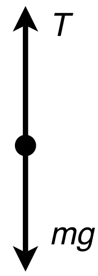
Elevator

The loaded cab of an elevator has a mass of 3.0×10^3 kg and moves 210m up the shaft in 23s at constant speed.

At what average rate does the force from the cable do work on the cab?

Solution: The elevator is moving at constant speed, so $a = 0$, so by N1L there is no net force on the cab.



So the tension in the cable is

$T = mg$

$= 3000 \times 9.8 = 29.4$ kN

Now the work done by the cable moving the elevator 210m is

$W = Fd = 29{,}400 \times 210 = 6.17 \times 10^6$ J

The power (= rate of doing work) is

$P = W/\Delta t = 6.17 \times 10^6$ J / 23s

$= 2.7 \times 10^5$ W

$= 270$ kW

Alternatively: the elevator moves 210 m in 23s at constant speed, so we can calculate that speed:

$v = \Delta x/\Delta t = 210$ m/23 s $= 9.13$ ms^{-1}

so

$P = Fv = 29.4 \times 10^3 \times 9.13 = 2.7 \times 10^5$ W