Name	•••••	• • • • • • • • • • • •	• • • • • • • • • • • • • •	
Current school	•••••			



WELLINGTON COLLEGE

I3+ SCHOLARSHIP EXAMINATION 2023

MATHEMATICS

TIME ALLOWED: 90 minutes

The marks available for each question are shown in square brackets.

This paper is divided into two sections:

Section A is worth 30 marks and contains seven questions. You should attempt all questions in Section A.

Section B is worth 60 marks and contains six questions. You may attempt all questions. Start with the ones that interest you most; answer as many questions as you can. You may find some easier than others.

Write your answers on the question paper.

You may use a calculator.

Credit will be given for the clarity of your work and your explanations.

Section A (30 marks)

1. Expand and simplify (a) $-2(8x-3) + \frac{3}{4}(12x+16)$ (b) (x-2)(4+4x)(c) $(3x-1)^2$

[1]

[1]

[1]

[2]

(d) $(x+3)^3$



2. Solve

(a) 2x - 4 = 9 [1] (b) 4x + 5 = 6 - 3x [1] (c) $\frac{x}{3} - \frac{x}{7} = 6$ [2]



4. Factorise fully

(a) 9x - 27[1](b) $kxp^2 - kx^2p$ [1](c) $x^4y^2 - x^2y^4$ [2]

5. Make *x* the subject of

(a)
$$y = 9x - 8$$
 [1]
(b) $4x - 3y - 5 = \frac{x + y}{3}$ [1]
(c) $\frac{5}{x - y} = x + 4$ [2]

6. Answer each question

(a) Increase 90 by 2%	[1]
(b) Decrease 810 by 6%	[1]
(c) A t-shirt is sold for £22 on sale. It is marked as "25% off". What was the original price of the t-shirt?	[2]



- 7. (a) A regular hexagon has a perimeter of 126 cm. What is the length of one side? [1]
 - (b) *ABCD* is a square. The shaded area is 10 cm^2 . What is the length of the square? [3]



Section B (60 marks)

8. A square *ABCD* of side 12 cm is drawn and two circular arcs are drawn inside it, one centred on *A* and passing from *B* to *D* and another centred on *D* and passing from *A* to *C*. The area below the arcs is shaded, as illustrated.



The arcs meet at *E*.

(a) Write down the length of the straight line AE .	[1]
(b) Hence, explaining your reasoning, give the size of angle <i>EAD</i> .	[2]
(c) Leaving your answer as a multiple of π , give the area of the sector the area bounded by the straight lines <i>AB</i> and <i>AE</i> and the arc <i>BE</i> .	r <i>ABE</i> (i.e. [2]
(d) Find the length <i>EF</i> , leaving your answer in the form \sqrt{n} , where <i>n</i> is a to be found.	a constant [2]
(e) Hence find, in an exact form, the area of the square which remains ι	unshaded. [5]



9. In a sequence of isosceles triangles, AB = BC = CD = DE = ... as illustrated:



- (a) Given that angle *BAC* is 16°, how many such isosceles triangles can be drawn [6] in this way?
- (b) Instead, the initial angle *BAC* is chosen so that exactly nine triangles can be drawn. Determine, explaining your reasoning, the range of possible values of angle *BAC*.





- 10. Six towns, no three in a straight line, are connected to each other by straight roads so that in every case there is a direct route between each town, not passing through any other town.
 - (a) How many roads are necessary to connect the six towns? [4](b) State a general result for the number of roads needed for *n* towns. [2]



11. Which of the following triangles are right-angled triangles?

In each case, make your reasoning clear.

(a) A triangle with angles 4x, 5x and 6x degrees. [2] [2]

[2]

[2]

[2]

- (b) A triangle with angles of *y*, 3*y* and 4*y* degrees.
 - (c) A triangle with sides 8 cm, 9 cm and 12 cm.
 - (d) A triangle BED, where ABCDEF is a regular hexagon.
 - (e) A triangle PQR where M, the mid-point of QR is equidistant from P, Q and R.



- 12. Inigo and Ed go out running. Each runs at *x* km/h and jogs at *y* km/h. Inigo takes the same total time to run 6 km and jog 4 km as Ed does to run 3 km and jog 6 km.
 - (a) Use the formula *distance* = $\frac{speed}{time}$ to make an equation, simplify it and show [5] that $y = \frac{2x}{3}$.
 - (b) They now run in opposite directions around a circular track. This track has [5] the centre O.

Both boys start at the same point P.

Inigo runs at *x* km/h and Ed jogs at *y* km/h.

They meet at point G.

Use a diagram to help you calculate the angle POG.





A <i>palindromic number</i> is one that reads the same backwards as it does forwards. For example, 1441 and 5831385 are examples of palindromic numbers.	
(a) Find a 3-digit palindromic number that is also a square number.	[1]
(b) Find a 3-digit palindromic number that is also a prime number.	[1]
(c) Find the difference between the largest 5-digit palindromic number and the smallest 6-digit palindromic number.	[2]
(d) The 7-digit palindromic number 42 <i>A</i> 7 <i>A</i> 24 is a multiple of 9. Find the value of the digit <i>A</i> , showing all of your working clearly.	[3]
(e) Show that if a four-digit number is palindromic then it is a multiple of 11.	[3]





