PEARSON EDEXCEL IAL PHYSICS | UNIT 1

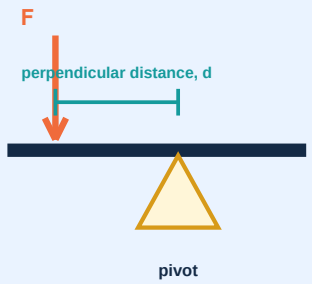
LESSON 1.1.5

Moments, Energy,

Work and Power

Forces can turn objects and transfer energy. Power tells us how quickly that transfer happens.

TURNING EFFECT ABOUT A PIVOT



FOUR IDEAS, ONE ENERGY STORY

MOMENT	WORK	ENERGY	POWER
M = Fd	W = Fs	E changes	P = E / t

THE COMMON LINK

A force can produce a turning effect or transfer energy through a displacement. Energy is conserved, while power describes the rate of transfer.

BY THE END, YOU SHOULD BE ABLE TO...

TURNING AND BALANCE

Calculate moments with perpendicular distance and apply clockwise moments = anticlockwise moments.

ENERGY AND RATE

Calculate work, kinetic and gravitational energy, power and efficiency with correct SI units.

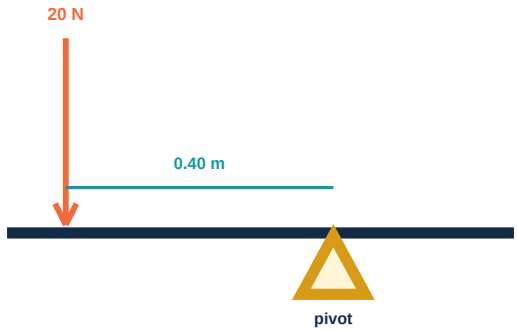
CORE HABIT

Start with a clear system or pivot, then identify the correct distance, direction and energy pathway.

1 Moments, equilibrium and work

A moment depends on perpendicular distance. Work depends on displacement in the direction of the force.

THE MOMENT OF A FORCE



USE THE PERPENDICULAR DISTANCE

$$M = Fd_{perpendicular}$$

$$M = (20)(0.40) = 8.0 \text{ N m}$$

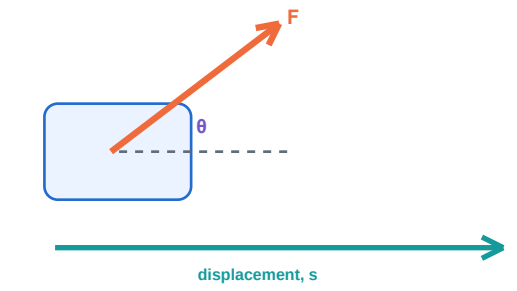
Unit: newton metre, N m

ROTATIONAL EQUILIBRIUM

sum of clockwise moments = sum of anticlockwise moments

Complete equilibrium also requires resultant force = 0.

WORK DONE BY A FORCE



parallel: $W = Fs$

at an angle: $W = Fs \cos \theta$

50 N through 3.0 m gives W = 150 J

COMMON TRAPS

Moment: do not use the handle length unless it is perpendicular. Work: only the component of force parallel to displacement transfers energy.

2 Energy, power and efficiency

Energy is transferred between stores. Power measures the transfer rate, and efficiency compares useful output with total input.

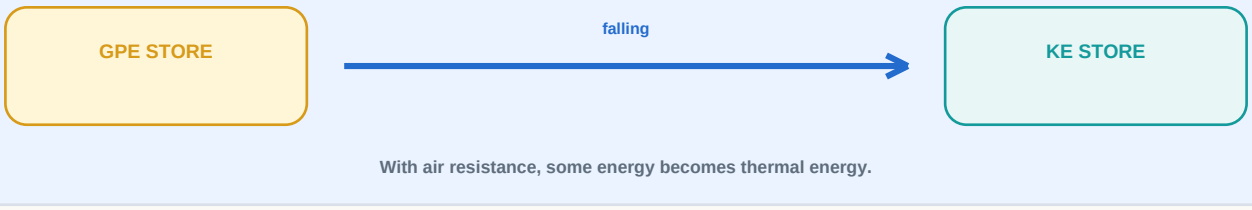
MECHANICAL ENERGY STORES

KINETIC ENERGY

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

GRAVITATIONAL POTENTIAL ENERGY

$$\Delta E_p = mg\Delta h$$



With air resistance, some energy becomes thermal energy.

POWER AND EFFICIENCY

ENERGY RATE

$$P = \frac{\Delta E}{\Delta t}$$

WORK RATE

$$P = \frac{W}{t}$$

EFFICIENCY

$$\text{efficiency} = \frac{\text{useful output}}{\text{total input}}$$

multiply by 100 for %

At constant velocity with force parallel to motion: $P = Fv$

WORKED CHECKS

LIFTING

$$\Delta E = mg\Delta h$$

$= (2.0)(9.81)(5.0) = 98.1$ J

MOTOR

$$P = E / t$$

$= 6000 / 20 = 300$ W

Check the unit: energy in joules, power in watts, and efficiency cannot exceed 100%.