

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 m^3) is heated from 0°C to 100°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 ΔU

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

(d) Calculate ΔU

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

(e) Calculate W

1 mole of an ideal gas with a (molar) specific heat at a constant volume given by $c_v = \frac{3}{2}R$ (J/mole K); $R = 8.314 \text{ J}/(\text{mol K})$ goes through an isovolumetric process at and changes temperature from 0°C to 100°C .

(f) Calculate W

(g) Calculate Q

(h) Calculate ΔU

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 m³) is heated from 0C to 100C. It is surrounded by the atmosphere which has a pressure of 1.01×10^5 Pa.

(a) Calculate Q

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

(b) Calculate W

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

(c) Calculate ΔU

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

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

(d) Calculate ΔU

$$\Delta U = 0$$

An ideal gas goes through an isobaric process at $P = 1 \times 10^5$ Pa and changes volume from 1 m³ to 2 m³.

(e) Calculate W

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

1 mole of an ideal gas with a (molar) specific heat at a constant volume given by

$$c_v = \frac{3}{2} R (\text{J/mole K}); R = 8.314 \text{ J/(mol K)}$$

of goes through an isovolumeric process and changes temperature from 0C to 100C.

(f) Calculate W $W = P\Delta V = 0$

(g) Calculate Q $Q = nc_v\Delta T = 1 \times \frac{3}{2} \times 8.314 \times 100 = 1247.1 \text{ J}$

(h) Calculate ΔU $\Delta U = Q - W = Q = 1247.1 \text{ J}$