P6.27 With 100 km/h = 27.8 m/s, the resistive force is

$$R = \frac{1}{2} D\rho A v^2 = \frac{1}{2}(0.250)\left(1.20 \text{ kg/m}^3\right)\left(2.20 \text{ m}^2\right)\left(27.8 \text{ m/s}\right)^2$$

$$= 255 \text{ N}$$

$$a = -\frac{R}{m} = -\frac{255 \text{ N}}{1\,200 \text{ kg}} = \boxed{-0.212 \text{ m/s}^2}$$

P6.28 Given $m = 80.0$ kg, $v_T = 50.0$ m/s, we write

$$mg = \frac{D\rho A v_T^2}{2}$$

which gives

$$\frac{D\rho A}{2} = \frac{mg}{v_T^2} = 0.314 \text{ kg/m}$$

(a) At $v = 30.0$ m/s,

$$a = g - \frac{D\rho A v^2/2}{m} = 9.80 \text{ m/s}^2 - \frac{(0.314 \text{ kg/m})(30.0 \text{ m/s})^2}{80.0 \text{ kg}}$$

$$= \boxed{6.27 \text{ m/s}^2 \text{ downward}}$$

(b) At $v = 50.0$ m/s, terminal velocity has been reached.

$$\sum F_y = 0 = mg - R$$

$$\Rightarrow R = mg = (80.0 \text{ kg})\left(9.80 \text{ m/s}^2\right) = \boxed{784 \text{ N directed up}}$$

(c) At $v = 30.0$ m/s,

$$\frac{D\rho A v^2}{2} = (0.314 \text{ kg/m})(30.0 \text{ m/s})^2 = \boxed{283 \text{ N upward}}$$

P6.33 We start with Newton's second law,

$$\sum F = ma$$

substituting,

$$-kmv^2 = m\frac{dv}{dt}$$

$$-kdt = \frac{dv}{v^2}$$

$$-k\int_0^t dt = \int_{v_i}^{v} v^{-2}\,dv$$

integrating both sides gives

$$-k(t-0) = \left.\frac{v^{-1}}{-1}\right|_{v_i}^{v} = -\frac{1}{v} + \frac{1}{v_i}$$

$$\frac{1}{v} = \frac{1}{v_i} + kt = \frac{1 + v_i kt}{v_i}$$

$$\boxed{v = \frac{v_i}{1 + v_i kt}}$$

P6.35 (a) We must fit the equation $v = v_i e^{-ct}$ to the two data points:

At $t = 0$, $v = 10.0$ m/s, so $v = v_i e^{-ct}$ becomes

$$10.0 \text{ m/s} = v_i e^0 = (v_i)(1)$$

which gives $v_i = 10.0$ m/s

At $t = 20.0$ s, $v = 5.00$ m/s so the equation becomes

$$5.00 \text{ m/s} = (10.0 \text{ m/s})e^{-c(20.0 \text{ s})}$$

giving $$0.500 = e^{-c(20.0 \text{ s})}$$

or $$-20.0c = \ln\left(\frac{1}{2}\right) \rightarrow c = -\frac{\ln\left(\frac{1}{2}\right)}{20.0} = \boxed{3.47 \times 10^{-2} \text{ s}^{-1}}$$

(b) At $t = 40.0$ s

$$v = (10.0 \text{ m/s})e^{-40.0c} = (10.0 \text{ m/s})(0.250) = \boxed{2.50 \text{ m/s}}$$

(c) The acceleration is the rate of change of the velocity:

$$a = \frac{dv}{dt} = \frac{d}{dt}v_i e^{-ct} = v_i\left(e^{-ct}\right)(-c) = -c\left(v_i e^{-ct}\right)$$
$$= \boxed{-cv}$$

Thus, the acceleration is a negative constant times the speed.