1. (d) $\eta = \frac{T_1 - T_2}{T_1} - \frac{W}{Q} \Rightarrow Q = \left(\frac{T_1}{T_1 - T_2}\right) W$

$= \frac{600}{(600-300)} \times 800 = 1600\ J$

2. (c) Coefficient of performance

$K = \frac{T_2}{T_1 - T_2} = \frac{273}{303 - 273} = \frac{273}{30} = 9$

3. (b)

4. (d) For a reversible process $\int \frac{dQ}{T} = 0$

5. (b) For cyclic forces $\Delta U = 0$ So, $\Delta Q = \Delta W$

6. (d) $\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{400}{500} = \frac{1}{5} \because \eta = \frac{W}{Q} \Rightarrow \frac{1}{5} = \frac{W}{Q}$

$\Rightarrow W = \frac{Q}{5} = \frac{6}{5} \times 10^4 = 1.2 \times 10^4\ J$

7. (b) $\eta = 1 - \frac{T_2}{T_1} \Rightarrow \frac{30}{100} = 1 - \frac{350}{T_1}$

$\Rightarrow \frac{350}{T_1} = 1 - \frac{50}{100} = \frac{70}{100} = \frac{7}{10} \Rightarrow T_1 = 500\ K = 227°C$

8. (c) $\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{(273+69)}{(273+411)} = 0.5$

$\Rightarrow$ Work done $= \eta \times Q = 0.5 \times 1000 = 500\ J$

9. (b) $\because \eta = 1 - \frac{T_2}{T_1} = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$

where Q_1 = heat absorbed, Q_2 = heat rejected

$\Rightarrow 1 - \frac{T/3}{T} = \frac{W}{Q_1} \Rightarrow \frac{2}{3} = \frac{W}{Q_1} = \frac{Q_1 - Q_2}{Q_1}$

$\Rightarrow \frac{2}{3} = 1 - \frac{Q_2}{Q_1} \Rightarrow \frac{Q_2}{Q_1} = \frac{1}{3} \Rightarrow Q_2 = \frac{Q_1}{3} = \frac{Q}{3}$

10. (c) $\eta = 1 - \frac{T_2}{T_1} \Rightarrow \frac{25}{100} = 1 - \frac{300}{T_1} \Rightarrow \frac{1}{4} = 1 - \frac{300}{T_1}$

$T_1 = 400\ K = 127°C$

11. (a) $\eta = 1 - \frac{T_2}{T_1} = \frac{T_1 - T_2}{T_1} \Rightarrow \eta_1 = \frac{(473-273)}{473} = \frac{200}{473}$

and $\eta_2 = \frac{273 - 73}{273} = \frac{200}{273}$

So required ratio $\frac{\eta_1}{\eta_2} = \frac{273}{473} = 0.577$

12. (b) $\eta = 1 - \frac{T_2}{T_1} = 1 - \frac{300}{500} = \frac{2}{5}$

13. (d)

14. (b) $\eta = 1 - \frac{T_2}{T_1} \Rightarrow \frac{1}{2} = 1 - \frac{500}{T_1} \Rightarrow \frac{500}{T_1} = \frac{1}{2}$ .....(i)

$\frac{60}{100} = 1 - \frac{T_2'}{T_1} \Rightarrow \frac{T_2'}{T_1} = \frac{2}{5}$ .....(ii)

Dividing equation (i) by (ii), $\frac{500}{T_2'} = \frac{5}{4} \Rightarrow T_2' = 400K$

15. (c)

16. (a)

17. (b) $\eta = 1 - \frac{T_2}{T_1} = \frac{W}{Q} \Rightarrow W = \left(1 - \frac{T_1}{T_2}\right) Q = \left\{1 - \frac{(273+27)}{(273+627)}\right\}$

$\Rightarrow W = \left(1 - \frac{300}{900}\right) \times 3 \times 10^6 = 2 \times 10^6 \times 4.2\ J = 8.4 \times 10^6\ J$

18. (a)

19. (c) Coefficient of performance

$K = \frac{T_2}{T_1 - T_2} \Rightarrow 5 = \frac{(273-13)}{T_1 - (273-13)} = \frac{260}{T_1 - 260}$

$\Rightarrow 5T_1 - 1300 = 260 \Rightarrow 5T_1 = 1560$

$\Rightarrow T_1 = 312K \rightarrow 39°C$

20. (a) Coefficient of performance $K = \frac{T_2}{T_1 - T_2}$

$= \frac{(273-23)}{(273+27)-(273-23)} = \frac{250}{300-250} = \frac{250}{20} = 5$