Dynamics 5


VMC
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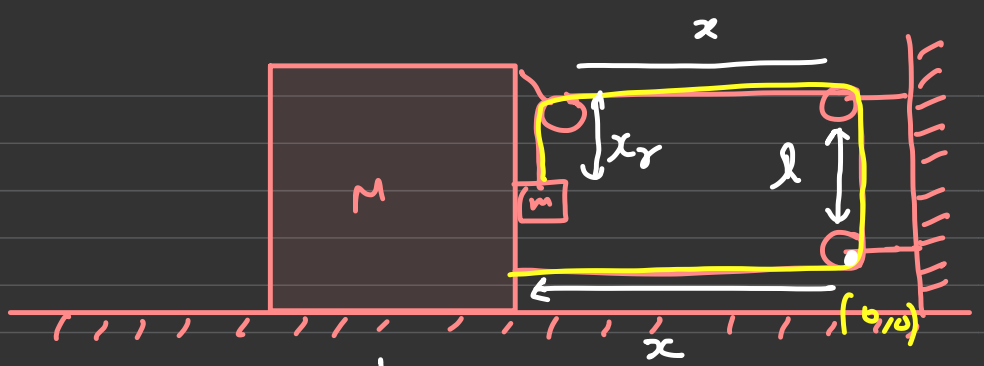
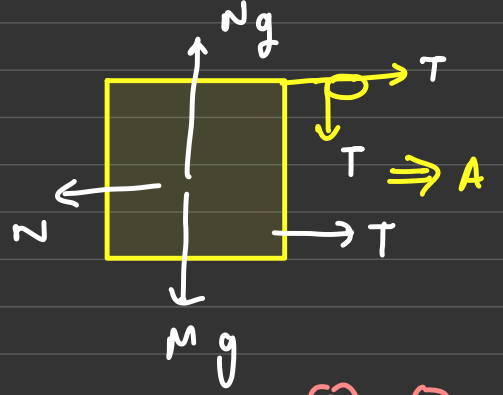
Classes
SINCE 1986
IIT JEE | MEDICAL | FOUNDATION

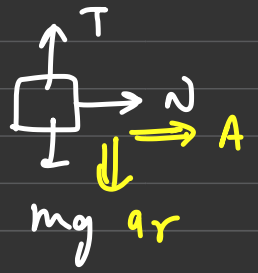
Q)



① fixed point
② Position of blocks
③ write eqn
④ Diff it twice for acc. relation

① FBD

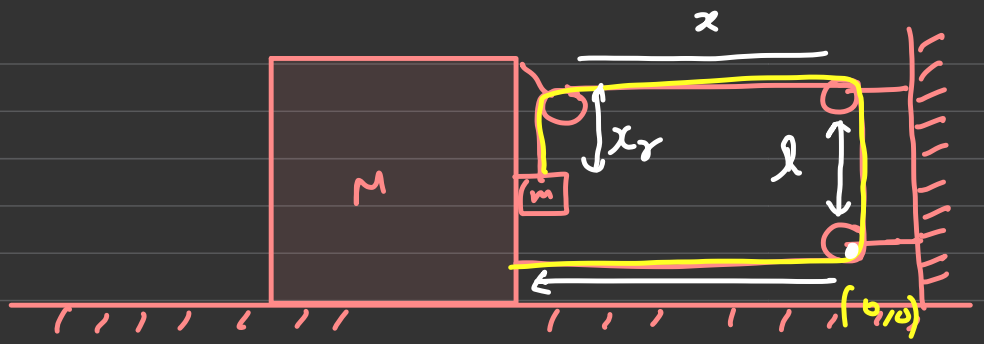




$$\begin{cases} N = mA & \text{—(iii)} \\ mg - T = m a_r & \text{(iv)} \end{cases}$$

②

$$\begin{cases} 2T - N = MxA & \text{—(i)} \\ Mg + T = Ng & \text{—(ii)} \end{cases}$$



$$x + l + x + x_r = L$$ ← Total length of string

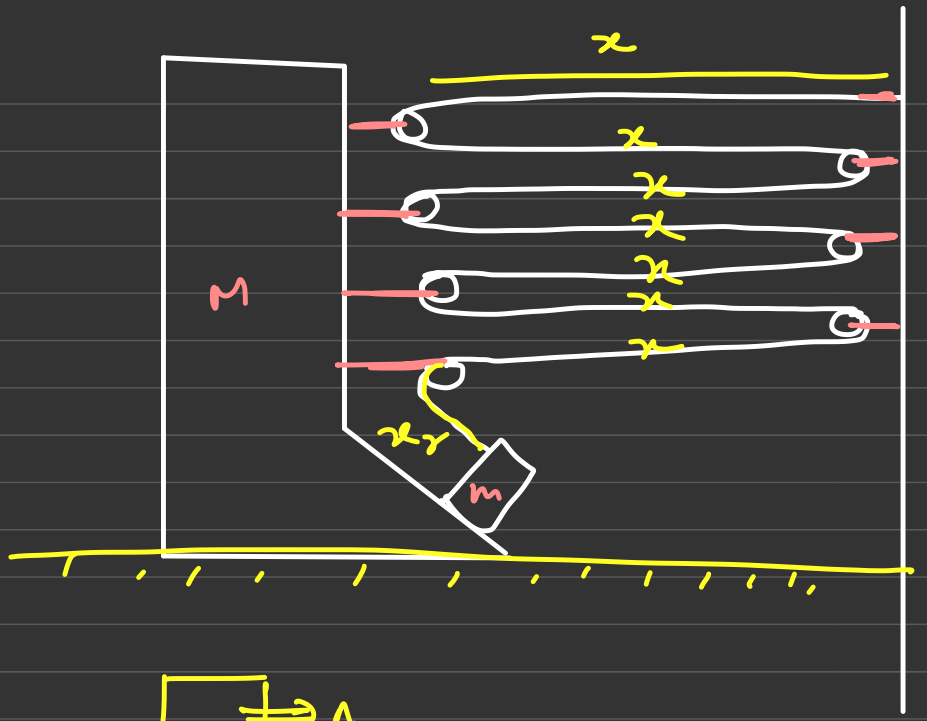
$$2x + x_r = (L - l)$$

$$2\frac{d^2x}{dt^2} + \frac{d^2x_r}{dt^2} = 0$$

$$-2A + a_r = 0$$

$$a_r = 2A \quad \text{(v)}$$

a)



find Acc. of m, and M?

String Constraint

$7x + x_r = L$

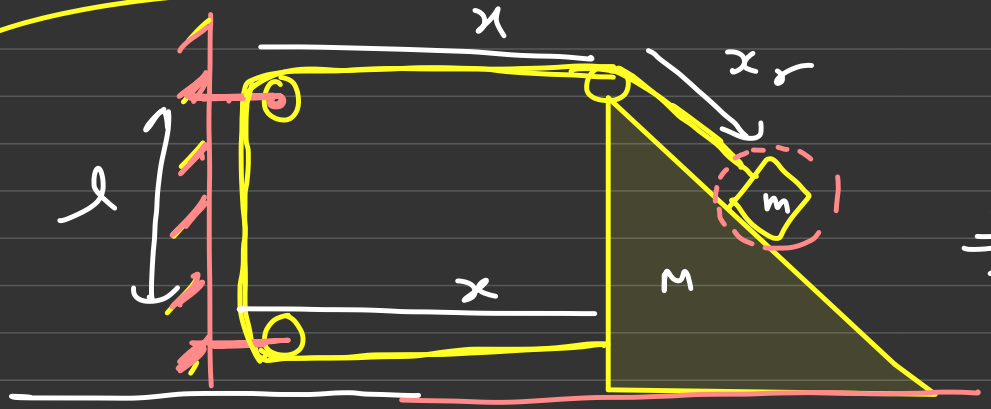
$\# \quad 7\frac{d^2x}{dt^2} + \frac{d^2x_r}{dt^2} = 0$

$7(-A) + a_r = 0$

$a_r = 7A$

Q) Smooth Surface

find acceleration of m and M?



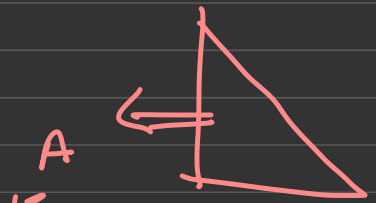
$\Rightarrow 2x + l + x_r = L$

$2x + x_r = (L - l)$

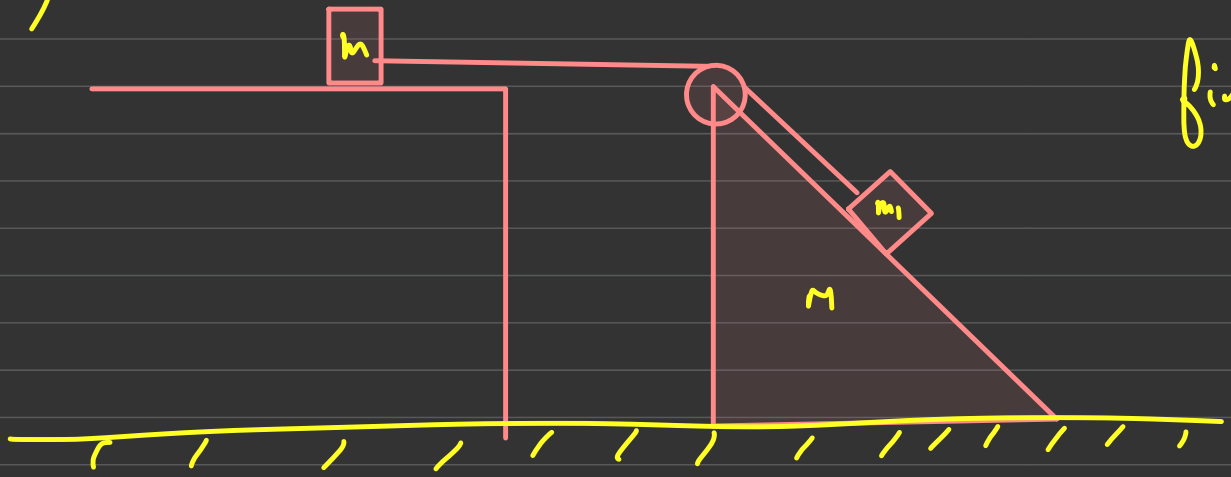
$2\frac{d^2x}{dt^2} + \frac{d^2x_r}{dt^2} = 0$

$2(-A) + a_r = 0$

$a_r = 2A$



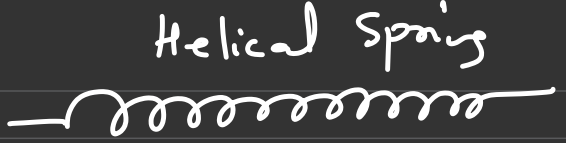
Q) (Homework)

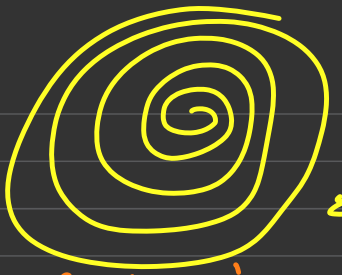


Smooth surface

find acceleration of all three block?

Spring:





Total change in length

l_0 "Natural length"

{ No - Compression
No - elongation

$(l_0 + x)$

F F F F

$F \propto (x)$ {

{ massless Spring

$F = kx$

{ Under elastic limit

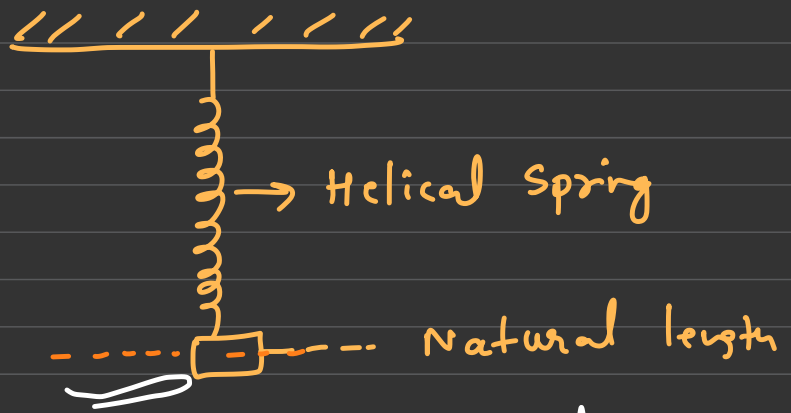
{ if Spring can restore Completely }

(#) $F = kx$

Spring Constant

(11) "Spring always tries to restore its original Shape and Size"

9)

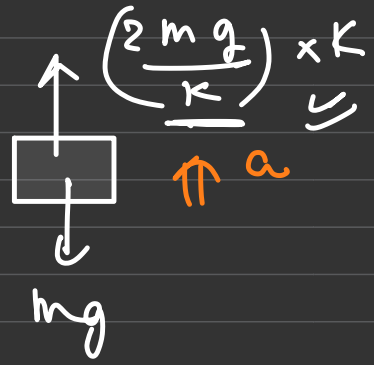


(i) if block is released from rest then find elongation when block is in equilibrium?

$mg = kx_{eq}$ { equilibrium }

$x_{eq} = \left\{ \frac{mg}{k} \right\}$

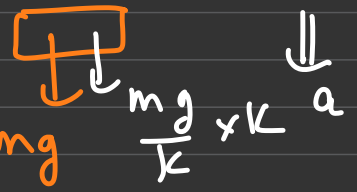
(ii) find acceleration of block when elongation is double the elongation at equilibrium



$2mg - mg = ma$

$a = g \uparrow$

(iii) find a of block when compression in the Spring $\frac{mg}{K}$?



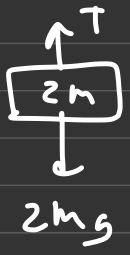
$2mg = ma \downarrow$

$a = 2g \downarrow$

Q)

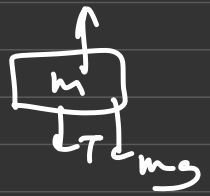
a) find elongation in the spring? at equilibrium

FBD : 2m



$2mg = T$

FBD m:



$3mg = kx$

$x = \frac{3mg}{k}$

b)

if System is in equilibrium and string is cut as shown in the figure then find acceleration of both block just after cutting the string?

(i) if string and Spring is cut then Simply remove the String or Spring

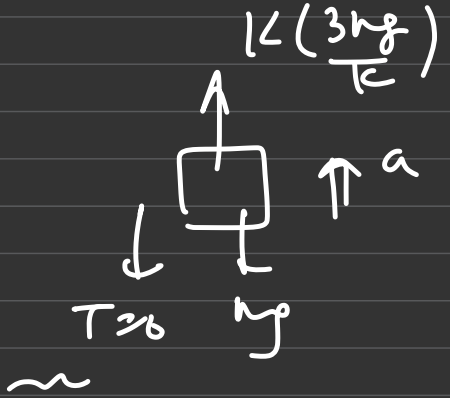
(ii) Draw FBD and calculate accelerations

(iii) Spring force does not change just after cutting

(a)

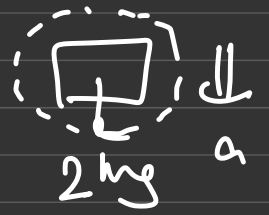
String or Spring

b) String force may change



$3mg - mg = ma$

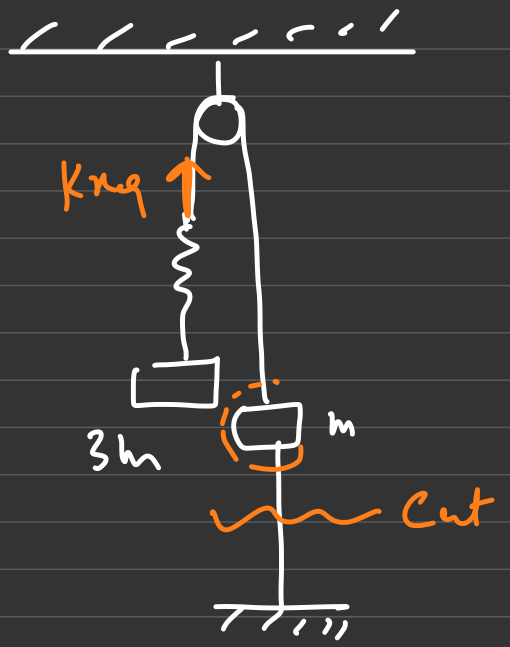
$a = 2g \uparrow$



$2mg = 2ma \downarrow$

$a = g \downarrow$

a)

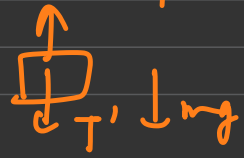


initial System is in equilibrium?

if String is cut as shown in the figure then find acceleration of 3m and m!

① Analysis at equilibrium

$$x_{eq} = \frac{3mg}{K}$$

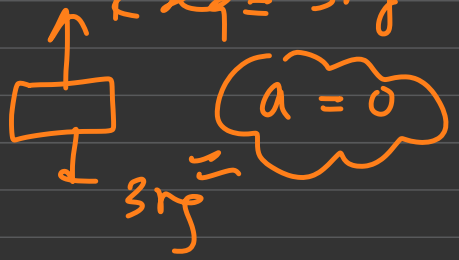


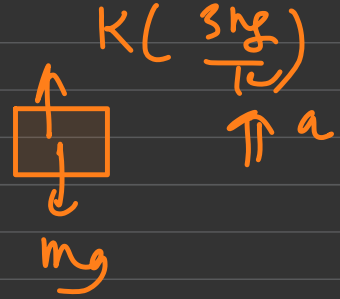
$Kx_2 = T' + mg$

$T' = 3mg - mg$

$T' = 2mg$

(ii) Analysis just after cutting $3mg$



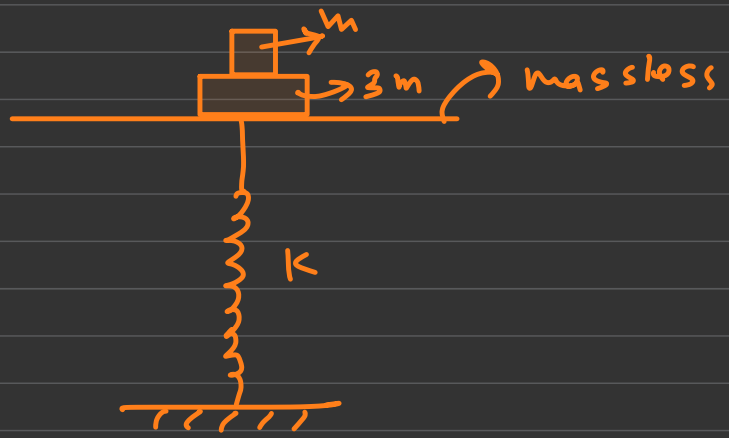


$a = \frac{3mg - mg}{m}$

$a = 2g\uparrow$

(iii) just after cutting the string system is at rest ($v = 0$)

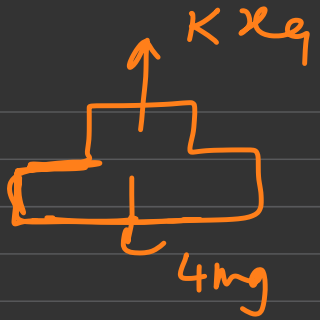
a)



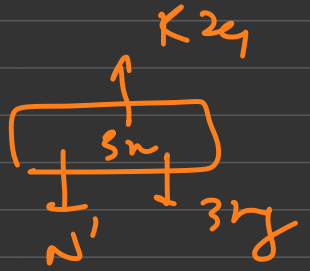
initial system is at equilibrium?

find acceleration of 3m just after removing m.

Equilibrium:



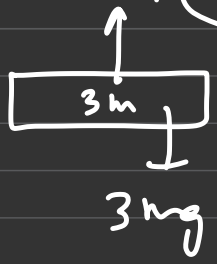
$$4mg = Kx_{eq} \quad -(1)$$



if we remove 'n' 'at rest'

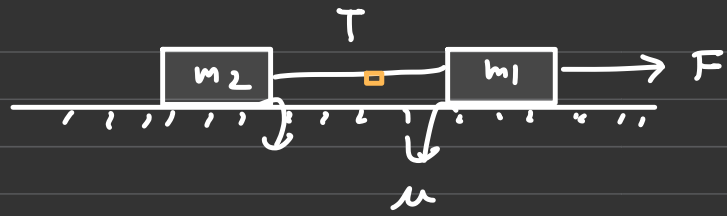
$$4mg - 3mg = 3x_{eq}$$

$$K(x_{eq}) = k\left(\frac{4mg}{k}\right) \Uparrow \quad a = \frac{2g}{3m}$$



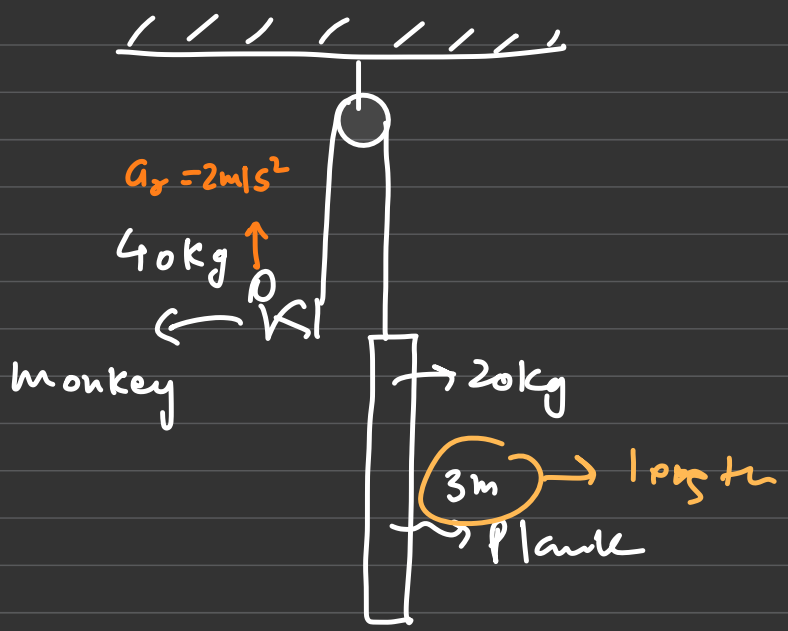
① Homework #1

F ↑



$T(F) =$ { }

(2)



a_r = relative acceleration of monkey w.r.t rope is $2 m/s^2 \uparrow$

then find

(i) acceleration of monkey and plank w.r.t ground

(ii) find time after which monkey reaches bottom of plank?