A potential energy function for a one-dimensional force is of the form: $U(x) = 2x^3$ Joules, where *x* is in meters.
The magnitude of the corresponding force (in N) that acts at the point x = 4 m is:

A. 6
B. 12
C. 24
D. 54
E. 96

[1] $F = \frac{\partial U}{\partial x} = 6x^2$

$F @ x = 4 = 6(4)^2 = 96 \rightarrow$ E1

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:

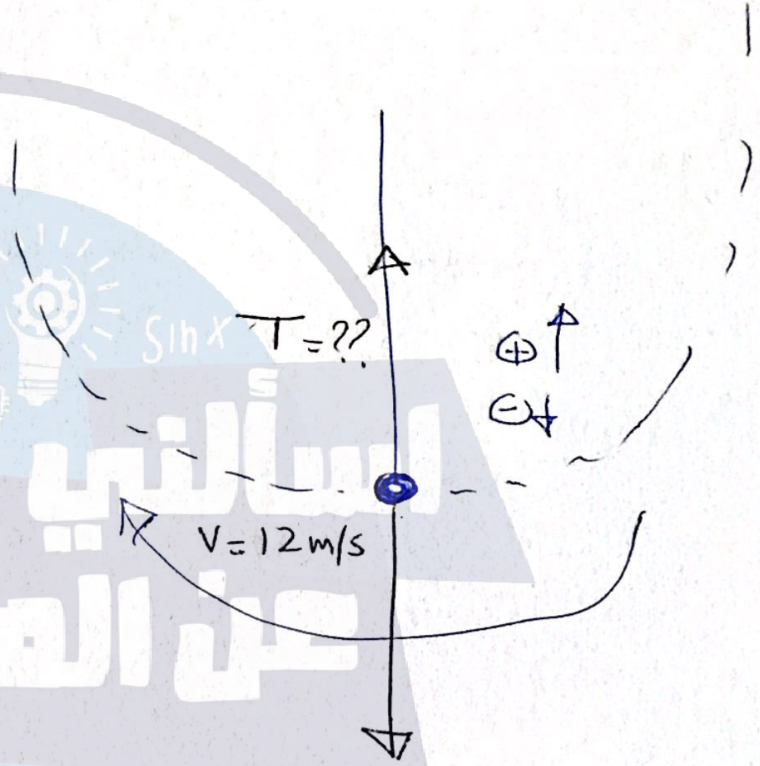
A. 31.5 N
B. 36.7 N
C. 56.2 N
D. 40.9 N
E. 23.7 N

[2] $\Sigma F_r = \frac{mv^2}{r}$

$T - mg = \frac{mv^2}{r}$

$T - 4.9 = \frac{0.5(12)^2}{2}$

$\boxed{T = 40.9\ N}$ — $\underline{\underline{D}}$

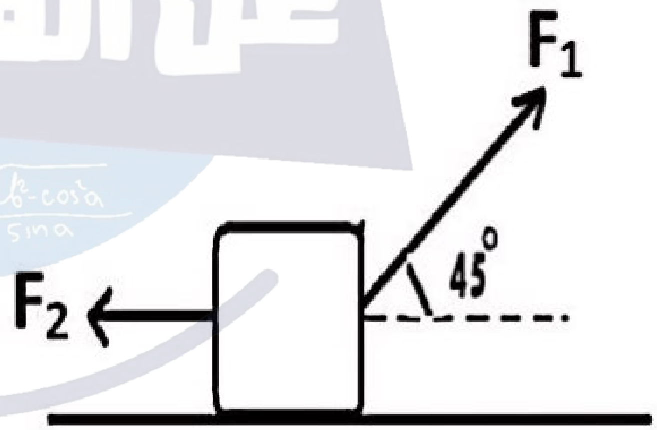


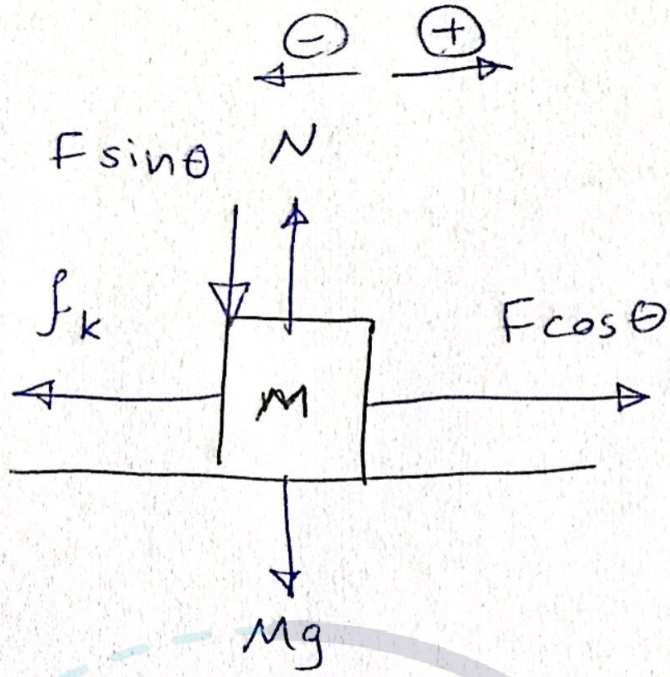
$mg = 0.5\ (9.8)$

$= \underline{\underline{4.9\ N}}$

A block sits on a rough (خشن), horizontal surface. When the forces $F_1 = 40$ 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. 18.3 N, towards right
E. 18.3 N, towards left





3) $\sum F_y = 0$

$N - F\sin\theta - Mg = 0$

$N - 20\sin 30 - 3(9.8) = 0$

$N = \underline{\underline{39.4}}\ N$

$f_k = \mu_k N = 0.3(39.4) = \underline{\underline{11.82}}\ N$

$\sum F_x = ma$

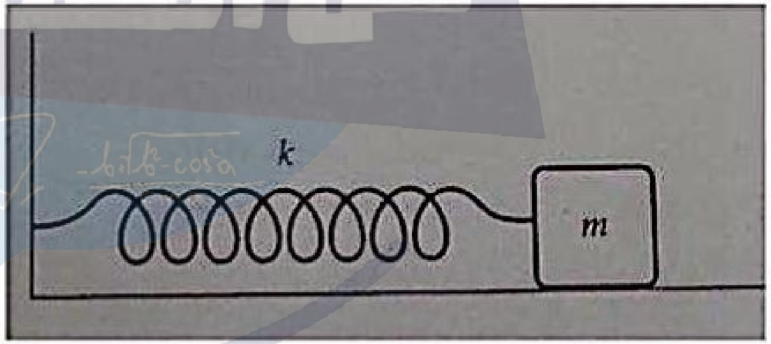
$F\cos\theta - f_k = ma$

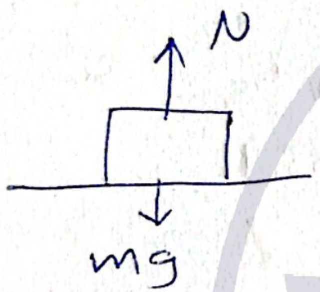
$20\cos 30 - 11.82 = 3a$

$\boxed{a = 1.8\ m/s^2}$ — (A)

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 = 0.1 m, and the coefficient (معامل) of kinetic friction between the block and the horizontal surface is equal to 0.05, determine the speed of the block when it first passes through the position for which the spring is unstretched (غير ممتد).

A. 0.94 m/s
B. 0.71 m/s
C. 0.84 m/s
D. 0.53 m/s
E. 0.34 m/s





$\Sigma F_y = 0$

$N - mg = 0 \Rightarrow N = 0.5 * 9.8 = 4.9\ N$

$f_k = \mu_k N = 0.05(4.9) = \underline{\underline{0.245\ N}}$

$E_1 + W_{f_k} = E_2$

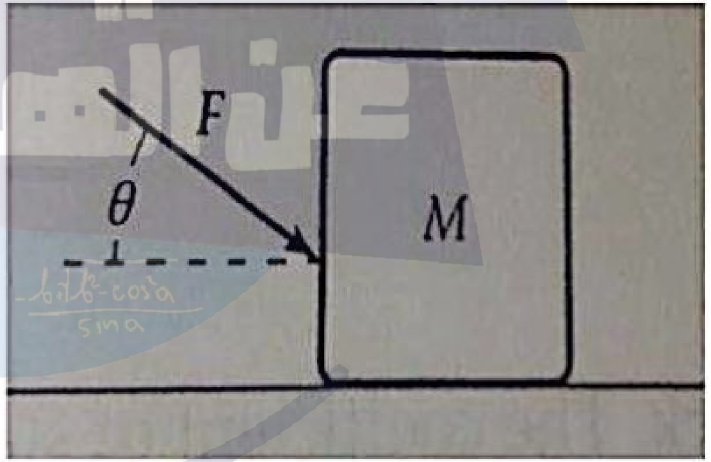
$\cancel{\frac{1}{2} m v_1^2} + \frac{1}{2} k \Delta x^2 - f_k d = \frac{1}{2} m v_2^2 + \cancel{\frac{1}{2} k \Delta x^2}$

$\frac{1}{2}(50)(0.1)^2 - 0.245(0.1) = \frac{1}{2}(0.5) V_2^2$

$\boxed{V_2 = 0.94\ m/s} \rightarrow \underline{\underline{A}}$

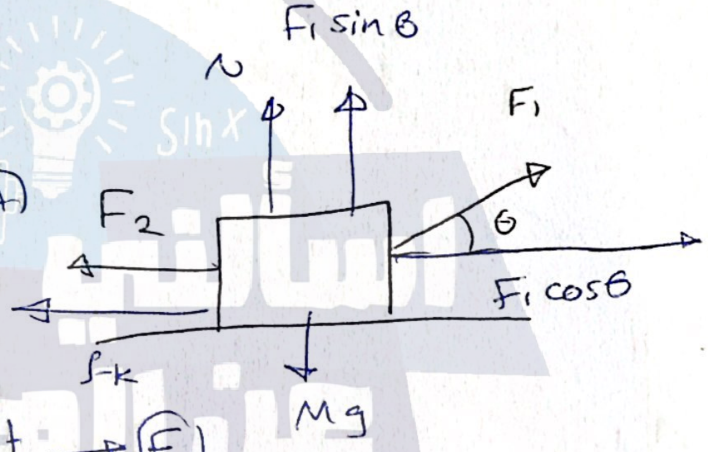
A block of mass M is pushed across a horizontal surface by the force F that is shown in the figure below. If the coefficient (معامل) of kinetic friction between the block and the surface is 0.3, F = 20 N, $\theta = 30^0$, and M = 3 kg, what is the magnitude of the acceleration of the block?

A. $1.8\ m/s^2$
B. $5.6\ m/s^2$
C. $3.8\ m/s^2$
D. $7.9\ m/s^2$
E. $9.8\ m/s^2$



نفرض اتجاه الحركة باتجاه القوة الأكبر (+) →

$F_1 \cos\theta > F_2$



$\sum F_x = 0 \quad (a = 0, \; V = \text{constant})$

$F_1 \cos\theta - F_2 - f_k = 0$

$40 \cos 45 - 10 - f_k = 0$

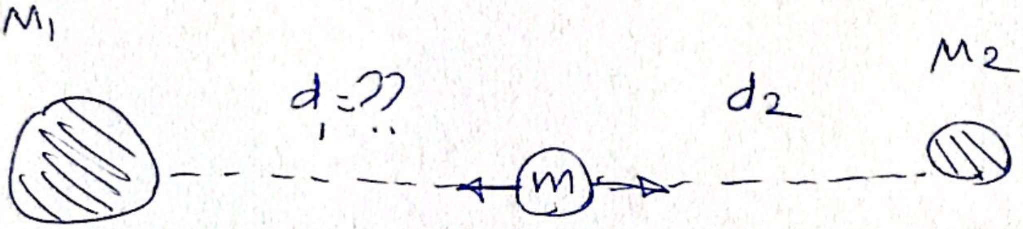
$f_k = 18.3$ towards left → (E)

* في حال حليت نفس الحل لكن فرضت اتجاه الحركة لليسار بتطلع معي الاحتكاك نفس القيمة ولكن سالب يعني عكس الاتجاه اللي أنا فرضته للاحتكاك (باتجاه اليسار)

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



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

$$\frac{10 M_2}{d_1^2} = \frac{M_2}{d_2^2}$$

$$10 d_2^2 = d_1^2 \Rightarrow d_1 = \sqrt{10}\, d_2$$

$$d_2 = \frac{1}{\sqrt{10}} d_1 = 0.316\, d_1$$

$$R = d_1 + d_2 = d_1 + 0.316\, d_1$$

$$R = 1.316\, d_1 \Rightarrow d_1 = \frac{R}{1.316} = \boxed{0.76 R} \rightarrow D$$

The work performed as a function of time for a certain process is given by: $W = at^3$, where $a = 2$ J/s³. The instantaneous power output (measured in Watts) at $t = 1$ sec is:

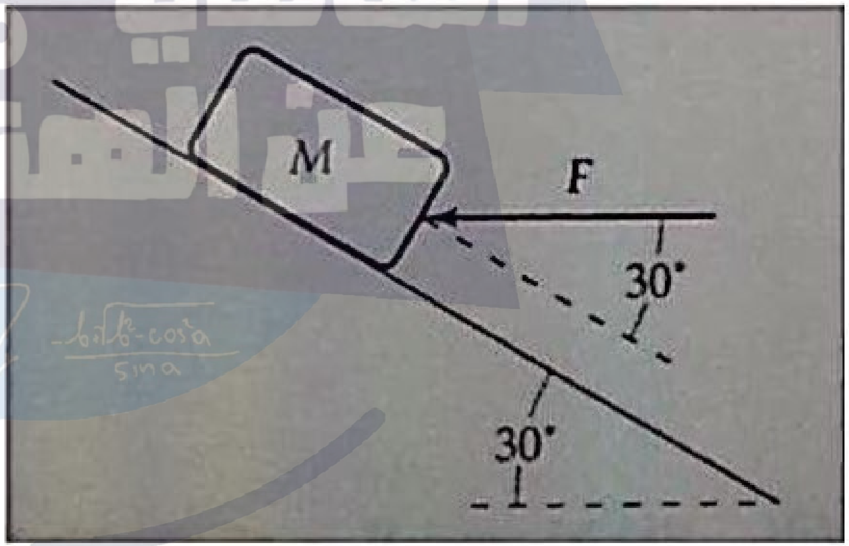
A. 24
B. 69
C. 54
D. 207
E. 6

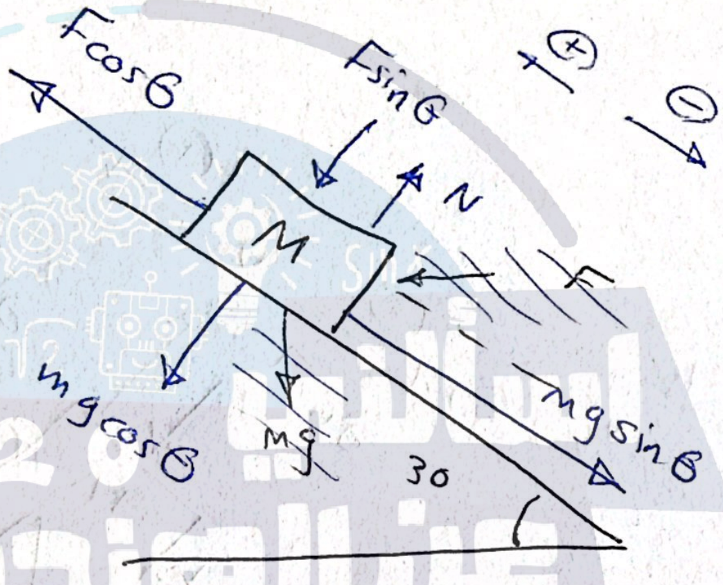
$W = 2t^3$

$P = \frac{dW}{dt} = 6t^2 = 6(1)^2 = \boxed{6\ W} \rightarrow E$

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 = 3.5 kg, the magnitude of the resulting acceleration of the block is:

A. 7.3 m/s^2
B. 5.9 m/s^2
C. 8.5 m/s^2
D. 1.3 m/s^2
E. 9.8 m/s^2





$\Sigma F_x = ma$

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

$25\cos 30 - 3.5(9.8)\sin 30 = 3.5\,a$

$a = 1.3\ m/s^2$ → D

In a given displacement of a particle, its kinetic energy increases by 25 J while its potential energy decreases by 10 J. Determine the work of the nonconservative forces acting on the particle during this displacement.

A. -15 J
B. +15 J
C. -35 J
D. +35 J
E. +55 J

$$E_1 + W_F = E_2$$

$$U_1 + K_1 + W_F = U_2 + K_2$$

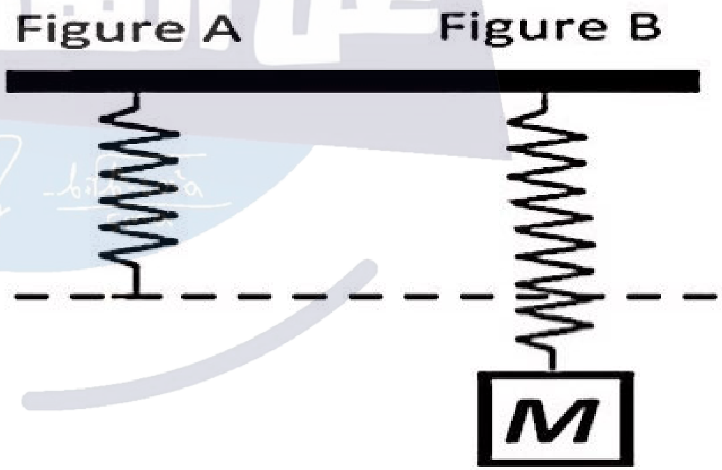
$$W_F = (U_2 - U_1) + (K_2 - K_1)$$

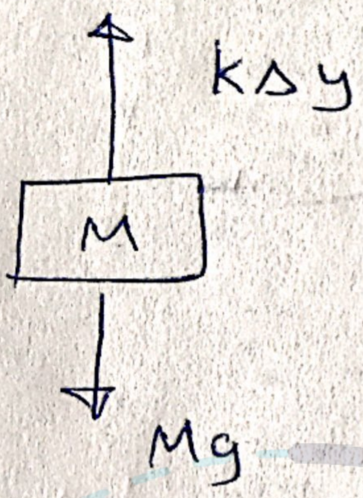
$$= -10 + 25$$

$$W = +15 J \rightarrow B$$

The adjacent figure shows two configurations (هيئتين) of a spring (زنبرك) that is hung (معلق) vertically. In A, it has a length of *20 cm*, and in B, when the mass $M = 300\ g$ is attached to it and becomes at rest, the length of the spring becomes 22 cm. The spring constant (K) in units of N/m is: [Hint: The acceleration due to gravity (g) is 9.8 m/s^2].

A. 54
B. 67
C. 77
D. 147
E. 98





$$\Sigma F_y = 0$$

$$Mg = k\Delta y \Rightarrow 0.3(9.8) = k(0.02)$$

$$\boxed{k = 147 \ N/m}$$

A force $\vec{F} = (3\hat{i} - \hat{j})$ N acts on an object. The work (in J) that this force does as the object moves from the origin (0, 0, 0) to the point (2, 4, 0) m is:

A. 10
B. 8
C. 6
D. 4
E. 2

$\vec{F} = (3\hat{i} - \hat{j})$

$\vec{r} = (2-0)\hat{i} + (4-0)\hat{j} + (0-0)\hat{k}$

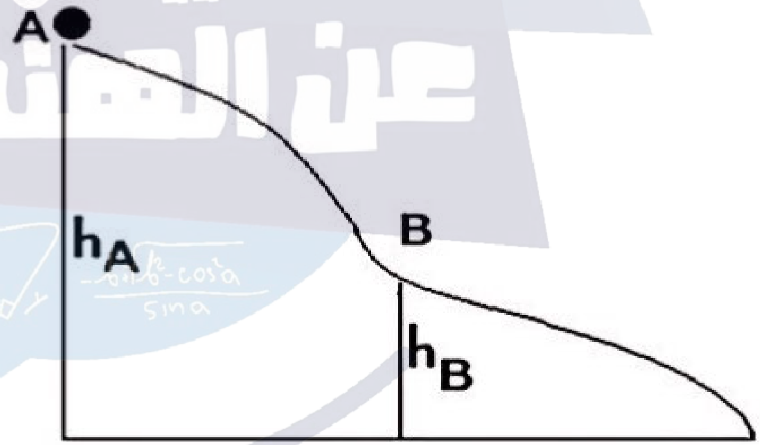
$\vec{r} = 2\hat{i} + 4\hat{j}$

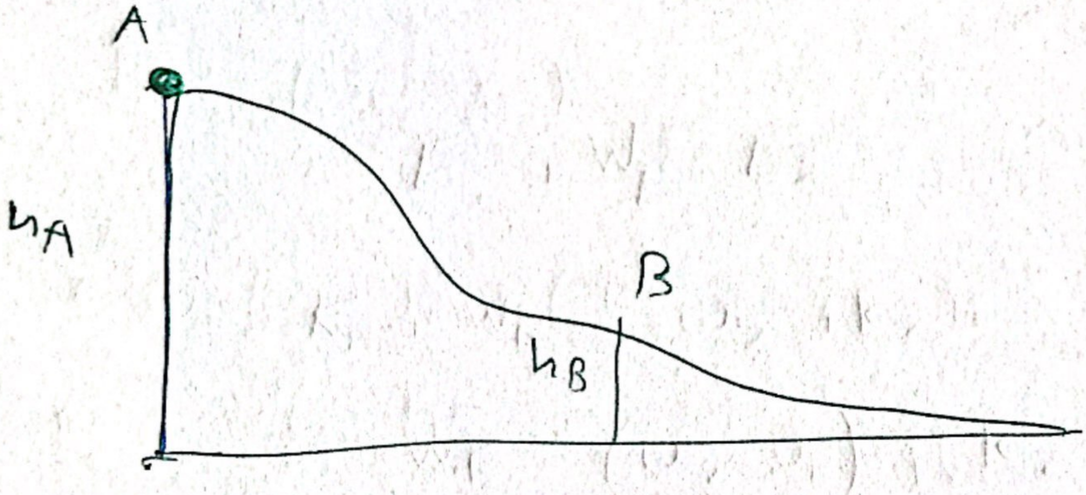
$W = \vec{F} \cdot \vec{r} = (3)(2) + (4)(-1)$

$= 2\ J \longrightarrow \boxed{E}$

A particle of mass m = 5 kg is *released from rest* (ترك من السكون) at point A and slides on the *frictionless track* (المسار الغير خشن) shown in the adjacent figure.
If h_A = 12 m and h_B = 4 m. The particle's speed (in m/s) at point B is:

A. 14
B. 1.3
C. 12.5
D. 7.6
E. 10.8





$$E_A = E_B$$

$$\frac{1}{2}mv_A^2 + mgh_A = \frac{1}{2}mv_B^2 + mgh_B$$

$$(9.8)(12) = \frac{1}{2}v_B^2 + (9.8)(4)$$

$$v_B = 12.5 \longrightarrow \underline{\underline{C}}$$