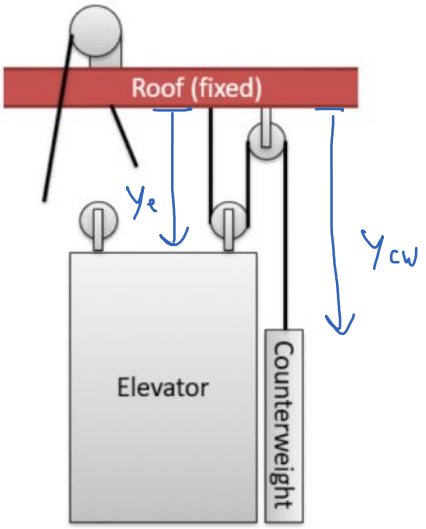
Problem 2

The elevator shown to the right has a mass of 1500 kg and the counterweight has a mass of 500kg. At some point the cable attached to the motor snaps, causing the elevator to begin falling. After falling 3 meters with no outside forces, what is the speed of the elevator? If the emergency brake is then applied at this point (3m down) exerting a constant force of 15,000 N, how much farther will the elevator fall before coming to a stop?



$$L = ? = 2y_e + y_{cw}$$

$$\dot{L} = 0 = 2\dot{y}_e + y_{cw}$$

$$2V_e = -V_{cw}$$

before brakes

$$W = \Delta KE + \Delta PE$$

if the elevator goes down 3m, the CW goes up 6m

$$0 = \underbrace{\tfrac{1}{2}(1500\,kg)(V_e)^2 + \tfrac{1}{2}(500\,kg)(V_{cw})^2}_{\Delta KE} + \underbrace{(1500\,kg)\left(9.81\,\tfrac{N}{kg}\right)(-3m) + (500\,kg)(9.81)(6m)}_{\Delta PE}$$

$$0 = 750V_e^2 + 250(-2V_e)^2 - 14715\,Nm$$

$$\boxed{V_e = 2.9\ m/s}$$

Brakes applied

$$W = \Delta KE + \Delta PE$$

$$(-15{,}000\ N)\, d = \underbrace{-750(2.9)^2 - 250(-2(2.9))^2}_{\Delta KE} + \underbrace{(1500)(9.81)(-d) + (500)(9.81)(2d)}_{\Delta PE}$$

$$-15{,}000\, d = -1471S - 490S\, d$$

$$d = \frac{-1471S}{-15{,}000 + 490S} = \boxed{1.46m}$$