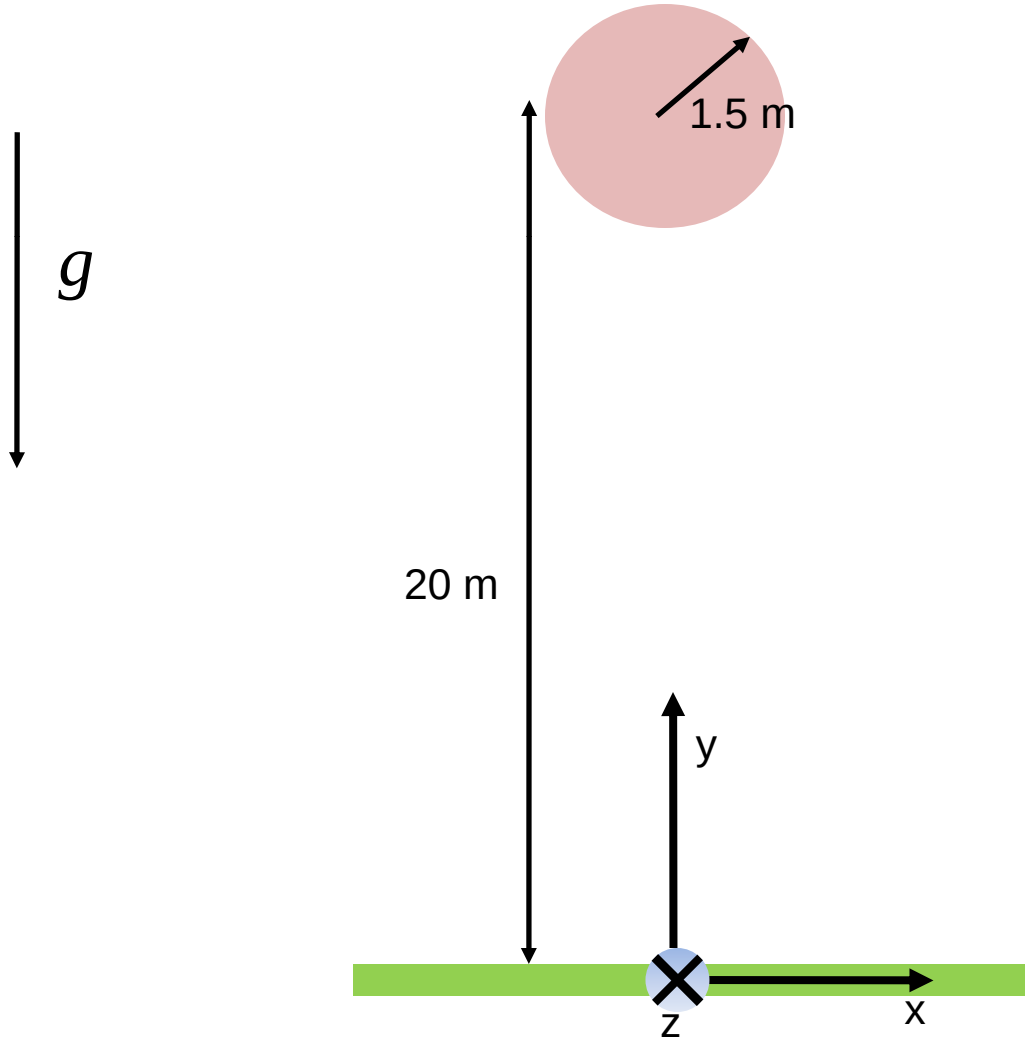
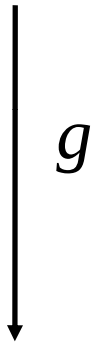
Bouncing Ball: Free Fall

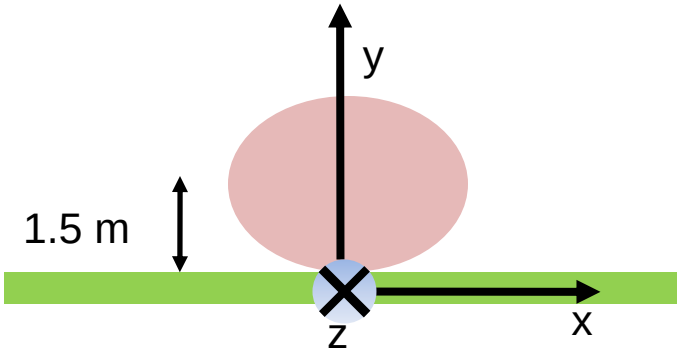


Free Fall Equation

$$\ddot{y} = -g$$

Bouncing Ball: Collision





Collision Equation

$$y < 1.5$$

$$\ddot{y} = K(1.5 - y) - g$$

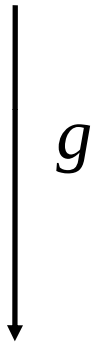
Volume Conservation

$$\frac{4}{3}\pi r^3 = \frac{4}{3}\pi abc$$

if a=b, and c=y, then

$$a = \sqrt{\frac{r^3}{y}}$$

Bouncing Ball: Energy Loss To Floor



Modified Collision Equation

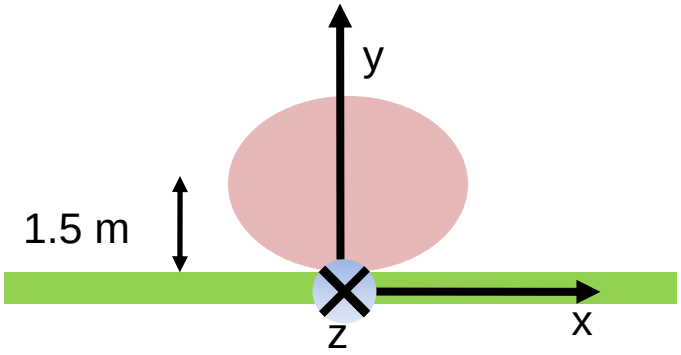
$$y < 1.5$$

$$\ddot{y} = K(1.5 - y) + Bv - g, v < 0$$

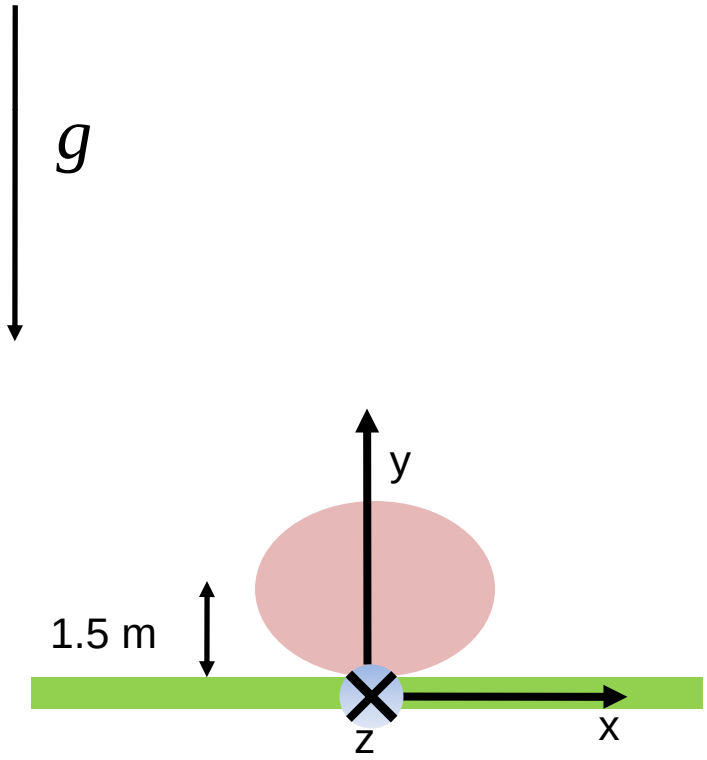
$$\ddot{y} = K(1.5 - y) - g, v \geq 0$$

Energy Loss During Contact

$$\Delta W = \int Bvdv$$



Bouncing Ball: Temperature Rise



Energy Loss During Contact

$$\Delta T = C\int Bvdv$$

Heat Equation

$$\frac{\partial u}{\partial t} = \alpha(u_{xx} + u_{yy} + u_{zz}) + q,$$

$$\alpha = 1$$

$$u_{xx}, u_{yy}, u_{zz} = 0$$

Cumulative Temperature Rise

$$\Delta T = \Delta T_1 + \Delta T_2 + \Delta T_3 + \ldots$$