15) A 40 kg box initially at rest is pushed 5 m along a rough, horizontal floor with a constant applied horizontal force of 130 N. If the coefficient of friction between box and floor is 0.3, find

a) The work done by the applied force,
b) The work done by the friction force,
c) The work done by the gravitational force,
d) The final speed of the box.

15)

a) $W_F = Fs\cos\theta = (130)(5)\cos(0) = 650\ \text{J}$

b) $\sum F_y = m a_y$: $\quad n-400 = 0 \qquad n = 400\ \text{N}$

$f_k = \mu_k n = (0.3)(400) = 120\ \text{N}$

$W_f = f_k s\cos\theta = (120)(5)\cos(0) = 600\ \text{J}$

c) $W_g = mg\, s\cos\theta = (400)(5)\cos(-90) = 0$

d) $\Delta K = K_f - K_i = \sum W_{other} - \Delta E_{int}$

$$\frac{1}{2}mv_f^2 - 0 = 650 - 600 + 0 + 0 = 50\ \text{J}$$

$$v_f = \sqrt{\frac{2k_f}{m}} = \sqrt{\frac{2(50)}{40}} = 1.58\ \text{m/s}$$

2- How much work is done by a person lifting a 2.0-kg object from the bottom of a well at a constant speed of 2.0 m/s for 5.0 s?

a) 0.22 kJ b) 0.20 kJ c) 0.24 kJ d) 0.27 kJ e) 0.31 kJ

3- The force required to stretch a spring varies from zero to 50 N as we stretch the spring by moving one end 12 cm from its unstretched position. Find the work done in stretching the spring.

a) 10 J b) 12 J c) 15 J d) 5 J e) 3 J

6- If you push horizontally a 40 kg box across a horizontal floor of kinetic coefficient friction $\mu_k = 0.25$, calculate the power required to maintain a speed of 1.4 m/s?

a) 100 W **b)** 120 W **c)** 140 W **d)** 20 W **e)** 80 W

Q(10): The work of a force F = (3i + 4j) N to displace a particle a displacement s = (13i + 14j) m is:

a) 25 b) 95 c) 365 d) 34

Bonus question: A parcel (m = 2 kg) is pulled by a force F = (6i + 2j) N on a rough surface. If the frictional force is f= -2i and the parcel is displaced 3 m then calculate the net change in the kinetic energy of the parcel.

الحل

$W_{net} = \Delta K$

$F \cdot S = \Delta K$

$(6i+2j) \cdot (3i) + (-2i \cdot 3i) = \Delta K$

$18 - 6 = \Delta K$

$\therefore \Delta K = 12\ J$

2- A 700-N man climbs a 10 m vertical rope at a constant speed in 8 s. What is his power output?

a) 320 W b) 875 W c) 530 W d) 240 W e) 750 W

7- A raindrop of mass 3.35×10^{-5} kg falls vertically at constant speed under the influence of gravity. As it falls 100 m, what is the work done on the raindrop by the gravitational force. *(Model the drop as a particle)*

7

a) 3.35×10^{-2} J b) 4.02×10^{-2} J c) 5.36×10^{-2} J d) 1.28×10^{-2} J e) 7.33×10^{-2} J

8- At what maximum speed can a car safely negotiate a horizontal unbanked turn (radius = 51 m) in dry weather (coefficient of static friction = 0.95)

6

a) 15 m/s b) 5 m/s c) 22 m/s d) 27 m/s e) 19 m/s

9- A box of mass 10 kg is pulled up a rough incline. The pulling force is parallel to the incline, which makes an angle of 20° with the horizontal. The coefficient of kinetic friction is 0.4, and the box is pulled 5 m. How much work is done by the frictional force on the box?

7

a) 92 J b) 282 J c) 188 J d) 141 J e) 58 J

10- A 10-kg block on a rough horizontal surface is attached to a light spring (force constant = 1.4 kN/m). The block is pulled 8 cm to the right from its equilibrium position and released from rest. The frictional force between the block and surface has a magnitude of 30 N. What is the kinetic energy of the block as it passes through its equilibrium position?

a) 1.3 J b) 2.1 J c) 6.9 J d) 6.6 J e) 4.1 J

1- A 3 kg mass has an initial velocity $v_0 = (5i-3j)$ m/s. What is the work done if its velocity changes to v = (8i+4j) m/s?

a) 103 J b) 96 J c) 69 J d) 37J e) 23 J

2- If 4×10^4 J of work is performed by a 60 kg person to climb vertically, to what height can that person reach?

a) 100 m b) 23 m c) 67 m d) 33 m e) 51 m

3- The force required to stretch a spring varies from zero to 50 N. As we stretch the spring by moving one end 12 cm from its unstressed position, what is the work done in stretching the spring?

a) 3 J b) 9 J c) 14 J d) 15 J e) 21 J

4- A 100 kg wooden box is at rest on a level stone floor of $\mu_s = 0.5$ and $\mu_k = 0.4$, what is the minimum horizontal force needed to start moving the box?

a) 160 N b) 100 N c) 350 N d) 500 N e) 450 N

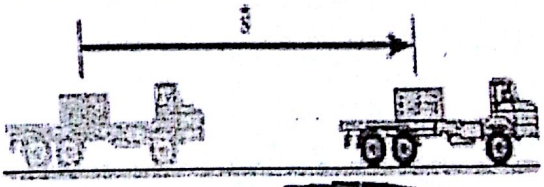
5- What is the power output of an engine of 1200 kg car if the car can go from 25 km/h to 100 km/h in 12 s?

a) 36.2 kW b) 22.1 kW c) 12.3 kW d) 41.2 kW e) 55.4 kW

6- A coin placed 50.0 cm from the center of a rotating, horizontal turntable. The coin slips when its speed is 50.0 cm/s. What is the coefficient of static friction between the coin and the turntable?

a) 0.56 b) 0.21 c) 0.05 d) 0.02 e) 0.78

7- The figure shows a 120-kg box on the flatbed of a truck that is moving with an acceleration of 1.5 m/s^2 along the positive x axis. The box does not slip with respect to the truck as the truck undergoes a displacement whose magnitude is s = 65 m. What is the total work done on the box by all of the forces acting on it?



a) 2.2×10^3 J b) 3.4×10^2 J c) 6.7×10^5 J d) 4.3×10^6 J e) 1.2×10^4 J

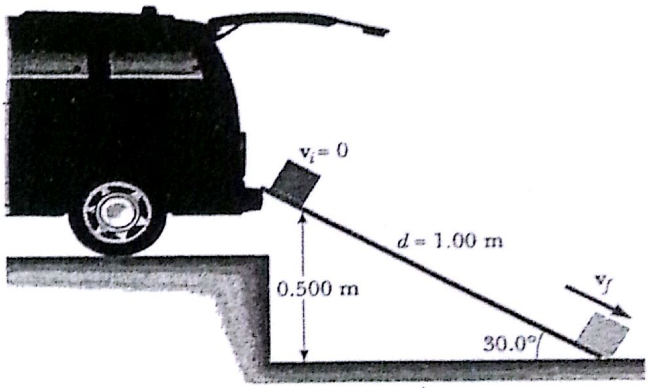
4- If it takes 4.00 J of work to stretch a Hooke's-law spring 10.0 cm from its unstressed length, determine the spring constant.

a) 800 N/m b) 700 N/m c) 500 N/m d) 1050 N/m e) 350 N/m

5- A 2.0-kg particle has an initial velocity of $(5\mathbf{i} - 4\mathbf{j})$ m/s. Some time later, its velocity is $(7\mathbf{i} + 3\mathbf{j})$ m/s. How much work was done by the resultant force during this time interval?

a) 49 J b) 19 J c) 17 J d) 27 J e) 53 J

6- A 3 kg box slides down a ramp. The ramp is 1 m in length and inclined at an angle of 30° as shown in the figure. The box starts from rest at the top of height 0.5 m, and experiences a constant friction force of magnitude 5 N. Determine the speed of the box at the bottom of the ramp.



a) 1.52 m/s b) 5.71 m/s c) 2.58 m/s d) 7.52 m/s e) 4.53 m/s

(2) A 3.0-kg block is dragged over a rough horizontal surface by a constant force of 16 N acting at an angle of 37° above the horizontal [redacted]. The speed of the block increases from 4.0 m/s to 6.0 m/s in a displacement of 5.0 m. What is the work done by the frictional force during this displacement?

a) 64 J b) 94 J c) -64 J d) 30 J e) -34 J

(3) A 70 kg man climbs a 10.0-m vertical rope at a constant speed in 8.00 s. What is his power output?

a) 875 W b) 300 W c) 450 W d) 975 W e) 230 W

(4) A 2.0-kg block sliding on a frictionless horizontal surface is attached to one end of a horizontal spring (k = 600 N/m) which has its other end fixed. If the block is oscillating around its equilibrium position and its maximum speed is 5 m/s at that position, what is the kinetic energy of the block when the spring is extended 20 cm from the equilibrium position as it oscillates?

a) 20 J b) 5 J c) 16 J d) 29 J e) 0 J

أجب عن المسألة الآتية بالتفصيل خلف هذه الورقة

(8) A single conservative force acts on a 5.00-kg particle. The equation $F_x = (2x + 4)$ N describes the force, where x is in meters. As the particle moves along the x axis from $x = 1$ m to $x = 5$ m, calculate:

(a) The work done by this force,

(b) The change in the potential energy of the system, and

(c) The kinetic energy of the particle at $x = 5$ m if its speed is 3 m/s at $x = 1$ m.

(8) (a) $W = \int F_x dx = \int_1^{5.00\text{ m}} (2x+4)\,dx = \left(\frac{2x^2}{2} + 4x\right)_1^{5.00\text{ m}} = 25.0 + 20.0 - 1.00 - 4.00 = \boxed{40.0\text{ J}}$

(b) $\Delta K + \Delta U = 0$ $\quad \Delta U = -\Delta K = -W = \boxed{-40.0\text{ J}}$

(c) $\Delta K = K_f - \frac{m v_1^2}{2}$ $\quad K_f = \Delta K + \frac{m v_1^2}{2} = \boxed{62.5\text{ J}}$

8- A 50 kg box initially at rest is pushed 5 m along a rough, horizontal floor with a constant applied horizontal force of 150 N. if the coefficient of friction is 0.2 find the following:

a) The work done by the applied force

b) The work done by the frictional force

c) The final speed of the box

(8) a) $W_A = (150)(5) = \boxed{750\ J}$

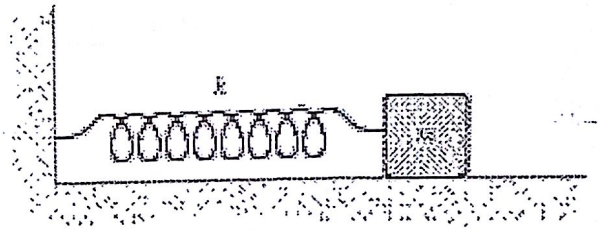
b) $f = \mu mg = (0.2)(50)(9.8) = 98\ N$

$W_f = (98)(5)\cos 180 = \boxed{-490\ J}$

c) $W_{net} = 750 - 490 = \frac{1}{2}mv^2 = 260$

$v = \left(\frac{260}{25}\right)^{\frac{1}{2}} = \boxed{3.22\ m/s}$

9- The block shown is released from rest when the spring is stretched a distance d. If $k = 50$ N/m, $m = 0.50$ 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.



a) 92 cm/s b) 61 cm/s c) 71 cm/s d) 82 cm/s e) 53 cm/s

3- When a ball rises vertically to a height h and returns to its original point of projection, the total work done by the gravitational force is:

a) -mgh b) mgh c) 0 d) -2 mgh e) 2 mgh

4- If a force $\mathbf{F} = (5\,\mathbf{i} - \mathbf{j})$ N acts on a particle that undergoes a displacement $\Delta\mathbf{r} = (4\mathbf{i} + 2\mathbf{j})$ m, what is the work done by the force on the particle and the angle between $\mathbf{F}$ and $\Delta\mathbf{r}$?

a) 16 J, 36.9° b) 18 J, 37.9° c) 18 J, 25.8° d) 16 J, 26.5° e) 12 J, 23.3°

5- If it takes 3 J of work to stretch a spring 8 cm from its unstressed length, what is the extra work required to stretch it an additional 8 cm?

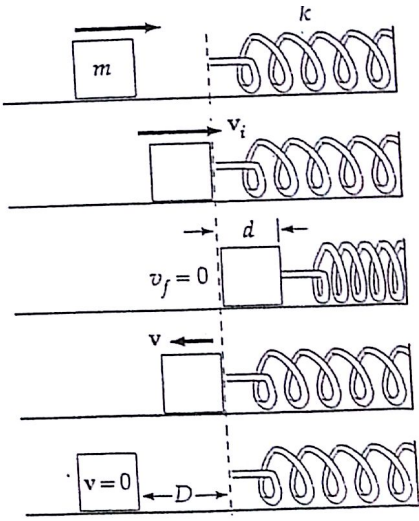
a) 12 J b) 20 J c) 15 J d) 9 J e) 5 J

A 1.00-kg object slides to the right on a surface having a coefficient of kinetic friction 0.250 (as in the figure). The object has a speed of $v_i = 3.00$ m/s when it makes contact with a light spring that has a force constant of 50.0 N/m. The object comes to rest after the spring has been compressed a distance d. The object is then forced toward the left by the spring and continues to move in that direction beyond the spring's unstretched position. Finally the object comes to rest a distance D to the left of the unstretched spring. Find

a) The distance of compression d,

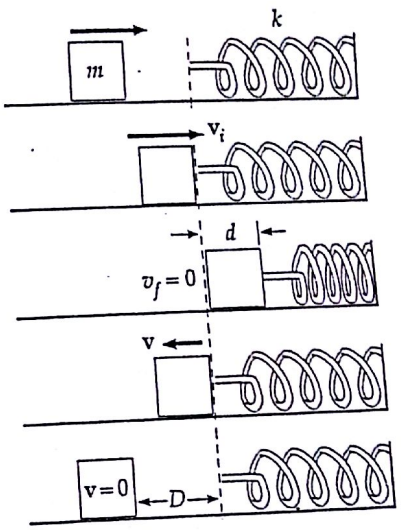
b) The speed v at the unstretched position when the object is moving to the left

c) The distance D where the object comes to rest.



هل هذا السؤال موجود في الصف؟

8- a) Between the second and the third picture, $\Delta E_{\text{m ech}} = \Delta K + \Delta U$



$$-\mu m g d = -\frac{1}{2} m v_i^2 + \frac{1}{2} k d^2$$

$$\frac{1}{2}(50.0\ \text{N/m})d^2 + 0.250(1.00\ \text{kg})(9.80\ \text{m/s}^2)d - \frac{1}{2}(1.00\ \text{kg})(3.00\ \text{m/s}^2) = 0$$

$$d = \frac{[-2.45 \pm 21.25]\ \text{N}}{50.0\ \text{N/m}} = \boxed{0.378\ \text{m}}$$

b) Between picture two and picture four, $\Delta E_{\text{m ech}} = \Delta K + \Delta U$

$$-f(2d) = \frac{1}{2} m v^2 - \frac{1}{2} m v_i^2$$

$$v = \sqrt{(3.00\ \text{m/s})^2 - \frac{2}{(1.00\ \text{kg})}(2.45\ \text{N})(2)(0.378\ \text{m})}$$

$$= \boxed{2.30\ \text{m/s}}$$

c) For the motion from picture two to picture five, $\Delta E_{\text{m ech}} = \Delta K + \Delta U$

$$-f(D + 2d) = -\frac{1}{2}(1.00\ \text{kg})(3.00\ \text{m/s})^2$$

$$D = \frac{9.00\ \text{J}}{2(0.250)(1.00\ \text{kg})(9.80\ \text{m/s}^2)} - 2(0.378\ \text{m}) = \boxed{1.08\ \text{m}}$$