

3. A steam engine delivers $5.4 \times 10^8 \text{ J}$ of work per minute and services $3.6 \times 10^9 \text{ J}$ of heat per minute from its boiler. What is the efficiency of the engine? How much heat is wasted per minute?

Sol. Work done by the steam engine per minute, $W = 5.4 \times 10^8 \text{ J}$

Heat supplied from the boiler, $H = 3.6 \times 10^9 \text{ J}$

Efficiency of the engine = $\frac{\text{Output energy}}{\text{Input energy}}$

$$\therefore \eta = \frac{W}{H} = \frac{5.4 \times 10^8}{3.6 \times 10^9} = 0.15$$

Hence, the percentage efficiency of the engine is 15 %.

Amount of heat wasted = $3.6 \times 10^9 - 5.4 \times 10^8$

$$= 30.6 \times 10^8$$

$$= 3.6 \times 10^9 \text{ J}$$

Therefore, the amount of heat wasted per minute is $6 \times 10^9 \text{ J}$.