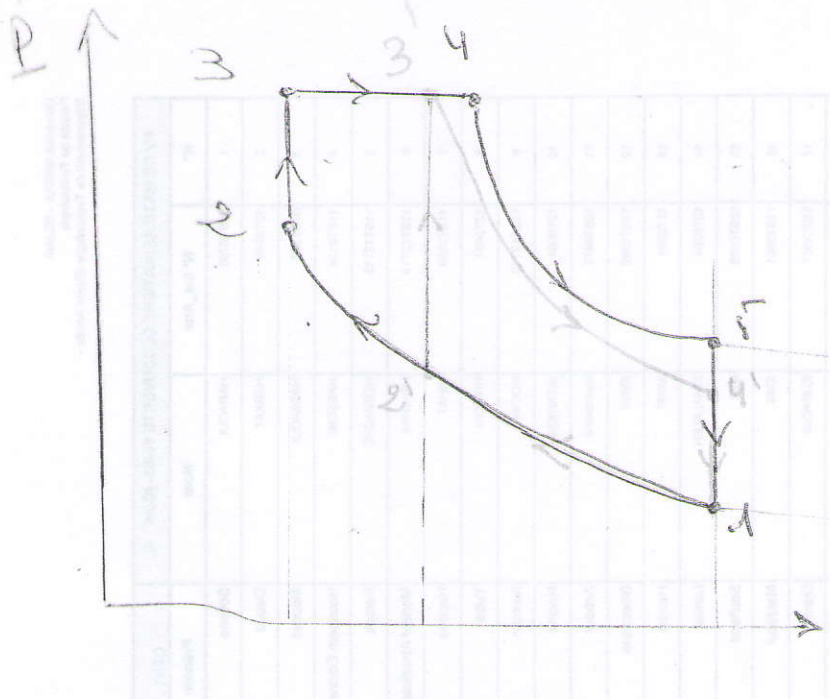
Corrigé DGM



(2)

$P_1 = 1$ bar

$T_1 = 360$ k

$Q_c = 1260$ kJ/kg

$P_3' = P_3 = P_4$

$c_v = 717,5$ J/kg.k

2°/ Cycle de Beau de Rochas :

	①	②	③'	④'
P(bar)	1,00	12,286	41,544	3,381
T (K)	360	737,16	2492,65	1217,309
v (m^3/kg)	1,03356	0,17226	0,17226	1,03356

Etat ①

$$v_1 = \frac{r T_1}{P_1} = \frac{287,1 \cdot 360}{10^5} = 1,033560 \ m^3/kg$$

Etat ②'

$$\frac{T_2'}{T_1} = \left(\frac{V_1}{V_2'}\right)^{\gamma-1} \Rightarrow T_2' = T_1 \left(\frac{V_1}{V_2}\right)^{\gamma-1}$$

$$T_2' = 360 \cdot (6)^{0,4} = 737,16 \ K$$

$$\frac{V_1}{V_2'} = 6 \Rightarrow V_2' = \frac{V_1}{6} = 0,17226 \ m^3/kg$$ (0,75)

$$\frac{P_2}{P_1} = \left(\frac{V_1}{V_2'}\right)^{\gamma} \Rightarrow P_2' = P_1 \left(\frac{V_1}{V_2}\right)^{\gamma}$$

$$P_2' = 1\left(6\right)^{1,4} = 12,286 \text{ bars}$$ (0,75)

Calcul au point (3')

$$Q_c = C_v (T_3' - T_2') = 1260 \ kJ$$

$$C_v = \frac{r}{\gamma - 1} = \frac{0,2871}{0,4} = 0,717775 \ kJ/kg\cdot K$$

$$T_3' - T_2' = \frac{Q_c}{C_v} \Rightarrow T_3' = T_2' + \frac{Q_c}{C_v}$$

$$T_3' = 737,16 + \frac{1260}{0,717775}$$

$$\boxed{T_3' = 2492,646}$$ (0,75)

$$P_3' = \frac{r T_3'}{V_3'} = \frac{287,1 \cdot 2492,65}{0,17226}$$

$$\boxed{P_3' = 41,594 \text{ bars}}$$ (0,75)

$$V_3' = V_2'$$ (0,75)

Calcul au point 4' $V_4' = V_1$ (0,75)

$$\frac{T_4'}{T_3'} = \left(\frac{V_3'}{V_4'}\right)^{\gamma-1} = \left(\frac{V_2'}{V_1}\right)^{\gamma-1}$$

$$T_4' = T_3' \left(\frac{V_2'}{V_1}\right)^{\gamma-1}$$

$$T_4' = 2492,65 \left(\frac{1}{6}\right)^{0,4}$$

$$\boxed{T_4' = 1217,309\ K}$$ (0,75)

$$P_4' V_4'^{\gamma} = P_3' V_3'^{\gamma}$$

$$P_4' = P_3' \left(\frac{V_3'}{V_4'}\right)^{\gamma} = P_3' \left(\frac{V_2'}{V_1'}\right)^{\gamma}$$

$$P_4' = 41,54 \cdot \left(\frac{1}{6}\right)^{1,4}$$

$$\boxed{P_4' = 3,381\ bar}$$ (0,75)

Calcul Q_F :

$$Q_F = C_v (T_4' - T_1) = 717,75\ (1217,31 - 360)$$

$$\boxed{Q_F = -615,33\ kJ/kg}$$ (1,25)

5°/ Calcul du rendement :

$$\eta_{th} = 1 - \frac{\Phi_F}{\Phi_C} = 1 - \frac{615,33}{1260}$$

$$\eta_{th_{BDR}} = 51,169\ \%$$

1,25

Calcul du cycle Sabathé :

	①	②	③	④	⑤
P(bar)	1	32,423	41,544	41,544	3,0295
T(K)	360	972,69	1246,32	2304,83	1090,654
v(m³/kg)	1,03356	0,08613	0,08613	0,1592	1,03356

point ② $\quad V_2 = \frac{V_1}{12}$ (0,5)

$$\frac{T_2}{T_1} = \left(\frac{V_1}{V_2}\right)^{\gamma-1} \Rightarrow T_2 = 360\,(12)^{0,4}$$

$$\boxed{T_2 = 972,69\ K}\ (0,5) \qquad V_2 = \frac{V_1}{12}\ (0,5)$$

$$P_2 = \frac{r T_2}{V_2} = \frac{287,1 \cdot 972,69}{0,08613} = 32,423\ \text{bar}\ (0,5)$$

point ③ $\quad \boxed{V_3 = V_2 = 0,08613\ m^3/kg}$ (0,5)

$P_3 = P_{max} = 41,544$ bar (0,5)

$$T_3 = \frac{P_3 V_3}{r} = \frac{41,544 \cdot 10^5 \cdot 0,08613}{287,1}$$

$$\boxed{T_3 = 1246,32\ K}\ (0,5)$$

point (4)

$$P_4 = P_{max}$$ (0,5)

$$V_4 = \frac{rT_4}{P_4}$$

$$\boxed{V_4 = 0,1592 \ m^3/kg}$$ (0,5)

point (5)

$$V_5 = V_1$$ (0,5)

$$\frac{T_5}{T_4} = \left(\frac{V_4}{V_5}\right)^{\gamma-1} \Rightarrow T_5 = T_4 \left(\frac{V_4}{V_5}\right)^{\gamma-1}$$

$$T_5 = 2304,83 \left(\frac{0,1592}{1,03356}\right)^{0,4}$$

$$\boxed{T_5 = 1090,64 \ K}$$ (0,5)

$$P_5 = \frac{rT_5}{V_5} = \frac{287,1 \cdot 1090,64}{1,03356}$$

$$\boxed{P_5 = 3,02955 \ bar}$$ (0,5)

Calcul Q_F :

$$Q_F = C_V (T_5 - T_1)$$

$$\boxed{Q_F = -524,53 \ kJ/kg}$$ (0,5)

$$\eta = 1 - \frac{Q_F}{Q_C}$$

$$= 1 - \frac{524,53}{1260}$$

$$\boxed{\eta_{th_{Sabathé}} = 58,37\%} \quad (0,5)$$

$$\eta_{th\ sabathé} > \eta_{th\ BDR} \quad (1)$$

$$\Rightarrow \tau_{sabathé} > \tau_{BDR} \quad (1)$$