Question

A boy whose mass is 40kg runs up a flight of 30 steps, each 150mm high, in 6 seconds. Find the average power developed. (Take g as 10m/s2).

Solution. Lifting to the height h the boy doing work against gravity which is

$$W = F \cdot h$$

where $F = mg$ is the force equal to the weight of the boy. The height h is equal to the step height d multiplied by the number of steps, $h = d \cdot 30$. The step height in meters is

$$d = \frac{150 \ mm}{1000 \ mm/m} = 0.15 \ m$$

Then the work done is

$$W = mg \cdot h = 40 \ kg \cdot 10 \frac{m}{c^2} \cdot 0.15 \ m \cdot 30 = 1800 J$$

The average power is the rate at which work is done, that is

$$P = \frac{W}{t}$$

Substituting $W = 1800 J$ and $t = 6 \ s$ we get

$$P = \frac{1800 \ J}{6 \ s} = 300 \ \frac{J}{s} = 300 \ W$$

Answer: the developed average power is $P = 300$ watt.