Work, power, energy and machine advantage

Calculate mechanical advantage and convert commercial electrical units to joules

Machines, power and energy units

◈ Mechanical advantage (MA)

- Mechanical advantage MA = Load (L) ÷ Effort (E); it has no unit as newtons cancel.
- Worked example: lifting a 200 N load with a 50 N effort gives MA = 200 ÷ 50 = 4.
- MA > 1 means the machine multiplies force; MA < 1 trades force for speed or range.

○ Work and conservation of energy

- Work $W = F \times d \cos\theta$; SI unit is the joule (1 J = 1 N × 1 m).
- In an unpowered machine with no stored-energy release, output work cannot exceed input work.
- For an ideal machine, a fourfold force gain needs fourfold effort distance.

◇ Power: rate of doing work

- Power P = Work ÷ time = Energy ÷ time; SI unit is the watt ($1\ W = 1\ J\ s^{-1}$).
- 1 kilowatt = 1000 watts = 1000 joules per second.
- Do not confuse power (rate of use) with energy (power × time).

□ Kilowatt-hour (kWh) to joules

- 1 kWh is the energy used by a 1 kW device running for 1 hour (3600 seconds).
- Conversion: 1 kWh = 1000 W × 3600 s = 3,600,000 J = 3.6×10^6 J.
- Electricity consumption is commonly billed in units of 1 kWh.

REMEMBER Mechanical advantage is Load ÷ Effort (200 N ÷ 50 N = 4), and 1 kWh is a unit of energy equal to 3.6×10^6 J.

Sources & practice · OpenStax — Electrical energy and power

mindmapsforupsc.com/mindmaps/pet-work-power-energy/?lang=en