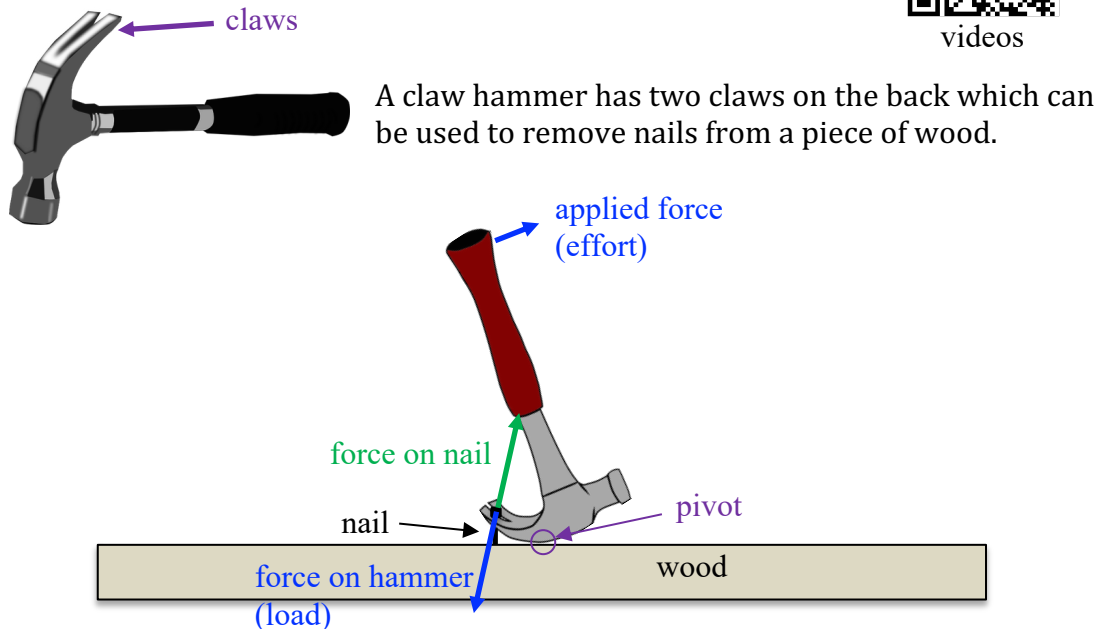


5.4.3 Levers

Levers are devices for increasing force. They are called 'force multipliers'. One example is the claw hammer.



videos



A force is applied to the top of the hammer handle. The hammer rotates around the pivot (where it is in contact with the wood). This transmits a force to the nail. The force on the nail is greater than the applied force. Note that the force of the nail on the hammer (load) is equal in size and opposite in direction to the force of the hammer on the nail.

(1) ✎ Why is a hammer needed to remove the nail?

The force on the nail is greater than the applied force because of the 'principle of moments'. This states that:

the sum of clockwise moments = the sum of anticlockwise moments

(2) ✎ What force is attempting to turn the hammer clockwise around the pivot?

(3) ✎ What force is resisting this turning effect (i.e. producing an anticlockwise moment)?

A moment is the turning effect of a force.

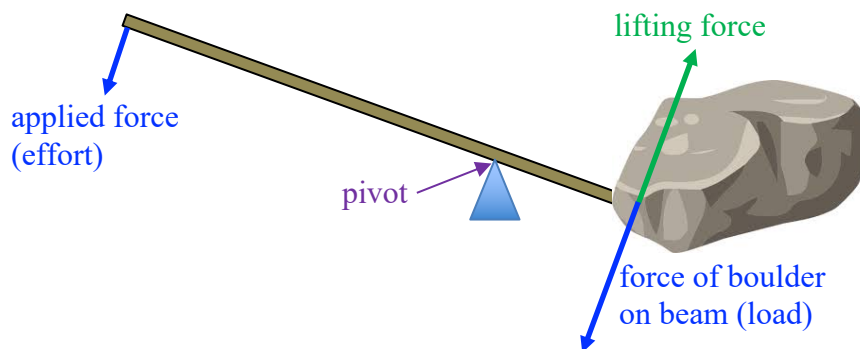
moment = force $\times$ perpendicular distance to pivot

(4)  What unit are moments measured in? (Hint: look at the equation to see what units are multiplied together.)

(5)  A force of 320N is applied to the top of the handle at a (perpendicular) distance of 0.30m from the pivot. Calculate the clockwise moment.

(6)  The nail is at a (perpendicular) distance of 0.030m from the pivot. Using the principle of moments, calculate the force of the hammer claws on the nail. (Hint: The clockwise and anticlockwise moments are equal in size.)

Consider the following situation:



A lever is being used to lift a boulder.

(7)  Why is the lifting force greater than the applied force?

(8)  What could be done to achieve a greater lifting force? Explain.

(9)  Which end of the beam moves furthest? The end where the force is applied or the end lifting the boulder?

Recall that:

$$\text{work done} = \text{force} \times \text{distance moved in the direction of the force}$$

(10)  Explain why, even though the force is magnified (for levers), you don't get more work out than you put in. (Hint: Look at the equation for work done, and consider the distance moved by the applied effort force and the load force.)