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GCSE MATHEMATICS • NUMBER

Rounding and Estimation

Worked Solutions

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • No calculator

Full worked solutions for the free Rounding and Estimation worksheet, GCSE and iGCSE Maths



Tap a section to jump straight to it

Full worked solutions for every question on the Rounding and Estimation 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.

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A**Your turn answers**

Compare each line of your working with the solution. For estimates, a different sensible rounding can also earn the marks.

FOUNDATION

A1 (a) 0.003 851: the 5 rounds the 8 up **0.0039** (b) 7249: the 4 leaves the 2 **7200**

A2 $\frac{60 \times 2}{6} = \frac{120}{6} = \mathbf{20}$

A3 $\frac{80 - 20}{0.2} = \frac{60}{0.2}$ Dividing by 0.2 is the same as multiplying by 5: $60 \times 5 = \mathbf{300}$

HIGHER

A4 The top was rounded **down**, which makes the answer smaller. The bottom was rounded **up**, and dividing by a bigger number also makes the answer smaller. **underestimate**

A5 $7^2 = 49$ and $8^2 = 64$, so $\sqrt{55}$ is between 7 and 8 55 is 6 above 49 and the gap is 15: $\frac{6}{15} = 0.4$
 $\sqrt{55} \approx 7.4$

A6 Volume $\approx 4 \times 5 \times 10 = 200 \text{ cm}^3$ Mass $\approx 600 \text{ g}$ Density $\approx \frac{600}{200} = \mathbf{3 \text{ g/cm}^3}$

A7 $25 \times 4 = \mathbf{100}$ To 1 significant figure 24.7 becomes 20, which loses nearly a fifth of the number. That estimate, $20 \times 4 = 80$, is much further from the exact value (96.33).

B**Fluency solutions**

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

FOUNDATION

B1 (a) **3750** (b) **3700** (c) **4000** (d) **4000**

In (d), 3996 rounds up to 400 tens, so the rounding carries all the way to the thousands.



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- B2** (a) **6.3** (b) **6.28** (c) **6.285** (d) **5.00**

Always round from the original number. In (d) the zeros must be written: 5.00 shows the answer is correct to 2 decimal places.

- B3** (a) **50 000** (b) **48 400** (c) **0.07** (d) **0.0706**

Zeros at the front of 0.070 56 are not significant. The zero between the 7 and the 5 is.

- B4** (a) **7.9** (b) **7.8** (c) **0.43** (d) **60.0**

Truncating means cutting off the extra digits without rounding.

- B5** (a) $40 \times 50 =$ **2000** (b) $600 \div 30 =$ **20** (c) $8^2 =$ **64** (d) $200 \times 0.5 =$ **100**

- B6** (a) $\frac{6 \times 4}{2} =$ **12** (b) $\frac{90 + 10}{5} =$ **20** (c) $\frac{300}{0.3 \times 10} = \frac{300}{3} =$ **100**

HIGHER

- B7** (a) $5^2 = 25$, $6^2 = 36$: between 5 and 6. 30 is $\frac{5}{11}$ of the way, about 0.5 **5.5** 2 marks

- (b) $12^2 = 144$, $13^2 = 169$: between 12 and 13. 150 is $\frac{6}{25}$ of the way, about 0.2 **12.2** 2 marks

- (c) $4^3 = 64$, $5^3 = 125$: between 4 and 5. 70 is $\frac{6}{61}$ of the way, about 0.1 **4.1** 2 marks

- B8** (a) Both rounded up: **overestimate** (b) First number down, number subtracted up: **underestimate**

- (c) Top down, bottom up: **underestimate**

- (d) 61 was rounded down but 0.48 was rounded up, so the directions disagree. The exact value is $61 \times 0.48 = 29.28$, so 30 is an **overestimate**

- B9** (a) $3^3 =$ **27** (b) $\frac{\sqrt{100}}{0.2} = \frac{10}{0.2} =$ **50** (c) $\frac{20^2}{\sqrt[3]{8}} = \frac{400}{2} =$ **200**



C

Reasoning solutions

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

FOUNDATION

- C1** 19.7×5.1 is about $20 \times 5 = 100$. Kai's answer is about ten times too big, so the decimal point is in the wrong place.
- C2** He rounded twice. You must round from the original number: 2499 is nearer to 2000 than to 3000. **2000**
- C3** **4.0** shows the number is correct to 1 decimal place. Writing 4 suggests it was only rounded to the nearest whole number.
- C4** **No.** 9 minibuses hold only $9 \times 16 = 144$ students, so 6 students would be left behind. He must round up to 10.
- C5** (a) Any of 5.350, 5.351, 5.352, 5.353, 5.354, for example **5.352** (b) **5.354** (5.355 would round to 5.36)

HIGHER

- C6** The top was rounded up (bigger answer). The bottom was rounded down, and dividing by a smaller number gives a bigger answer. **overestimate**
- C7** (a) $6.5^2 = 42.25$, which is more than 40, so 6.5 is too big.
 (b) 40 is 4 above 36 and the gap from 36 to 49 is 13. $\frac{4}{13}$ is about 0.3 **6.3**
- C8** The smallest is 3500 and the largest is 4499. $4499 - 3500 + 1 =$ **1000 numbers**
- C9** $\frac{400 \times 7}{0.5 \times 70} = \frac{2800}{35} = 80$ **Not reasonable.** The answer should be about 80. 8.09 is about ten times too small, so a decimal point has probably been misplaced.
- C10** (a) Estimate: $1 \times 1 = 1$ Exact: $1.49 \times 1.49 = 2.2201$ Half of 2.2201 is 1.11, and 1 is less than this.
 (b) Round to 1 decimal place instead: $1.5 \times 1.5 =$ **2.25** Rounding 1.49 to 1 throws away a third of the number.



D**Problem solving solutions**

Other sensible roundings are acceptable if the method is clear.

FOUNDATION

D1 $20 \times 40 = \boxed{\text{£800}}$

D2 Area $\approx 6 \times 3 = 18 \text{ m}^2$ Two coats: $18 \times 2 = 36 \text{ m}^2$ One tin covers about 10 m^2 : $36 \div 10 = 3.6$
Round up, because 3 tins are not enough. **4 tins**

D3 $300 \div 40 = \boxed{7.5 \text{ miles per litre}}$

D4 $10 \times 40 \times 50 = \boxed{\text{£20 000}}$

D5 (a) About 20 km in 60 minutes: $60 \div 20 = \boxed{3 \text{ minutes}}$

(b) **Underestimate.** The speed was rounded up, and a faster cyclist takes less time.

HIGHER

D6 $V \approx \frac{4}{3} \times 3 \times 3^3 = 4 \times 27 = \boxed{108 \text{ cm}^3}$

D7 $\frac{70\,000\,000}{200\,000} = \frac{700}{2} = \boxed{350 \text{ people per km}^2}$

D8 $90^2 = 8100$ and $91^2 = 8281$, so $\sqrt{8300}$ is about 91 Perimeter $\approx 4 \times 91 = \boxed{364 \text{ m}}$ (accept answers from 360 m to 368 m)

D9 (a) $20 \times 40 = \boxed{800}$ (b) $25 \times 35 = \boxed{875}$

(c) **The second estimate is better**: it is about 9 away, and the first is about 66 away. To 1 significant figure, 24.6 drops by 4.6 and 35.2 rises by 4.8, which are large changes compared with the size of the numbers.

D10 $\frac{L}{g} \approx \frac{0.9}{10} = 0.09$ $\sqrt{0.09} = 0.3$ $T \approx 2 \times 3 \times 0.3 = \boxed{1.8 \text{ seconds}}$



E

Exam practice solutions

Marks are shown on the right of each line.

FOUNDATION

Foundation and Higher crossover

- E1 (a) **7800** B1
- (b) **3.50** B1
- (c) **0.0041** B1
- (d) **50 000** B1

E2
$$\frac{5 \times 30}{0.2}$$
 M1 at least two correct roundings

$$= \frac{150}{0.2}$$
 M1

$$= \mathbf{750}$$
 A1

- E3 (a) 300×5 M1
- £1500** A1
- (b) **Overestimate**, because both numbers were rounded up. C1

E4
$$\frac{10 + 20}{0.3 \times 5}$$
 M1

$$= \frac{30}{1.5} = 20$$
 as required A1

HIGHER

- E5 (a) $300 \div 50$ M1
- 6 hours** A1
- (b) **Overestimate.** C1
- The distance was rounded up and the speed was rounded down. Both changes make the time longer.
- C1

E6
$$\sqrt{8^2 + 6^2}$$
 M1

$$= \sqrt{64 + 36} = \sqrt{100}$$
 M1

$$= \mathbf{10}$$
 A1



E7	$\frac{40 \times (8 - 4)}{0.5}$	M1
	$= \frac{160}{0.5} = 320$	A1
	Not reasonable. The answer should be about 320, so 32.1 is about ten times too small.	C1
E8	$\sqrt[3]{65.2} \approx \sqrt[3]{64} = 4$	M1
	$\sqrt{0.0391} \approx \sqrt{0.04} = 0.2$	M1
	$4 \times 0.2 = \mathbf{0.8}$	A1
E9	350 to 2 significant figures: n is from 345 to 354	P1
	300 to 1 significant figure: n is less than 350, so n is from 345 to 349	P1
	Multiples of 4 near here are 344, 348, 352	P1
	$n = \mathbf{348}$	A1

