Question 1:

Convert the following quantities to $\frac{\text{m}}{\text{s}}$ (Remember to refer to the conversion table)

1. $6004\frac{\text{ft}}{\text{h}}$

Solution.

$$6004\frac{\text{ft}}{\text{h}}\left(\frac{1\,\text{m}}{3.28084\,\text{ft}}\right)\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)$$

$$6004\frac{\cancel{\text{ft}}}{\cancel{\text{h}}}\left(\frac{1\,\text{m}}{3.28084\cancel{\text{ft}}}\right)\left(\frac{1\cancel{\text{h}}}{3600\,\text{s}}\right)=\left(\frac{6004}{3.28084\cdot 3600}\right)\frac{\text{m}}{\text{s}}=0.5083\frac{\text{m}}{\text{s}}$$

2. $312300\frac{\text{cm}}{\text{h}}$

Solution.

$$3123\frac{\text{cm}}{\text{h}}\left(\frac{1\,\text{m}}{100\,\text{cm}}\right)\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)$$

$$3123\frac{\cancel{\text{cm}}}{\cancel{\text{h}}}\left(\frac{1\,\text{m}}{100\cancel{\text{cm}}}\right)\left(\frac{1\cancel{\text{h}}}{3600\,\text{s}}\right)=\left(\frac{3123}{100\cdot 3600}\right)\frac{\text{m}}{\text{s}}=0.8675\frac{\text{m}}{\text{s}}$$

3. $5\frac{\text{km}}{\text{h}}$

Solution.

$$5\frac{\text{km}}{\text{h}}\left(\frac{1000\,\text{m}}{1\,\text{km}}\right)\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)$$

$$5\frac{\cancel{\text{km}}}{\cancel{\text{h}}}\left(\frac{1000\,\text{m}}{1\cancel{\text{km}}}\right)\left(\frac{1\cancel{\text{h}}}{3600\,\text{s}}\right)=\left(\frac{5\cdot 1000}{3600}\right)\frac{\text{m}}{\text{s}}=1.389\frac{\text{m}}{\text{s}}$$

4. $10^3\frac{\text{mi}}{\text{h}}$

Solution.

$$1000\frac{\text{mi}}{\text{h}}\left(\frac{1\,\text{m}}{6.21371\times 10^{-4}\,\text{mi}}\right)\left(\frac{1\,\text{h}}{3600\,\text{s}}\right)$$

$$1000\frac{\cancel{\text{mi}}}{\cancel{\text{h}}}\left(\frac{1\,\text{m}}{6.21371\times 10^{-4}\cancel{\text{mi}}}\right)\left(\frac{1\cancel{\text{h}}}{3600\,\text{s}}\right)=\left(\frac{1000}{6.21371\cdot 3600}\right)\frac{\text{m}}{\text{s}}=447.04\frac{\text{m}}{\text{s}}$$

5. $566\frac{\text{in}}{\text{min}}$

Solution.

$$566\frac{\cancel{\text{in}}}{\cancel{\text{min}}}\left(\frac{1\,\text{m}}{39.370\cancel{\text{in}}}\right)\left(\frac{1\cancel{\text{min}}}{60\,\text{s}}\right)=\left(\frac{566}{39.370\cdot 60}\right)\frac{\text{m}}{\text{s}}=0.239\frac{\text{m}}{\text{s}}$$

Question 2:

At the University of Waterloo, students may begin to feel nervous if during an exam, someone manages to complete it after 5 minutes. Lets say the fastest problem solver in the exam room is student X, who solves problems at a rate of $60\frac{\text{problems}}{\text{h}}$ and that the exam has 10 questions. Determine weather or not the students in the exam room will feel nervous or not, completely justify your answer.

Solution.

We begin by determining the number of problems he solves per minute and then multiply the result by 5 in order to determine the number of problems he solves after 5 minutes,

$$120\frac{\text{problems}}{\cancel{\text{h}}}\left(\frac{1\cancel{\text{h}}}{60\,\text{min}}\right) = \left(\frac{120}{60}\right)\frac{\text{problems}}{\text{min}} = 2\frac{\text{problems}}{\text{min}}$$

Therefore X will solve $2 \cdot 5 = 10$ problems after 5 minutes, meaning he will complete the exam, and leave the students in a nervous condition.

Question 3:

Daniel has recently ran into a potentially lucrative opportunity, he happened to come across 60 carrots of gold. He wants to know how many coffees he can order. He knows the following information,

- 1 carrot of gold = 0.5 brits
- 1 brit = 6000 USD
- 1 USD = 1.25 CAD
- 1 coffee = 2 CAD

Help him determine the number of coffees he can order.

Solution.

We setup a product of the correct conversion factors in order to get from carrot of gold $\rightarrow$ coffees

$$60 \cancel{\text{ carrot of gold}}\left(\frac{0.5 \cancel{\text{ brits}}}{1 \cancel{\text{ carrot of gold}}}\right)\left(\frac{6000 \cancel{\text{ USD}}}{1 \cancel{\text{ brit}}}\right)\left(\frac{1.25 \cancel{\text{ CAD}}}{1 \cancel{\text{ USD}}}\right)\left(\frac{1 \text{ coffee}}{2 \cancel{\text{ CAD}}}\right) = \left(\frac{60 \cdot 6000 \cdot 1.25}{2}\right) \text{ coffees}$$
$$= 112500 \text{ coffees}$$

Question 4:

(CHALLENGE WARNING) A mechanical engineering student over at the University of Waterloo wants to know the amount of energy he will need in order to weld a 6 rods of steel. He knows that each rod of steel has a density of $650\,\mathrm{kg}/\,\mathrm{m}^3$ and a Calorific Value of 6 kWh/ kg. Determine the amount of energy **(In Kila Jouls)** 6 rods of steel will require. Make note of the following,

- 1 rod of steel has a volume of $100\,\mathrm{ft}^3$
- 1 BTU $= 2.931 \times 10^{-4}$kWh
- $1\,\mathrm{J} = 9.4782 \times 10^{-4}$ BTU
- $1\,\mathrm{k\,J} = 1000\,\mathrm{J}$

Solution.

Our goal is to determine the total energy nessessary to weld all 6 rods, to do so we must go from (steel $\to$ k J). To do so we setup the appropriate product of conversion factors.

$$\begin{aligned}
&\cancel{6\text{ steel rod}}\left(\frac{100\,\cancel{\mathrm{ft}^3}}{1\,\cancel{\text{steel rod}}}\right)\left(\frac{1\,\cancel{\mathrm{m}^3}}{35.31467\,\cancel{\mathrm{ft}^3}}\right)\left(\frac{650\,\cancel{\mathrm{kg}}}{1\,\cancel{\mathrm{m}^3}}\right)\left(\frac{6\,\cancel{\mathrm{kWh}}}{1\,\cancel{\mathrm{kg}}}\right)\left(\frac{1\,\cancel{\mathrm{BTU}}}{2.931\times10^{-4}\,\cancel{\mathrm{kWh}}}\right)\left(\frac{1\,\cancel{\mathrm{J}}}{9.4782\times10^{-4}\,\cancel{\mathrm{BTU}}}\right)\left(\frac{1\ \mathrm{k\,J}}{1000\,\cancel{\mathrm{J}}}\right)\\
&\quad=\left(\frac{6\cdot100\cdot650\cdot6}{35.31467\cdot2.931\times10^{-4}\times9.4782\times10^{-4}}\right)\ \mathrm{k\,J}\\
&\quad=2.385\times10^{9}\ \mathrm{k\,J}
\end{aligned}$$