

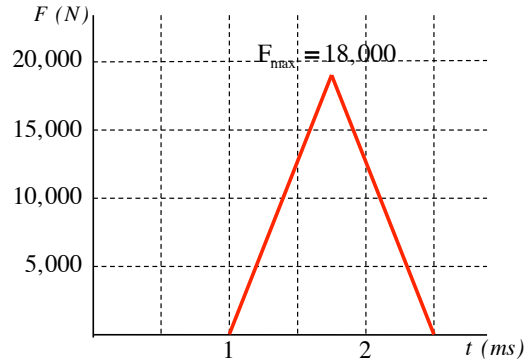
Problem 9.11

The graph is an approximation of the force a baseball feels when hit by a bat. Ignoring the fact that it is sad they didn't give you a more realistic graph (they usually look more like a Bell curve):

a.) What is the *impulse* associated with the force?

The *impulse* in its most general form is defined as " $I = \int F dt$ " (though in some books the symbol is a "J"). Extrapolating from this, you can see that the impulse is, in fact, simply the *area* under the *Force vs time* graph. In this case, that area is:

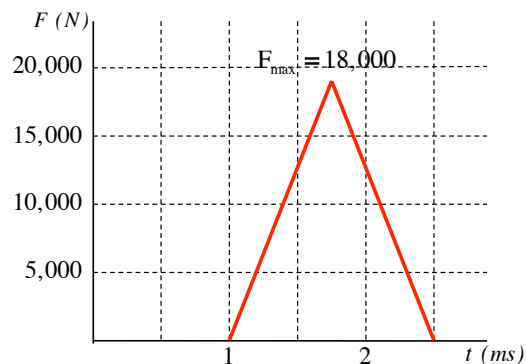
$$I = \frac{1}{2} (1.50 \times 10^{-3} \text{ s}) (1.80 \times 10^4 \text{ N}) \\ = 13.5 \text{ N} \cdot \text{s}$$



1.)

b.) The average force on the ball will be:

$$I = F_{\text{avg}} \Delta t \\ \Rightarrow F_{\text{avg}} = \frac{I}{\Delta t} \\ \Rightarrow F_{\text{avg}} = \frac{(13.5 \text{ N} \cdot \text{s})}{(1.50 \times 10^{-3} \text{ s})} \\ = 9.00 \times 10^3 \text{ N} \quad (\text{or } 9.00 \text{ kN})$$



2.)