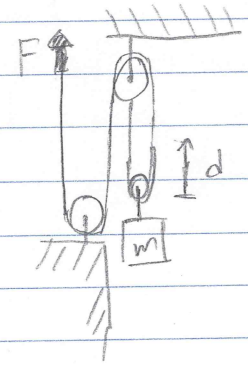
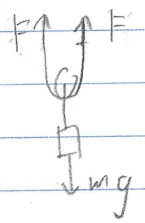
20-P-MOM-DY-45

A $m = 20\,kg$ box is connected to a complex pulley system. Determine the distance the mass travels in $t = 4s$. $F = (250 + t^2)N$. The system starts at rest. ☆



Solution:



$$mv_1 + 2\int F\,dt = mv_2$$

$$0 + 2\int F\,dt - mgt_2 = mv_2$$

$$v_2 = \frac{2}{m}\int_0^t (250 + t^2) - mgt$$

$$= \frac{2}{m}\left(250t + \frac{t^3}{3}\right) - mgt \ \ m/s$$

$$\int_0^s ds = \int_0^t v_2 = \int_0^t \frac{2}{m}\left(250t + \frac{t^3}{3}\right) - mgt \ \ m/s$$

$$s = \frac{2}{m}\left(\frac{250t^2}{2} + \frac{t^4}{12}\right)\Big|_0^4 - \frac{mgt^2}{2}\Big|_0^4$$

$$= 202.1\ m \quad \text{large displacement.}$$