hi 3002

Work, $W_2 = \int_1^2 F_x \, dx = F_x l_x$ Joule

Units $Nm \simeq J$ Book: kJ

Work / unit time $F_x v_x$

$Nm/s = J/s \equiv W$ Watt

UK 1 hp = 550 ft lbf/s (A 1)

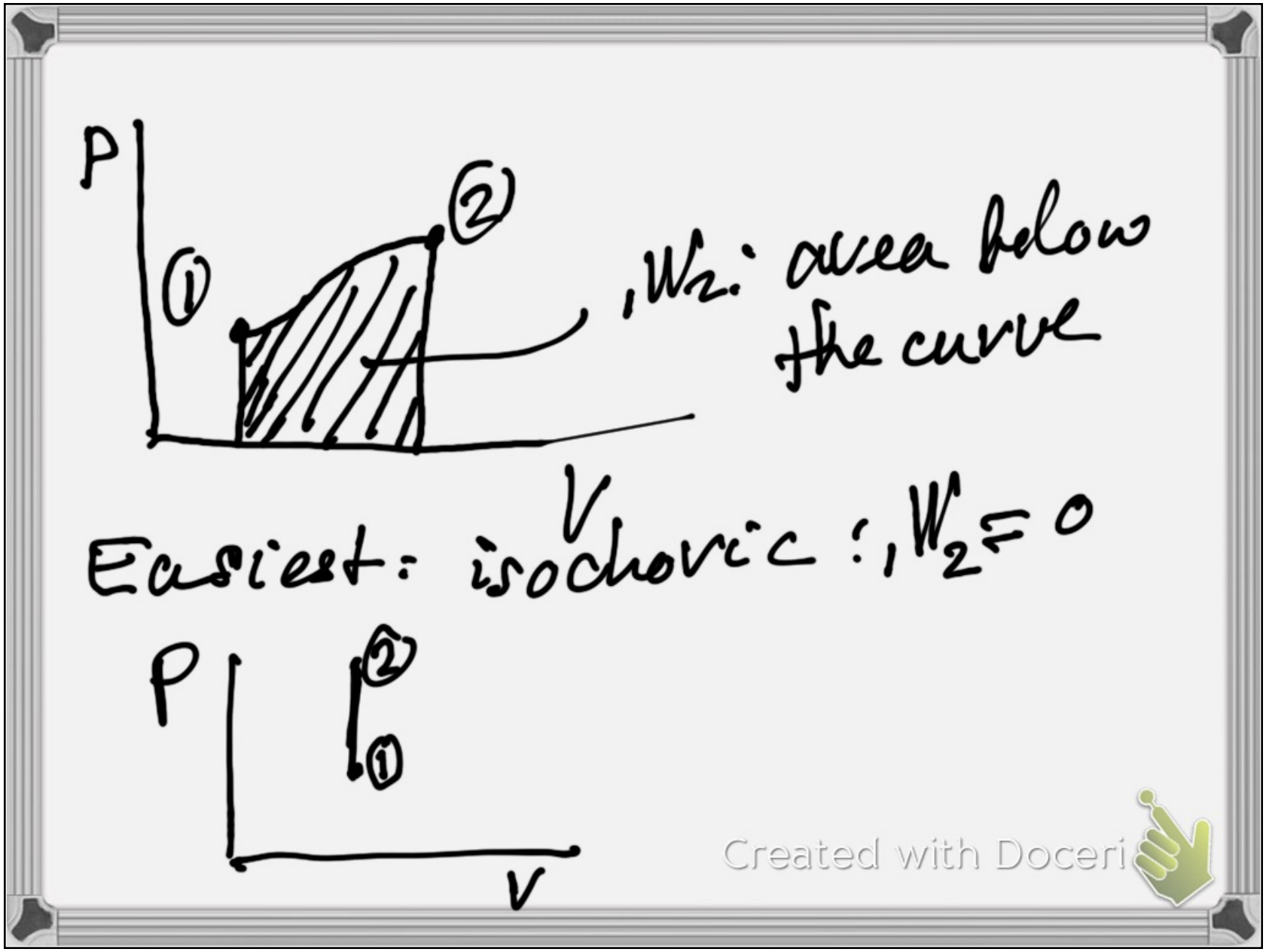
Specific work $w = \frac{W}{m}$

# work done by substance


$t \qquad t+dt$

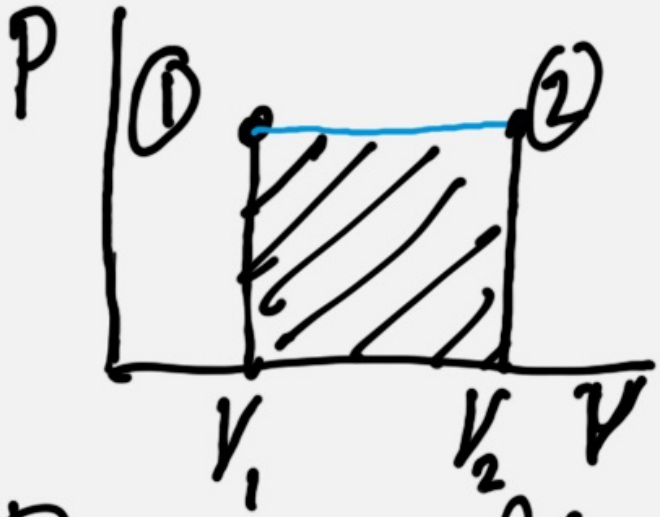
$$dW_{t \to t+dt} = PA\,dh = P\,dV$$

$$\boxed{{}_1W_2 = \int_1^2 P\,dV} \text{ by substance}$$




$W_2$: area below the curve

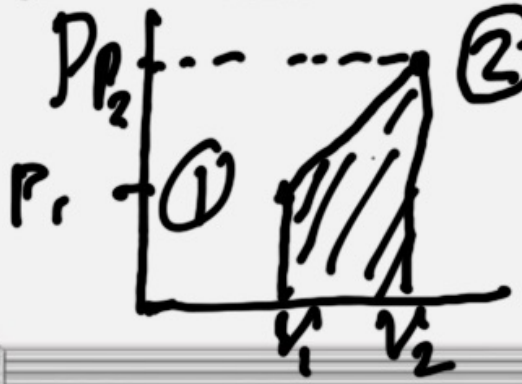
second law test : isobaric




$W_2 = P(V_2 - V_1)$

$P_2 = P_1 = P$

P varies linearly with V




$W_2 = \frac{P_1 + P_2}{2}(V_2 - V_1)$

$(P = A + BV)$

Polytropic $PV^n = \text{constant}$

$n$ called polytropic coefficient

$\neq \bar{n}$ : number of moles

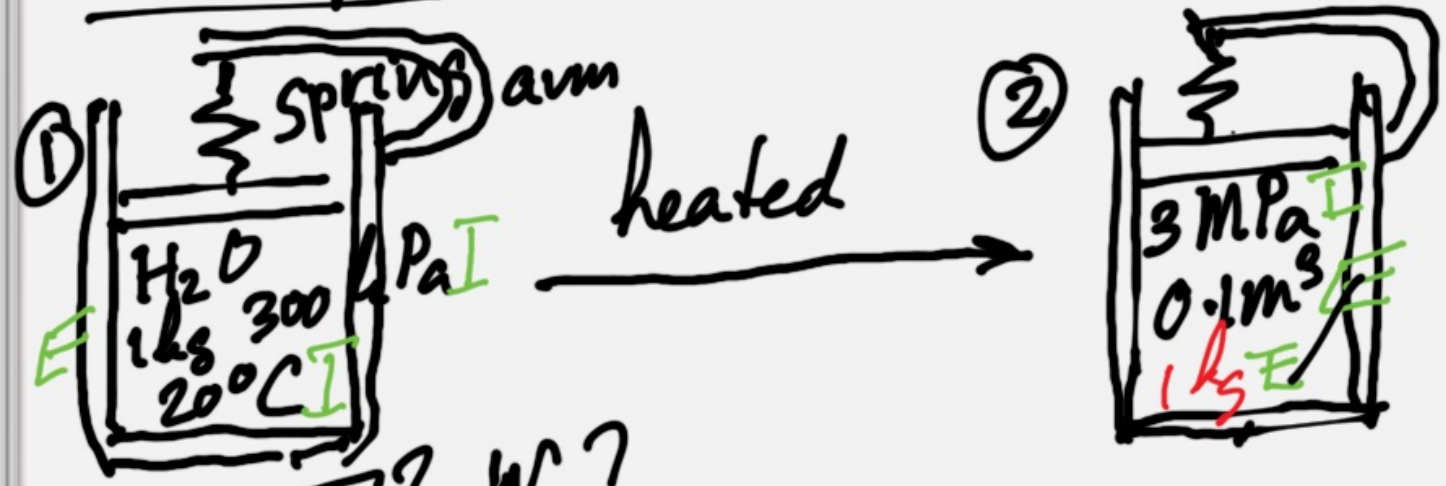
$$W_2 = \frac{P_2V_2 - P_1V_1}{1-n} \quad n \neq 1$$

$$W_2 = P_1V_1 \ln\left(\frac{V_2}{V_1}\right) \quad n = 1$$

For an ideal gas $PV = mRT$

if isothermal I.G. $\rightarrow$ polytropic $n=1$

# Example Given in black

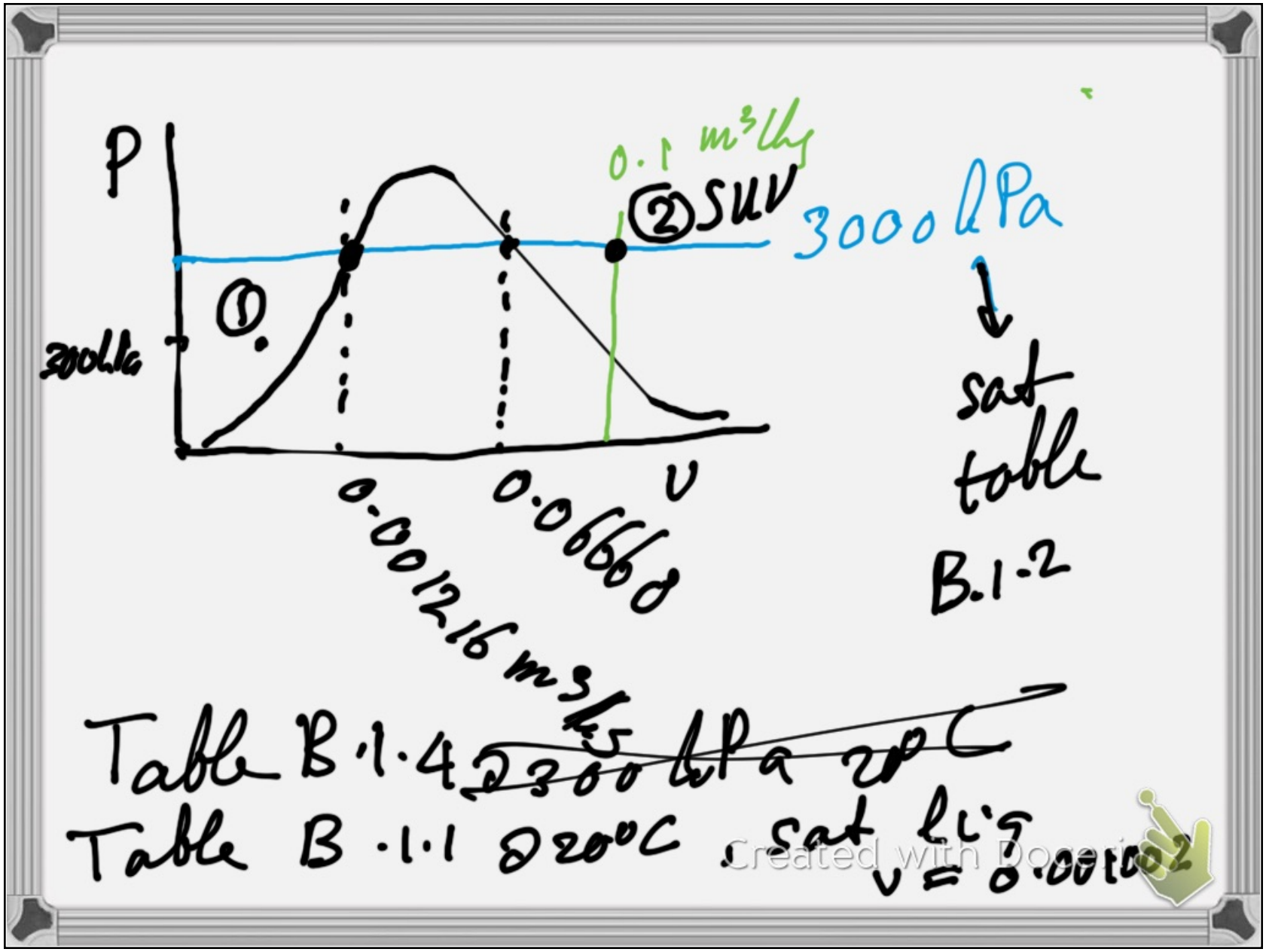


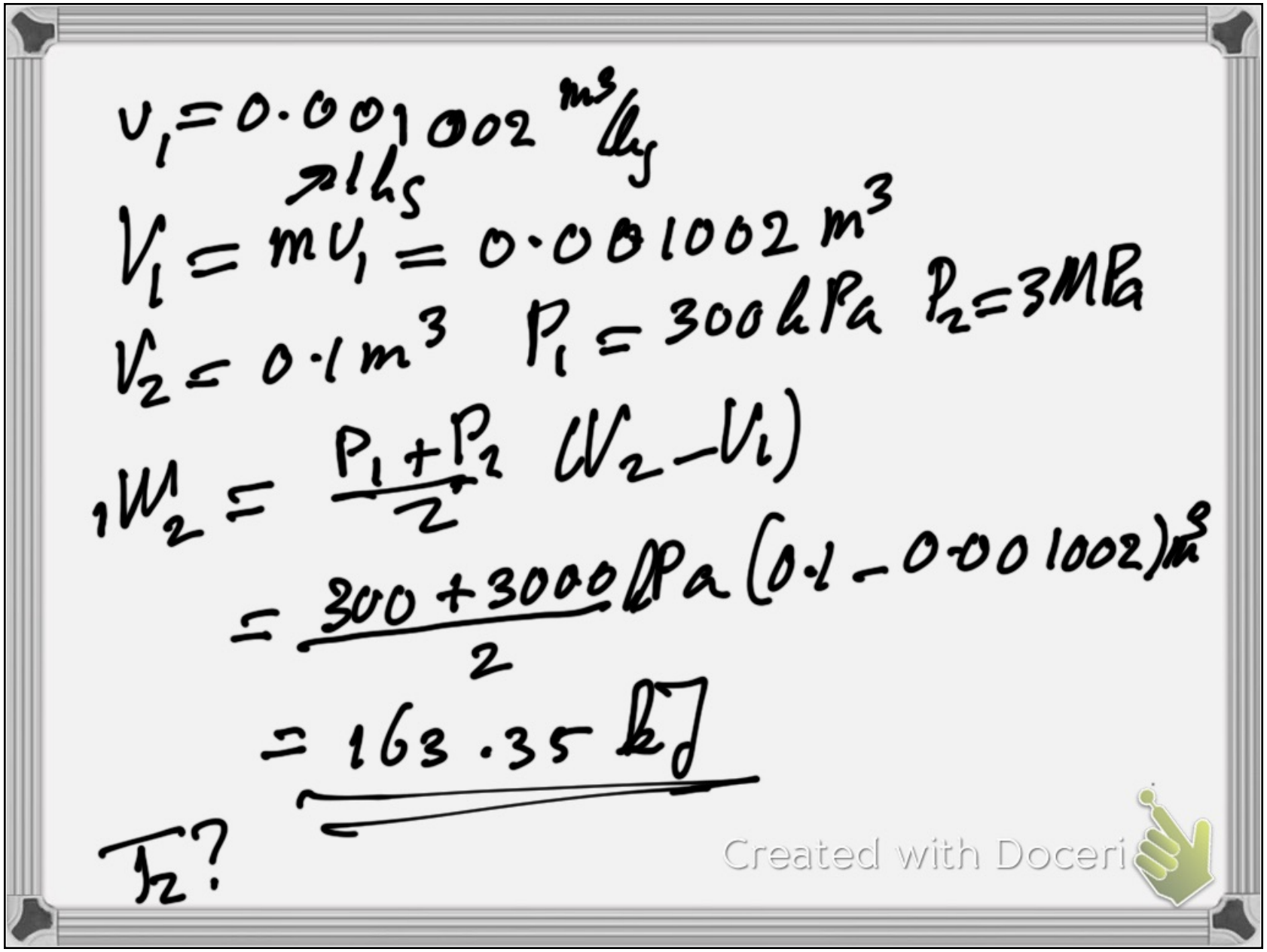

Asked $T_2$? , $W_2$?

Solution should do phase consulter

① P, T ① C.L (common sense)

② $P = 3\ MPa$, $v = \frac{V}{m} = \frac{0.1\ m^3}{1\ kg} = 0.1\ \frac{m^3}{kg}$


P
0.1 m³/kg
② SAT V
3000 kPa
sat table
B.1.2
① 200 kPa
0.00216 m³/kg
0.0666
V
Table B.1.4 ~~2300 kPa 20°C~~
Table B.1.1 @ 20°C sat liq
V = 0.001002


$v_1 = 0.001002 \frac{m^3}{kg}$
$\rightarrow 1 kg$
$V_1 = m v_1 = 0.001002\ m^3$
$V_2 = 0.1\ m^3$ $P_1 = 300\ kPa$ $P_2 = 3\ MPa$
$W_2 = \frac{P_1 + P_2}{2}(V_2 - V_1)$
$= \frac{300 + 3000\ kPa}{2}(0.1 - 0.001002)\ m^3$
$= 163.35\ kJ$
$T_2$?
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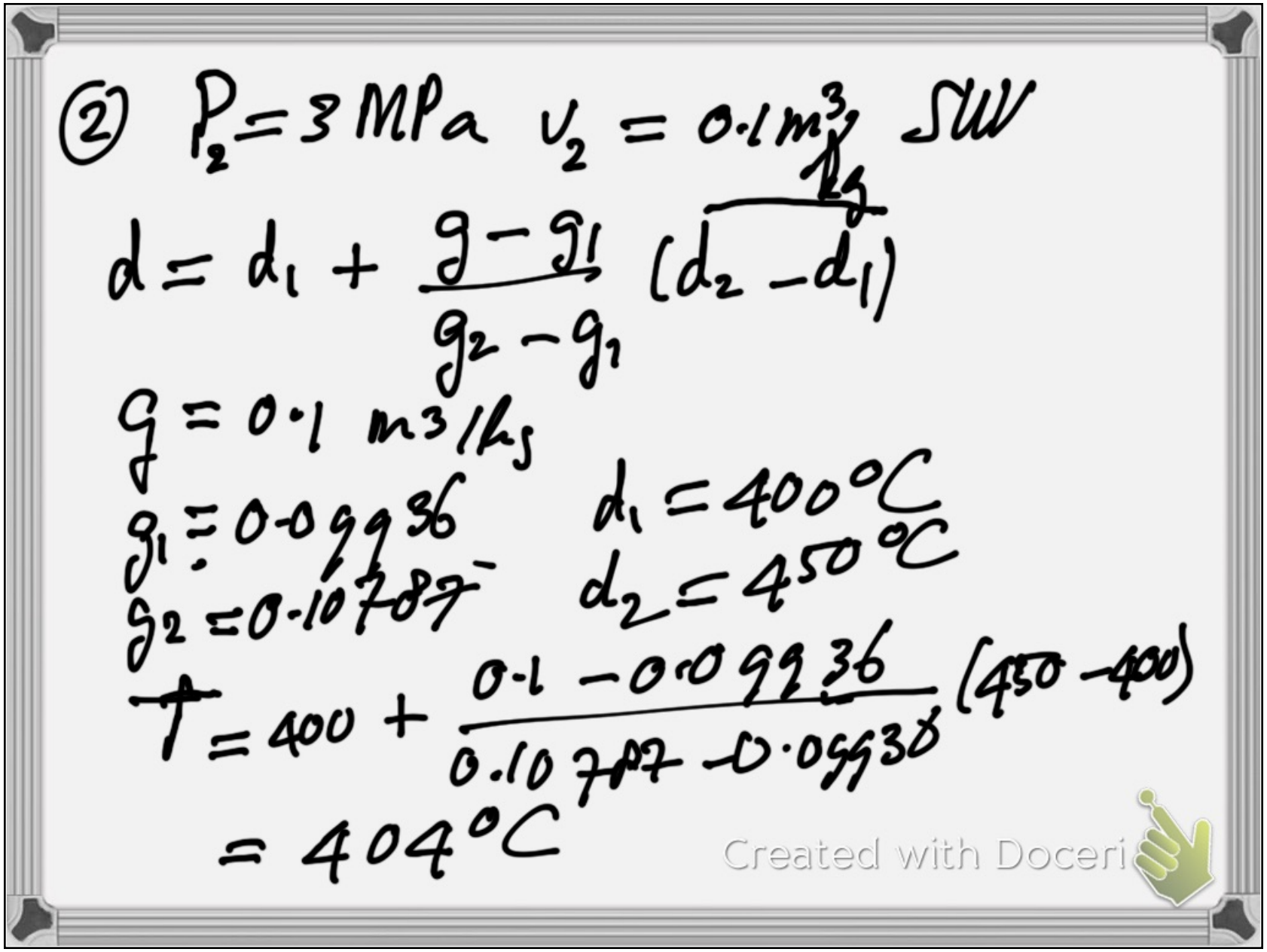
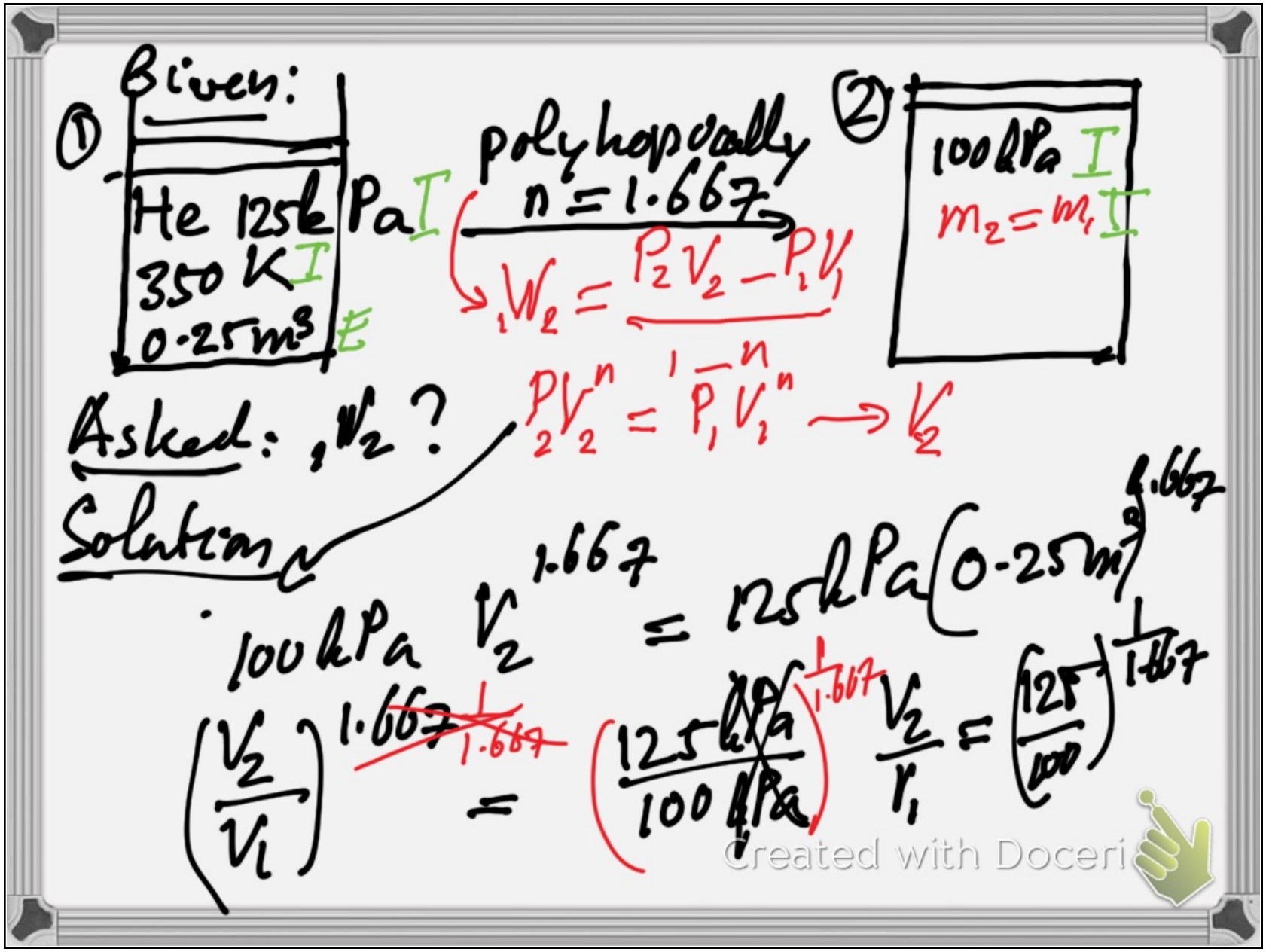

② $P_2 = 3\,MPa$ $v_2 = 0.1\,m^3/kg$ SHV
$d = d_1 + \frac{g - g_1}{g_2 - g_1}(d_2 - d_1)$
$g = 0.1\ m^3/kg$
$g_1 = 0.09936$ $d_1 = 400°C$
$g_2 = 0.107087$ $d_2 = 450°C$
$T = 400 + \frac{0.1 - 0.09936}{0.107087 - 0.09936}(450 - 400)$
$= 404°C$
Created with Doceri


Given:
① He 125kPa I
350 K I
0.25 m³ E
polytropically
n = 1.667
② 100 kPa I
m₂ = m₁ I
Asked: V₂?
Solution
100 kPa V₂^1.667 = 125 kPa (0.25 m³)^1.667
(V₂/V₁)^1.667 = (125 kPa / 100 kPa)
V₂/V₁ = (125/100)^1/1.667
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