J kg $\frac{m}{s}$ NOT $\frac{km}{h}$!

$E_k = \frac{1}{2} mv^2$

$J = \frac{1}{2}(kg)\left(\frac{m}{s}\right)^2$ ← DO NOT FORGET

What are the units of kinetic energy?

Practice Problems = really exercises → m/s

1. A car with a mass of 1500 kg is moving at a speed of 50 km/h.

   What is its E_k? start with the formula

$V = 50\frac{km}{h} \times \frac{1000m}{1km} \times \frac{1h}{3600s} = 14\frac{m}{s}$

$m = 1500\,kg$

$E_K = ?$

$E_K = \frac{1}{2}mv^2 = \frac{1}{2}(1500kg)\left(\frac{14m}{s}\right)^2 = 150000\,J$

2. A hockey puck has a mass of 210 g. — m

   If the hockey puck has 73 J of kinetic energy, what is its speed? — V = ?

$\sqrt{\frac{2 \cdot E_K}{m}} = \sqrt{\frac{\frac{1}{2}mv^2 \cdot 2}{m}}$ — E_K

$210g \times \frac{1kg}{1000g} = 0.21\,kg$

$\therefore V = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(73J)}{0.21\,kg}} = 26\frac{m}{s} = V$

Work and potential energy

If work is done on an object to set that object in motion (example: throwing a baseball), then this is considered **positive work**.

F → d

If work removes kinetic energy from the object (example: catching the baseball), then this is considered **negative work**.

← F → d

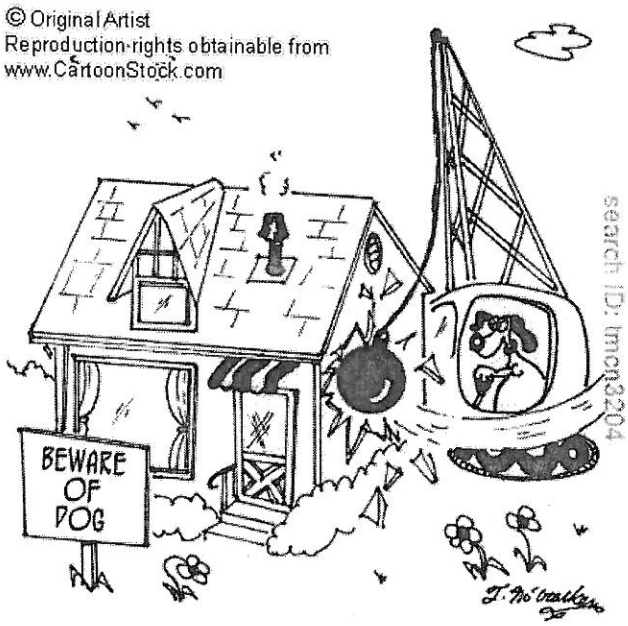
Ball

Other examples of negative work - braking a car.

Practice Questions

1. A wrecking ball, as seen in the diagram below, has a mass of 315 kg.

   If it is moving at a speed of 5.12 m/s, what is its kinetic energy?



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

$E_k = ?$

$= \frac{1}{2}(315\,kg)\left(5.12\,\frac{m}{s}\right)^2$

$= 4130\ J$

2. A freight elevator with a mass of 120 kg is moving with a speed of 2.50 m/s.

   What is its kinetic energy?

$E_k = \frac{1}{2} m v^2 = \frac{1}{2}(120\,kg)\left(2.50\,\frac{m}{s}\right)^2$

$= 380\ J$

3. A student with a mass of 55 kg is jogging at a speed of 1.6 m/s.

   What is the student's kinetic energy?

$E_k = \frac{1}{2} m v^2 = \frac{1}{2}(55\,kg)(1.6\,m/s)^2 = 70.\ J$

4. An electron with a mass of 9.11×10^{-31} kg is moving at a speed of 2.19×10^{7} m/s.

   What is the kinetic energy of the electron?

$E_k = \frac{1}{2} m v^2 = \frac{1}{2}(9.11 \times 10^{-31}\,kg)(2.19 \times 10^{7}\,m/s)^2$

$= 2.18 \times 10^{-16}\ J$

? — v — Ek

5. A basketball that is moving with a speed of 6.1 m/s has 8.4 J of kinetic energy. What is the mass of the basketball?

$$\frac{2 \cdot E_K}{v^2} = \frac{\frac{1}{2} m v^2 \cdot 2}{v^2} = \frac{2 \times 8.4\,J}{(6.1\,m/s)^2} = 0.45\,kg$$

6. A bowling ball is moving at a speed of 2.21 m/s. — v

If the kinetic energy of the bowling ball is 15.7 J, what is its mass? — Ek

$$m = \frac{2E_K}{v^2} = \frac{2(15.7\,J)}{(2.21\,m/s)^2} = 6.43\,kg$$

7. What is the speed of a 0.155 kg billiard ball that has 12.0 J of kinetic energy?

$$v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(12.0\,J)}{0.155\,kg}} = 12.4\,m/s$$

8. You are paddling a canoe. The combined mass of the canoe and your body is 115 kg.

If you and the canoe have a kinetic energy of 75 J, how fast are you paddling the canoe?

$$v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(75\,J)}{115\,kg}} = 1.1\,m/s$$

9. A 15 kg child is sliding down a playground slide.

If the child's kinetic energy is 77J, how fast is the child sliding?

$$v = \sqrt{\frac{2E_K}{m}} = \sqrt{\frac{2(77\,J)}{15\,kg}} = 3.2\,m/s$$