Physics 20

Unit C: Circular motion and energy

Energy transfer technologies

A meteor meets the ground

- A meteor of mass 2.40 times 10 to the fifth kilograms hits at 1.10 times 10 to the fourth m/s.
- Its kinetic energy is 1.45 times 10 to the thirteenth joules, a sudden transfer into the ground.



Efficiency and energy transfer

- A space probe swings past a moving planet and trades speed with that planet.
- Efficiency equals useful output divided by total input.
- A sustainable transfer does the job and looks after the land, the fuel, and the waste.

Key terms

gravity assist

A gravity assist is a close pass by a moving planet that exchanges momentum and energy with a spacecraft.

efficiency

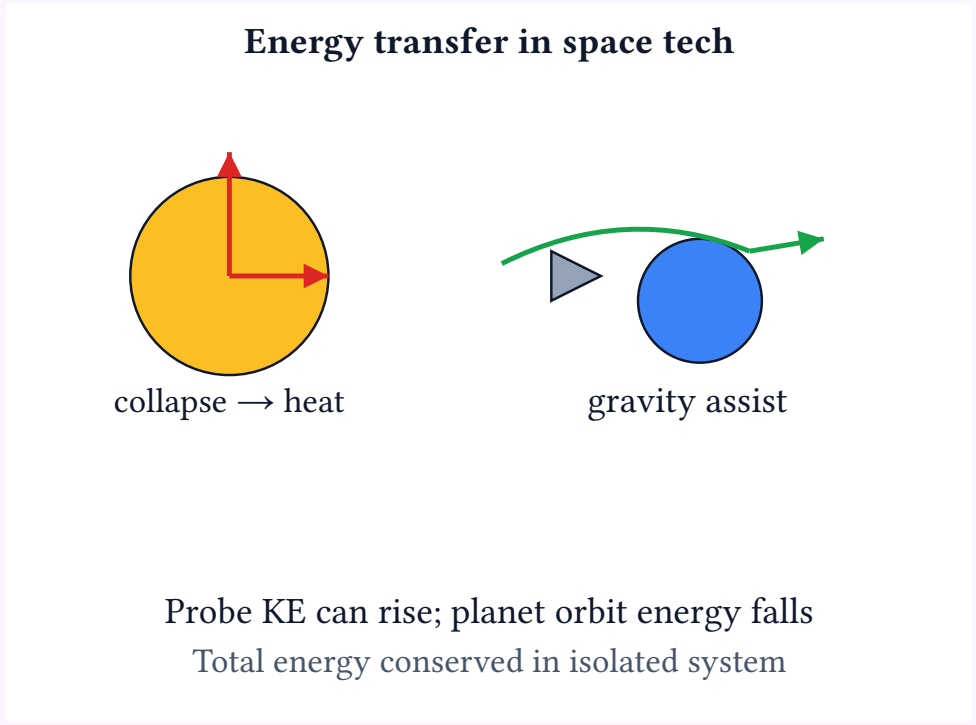
Efficiency is the useful energy output divided by the total energy input. (efficiency = useful output / total input)

sustainable energy transfer

Sustainable energy transfer meets an energy need while caring for the environment that receives the waste and supplies the source.

A collapsing shell and a planetary swing

- A collapsing star turns gravitational potential energy into thermal energy and radiation.
- A space probe swings past a moving planet and trades speed with that planet.
- The probe's kinetic energy can rise while the planet's orbital energy falls by the same amount.

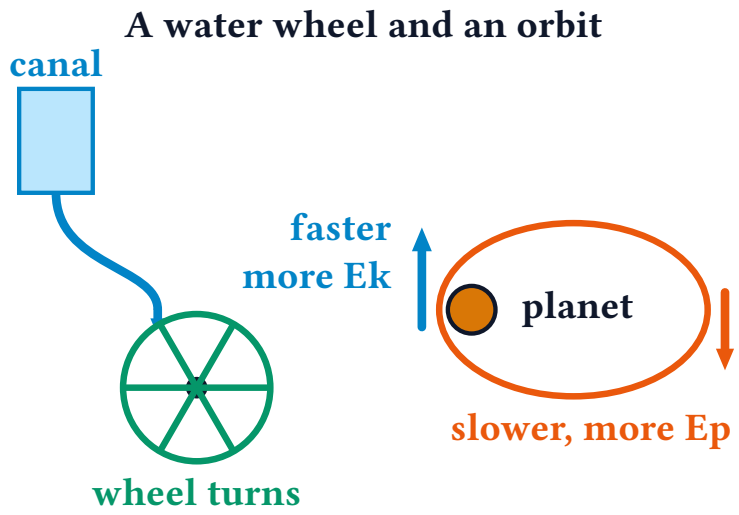


Kinetic energy of the meteor

- Mass 2.40 times 10 to the fifth kilograms, speed 1.10 times 10 to the fourth m/s.
- Ek = one half × $(2.40\times10^{5}\ \text{kg}) \times (1.10\times10^{4}\ \text{m/s})^{2}$.
- That kinetic energy is 1.45×10^{13} J into the ground.

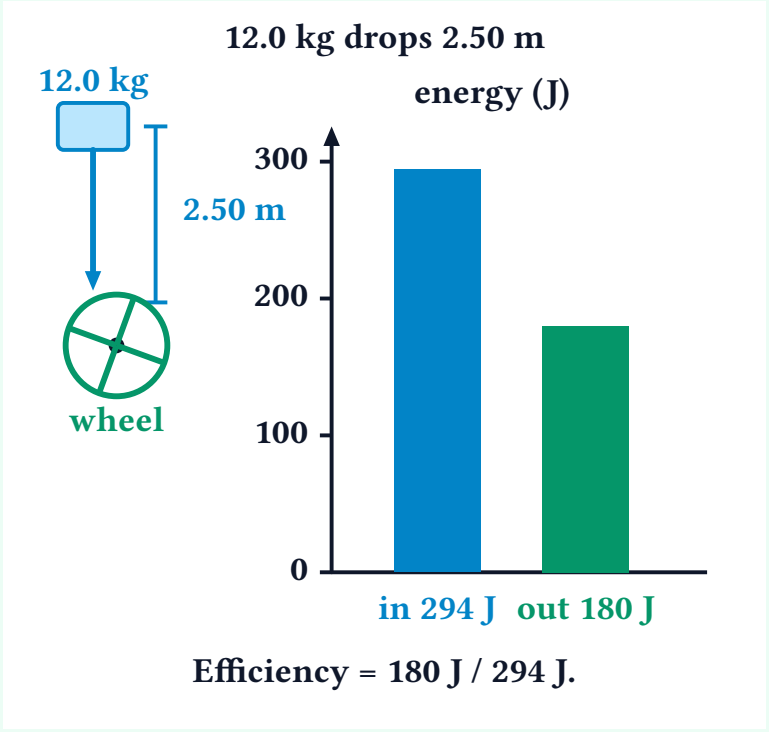
Historical energy technologies

- Closer to the planet the satellite moves faster. Farther out it moves slower, trading kinetic energy and gravitational potential energy.
- Inca terrace canals move water by gravity, and a water wheel turns that motion into rotation.
- Efficiency is useful output over total input, and an Alberta furnace or hydro plant can raise it.



Efficiency of the terrace wheel

- Canal water of mass 12.0 kg drops 2.50 m and can supply 294 J.
- The wheel delivers 180 J of rotation.
- Efficiency is useful output divided by total input.



The furnace ratio

- A home needs 64.0 MJ of useful heat.
- Compare fuel input at efficiency 0.680 with fuel input at efficiency 0.960.
- Say how the higher ratio cares for the surroundings.

Image credits

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