

- 1 A student wishes to calibrate his 3D printer. His 3D printer ejects and deposit molten plastic material to form a physical object based on a digitally designed model. He prints multiple copies of a cube designed to have width of 2.0 cm.

(a) Using a well-calibrated vernier caliper, he measures the width of each cube.

- (i) Explain how he can check whether the width of his printed cubes is accurate.

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.....[2]

- (ii) Explain how he can check whether the dimensions of his printed cubes are precise.

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.....[2]

- (iii) Explain how he can reduce the random error in the determination of the width of each printed cube.

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.....[2]

**(b)** The student measures the three dimensions of one printed solid cube:

width =  $1.99 \text{ cm} \pm 1\%$ ,

length =  $1.95 \text{ cm} \pm 1\%$ ,

height =  $2.02 \text{ cm} \pm 1\%$ .

The manufacturer of the material quotes the density of the material as  $(1.24 \pm 0.05) \text{ g cm}^{-3}$ .

Determine the mass of the cube. Express the mass of the cube together with its uncertainty.

mass = (.....  $\pm$  .....) g [4]

