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TOPIC 7: WORK, ENERGY, POWER

THE ABOUT

CHAPTER ANALYSIS

MASTERY

- Need to be clear about relationship between energy & work done
- Heavy calculation chapter

EXAM

- Conservation of energy commonly tested
- Know how to calculate work done

WEIGHTAGE

- Medium overall weightage
- Constitute to around **4%** of marks for past 5 year papers

KEY CONCEPT

ENERGY
KINETIC ENERGY & GRAVITATIONAL POTENTIAL ENERY
WORK DONE

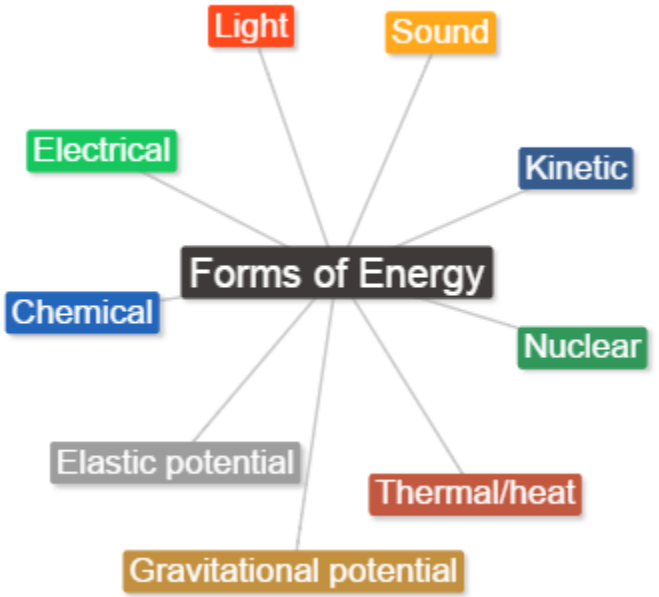
ENERGY

ENERGY

Energy is defined as the **capacity to do work.**

Unit: **Joule (J)**

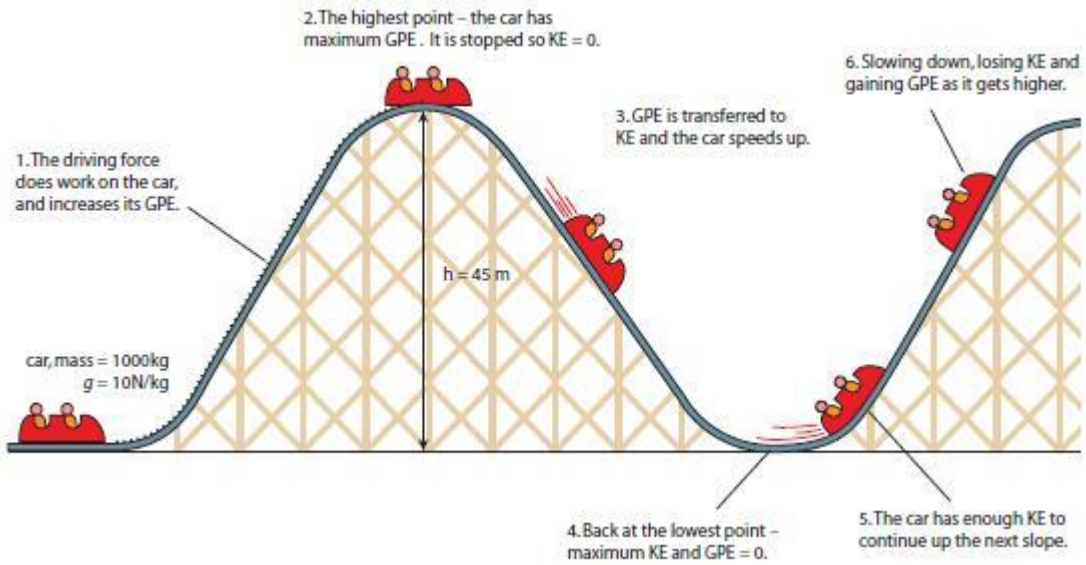
Energy is a scalar quantity.



PRINCIPLE OF CONSERVATION OF ENERGY

Principle of Conservation of Energy

The principle of conservation of energy states that **energy cannot be created or destroyed** but can only change from one form to another or transferred from one body to another but the **total amount of energy** in the system is **always constant**.



Kinetic Energy

Kinetic energy is defined as the energy a body possesses due to its motion.

Formula:

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

Kinetic energy is directly proportional to mass and velocity squared.

Gravitational Potential Energy

Gravitational potential energy is the energy possessed by a body due to its position within a gravitational field.

Formula:

$$GPE = mgh$$

Gravitational potential energy is directly proportional to mass and height of object.

WORK DONE

Work done & energy has the same units, Joules (J).

The best way to understand their relationship is:

"We use energy to get work done"

WORK DONE

Work done is defined as the product of the force and the distance moved in the direction of the force.

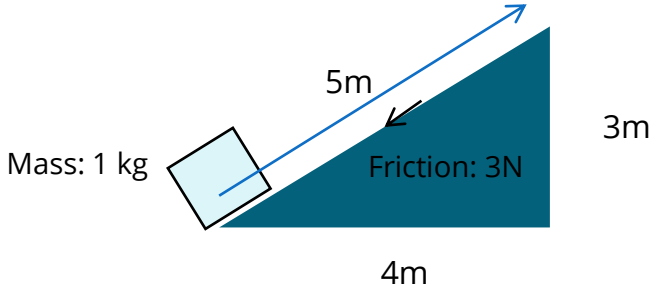
Units: Joule (J) or Nm

Formula:

Work Done = F x d

Work done can also be understood as the amount of energy that has been converted from one form to another or transferred from one body to another.

Example



For the box to move up the slope, there is work done to overcome friction.

Work Done against friction = F x d = 3N x 5m =15 J

The box also gained gravitational potential energy. This gain in energy is also work done as somebody had to exert energy to move the box to its new position.

Gain in GPE = mgh = 1 x 10 x 3 = 30 J

KEY CONCEPT

POWER EFFICIENCY

POWER

Efficiency

Efficiency is defined as the ratio of useful energy output to total energy input.

Formula:

$$\text{Efficiency} = \frac{\text{Useful output}}{\text{Total output}} \times 100\%$$

**Note that no system in the world is 100% efficient!*

POWER

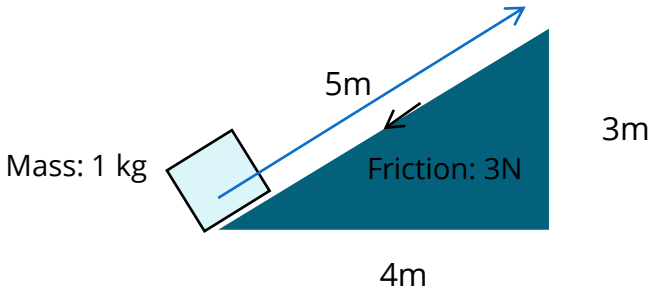
Power is defined as rate of doing work or the rate at which energy changes from one form to another.

Units: watt (W)

Formula:

$$\text{Power} = \frac{\text{Work Done}}{\text{Time}} = \frac{\triangle \text{ energy}}{\text{Time}}$$

Example



Work Done against friction = F x d = 3N x 5m =15 J

Gain in GPE = mgh = 1 x 10 x 3 = 30 J

Total work done = 45 J

If the entire process took 10s,

P = Work Done / time
= 45J / 10s
= 4.5 W

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