Monday warm-up: unit analysis and vectors

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1 Chapter 1 - Unit analysis

1. Convert 100 km hr^{-2} to m s^{-1}:

   - A: 27.8 m
   - B: 27.8 m s^{-1}
   - C: 360 m
   - D: 360 m s^{-1}

1. Convert 30 miles to km. *Hint: 1 mile is 1.6 km.*

   - A: 24 km
   - B: 36 km
   - C: 48 km
   - D: 60 km

1. An empty pool has a volume of 30 m^3. If we must fill the pool with barrels of water, each with a volume of 100 liters, how many barrels of water are needed to fill the pool? *Hint: 1 liter is 1000 mL, and 1 mL is 1 cm^3.*

   - A: 3 barrels
   - B: 30 barrels
   - C: 300 barrels
   - D: 3000 barrels

1. How many seconds are in a year? *(This is important for calculations involving cumulative exposure to radiation).*

   - A: 10^4 seconds
   - B: 10^5 seconds
   - C: 10^6 seconds
   - D: 10^7 seconds

2 Chapter 2 - Vectors

1. Suppose a ship leaves an island, heading Northeast, at 25 km hr^{-1}. After 1 hour, the ship turns North and continues at the same speed for another hour. What is the final location of the ship?

   - A: (17.7,17.7) km
   - B: (35.5,35.5) km
   - C: (17.7,42.7) km
   - D: (35.5,60.5) km

2. If an aircraft flies North for 100 km, and then flies 100 km East (to avoid a mountain range), how far is the craft from the original location?

   - A: 70.7 km
   - B: 141.4 km
   - C: 200 km
   - D: 100 km

3. **Let us introduce the $\hat{i}\hat{j}\hat{k}$ notation for vectors.** The vector $\hat{i}$ has no units, and a length of 1 in the x-direction. The $\hat{j}$ vector is identical to $\hat{i}$, but pointed in the y-direction. The vector $\hat{k}$ goes with the z-direction. Compute the following:

   - $\vec{x} = 2\hat{i} + 2\hat{j}$, and $\vec{y} = -2\hat{i} + 2\hat{j}$. $\vec{x} + \vec{y} =$

   - $\vec{x} = 2\hat{i} + 4\hat{j}$, and $\vec{y} = 2\hat{i} - 4\hat{j}$. $\vec{x} + \vec{y} =$

   - $\vec{x} = \hat{i} + \hat{j}$, and $\vec{y} = \hat{i} - \hat{j}$. $\vec{x} - \vec{y} =$