Chapter 13

Problems & Exercises

1.

102ºF

3.

20.0ºC and 25.6ºC

5.

9890ºF

7.

(a) 22.2ºC

(b)

$$\begin{aligned}\Delta T\,(^\circ\mathrm{F}) &= T_2\,(^\circ\mathrm{F}) - T_1(^\circ\mathrm{F})\\ &= \tfrac{9}{5}T_2\,(^\circ\mathrm{C}){+}32.0^\circ - \left(\tfrac{9}{5}T_1\,(^\circ\mathrm{C}){+}32.0^\circ\right)\\ &= \tfrac{9}{5}(T_2\,(^\circ\mathrm{C}) - T_1(^\circ\mathrm{C})) = \tfrac{9}{5}\Delta T\,(^\circ\mathrm{C})\end{aligned}$$

9.

169.98 m

11.

5.4×10^{-6} m

13.

Because the area gets smaller, the price of the land DECREASES by ~$17, 000.

15.

$$\begin{aligned}V &= V_0 + \Delta V = V_0(1+\beta\Delta T)\\ &= (60.00\ \mathrm{L})\left[1+\left(950\times10^{-6}/^\circ\mathrm{C}\right)(35.0^\circ\,\mathrm{C} - 15.0^\circ\,\mathrm{C})\right]\\ &= 61.1\ \mathrm{L}\end{aligned}$$

17.

(a) 9.35 mL

(b) 7.56 mL

19.

0.832 mm

21.

We know how the length changes with temperature: $\Delta L = \alpha L_0 \Delta T$. Also we know that the volume of a cube is related to its length by $V = L^3$, so the final volume is then $V = V_0 + \Delta V = (L_0 + \Delta L)^3$. Substituting for ΔL gives

$V = (L_0 + \alpha L_0 \Delta T)^3 = L_0^3 (1 + \alpha \Delta T)^3$.

Now, because $\alpha \Delta T$ is small, we can use the binomial expansion:

$V \approx L_0^3(1 + 3\alpha \Delta T) = L_0^3 + 3\alpha L_0^3 \Delta T$.

So writing the length terms in terms of volumes gives $V = V_0 + \Delta V \approx V_0 + 3\alpha V_0 \Delta T$, and so

$\Delta V = \beta V_0 \Delta T \approx 3\alpha V_0 \Delta T, \text{ or } \beta \approx 3\alpha$.

22.

1.62 atm

24.

(a) 0.136 atm

(b) 0.135 atm. The difference between this value and the value from part (a) is negligible.

26.

(a) nRT = (mol)(J/mol · K)(K) = J

(b) nRT = (mol)(cal/mol · K)(K) = cal

(c)
$$\begin{aligned} \mathrm{nRT} &= (\mathrm{mol})(\mathrm{L} \cdot \mathrm{atm/mol{\cdot}K})(\mathrm{K}) \\ &= \mathrm{L} \cdot \mathrm{atm} = (\mathrm{m}^3)(\mathrm{N/m}^2) \\ &= \mathrm{N} \cdot \mathrm{m} = \mathrm{J} \end{aligned}$$

28.

7.86×10^{-2} mol

30.

(a) $6.02 \times 10^5\ \mathrm{km}^3$

(b) 6.02×10^8 km

32.

$-73.9^{\mathrm{o}}\mathrm{C}$

34.

(a) $9.14 \times 10^6\ \mathrm{N/m}^2$

(b) $8.23 \times 10^6\ \mathrm{N/m}^2$

(c) 2.16 K

(d) No. The final temperature needed is much too low to be easily achieved for a large object.

36.

41 km

38.

(a) 3.7×10^{-17} Pa

(b) 6.0×10^{17} m^3

(c) 8.4×10^{2} km

39.

1.25×10^{3} m/s

41.

(a) 1.20×10^{-19} J

(b) 1.24×10^{-17} J

43.

458 K

45.

1.95×10^{7} K

47.

6.09×10^{5} m/s

49.

7.89×10^{4} Pa

51.

(a) 1.99×10^{5} Pa

(b) 0.97 atm

53.

3.12×10^{4} Pa

55.

78.3%

57.

(a) 2.12×10^{4} Pa

(b) 1.06 %

59.

(a) 8.80×10^{-2} g

(b) 6.30×10^{3} Pa; the two values are nearly identical.

61.

82.3%

63.

4.77ºC

65.

38.3 m

67.

$\frac{(F_{\mathrm{B}}/w_{\mathrm{Cu}})}{(F_{\mathrm{B}}/w_{\mathrm{Cu}})'} = 1.02$. The buoyant force supports nearly the exact same amount of force on the copper block in both circumstances.

69.

(a) 4.41×10^{10} mol/m^3

(b) It's unreasonably large.

(c) At high pressures such as these, the ideal gas law can no longer be applied. As a result, unreasonable answers come up when it is used.

71.

(a) 7.03×10^{8} m/s

(b) The velocity is too high—it's greater than the speed of light.

(c) The assumption that hydrogen inside a supernova behaves as an idea gas is responsible, because of the great temperature and density in the core of a star. Furthermore, when a velocity greater than the speed of light is obtained, classical physics must be replaced by relativity, a subject not yet covered.