

CHAPTER 7

REVIEW QUESTIONS

1. In 2001, the first iPod™ by Apple had a rated battery life of 10 hours [h] to run audio files. The 6th model, introduced in 2009, had rated battery life of 36 hours [h] to run audio files. If the average song is 3.5 minutes [min], how many more songs can you listen to using the 6th model iPod rather than the original iPod on a single battery charge?
2. New plastic fuel tanks for cars can be molded to many shapes, an advantage over the current metal tanks, allowing manufacturers to increase the tank capacity from 77 liters [L] to 82 liters [L]. What is this capacity increase in units of gallons [gal]?
3. The longest sea bridge, the Jiaozhou Bay Bridge in China, spans 26.4 miles [mi]. The longest sea bridge in the United States is the Lake Pontchartrain Causeway in Louisiana, which spans 41,940 yards [yd]. How much longer is the Jiaozhou Bridge, in units of feet [ft], than the Lake Pontchartrain Causeway?
4. The term “deep sea” refers to everything in the ocean below a depth of 200 meters [m]. It is estimated more than 90% of the living space on the planet exists at this depth. The deep sea is an area of great interest for explorers. If a submarine dives to a depth of 400 meters [m], how deep is this in units of miles [mi]?
5. A category F5 tornado can have wind speeds of 300 miles per hour [mph]. What is this velocity in units of meters per second [m/s]?
6. Some species of bamboo have been measured to grow at a rate of up to 4 inches per hour [in/h]. Express this growth rate in units of micrometers per second [$\mu\text{m/s}$].
7. A new hybrid automobile with regenerative braking has a fuel economy of 55 miles per gallon [mi/gal or mpg] in city driving. What is this fuel economy expressed in units of feet per milliliter [ft/mL]?
8. If a liquid evaporates at a rate of 50 kilograms per minute [kg/min], what is this evaporation rate in units of pounds-mass per second [lb_m/s]?
9. Acetone must be kept in a closed pressure tank due to evaporation. Acetone evaporates at a rate of 3 grams per minute [g/min]. If the tank holds 50 pound-mass [lb_m] of acetone and is allowed to remain open to the atmosphere, how many days [d] will it take for half of the acetone to evaporate?
10. The AbioCor™ artificial heart pumps at a rate of 10 liters per minute [L/min]. Express this rate in units of gallons per second [gal/s].
11. If a pump moves water at 70 gallons per minute [gal/min or gpm], what is the volumetric flow rate in units of cubic inches per second [in^3/s]?
12. On April 20, 2010, the *DeepWater Horizon* oil drilling operation exploded, causing the largest marine oil spill ever recorded. Many estimates have been given to describe the volume of oil lost per day. One estimate, just before the well was capped, places the escaping oil at 8400 cubic meters per day [m^3/d]. One barrel [bbl] of oil is 42 gallons [gal]. Convert this rate of escaping oil into barrels per hour [bbl/h].
13. One of the National Academy of Engineering Grand Challenges for Engineering is **Provide Access to Clean Water**. Only 5% of water is used for households—the majority is used for agriculture and industry. It is estimated that 528 gallons [gal] of water are required to produce food for one person for one day [d]. How many liters per year [L/yr] are required to feed one person?

EX: Determine if each is a valid equation

if $U: \text{m/s}$, $g: \text{m/s}^2$ $H: \text{m}$

$P: \text{Pa}$, $\rho: \frac{\text{kg}}{\text{m}^3}$

(a) $U = \frac{P}{\rho} + \sqrt{2gH}$

(b) $U = \sqrt{\frac{2P}{\rho} + 2H}$

(c) $U = \sqrt{\frac{2P}{\rho} + 2gH}$

EX: Find if each equation is valid if

$P: \text{W}$ $A: \text{m}^2$ $U: \frac{\text{m}}{\text{s}}$ $\eta: \text{unitless}$

$\rho: \frac{\text{kg}}{\text{m}^3}$

(a) $P = \eta \rho A U^2$

(b) $P = \eta \rho A U^3$