Approximation

Rounding to a required number of decimal places

The key is to look at the number after the required number of decimal places.

e.g. write 7.718**6** to 3 decimal places(d.p.)

The **6** is what is called the 'decider'.

If this number is '5' or more, then the 3rd decimal is 'rounded up'. Less than '5' and the decimal stays

the same.

In this example 5.7186 becomes 5.719

The '8' is rounded up to '9', because '6' is 5 or more.

Examples

19.17 to 1 d.p. is 19.2

0.0214 to 2 d.p. is 0.02

34.4255 to 3 d.p. is 34.426

Rounding to tens, hundreds, thousands etc.

examples

24,214 to the nearest thousand is 24,000

24,214 to the nearest hundred is 24,200

35,712 to the nearest thousand is 36,000

35,712 to the nearest hundred is 35700

795 to the nearest hundred is 800

56 to the nearest ten is 60

Rounding to a number of significant figures

The required number is found by ignoring any zeros infront or behind the line of numerals and rounding where needed.

Example #1

0.001292 ....to 3 significant figures

the three figures are 1 2 9

answer = 0.00129

Example #2

120,101 ....to 4 significant figures

the four figures are 1201

answer = 120,100

Example #3

13.27 ....to 3 significant figures

the 13.272 rounds up to 13.3

the three figures are 133

Estimates - An estimate is a rough approximation, usually of a calculation.

The rule is to round to **one** significant figure.

Example #1

$$(35.1 - 12.9) \times 327$$
$$\approx (40 - 10) \times 300$$
$$= 30 \times 300$$
$$= 9000$$

Example #2

$$\frac{0.0391 \times 8789.8}{32.9 \times 0.192}$$
$$\approx \frac{0.04 \times 9000}{30 \times 0.2}$$
$$= \frac{300}{5}$$
$$= 60$$

Example #3

$$2.119 \times 0.0091 \times 34927$$
$$\approx 2 \times 0.01 \times 30000$$
$$= 600$$

Upper & lower Bounds

The use of 'bounds' is a practical mathematical method quite different from 'decimal rounding'. Do not

confuse the two. Decimal rounding depends on a '5 or more' being rounded up. Bounds is quite different.

Whenever measurements are expressed in the real world they are often given an upper bound(highest value)

and a lower bound(lower value).

example - A length of wood is 1500 mm long, correct to the nearest 'm.m.'.

The upper bound is therefore: 1500.5 m.m.

The lower bound is therefore: 1499.5 m.m.

Note - The upper & lower bounds are HALF the degree of accuracy.

In our example, +/- 0.5 m.m., that is half of 1 m.m.

Example #1 - A poster measures 99.5 cm x 192.2 cm correct to the nearest 0.1 cm.

Find the upper and lower bounds for the poster's dimensions, hence find its maximum & minimum area.(to 2 d.p.)

upper bounds 99.55 , and 192.25................lower bounds 99.45 , 192.15

maximum area = 99.55 x 192.25 = 19138.488 = 19138.49 (2d.p.) sq. c.m.

minimum area = 99.45 x 192.15 = 19109.318 = 19109.32 (2 d.p.)sq. c.m.

Example #2 - A rocket travels a vertical distance of 50k.m.(correct to nearest k.m.) in 23.1 seconds(correct to the nearest 0.1 second.

What are the upper and lower limits to the rocket's average speed?

upper bounds 50.5k.m. , and 23.15 sec...........lower bounds 49.5k.m. , 23.05

$$\text{average speed} = \frac{\text{distance}}{\text{time}}$$

The highest average speed is with the largest distance divided by the smallest time.

$$\text{upper bound average speed} = \frac{\text{upper bound distance}}{\text{lower bound time}}$$
$$= \frac{50.5}{23.05}$$
$$= 2.1692 \text{ k.m./sec (x1000 to get m/sec.)}$$
$$= 2169.2 \text{ m./sec}$$

$$\text{lower bound average speed} = \frac{\text{lower bound distance}}{\text{upper bound time}}$$
$$= \frac{49.5}{23.15}$$
$$= 2.1598 \text{ k.m./sec (x1000 to get m/sec.)}$$
$$= 2159.8 \text{ m./sec}$$