

## Ratio and Proportion

### *Other Handouts:*

- Scientific notation
- Logarithms
- Significant Figures
- Units
- Review of Number
- Graphing

A **ratio** compares the sizes of two quantities. A **proportion** describes the relationship of a part to the whole.

**Example 1** In a laboratory class of students there are 16 males and 24 females. The ratio of males to females would be written as 16 : 24

The total number of students in the class is 40 so the proportion or fractional share of males in the class is  $\frac{16}{40} = \frac{2}{5}$  and the proportion of females in the class is  $\frac{24}{40} = \frac{3}{5}$

Note that the ratio of males to females is equivalent to the ratio of the proportion of males to the proportion of females:

$$\frac{16}{40} : \frac{24}{40} \quad \text{or} \quad 16 : 24 \quad (\text{multiply both sides by } 40) \quad \text{or} \quad 2 : 3 \quad (\text{divide both sides by } 8)$$

They are all equivalent ratios. Note that the proportion of males is  $\frac{2}{2+3} = \frac{2}{5}$  and the proportion of females is  $\frac{3}{2+3} = \frac{3}{5}$

**Example 2** A beaker contains 250 ml of liquid A and 600ml of liquid B.

The ratio of the amount of liquid A to the amount of liquid B is 250 : 600 which is equivalent to 50 : 120 (divide by 5) or 5 : 12 (divide by 10).

The proportion of liquid A in the beaker is  $\frac{250}{850} = \frac{5}{17}$ , and of liquid B is  $\frac{600}{850} = \frac{12}{17}$

### Practice Problems: Ratio and Proportion

1. Express the following ratios in simplest form:

- Length (cm) to width (cm) - a block of wood with length 5.5cm and width 3.5cm
- Flour to sugar (cups) - a recipe requires three quarters of a cup of flour and half a cup of sugar

2. A mineral assay of a sample shows that an ore is only made up of two metals, iron and nickel, in a ratio of 9 : 11.

- What proportion of the sample ore is iron?
- For an ore deposit mass 1800kg, what mass of nickel would you expect to be in the deposit based on this assay result?

3. There are 20 sheep in a paddock with black wool and the rest have white wool. If there are 100 sheep in total

- What is the ratio of (i) white to black sheep? (ii) black to white sheep?
- What is the proportion of white sheep?
- What is the percentage of black sheep?

4. What proportion of 42 is (a) 6 (b) 8 (c) 14 in simplest terms?

5. If 75% of science students at Murdoch University are studying mathematics, what is the ratio of those studying maths to those not studying maths?

## Equating proportions

**Example 3** How much salt is needed to make up one litre of a saline solution with the same concentration as a saline solution containing 5 mg of salt in 100 ml of water?

Let  $x$  be the number of mg of salt needed in the 1 litre of solution.

So in the new one litre solution there will be  $x$  mg salt in 1000ml water

We equate the proportions of salt and water in the two solutions  $\frac{\text{new solution}}{\text{given solution}}$

to give  $\frac{x}{5} = \frac{1000}{100}$  so  $\frac{x}{5} = 10$  and multiplying both sides by 5 gives  $x = 50$ .

So I need 50 mg of salt to give the same salt concentration in 1 litre of liquid.

**Example 4** Twelve oranges cost \$5. How much will 20 oranges cost?

Let 20 oranges cost \$ $x$

Equating the proportions of quantity and cost gives

$$\frac{20}{12} = \frac{x}{5} \text{ and } \frac{20}{12}(5) = x$$

So  $x = 8.333 \dots$  and rounding to the nearest cent gives the cost of 20 oranges as \$8.33.

(If using significant figures the cost would be \$8 to 1 s.f.!) )

## Practice Problems: Equating Proportions

- At Walter's cafe 5 salad rolls can be bought for \$26.50.  
(a) How much would 7 salad rolls cost? (b) How many salad rolls could you buy for \$58.30?  
(c) How many could you buy for \$100?
- A soft drink NEW is a mixture of liquid component A and liquid component B in the ratio of 1 : 4.  
(a) If you have 200ml of component A and an unlimited supply of component B what volume of the NEW drink can you make?  
(b) How much of component A is required to make 150 litres of the NEW soft drink?
- A 750 ml solution of copper sulphate was made by dissolving 200mg copper in sulphuric acid.  
(a) How much copper should be dissolved in 900ml of acid to produce the same concentration?  
(b) To strengthen the concentration by 25%, what would be the new ratio of copper to acid?  
(c) How much extra copper should be added to the 900ml solution?
- Methane is an important greenhouse gas that contributes to global warming. Every 16.04g of methane contains 12.01g of carbon. What mass of carbon would be found in 2 tonnes of methane?

### Solutions : Ratio and Proportion

- 1 (a) 11 : 7 (b) 3 : 2 2.(a)  $\frac{9}{20}$  (b) 990 kg  
3.(a) (i) 80 : 20 or 4 : 1 (ii) 1 : 4 (b)  $\frac{80}{100}$  or  $\frac{4}{5}$  (c) 20 %  
4.(a)  $\frac{1}{7}$  (b)  $\frac{4}{21}$  (c)  $\frac{1}{3}$   
5. 75 : 25 or 3 : 1

### Solutions : Equating Proportions

1. (a) \$ 37.10 (b) 11 (c) 18  
2. (a) 1 litre = 1000 ml (b) 30 litres  
3. (a) 240 mg (b) 1 : 3 (c) 60mg  
4. 1.49 tonnes carbon