10/30/2013

S10 Unit B: Work and Energy Practice

Name: Key!

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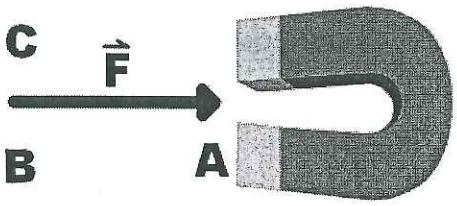
1. A Big Mac sandwich contains 2300 J. Assuming all of this energy is converted to useful energy in your body, how much work can you do after consuming the sandwich?

$W = \Delta E$

$W = 2300\,J$ of 25N

2. An iron nail placed near a powerful magnet that creates a magnetic force acting to the right, as shown. The nail is moved from point **A** to point **B** (a distance of 2.1 m), then from point **B** to point **C**.



a) What work is done on the nail by the magnet when moving from **A** to **B**?

$W = \vec{F}\vec{d}$

$= (25N)(2.1m) = 52.5J = 53J$

b) What work is done on the nail by the magnet when moving from **B** to **C**?

None. $\vec{F}$ → ↑ $\vec{d}$

3. Determine the displacement traveled by a car with an engine that applies a force of -5500 N and which consumes 6.5×10^6 J of energy.

variables list	*formula*	*substitution (with units) and algebra*
$\vec{F} = -5500N$ $WE = 6.5\times10^6 J$ $d = ?$	$W = \vec{F}\vec{d}$	$W = \vec{F}\vec{d}$ $6.5\times10^6 J = (-5500N)\,\vec{d}$ $\vec{d} = 1182m = -1.2\times10^3 m$

4. A spacecraft uses solar energy to power its thrust engines. The average output thrust force of one such engine is 7.1 mN. Determine the amount of work needed for one engine to move through 150 km in outer space.

variables list	formula	substitution (with units) and algebra
$F = 7.1\,mN$ $= 0.0071\,N$ $\vec{d} = 150\,km$ $= 150000\,m$ $W = ?$	$W = \vec{F}\vec{d}$	$W = (0.0071\,N)(150000\,m)$ $= 1065\,J$ $= 1.1 \times 10^3\,J$

5. Determine the gravitational potential energy of a 25 kg object moved to 20 m from the Earth's surface.

variables list	formula	substitution (with units) and algebra
$m = 25\,kg$ $h = 20\,m$ $\vec{g} = 9.81\,m/s^2$ $E = ?$	$E_p = mgh$	$E_p = (25\,kg)(9.81\,m/s^2)(20\,m)$ $= 4.9 \times 10^3\,J$

6. To what height would a 70 kg student need to climb a ladder if the student wanted to gain 10000 J of energy?

variables list	formula	substitution (with units) and algebra
$h = ?$ $m = 70\,kg$ $E = 10000\,J$ $\vec{g} = 9.81\,m/s^2$	$E_p = mgh$	$\div 70 \quad \div 9.81 \qquad \div 70 \quad \div 9.81$ $10000\,J = (70\,kg)(9.81\,m/s^2)h$ $h = 15\,m$

7. What amount of gravitational potential energy is given to a 500 g rock if it is moved 650 cm above the Earth's surface?

variables list	formula	substitution (with units) and algebra
$m = 500\,g$ $= 0.5\,kg$ $h = 650\,cm$ $= 6.5\,m$ $\vec{g} = 9.81\,m/s^2$	$E_p = mgh$	$\vec{E}_p = (0.5\,kg)(9.81\,m/s^2)(6.5\,m)$ $= 31.9\,J$

$E_p = ?$

8. Determine the kinetic energy of a 2700 kg car moving at 25 m/s.

variables list	formula	substitution (with units) and algebra
$m = 2700\,kg$ $\vec{v} = 25\,m/s$ $E_K = ?$	$E_K = \frac{1}{2}m\vec{v}^2$	$E_K = \frac{1}{2}(2700\,kg)(25\,m/s)^2$ $= 843750\,J$ $= 8.4 \times 10^5\,J$

9. A bumble bee has a mass of 4.00 g and can move with a speed of 80 km/h. Determine the kinetic energy of this bee.

variables list	formula	substitution (with units) and algebra
$m = 4\,g$ $= 0.004\,kg$ $v = 80\,km/h$ $= 22.2\,m/s$ $E_K = ?$	$E_K = \frac{1}{2}mv^2$	$E_K = \frac{1}{2}(0.004\,kg)(22.2\,m/s)^2$ $= 0.99\,J$

10. A rock is thrown with a velocity of 10 m/s and has a kinetic energy of 250 J. What is the mass of the rock?

variables list	formula	substitution (with units) and algebra
$v = 10\,m/s$ $E_K = 250\,J$ $m = ?$	$E_K = \frac{1}{2}mv^2$	$\div 0.5 \quad \div 0.5$ $250\,J = \frac{1}{2}(m)(10\,m/s)^2$ $\div 10^2 \quad 500 = m(10\,m/s)^2 \div 10^2$ $m = 5.0\,kg$

11. A 13 kg box is pushed and given a kinetic energy of 400 J. Determine the speed of the box, in m/s.

variables list	formula	substitution (with units) and algebra
$m = 13\,kg$ $E_K = 400\,J$ $v = ?$	$E_K = \frac{1}{2}mv^2$	$\div 0.5 \quad \div 0.5$ $400\,J = \frac{1}{2}(13\,kg)\vec{v}^2$ $\div 13 \quad \div 13$ $800 = 13(v)^2$ $\sqrt{61.5} = \sqrt{v^2}$ $\vec{v} = 7.8\,m/s$