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GCSE MATHEMATICS • NUMBER

Error Intervals & Bounds

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator only where shown

Full worked solutions for the free Error Intervals and Bounds worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Error Intervals & Bounds worksheet, in the same order and with the same question numbers.

How to mark your work. Tick each step you got right, not just the final answer. In the exam, method marks are given for correct working even when the final answer is wrong. If you lost marks, find the *first* line where your working is different from ours. That is the thing to fix.

In Section E: **M** = method mark, **P** = process mark, **A** = accuracy mark, **B** = independent mark, **C** = communication mark.

Question sheet

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A**Your turn answers**

Compare each line of your working with the solution.

FOUNDATION

A1 Half a kilogram each way. $22.5 \leq m < 23.5$

A2 (a) step 0.01, half 0.005 $7.615 \leq x < 7.625$ (b) step 1000, half 500 $2500 \leq y < 3500$

A3 The smallest value is 12.37 itself, and it must stay below 12.38 $12.37 \leq n < 12.38$

HIGHER

A4 Lower bounds: 9.25 and 5.75 (a) $2 \times (9.25 + 5.75) = 30 \text{ cm}$ (b) $9.25 \times 5.75 = 53.1875 \text{ cm}^2$

A5 p is from 35 to 45 and q is from 16.5 to 17.5

Upper bound = $45 - 16.5 = 28.5$ Lower bound = $35 - 17.5 = 17.5$

A6 For the smallest density use the smallest mass and the biggest volume. $535 \div 72.5 = 7.3793\dots$
 7.38 g/cm^3

A7 Upper: $56.25 \div 4.365 = 12.886\dots$ Lower: $56.15 \div 4.375 = 12.834\dots$
 To 1 d.p. these are 12.9 and 12.8 (different). To the nearest whole number both are 13.
 $w = 13$, because both bounds round to 13

B**Fluency solutions**

One mark for each correct part unless stated. The notes in italics explain why each sequence was chosen.

FOUNDATION

B1 (a) $35 \leq x < 45$ (b) $350 \leq x < 450$ (c) $395 \leq x < 405$ (d) $399.5 \leq x < 400.5$

Parts (b), (c) and (d) are all "400". The interval depends on the accuracy, not on the number.

B2 (a) $3.65 \leq x < 3.75$ (b) $3.695 \leq x < 3.705$ (c) $0.075 \leq x < 0.085$ (d) $11.95 \leq x < 12.05$

3.7 and 3.70 are the same number but different statements about accuracy.



B3 (a) $4500 \leq x < 5500$ (b) $4950 \leq x < 5050$ (c) $0.55 \leq x < 0.65$ (d) $0.0595 \leq x < 0.0605$

B4 (a) $7 \leq x < 8$ (b) $2.5 \leq x < 2.6$ (c) $0.34 \leq x < 0.35$ (d) $180 \leq x < 190$

A truncated value is the **bottom** of its interval, not the middle.

B5 (a) 63.5 and 64.5 (b) 8.15 and 8.25 (c) 1450 and 1550 (d) 245 and 255

HIGHER

B6 x is from 6.35 to 6.45 and y is from 2.65 to 2.75

(a) $6.45 + 2.75 = 9.2$ (b) $6.35 + 2.65 = 9.0$ (c) $6.45 - 2.65 = 3.8$ (d) $6.35 - 2.75 = 3.6$

For a difference, the bounds are crossed: biggest minus smallest, and smallest minus biggest.

B7 a is from 7.5 to 8.5 and b is from 2.45 to 2.55

(a) $8.5 \times 2.55 = 21.675$ (b) $7.5 \times 2.45 = 18.375$ (c) $8.5 \div 2.45 = 3.469 \dots 3.47$ (d) $7.5 \div 2.55 = 2.941 \dots 2.94$

B8 Half of 5 is 2.5, and half of 0.5 is 0.25 (a) $142.5 \leq l < 147.5$ (b) $57.5 \leq s < 62.5$
(c) $3.25 \leq t < 3.75$

C

Reasoning solutions

Your wording can be different. Check that your reason makes the same point.

FOUNDATION

C1 9.5 rounds up to 10, so it cannot be included. The second sign should be $<$, giving $8.5 \leq x < 9.5$

C2 Any number bigger than 8.4 and less than 8.5, for example 8.47

C3 (a) $13.5 \leq m < 14.5$ (b) $14 \leq m < 15$ The intervals are different, so you must know which method was used.

C4 Pencil A: $11.5 \leq l < 12.5$ Pencil B: $11.95 \leq l < 12.05$ **Pencil B**, because its interval is ten times narrower.



C5 The interval is $45 \leq x < 55$ **45 and 54.99** (55 rounds up to 60, and 44.9 rounds down to 40)

HIGHER

C6 Upper bound of each mass is 74.5 kg $6 \times 74.5 = 447$ kg $447 < 450$ **Yes, it is certain**, because even the greatest possible total is under the limit.

C7 Taking away a **smaller** number leaves a **bigger** answer. So to make $a - b$ as big as possible you need the biggest a and the smallest b .

C8 The upper bound of x is 5.05 $5.05^2 = 25.5025$ $25.5025 < 25.6$ **Yes, it is certain**

C9 (a) Upper: $3.25 \div 0.35 = 9.285\dots$ **9.29 (3 s.f.)** Lower: $3.15 \div 0.45 =$ **7**
 (b) An error of 0.05 is small compared with 3.2 but large compared with 0.4 (it is one eighth of it). Dividing by a number with a large percentage error gives a large percentage error in the answer.

D

Problem solving solutions

There is often more than one correct method. Any complete, correct method scores full marks.

FOUNDATION

D1 The interval is $23500 \leq n < 24500$. The number of people must be a whole number.
smallest 23 500, largest 24 499

D2 **No.** His height could be as low as 1.35 m, which is less than 1.4 m.

D3 The interval is $6.5 \leq x < 7.5$, which is half a unit either side of 7 **7, to the nearest whole number**

D4 (a) **$2.718 \leq x < 2.719$** (b) **Yes**, because 2.7189 is in the interval. Truncating it to 3 decimal places gives 2.718

D5 (a) Each book could be up to 4.5 cm: $20 \times 4.5 = 90$ cm. The shelf could be as short as 79.5 cm. $90 > 79.5$, so they might not fit.

(b) Use the shortest shelf and the widest books: $79.5 \div 4.5 = 17.66\dots$ **17 books**



HIGHER

D6 $\frac{1}{2} \times 9.35 \times 6.15 = 28.75125 \text{ cm}^2$

D7 Upper bound of speed: $100.5 \div 9.75 = 10.307 \dots$ Lower bound of speed: $99.5 \div 9.85 = 10.101 \dots$
 To 3 significant figures these are 10.3 and 10.1 (different). To 2 significant figures both are 10.
 10 m/s , because both bounds agree when rounded to 2 significant figures.

D8 Upper bounds: width 36.5 m, length 122.5 m $2 \times (36.5 + 122.5) = 318 \text{ m}$

D9 Biggest mass and smallest volume: $2465 \div 305 = 8.0819 \dots$ 8.08 g/cm^3

D10 For the biggest R : biggest top, smallest bottom. The bottom $b - c$ is smallest using the smallest b and the biggest c .

Top = 12.5 Bottom = $7.45 - 3.25 = 4.2$ $12.5 \div 4.2 = 2.976 \dots$ 2.98

E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION *Foundation and Higher crossover*

E1 $6.25 \leq n < 6.35$

B1 for 6.25 and 6.35, B1 for correct inequality signs

E2 $24.5 \leq L < 25.5$

B1 B1

E3 $4.8 \leq m < 4.9$

B1 for 4.8 and 4.9, B1 for correct inequality signs

E4 Nearest centimetre is 0.01 m, so half a step is 0.005 $3.195 \leq h < 3.205$

B1 B1

HIGHER

E5 Upper bounds 15.35 and 8.65

B1

15.35×8.65

M1

132.7775 cm^2

A1



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E6	9.65 – 3.45	M1
	6.2	A1
E7	Lower bound of distance 375, upper bound of time 4.55	B1
	$375 \div 4.55 = 82.417 \dots$	M1
	82.4 km/h	A1
E8	Bounds of p : 7.255 and 7.265 Bounds of q : 2.395 and 2.405	B1
	Upper bound of $y = \sqrt{7.265 \div 2.395} = 1.7416 \dots$	M1
	Lower bound of $y = \sqrt{7.255 \div 2.405} = 1.7368 \dots$	M1
	To 3 d.p. these are 1.742 and 1.737 (different). To 2 d.p. both are 1.74	A1
	$y = 1.74$, because both bounds agree to 2 decimal places.	C1

