**Chapter 19**

1. Liquid nitrogen has a boiling point of -195.81 °C at atmospheric pressure. Express this temperature (a) in degrees Fahrenheit and (b) in kelvins.

Solution:

2. A copper telephone wire has essentially no sag between poles 35.0 m apart on a winter day when the temperature is 220.0 °C. How much longer is the wire on a summer day when the temperature is 35.0 °C?

Solution:

3. An auditorium has dimensions 10.0 m 20.0 m 30.0 m. How many molecules of air fill the auditorium at 20.0 °C and a pressure of 101 kPa (1.00 atm)?

Solution:

4. The pressure gauge on a tank registers the gauge pressure, which is the difference between the interior pressure and exterior pressure. When the tank is full of oxygen (O2), it contains 12.0 kg of the gas at a gauge pressure of 40.0 atm. Determine the mass of oxygen that has been withdrawn from the tank when the pres- sure reading is 25.0 atm. Assume the temperature of the tank remains constant.

Solution:

**Solutions for Chapter 19**

1. Liquid nitrogen has a boiling point of -195.81 °C at atmospheric pressure. Express this temperature (a) in degrees Fahrenheit and (b) in kelvins.

Solution:

(a) By Equation 19.2,



(b) Applying Equation 19.1,

*T* = *TC* + 273.15 = −195.81°C + 273.15 = 77.3 K

2. A copper telephone wire has essentially no sag between poles 35.0 m apart on a winter day when the temperature is 220.0 °C. How much longer is the wire on a summer day when the temperature is 35.0 °C?

Solution:

The wire is 35.0 m long when *TC* = −20.0°C.



Since for  Cu,

Δ*L* = (35.0 m)[1.70 × 10−5 (°C)−1][35.0°C−(−20.0°C)]

= +3.27 cm

3. An auditorium has dimensions 10.0 m 20.0 m 30.0 m. How many molecules of air fill the auditorium at 20.0 °C and a pressure of 101 kPa (1.00 atm)?

Solution:

The equation of state of an ideal gas is *PV* = *nRT,* so we need to solve for the number of moles to find *N*.



Then,

*N* = *nNA* = (2.49 × 105 mol)(6.022 × 1023 molecules/mol)

= 1.50 × 1029 molecules

4. The pressure gauge on a tank registers the gauge pressure, which is the difference between the interior pressure and exterior pressure. When the tank is full of oxygen (O2), it contains 12.0 kg of the gas at a gauge pressure of 40.0 atm. Determine the mass of oxygen that has been withdrawn from the tank when the pres- sure reading is 25.0 atm. Assume the temperature of the tank remains constant.

Solution:

From the ideal gas law, *PV* = *nRT*, and



so 

and 