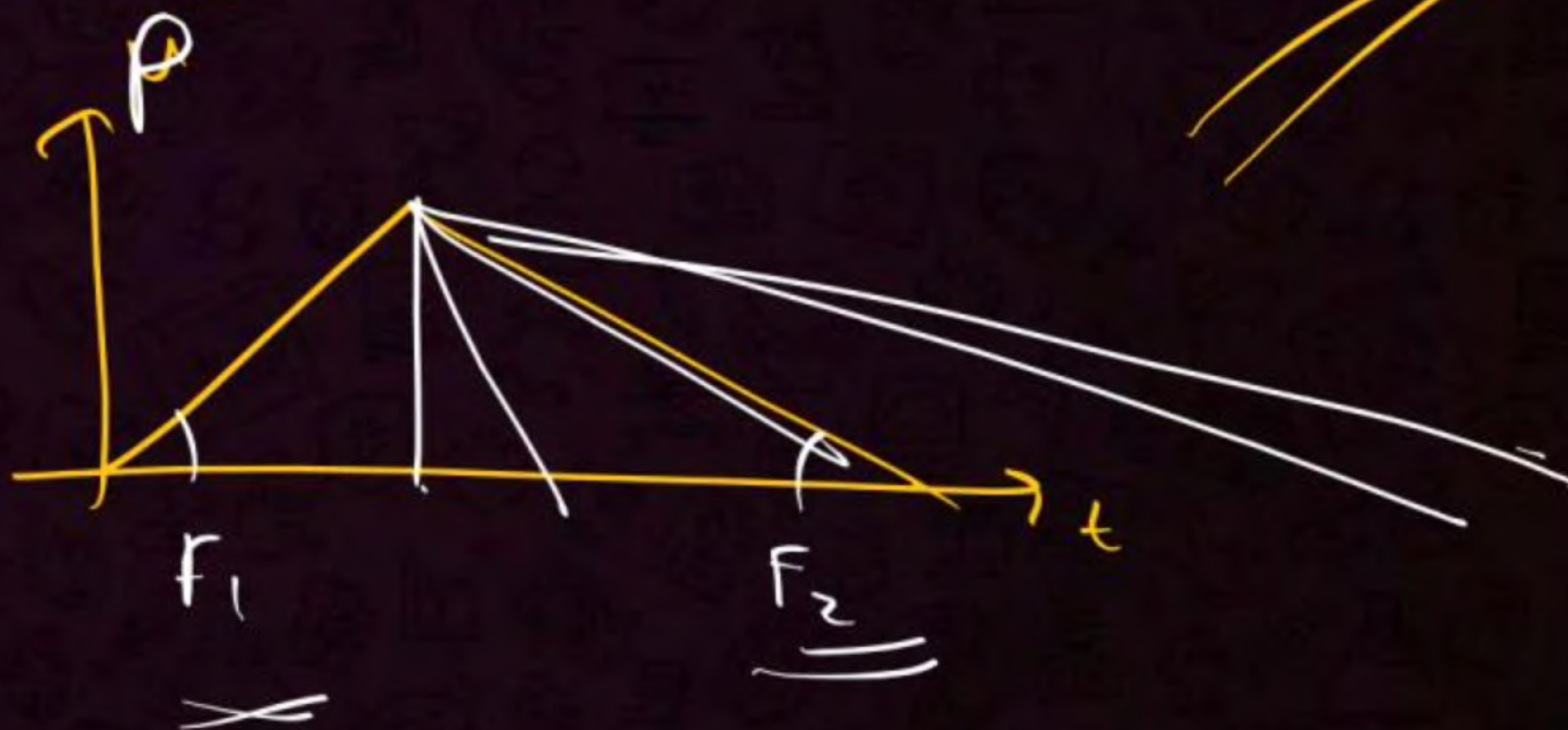
QUESTION-71

Difficulty Level : YODHA



A force F_1 acts on a particle so as to accelerate it from rest to a velocity v . The force F_1 is then replaced by F_2 which decelerates it to rest. **[HCV Objective]**

- 1 F_1 must be equal to F_2 ✗
- 2 F_1 may be equal to F_2 ✓
- 3 F_1 must be unequal to F_2 ✗
- 4 none of these.



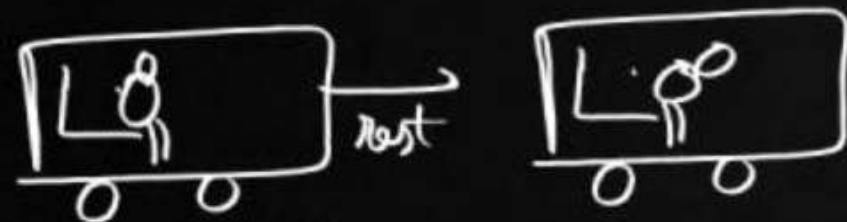
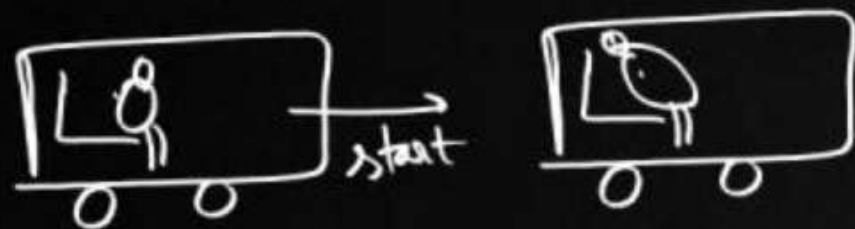
PUPPY POINTS 1

Aristotle's Fallacy - Force for motion

Galileo - Inertia - resistance to change

Inertia $\propto$ Mass (same mass, same inertia)

$\rightarrow$ rest, motion, direction



Force $1\text{N} = 10^5 \text{ dyne}$ $1\text{kGf} = 9.8\text{N}$

$1\text{gf} = 9.8 \times 10^{-3} \text{ N}$ $[\text{MLT}^{-2}]$

rest $\leftarrow$ means $\rightarrow$ No Force

constant $\rightarrow$ means $\rightarrow$ $F_{\text{net}} = 0$

1st Law - Physical Dependence of Force, defination

3rd Law - Force is interaction btw 2 objects

- Force occurs in pairs
- Action Reaction cannot act on same object
- Equal, opp, No cause effect, simultaneous
- Creation of Force

Force types

EM - T, N, fr, Contact, ...

Gravitational - weakest

Nuclear - strong (at very small range)
weak

Classical mechanics is not valid

$\rightarrow$ v. small (Quantum)

$\rightarrow$ high speed (Relativistic)

$P = \text{Momentum} = m v$

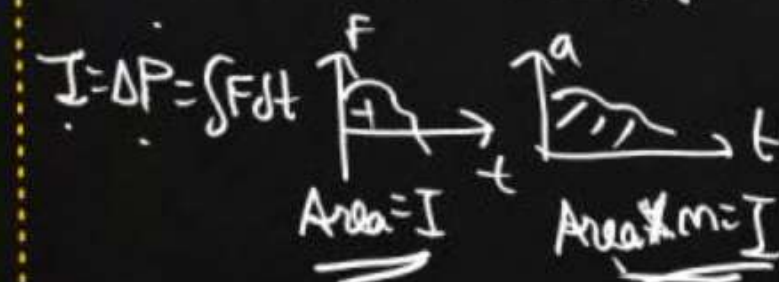
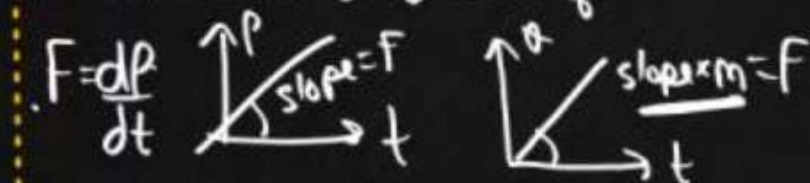
Impulse = $m(\vec{v}_2 - \vec{v}_1)$

$I = \vec{F}_{\text{avg}} t_{\text{contact}}$

$\vec{F} = \frac{d\vec{P}}{dt} = \underline{ma}$ (mass constant)

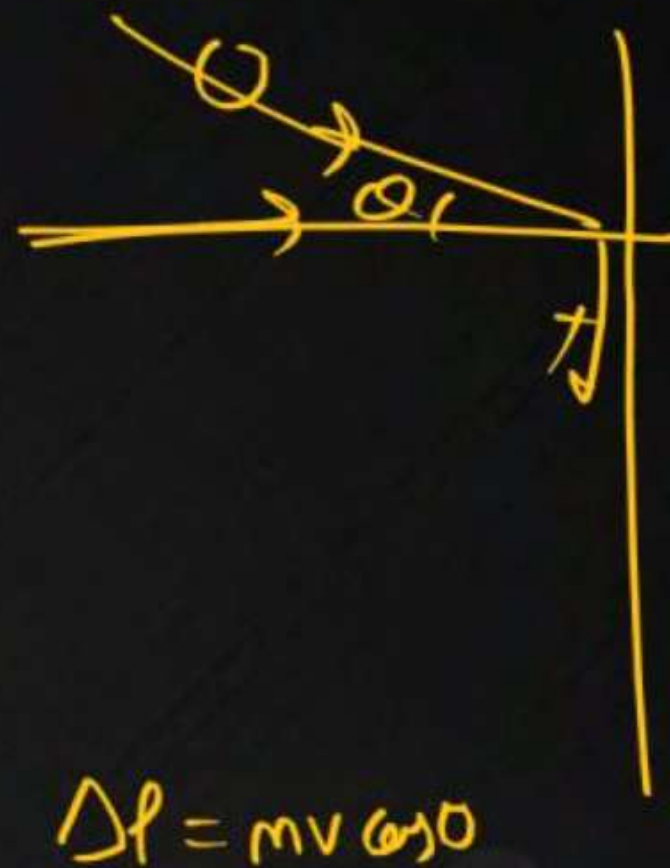
Solve $a = \frac{F}{m}$, $v = \frac{P}{m}$ use MISL

2nd Law - Measurement of Force.



Momentum

Ball-Wall



Part 4 – Normal, Tension, Spring, Weight & Upthrust



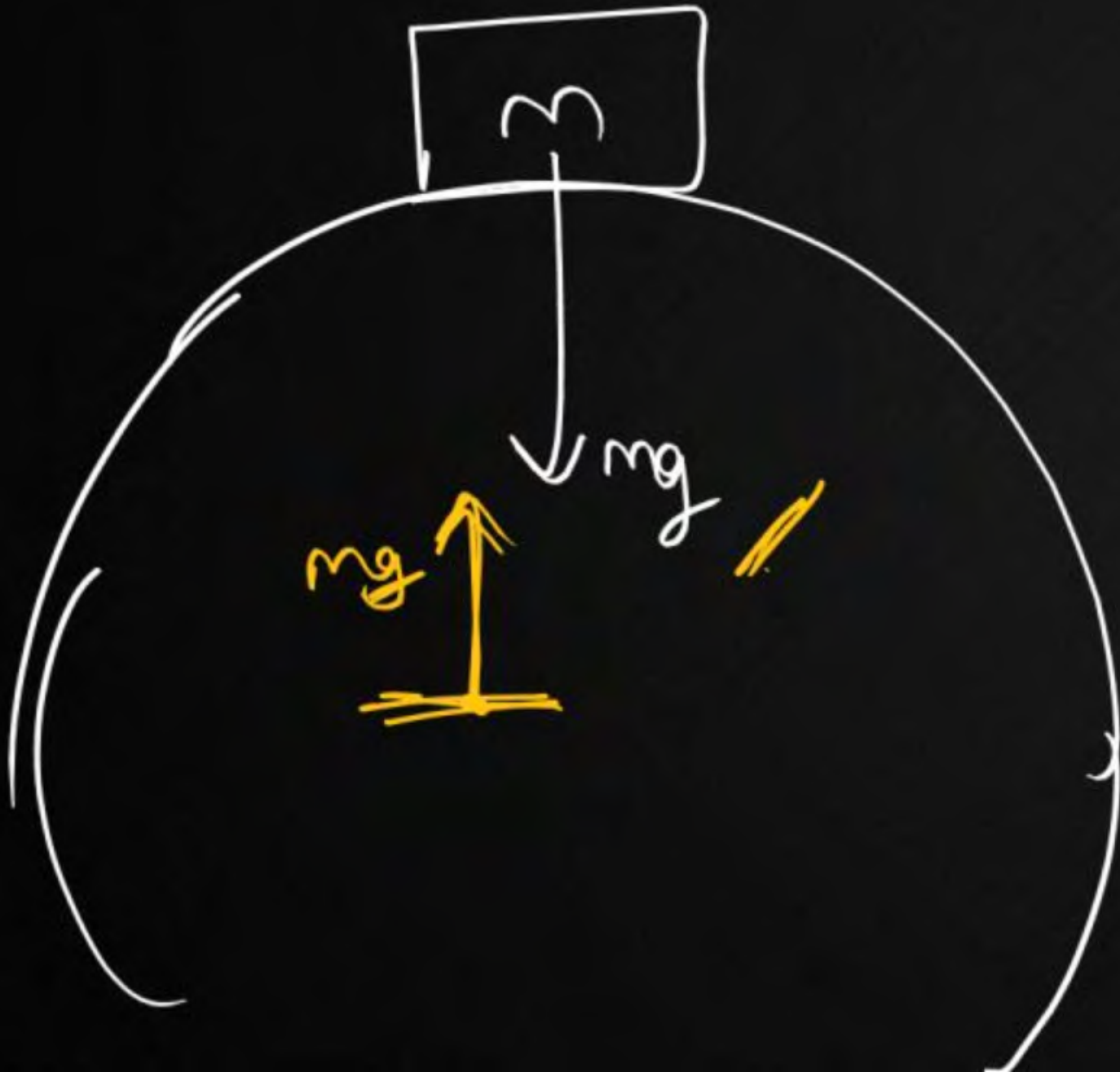
4.1 Commonly used Forces

1. **Weight:** The force exerted on an object due to gravity. It is calculated as the product of the mass of the object and the acceleration due to gravity ($W = mg$).
2. **Normal Force:** The force exerted by a surface perpendicular to an object in contact with it.
3. **Tension Force:** The force transmitted through a string, rope, cable, or any other form of a flexible connector when it is pulled tight by forces acting from opposite ends.
4. **Spring Force:** The force exerted by a compressed or stretched spring upon any object that is attached to it.
5. **Upthrust (Buoyant Force):** The upward force exerted by a fluid on an object placed in it.

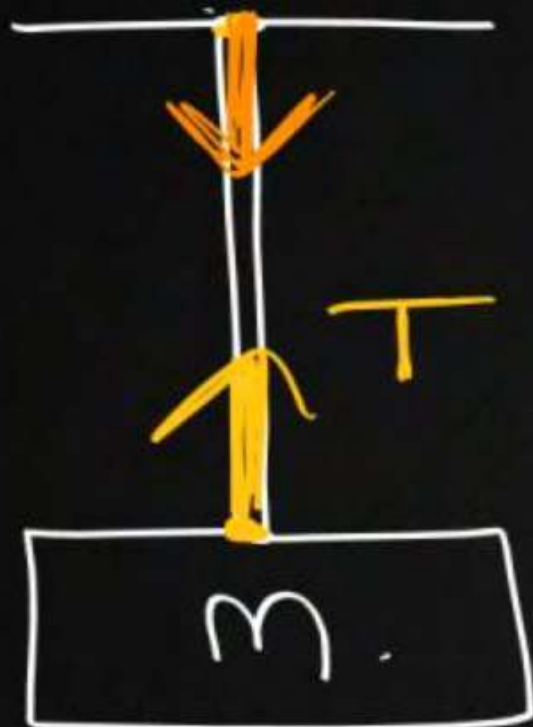
Weight → Force of gravity by which a planet pull you.



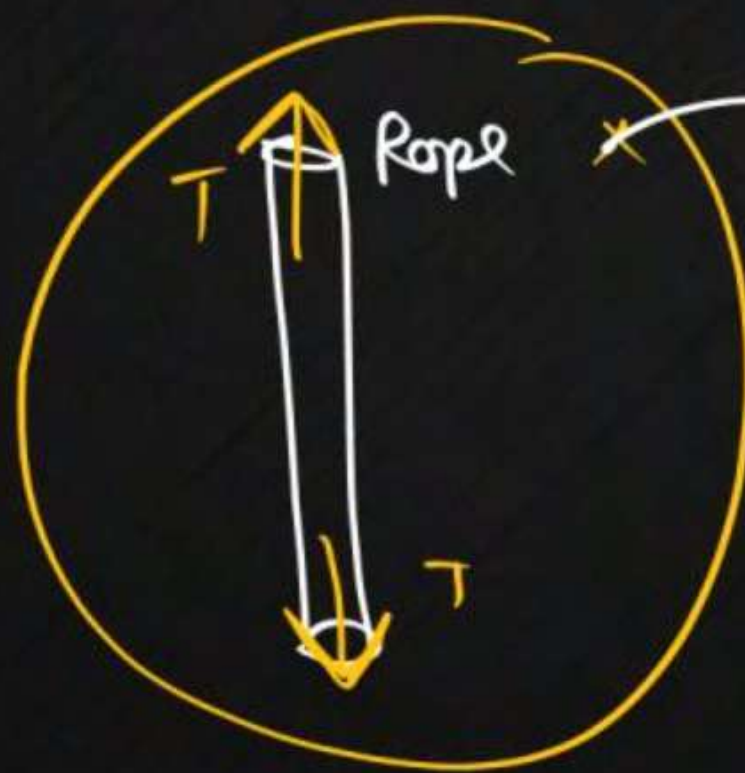
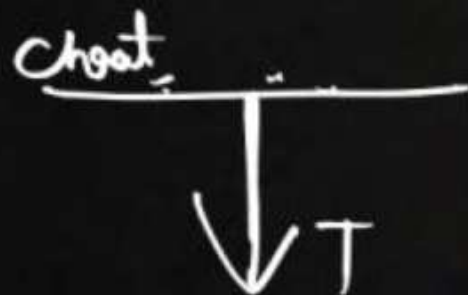
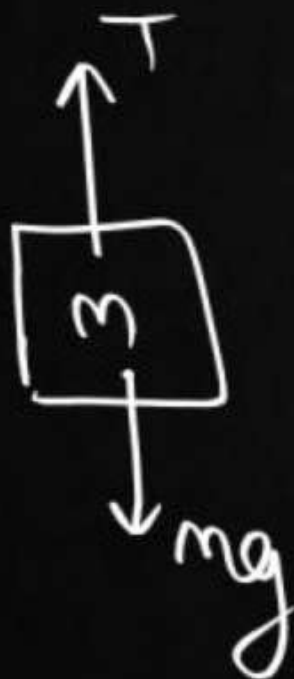
$$W = mg$$



Tension → String (massless)



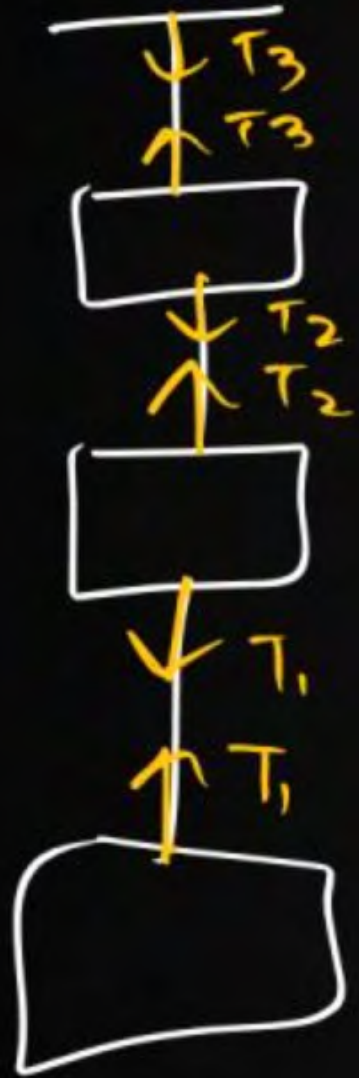
m is pulling rope down
rope is pulling mass up



→ 1st & Last time

Tension - lena a nahi dene ka

(same string me same tension)



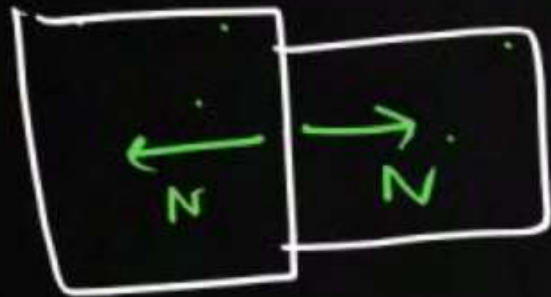
Normal — Chipakne ka Force



(If friction is zero, then Normal = Reaction = Contact)

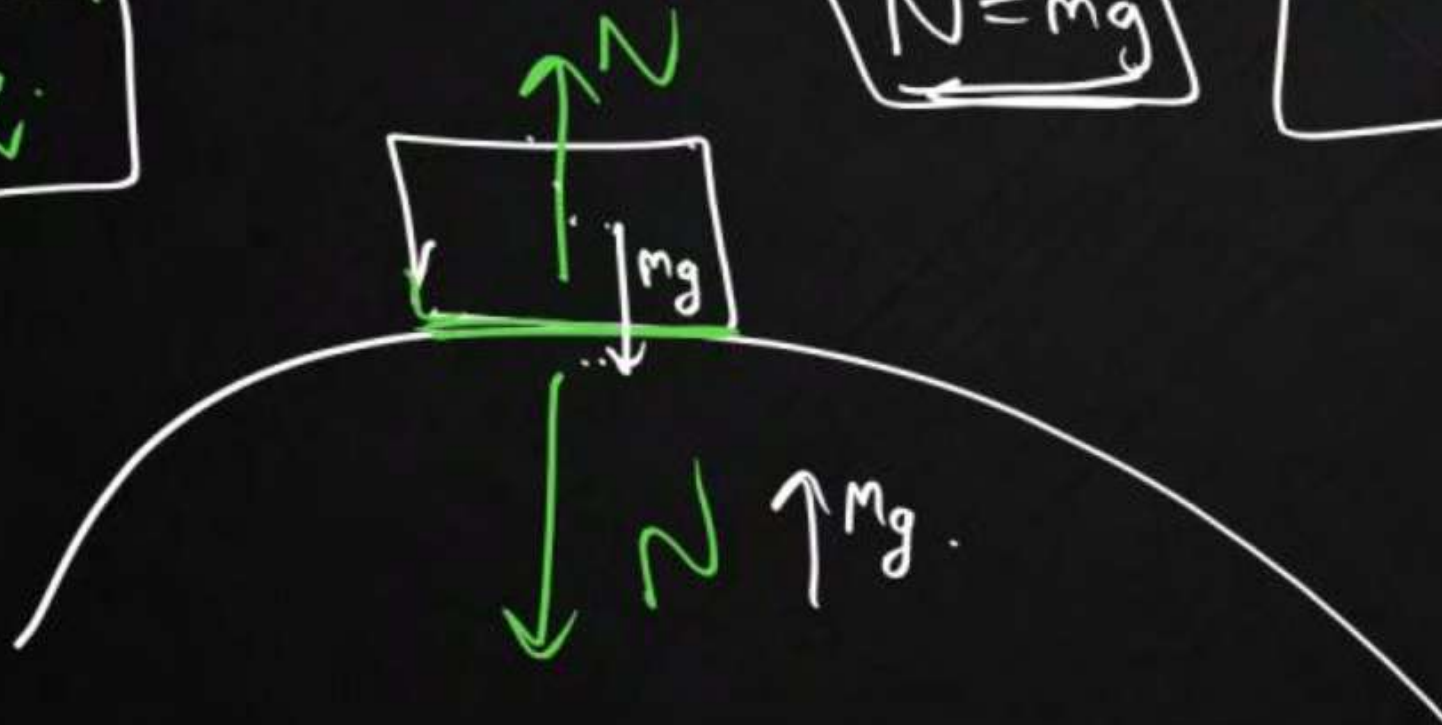
If friction is not zero, then $N \neq \text{Reaction}$
 $N \neq \text{Contact}$

If 2 bodies touch, they will have N between them.



$$N = mg$$

♥ N & mg are Not action reaction pair



QUESTION-72

Difficulty Level : Easy



Which one of the following is not force?

[NCERT Based]

- 1 Impulse ✓
- 2 Tension
- 3 Thrust
- 4 Weight

QUESTION-73

Difficulty Level : Easy



A man weighing 100 kg carries a load of 10 kg on his head. He jumps from a tower with the load on his head. What will be the weight of the load as experienced ^{in a pool} by the man?

- ☒ 1 Zero
- ☐ 2 10 kg
- ☐ 3 Slightly more than 10 kg
- ☐ 4 110 kg



QUESTION-74

Difficulty Level : YODHA



A smooth wedge A is fitted in a chamber hanging from a fixed ceiling near the earth's surface. A block B placed at the top of the wedge takes a time T to slide down the length of the wedge. If the block is placed at the top of the wedge and the cable supporting the chamber is broken at the same instant, the block will

[HCV Objective]

- 1 take a time longer than T to slide down the wedge
- 2 take a time shorter than T to slide down the wedge
- 3 remain at the top of the wedge ✓
- 4 jump off the wedge



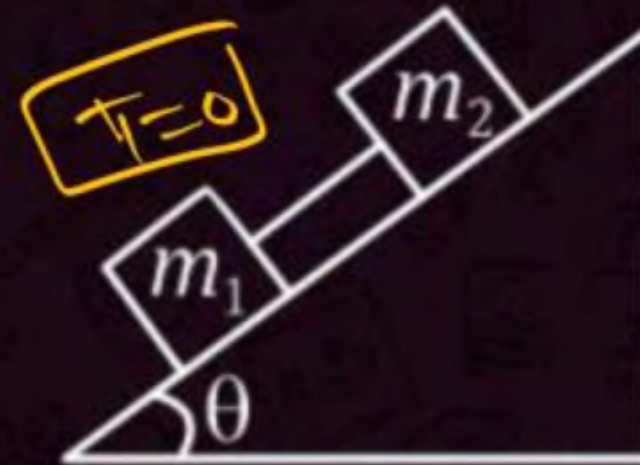
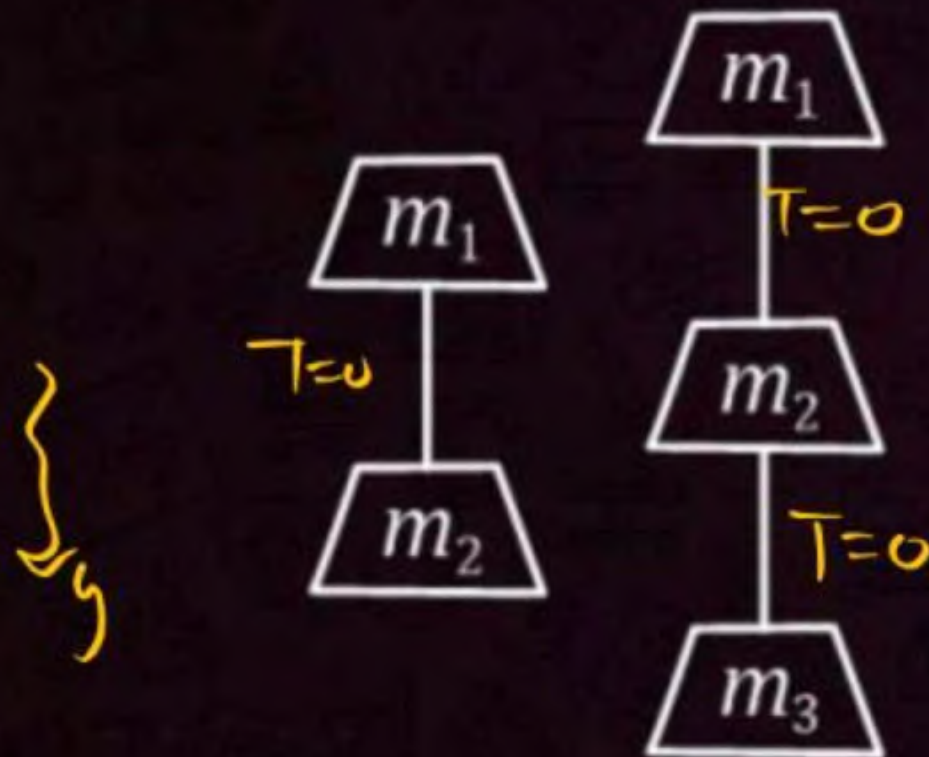
QUESTION-75

Difficulty Level : Easy



Find Tensions in all cases

$$T=0$$



PUPPY POINTS 2



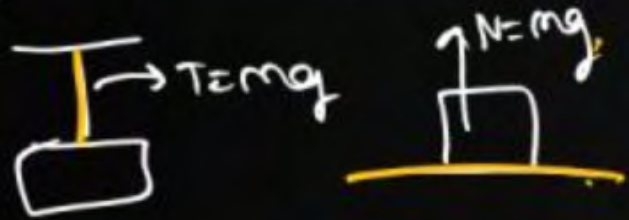
$$W=mg$$

T (dene ka)

N (chipane ka force)

Contact lost $N=0$

~~Upthrust - Buoyancy~~



Condition when $F_{\text{net}} = 0$ ✓

rest

Constant velocity

Part 5 – Equilibrium



5.1 Conceptual Questions



QUESTION-76

Difficulty Level : Easy



A body is said to be in equilibrium if all the forces acting on it

[NCERT Based]

1 are in the same direction ✓

2 are equal in magnitude ✗

3 have zero resultant ✓

4 can be arranged in pair

QUESTION-77

Difficulty Level: ~~Hard~~ ^{Medium}

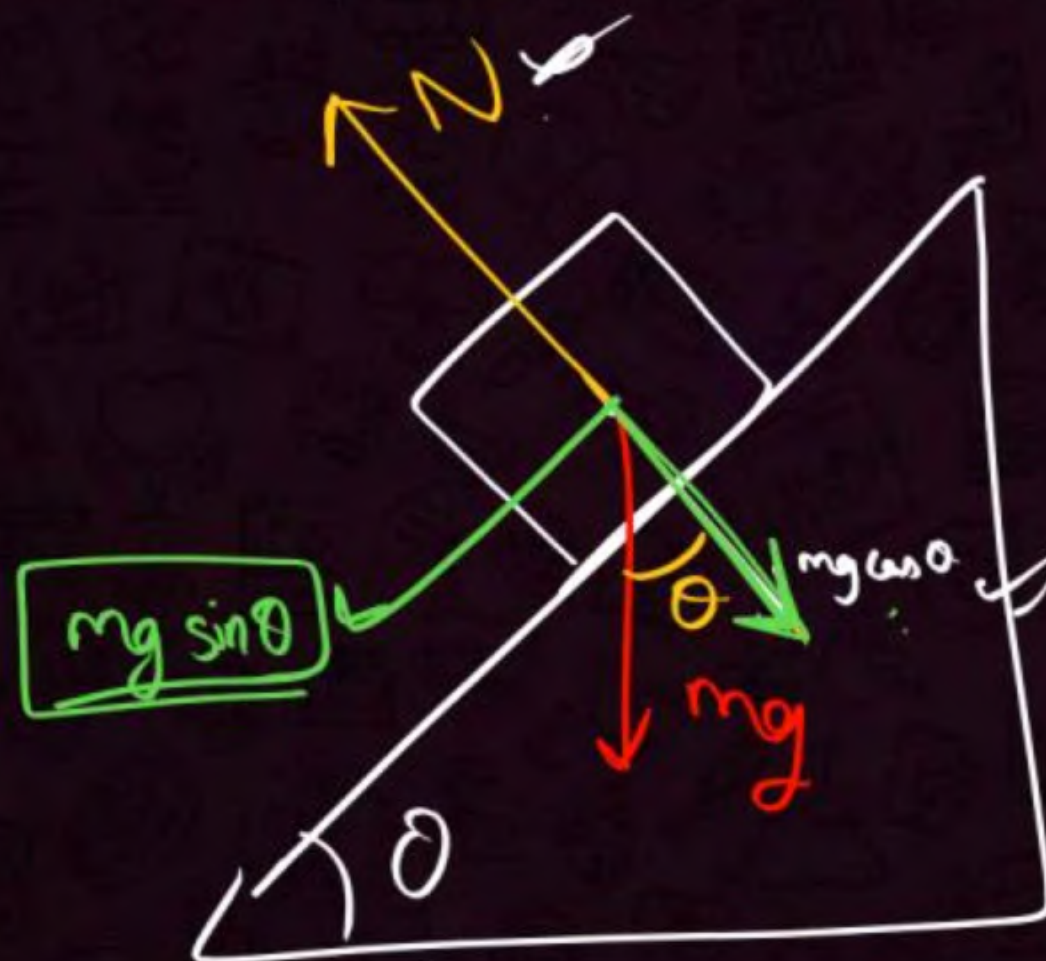


(No friction)

A block of mass m is placed on a smooth inclined plane of inclination θ with the horizontal. The force exerted by the plane on the block has a magnitude

[HCV Objective]

- 1 mg
- 2 $mg/\cos \theta$
- 3 $mg \cos \theta$
- 4 $mg \tan \theta$



$$N = mg \cos \theta$$

$$a = \frac{F}{m} = \frac{mg \sin \theta}{m}$$



QUESTION-78

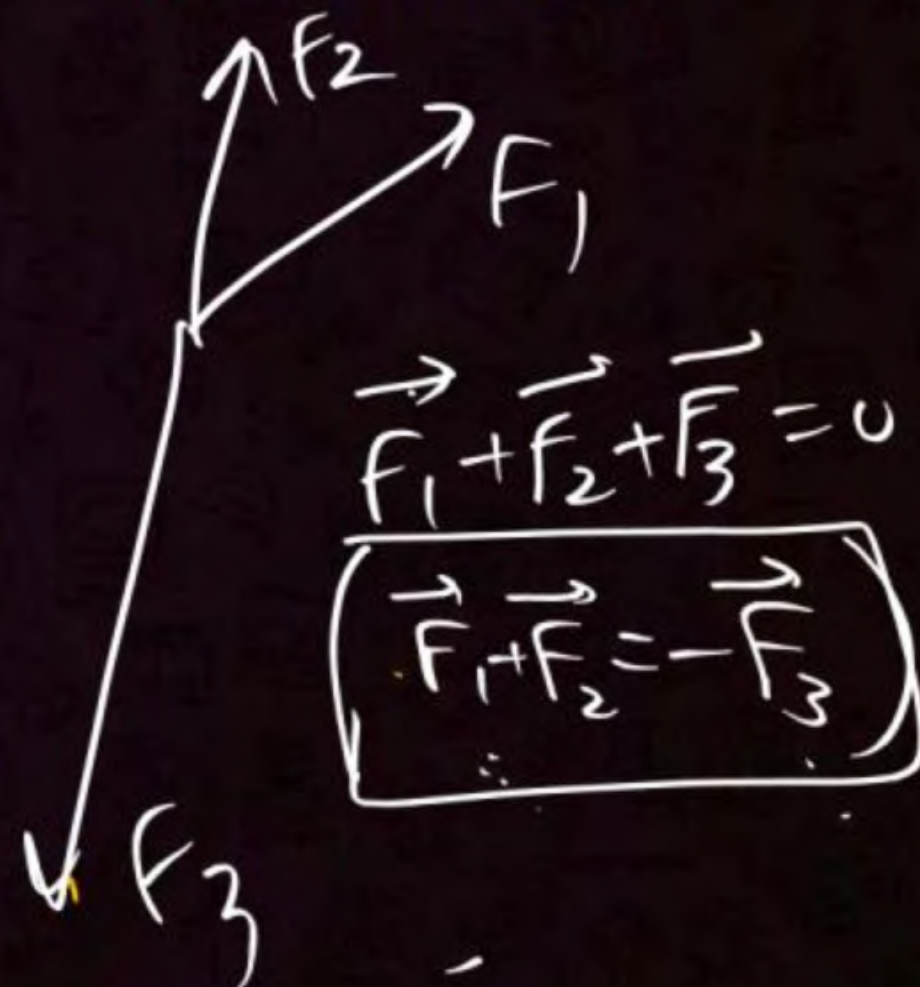
Difficulty Level : MEDIUM



A body subjected to three concurrent forces is found to be in equilibrium. The resultant of any two forces

[NCERT Based]

- 1 is equal to third force in magnitude ✓
- 2 is opposite to third force ✓
- 3 is collinear with the third force ✓
- 4 all of these ✓





Three concurrent co-planar forces 1 N, 2 N and 3 N acting along different directions on a body

hw

[NCERT Based]

- 1 can keep the body in equilibrium if 2 N and 3 N act at right angle.
- 2 can keep the body in equilibrium if 1 N and 2 N act at right angle.
- 3 cannot keep the body in equilibrium.
- 4 can keep the body in equilibrium if 1 N and 3 N act at an acute angle.

QUESTION-80**Difficulty Level : MEDIUM**

A body is moving under the action of two forces $\vec{F}_1 = 2\hat{i} - 5\hat{j}$; $\vec{F}_2 = 3\hat{i} - 4\hat{j}$. Its velocity will become, uniform under a third force $\vec{F}_3$ given by **[NCERT Based]** ^{hw}

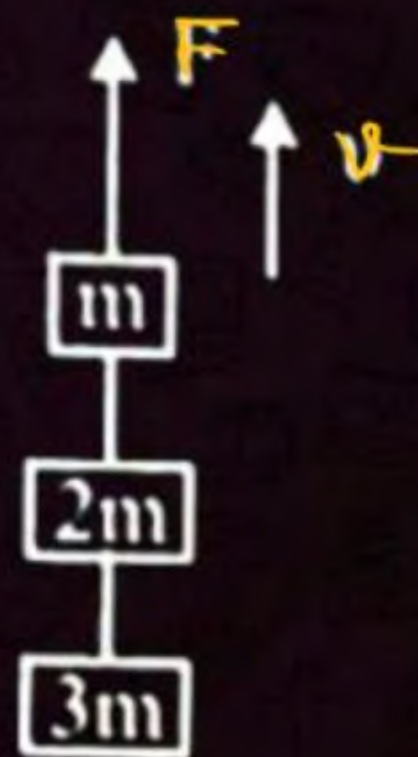
- 1 $5\hat{i} - \hat{j}$
- 2 $-5\hat{i} - \hat{j}$
- 3 $5\hat{i} + \hat{j}$
- 4 $-5\hat{i} + 9\hat{j}$

QUESTION-81**Difficulty Level : MEDIUM**

Three blocks with masses m , $2m$ and $3m$ are connected by strings, as shown in the figure. After an upward force F is applied on block m , the masses move upward at constant speed v . What is the net force on the block of mass $2m$? (g is the acceleration due to gravity)

[2013]

- 1 6 mg
- 2 Zero ✓
- 3 2 mg
- 4 3 mg



QUESTION-82

(Tug of War)

Difficulty Level : Easy



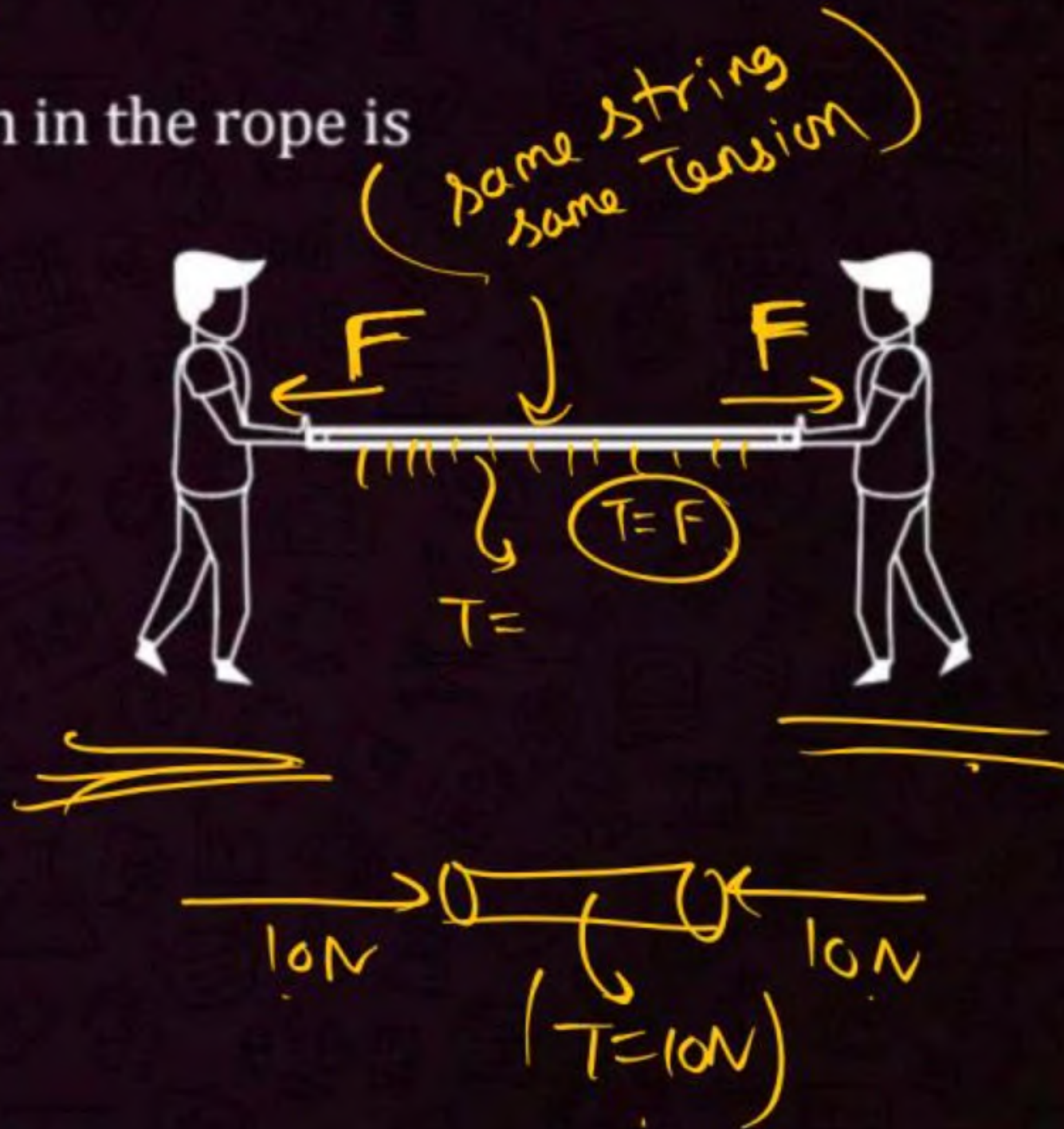
Both boys pulls the rope by force F . Tension in the rope is

1 F ✓✓

2 $2F$

3 $4F$

4 $F/2$



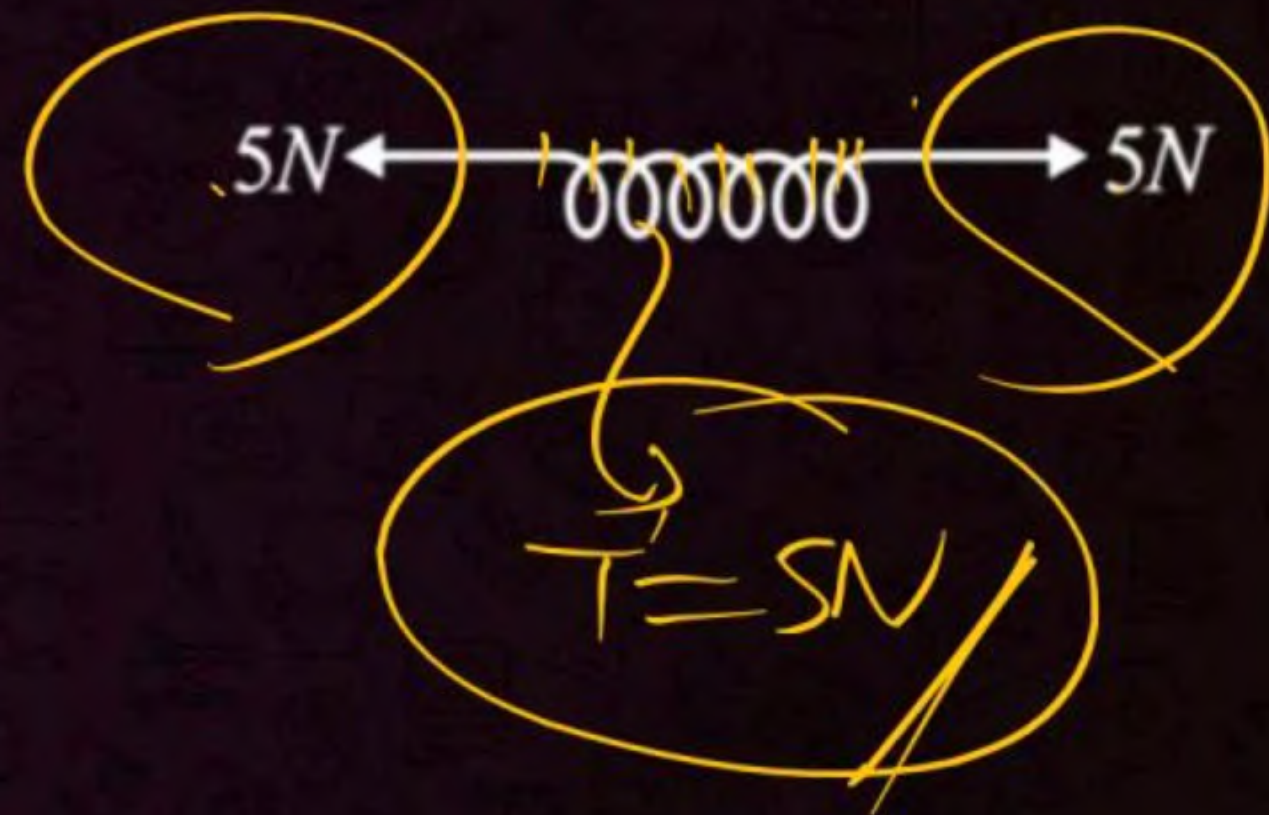
QUESTION-83

Difficulty Level : Easy



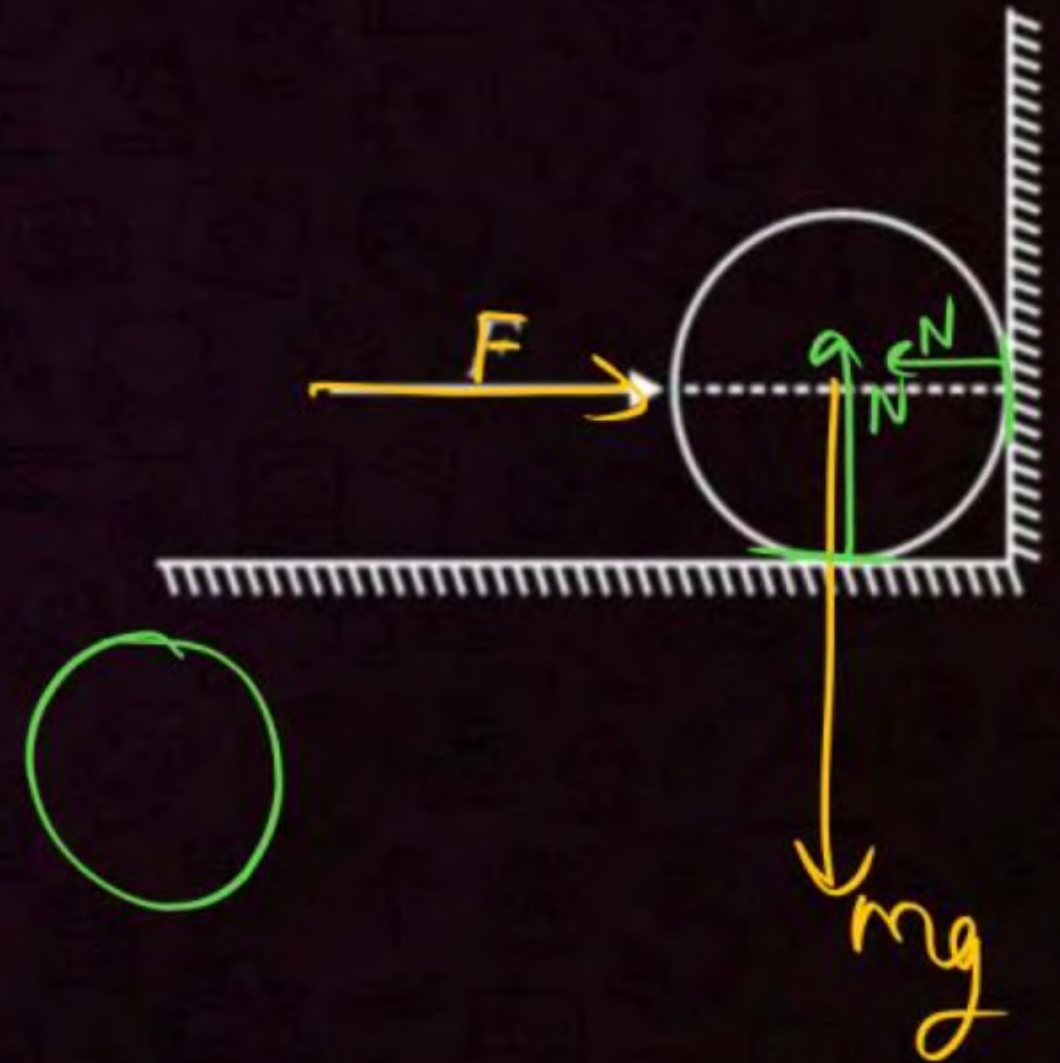
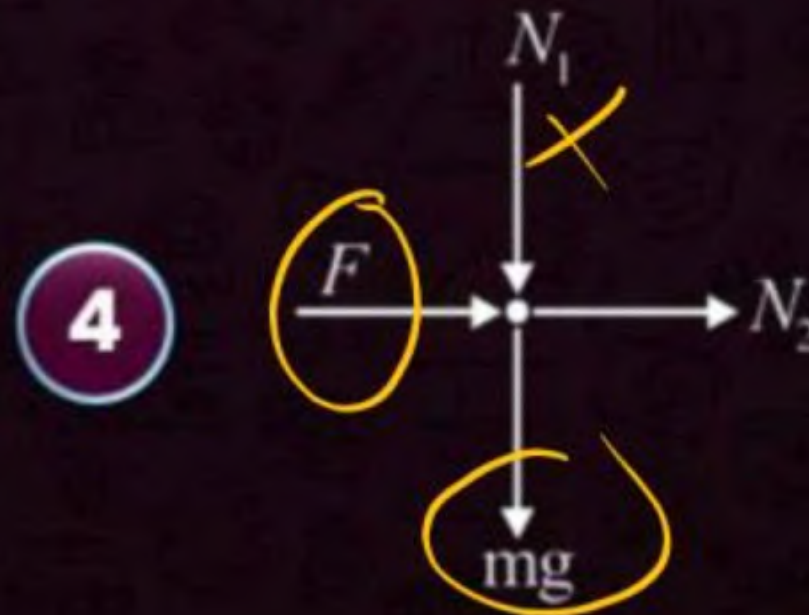
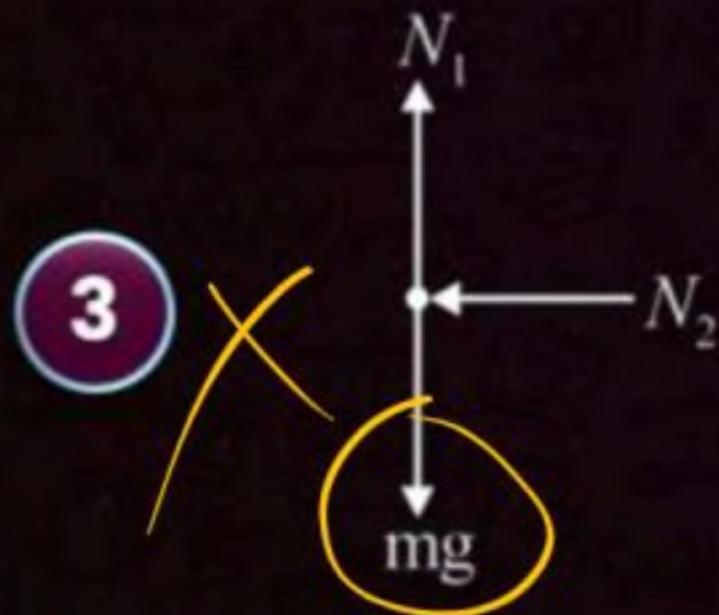
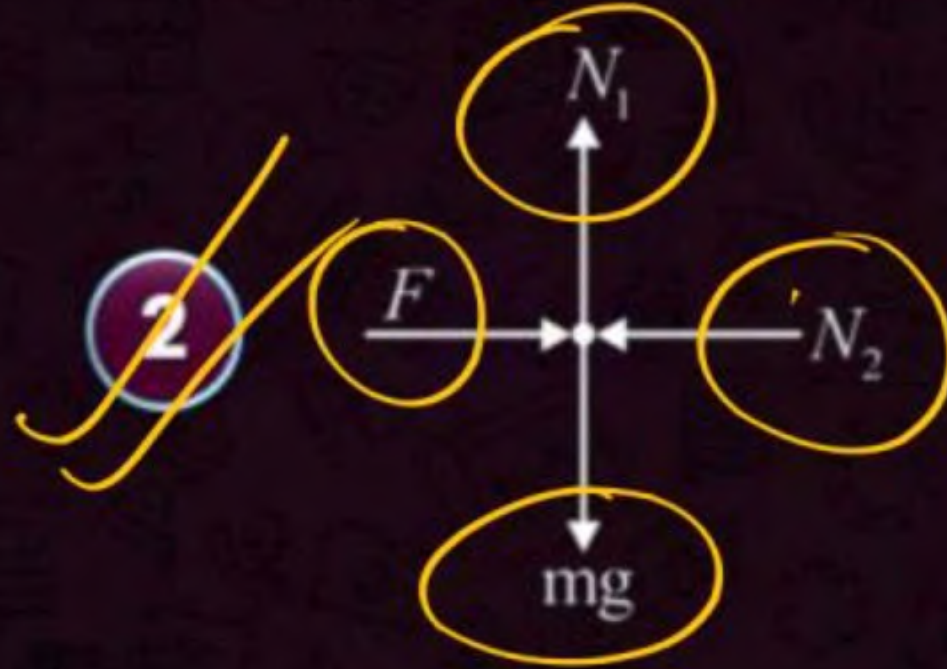
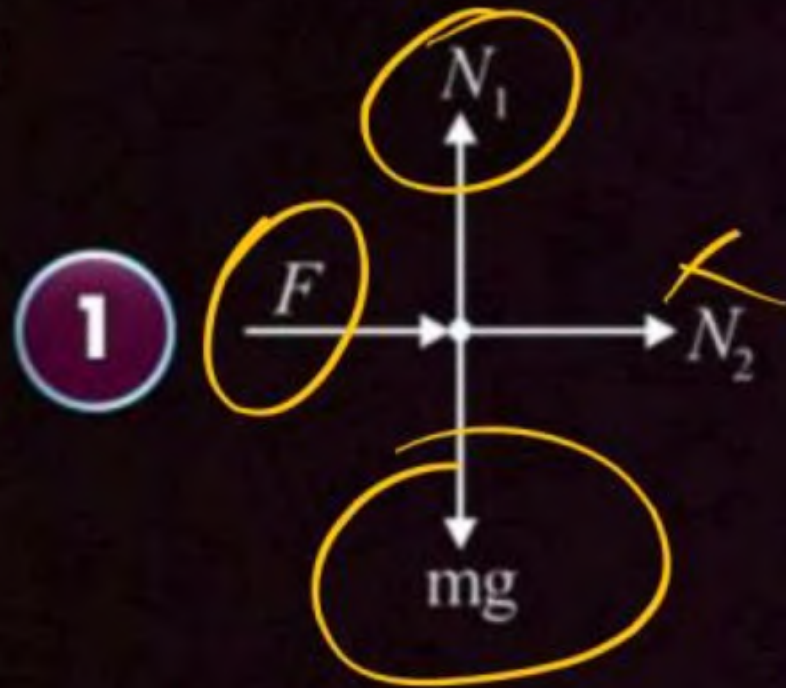
The tension in the spring is

- 1 Zero
- 2 2.5 N
- 3 5 N
- 4 10 N



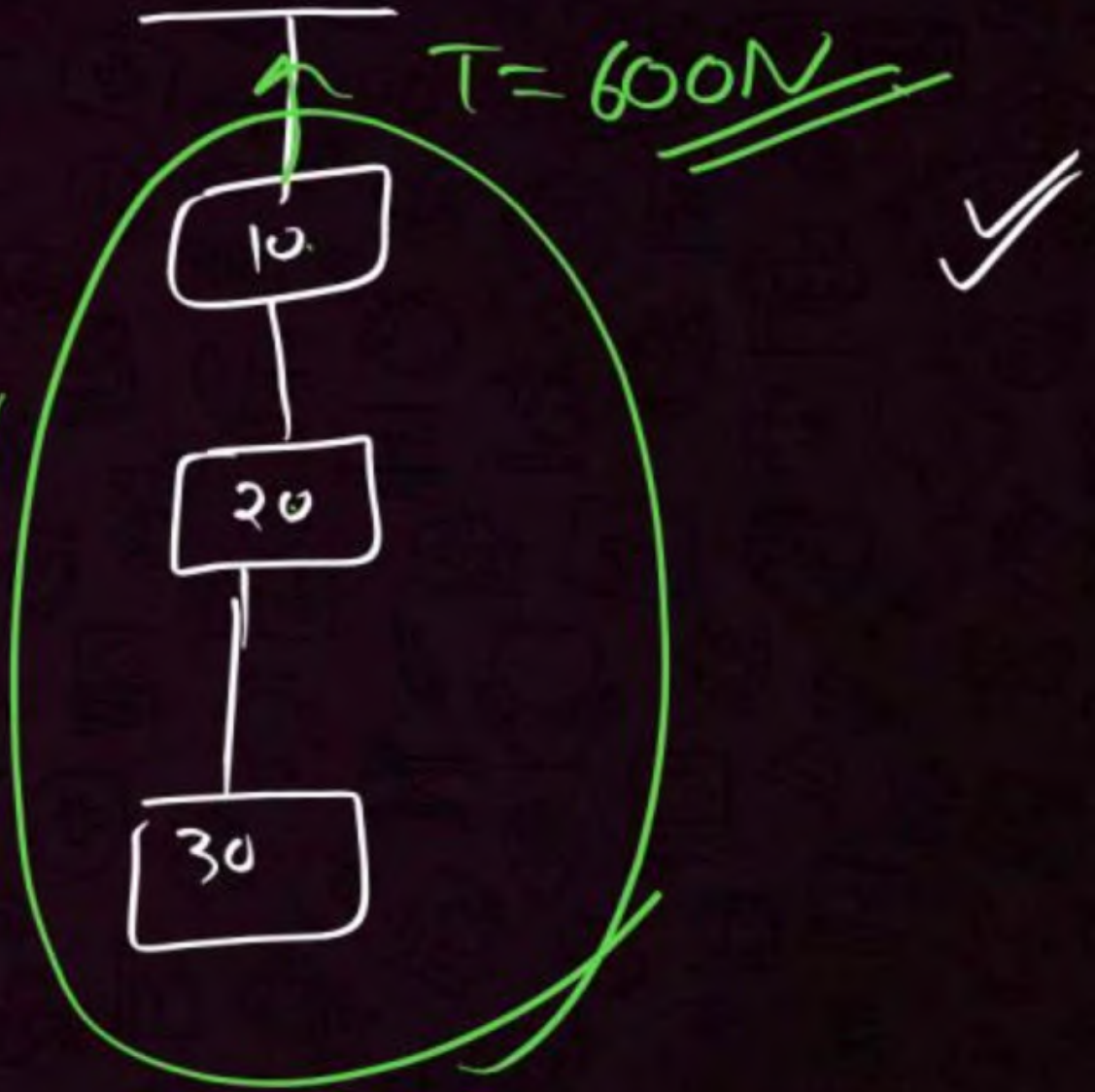
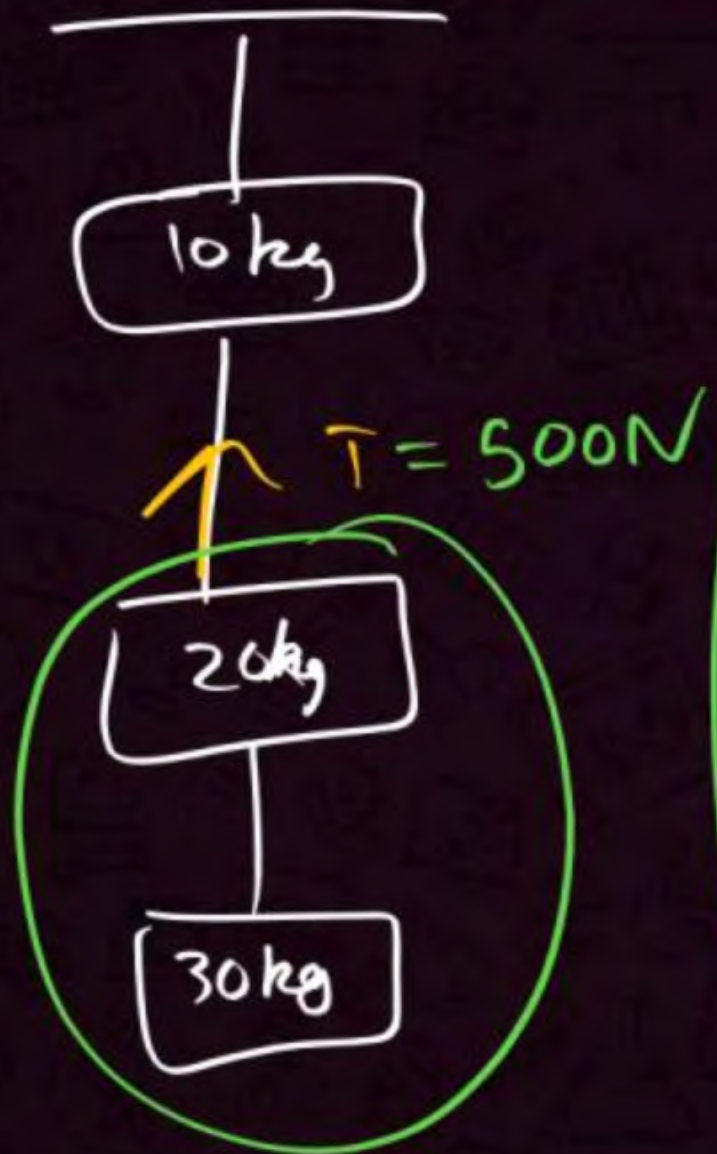
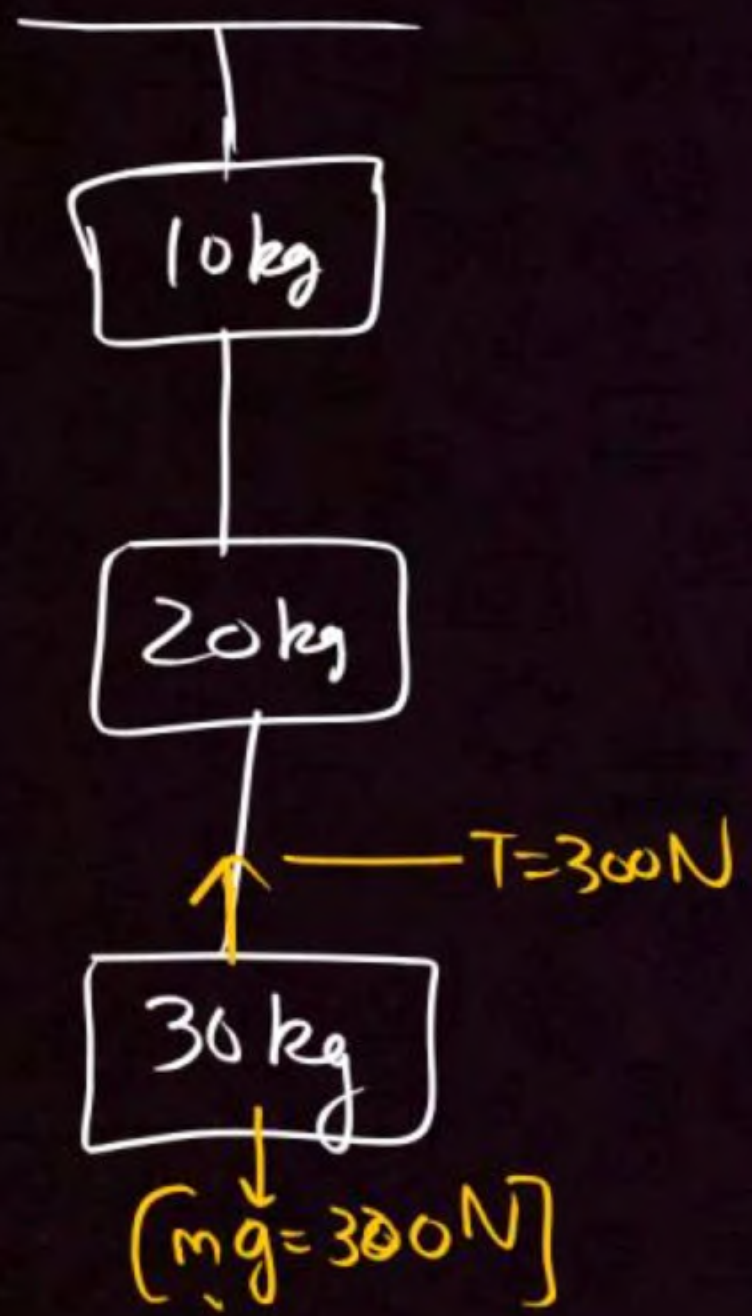
QUESTION-84**Difficulty Level : HARD**

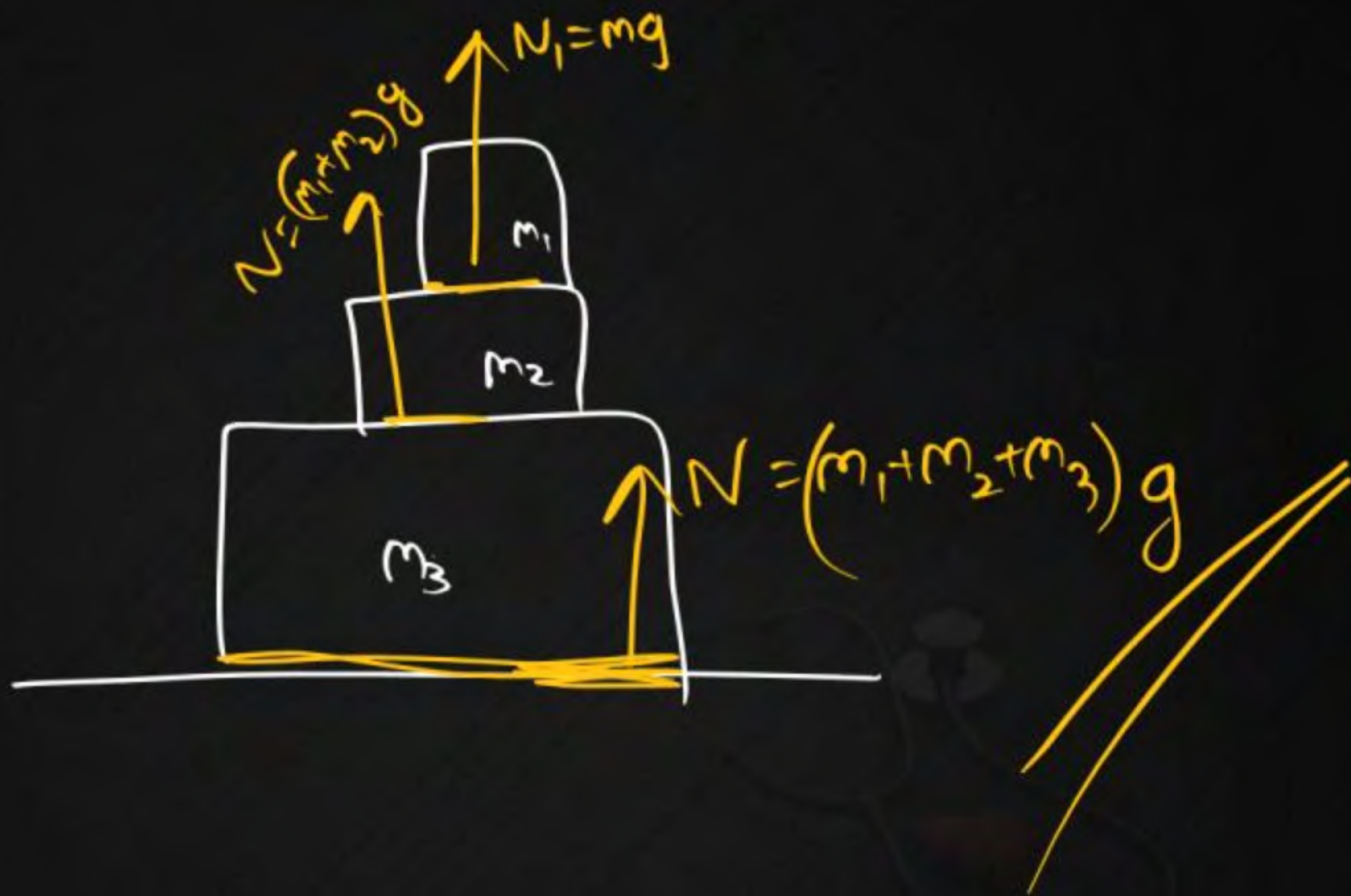
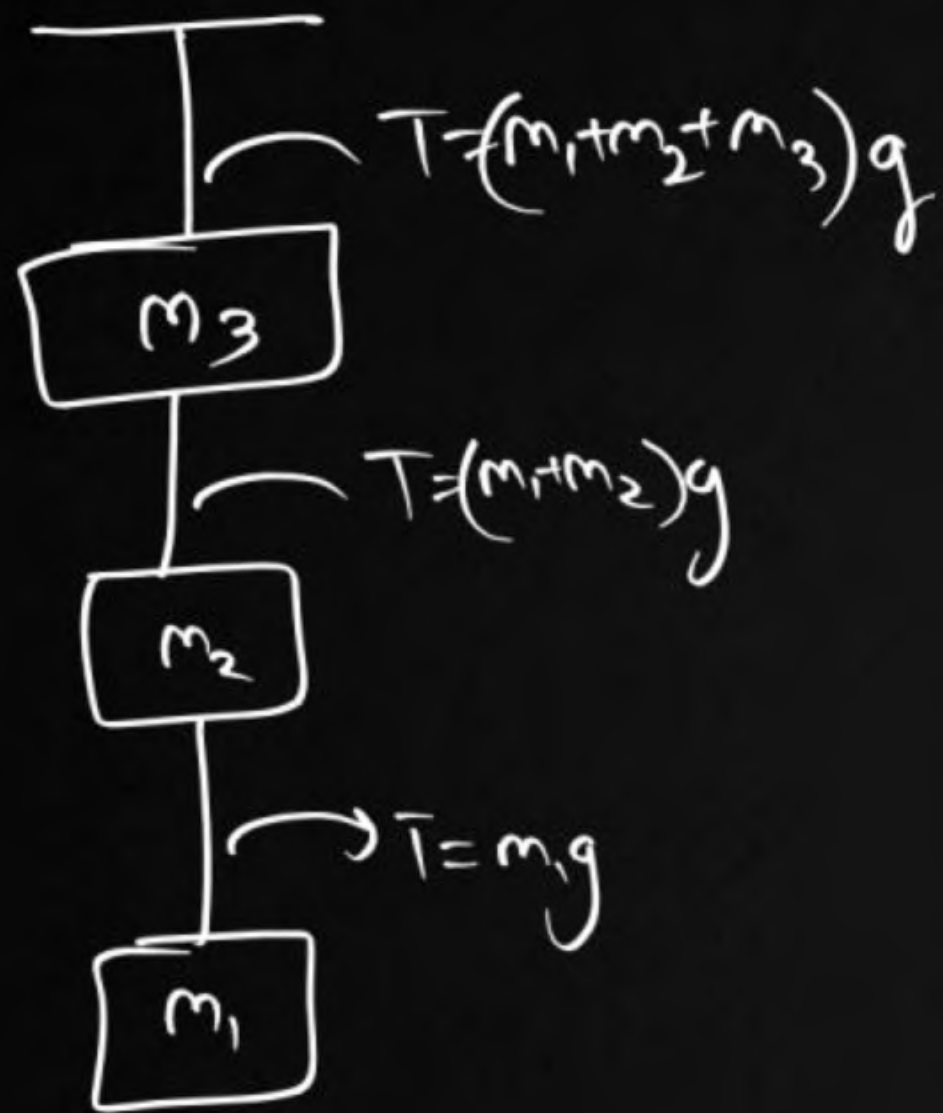
A ball of mass m kept at the corner as shown in the figure, is acted by a horizontal force F . The correct free body diagram of ball is-



$(g=10)$

5.2 Tensions and Normals Direct Questions





QUESTION-85

Difficulty Level : Easy



A body of weight w_1 is suspended from the ceiling of a room through a chain of weight w_2 . The ceiling pulls the chain by a force **[HCV Objective]**

- 1 w_1
- 2 w_2
- 3 $w_1 + w_2$
- 4 $\frac{w_1 + w_2}{2}$



QUESTION-86

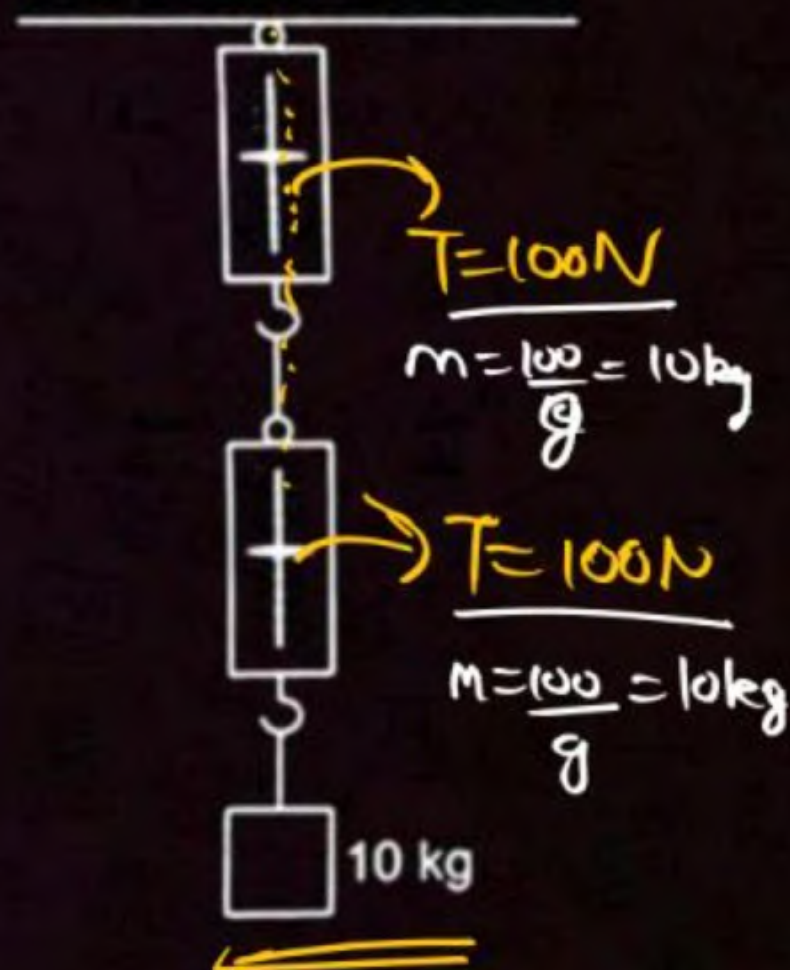
♥ Spring Balance } → Weight → $\frac{W}{g}$ → Ans//
♥ Weighing Machine }
♥ Mass → Physical Balance - Tareza

Difficulty Level : Easy



A block of mass 10 kg is suspended through two light spring balances as shown in figure. **[HCV Objective]**

- 1 Both the scales will read 10 kg.
- 2 Both the scales will read 5 kg.
- 3 The upper scale will read 10 kg and the lower zero.
- 4 The readings may be anything but their sum will be 10 kg.



QUESTION-87

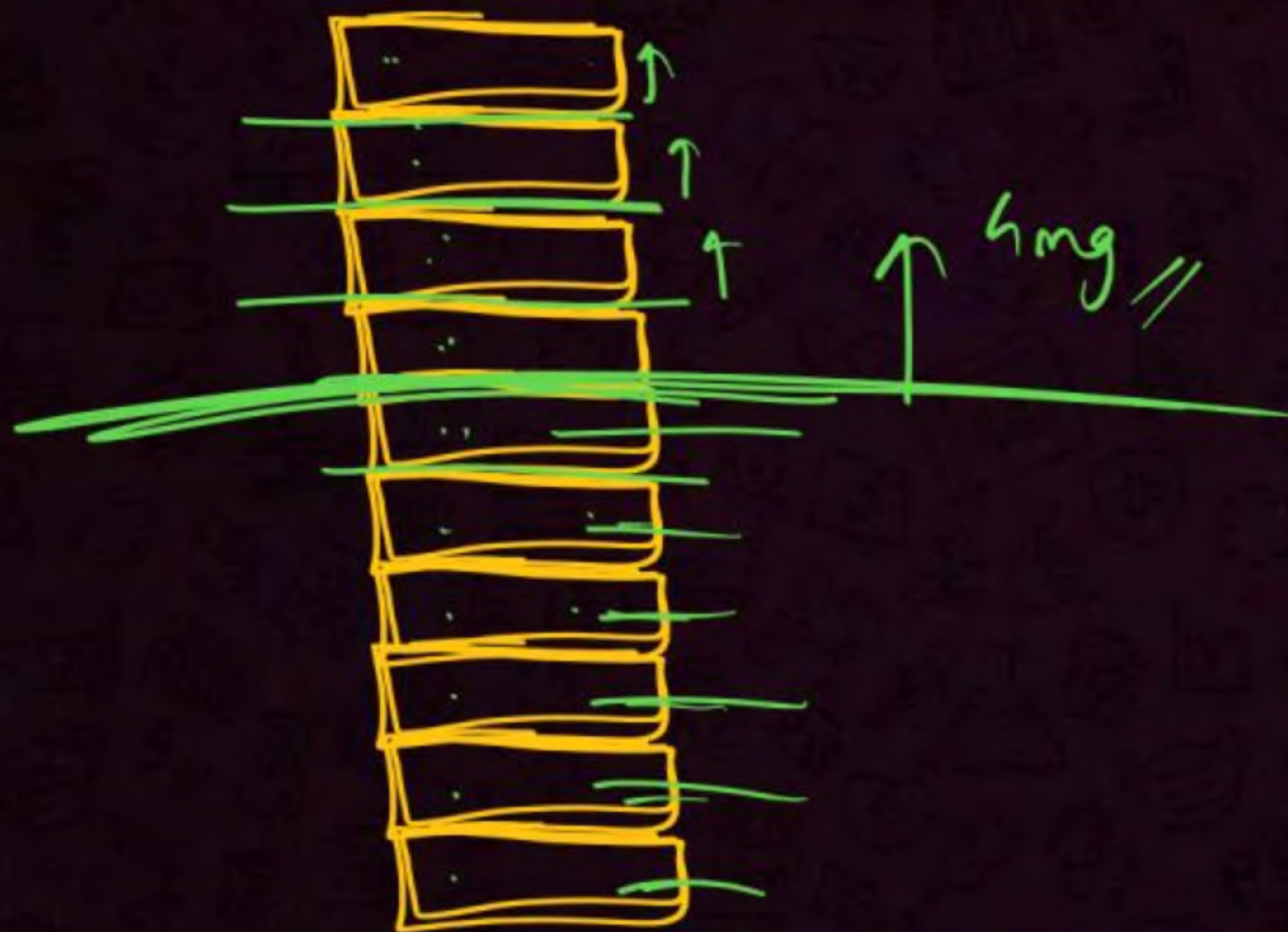
Difficulty Level : MEDIUM



Ten one-rupee coins are put on top of each other on a table. Each coin has a mass m . The reaction of the 6th coin (counted from the bottom) on the 7th coin is

[NCERT Based]

- ☒ 1 4 mg
- ☐ 2 6 mg
- ☐ 3 7 mg
- ☐ 4 3 mg



QUESTION-88

Difficulty Level : Easy



Find the tension T_2 for the system shown in figure.

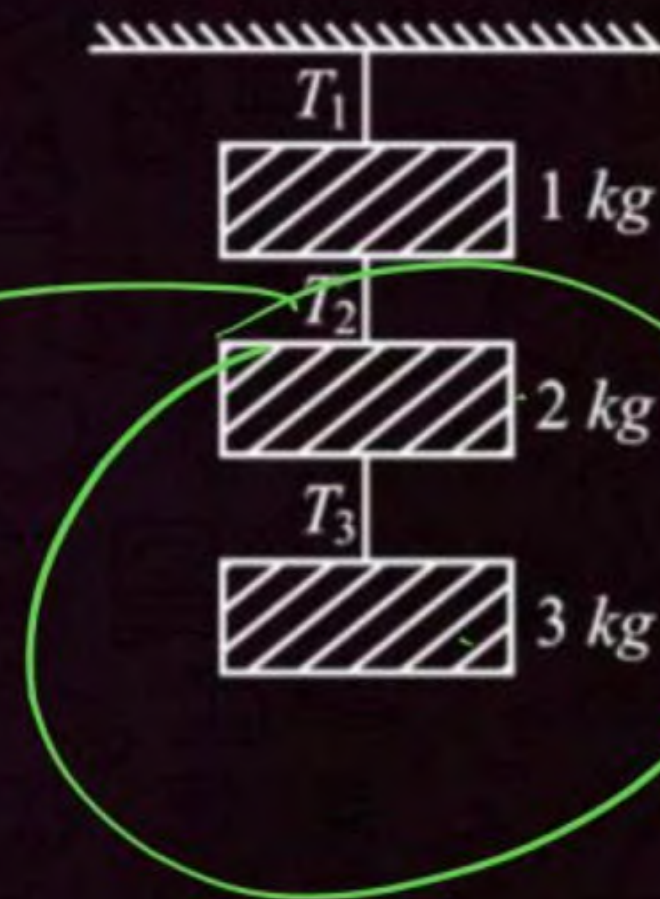
1 $1g \text{ N}$

2 $2g \text{ N}$

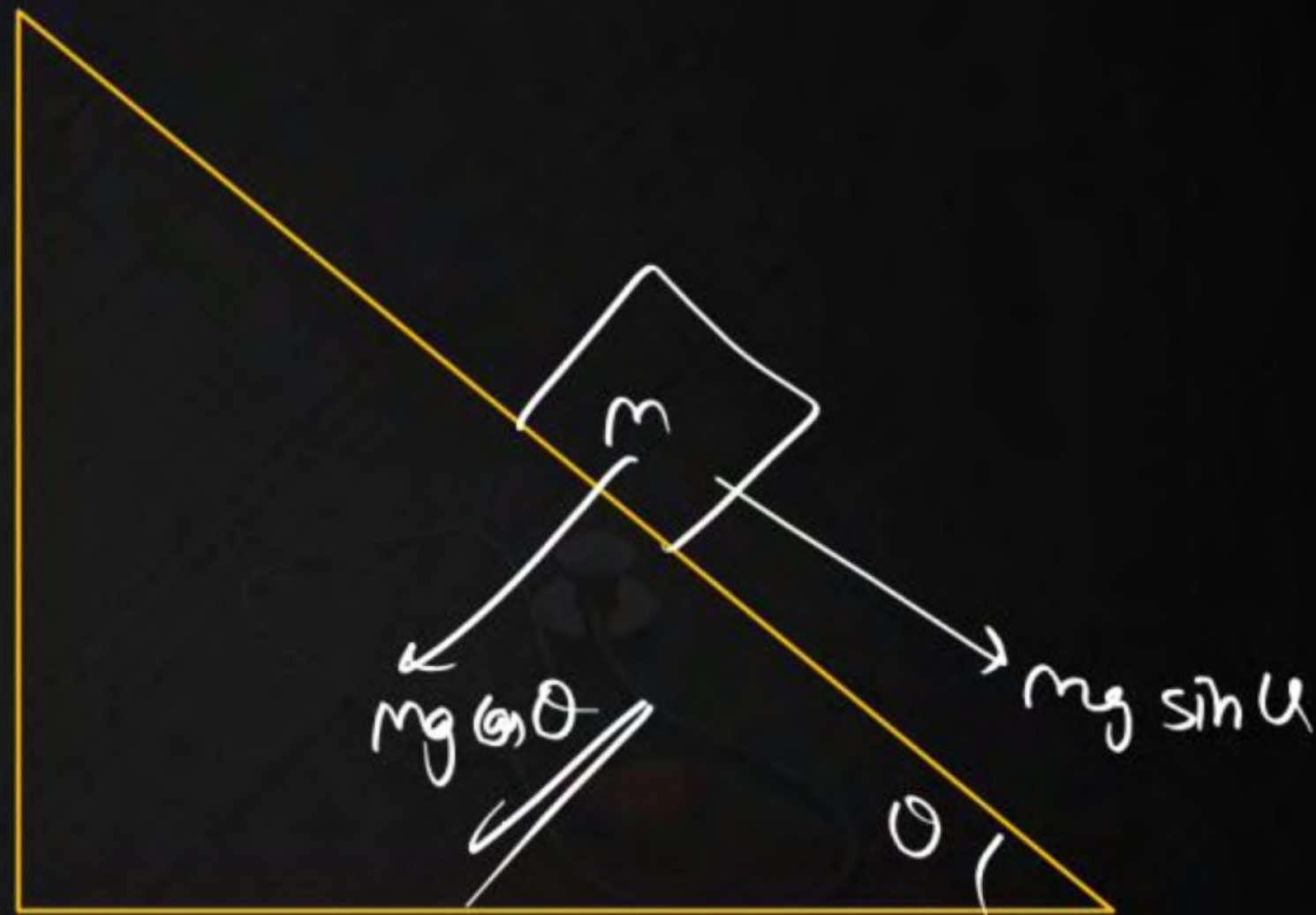
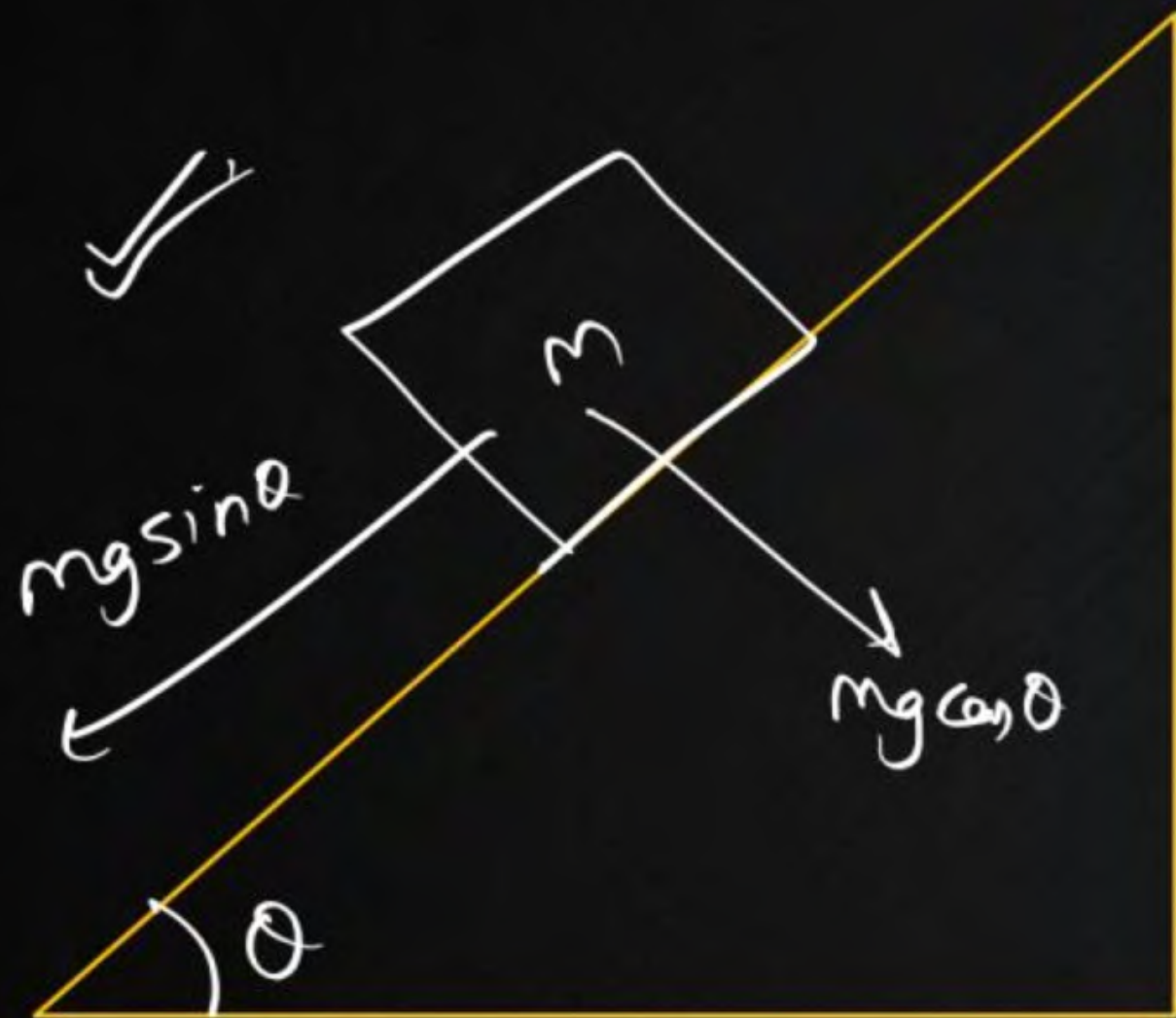
3 $5g \text{ N}$ ✓

4 $6g \text{ N}$

$F = 50 \text{ N}$
 $F = 5g \text{ N}$

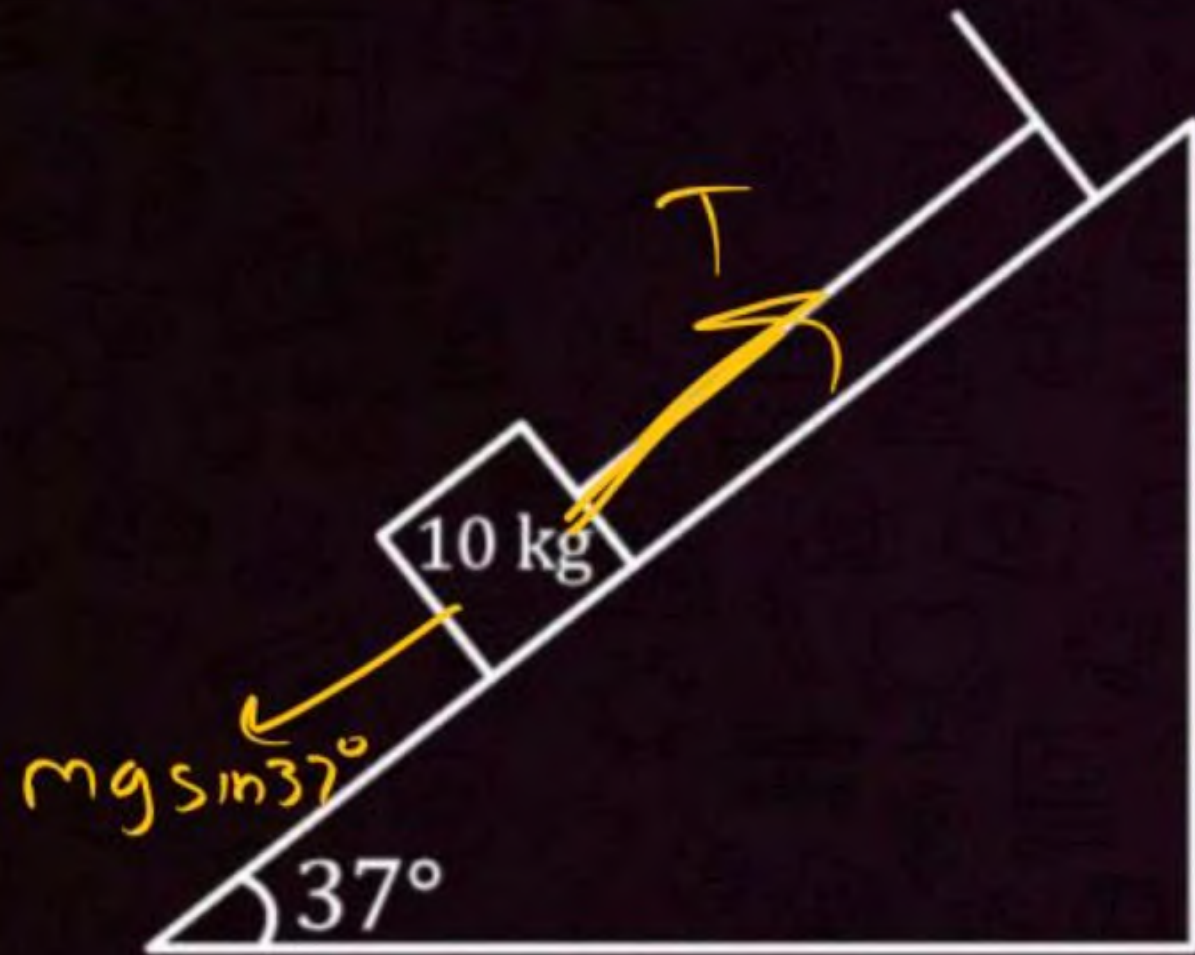


Wedge



QUESTION-89

Difficulty Level : Easy



$$T = ??$$

$$10 \times 10 \times \frac{3}{5} = T$$

$$T = 60 \text{ N}$$

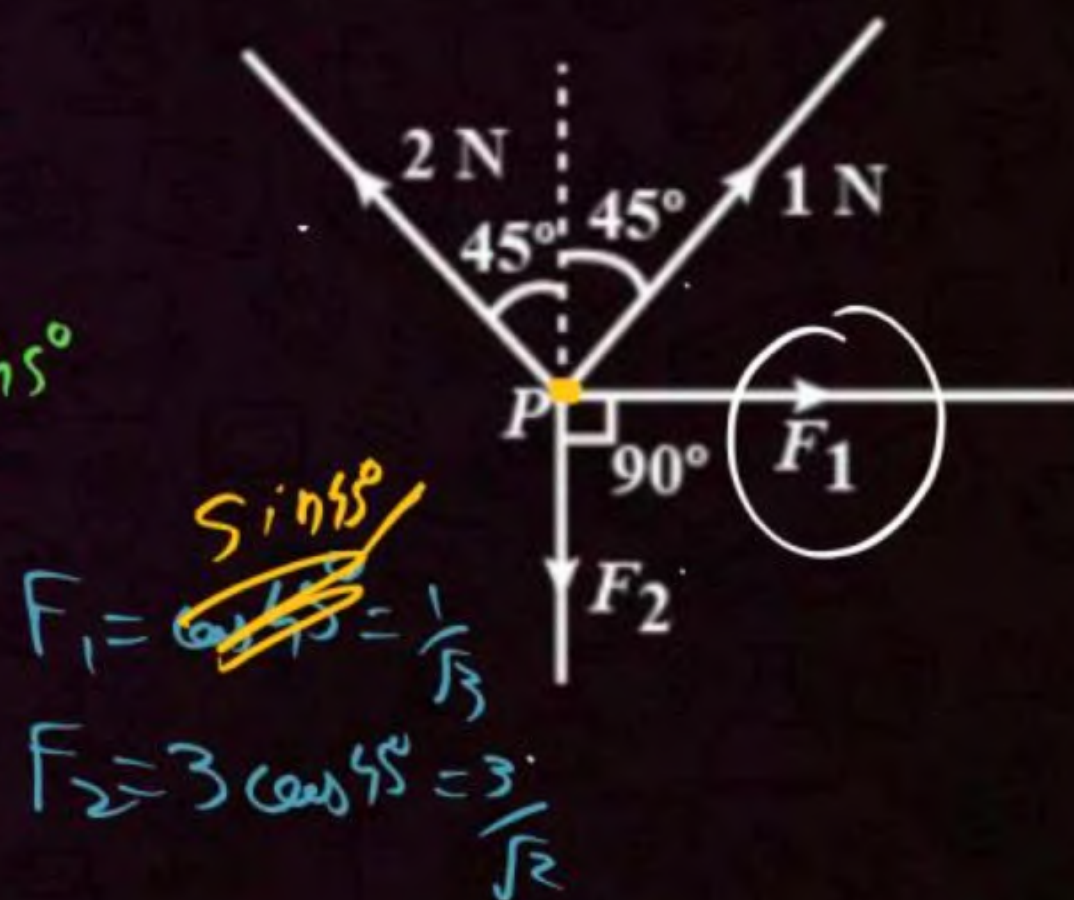
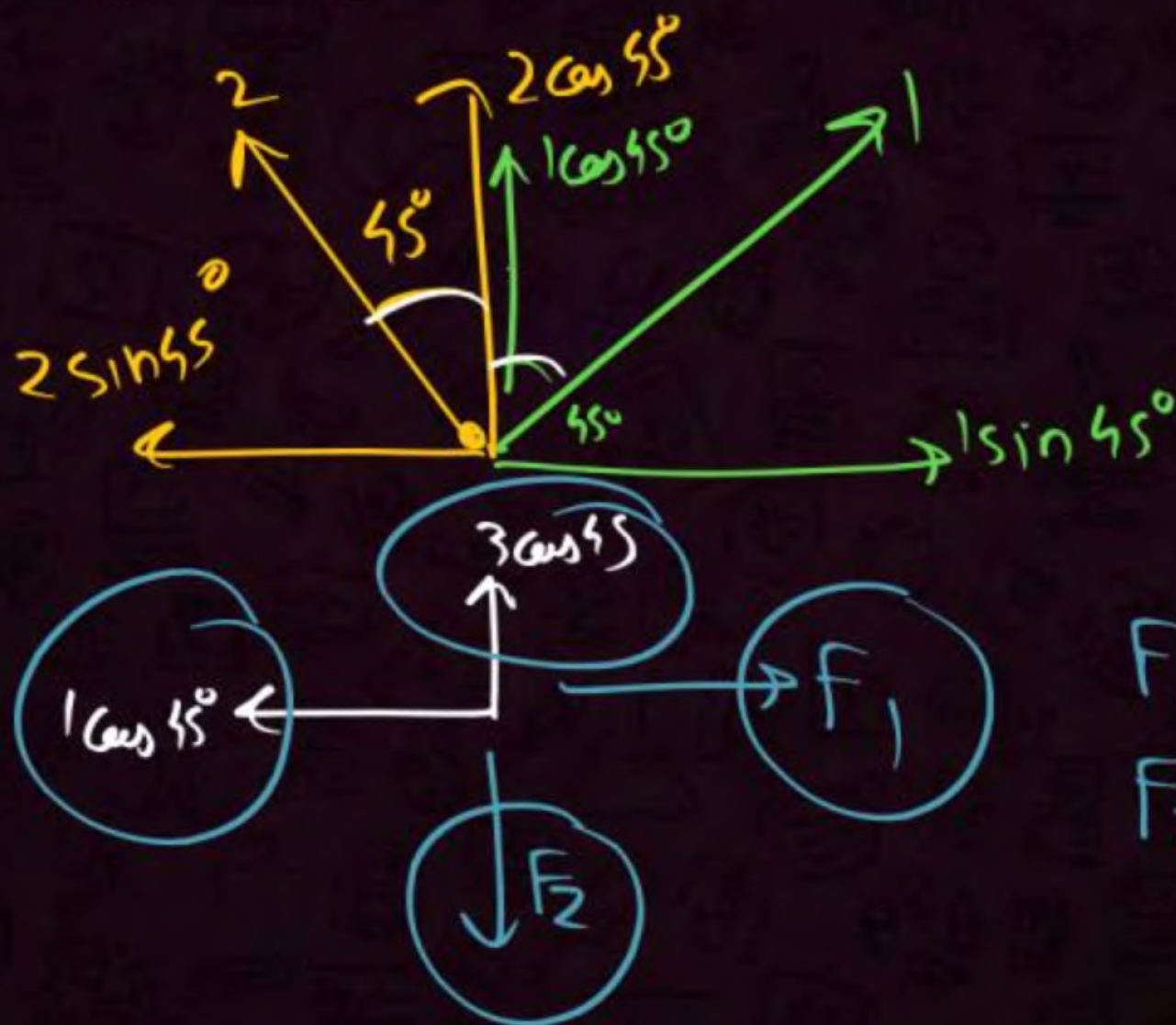
QUESTION-90

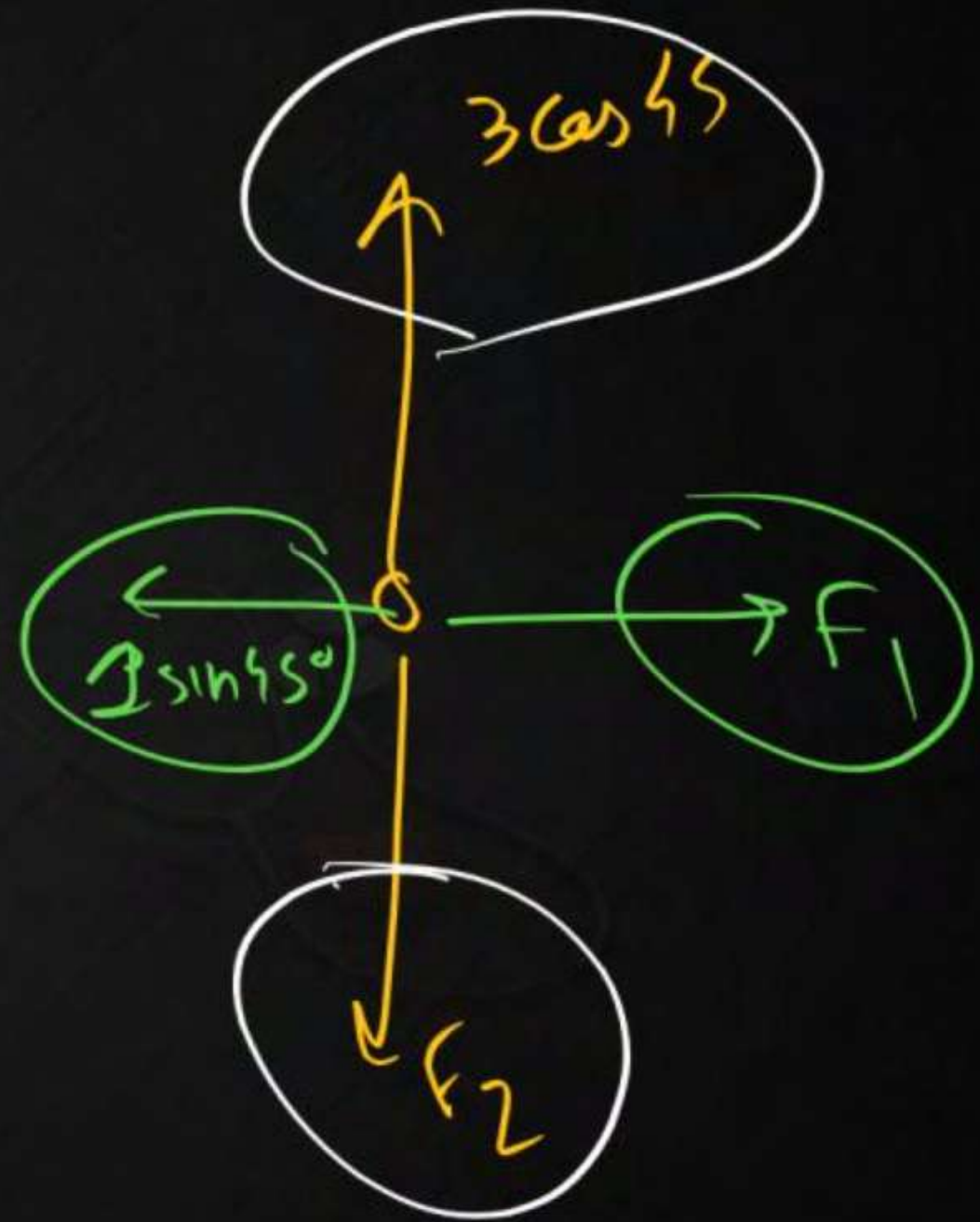
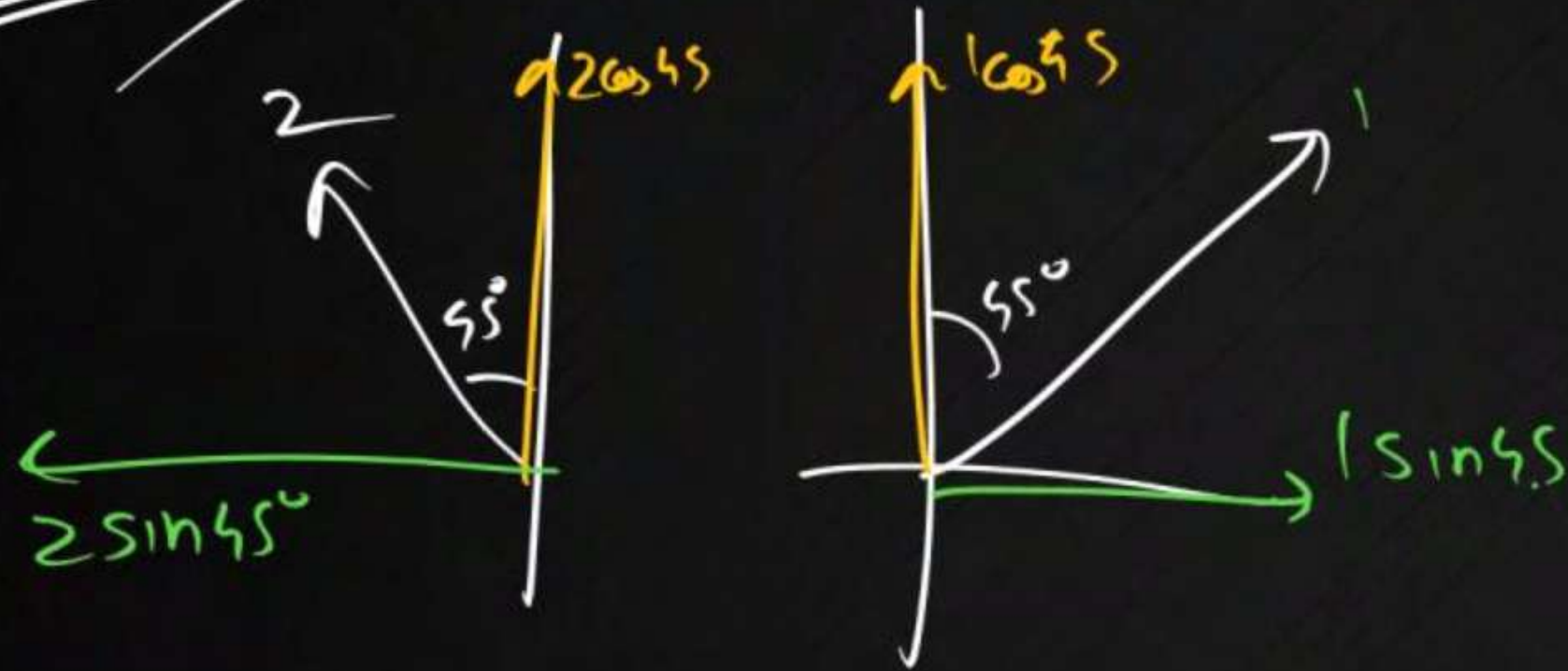
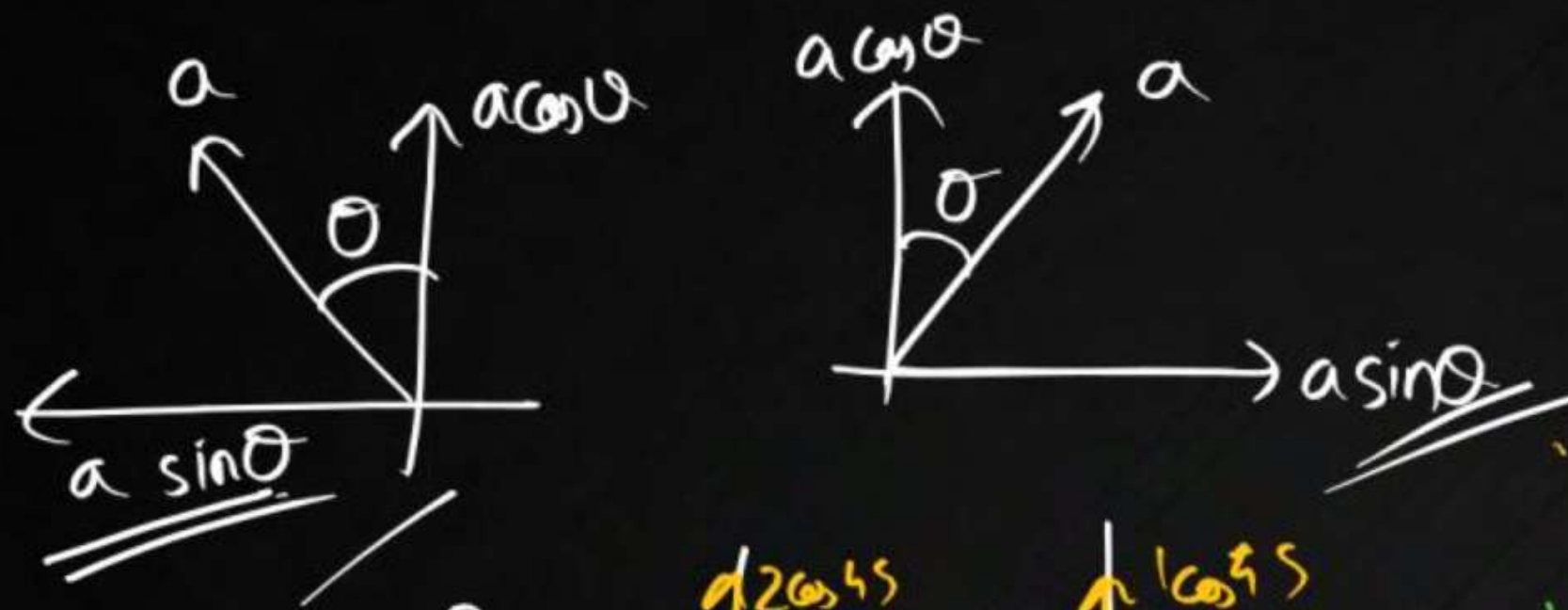
Difficulty Level : MEDIUM



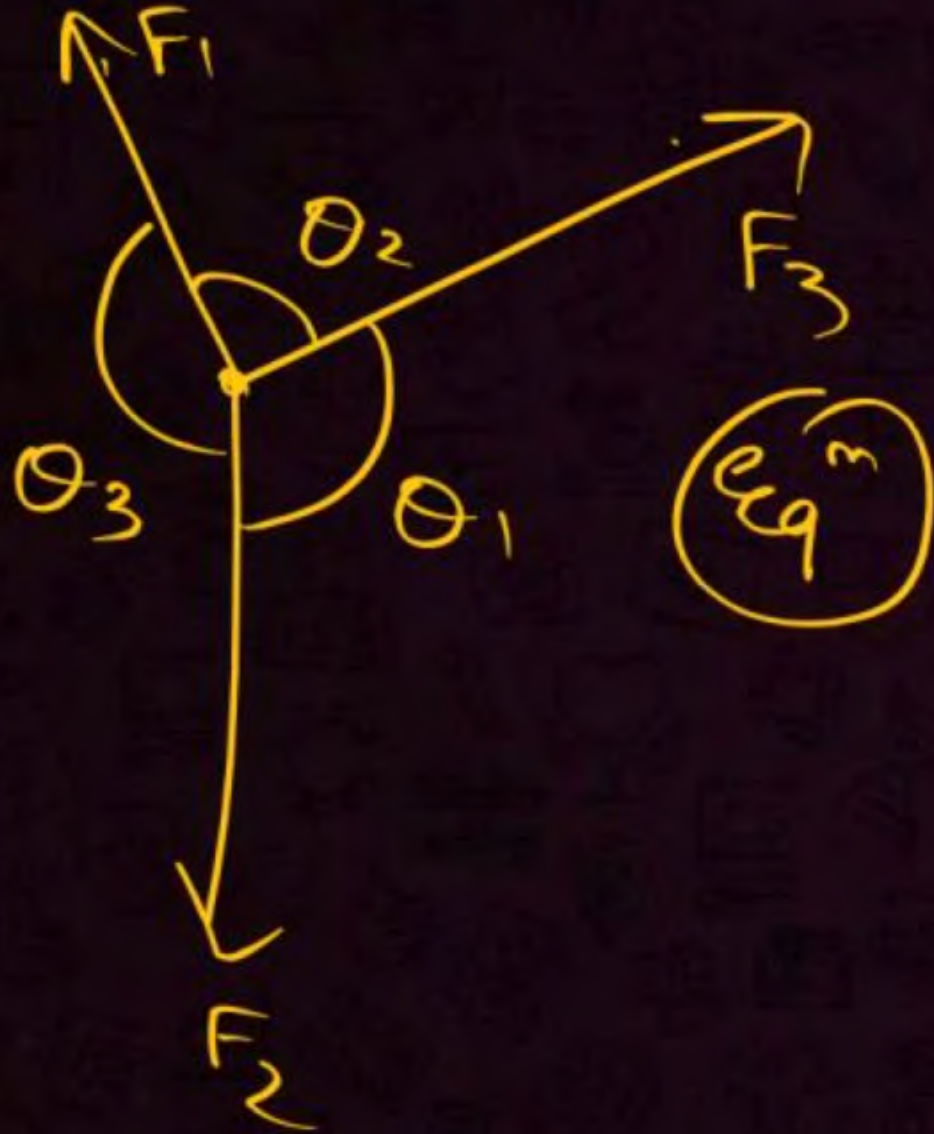
There are four forces acting at a point P produced by strings as shown in figure, which is at rest. The forces F_1 and F_2 are **[NCERT Based]**

- 1 $\frac{1}{\sqrt{2}} \text{ N}, \frac{3}{\sqrt{2}} \text{ N}$
- 2 $\frac{3}{\sqrt{2}} \text{ N}, \frac{1}{\sqrt{2}} \text{ N}$
- 3 $\frac{1}{\sqrt{2}} \text{ N}, \frac{1}{\sqrt{2}} \text{ N}$
- 4 $\frac{3}{\sqrt{2}} \text{ N}, \frac{3}{\sqrt{2}} \text{ N}$



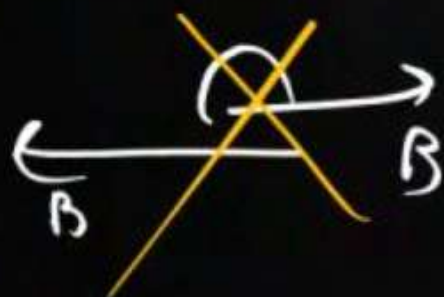
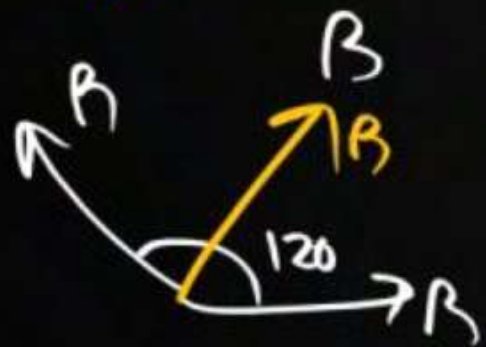
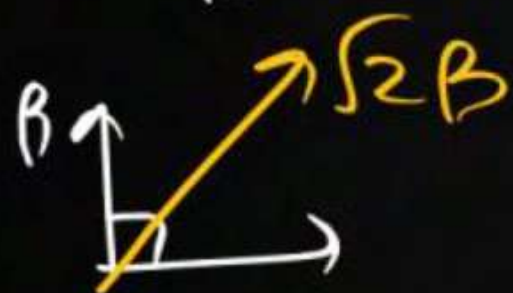
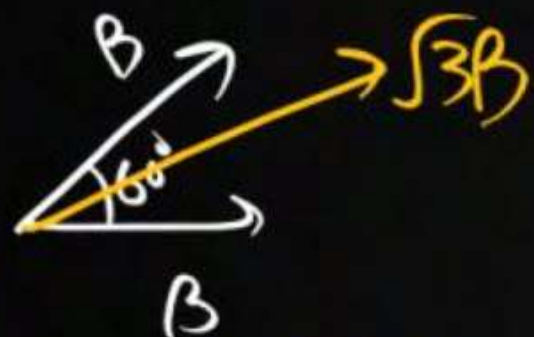
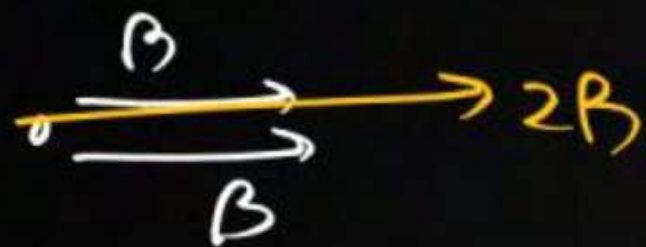


5.3 Lami's Theorem & Lami Aunty

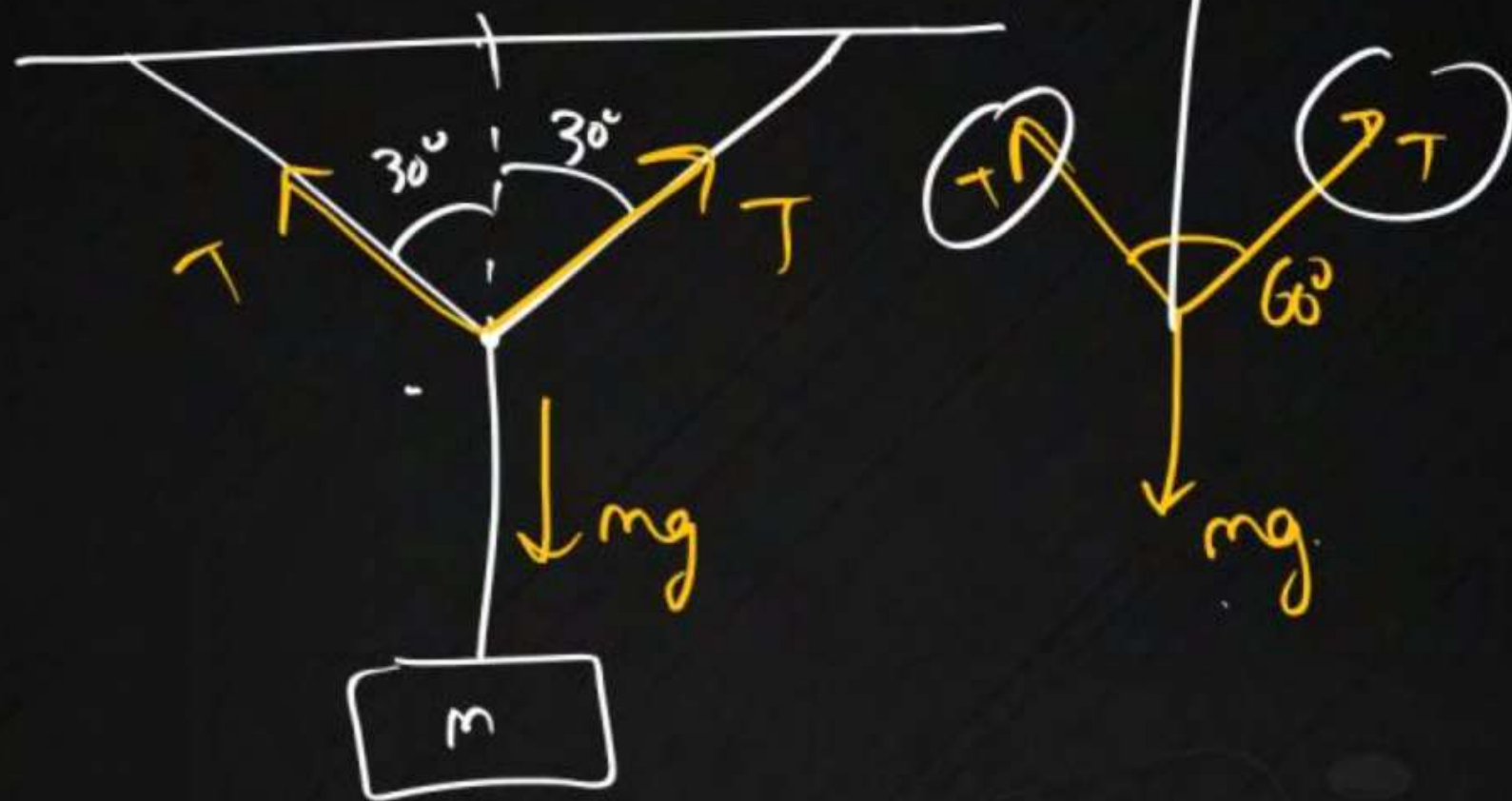


$$\frac{F_1}{\sin \theta_1} = \frac{F_2}{\sin \theta_2} = \frac{F_3}{\sin \theta_3}$$

Babli addition



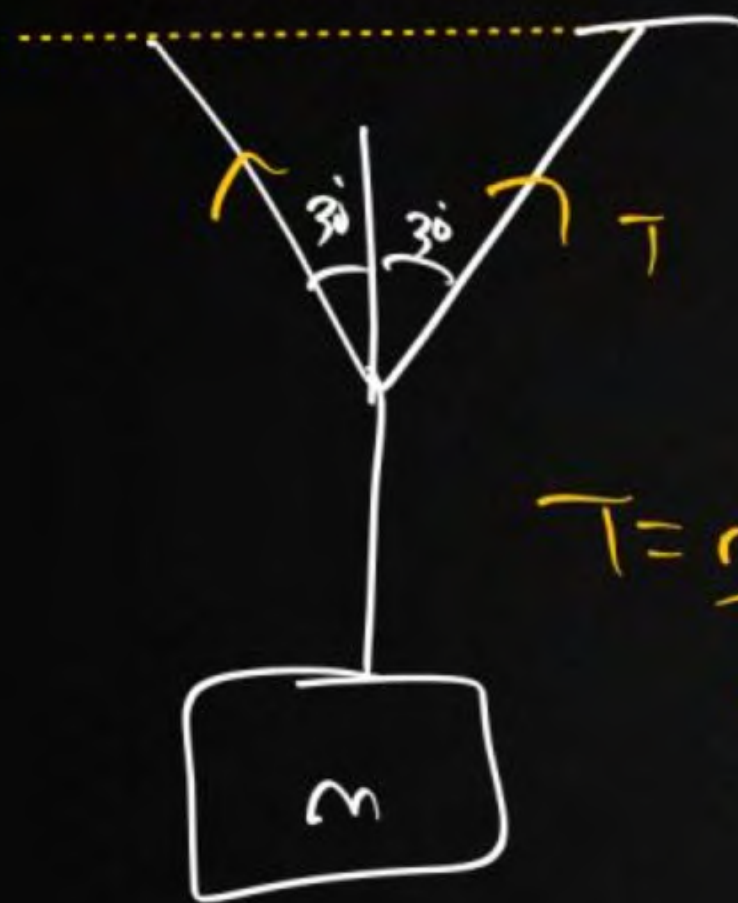
Babli + Lami



$$\sqrt{3}T = mg$$

$$T = \frac{mg}{\sqrt{3}}$$

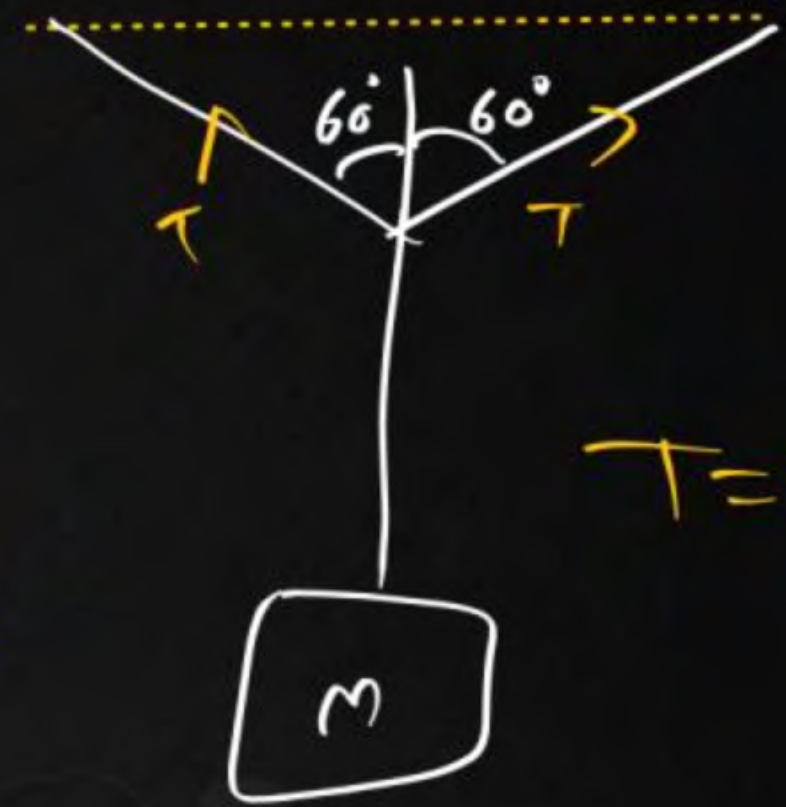
Y/W



$$T = \frac{mg}{\sqrt{3}}$$

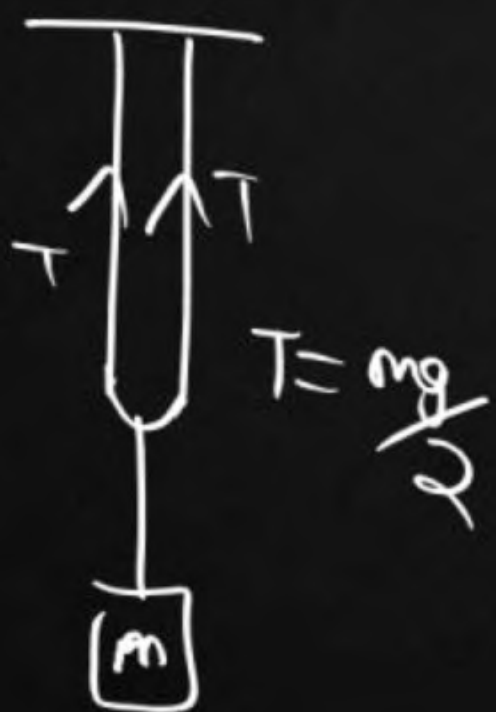


$$T = \frac{mg}{\sqrt{2}}$$



$$T = mg$$

Least Tension



$$T = \frac{mg}{2}$$

Max Tension ($T = \infty$)



QUESTION-91

Difficulty Level : MEDIUM



A weight Mg is suspended from the middle of a rope whose ends are at the same level. The rope is no longer horizontal. The minimum tension required to completely straighten the rope is

- 1 $Mg/2$
- 2 $Mg \cos \theta$
- 3 $2 Mg \cos \theta$
- 4 Infinitely large

QUESTION-92**Difficulty Level : Easy***hw*

Two persons hold a rope of negligible weight tightly at its ends so that it is horizontal. A 15 N weight is attached to the rope at the mid point which now no longer remains horizontal. The minimum tension required to completely straighten the top is

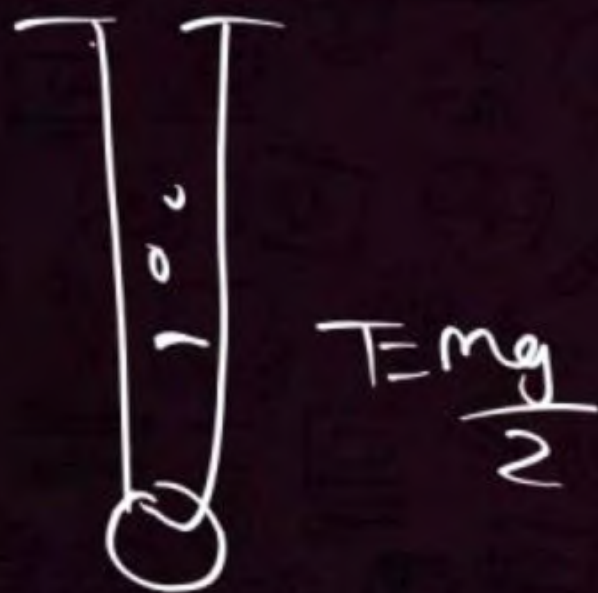
- 1** 15 N
- 2** $15/2$ N
- 3** 5 N
- 4** Infinitely large



QUESTION-93**Difficulty Level : MEDIUM**

A boy of mass 40 kg is hanging from the horizontal branch of a tree. The tension in his arms is minimum when the angle between the arms is:-

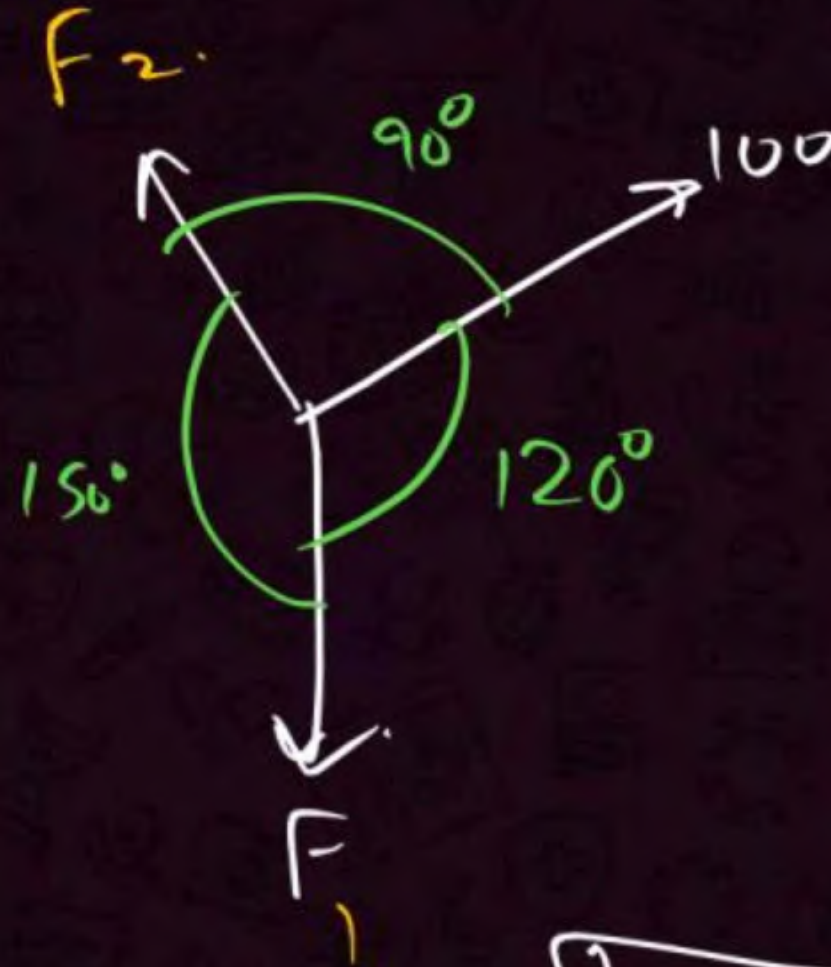
- ☒ 1 0°
- ☐ 2 90°
- ☐ 3 120°
- ☐ 4 180°



QUESTION-94

Q. 94^m $F = ??$

Difficulty Level : MEDIUM



$$\frac{F_1}{\sin 90} = \frac{F_2}{\sin 120} = \frac{100}{\sin 150}$$

$$F_1 = \frac{F_2}{\sqrt{3}} = \frac{100 \times 2}{\sqrt{3}}$$

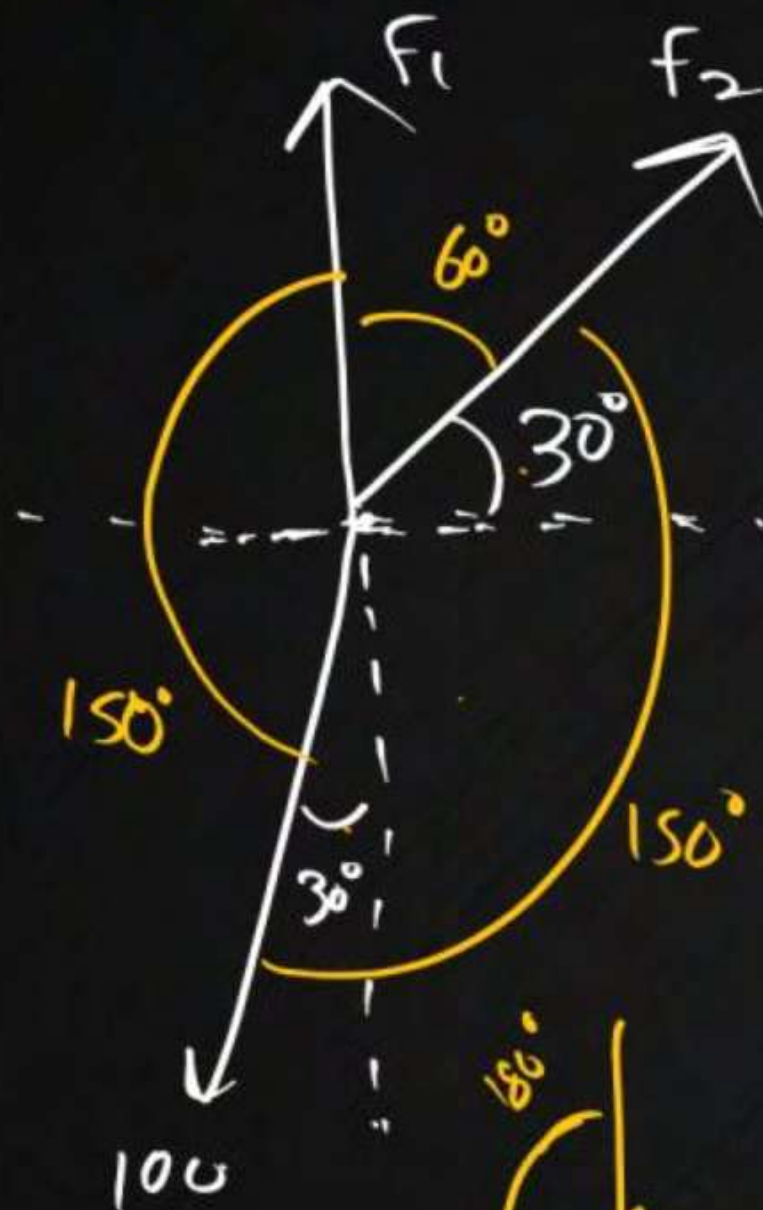
$$F_1 = 200N$$

$$F_2 = \frac{100 \times \sqrt{3}}{\sqrt{3}}$$

$$F_2 = 100\sqrt{3}$$

θ	$\sin \theta$
0	0
30	$\frac{1}{2}$
45	$\frac{1}{\sqrt{2}}$
60	$\frac{\sqrt{3}}{2}$
90	1
120	$\frac{\sqrt{3}}{2}$
135	$\frac{1}{\sqrt{2}}$
150	$\frac{1}{2}$
180	0

(I) Angles



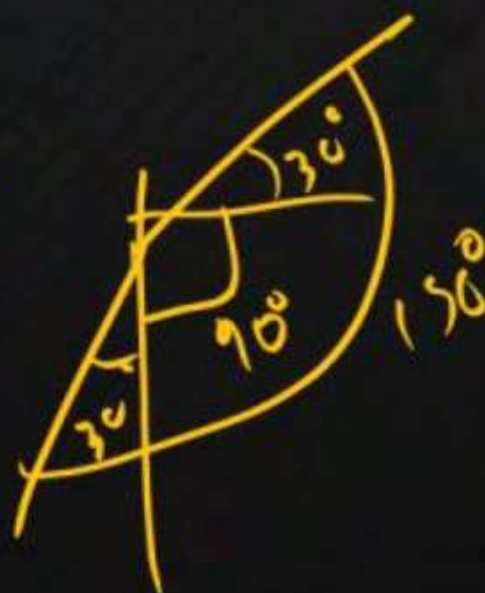
$$\frac{F_1}{\sin 150} = \frac{F_2}{\sin 150} = \frac{100}{\sin 60}$$

$$\cancel{F_1} = \cancel{F_2} = \cancel{100} \sqrt{3}$$

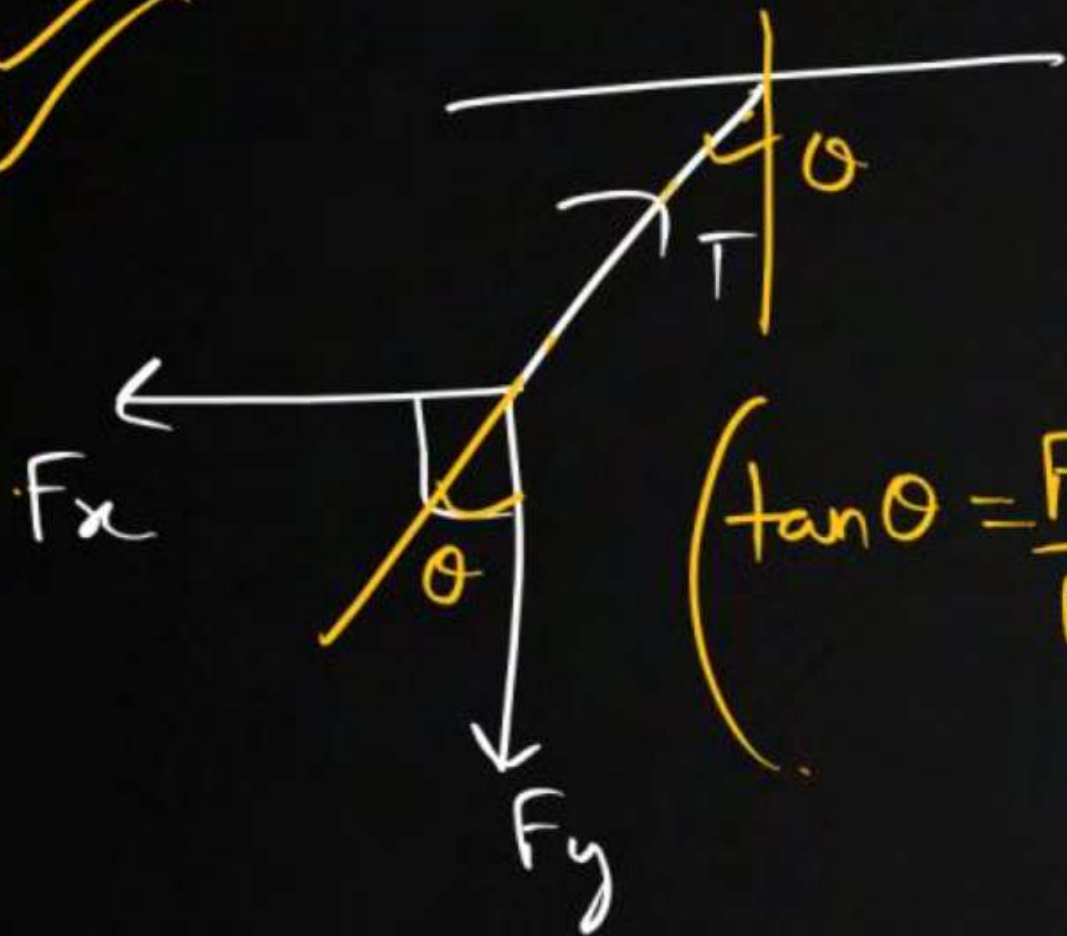
$$\sin 150 = \frac{1}{2}$$

$$\sin 60 = \frac{\sqrt{3}}{2}$$

$$F_1 = F_2 = \frac{100}{\sqrt{3}}$$



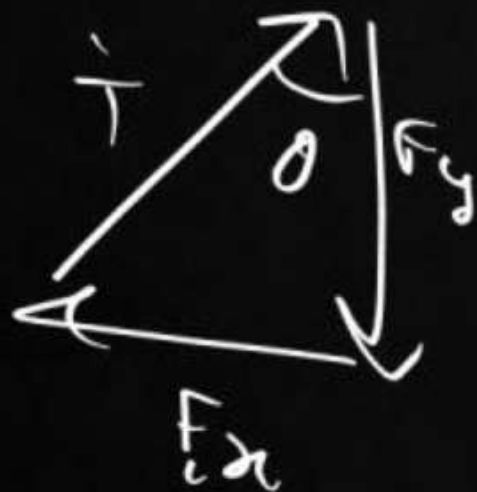
Lami Aunty @ 90 ✓



$$\left(\tan \theta = \frac{F_x}{F_y} \right)$$

$$\vec{F}_x + \vec{F}_y + \vec{T} = 0$$

$$T = \sqrt{F_x^2 + F_y^2}$$



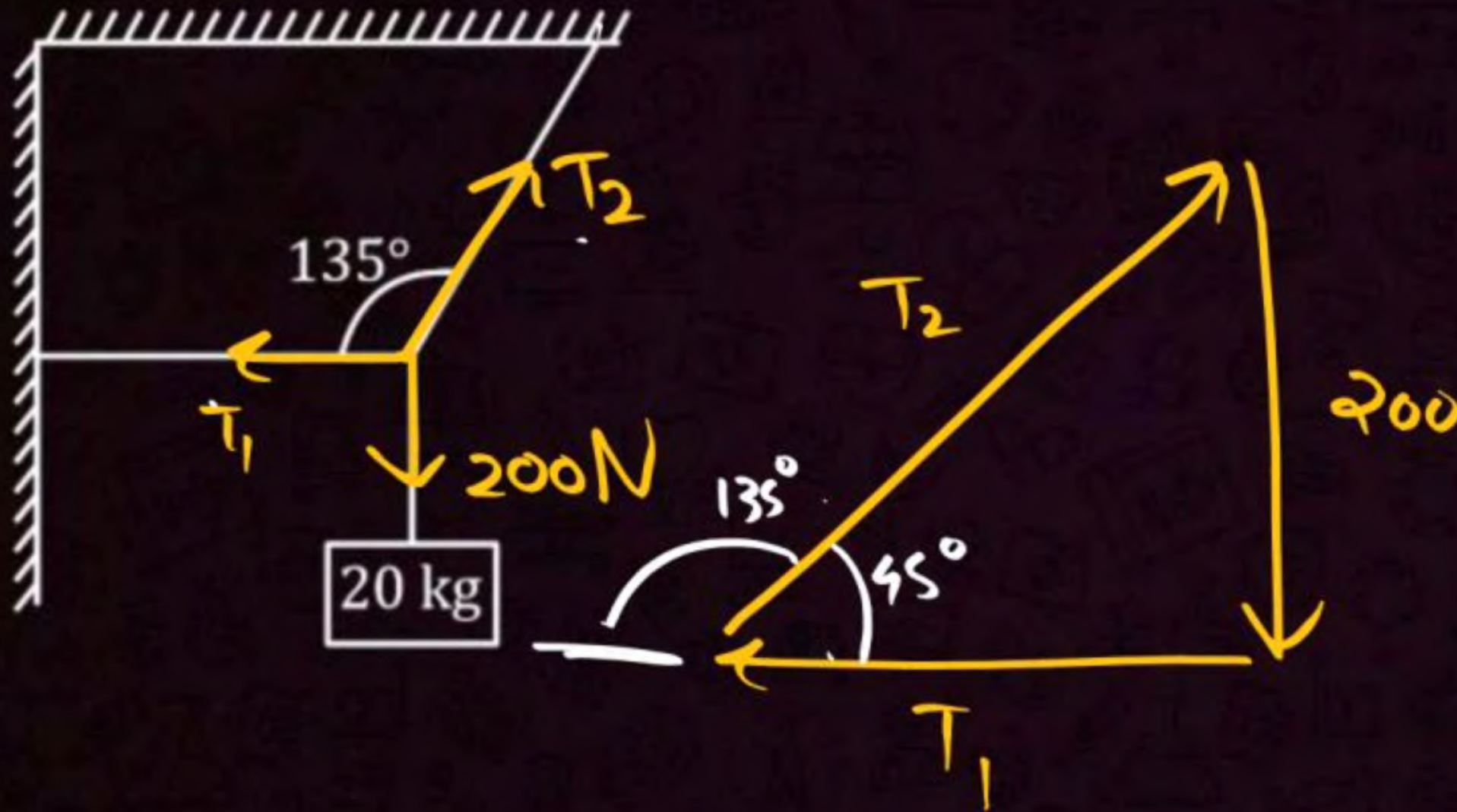
$$\tan \theta = \frac{F_x}{F_y}$$

$$\sin \theta = \frac{F_x}{T}$$

$$\cos \theta = \frac{F_y}{T}$$

QUESTION-95

Difficulty Level : MEDIUM



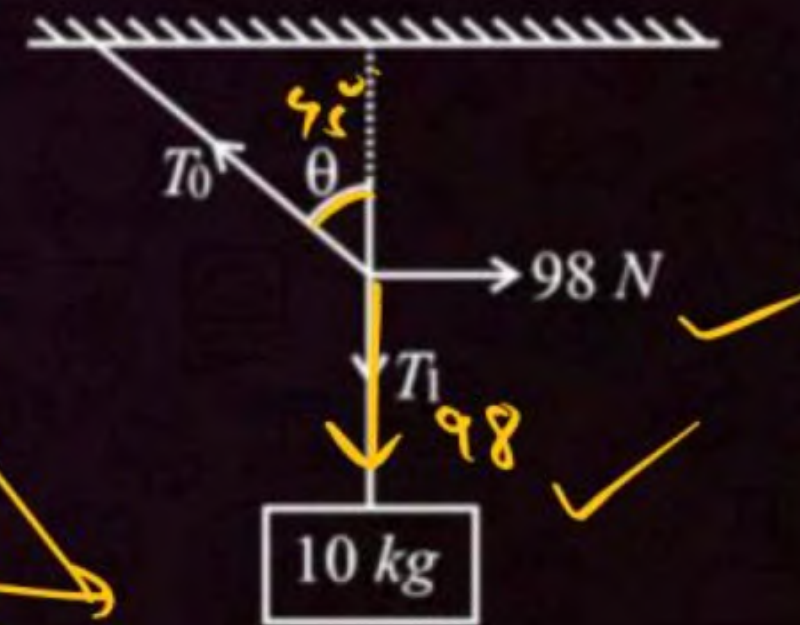
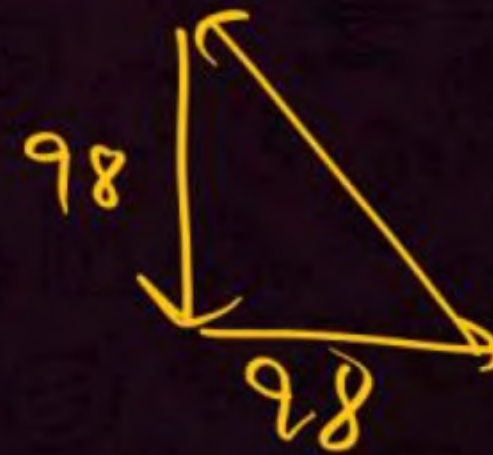
QUESTION-96**Difficulty Level : MEDIUM**

$$g = 9.8$$



A mass of 10 kg is suspended by a rope of length 2.8 m from a ceiling. A force of 98 N is applied at the midpoint of the rope as shown in figure. The angle which the rope makes with the vertical in equilibrium is

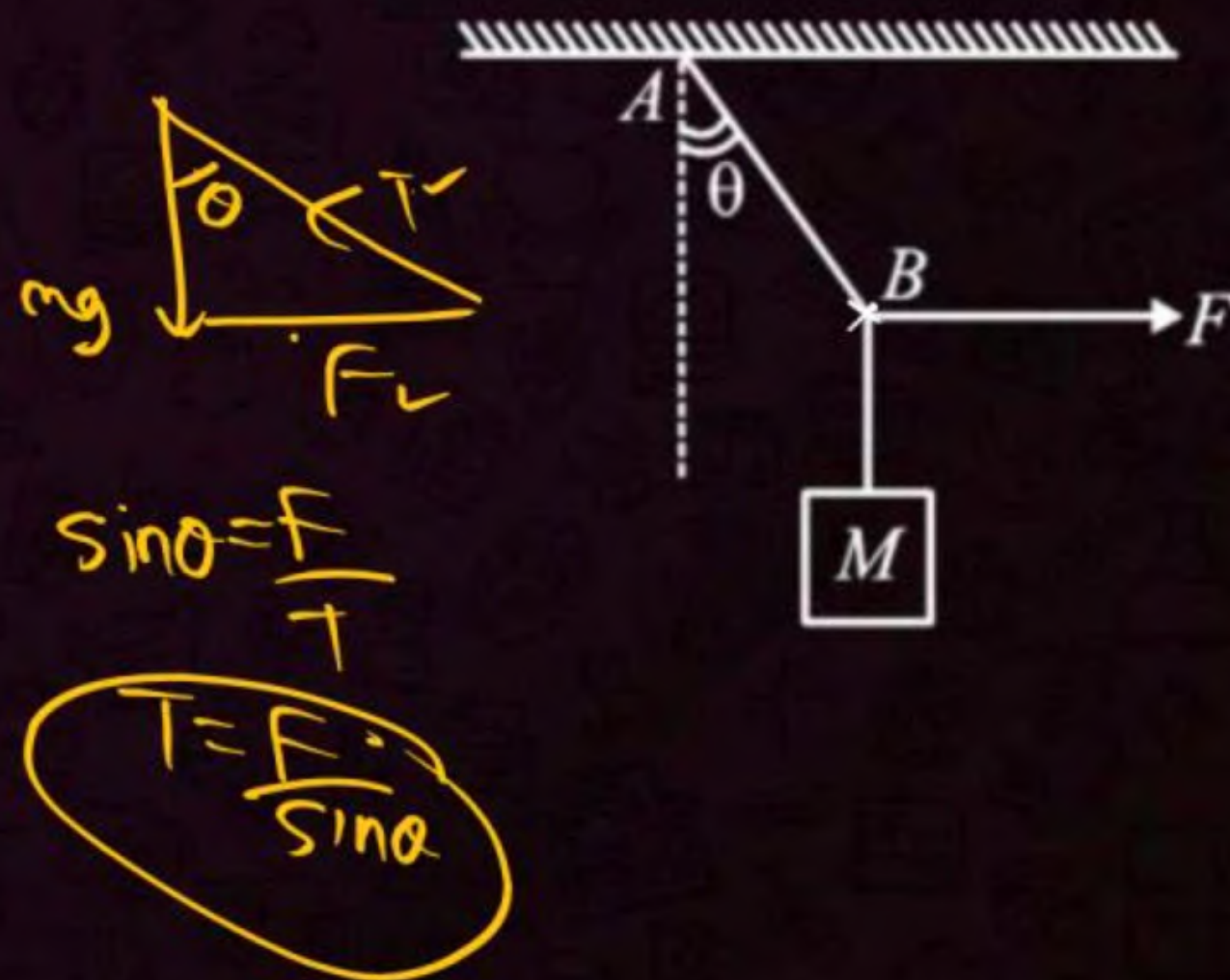
- 1 30°
- 2 60°
- 3 45°
- 4 90°



QUESTION-97**Difficulty Level : MEDIUM**

A mass is suspended by a rope from a rigid support at A as shown in figure. Another rope is tied at the end B, and it is pulled horizontally with a force F . If the rope AB makes an angle θ with the vertical in equilibrium, then the tension in the string AB is

- 1 $F \sin \theta$
- 2 $F / \sin \theta$
- 3 $F \cos \theta$
- 4 $F / \cos \theta$



QUESTION-98

Difficulty Level : MEDIUM



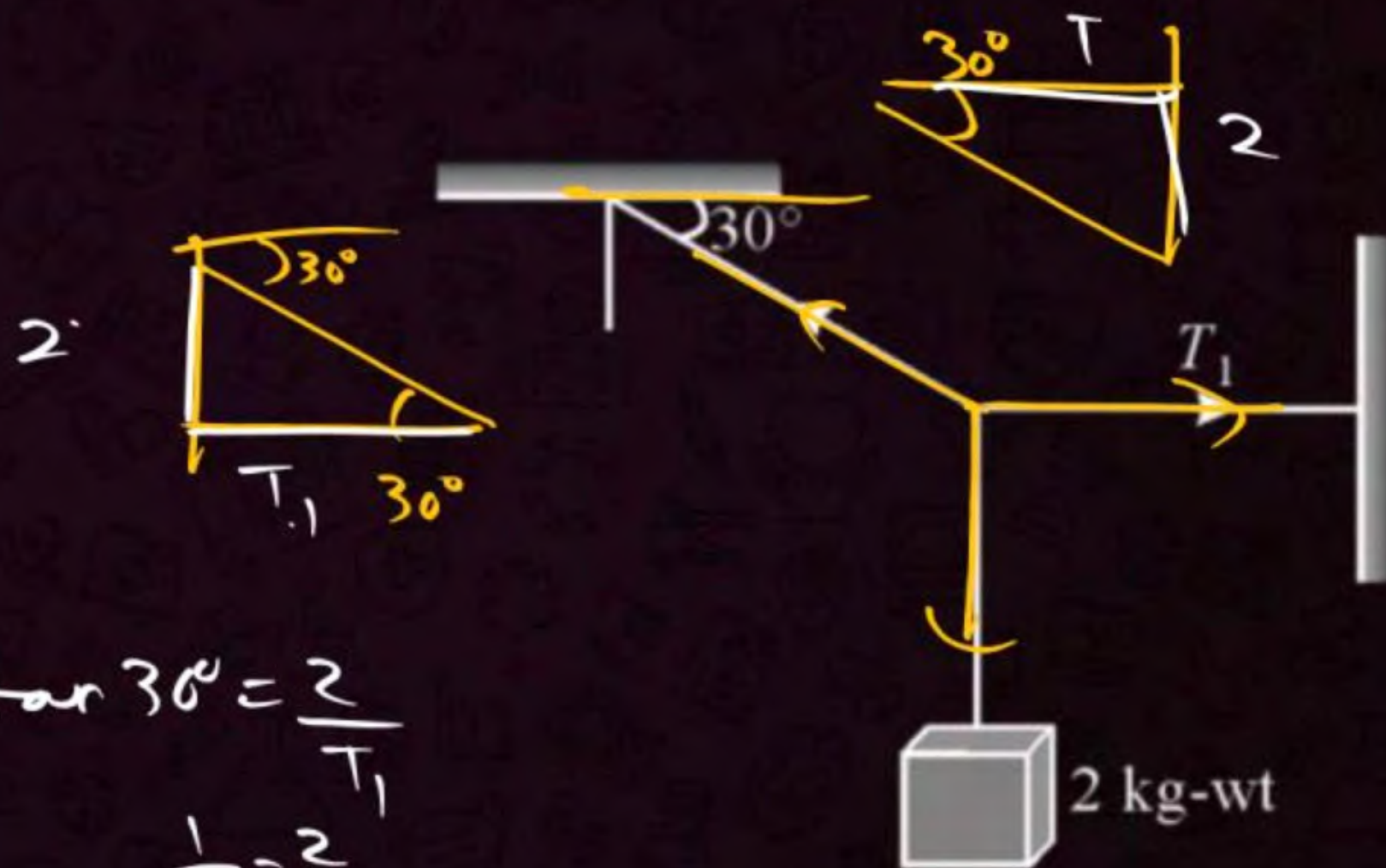
A body of weight 2 kg is suspended as shown in the figure. The tension T_1 in the horizontal string (in kg wt.) is

1 $2/\sqrt{3}$

2 $\sqrt{3}/2$

3 $2\sqrt{3}$

4 2



$$\tan 30^\circ = \frac{2}{T_1}$$

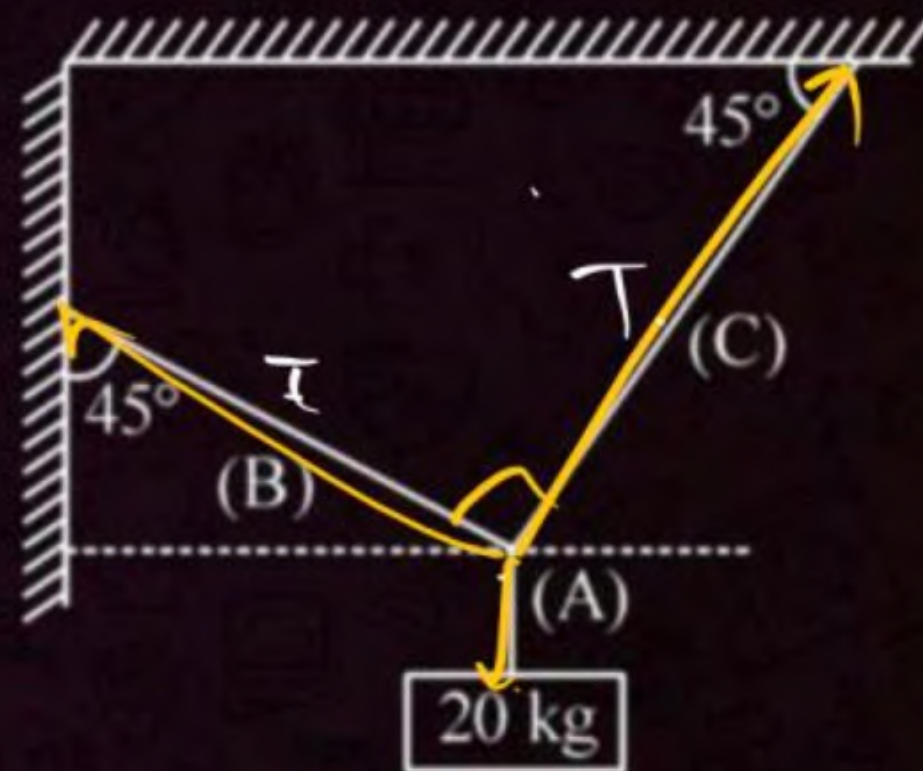
$$\frac{1}{\sqrt{3}} = \frac{2}{T_1}$$

$$T_1 = 2\sqrt{3}$$

QUESTION-99**Difficulty Level : MEDIUM***HW //*

In the given diagram, the tension in string C is:

- 1 100 N
- 2 70.7 N
- 3 141 N
- 4 200 N

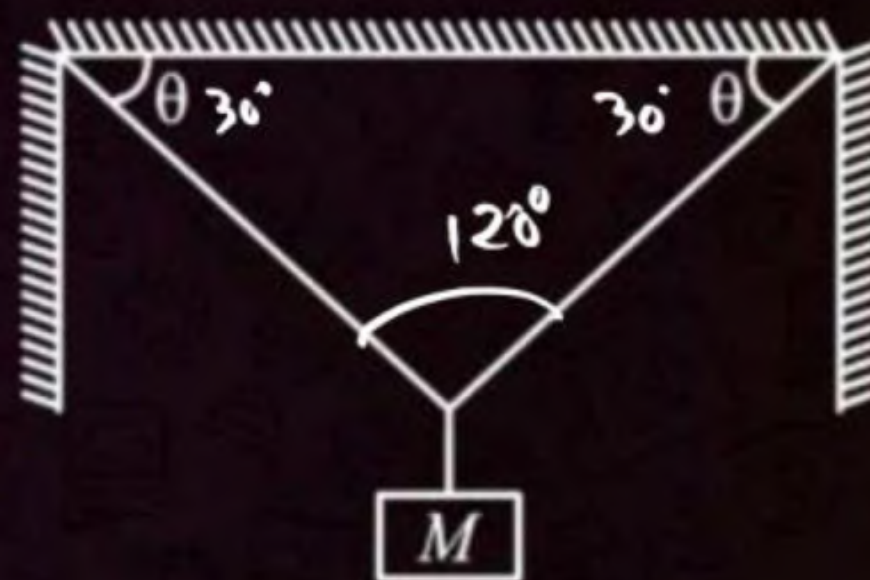


$$200 = T\sqrt{2}$$

QUESTION-100**Difficulty Level : MEDIUM***hw //*

Find tension in string if $\theta = 30^\circ$ and the mass hanged in middle of the string is equal to 22kg.

- 1 110 N
- 2 220 N ✓
- 3 Infinite
- 4 Between 110 N & 220 N

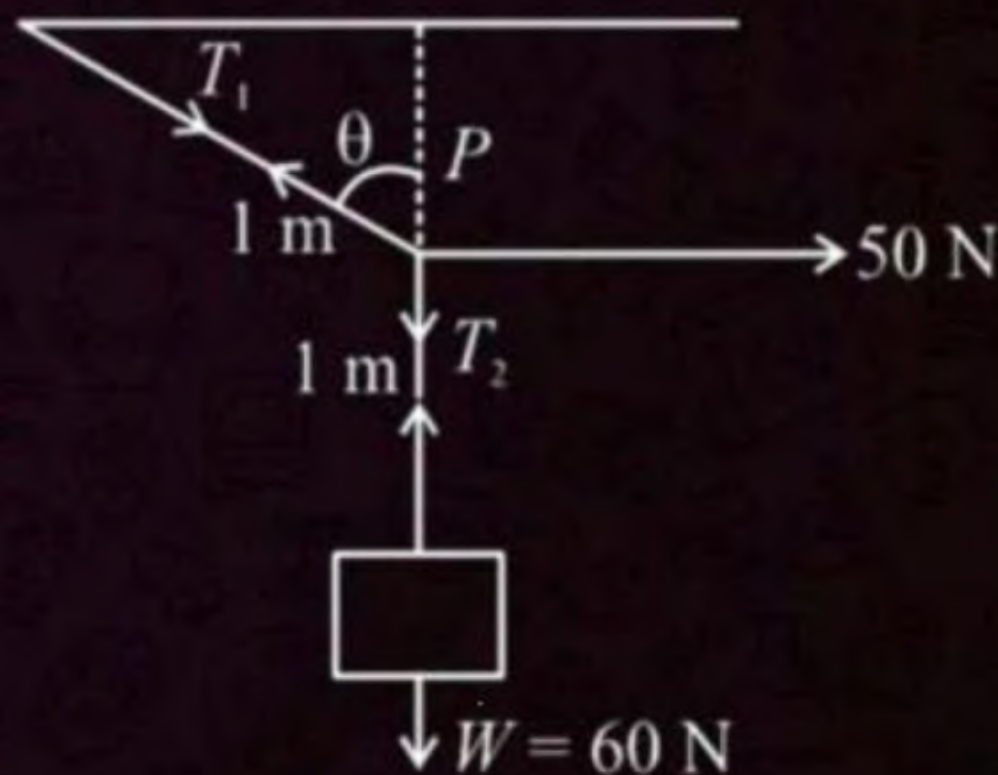


QUESTION-101**Difficulty Level : MEDIUM**

nw//

A mass of 6 kg is suspended by a rope of length 2 m from a ceiling. A force of 50 N is applied in horizontal direction at the mid point of the rope. What is the angle between the rope and the vertical in equilibrium:-

- 1 $\tan^{-1} \left(\frac{4}{5} \right)$
- 2 $\tan^{-1} \left(\frac{5}{4} \right)$
- 3 $\tan^{-1} \left(\frac{5}{6} \right)$
- 4 None

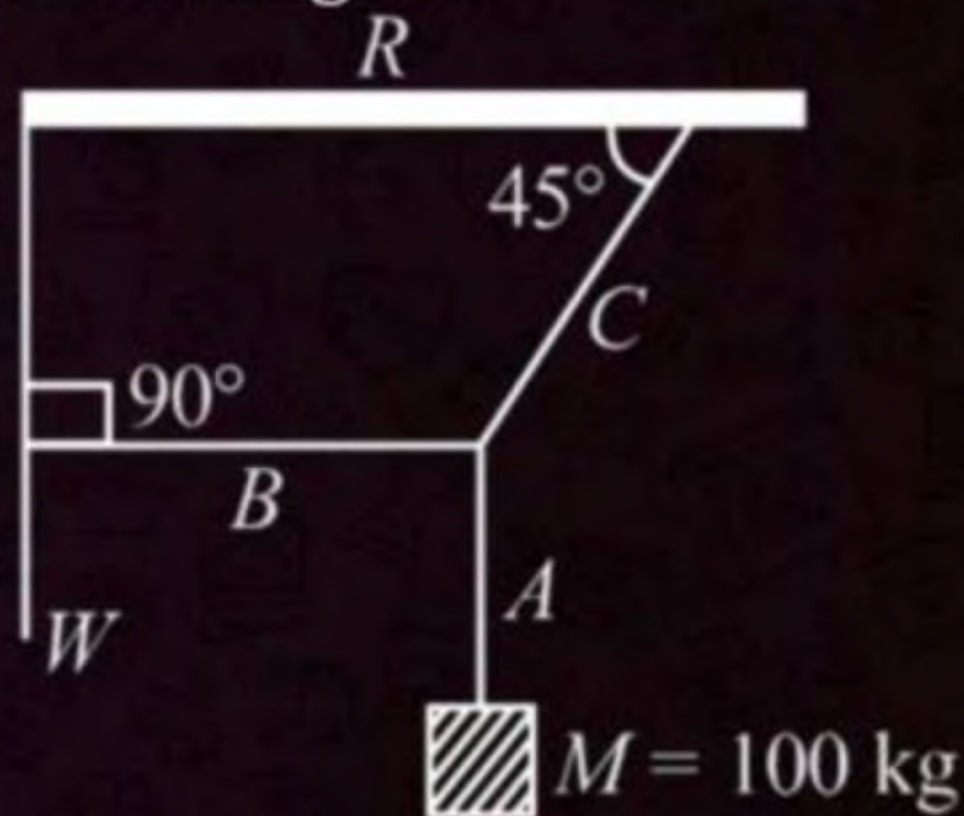


QUESTION-102**Difficulty Level : MEDIUM**

nw//

A mass $M = 100$ kg is suspended with the use of stings A, B and C as shown, W is a vertical wall and R is a rigid horizontal rod. The tension in string B is:

- 1 100 g newton
- 2 zero
- 3 $100\sqrt{2}$ gnewton
- 4 $100/\sqrt{2}$ gnewton



QUESTION-103

Difficulty Level : Hard



A metal sphere is hung by a string fixed to a wall. The forces acting on the sphere are shown in fig. Which of the following statements is correct?

- (a) $\vec{R} + \vec{T} + \vec{W} = 0$ ✓
 (b) $T^2 = R^2 + W^2$ ✓
 (c) $T = R + W$ ✗
 (d) $R = W \tan \theta$

- 1 a, b, c ✗
 2 b, c, d ✗
 3 a, b, d ✓
 4 a, b, c, d ✗



$$\tan \theta = \frac{R}{w}$$



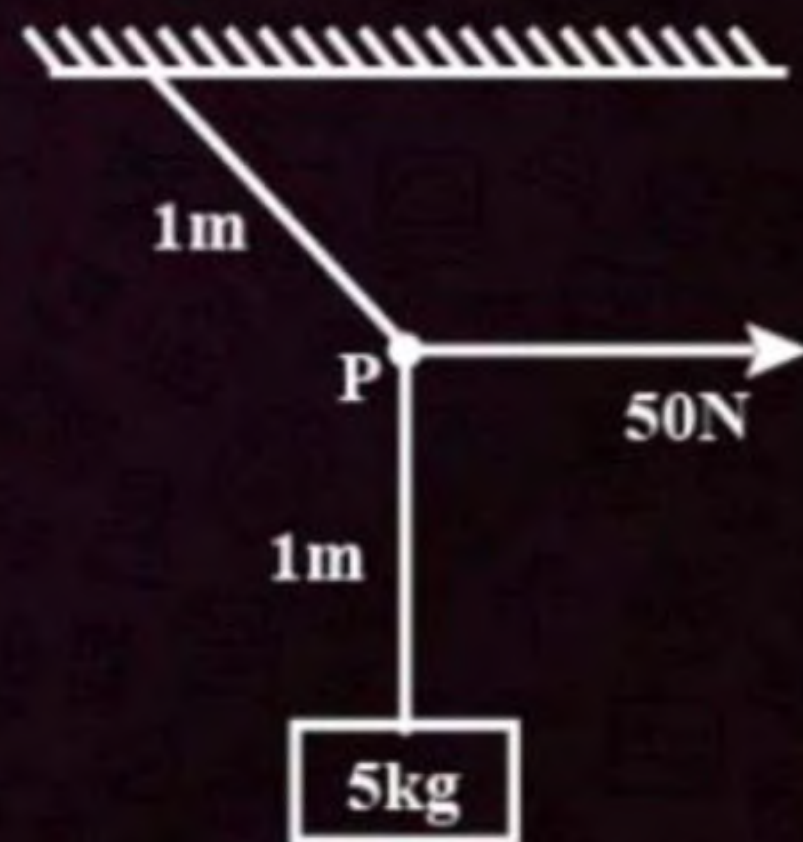
QUESTION-104**Difficulty Level : MEDIUM**

nw ✓✓

A block of mass 5 kg is suspended by a massless rope of length 2 m from the ceiling. A force of 50 N is applied in the horizontal direction at the midpoint P of the rope, as shown in the figure. The angle made by the rope with the vertical in equilibrium is (Take $g = 10 \text{ m s}^{-2}$)

[NCERT Based]

- 1 30°
- 2 40°
- 3 60°
- 4 45°



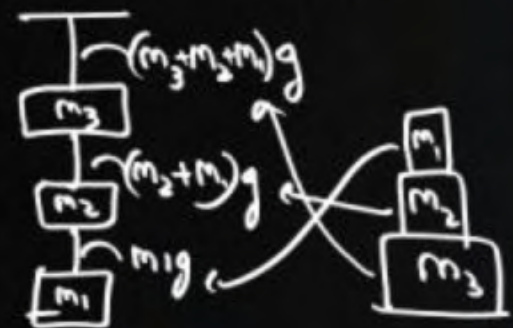
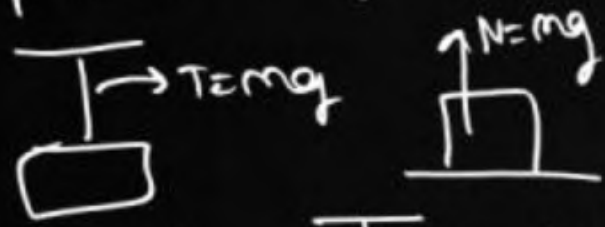
PUPPY POINTS 2

$$W = mg \quad T \text{ (dane ka)}$$

N (chipane ka force)

Contact lost $N = 0$

Upthrust - Buoyancy



F_1, F_2, F_3
 $\theta_1, \theta_2, \theta_3$
 $\frac{F_1}{\sin \theta_1} = \frac{F_2}{\sin \theta_2} = \frac{F_3}{\sin \theta_3}$
 $\tan \theta = \frac{F_x}{F_y}$
 $\vec{F}_x + \vec{F}_y + \vec{T} = 0$
 $T = \sqrt{F_x^2 + F_y^2}$

use Babli

QUESTION-105**Difficulty Level : Hard**

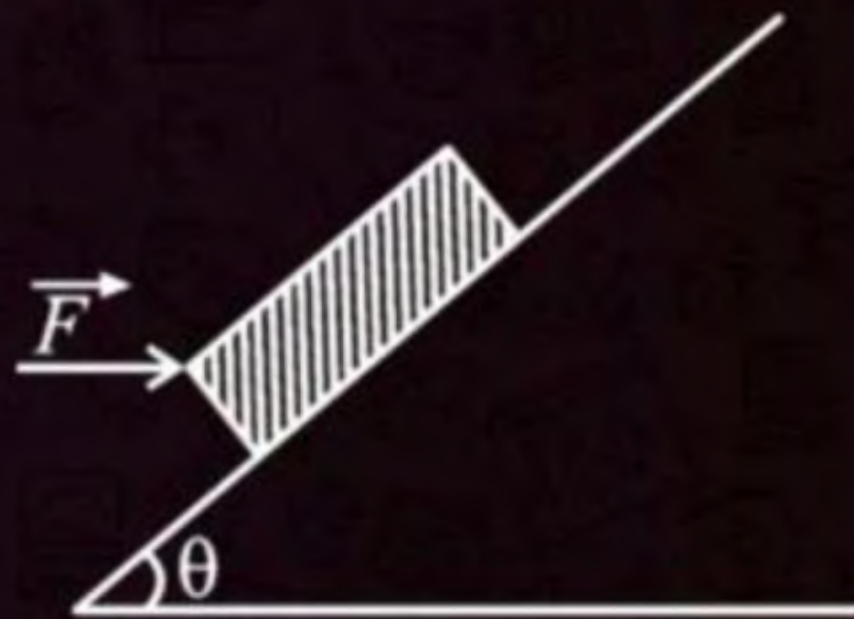
The figure shows a horizontal force $\vec{F}$ acting on a block of mass M on an inclined plane (angle θ). What is the normal reaction on the block?

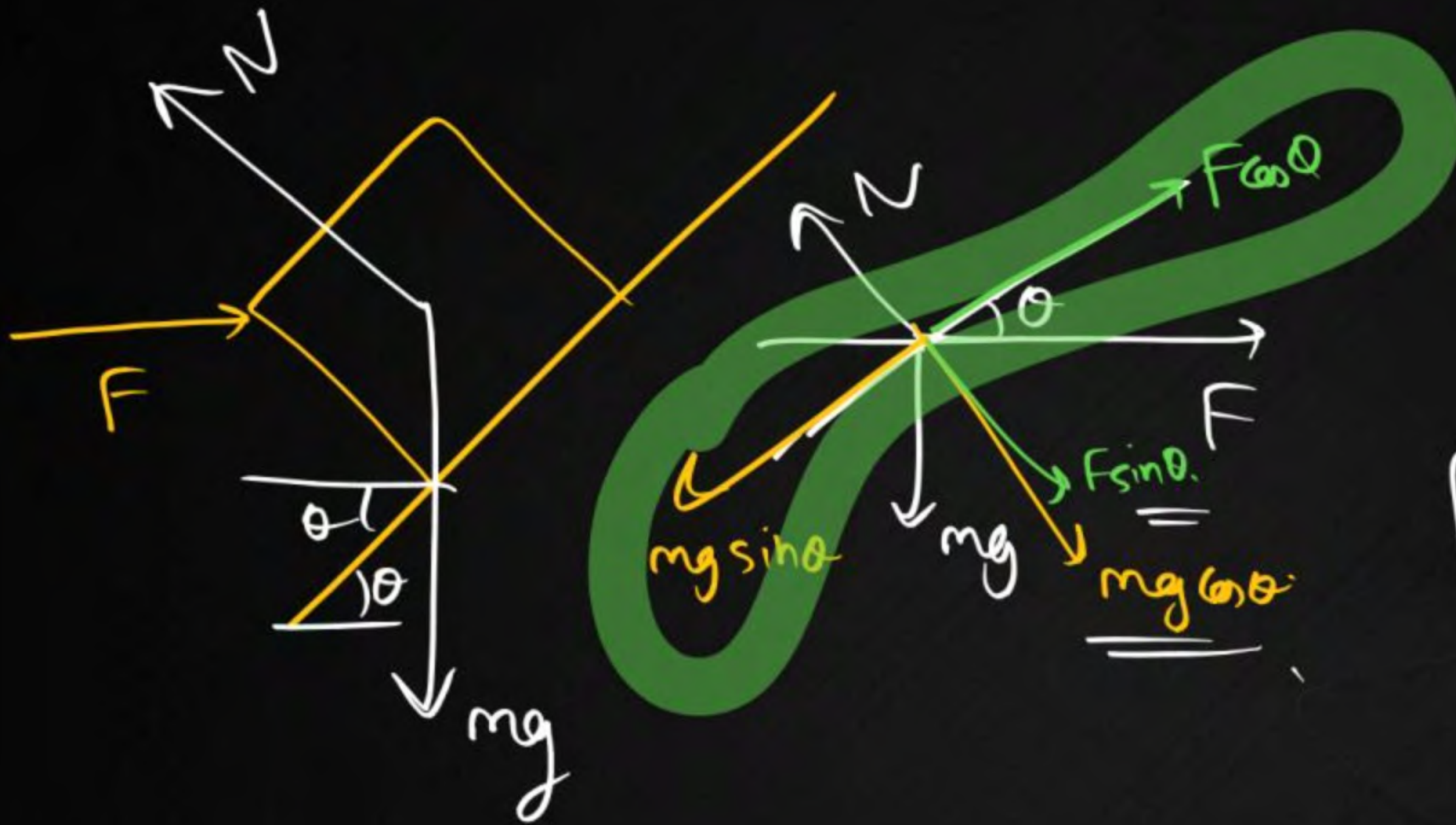
1 $mg \sin \theta + F \cos \theta$

2 $mg \sin \theta - F \cos \theta$

3 $mg \cos \theta - F \sin \theta$

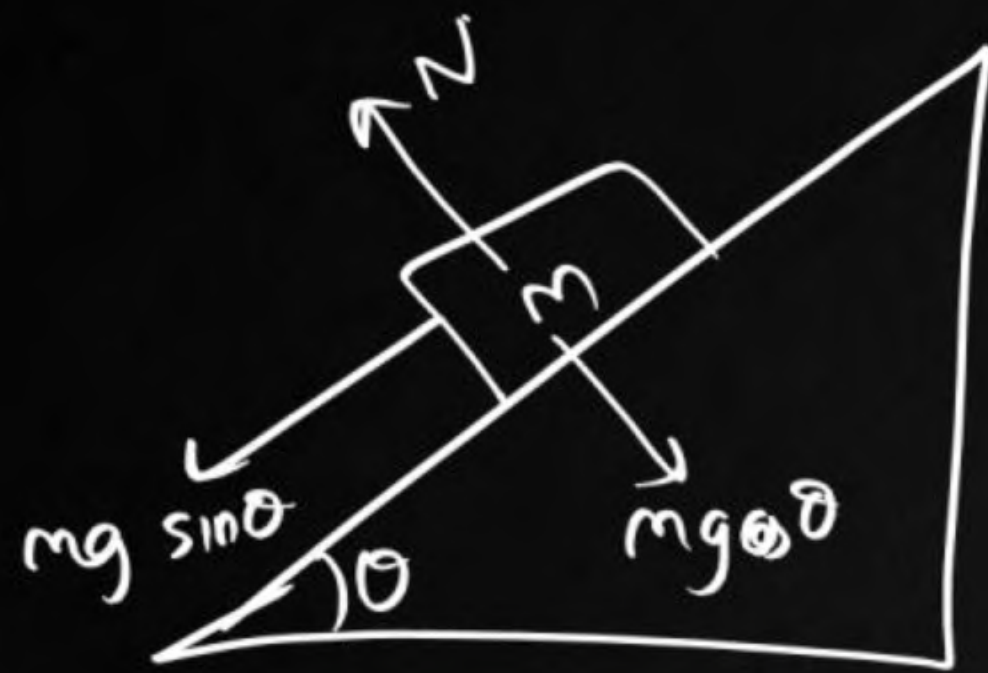
4 $mg \cos \theta + F \sin \theta$ ✓✓



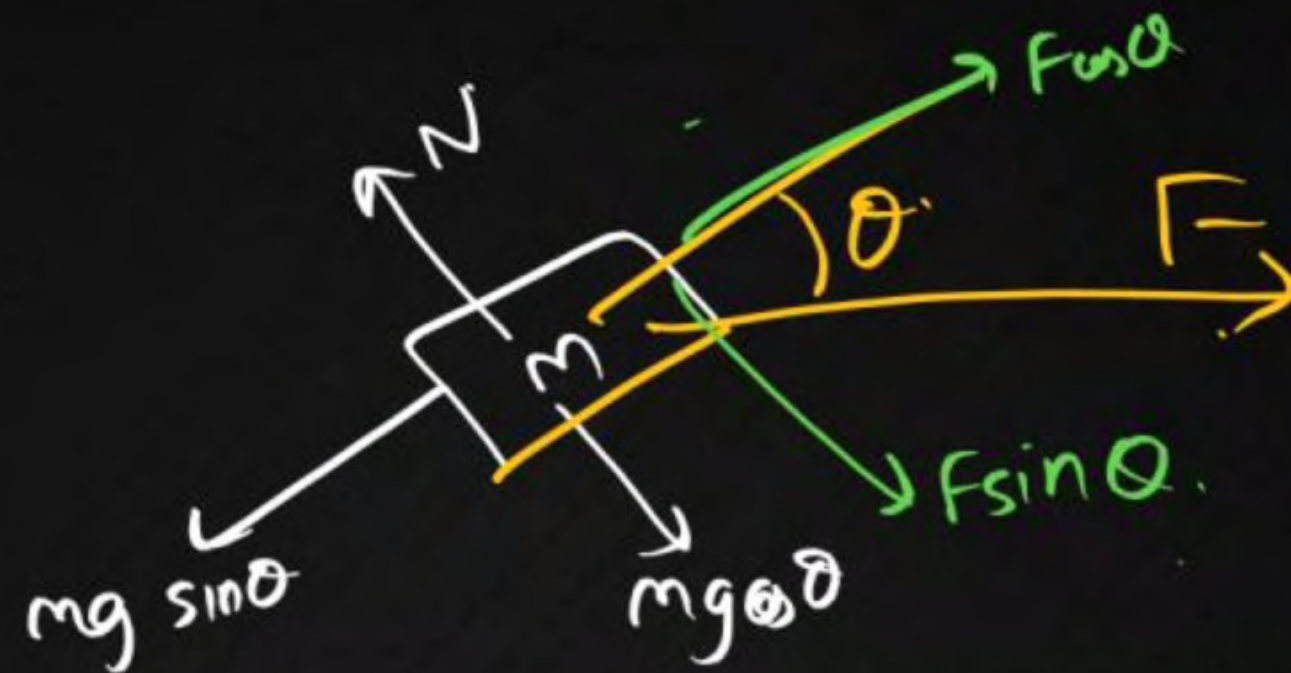


$$mg \sin \theta = F \cos \theta$$

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



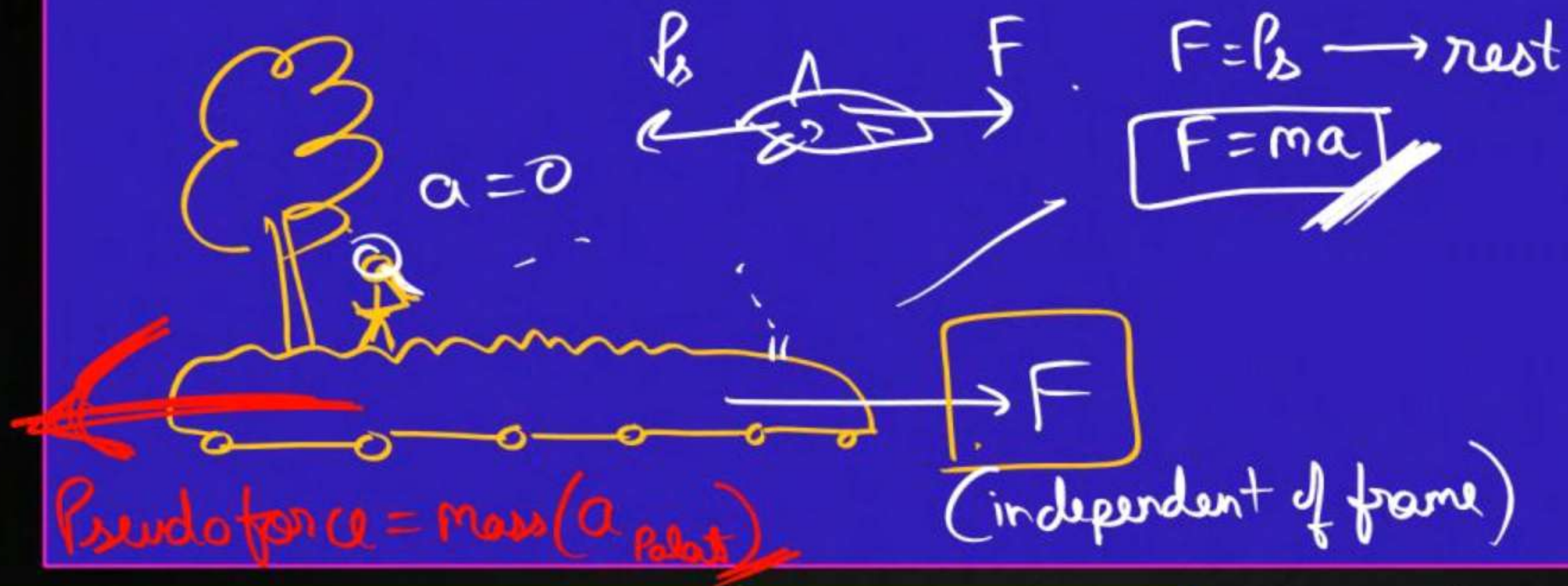
$$N = mg \cos \theta$$



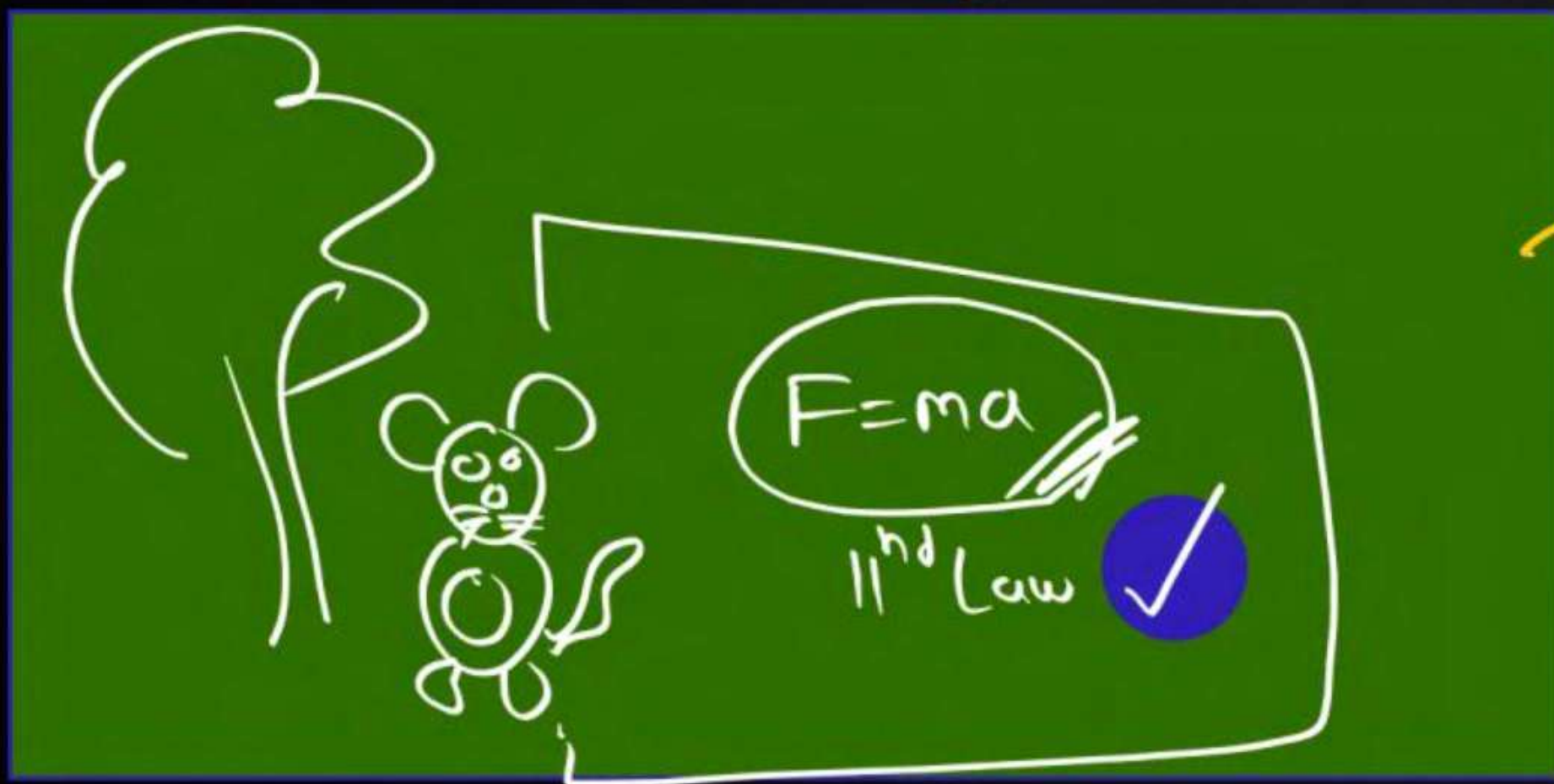
$$N = mg \cos \theta + F \sin \theta$$

Part 6 – Pseudoforce

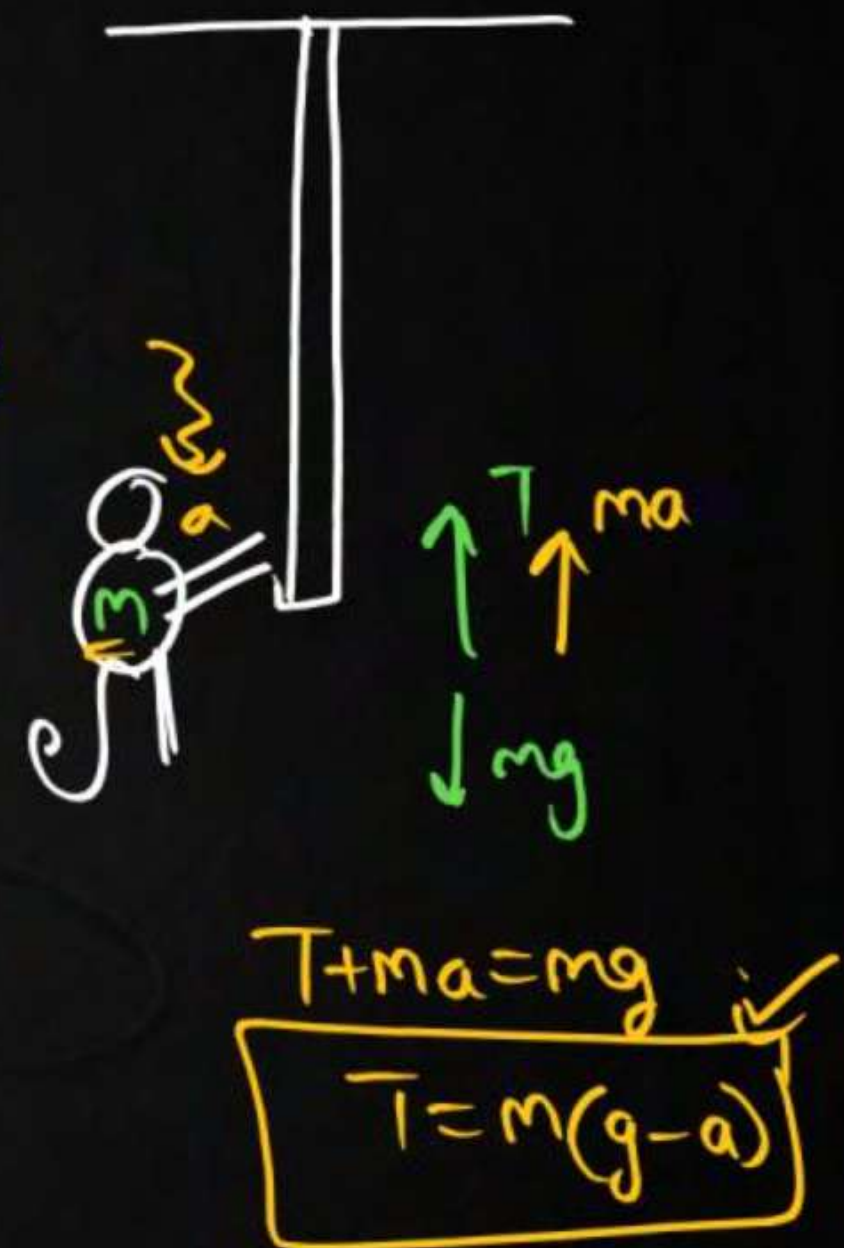
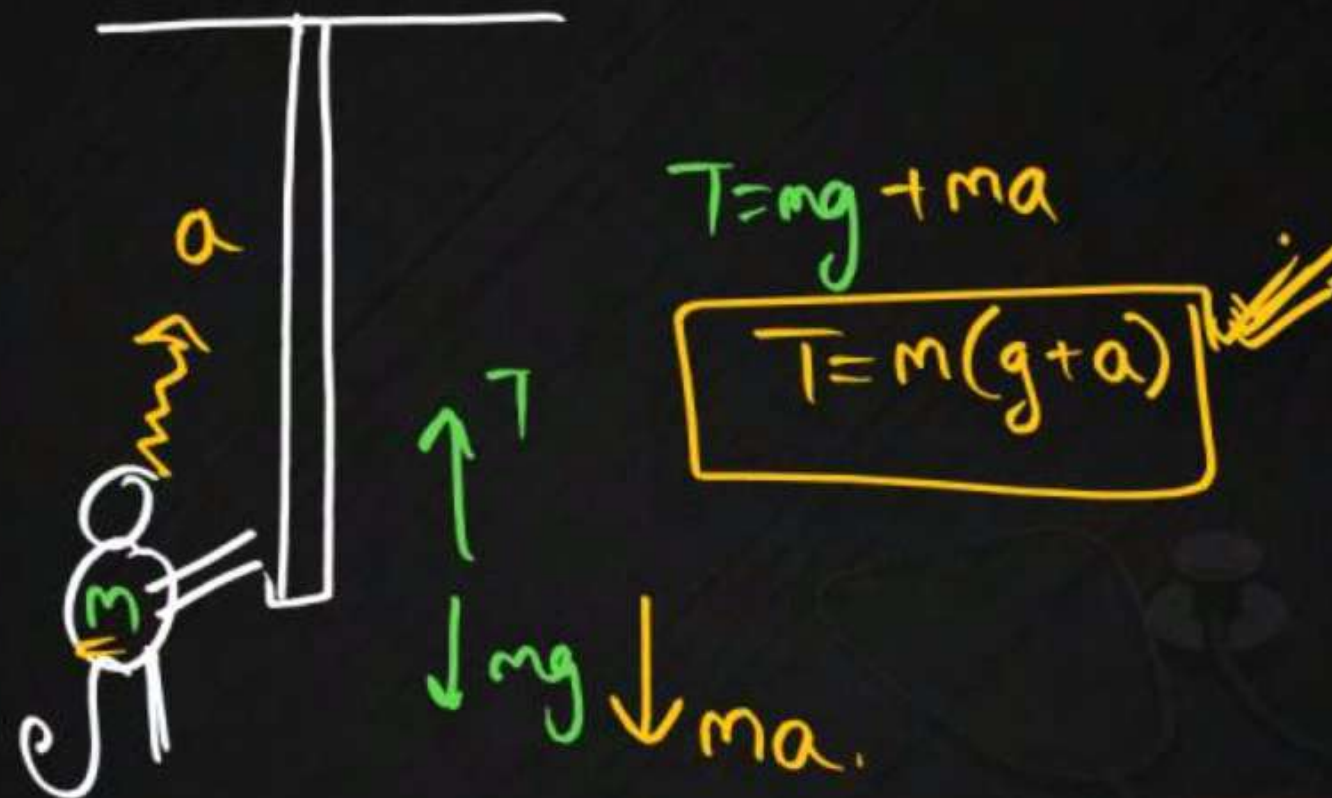
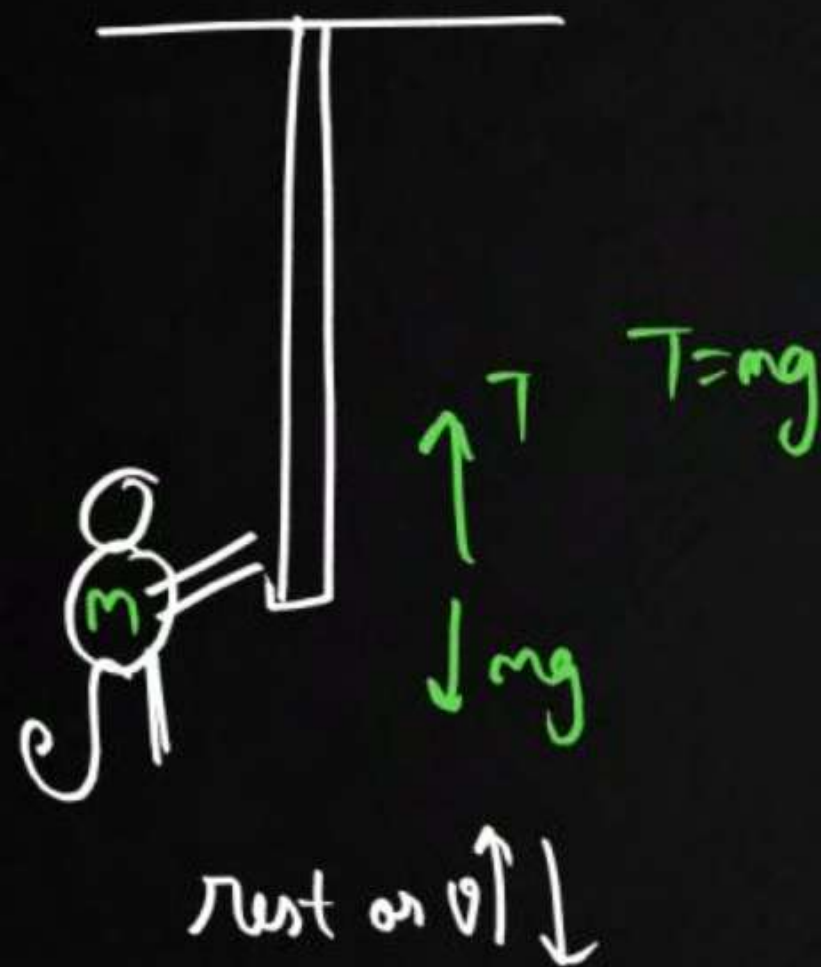




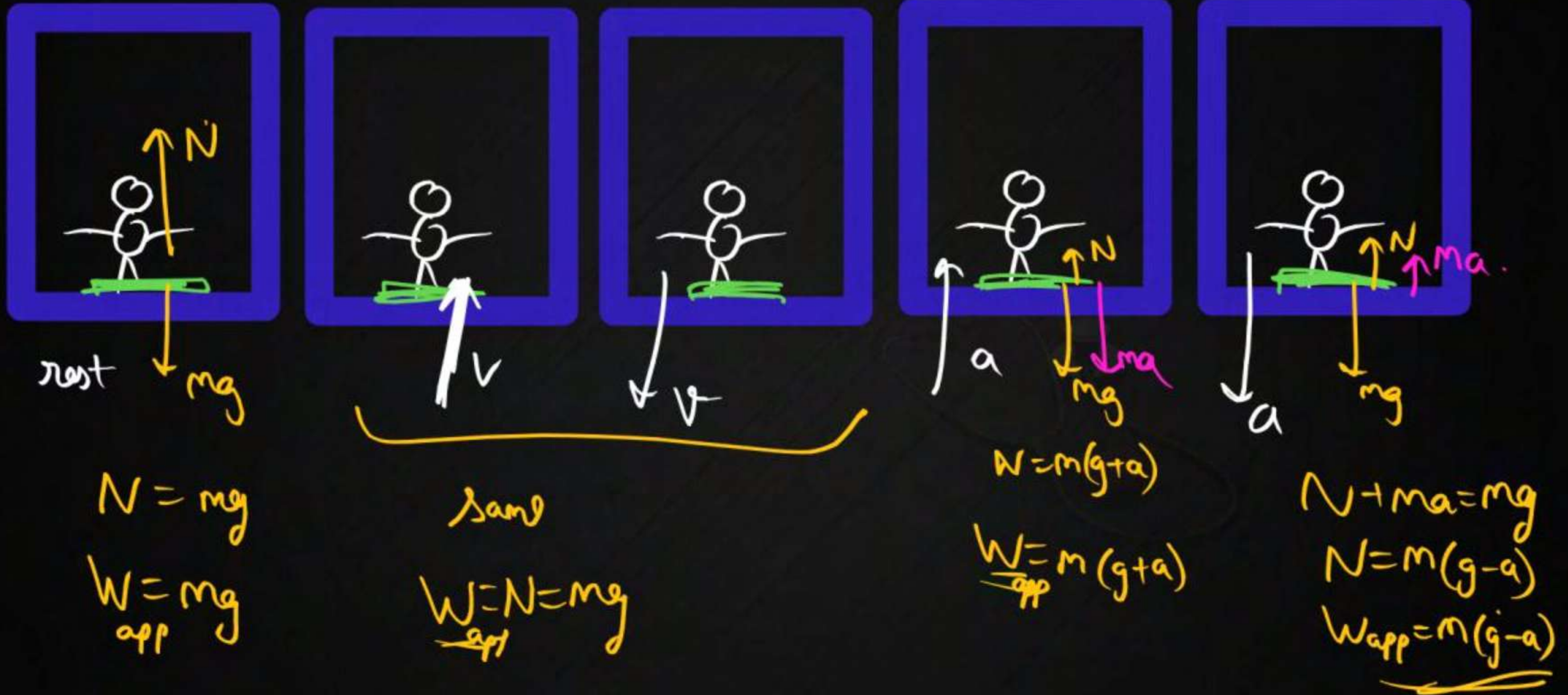
Non inertial frame.
 $(a \neq 0)$



Inertial Frame ($a = 0$)
(Newton's Law are valid)
(At Rest / uniform motion)



♡ Weighing machine measures Normal force.



QUESTION-106

Difficulty Level : Easy

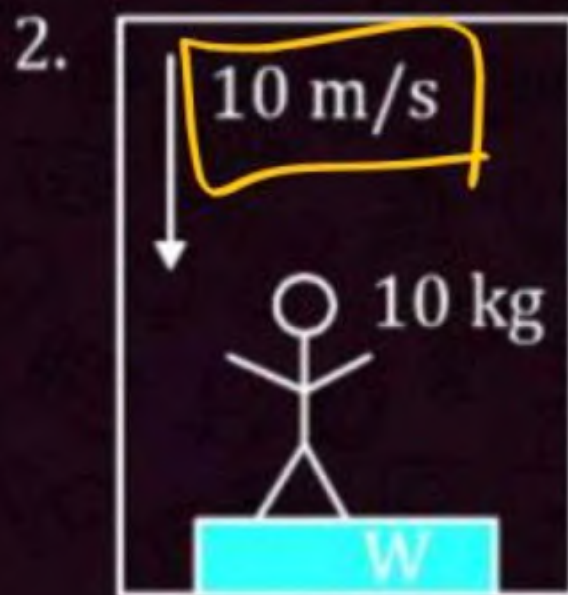


Find weight reading showing in weighing machine

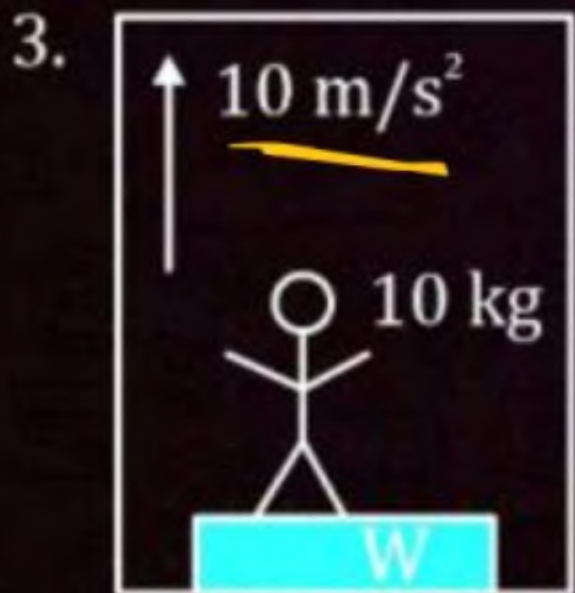


g ~~g~~

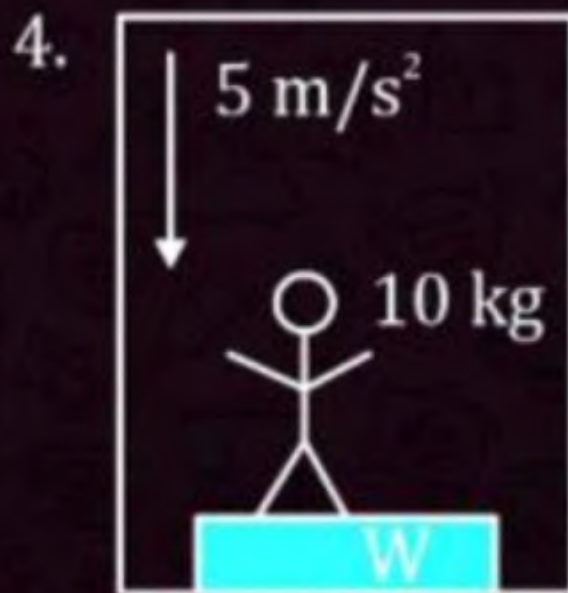
$W = 100N$



$W = 100N$



$W = m(g + a)$
 $= 10(10 + 10)$
 $= 10 \times 20 = \underline{\underline{200N}}$



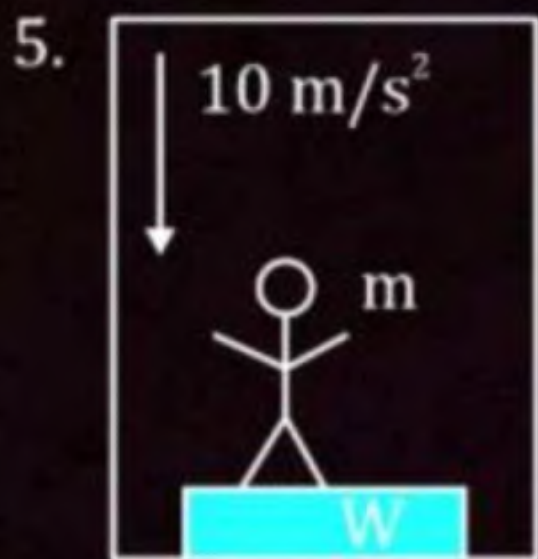
$W = m(g - a)$
 $= 10(10 - 5)$
 $= 10 \times 5$
 $= \underline{\underline{50N}}$

QUESTION-107

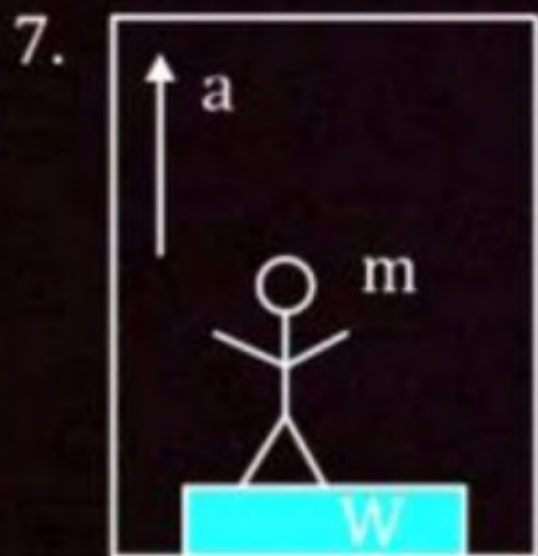
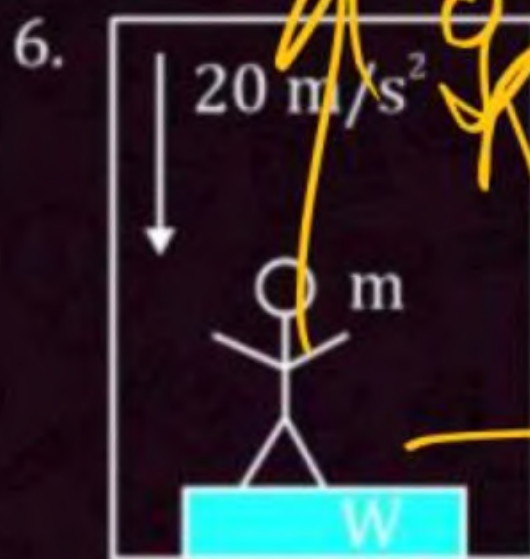
Difficulty Level : Easy



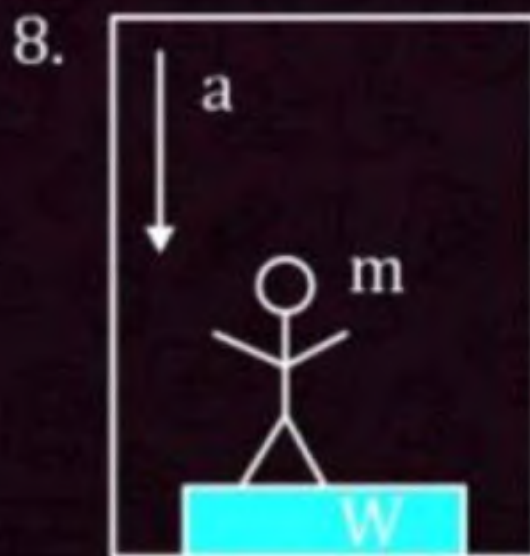
Find weight reading showing in weighing machine



$W=0$
Weightless ness



$W=m(g+a)$



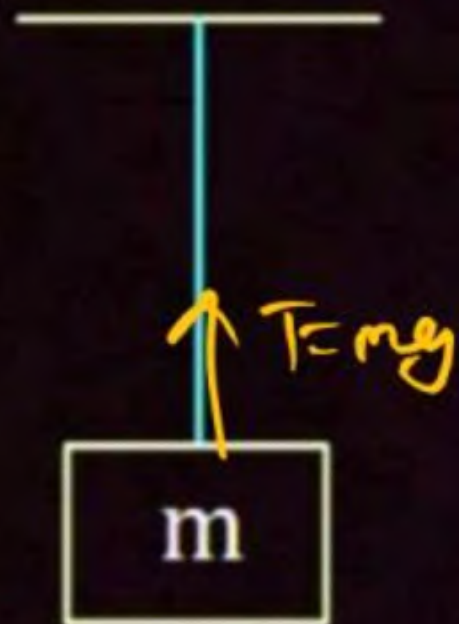
$W=m(g-a)$ ✓

QUESTION-108

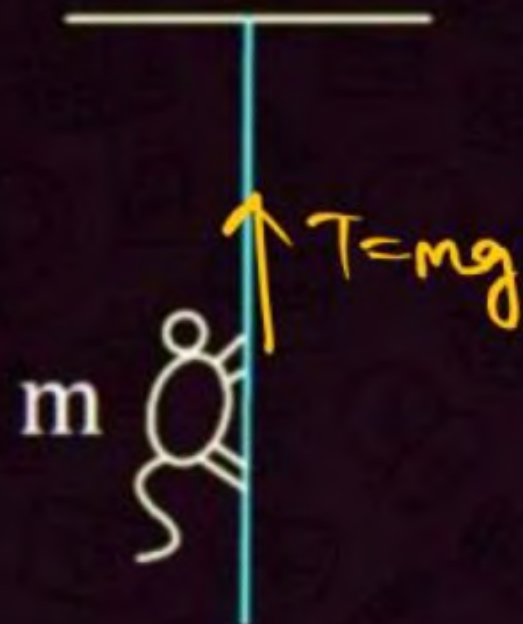
Difficulty Level : Easy



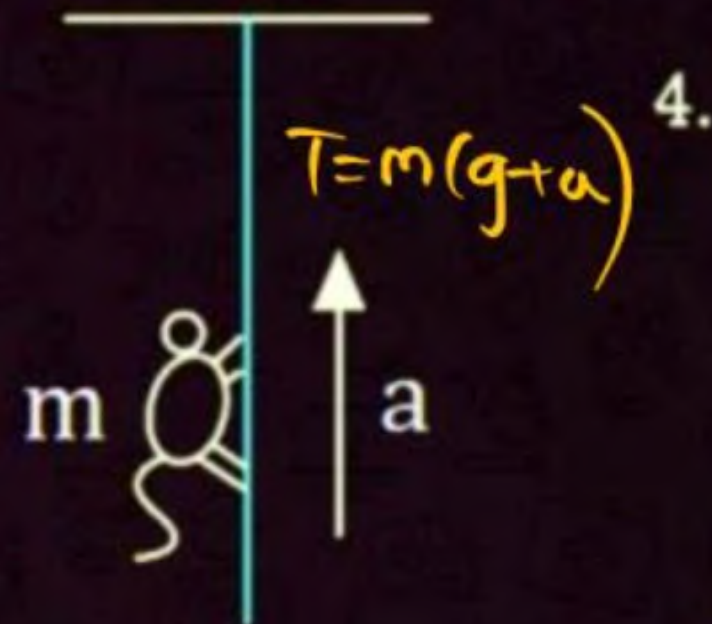
1.



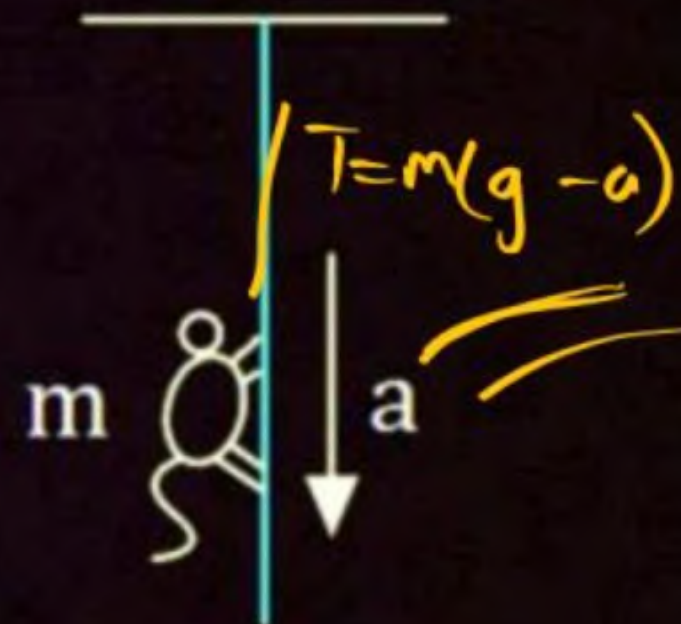
2.



3.



4.

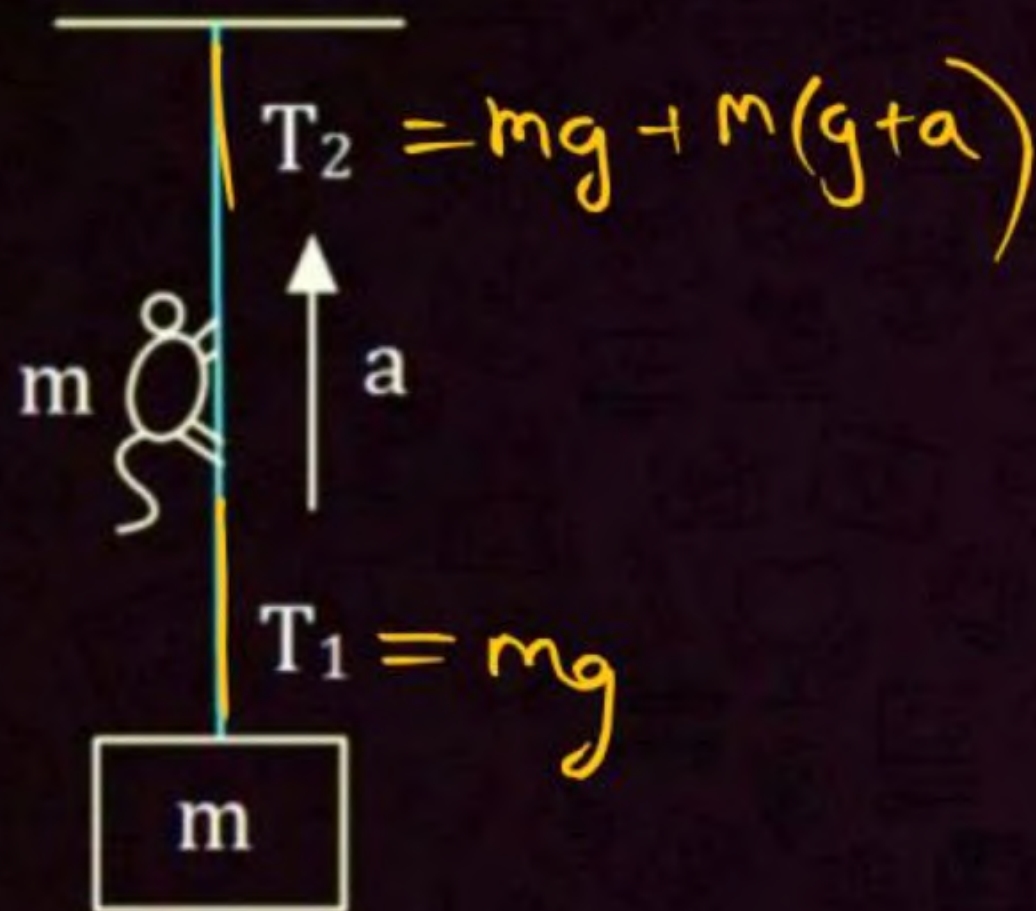


QUESTION-109

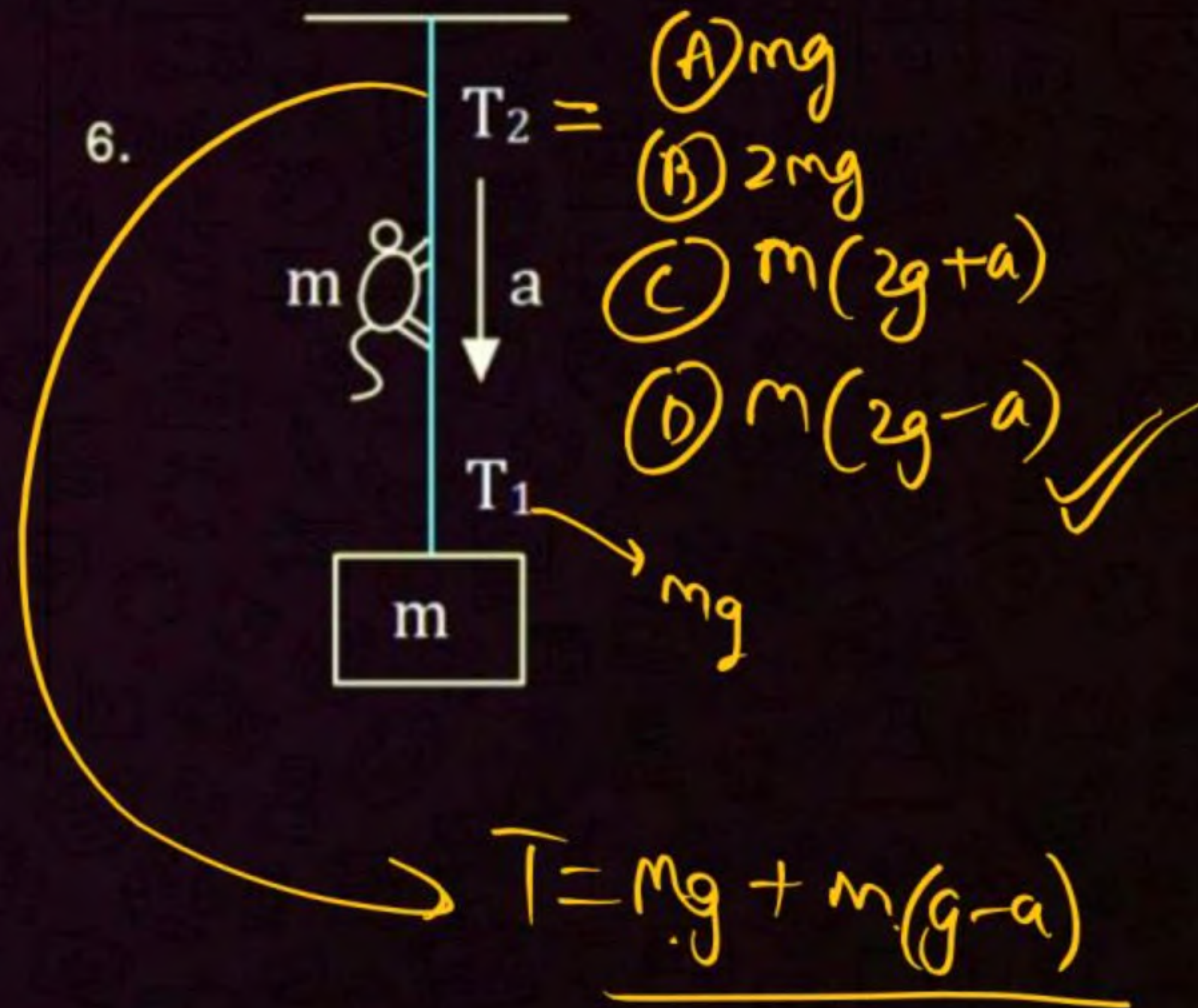
Difficulty Level : Easy



5.



6.



QUESTION-110

Difficulty Level : **YODHA**



The force exerted by the floor of an elevator on the foot of a person standing there is more than the weight of the person if the elevator is **[HCV Objective]**

- 1 going up and ~~slowing down~~ $\uparrow a$
- 2 going up at constant rate $\times$
- 3 ☒ going down and slowing down $\uparrow a$
- 4 going down and speeding up $\downarrow a \times$

$$W = m(g+a)$$



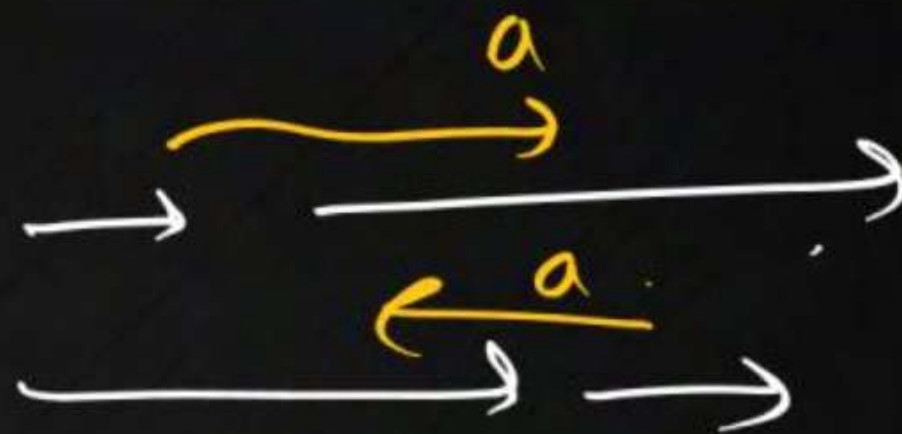
acceleration direction

speed up

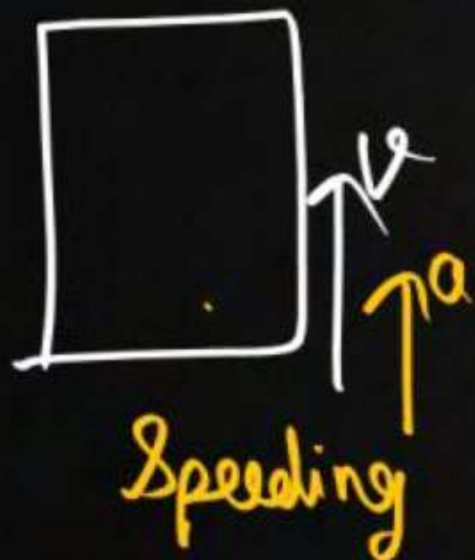
$\vec{a}$ is $\parallel$ to $\vec{v}$

speed down

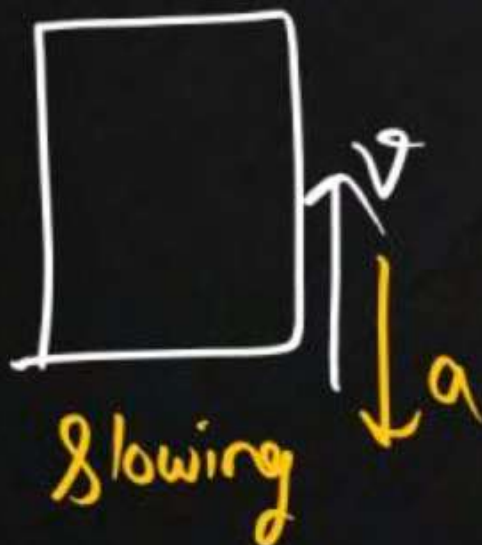
$\vec{a}$ is anti $\parallel$ to $\vec{v}$



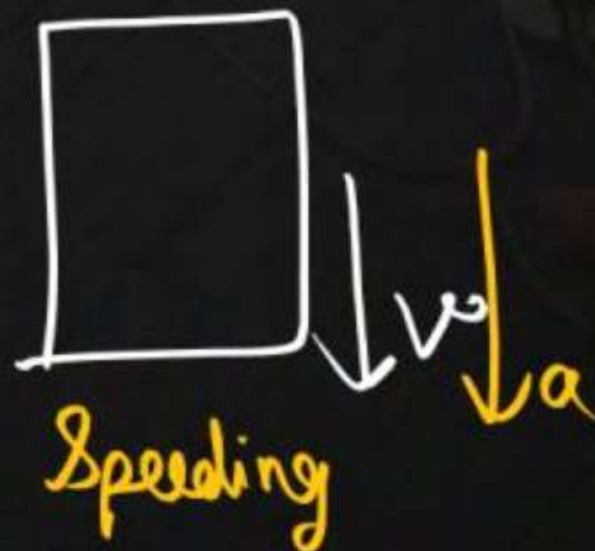
Going Up



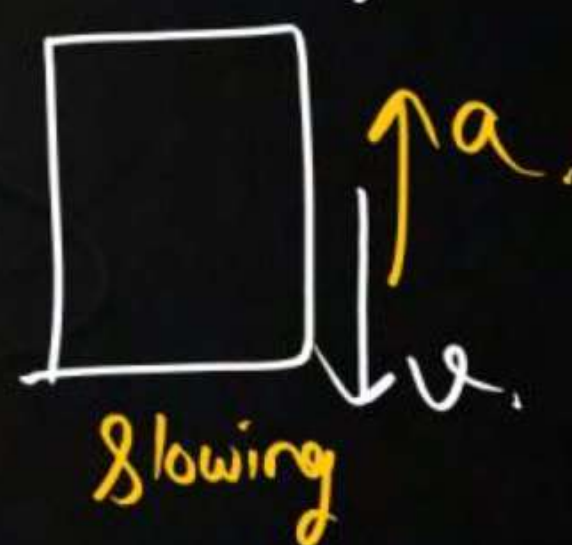
Going Up



Going Down



Going Down



QUESTION-111

Difficulty Level : HARD

hw ✓



If the tension in the cable supporting an elevator is equal to the weight of the elevator, the elevator may be [HCV Objective]

- 1 going up with increasing speed ✗
- 2 going down with increasing speed ✗
- 3 going up with increasing speed ✗
- 4 going down with uniform speed ✓

$$T = W$$



QUESTION-112**Difficulty Level : MEDIUM**

A rocket is going upwards with accelerated motion. A man sitting in it feels his weight increased 5 times his own weight. If the mass of the rocket including that of the man is 1.0×10^4 kg, how much force is being applied by rocket engine? (Take $g = 10 \text{ ms}^{-2}$)

[NCERT Based]

1 $5 \times 10^4 \text{ N}$

2 $5 \times 10^5 \text{ N}$ ✓

3 $5 \times 10^8 \text{ N}$

4 $2 \times 10^4 \text{ N}$



$$W = 5mg = m(g + a)$$

$$5mg = mg + ma$$

$$4mg = ma$$

$$a = 4g \checkmark$$

$$W = 5 \times 10000 \times 10$$

QUESTION-113**Difficulty Level : Easy**

A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of 5 m/s^2 . What would be the reading on the scale? ($g = 10 \text{ m/s}^2$):

[2003]

$$80 \times 15$$

- 1** Zero
- 2** 400 N
- 3** 800 N
- 4** 1200 N

QUESTION-114**Difficulty Level : HARD**

hw
A small ball is suspended from a thread. It is lifted up with an acceleration 4.9 ms^{-2} and lowered with an acceleration 4.9 ms^{-2} then the ratio of tensions in the thread in both cases will be: **[1998]**

- 1 $1 : 3$
- 2 $3 : 1$ ✓
- 3 $1 : 1$
- 4 $1 : \sqrt{5}$

QUESTION-115

Difficulty Level : MEDIUM



A monkey is descending from branch of a tree with constant acceleration. If the breaking strength is 75% of the weight of the monkey, the minimum acceleration with which monkey can slide down without branch is: [1993]

- 1 g
- 2 $3g/4$
- 3 $g/4$
- 4 $g/2$

Handwritten solution:

75% of mg Break

$$T = \frac{75 \times mg}{100}$$

$T = \frac{3mg}{4}$

$$T = m(g - a)$$

$$\frac{3}{4} mg = m(g - a)$$

$a = \frac{g}{4}$

A monkey is descending from branch of a tree with constant acceleration. If the breaking strength is 75% of the weight of the monkey, the minimum acceleration with which monkey can slide down without branch is: [1993]

- 1 g
- 2 $3g/4$
- 3 $g/4$ ✓
- 4 $g/2$

$$T = m(g - a) = \frac{3mg}{4}$$

$\rightarrow a = g/4$

$$\% = \frac{1}{100}$$
$$df = x$$

$$T_{\text{break}} = 75\% \text{ of } mg$$

$$T_{\text{break}} = \frac{75}{100} \times mg = \frac{3mg}{4}$$

QUESTION-116**Difficulty Level : Easy***hw //*

A person of mass 50 kg stands on a weighing scale on a lift. If the lift is ascending upwards with a uniform acceleration of 9 m s^{-2} , what would be the reading of the weighing scale? (Take $g = 10 \text{ m s}^{-2}$)

[NCERT Based]

- 1** 50 kg
- 2** 60 kg
- 3** 95 kg ✓
- 4** 100 kg

QUESTION-117**Difficulty Level : MEDIUM**

HW //

A monkey of mass 40 kg climbs on a massless rope which can stand a maximum tension of 500 N. In which of the following cases will the rope break?

(Take $g = 10 \text{ m s}^{-2}$)

[NCERT Based]

- 1 The monkey climbs up with an acceleration of 5 m s^{-2} .
- 2 The monkey climbs down with an acceleration of 5 m s^{-2} .
- 3 The monkey climbs up with a uniform speed of 5 m s^{-1} .
- 4 The monkey falls down the rope freely under gravity.



QUESTION-118

Difficulty Level: **YODHA**



A helicopter of mass 2000 kg rises with a vertical acceleration of 15 m s^{-2} . The total mass of the crew and passengers is 500 kg. Choose the correct statements from the following. (Take $g = 10 \text{ m s}^{-2}$)

- (i) ✓ The force on the floor of the helicopter by the crew and passengers is $1.25 \times 10^4 \text{ N}$ vertically downwards. $500(10+15) = 25 \times 500 = 12500$ ✓
- (ii) ✓ The action of the rotor of the helicopter on the surrounding air is $6.25 \times 10^4 \text{ N}$ vertically downwards.
- (iii) ✓ The force on the helicopter due to the surrounding air is $6.25 \times 10^4 \text{ N}$ vertically upwards.

[NCERT Based]

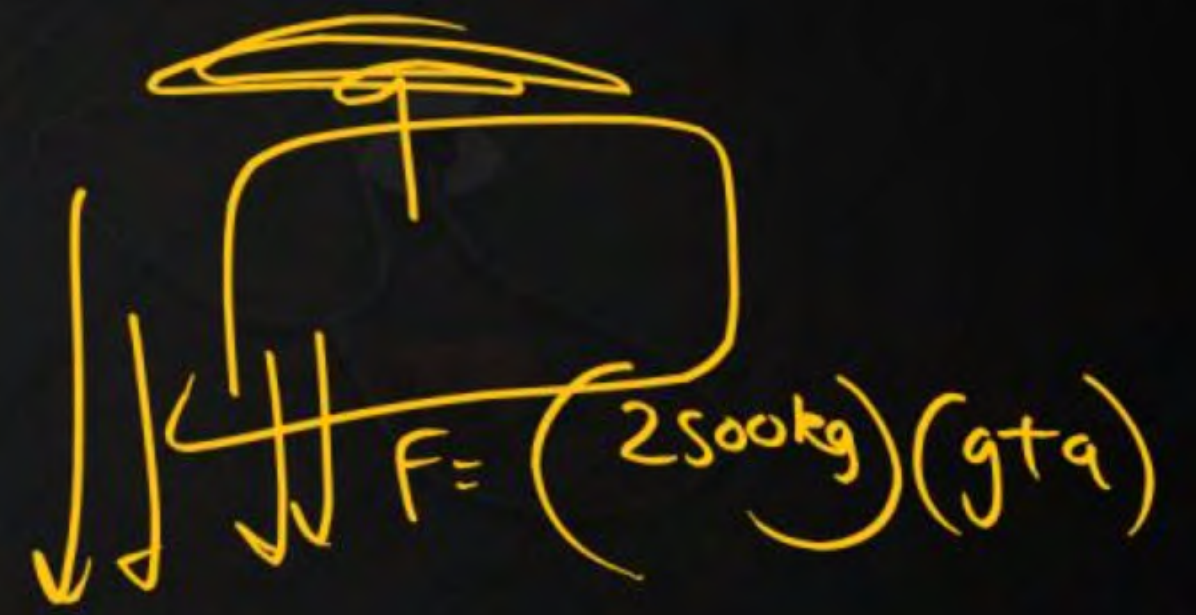
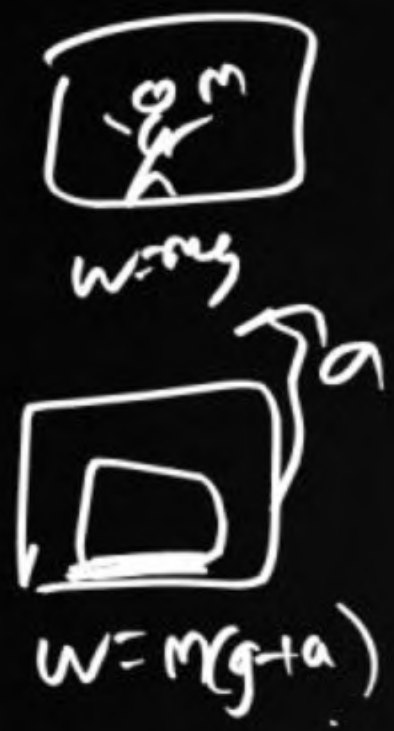
$$\begin{aligned} 2500 \times (10+15) &= \\ 2500 \times 25 &= \\ \underline{62500} \end{aligned}$$

1 (i) and (ii)

2 (ii) and (iii)

3 (i) and (iii)

✓ **4** All the three

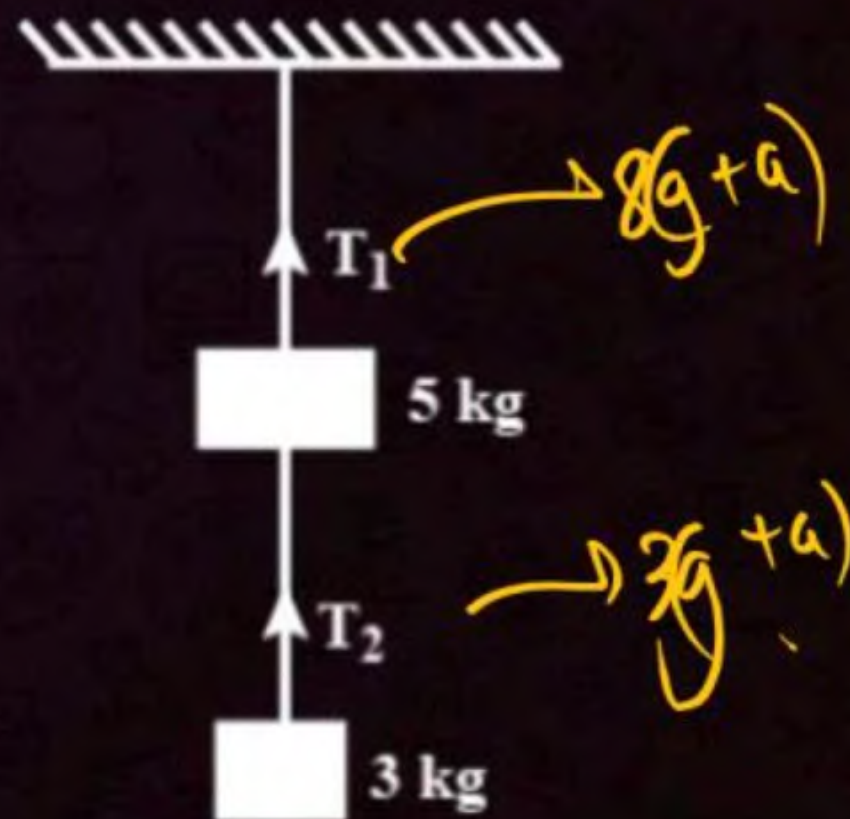


QUESTION-119**Difficulty Level : MEDIUM***HW*

Two masses of 5 kg and 3 kg are suspended with the help of massless inextensible strings as shown in figure. The whole system is going upwards with an acceleration of 2 m s^{-2} . The tensions T_1 and T_2 are respectively
(Take $g = 10 \text{ m s}^{-2}$)

[NCERT Based]

- 1** 96 N, 36 N
- 2** 36 N, 96 N
- 3** 96 N, 96 N
- 4** 36 N, 36 N



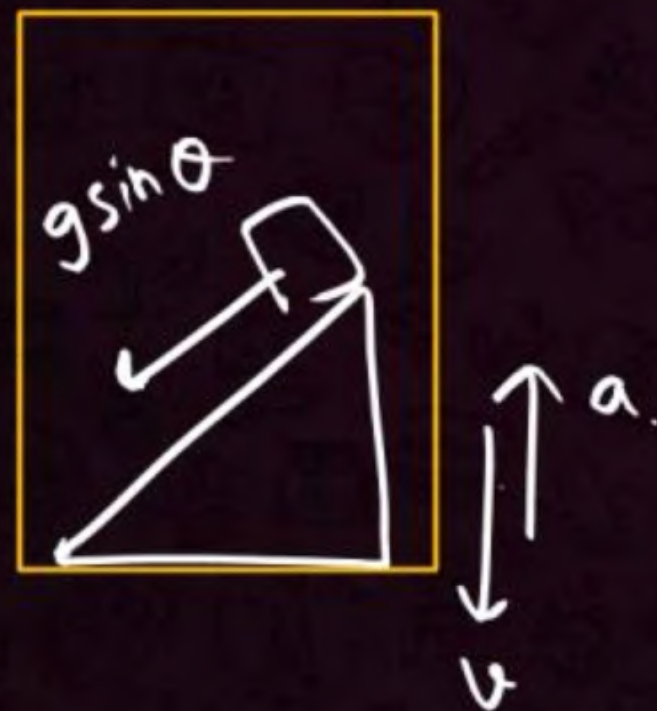
A block can slide on a smooth inclined plane of inclination θ kept on the floor of a lift. When the lift is descending with retardation a , the acceleration of the block relative to the incline is: slow

1 ✓ $(g + a) \sin \theta$

2 $(g - a)$

3 $g \sin \theta$

4 $(g - a) \sin \theta$



$(g + a) \sin \theta$

QUESTION-121**Difficulty Level : MEDIUM**

The mass of a body measured by a physical balance in a lift at rest is found to be m. If the lift is going up with an acceleration a , its mass will be measured as:

1 $m\left(1 - \frac{a}{g}\right)$

2 $m\left(1 + \frac{a}{g}\right)$

3 m

4 zero

$$\frac{W}{g} = m$$

$$m' = \frac{W'}{g} = \frac{m(g+a)}{g} = m\left(1 + \frac{a}{g}\right)$$

QUESTION-122

Difficulty Level : Hard



A block of mass m is placed on the floor of lift which is moving with velocity $v = 4t^2$, where t is time in second and velocity m/s. find the time at which normal force on the block is three times of its weight.

1 $(3g/8)s$

2 $g/4 s$

3 $4g s$

4 $3g s$

$$a = \frac{dv}{dt} = 8t$$

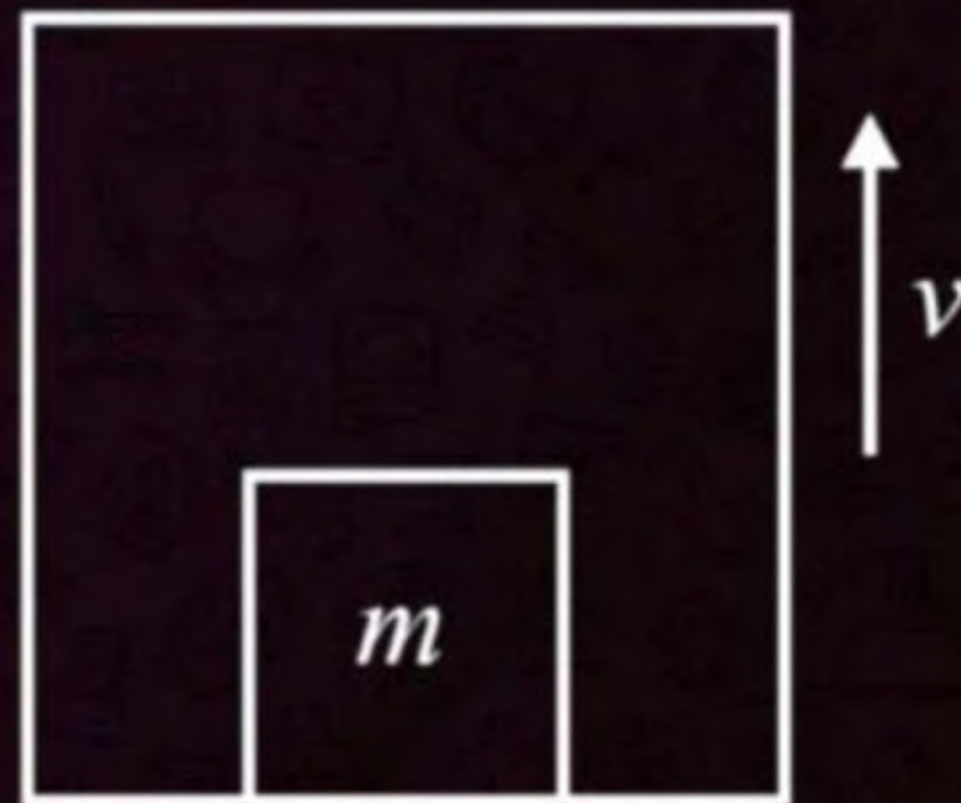
$$N = m(g+a) = 3mg$$

$$g+a=3g$$

$$a=2g$$

$$8t=2g$$

$$t = g/4$$



QUESTION-123**Difficulty Level : Easy**

hw

A person of mass 60 kg is inside a lift of mass 940 kg and presses the bottom on control panel. The lift starts moving upwards with an acceleration 1.0 m/s^2 . If $g = 10 \text{ ms}^{-2}$, the tension in the supporting cable is

[Pre-2011]**1** 8600 N**2** 9680 N**3** 11000 N ✓**4** 1200 N

QUESTION-124

Difficulty Level : Easy



The mass of a lift is 2000 kg. When the tension in the supporting cable is 28000 N, then its acceleration is: **[2009]**

- 1** 4 ms^{-2} upwards ✓
- 2** 4 ms^{-2} downwards
- 3** 14 ms^{-2} upwards
- 4** 30 ms^{-2} downwards

QUESTION-125**Difficulty Level : Easy**

nw//

A monkey of mass 20 kg is holding a vertical rope. The rope will not break when a mass of 25 kg is suspended from it but will break if the mass exceeds 25 kg. What is the maximum acceleration with which the monkey can climb up along the rope? ($g = 10 \text{ m/s}^2$)

[2003]

- 1** 5 m/s^2
- 2** 10 m/s^2
- 3** 25 m/s^2
- 4** 2.5 m/s^2

QUESTION-126**Difficulty Level : Easy***hw //*

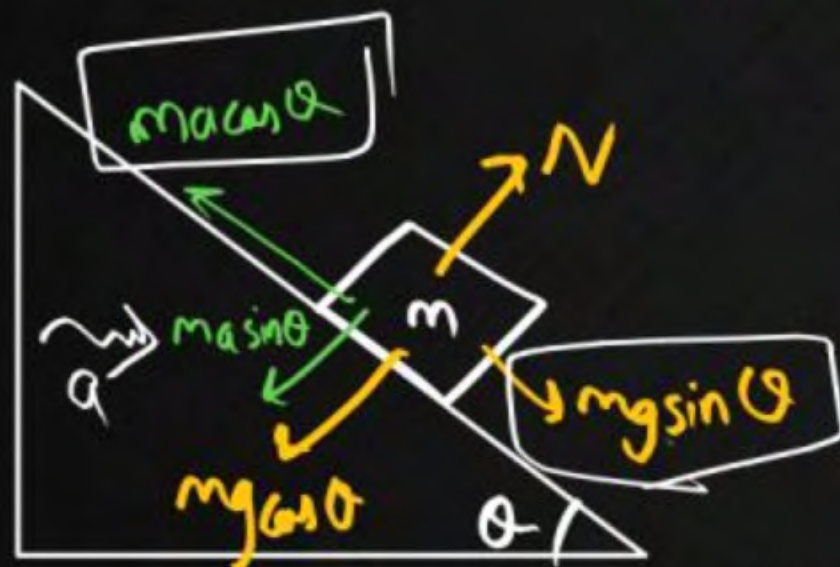
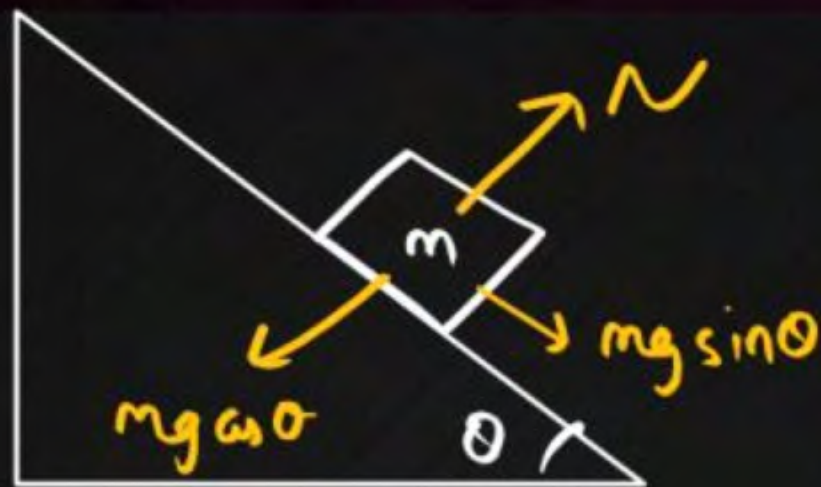
A lift of mass 1000 kg which is moving with acceleration of 1 m/s^2 in upward direction, then the tension developed in string which is connected to lift is:

[2002]

- 1** 9800 N
- 2** 10,800 N
- 3** 11000 N
- 4** 10.000 N

Note

Wedge pe Aish, Trolly me Jolly



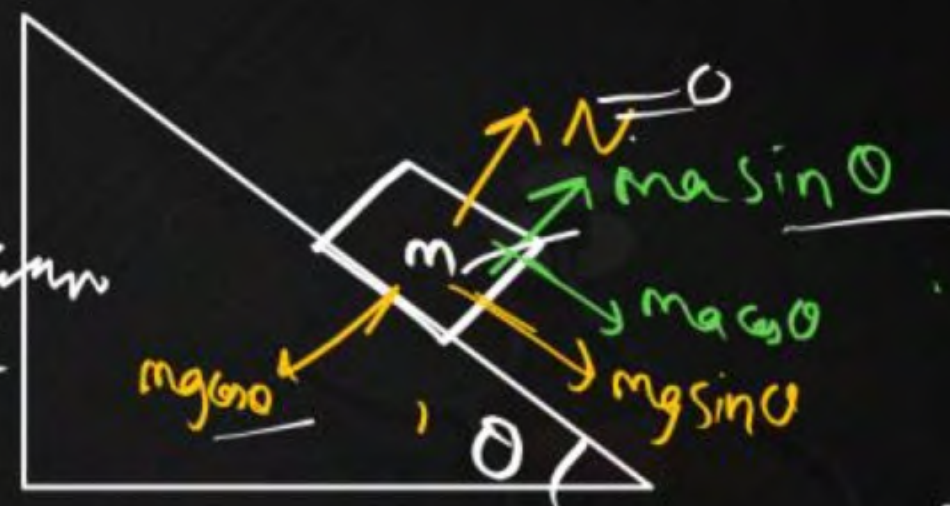
No slip

$$m a \cos \theta = m g \sin \theta$$
$$a = g \frac{\sin \theta}{\cos \theta}$$

$$a = g \tan \theta$$

$$N = m \sin \theta + m g \cos \theta$$

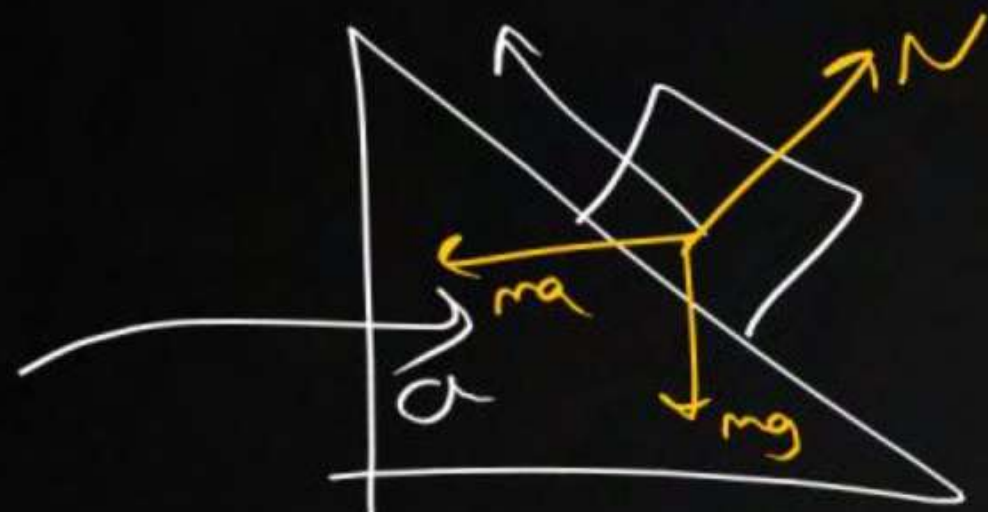
$$N = \frac{m g}{\cos \theta} = m g \sec \theta$$



Block loses contact

$$a = g \tan \theta$$

$$N = 0$$



$$a = g \tan \theta$$

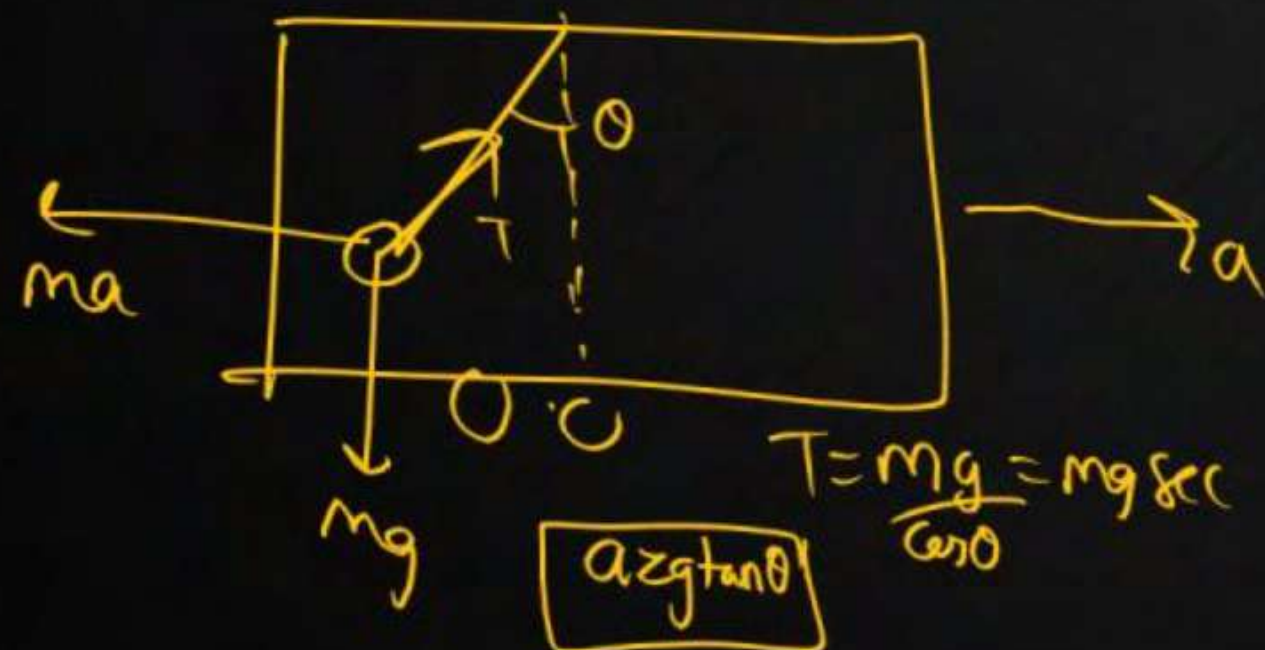
No slip

$$N = \frac{mg}{\cos \theta} = mg \sec \theta$$



$N = 0$ → loose contact

$$a = g \tan \theta$$



$$T = \frac{mg}{\cos \theta} = mg \sec \theta$$

$$a = g \tan \theta$$

QUESTION-127**Difficulty Level : Easy**

A block of mass m is placed on a smooth wedge of inclination θ . The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be:

[2004]

1 $mg \sin \theta$

2 mg

3 $\frac{mg}{\cos \theta}$

4 $mg \cos \theta$

$$a = g \tan \theta$$

$$N = \frac{mg}{\cos \theta}$$



A block of mass m is placed on a smooth wedge of inclination θ . The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block has a magnitude **[HCV Objective]**

- 1 mg
- 2 $mg/\cos \theta$
- 3 $mg \cos \theta$
- 4 $mg \tan \theta$

QUESTION-129**Difficulty Level : Easy**

A block of mass m is placed on a smooth inclined wedge ABC of inclination θ as shown in the figure. The wedge is given an acceleration ' a ' towards the right. The relation between a and θ for the block to remain stationary on the wedge is:

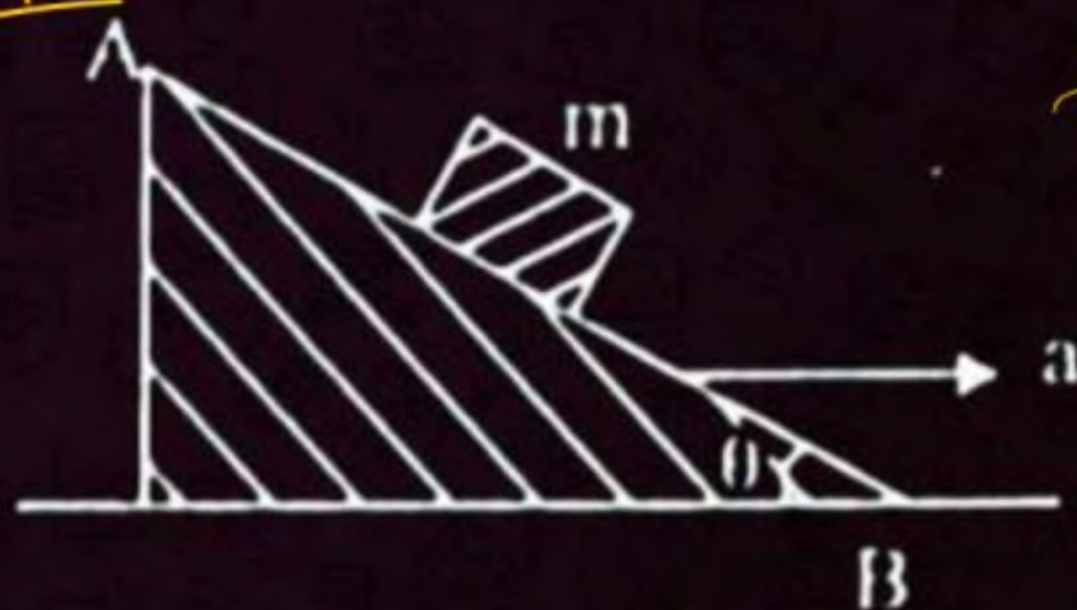
[2018]No slip

1 $a = g \cos \theta$

2 $a = \frac{g}{\sin \theta}$

3 $a = \frac{g}{\operatorname{cosec} \theta}$

4 $a = g \tan \theta$



QUESTION-130**Difficulty Level : Easy**

NW

A mass M is placed on a very smooth wedge resting on a surface without friction. Once the mass is released, the acceleration to be given to the wedge so that M remains at rest is a where

[1998]

- 1** a is applied to the left and $a = g \tan \theta$
- 2** a is applied to the right and $a = g \tan \theta$
- 3** a is applied to the left and $a = g \sin \theta$
- 4** a is applied to the left and $a = g \cos \theta$



QUESTION-131**Difficulty Level : Easy**

A pendulum bob is suspended in a car moving horizontally with acceleration ' a ' the angle the string will make with vertical is

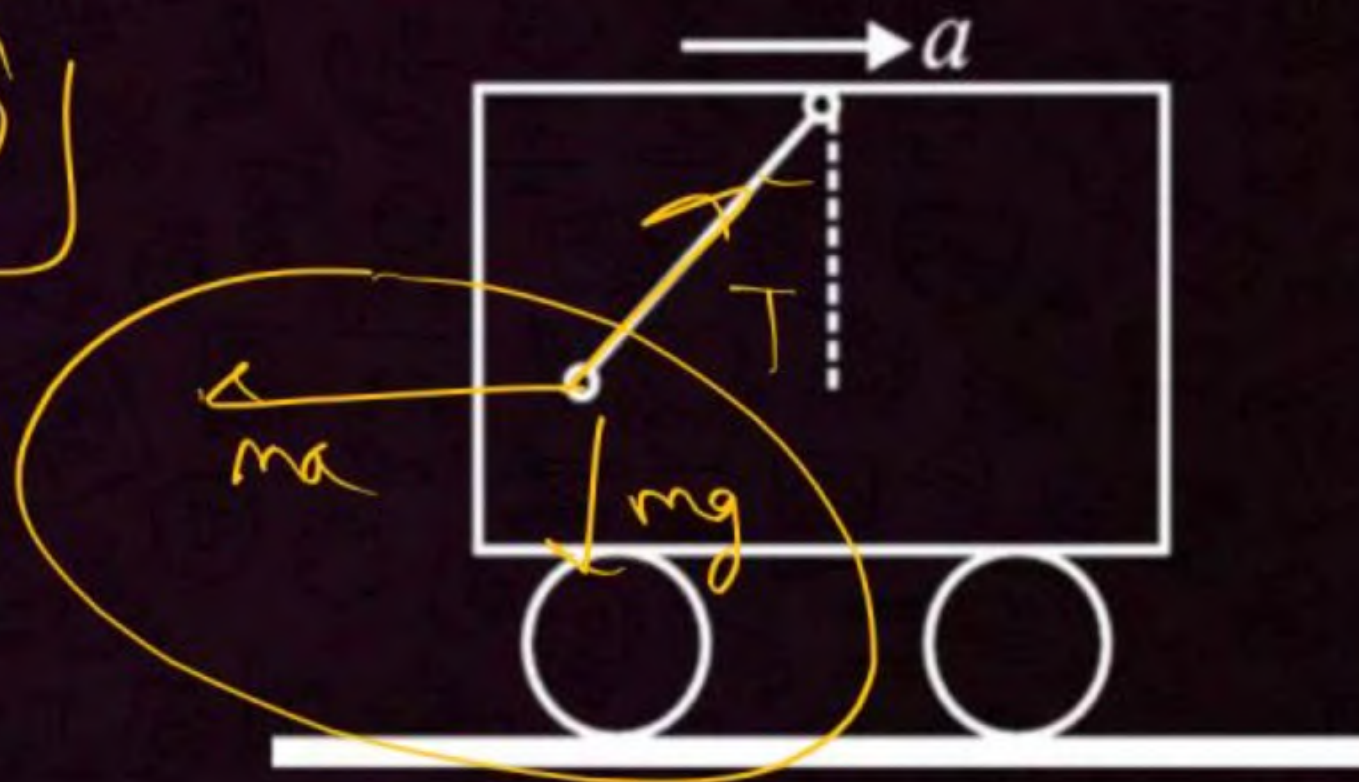
1 $\tan^{-1} \frac{g}{a}$

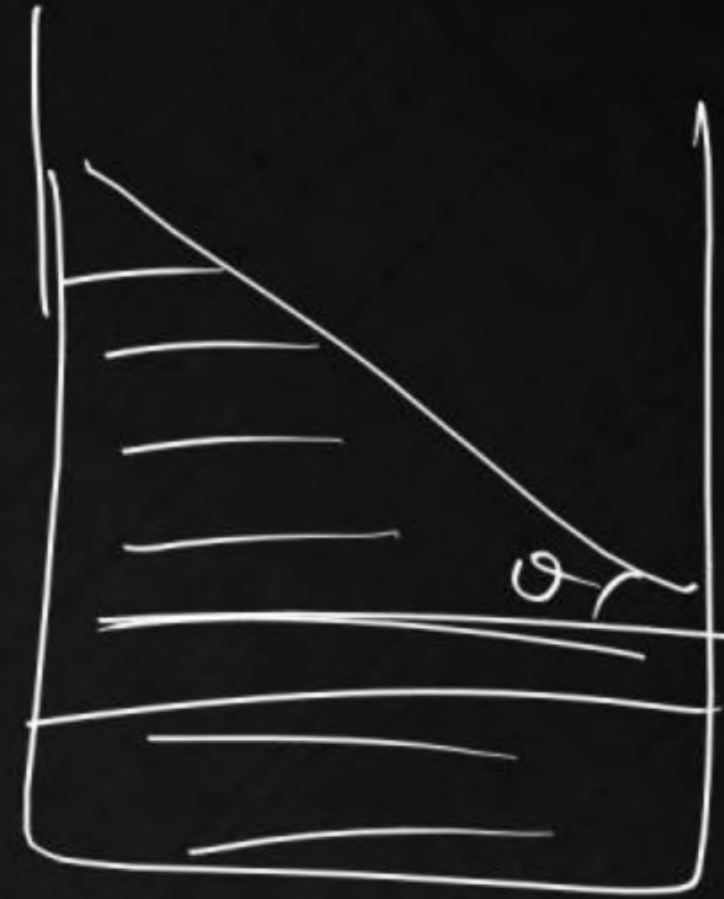
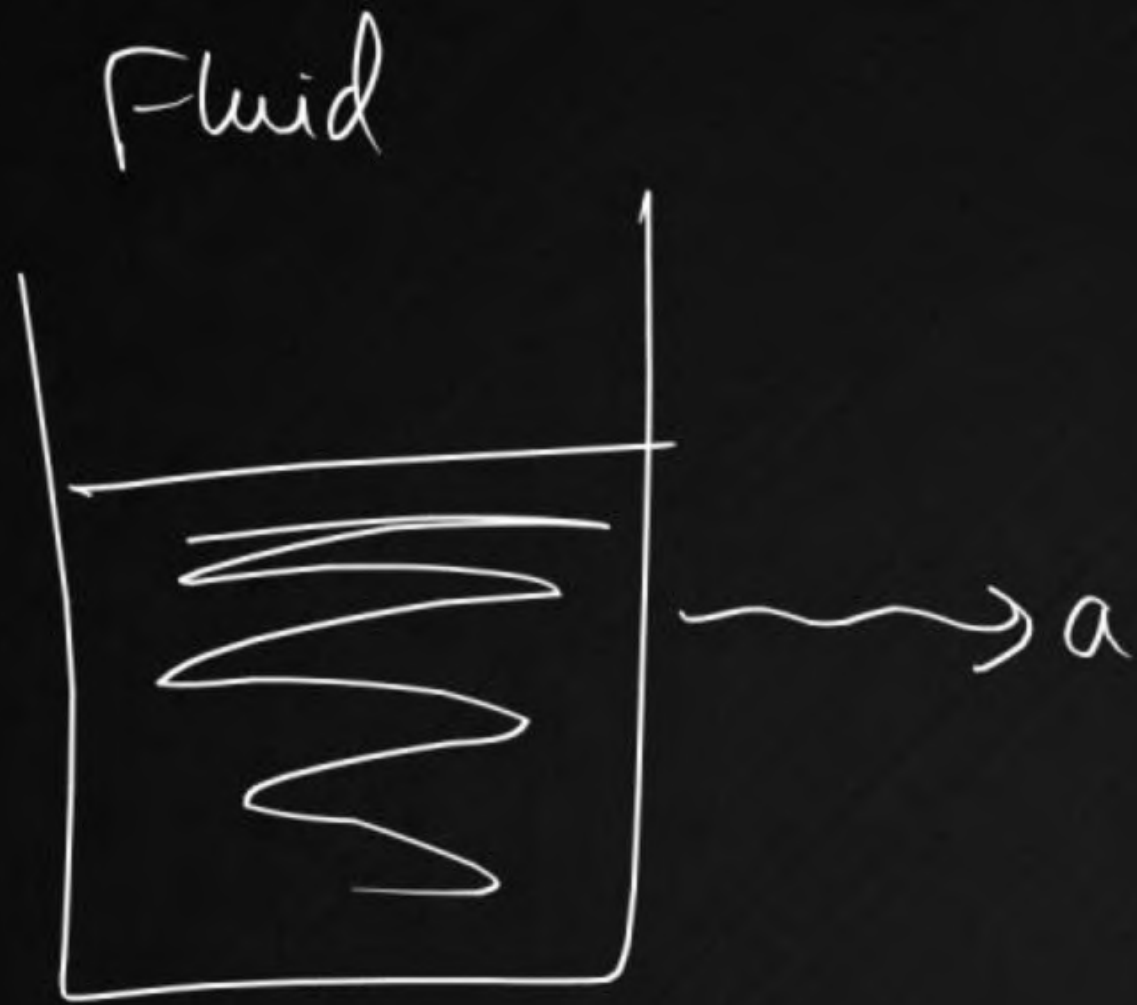
2 $\tan^{-1} \frac{a}{g}$ ✓✓

3 $\sin^{-1} \frac{a}{g}$

4 $\cos^{-1} \frac{a}{g}$

$$a = g \tan \theta$$

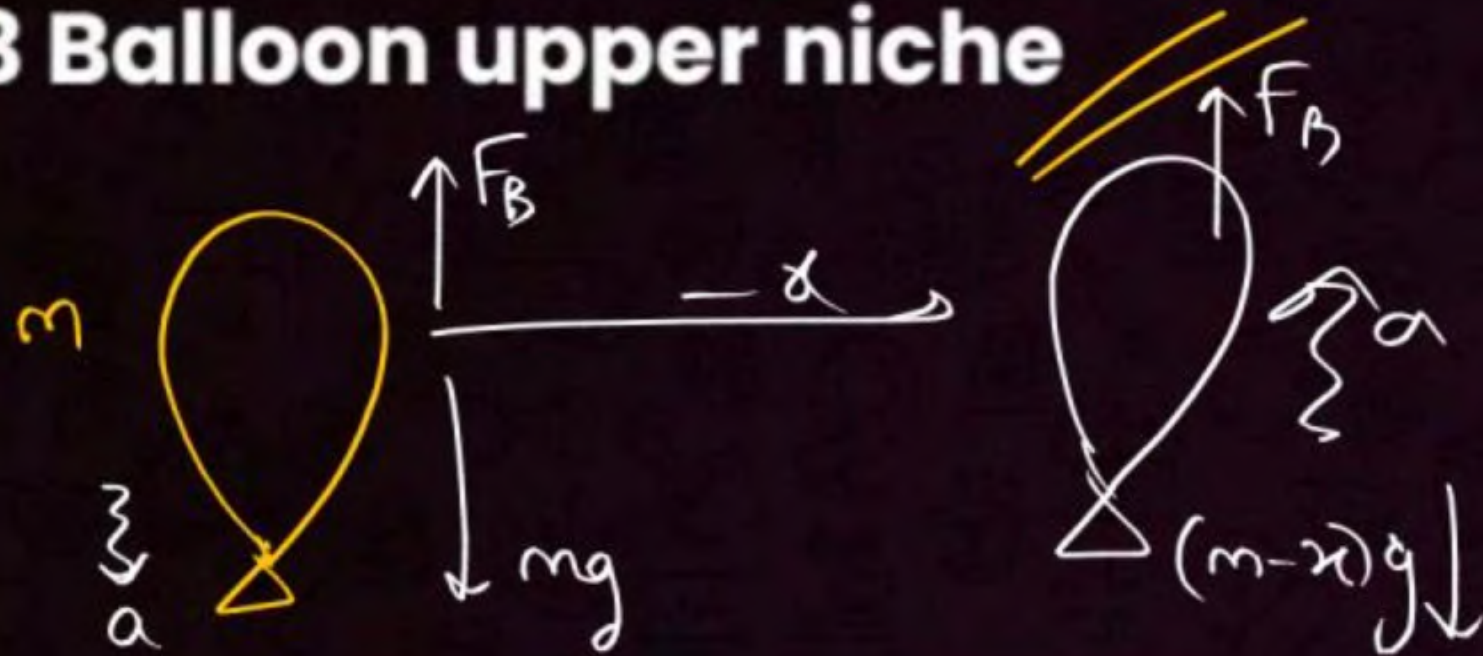




$$a = g \tan \theta$$



6.3 Balloon upper niche



$$F_B = m(g-a)$$

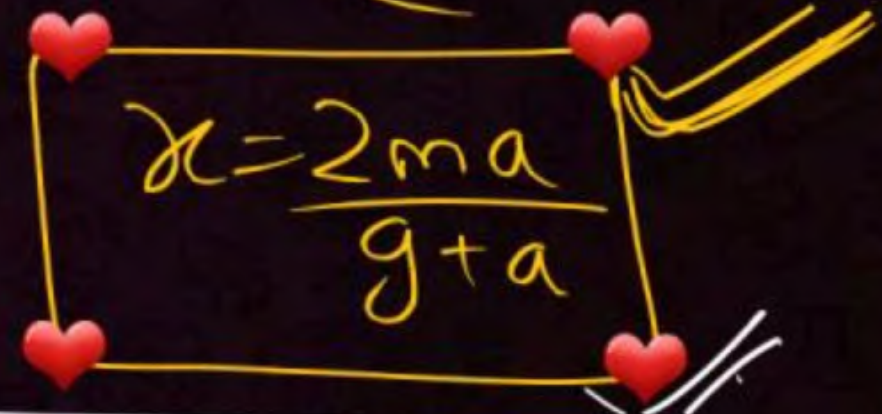
$$F_B = (m-x)(g+a)$$

$$m(g-a) = (m-x)(g+a)$$

$$m \left(\frac{g-a}{g+a} \right) = m-x$$

$$x = m \left[1 - \frac{g-a}{g+a} \right]$$

$$x = m \left[\frac{\cancel{g+a} - \cancel{g} + a}{g+a} \right]$$



$$\text{Mass kitna nikala} = \frac{2ma}{g+a}$$

QUESTION-132**Difficulty Level : YODHA**

A balloon with mass m is descending down with an acceleration a (where $a < g$). How much mass should be removed from it so that it starts moving up with an acceleration a ? [2014]

1 $\frac{2ma}{g+a}$

2 $\frac{2ma}{g-a}$

3 $\frac{ma}{g+a}$

4 $\frac{ma}{g-a}$

QUESTION-133**Difficulty Level : Easy**

A balloon of mass M is descending with a constant acceleration $\frac{g}{3}$. When a mass m is released from the balloon it starts rising with the same acceleration $\frac{g}{3}$. The value of m is (Assuming that its volume does not change):-

1 $M/2$

2 $M/4$

3 $4M$

4 $2M$

$a = g/3$

hw

hw

6.4 Frame ki baate



THEORY KA BAAP

QUESTION-134

Difficulty Level : HARD



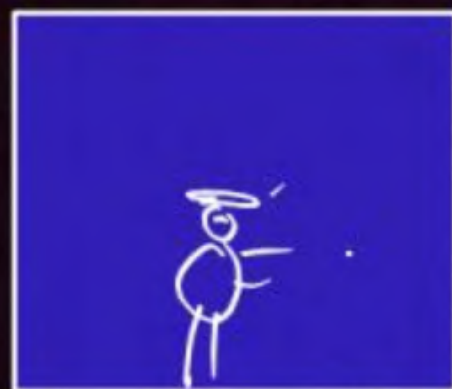
A particle is observed from two frames S_1 and S_2 . The frame S_2 moves with respect to S_1 with an acceleration α . Let F_1 and F_2 be the pseudo forces on the particle when seen from S_1 and S_2 respectively. Which of the following are not possible? [HCV Objective]

1 $F_1 = 0, F_2 \neq 0$ ✓

2 $F_1 \neq 0, F_2 = 0$ ✓

3 $F_1 \neq 0, F_2 \neq 0$ ✓

4 $F_1 = 0, F_2 = 0$ ✗



① rest
→ a
→ a_1



→ a
rest
→ $a_1 + a$

QUESTION-135

Difficulty Level : ~~Hard~~ Easy



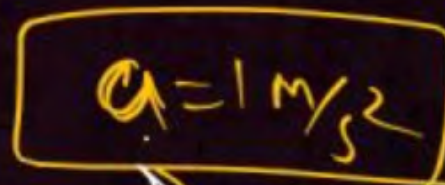
A stone of mass 1 kg is lying on the floor of a train which is accelerating with 1 ms^{-2} . The net force acting on the stone is **[NCERT Based]**

~~1 zero~~

2 1 N

3 5 N

4 10 N



$$F = ma = 1 \times 1 = 1 \text{ N}$$

QUESTION-136**Difficulty Level : MEDIUM**

ww
A person says that he measured the acceleration of a particle to be nonzero while no force was acting on the particle. $a \neq 0$
[HCV Objective]

- 1 He is a liar. 
- 2 His clock might have run slow.
- 3 His meter scale might have been longer than the standard.
- 4 He might have used non inertial frame. ✓



A particle is found to be at rest when seen from a frame S_1 and moving with a constant velocity when seen from another frame S_2 . Mark out the possible options. HW ✓

[HCV Objective]

- 1 Both the frames are inertial.
- 2 Both the frames are non inertial. ✓
- 3 One of S_1 or S_2 is non inertial.
- 4 Both 1 & 2 ✓

H W

Identify Wrong statement. A reference frame attached to the earth [HCV Objective]

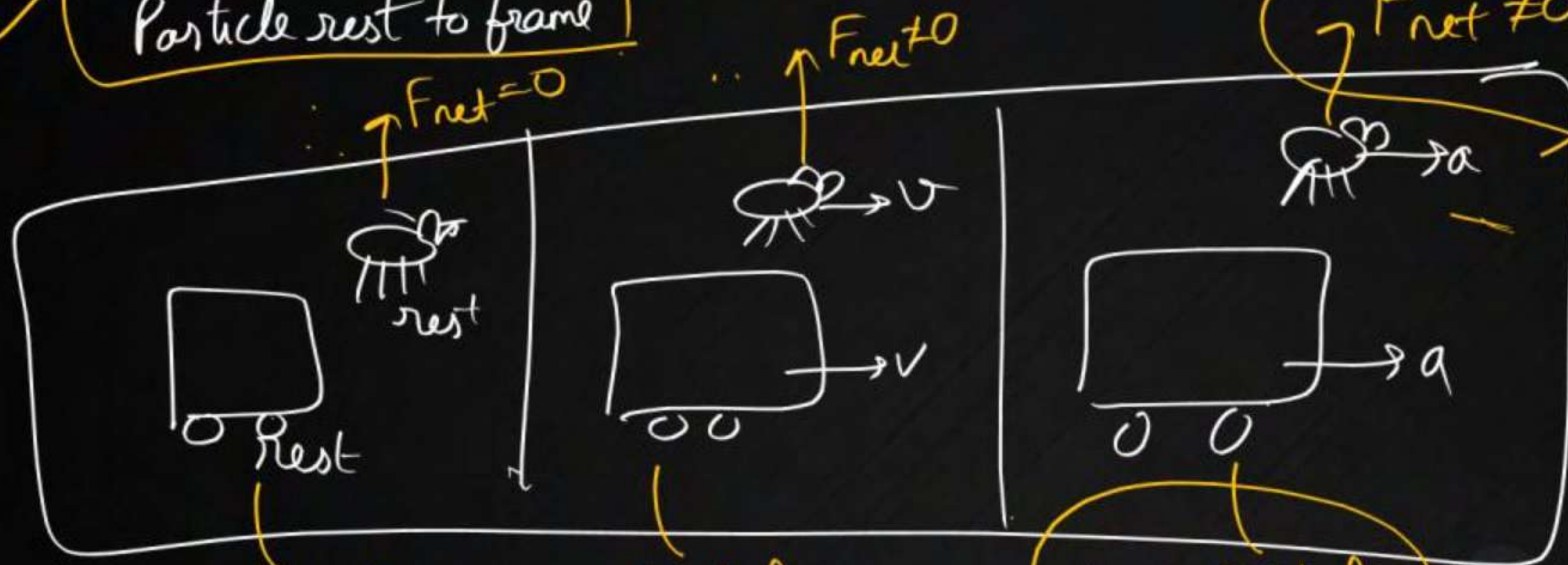
- ① is a non inertial frame by definition ✓
- ② cannot be an inertial frame because the earth is revolving around the sun ✓
- ~~③ is an inertial frame because Newton's laws are applicable in this frame~~ ✗
- ④ cannot be an inertial frame because the earth is rotating about its axis. ✓

A particle stays at rest as seen in a frame. 100% incorrect statement is [HCV Objective]

- 1 the frame is inertial
- 2 resultant force on the particle may or may not be zero
- ~~3 the frame may be inertial but the resultant force on the particle is zero~~
- 4 the frame may be non inertial but there is a non zero resultant force.



Particle rest to frame



Inertial

Inertial

Non-Inertial

Telegram

PUPPY POINTS 2

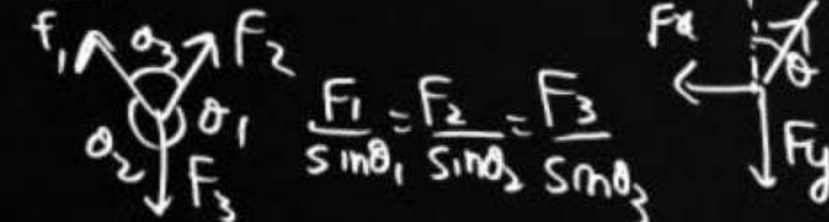
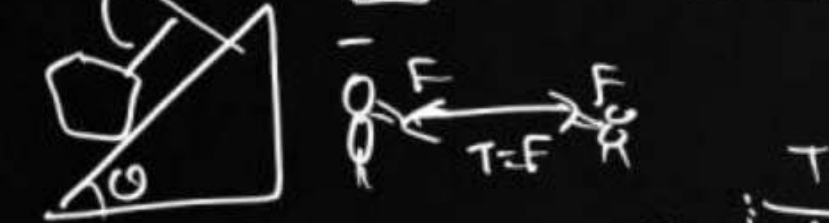
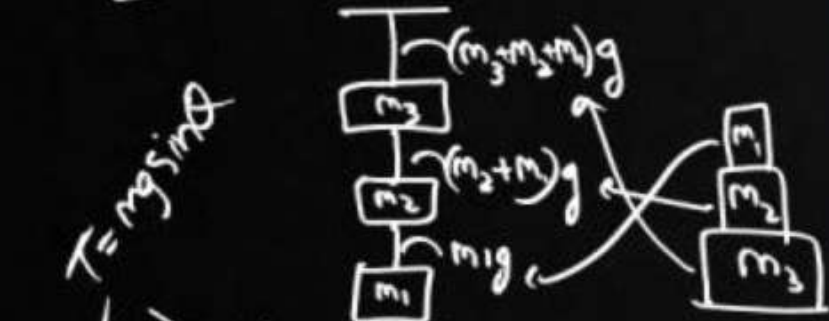
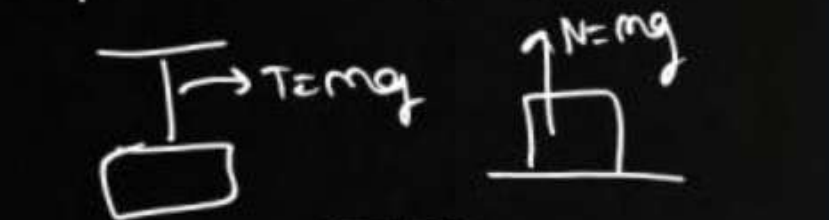
$$W=mg$$

T (dene ka)

N (chipane ka force)

Contact lost $N=0$

Upthrust - Buoyancy

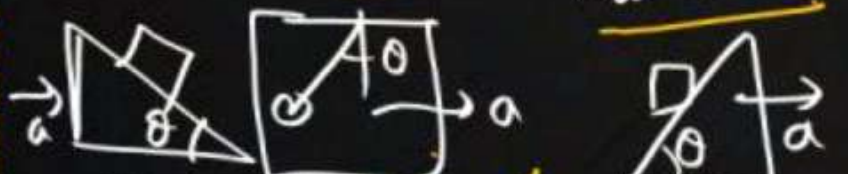


$$\tan \theta = \frac{F_x}{F_y}, T = \sqrt{F_x^2 + F_y^2}, F_x + F_y + T = 0$$

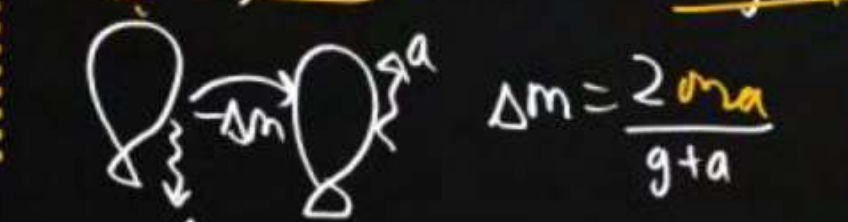
Pseudo Force = $m(\vec{a} \text{ palat kr})$

$$\begin{cases} a \\ a \\ a \end{cases} \quad \begin{cases} g \\ g \\ g \end{cases}$$

$$g_{eff} = g + a \quad g_{eff} = g - a \quad g_{eff} = \sqrt{g^2 + a^2}$$



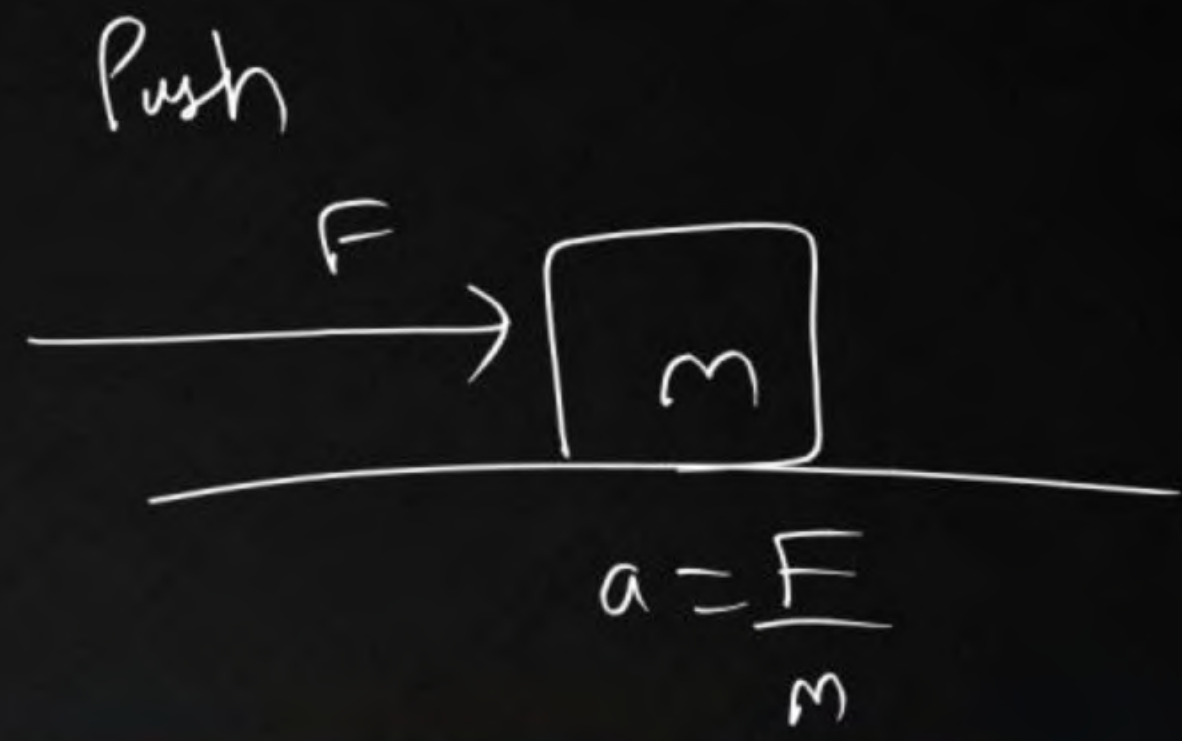
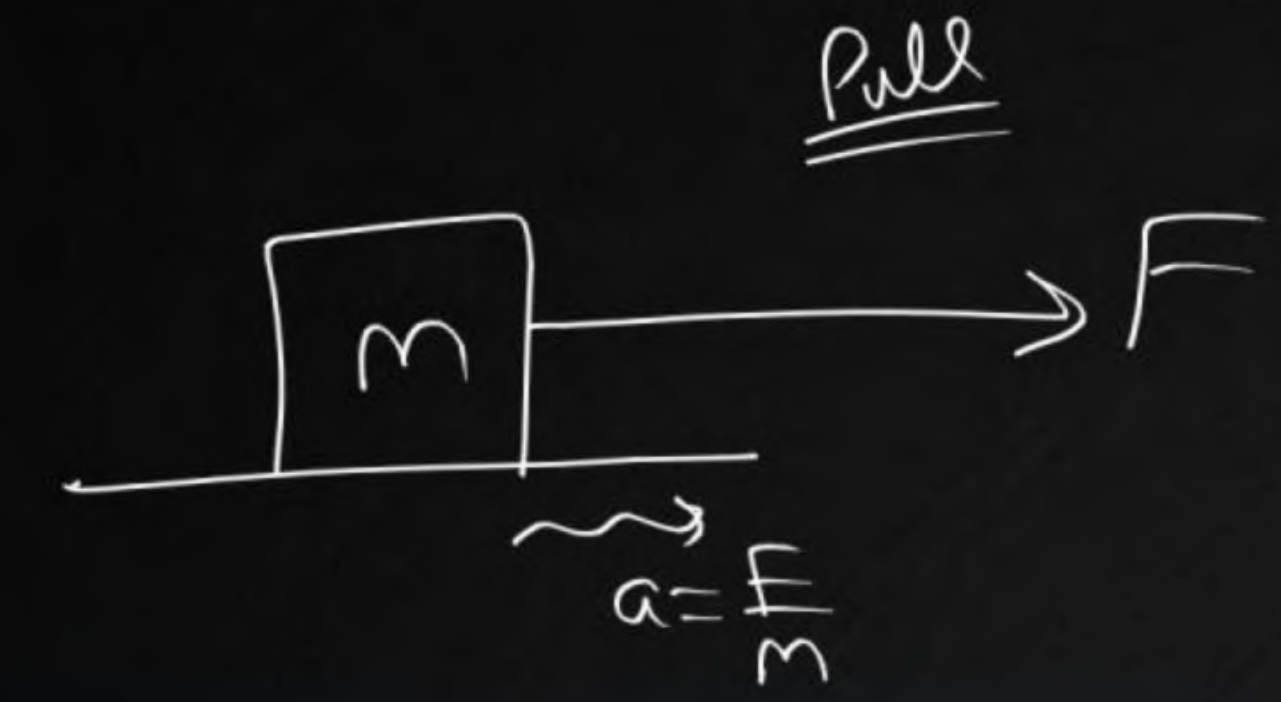
$$a = g \tan \theta \text{ (loss/p)} \quad \text{Contact loose} \quad N = 0 \quad a = g \sin \theta$$



$$\Delta m = \frac{2ma}{g+a}$$

Part 7 – Push and Pull





7.1 Simple Pull

$$a = \frac{F_{\text{net}}}{m_{\text{total}}}$$

$m \rightarrow 10 \text{ N}$ $a = \frac{10}{m}$

$m - m \rightarrow 10 \text{ N}$ $a = \frac{10}{2m}$

$m - m - m \rightarrow 10 \text{ N}$ $a = \frac{10}{3m}$

$m - m - m - m \rightarrow 10 \text{ N}$ $a = \frac{10}{4m}$

$m - m - m - m - m \rightarrow 10 \text{ N}$ $a = \frac{10}{5m}$

7.2 Simple Push



$$10\text{ N} \longrightarrow \boxed{m} \quad a = \frac{10}{m}$$

$$10\text{ N} \longrightarrow \boxed{m} \boxed{m} \quad a = \frac{10}{2m}$$

$$10\text{ N} \longrightarrow \boxed{m} \boxed{m} \boxed{m} \quad a = \frac{10}{3m}$$

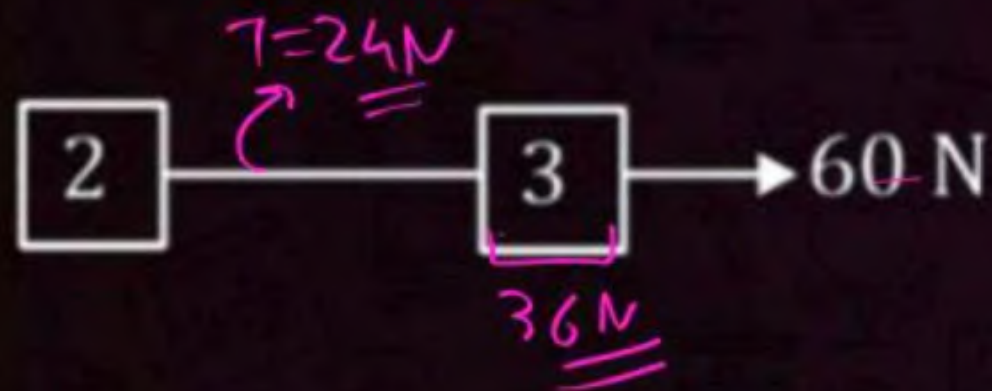
$$10\text{ N} \longrightarrow \boxed{m} \boxed{m} \boxed{m} \boxed{m} \quad a = \frac{10}{4m}$$



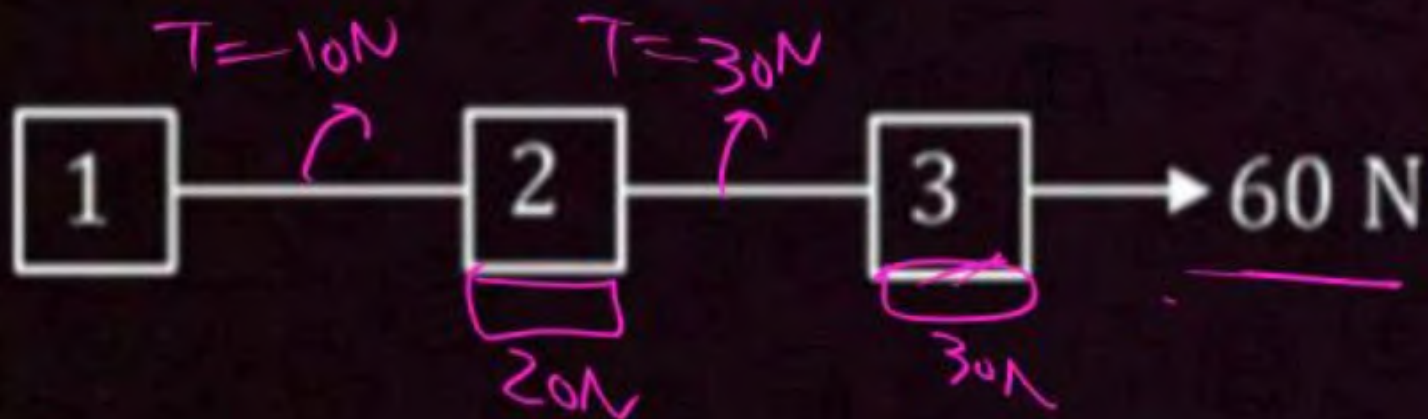
7.3 Pull & Push - Bhandara (Nemoda)



$$a = \frac{100}{50} = 2 \text{ m/s}^2 \Rightarrow 2 \text{ N/kg}$$



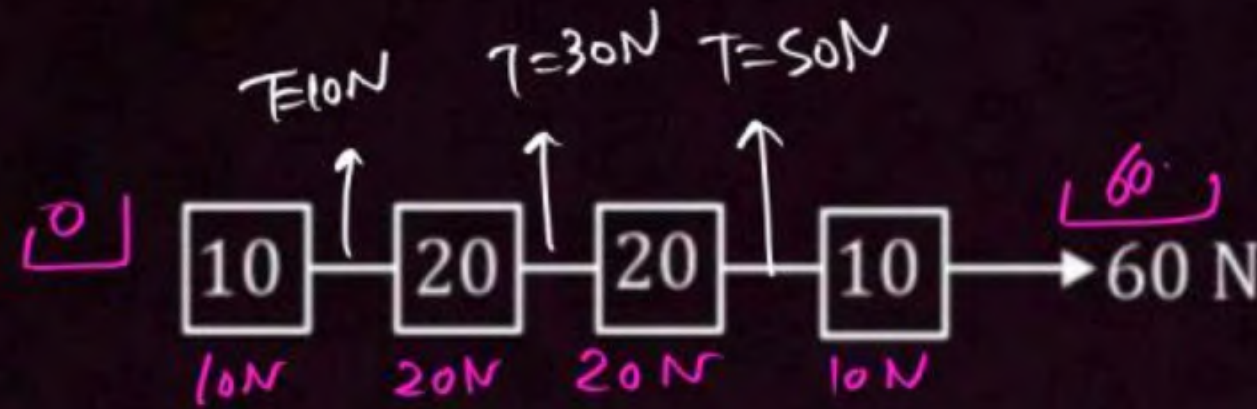
$$a = \frac{60}{5} = 12 \text{ N/kg}$$



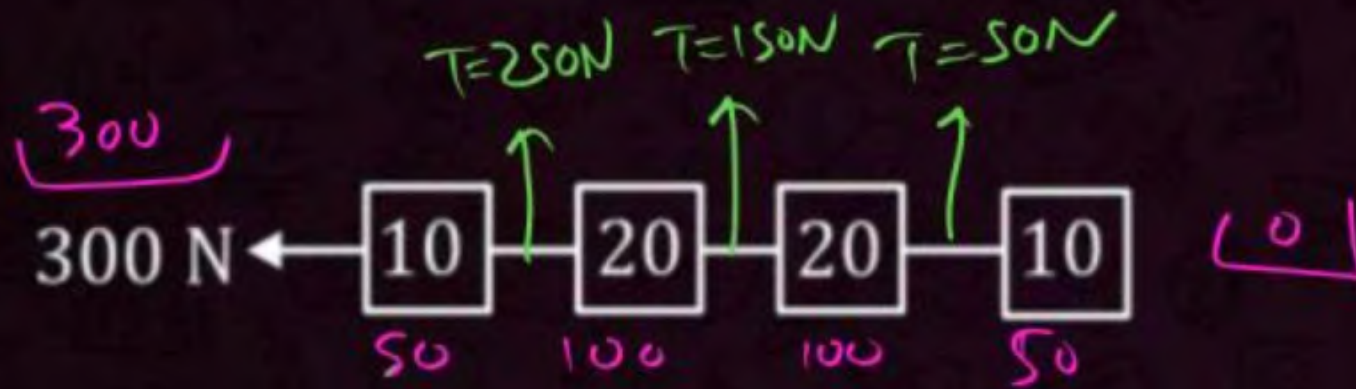
$$a = \frac{60}{6} = 10 \text{ N/kg}$$

QUESTION-140

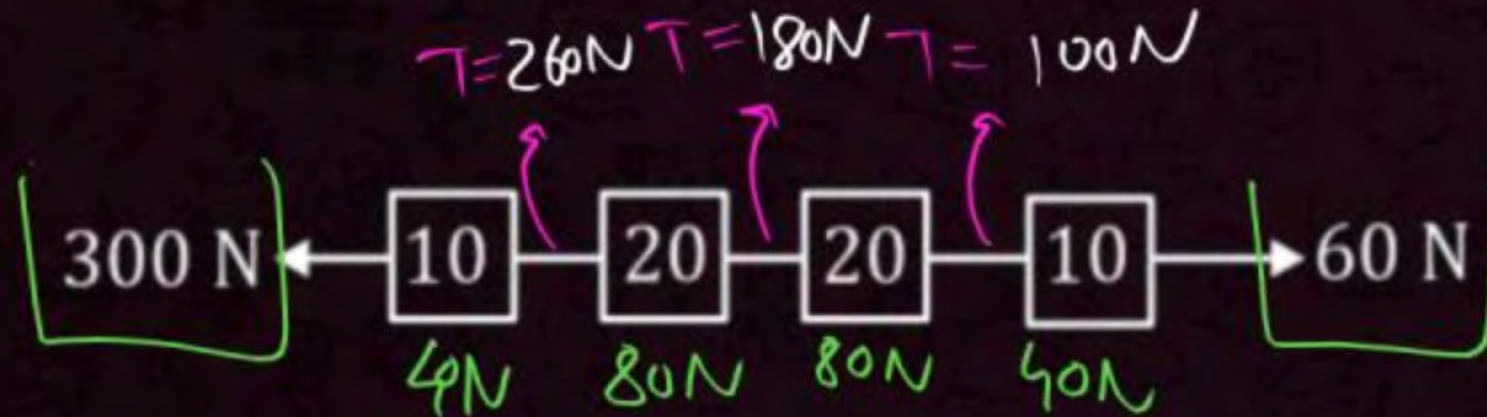
Difficulty Level : MEDIUM



$$a = \frac{60}{60} = 1 \text{ N/kg}$$



$$a = \frac{300}{60} = 5 \text{ N/kg}$$

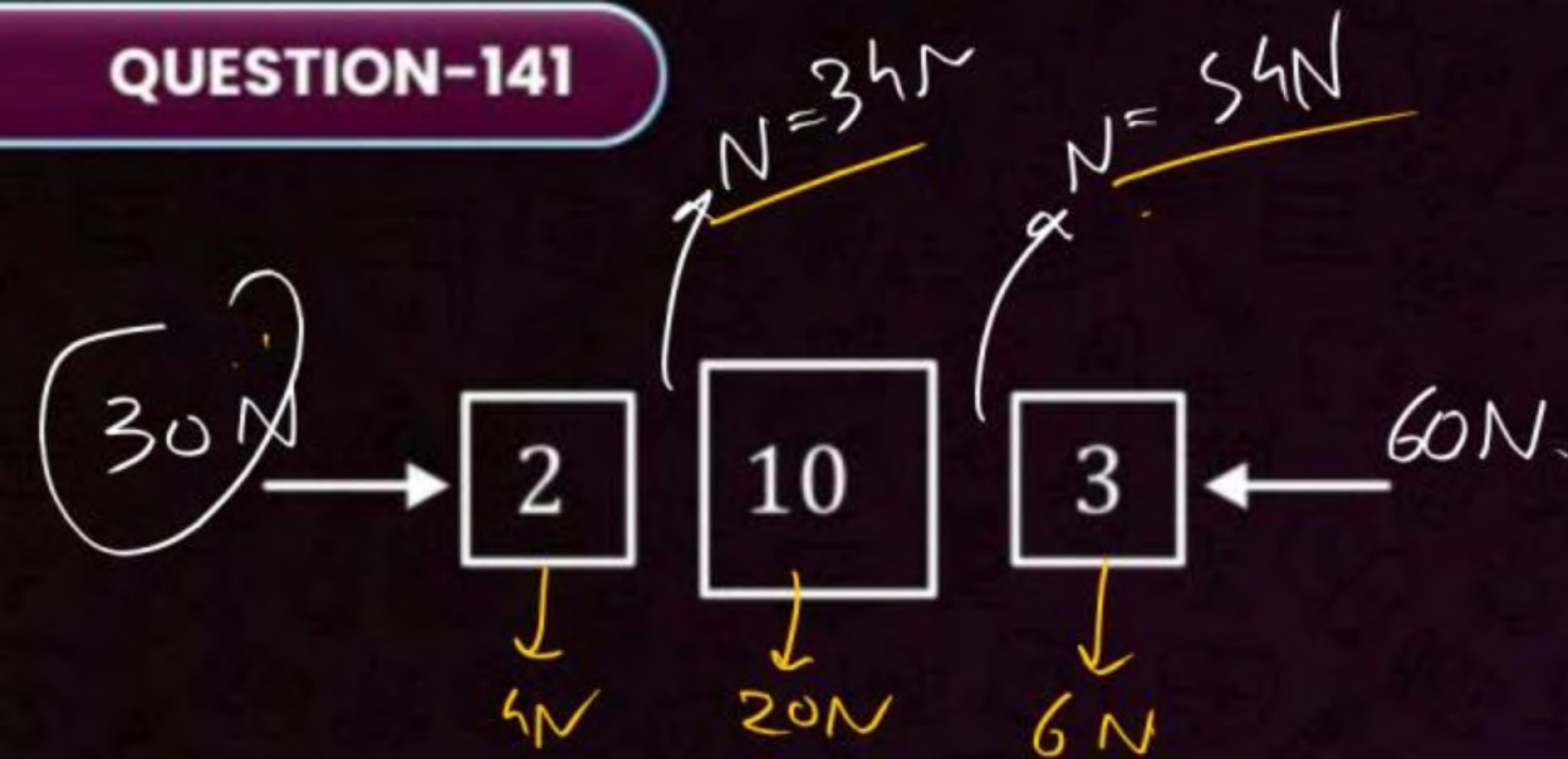


$$a = \frac{300 - 60}{60} = 4 \text{ N/kg}$$



QUESTION-141

Difficulty Level : MEDIUM



$$a = \frac{60 - 30}{15} = \frac{30}{15} = 2 \text{ N/kg}$$

QUESTION-142**Difficulty Level : MEDIUM**

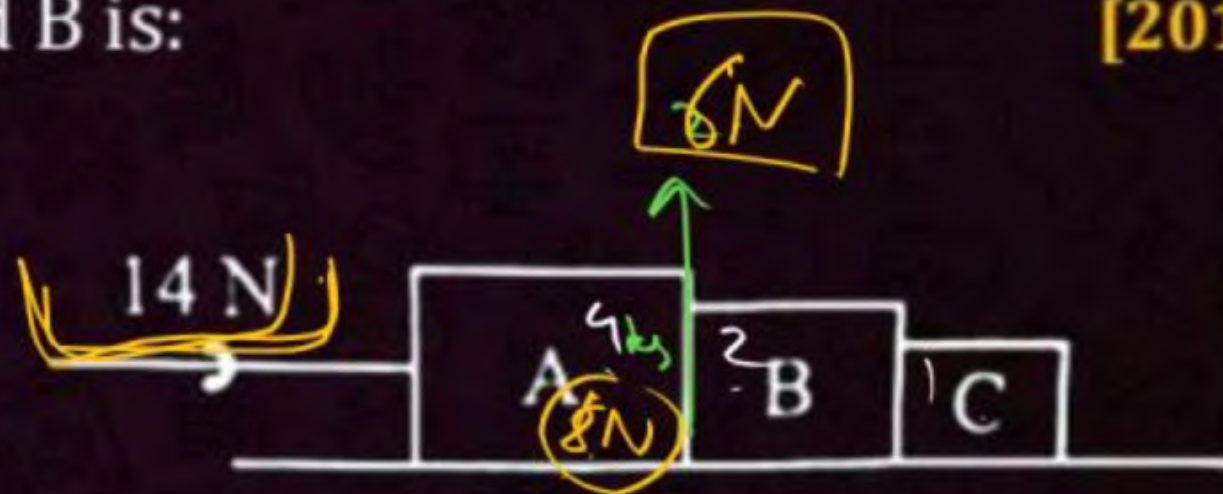
Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a friction less surface, as shown. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is: [2015]

☒ 1 6 N

☐ 2 8 N

☐ 3 18 N

☐ 4 2 N



$$a = \frac{14}{7} = 2 \text{ N/kg}$$

QUESTION-143**Difficulty Level : Easy***hir*

Two blocks of masses 10 kg and 20 kg are connected by a massless string and are placed on a smooth horizontal surface as shown in the figure. If a force $F = 600$ N is applied to 10 kg block, then the tension in the string is

[NCERT Based]

- 1** 100 N
- 2** 200 N
- 3** 300 N
- 4** 400 N



QUESTION-144**Difficulty Level : Easy**

Two blocks of masses 10 kg and 20 kg are connected by a massless string and are placed on a smooth horizontal surface as shown in the figure. If a force $F = 600\text{ N}$ is applied to 20 kg block, then the tension in the string is

nw

1 100 N ✓

2 200 N

3 300 N

4 400 N

[NCERT Based]

QUESTION-145

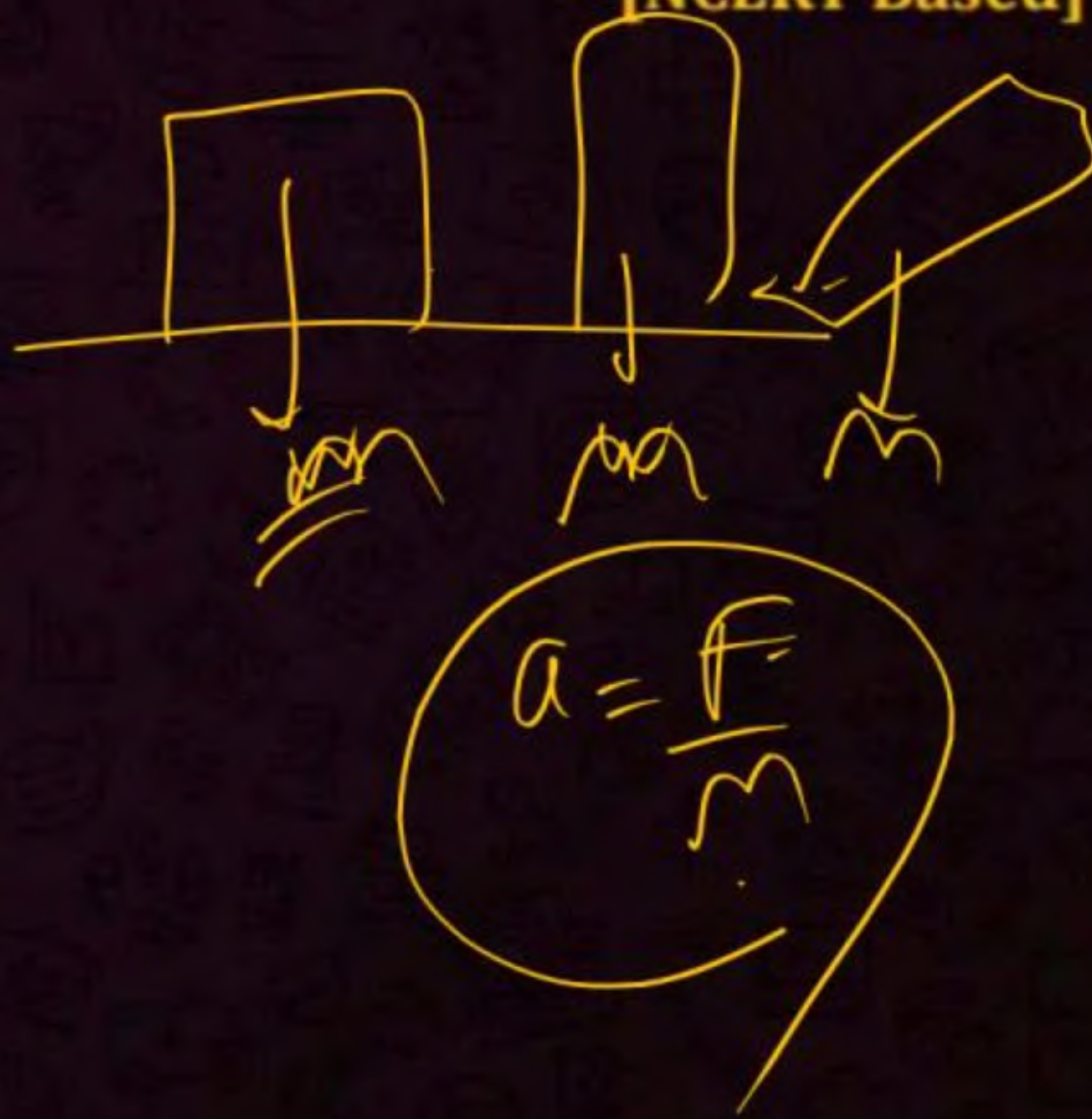
Difficulty Level : Easy



An iron block of sides $50\text{ cm} \times 8\text{ cm} \times 15\text{ cm}$ has to be pushed along the floor. The force required will be minimum when the surface in contact with ground is

[NCERT Based]

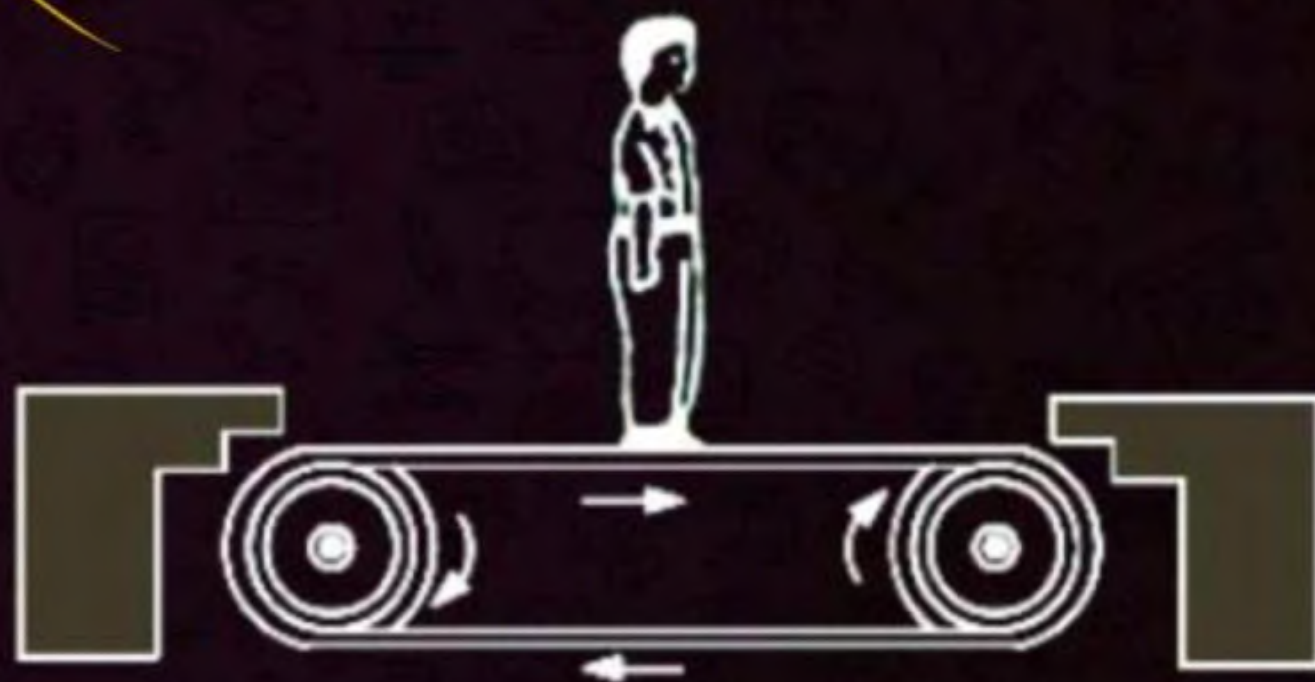
- 1 $8\text{ cm} \times 15\text{ cm}$ surface
- 2 $50\text{ cm} \times 15\text{ cm}$ surface
- 3 $8\text{ cm} \times 50\text{ cm}$ surface
- 4 force is same for all surfaces ✓



QUESTION-146**Difficulty Level : Easy**

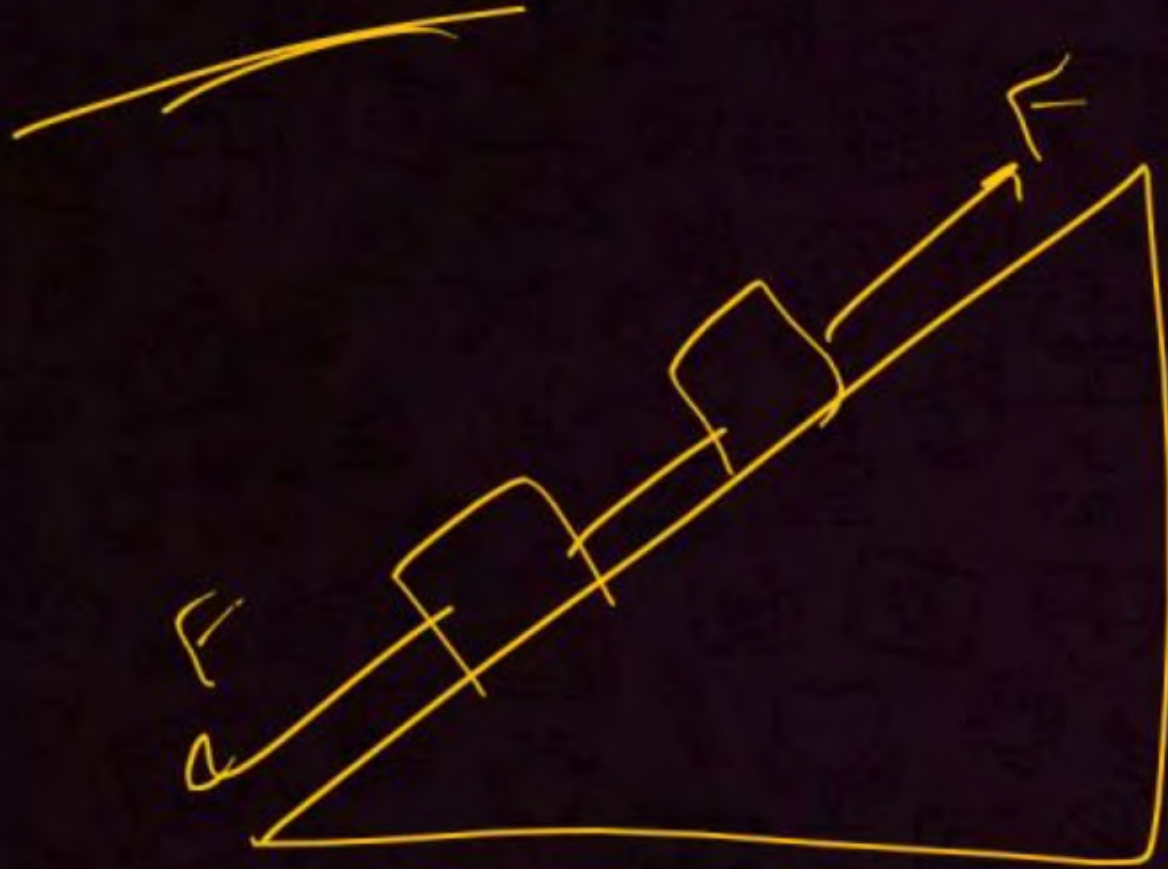
Figure shows a man of mass 55 kg standing stationary with respect to a horizontal conveyor belt that is accelerating with 1 m s^{-2} . The net force acting on the man is **[NCERT Based]**

- 1 35 N
- 2 45 N
- 3 55 N
- 4 65 N



Nimoda

7.4 Bhandara on incline

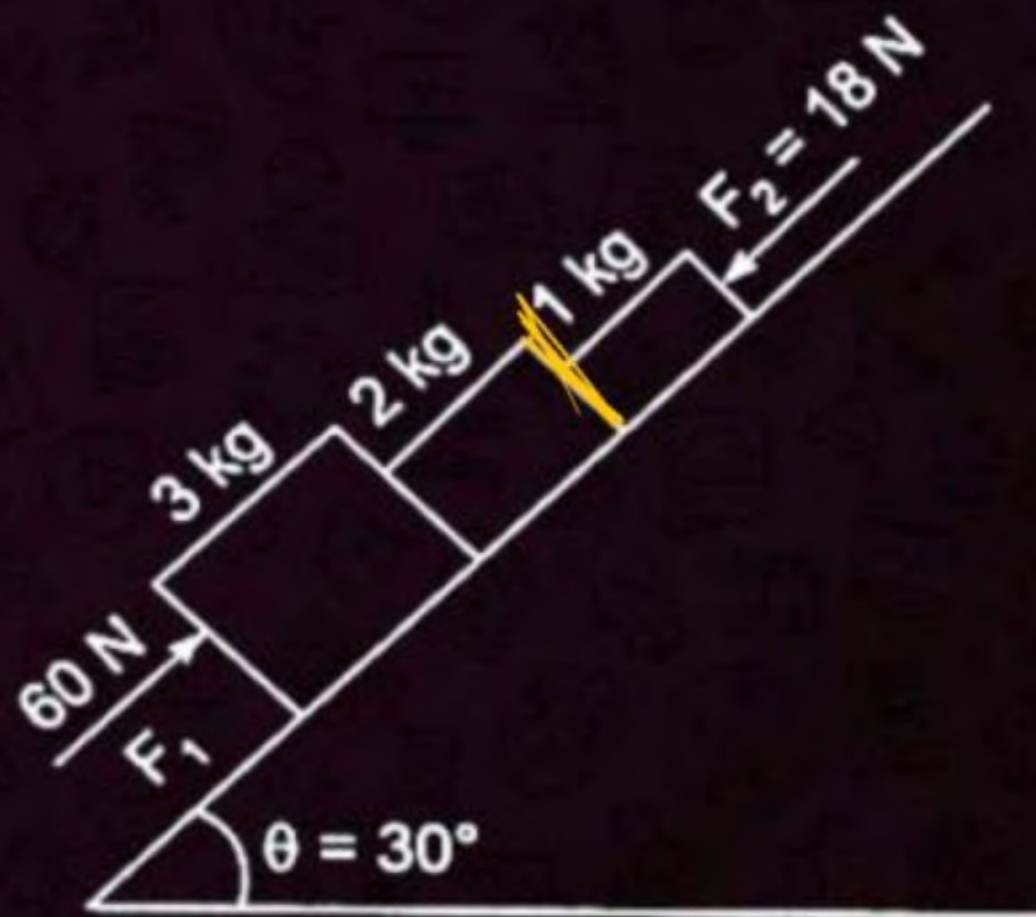


Nimoda is valid on incline too

QUESTION-147**Difficulty Level : HARD**

In the diagram shown, the normal reaction force between 2 kg and 1 kg is (Consider the surface, to be smooth): Given $g = 10 \text{ ms}^{-2}$. **[2022 Re]**

- 1 10 N
- 2 25 N
- 3 39 N
- 4 6 N



Difficulty Level: HARD

[2022 Re]



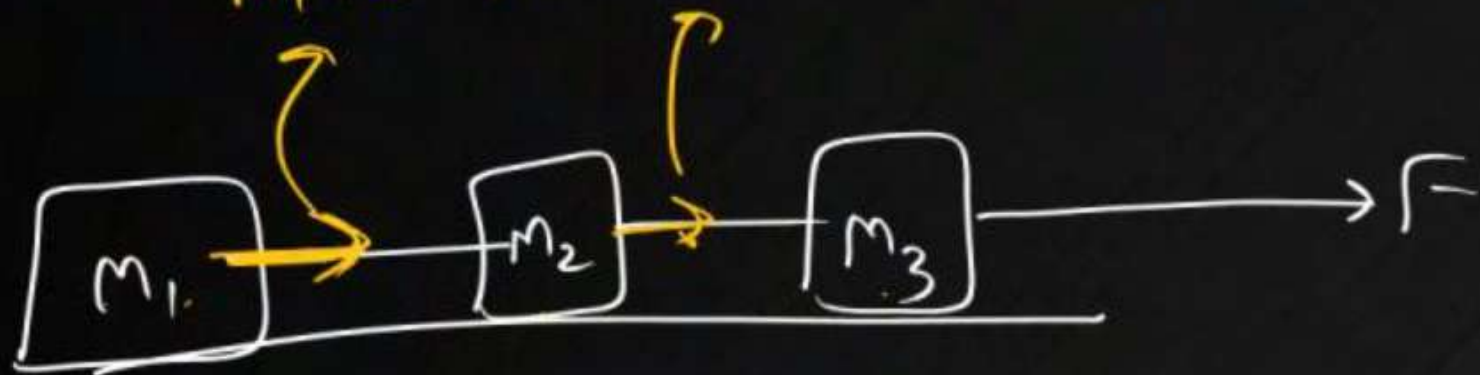
$$a = \frac{60 - 18}{6} = 7 \text{ N/kg}$$



Reaction force between 2 kg and 1 kg is 7 N . Given $g = 10 \text{ ms}^{-2}$.

$$T = \frac{m_1 F}{m_1 + m_2 + m_3}$$

$$T = \frac{(m_1 + m_2) F}{m_1 + m_2 + m_3}$$



$$T = \chi_{\text{mass pulled}} \times F$$

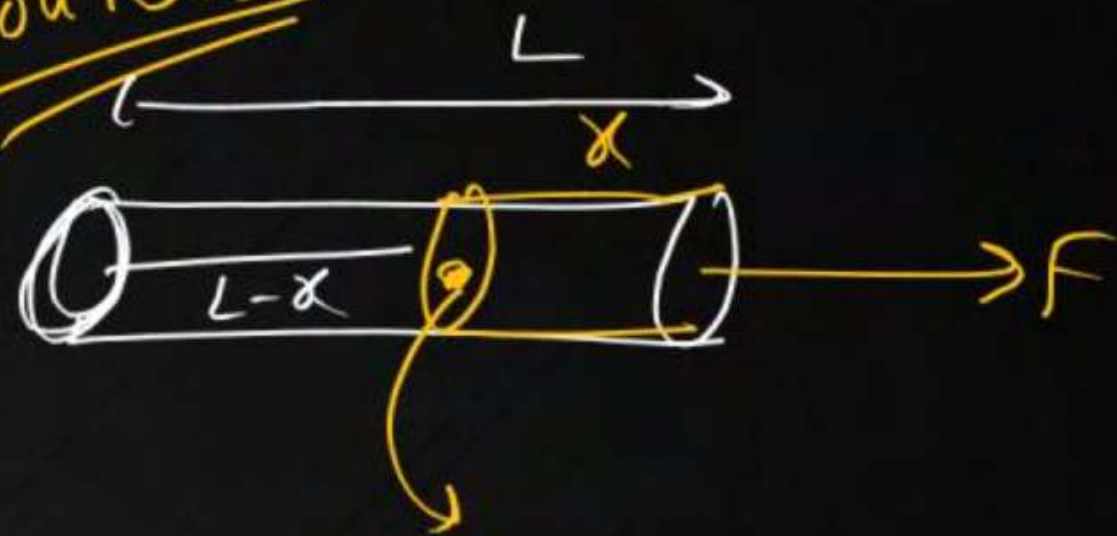
$$N = \chi_{\text{mass pushed}} \times F$$



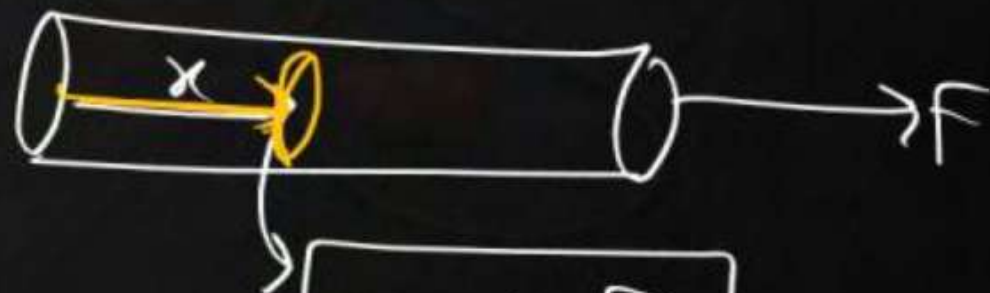
$$N = \frac{(m_2 + m_3) F}{m_1 + m_2 + m_3}$$

$$N = \frac{m_3 F}{(m_1 + m_2 + m_3)}$$

Moti Rossi



$$T = \left(\frac{L-x}{L} \right) F$$



$$T = \frac{x F}{L}$$

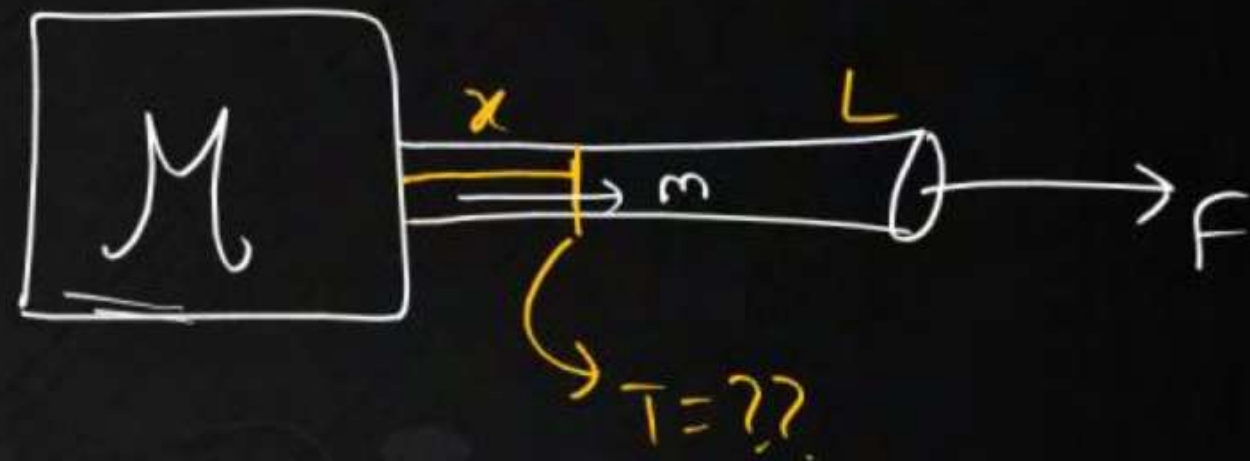
$\lambda \rightarrow$ Linear mass density

$$\text{mass} = \lambda (\text{length})$$

✓✓  $M_0 = \lambda L$

✓✓  $m = \lambda x$

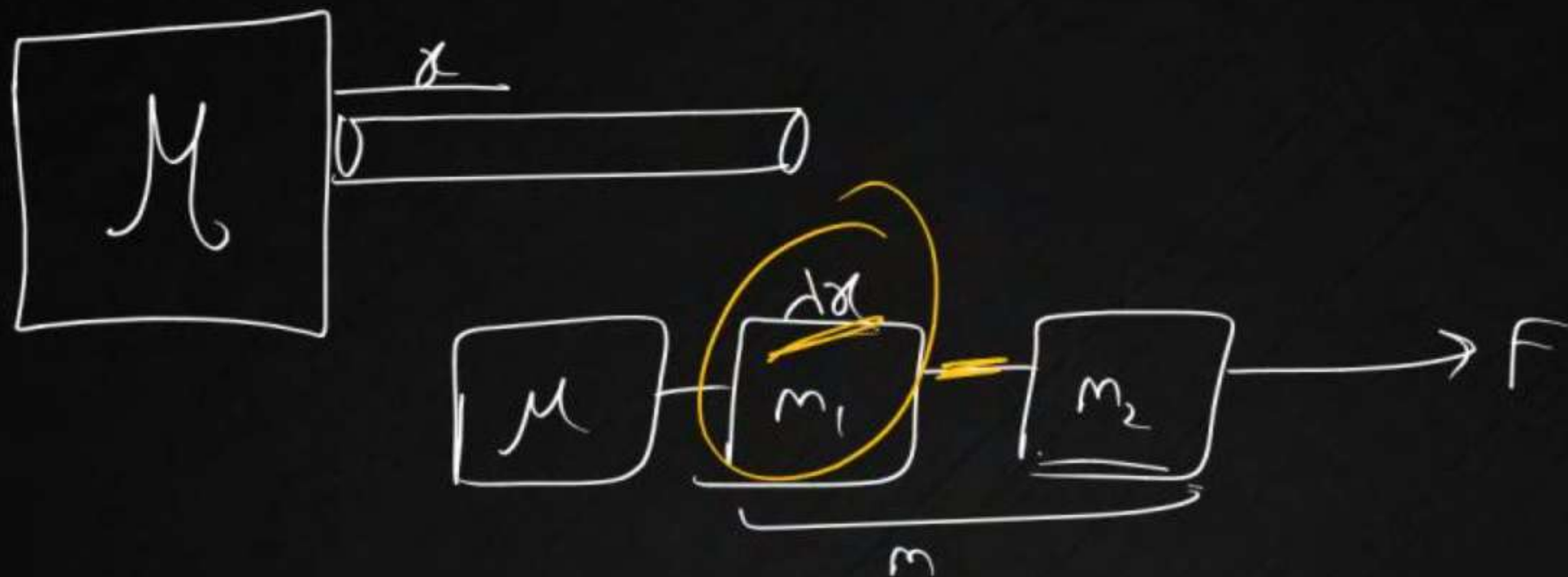
Kodhala



$$T = \frac{\text{mass pulled} \times F}{\text{total mass}}$$

$$= \left(\frac{M + \lambda x}{M + m} \right) F$$

($m = \lambda L$)



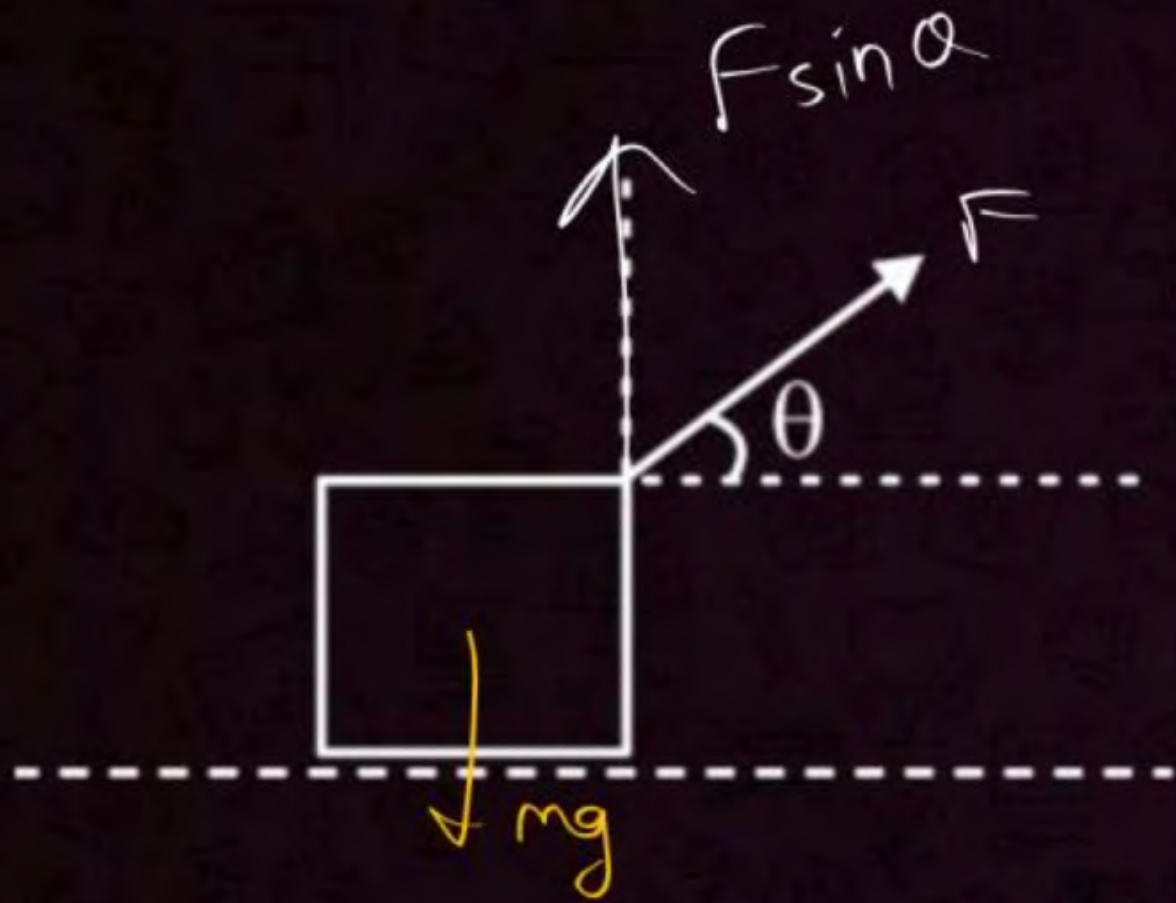
$$T = \left(\frac{M + m_1}{M + m} \right) F$$

$$T = \left(\frac{M + \lambda x}{M + m} \right) F$$

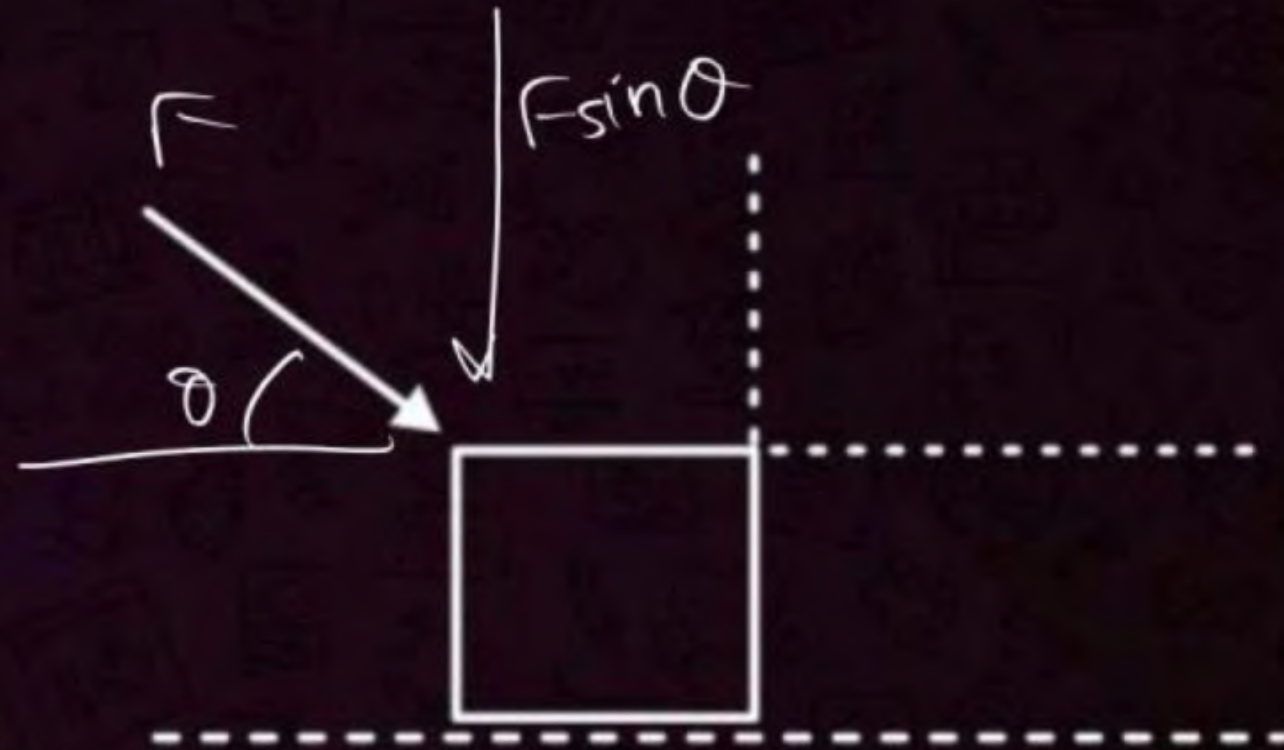
$$\lambda = \frac{m}{L}$$

✓✓

7.5 Pulling Striling



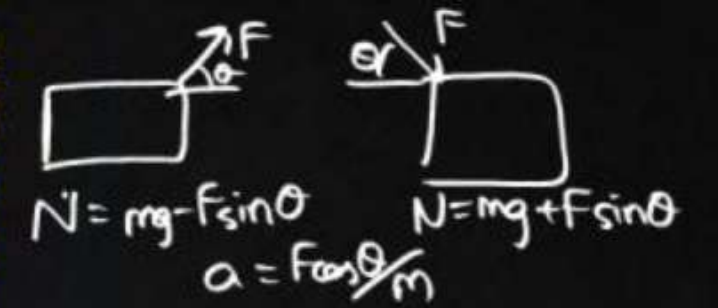
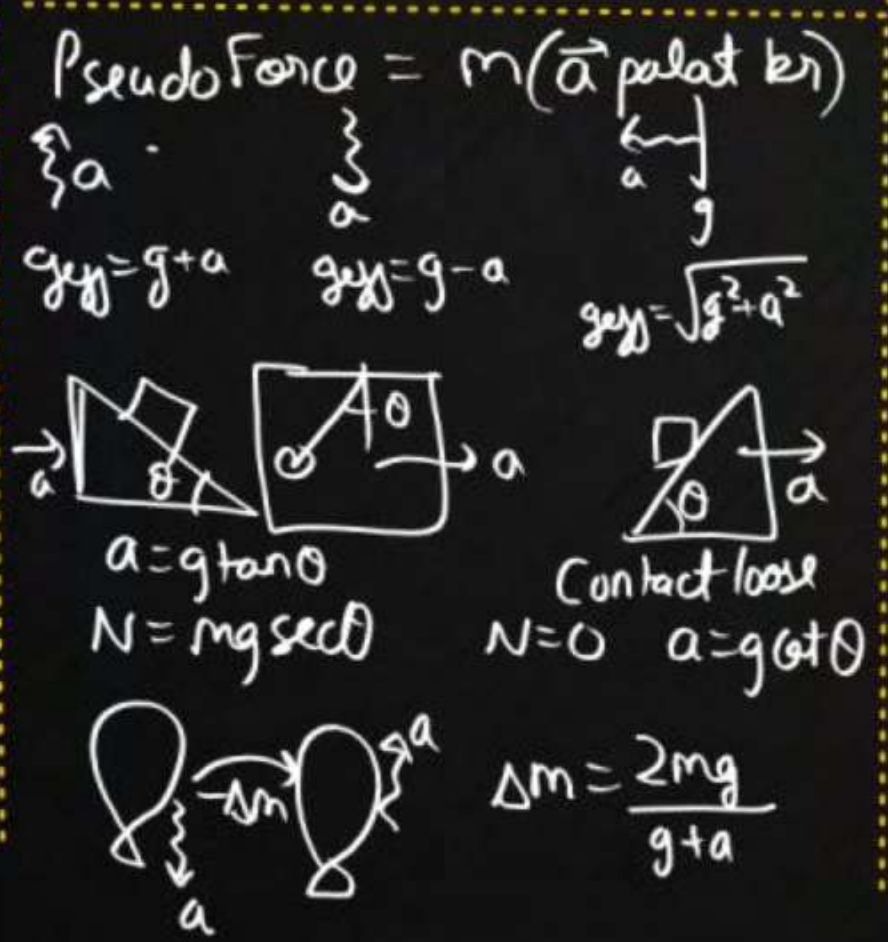
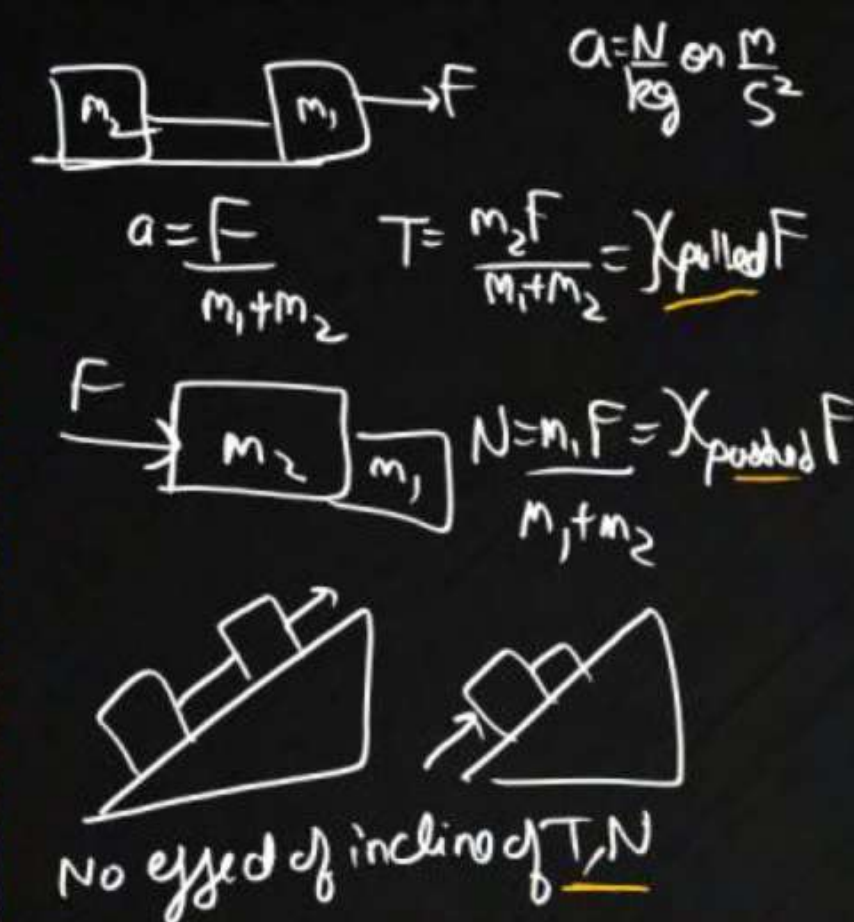
$$\underline{N = mg - F \sin \theta}$$



$$\underline{N = mg + F \sin \theta}$$

PUPPY POINTS 2

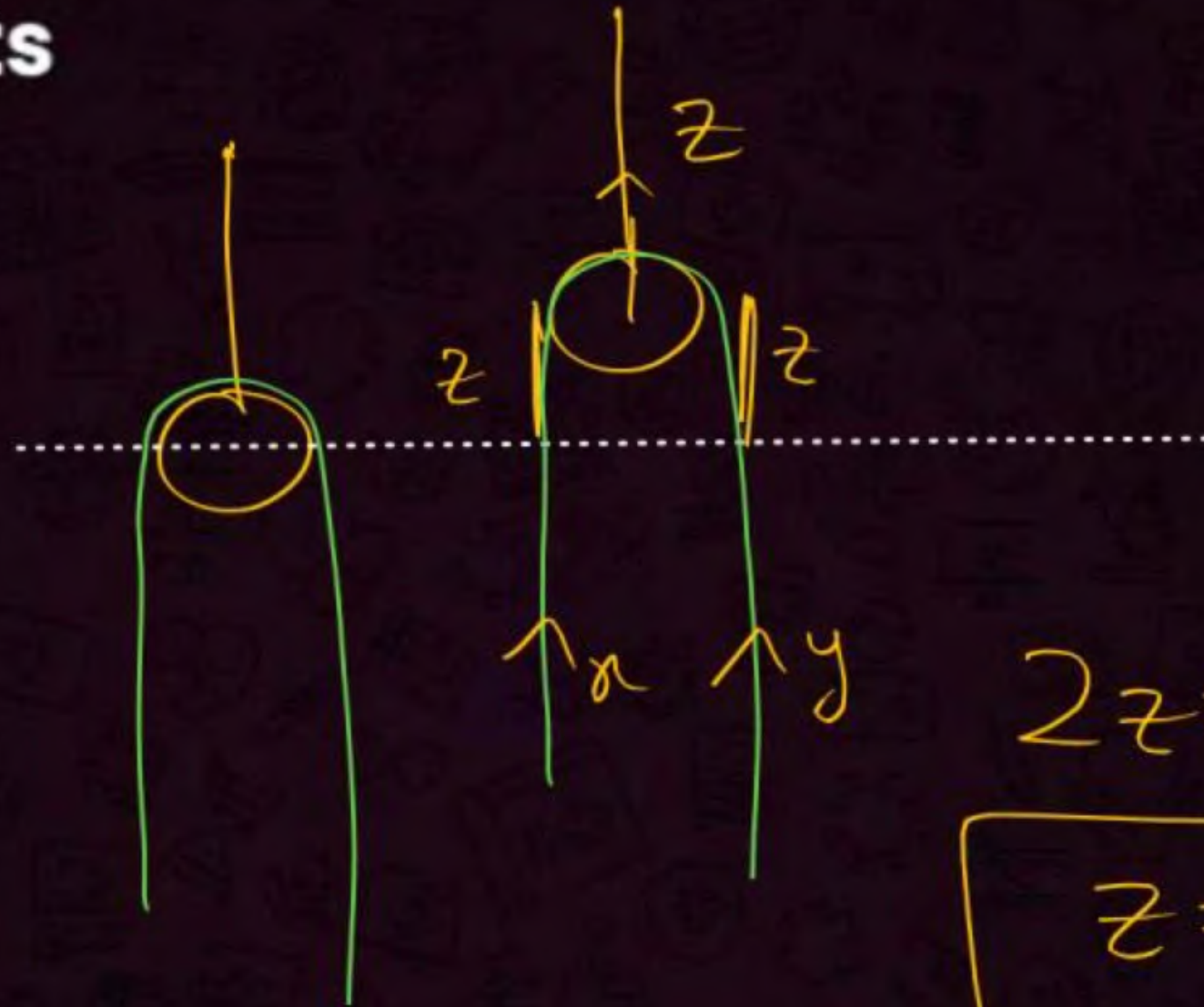
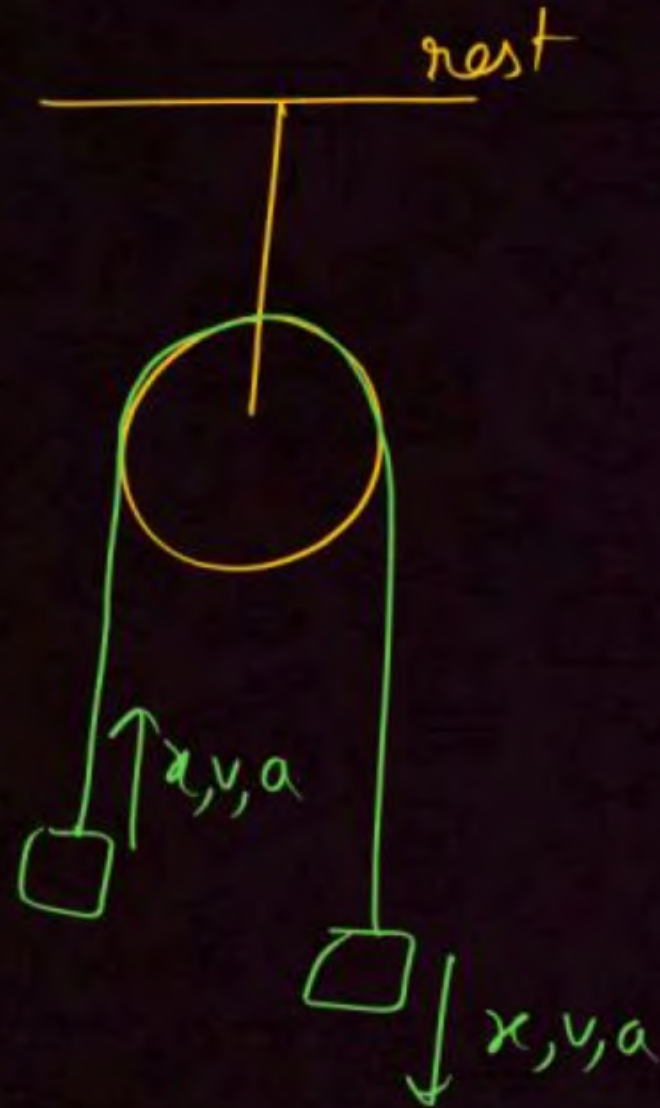
$W=mg$
 T (dene ka)
 N (chipane ka force)
 Contact lost $N=0$
 Upthrust - Buoyancy



Part 8 – Constraint Motion



8.1 Pulley Constraints



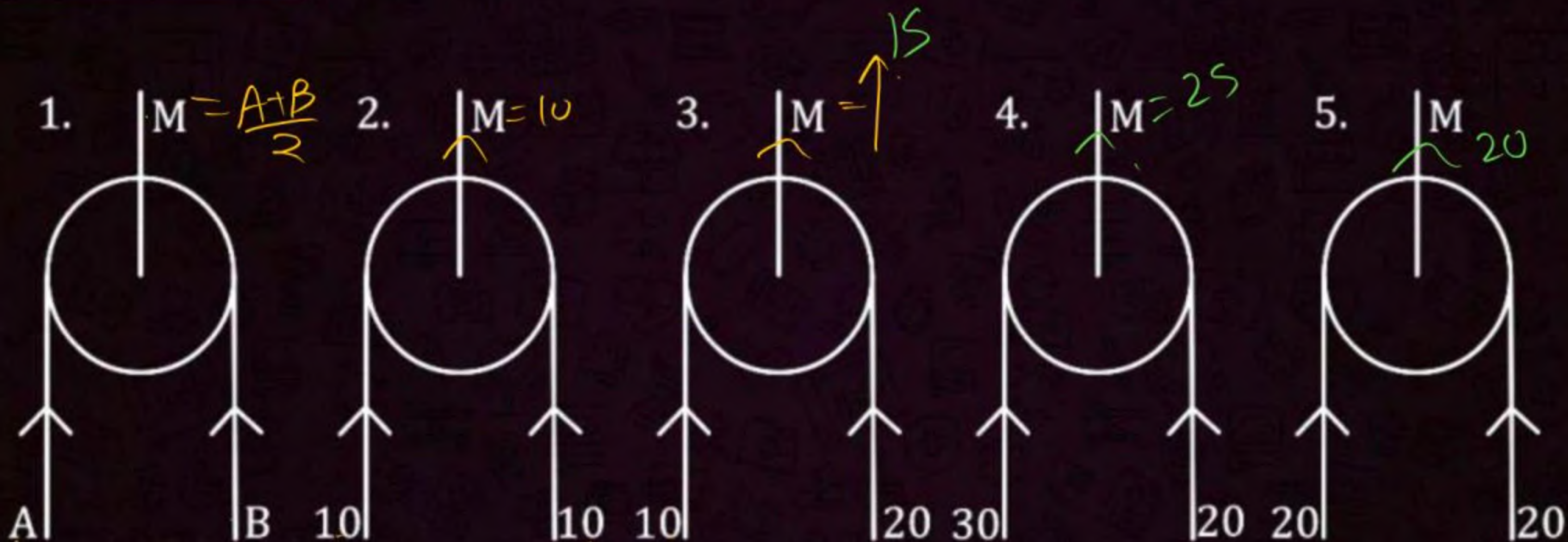
$$2z = x + y$$

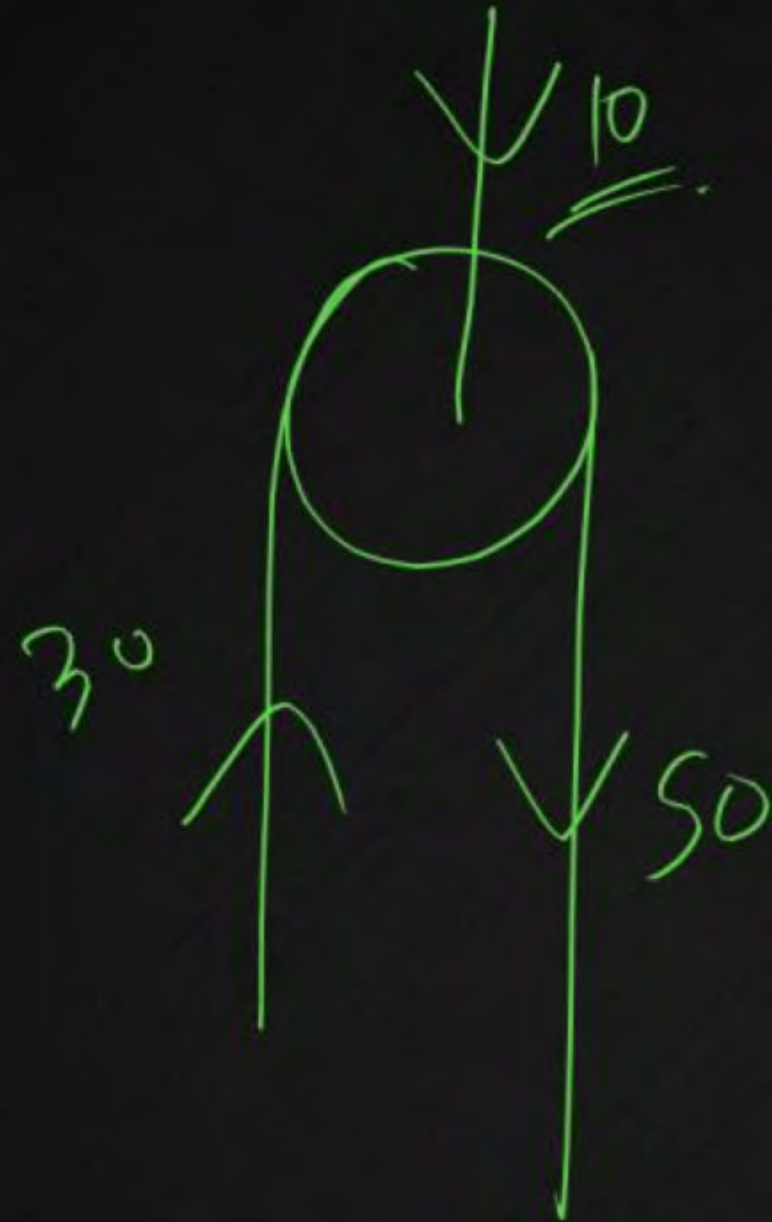
$$z = \frac{x + y}{2}$$

→ Pulley

QUESTION-148

Difficulty Level : Easy



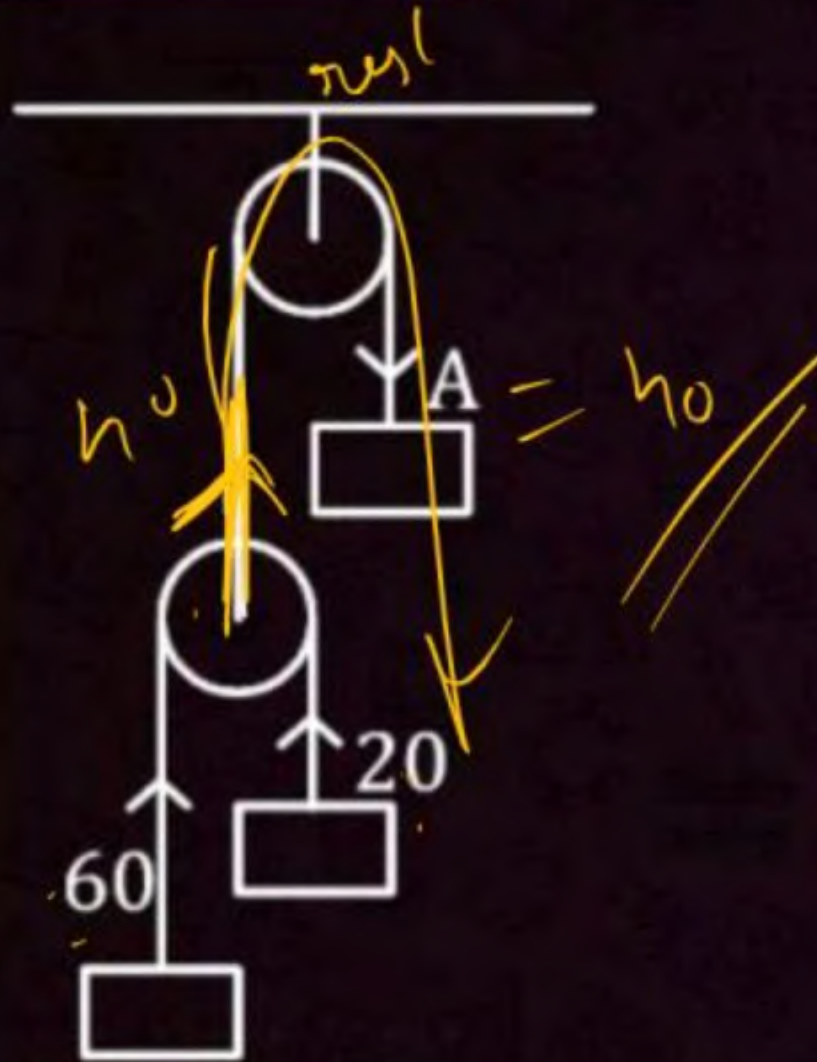


$$M = \frac{30 - 50}{2} = -\frac{20}{2} = -10$$

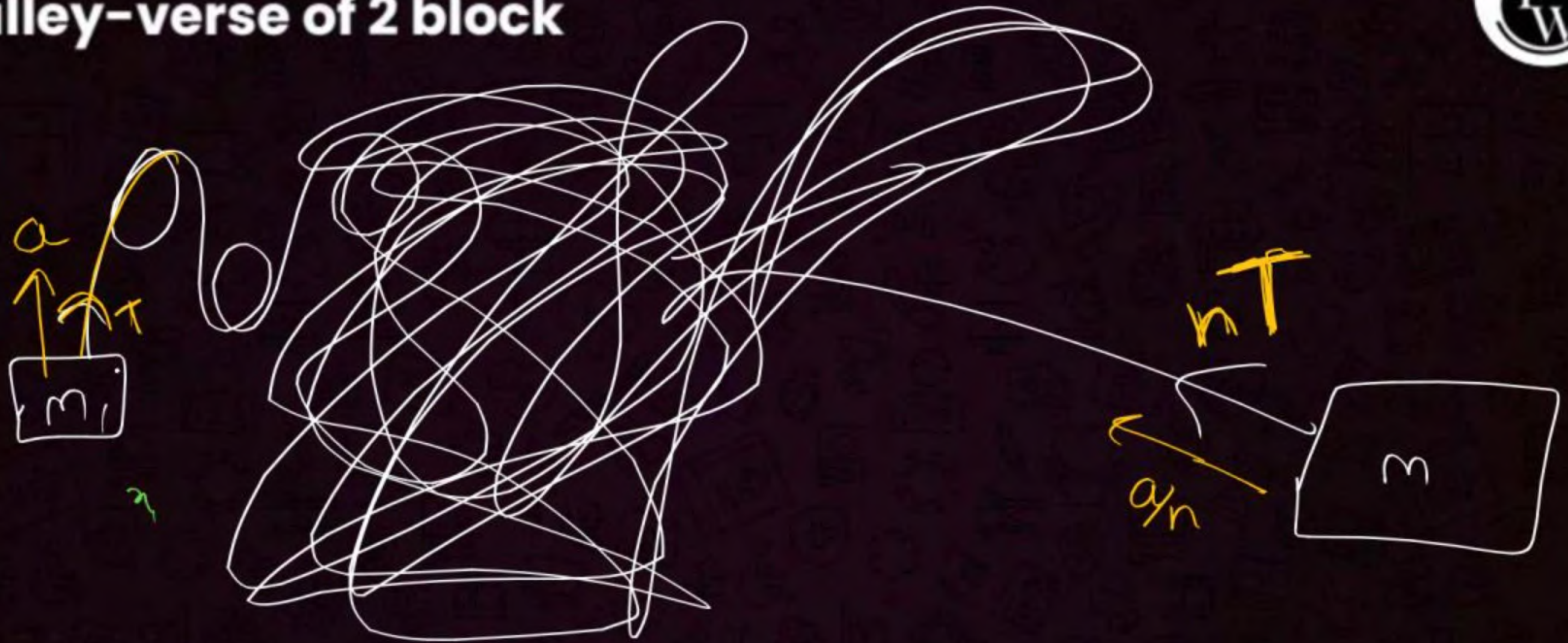


QUESTION-149

Difficulty Level : Easy

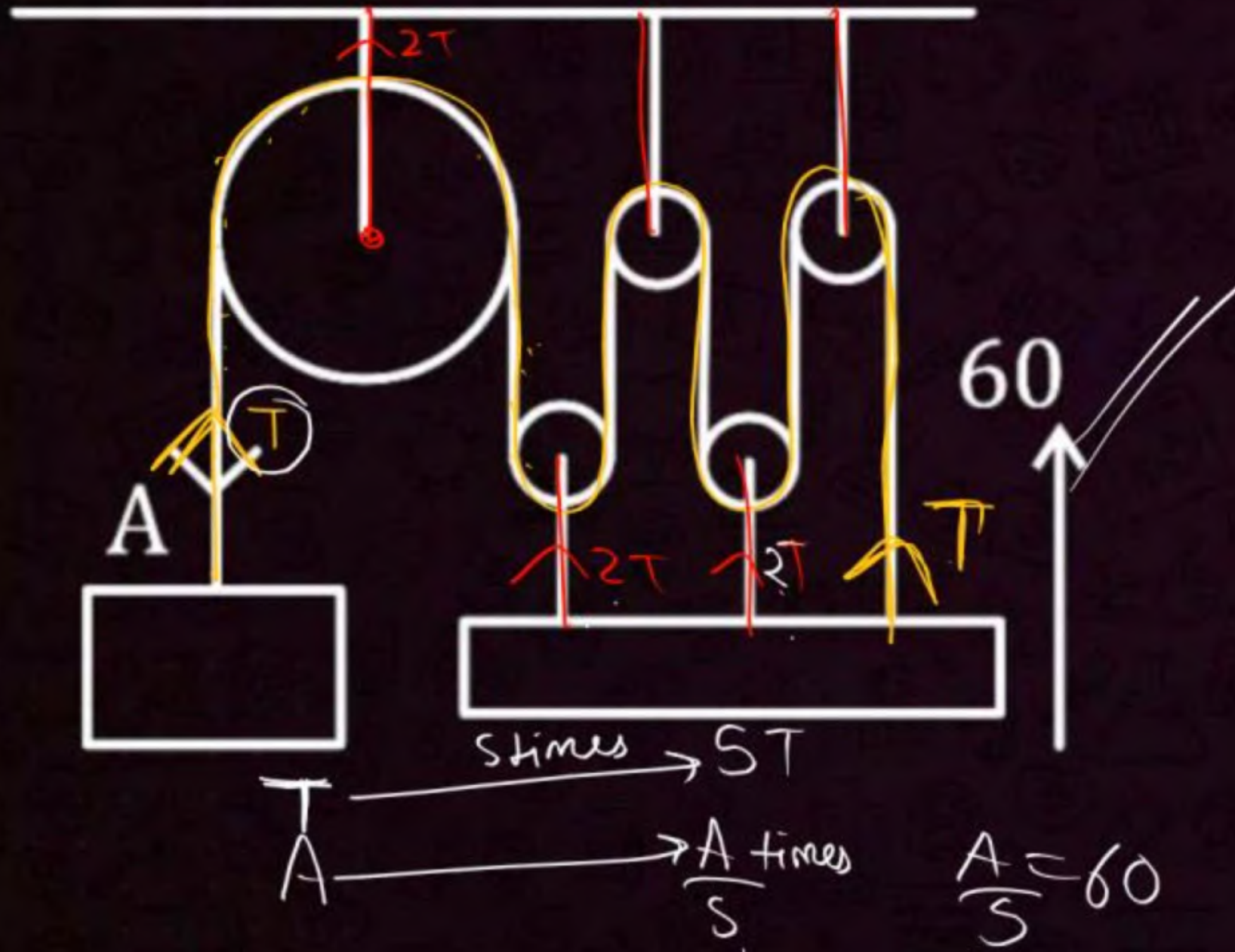


8.2 Pulley-verse of 2 block



QUESTION-150

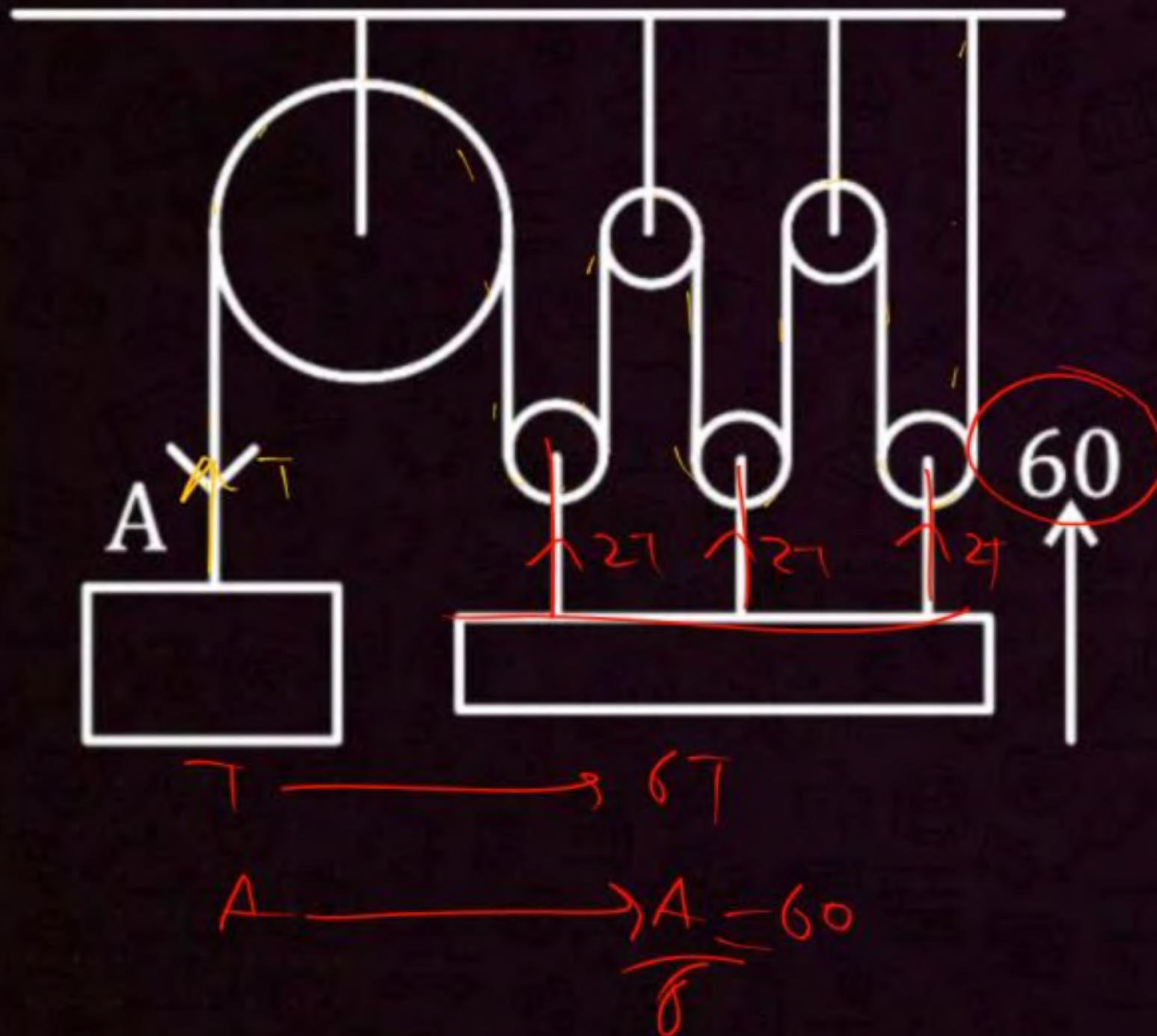
Difficulty Level : MEDIUM



$$A = 300$$

QUESTION-151

Difficulty Level : MEDIUM



(A) 30V

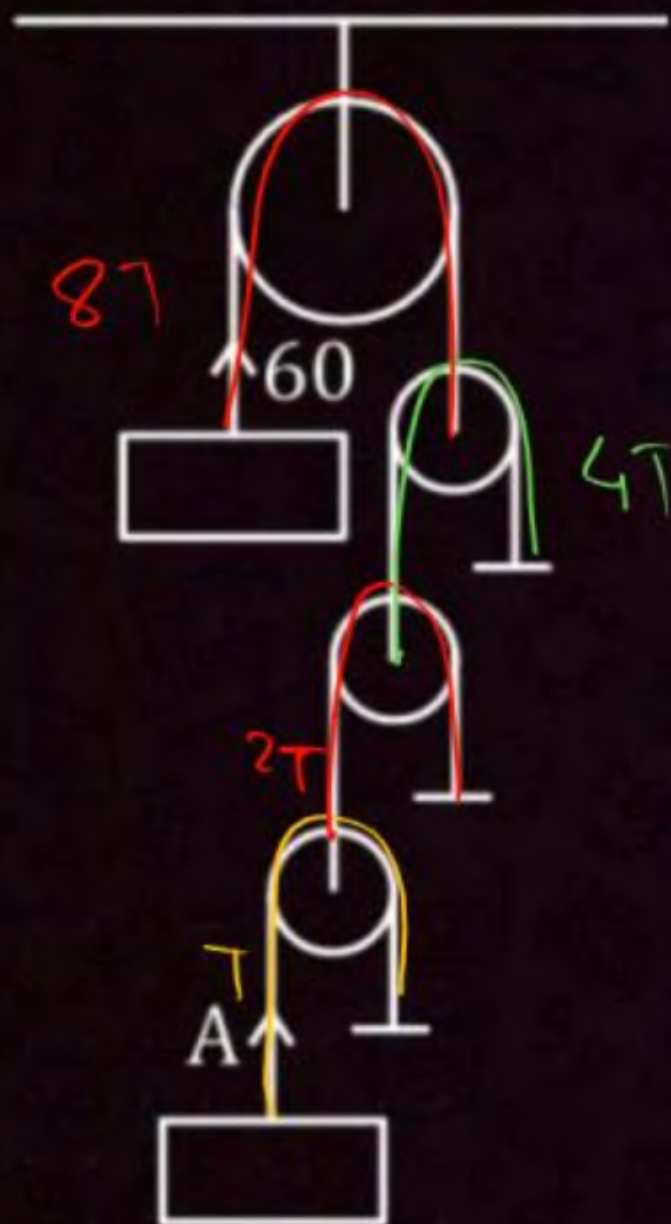
~~(B) 36V~~

(C) 40V

(D) 50

QUESTION-152

Difficulty Level : HARD



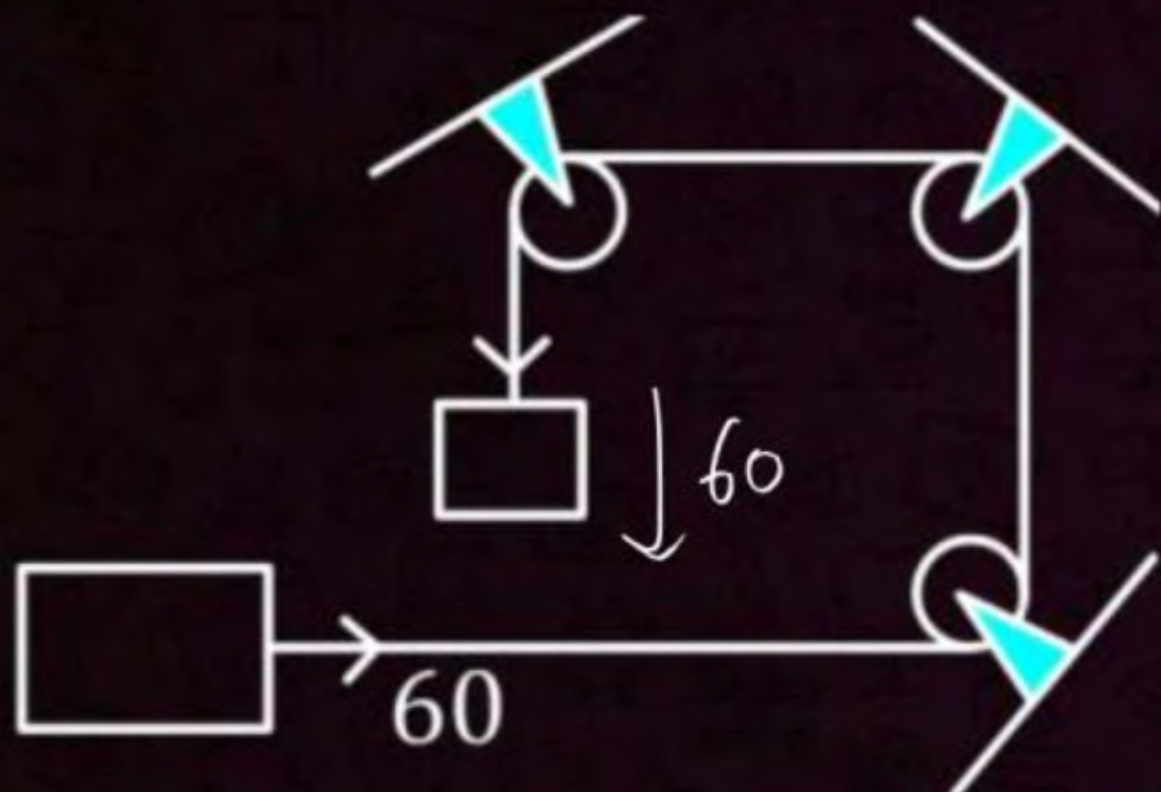
$$\begin{array}{c}
 \begin{array}{c} \uparrow \\ \boxed{A} \end{array} \xrightarrow{8T} \begin{array}{c} \boxed{A} \\ \hline \frac{A}{8} = 60 \end{array} \quad \boxed{A = 480}
 \end{array}$$

QUESTION-153

Difficulty Level : MEDIUM



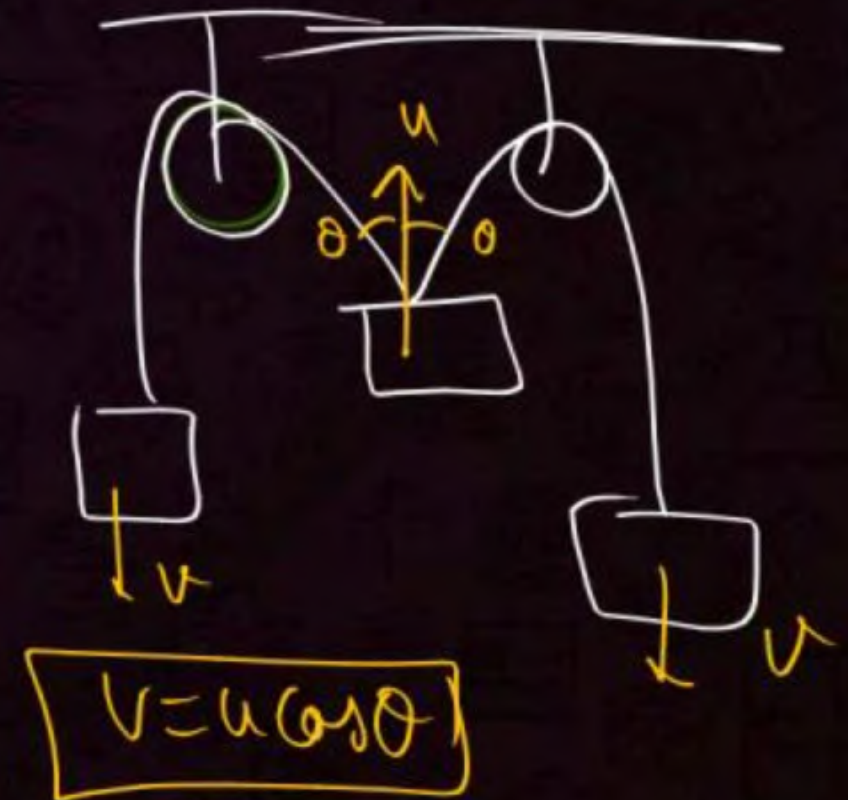
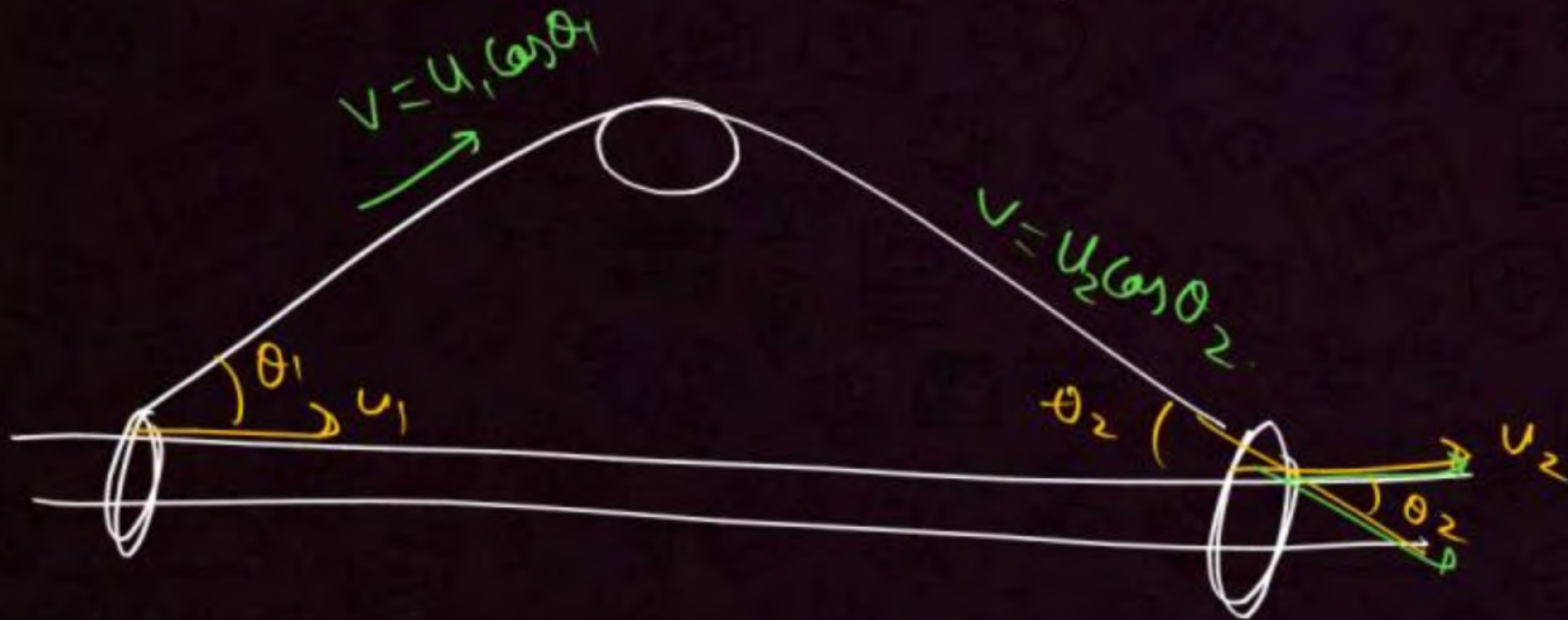
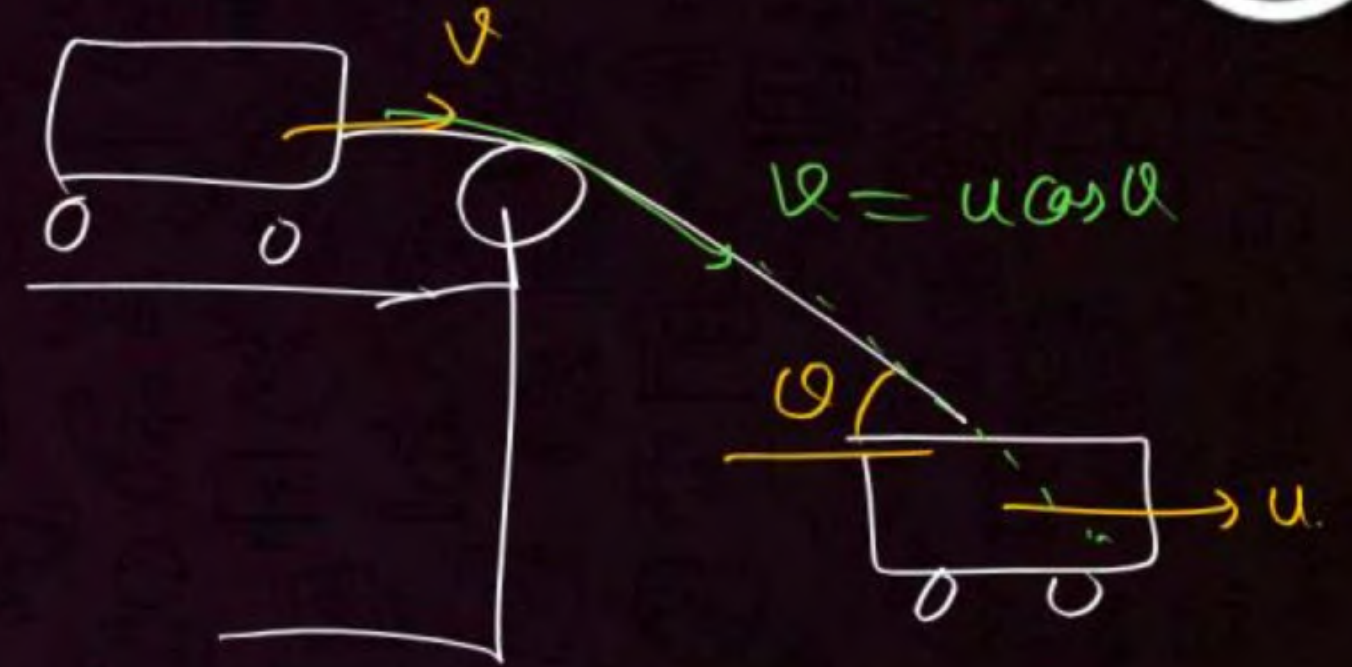
HW



8.3 Along the thread

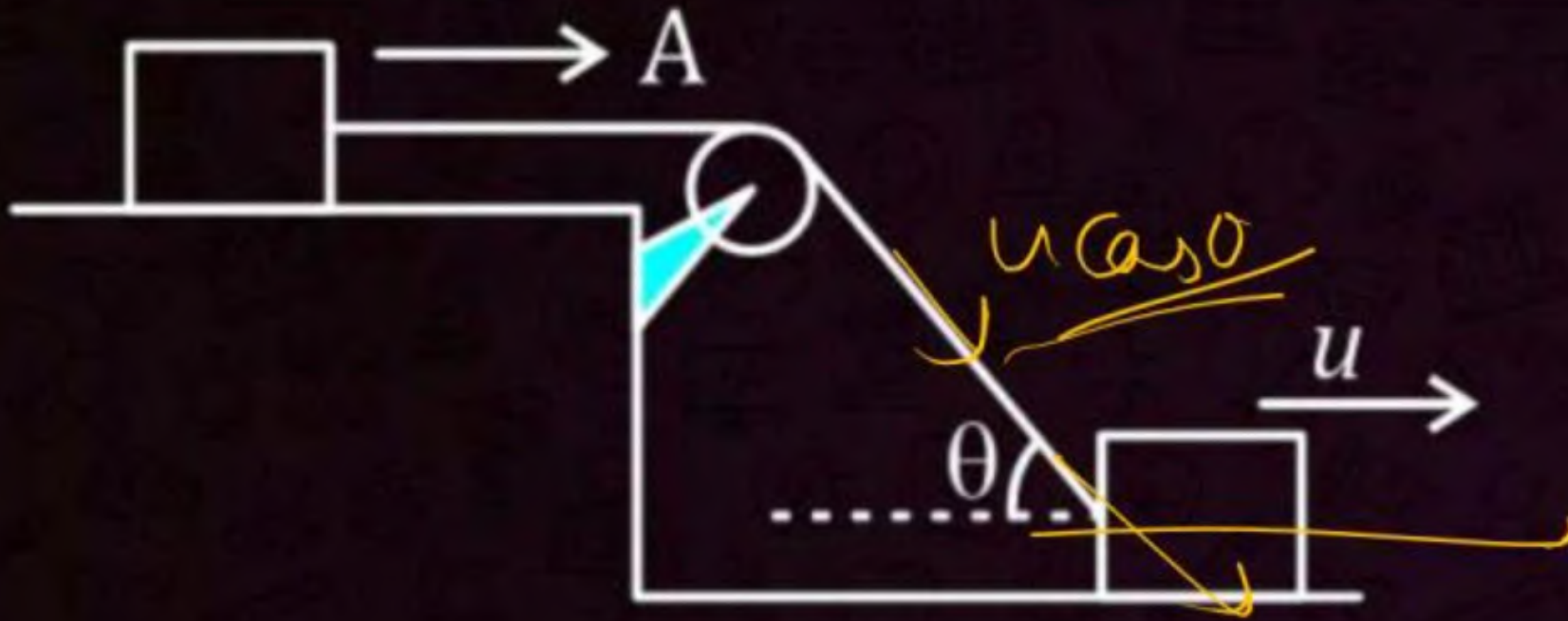


Moh-Moh ke Dhaage
u ka $\cos\theta$ len kr bhaage



QUESTION-154

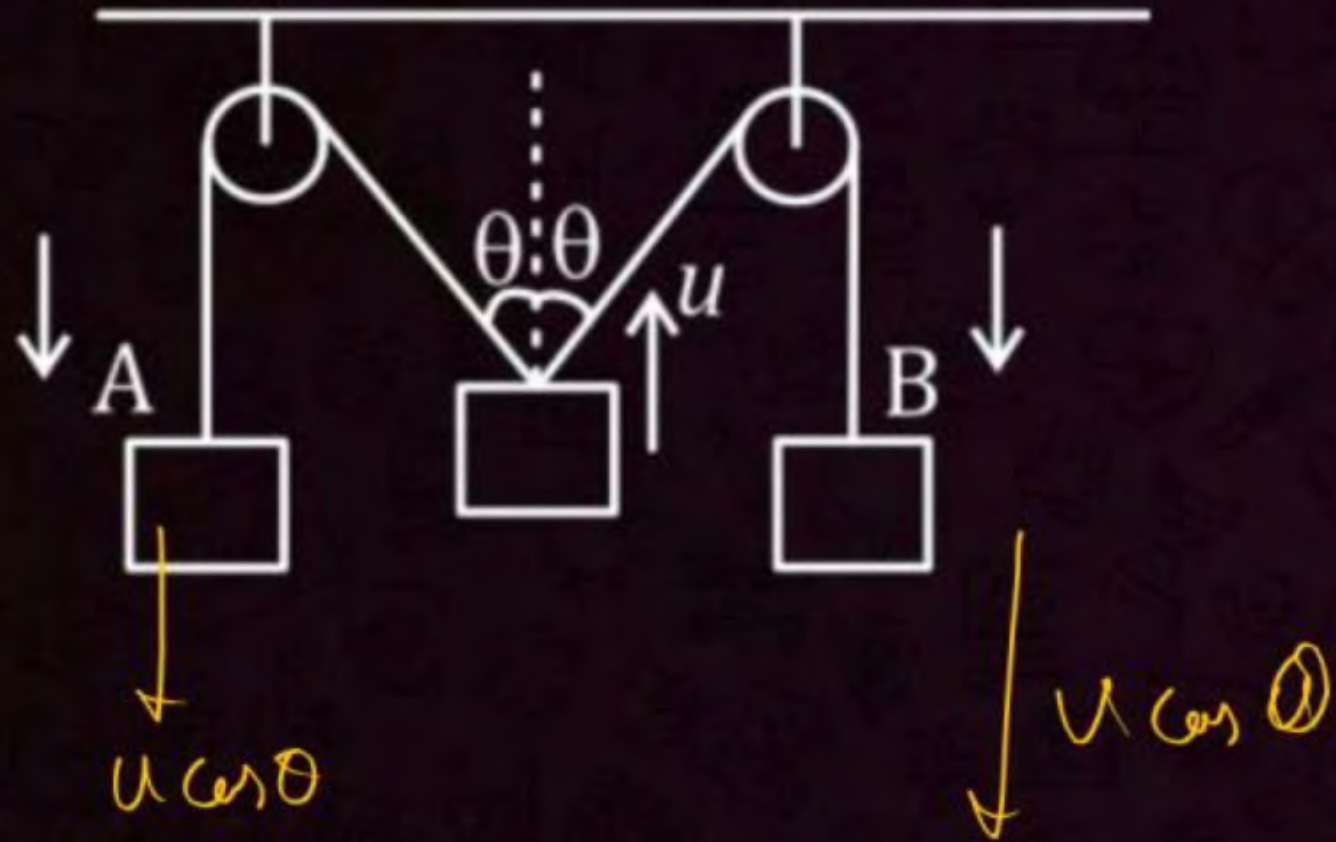
Difficulty Level : Easy



- (A) $A = u \cos \theta$
- (B) $u = A \cos \theta$
- (C) $u = A$
- (D) $u = \tan \theta A$

QUESTION-155

Difficulty Level : HARD

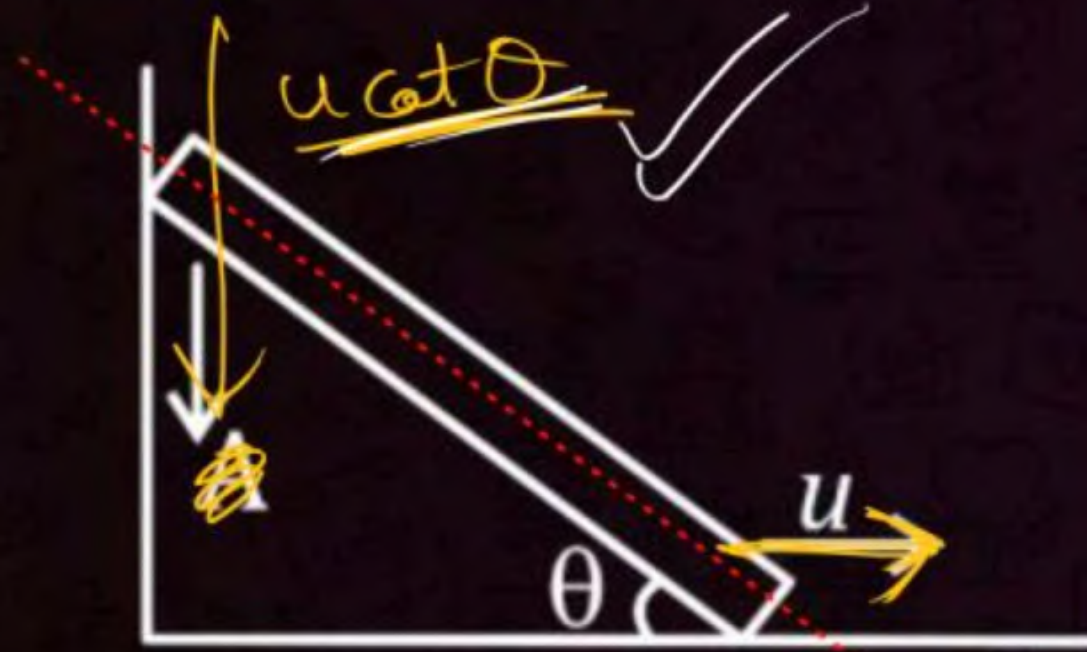


8.4 Rod k 2 fix cases

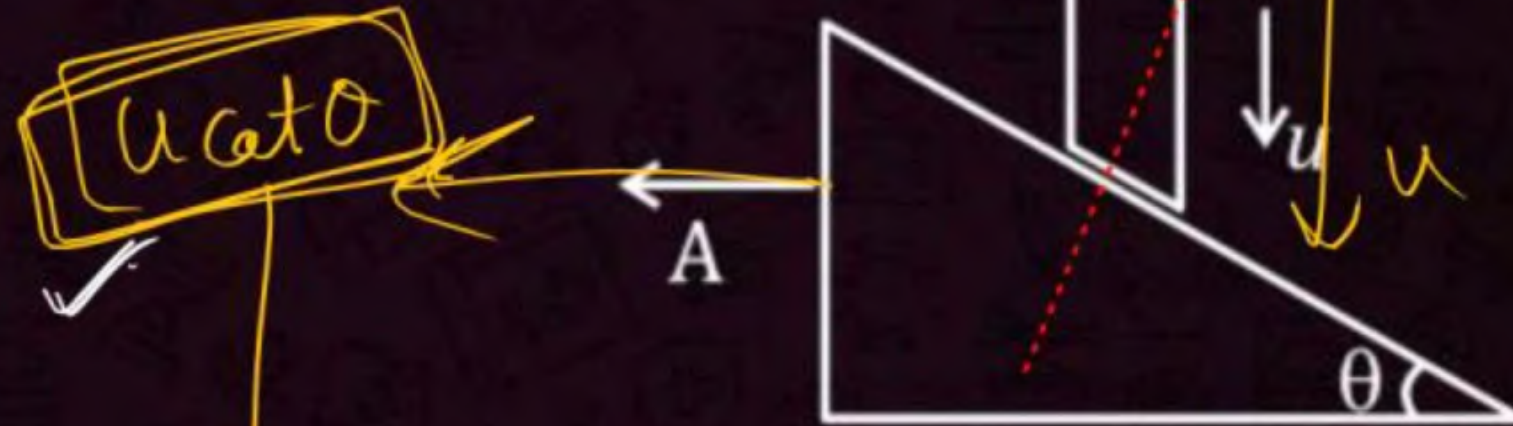
Difficulty Level : Easy



QUESTION-156

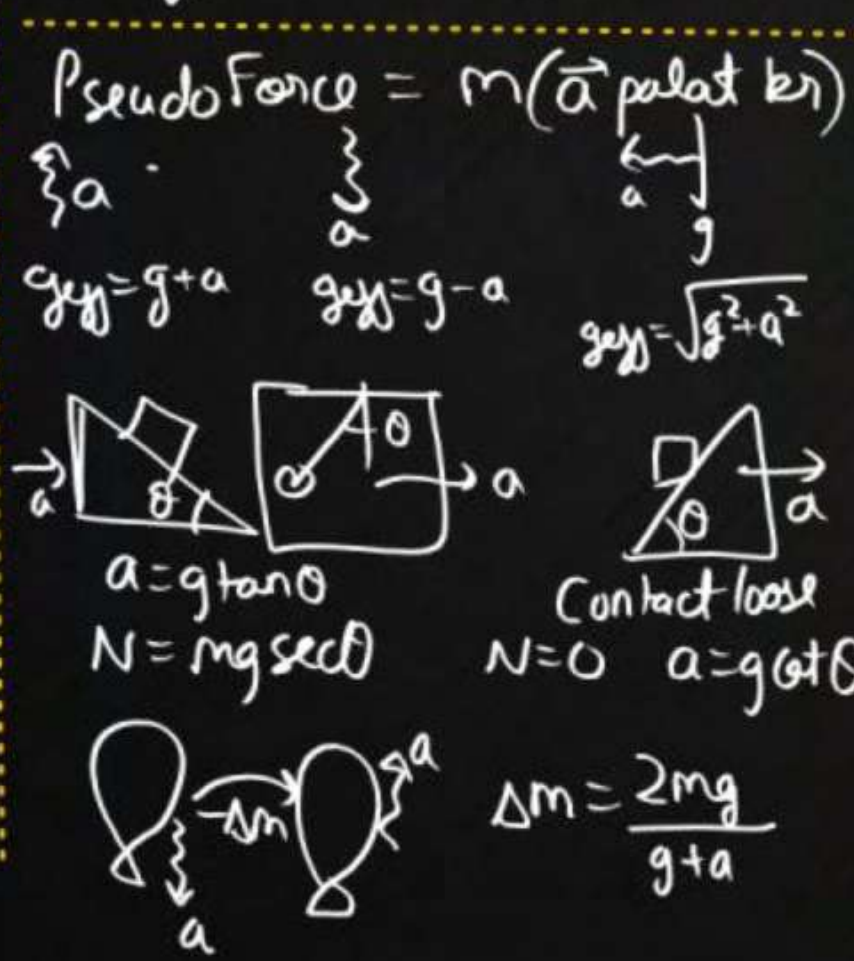
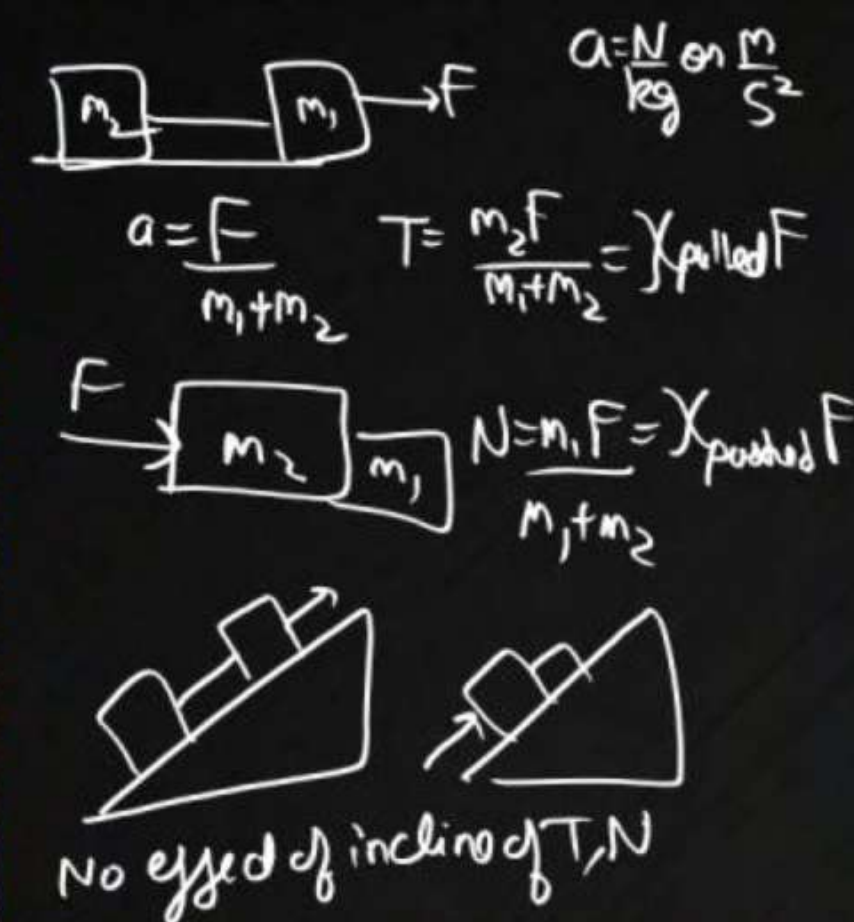


QUESTION-157



PUPPY POINTS 2

$W=mg$
 T (dene ka)
 N (chipane ka force)
 Contact lost $N=0$
 Upthrust - Buoyancy



Part 9 – Atwood Machine Pulley



Reduced Mass



Solve

$$\frac{m_1 m_2}{m_1 + m_2}$$

μ (reduced mass)

$$m$$

$$m$$

$$\mu = \frac{m}{2}$$

$$m$$

$$2m$$

$$\mu = \frac{m(2m)}{m+2m} = \frac{2m}{3}$$

$$m$$

$$3m$$

$$\mu = \frac{3m}{4}$$

$$m$$

$$10m$$

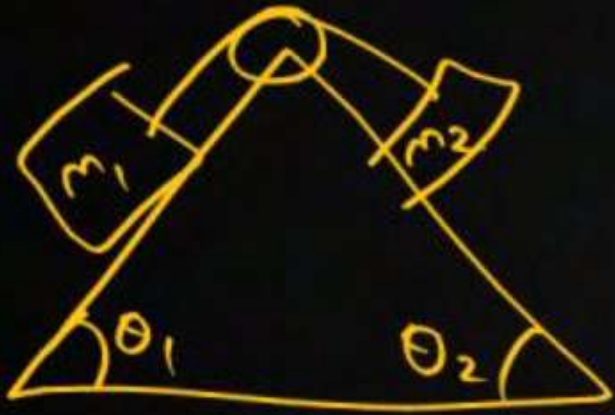
$$\mu = \frac{10m}{11}$$

11

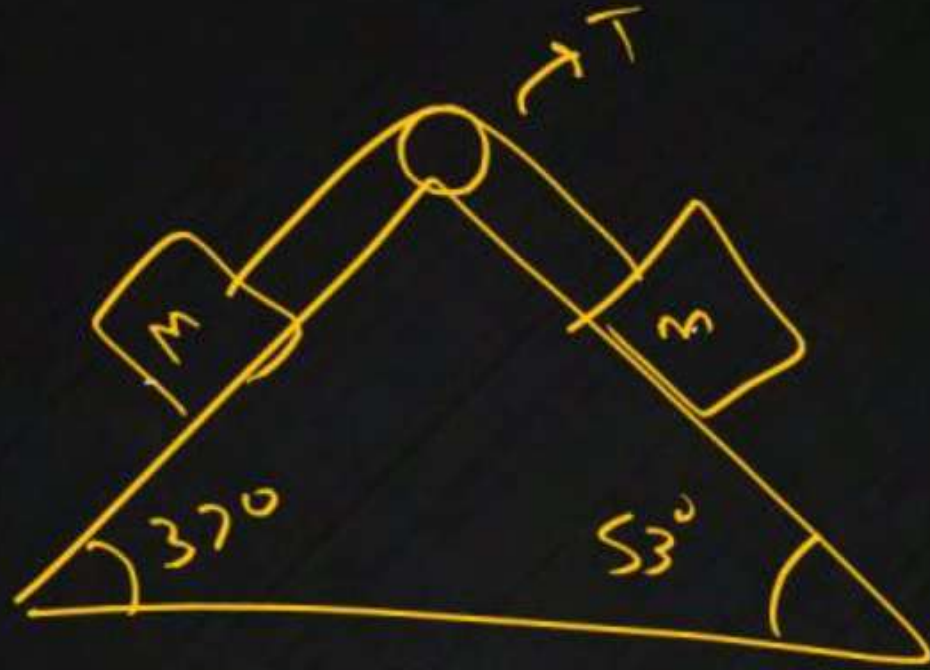
Universal Formula for all top tension in Atwood machine //



$$T = \mu g (\sin \theta_1 + \sin \theta_2)$$



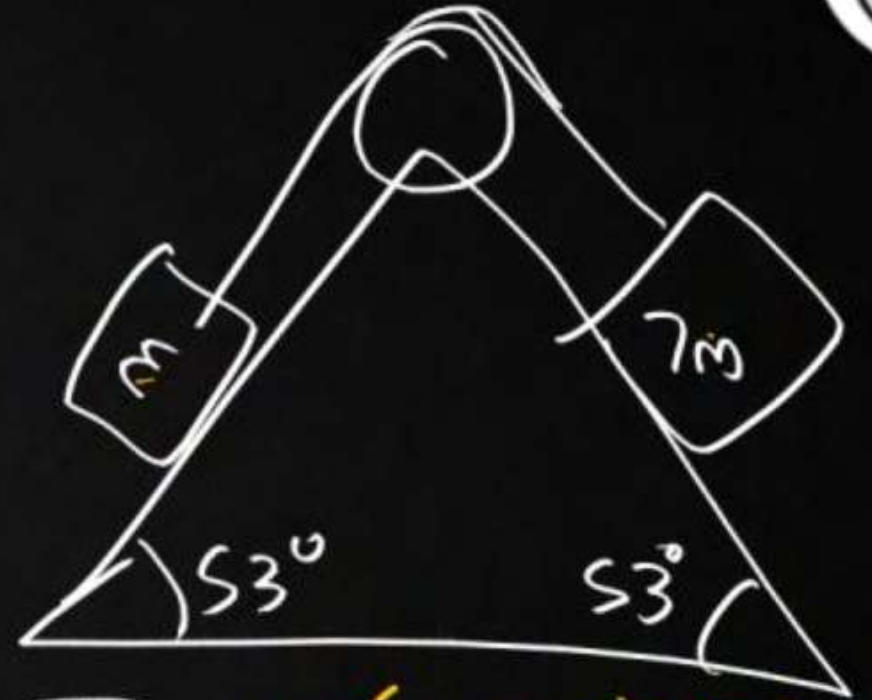
$$T = \mu g (\sin \theta_1 + \sin \theta_2)$$



$$T = \mu g (\sin 37 + \sin 53)$$

$$= \frac{m}{2} g \left(\frac{3}{5} + \frac{4}{5} \right)$$

$$T = \frac{7mg}{10}$$

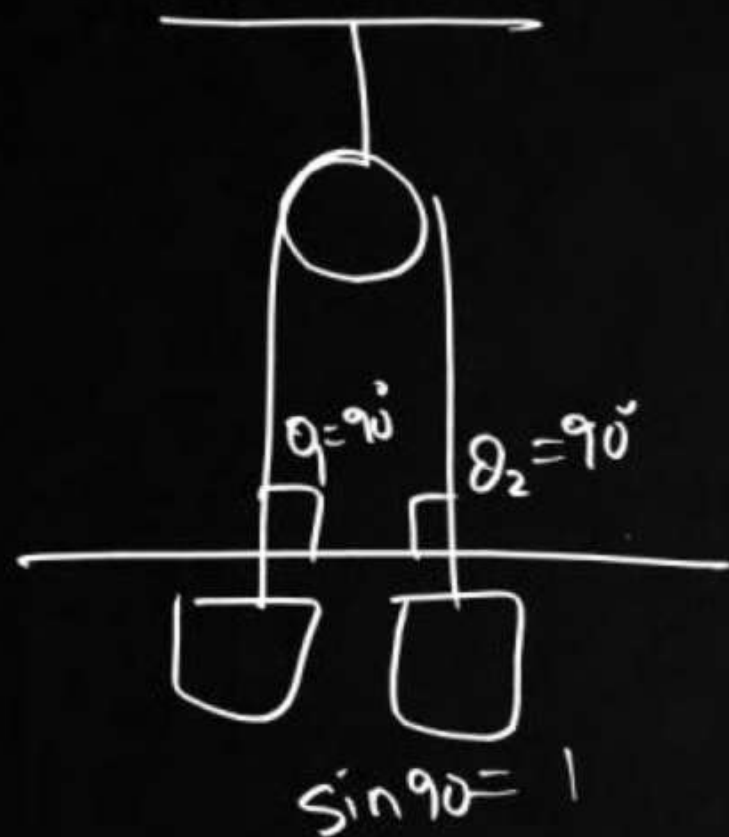


$$T = \mu g (\sin 53 + \sin 53)$$

$$= \frac{7m}{8} g \left(\frac{4}{5} + \frac{4}{5} \right)$$

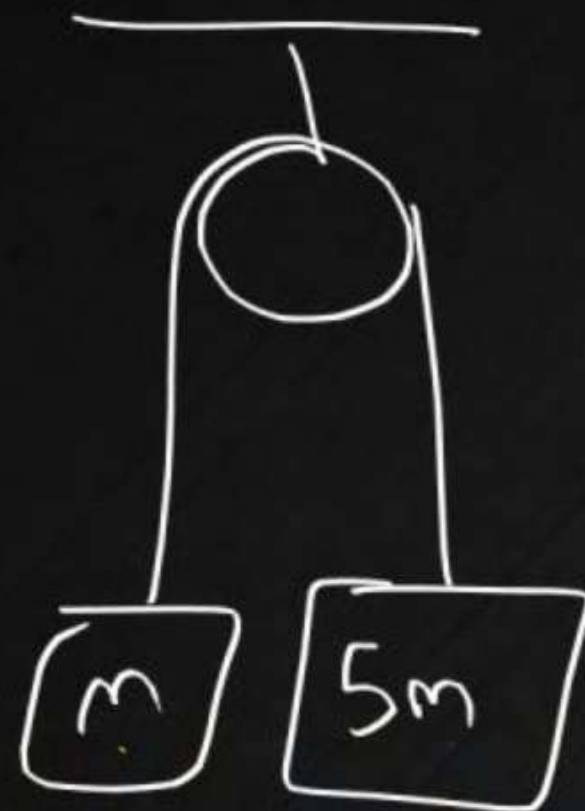
$$= \frac{7mg}{8} \times \frac{8}{5}$$

$$T = 7mg/5$$



$$T = \mu g (\sin 90 + \sin 90)$$

$$T = 2\mu g$$



$$T = 2 \times \frac{5mg}{6}$$

$$T = \frac{5mg}{3}$$



$$T = 2 \times \frac{3 \times 15 \times 10}{3 + 15}$$

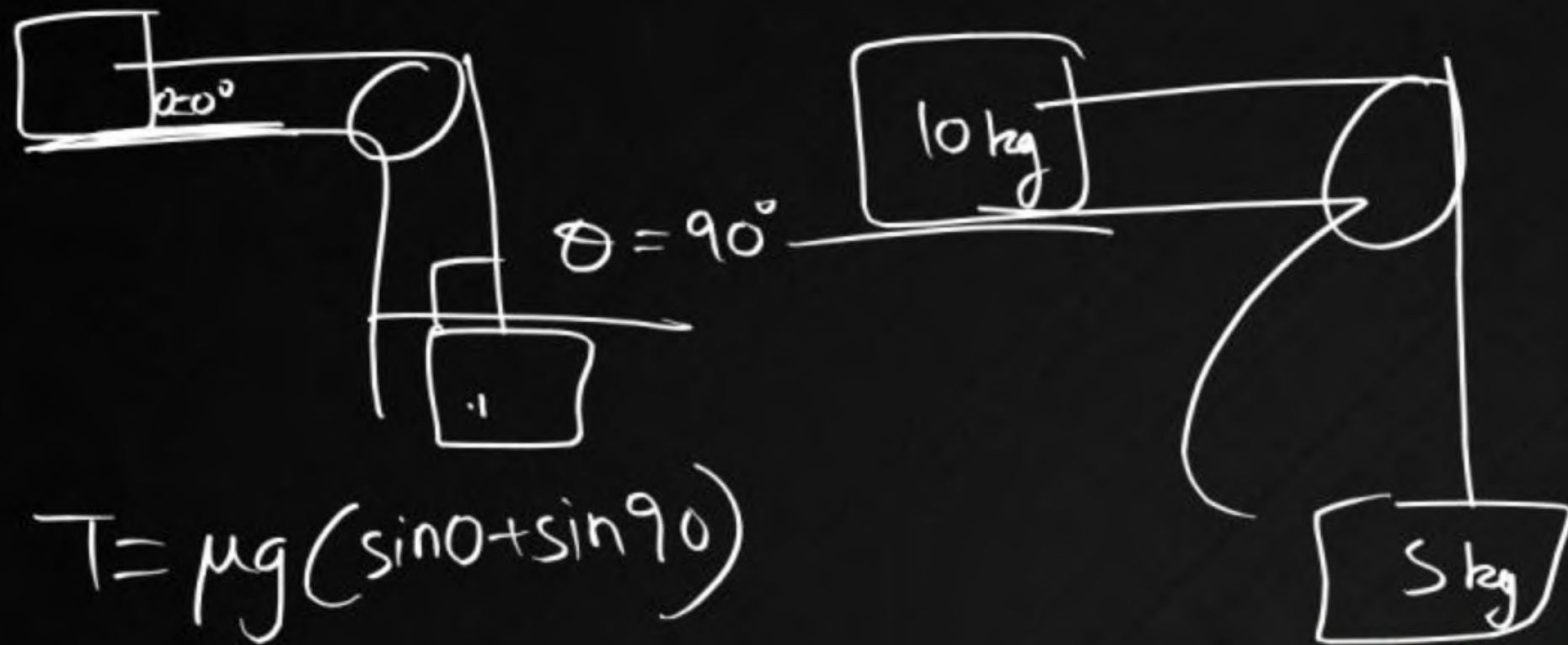
$$= \frac{2 \times 3 \times 15 \times 10}{18}$$

$$T = \textcircled{A} 30N$$

$$\textcircled{B} 40N$$

$$\textcircled{C} 50N$$

$$\textcircled{D} 60N$$

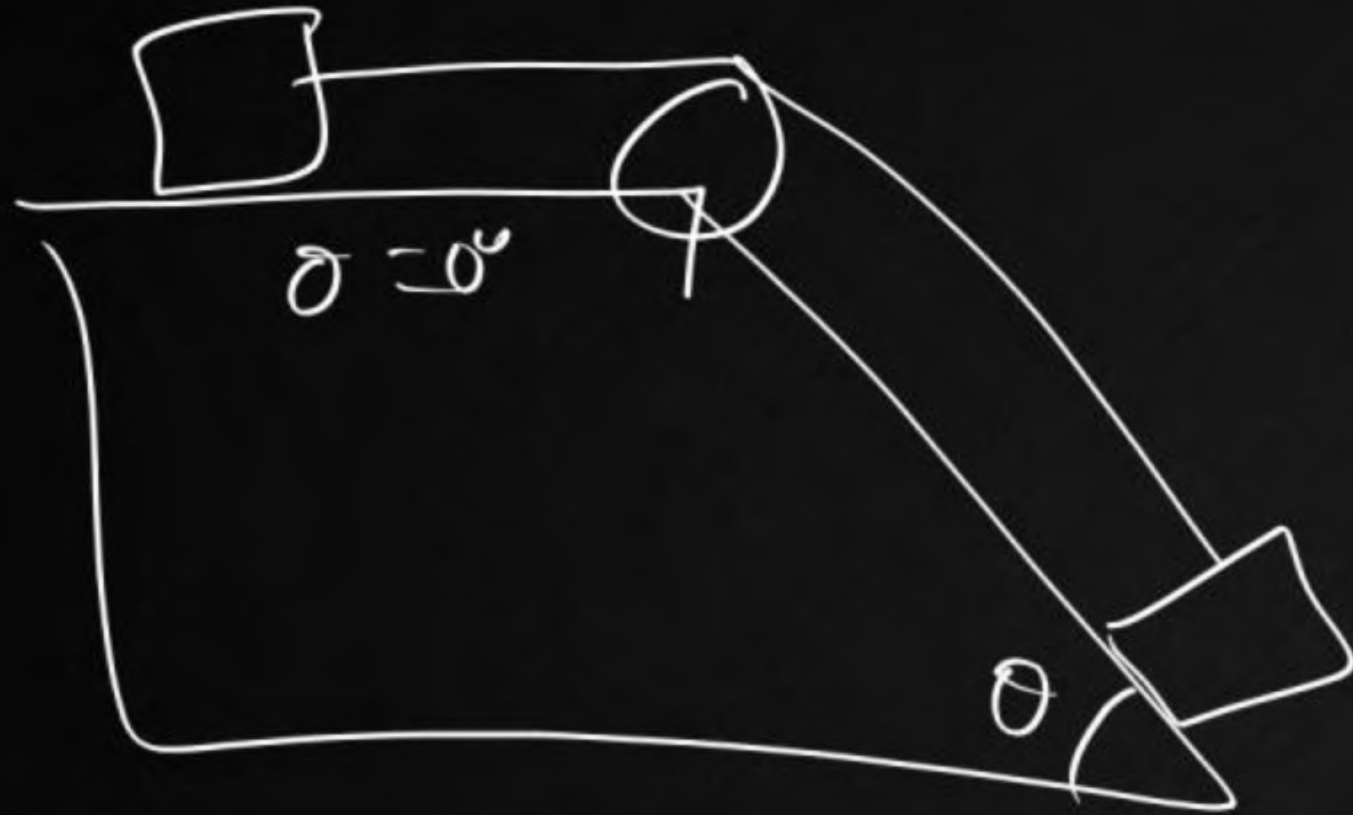


$$T = \mu g (\sin 0 + \sin 90)$$

$$T = \mu g (0 + 1)$$

$$T = \mu g$$

$$T = \frac{10 \times 5 \times 10}{10 + 5} = \frac{10 \times 5 \times 10}{15} = 100 \text{ N}$$

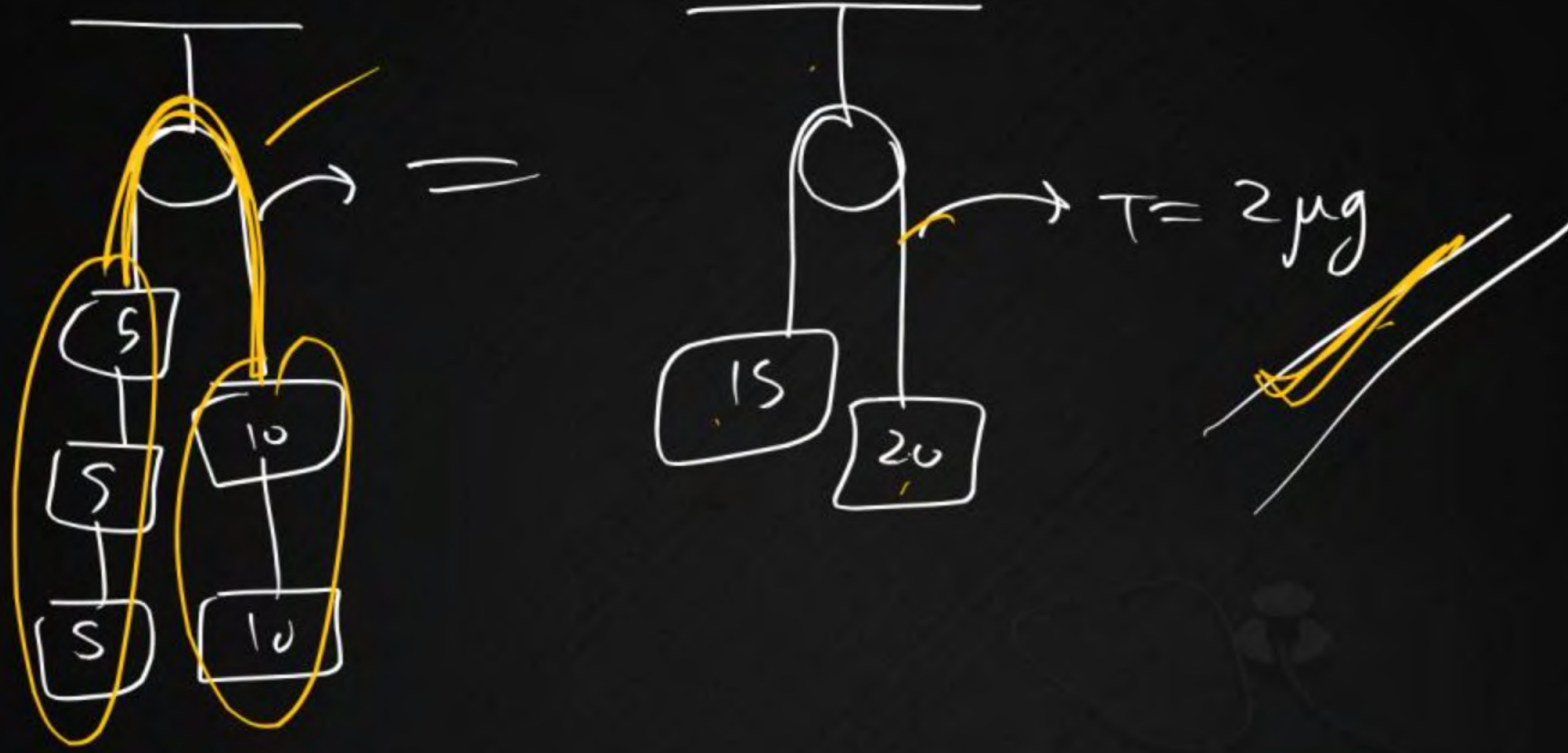


$$T = \mu g \sin \theta$$

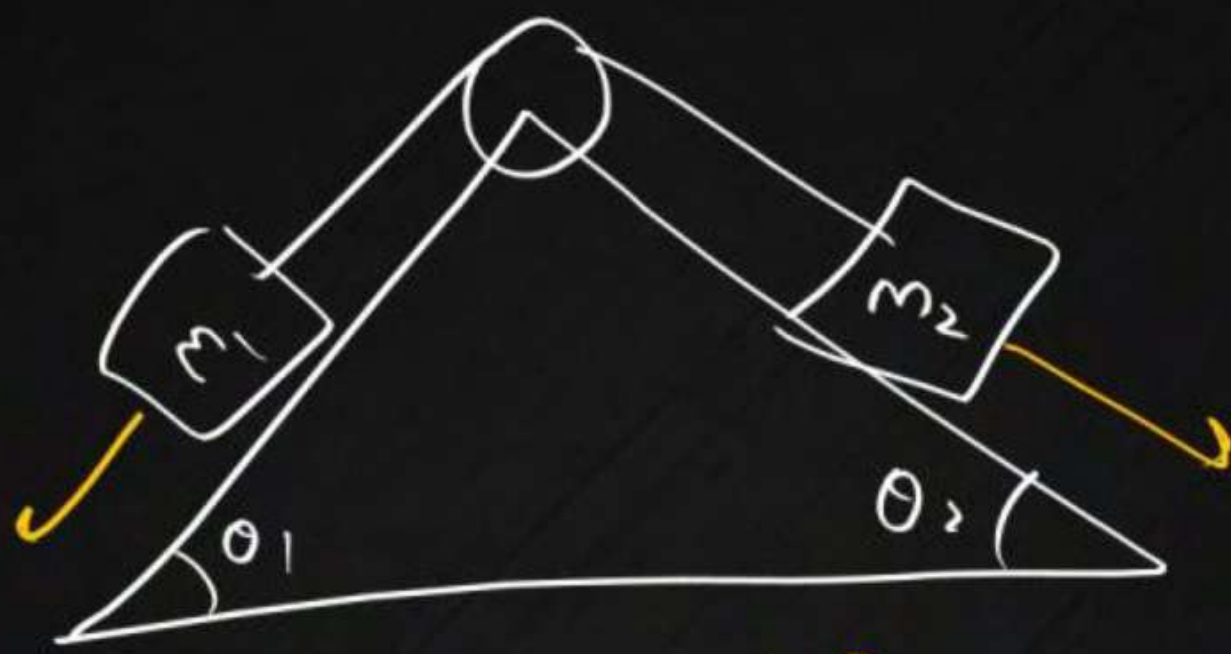
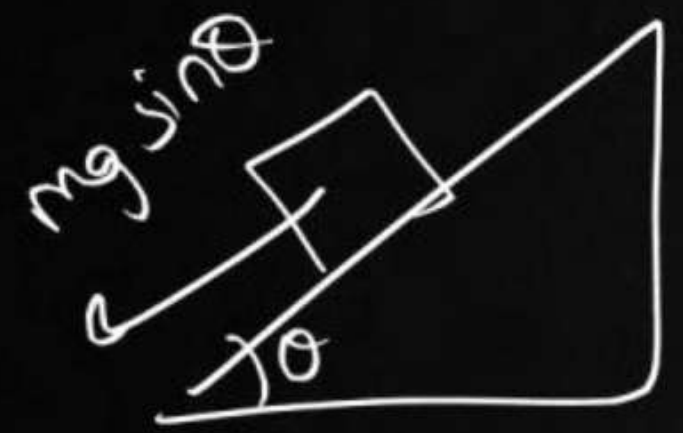


$$T = \mu g (\sin \theta + 1)$$

~~$$T = \mu g (\sin \theta_1 + \sin \theta_2)$$~~



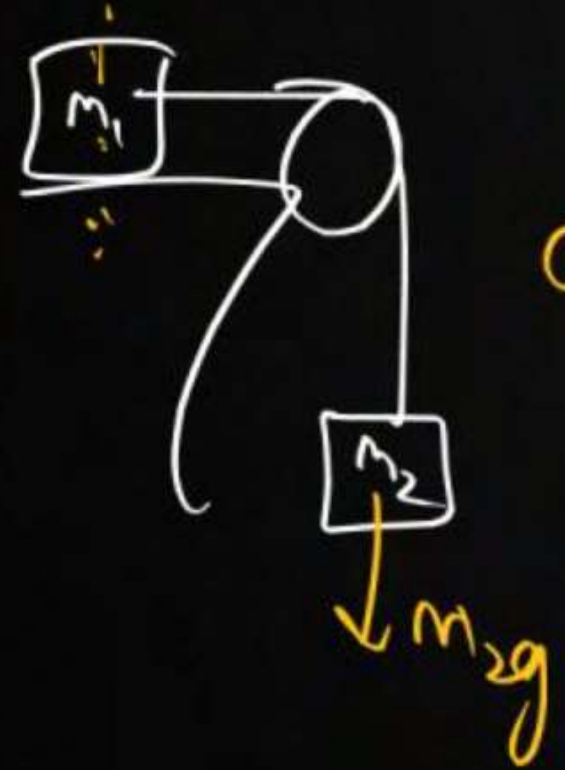
$$a = \frac{F_{\text{net}}}{M_{\text{total}}}$$



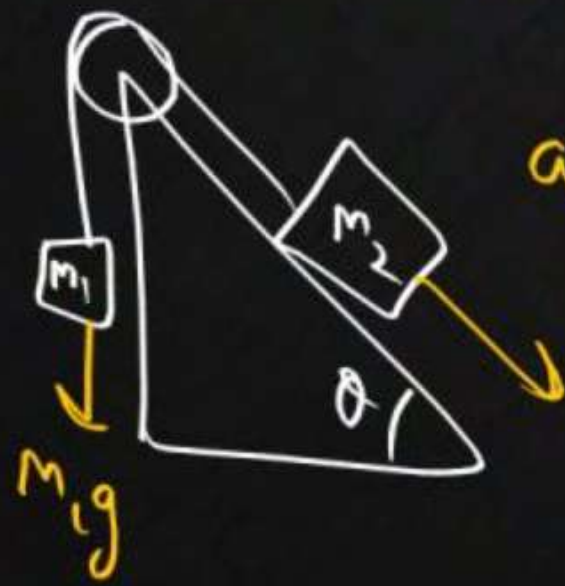
$$a = \frac{m_1 g \sin \theta_1 - m_2 g \sin \theta_2}{m_1 + m_2}$$



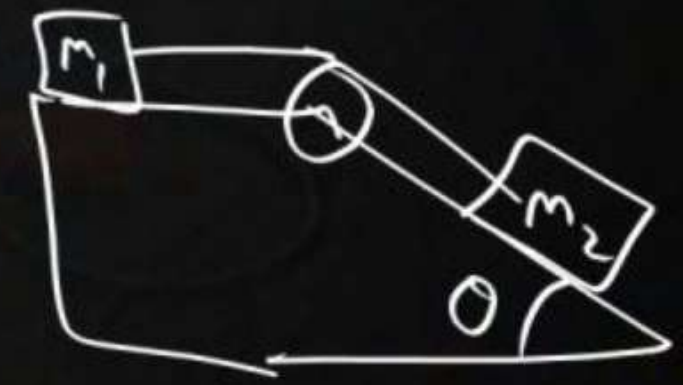
$$a = \frac{m_1 g - m_2 g}{m_1 + m_2}$$



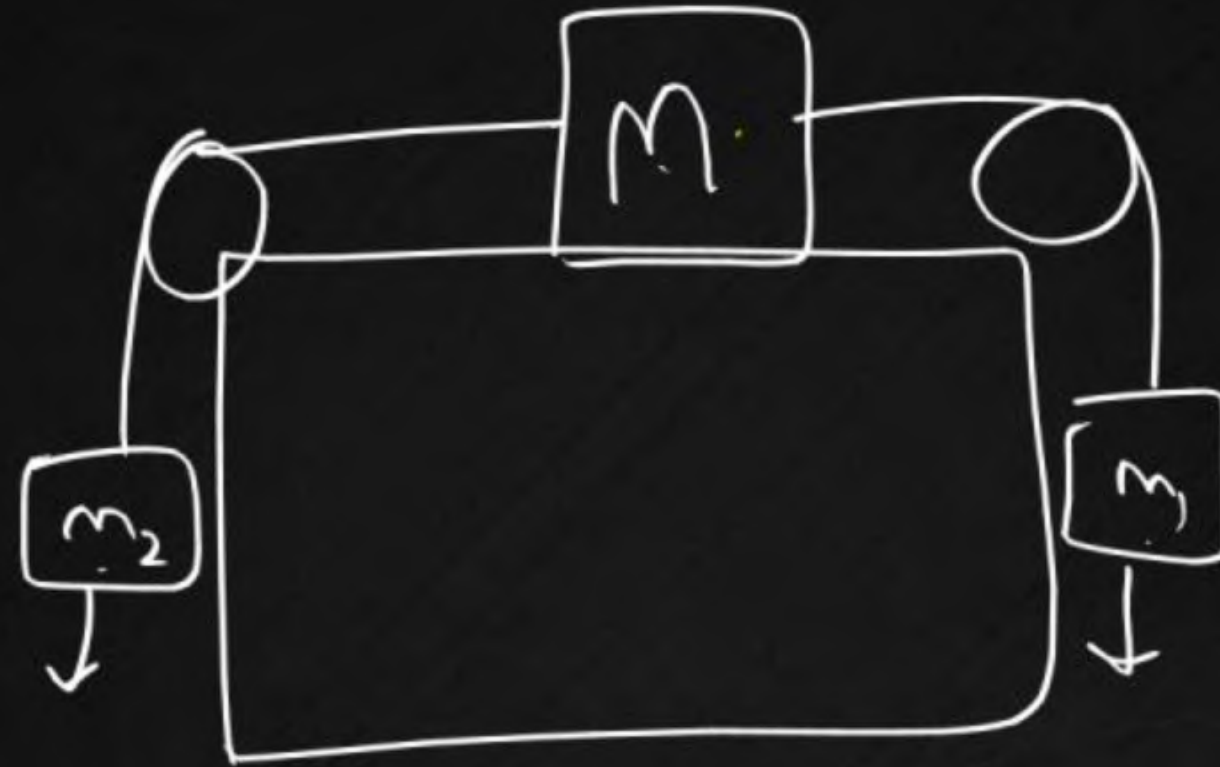
$$a = \frac{m_2 g}{m_1 + m_2}$$



$$a = \frac{m_1 g - m_2 g \sin \theta}{m_1 + m_2}$$



$$a = \frac{m_2 g \sin \theta}{m_1 + m_2}$$



$$a = \frac{m_2 g - m_1 g}{m_1 + m_2 + M}$$

QUESTION-163**Difficulty Level : Easy**

Two masses as shown are suspended from a 'massless pulley'. Calculate the acceleration of the system, when masses are left free: **[2000]**

- 1** $2g/3$
- 2** $g/3$
- 3** $g/9$
- 4** $g/7$

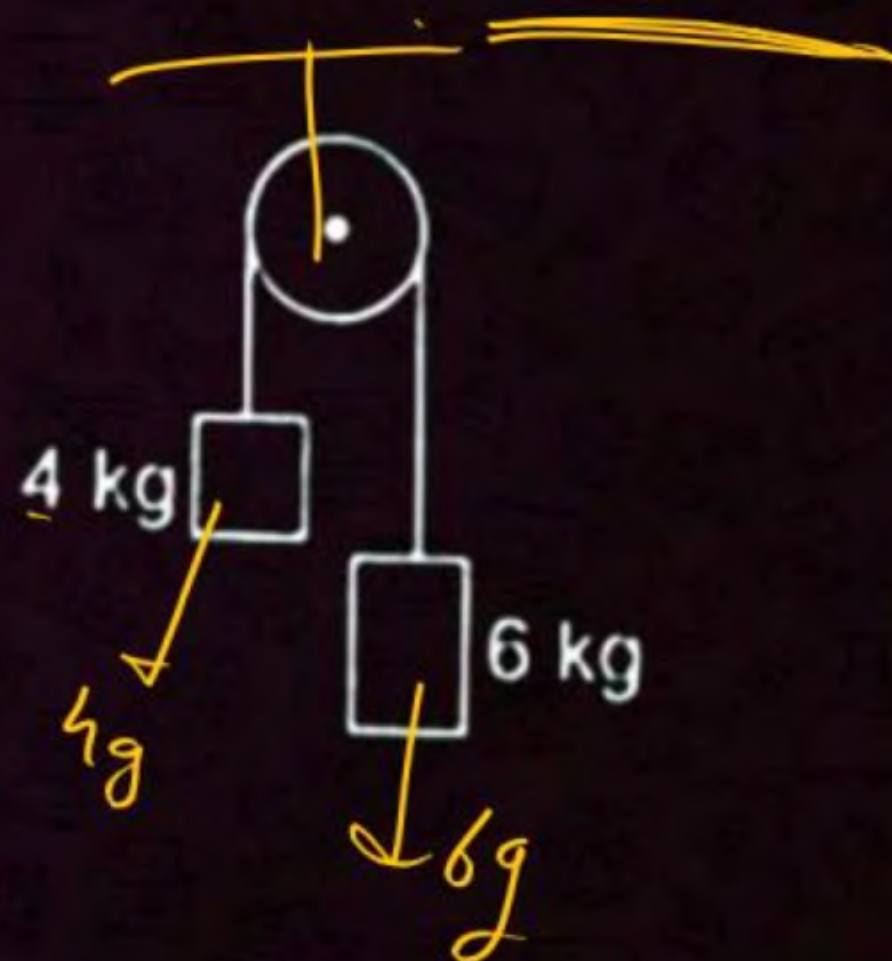
HW

QUESTION-164**Difficulty Level : Easy**

Two bodies of mass 4 kg and 6 kg are tied to the ends of a massless string. The string passes over a pulley which is frictionless (see figure). The acceleration of the system in terms of acceleration due to gravity (g) is: **[2020]**

- 1 $g/2$
- 2 $g/5$
- 3 $g/10$
- 4 g

$$a = \frac{F_{\text{net}}}{m_{\text{total}}} = \frac{6g - 4g}{10} = \frac{2g}{10}$$



QUESTION-165**Difficulty Level : Easy**

Two blocks of masses 8 kg and 12 kg are connected at the two ends of a light inextensible string. The string passes over a frictionless pulley. The acceleration of the system is [NCERT Based]

1 $\frac{g}{4}$

2 $\frac{g}{5}$

3 $\frac{g}{8}$

4 $\frac{g}{6}$

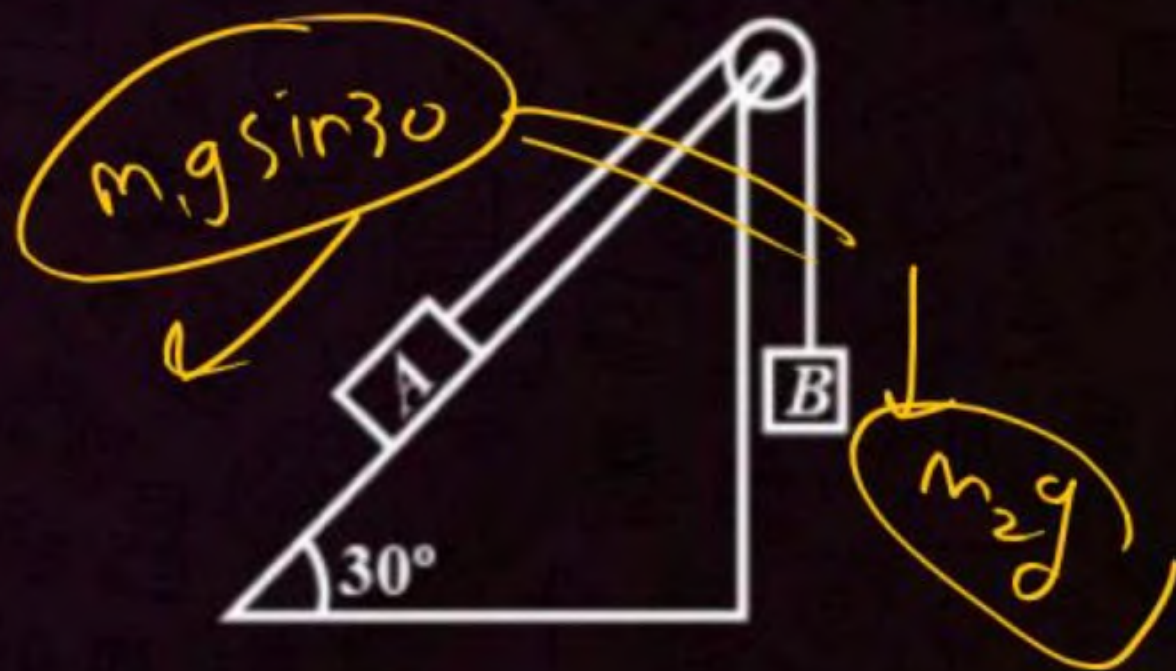
QUESTION-168**Difficulty Level : Easy**

nw

Block A of weight 100 N rests on a frictionless inclined plane of slope angle 30° as shown in the figure. A flexible cord attached to A passes over a frictionless pulley and is connected to block B of weight W . Find the weight W for which the system is in equilibrium.

[NCERT Based]

- 1 25 N
- 2 50 N
- 3 75 N
- 4 100 N



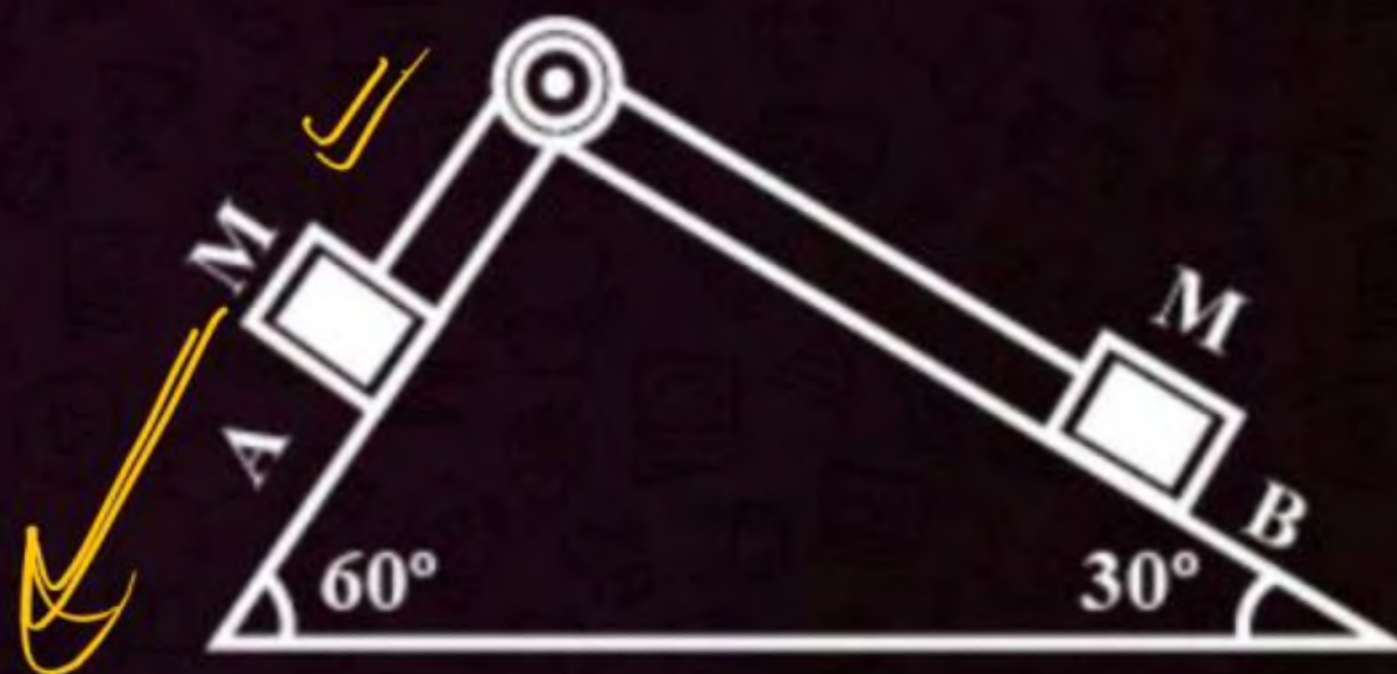
QUESTION-169

Difficulty Level : Easy



Two blocks each of mass M are resting on a frictionless inclined plane as shown in figure. Then
[NCERT Based]

- 1 The block A moves down the plane.
- 2 The block B moves down the plane.
- 3 Both the blocks remain at rest.
- 4 Both the blocks move down the plane.



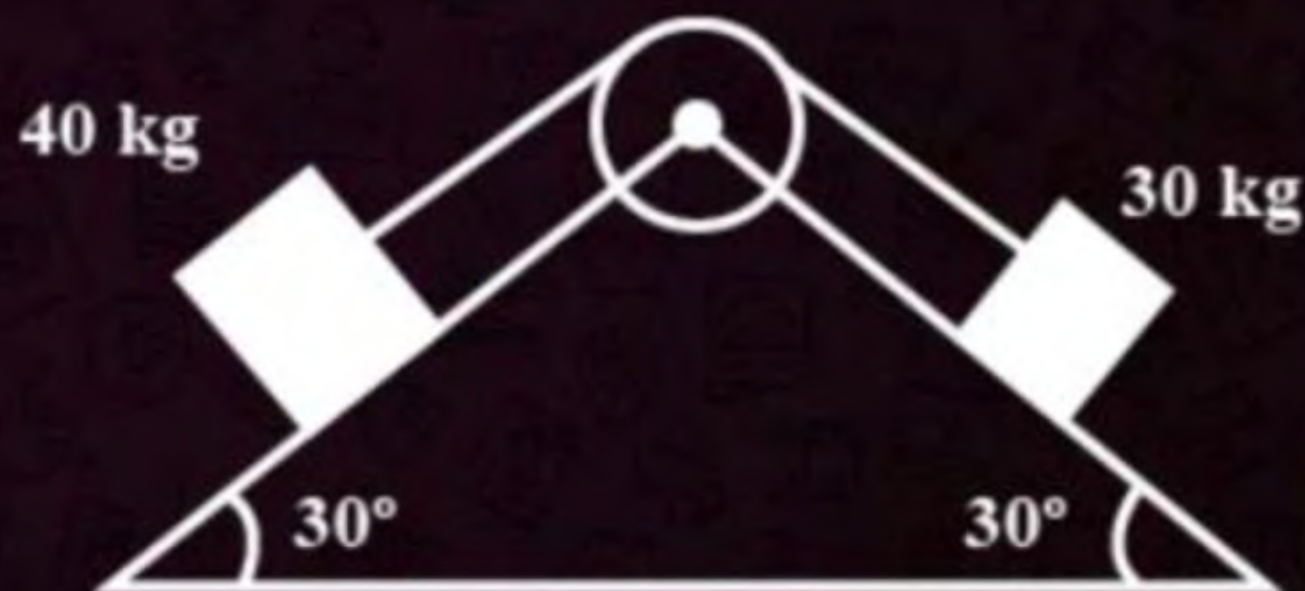
QUESTION-170**Difficulty Level : Easy**

Two blocks of masses 40 kg and 30 kg are connected by a weightless string passing over a frictionless pulley as shown in the figure. ^{hw}

The acceleration of the system would be

[NCERT Based]

- 1** 0.7 m s^{-2}
- 2** 0.8 m s^{-2}
- 3** 0.6 m s^{-2}
- 4** 0.5 m s^{-2}

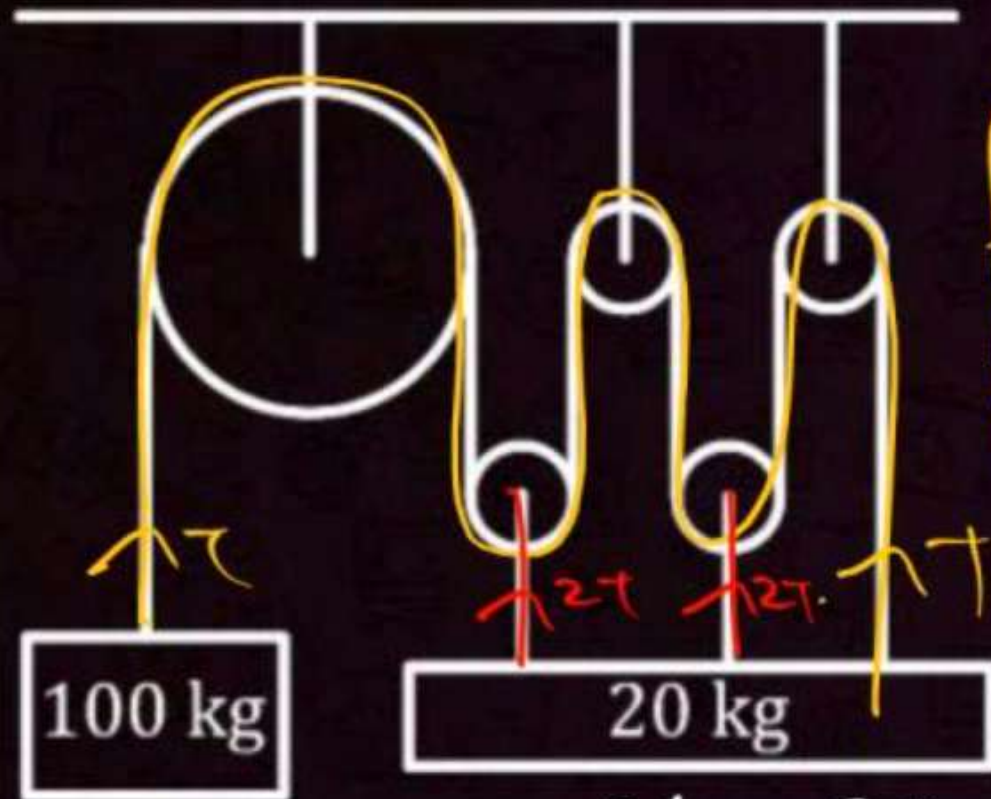
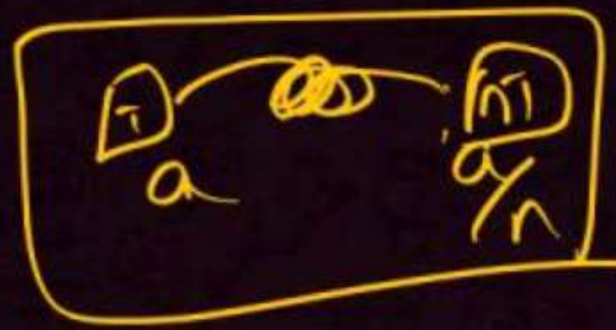


9.4 Pulley-Verse Returns



QUESTION-171

Difficulty Level: **YODHA**



Pulley very
reduces
Atwood

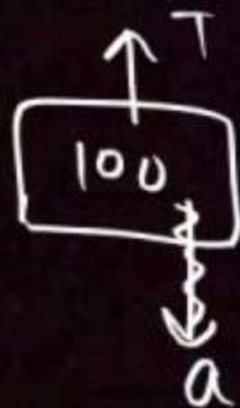
$$5 \times 100(10 - a) = 20(10 + \frac{a}{5})$$

$$250 - 25a = 10 + \frac{a}{5}$$

$$240 = 25a + \frac{a}{5}$$

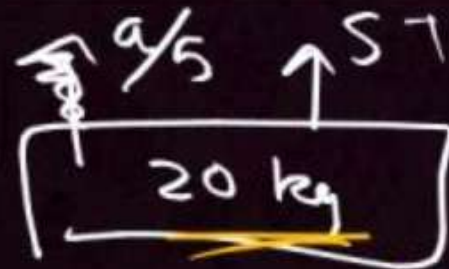
$$240 = \frac{126a}{5}$$

$$a = \frac{240 \times 5}{126}$$



$$T = m(g - a)$$

$$T = 100(10 - a)$$

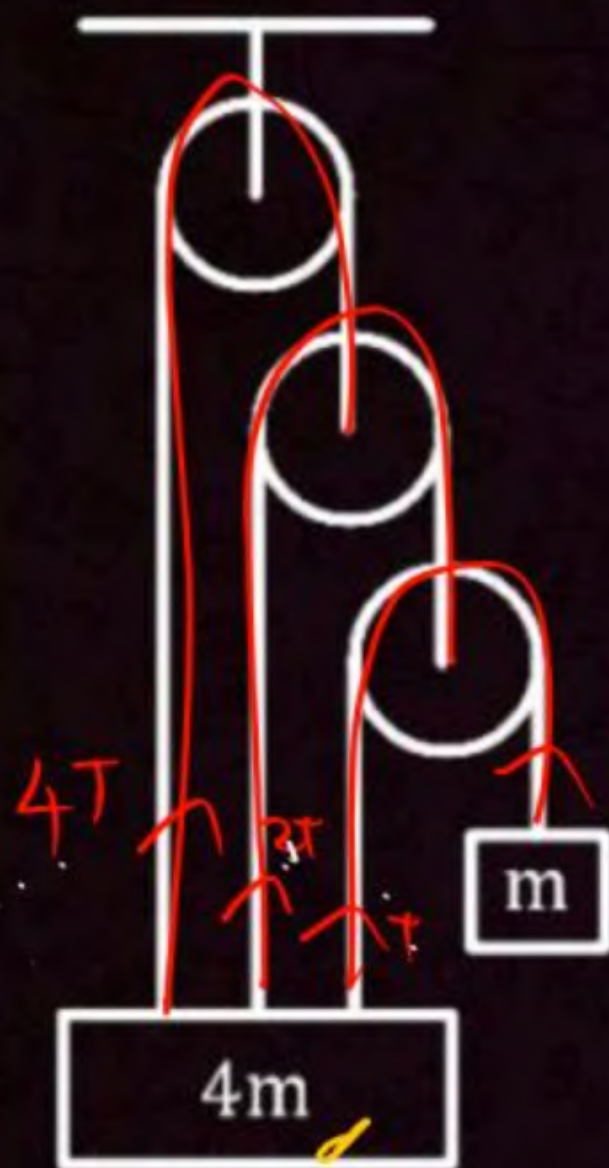


$$5T = m'(g + a)$$

$$5T = 20(10 + \frac{a}{5})$$

QUESTION-172

Difficulty Level: YODHA



$$T = m(g + a)$$

$$7T = 4m\left(g - \frac{a}{7}\right)$$

$$7m(g + a) = 4m\left(g - \frac{a}{7}\right)$$

$$7g + 7a = 4g - \frac{4a}{7}$$

$$7a - \frac{4a}{7} = -3g$$

$$\frac{45a}{7} = -3g$$

$$a = -\frac{21g}{15}$$

QUESTION-173

Difficulty Level : **YODHA**



In the system shown in the figure, the acceleration of 1 kg mass is **[NCERT Based]**

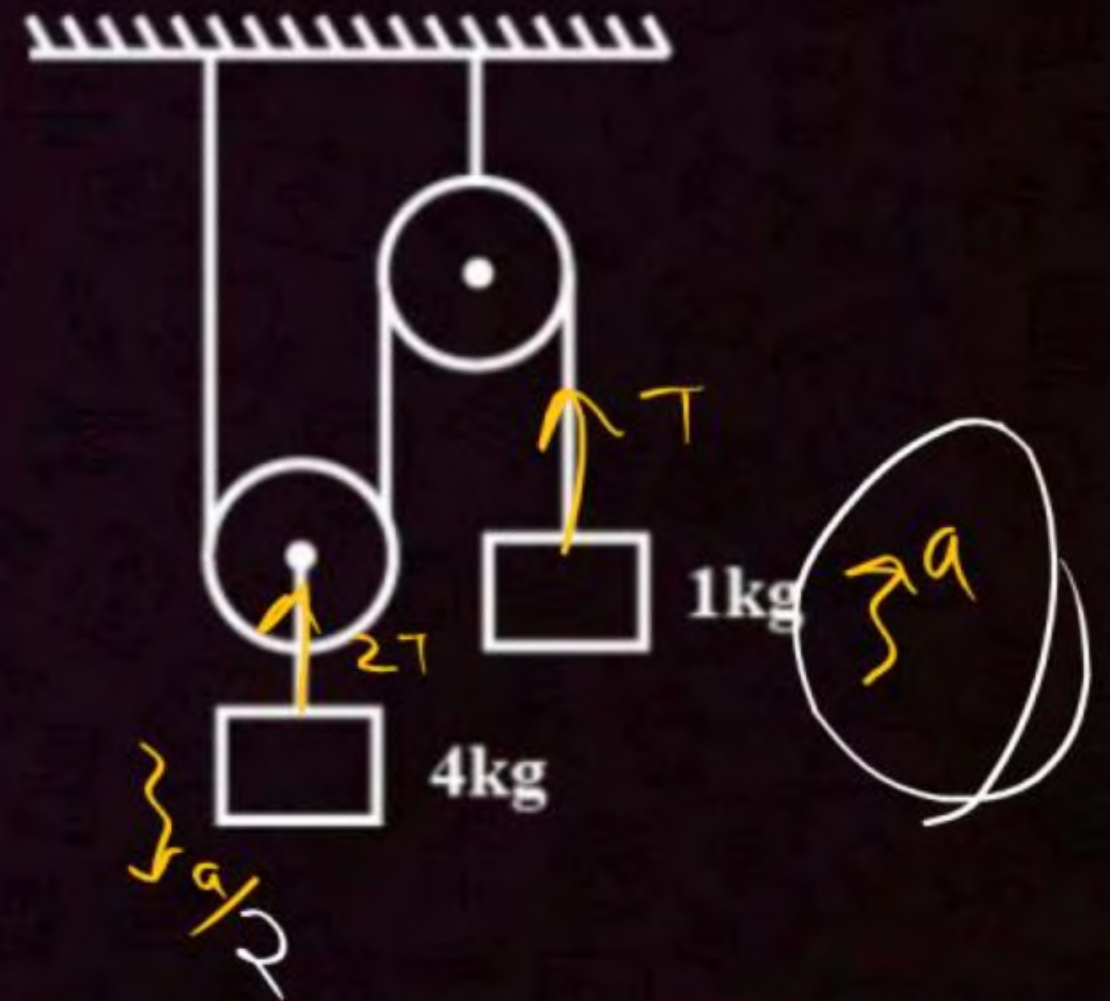
1 $\frac{g}{4}$ downwards

2 $\frac{g}{2}$ downwards

3 $\frac{g}{2}$ upwards

4 $\frac{g}{4}$ upwards

$$\begin{aligned}
 T &= 1(g+a) \\
 2T &= 4(g-a) \\
 2(g+a) &= 4(g-a) \\
 2g+2a &= 4g-4a \\
 4a &= 2g \\
 a &= \frac{2g}{4} = \frac{g}{2}
 \end{aligned}$$



PUPPY POINTS 2

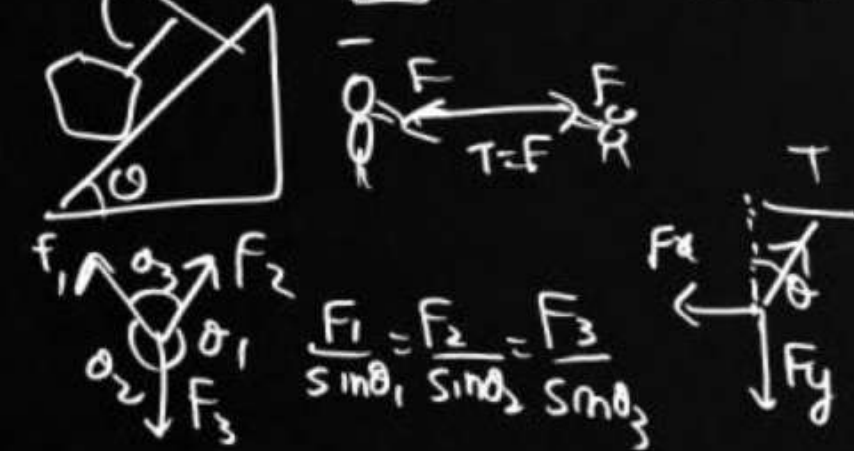
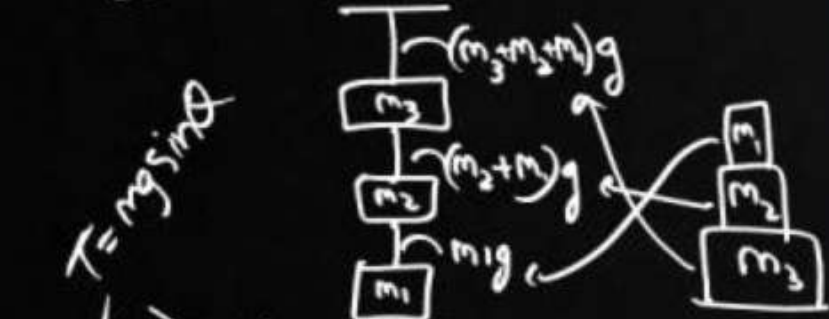
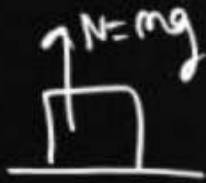
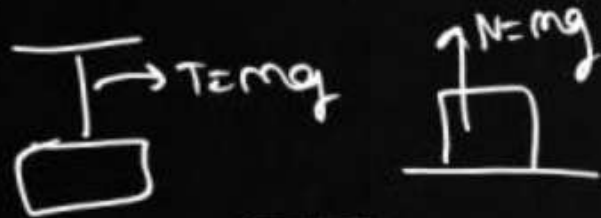
$$W=mg$$

T (dene ka)

N (chipane ka force)

Contact lost $N=0$

Upthrust - Buoyancy



$$\tan \theta = \frac{F_x}{F_y}, T = \sqrt{F_x^2 + F_y^2}, F_x + F_y + T = 0$$

$$a = \frac{N}{kg} \text{ or } \frac{m}{s^2}$$

$$a = \frac{F}{m_1 + m_2} \quad T = \frac{m_2 F}{m_1 + m_2} = \text{pulled } F$$

$$F \rightarrow m_2 \leftarrow m_1 \quad N = \frac{m_1 F}{m_1 + m_2} = \text{pushed } F$$



Pseudo Force = $m(\vec{a} \text{ parast kr})$

$\{ \vec{a} \}$

$g_{eff} = g + a \quad g_{eff} = g - a \quad g_{eff} = \sqrt{g^2 + a^2}$

$a = g \tan \theta$
 $N = mg \sec \theta$

Contact loose
 $N=0 \quad a = g \tan \theta$

$\Delta m = \frac{2mg}{g+a}$

$$N = mg - F \sin \theta \quad a = \frac{F \cos \theta}{m}$$

$$z = \frac{x+y}{2}$$

$$u_1 \cos \theta_1 = u_2 \cos \theta_2$$

$$\mu = \frac{m_1 m_2}{m_1 + m_2}$$

$T = 2\mu g$

$a = \frac{(m_2 - m_1)g}{m_1 + m_2}$

$a_{cm} = \frac{(m_2 - m_1)^2 g}{(m_1 + m_2)}$

$a = \frac{m_2 g}{m_1 + m_2} \quad T = \mu g$

$T = \mu g (\sin \theta_1 + \sin \theta_2)$

$a = \frac{m_2 g \sin \theta_2 - m_1 g \sin \theta_1}{m_1 + m_2}$

✓
Part 10 – Spring Force

10.1 Direct



wire coil

Elastic



→ Spring

Natural length

$F=0$

$$U = \frac{1}{2} k x^2$$

$x \rightarrow$ elongation
 $\hookrightarrow$ compression



$$(F_s = -kx)$$

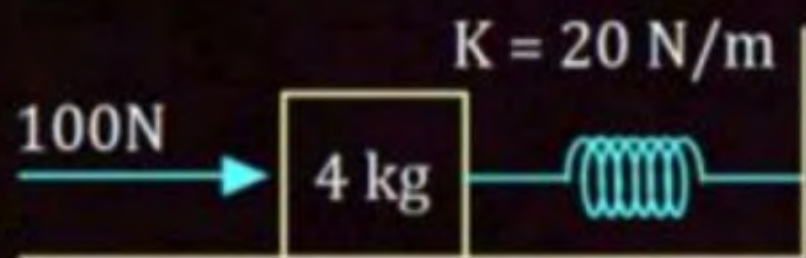
$$F = -kx$$

QUESTION-174

Difficulty Level : Easy



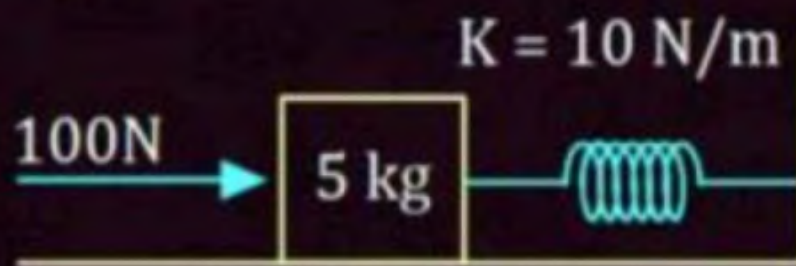
1.



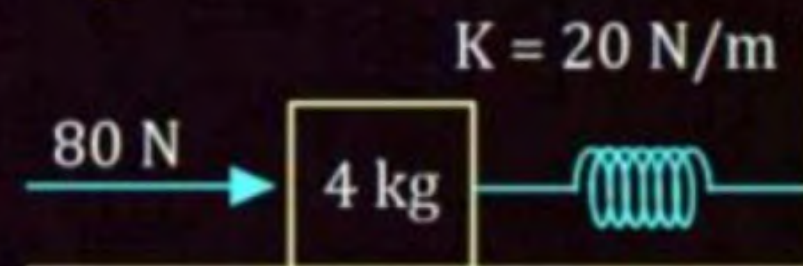
$$F = kx$$

~~$100 = 20x$~~
 $x = 5m$

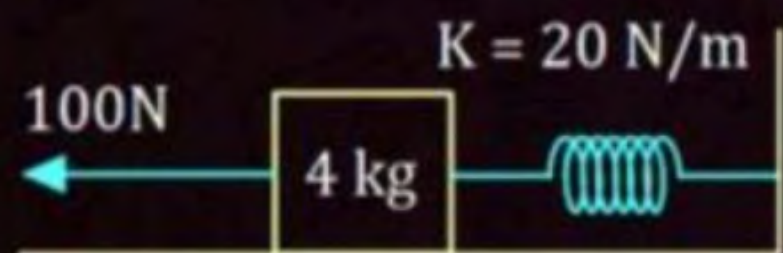
2.



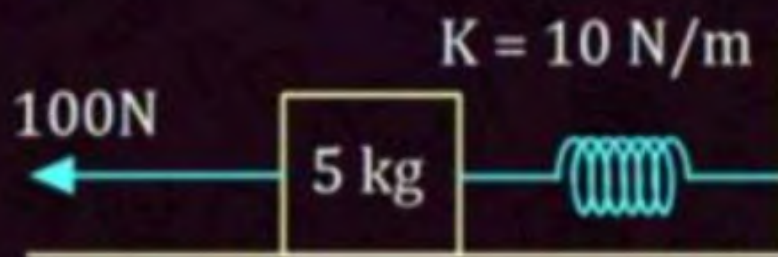
3.



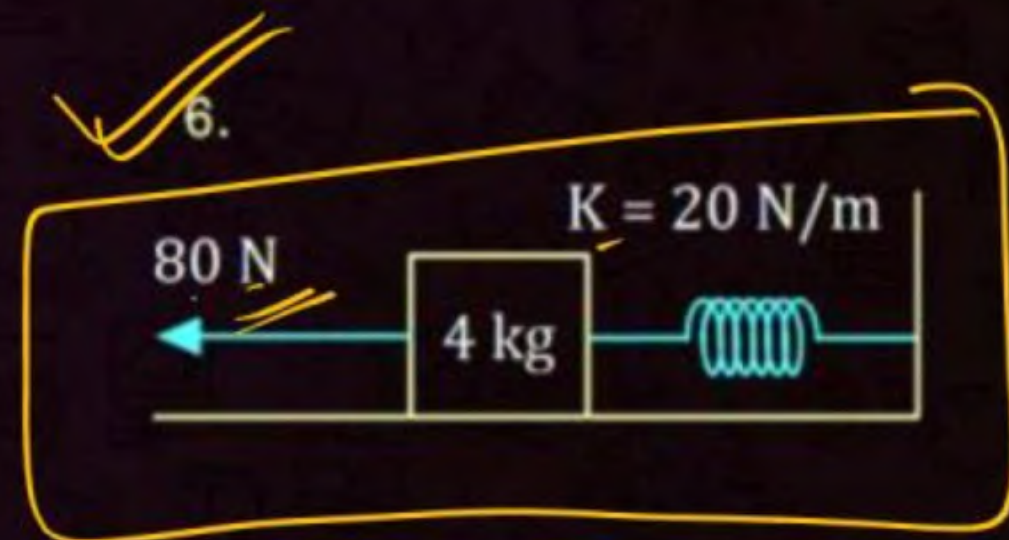
4.



5.



6.

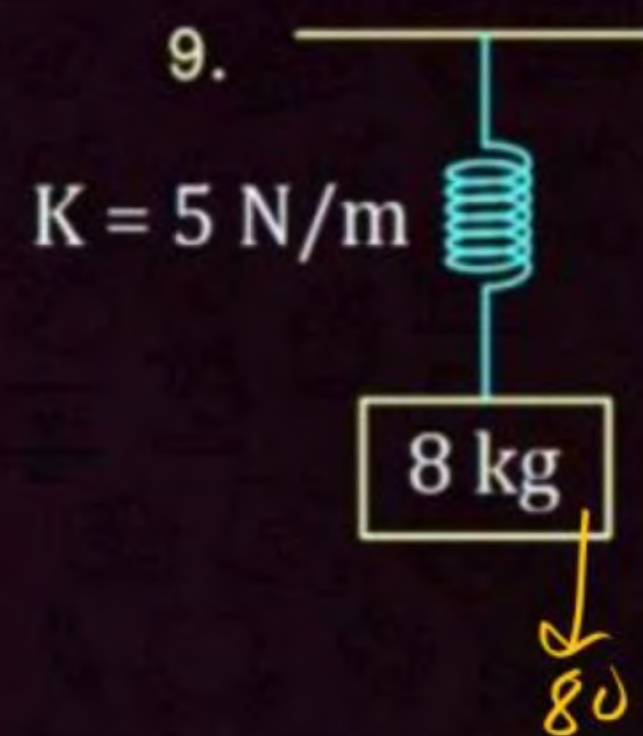
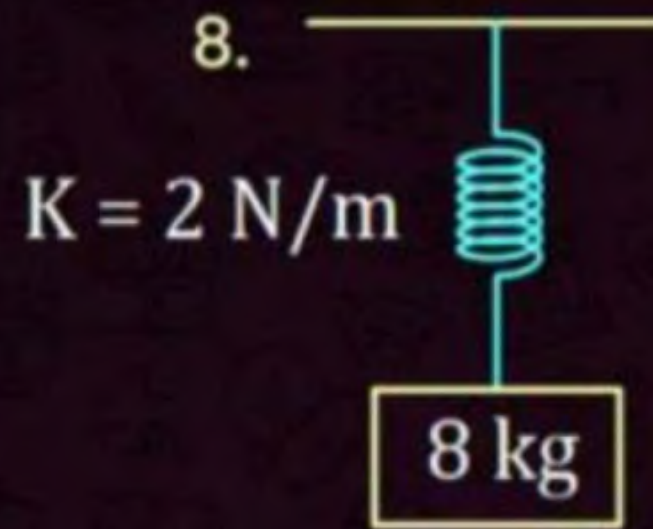
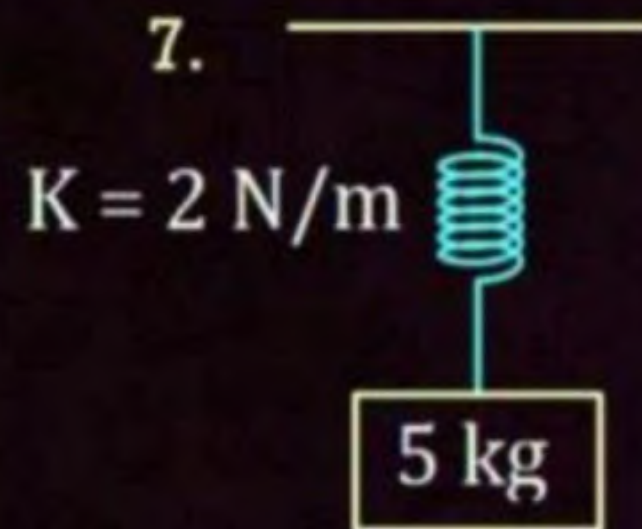


♥ $k \uparrow$ spring $x \downarrow$

~~$F = kx$~~
 ~~$80 = 20x$~~
 $4 = x$

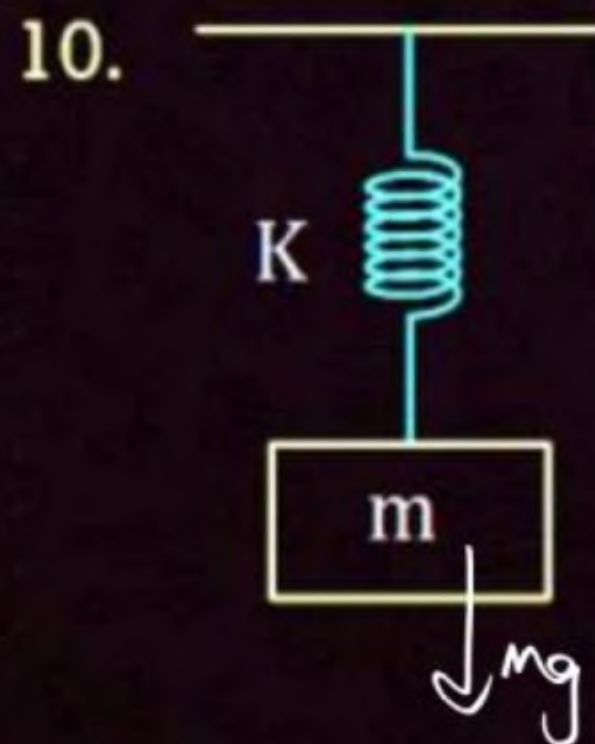
QUESTION-175

Difficulty Level : Easy



$$80 = 5x$$

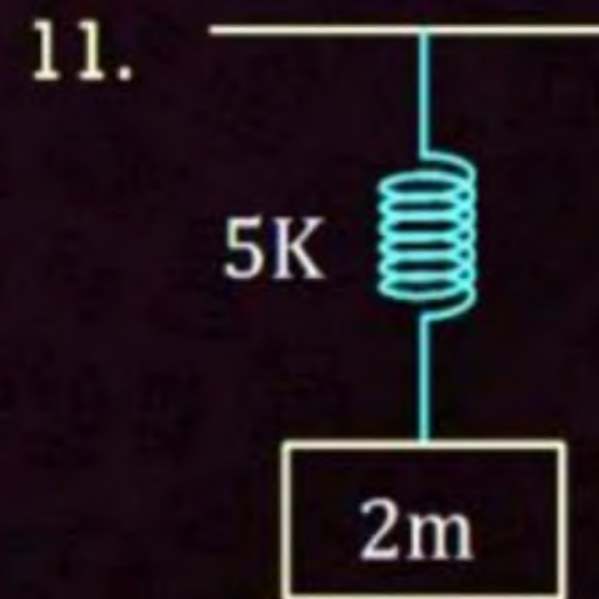
$$x = \frac{80}{5}$$



$$F = kx$$

$$mg = kx$$

$$x = \frac{mg}{k}$$



The two ends of a spring are displaced along the length of the spring. All displacements have equal magnitudes. In which case or cases the tension or compression in the spring will have a maximum magnitude?

[HCV Objective]

- 1 the right end is displaced towards right and the left end towards left



- 2 both ends are displaced towards right or left in same direction



- 3 the right end is displaced towards left and the left end towards right



- 4 Both 1 & 3

x_{max}

10.2 Combination of Springs - Series



$$\frac{1}{k_s} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} + \dots$$



$$k_s = \frac{k_1 k_2}{k_1 + k_2}$$

Parallel

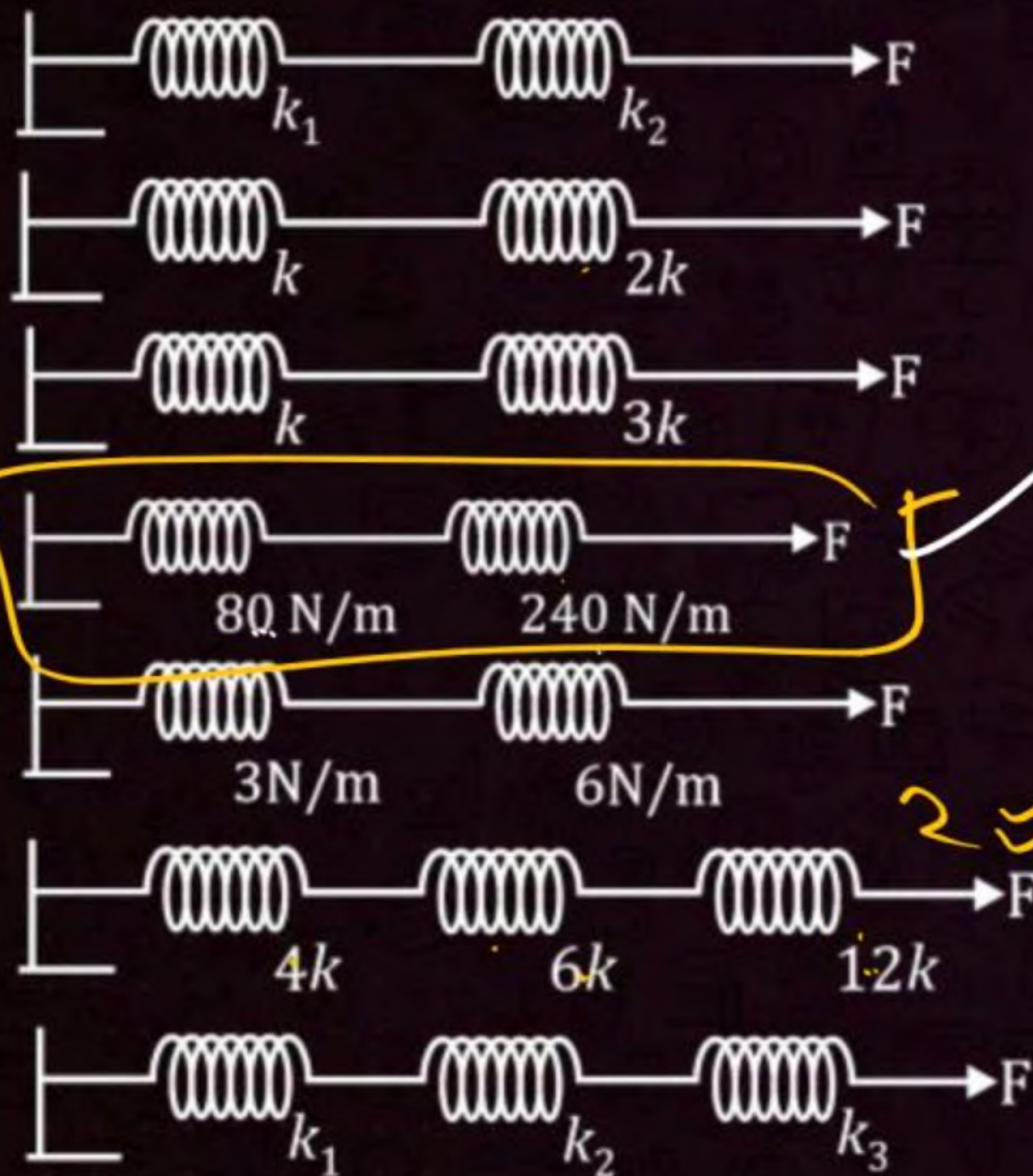


$$k_p = k_1 + k_2 + k_3 + k_4 + k_5 + k_6 + k_7$$

QUESTION-177

Practise

Difficulty Level : Easy

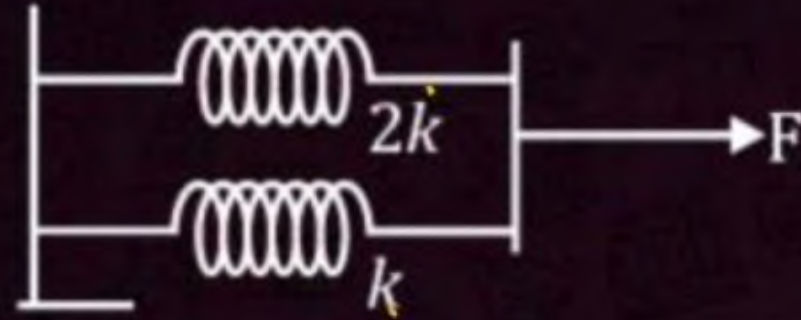
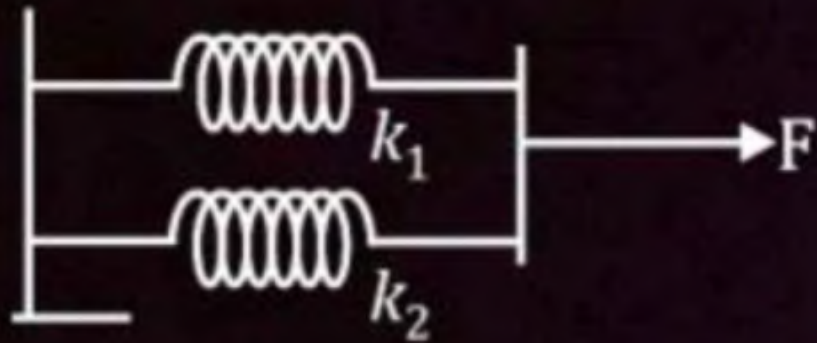


$$k_s = \left(\frac{nk}{n+1} \right)$$

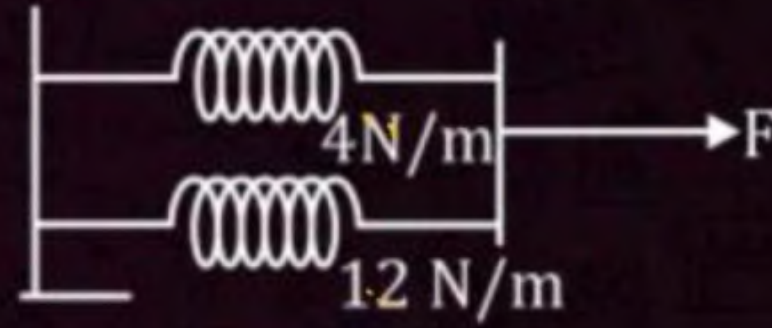
$$\frac{3}{2} \times \frac{20}{80} = \underline{\underline{60 \text{ N/m}}}$$

QUESTION-178

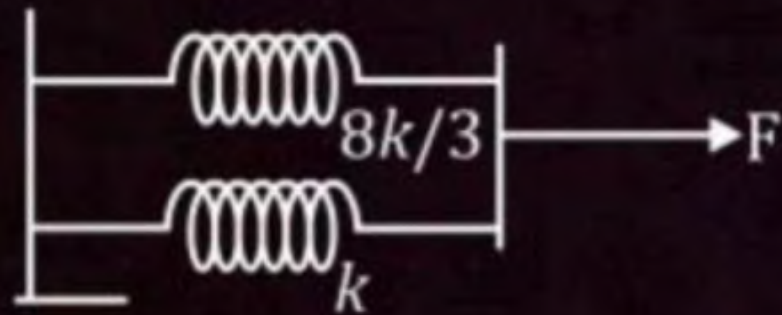
Difficulty Level : Easy



$$k_p = 3k$$

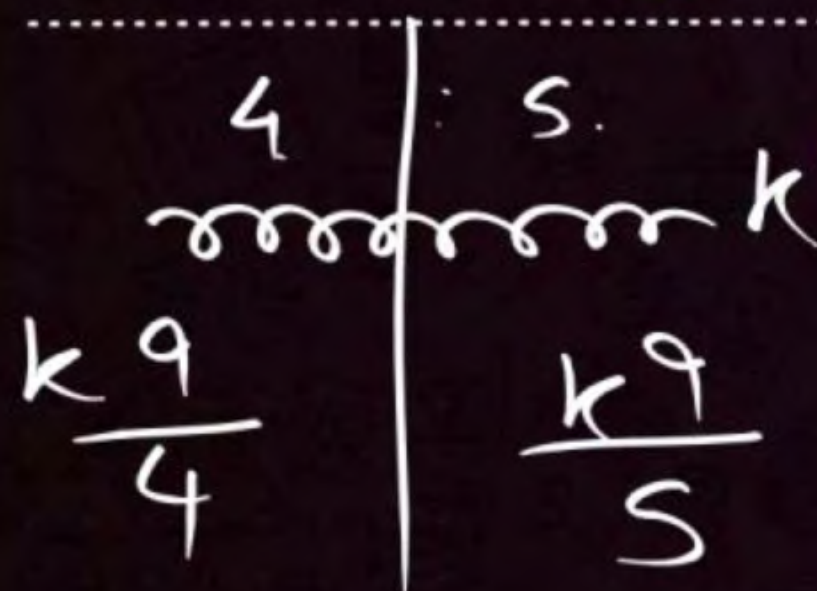


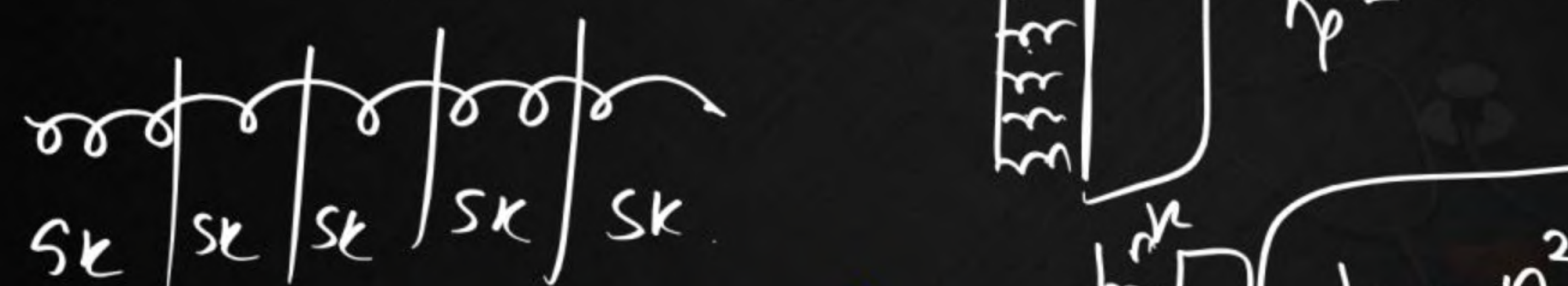
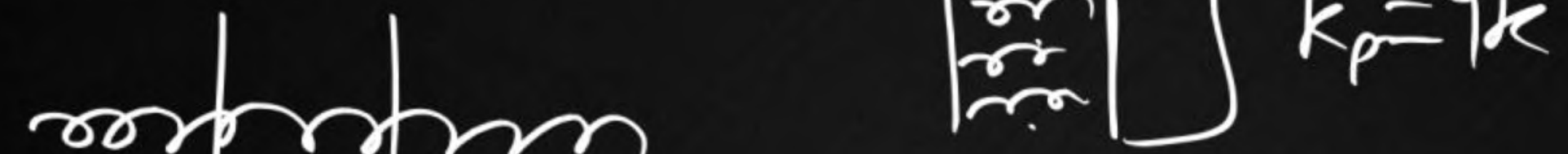
$$k_p = 16 \text{ N/m}$$



$$k_p = k_1 + k_2$$

10.4 Splitting of Spring





*rw*

A spring having spring constant K is cut in half. What will be the value of new spring constant of the cut spring.

A spring having spring constant K is ratio of $1 : 3$. What will be the value of new spring constant of the cut springs.

A spring having spring constant K is ratio of $2 : 3$. What will be the value of new spring constant of the cut springs.

A spring having spring constant K is ratio of $x : y$. What will be the value of new spring constant of the cut springs.



Spring having spring constant K is cut in half. The two Springs are connected in parallel with each other. What will be the new value of spring constant of the combination of Springs.

$$(4K) \checkmark$$

Spring having spring constant K is cut in three parts. The parts are connected in parallel with each other. What will be the new value of spring constant of the combination of Springs.

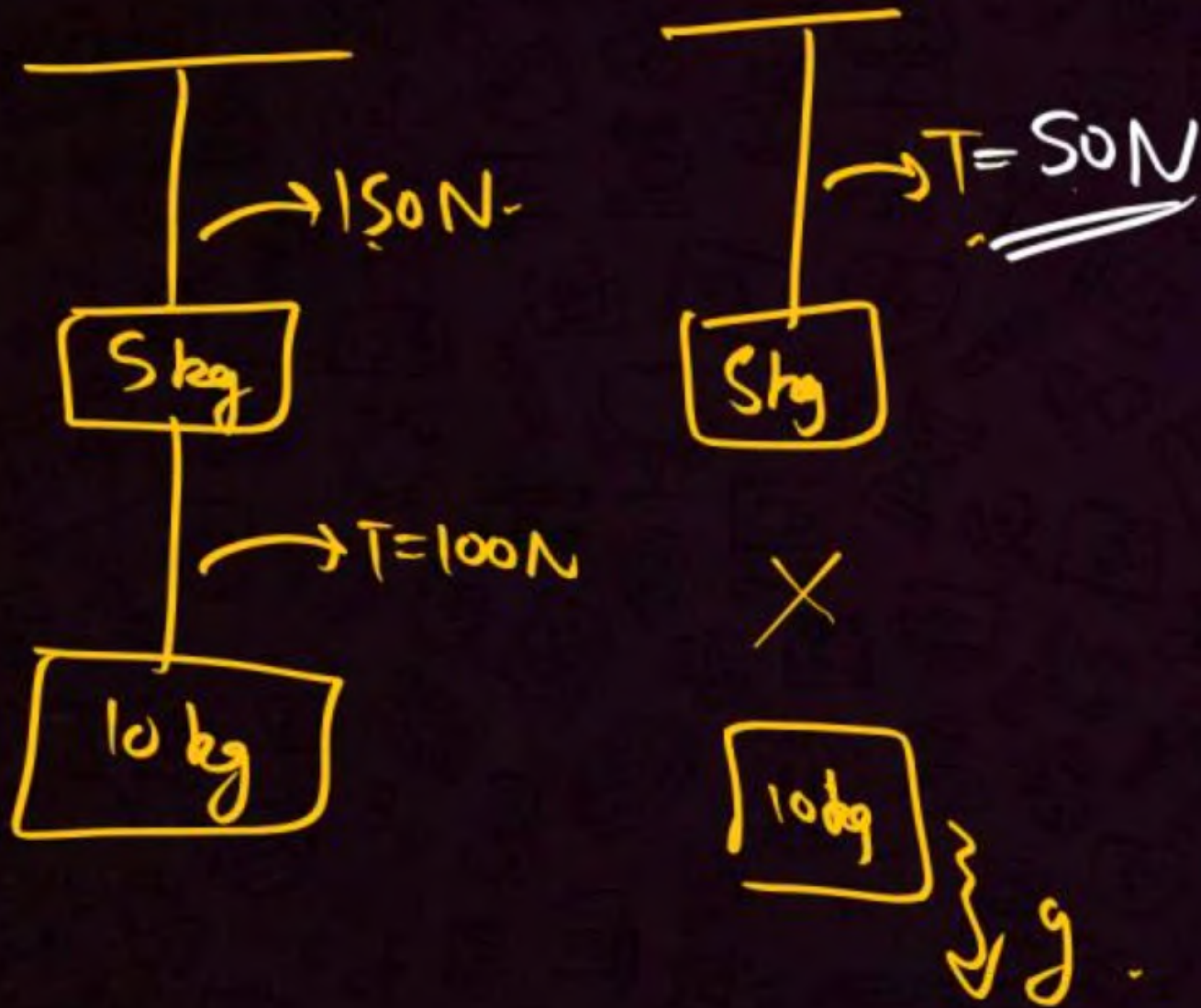
$$9K$$

Spring having spring constant K is cut in n parts. The parts are connected in parallel with each other. What will be the new value of spring constant of the combination of Springs.

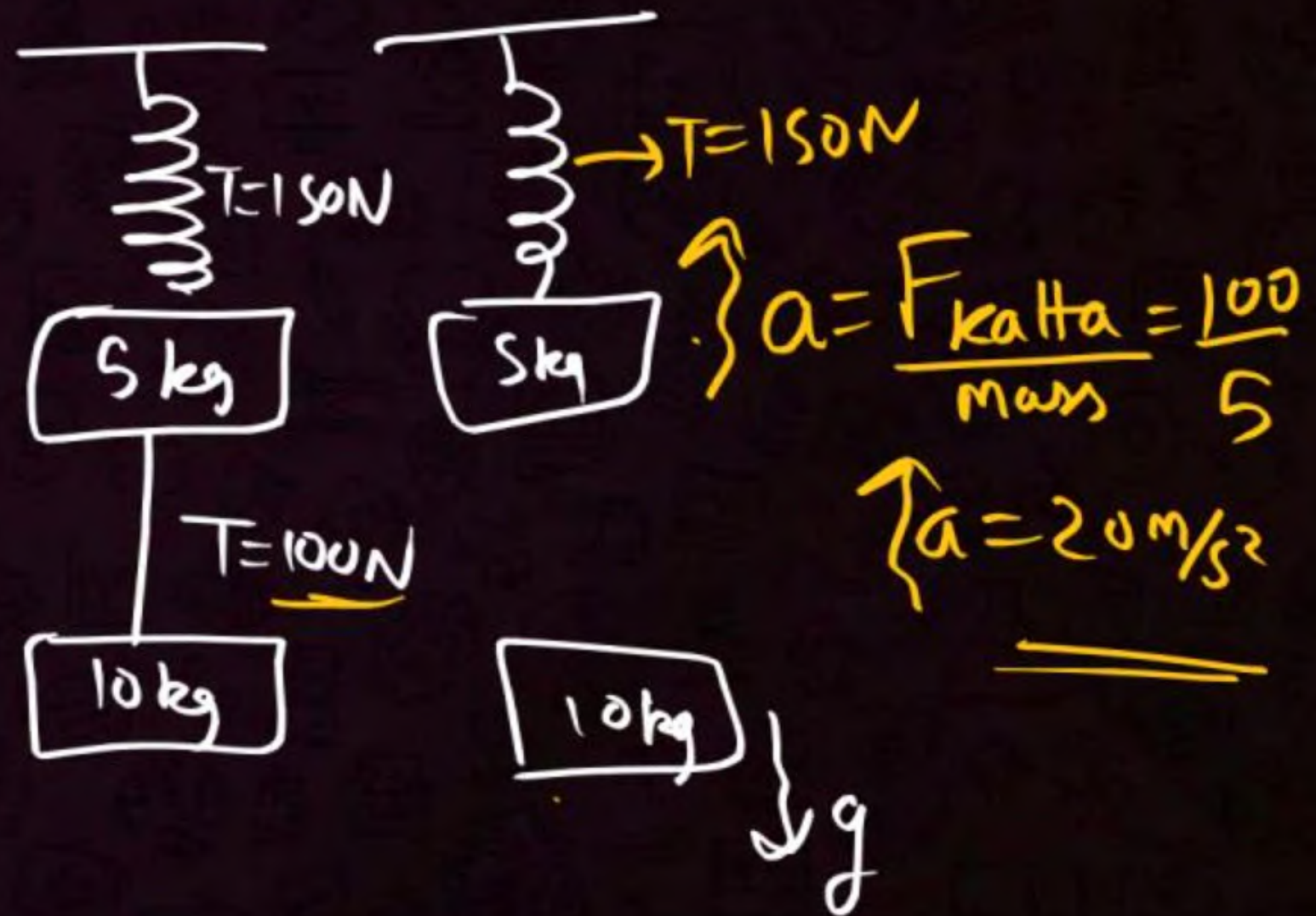
$$n^2 K$$

10.6 Cutting Strings & springs

String - On spot change



Spring - On spot acceleration
Force change slowly



QUESTION-181

Difficulty Level : HARD

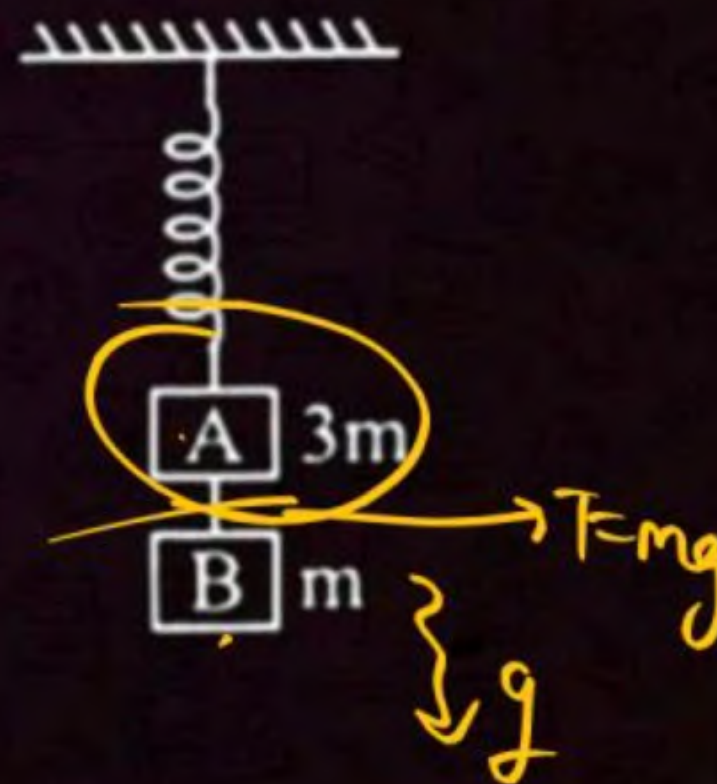


Two blocks A and B of masses $3m$ and m respectively are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in figure. The magnitudes of acceleration of A and B, immediately after the string is cut, are respectively:

[Delhi-2017]

- 1 $g, \frac{g}{3}$
- 2 g, g
- 3 $\frac{g}{3}, \frac{g}{3}$
- 4 $\frac{g}{3}, g$

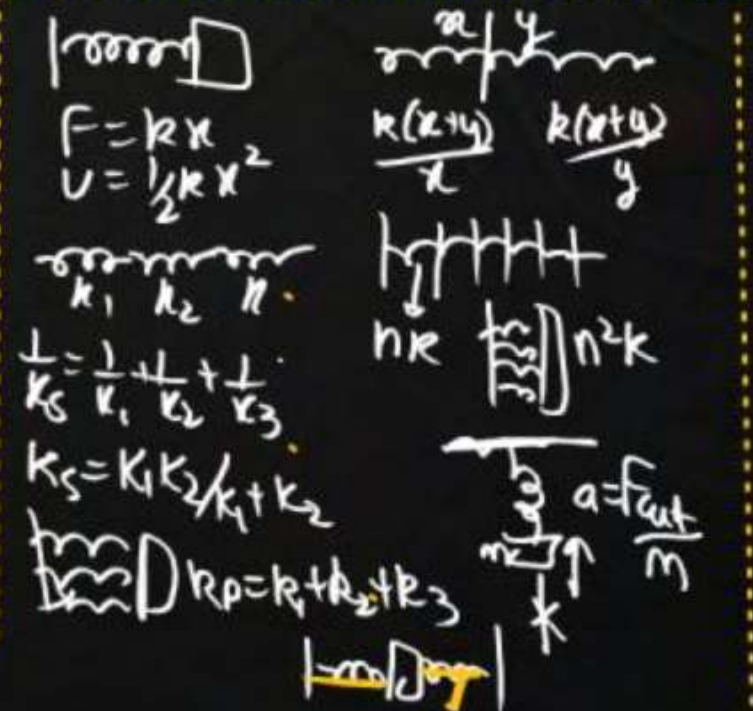
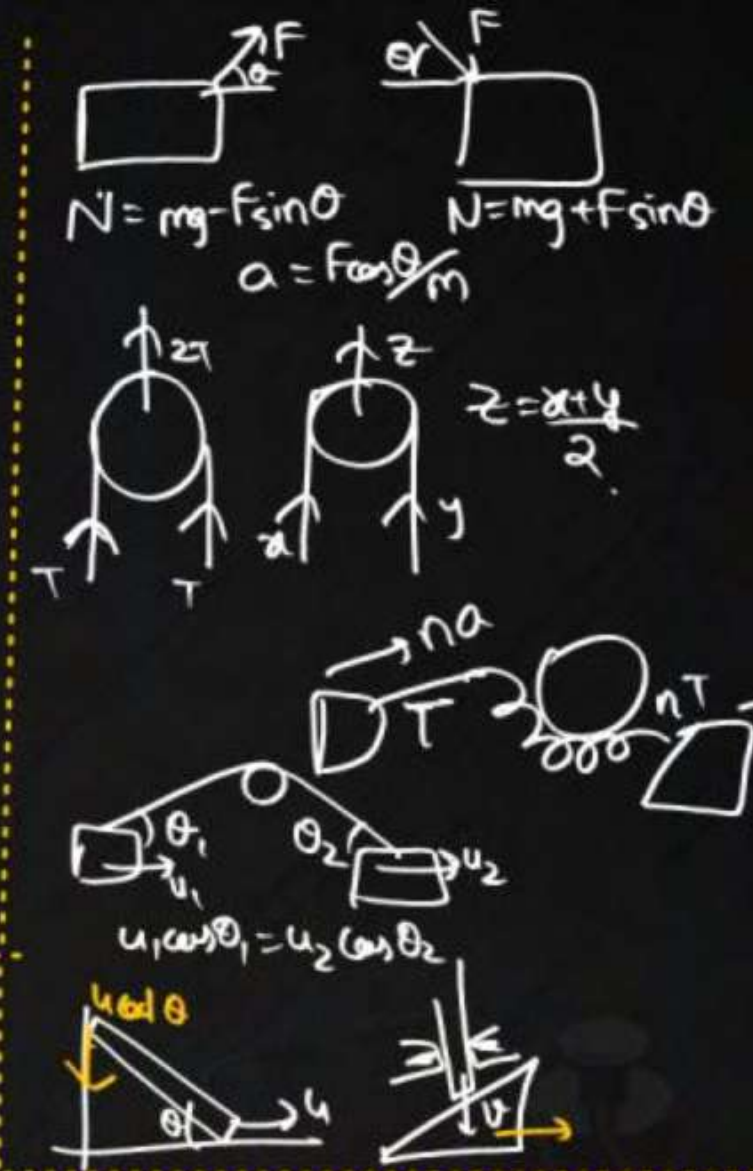
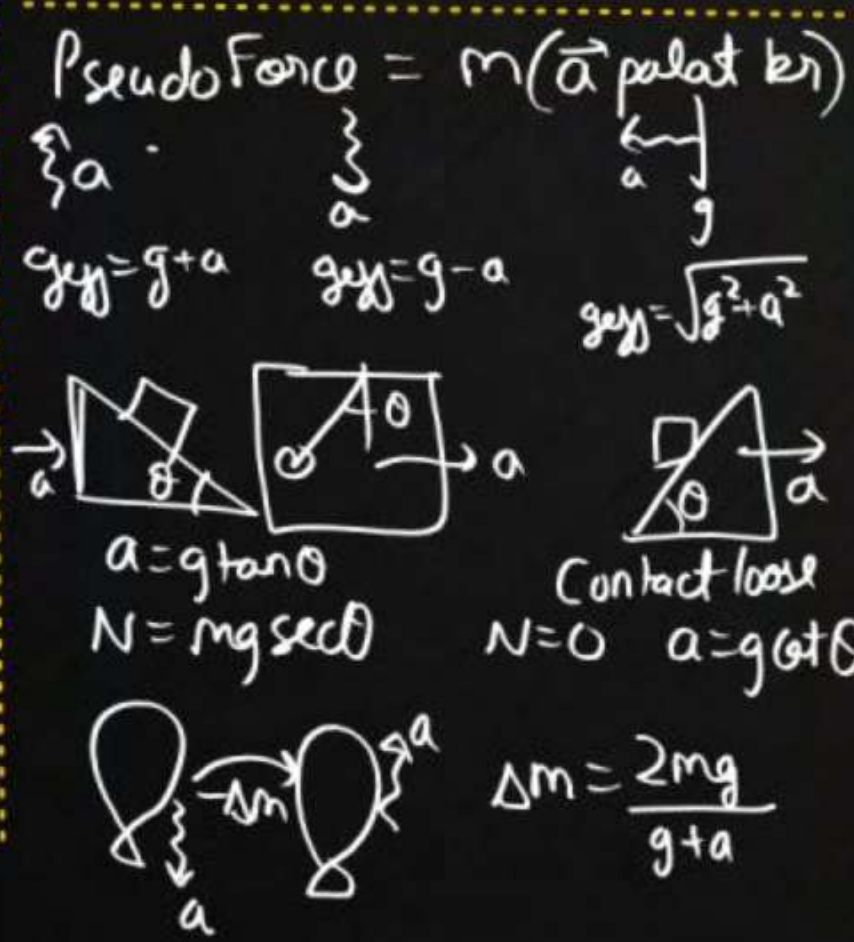
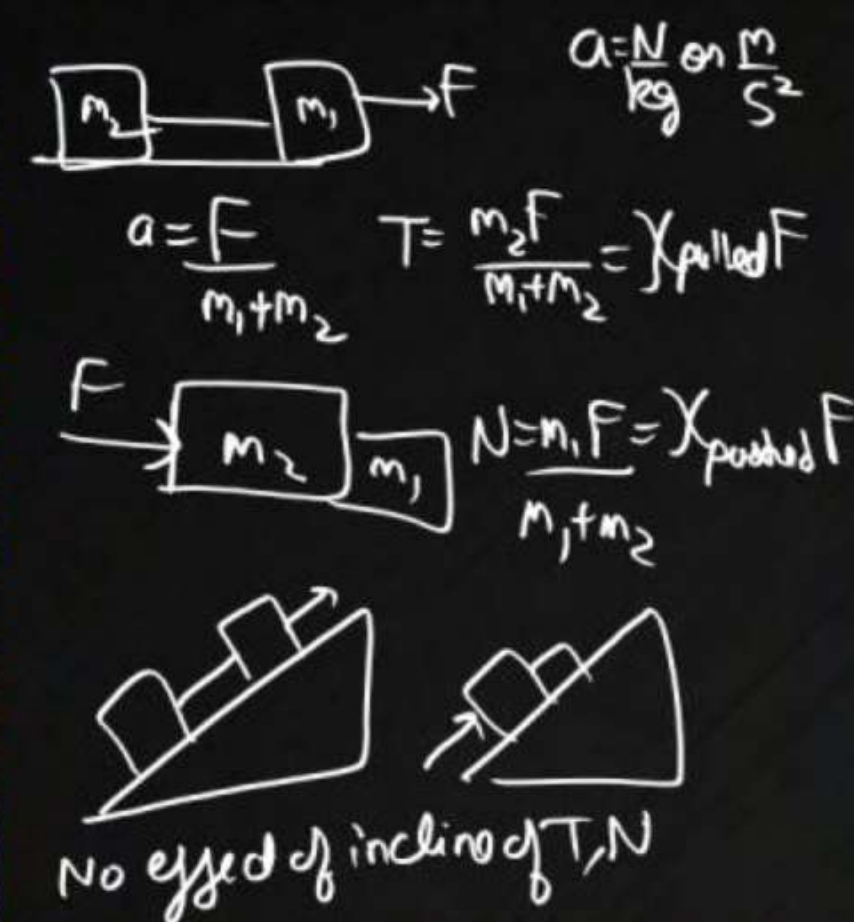
$$a = \frac{T_{\text{cut}}}{3m} = \frac{mg}{3m}$$





PUPPY POINTS 2

$W=mg$
 T (dene ka)
 N (chipane ka force)
 Contact lost $N=0$
 Upthrust - Buoyancy



Part 11 – Variable Mass System



11.1 Variable mass



$$F_{vm} = \frac{dp}{dt} = \frac{d(mv)}{dt}$$

$$v \frac{dm}{dt}$$

(v constant)



$$v \frac{dm}{dt} = ma$$



A satellite in force free space sweeps stationary interplanetary dust at a rate of $\frac{dM}{dt} = \alpha v$, where M is mass and v is the speed of satellite and α is a constant.

The acceleration of satellite is:

[1995]

1 $\frac{-\alpha v^2}{2M}$

2 $-\alpha v^2$

3 $\frac{-2\alpha v^2}{M}$

4 $\frac{-\alpha v^2}{M}$

$$\frac{dm}{dt} = \alpha v$$

$$ma = v \frac{dm}{dt}$$

$$ma = v \alpha v$$

$$a = \frac{\alpha v^2}{m} \quad \pm$$

11.2 Balam Pichkari



$$F_{vm} = v \frac{dm}{dt}$$

$$F_{vm} = \rho A v^2$$

$$F_{vm} = \frac{1}{2} \rho v^2$$

$$F_{vm} = \frac{v \rho m}{t}$$



$$F_{vm} = \pm v \frac{dm}{dt} = \rho A v^2 = \lambda v^2 = \frac{v n m}{t}$$

QUESTION-183

Difficulty Level : MEDIUM



A stream of water flowing horizontally with a speed of 15 ms^{-1} gushes out of a tube of cross-sectional area 10^{-2} m^2 , and hits a vertical wall normally. Assuming that it does not rebound from the wall, the force exerted on the wall by the impact of water is

[NCERT Based]

1 $1.25 \times 10^3 \text{ N}$

2 $2.25 \times 10^3 \text{ N}$

3 $2.25 \times 10^3 \text{ N}$

4 $4.25 \times 10^3 \text{ N}$

$$\rho = 1000 \text{ kg/m}^3$$

$$F_{\text{im}} = \rho A v^2$$

$$1000 \times 10^{-2} \times 15 \times 15$$

$$2250$$

QUESTION-184**Difficulty Level : Easy***hw*

A stream of water flowing horizontally with a speed of 25 ms^{-1} gushes out of a tube of cross-sectional area 10^{-3} m^2 , and hits at a vertical wall nearby. What is the force exerted on the wall by the impact of water?

[NCERT Based]

- 1** 125 N
- 2** 625 N
- 3** -650 N
- 4** -1125 N

QUESTION-185**Difficulty Level : HARD**

A mass of M is kept in air by shooting bullets by a gun vertically. If mass of each bullet is m , what is the rate of firing if speed of bullet is u .



$$Mg = F_{vm}$$

$$Mg = \frac{u n m}{t}$$

$$\text{Rate of firing } \frac{n}{t} = \frac{Mg}{m u}$$

QUESTION-186**Difficulty Level : Easy**

A mass of 10 kg is kept in air by shooting bullets by a gun vertically. If mass of each bullet is 10 g, what is the rate of firing if speed of bullet is 50 m/s.

$$100 \text{ N} = \frac{v n m}{t}$$

$$100 = 50 \frac{n}{t} \frac{10}{1000}$$

$$\frac{n}{t} = 200$$



QUESTION-187**Difficulty Level : Easy**

A rocket with a lift-off mass 2×10^4 kg is blasted upwards with an initial acceleration of 5 ms^{-2} . The initial thrust of the blast is (Take $g = 10 \text{ ms}^{-2}$)

[NCERT Based]

1 $2 \times 10^5 \text{ N}$

2 $3 \times 10^5 \text{ N}$ ✓

3 $4 \times 10^5 \text{ N}$

4 $5 \times 10^5 \text{ N}$



$g = 10$
 $a = 5$

$$F = m(g + a) = 20000(10 + 5)$$
$$= 20000 \times 15 = 30 \times 10^4 = 3 \times 10^5$$

QUESTION-188

Difficulty Level : Easy



A rocket of initial mass 6000 kg ejects gases at a constant rate of 16 kg s^{-1} with constant relative speed of 11 km s^{-1} . What is the acceleration of the rocket one minute after the blast? [NCERT Based]

1 25 ms^{-2}

2 50 ms^{-2}

3 10 ms^{-2}

4 35 ms^{-2}

$$v = 11000 \text{ m/s}$$



After 1 min
mass loss $m = \frac{6000 - 16 \times 60}{1}$

$$v \frac{dm}{dt} = m(a + g)$$

$11000(16) = m(10 + a)$

QUESTION-189

Difficulty Level : Easy

✓✓✓



If the force on a rocket, moving with a velocity of 300 m s^{-1} is 210 N , then the rate of combustion of the fuel is **[NCERT Based]**

- 1 0.07 kg s^{-1}
- 2 1.4 kg s^{-1}
- 3 0.7 kg s^{-1}
- 4 10.7 kg s^{-1}



A 600 kg rocket is set for a vertical firing. If the exhaust speed is 1000 ms^{-1} , the mass of the gas ejected per second to supply the thrust needed to overcome the weight of rocket is: [1990]

- 1 117.6 kgs^{-1}
- 2 58.6 kgs^{-1}
- 3 6 kgs^{-1}
- 4 76.4 kgs^{-1}

For a rocket propulsion velocity of exhaust gases relative to rocket is 2 km/s. If mass of rocket system is 1000 kg, then the rate of fuel consumption for a rocket to rise up with acceleration 4.9 m/s^2 will be: [1998]

- 1 12.25 kg/s
- 2 17.5 kg/s
- 3 7.35 kg/s
- 4 5.2 kg/s

In a rocket, fuel burns at the rate of 1 kg/s . This fuel is ejected from the rocket with a velocity of 60 km/s . This exerts a force on the rocket equal to: **[1994]**

1 6000 N

2 60000 N

3 60 N

4 600 N

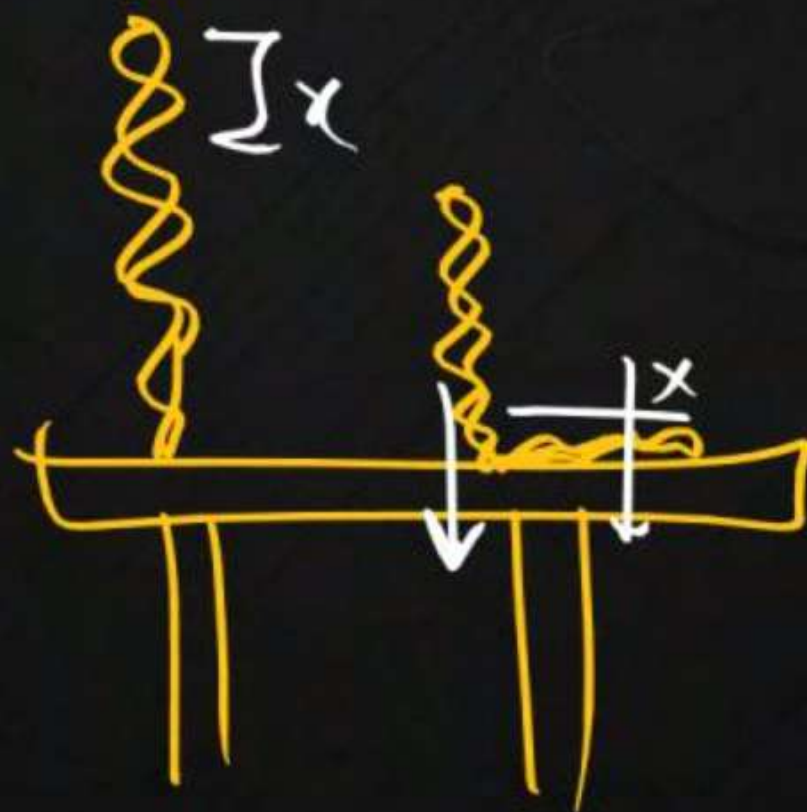


$$F_{\text{vm}} = \underline{\underline{\lambda v^2}}$$



$$v = \sqrt{2gx}$$

$$v^2 = 2gx$$



Force on table

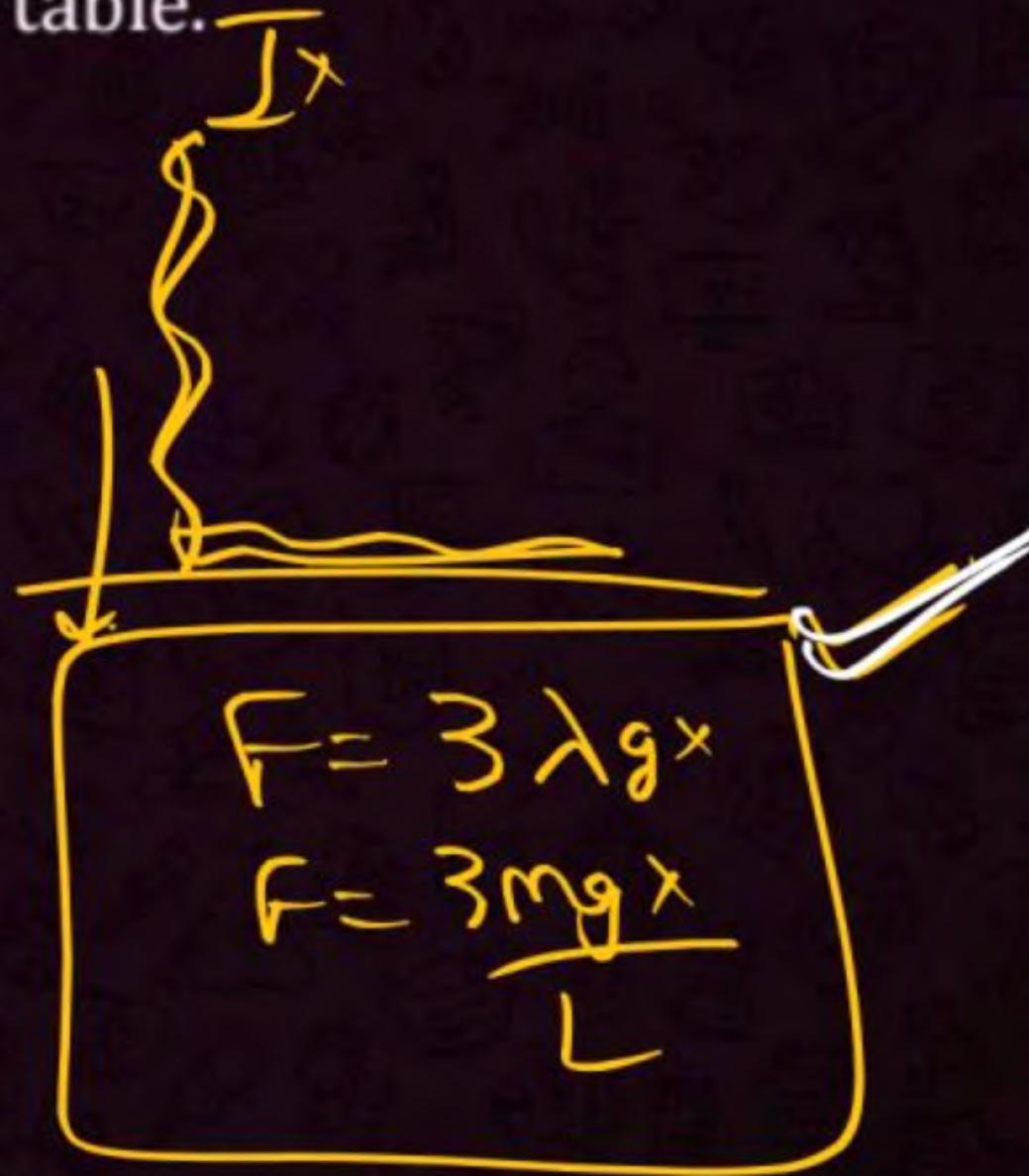
$$\lambda x g + \lambda v^2$$

$$\lambda x g + \lambda 2gx$$

$$F = 3\lambda gx = 3Mgx \frac{x}{L}$$

QUESTION-193**Difficulty Level : HARD**

A chain of mass M and length L is falling on a table. What is the force exerted on the table when x of chain is lying in the table.



QUESTION-194**Difficulty Level : Easy**

A chain of mass 10 kg and length 10 m is falling on a table. What is the force exerted on the table when 4 m of chain is lying in the table.



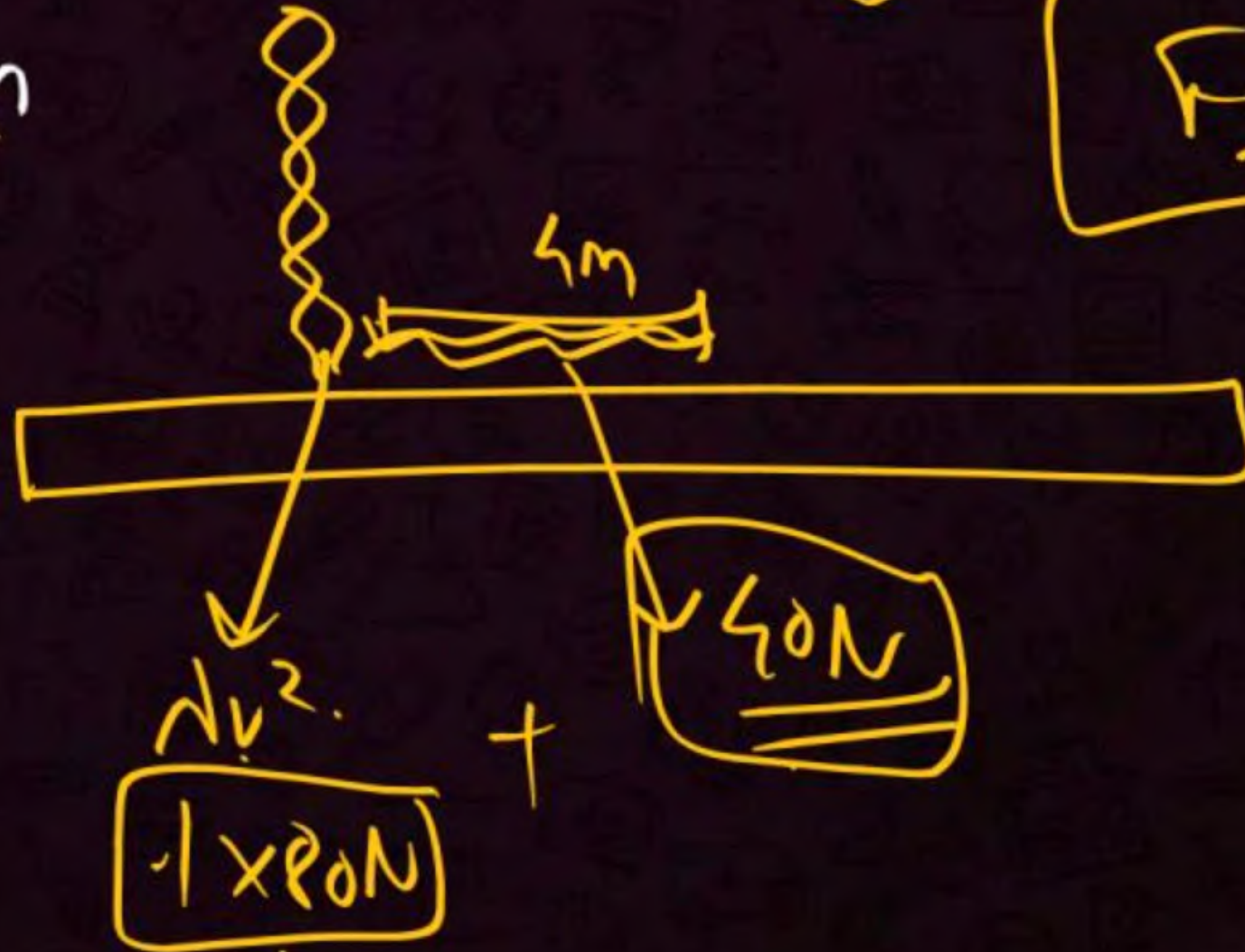
$$\lambda = \frac{m}{L} = \frac{10}{10} = 1 \text{ kg/m}$$

4m

$$v = \sqrt{2gh}$$

$$= \sqrt{2 \times 10 \times 4}$$

$$v^2 = 80$$



$$F_{\text{table}} = 120 \text{ N}$$

PUPPY POINTS 2

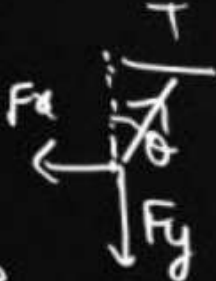
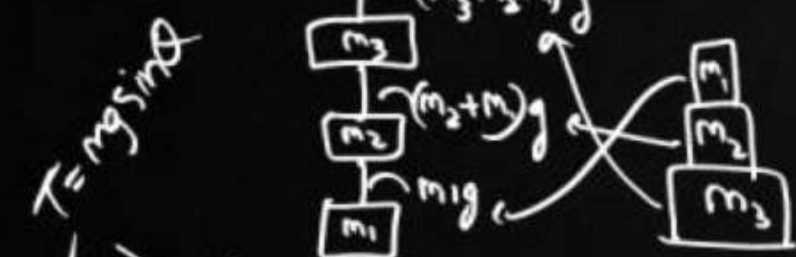
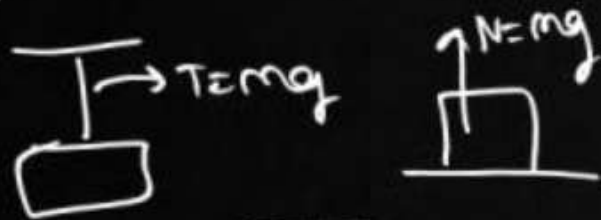
$$W=mg$$

T (dene ka)

N (chipane ka force)

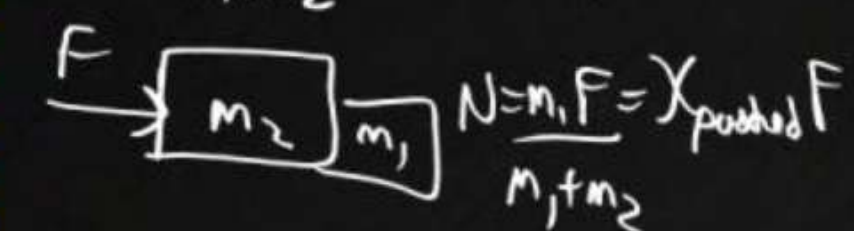
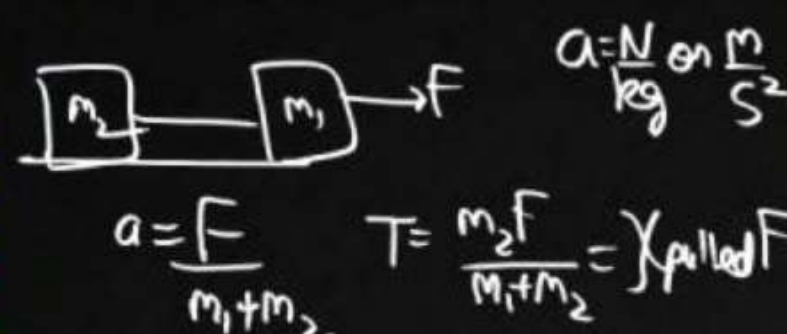
Contact lost $N=0$

Upthrust - Buoyancy



$$\frac{F_1}{\sin \theta_1} = \frac{F_2}{\sin \theta_2} = \frac{F_3}{\sin \theta_3}$$

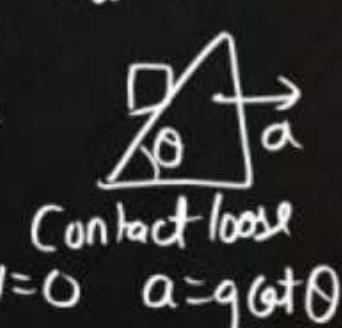
$$\tan \theta = \frac{F_x}{F_y}, T = \sqrt{F_x^2 + F_y^2}, F_x + F_y + T = 0$$



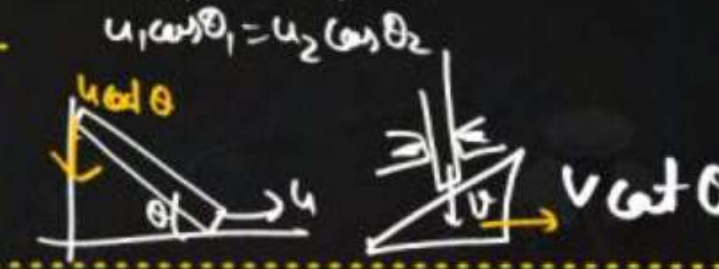
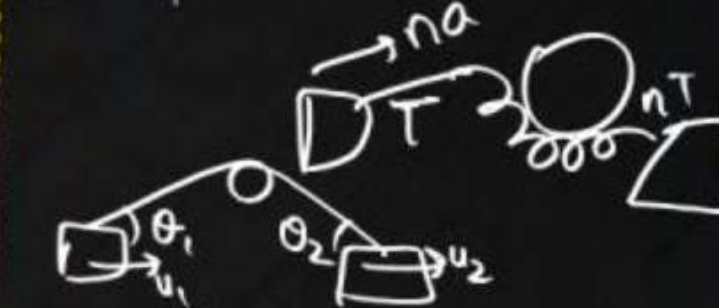
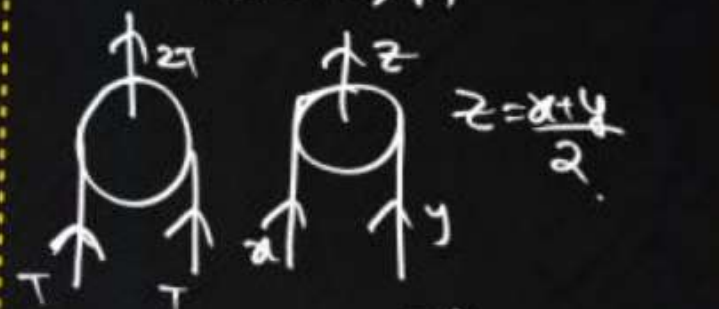
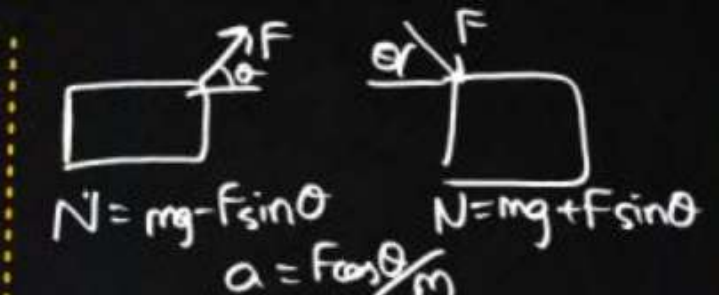
No effect of incline of T, N

$$\text{Pseudo Force} = m(\vec{a} \text{ parast kr})$$

$g_{\text{eff}} = g + a, g_{\text{eff}} = g - a, g_{\text{eff}} = \sqrt{g^2 + a^2}$



$$\Delta m = \frac{2mg}{g+a}$$

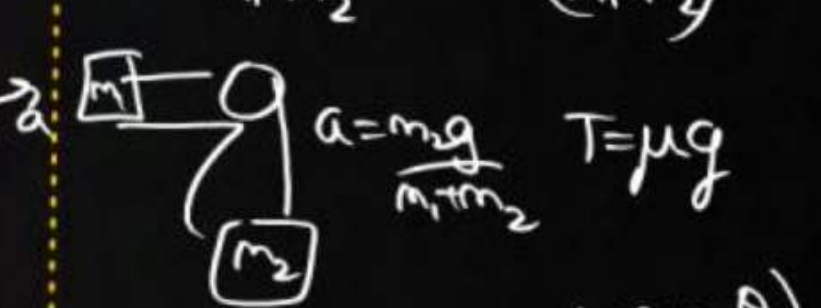


$$F = kx, U = \frac{1}{2} kx^2$$

$$k_s = k_1 k_2 / (k_1 + k_2), k_p = k_1 + k_2 + k_3$$



$$a = \frac{(m_2 - m_1)g}{m_1 + m_2}, a_{\text{cm}} = \frac{(m_2 - m_1)^2 g}{(m_1 + m_2)^2}$$



$$T = \mu g (\sin \theta_1 + \sin \theta_2), a = \frac{m_2 g \sin \theta_2 - m_1 g \sin \theta_1}{m_1 + m_2}$$

$$F = \lambda v^2, W = 3\lambda g x = 3Mg x$$

$$Mg = \frac{v \frac{dm}{dt}}{t}, F_{\text{im}} = v \frac{dm}{dt}, v \frac{dm}{dt} = ma$$

Part 18 – Theory and AR Questions



QUESTION-195 (Assertion and Reason)

Assertion: An external force is required to keep a body in motion.

Reason: If the net external force is zero, a body at rest continues to remain at rest and a body in motion continues to move with a uniform velocity.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-196 (Assertion and Reason)

Assertion: For applying the second law of motion, there is no conceptual distinction between inanimate and animate objects.

Reason: An animate object requires an external force to accelerate.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-197 (Assertion and Reason)

Assertion: If a body is momentarily at rest, it means that force or acceleration are necessarily zero at that instant.

Reason: Force on a body at a given time is determined by the direction of motion only.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-198 (Assertion and Reason)

Assertion: If external force on a body is zero, its acceleration is zero.

Reason: This is the simple form of Newton's second law of motion.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-199 (Assertion and Reason)

Assertion: There is no appreciable change in the position of the body during the action of the impulsive force.

Reason: In case of impulsive force the time of action of the force is very short.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-200 (Assertion and Reason)

Assertion: On a merry-go-around, all parts of our body are subjected to an inward force.

Reason: We have a feeling of being pushed outward in the direction of impending motion.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-201 (Assertion and Reason)

Assertion: The moment after a stone is released out of an accelerated train, there is no horizontal force or acceleration on the stone.

Reason: Force on a body at a given time is determined by the situation at the location of the body at that time.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-202 (Assertion and Reason)

Assertion: Force on a body A by body B is equal and opposite to the force on the body B by A.

Reason: Forces in nature always occur between pairs of bodies.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-203 (Assertion and Reason)

Assertion: There is no cause-effect relation between action and reaction.

Reason: Action and reaction forces are not simultaneous forces.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-204 (Assertion and Reason)

Assertion: The terms action and reaction in the third law of motion stand for simultaneous mutual forces between a pair of bodies.

Reason: In this context action always precede or cause reaction.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-205 (Assertion and Reason)

Assertion: The total momentum of an isolated system of particles is conserved.

Reason: The law of conservation of momentum follows from the second and third law of motion.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-206 (Assertion and Reason)

Assertion: The familiar equation $mg = R$ for a body on a table is true only if the body is in equilibrium.

Reason: The equality of mg and R has no connection with the third law.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-207 (Assertion and Reason)

Assertion: Inertia is the property by virtue of which the body is unable to change its state by itself.

Reason: The bodies do not change their state unless acted upon by an unbalanced external force.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-208 (Assertion and Reason)

Assertion: If the net external force on the body is zero then its acceleration is also zero.

Reason: Acceleration does not depend on force.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-209 (Assertion and Reason)

Assertion: Newton's second law of motion gives the measurement of force.

Reason: According to Newton's second law of motion, force is directly proportional to the rate of change of momentum.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-210 (Assertion and Reason)

Assertion: If two objects of different masses have the same momentum, the lighter body possesses greater velocity.

Reason: For all bodies, momentum always remains the same.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-211 (Assertion and Reason)

Assertion: Airplanes always fly at low altitudes.

Reason: According to Newton's third law of motion, for every action there is an equal and opposite reaction.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-212 (Assertion and Reason)

Assertion: No force is required by the body to remain in any state of uniform linear motion.

Reason: In uniform linear motion, acceleration has a finite value.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-213 (Assertion and Reason)

Assertion: Mass is a measure of inertia of the body in linear motion.

Reason: Greater the mass, greater is the force required to change its state of rest or of uniform motion.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

Ans: (1)

QUESTION-214 (Assertion and Reason)

Assertion: The slope of momentum versus time curve gives us the acceleration.

Reason: Acceleration is given by the rate of change of momentum.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-215 (Assertion and Reason)

Assertion: A bullet is fired from a rifle. If the rifle recoils freely, the kinetic energy of rifle is more than that of the bullet.

Reason: In the case of rifle-bullet system, the law of conservation of momentum is violated.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-216 (Assertion and Reason)

Assertion: A rocket works on the principle of conservation of linear momentum.

Reason: Whenever there is a change in the momentum of one body, the same change occurs in the momentum of the second body of the same system but in the opposite direction.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

Ans: (1)

QUESTION-217 (Assertion and Reason)

Assertion: The apparent weight of a body in an elevator moving with some downward acceleration is less than the actual weight of body.

Reason: The part of the weight is spent in producing downward acceleration, when body is in an elevator.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-218 (Assertion and Reason)

Assertion: When the lift moves with uniform velocity, the man in the lift will feel weightlessness.

Reason: In downward accelerated motion of the lift, apparent weight of a body increases.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-219 (Assertion and Reason)

Assertion: In the case of free fall of the lift, the man will feel weightlessness.

Reason: In free fall, acceleration of lift is equal to acceleration due to gravity.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-220 (Assertion and Reason)

Assertion: A player lowers his hands while catching a cricket ball and suffers less reaction force.

Reason: The time of catch increases when cricketer lowers his hand while catching a ball.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-221 (Assertion and Reason)

Assertion: The acceleration produced by a force in the motion of a body depends only upon its mass.

Reason: Larger is the mass of the body, lesser will be the acceleration produced.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-222 (Assertion and Reason)

Assertion: Newton's third law of motion is applicable in any state of bodies.

Reason: Newton's third law applies to all types of forces, for example, gravitational, electric or magnetic forces, etc.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-223 (Assertion and Reason)

Assertion: A reference frame attached to the Earth is an inertial frame of reference.

Reason: The reference frame which has zero acceleration is called a non-inertial frame of reference.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-224 (Assertion and Reason)

Assertion: A table cloth can be pulled from a table without dislodging the dishes.

Reason: To every action there is an equal and opposite reaction.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-225 (Assertion and Reason)

Assertion: A body subjected to three concurrent forces cannot be in equilibrium.

Reason: If large numbers of concurrent forces are acting on the same point then the point will always be in equilibrium.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-226 (Assertion and Reason)

Assertion: Impulse and momentum have different dimensions.

Reason: From Newton's second law of motion, impulse is equal to momentum.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-227 (Assertion and Reason)

Assertion: Two bodies of masses M and m ($M > m$) are allowed to fall from the same height. If the air resistance for each be the same, then both the bodies will reach the Earth simultaneously.

Reason: For the same air resistance, acceleration of both the bodies will be the same.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-228 (Assertion and Reason)

Assertion: The acceleration of a body down a rough inclined plane is greater than the acceleration due to gravity.

Reason: The body is able to slide on an inclined plane only when its acceleration is greater than acceleration due to gravity.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-229 (Assertion and Reason)

Assertion: Velocity of a particle with respect to ground (assuming inertial frame) is $\vec{v}$. If it is observed from any inertial frame, then its velocity is observed to be $\vec{v}$.

Reason: Non-accelerated frame is non-inertial frame.

- 1** If both A and R are true and reason is the correct explanation of assertion.
- 2** If both A and R are true but reason is not the correct explanation of assertion.
- 3** If assertion is true but reason is false.
- 4** If both assertion and reason are false.

QUESTION-230 (Assertion and Reason)

Assertion: A block is at rest on an inclined plane of inclination, net contact force on the block is mg .

Reason: If block is at rest then net force on the block is zero.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-231 (Assertion and Reason)

Assertion: A string can never remain horizontal, when loaded at the middle, howsoever large the tension may be.

Reason: If string is horizontal, then there is no component of tension which can balance the weight of the body.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-232 (Assertion and Reason)

Assertion: A net force acts on a body even if its velocity is zero.

Reason: Force is the rate of change of momentum at that instant.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-233 (Assertion and Reason)

Assertion: Two blocks kept side by side and moving with the same acceleration may have contact force between them.

Reason: If external force acting on one of the two blocks causes same acceleration in of both them, then contact force exists between them.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-234 (Assertion and Reason)

Assertion: A bike helmet protects our head.

Reason: Helmet is made by very hard material.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-235 (Assertion and Reason)

Assertion: A rocket can move in air free space but jet planes cannot.

Reason: Jet plane propulsion is based on conservation of linear momentum.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-236 (Assertion and Reason)

Assertion: Action and reaction forces do not balance each other.

Reason: Action and reaction forces are always equal in magnitude and opposite in direction.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-237 (Assertion and Reason)

Assertion: A monkey slides down a vertical rope with constant acceleration ($< g$). The tension force on the monkey is in the upward direction.

Reason: In assertion, net force on the monkey is in the downward direction.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-238 (Assertion and Reason)

Assertion: Passengers are thrown backward from their seats if bus suddenly starts.

Reason: Inertia of rest opposes the change of state of passenger.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-239 (Assertion and Reason)

Assertion: While applying laws of motion in a non-inertial reference frame, a pseudo force is taken to be acting on the body considered.

Reason: A non-inertial frame has zero acceleration.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-240 (Assertion and Reason)

Assertion: A car accelerates on a horizontal road due to the force exerted by the engine of the car.

Reason: To accelerate a body, force is always needed in the opposite direction of required acceleration.

- 1** If both A and R are true and reason is the correct explanation of assertion.
- 2** If both A and R are true but reason is not the correct explanation of assertion.
- 3** If assertion is true but reason is false.
- 4** If both assertion and reason are false.

QUESTION-241 (Assertion and Reason)

Assertion: A person says that he measured the acceleration of a particle to be nonzero when no force was acting on the particle. He might have used non-inertial frame.

Reason: Frame moving with constant velocity is a non-inertial frame.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-242 (Assertion and Reason)

Assertion: A body is at rest under the effect of two equal and opposite forces acting on it.

Reason: According to Newton's third law of motion, action and reaction are equal and opposite and hence the body will be in equilibrium.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-243 (Assertion and Reason)

Assertion: The driver in a vehicle moving with a constant speed on a straight road is in a non-inertial frame of reference.

Reason: A reference frame in which Newton's laws of motion are applicable is non-inertial.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-244 (Assertion and Reason)

Assertion: Impulsive force is large and acts for a short time.

Reason: Finite change in momentum should be produced by the force.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-245 (Assertion and Reason)

Assertion: Automobiles tyres are generally provided with irregular projections.

Reason: Irregular projections provide extra force for motion.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-246 (Assertion and Reason)

Assertion: In absence of external forces, the components of the system can change their position of rest or motion.

Reason: The internal forces can change the position of components of the system.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-247 (Assertion and Reason)

Assertion: Force on rocket increases if fuel is burnt out with faster rate.

Reason: Force on rocket is directly proportional to rate of fuel consumption.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-248 (Assertion and Reason)

Assertion: An athlete runs some distance before taking a long jump.

Reason: Inertia of rest is more than inertia of motion.

- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

QUESTION-249 (Assertion and Reason)

Assertion: Newton's second law holds good in an inertial frame only.

Reason: Newton's second law is a basic law.

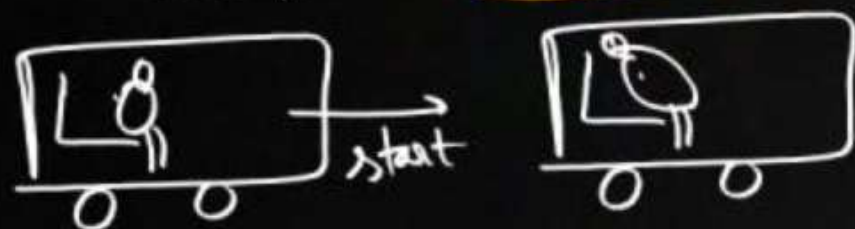
- 1 If both A and R are true and reason is the correct explanation of assertion.
- 2 If both A and R are true but reason is not the correct explanation of assertion.
- 3 If assertion is true but reason is false.
- 4 If both assertion and reason are false.

Part 19 – Revision and PUPPY POINTS



PUPPY POINTS 1

Aristotle's Fallacy - Force for motion ✗
 Galileo - Inertia - resistance to change
 Inertia & Mass (same mass, same inertia)
 ↳ rest, motion, direction



Force $1\text{N} = 10^5 \text{ dyne}$ $1\text{kGf} = 9.8\text{N}$

$1\text{gf} = 9.8 \times 10^{-3} \text{ N}$ $[\text{MLT}^{-2}]$

rest $\leftarrow$ means $\rightarrow$ No Force

constant $\rightarrow$ $F_{\text{net}} = 0$

1st Law - Physical Dependence of Force, definition

3rd Law - Force is interaction b/w 2 objects

- Force occurs in pairs
- Action Reaction cannot act on same object
- Equal, opp, No cause effect, simultaneous
- Creation of Force ✓

Force types
 EM - T, N, fr, Contact, ...
 Gravitational - weakest ✓
 Nuclear - strong (at very small range)
 weak

Classical mechanics is not valid
 ↳ v. small (Quantum)
 ↳ high speed (Relativistic)

$P = \text{Momentum} = mv$

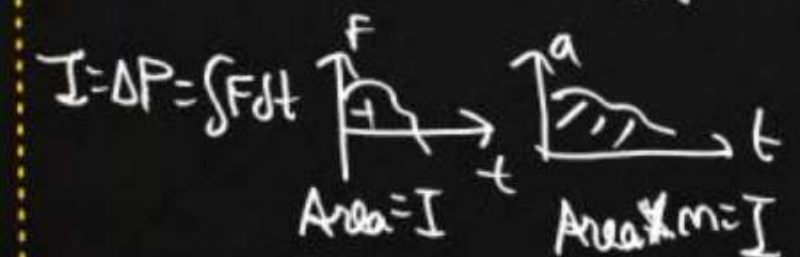
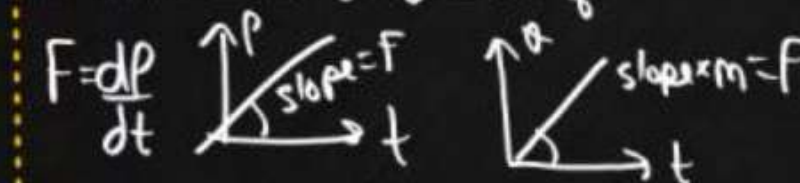
Impulse = $m(\vec{v}_2 - \vec{v}_1)$

$I = \vec{F}_{\text{avg}} t_{\text{contact}}$

$\vec{F} = \frac{d\vec{P}}{dt} = m\vec{a}$ (mass constant)

Solve $a = \frac{F}{m}$, $v = \frac{P}{m}$ use MISL

2nd Law - Measurement of Force.



PUPPY POINTS 2

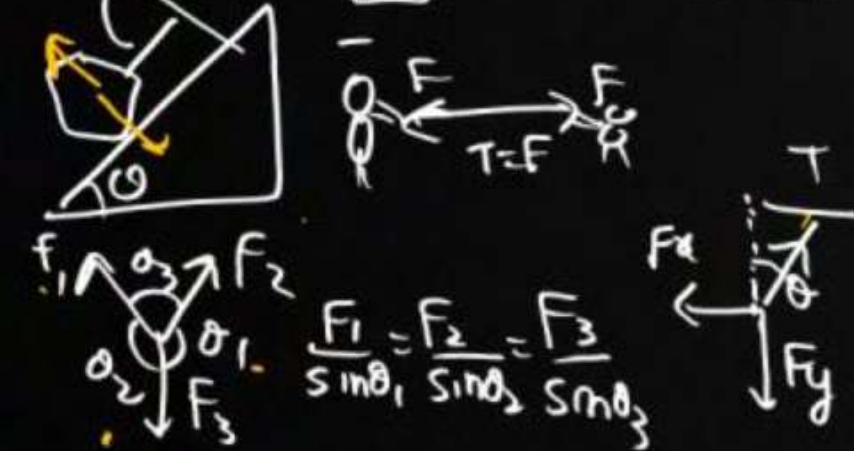
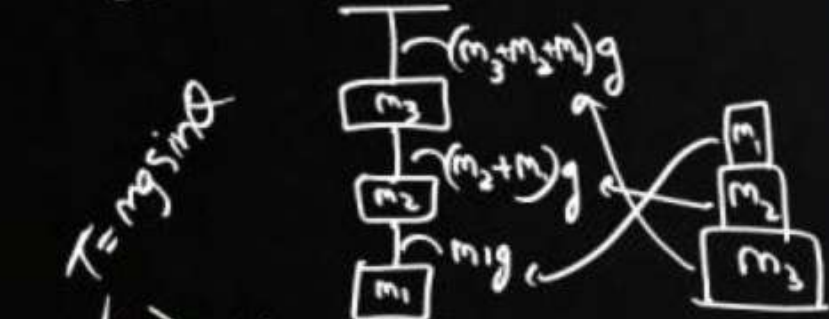
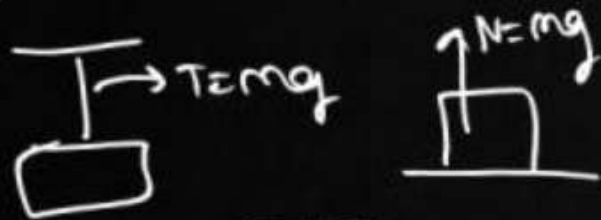
$$W=mg$$

T (dene ka)

N (chipane ka force)

Contact lost $N=0$

Upthrust - Buoyancy



$$\tan \theta = \frac{F_x}{F_y}, T = \sqrt{F_x^2 + F_y^2}, F_x + F_y + T = 0$$

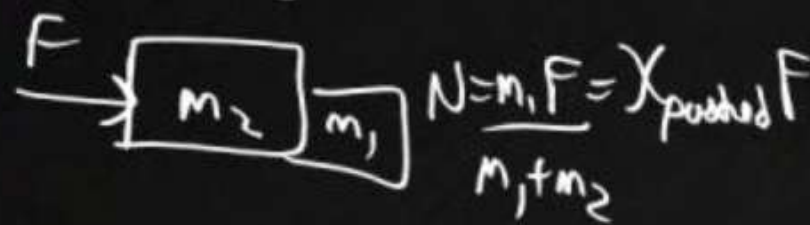
Q96Li

Normal mode



$$a = \frac{N}{kg} \text{ or } \frac{m}{s^2}$$

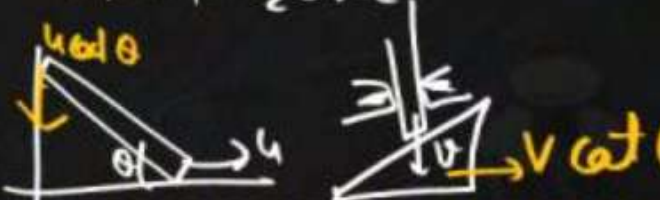
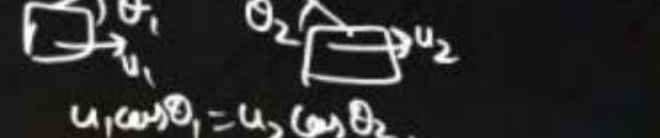
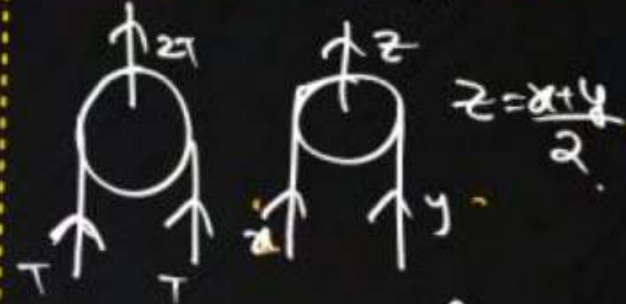
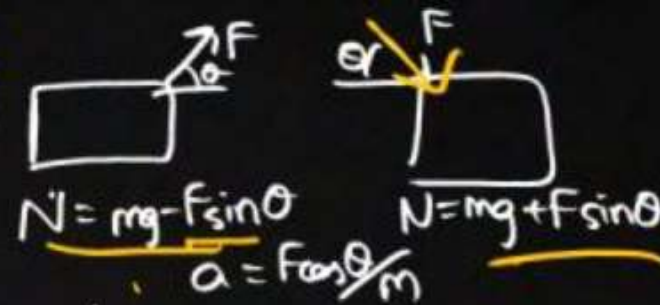
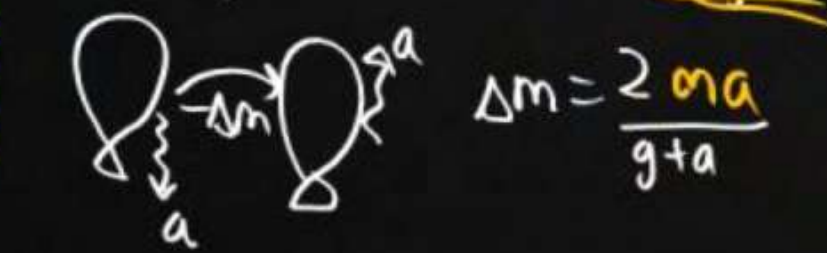
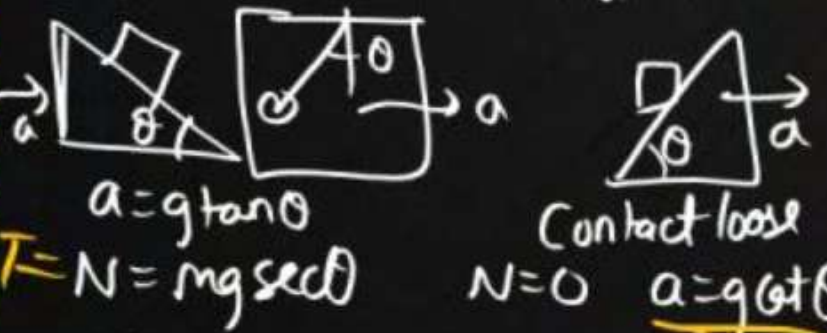
$$a = \frac{F}{m_1 + m_2} \quad T = \frac{m_2 F}{m_1 + m_2} = \text{pulled } F$$



No effect of incline of T, N

Pseudo Force = $m(\vec{a} \text{ parast kr})$

$$g_{eff} = g + a \quad g_{eff} = g - a \quad g_{eff} = \sqrt{g^2 + a^2}$$

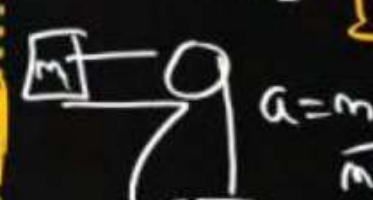


$$F = kx \quad U = \frac{1}{2} kx^2 \quad \frac{1}{k_s} = \frac{1}{k_1} + \frac{1}{k_2} + \frac{1}{k_3} \quad k_s = k_1 k_2 / (k_1 + k_2)$$

$$\mu = \frac{m_1 m_2}{m_1 + m_2}$$



$$a = \frac{(m_2 - m_1)g}{m_1 + m_2}$$



$$T = \mu g (\sin \theta_1 + \sin \theta_2)$$



$$F = \lambda v^2 \quad W = 3 \lambda g x = 3 M g x \quad F_{vm} = v \frac{dm}{dt} \quad v \frac{dm}{dt} = ma$$



THANK YOU

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