Johannes Byle

15.1

Newtons first law can be expressed as:

$$\sum F = 0 \Leftrightarrow \frac{dv}{dt} = 0$$

Assuming mass is a nonzero constant.
Under Galilean transformation:

$$v' = v + \beta$$

Since the derivative of this is still zero the first law still holds.

$$\frac{d}{dt}(v + \beta) = 0$$

Newtons third law can be written as:

$$F_a = -F_b$$

$$m_a \frac{dv_a}{dt} = m_b \frac{dv_b}{dt}$$

Under Galilean transformation both derivatives would not change for the same reason as stated above:

$$\frac{d}{dt}(v + \beta) = \frac{d}{dt}(v) + \frac{d}{dt}(\beta) = \frac{dv}{dt}$$

15.6

$$t' = \frac{t}{\sqrt{1 - \frac{v^2}{c^2}}}$$

$$\frac{t}{t'} = \sqrt{1 - \frac{v^2}{c^2}}$$

$$c\sqrt{1 - \frac{t^2}{t'^2}} = v$$

$$v = \sqrt{\frac{2}{3}}c$$