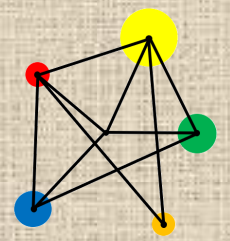
Estimate Calculations



Find an estimate of the value of a calculation.

Vocabulary

Estimate
To use rounded numbers to find the approximate size of a calculation.

Truncate
To make something shorter by cutting of the end.

Review of Rounding

Round these numbers to the accuracy stated

a) 82 (nearest ten)

b) 2139 (nearest hundred)

c) 579 (nearest ten)

d) 13 670 (nearest hundred)

e) 4150 (nearest hundred)

a) 4.831 (nearest 0.1)

b) 0.00318 (4 d.p.)

c) 13384 (1 s.f.)

d) 0.000455 (2 s.f.)

e) Truncate 13.8372 after the 2nd decimal place

An integer is rounded to 3 significant figures.

The result is 125 000

How big could the original integer have been?

How small?

d.p = decimal places

s.f = significant figures

Solutions

Round these numbers to the accuracy stated

a) 82 (nearest ten) **80**

b) 2139 (nearest hundred) **2100**

c) 579 (nearest ten) **580**

d) 13 670 (nearest hundred) **13 700**

e) 4150 (nearest hundred) **4200**

a) 4.831 (nearest 0.1) **4.8**

b) 0.00318 (4 d.p.) **0.0032**

c) 13384 (1 s.f.) **10 000**

d) 0.000455 (2 s.f.) **0.00046**

e) Truncate 13.8372 after the 2nd decimal place **13.83**

An integer is rounded to 3 significant figures.

The result is 125 000

How big could the original integer have been? **125 499**

How small? **124 500**

d.p = decimal places

s.f = significant figures

Key Fact

To **estimate** the result of a calculation, round each number in the calculation to 1 significant figure.

Example

Estimate the value of $\dfrac{192 \times 8.99}{0.496}$

Solution

$$\frac{192 \times 8.99}{0.496} \approx \frac{200 \times 9}{0.5}$$

$$= 3600$$

You try...

Estimate the value of 42 x 87.

Calculate the exact value of 42 x 87.

What is the percentage error in your estimate?

Solutions

Estimate the value of 42 x 87. **40 x 90 = 3600**

Calculate the exact value of 42 x 87. **42 x 97 = 3654**

What is the percentage error in your estimate? $\frac{54}{3600} \times 100$

$= 1.5\%$

Exercise

Estimate the value of:

1. 2.103×1.997
2. $39.8832 - 12.012$
3. $\dfrac{8.6}{2.898}$
4. 1.982746^2
5. $\sqrt{103.8}$
6. 3.01^3

Estimate the value of:

1. $7.77 \div 0.89^2$
2. $(15.654 + 4.39)^2$
3. $\dfrac{1080}{0.112}$
4. $\dfrac{0.0102}{989}$
5. $1.2 + 2.9^2$
6. $\dfrac{600 \times 49.6}{478}$

Estimate the value of:

1. $\sqrt{1.1 + \sqrt{63.82}}$
2. $\dfrac{19.78 \times 10.03}{\sqrt{17}}$
3. $96.5748^{2.07}$

Solutions

Estimate the value of:

1. 2.103×1.997 ≈ 4
2. $39.8832 - 12.012$ ≈ 30
3. $\frac{8.6}{2.898}$ ≈ 3
4. 1.982746^2 ≈ 4
5. $\sqrt{103.8}$ ≈ 10
6. 3.01^3 ≈ 27

Estimate the value of:

1. $7.77 \div 0.98^2$ ≈ 8
2. $(15.654 + 4.39)^2$ ≈ 400
3. $\frac{1080}{0.112}$ ≈ 10 000
4. $\frac{0.0102}{989}$ ≈ 0 00001
5. $1.2 + 2.9^2$ ≈ 10
6. $\frac{600 \times 49.6}{478}$ ≈ 60

Estimate the value of:

1. $\sqrt{1.1 + \sqrt{63.82}}$ ≈ 3
2. $\frac{19.78 \times 10.03}{\sqrt{17}}$ ≈ 50
3. $96.5748^{2.07}$ ≈ 10 000

Worded Questions

Maria wants to estimate the cost of her gas bill this month.

Gas costs 6.96 pence per unit.

The daily standing charge is 33.07 pence per day.

Maria’s gas meter says that she used 403 units of gas in the last 30 days.

Estimate the cost of Maria’s gas bill for the last 30 days.

Solution

Maria wants to estimate the cost of her gas bill this month.

Gas costs 6.96 pence per unit.

The daily standing charge is 33.07 pence per day.

Maria's gas meter says that she used 403 units of gas in the last 30 days.

Estimate the cost of Maria's gas bill for the last 30 days.

30p x 30 = 900p

7p x 400 = 2800p

3700p = **£37**

Exercise

1. Denis changes his broadband package.
   The new package costs £17.99 per month.
   The contract is 30 months long.

   Estimate the total cost of Denis' broadband package.

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2. Freddie buys 22 packs of sweets for his team mates.

   Each pack of sweets costs £1.99.

   Estimate the total cost of the sweets.

3. It takes 5.9 seconds for a machine to make a model.

   Estimate how models the machine can make in 49 minutes.

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4. The speed of light is 299 792 458 m / s.

   By rounding to 1 significant figure, estimate how far light will travel in 1 year.

   Do you think your estimate will be an overestimate?

   Where is the biggest weakness in your estimate?

Solutions

1. Denis changes his broadband package.
   The new package costs £17.99 per month.
   The contract is 30 months long.

   Estimate the total cost of Denis' broadband package. **≈ £540**

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2. Freddie buys 22 packs of sweets for his team mates.

   Each pack of sweets costs £1.99.

   Estimate the total cost of the sweets.

   ≈ £44

3. It takes 5.9 seconds for a machine to make a model.

   Estimate how models the machine can make in 49 minutes.

   ≈ 500

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4. The speed of light is 299 792 458 m / s.

   By rounding to 1 significant figure, estimate how far light will travel in 1 year.
   ≈ 8 640 000 000 000 000 metres
   Do you think your estimate will be an overestimate?**Underestimate, true value =**

   ≈ 9 460 730 472 580 000 m
   Where is the biggest weakness in your estimate?

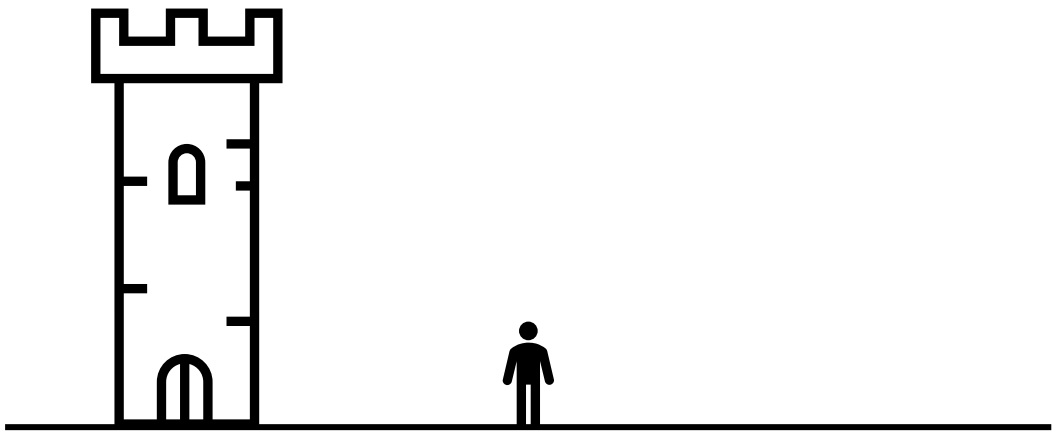
   1 day ≈ 20 hours and 1 year ≈ 400 days

Estimating heights

The diagram shows a man stood next to a tower.

The man is of average height.

The man and the tower are drawn to the same scale.



a) Write down an estimate for the real height, in metres, of the man.

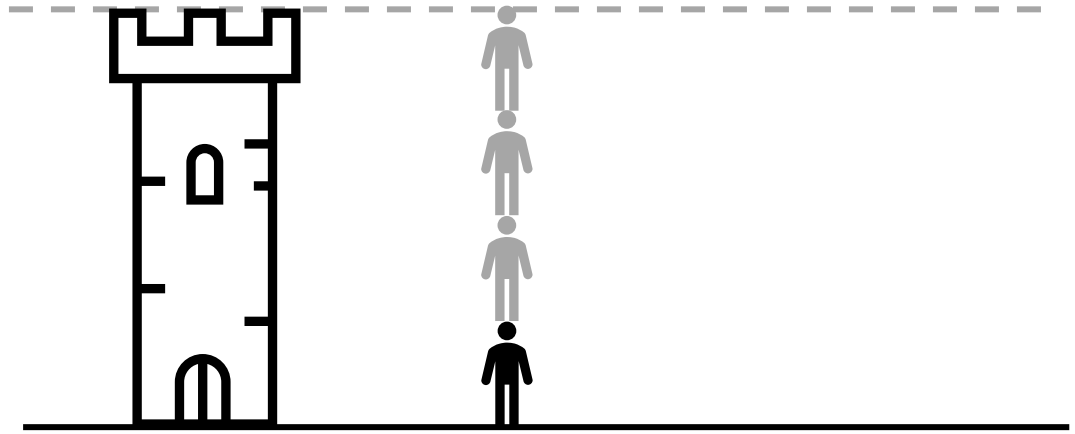
b) Find an estimate for the real height, in metres, of the tower.

Solution

The diagram shows a man stood next to a tower.

The man is of average height.

The man and the tower are drawn to the same scale.



a) Write down an estimate for the real height, in metres, of the man. **1.6 – 2 metres.**

b) Find an estimate for the real height, in metres, of the tower. **4 x answer to a)**

Extension

Josh rounds two numbers, a and b, to 1 significant figure.

The results are 7 and 10.

What are the least and greatest possible values of a and b?

Solution

Josh rounds two numbers, a and b, to 1 significant figure.

The results are 7 and 10.

What are the least and greatest possible values of a and b?

$$\mathbf{6.5} \leq \boldsymbol{a} < \mathbf{7.5}$$

$$\mathbf{9.5} \leq \boldsymbol{b} < \mathbf{15}$$

Exam Style Question

Use approximations to 1 significant figure to estimate the value of

$$\frac{0.5192 \times 19.8^2}{\sqrt{98.96}}$$

You **must** show your working.

Solution

Use approximations to 1 significant figure to estimate the value of

$$\frac{0.5192 \times 19.8^2}{\sqrt{98.96}}$$

You **must** show your working.

$$\frac{\mathbf{0.5} \times \mathbf{20^2}}{\sqrt{\mathbf{100}}}$$

$$= \frac{\mathbf{0.5} \times \mathbf{400}}{\mathbf{10}}$$

$$= \frac{\mathbf{200}}{\mathbf{10}} \qquad \underline{\mathbf{= 2}}$$

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