

BENENDEN
MATHEMATICS

Sixth Form Entrance Examination 2021

Time: 1 hour 30 minutes

Full Name:.....

Current School:.....

Date:.....

Instructions to Candidates:

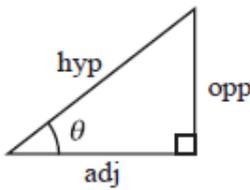
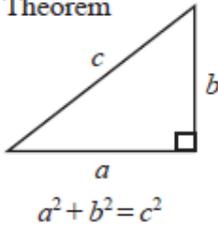
- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B). Coloured pencils and highlighter pens must not be used.
- **Calculators and geometrical instruments are allowed in this examination.**
- Answer the questions in the spaces provided – *there may be more space than you need*. Ensure that your answers to parts of questions are clearly labelled.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- When a calculator is used, the answer should be given to an appropriate degree of accuracy.

Information

- There are 21 questions in this examination and the total mark for this paper is 100.
- Check your answers if you have time at the end.

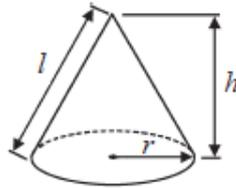
FORMULA SHEET

Pythagoras' Theorem



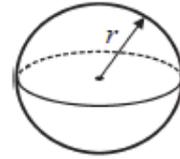
Volume of cone = $\frac{1}{3} \pi r^2 h$

Curved surface area of cone = $\pi r l$



Volume of sphere = $\frac{4}{3} \pi r^3$

Surface area of sphere = $4\pi r^2$



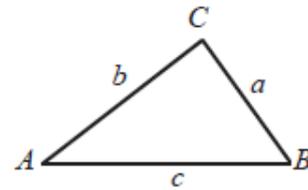
adj = hyp \times cos θ
opp = hyp \times sin θ
opp = adj \times tan θ

or $\sin \theta = \frac{\text{opp}}{\text{hyp}}$

$\cos \theta = \frac{\text{adj}}{\text{hyp}}$

$\tan \theta = \frac{\text{opp}}{\text{adj}}$

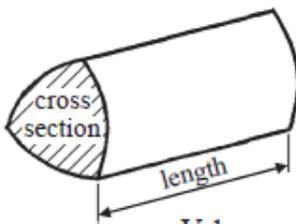
In any triangle ABC



Sine rule: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Cosine rule: $a^2 = b^2 + c^2 - 2bc \cos A$

Area of triangle = $\frac{1}{2} ab \sin C$



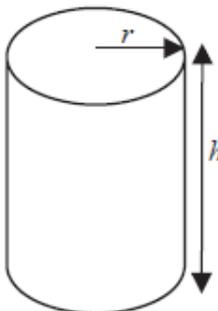
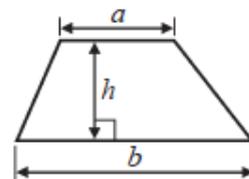
Volume of prism = area of cross section \times length



Circumference of circle = $2\pi r$

Area of circle = πr^2

Area of a trapezium = $\frac{1}{2}(a + b)h$



Volume of cylinder = $\pi r^2 h$

Curved surface area of cylinder = $2\pi r h$

The Quadratic Equation

The solutions of $ax^2 + bx + c = 0$, where $a \neq 0$, are given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

1. (a) The length of an Airbus A300 aeroplane is 54 m.
The ratio of the length of this aeroplane to its wingspan is 6 : 5

Work out the wingspan of the aeroplane.

..... m
(2)

- (b) A model is made of the Airbus A300 aeroplane.
The length of the model is 36 cm.
The length of the real aeroplane is 54 m.

Find the ratio of the length of the model to the length of the real aeroplane.
Give your ratio in the form 1 : n

1 :
(3)

(Total for Question 1 is 5 marks)

2. $A = 2x^2 + kx$

(a) $x = -3$
 $k = 4$

Work out the value of A .

$A = \dots\dots\dots$ (2)

(b) $A = 38$
 $x = 4$

Work out the value of k .

$k = \dots\dots\dots$ (3)

(Total for Question 2 is 5 marks)

3. (a) Work out the value of $\frac{(9.7 - 5.83)^2}{3.98 \times 4.6}$ on your calculator, writing down all the digits of the answer:

.....
(2)

- (b) Round your answer to 2 significant figures:

.....
(1)

(Total for Question 3 is 3 marks)

4. (a) Write $2^3 \times 2^6$ as a single power of 2

.....
(1)

- (b) Write $\frac{3^9}{3^4}$ as a single power of 3

.....
(1)

- (c) $\frac{5^n}{5^4 \times 5^6} = 5^3$

Find the value of n .

$n =$
(2)

(Total for Question 4 is 4 marks)

5. A group of students take a test.
The group consists of 12 boys and 8 girls.
The mean mark for the boys is 18
The mean mark for the girls is 16.5

Calculate the mean mark for the whole group.

.....
(Total for Question 5 is 4 marks)

6. (a) Solve $3(2x - 1) = 6$
Show clear algebraic working.

$x =$
(3)

- (b) Solve $\frac{2y+1}{3} = \frac{y-2}{4}$

Show clear algebraic working.

$y =$
(4)

(Total for Question 6 is 7 marks)

7. The table shows information about the snowfall in Ottawa in January one year.

Snowfall (s cm)	Number of days
$0 \leq s < 2$	19
$2 \leq s < 4$	8
$4 \leq s < 6$	3
$6 \leq s < 8$	0
$8 \leq s < 10$	1

Work out an estimate for the **total** snowfall in January.

..... cm

(Total for Question 7 is 3 marks)

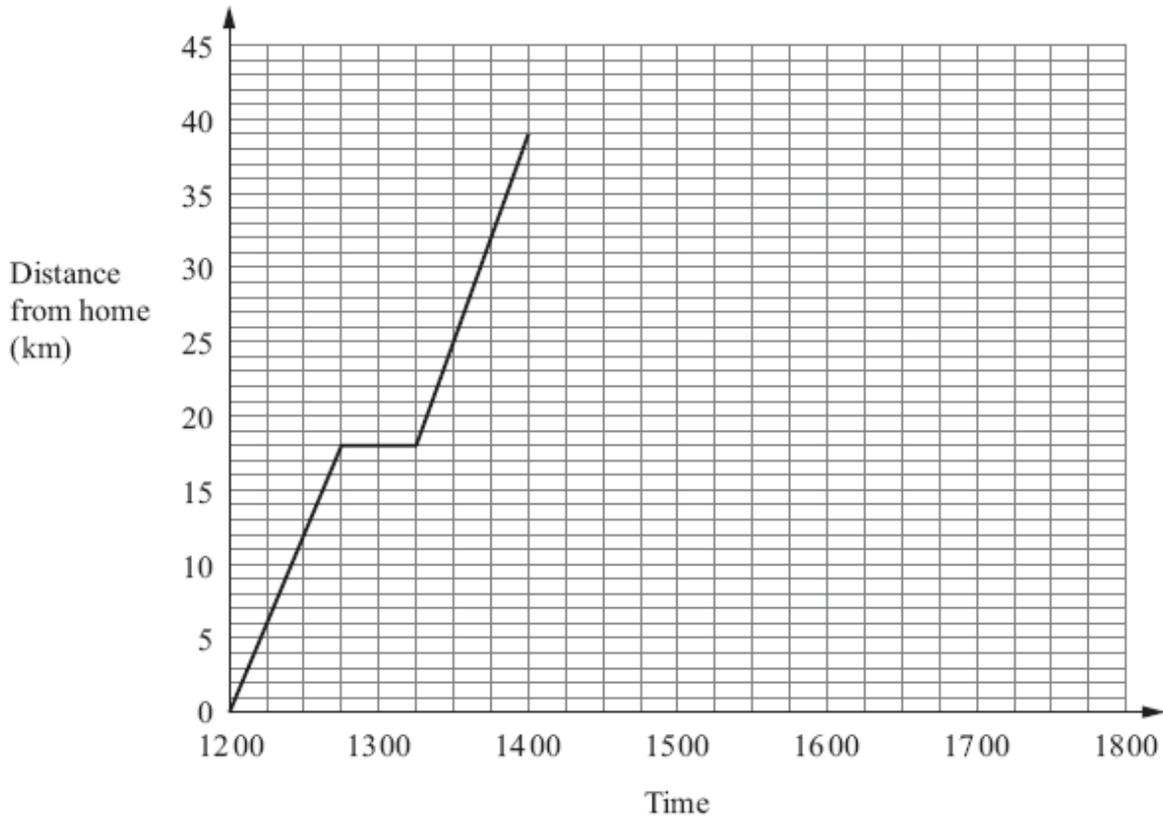
8. Express 300 as a product of its prime factors.

.....

(Total for Question 8 is 3 marks)

9. Bhavik left his home at 12 00 to cycle to Sam's house.

On the way Bhavik stopped for a rest, and then continued his journey.
The distance-time graph shows his journey.



(a) (i) For how many minutes did Bhavik stop for a rest?

..... minutes

(ii) After his rest, how many more kilometres did Bhavik cycle to Sam's house?

..... km
(2)

(b) Bhavik stayed at Sam's house for 2 hours.
He then cycled back to his home.
He arrived home at 17 15.

Show all this information on the graph.

(2)

(c) Write down the times at which Bhavik was 24 kilometres from his home.

.....

.....

(2)

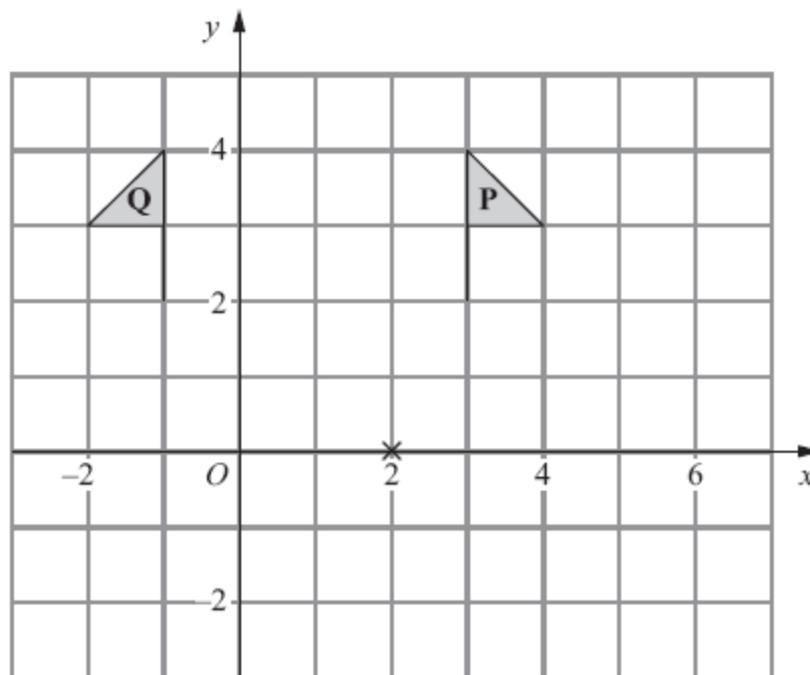
- (d) Work out the average speed, in kilometres per hour, of Bhavik's journey back to his home, from when he left Sam's house.

Give your answer correct to 1 decimal place.

..... km/h
(3)

(Total for Question 9 is 9 marks)

10.



- (a) Describe fully the single transformation that maps shape **P** onto shape **Q**.

.....

...

(2)

- (b) On the grid, rotate shape **P** 90° clockwise about the point $(2, 0)$.
Label the new shape **R**.

(2)

(Total for Question 10 is 4 marks)

11. (a) Show that $\frac{4}{5} \div \frac{7}{15} = 1\frac{5}{7}$

(2)

(b) Show that $5\frac{1}{4} - 1\frac{2}{3} = 3\frac{7}{12}$

(3)

(Total for Question 11 is 5 marks)

12. On 9th May, 2009, there were 3440 people in the world with swine flu.
Of these people, 1639 were in the USA.

(a) Express 1639 as a percentage of 3440
Give your answer correct to 1 decimal place.

..... %
(2)

The 3440 people who had swine flu on 9th May was an increase of 37.6% on the number of people who had swine flu on 8th May.

(b) Calculate the number of people who had swine flu on 8th May.

.....
(3)

(Total for Question 12 is 5 marks)

13. The mass of the Space Shuttle is 7.8×10^4 kilograms.

(a) Write 7.8×10^4 as an ordinary number.

.....
(1)

The Space Shuttle docks with the International Space Station.
The mass of the International Space Station is 4.62×10^5 kilograms.

(b) Calculate the total mass of the Space Shuttle and the International Space Station.
Give your answer in standard form.

..... kg
(2)

(Total for Question 13 is 3 marks)

14. Factorise the following:

(a) $x^2 + 5x - 24$

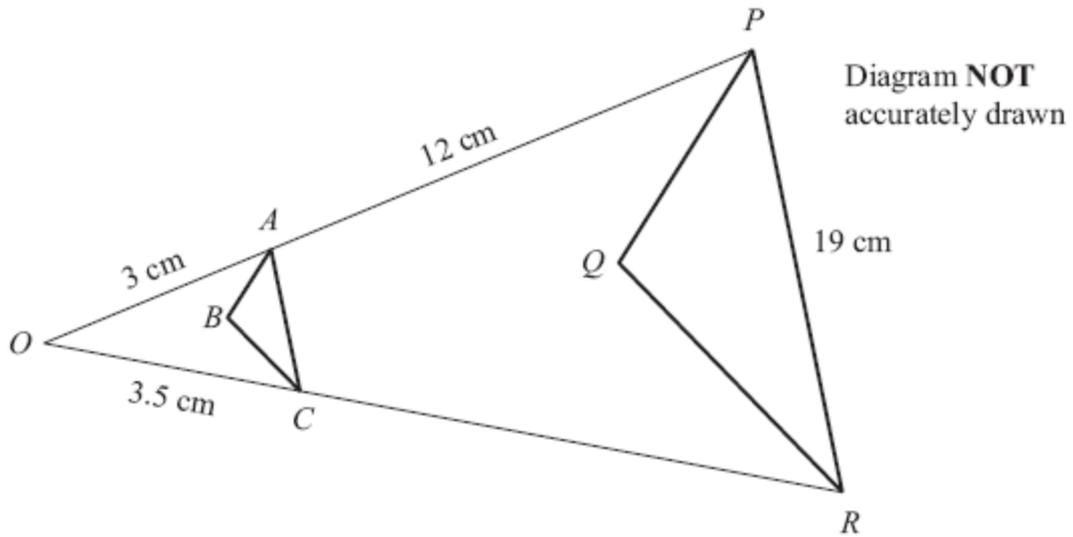
.....
(2)

(b) $2x^2 - 3x - 35$

.....
(3)

(Total for Question 14 is 5 marks)

15.



Triangle PQR is an enlargement, centre O , of triangle ABC .
 OAP and OCR are straight lines.
 $OA = 3$ cm.
 $AP = 12$ cm.
 $OC = 3.5$ cm.
 $PR = 19$ cm.

(a) Work out the length of CR .

..... cm
(2)

(b) Work out the length of AC .

..... cm
(3)

The area of triangle ABC is 2 cm²

(c) Work out the area of triangle PQR .

..... cm²
(2)

(Total for Question 15 is 7 marks)

16.

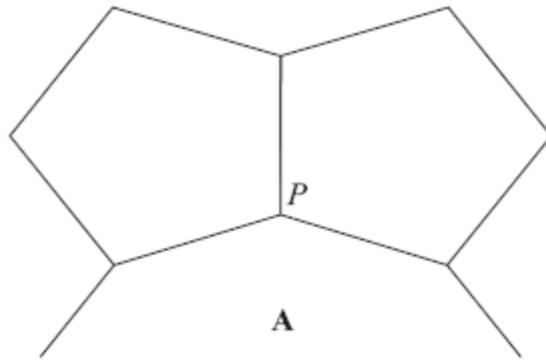


Diagram **NOT**
accurately drawn

The diagram shows two congruent regular pentagons and part of a regular n -sided polygon **A**.

Two sides of each of the regular pentagons and two sides of **A** meet at the point P .

Calculate the value of n .
Show your working clearly.

$n = \dots\dots\dots$

(Total for Question 16 is 5 marks)

17. (a) The equation of a line **L** is $2x - 3y = 6$
Find the gradient of **L**.

.....
(3)

- (b) Find the equation of the line which is parallel to **L** and passes through the point (6, 9).

.....
(2)

(Total for Question 17 is 5 marks)

18.

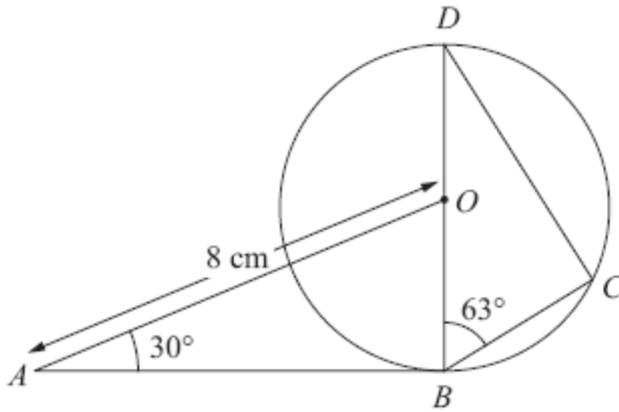


Diagram **NOT**
accurately drawn

B , C and D are points on a circle, centre O .
 BOD is a diameter of the circle.
 AB is the tangent to the circle at B .
 $AO = 8$ cm. Angle $BAO = 30^\circ$ Angle $CBD = 63^\circ$

Calculate the length of BC .
Give your answer correct to 3 significant figures.

..... cm

(Total for Question 18 is 4 marks)

19. Find the point of intersection of the lines

$$2x + 3y = 9 \quad \text{and}$$

$$6x - y = -13$$

.....

(5)

(Total for Question 19 is 5 marks)

20.

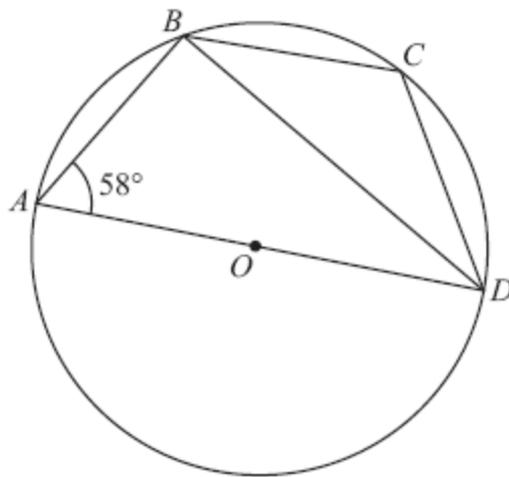


Diagram **NOT** accurately drawn

A , B , C and D are four points on a circle, centre O .
 AD is a diameter of the circle.
Angle $BAD = 58^\circ$

(a) Calculate the size of angle ADB .

.....
(2)

(b) (i) Calculate the size of angle BCD .

.....

(ii) Give a reason for your answer.

.....
..
.....
..

(2)

(Total for Question 20 is 4 marks)

21.

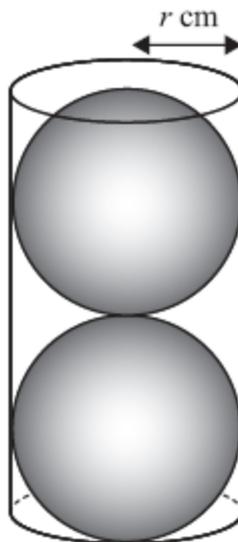


Diagram **NOT**
accurately drawn

Two solid spheres, each of radius r cm, fit exactly inside a hollow cylinder.
The radius of the cylinder is r cm.
The height of the cylinder is equal to $4r$ cm.

The volume of the space inside the cylinder, not occupied by the spheres, is $\frac{125}{6} \pi \text{ cm}^3$

Calculate the value of r .
Show your working clearly.

$r = \dots\dots\dots$

(Total for Question 21 is 5 marks)

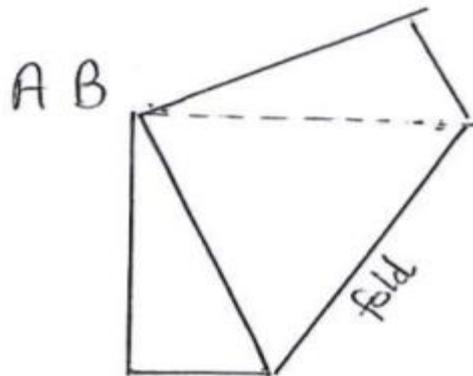
TOTAL FOR THE PAPER IS 100 marks

Check your work and, if you have time, try the following two questions.

1. A rectangular piece of paper measures 12cm by 9cm.

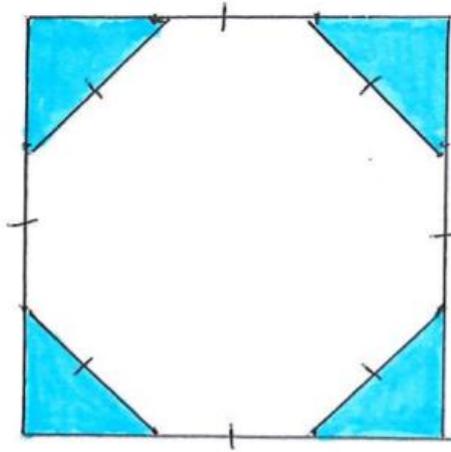


It is folded so that two diagonally opposite corners lie together (ie corner B is moved left and up, to touch corner A and the paper is folded flat):



Work out the length of the fold.

2. An $n \times n$ square has four triangles cut off the corners, to form a regular octagon.



What is the area, in terms of n , which is removed from the square (ie the shaded area)?