UNIT 3: Reading - Force Diagrams

Consider the analysis of forces acting on a log as a tractor pulls it at a constant speed. (Figure 2 below) The analysis proceeds as follows:

1. Sketch the system and its surroundings.
2. Enclose the system within a system boundary.
3. Shrink the system to a point at the center of coordinate axes with one axis parallel to the direction of motion.
4. Represent all relevant forces (across the system boundary) by a vector labeled with an appropriate symbol.

As an illustration of this process, consider the forces acting on a log being pulled by a tractor follows:

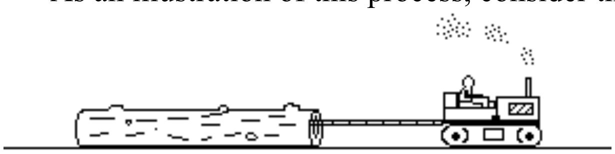

Figure 2

Step 1
Sketch a diagram of the system and its surroundings as illustrated in Figure 2:

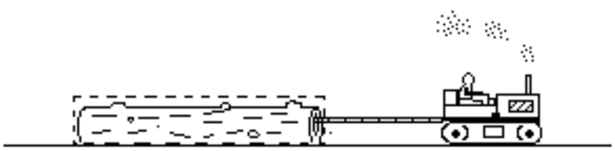

Figure 3

Step 2
In order to assist in the identification of the relevant forces acting on the system, enclose the system (log) within a closed boundary line.

A broken line was used for emphasis in this sample problem; however, the line need not be broken.

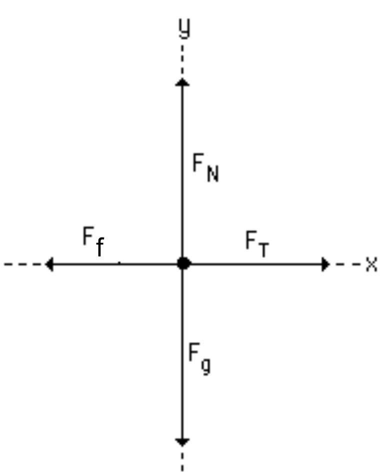

Figure 4

Step 3
Since the shape of the object is unimportant, shrink it to a point. Place it at the intersection of a set of coordinate axes with one of the *axes parallel to the direction of motion* as shown in figure 4.

Step 4
Proceed around the system boundary line and identify all points at which there is contact between the system (log) and its surroundings. Construct qualitative vectors (indicate directions and relative magnitudes) to represent these forces. The contact forces would be kinetic friction, F_f (parallel to the supporting surface), the normal force, F_N (the component of force that is perpendicular to the supporting surface), and the tension force of the rope, F_T. The long range force(s), in this case would be only the force of gravity, F_g. See Figure 4.

Now, it should be easy to determine the net force on the object. To do this, consider the force in each direction (x or y) separately.
That is,

x-axis	y-axis
F_T and F_f	F_g and F_N

In this case, the two forces in the x-direction are equal, but opposite, so they sum to zero. Also note that the two forces in the y-direction sum to zero. Therefore, you can conclude that this object will *not* accelerate in either direction. That leaves two possibilities: it is either motionless, or it is moving at constant velocity.