

Accuracy, Significant Figures & Standard Form Worksheet

Decimal places, significant figures, standard form, estimation and bounds

Questions only • Increasing difficulty • Full working expected

Instructions. Attempt the questions in order. Show the digit that controls each rounding decision when it is not obvious, keep full calculator values during working, and include units. Unless a question specifies another accuracy, give non-exact numerical answers to 3 **significant figures**; exact answers may remain exact.

A. Decimal places, significant figures and IB accuracy

1. For each number, give the value (i) to 2 decimal places and (ii) to 3 significant figures.

- (a) 14.2768
- (b) 0.0063847
- (c) 98 643.2

2. For each number, state how many significant figures are shown and briefly explain the role of any zeros.

- (a) 0.00520
- (b) 20.07
- (c) 9.000
- (d) 0.0009040

3. Four measurements appear in a report.

- (a) A cafe total is EUR 47.836. Give the amount payable to the nearest cent.
- (b) A race time is 12.4862 s. Give it to the nearest 0.01 s.
- (c) A bacteria estimate is 6 284 913. Give it to 3 significant figures in standard form.
- (d) A film thickness is 0.0047286 mm. Give it to 3 significant figures.

For each part, state whether the instruction is fundamentally about decimal places or significant figures.

4. The exact value of a quantity is $\sqrt{73}$.

- (a) State the exact answer.
- (b) Give a decimal answer suitable under the normal IB accuracy convention.
- (c) Explain why 8.544 is not the standard final decimal response when no other accuracy is requested.

5. A student evaluates

$$\frac{2.37}{1.28} \times 5.27.$$

Student A keeps the full calculator value until the end. Student B rounds 2.37/1.28 to 1.85 first.

- (a) Find Student A's final answer to 3 significant figures.
- (b) Find Student B's final answer to 3 significant figures.
- (c) Explain the lesson for IB working.

B. Standard/scientific form and scale

6. Convert the following.
- (a) 72 400 000 into standard form.
 - (b) 0.0000385 into standard form.
 - (c) 6.02×10^7 into an ordinary number.
 - (d) 4.70×10^{-6} into an ordinary decimal, preserving the stated significant figures.
7. Give each answer in standard form.
- (a) $(2.5 \times 10^6)(3.2 \times 10^4)$
 - (b) $\frac{9.6 \times 10^{-3}}{3.2 \times 10^5}$
 - (c) $5.3 \times 10^8 + 7.4 \times 10^7$
 - (d) $8.1 \times 10^{-5} - 2.6 \times 10^{-5}$
8. A cloud archive contains 2.85×10^9 images. Each image uses an average of 3.6×10^6 bytes.
- (a) Estimate the total storage using one significant figure for each factor.
 - (b) Calculate the total storage exactly from the given values.
 - (c) Give the final answer to 3 significant figures in standard form.
9. A research signal has wavelength 7.2×10^{-7} m and another has wavelength 5.4×10^{-5} m.
- (a) Which wavelength is larger?
 - (b) How many times larger is it? Give the answer to 3 significant figures.
 - (c) Explain how the exponents let you predict the approximate scale before calculating.

C. Estimation, bounds and measurement

10. A car travels 643 km using 52.7 L of fuel.
- (a) Obtain a sensible mental estimate for the fuel efficiency in km/L.
 - (b) Calculate the fuel efficiency and give the final answer in normal IB form.
 - (c) A student obtains 122 km/L. Use your estimate to explain why this cannot be correct.
11. Write an error interval for each measurement.
- (a) 1.8 m to the nearest 0.1 m.
 - (b) 4.26 kg correct to 2 decimal places.
 - (c) 128 km to the nearest kilometre.
12. A distance is reported as 73.5 km correct to 3 significant figures.
- (a) Identify the rounding unit.
 - (b) Write the error interval.
 - (c) Explain why “3 significant figures” does not always mean the same absolute rounding unit.
13. A rectangular display is measured as 42.6 cm by 24.0 cm, each correct to the nearest 0.1 cm.
- (a) State the error interval for each dimension.
 - (b) Find the lower bound for the area.
 - (c) Find the upper-bound value for the area.
 - (d) Give the nominal area 42.6×24.0 to 3 significant figures and explain why it does not replace the bound calculation.
14. A journey distance is 128 km to the nearest kilometre and the travel time is 1.70 h to the nearest 0.01 h.
- (a) Find the lower and upper bounds for the distance and time.
 - (b) Find the lower bound for the mean speed.
 - (c) Find the upper-bound value for the mean speed.
 - (d) Give both speed bounds to 3 significant figures.
15. An experiment gives 4.72 s while an accepted value is 4.68 s.
- (a) Find the absolute error.
 - (b) Find the percentage error, giving the answer to 3 significant figures.
 - (c) Explain why 0.855% is a 3-significant-figure answer even though it also has three decimal places.

D. Mixed applications - medium to difficult

16. A precision bolt is labelled 8.40 mm, meaning it has been rounded to the nearest 0.01 mm.
- (a) State how many significant figures the label contains.
 - (b) Write the error interval for the diameter.
 - (c) Find the error interval for the radius.
 - (d) Explain what information would be lost if the label were written as 8.4 mm instead.
17. A laboratory sample has mass 48.6 g correct to the nearest 0.1 g and volume 17.2 cm^3 correct to the nearest 0.1 cm^3 .
- (a) Calculate the density $\rho = m/V$ using the stated values and give the answer to 3 significant figures.
 - (b) Find the lower bound for the density.
 - (c) Find the upper-bound value for the density.
 - (d) A report gives the density as $2.8255814 \text{ g cm}^{-3}$. Explain why the extra decimal places do not make the experimental conclusion more accurate.
18. A satellite sensor records an area as $8.6472391 \times 10^4 \text{ m}^2$. The instrument transmits one reading every 0.0376 s for $2.40 \times 10^4 \text{ s}$.
- (a) Give the area as an ordinary number to 2 decimal places.
 - (b) Give the area to 3 significant figures in standard form.
 - (c) Calculate the number of readings transmitted, giving your answer in standard form to 3 significant figures.
 - (d) Before calculating part (c), give a one-significant-figure estimate and use it to check the scale of your answer.
 - (e) The area in part (a) was actually recorded correct to the nearest 0.01 m^2 . Write its error interval.

End of Worksheet - 18 questions