Chapter 1: Introduction to Physics

**Solutions to Problems and Conceptual Exercises**

**62.** Show that the equation  is dimensionally consistent. Note that  and  are velocities and that *a* is an acceleration.

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|  | **Picture the Problem**: This is a dimensional analysis question. | |
|  | **Strategy:** Manipulate the dimensions in the same manner as algebraic expressions. | |
|  | **Solution:** Substitute dimensions for the  variables on both sides of the equation: |  |
|  | **Insight:** Two numbers must have the same dimensions in order to be added or subtracted. | |

**63.** **(a)** The largest building in the world by volume is the Boeing 747 plant in Everett, Washington. It measures approximately 631 m long, 707 yards wide, and 110 ft high. What is its volume in cubic feet? **(b)** Convert your   
result from part (a) to cubic meters.

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|  | **Picture the Problem**: This problem is about the conversion of units. | |
|  | **Strategy:** Multiply the known quantity by appropriate conversion factors to change the units. | |
|  | **Solution:** **1.** **(a)** Find the length in feet: |  |
|  | **2.** Find the width in feet: |  |
|  | **3.** Find the volume in cubic feet: |  |
|  | **4. (b)** Convert to cubic meters: |  |
|  | **Insight:** Conversion factors are conceptually equal to one, even though numerically they often equal something other than one. They are often helpful in displaying a number in a convenient, useful, or easy-to-comprehend fashion. | |

**64.** How long does it take for radiation from a cesium-133 atom to complete 1.5 million cycles?

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|  | **Picture the Problem**: This problem is about the conversion of units. | |
|  | **Strategy:** Convert the frequency of cesium-133 given on page 4 to units of microseconds per megacycle, then multiply by the number of megacycles to find the elapsed time. | |
|  | **Solution:** Convert to micro­ seconds per megacycle and  multiply by 1.5 megacycles: |  |
|  | **Insight:** Only two significant figures remain in the answer because of the 1.5 Mcycle figure given in the problem statement. The metric prefix conversions are considered exact and have an unlimited number of significant figures, but most other conversion factors have a limited number of significant figures. | |

**65.** IP **(a)** A standard sheet of paper measures 8 1/2 by 11 inches. Find the area of one such sheet of paper in m2.   
**(b)** A second sheet of paper is half as long and half as wide as the one described in part (a). By what factor   
is its area less than the area found in part (a)?

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|  | **Picture the Problem**: This problem is about the conversion of units. | |
|  | **Strategy:** Multiply the known quantity by appropriate conversion factors to change the units. Then use a ratio to find the factor change in part (b). | |
|  | **Solution: 1.** **(a)** Convert square  inches to square meters: |  |
|  | **2. (b)** Calculate a ratio to find the new area: |  |
|  | **Insight:** If you learn to use ratios you can often make calculations like these very easily. Always put the new quantity in the numerator and the old quantity in the denominator to make the new quantity easier to calculate at the end. | |

**66.** You’ve just won the $12 million cash lottery, and you go to pick up the prize. What is the approximate weight of the cash if you request payment in **(a)** quarters or **(b)** dollar bills?

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|  | **Picture the Problem**: The lottery winnings are represented either by quarters or paper dollars. | |
|  | **Strategy:** There are about 5 quarters and about 30 dollar bills per ounce. | |
|  | **Solution: 1.** **(a)** Multiply by  conversion factors: |  |
|  | **2. (b)** Repeat for the dollar bills: |  |
|  | **Insight:** Better go with large denominations or perhaps a single check when you collect your lottery winnings! Even the dollar bills weigh over ten tons! | |

**67.** **Ten and Ten** When Coast Guard pararescue jumpers leap from a helicopter to save a person in the water, they like   
to jump when the helicopter is flying “ten and ten,” which means it is 10 feet above the water and moving forward   
with a speed of 10 knots. What is “ten and ten” in SI units? (A knot is one nautical mile per hour, where a nautical   
mile is 1.852 km.)

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|  | **Picture the Problem**: This problem is about the conversion of units. | |
|  | **Strategy:** Multiply the known quantity by appropriate conversion factors to change the units. | |
|  | **Solution: 1.** Convert ten feet to m: |  |
|  | **2.** Convert ten knots to m/s: |  |
|  | **Insight:** If we were to describe the flying parameters of the helicopter in SI units, we would say it is flying “3 and 5”! | |