



**eClassroom**

GCSE Mathematics

# **Rounding & Estimation**

**Worked Solutions**

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Pearson Edexcel GCSE & iGCSE Mathematics



## Section A — Foundation — Worked Solutions

### [Fluency] Question 1

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4738: the hundreds digit is 7. The tens digit is  $3 < 5$ , so round down.

$\therefore$  **4700**

### [Fluency] Question 2

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3.467: the 2nd decimal place is 6. The 3rd is  $7 \geq 5$ , so round up.

$\therefore$  **3.47**

### [Fluency] Question 3

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Leading zeros are not significant. 1st s.f. is 8, 2nd is 4.

Next digit is  $5 \geq 5$ , so round up the 4 to 5.

$\therefore$  **0.085**

### [Fluency] Question 4

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3rd s.f. is 8 (in the hundreds place). Next digit is  $5 \geq 5$ , round up.

$\therefore$  **67 900**

### [Fluency] Question 5

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Leading zeros are not significant. 1st s.f. is 4.

Next digit is  $6 \geq 5$ , so round up.

$\therefore$  **0.005**

### [Reasoning] Question 6

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Round to 1 s.f.:  $38.2 \rightarrow 40$     $5.9 \rightarrow 6$

Estimate:  $40 \times 6 = 240$

$\therefore$  **240 (actual  $\approx$  225.4)**

### [Reasoning] Question 7

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Round:  $97.3 \rightarrow 100$     $4.8 \rightarrow 5$

$$\frac{\sqrt{100}}{5} = \frac{10}{5} = 2$$

$\therefore$  **2 (actual  $\approx$  2.06)**

**[Reasoning] Question 8**

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Round: 289 → 300   0.048 → 0.05   5.1 → 5

$$\frac{300 \times 0.05}{5} = \frac{15}{5} = 3$$

∴ **3 (actual ≈ 2.72)**

**[Problem Solving] Question 9**

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(a)  $7.3 \rightarrow 7$  (1 s.f.): Area  $\approx \pi \times 7^2 = 49\pi \approx 153.9 \text{ cm}^2$

(b) Actual area =  $\pi \times 7.3^2 = 167.4 \text{ cm}^2$  (1 d.p.)

(c)  $|153.9 - 167.4| = 13.5 \text{ cm}^2$

∴ **(a) ≈ 154 cm<sup>2</sup>   (b) 167.4 cm<sup>2</sup>   (c) 13.5 cm<sup>2</sup> out**

**[Problem Solving] Question 10**

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(a)  $48 \rightarrow 50$ , £3.85 → £4: estimate =  $50 \times 4 = \text{£}200$

(b) Exact cost =  $48 \times \text{£}3.85 = \text{£}184.80$

% error =  $|200 - 184.80| \div 184.80 \times 100 = 15.2 \div 184.80 \times 100 \approx 8.2\%$

∴ **(a) ≈ £200   (b) Exact = £184.80, % error ≈ 8.2%**



## Section B — Higher — Worked Solutions

### [Fluency] Question 1

3 s.f.: 1, 0, 9. Next digit is  $5 \geq 5$ , so round up the 9 to 10  $\rightarrow$  carry.

$\therefore$  **1.10**

### [Fluency] Question 2

Leading zeros not significant. 1st s.f. is 9, 2nd is 0.

Next digit is  $5 \geq 5$ , so round up the 0 to 1.

$\therefore$  **0.0091**

### [Fluency] Question 3

Round to 1 s.f.:  $5.82 \rightarrow 6$ ,  $3.14 \rightarrow 3$ ,  $2.03 \rightarrow 2$ ,  $4.97 \rightarrow 5$

$$\frac{(6+3)^2}{2 \times 5} = \frac{81}{10} = 8.1$$

$\therefore$  **8.1 (actual  $\approx$  7.96)**

### [Reasoning] Question 4

Round:  $3.87 \rightarrow 4$ ,  $10^3$  stays,  $0.214 \rightarrow 0.2$ ,  $10^2$  stays

$$\frac{4 \times 10^3}{0.2 \times 10^2} = \frac{4000}{20} = 200$$

$\therefore$  **200 (actual  $\approx$  181)**

### [Reasoning] Question 5

(a)  $6.94 \rightarrow 7$ ,  $8.13 \rightarrow 8$ : estimate =  $7 \times 8 = 56$

(b) Actual =  $6.94 \times 8.13 = 56.4222$

% error =  $|56 - 56.4222| \div 56.4222 \times 100 \approx 0.75\%$

$\therefore$  **(a) 56 (b) % error  $\approx$  0.75%**

### [Reasoning] Question 6

2.45 is exactly halfway between 2.4 and 2.5.

By the standard GCSE convention, digits of 5 or more are rounded up.

2.45 rounds up to 2.5, not down to 2.4.

$\therefore$  **Jake is wrong. Correct answer: 2.5**



### [Problem Solving] Question 7

(a)  $3.6 \rightarrow 4$ ,  $2.4 \rightarrow 2$ : estimate =  $4^2 + 2^2 = 16 + 4 = 20$

(b) Upper bound:  $x \in [3.55, 3.65)$ ,  $y \in [2.35, 2.45)$

Upper bound of  $x^2 + y^2 = 3.65^2 + 2.45^2 = 13.3225 + 6.0025 = 19.325$

(c) Lower bound =  $3.55^2 + 2.35^2 = 12.6025 + 5.5225 = 18.125$

$\therefore$  (a) 20 (b) Upper bound = 19.325 (c) Lower bound = 18.125

### [Problem Solving] Question 8

Speed  $s \in [129.5, 130.5)$  km/h Time  $t \in [2.35, 2.45)$  h

(a) Upper bound of distance = max speed  $\times$  max time =  $130.5 \times 2.45 = 319.725$  km

(b) Lower bound = min speed  $\times$  min time =  $129.5 \times 2.35 = 304.325$  km

$\therefore$  (a) Upper bound = 319.725 km (b) Lower bound = 304.325 km

### [Problem Solving] Question 9

(a)  $n \in [5.25 \times 10^{-3}, 5.35 \times 10^{-3})$

(b)  $n \approx 5 \times 10^{-3}$

$n^2 \approx (5 \times 10^{-3})^2 = 25 \times 10^{-6}$ ;

$\therefore$  (a)  $5.25 \times 10^{-3} \leq n < 5.35 \times 10^{-3}$  (b)  $n^2 \approx 2.5 \times 10^{-5}$

### [Problem Solving] Question 10

(a) Rounded to 1 d.p.:  $4.65 \leq x < 4.75$

(b) Truncated to 1 d.p.:  $4.7 \leq y < 4.8$

(c) Rounding can adjust up or down (max error = half the rounding unit = 0.05).

Truncation always rounds down (max error = full unit = 0.1).

Rounding produces the smaller maximum error.

$\therefore$  (a)  $4.65 \leq x < 4.75$  (b)  $4.7 \leq y < 4.8$  (c) Rounding gives smaller max error (0.05 vs 0.1).