# CALCULATIONS POTENTIAL + KINETIC ENERGY WORKSHEETS

$$E_p = m g h$$

The **POTENTIAL ENERGY** contained by a body is the energy contained by virtue of its position.

**PROBLEM**

What POTENTIAL ENERGY is gained by a bucket of water, mass 20kg, if it is raised 2 m vertically.

Interpret the question. What information has been given?

$m = 20$ kg
$h = 2$ m
$g = 9.8$ m $s^{-2}$

What do you have to find?

$E_p = ?$

What mathematical equation will you use?

$E_p = mgh$

Substitute into the equation.

$E_p = 20 \times 9.8 \times 2$

Calculate the value of $E_p$.

$E_p = 392$ J

State the result clearly.

The energy gained by bucket of water was 392 J.

# POTENTIAL ENERGY

(Use $g = 9.8\ m/s^2$)

1. An oil drum is rolled onto a utility 1 m above the ground. The potential energy acquired by the drum is 2 000 J. Find the mass of the drum.

2. An artificial satellite (mass 20 kg) reaches a height of 100 km above the surface of the earth. What is its gain in potential energy?

3. A lawn-mower is pushed up a ramp onto the back of a trailer. The $E_p$ of the mower increased by 750 J. If the mass of the mower is 100 kg find the height of the trailer.

4. The mass of an aeroplane is 12 000 kg. If it climbs up 5 000 m after take off what is its increase in potential energy?

5. The gain in potential energy of an aeroplane after take off is $5 \times 10^6$ J. If its mass is 10 000 kg what is its height above the ground?

6. If a ball of mass 0.5 kg is thrown vertically into the air to a height of 20 m what is the maximum potential energy it could acquire?

7. A pendulum bob weighing 30 N is displaced so it is 0.1 m above its lowest position. What is its potential energy?

**ANSWERS**

| | |
|---|---|
| 1. 204 kg | 5. 51 m |
| 2. $1.96 \times 10^7$ J | 6. 98 J |
| 3. 0.76 m | 7. 3 J |
| 4. $5.88 \times 10^8$ J. | |

**KINETIC ENERGY** is the energy a body has because it is in motion.

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

**PROBLEM:**

How much heat and would energy will be produced when a bullet of mass 1 g travelling at 400 $ms^{-1}$ strikes and comes to rest in a wooden target?

**Interpret the question**

The kinetic energy of the bullet will be converted into heat and sound.

**What information has been given? What do you have to find?**

$m = 1\ g = 0.001\ kg$
$v = 400\ ms^{-1}$
$E_k = ?$

**Write down the mathematical equation you will use.**

$E_k = 0.5\ m\ v^2$

**Substitute into the equation.**

$= 0.5 \times 0.001 \times 400 \times 400$

**Calculate the value of $E_k$.**

$= 80\ J$

**State the answer clearly.**

80 J of heat and sound will result from the deceleration of the bullet.

# KINETIC ENERGY

1. Calculate the Kinetic energy of a mass of 20 kg moving at a speed of 4 $ms^{-1}$.

2. A body accelerates at 5 $ms^{-2}$ for 20 seconds from rest. If the increase in kinetic energy is 2 5000 J find the mass of the body.

3. Calculate the kinetic energy of:

   (i) a cyclist of mass 80 kg travelling at 9 $ms^{-1}$.
   (ii) a car of mass 1 200 kg travelling at 30 $ms^{-1}$.
   (iii) a bullet of mass 4 g travelling at 400 $ms^{-1}$.

4. A body accelerates at 10 $ms^{-2}$ for 10 seconds from rest. If the mass of the body is 20 kg calculate its increase in kinetic energy.

5. Calculate the kinetic energy of a body of mass 5 kg, 10 seconds after starting from rest with an acceleration of 4 $ms^{-2}$.

6. An object of mass 10 kg is moving at 20 $ms^{-1}$.

   (i) What is its kinetic energy?
   (ii) If it is now accelerated by a force so it reaches a velocity of 40 $ms^{-1}$ what will be the increase in kinetic energy?

**ANSWERS**

1. 160 J

2. 0.5 kg

3. (i) 3240 J
   (ii) 540 000 J
   (iii) 320 J

4. 100 000 J

5. 4 000 J

6. (i) 2 000 J
   (ii) 6 000 J