DULWICH COLLEGE
FOUNDED 1619

Upper School Entrance Examination

Specimen Paper

Mathematics

Surname	
First Name	
Age	
Current school	

Time allowed for this paper 60 minutes
There are 50 marks (Section A: 25 marks. Section B: 25 marks)

Do all your written work on this paper, **showing all your working**.
Calculators are allowed.

You should attempt all questions.
Questions in section A are aimed at testing mathematical skills and content.
Questions in section B require more problem solving skills.

Read the following options and then tick *one* of the boxes to indicate which option you are applying for.

☐ Single Mathematics — This option leads to *one* A level in Mathematics. Students taking this option take two other subjects at the start of the course.

☐ Further Mathematics — This is the highest option for Mathematics and leads to *two* A levels in Mathematics. Students taking this option take two other subjects.

List all Mathematics qualifications **you have taken so far**, e.g. GCSE, IGCSE, 'O' level, HKCEE etc. and the grade you achieved if known	
List any *other* Mathematics examinations that **you are due to take**	

Formulae

Quadratic Equation: $ax^2 + bx + c = 0, a \neq 0$

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

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

Cosine Rule: $c^2 = a^2 + b^2 - 2ab\cos C$ or

$$\cos C = \frac{a^2 + b^2 - c^2}{2ab}$$

Area of a Triangle: $\frac{1}{2}ab\sin C$

Volumes:

Cone: $\frac{1}{3}\pi r^2 h$
Cylinder: $\pi r^2 h$
Sphere: $\frac{4}{3}\pi r^3$

Curved Surface Areas:

Cone: πrl (where l is the slant height)
Cylinder: $2\pi rh$
Sphere: $4\pi r^2$

Section A – 25 marks

Questions in section A are aimed at testing mathematical skills and content.

1. Solve the following equations for x

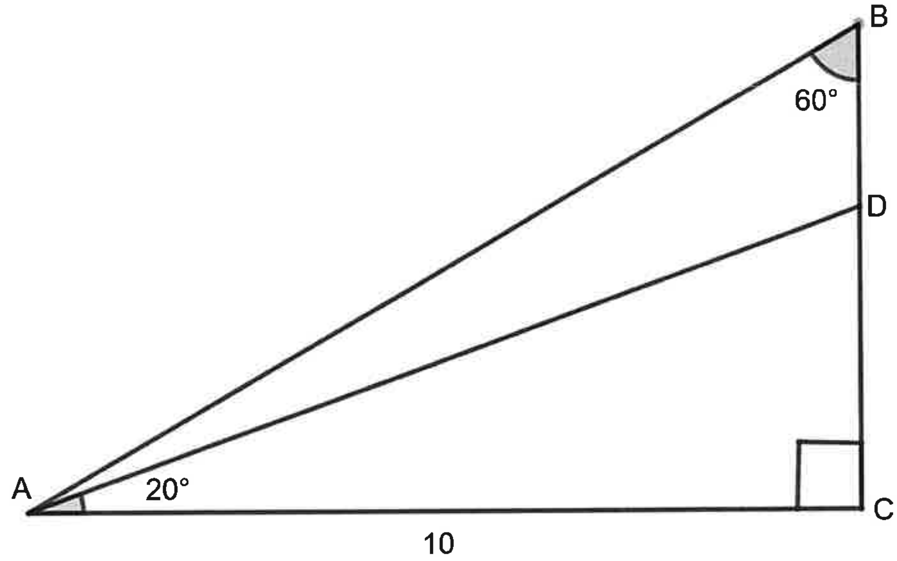
   a) $6 - 2(7 - 3x) = 8 - (3x + 7)$

   ____________ [2]

   b) $\frac{3}{5}x + \frac{1}{2}x = 22$

   ____________ [2]

2. A right angled triangle has one side of length 10 units and angles as shown.



Find BD to 3 significant figures

______________ [3]

3. Simplify

a) $\frac{(4xy^2)^2}{(2x)^3}$

_____________ [2]

b) $\frac{1}{x+5} - \frac{x-1}{x^2-25}$

_____________ [2]

4. Rearrange to make x the subject

a) $y = \frac{x+a}{x+b}$

______________ [3]

b) $x = y\sqrt{x^2 + 1}$ (for $x > 0$)

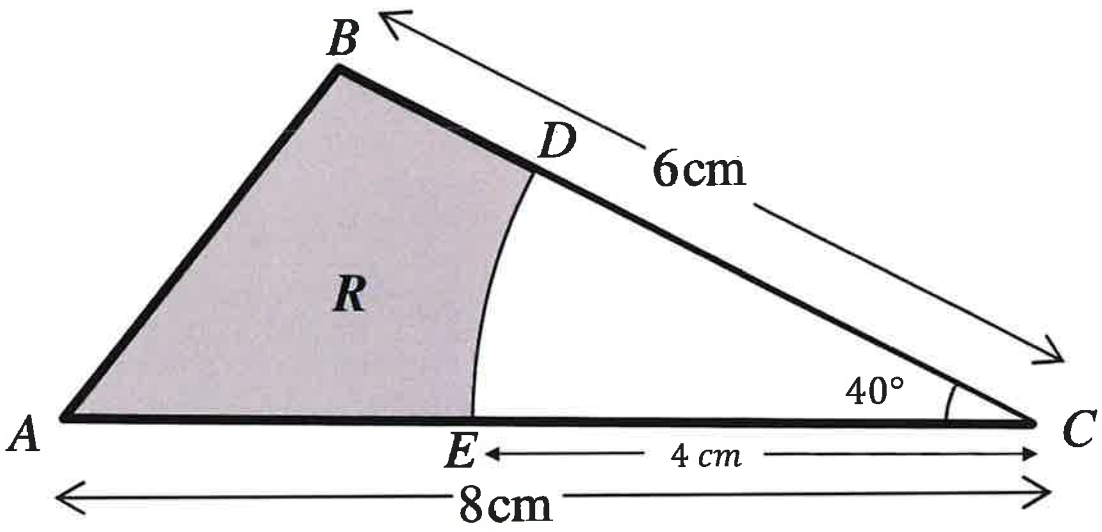
______________ [2]

5. Solve the following sets of simultaneous equations

$$x - y = 6$$
$$(x + y)^2 = 4$$

_______________________ [4]

6.



The figure above shows a triangle ABC where the lengths of AC and BC are 8 cm and 6 cm, respectively. The angle BCA is 40 degrees. A circular arc with radius 4cm is drawn inside the triangle. The arc intersects at points D and E

a) Find the length of AB

________________(3 sf) [2]

b) Find the area of triangle ABC

____________(3 sf) [1]

c) Calculate area of R

____________(3 sf) [2]

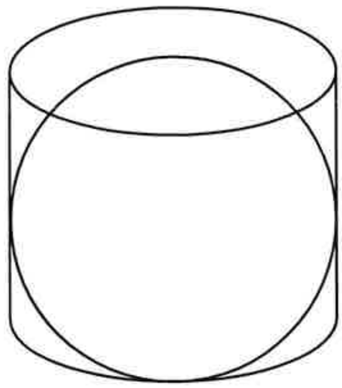
Section B – 25 marks

Questions in section B require more problem solving skills.

1. Express $\sqrt{126}$ is the form a$\sqrt{b}\sqrt{c}$ where a, b and c are prime numbers.

____________ [2]

2. A sphere is enclosed exactly in a cylinder as shown below



The sphere has a volume of $2304\pi cm^3$. Find the surface area of the cylinder, leaving your answer in exact form

_____________ [4]

3. The straight line l_1 passes through the points $A(2,1)$ and $B(k, 8)$, where k is a constant.

a) Given the gradient of l_1 is $\frac{7}{2}$ show that $k = 4$

[2]

b) Find an equation for l_1

_______________ [1]

The straight line l_2 is parallel to the y axis and passes through A

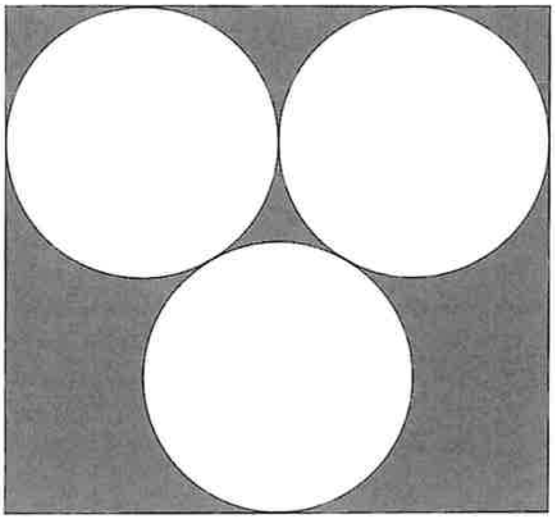
The point C lies on l_2 so that the length of BC is exactly $2\sqrt{2}$.

c) Find the possible coordinates of C.

_______________ [3]

4. The diagram shows 3 identical circles inside a rectangle.

Each circle touches the other two circles and the sides of the rectangle:



The radius of each circle is 1m.

Calculate the shaded area

Give you answer in exact form

_____________ [3]

5. Solve the following equation for x

$$(x^2 - 10x - 24)^{(x^2-2x-24)} = 1$$

______________ [4]

6. Exactly one of the following numbers is a prime number.
   Decide which number is prime. Justify your answer.
   a) $1000000^2 + 111111^2$
   b) $555555^2 + 666666^2$
   c) $2000000^2 - 99999^2$
   d) $1000001^2 + 1000003^2$

_____________ [3]

7. $98 + 76 + 5 + 4 + 3 + 2 + 10 = 198$
How many **other** ways can 9 8 7 6 5 4 3 2 1 0 in that order and with only addition signs between, make a total of 198?

_____________ [3]

END OF EXAMINATION