OCR Paper 4H Practice Booklet

20 practice questions based on the advance information

Copies of this booklet, as well as hints & solutions, are available at bossmaths.com/advanceinfo

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Question 1

Calculate $\dfrac{707 + 7007}{7 \times (600 - 7^2)} - 7 + 5$

Entering this into a calculator, we see

$$\frac{707 + 7007}{7 \times (600 - 7^2)} - 7 + 5 = 0$$

Question 2

y is directly proportional to x^2. When $x = 11$, $y = 605$. Find the value of x when $y = 720$.

x	x^2	y
11	121 $\xleftarrow{\div 5}$	605
12	144 $\xleftarrow{\div 5}$	720

When $y = 720$, $x = 12$

Question 3

An antique vase was worth £8400 on January 1st 2019.
By January 1st 2020, it had increased in value.
By January 1st 2021, however, its value fell by 25% to £8190.

(a) What was the antique worth on January 1st 2020?

2020 £? 2021 £8190

×0.75

$\frac{8190}{0.75} = £10,920$

(b) By what percentage did the value of the vase increase between January 1st 2019 and January 1st 2020?

2019 £8400 2020 £10,920

×?

$\frac{10,920}{8400} = 1.3 = 130\%$

i.e. a 30% increase.

Question 4

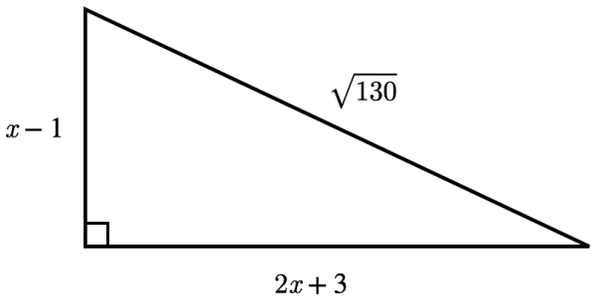
Nikolai is conducting a survey to find out how often people attend football matches. He waits outside a football stadium on a match day and asks fans to tell him roughly how many matches they attend in a year.

Comment on the suitability of Nikolai's sampling method.

The sample is likely to be biased. People at a football match are likely to attend more matches than the population average.

Question 5

The diagram shows the lengths, in centimetres, of the sides of a right-angled triangle.
Show that $x^2 + 2x - 24 = 0$.



Pythagoras' theorem $\Rightarrow (2x+3)^2 + (x-1)^2 = (\sqrt{130})^2$

$\Rightarrow 4x^2 + 12x + 9 + x^2 - 2x + 1 = 130$

$\Rightarrow 5x^2 + 10x + 10 = 130$

$\Rightarrow 5x^2 + 10x - 120 = 0$

$\Rightarrow x^2 + 2x - 24 = 0$

Question 6

(a) Factorise $3x^2 + 16x - 12$

$(3x - 2)(x + 6)$

(b) Expand and simplify as far as possible: $-7x - 3(9 - 2x)$

$-7x - 27 + 6x$

$\equiv -x - 27$

Question 7

Simplify fully $\dfrac{2x^2 + 9x - 5}{(3x + 4) - (x + 5)}$

$\equiv \dfrac{(2x-1)(x+5)}{2x-1} \equiv x + 5$

Question 8

Write the number six billion, eleven million and seventy in standard form.

$6{,}011{,}000{,}070 = 6.01100007 \times 10^{9}$

Question 9

An aeroplane lands on runway at a speed of 100 **knots**.

You are given that 1 knot = 1.852 km/h

Calculate the speed of the aircraft in metres per second.

100 knots = 185.2 km/h

= 185,200 metres / hour

There are $60 \times 60 = 3600$ seconds in 1 hour,

so 185,200 metres / hour

$= \frac{185{,}200}{3600}$ metres/second

= 51.4 m/s to 3 s.f.

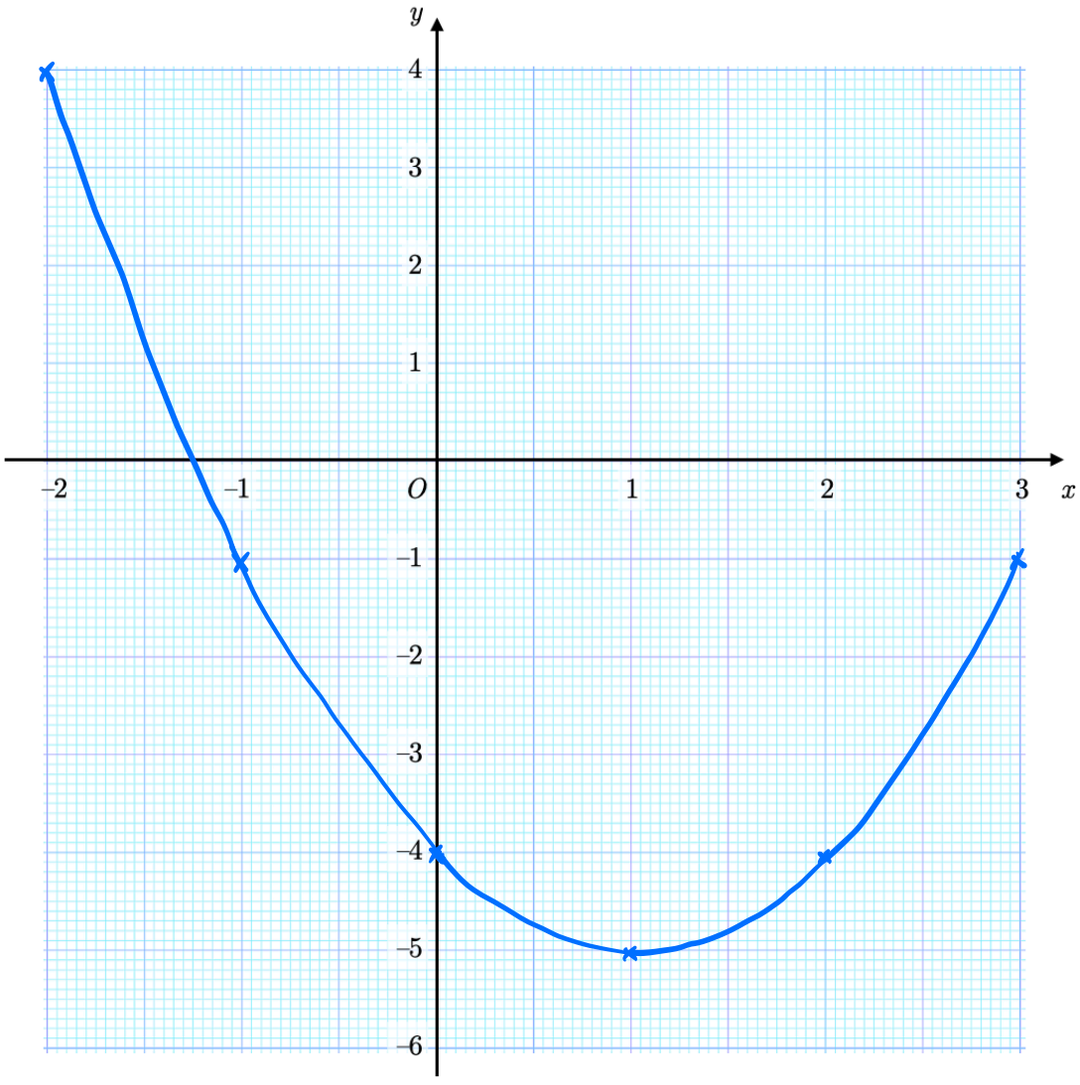
Question 10

(a) $f(x) = x^2 - 2x - 4$

Complete the table of values for $y = f(x)$

x	–2	–1	0	1	2	3
y	4	-1	-4	-5	-4	-1

(b) On the grid, draw the graph of $y = f(x)$ for values of x from –2 to 3.

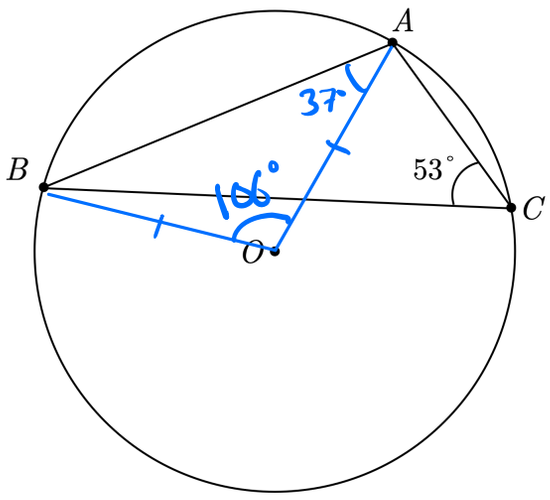


(c) Write down the coordinates of the turning point of $f(x)$.

(1, -5)

Question 11

The diagram shows a circle, with centre O, and points A, B, and C marked on the circumference.



(a) Fill in the blank using one of the words from the list below:

The line segment BC is a ..... chord ..... of the given circle.

diameter radius segment sector chord

(b) Given that angle $ACB = 53^\circ$, calculate the size of angle OAB.

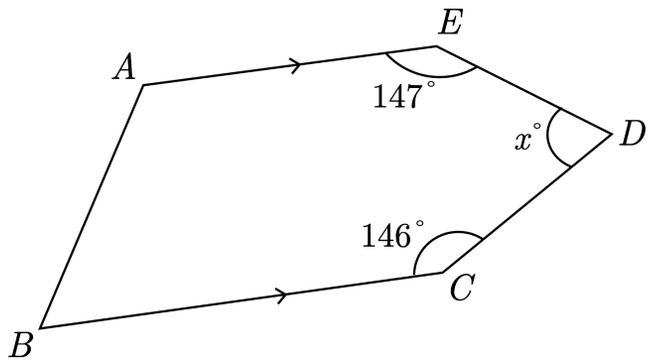
$\angle AOB = 106^\circ$ (angle at centre is the angle at the circumference)

Triangle AOB is isosceles, since OA = OB (radii)

So $\angle OAB = \frac{180 - 106}{2} = 37^\circ$

Question 12

The diagram shows pentagon $ABCDE$.
A, B and C lie on a straight line.
AE is parallel to BC.
Angle $DCB = 146°$and angle $AED = 147°$.



Find the value of x.

The interior angles of an n-sided polygon add up to $180(n-2)$ or $180n - 360$.

So the interior angles of a pentagon add up to $540°$.

$\angle EAB + \angle ABC = 180°$ (cointerior)

So $x = 540 - 180 - 146 - 147$

$= \underline{67}$

Question 13

The following table shows the probabilities of rolling each number on a **biased** dice.

Number	1	2	3	4	5	6
Probability	0.23	b	$2b$	$3a-1$	0.14	0.13

You are given these two facts:
P(rolling a 4) $\geq$ P(rolling a 5).
P(rolling a 4) $\leq$ P(rolling a 1).

(a) Find the minimum and maximum possible values of a.

$P(5) \leq P(4) \leq P(1)$

$\Rightarrow \quad 0.14 \leq 3a-1 \leq 0.23$

$\Rightarrow \quad 1.14 \leq 3a \leq 1.23$

$0.38 \leq a \leq 0.41$

(b) Find the maximum possible value of b, writing your answer as a fraction in its simplest form.

To maximise b, we need to minimise $3a-1$
i.e. let it equal 0.14.

Then $P(1) + P(4) + P(5) + P(6)$
$= 0.23 + 0.14 + 0.14 + 0.13 = 0.64$

$P(2) + P(3) = 1 - 0.64$

$\Rightarrow \quad 3b = 0.36$

$\Rightarrow \quad b = 0.12 = \frac{3}{25}$

Question 14

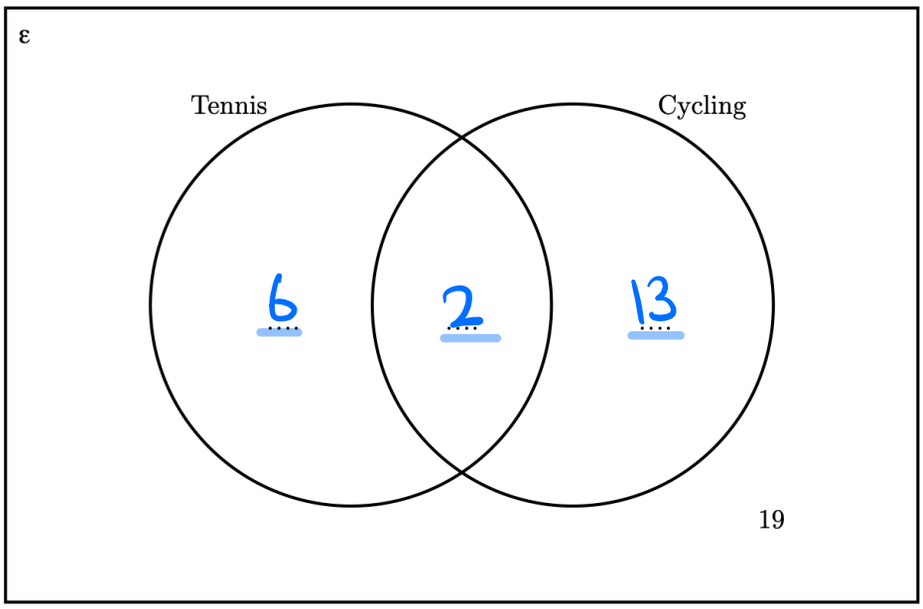
A group of 40 people are asked whether like tennis, cycling, both, or neither.

The probability that a randomly chosen individual likes tennis is $\frac{1}{5}$. } 8 people

The probability that a randomly chosen individual likes cycling is $\frac{3}{8}$. } 15 people

Of the 40 people, 19 said they didn't like either tennis or cycling. } The missing numbers must add up to $40-19 = 21$.

(a) Fill in the three blanks in this Venn diagram.



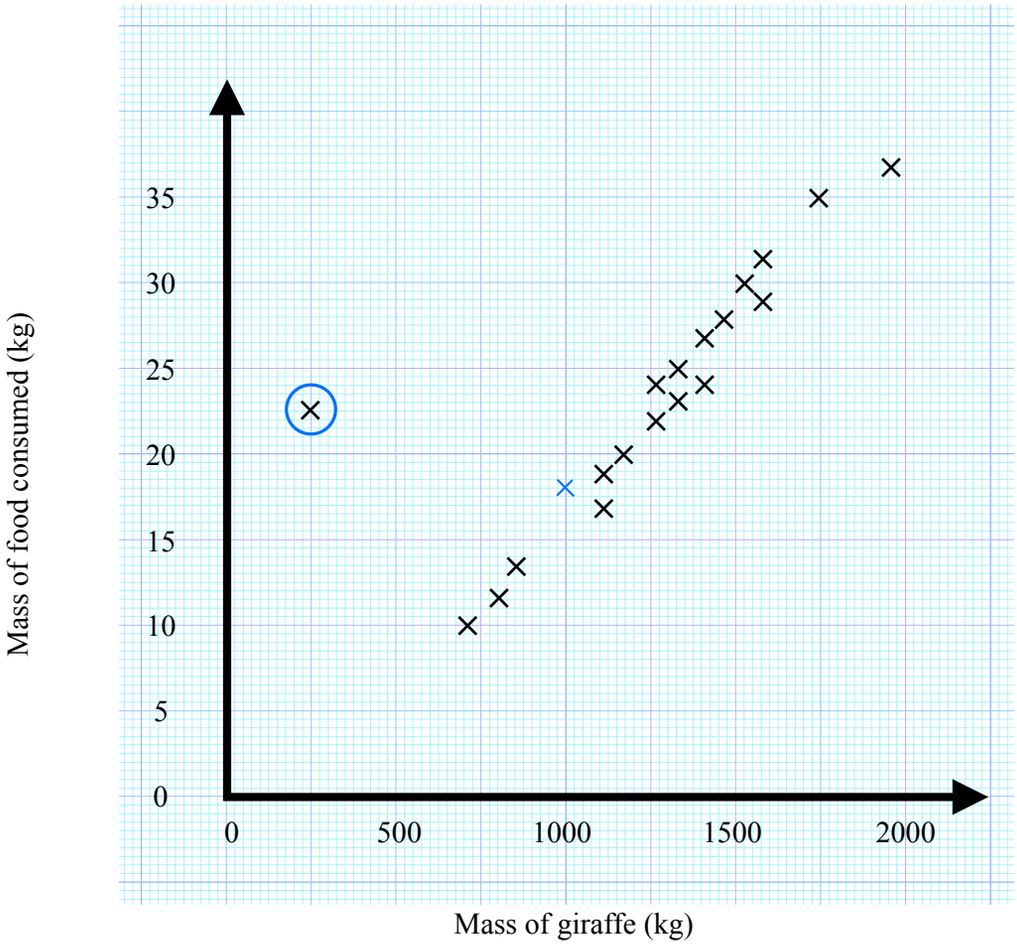
Since $8+15=23$, there must be 2 people that like both tennis and cycling.

(b) Write down the probability that a randomly chosen individual likes tennis given that they like cycling.

$\frac{2}{15}$

Question 15

This scatter diagram shows information on the masses of food consumed in a day by 19 giraffes in a zoo, and the masses of those giraffes.



(a) An error was made when recording the mass of one giraffe. On the scatter diagram, circle the plot that is most likely to correspond to this giraffe.

(b) Describe the type and strength of the correlation shown in this diagram.

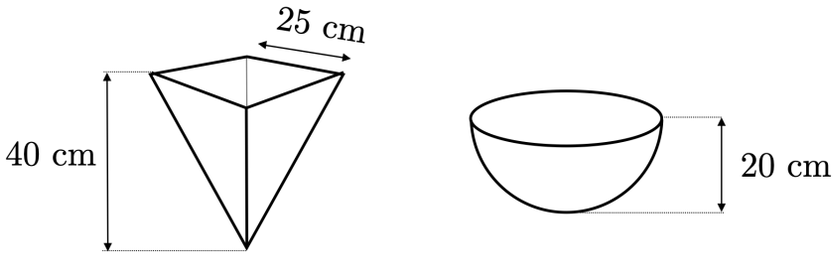
Strong, positive correlation

(c) Another giraffe was recorded as having a mass of 1000 kg. This giraffe consumed 18 kg of food in a day. Plot this result on the scatter diagram.

See above

Question 16

John has two empty containers. He starts to fill them with water at the same time.
One container is a square-based pyramid, and the other is a hemispherical bowl.
The dimensions of the containers are shown:



The tap being used to fill the pyramid container runs at a rate of 35 cm^3 per second.
The tap being used to fill the hemispherical bowl runs at a rate of 60 cm^3 per second.

State which container will fill up first. You must show your working.

Volume of pyramid $= \frac{1}{3} \times 25^2 \times 40 = 8333.\dot{3}\ cm^3$

This will take $\frac{8333.\dot{3}}{35} = 238.09\ldots$ seconds to fill

Volume of bowl $= \frac{2}{3} \times \pi \times 20^3 = 16,755.16\ldots\ cm^3$

This will take $\frac{16,755.16\ldots}{60} = 279.25\ldots$ seconds to fill

So the pyramid will fill up first.

Question 17

Prove that the product of two consecutive odd numbers is always one less than a multiple of 4.

Let n be an integer.

Then $2n+1$ and $2n+3$ are consecutive odd numbers.

$$\text{Product} = (2n+1)(2n+3)$$

$$= 4n^2 + 8n + 3$$

$$= 4n^2 + 8n + 4 - 1$$

$$= 4(n^2 + 2n + 1) - 1$$

which is 1 less than a multiple of 4.

Question 18

(a) $\dfrac{x+2}{x-1} - \dfrac{x+3}{x+1}$ can be written in the form $\dfrac{x+a}{x^2+b}$, where a and b are integers.

Work out the values of a and b.

$$\frac{(x+2)(x+1)}{(x-1)(x+1)} - \frac{(x-1)(x+3)}{(x-1)(x+1)}$$

$$= \frac{(x^2+3x+2)}{(x-1)(x+1)} - \frac{(x^2+2x-3)}{(x-1)(x+1)}$$

$$= \frac{x+5}{x^2-1} \qquad \text{so } \underline{a=5},\ \underline{b=-1}$$

(b) Hence, or otherwise, work out $\dfrac{1002}{999} - \dfrac{1003}{1001}$

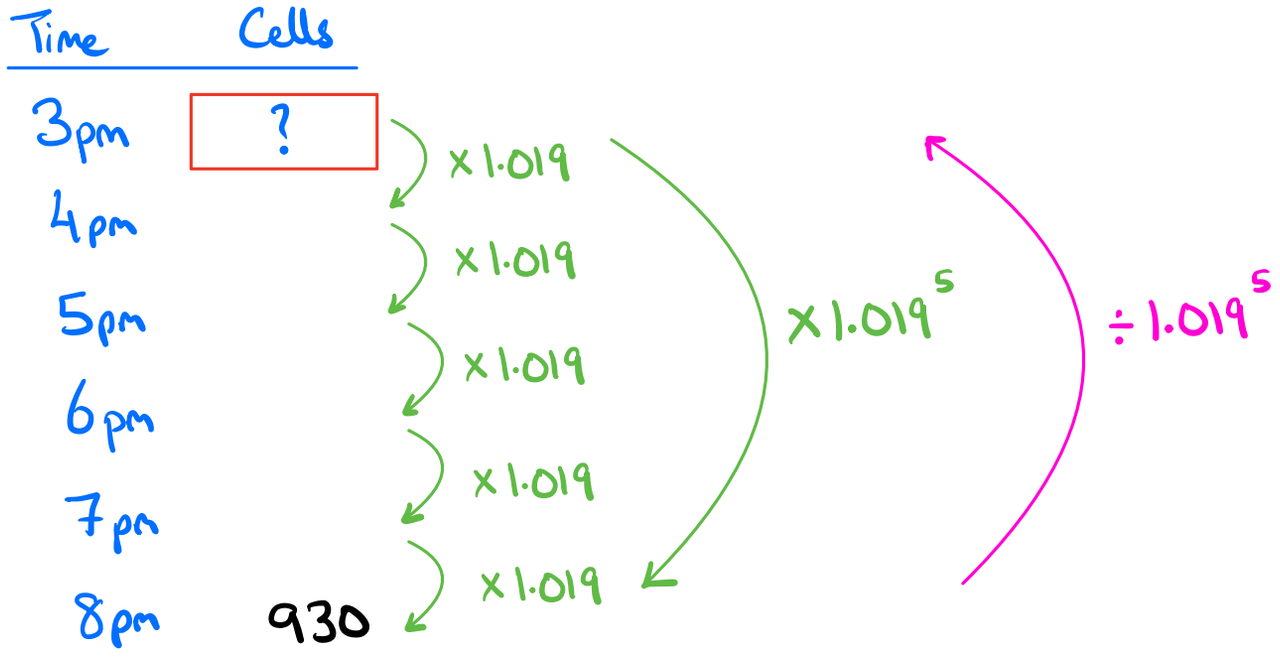
Substitute $x = 1000$ above to get

$$\frac{1002}{999} - \frac{1003}{1001} = \frac{1000+5}{1000^2-1} = \underline{\frac{1005}{999{,}999}}$$

Question 19

A scientist is growing cells in a petri dish.
He starts his experiment at noon.
The number of cells in the dish increases by 1.9% every hour.
At 8 pm, there are 930 cells in the petri dish.
How many cells would there have been at 3 pm?

} hourly multiplier = 1.019



To find the number of cells at 3pm, we calculate $\frac{930}{1.019^5} = 846$ to the nearest whole number.

Question 20

(a) The circle R has equation $x^2 + y^2 = k$. Given that the point with coordinates (6, 3) lies on C, find the value of k.

Substituting $x = 6$, $y = 3$ into $x^2 + y^2 = k$, we see

$$6^2 + 3^2 = k$$

so $k = 45$

(b) The circle S has centre (0, 0). The point with coordinates (4, 8) lies on S.
Find the ratio of the circumference of R to the circumference of S.

Radius of circle $S = \sqrt{4^2 + 8^2} = \sqrt{80} = 4\sqrt{5}$

Radius of circle $R = \sqrt{45} = 3\sqrt{5}$

Since a circle's circumference is directly proportional to its radius, the ratio is

$3\sqrt{5} : 4\sqrt{5} = 3:4$