



**ST PAUL'S**  
GIRLS' SCHOOL

Name: .....

School: .....

Year 12 Entrance Examination      **Mathematics and Further Mathematics**

Time allowed: 45 minutes

GCSE Board (if known).....

**Proposed Maths A level course (please tick)**

**Maths**

☐

**Maths & Further Maths**

☐

**Unsure**

☐

**Instructions/information**

There are 9 questions. Answer **ALL** the questions in the spaces provided.

***All working should be shown.***

If you require more space use the back pages, indicating clearly when you have done so.

If you cannot do a question, leave it and go on to the next one: try again later.

***A calculator may be used.***

## FORMULA SHEET

### Arithmetic series

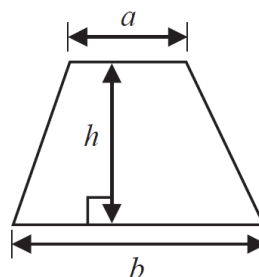
Sum to  $n$  terms,  $S_n = \frac{n}{2} [2a + (n-1)d]$

### The quadratic equation

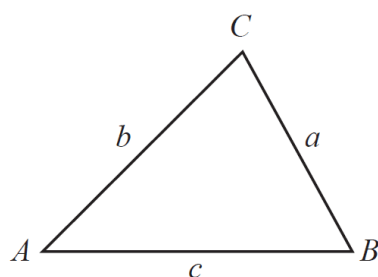
The solutions of  $ax^2 + bx + c = 0$  where  $a \neq 0$  are given by:

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

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



### Trigonometry



**In any triangle ABC**

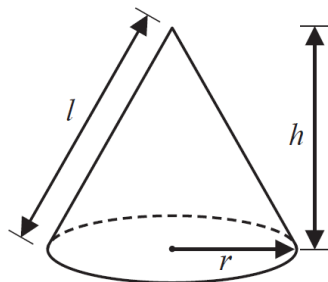
**Sine Rule**  $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

**Cosine Rule**  $a^2 = b^2 + c^2 - 2bc \cos A$

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

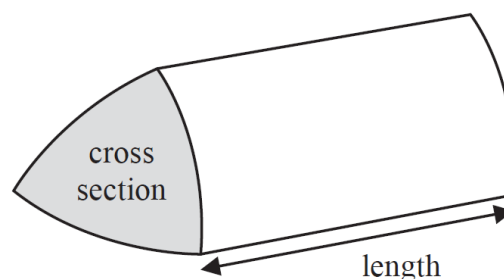
**Volume of cone**  $= \frac{1}{3}\pi r^2 h$

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



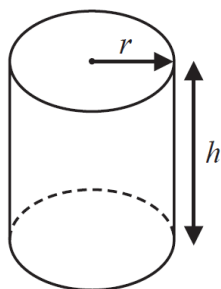
**Volume of prism**

$= \text{area of cross section} \times \text{length}$



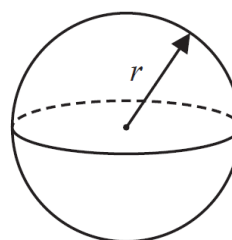
**Volume of cylinder**  $= \pi r^2 h$

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



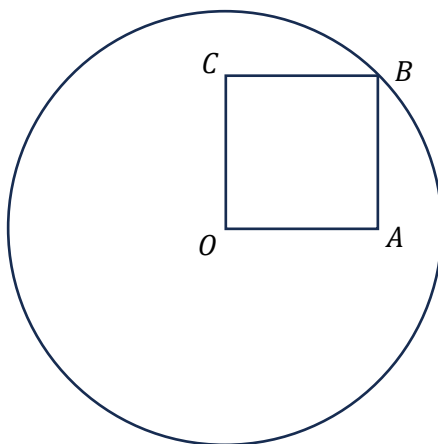
**Volume of sphere**  $= \frac{4}{3}\pi r^3$

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



1.

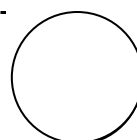
$OABC$  is a square, drawn such that  $B$  is a point on a circle with centre  $O$ .



The ratio *perimeter of the square : circumference of the circle* can be written in the form:

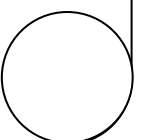
$$\sqrt{y} : \pi$$

Find  $y$ .

[illegible]

A pipeline is to be constructed under a lake. It is calculated that the first mile will take 15 days to construct. Each further mile will take 3 days longer than the one before, so the times taken for each successive mile form an arithmetic sequence.

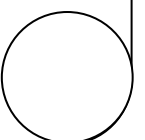
- 
- This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



3.

Solve, giving your answers to 3 significant figures:

$$\frac{x^2 - 9}{x^2 - x - 6} - \frac{2x + 6}{x^2 - 4} = \frac{2}{x + 2}$$

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

4.

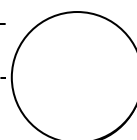
a) Given that

$$x + 2y + 2z = -1,$$

$$x + y + z = \frac{3}{2},$$

$$x - 2y - 4z = 10,$$

find the value of  $xyz$ .

This image shows a single page of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

[illegible]

Express the average speed of the journey in the form

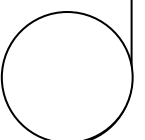
$$\frac{k_1 ab}{k_2 a + k_3 b}$$
[illegible]

6.

a) Expand  $(2k - 1)^3$

[illegible]

b) Hence prove that the difference between an odd integer and its cube is always a multiple of four.

This image shows a single sheet of white paper with horizontal blue ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



Handwriting practice lines on page 9. The page contains 20 sets of horizontal lines, each consisting of a solid top line, a dashed middle line, and a solid bottom line. A small circle is located in the bottom right corner of the page.

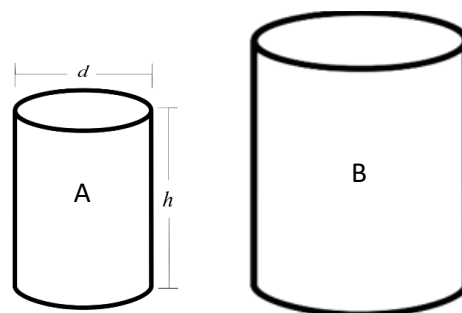
7.

- a) A and B are similar cylinders with their heights in the ratio 2:3.

A has height  $h$  and diameter  $d$ .

Write down the ratio *volume A : volume B*

Diagram not to scale.




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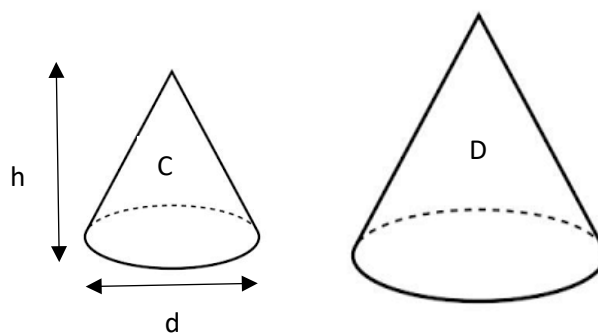


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C and D are similar cones with their heights in the ratio 3:4.

C has height  $h$  and diameter  $d$ .

Diagram not to scale.



The shape of cone C is carved out of the cylinder A and the cone D is carved out of the cylinder B to create new solids E and F:

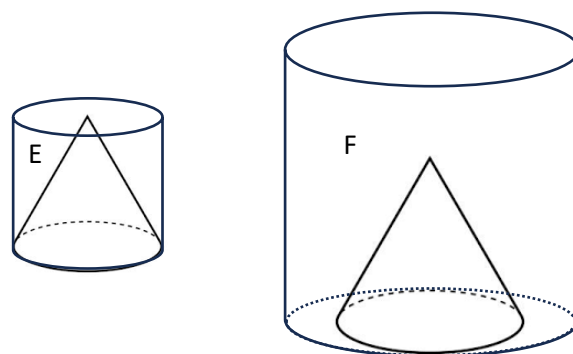
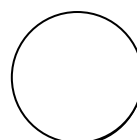


Diagram not to scale.

- (b) Show that the ratio *volume of E : volume of F* is 432 : 1675.



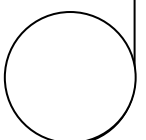
Handwriting practice lines on page 11. The page contains 28 horizontal lines, with a thicker line separating the first group of 10 lines from the second group of 18 lines. A small circle is located in the bottom right corner of the page.

8.

A toddler has two bags of coloured cubes. Bag A has three red cubes, two blue cubes and four green cubes. Bag B has one red cube, three blue cubes and a number of green cubes.

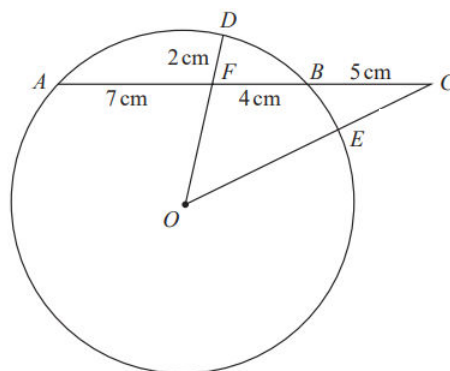
The toddler selects at random a cube from bag A and places it into bag B. They then select a cube at random from bag B.

In the space below, draw a tree diagram to represent this situation.

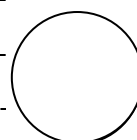


This image shows a full page of blank handwriting practice paper. It features approximately 28 horizontal black lines spaced evenly across the page. The lines are thin and consistent in thickness, providing a guide for letter height and placement. There are no margins, text, or other markings on the page.

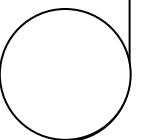
A, D, B and E are points on a circle with centre O.  
AFBC, OEC and OFD are straight lines.  
AF = 7cm, FB= 4cm, BC= 5cm, FD=2cm.

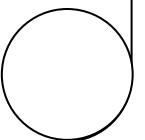


This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



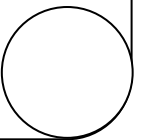
Handwriting practice lines on page 15. The page contains 28 horizontal lines, with a thicker line separating the first section (8 lines) from the second section (20 lines). The lines are evenly spaced and extend across the width of the page.



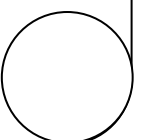
[illegible]



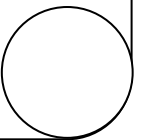
## This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general note-taking. There are no margins, text, or other markings on the page.



## This image shows a single page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page. There are approximately 20 lines visible. The paper appears to be a standard notebook page or a sheet of stationery. There is no handwriting or other markings on the page.



## This image shows a full page of white paper with horizontal blue or grey ruling lines. The lines are evenly spaced and run across the width of the page, providing a template for handwriting practice or general note-taking. There are no margins, text, or other markings on the page.



There are no questions on this page

