
Chapter 8.

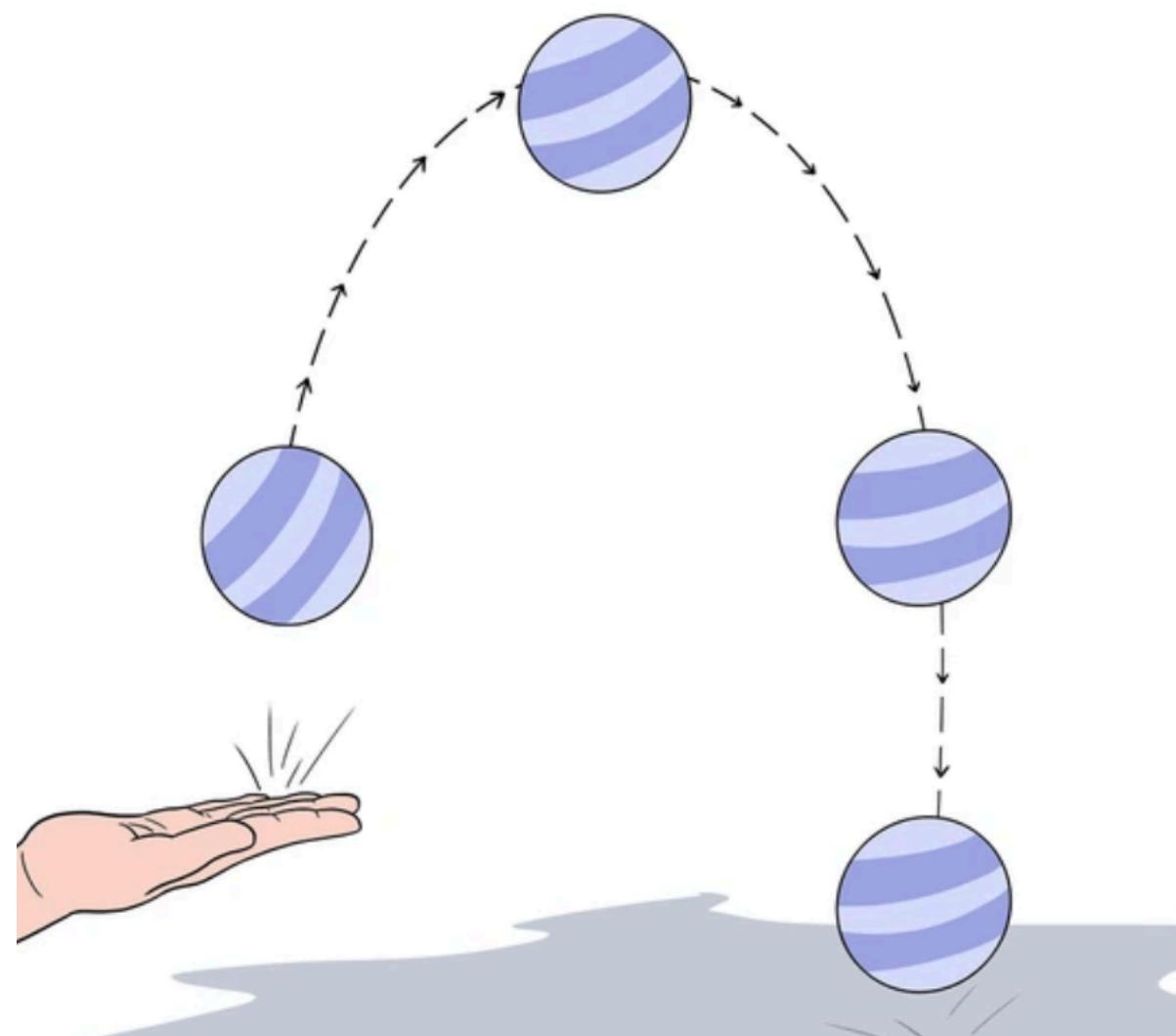
Work and Power

New Words

crane, crate, plank, ramp, work, power

Work Done & Energy Transfer

Throw a ball vertically upwards, how does its speed/energy change during the whole process? why does its energy change?



Work Done & Energy Transfer

Work done by a force = force * distance in the direction of force

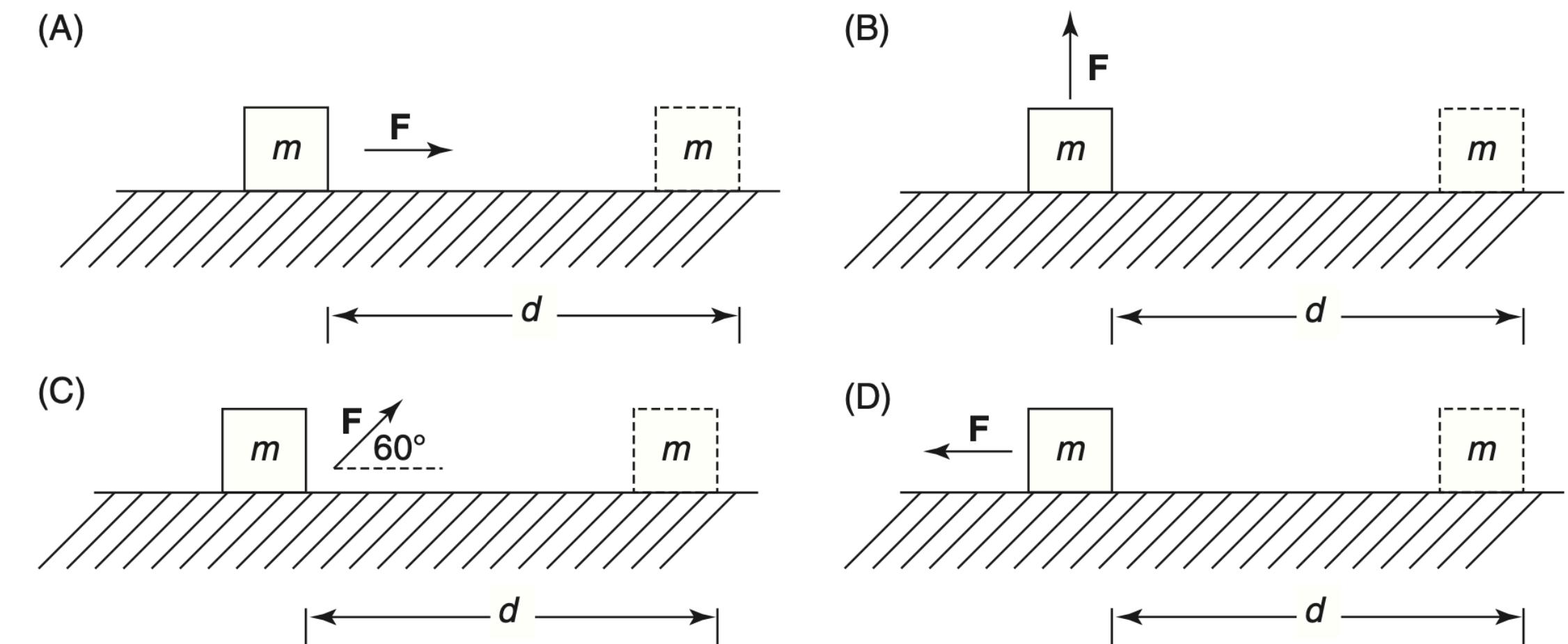
★Equation:

$$W = Fd$$

Italic

Unit: J 1 J = 1 Nm

Recall:



Gravitational potential energy(g.p.e): energy due to **height**

★Equation: $E_p = mgh$

g.p.e. = Mass × gravitational field strength × height

Unit: J 1 J = 1 Nm Same as moment M; *Unit of Impulse? Pressure?*

Work Done & Energy Transfer

Work done by a force = force * distance in the direction of force

★Equation:

$$W = Fd$$

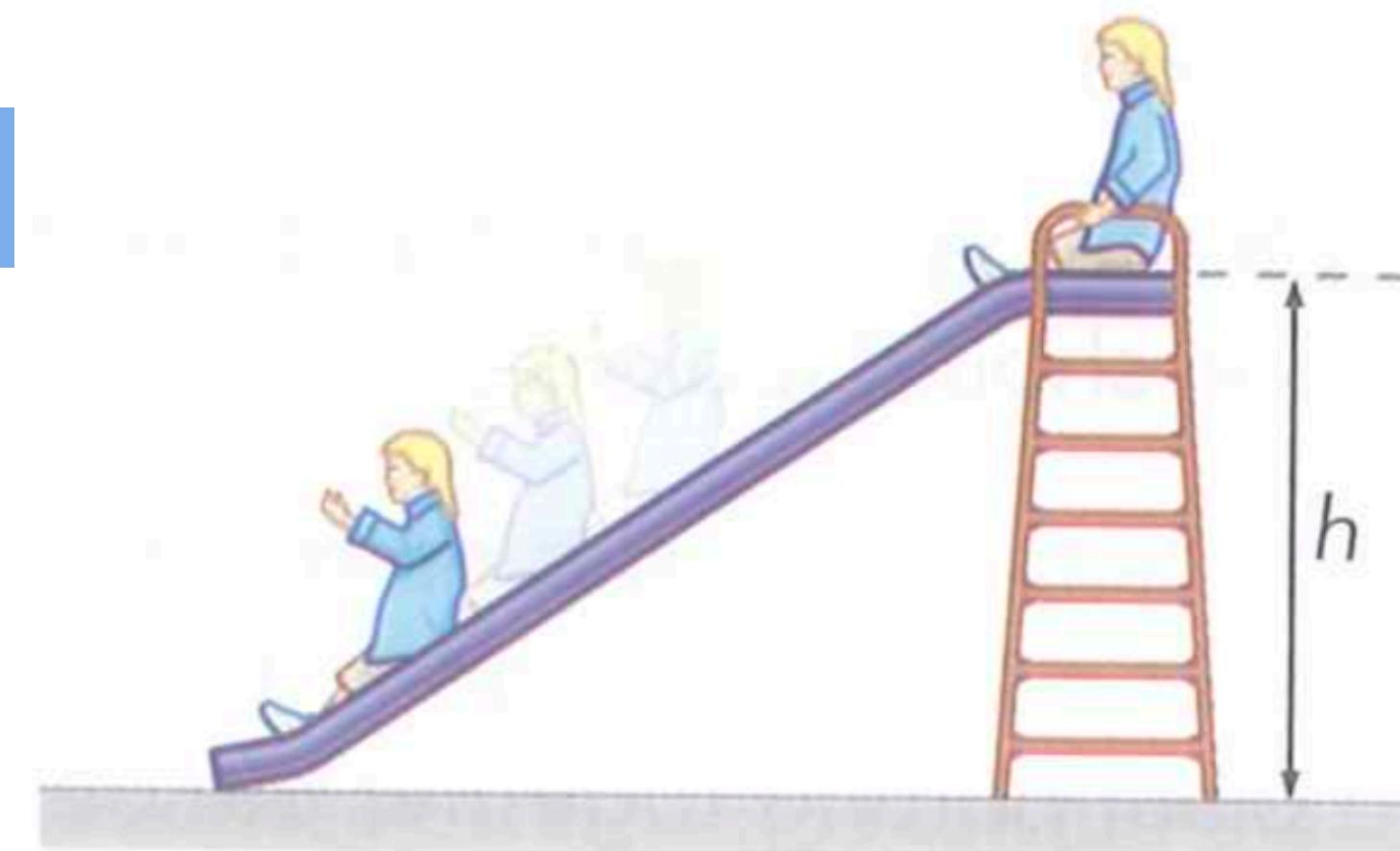
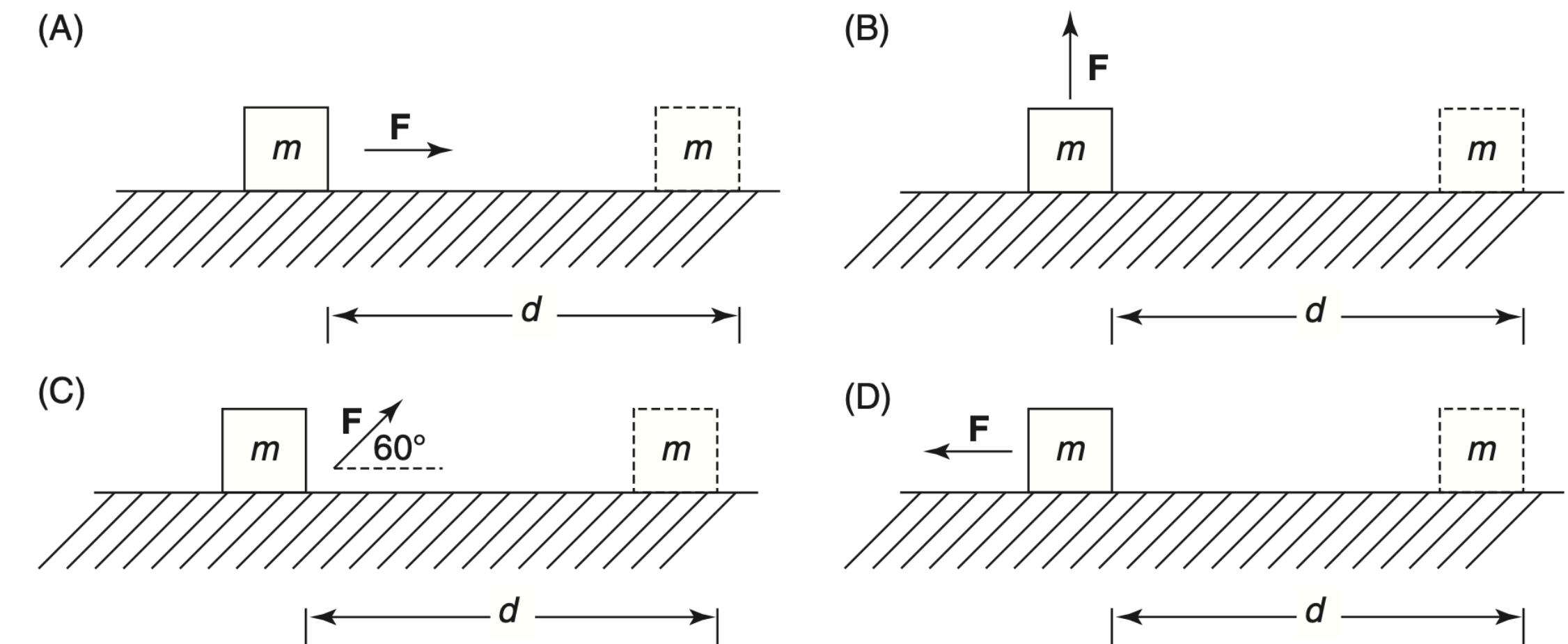
Unit: J $1 \text{ J} = 1 \text{ Nm}$

Italic

To increase work:

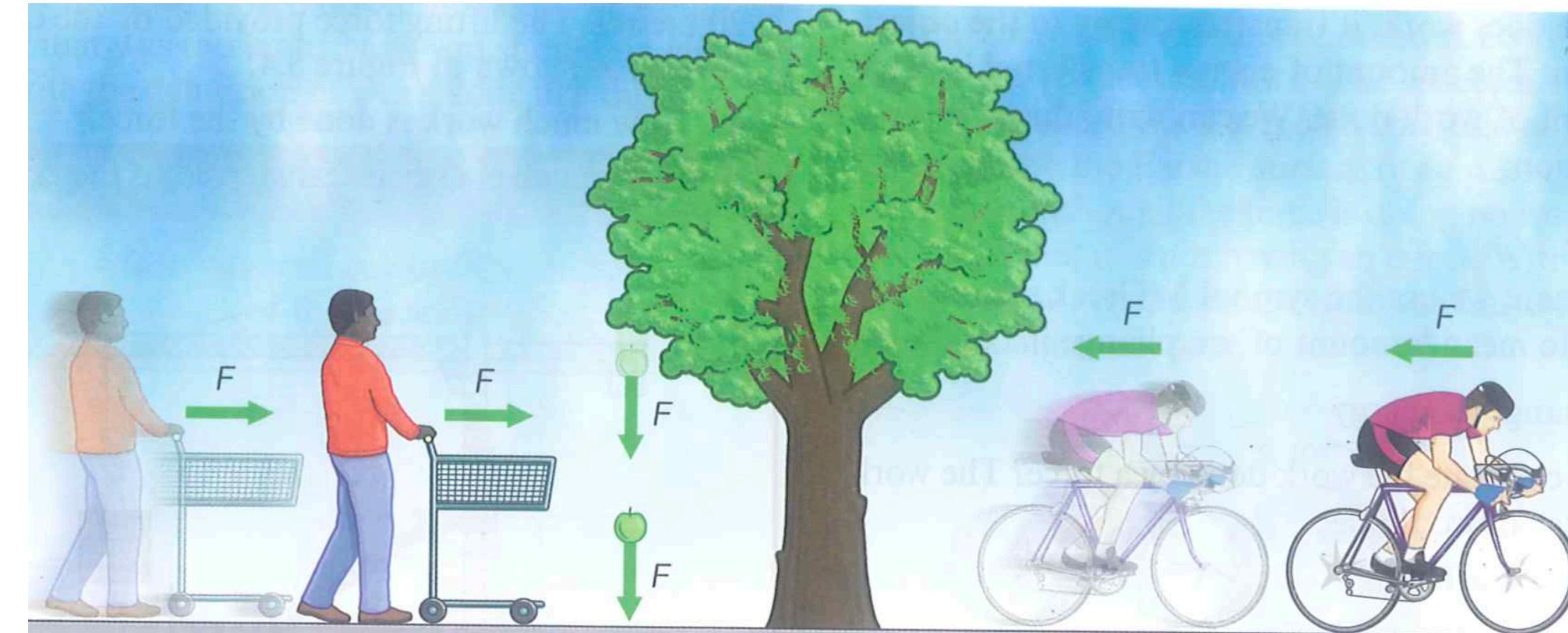
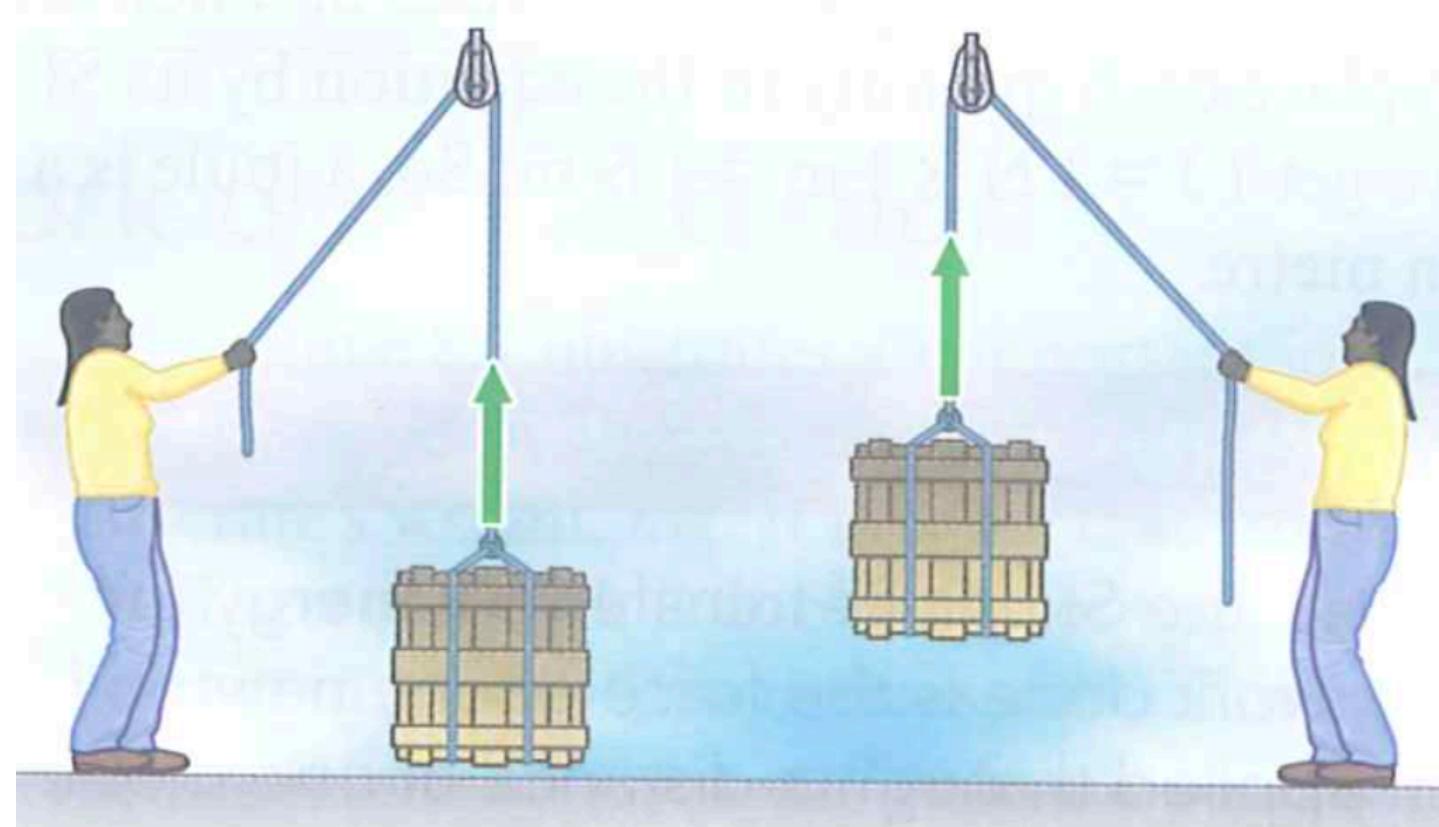
Increase Force

Increase distance moved in the direction of force



Exercise

How energy is transferred in the following cases?



Work done = energy transfer

★Equation:

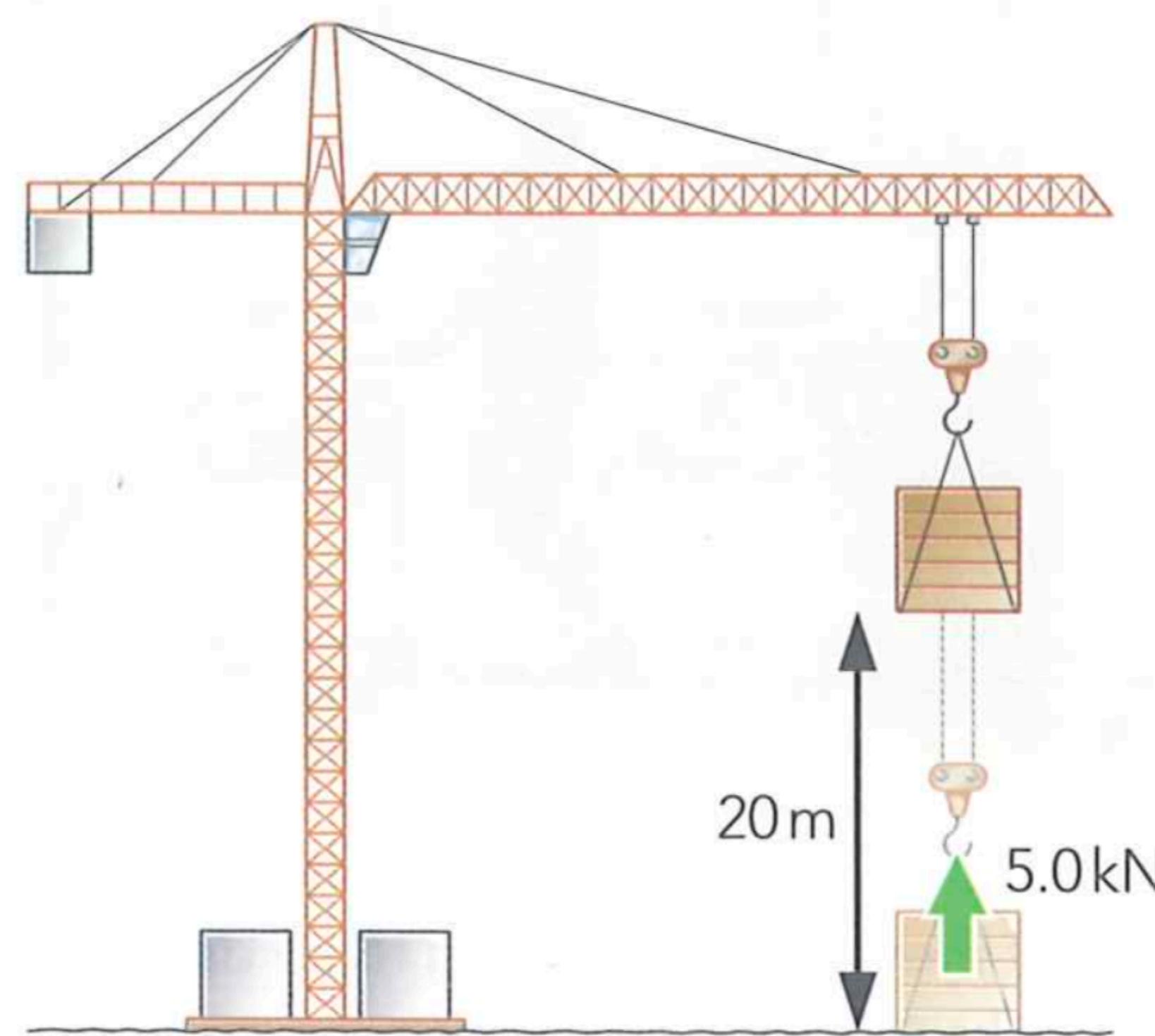
$$W = \Delta E$$

Work Done & Energy Transfer

A crane lifts a crate upwards through a height of 20 meter. The lifting force provided by the crane is 5.0kN, as shown in the figure.

How much work is done by the force

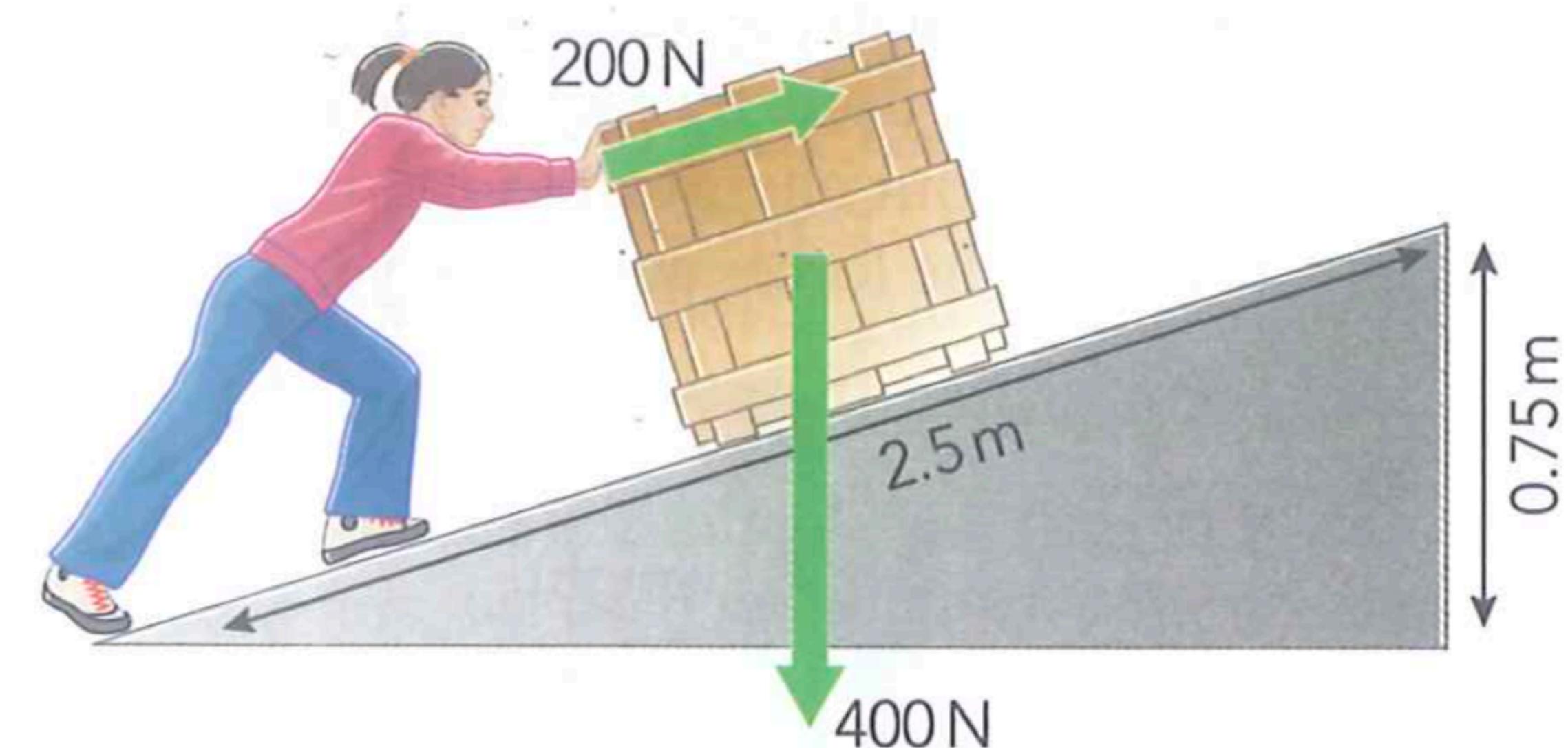
How much energy is transferred by to the crate?



Exercise

A girl can provide a maximum pushing force of 200N. To move a box weighing 400N onto a platform, she uses a plank as a ramp. As shown in the figure below.

1. How much work does she do in raising the box?
2. How much g.p.e does the box gain?

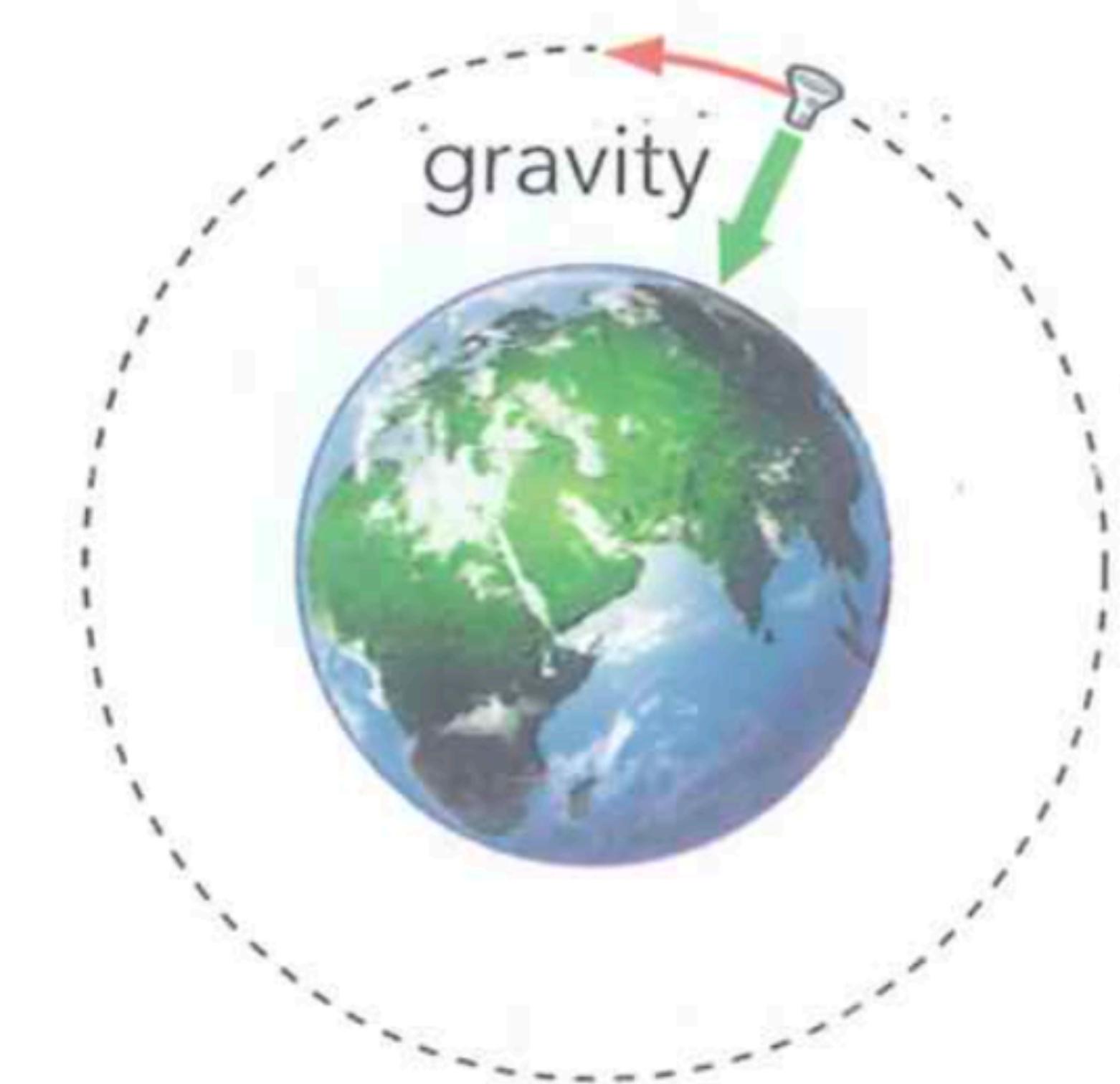


Exercise

You drop a stone weighing 5.0 N from the top of a 50 m high cliff. What is the work done by the force of gravity?

Exercise

A satellite orbits the Earth at a constant height and at a constant speed. The weight of the satellite at this height is 500 N. What is the work done by the force of gravity?



Exercise

You sit still in a chair, draw a free body diagram and explain how much work do the forces done to you?

No distance moved in the direction of force **=> No work done**

Power

How to describe the rate at which work is done?

Power is work done per unit time

★**Equation:**

$$p = \frac{W}{t} = \frac{\Delta E}{t}$$

Unit: W (Watt) $1\text{ W} = 1\text{J/s}$

To increase power: increase work

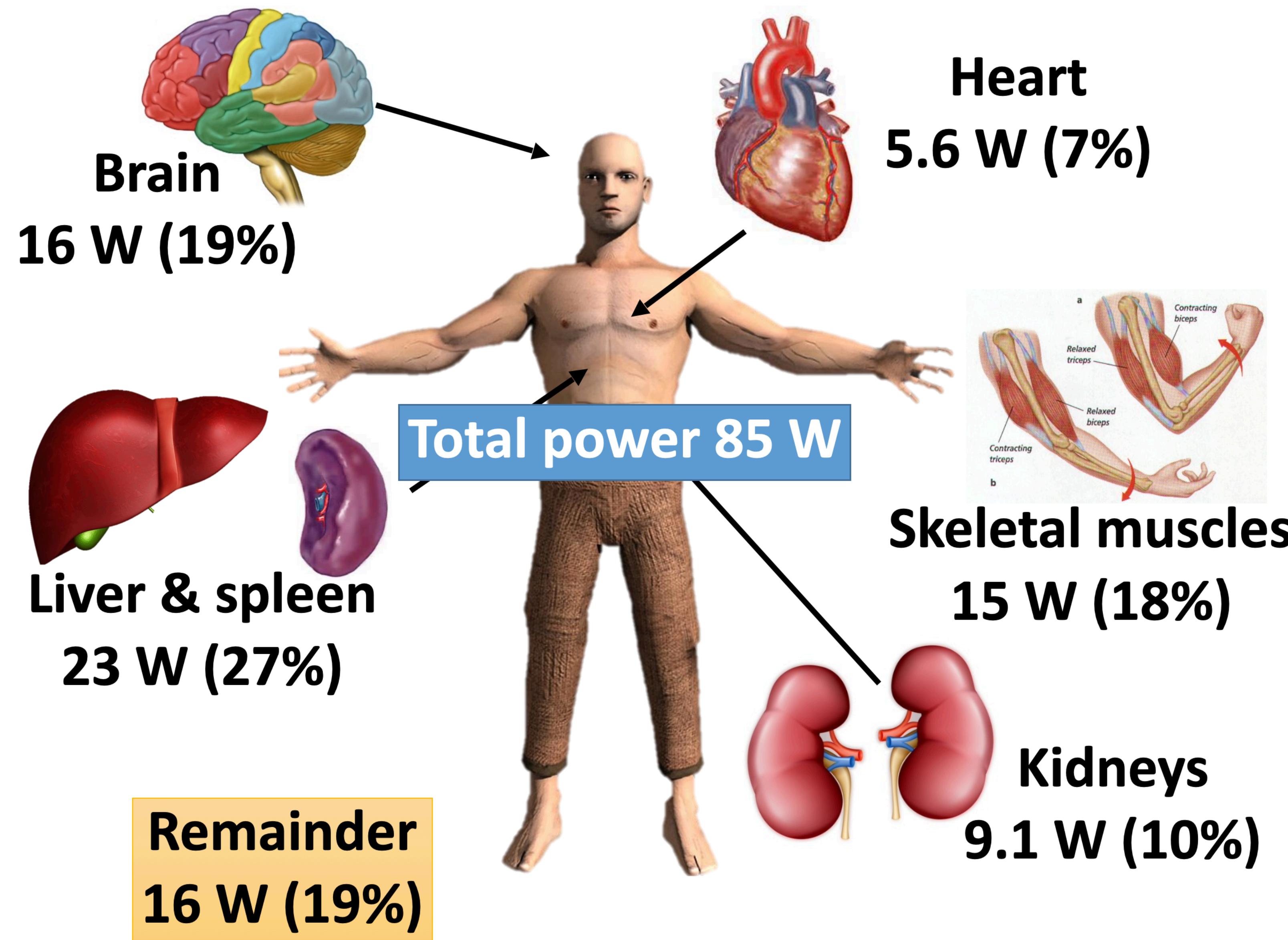
decrease time used

Power in general: energy transfer rate

The faster you work
The greater you power



Power



Power

★**Equation:**

$$p = \frac{W}{t} = \frac{\Delta E}{t}$$

percentage efficiency =

$$\frac{\text{useful energy output}}{\text{total energy input}} \times 100\% = \frac{\text{useful power output}}{\text{total power input}} \times 100\%$$

Exercise

A light bulb transfers 100J in 8.0s. What is its power?

Exercise

A car of mass 800kg accelerates from rest to a speed of 25m/s in 10s. What is its power?

Exercise

A man pushes a box with a force of 50N at a speed of 10m/s. What is its power?