Physics 20

Unit C: Circular motion and energy

Work and power

A sled rope at 25 degrees

- A student pulls a sled with 48.0 N at 25 degrees above the horizontal through a displacement of 6.00 m.
- That pull transfers 261 J, and the same job done in 8.00 s has a power of 32.6 W.

Work and power

- W is the work, F is the force, d is the displacement, and theta is the angle between them.
- Work equals F d cos theta. P is the power, equal to W divided by delta t, and delta means final minus initial.
- W_{net} means the net work. It equals delta Ek, the change in kinetic energy.

Key terms

work

Work is the energy transferred by a force along a displacement, equal to F d cos theta. (W = F d cos theta)

power

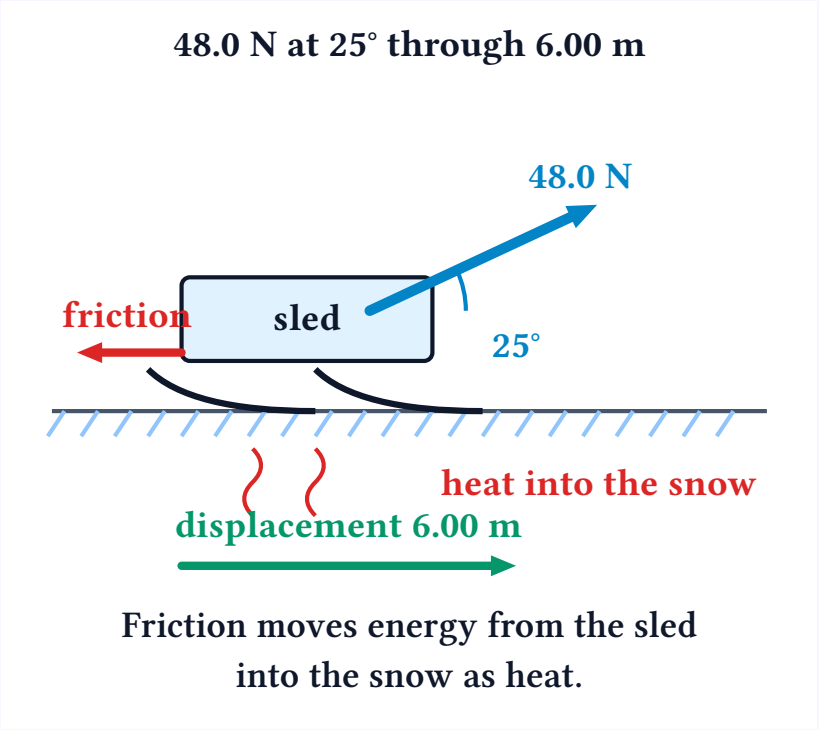
Power is the rate of doing work, equal to work divided by the elapsed time. (P = W / delta t)

work energy theorem

The work energy theorem says the net work on an object equals its change in kinetic energy. (W_{net} = delta Ek)

An open system warms the snow

- A free body diagram organizes the forces before work is calculated.
- An open system exchanges energy with the surroundings, so mechanical energy inside can change.
- Friction transfers energy into the snow and the runners as thermal energy.



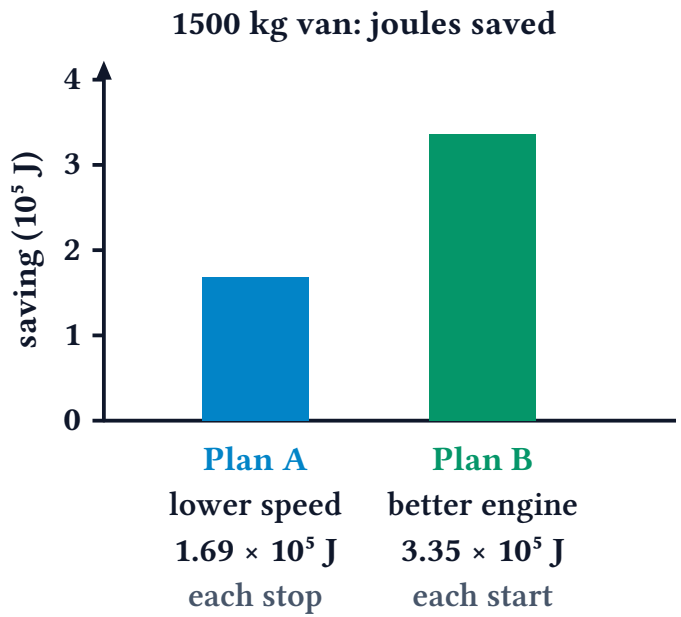
Friction moves energy from the sled into the snow as heat.

Joules and watts for the sled pull

- The pull is 48.0 N through 6.00 m at 25 degrees from the displacement.
- W = (48.0 N)(6.00 m)(cos 25 degrees) = 261 J.
- Power = 261 J / 8.00 s = 32.6 W.

Net work and kinetic energy

- W_{net}, the net work, equals delta Ek, the change in kinetic energy.
- A lower speed limit and a more efficient engine save different joules on a 1500 kg van.
- A table of the two savings, a bar for each plan, and one sentence say which plan saves more joules.



Net work equals the kinetic energy change.

Comparing energy savings

- Plan A saves 1.69 times 10 to the fifth joules of kinetic energy at each stop.
- Plan B saves 3.35 times 10 to the fifth joules of fuel energy at each acceleration to 25.0 m/s.
- State which route data would decide the better plan.

A car’s kinetic energy change

- A 1000 kg car speeds up from 10.0 m/s to 20.0 m/s over 50.0 m.
- Find delta Ek and the net force along the displacement.
- Name the theorem that links them.