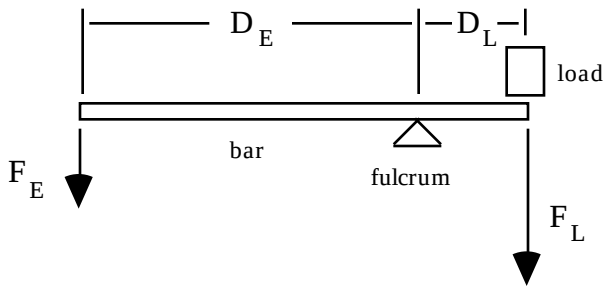
The Lever : Notes/W.S.-80

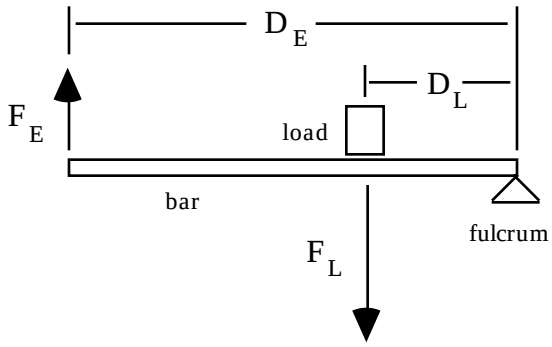
The **simple lever** consists of a rigid bar supported by a fulcrum. There are three classes of levers. These three classes are part of many compound machines.

The three classes are shown below. The load and effort forces are labeled F_L and F_E. The distances from the fulcrum of the two forces are labeled D_L and D_E.

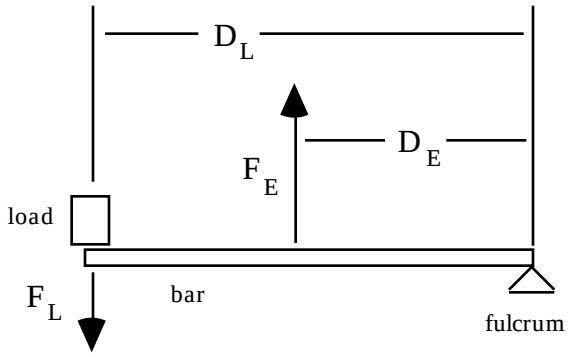
The First Class Lever



The Second Class Lever



The Third Class Lever



For all three classes of levers, the mechanical advantage is given by the equation below.

$$\text{M. A.} = \frac{F_L}{F_E} = \frac{D_E}{D_L}$$

This can be written as the **Law of the Lever** .

$$F_L \cdot D_L = F_E \cdot D_E$$

Questions:

1) What is a lever?

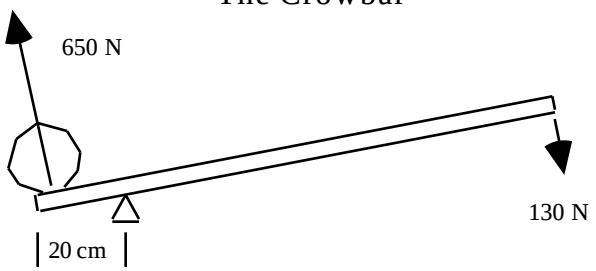
2) Give an example of each of the three classes of levers.

3) Which class of lever has a mechanical advantage that is less than one?

4) Write out the “Law of the Lever” in words.

5) The pry-bar (or crowbar) shown below is a first class lever. It is used here to move a big rock.

The Crowbar

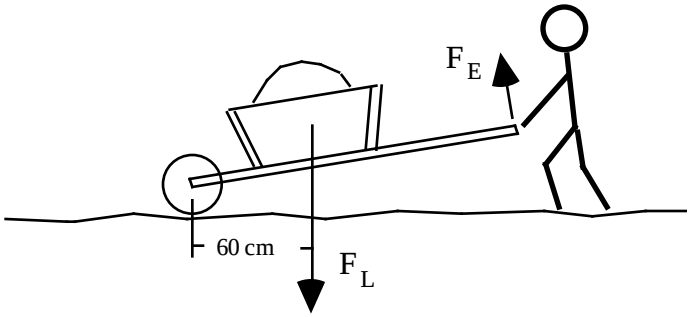


a) What is the mechanical advantage?

b) What is the length of the bar?

6) The wheelbarrow shown below makes use of a second class lever. There is also a wheel-and-axle.

Wheelbarrow



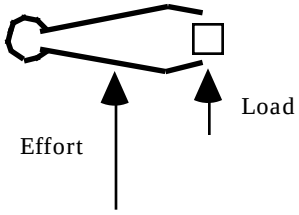
a) Where is the fulcrum?

b) The M.A. = 2.4. If the effort force is 160 N, what is the load force?

c) What is the length of the wheel barrow?

7) Tongs are an example of a third class lever.

Sugar Tongs



a) If the effort force is 42 N what is the approximate value of the load force for the above tongs?

b) Give an advantage of the third class lever.

8) Give the class for each of the following levers: scissors, nut-cracker, tweezers, teeter-totter, canoe paddle, hammer (when used to remove a nail), your forearm (when used to lift something), bottle opener.

Answers: 1) A lever is a rigid bar that is supported by a fulcrum., 2) class 1, crowbar; class 2, wheelbarrow; class 3, sugar tongs, 3) third, 4) The load force multiplied by the distance from the load to the fulcrum equals the effort force multiplied by the distance from the effort force to the fulcrum., 5)a) 5.0, b) 120 cm, 6)a) The fulcrum is the wheel axle., b) 384 N, c) 144 cm, 7)a) 21 N (about half the effort), b) Sometimes, you want to reduce the size of the effort force. This helps when doing delicate work., 8) 1, 2, 3, 1, 3, 1, 3, 2.