

INTERNATIONAL BACCALAUREATE
Mathematics: applications and interpretation

MAI

EXERCISES [MAI 1.1]
NUMBERS – ROUNDING – PERCENTAGE ERROR

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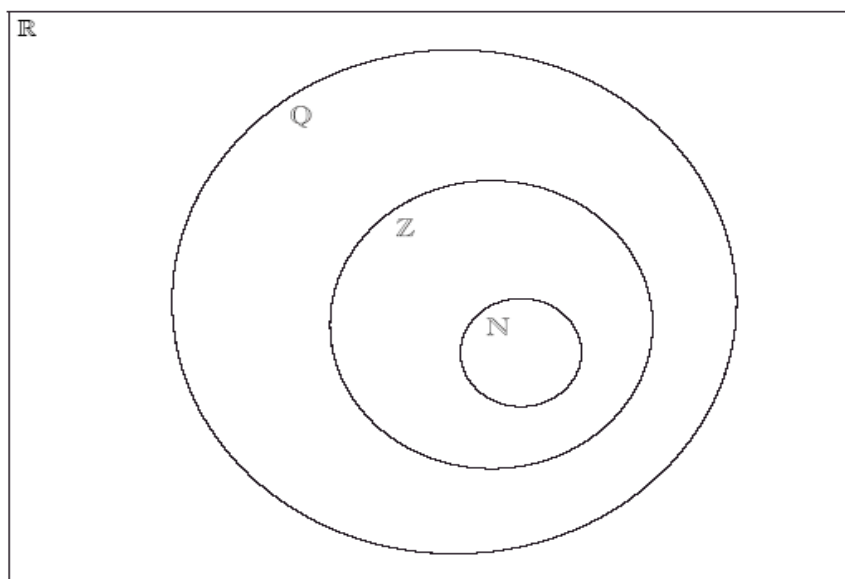
A. Paper 1 questions (SHORT)

NUMBERS AND ROUNDING

1. [Maximum mark: 5]

The Venn diagram shows the number sets \mathbb{N} , \mathbb{Z} , \mathbb{Q} and \mathbb{R} . Place each of the following numbers in the appropriate region of the Venn diagram.

$$\frac{1}{4}, -3, \pi, -0.3, 2.7 \times 10^3, 3.4 \times 10^{-2}$$



2. [Maximum mark: 4]

(a) Write down the following numbers in increasing order.

$$3.5, 1.6 \times 10^{-19}, 60730, 6.073 \times 10^5, 0.006073 \times 10^6, \pi, 9.8 \times 10^{-18}.$$

[3]

(b) State which of the numbers in part (a) is irrational.

[1]

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3. [Maximum mark: 8]

Let $x = 1352.406$ and $y = 0.0001352406$

- (a) State the value of x correct
 - (i) to 2dp. (ii) to 3sf. (iii) to 2sf. [3]
- (b) State the value of y correct
 - (i) to 5dp. (ii) to 3sf. (iii) to 2sf. [3]
- (c) State the value of x in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]
- (d) State the value of y in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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4. [Maximum mark: 4]

- (a) Given $x = 2.6 \times 10^4$ and $y = 5.0 \times 10^{-8}$, calculate the value of $w = x \times y$. Give your answer in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]
- (b) Which **two** of the following statements about the nature of x , y and w above are **incorrect**?
 - (i) $x \in \mathbb{N}$ (ii) $y \in \mathbb{Z}$ (iii) $y \in \mathbb{Q}$
 - (iv) $w < y$ (v) $x + y \in \mathbb{R}$ (vi) $\frac{1}{w} < x$ [2]

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5. [Maximum mark: 4]

Let $A = 4.5 \times 10^{-3}$ and $B = 6.2 \times 10^{-4}$. Find

(a) AB ; [2]

(b) $2(A + B)$. [2]

Give your answers in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$.

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6. [Maximum mark: 5]

Consider the following four numbers.

$$p = 0.00314 ; \quad q = 0.00314 \times 10^2 ; \quad r = \frac{\pi}{1000} ; \quad s = 3.14 \times 10^{-2}$$

(a) One of these numbers is written in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$..

Write down this number. [1]

(b) Write down the smallest of these numbers. [1]

(c) Write down the value of $q + s$. [2]

(d) Give your answer to part (c) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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7. [Maximum mark: 8]

Let $m = 6.0 \times 10^3$ and $n = 2.4 \times 10^{-5}$.

(a) Express each of the following in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$.

(i) mn (ii) $\frac{m}{n}$ (iii) m^2 [6]

(b) Find the **exact** value of $m + n$ [2]

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8. [Maximum mark: 8]

(a) The value of x correct to 3 sf is 34500. Find the range of the possible values of x . [2]

(b) The value of y correct to 3 sf is 0.0301. Find the range of the possible values of y . [2]

(c) The value of z correct to 2 dp is 15.30. Find the range of the possible values of z . [2]

(d) The value of w correct to 3 sf is 145. Find the range of the possible values of w . [2]

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9. [Maximum mark: 4]

Calculate $3.7 \times 16.2^2 - 500$, writing your answer

(a) correct to two decimal places; [1]

(b) (i) correct to three significant figures;

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

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10. [Maximum mark: 6]

Let $x = 7.94$.

(a) Calculate the value of $\frac{2x+1}{x^3}$. [2]

(b) (i) Give your answer correct to **three** decimal places.

(ii) Write your answer to (b)(i) as a percentage. [2]

(c) Give your answer to part (b)(i) in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [2]

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11. [Maximum mark: 6]

The total weight of 256 identical pencils is 4.24kg. Calculate the weight of one pencil, in kg.

- (a) Give your answer exactly. [2]
- (b) Give your answer correct to three significant figures. [2]
- (c) Write your answer to part (b) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

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12. [Maximum mark: 4]

- (a) A girl's height is 1.623 m. Write her height **to the nearest cm**. [1]
- (b) The time taken to fill a tank was 2 hours 43 minutes. Write this time **to the nearest 5 minutes**. [1]
- (c) The attendance at a show was 2591 people. How many people, **to the nearest 100**, were at the show? [1]
- (d) The mean distance of the Moon from the Earth is approximately 384 403 km. Write this distance in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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13. [Maximum mark: 4]

Given that $h = \sqrt{l^2 - \frac{d^2}{4}}$,

- (a) Calculate the **exact** value of h when $l = 0.03625$ and $d = 0.05$. [1]
- (b) Write down the answer to part (a) correct to three decimal places. [1]
- (c) Write down the answer to part (a) correct to three significant figures. [1]
- (d) Write down the answer to part (a) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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14. [Maximum mark: 4]

The value of x correct to 3 sf is 1230.

- (a) Find the range of possible values of x . [2]

Ann estimates x^2 with x correct to 3sf

Bob estimates x^2 based on smallest possible value of x found in question (a).

- (b) Find the difference between the two estimations. [2]

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PERCENTAGE ERROR

15. Complete the following table

Exact value of x	Approximated value of x	Percentage error (exact or in 3 sf)
100	103	
100	97	
103	100	
97	100	
1000	1003	
10	13	
34567	34600 (3sf)	
0.34567	0.346 (3sf)	

16. [Maximum mark: 6]

A problem has an **exact** answer of $x = 0.1265$. Find

- (a) the **exact** value of x in the form $a \times 10^k$ where k is an integer and $1 \leq a < 10$. [2]
- (b) the value of x given correct to **two** significant figures. [1]
- (c) the percentage error if x is given correct to **two** significant figures. [3]

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17. [Maximum mark: 6]

Given $p = x - \frac{\sqrt{y}}{z}$, $x = 1.775$, $y = 1.44$ and $z = 48$,

(a) Calculate the value of p . [2]

Barry **first** writes x , y and z correct to one significant figure and **then** uses these values to estimate the value of p .

(b) (i) Write down x , y and z each correct to one significant figure.

(ii) Write down Barry's estimate of the value of p . [2]

(c) Calculate the percentage error in Barry's estimate of the value of p . [2]

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18. [Maximum mark: 6]

(a) Calculate exactly $\frac{(3 \times 2.1)^3}{7 \times 1.2}$. [1]

(b) Write the answer to part (a) correct to 2 significant figures. [1]

(c) Calculate the percentage error in the answer of (b) [2]

(d) Write your answer to part (c) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

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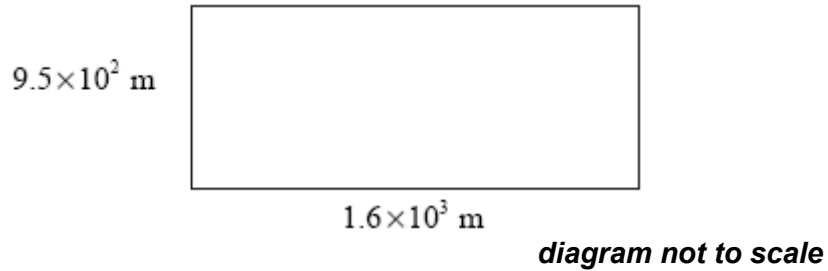
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PROBLEMS

19. [Maximum mark: 6]

The following diagram shows a rectangle with sides of length 9.5×10^2 m and 1.6×10^3 m.



(a) Write down the area of the rectangle in the form $a \times 10^k$, where $1 \leq a < 10$, $k \in \mathbb{Z}$. [3]

Helen's estimate of the area of the rectangle is 1 600 000 m².

(b) Find the percentage error in Helen's estimate. [3]

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20. [Maximum mark: 4]

A rectangle has length 2.6×10^4 and width 1.9×10^4 . Find each of the following, giving your answer in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$.

(a) The area of the rectangle; [2]

(b) The perimeter of the rectangle. [2]

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21. [Maximum mark: 6]

(a) Calculate $\frac{77.2 \times 3^3}{3.60 \times 2^2}$. [1]

(b) Express your answer to part (a) in the form $a \times 10^k$, where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

(c) Juan estimates the length of a carpet to be 12 metres and the width to be 8 metres. He then estimates the area of the carpet.

(i) Write down his estimated area of the carpet.

When the carpet is accurately measured it is found to have an area of 90 square metres.

(ii) Calculate the percentage error made by Juan. [3]

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22. [Maximum mark: 5]

A rectangle is 2680 cm long and 1970 cm wide.

(a) Find the perimeter of the rectangle, giving your answer in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [2]

(b) Find the area of the rectangle, giving your answer correct to the nearest thousand square centimetres. [3]

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23. [Maximum mark: 6]

A shipping container is a cuboid with dimensions 16 m, $1\frac{3}{4}$ m and $2\frac{2}{3}$ m.

- (a) Calculate the **exact** volume of the container. Give your answer as a fraction. [3]

Jim estimates the dimensions of the container as 15 m, 2 m and 3 m and uses these to estimate the volume of the container.

- (b) Calculate the percentage error in Jim's estimated volume of the container. [3]

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24. [Maximum mark: 4]

Using the formula $V = \pi r^2 (H - h)$, and your calculator value of π , calculate the value of V when $r = 4.26$, $H = 21.58$ and $h = 14.35$.

- (a) Give the full calculator display. [1]
- (b) Give your answer to two decimal places. [1]
- (c) Give your answer to two significant figures. [1]
- (d) Write your answer to part (c) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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25. [Maximum mark: 4]

The volume of a sphere is $V = \sqrt{\frac{S^3}{36\pi}}$, where S is its surface area.

The surface area of a sphere is 500 cm^2 .

- (a) Calculate the volume of the sphere. Give your answer correct to **two decimal places**. [2]
- (b) Write down your answer to (a) correct to the nearest integer. [1]
- (c) Write down your answer to (b) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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26. [Maximum mark: 6]

In a television show there is a transparent box completely filled with identical cubes. Participants have to estimate the number of cubes in the box. The box is 50 cm wide, 100 cm long and 40 cm tall.

- (a) Find the volume of the box. [2]

Joaquin estimates the volume of one cube to be 500 cm^3 . He uses this value to estimate the number of cubes in the box.

- (b) Find Joaquin's estimated number of cubes in the box. [2]

The actual number of cubes in the box is 350.

- (c) Find the percentage error in Joaquin's estimated number of cubes in the box. [2]

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27. [Maximum mark: 5]

A satellite travels around the Earth in a circular orbit 500 kilometres above the Earth's surface. The radius of the Earth is taken as 6400 kilometres.

- (a) Write down the radius of the satellite's orbit. [1]
- (b) Calculate the distance travelled by the satellite in one orbit of the Earth.
Give your answer correct to the nearest km. [3]
- (c) Write down your answer to (b) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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28. [Maximum mark: 5]

The planet Earth takes one year to revolve around the Sun. Assume that a year is 365 days and the path of the Earth around the Sun is the circumference of a circle of radius 150 000 000 km.

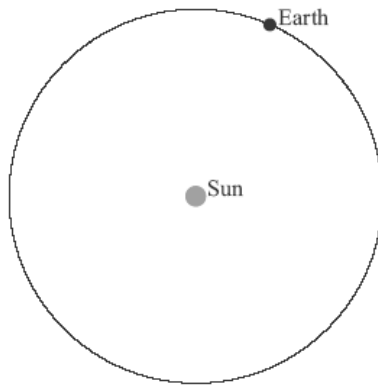


diagram not to scale

- (a) Calculate the distance travelled by the Earth in **one day** (answer in 3sf) [4]
- (b) Give your answer to part (a) in the form $a \times 10^k$ where $1 \leq a < 10$ and $k \in \mathbb{Z}$. [1]

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