

RECOMMENDED PROBLEMS

CHAPTER 7



Physics A – Serway

إعداد

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معيدي قسم الفيزياء في الجامعة الإسلامية

5. A block of mass $m = 2.50$ kg is pushed a distance $d = 2.20$ m along a frictionless, horizontal table by a constant applied force of magnitude $F = 16.0$ N directed at an angle $\theta = 25.0^\circ$ below the horizontal as shown in Figure P7.5. Determine the work done on the block by (a) the applied force, (b) the normal force exerted by the table, (c) the gravitational force, and (d) the net force on the block.

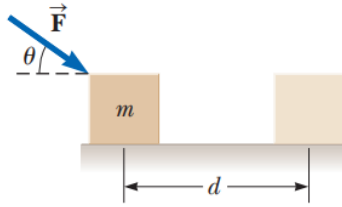


Figure P7.5

- 14.** The force acting on a particle varies as shown in Figure P7.14. Find the work done by the force on the particle as it moves (a) from $x = 0$ to $x = 8.00$ m, (b) from $x = 8.00$ m to $x = 10.0$ m, and (c) from $x = 0$ to $x = 10.0$ m.

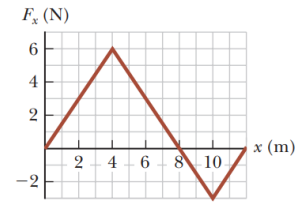


Figure P7.14

- 15.** A particle is subject to a force F_x that varies with position as shown in Figure P7.15. Find the work done by the force on the particle as it moves (a) from $x = 0$ to $x = 5.00$ m, (b) from $x = 5.00$ m to $x = 10.0$ m, and (c) from $x = 10.0$ m to $x = 15.0$ m. (d) What is the total work done by the force over the distance $x = 0$ to $x = 15.0$ m?

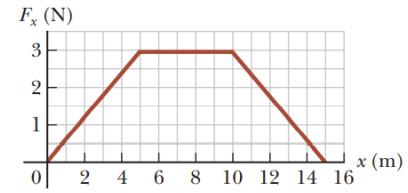


Figure P7.15 Problems 15 and 34.

25. A small particle of mass m is pulled to the top of a frictionless half-cylinder (of radius R) by a light cord that passes over the top of the cylinder as illustrated in Figure P7.25. (a) Assuming the particle moves at a constant speed, show that $F = mg \cos \theta$. *Note:* If the particle moves at constant speed, the component of its acceleration tangent to the cylinder must be zero at all times. (b) By directly integrating $W = \int \vec{F} \cdot d\vec{r}$, find the work done in moving the particle at constant speed from the bottom to the top of the half-cylinder.

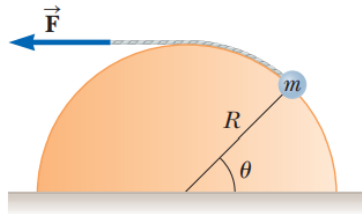


Figure P7.25

33. A 0.600-kg particle has a speed of 2.00 m/s at point **(A)** and kinetic energy of 7.50 J at point **(B)**. What is (a) its kinetic energy at **(A)**, (b) its speed at **(B)**, and (c) the net work done on the particle by external forces as it moves from **(A)** to **(B)**?

- 39. Review.** A 5.75-kg object passes through the origin at time $t = 0$ such that its x component of velocity is 5.00 m/s and its y component of velocity is -3.00 m/s. (a) What is the kinetic energy of the object at this time? (b) At a later time $t = 2.00$ s, the particle is located at $x = 8.50$ m and $y = 5.00$ m. What constant force acted on the object during this time interval? (c) What is the speed of the particle at $t = 2.00$ s?

41. A 0.20-kg stone is held 1.3 m above the top edge of a water well and then dropped into it. The well has a depth of 5.0 m. Relative to the configuration with the stone at the top edge of the well, what is the gravitational potential energy of the stone–Earth system (a) before the stone is released and (b) when it reaches the bottom of the well? (c) What is the change in gravitational potential energy of the system from release to reaching the bottom of the well?

42. A 400-N child is in a swing that is attached to a pair of ropes 2.00 m long. Find the gravitational potential energy of the child–Earth system relative to the child's lowest position when (a) the ropes are horizontal, (b) the ropes make a 30.0° angle with the vertical, and (c) the child is at the bottom of the circular arc.

59. A 6 000-kg freight car rolls along rails with negligible friction. The car is brought to rest by a combination of two coiled springs as illustrated in Figure P7.59. Both springs are described by Hooke's law and have spring constants $k_1 = 1\,600\text{ N/m}$ and $k_2 = 3\,400\text{ N/m}$. After the first spring compresses a distance of 30.0 cm, the second spring acts with the first to increase the force as additional compression occurs as shown in the graph. The car comes to rest 50.0 cm after first contacting the two-spring system. Find the car's initial speed.

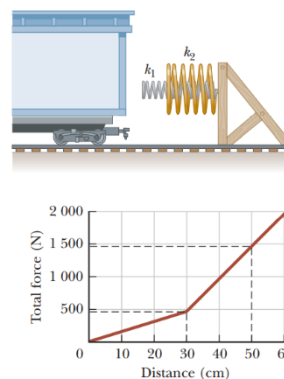


Figure P7.59

- 63.** An inclined plane of angle $\theta = 20.0^\circ$ has a spring of force constant $k = 500 \text{ N/m}$ fastened securely at the bottom so that the spring is parallel to the surface as shown in Figure P7.63. A block of mass $m = 2.50 \text{ kg}$ is placed on the plane at a distance $d = 0.300 \text{ m}$ from the spring. From this position, the block is projected downward toward the spring with speed $v = 0.750 \text{ m/s}$. By what distance is the spring compressed when the block momentarily comes to rest?

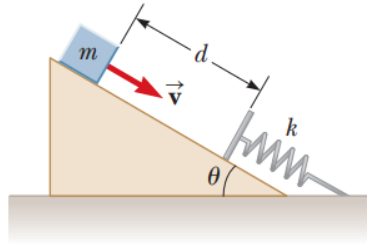


Figure P7.63

Problems 63 and 64.

64. An inclined plane of angle θ has a spring of force constant k fastened securely at the bottom so that the spring is parallel to the surface. A block of mass m is placed on the plane at a distance d from the spring. From this position, the block is projected downward toward the spring with speed v as shown in Figure P7.63. By what distance is the spring compressed when the block momentarily comes to rest?

Solution of chapter (7) 8)

معيدة قسم الفيزياء 2021
أ.أ.أ. فاضل العتيبي
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- ⑤ A block of mass $m = 2.5 \text{ kg}$ is pushed a distance $d = 2.2 \text{ m}$ along a frictionless, horizontal table by constant applied force of magnitude $F = 16 \text{ N}$ directed at an angle $\theta = 25^\circ$ below the horizontal as shown. Determine the work done on the block by

(a) the applied Force ربط القوة المطبقة

$m = 2.5 \text{ kg}$
 $d = 2.2 \text{ m}$
 $\theta = 25^\circ$
 $F = 16 \text{ N}$

$$W = F \cdot d \cdot \cos \theta$$

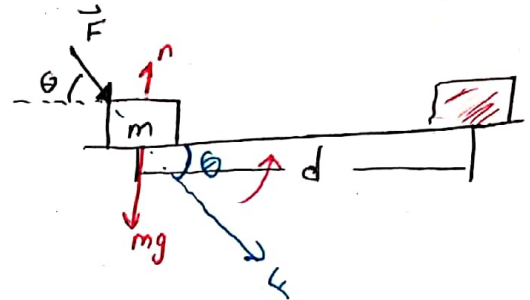
$$= F \cdot d \cdot \cos \theta = 16 \times 2.2 \cos 25^\circ$$

لأنه الزاوية θ تكون بين F و d بما بينهما

هنا فقط كما اعلم من قبل

$$= 16 \times 2.2 \cos(25^\circ)$$

$$W = 31.9 \text{ J}$$



(b) the normal force exerted by the table.

تسفل قوة التماس العمودية يساوي صفر لأنه قوة التماس

$$N \cdot d \cos 90^\circ = 0$$

(c) the gravitational force.

تسفل قوة الجاذبية يساوي صفر لأنه قوة الجاذبية عمودية على اتجاه الحركة

(d) the net force on the block.

$$W_{\text{net}} = W_{mg} + W_n + W_F = 0 + 0 + 31.9 = 31.9 \text{ J}$$

- ⑭ The force acting on a particle varies as shown. Find the work done by the force on particle as it moves

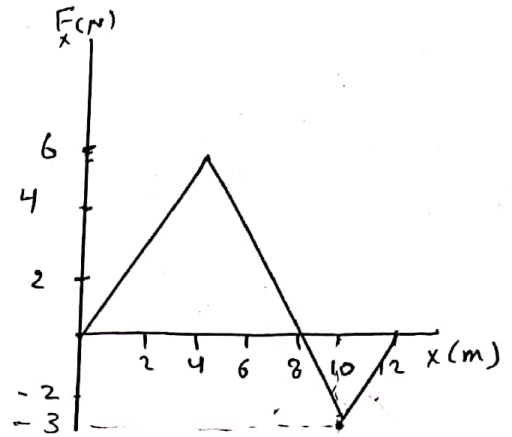
(a) From $x=0$ to $x=8\text{ m}$

انقل بيادي المسافة، فمعرفة انقل من (القوة، المسافة).

$W = \text{Area under the curve.}$

$$= \frac{1}{2} (\text{base}) \times (\text{height})$$

$$= \frac{1}{2} \times 8 \times 6 = 24 \text{ J}$$



(b) From $x=8\text{ m}$ to $x=10\text{ m}$

$W = \text{Area}$

$$= \frac{1}{2} \times (10-8) \times -3 = -3 \text{ J}$$

(c) From $x=0$ to $x=10\text{ m}$

$$W_{\text{net}} = W_{0 \rightarrow 8} + W_{8 \rightarrow 10} = 24 - 3 = 21 \text{ J}$$

- ⑮ A particle is subjected to a force F_x that varies with position as shown. Find the work done by the force on the particle as it moves.

(a) from $x=0$ to $x=5\text{ m}$

$W = \text{Area}$ (مثلث) triangle.

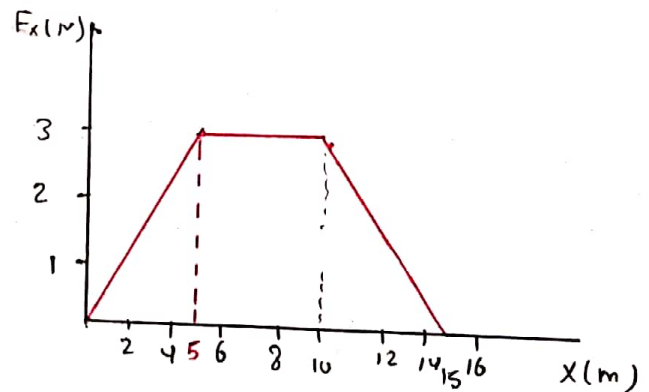
$$= \frac{1}{2} \times (\text{base}) \times (\text{height})$$

$$= \frac{1}{2} \times 5 \times 3 = 7.5 \text{ J}$$

(b) from $x=5\text{ m}$ to $x=10\text{ m}$

$W = \text{Area}$ (مربع) square

$$= (10-5) \times 3 = 5 \times 3 = 15 \text{ J}$$



(c) from $x=10\text{ m}$ to $x=15\text{ m}$

$W = \text{Area}$ (مثلث) triangle

$$= \frac{1}{2} \times (15-10) \times 3 = \frac{1}{2} \times 5 \times 3 = 7.5 \text{ J}$$

(d) the total work from $x=0\text{ m}$ to $x=15\text{ m}$

$$W = W_{0 \rightarrow 5} + W_{5 \rightarrow 10} + W_{10 \rightarrow 15} = 7.5 + 15 + 7.5 = 30 \text{ J}$$

$$W = \left(\frac{\text{مساحة المثلث}}{2} \right) \times \text{ارتفاع} = \left(\frac{15+5}{2} \right) \times 3 = 30 \text{ J} \quad (2)$$

(25) A small particle of mass m is pulled to the top of frictionless half cylinder (of Radius R) by a light cord that passes over the top of cylinder as shown,

(a) Assuming the particle moving with constant speed, show that

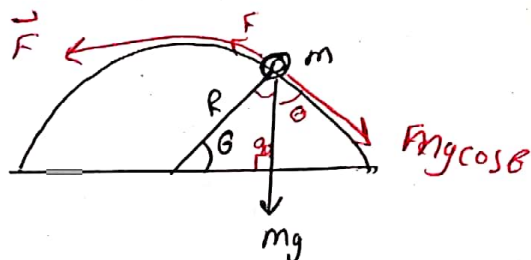
$$F = mg \cos \theta.$$

السرعة ثابتة $a=0$

$$\Sigma F = ma = 0$$

$$mg \cos \theta - F = 0$$

$$F = mg \cos \theta$$



(b) By directly integrating $W = \int \vec{F} \cdot d\vec{r}$, Find the work done in moving the particle at constant speed from the bottom to the top of half cylinder.

$$W = \int_{\pi/2}^0 F \cdot dr$$

$0 \rightarrow R$

لكن نصف $F = mg \cos \theta$ المتغير الزاوية

$$W = \int_0^{\pi/2} F \cdot dr$$

$\theta = \frac{\text{طول القوس}}{\text{نصف}}$

$$= \int_0^{\pi/2} mg \cos \theta \cdot (R d\theta)$$

$$G = \frac{s}{R}$$

$$r = s = R\theta$$

$$dr = R d\theta$$

$$= mg R \int_0^{\pi/2} \cos \theta d\theta$$

$$= mg R [\sin \theta]_0^{\pi/2}$$

$$= mg R (\sin \pi/2 - \sin 0)$$

$$= mg R (1 - 0) = mg R$$



33) A 0.6 kg particle has a speed of 2 m/s at point (A) and kinetic energy of 7.5 J at point (B). What is

(a) its kinetic energy at (A).

$$K_A = \frac{1}{2} m v_A^2 = \frac{1}{2} \times 0.6 \times 2^2 = 1.2 \text{ J}$$

(b) its speed at (B)

$$K_B = \frac{1}{2} m v_B^2 \Rightarrow v_B = \sqrt{\frac{2 K_B}{m}} = \sqrt{\frac{2 \times 7.5}{0.6}} = 2.5 \text{ m/s}$$

(c) the net work done on the particle by external forces as it moves from (A) to (B)

$$W = \Delta K = K_B - K_A = 7.5 - 1.2 = 6.3 \text{ J}$$

39) A 5.75 kg object passes through the origin at time $t=0$ such that its x component of velocity is 5 m/s and its y component of velocity is -3 m/s.

(a) What is the kinetic energy of the object at this time?

$$K = \frac{1}{2} m v^2 = \frac{1}{2} \times 5.75 \times (5.83)^2$$

$$K = 97.75 \text{ J}$$

$$v_x = 5 \text{ m/s}$$

$$v_y = -3 \text{ m/s}$$

$$v = 5i - 3j$$

$$|v| = \sqrt{5^2 + (-3)^2} = 5.83 \text{ m/s}$$

لأنه v_x و v_y مركبتا السرعة
كانت الطاقة حركية

(b) At a later time $t = 2 \text{ sec}$, the particle is located at $x = 8.5 \text{ m}$ and $y = 5 \text{ m}$. What constant force acted on the object during this time interval.

بعد $t = 2 \text{ sec}$ ، موضع كل مركبة x و y أصبح

$$x_f = v_x \times t = 5 \times 2 = 10 \text{ m}$$

$$y_f = v_y \times t = -3 \times 2 = -6 \text{ m}$$

(F) مركبة x و y

$$x_f = 8.5 \text{ m}$$

$$y_f = 5 \text{ m}$$

مركبة x و y أصبحت

$$\vec{r} = 10i - 6j$$

$$F = ma \begin{cases} F_x = m a_x \\ F_y = m a_y \end{cases}$$

صبي ترك سيارة اسباقه، ويمر عليه نرسم، نحتاج المسافة ...
 $\Delta x = v_{ix} t + \frac{1}{2} a_x t^2$
 $8.5 = 5 \times 2 + \frac{1}{2} a_x (2)^2 \Rightarrow a_x = \frac{8.5 - 10}{2} = -0.75 \text{ m/s}^2$

$\Delta y = v_{iy} t + \frac{1}{2} a_y t^2$
 $5 = (-3 \times 2) + \frac{1}{2} a_y (2)^2 \Rightarrow a_y = \frac{5 + 6}{2} = 5.5 \text{ m/s}^2$

$F_x = m a_x = 5.75 \times -0.75 = -4.31 \text{ N}$
 $F_y = m a_y = 5.75 \times 5.5 = 31.62 \text{ N}$

$F = F_x i + F_y j = (-4.31 i + 31.62 j) \text{ N}$

(C) What is the speed of the particle at $t = 2 \text{ sec}$.

السرعة بعد منه (2 sec) يعني كأنه يده (v_f) .

① شو رأيكم نحل السؤال على معادلات الحركة أولاً.

$v_{fx} = v_{ix} + a_x t$
 $= 5 + -0.75 \times 2 = 3.5 \text{ m/s}$

$v_{fy} = v_{iy} + a_y t$
 $= -3 + 5.5 \times 2 = 8 \text{ m/s}$

(velocity) $\vec{v} = (3.5 i + 8 j) \text{ m/s}$

(speed) $|v| = \sqrt{3.5^2 + 8^2} = 8.73 \text{ m/s}$

السرعة $w = \Delta k$

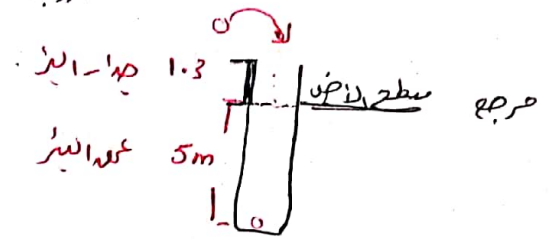
② حل السؤال بالقدام

(41)

ارتفاع صلب - الحجر
A 0.2 kg stone is held 1.3 m above the top edge of water well and then dropped into it. The well has depth of 5 m. Relative to the configuration with the stone at the top edge of the well, what is the gravitational potential energy of the stone - Earth system

(a) before the stone is released.
الارتفاع قبل السقوط

$$U = mgh$$
$$= 0.2 \times 9.8 \times 1.3 = 2.548 \text{ J}$$



(b) when it reaches the bottom of the well.

$$U = mgh$$
$$= 0.2 \times 9.8 \times (-5) = -9.8 \text{ J}$$

(c) what is the change in gravitational potential energy of the system from release to reaching the bottom of the well.

$$\Delta U = U_f - U_i = -9.8 - 2.548 = -12.3 \text{ J}$$

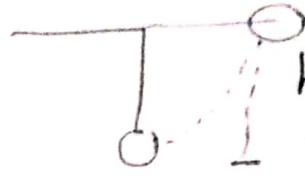
تغير الطاقة الكامنة الجاذبية
من الوضع الأول إلى الثاني

(42) A 400 N child is in a swing that is attached to a pair of ropes 2 m long. Find the gravitational potential energy of the child-Earth system relative to the child's lowest position when

(a) the ropes are horizontal.

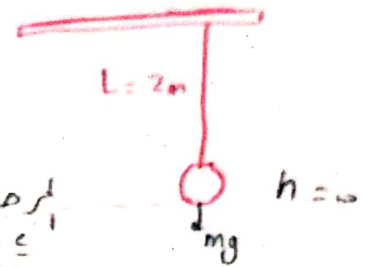
كم طاقة الوضع عند هذا الموضع (المثلث) في أقصى اليمين.

$$U = mgh = (400) \times 2 = 800 \text{ J}$$



$$h = L = 2 \text{ m}$$

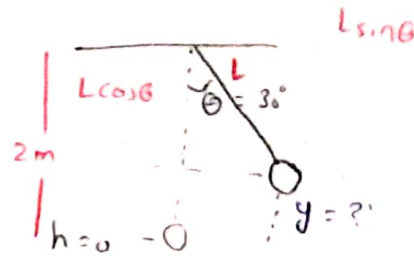
الموضع لأقصى اليمين
في الأسفل هو نقطة
المرجع



(b) the ropes make 30° angle with the vertical.

$$U = mgh = (400) \times 0.26$$

$$U = 107 \text{ J}$$



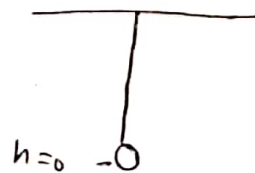
$$y = 2 - L \cos \theta$$

$$= 2 - L \cos 30^\circ$$

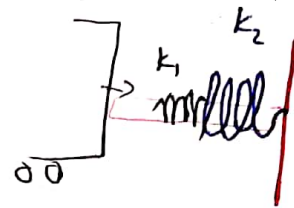
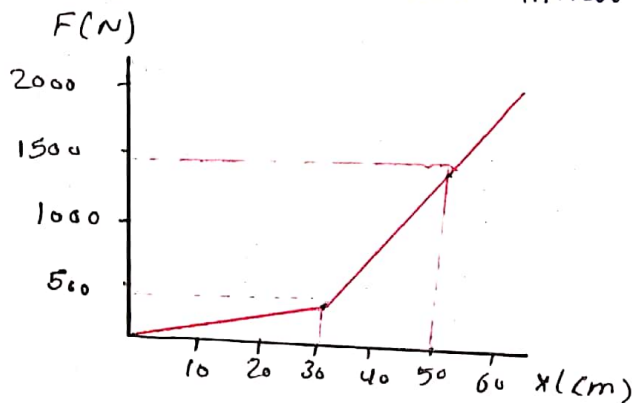
$$= 2 - 2 \cos 30^\circ = 0.26 \text{ m}$$

(c) the child is at bottom of the circular arc.

$$U = mgh = (400) \times 0 = 0 \text{ J}$$



59) A 6000 kg freight car rolls along rails with negligible friction. The car is brought to rest by a combination of two coiled springs as shown. Both springs are described by Hooke's law and have spring constant $k_1 = 1600 \text{ N/m}$ and $k_2 = 3400 \text{ N/m}$. After the first spring compresses a distance of 30 cm, the second acts with first to increase the forces as additional compression occurs as shown in fig. The car comes to rest 50 cm after first contacting the two-spring. Find the car's initial speed.



قطر سيرة سيرة ضغط على ناظمة فتترك الاول (الناظمة الاول) ، ضغط 30cm ، ثم
الناظمة الثانية (الناظمة الاول ، الناظمة) سيرة 20cm ، ثم ضغط 50cm .
هنا سيرة الناظمة الاول 30cm ، سيرة الناظمة الثانية 20cm . وزيد سيرة الناظمة
سيرة . طوبى قوة و سيرة ، سيرة $W = \Delta K$

القطر ، الاول الناظمة سيرة 30cm ، كوكب القطر . $W = \Delta K$
 $W_1 + W_2 = K_2 - K_1$

$$\frac{1}{2} k_1 x_1^2 + \frac{1}{2} k_2 x_2^2 = -\frac{1}{2} m v_i^2$$

$$\frac{1}{2} \times 1600 \times (0.5)^2 + \frac{1}{2} \times 3400 \times (0.2)^2 = -\frac{1}{2} \times 6000 \times v_i^2$$

$$200 + 68 = -3000 v_i^2$$

$$v_i = 0.29 \text{ m/s}$$

الشغل سيرة الناظمة للفرقة .

(63)

An inclined plane of angle $\theta = 20^\circ$ has a spring of force constant $k = 500 \text{ N/m}$ fastened securely at the bottom so that the spring is parallel to the surface as shown. A block of mass $m = 2.5 \text{ kg}$ is placed on the plane at distance $d = 0.3 \text{ m}$ from the spring. From this position, the block is projected downward toward the spring with speed $v = 0.75 \text{ m/s}$. By what distance is the spring compressed when the block momentarily comes to rest.

$$\theta = 20^\circ$$

$$k = 500 \text{ N/m}$$

$$d = 0.3 \text{ m}$$

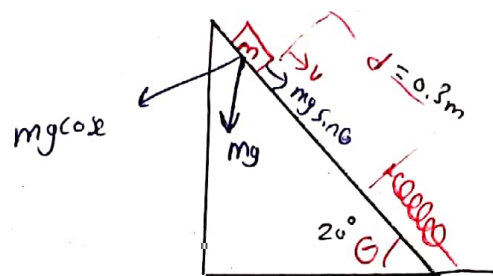
$$m = 2.5 \text{ kg}$$

$$v_i = 0.75$$

$$v_f = 0 \quad \text{عند توقف الجسم}$$

$$\text{في قمة السطح}$$

$$x = ? \quad \text{كم سوف ينضغط الزنبرك}$$



$$W = \Delta K$$

$$W_g + W_s = \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2$$

يوجد تغير في الطاقة الحركية
← شغل الجاذبية
← شغل الزنبرك

$$mg \sin \theta \times (d + x) - \frac{1}{2} k x^2 = -\frac{1}{2} m v_i^2$$

$$-\frac{1}{2} k x^2 + mg \sin \theta x + mg \sin \theta d + \frac{1}{2} m v_i^2 = 0$$

معادلة تربيعية من الدرجة الثانية لا يمكن حلها

نستخدم القانون العام

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-8.37 \pm \sqrt{(8.37)^2 - 4 \times -250 \times 5.12}}{2 \times -250}$$

$$x = 0.16 \text{ m}$$

$$a = -\frac{1}{2} \times k$$

$$= -\frac{1}{2} \times 500$$

$$a = -250$$

$$b = mg \sin \theta$$

$$= 2.5 \times 9.8 \sin 20$$

$$b = 8.37$$

$$c = mg \sin \theta d + \frac{1}{2} m v_i^2$$

$$c = 5.12$$

(64)

فصل سوال السابعة كنه يدور ارباع

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$= \frac{-mg \sin \theta \pm \sqrt{(mg \sin \theta)^2 - 4 \times -\frac{1}{2}k \times (mg \sin \theta \times d + \frac{1}{2}mv_i^2)}}{2 \times -\frac{1}{2}k}$$

✱

بسم الله الرحمن الرحيم
 م. السبعين (مساكن)
 P. السبعين (مساكن)