

Thermal Physics revision:

Calorimetry:

1. What quantity of heat is required to raise the temperature of 0.5 kg of water from 15°C to 85°C . The specific heat of water is $4180 \text{ J kg}^{-1} \text{ K}^{-1}$.
2. If a body of mass 250 g increases in temperature by 30°C by absorbing 3 kJ of heat, what is its specific heat?

Expansion/contraction:

3. A uniform rod has a length of 5.5 m at 25°C . If the coefficient of thermal expansion is 10^{-3} K^{-1} , what is the length of the rod at 75°C ?
4. A uniform bar ~~is~~ has a length of 7 m at 0°C . If the bar has a length of 6.99 m at a temperature of -10°C , what is the coefficient of thermal expansion?

Power/Energy:

5. An LED has a constant power of 50 mW . What is the energy used when it is illuminated for 0.5 s ?

Thermal Physics revision examples solutions:

Calorimetry:

$$Q = m c \Delta T$$

①

ΔT = change in temperature as a result of body acquiring heat energy

$$\Delta T = 70^\circ \text{C}$$

$$c = 4180 \text{ J kg}^{-1} \text{K}$$

$$m = 0.5 \text{ kg}$$

$$Q = 0.5 \times 4180 \times 70$$

$$\underline{Q = 146,300}$$

②

$$m = 0.25 \text{ kg}$$

$$\Delta T = 30^\circ \text{C}$$

$$Q = 3000 \text{ J}$$

$$c = \frac{Q}{m \Delta T} = \frac{3000}{0.25 \times 30}$$

$$\underline{c = 400 \text{ J kg}^{-1} \text{K}^{-1}}$$

Expansion / Contraction

$$L(T) = L(T_0) [1 + \alpha (T - T_0)]$$

$L(T)$ is length at temperature T

$L(T_0)$ is length at temperature T_0

α thermal expansion coefficient

(3)

$$L(75^\circ\text{C}) = 5.5 [1 + 10^{-3} \times 50]$$

$$L(75^\circ\text{C}) = 5.5 [1.05]$$

$$L(75^\circ\text{C}) = 5.775 \text{ m}$$

$$L(75^\circ\text{C}) = 5.78 \text{ to 2 D.P.}$$

(4)

$$L(-10^\circ\text{C}) = 6.99 \text{ m}$$

$$L(0^\circ\text{C}) = 7 \text{ m}$$

$$\Delta T = 10^\circ\text{C}$$

$$L(0^\circ\text{C}) = L(-10^\circ\text{C}) [1 + \alpha \times 10]$$

$$7 = 6.99 [1 + 10\alpha]$$

$$\frac{7}{6.99} = 1 + 10\alpha$$

$$10\alpha = \frac{7}{6.99} - 1 = 1.43 \times 10^{-3}$$

$$\therefore \alpha = 1.43 \times 10^{-4} \text{ K}^{-1}$$