

Powers, roots and indices

Exam questions

Foundation and Higher tiers

Please write clearly in block capitals.

Name

Class

Teacher

Time allowed: 85 minutes

Materials

For this booklet you need a black pen, a pencil, a ruler, a rubber and a calculator for Section B.

Instructions

- Use black ink or black ballpoint pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer all questions in the spaces provided.
- **Section A** (questions 1 to 14): you must not use a calculator.
- **Section B** (questions 15 to 23): you may use a calculator.
- Do all rough work in this booklet. Cross through any work you do not want marked.

Information

- The marks for each question are shown in brackets.
- The maximum mark for this booklet is 74.

Advice

- Read each question carefully.
- In all calculations, show clearly how you work out your answer.

For teacher's use

Q	Mark	Q	Mark
1		13	
2		14	
3		15	
4		16	
5		17	
6		18	
7		19	
8		20	
9		21	
10		22	
11		23	
12			
TOTAL			

Section A**You must not use a calculator**Do not
write
outside
the box**1** Here is a list of numbers.

4 8 12 16 27 32 49 64

(a) From the list, write down all the cube numbers.

Answer _____

[1 mark]**(b)** From the list, write down the number that is a square number and also a cube number.

Answer _____

[1 mark]**(c)** From the list, write down a power of 2 that is not a square number.

Answer _____

[1 mark]**2** Work out $\sqrt{3^4 - 2^5}$

Answer _____

[2 marks]

- 3** (a) Write $5^3 \times 5^4$ as a single power of 5

Answer _____ [1 mark]

- (b) Write $7^9 \div 7^3$ as a single power of 7

Answer _____ [1 mark]

- (c) Write $(2^3)^4$ as a single power of 2

Answer _____ [1 mark]

- 4** A square courtyard is covered exactly by 25 square paving slabs.
Each slab has an area of 3600 cm^2

Work out the perimeter of the courtyard.
Give your answer in metres.

Answer _____ m [3 marks]

- 5** (a) Write down the value of 9^0

Answer _____

[1 mark]

- (b) Work out the value of 2^{-3}
Give your answer as a fraction.

Answer _____

[1 mark]

- (c) Write $\frac{1}{25}$ as a power of 5

Answer _____

[1 mark]

- 6** (a) $(5^2)^n \times 5^3 = 5^{11}$
Work out the value of n .

$n =$ _____

[2 marks]

- (b) $8 \times 2^m = 2^{10}$
Work out the value of m .

$m =$ _____

[2 marks]

- 7** **(a)** Lily says,
 “ $3^4 \times 2^3 = 6^7$ ”
 Explain why Lily is wrong.

[1 mark]

- (b)** Write $2^5 \times 4^2$ as a single power of 2

Answer _____

[2 marks]

- 8** **(a)** $\sqrt{83}$ lies between two consecutive whole numbers.
 Write down the two numbers.

Answer _____

[1 mark]

- (b)** Estimate the value of $\sqrt{83}$ to 1 decimal place.
 You must show your working.

Answer _____

[2 marks]

- 9** (a) Write down the value of $36^{\frac{1}{2}}$

Answer _____ [1 mark]

- (b) Work out the value of $1000^{\frac{2}{3}}$

Answer _____ [2 marks]

- 10** Write these numbers in order of size. Start with the smallest.

$$3^{-2} \quad 27^{\frac{1}{3}} \quad 5^0 \quad 16^{-\frac{1}{4}} \quad \left(\frac{1}{2}\right)^{-2}$$

Answer _____ [2 marks]

- 11** $25^x = \frac{125}{\sqrt{5}}$
Work out the value of x .

$x =$ _____ [3 marks]

12 Show that $\left(\frac{8}{27}\right)^{-\frac{2}{3}} \times 16^{\frac{1}{4}} = \frac{9}{2}$

[3 marks]

13 Show that 2^{160} is greater than 3^{100}

[3 marks]

14 $8^x \times 4^y = 128$

$$\frac{27^x}{9^y} = \frac{1}{3}$$

Work out the values of x and y .
You must show your working.

Answer _____

[4 marks]

Section B



You may use a calculator

Do not
write
outside
the box

- 15** (a) Mina is comparing two calculations.
She thinks that 4.2^2 gives a larger answer than 2.6^3
Decide whether Mina is right.
Show how you decide.

[2 marks]

- (b) Find the exact answer to $\sqrt{7.29} + 1.5^3$

Answer _____

[1 mark]

- 16** (a) Use your calculator to work out $\frac{\sqrt{6.4^3 - 18.7}}{2.5^2}$
Write down all the figures on your calculator display.

Answer _____

[2 marks]

- (b) Give your answer to part (a) to 2 decimal places.

Answer _____

[1 mark]

- 17** 50 small candles are each a cube with edge 3.2 cm
All 50 candles are melted down. All the wax is made into one large cube.

Work out the edge length of the large cube.
Give your answer to 1 decimal place.

Answer _____ cm

[3 marks]

- 18** A scientist grows cells in a dish. She starts with 50 cells.
The number of cells, N , after t hours is given by

$$N = 50 \times 3^t$$

- (a)** Work out the number of cells after 9 hours.
Give your answer in standard form.

Answer _____

[1 mark]

- (b)** After how many whole hours is the number of cells first more than 5 million?
You must show your working.

Answer _____ hours

[3 marks]

19

(a) Work out $\frac{5.3^3 - \sqrt{41.6}}{1.7^{-2}}$

Give your answer to 3 significant figures.

Answer _____

[2 marks]

(b) Ben wants to work out $64^{\frac{1}{3}}$

He types $64 \div 3$ into his calculator and gets 21.333...

Explain Ben's mistake and write down the correct value of $64^{\frac{1}{3}}$

Answer _____

[2 marks]

- 20** The energy, E kilocalories, a resting animal needs each day is given by

$$E = 70m^{\frac{3}{4}}$$

where m kg is the mass of the animal.

- (a) A horse has a mass of 520 kg
Work out the energy it needs each day.
Give your answer to 3 significant figures.

Answer _____ kilocalories

[2 marks]

- (b) A dog needs 1050 kilocalories each day.
Work out the mass of the dog.
Give your answer to the nearest kilogram.

Answer _____ kg

[3 marks]

- 21** For a planet moving round the Sun,

$$T = a^{\frac{3}{2}}$$

where T is the time for one orbit, in years, and a is the planet's average distance from the Sun, in astronomical units.

Planet P takes 3.5 times as long as planet Q to make one orbit.

How many times further from the Sun is planet P than planet Q ?

Give your answer to 3 significant figures.

Answer _____

[3 marks]

22 (a) Solve $x^{\frac{2}{3}} = 7.2$

Give all the solutions to 3 significant figures.

$$x = \underline{\hspace{4cm}}$$

[2 marks]

(b) Mia says,

“ $x^{\frac{3}{2}} = 7.2$ also has two solutions.”

Is Mia correct? Give a reason for your answer.

[1 mark]

23 Water flows out of a pipe. The flow, F litres per second, is given by

$$F = kd^{\frac{5}{2}}$$

where d is the diameter of the pipe and k is a constant.

- (a) The diameter of the pipe is increased by 20%
Work out the percentage increase in the flow.
Give your answer to 1 decimal place.

Answer $\underline{\hspace{4cm}}$ %

[2 marks]

- (b) Work out the percentage increase in the diameter that would double the flow.
Give your answer to 1 decimal place.

Answer $\underline{\hspace{4cm}}$ %

[2 marks]

END OF QUESTIONS