<table>
<tr><td>Outcome</td><td>NF4</td><td>Student can consistently:</td><td>Use approximations to estimate the answer to calculations.</td></tr>
<tr><td>How the topic is examined</td><td colspan="3">

Examined through test paper questions.
There are two uses of this topic on examination papers:

Students are directly asked to use approximations to estimate an answer to a problem. This will always appear on a non-calculator paper.
Students use approximations to check an answer to a question they have just answered. This will help them see if their answer is reasonable.

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<tr><td>Prior knowledge</td><td colspan="3">

Students should be confident:

Multiplying and dividing without a calculator.
Fractions (NF1)

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<tr><td>Suggested tuition approaches</td><td colspan="3">

Students should always be encouraged to use approximations to estimate an answer to any question they have been given. This allows them to check whether their answer is reasonable.
Questions can specifically ask students to use approximations to estimate an answer to a question. The method students should use is:

Round each number to 1 significant figure. This will make the calculation much easier.
Carry out the calculation.

(e.g. Use approximations to estimate the answer to $\frac{179 \times 2.951}{19.5 + 36}$

If you round each number to 1 significant figure you get

$\frac{200 \times 3}{20 + 40}$

This should make it easier to carry out the calculation

$\frac{600}{60} = 10$

A common feature of these questions is dividing by a decimal.

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	$\frac{179 \times 2.951}{0.516} = \frac{200 \times 3}{0.5} = \frac{600}{0.5}$ • Remember dividing by 0.5 is the same as multiplying by 2. Or you can multiply numerator and denominator by 10. $\frac{6000}{5} = 1200$
Common errors and misconceptions	• When asked to estimate an answer to a problem on a non-calculator exam some students have a tendency to try to work out the exact answer working with exact numbers provided. • Students don't round to one significant figure. For example they might round 179 to 180. Explain to students that it is much easier to calculate with 200. • Students round decimals less than 1 to the nearest whole number. For example the number 0.516, many students would round this up to 1. They should round to 0.5 • Usually these questions involve dividing by a decimal. Students think that dividing by 0.5 is the same as halving the number. Encourage students whenever they have a decimal on the bottom to multiply the numerator and denominator of their approximations by 10 (or 100).
Suggested resources	• Questions o http://www.cimt.org.uk/projects/mepres/allgcse/bka6.pdf (pp 228 - 230) o https://corbettmaths.files.wordpress.com/2013/02/estimation-pdf.pdf • Past GCSE Questions o https://keshgcsemaths.files.wordpress.com/2013/11/55_estimation.pdf • Video tutorial o http://corbettmaths.com/2012/08/21/approximation-to-calculations/