Had a look ☐ Nearly there ☐ Nailed it! ☐

Estimation

You can estimate the answer to a calculation by rounding each number to **1 significant figure**, and then doing the calculation. You can use this method to check your answers, or to estimate calculations on your **non-calculator paper**. Here are two examples:

1. $4.32 \times 18.09 \approx 4 \times 20 = 80$
   The answer is approximately equal to 80.
2. $327^2 \approx 300^2 = 3^2 \times 100^2 = 90000$
   The answer is approximately equal to 90000.

≈ means 'is approximately equal to'

Decimal division trick

You might have to divide by a decimal on your non-calculator paper. If you multiply both numbers in a division by the same amount the answer stays the same.

$$\frac{1400}{0.05} \overset{\times 100}{=} \frac{140000}{5} \overset{\times 2}{=} \frac{280000}{10} = 28000$$

Worked example

Target grade 4

Work out an estimate for

(a) $\dfrac{4.31 \times 278}{0.487}$ **(2 marks)**

$\dfrac{4.31 \times 278}{0.487} \approx \dfrac{4 \times 300}{0.5} = \dfrac{1200}{0.5} = 2400$

(b) 37.4^3 **(2 marks)**

$37.4^3 \approx 40^3 = 4^3 \times 10^3 = 64 \times 1000 = 64000$

Round all the numbers to **1 significant figure**. Then **write out** the calculation with the rounded values before calculating your estimate.

You can use the laws of indices to work out 40^3 without a calculator.
$(ab)^n = a^n \times b^n$
so $40^3 = (4 \times 10)^3 = 4^3 \times 10^3$

Problem solved! On your non-calculator paper you can use $\pi = 3.142$ then round to 1 s.f. to make your estimate.

Examiners' report

You have rounded **both values down** so your answer will be an underestimate. The question says 'give a reason' so show working and write a conclusion in **words**.

Real students have struggled with questions like this in recent exams – **be prepared!**

Worked example

Target grade 5

A spherical ball-bearing has a radius of 2.35 cm.

Surface area of sphere $= 4\pi r^2$

(a) Work out an estimate for its surface area in square centimetres. **(2 marks)**

$4\pi r^2 = 4 \times 3.142 \times 2.35^2$
$\approx 4 \times 3 \times 2^2 = 48 \text{ cm}^2$

(b) Is your answer to part (a) an overestimate or an underestimate? Give a reason for your answer. **(1 mark)**

$3 < 3.142$ and $2 < 2.35$
so the answer is an underestimate.

Now try this

Target grade 4

1 Showing your rounding, work out an estimate for

$$\frac{82 \times 285}{64 \times 35}$$ **(2 marks)**

Worked solution video

Target grade 5

2 A scientist models a raindrop as a sphere with radius 3.2 mm.
Volume of a sphere $= \frac{4}{3}\pi r^3$

(a) Work out an estimate for the volume of the raindrop. **(2 marks)**

(b) Is your answer to part (a) an overestimate or an underestimate?
Give a reason for your answer. **(1 mark)**