Approximations and Error: exam practice

10 questions · 33 marks · worked solutions and markschemes

Name _____ Date _____ Score / 33

- Answer every question before you look at the solutions. They start after the last question, with the marks for each line: M for method, A for accuracy, R for reasoning.
- Online, with more practice: ibmathrevision.com/slai/approximations-and-error-exam-practice

1. **1 mark · Paper 1 style · calculator allowed**

Write 7.1×10^{-3} as an ordinary number.

2. **2 marks · Paper 1 style · calculator allowed**

Ravi estimates the height of a door to be 2.5 m. Its actual height is 2.43 m.

Calculate the percentage error in Ravi's estimate. **[2]**

3. **3 marks · Paper 1 style · calculator allowed**

The Earth can be modelled as a sphere of radius 6.371×10^{6} m.

Find the volume of the Earth, giving your answer in the form $a \times 10^{k}$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$, with a correct to three significant figures. **[3]**

4. **3 marks · Paper 1 style · calculator allowed**

A student estimates the mass of a chemical sample to be $45\ \text{kg}$. The exact mass of the sample is measured precisely as $45.6\ \text{kg}$.

1. Calculate the exact absolute error in the student's estimate.
2. Calculate the percentage error, giving your answer correct to 3 significant figures.

5. **3 marks · Paper 1 style · calculator allowed**

Mia estimates $\sqrt{50}$ to be 7.

(a) Write down $\sqrt{50}$ correct to four significant figures. **[1]**

(b) Calculate the percentage error in Mia's estimate. **[2]**

6. **4 marks · Paper 1 style · calculator allowed**

(a) Write $0.000\,452$ in the form $a \times 10^{k}$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. **[2]**

(b) Calculate $(3.2 \times 10^{5}) \times (4.5 \times 10^{-2})$, giving your answer in the same form. **[2]**

7. **3 marks · Paper 2 style · calculator allowed**

The side of a square is measured as 6.3 cm, correct to one decimal place.

a. Write down the lower and upper bounds of the side length. **[1]**

b. Find the upper bound of the area of the square. **[2]**

8. **4 marks · Paper 1 style · calculator allowed**

The speed of light is $299\,792\,458$ m s^{-1}.

(a) Write this speed correct to three significant figures, in the form $a \times 10^{k}$. **[2]**

(b) Find the percentage error when the speed is written as in part (a). **[2]**

9. **5 marks · Paper 1 style · calculator allowed**

A rectangle has length 12.4 cm and width 7.6 cm, both measured correct to one decimal place.

(a) Write down the upper bound of the length. **[1]**

(b) Find the upper bound of the area of the rectangle. **[2]**

(c) Find the lower bound of the perimeter of the rectangle. **[2]**

10. **5 marks · Paper 2 style · calculator allowed**

A runner covers a distance of 120 m, measured to the nearest 10 m, in a time of 14.2 s, measured to the nearest 0.1 s.

(a) Write down the upper and lower bounds of the distance. **[2]**

(b) Find the upper bound of the runner's average speed. **[3]**

Answers and worked solutions

Question 1 — 1 mark

Answer: 0.0071

0.0071 **A1**

Question 2 — 2 marks

Answer: 2.88%

$\left|\frac{2.5-2.43}{2.43}\right| \times 100\%$ **(M1)**

2.88% **A1**

Question 3 — 3 marks

Answer: $1.08 \times 10^{21}\ \text{m}^3$

$\frac{4}{3}\pi(6.371 \times 10^6)^3$ **(M1)**

$1.0832\ldots \times 10^{21}$ **(A1)**

$1.08 \times 10^{21}\ \text{m}^3$ **A1**

Question 4 — 3 marks

Answer: (a) 0.6; (b) 1.32

1. Absolute error
   $= |45 - 45.6| = 0.6\ \text{kg}$
   A1
2. Percentage error
   $= \frac{0.6}{45.6} \times 100\%$ **M1**
   $= 1.3157\ldots\% \approx 1.32\%$
   A1

Question 5 — 3 marks

Answer: (a) 7.071; (b) 1.01%

(a)

7.071 **A1**

(b)

$\left|\frac{7-\sqrt{50}}{\sqrt{50}}\right| \times 100\%$ **(M1)**

1.01% **A1**

Question 6 — 4 marks

Answer: (a) 4.52×10^{-4}; (b) 1.44×10^4

(a)

4.52×10^{-4} **A1A1**

(b)

$14\,400$ **(A1)**

1.44×10^4 **A1**

Question 7 — 3 marks

Answer: (a) $6.25, 6.35$; (b) $40.3225\ \text{cm}^2$

a. 6.25 cm and 6.35 cm **A1**

b. 6.35^2 **(M1)**
$40.3225\ \text{cm}^2$ **A1**

Question 8 — 4 marks

Answer: (a) $3.00 \times 10^8\ ms^{-1}$; (b) 0.0692%

(a)

$300\,000\,000$ **(A1)**

3.00×10^8 **A1**

(b)

$\frac{300\,000\,000 - 299\,792\,458}{299\,792\,458} \times 100\%$ **(M1)**

0.0692% **A1**

Question 9 — 5 marks

Answer: (a) 12.45 cm; (b) $95.2\ \text{cm}^2$; (c) 39.8 cm

(a)

12.45 cm **A1**

(b)

12.45×7.65 **(M1)**

$95.2\ \text{cm}^2$ (95.2425) **A1**

(c)

$2(12.35 + 7.55)$ **(M1)**

39.8 cm **A1**

Question 10 — 5 marks

Answer: (a) $115\ m$ and $125\ m$; (b) $8.83\ ms^{-1}$

(a)

$115\ m$ **A1**

$125\ m$ **A1**

(b)

greatest distance and least time **(M1)**

$\frac{125}{14.15}$ **(A1)**

$8.83\ ms^{-1}$ **A1**

Every solution is also on ibmathrevision.com/slai/approximations-and-error-exam-practice
Our own original questions, written and checked by IB Math Revision. IB Math Revision is independent and is not affiliated with, endorsed by or connected to the International Baccalaureate Organization. This work/product/service has been developed independently from and is not endorsed by the International Baccalaureate Organization. International Baccalaureate, Baccalauréat International, Bachillerato Internacional and IB are registered trademarks owned by the International Baccalaureate Organization.