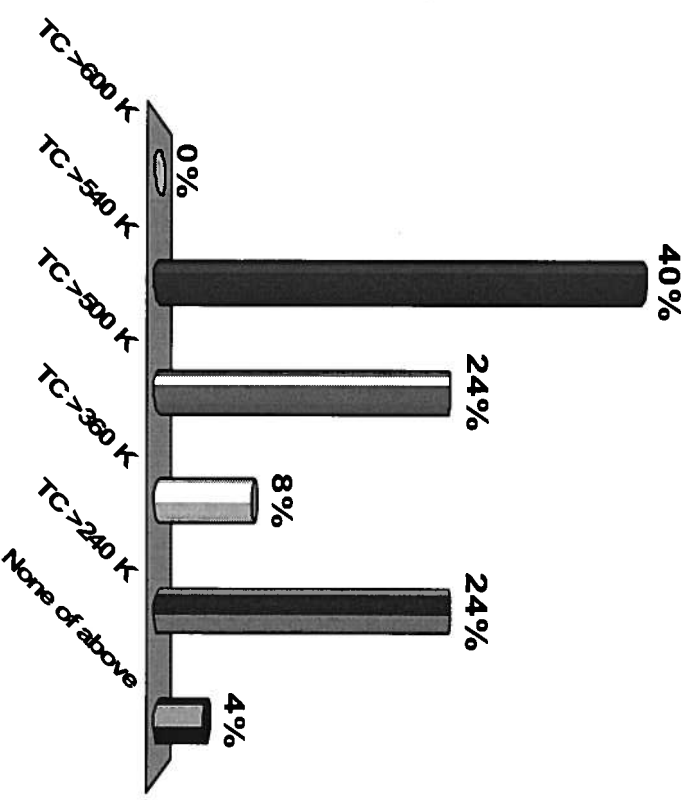


A heat engine takes in 100 J of heat and performs 60 J of work in each cycle. If its maximum Temperature is $T_H = 900$ K, what at most can be inferred about its minimum

(exhaust) temperature, T_C ?

- a) $T_C > 600$ K
- b) $T_C > 540$ K
- c) $T_C > 500$ K
- d) $T_C > 360$ K
- e) $T_C > 240$ K
- f) None of above



One concludes that the exhaust temperature, $T_c < 360 \text{ K}$ (i.e. answer (d)), as follows:

- $\eta_{\text{ACTUAL}} < \eta_{\text{CARNOT}}$ implies
 - (i) $1 - (Q_{\text{OUT}}/Q_{\text{IN}}) < 1 - (T_c/T_H)$, so that
 - (ii) $(Q_{\text{OUT}}/Q_{\text{IN}}) > (T_c/T_H)$, or
 - (iii) $T_H * (Q_{\text{OUT}}/Q_{\text{IN}}) > T_c$.
- Since (1st Law, with $\Delta U = 0$) implies:
 - (iv) $Q_{\text{IN}} - Q_{\text{OUT}} = W_{\text{OUT}}$
 - Or (v) $Q_{\text{IN}} - W_{\text{OUT}} = Q_{\text{OUT}}$,
 - (iii) becomes
 - (vi) $(Q_{\text{IN}} - W_{\text{OUT}})/Q_{\text{IN}} * T_H > T_c$ and compute
 - $((100 - 60)/100) * 900 \text{ K} > T_c$
 - or $360 \text{ K} > T_c$.