Time left 1:10:06

Question 5

Not yet answered

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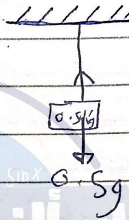
A 0.5 kg mass attached to the end of a string swings (تتأرجح) in a vertical circle of radius 2 m. When the mass is at the lowest point on the circle, the speed of the mass is 12 m/s. The magnitude of the tension force in the string at that moment is:

A. 31.5 N
B. 36.7 N
C. 56.2 N
D. 40.9 N
E. 23.7 N

$m = 0.5\ Kg$

$r = 2\ m$

$v = 12\ m/s$



$$\Sigma F_n = \frac{mv^2}{r} = \frac{0.5(12)^2}{2} = 36\ N$$

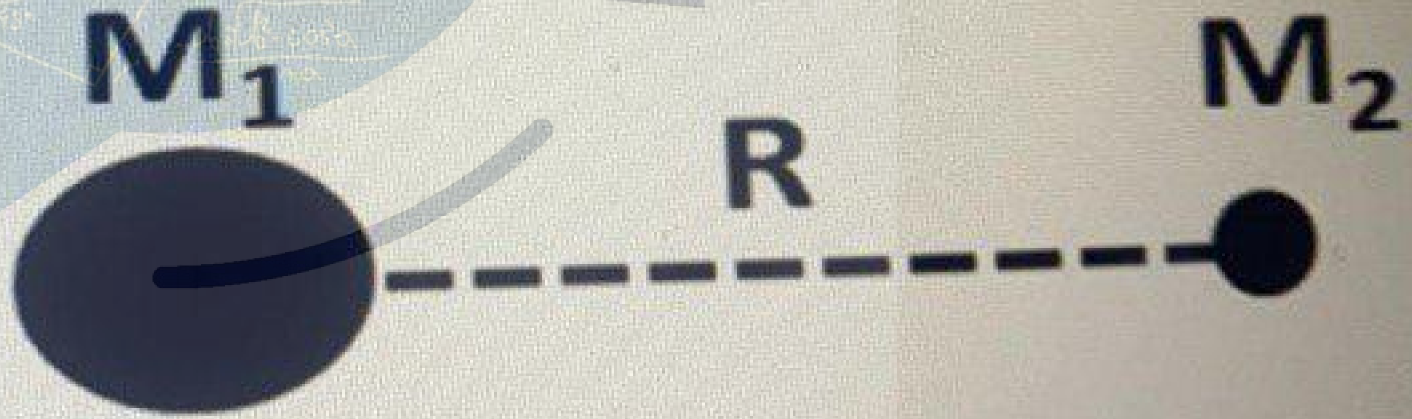
$$\Sigma F_n = T - 0.5g$$

$$36 = T - 0.5g$$

$$T = 40.9\ N$$

Far from any other planet (كوكب), two masses M_1 and M_2 are separated by a distance R, as shown in the figure below.

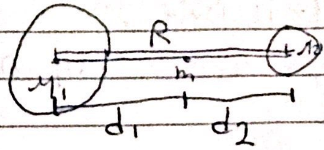
If $M_1 = 10\ M_2$, then, the distance d (measured from M_1) where a point-like particle of mass m can be placed in between M_1 and M_2 such that it experiences zero gravitational force is:



A. 0.33 R
B. 0.50 R
C. 0.85 R
D. 0.76 R
E. 0.15 R

$M_1 = 10\,M_2$

$d_1 + d_2 = R$



$\Sigma F_{Particle} = 0$, so it experiences zero gravitational force.

$$\Sigma F_{Particle} = \frac{G m M_1}{(d_1)^2} - \frac{G m M_2}{(d_2)^2}$$

$$0 = \frac{G m M_1}{d_1^2} - \frac{G m M_2}{d_2^2}$$

$$\frac{\cancel{G m} M_2}{d_2^2} = \frac{\cancel{G m} M_1}{d_1^2}$$, we substitute $M_1 = 10 M_2$

$$\frac{\cancel{M_2}}{d_2^2} = \frac{10 \cancel{M_2}}{d_1^2}$$, we substitute $d_2 = R - d_1$, because we need to find the distance between M_1 and the particle (d_1 in terms of R)

$$10(R-d_1)^2 = d_1^2$$

$$10R^2 - 20Rd_1 + \cancel{10}\,9\,d_1^2 = \cancel{d_1^2}$$ ← You can use calculator to find d_1, or:

$$d_1 = \frac{-(-20R) \mp \sqrt{(-20R)^2 - 4(10)(9)(R^2)}}{2(9)}$$

$$= \frac{20R \mp \sqrt{40R^2}}{18} = \frac{10R}{9} \mp \frac{2\sqrt{10}\,R}{\cancel{18}\;9}$$

$$d_1 = \frac{10 + \sqrt{10}}{9} R \quad \text{OR} \quad \boxed{\frac{10 - \sqrt{10}}{9} R}$$

Wrong because $R > d_1$ This is correct.

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A car of mass 1500 Kg can accelerate from rest to a speed of 20 m/s in a time of 10 sec. Ignoring friction losses, what average power must the motor produce in order to cause this acceleration?

A. 15 kW
B. 20 kW
C. 25 kW
D. 30 kW
E. 35 kW

$M = 1500\ Kg$

$V_f = 20\ m/s\ ,\ v_i = 0$

$t = 10s$

$$Acceleration = \frac{20-0}{10} = 2\ m/s$$

$$F = ma$$
$$= (1500)(2) = 3000\ N$$

$$W = Fd \rightarrow d = \frac{1}{2} a t^2 = \frac{1}{2}(2)(10)^2 = 100 \text{ meters}$$
$$= (3000)(100) = 300\,000\ J$$

$$P = \frac{W}{t} = \frac{300\,000}{10} = 30\,000\ W = \boxed{30\ KW}$$

Question 10

Not yet answered

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A mass $M = 50$ Kg is hung (معلقة) using three wires as shown in the figure below. If $\theta_1 = \theta_2 = 60^0$, the tension T_3 is:

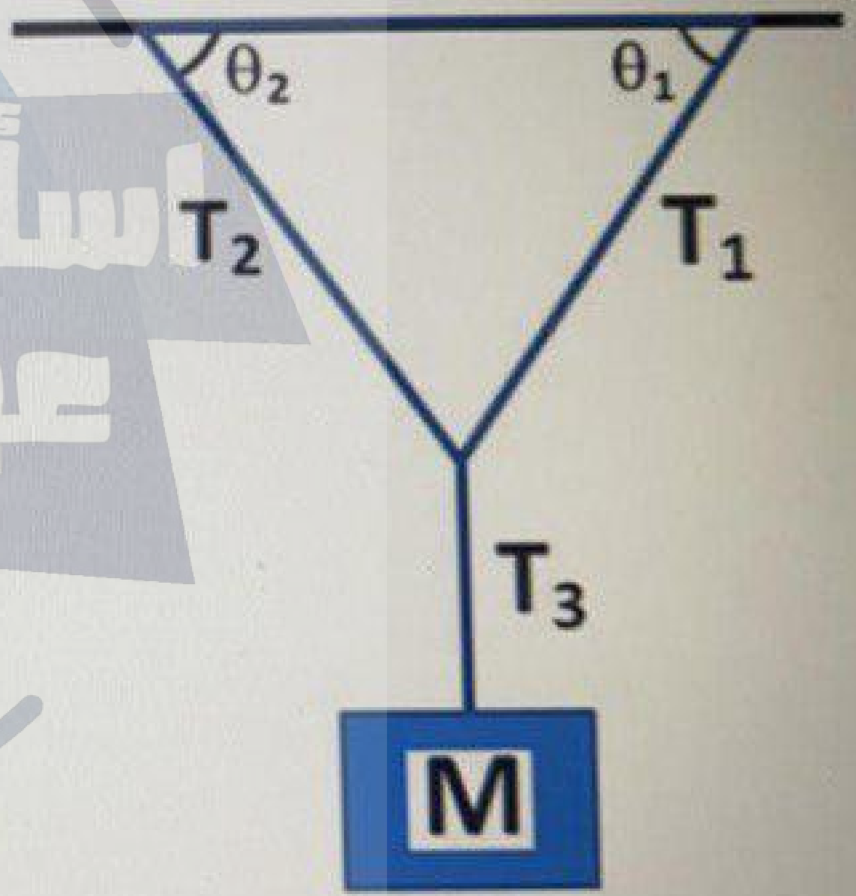
A. 100 N

B. 250 N

C. 325 N

D. 490 N

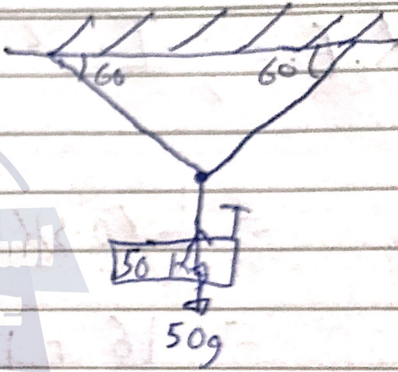
E. 510 N



$\Sigma F_y = 0$

$\Sigma F_y = T - 50g$

$T = 50g = 490N$



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Two masses $M_1 = 2$ kg and $M_2 = 4$ kg are attached by a rigid rod of negligible mass (ذو كتلة مهملة). The rod rotates in the horizontal plane about an axle that passes through o as shown in the adjacent figure with an angular speed of 8 rad/s. If M_1 is at a distance 0.5 m from o and M_2 is at a distance 1 m from o, the rotational kinetic energy (in J) of the entire setup is:

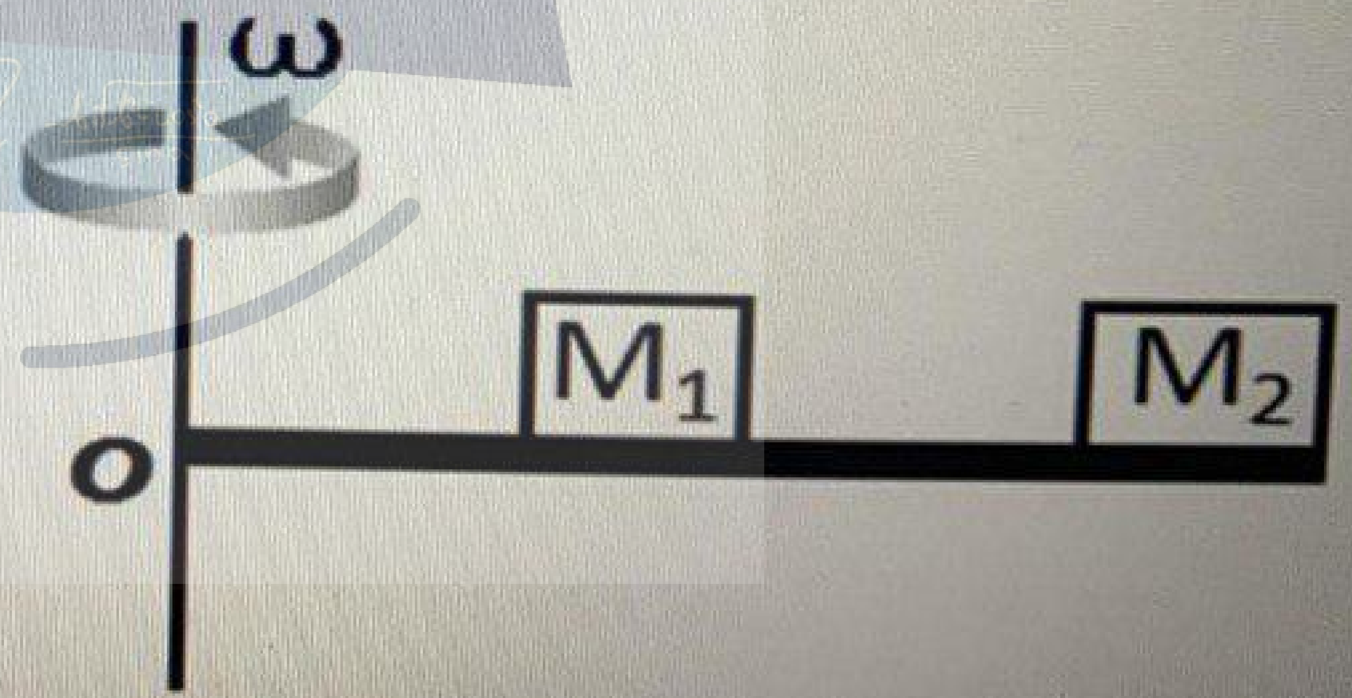
A. 250

B. 100

C. 177

D. 144

E. 312



$$K.E. = \frac{1}{2} I \omega^2$$

$$I_1 = m r^2 = 2(0.5)^2 = 0.5$$

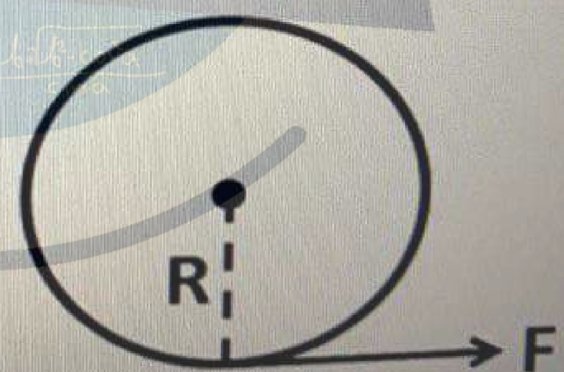
$$I_2 = 4(1)^2 = 4$$

$$= \frac{1}{2}(0.5)(8)^2 + \frac{1}{2}(4)(8)^2$$

$$= 16 + 128 = 144 \text{ J}$$

A disk of radius R = 25 cm is mounted in the horizontal plane and can rotate around a fixed axis that passes through its center and perpendicular to its surface. A force F = 150 N is applied tangentially as shown in the adjacent figure. If the moment of inertia of the disk about the rotation axis is 0.5 kg.m^2, the magnitude (in rad/sec^2) of the angular acceleration of the disk is:

A. 10
B. 75
C. 50
D. 25
E. 100



$R = 25 \text{ cm}$

$F = 150 \text{ N}$

$I = 0{,}5 \text{ Kg.m}^2$

$\tau = F R = 150(25 \times 10^{-2}) = 37.5 \text{ N.m}$

$\tau = I \alpha$

$37.5 = 0{,}5 \ \alpha$

$\alpha = \dfrac{37.5}{0{,}5} = \boxed{75 \text{ rad/sec}^2}$

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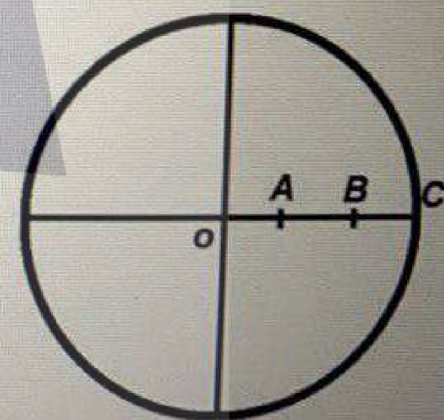
The disk in the adjacent figure rotates (يدور) with an angular speed ω about an axle (محور) passing through point *o* and perpendicular (عمودي) to the plane of the disk. If *ω*, *α* and *V* represent the angular speed, angular acceleration and linear speed, respectively (على التوالي), then which of the following statements is entirely (كلياً) correct:



A. $V_A = V_B = V_C$ and $\omega_A > \omega_B > \omega_C$

B. $\omega_A = \omega_B = \omega_C$ and $\alpha_A = \alpha_B = \alpha_C$

C. $V_A > V_B > V_C$ and $\omega_A = \omega_B = \omega_C$

D. $\alpha_A > \alpha_B > \alpha_C$ and $V_A = V_B = V_C$

E. $\omega_A = \omega_B = \omega_C$ and $V_A = V_B = V_C$

* عندما تدور الاجسام حول محور ثابت أو نقطة ثابتة جميع

النقاط على هذا المحور سوف تتحرك بمسار دائري

وسوف تكون ← angular velocity ← متساوية لجميع النقاط

الواقعة على هذا المحور أما بالنسبة لِـ (velocity)

فهي تزداد كلما زاد نصف القطر حسب المعادلة

التالية :-

$$\boxed{V = r\omega}$$

$\Longrightarrow V_c > V_B > V_a$

$\rightarrow \omega_c = \omega_B = \omega_a$

$\rightarrow \alpha_c = \alpha_B = \alpha_a$

$\Longrightarrow$ answer is B

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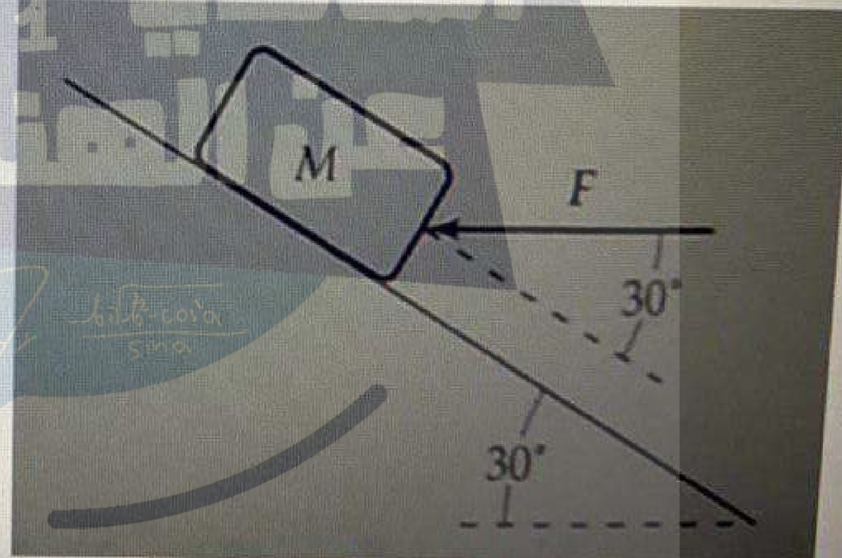
A block is pushed up a frictionless 30^0 incline (سطح مائل) by an applied force (F) as shown in the figure below. If F = 25 N and M = 3 kg, what is the magnitude of the resulting acceleration of the block?



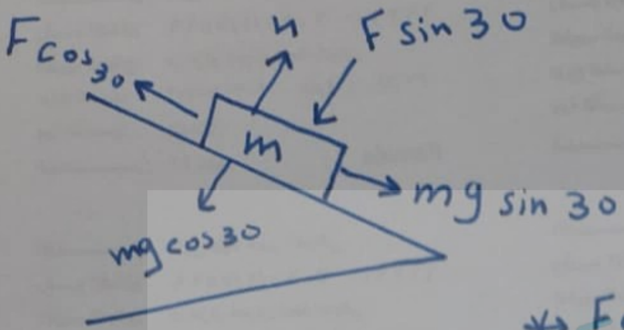
A. 2.3 m/s^2

B. 4.6 m/s^2

C. 3.5 m/s^2

D. 7.9 m/s^2

E. 9.8 m/s^2



$$\sum F = ma$$

* For y axis :-

$$\sum F = m a_y$$

$$n - F \sin 30 - mg \cos 30 = 0 = m a_y$$

$$m a_y = 0 \rightarrow \boxed{a_y = 0}$$

For x-axis :- $\sum F = m a_x$

$$F \cos 30 - mg \sin 30 = m a_x$$

$$25 * \frac{\sqrt{3}}{2} - 3 * 9.8 * \frac{1}{2} = 3 a_x$$

$$7 = 3 a_x$$

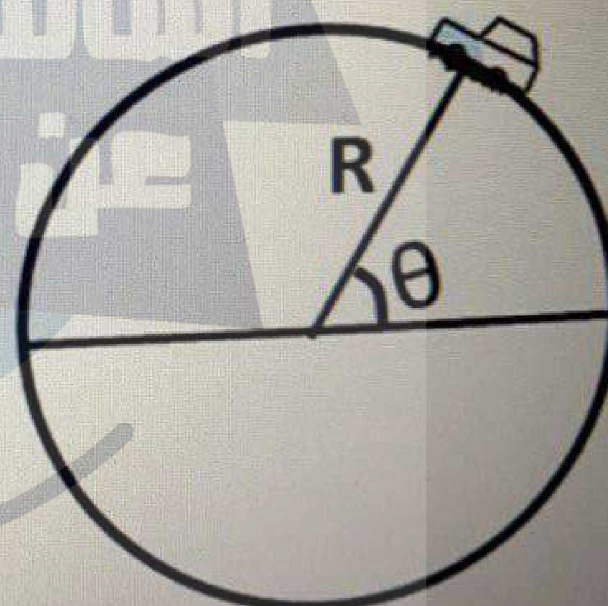
$$\boxed{a_x = 2.3 \ m/s^2}$$

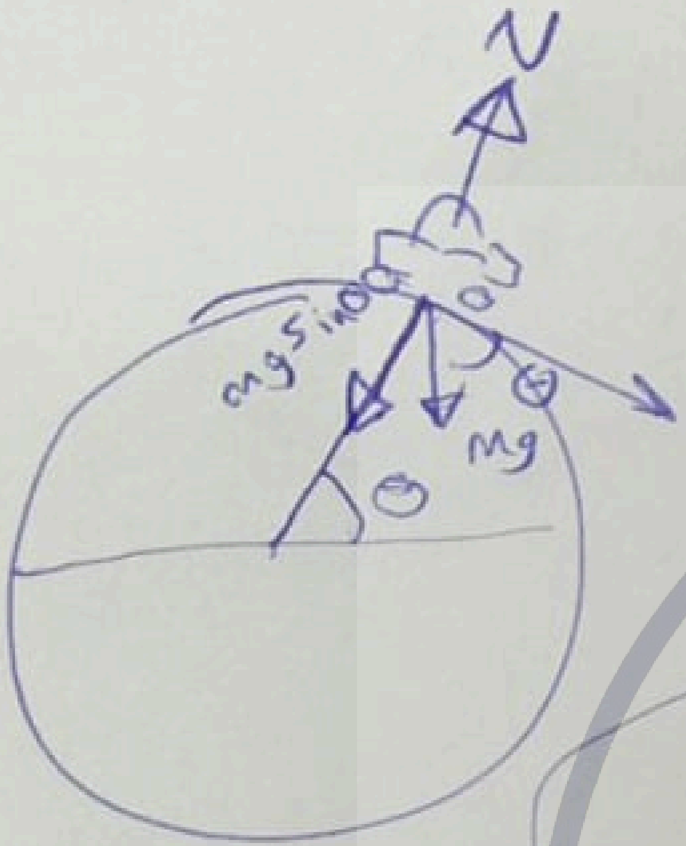
$$|a| = \sqrt{(a_x)^2 + (a_y)^2} = \sqrt{0 + (2.3)^2}$$

$$\rightarrow \boxed{|a| = 2.3 \ m/s^2}$$

A 1000-kg car moving with a speed of 80 km/h goes up a circular section of a road with radius R = 200 m, as shown in the figure below. The normal force (in N) on the car when θ = 60° is:

A. 3015
B. 2430
C. 2670
D. 8490
E. 6018





$$\Sigma F_r = \frac{mv^2}{R}$$

$$\boxed{mg\sin\theta - N = \frac{mv^2}{R}}$$

$$V = \frac{80(1000)}{3600} = 22.22\ m/s$$

$$N = mg\sin\theta - \frac{mv^2}{R}$$

$$= 1000(9.8)\sin 60 - \frac{1000(22.22)^2}{200}$$

$$\boxed{N = 6018\ N}$$

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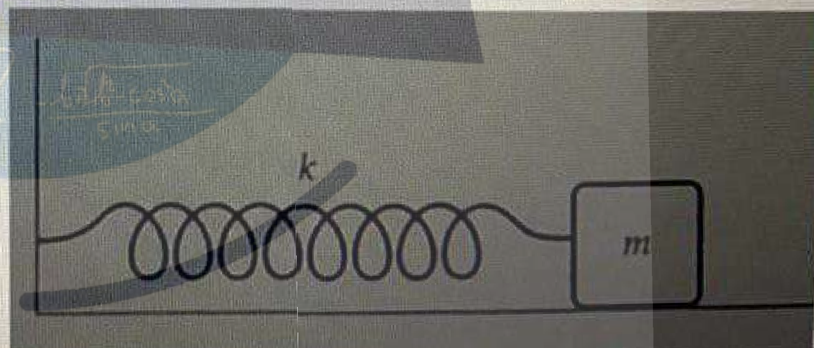
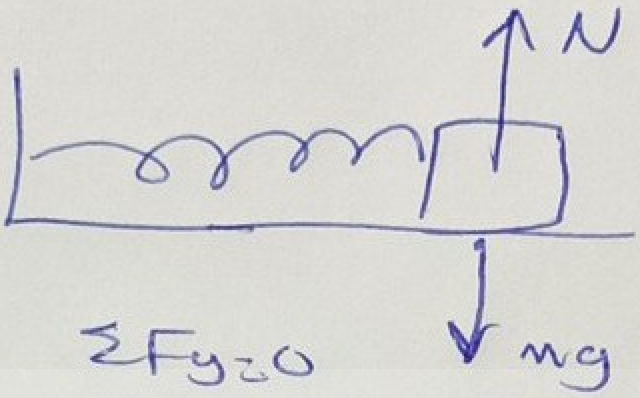
The block shown in the figure below is released from rest when the spring is stretched (ممتد) a distance d.
If k = 50 N/m, m = 0.5 kg, d = 10 cm, and the coefficient of kinetic friction between the block and the horizontal surface is equal to 0.25, determine the speed of the block when it first passes through the position for which the spring is unstretched (غير ممتد).

A. 92.2 cm/s
B. 71.4 cm/s
C. 82.8 cm/s
D. 53.1 cm/s
E. 34.7 cm/s

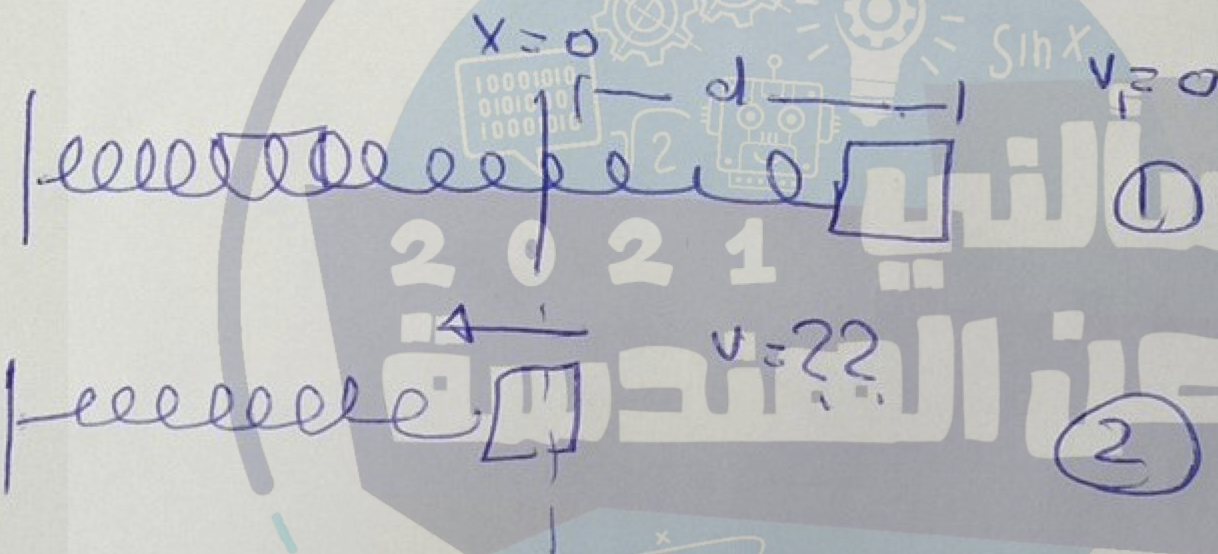




$\Sigma F_y = 0$

$N - mg = 0 \Rightarrow N = 0.5\,(9.8) = \underline{4.9\,N}$

$f_k = \mu N = 0.25\,(4.9) = \underline{1.225\,N}$



$E_1 + W_f = E_2$

$\frac{1}{2} k \Delta x^2 - f_k d = \frac{1}{2} m v_2^2$

$\frac{1}{2}(50)(0.1)^2 - 1.225\,(0.1) = \frac{1}{2}(0.5)\,v_2^2$

$v_2 = 0.714\ m/s = \underline{71.4\ cm/s}$ (B)

Three masses are in contact with each other and lie on a smooth horizontal surface, as shown in the figure below. If $M_1 = 10$ kg, $M_2 = 20$ kg and $M_3 = 20$ kg, and the force $F = 100$ N.

The magnitude of the contact force between M_1 and M_2 is:

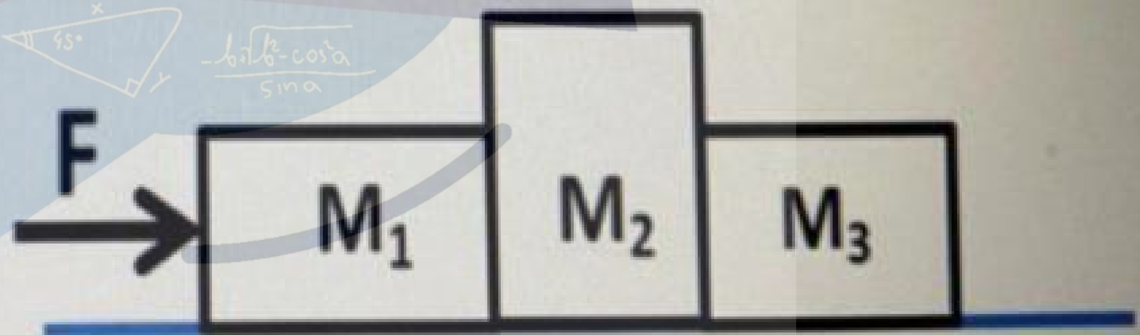
A. 20 N

B. 40 N

C. 60 N

D. 80 N

E. 100 N



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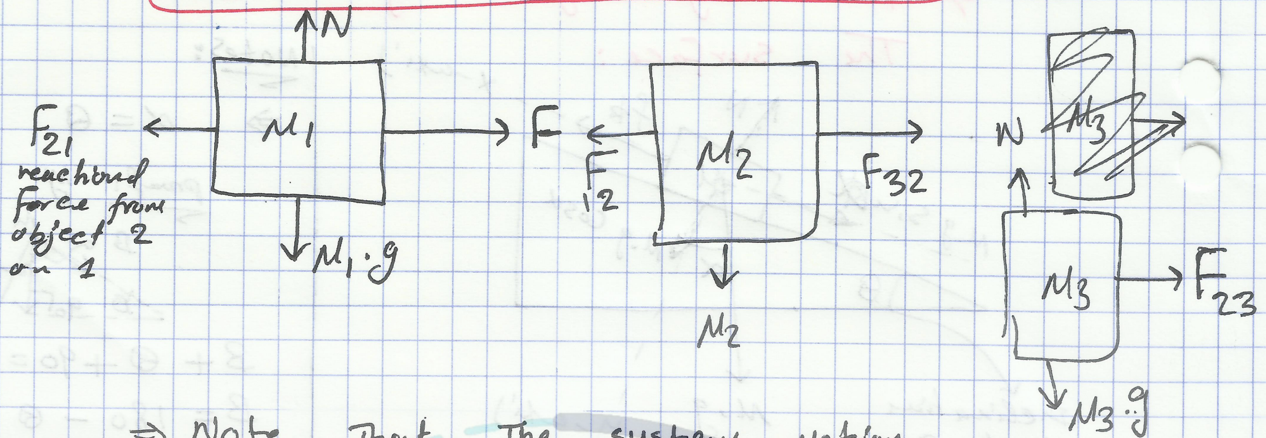
Free body diagram of The system:



⇒ Note That The system Motion is on Horizontal surface so, The System Moves in One direction x-axis which Means ΣF on y-axis For each Mass is zero

⇒ F is given as 100N

⇒ Note That no Energy Losses exist due to (frictional forces are set to zero as The surface is Smooth).

⇒ Now representing The system Mathematically:

* all Masses Moves under Constant Force F creating One system Moves at acceleration a for each Mass.

M_1	M_2	M_3
$F - F_{21} = M_1 \cdot a$	$F_{32} - F_{12} = M_2 \cdot a$	$F_{23} = M_3 \cdot a$
$100 + F_{12} = \frac{10 F_{12}}{-40}$	$-20a - F_{12} = 20kg\,a$	$F_{23} = 20\,a$
$\boxed{\lvert F_{12}\rvert = 80N}$	$F_{12} = -40a$	$F_{23} = +F_{32}$
# ans. D	$\boxed{a = \frac{F_{12}}{-40}}$	$-F_{21} = +F_{12}$
		contact Forces definition

Earth exerts a gravitational force (F_g) on the moon and so the moon moves in a nearly circular orbit of radius R around the earth as shown in the adjacent figure. The work the Earth's gravitational force does on the moon when it moves from point P_1 to point P_2 is:

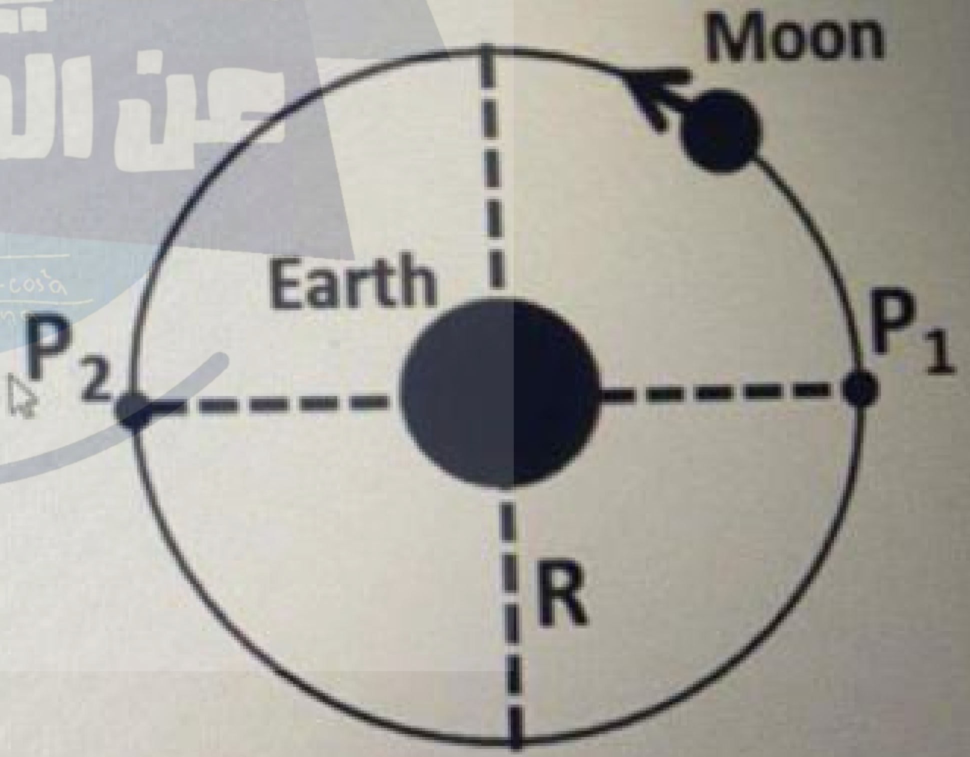
A. $\pi R F_g$

B. $2\pi R F_g$

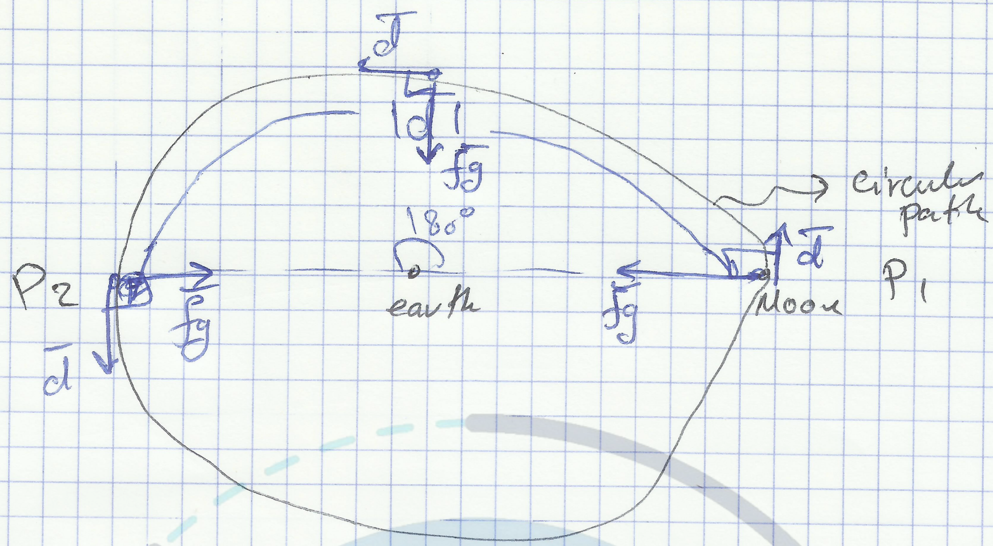
C. $\pi R^2 F_g$

D. $\pi R^2 F_g/2$

E. Zero

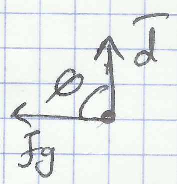


12 free body diagram of The Moon:



$\Rightarrow$ $Work = \bar{f_g} \cdot \bar{d}$ | dot product

$Work = |\bar{f_g}||\bar{d}| \cos(\varphi)$ | $\rightarrow \varphi$ Angle between $\bar{f_g}$ & $\bar{d}$ directions



$\varphi = 90°$

$\Rightarrow$ The path directional vector must be always Tangential to it at Any point in order To form That path Then:

** $\bar{d}$ Tangential To The circular path **

$\Rightarrow$ $\bar{f_g}$ direction is Toward The earth - with The Radius ~~There~~ force Therefore $\bar{d} \perp \bar{f_g}$ = from your Math classes = And Therefore, $\varphi = 90°$

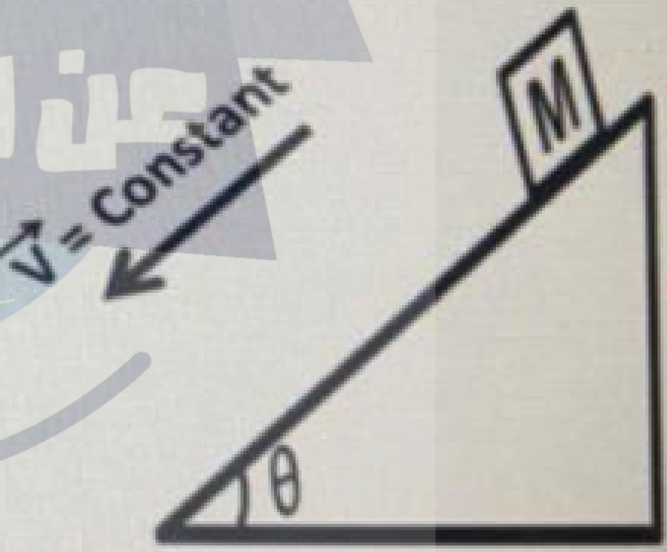
Then

$Work = \cancel{f_g}\,|f_g| \cdot |d| \cos(90°)$

$\boxed{Work = \varnothing_{zero}}$

A block of mass M slides (تنزلق) along a rough (خشن) inclined surface (سطح مائل) with a constant velocity. The inclination angle (زاوية ميلان) of the surface is θ as shown in the adjacent figure (الشكل المجاور). The coefficient (معامل) of kinetic friction (μ_k) of the inclined surface is:

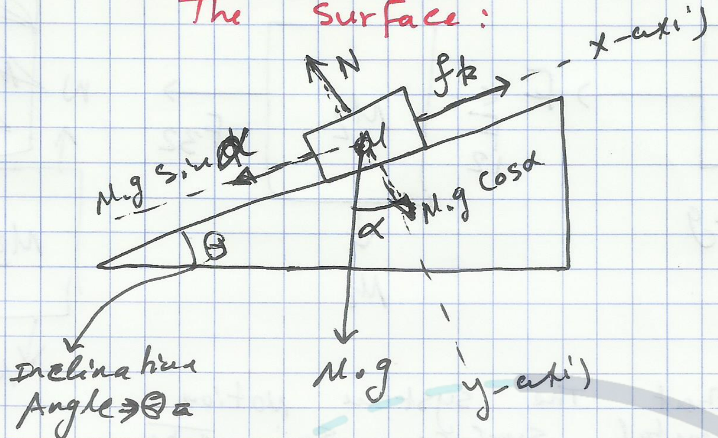
A. $\cos^2(\theta)$
B. $\cos(\theta)$
C. $\sin(2\theta)$
D. $\tan(\theta)$
E. $\sin(\theta)$



*Take $g = 9.8\ m/s^2$

13/

⇒ Free body diagram of The Mass on The surface:



⇒ Mathematical representation of The system:

y-axis

⇒ The Motion is at The surface so, y-axis forces must equal To Zero as no acceleration exist There;

$\sum f_y = \emptyset$

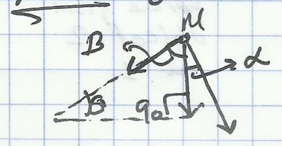
Then $N = M.g\cos(\alpha)$

$N = M.g\cos(\theta)$

Notes:

⇒ $\alpha = \theta$

proof: -by



$B + \theta + 90 = 180$

$B = 180 - \theta - 90$

$B = 90 - \theta$

but, $B + \alpha = 90°$

So, $\alpha = 90 - (90 - \theta)$

$\boxed{\alpha = \theta}$

⇒ fk used instead of The static friction As The object is in Motion - kinetic.

⇒ As ~~The~~ Motion happen at x-axis for Constant speed ⇒ $a = \frac{dV}{dt} \Rightarrow \emptyset$ constant

So, $a = \emptyset$ making $\sum F_x = \emptyset = M.a$

Then $M.g\sin\alpha = M.g\sin\theta = fk = N\cdot\mu k$

$\boxed{N = M.g\cos(\theta)}$

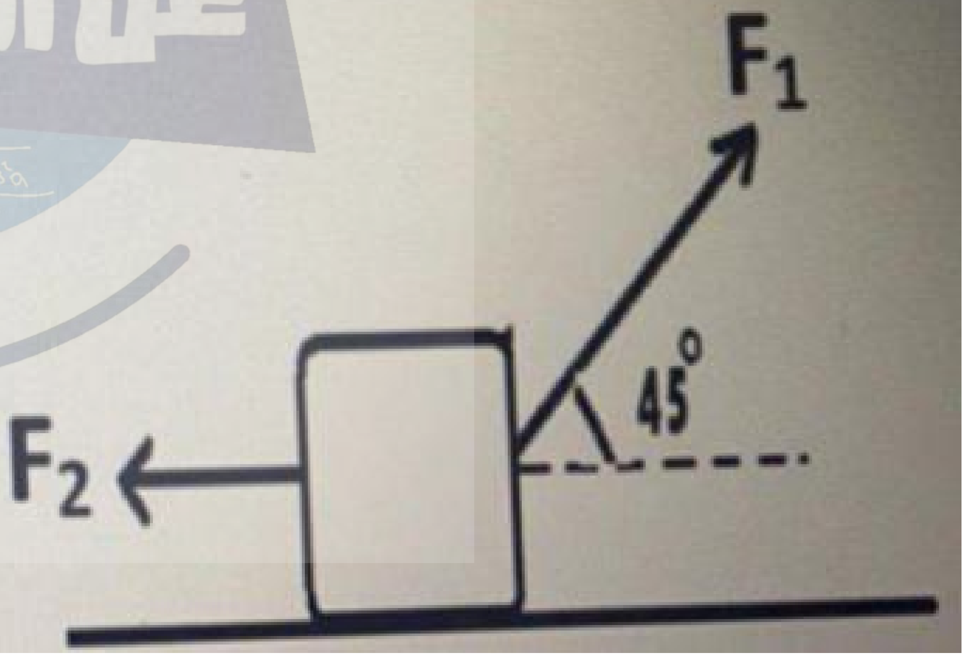
$[\cancel{M.g}\sin\theta] = [\cancel{M.g}\cos(\theta)]\mu k$

$$\boxed{\mu k = \frac{\sin(\theta)}{\cos(\theta)} = \tan(\theta)}$$

ans. D

A block sets on a rough (خشن), horizontal surface. When the forces $F_1 = 30$ N and $F_2 = 10$ N are applied on the block as shown below, it is found that the block moves with constant velocity. The force of kinetic friction (f_k) between the block and the surface is:

A. 4.14 N, towards left
B. 4.14 N, towards right
C. 11.2 N, towards left
D. 11.2 N, towards right
E. 15 N, towards left



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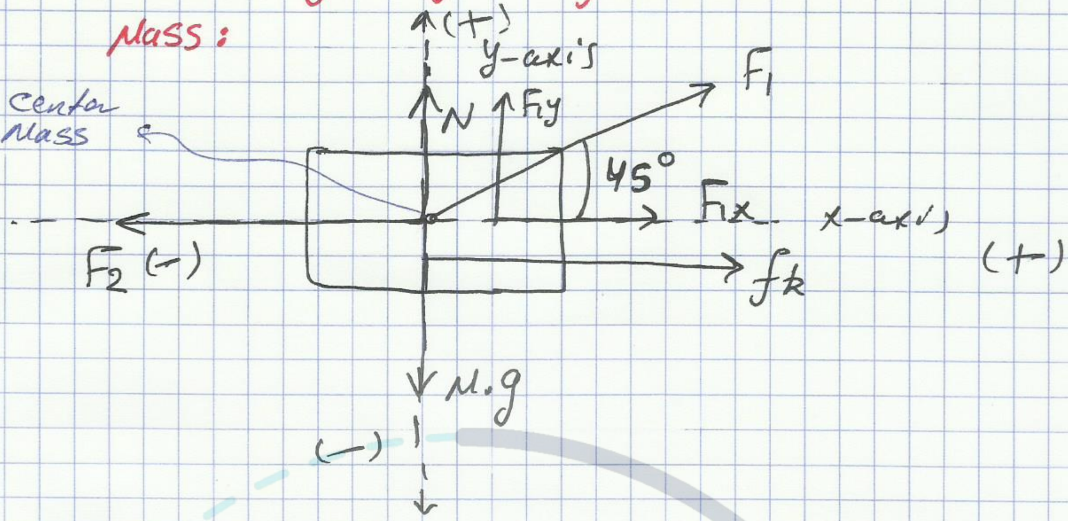
⇒ Free body diagram of the given Mass:



⇒ The Mathematical Model of the free body diagram:

Note:
$F_1 = 30N$
$F_2 = 10N$

→ y-axis Analysis:

No motion happens at y-axis

So; $a = \emptyset$ making $\sum F_y = \emptyset$

Therefore: $F_{1y} + N = M.g$

$N = M.g - F_{1y}$

→ x-axis Analysis:

The motion on this axis at constant speed so; $\left.\frac{dV}{dt}\right|_{V\text{-constant}} = \emptyset = a$

Making $\sum F_x = \emptyset$

Therefore $F_2 = f_k + f_{1x}$

$f_k = F_2 - f_{1x} = 10 - 30 \cos(45)$

$f_k = -11.213$ Newton or

11.213 Newton	Toward the left

ans. C