جامعة جدة
University of Jeddah
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PHYS 101

Ch. 6

Work and Kinetic Energy

Kinetic En. and the Work-En. Theo.

Example 1:

A particle moves 10 m in the positive x direction while being acted upon by a constant force $\vec{F} = (4\hat{i} + 4\hat{k})$N. The work done on the particle by this force is:

$d = 10\hat{i}$ (positive-X)

$F = 4i + 4k$

Solution:

(C)

(A) 20 J
(B) 10 J
(C) 40 J
(D) -20 J

$W = F \cdot d = 40 + 0 = 40$ J

Kinetic En. and the Work-En. Theo.

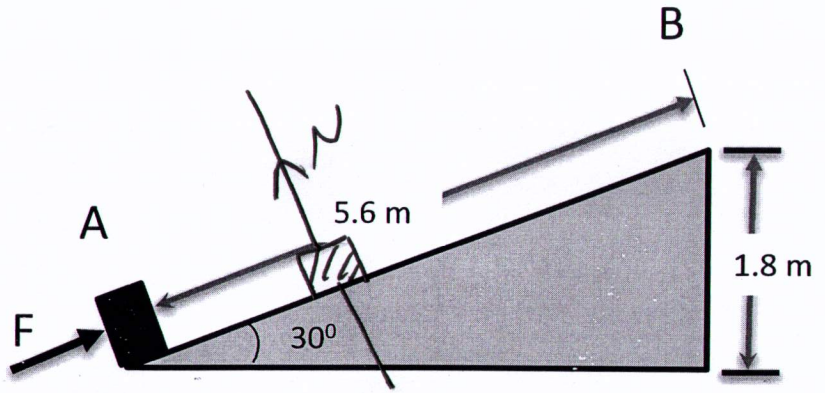
Example 2:

A force F causes the 2 kg box to slide up from point A to point B. The work done by the normal force on the box is:

Solution:

(C) $W_N = 0$ ⊥

(A) 49 J
(B) 110.84 J
(C) Zero
(D) 98 J



Kinetic En. and the Work-En. Theo.

Example 3:

Referring to Example 2, if F=100 N and the distance between point A to point B is 5.6 m, the work done by the applied force on the box is:

Solution:

(A) 560 J
(B) -117.6 J
(C) 98 J
(D) 980 J

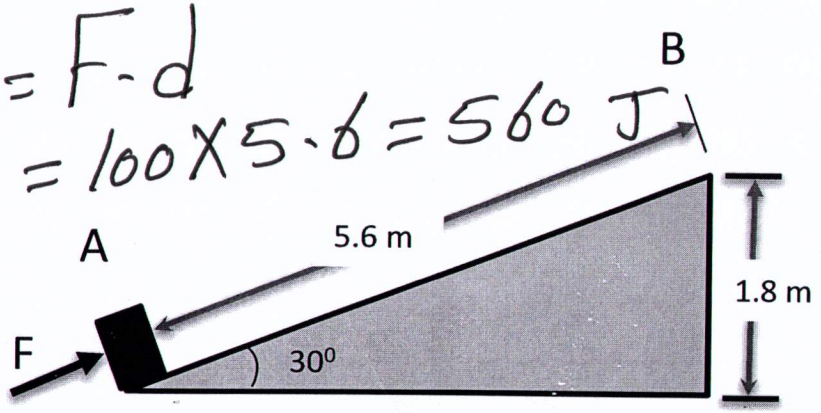
(A)

$F = 100\ N$

$d = 5.6\ m$

$W = F \cdot d$

$W = 100 \times 5.6 = 560\ J$



Kinetic En. and the Work-En. Theo.

Example :

A man of mass 102 kg climbs a stair of 5 m height at constant speed. The work done by the man is:

Solution:

(A) 999.6 J
(B) 510 J
(C) 4998 J
(D) 2499 J

(C)

$m = 102$ kg
$d = 5$ m

$$W = mgd$$

$W = 102 \times 9.8 \times 5$

$W = 4998$ J ©

Kinetic En. and the Work-En. Theo.

Kinetic Energy الطاقة الحركية

Kinetic energy K is energy associated with the *state of motion* of an object. The faster the object moves, the greater is its kinetic energy. When the object is stationary, its kinetic energy is zero.

For an object of mass m whose speed v is

$$K = \frac{1}{2}mv^2 \quad \text{(kinetic energy).}$$

* m mass kg
* v velocity m/s
* k kinetic E J

* The SI unit of kinetic energy (and every other type of energy) is the **joule** (J),

$$1 \text{ joule} = 1 \text{ J} = 1 \text{ kg} \cdot \text{m}^2/\text{s}^2$$

Kinetic En. and the Work-En. Theo.

Example 4:

الطاقة الحركية

An object that has kinetic energy must be:

Solution:

(A)

(A) moving
(B) falling
(C) at rest
(D) non of these

Kinetic En. and the Work-En. Theo.

Example 5:

A moving particle of mass 2 kg, has kinetic energy of 10 J. It speed is:

Solution:

(A) 980 m/s
(B) 9.8 m/s
(C) 10 m/s
(D) 3.16 m/s

(D)

$$K = \frac{1}{2} m v^2$$

$$10 = \frac{1}{2} \times 2 \times v^2$$

$$v = 3.16 \text{ m/s}$$

(d)

Kinetic En. and the Work-En. Theo.

Example 6:

A 4 kg cart starts up an incline with a speed of 3 m/s and comes to rest 2 m up the incline. The total work done on the cart is:

Solution:

(A) -6 J
(B) -8 J
(C) -12 J
(D) -18 J

(D)

$v_i = 3$ m/s

$v_f = 0$ m/s (Rest)

$m = 4$ kg

$$W = \frac{1}{2} m (v_f^2 - v_i^2)$$

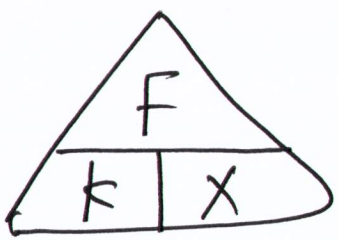
$$W = \frac{1}{2} \times 4 (0 - 9) \rightarrow W = -18 \text{ J}$$

Work and En. with Varying Forces

Example 8:

If the restoring force at distance 0.5 m is 15 N, then the work done in stretching spring a distance of 0.5 m is:

Solution:



(A)

$$k = \frac{F}{X} \qquad k = \frac{15}{0.5} = 30$$

(A) -3.75 J
(B) -6 J
(C) -9 J
(D) -12 J

$$W = -\frac{1}{2}k(\Delta X)^2$$

$$W = -\frac{1}{2} \times 30 (0.5)^2 = -3.75 \text{ J}$$

سالبة

Work and En. with Varying Forces

Example 9:

A force acts on a spring with length 30 cm. This force compressed it to be 25 cm. If the spring constant is 50 N/m, the work done by the spring is:

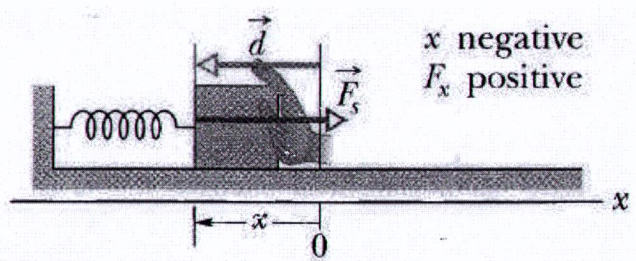
Solution:

(A) $W = -\frac{1}{2}k(\Delta x)^2$

$W = -\frac{1}{2} \times 50 (0.05)^2$

$W = -0.0625\ J$

(A) -0.0625 J
(B) -0.0825 J
(C) -0.0932 J
(D) -1.236 J



Power

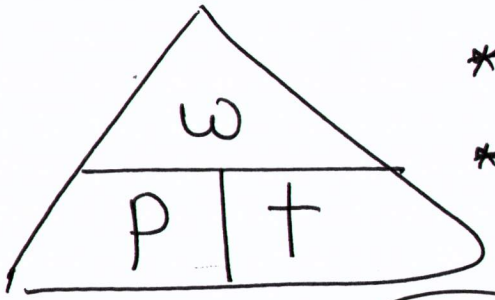
Example 10:

If the work done on a particle is 32 J in 4 s. The power is:

Solution:

(A) 36 W
(B) 8 W
(C) 1 W
(D) 6 W

(B)



* $W = 32$ J
* $t = 4$ s

$$P = \frac{32}{4} = 8 \text{ watt}$$

Power

Example 11:

A box was pushed 3 m across the floor in 12 s by a horizontal force of 200 N. The amount of power is:

Solution:

(C)

(A) 25 W
(B) 100 W
(C) 50 W
(D) 150 W

* $F = 200\ N$
* $d = 3\ m$
* $t = 12\ s$

$$P = \frac{w}{t} = \frac{F \cdot d}{t}$$

$$P = \frac{200 \times 3}{12} = 50 \text{ watt}$$