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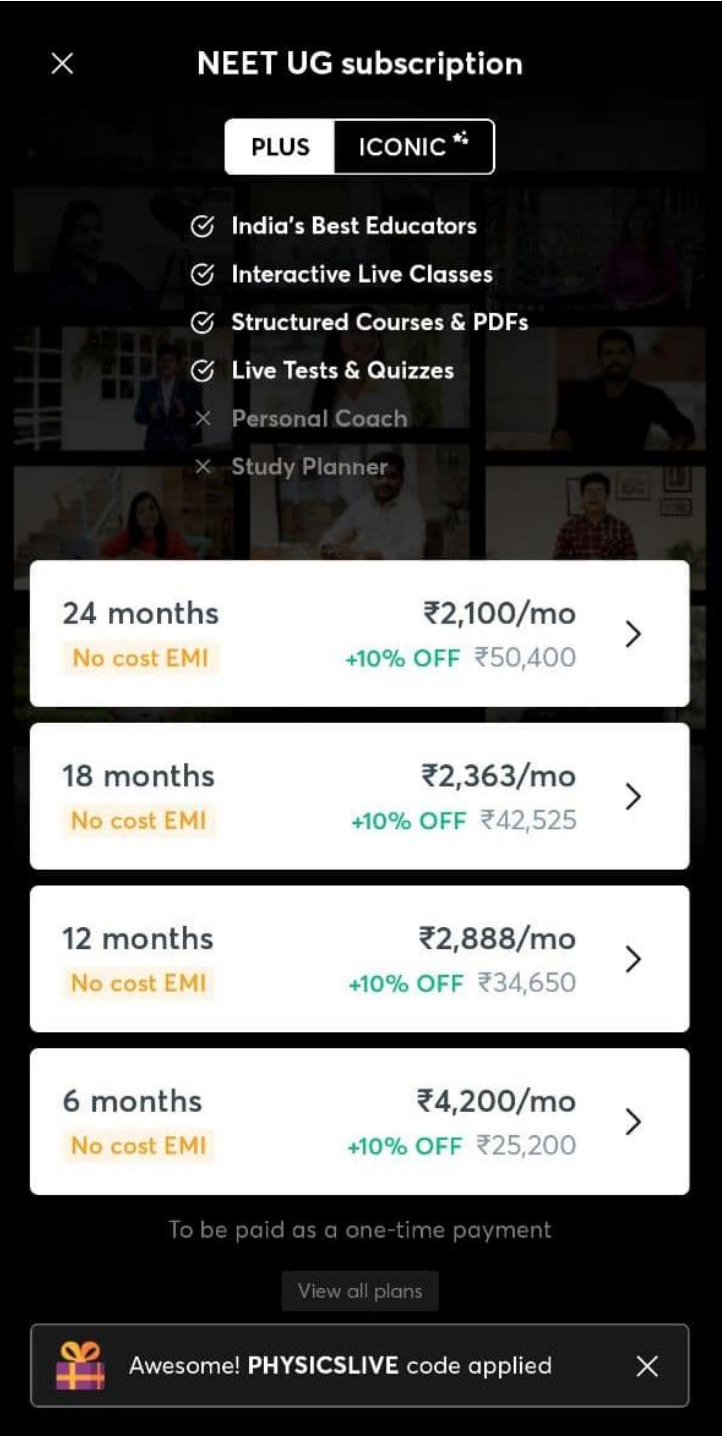

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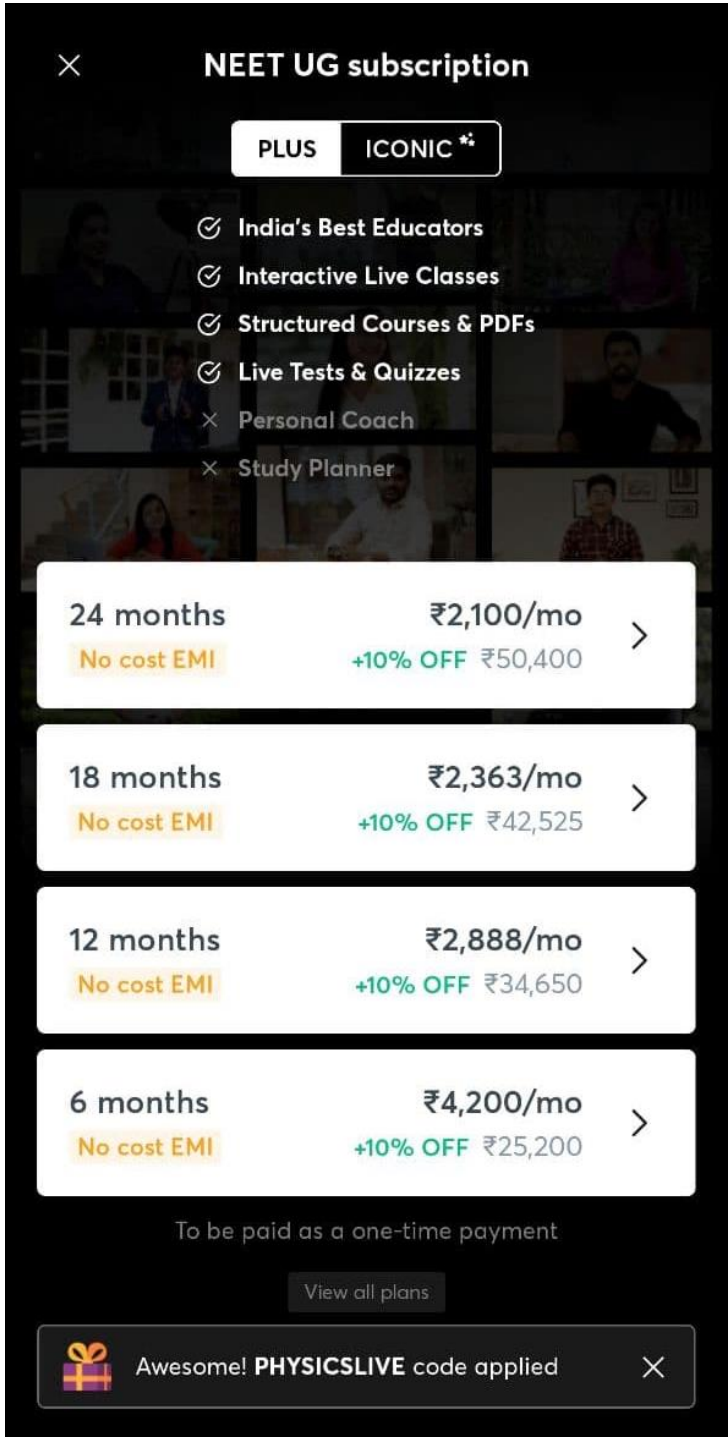

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Physics DPP

DPP-5 NLM: Spring Force

By Physicsaholics Team

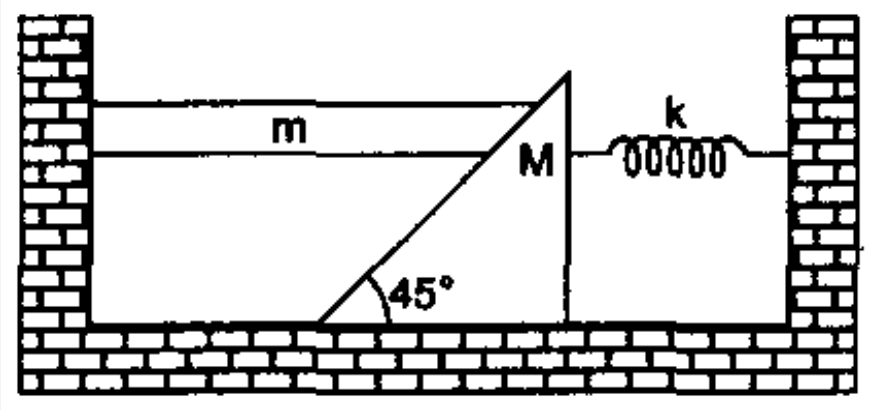
Q) All surfaces shown in figure are smooth. System is released with the spring unstretched. In equilibrium, compression in the spring will be:

(a) $\frac{mg}{\sqrt{2}k}$

(b) $\frac{2mg}{k}$

(c) $\frac{(M+m)g}{\sqrt{2}k}$

(d) $\frac{mg}{k}$

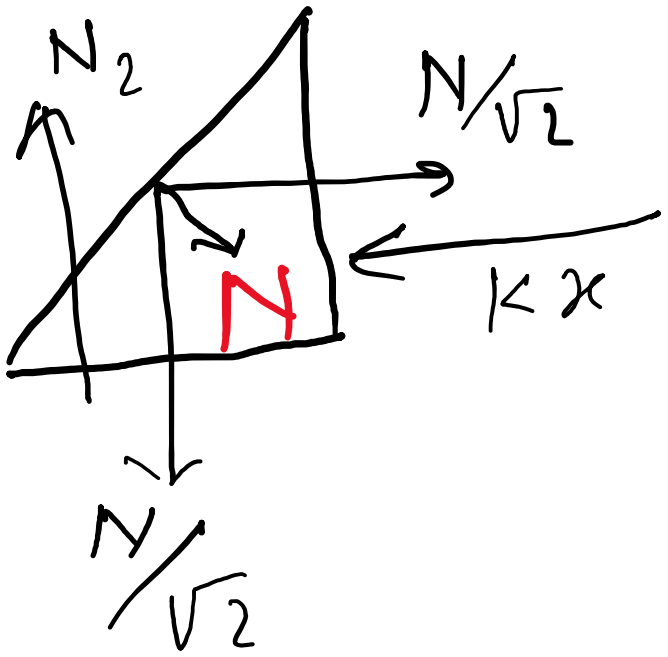


Ans. d

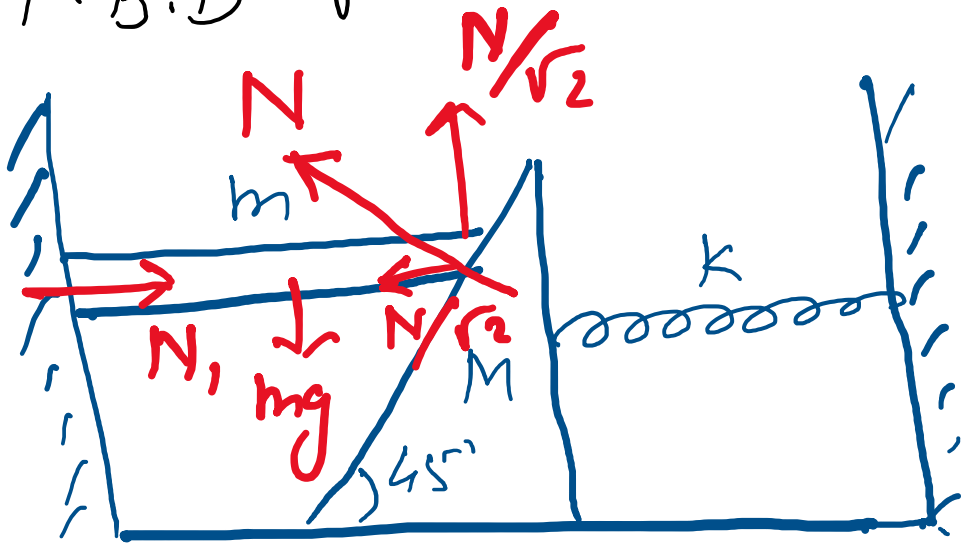
Solution: From F.B.D of Rod

$$\frac{N}{\sqrt{2}} = mg \quad \text{--- (1)}$$

F.B.D of Prism →



F.B.D of rod →



$$\frac{N}{\sqrt{2}} = kx$$

$$\Rightarrow kx = mg$$

$$\Rightarrow x = mg/k$$

(d)

Q) The system shown in figure is released from rest. The spring gets elongated

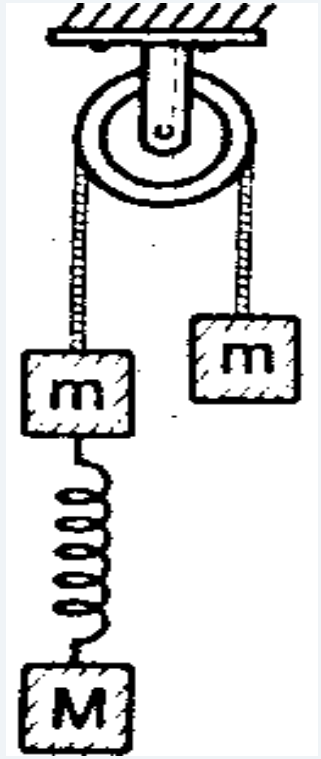
(a) if M > m

(b) if M > 2m

(c) if M > m/2

(d) for any value of M

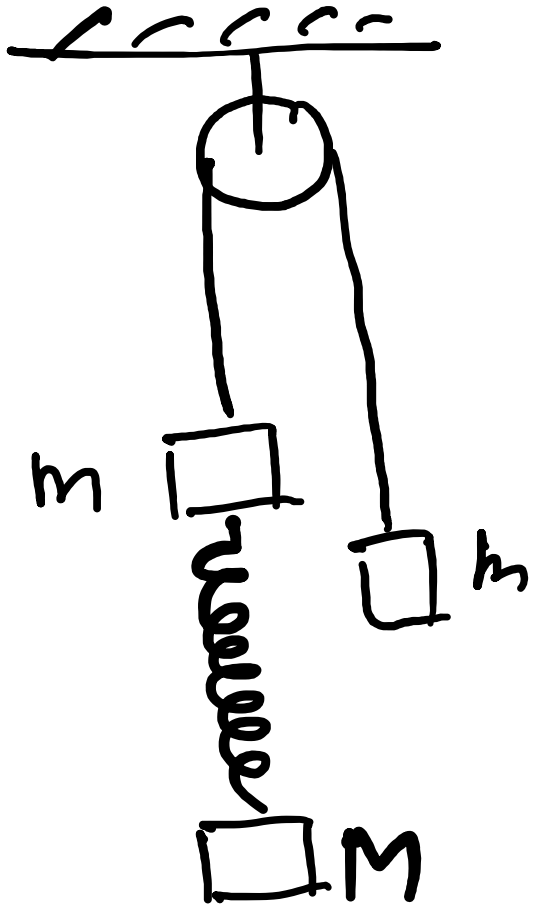
(Neglect friction and masses of pulley, string and spring)



Ans. d

Solution: In the absence of spring M will fall freely and m will remain at rest.

⇒ Whatever be the value of M. spring will elongate if it is present



(D)

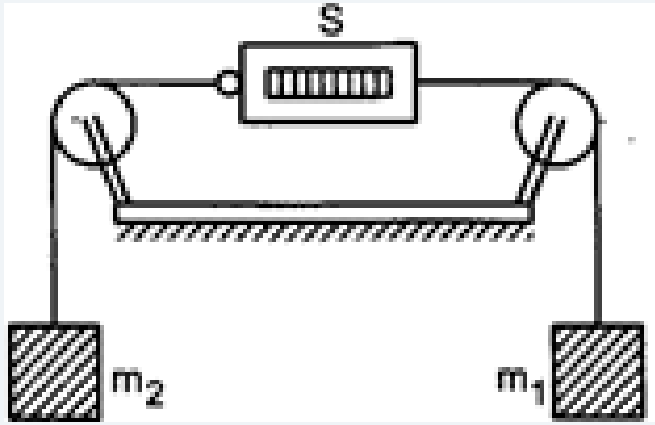
Q) In the arrangement shown, the pulleys are fixed and ideal, the strings are light, $m_1 > m_2$, and S is a spring balance which is itself massless. The reading of S (in units of mass) is

(a) $m_1 - m_2$

(b) $(m_1 + m_2)/2$

(c) $\frac{m_1 m_2}{m_1 + m_2}$

(d) $\frac{2m_1 m_2}{m_1 + m_2}$



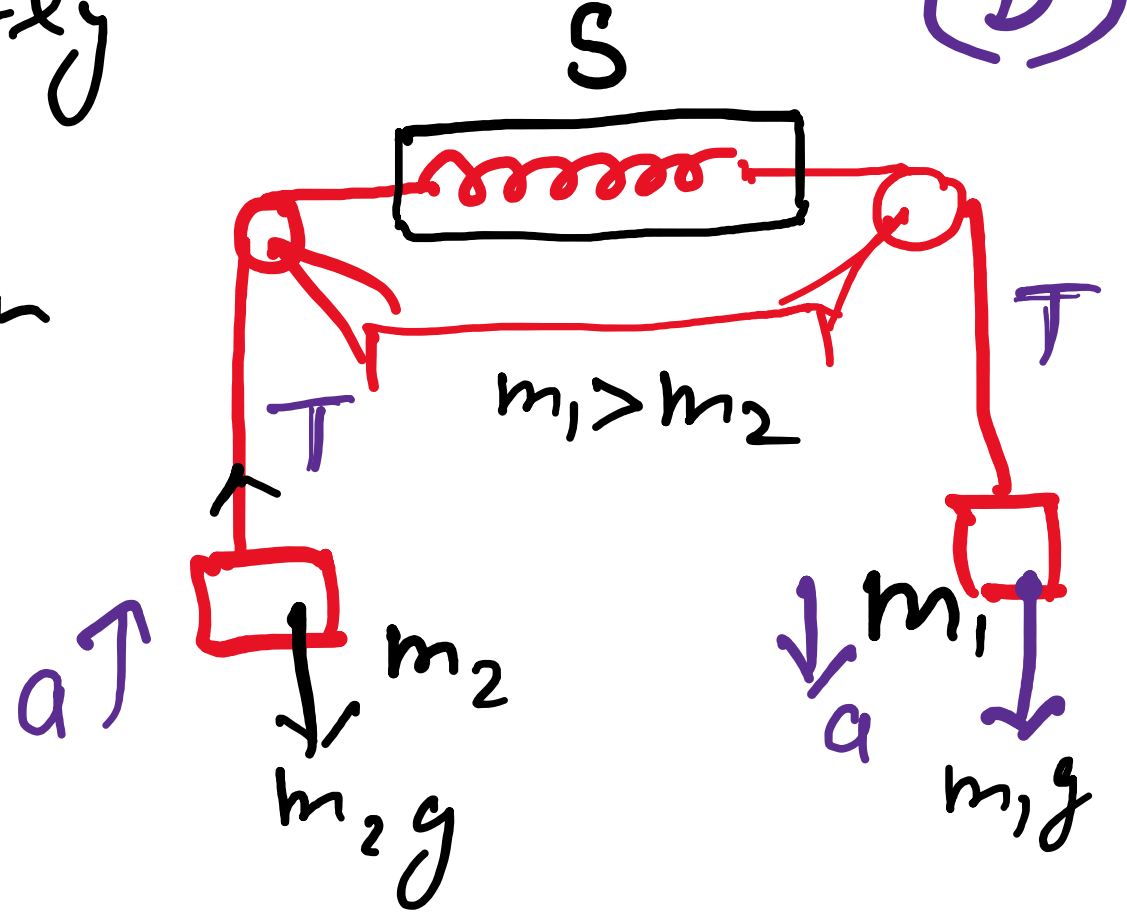
Ans. d

(D)

Solution:

When spring is directly Connected with string

Spring force = Tension



$$m_1 g - T = m_1 a$$

$$T - m_2 g = m_2 a$$

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

$$\Rightarrow \quad T = \frac{2 m_1 m_2}{m_1 + m_2} g \Rightarrow$$

Reading of spring ballance $= \frac{2 m_1 m_2}{m_1 + m_2} g$

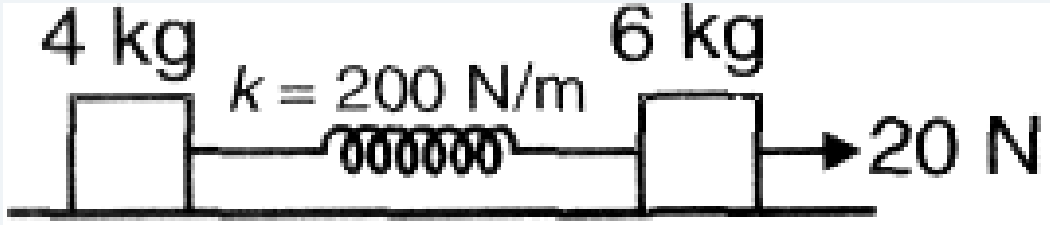
Q) Two blocks of mass 4 kg and 6 kg are attached by a spring of spring constant k = 200 N/m, both blocks are moving with same acceleration. Find elongation in spring

(a) 4 cm

(b) 10 cm

(c) 6 cm

(d) 2 cm

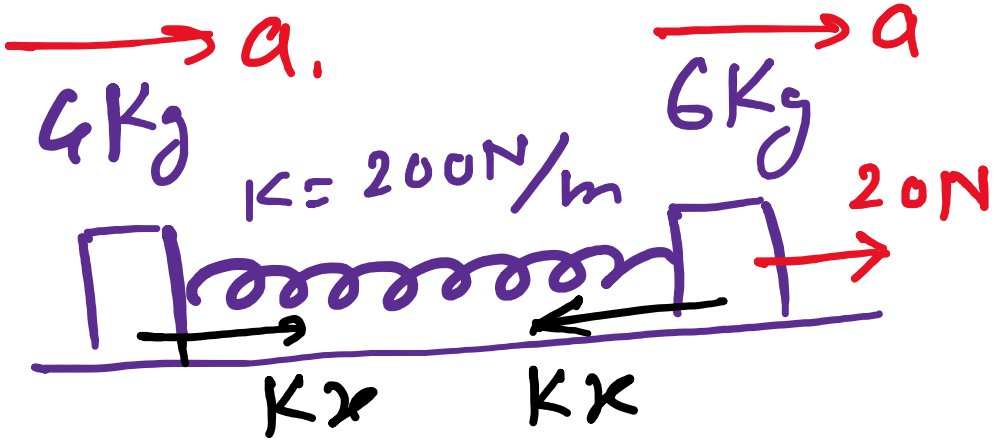


Ans. a

Solution:

$a \rightarrow$ acceleration of each block.

$x \rightarrow$ elongation in spring



$$20 - Kx = 6a$$

$$Kx = 4a$$

$$20 = 10a$$

$$a = 2\ m/Sec^2$$

$$\Rightarrow \quad x = \frac{4 \times 2}{200}$$

$$= .04\ m$$

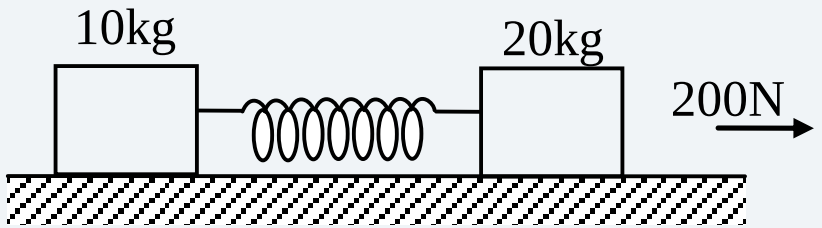
$$= 4\ cm$$

(A)

Q) The masses of 10 kg and 20 kg respectively are connected by massless spring as shown in the figure. A force of 200 N acts on the 20kg mass. At the instant shown, the 10 kg mass has acceleration of 12 m/S^2. What is the acceleration of 20 kg mass ?

(a) 12 m/S^2 (b) 4 m/S^2

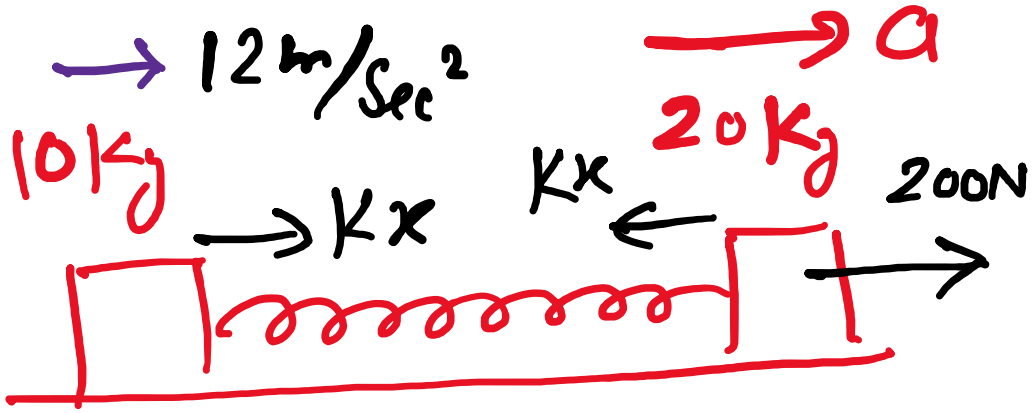
(c) 10 m/S^2 (d) zero



Ans. b

Solution:

from F.B.D of 10Kg block



$$Kx = 10 \times 12$$

$$= 120\,N$$

from F.B.D of 20Kg block

$$200 - Kx = 20a$$

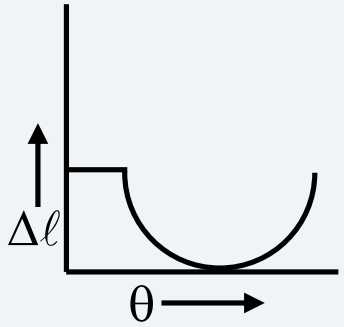
$$\Rightarrow \quad 200 - 120 = 20a \quad \Rightarrow \quad 20a = 80$$

$$\Rightarrow \quad a = 4\,m/Sec^2$$

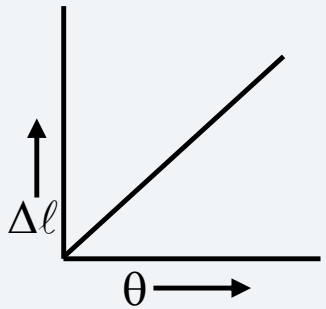
(B)

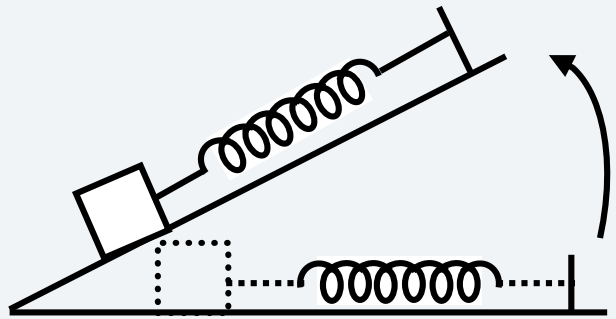
Q) A body is placed on a frictionless horizontal plane. The body is connected with an elastic spring which is initially unstretched. The plane is then gradually lifted from 0^o to 90^o then the curve between extension of spring $\Delta\ell$ and angle of inclination θ is–

(a)

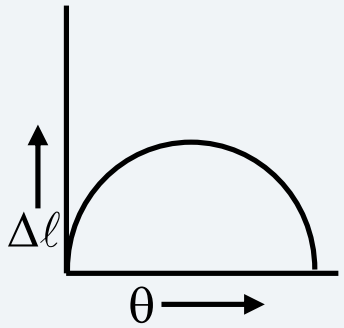


(b)

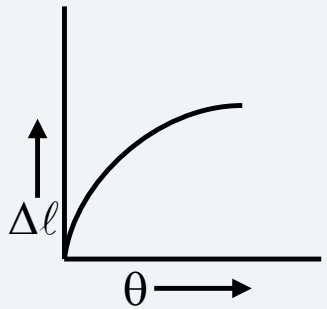




(c)



(d)



Ans. d

Solution:

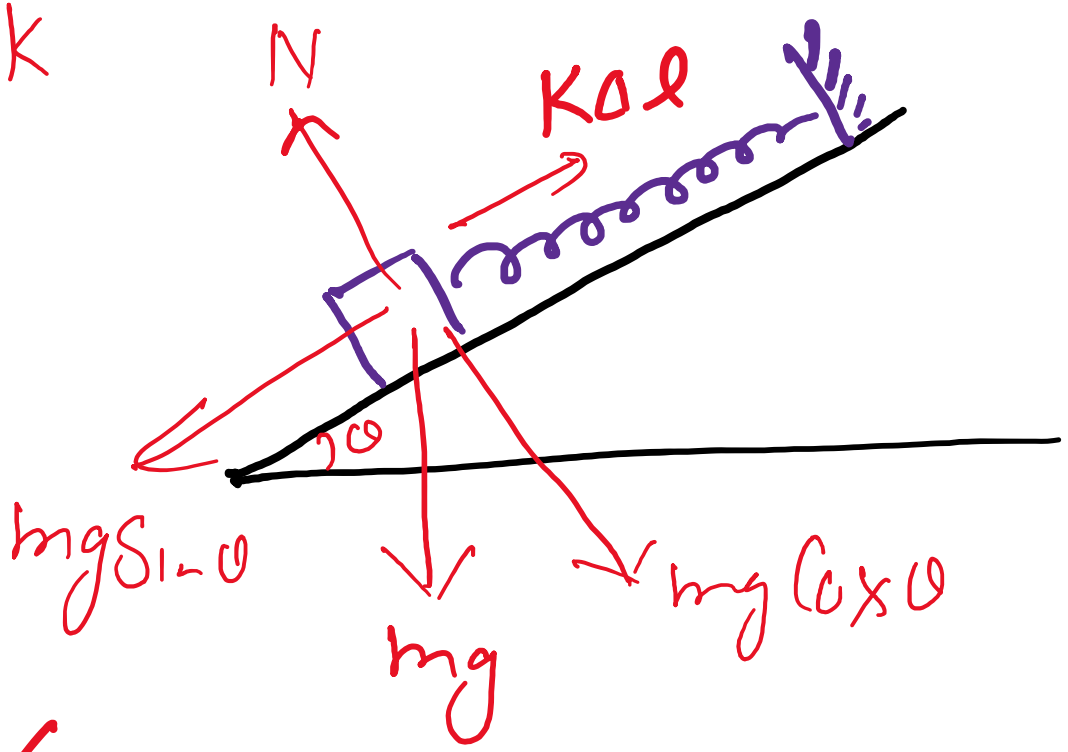
from F.B.D. of block

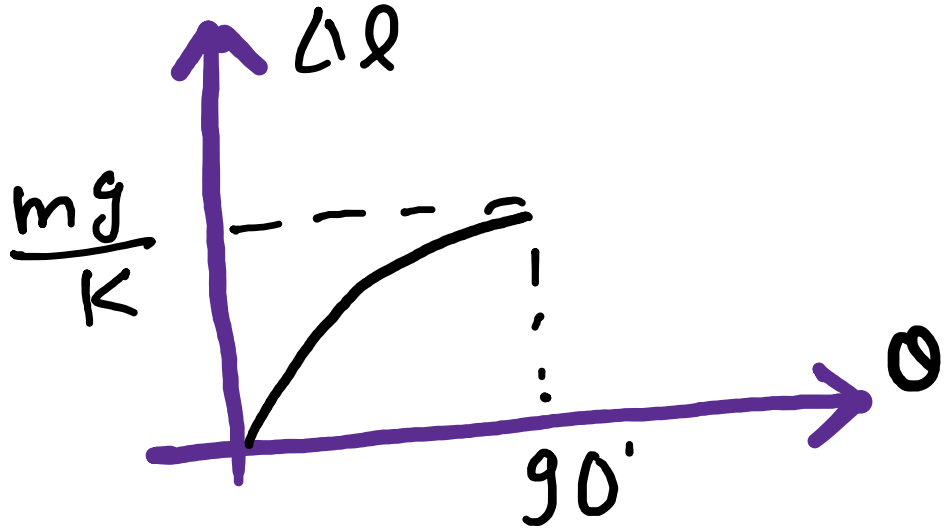
$$mg\sin\theta = k\,\Delta\ell$$

$$\Rightarrow \Delta\ell = \frac{mg}{k}\sin\theta$$

at $\theta = 0$, $\Delta\ell = 0$

at $\theta = 90^\circ$, $\Delta\ell = mg/k$





Q) A spring of force constant k is cut into two pieces such that one piece is double the length of other. Then long piece will have force constant of

(a) 2K/3

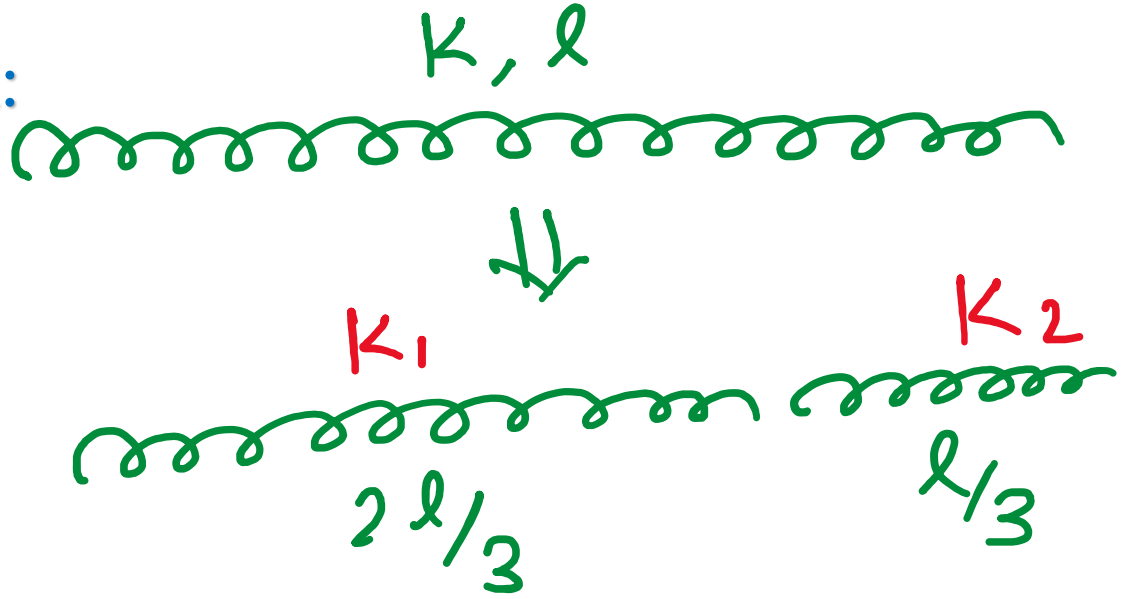
(b) 3K/2

(c) 3K

(d) 6K

Ans. b

Solution:



$$K_1 = \frac{K\ell}{2\ell/3} = \frac{3K}{2}$$

Spring Constant of part of a spring

$$K' = \frac{K\ell_0}{\ell}$$

$\ell_0 \rightarrow$ initial length

$\ell \rightarrow$ length of part

(B)

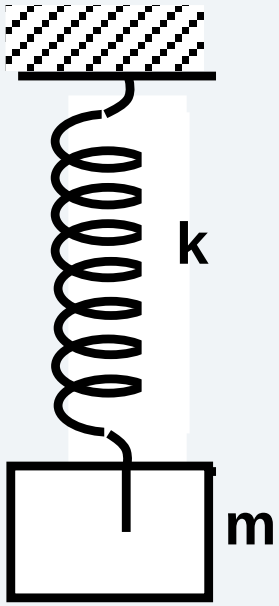
Q) The spring mass system shown in the figure is in equilibrium. If the mass m is pulled down by a distance mg/3k and released, its instantaneous acceleration will be

(a) g/3 upward

(b) 2g/3 downward

(c) g/3 downward

(d) 2g/3 upward



Ans. a

Solution:

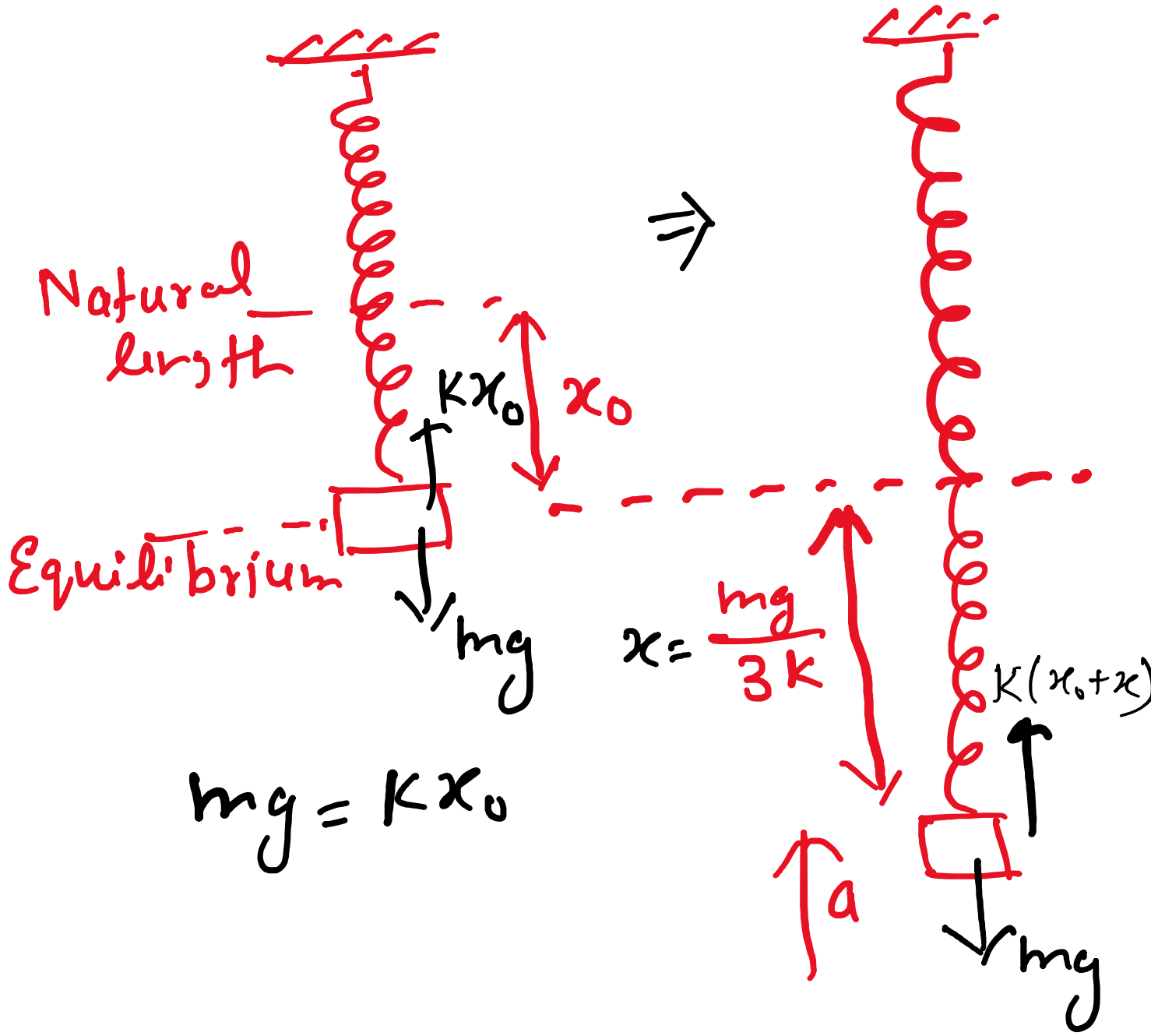
After displacing block

$$kx_0 + kx - mg = ma$$

$$a = \frac{kx}{m}$$

$$= \frac{mg}{3m} = \frac{g}{3}\uparrow$$

(A)



Q) A spring of stiffness k is devided in to 10 equal parts and all parts are connected in parallel . Stiffness of combination is

(a) K

(b) 100k

(c) 10k

(d) k/10

Ans. b

Solution:

natural length of original spring = ℓ

" " " one part = $\ell/10$

spring Constant of one part = $\frac{K \times \ell}{\ell/10}$

$= 10K$

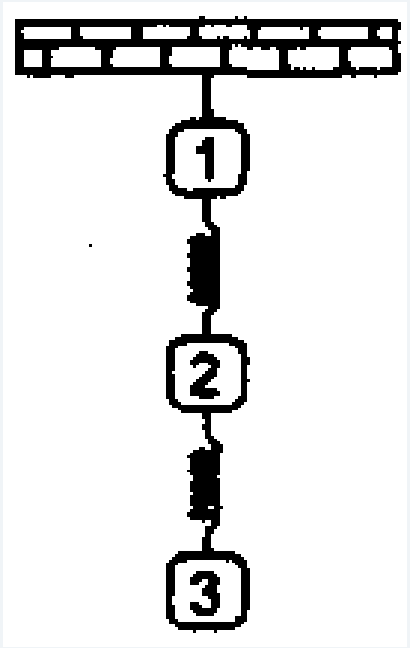
Stiffness of parallel Combination

$K_{eff} = 10K + 10K + 10K + \cdots$ 10 times

$= 100K$

(b)

Q) Three identical blocks are suspended on two identical springs one below the other as shown in figure. If thread is cut that supports block 1, then initially



(a) the second ball falls with zero acceleration

(b) the first ball fails with maximum acceleration

(c) both (a) and (b) are wrong

(d) both (a) and (b) are correct

Ans. d

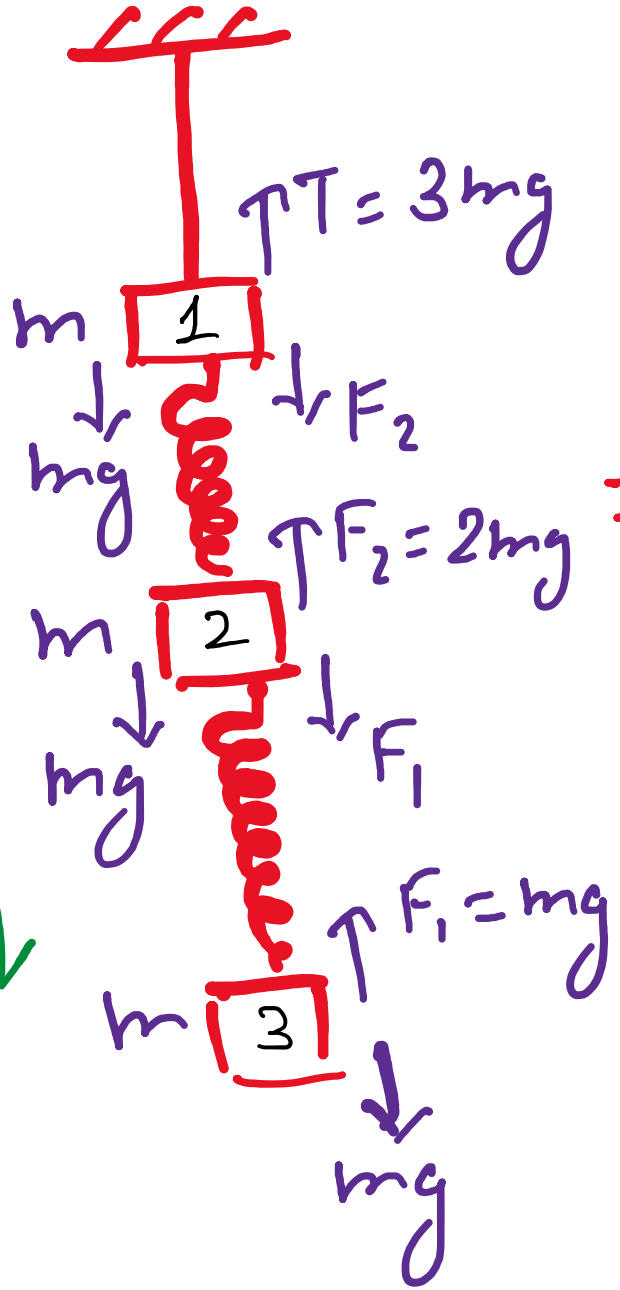
Solution:

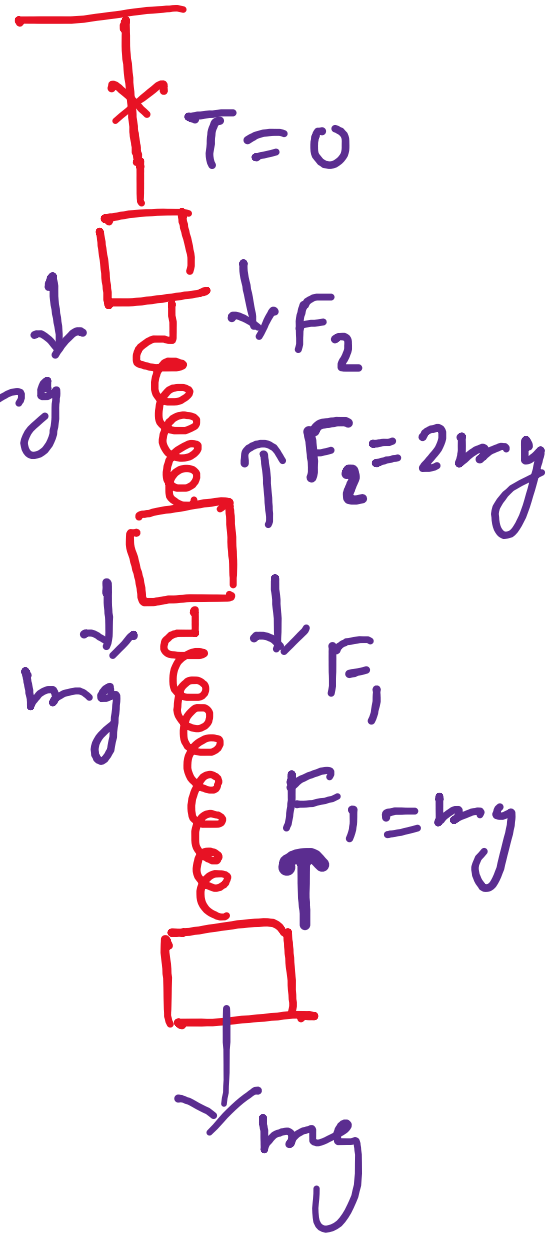
Just after cutting the string. Tension becomes zero but other forces remains unchanged.

$\Rightarrow a_2 = a_3 = 0$

& $a_1 = \dfrac{mg + F_2}{m} = 3g\downarrow$

(D)





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