CHAPTER 18

Measuring Temperature

Q1. In a constant-volume gas thermometer, the pressure is 0.019 atm at 100 degrees Celsius. Find the temperature when the pressure is 0.027 atm.Ans:257 degrees Celsius

Temperature Scales

Q2. Fahrenheit and Kelvin scales agree at a reading of:Ans:574.
Q3. A new temperature scale is called Z. On that scale, the boiling point of water is 150 degree Z and the freezing point is - 10 degree Z. Find the corresponding 70 degree Z in degree C.Ans:50 degree C.
Q4. It is recommended to use a new temperature scale called Z. On Z scale, the boiling point of water is 65.0 degrees Z and the freezing point is -15.0 degrees Z. To what temperature on the Fahrenheit scale would a temperature of -100 degrees Z correspond? [Note: both scales are linear]Ans:-159 Degrees Fahrenheit.

Thermal Expansion

Q5. A certain rod has a length of 25.0000 cm when measured at a room temperature of 22 degrees C. When the length of the rod is measured at 26 degree C it was found to be 25.0024 cm. The linear expansion coefficient of the rod material must be Ans:2.4×10^{-5} (C degree) $^{-1}$.
Q6. Consider a steel plate with area 2.0 m^2 at 20 degrees Celsius. What is magnitude of the change in its area when the temperature is lowered to -20 degrees Celsius? The coefficient of linear expansion of steel (alpha) = 11.7×10^{-6} /Celsius degrees.Ans:1.9×10^{-3} m^2
Q7. Calculate the change in the length of a 2.0 m aluminum thin wire if its temperature is changed by 54 F-degrees. (the coefficient of thermal expansion for aluminum is equal to 23×10^{-6} /C-degrees).Ans:1.4 mm

The Absorption of Heat by Solids and Liquids

Q8. A 20-g ice cube at 0 degree C is heated until 15 g has become water at 100 degree and 5.0 g has been converted to steam. How much heat is added to do this? (L(melting)=80 cal/g, L(vaporization) = 540 cal/g, c(water) = 1 cal/g/C).Ans:6.3×10^{3} cal.
Q9. Copper pellets, each of mass 1.0 g, are heated to 100 degrees Celsius. How many pellets must be added to 500 g of water initially at 20 degrees Celsius to make the final equilibrium temperature 30 degrees Celsius? (neglect the heat capacity of the container) Specific heat of copper = 0.0924 cal/g degree Celsius and specific heat of water = 1.0 cal/g degree Celsius.Ans:773
Q10. How much heat is needed to convert 80 g of ice initially at -10 degrees-C to steam at 100 degrees-C? (C(water) = 1.0 cal/g.degree C, L(f) = 80 cal/g, C(ice) = 0.5 cal/g.degree C, L(v) = 540 cal/g).Ans:58 kcal

Heat and Work

Q11. One mole of an ideal gas is taken through the cyclic process ABCA as shown in Fig. (2). What is the net heat absorbed, or lost, by the gas? Ans:-1.0×10^{3} J.

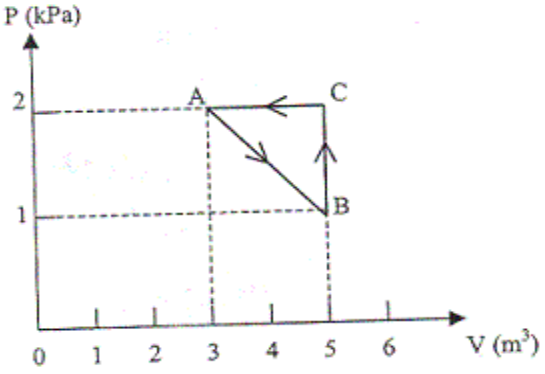

fig.(2)

Q12. In a PV diagram, a system of an ideal gas goes through the process shown in Figure 3. How much heat is absorbed after the system goes through this cycle 10 times. [Take P= 1.0 Pa and V= 1.0 m^3].Ans:20 Joules.

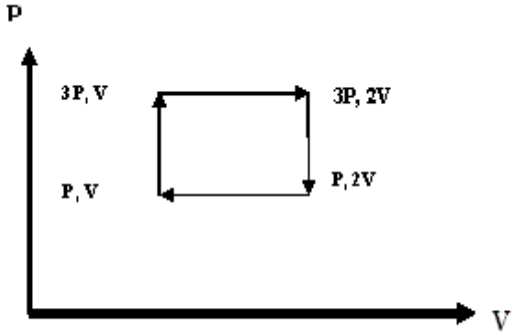

Figure 3

Some Special Cases of the First Law of Thermodynamics

Q13. Nitrogen gas (m = 1.00 kg) is confined in a cylinder with a movable piston at a pressure of 1 atm. A quantity of heat of 25 kcal is added to the gas in an isobaric process, and its internal energy increases by 8 kcal. What is the change in the volume of the gas?Ans:0.7 m^3

Q14. One gram of water is heated from 0 degree-C to 80 degree-C at a constant pressure of 1 atm. Determine the change in internal energy of the water. Neglect the change in volume of the water. (Cwater = 4186 J/kg.K.)Ans:80 cal

Q15. One gram of water is cooled from 100 degrees-C to zero degrees-C and becomes all ice. Determine the change in internal energy during this process. (Neglect any change in the volume of the water.) (For water: C= 4186 J/kg degrees-C and Lf= 3.33×10^5 J/kg.)Ans:-752 J

Heat Transfer Mechanisms

Q16. Calculate the rate of heat flow through a glass window, 2.0 m × 1.5 m in area and 3.3 mm in thickness, if the temperature of the outer and inner surfaces is 5.0 degrees C and -5.0 degrees C, respectively. [Thermal conductivity of glass = 0.84 J/(s.m. K]Ans:7636 W.

Q17. A glass window has an area of 0.50 m^2 and a thickness of 0.60 cm. If the rate of heat flow between the faces is 500 kJ/hour, find the temperature difference between the window's faces. K(glass) = 0.80 W/m C-degrees.Ans:2.1 C-degrees

Q18. An insulated alumimum rod has a length of 2.0 m and a diameter of 2.0 cm. The ends of the rod are maintained at a temperature difference of 200 degrees-C. Find the heat transferred along the rod in one minute.(Thermal conductivity of Al= 238 W/m.K.) Ans:449 J