chapter 3

* Ideal gas

H_2O
R-134a → Tables

CO_2, N_2, O_2, CO → أي مادة غير ال H_2O وال R-134a → Ideal gas

Table (A-1)

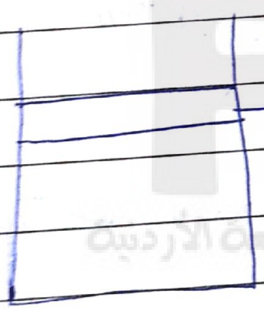
$$\underset{kPa}{P}\,\overset{m^3}{V} = \underset{kg}{m}\,R\,\underset{kelvin}{T}$$

$$PV = \underline{Z}mRT$$

$Z \neq 1$ so it's real gas

* vender val equation → معادلة في آخر الشابتر

* ch4 (closed system)



→ closed system يعبر عن piston دائماً ال

* لما ال piston بنزل لتحت → compression
* " " " يطلع لفوق → expansion

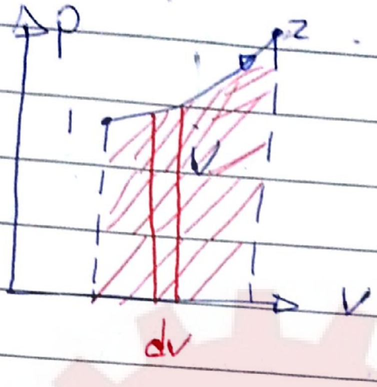
* boundary work → لما يطلع ال piston وينزل

* work = Fr

boundary work = $\int p\,dv$

boundry work of compression ⟶ ⊖

" " " expansion ⟶ ⊕



area = $\int p\,dv$

wb = area under p-v diagram

* boundary work / energ balance

مفاتيح حل السؤال

* constant volume ($V_1 = V_2$) ⟶ (Rigid tank / room)

isometric / isochoric

$W_b = 0$

* constant pressure ($P_1 = P_2$) ⟶ piston move freely

Isobaric

$W_b = P\Delta V = P(V_2 - V_1)$

* constant Temprature $T_1 = T_2$ ⟶ iso Thermal

عزم نكملها لو

$W_B = P_1 V_1 \ln \frac{V_2}{V_1}$

$P_2 V_2$

polytropic

* polytropic $PV^n = \text{constant}$

Loses 3

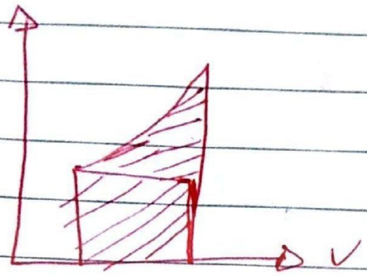
$P_1 V_1^n = P_2 V_2^n$

$W_b = \frac{P_2 V_2 - P_1 V_1}{1 - n}$

actul expansion or compression

shaft → rotation rod

* إذا ما زبطت معاك المعادلة نلجأ لل Area



spring work → مساحة المثلث

boundary work → مساحة المثلث + المستطيل

$$\text{spring work} = \frac{1}{2} k x^2$$

* Energy Balance: → ch4 (closed system)
→ ch5 (open system)

interal energy

$$\underbrace{Q_{in} - Q_{out}}_{\text{energy transfer by Heat}} + \underbrace{W_{in} - W_{out}}_{\text{energ transfer by work}} = \Delta u + \Delta ke + \Delta pe$$

energy transfer by Heat → Temp diffrence

voltage

$$W_{of\,circt} = I \times V \times t$$

current, time

* internal → طاقة الروابط بين الجزيئات

$$\Delta ke = \frac{V_2^2}{2} - \frac{V_1^2}{2}$$

$$\Delta pe = g(z_2 - z_1)$$

* $W_e = W_{in}$
↓
electrical

$W_b = W_{out}$

$W_{sh} = W_{in}$ or W_{out}
↓
shaft

~~Example 4-7~~ problem 4-35

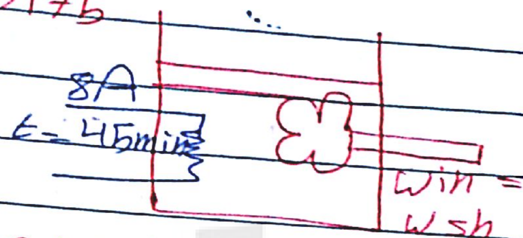
insluated $Q_{in} = Q_{out} = 0$

$V_1 = 5L$

water → Tables

State ①: saturated Liq water

$P_1 = 175\ Kpa$ → $v_1 = v_f @ 175$



② mixture $x = 0.5$

$P_2 = P_1 = 175$ $v_2 = v_f + x v_{fg}$ $W_{in} = W_e$ $= 400\ KJ$

① ~~sys~~

System → substane → الغاز → Wb → energy balance

$W_b = P\Delta V = P(V_2 - V_1) = \cancel{175}($
$= m P (v_2 - v_1)$ KJ

$\cancel{Q}_{in} - \cancel{Q}_{out} + W_{in} - W_{out} = \Delta U + \Delta \cancel{ke} + \Delta \cancel{pe}$

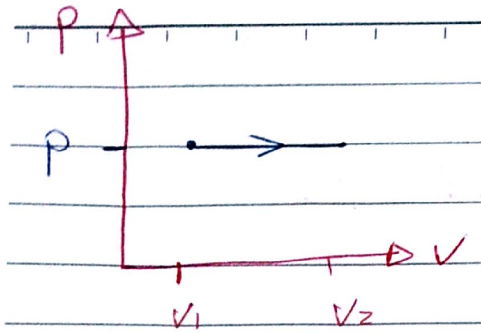
$IVt + 400 - V = m(u_2 - u_1)$

u_1 → $u_f @ 175$

u_2 → $u_f + x u_{fg}$

$V = m v$

$m = \frac{V_1}{v_1}$



$W_e = IVt$ ⟶ t sec

CO_2, O_2, N_2 ⟶ $\Delta H = m C_p \Delta T$

Table A-20 ⟶ $\Delta u = m C_v \Delta T$

C_p ⟶ مقدار الطاقة اللازمة لرفع حرارة الجسم درجة واحدة عندما يكون الضغط ثابت

$H = \underbrace{U}_{\text{internal}} + \underbrace{PV}_{\text{flow}}$

C_p and C_v Just for gases

$\underbrace{K}_{\text{Heat ration}} = \dfrac{C_p}{C_v}$ $\quad$ $\underbrace{R}_{\text{gas constant}} = C_p - C_v$

* 4-16

Closed system

$m = 2\,kg$

N_2

$P_1 = 100\,kPa$

$T_1 = 300\,K$

Ideal gas

$PV^{\overset{n}{1.4}} = \text{constant}$

$$*W_b = \frac{P_2V_2 - P_1V_1}{1-n} = \frac{mR(T_2 - T_1)}{1-n} = W_{in}$$

$PV = mRT$

$PV = mRT$

* amout of Heat transfer

$$Q_{in} - Q_{out} + w_{in} - w_{out} = \Delta u$$

* amount of Heat transfer

$$Q_{in} + w_{in} = m c_v \Delta T$$

↓ Table A-2

$$P_1 V_1^{1.41} = P_2 V_2^{1.41}$$

$$5 = P_2 V_2^{1.4}$$