Physics- Western- Saab- 9/21-28

Dimensional Analysis:

Dimensional analysis is a method of calculation utilizing a knowledge of units.

It is an easy way to convert from one unit of measure to another by multiplying be an appropriate conversion factor.

Conversion factors are used to manipulate units. It a fraction in which numerator and denominator are in different units, but equal to the same quantity.

The algebraic value of the conversion factor is always 1.

If a = b, then a/b = 1 and b/a = 1

1 ft = 12 in

so, we can write two conversion factors: 1 ft/12 in = 1 and 12 in/1ft = 1

$$\text{Given unit} \times \frac{\text{desired unit}}{\text{given unit}} = \text{desired unit}$$

Dimensional analysis:

It is all about units and canceling out unit.

$$\text{Given unit} \left(\frac{\text{Desired unit}}{\text{Given unit}} \right) = \text{Desired unit}$$

$\left(\frac{\text{Desired unit}}{\text{Given unit}} \right)$ is a know quantity and is called conversion factor, ratio,

Example 1:

1 dozen = 12 eggs

2 conversion factors ratios, ratio, fraction

$$\frac{1 \text{ dozen}}{12 \text{ eggs}}$$

$$\frac{12 \text{ eggs}}{1 \text{dozen}}$$

Example 2:

1 day = 24 hours

Two conversion factors (fractions)?

Example 3:

1 year = 365 days

Two conversion factors ratios?

Exercise 1: A car has a velocity of 105 km/h[N]. What is its displacement if it travels at this velocity for 2.5 h?

Displacement = (Average Velocity) x (Time) = 105 km/h [N] x 2.5 h = 260 km [N]

Method 2)

Use Dimensional Analysis to solve the problem

Velocity = 105 km [N]/ 1 h, **105 km [N] = 1h**

What are the two ratios, fraction, factors?

Write the 2 conversion factors ratios, ratio, fraction?

$$\frac{105 \text{ km [N]}}{1\text{h}} \quad (1)$$

$$\frac{1\text{h}}{105 \text{ km [N]}} \quad (2)$$

Dimensional Analysis formula: (Pay attention to the units)

$$\text{Given } \cancel{\text{unit}} \times \frac{\text{Desired unit}}{\text{Given } \cancel{\text{unit}}} = \text{Desired unit}$$

2.5 **h** x *(1)* or (2) = km [N]

Fraction (1): $\frac{105\ \text{km [N]}}{1\text{h}}$ (1)

$$2.5\ \cancel{\text{h}} \times \frac{105\ \textbf{km [N]}}{1\ \cancel{\textbf{h}}} = 260\ \textbf{km [N]}$$

$$\cancel{\textbf{h}} \times \frac{\textbf{km [N]}}{\cancel{\textbf{h}}} = \textbf{km [N]}$$ Correct

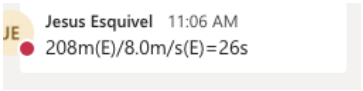
Fraction (2): Incorrect choice

$\frac{1\text{h}}{105\ \text{km [N]}}$ (2)

$$\cancel{\textbf{h}} \times \frac{\cancel{\text{h}}}{\cancel{\text{km [N]}}} = \cancel{\textbf{km [N]}}$$ Incorrect, It does not follow:

Given unit x $\frac{\text{Desired unit}}{\textbf{Given unit}}$ = Desired unit

Exercise 2: How long would it take a dolphin swimming a 8.0 m/s[E] to travel 208 m[E]? solve using dimensional analysis



Dimensional Analysis:

Velocity = 8.0 m [E] /1s **8.0 m [E] = 1s**

Write the two ratios for velocity;

8 m [E] = 1s

write the two ratios for velocity;

$$\frac{8 \text{ m [E]}}{1 \text{ s}} \quad \textbf{(1)}$$

$$\frac{1 \text{ s}}{8 \text{ m [E]}} \quad \textbf{(2)}$$

208 m [E] x (1) or (2)? = s

$$\text{Given ~~unit~~} \times \frac{\text{Desired unit}}{\text{Given ~~unit~~}} = \text{Desired unit (the unit that you need)}$$

$$208 \text{ ~~m [E]~~} \times \frac{1 \text{ s}}{8 \text{ ~~m [E]~~}} = 208/8 = 26 \text{ s}$$

Exercise 3: Use dimensional analysis to answer the following question:

How many days are in 6 years?

year ———————> days

1 year = 365 days

$$\frac{1\ \text{year}}{365\ \text{days}} \quad (1) \qquad\qquad \frac{365\ \text{days}}{1\ \text{year}} \quad (2)$$

$$6\ \text{~~years (from)~~} \times \frac{365\ \text{days (to)}}{1\ \text{~~year (from)~~}} = 6 \times 365 = 2190\ \text{(to) days}$$

$$\text{Given ~~unit~~} \times \frac{\text{Desired unit}}{\text{Given ~~unit~~}} = \text{Desired unit (the unit that you need)}$$

Exercise 4: Use dimensional analysis to answer the following question:

How many eggs are in 12 dozens?

12 eggs = 1 dozen

$$12 \text{ dozens} \times \frac{12 \text{ eggs}}{1 \text{ dozen}} = 12 \times 12 = 144 \text{ eggs}$$

How many dozens make 120 eggs?

$$120 \text{ eggs} \times \frac{1 \text{ dozen}}{12 \text{ eggs}} = 120 \times 1/12 = 120/12 = 10 \text{ dozens}$$

Exercise 5: Use dimensional analysis to answer the following question:

How many minutes are in 12 hours?

$$12 \text{ hours} \times \frac{60 \text{ minutes}}{1 \text{ hour}} = 12 \times 60 = 720 \text{ minutes}$$

How many hours are in 1440 minutes?

$$1440 \text{ minutes} \times \frac{1 \text{ hour}}{60 \text{ minutes}} = 1440/60 = 24 \text{ hours}$$