Key words

efficiency
force
gear wheel
pulley
work

1 Pulley systems

- A simple *pulley* does not magnify the *force* applied but changes the direction that the force acts. Distance ratio is 1.
- In 2- and 4-pulley systems a small effort raises a large load. In a 2-pulley system for every 1 m by which the load is raised the effort is applied for 2 m, thus the distance ratio is 2. In a 4-pulley system the distance ratio is 4.
- If pulley systems were perfect machines they would be frictionless and no energy would be lost thus, using a 4-pulley system, a 40 N load would be raised 1 m by an effort of 10 N moving a distance of 4 m.
- The *efficiency* of a machine is the ratio of useful *work* done, or energy output, to the work or energy input.

$$\text{efficiency} = \frac{\text{work input}}{\text{work output}} \times 100\%$$

or

$$\text{efficiency} = \frac{\text{force ratio}}{\text{distance ratio}} \times 100\%$$

- The efficiency of a machine is always less than 100% as not all of the energy input does useful work.

2 Screw threads

- In a screw thread machine, the thread is usually turned by a handle. Distance ratio equals ratio of the circumference of the circle made by the effort to the pitch of the screw.

3 Water wheels

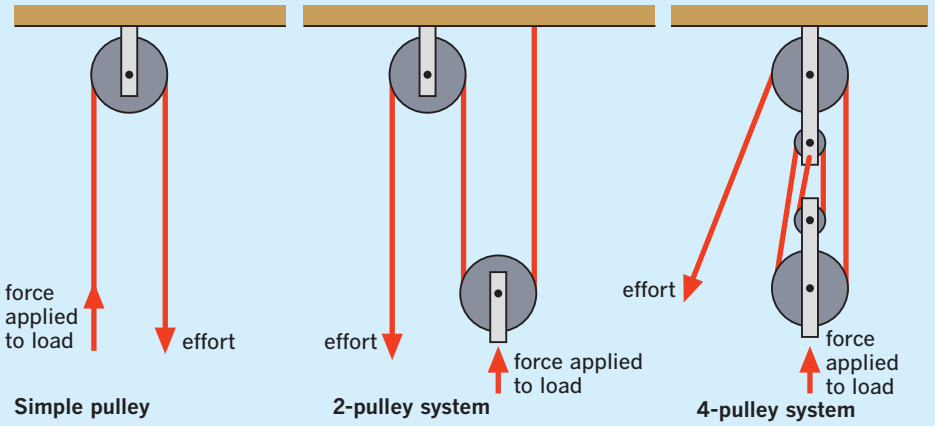
- Water wheels are driven by flowing water.

4 Gear wheels

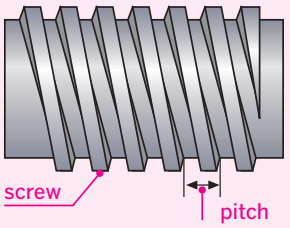
- The force ratio and distance ratio of a machine can be changed by *gears*.
- The 15 teeth gear makes two revolutions for each complete revolution of the 30 teeth gear.
- If the effort is applied to the smaller gear to drive the larger gear the distance ratio is 2.

Simple machines 2

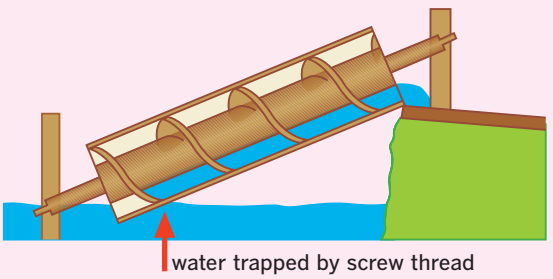
1 Pulley systems



2 Screw threads

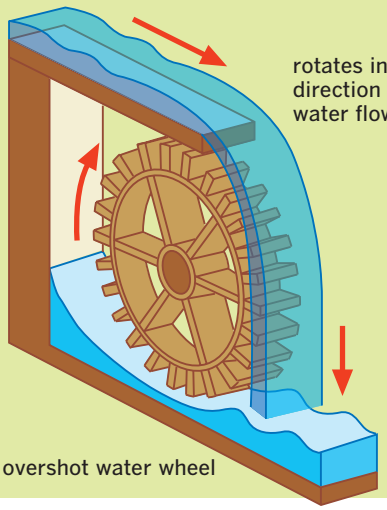


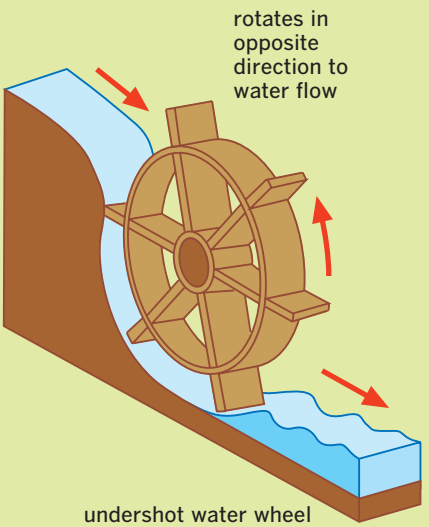
Screw-thread with a screw



Raising water with a screw

3 Water wheels





4 Gear wheels