A heat engine is operating between energy reservoirs at 25^0 C and 700^0 C. It is functioning at an efficiency that is 35% of its maximum possible efficiency. If the work output of the heat engine is 1500 J, how much energy is

(a) extracted from the hot reservoir?

(b) how much energy is exhausted into the cold reservoir?

Given:

Temperature of cold reservoir:	$T_C = 25^0$ C = 298 K
Temperature of hot reservoir;	$T_H = 700^0$ C = 973 K
Efficiency at which the heat engine is operating:	e = 35% of e_{max}
Work output of heat engine:	W =1500 J

Determine:

(a) Energy extracted from the hot reservoir: Q_H

(b) Energy exhausted into the cold reservoir: Q_C

First, the maximum possible efficiency of the heat engine has to be determined. Use formula:

$$e_{max} = 1 - (T_C / T_H) \text{ ------------------------(1)}$$

Substituting for T_C & T_H in (1):

$$e_{max} = 1 - (298 / 973) = 0.69 = 69\%$$

Since the efficiency of the heat engine is at 35% of e_{max}:

$$e = 0.35 \times e_{max} \text{ ---------------------------------(2)}$$

Substituting for e_{max} in (2):

$$e = 0.35 \times 0.69 = 0.24 = 24\%$$

(a) Energy extracted from the hot reservoir: Q_H

Use formula:

$e = W / Q_H$ ------------------------- (3)

Rearranging (3) and substituting for W & e in (3):

$\mathbf{Q_H = W / e = 1500 / 0.24 = 6,250\ J}$

(b) Energy exhausted into the cold reservoir: Q_C

Use formula;

$W = Q_H - Q_C$ --------------------(4)

Rearranging (4) and substituting for W & Q_H in (4):

$\mathbf{Q_C = Q_H - W = 6250 - 1500 = 4,750\ J}$