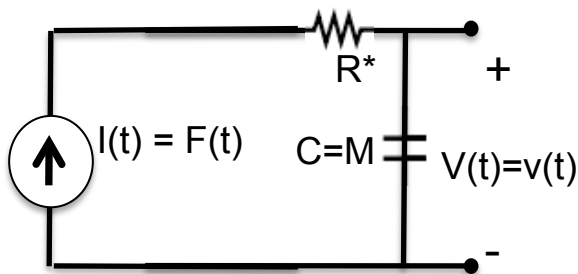


Answers (cont.)

Mathematically, the input/output relationship is given by:

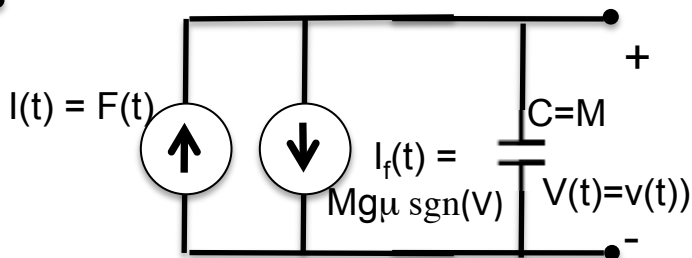
$$v(t) = \frac{1}{M} \int_{-\infty}^t (F(t') - Mg\mu \operatorname{sgn}(v(t'))) dt'$$

Using the simple model of friction given in Hint 1, the equivalent “circuit” would be:



where R^* is a peculiar “resistor” in which $I = \operatorname{sgn}(V)/R$ instead of the usual $I = V/R$ for which $R = Mg\mu$.

Alternatively...



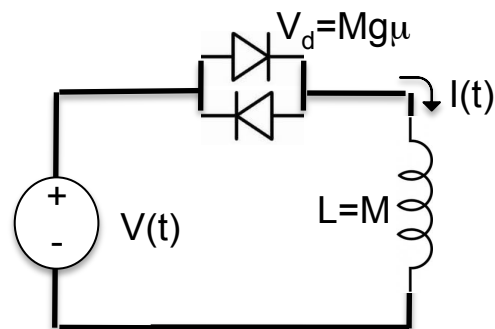
One clever student came up the following circuit:

Using the analogy,

velocity $v(t) \leftrightarrow$ current $I(t)$

Force $F(t) \leftrightarrow$ voltage $V(t)$,

find $I(t)$ as a function of $V(t)$.



Note, even restricting our model to velocities > 0 , this system is still not linear, but rather affine.