

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

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

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

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

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

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

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.

$$\text{mass} = (\dots \pm \dots) \text{ g} [4]$$

