3. A pump on the ground floor of a building can pump up water to fill a tank of volume 30 m^3 in 15 min. If the tank is 40 m above the ground, and the efficiency of the pump is 30%, how much electric power is consumed by the pump?

Sol. According to the question, Given

Volume of the tank, V = 30 m^3

Time required to fill the tank is, t = 15 min = 15 × 60s = 900 s

Height at which the tank is situated above the ground, h = 40 m

The efficiency of the pump, $\eta = 30\%$

Density of water, = 10^3kg / m^3

Mass of water, $m = pV = 30 \times 10^3 kg$

So, rise in potential energy of the water (Work done)

$= (30000kg)(9.8m/s^2)(40m) = 1.17 \times 10J$

The electric power consumed by the pump is:

$P_0 = \frac{\text{Workdone}}{Time} = \frac{mgh}{t}$

$= 1.17 \times 10J/900 = 13.067 \times 10^3 W$

For input power P_i, efficiency η is given by the relation:

$\eta = \frac{P_0}{P_i} = 30\%$

$P_i = \frac{13.067}{30} \times 100 \times 10^3$

$= 0.436 \times 10^5 W$

P_i = 43.6 kW

Hence, the power consumed by the pump is 43.6 kW.