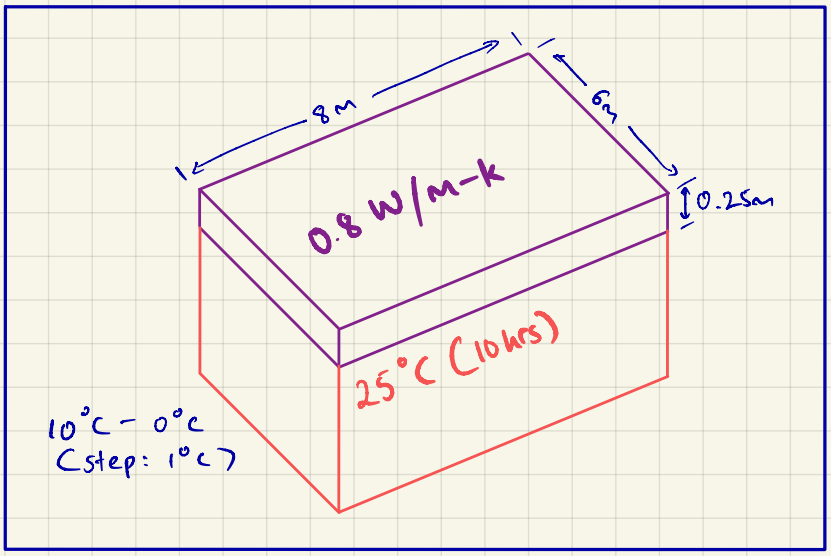
PROJECT 1 · RAJEEV THIMMAREDDY · ME113 · SEC01 · 09/24/2022



① Plot rate of heat loss through roof that night as a function of outer temp.

② Assume outer temp. remains constant @ 5°C.
↳ Find cost of heat loss if cost electricity is $0.08/kWh

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① Rate of heat loss = $\dot{Q} = k \cdot A \cdot \frac{\Delta T}{L}$ → $k = 0.8$ W/m-k, $A = l \times w = 6 \times 8 = 48\ m^2$, L = thickness = 0.25m

↳ $\Delta T = T_{IN} - T_{OUT}$
$= (25 + 273.15) - (t + 273.15)$, for t in range (10, 0, step = -1)
$= (25 - t)\ K$

$\therefore \dot{Q} = 0.8 \frac{W}{m-K} \cdot 48\ m^2 \cdot \frac{(25-t)\ K}{0.25\ m} \simeq (3840 - 153.6t)\ W$

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② $\dot{Q}(5) = 3840 - 153.6(5) \simeq 3072\ W$

$\therefore Q$ in 10 hours $= 3072\ W \cdot 10\ h \cdot \frac{1\ kW}{1000\ W} \simeq 30.72\ kWh$

$\therefore$ Cost of heat loss $= 30.72\ kWh \cdot 0.08 \frac{\$}{kWh} \simeq \$2.46$

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① $\dot{Q} = (3840 - 153.6t)\ W$ ② $\$2.46$