

1. صح السؤال الثاني / ارجو انظره !!

Q1. A piston-cylinder device initially contains 0.07 m^3 of nitrogen gas at 130 kPa and 120°C . The nitrogen is now expanded polytropically to a state of 100 kPa and 100°C . Determine the boundary work done during this process.

$$V_1 = 0.07 \text{ m}^3$$

$$P_1 = 130 \text{ kPa}$$

$$T_1 = (120 + 273) \text{ K}$$

(expanded (polytropically))

$$P_2 = 100 \text{ kPa}$$

$$T_2 = (100 + 273) \text{ K}$$

$$P_1 V_1^n = C$$

$$P_2 V_2^n = C$$

$$130 (0.07)^n = C$$

$$100 (0.086)^n = C$$

Division

$$1.3 \left(\frac{0.07}{0.086} \right)^n = 1$$

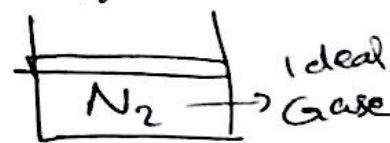
$$(0.81395)^n = 0.769$$

$$n = 1.3$$

Low
high

$$W_b = 1.67 \text{ KJ}$$

Wb??



$$P_1 V_1 = m R T_1$$

$$130 (0.07) = m (0.2968) (393)$$

$$m = 0.078 \text{ kg}$$

$$P_2 V_2 = m R T_2$$

$$100 [V_2] = (0.078) (0.2968) (373)$$

$$V_2 = 0.086 \text{ m}^3$$

$$P V^{1.3} = C$$

So the

$$W_b = \int_{V_1}^{V_2} P dV$$

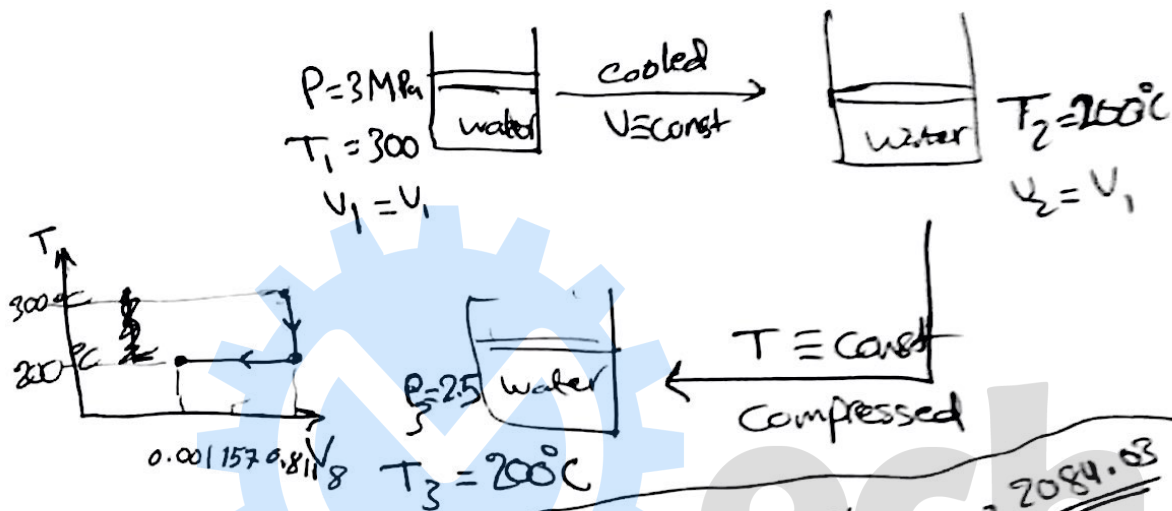
$$= \frac{P_2 V_2 - P_1 V_1}{1 - n}$$

$$= \frac{100 (0.086) - 130 (0.07)}{1 - 1.3}$$

$$P_1 V_1^{1.3} = P_2 V_2^{1.3}$$

$$V_2 = 0.086$$

Q.2 Water initially at 3.0 MPa and 300 °C is contained within a piston cylinder arrangement. The water is cooled at constant volume until it reaches a temperature of 200 °C. The water is (then) compressed isothermally to a state where the pressure of 2.5 MPa. Determine the missing properties at all three states and the quality where appropriate. Sketch the T-V diagram



	T °C	P (kPa)	v m³/kg	u kJ/kg	h kJ/kg	x	Phase
①	300	3000	0.008118	2750.8	2994.3	—	Superheated
②	200	1554.9	0.08118	1951.4	2084.3	0.635	Saturated vapor
③	200	2500	0.001157	850.46	852.76	—	Compressed liquid

$$x_2 = \frac{v_1 - v_f}{v_{fg}}$$

$$x_2 = 0.635$$

$$u_2 = u_f + x_2 u_{fg}$$

$$h_2 = h_f + x_2 h_{fg}$$