

UNIT 14 *Estimation and Approximation*

Teaching Notes

Historical Background and Introduction

Estimation and approximation are important when using mathematics in practical situations. This unit follows on from earlier work, but, at the *Express Route* level, takes the concept further by considering both the maximum/minimum values of measured quantities and the implications of these values when used in formulae. For example, if there is 5% possible error in the measurement of the diameter of a sphere, what are the possible errors when calculating the surface area or volume of the sphere?

For all students it is important that they appreciate the level of accuracy being used in particular estimations and approximations, and why that level is used. Clearly, it helps to be able to first estimate the answer to a complex calculation by making suitable approximations; you then know whether your answer from a calculator or computer, is of the correct order of magnitude.

Also note that some latitude is needed when marking questions that require estimation.

Routes

	Standard	Academic	Express
14.1 Rounding	✓	✓	(✓)
14.2 Estimation	✓	✓	✓
14.3 Calculator Use	✓	✓	✓
14.4 Error Propagation	×	×	✓

Language

	Standard	Academic	Express
Error propagation	×	(✓)	✓

Misconceptions

- the appreciation of the difference between *significant figures* and *decimal places*, e.g. 2.876, to 2 significant figures, is 2.9, and to 2 decimal places, is 2.88
- pupils must understand that small errors in a quantity, say x , become increased in x^2 and increase further in x^3 . The table below gives an example of the effect on a quantity, measured to the nearest cm.

	Quantity, x	x^2	x^3
Lower bound	4.5	20.25	91.125
Nearest cm	5	25	125
Higher bound	5.5	30.25	166.375

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Challenging Questions

The following questions are more challenging than others in the same section:

	<i>Section</i>	<i>Question No.</i>	<i>Page</i>
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" "	14.3	9	141
" "	14.4	11, 12	146