

Lesson XIII

Record the weather conditions.

What were the results of your experiments with the windlass at home?

The Law of the Pulley and the Law of Machines.—We are all acquainted with systems of pulleys such as are illustrated in the figure below. Let us examine them to find some relation between the weight lifted and the force. In (1) where there is just one pulley, if we have 10 lbs. of weight and we eliminate the friction, how much force will it take to support it? It will be just 10 lbs., as we shall see later. Notice, however (2). How many ropes are there supporting the weight? How much does each rope support? How much must the force be on the spring balance to support the weight? There are two ropes supporting the total weight of 15 lbs., so each supports just $\frac{1}{2}$ of it, or $7\frac{1}{2}$ lbs., and as the force is pulling against only one of these ropes it will be $\frac{1}{2}$ the weight, or $7\frac{1}{2}$ lbs. if the friction is eliminated.

Again in (3) there are three ropes supporting the total weight of 15 lbs. Each then will support $\frac{1}{3}$ of it, or 5 lbs., and as the force is pulling against only one of the ropes it will be equal to $\frac{1}{3}$ of the weight, or 5 lbs., i.e., if we eliminate the friction.

Similarly in (4) where there are four ropes supporting a total weight of 16 lbs., how much will the force be? The force will be $\frac{1}{4}$ of 16 lbs., or 4 lbs. if we eliminate the friction.

What then is the Law of the Pulley? May it be stated as follows: "If there were no friction, the force that would support a weight on any system of pulleys is equal to the weight divided by the number of ropes supporting the weight"?

Let us test this law experimentally.