

A material has a coefficient of linear expansion given by  $\alpha = 1 \times 10^{-4} / ^\circ\text{C}$ . The same material has a specific heat of 1500 J/kg C. Suppose 1 kg of this material (with a volume of  $0.04 \text{ m}^3$ ) is heated from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ . It is surrounded by the atmosphere which has a pressure of  $1.01 \times 10^5 \text{ Pa}$ .

(a) Calculate Q

(b) Calculate W

(c) Calculate  $\Delta U$

An ideal gas goes through an isothermal process at  $T = 100^\circ\text{C}$ .

(d) Calculate  $\Delta U$

An ideal gas goes through an isobaric process at  $P = 1 \times 10^5 \text{ Pa}$  and changes volume from  $1 \text{ m}^3$  to  $2 \text{ m}^3$ .

(e) Calculate W

A material has a coefficient of linear expansion given by  $\alpha = 1 \times 10^{-4} / ^\circ\text{C}$ . The same material has a specific heat of  $1500 \text{ J/kg } ^\circ\text{C}$ . Suppose  $1 \text{ kg}$  of this material (with a volume of  $0.04 \text{ m}^3$ ) is heated from  $0^\circ\text{C}$  to  $100^\circ\text{C}$ . It is surrounded by the atmosphere which has a pressure of  $1.01 \times 10^5 \text{ Pa}$ .

(a) Calculate  $Q$

$$Q = mc\Delta T = 1 \text{ kg} \times 1500 \text{ J/Kg } ^\circ\text{C} \times 100^\circ\text{C} = 1.5 \times 10^5 \text{ J}$$

(b) Calculate  $W$

$$W = P\Delta V = 3 \times 1.01 \times 10^5 \times 0.04 \times 100 = 121 \text{ J}$$

(c) Calculate  $\Delta U$

$$\Delta U = Q - W \approx 1.5 \times 10^5 \text{ J}$$

An ideal gas goes through an isothermal process at  $T = 100^\circ\text{C}$ .

(d) Calculate  $\Delta U$

$$\Delta U = 0$$

An ideal gas goes through an isobaric process at  $P = 1 \times 10^5 \text{ Pa}$  and changes volume from  $1 \text{ m}^3$  to  $2 \text{ m}^3$ .

(e) Calculate  $W$

$$W = P\Delta V = 1 \times 10^5 (2) = 2 \times 10^5 \text{ J}$$