

4.2 Work and Power

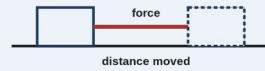
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1. KEY VOCABULARY

TERM	MEANING
Work done	Energy transferred when a force moves an object (joules, J).
Power	The rate of transferring energy — joules per second (watts, W).
Joule	The unit of energy and of work done.
Watt	The unit of power — one joule per second.
g	Gravitational field strength — about 10 N/kg on Earth.

2. DOING WORK

DOING WORK



Work is done whenever a force moves an object through a distance — energy is transferred.

Work done = energy transferred (both in joules, J)

THE EQUATIONS

work done = force × distance
 $W = F \times d$ (in the direction of the force)

power = work done ÷ time
 $P = W \div t$ — power is measured in watts (W)

gravitational PE = mass × g × height
 kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{velocity}^2$

Power is the RATE of doing work — how much energy is transferred each second.

3. THE KEY EQUATIONS

work done = force × distance moved ($W = F \times d$)

power = work done ÷ time taken ($P = W \div t$)

work done = energy transferred

4. ENERGY EQUATIONS

gravitational PE = mass × g × height

kinetic energy = $\frac{1}{2} \times \text{mass} \times \text{velocity}^2$

When an object falls, gravitational PE is transferred to kinetic energy.

5. WORK vs POWER

Work done tells you HOW MUCH energy was transferred.

Power tells you HOW FAST it was transferred.

A more powerful motor does the same work in less time.

6. THE WHY

Why no work is done holding a heavy box still: the box does not move, so the distance moved is zero — and $W = F \times d$.

Why power matters as well as work: two machines can do the same job, but the one that does it faster is more powerful.

7. COMMON EXAM MISTAKES

✗ "Holding something up does work."

✓ No movement means no distance — so no work is done.

✗ Confusing the units of work and power.

✓ Work / energy = joules (J); power = watts (W).

✗ Forgetting to square the velocity in KE.

✓ $KE = \frac{1}{2} m v^2$ — the velocity is squared.

8. SELF-CHECK · cover & quiz

Can you...

1. Define work done and power, with units?

2. Use $W = F \times d$ and $P = W \div t$?

3. Calculate gravitational PE and kinetic energy?

4. Explain the difference between work and power?

5. Explain why holding a box still does no work?