Chapter 7 Problem 80

$\Delta h = 50\,m$

$P = 500\,W$

How much coal per minute can be brought to the surface

The ~~one~~ work done to lift an object against gravity is

$$W = mg\Delta h$$

Power is $P = \frac{W}{\Delta t}$

so $W = P \cdot t$

Since we are ignoring friction, we are only doing work against gravity. So,

$$P \cdot t = mg\Delta h$$

Solving for mass per time gives

$$\frac{m}{t} = \frac{P}{g\Delta h}$$

Substituting in values gives

$$\frac{m}{t} = \frac{500\,W}{(9.8\,m/s^2)(50\,m)} = 1.02\,\frac{W}{\frac{m}{s^2}\cdot m}$$

now watts is ~~J~~ $\frac{J}{s} = \frac{N\cdot m}{s} = \frac{\left(kg\frac{m}{s^2}\right)m}{s} = kg\frac{m^2}{s^3}$

So the units for this answer are

$$\frac{m}{t} = 1.02\,\frac{kg\frac{m^2}{s^3}}{\frac{m^2}{s^2}} = 1.02\,\frac{kg}{s}$$

In one minute we have

$$\frac{m}{t} = 1.02\,\frac{kg}{s}\left(\frac{60\,s}{1\,min}\right) = \boxed{61.2\,kg/min}$$