Class XI

Thermodynamics worksheet 1

1. Can you design heat energy of 100% efficiency? 1

Ans. $\eta = 1 - \frac{T_2}{T_1}$

η can be 100% if T_2=0K or T_1=∞

Since both these conditions cannot be practically attained, so heat engine cannot have 100% efficiency.

2. Does the working of an electric refrigerator defy second law of thermodynamics? 1

Ans. No, it is not against the second law; this is because external work is done by the compressor or for this transfer of heat.

3. A Carnot engine absorb 6×10^5 cal at 227 ^{0}C. Calculate work done per cycle by the engine if its sink is at 127 ^{0}C? 2

Ans. $Q_1 = 6\times10^5 cal$

$T_1 = 227\ ^0C = 227 + 273 = 500K$

$T_2 = 127\ ^0C = 127 + 273 = 400K$

$W = ?$

$\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{400}{500} = \frac{1}{5}$

$\eta = \frac{W}{Q_1}$

$\frac{1}{5} = \frac{W}{6\times10^5}$

$W = \frac{6\times10^5}{5} = 1.2\times10^5 cal$

4. How does second law of thermodynamics explain expansion of gas? 2

Ans. Since from second law, d S ≥ O [d S - change in entropy]

During the expansion of gas, the thermodynamic probability of gas is larger and hence its entropy is also very large. Since form second law, entropy cannot decrease

∴ following the second law, gas molecules move from one partition to another.

5. Calculate difference in efficiency of a Carnot energy working between 2

1) 400K and 350K

2) 350K and 300K

Ans. $\eta_1 = 1 - \frac{T_2}{T_1} = 1 - \frac{350}{400} = \frac{1}{8}$

$\eta_2 = 1 - \frac{T_2}{T_1} = 1 - \frac{300}{350} = \frac{1}{7}$

$Change\ in\ efficiency = \eta_2 - \eta_1 = \frac{1}{7} - \frac{1}{8} = \frac{1}{56}\times100\% = 1.8\%$

6. Derive an expression for the work done during isothermal expansion? 3

7. Briefly describe a Carnot cycle and derive an expression for the efficiency of Carnot cycle? 5