Marking guide | Measurement

Measurement topic test 4

10 questions | 55 marks | 75 minutes

Models, scale and uncertainty. Use a scientific calculator, show working and include units. Sketches are not to scale.

Equivalent correct methods earn the corresponding marks.

1. Three readings of a 1.000 kg reference mass are 0.996 kg, 0.997 kg and 0.996 kg. [5 marks]

(a) Calculate the mean reading to six decimal places. [2 marks]

$(0.996 + 0.997 + 0.996)/3 = 0.996333\ldots$ kg.

Answer: 0.996333 kg.

(b) Find percentage error of the mean to two decimal places and comment. [3 marks]

Error $= (1 - 0.996333\ldots)/1 \times 100 = 0.366666\ldots\%$. The close readings indicate repeatability, not absence of bias.

Answer: 0.37%; closely grouped but slightly low.

2. A rectangular room is drawn 4 cm by 2.5 cm at scale 1:200. Carpet tiles cover 1.6 m^2 per box. Add 10% area for cuts; each box costs AUD 33.50. [5 marks]

(a) Find the real floor area. [2 marks]

Real dimensions are 8 m by 5 m; area $= 40\ m^2$.

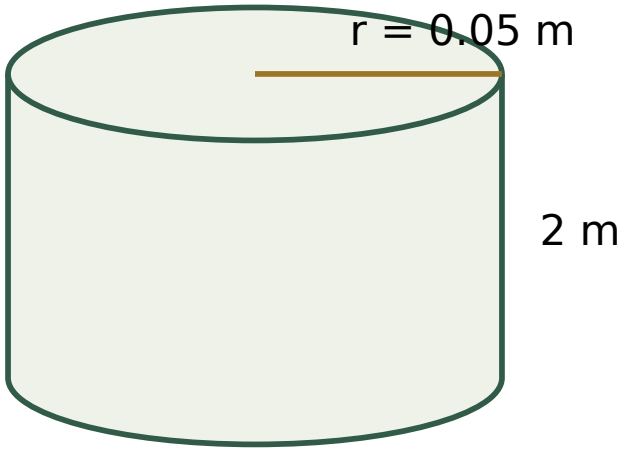
Answer: 40 m^2.

(b) Find box count and cost. [3 marks]

Area with allowance $= 44\ m^2$; $44/1.6 = 27.5$, so buy 28. Cost $= 28 \times 33.50 = 938$.

Answer: 28 boxes; AUD 938.

3. Four identical pipes each have outside radius 0.05 m and length 2 m. Only the curved outer surfaces are painted. [5 marks]



Sketch not to scale

(a) Find total painted area to three decimal places. [3 marks]

One pipe gives $2\pi(0.05)(2) = 0.2\pi$ m^2; four give $0.8\pi \approx 2.513$.

Answer: 2.513 m^2.

(b) Explain why the circular cross-sections are not added. [2 marks]

The end cross-sections are not included in the requested coating area.

Answer: The problem specifies curved outer surfaces only.

4. A 1:500,000 map shows a journey with sections 3.2 cm and 4.4 cm long. Travel is at a constant 76 km/h, with no stops. [5 marks]

(a) Find total real distance. [2 marks]

1 cm represents 5 km; $(3.2 + 4.4) \times 5 = 38$ km.

Answer: 38 km.

(b) Find travel time in minutes and state one limitation. [3 marks]

$38/76 = 0.5$ h $= 30$ min; traffic or stops would change the time.

Answer: 30 minutes; constant speed/no stops is an idealisation.

5. A new shower flows at 8 L/min rather than 12 L/min. Four people each shower for 6.5 minutes daily. [5 marks]

(a) Find daily water use with each shower. [3 marks]

New $= 8 \times 6.5 \times 4 = 208$; old $= 12 \times 6.5 \times 4 = 312$.

Answer: New: 208 L; old: 312 L.

(b) Find the saving over 30 days in litres and cubic metres. [2 marks]

Daily saving $= 104$ L; $104 \times 30 = 3120$ L; divide by 1000 for cubic metres.

Answer: 3120 L; 3.12 m^3.

6. One hundred closed cube boxes each have side 2.5 cm. Allow 12% extra wrapping area for overlap. [5 marks]

(a) Find the total box surface area in square centimetres. [2 marks]

One cube gives $6(2.5)^2 = 37.5$ cm^2; 100 give 3750.

Answer: 3750 cm^2.

(b) Find wrapping area including allowance, in square metres. [3 marks]

$3750 \times 1.12 = 4200$ cm^2; $4200/10\,000 = 0.42$ m^2.

Answer: 0.42 m^2.

7. A pool is 12 m long and 5 m wide. Its depth increases uniformly along the length from 1 m to 2 m. [5 marks]

(a) Explain why the average depth is 1.5 m under this model. [2 marks]

$(1 + 2)/2 = 1.5$ m; the assumption is a straight sloping floor and constant width.

Answer: The depth varies linearly, so the mean of the endpoint depths is appropriate.

(b) Find the water volume when filled to the stated depths. [3 marks]

$12 \times 5 \times 1.5 = 90$ m^3, then multiply by 1000.

Answer: 90 m^3; 90,000 L.

8. A 4 m by 3 m rectangular sandpit includes an internal border 0.2 m wide on every side. [5 marks]

(a) Find the inner sand area. [3 marks]

Inner dimensions are $4 - 0.4 = 3.6$ m and $3 - 0.4 = 2.6$ m; product 9.36.

Answer: 9.36 m^2.

(b) Find sand volume for a uniform depth of 0.3 m. [2 marks]

$9.36 \times 0.3 = 2.808$.

Answer: 2.808 m^3.

9. A rectangle measures 6.2 m by 4.8 m, each rounded to the nearest 0.1 m. [6 marks]

(a) Find the minimum possible area. [3 marks]

$6.15 \times 4.75 = 29.2125$.

Answer: 29.2125 m^2.

(b) Find an upper bound for its area and state whether it is included. [3 marks]

$A < 6.25 \times 4.85 = 30.3125$ m^2 because the upper length endpoints are excluded.

Answer: 30.3125 m^2, excluded.

10. An open V-shaped trough is 6 m long. Its triangular cross-section has top width 2 m, perpendicular depth 1 m and two sloping sides each $\sqrt{2}$ m. Both triangular ends are closed. [9 marks]

(a) Find full capacity. [3 marks]

Cross-section area $= \frac{1}{2}(2)(1) = 1$ m^2; multiply by 6.

Answer: 6 m^3; 6000 L.

(b) Find the material area, excluding the open top. Give two decimal places. [3 marks]

Two triangular ends total 2 m^2; walls total $2(6\sqrt{2}) = 12\sqrt{2}$. Total $= 2 + 12\sqrt{2} \approx 18.97$.

Answer: 18.97 m^2.

(c) At half the full depth, find the water volume. [3 marks]

Similar cross-section lengths are halved, so its area is one quarter; the trough length is unchanged. Water volume $= 6/4 = 1.5$ m^3.

Answer: 1.5 m^3; 1500 L.