



**eClassroom**

GCSE Mathematics

# **Error Intervals & Bounds**

**Worked Solutions**

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Pearson Edexcel GCSE & iGCSE Mathematics



## Section A — Foundation — Worked Solutions

### [Fluency] Question 1

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Rounded to nearest 1: half unit = 0.5

Lower bound:  $47 - 0.5 = 46.5$     Upper bound:  $47 + 0.5 = 47.5$

∴

### [Fluency] Question 2

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Rounded to 1 d.p.: half unit = 0.05

Lower bound:  $8.30 - 0.05 = 8.25$     Upper bound:  $8.30 + 0.05 = 8.35$

∴

### [Fluency] Question 3

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Rounded to nearest 10: half unit = 5

Lower bound:  $150 - 5 = 145$     Upper bound:  $150 + 5 = 155$

∴

### [Fluency] Question 4

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Rounded to 1 d.p.: half unit = 0.05

Lower bound:  $6.00 - 0.05 = 5.95$     Upper bound:  $6.00 + 0.05 = 6.05$

∴

### [Fluency] Question 5

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Rounded to nearest 100: half unit = 50

Lower bound:  $3400 - 50 = 3350$     Upper bound:  $3400 + 50 = 3450$

∴

### [Reasoning] Question 6

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$p \in [8.35, 8.45)$      $q \in [3.15, 3.25)$

Lower bound of  $p + q$ :  $8.35 + 3.15 = 11.50$

Upper bound of  $p + q$ :  $8.45 + 3.25 = 11.70$

∴

**[Reasoning] Question 7**

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$$a \in [11.5, 12.5) \quad b \in [4.5, 5.5)$$

(a) Upper bound of  $a - b = \max(a) - \min(b) = 12.5 - 4.5 = 8.0$

(b) Lower bound of  $a - b = \min(a) - \max(b) = 11.5 - 5.5 = 6.0$

**$\therefore$  (a) Upper bound = 8.0 (b) Lower bound = 6.0**

**[Reasoning] Question 8**

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$$\text{Length} \in [6.35, 6.45) \quad \text{Width} \in [3.05, 3.15)$$

(a) Upper bound of area =  $6.45 \times 3.15 = 20.3175 \text{ cm}^2$

(b) Lower bound of area =  $6.35 \times 3.05 = 19.3675 \text{ cm}^2$

**$\therefore$  (a) 20.3175 cm<sup>2</sup> (b) 19.3675 cm<sup>2</sup>**

**[Problem Solving] Question 9**

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$$\text{Each box mass } m \in [235, 245) \text{ g}$$

Lower bound of total:  $12 \times 235 = 2820 \text{ g}$

Upper bound of total:  $12 \times 245 = 2940 \text{ g}$

**$\therefore$  Lower bound = 2820 g Upper bound = 2940 g**

**[Problem Solving] Question 10**

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$$\text{Density } D \in [8.85, 8.95) \text{ g/cm}^3 \quad \text{Volume } V \in [14.5, 15.5) \text{ cm}^3$$

(a) Upper bound of mass =  $\max D \times \max V = 8.95 \times 15.5 = 138.725 \text{ g}$

(b) Lower bound of mass =  $\min D \times \min V = 8.85 \times 14.5 = 128.325 \text{ g}$

**$\therefore$  (a) Upper bound = 138.725 g (b) Lower bound = 128.325 g**



## Section B — Higher — Worked Solutions

### [Fluency] Question 1

Truncation to 2 s.f. means the digits after the 2nd significant figure are dropped.

The value is at least 0.057. The next 2 s.f. value is 0.058.

Lower bound = 0.057 (included)    Upper bound = 0.058 (not included)

∴

### [Fluency] Question 2

Rounded to 2 s.f.: half unit = 50

Lower bound:  $4700 - 50 = 4650$     Upper bound:  $4700 + 50 = 4750$

∴

### [Fluency] Question 3

t rounded to 1 d.p.: half unit = 0.05

(a)  $t \in [2.75, 2.85)$

(b) Lower bound of  $t^2 = 2.75^2 = 7.5625$

Upper bound of  $t^2 = 2.85^2 = 8.1225$

∴ **(a) [2.75, 2.85)    (b)  $7.5625 \leq t^2 < 8.1225$**

### [Reasoning] Question 4

$x \in [3.35, 3.45)$      $y \in [1.75, 1.85)$

(a) Upper bound of  $x \div y = \max(x) \div \min(y) = 3.45 \div 1.75 = 1.9714... \approx 1.971$

(b) Lower bound of  $x \div y = \min(x) \div \max(y) = 3.35 \div 1.85 = 1.8108... \approx 1.811$

∴ **(a) Upper bound  $\approx 1.971$     (b) Lower bound  $\approx 1.811$**

### [Reasoning] Question 5

Distance  $d \in [42.5, 47.5)$  miles    Speed  $s \in [55, 65)$  mph

(a) Upper bound of time = max distance  $\div$  min speed =  $47.5 \div 55$

= 0.8636... hours =  $0.8636 \times 60 = 51.82$  minutes

(b) Lower bound of time = min distance  $\div$  max speed =  $42.5 \div 65$

= 0.6538... hours =  $0.6538 \times 60 = 39.23$  minutes

∴ **(a) Upper bound  $\approx 51.8$  minutes    (b) Lower bound  $\approx 39.2$  minutes**



### [Reasoning] Question 6

$$p \in [2.75, 2.85) \quad q \in [1.35, 1.45)$$

$$\text{Upper bound of } p \div q = \max(p) \div \min(q) = 2.85 \div 1.35$$

$$= 285 \div 135 = 57 \div 27 = 19 \div 9 \checkmark$$

$$\therefore \text{Upper bound of } p \div q = 19/9 \checkmark$$

### [Problem Solving] Question 7

$$R_1 \in [4.65, 4.75) \quad R_2 \in [8.25, 8.35) \quad R_3 \in [2.05, 2.15)$$

$$(a) \text{ Upper bound of } R = 4.75 + 8.35 + 2.15 = 15.25 \Omega$$

$$(b) \text{ Lower bound of } R = 4.65 + 8.25 + 2.05 = 14.95 \Omega$$

$$\therefore (a) \text{ Upper bound} = 15.25 \Omega \quad (b) \text{ Lower bound} = 14.95 \Omega$$

### [Problem Solving] Question 8

$$\text{Area } A \in [153.5, 154.5) \text{ cm}^2$$

$$A = \pi r^2 \rightarrow r = \sqrt{A/\pi}$$

$$(a) \text{ Upper bound of } r = \sqrt{(154.5/\pi)} = \sqrt{(49.1803\dots)} = 7.0129 \text{ cm (4 d.p.)}$$

$$(b) \text{ Lower bound of } r = \sqrt{(153.5/\pi)} = \sqrt{(48.8622\dots)} = 6.9901 \text{ cm (4 d.p.)}$$

$$\therefore (a) \text{ Upper bound} = 7.0129 \text{ cm} \quad (b) \text{ Lower bound} = 6.9901 \text{ cm}$$

### [Problem Solving] Question 9

$$u \in [11.5, 12.5) \quad t \in [2.95, 3.05) \quad a \in [1.5, 2.5)$$

$$(a) \text{ Upper bound of } s: \text{ use max } u, \text{ max } t, \text{ max } a$$

$$s = 12.5 \times 3.05 + 0.5 \times 2.5 \times 3.05^2$$

$$= 38.125 + 0.5 \times 2.5 \times 9.3025 = 38.125 + 11.628 = 49.753 \text{ m}$$

$$(b) \text{ Lower bound of } s: \text{ use min } u, \text{ min } t, \text{ min } a$$

$$s = 11.5 \times 2.95 + 0.5 \times 1.5 \times 2.95^2$$

$$= 33.925 + 0.5 \times 1.5 \times 8.7025 = 33.925 + 6.527 = 40.452 \text{ m}$$

$$\therefore (a) \text{ Upper bound} = 49.753 \text{ m} \quad (b) \text{ Lower bound} = 40.452 \text{ m}$$



### [Problem Solving] Question 10

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(a) Rounded to 1 d.p.: half unit = 0.05

Error interval:  $5.65 \leq y < 5.75$

(b) Truncated to 1 d.p.: digits after 1 d.p. removed, no rounding up.

Error interval:  $5.7 \leq x < 5.8$

(c) Rounding adjusts to the nearest value (up or down); truncation always removes digits without rounding up.

Rounding produces a smaller maximum error (half the rounding unit vs a full unit for truncation).

**$\therefore$  (a)  $5.65 \leq y < 5.75$  (b)  $5.7 \leq x < 5.8$  (c) Rounding has smaller max error.**