MECHANICAL ENGINEERING SCIENCE (UE25ME141A/B)

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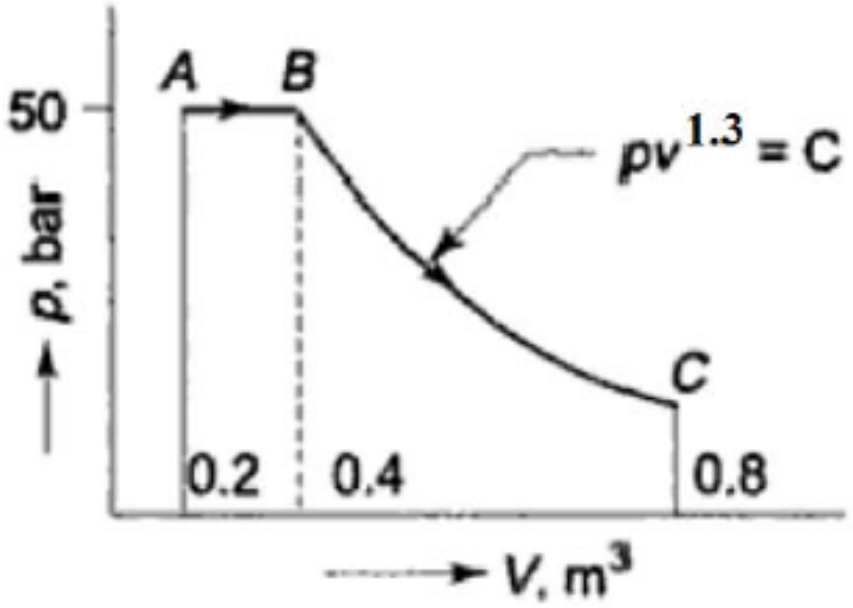
Numericals on Moving Boundary Work

Determine the total work done by a gas system following an expansion process shown in the figure.



Important Observations

A-B: Constant Pressure Process

B-C: Polytropic Process

Data Provided

$p_A = p_B = 50$ bar

1 bar = 100 kPa

$V_A = 0.2\ m^3; V_B = 0.4\ m^3; V_C = 0.8 m^3$

$p_B {V_B}^{1.3} = p_C {V_C}^{1.3}$

Numericals on Moving Boundary Work

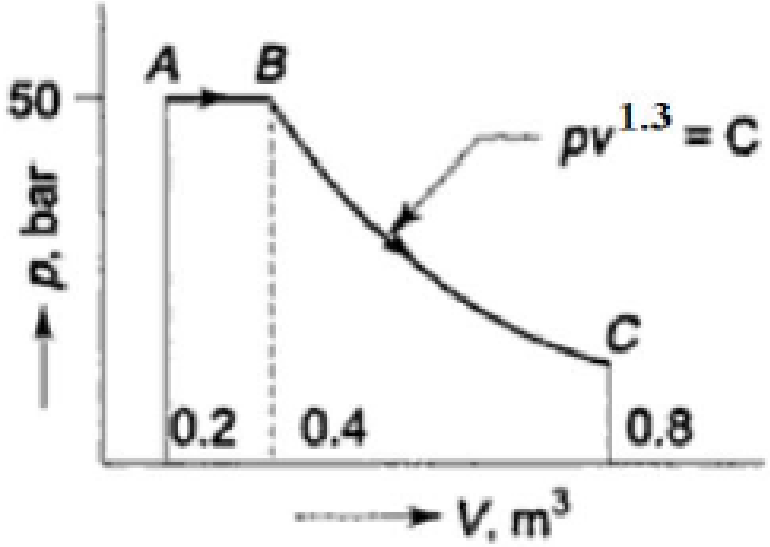
Solution

1. Determination of p_C

$$p_B V_B^{1.3} = p_C V_C^{1.3}$$

$$p_C = p_B \left(\frac{V_B}{V_C}\right)^{1.3} = 50 \times 100 \times \left(\frac{0.4}{0.8}\right)^{1.3}$$

$$\mathbf{p_C = 2030.63\ kPa}$$



Numericals on Moving Boundary Work

Solution (Cont'd)

2. Determination of total work done

$$W_{A-B} = p_A(V_B - V_A) = 50 \times 100 \times (0.4 - 0.2)$$

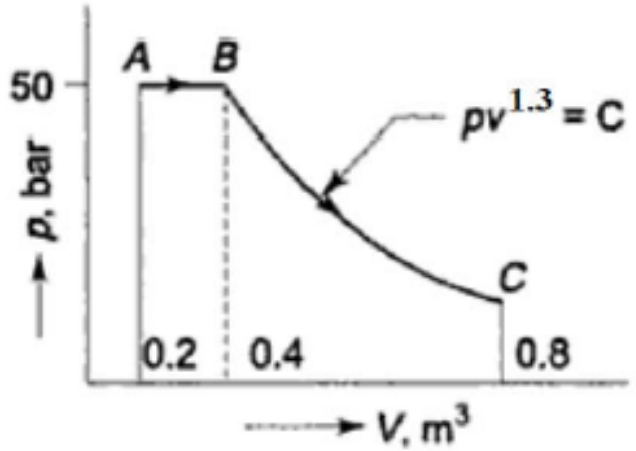
$$\mathbf{W_{A-B} = 1000\ kJ}$$

$$W_{B-C} = \frac{p_B V_B - p_C V_C}{n-1} = \frac{50 \times 100 \times 0.4 - 2030.63 \times 0.8}{1.3 - 1}$$

$$\mathbf{W_{B-C} = 1251.65\ kJ}$$

$$W_{Total} = W_{A-B} + W_{B-C} = \mathbf{1000 + 1251.65}$$

$$\mathbf{W_{Total} = 2251.65\ kJ}$$



THANK YOU

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