

Physics

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(Chapter 11) (Thermodynamics) (Exercises)

(Class 11)

Question 11.1:

A geyser heats water flowing at the rate of 3.0 litres per minute from 27 °C to 77 °C. If the geyser operates on a gas burner, what is the rate of consumption of the fuel if its heat of combustion is 4.0×10^4 J/g?

Answer 11.1:

Water is flowing at a rate of 3.0 litre/min.

The geyser heats the water, raising the temperature from 27°C to 77°C.

Initial temperature, $T_1 = 27^\circ\text{C}$ and Final temperature, $T_2 = 77^\circ\text{C}$

Rise in temperature, $\Delta T = T_2 - T_1 = 77 - 27 = 50^\circ\text{C}$

Heat of combustion = 4×10^4 J/g

Specific heat of water, $c = 4.2 \text{ J g}^{-1} ^\circ\text{C}^{-1}$

Mass of flowing water, $m = 3.0 \text{ litre/min} = 3000 \text{ g/min}$

Total heat used, $\Delta Q = mc \Delta T = 3000 \times 4.2 \times 50 = 6.3 \times 10^5 \text{ J/min}$

\therefore Rate of consumption = $\frac{6.3 \times 10^5}{4 \times 10^4} = 15.75 \text{ g/min}$

Question 11.2:

What amount of heat must be supplied to 2.0×10^{-2} kg of nitrogen (at room temperature) to raise its temperature by 45 °C at constant pressure? (Molecular mass of $N_2 = 28$; $R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$.)

Answer 11.2:

Mass of nitrogen, $m = 2.0 \times 10^{-2} \text{ kg} = 20 \text{ g}$ and Rise in temperature, $\Delta T = 45^\circ\text{C}$

Molecular mass of N_2 , $M = 28$

Universal gas constant, $R = 8.3 \text{ J mol}^{-1} \text{ K}^{-1}$

Number of moles, $n = \frac{m}{M} = \frac{2.0 \times 10^{-2} \times 10^3}{28} = 0.714$

Molar specific heat at constant pressure for nitrogen $C_p = \frac{7}{2}R = \frac{7}{2} \times 8.3 = 29.05 \text{ J mol}^{-1} \text{ K}^{-1}$

The total amount of heat to be supplied is given by the relation: $\Delta Q = nC_p \Delta T$

$= 0.714 \times 29.05 \times 45 = 933.38 \text{ J}$

Therefore, the amount of heat to be supplied is 933.38 J.

Question 11.3:

Explain why

- (a) Two bodies at different temperatures T_1 and T_2 if brought in thermal contact do not necessarily settle to the mean temperature $(T_1 + T_2)/2$.
- (b) The coolant in a chemical or a nuclear plant (i.e., the liquid used to prevent the different parts of a plant from getting too hot) should have high specific heat.
- (c) Air pressure in a car tyre increases during driving.
- (d) The climate of a harbour town is more temperate than that of a town in a desert at the same latitude.

Answer 11.3:

- (a) When two bodies at different temperatures T_1 and T_2 are brought in thermal contact, heat flows from the body at the higher temperature to the body at the lower temperature till equilibrium is achieved, i.e., the temperatures of both the bodies become equal. The equilibrium temperature is equal to the mean temperature $(T_1 + T_2)/2$ only when the thermal capacities of both the bodies are equal.

Thermodynamics Laws Chapter 12th Std Ssc Board

Hussin A.Rothana



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