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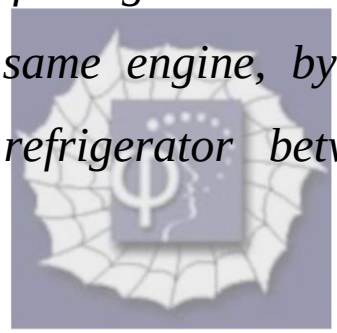
Problem 26.17 (RHK)

(a) *A Carnot engine operates between a hot reservoir at* 322 K *and a cold reservoir at* 258 K. *If it absorbs* 568 J *of heat per cycle at the hot reservoir, we have to find the work per cycle that it delivers.* (b)*We have to calculate the work per cycle that must be supplied for transferring* 1230 J *of heat from the cold reservoir, if the same engine, by working in reverse, functions as a refrigerator between the same two reservoirs.*



Solution:

From the data given in the statement of the problem, we note that

$T_L = 258$ K,

$T_H = 322$ K.

For a Carnot engine, we have

$$\frac{W}{Q_H} = \frac{T_H - T_L}{T_H}.$$

Heat absorbed by the engine per cycle at the hot-reservoir Q_H is 568 J.

Therefore, the work per cycle that the engine delivers, *W*, will be

$$W = \frac{568 \times (322 - 258)}{322} \text{ J} = 112.9 \text{ J}.$$

(b)

For answering the second part of the problem, when the same Carnot engine works between the reservoirs in reverse that is it functions as a refrigerator, we use the result that the heat released to the hot-reservoir Q_H and the heat absorbed at the cold-reservoir Q_L in each cycle are related as

$$\frac{Q_H - Q_L}{Q_L} = \frac{W}{Q_L} = \frac{T_H - T_L}{T_L}.$$

In the engine working as a refrigerator *W* is the work done on the engine per cycle. If the amount of heat that is to be transferred per cycle

$Q_L = 1230$ J,

the amount of work that must be supplied to the refrigerator per cycle will be

$$W = \frac{1230 \times (322 - 258)}{258} \text{ J} = 305.1 \text{ J}.$$