(a)

$$\eta_I = 0.25 = \frac{W_{actual}}{Q_H} \quad \text{— (1)}$$

$$\eta_{II} = 0.5 = \frac{W_{actual}}{W_{reversible}} = \frac{W_{actual}}{Q_H\left(1-\frac{T_L}{T_H}\right)} \quad \text{— (2)}$$

$$1-\frac{T_L}{T_H} = \eta_{rev.} = \frac{W_{rev.}}{Q_H}$$

$$W_{rev} = Q_H\left(1-\frac{T_L}{T_H}\right)$$

Eqn (1)/(2)

$$\frac{0.25}{0.5} = 1-\frac{T_L}{T_H}$$

$$\frac{1}{2} = 1-\frac{T_L}{T_H}$$

$$\frac{T_L}{T_H} = \frac{1}{2} \Rightarrow T_H = 2T_L$$

$$T_H = 560\,K$$

(b) Second law efficiency is non zero.
Hence engine is not working reversibly.

(c) $\dot{W}_{actual} = (0.25)\,Q_H = 25000$ kW

$\dot{W}_{rev} = \frac{\dot{W}_{actual}}{\eta_{II}} = \frac{250}{0.5} = 500$ kW

Lost work = $W_{rev} - W_{actual} = 250$ kW

(d) $T_L \dot{S}_S$ = Lost work

$$T_L = \frac{250\,kW}{280\,kJ}$$ Ans.