**REGENT SECONDARY SCHOOL**
**PRELIMINARY EXAMINATION 2020**
**SECONDARY FOUR EXPRESS**

NAME: ________________________________ INDEX NUMBER: ________

CLASS: ________ SETTER: MS SU RY

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## ADDITIONAL MATHEMATICS 4047/01

Paper 1 **14 September 2020**

**2 hours**

Candidates answer on the Question Paper.
No Additional Materials are required.

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**READ THESE INSTRUCTIONS FIRST**

Write your class, index number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a pencil for any diagrams or graphs.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
Give your answers on the separate Answer Paper provided.
Give non-exact numerical answers correct to 3 significant figures, or 1 decimal place in the case of angles in degrees, unless a different level of accuracy is specified in the question.
The use of an approved scientific calculator is expected, where appropriate.
You are reminded of the need for clear presentation in your answers.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total of the marks for this paper is 80.

| | TARGET |
|---|---|
| 80 | |
| PARENT'S SIGNATURE | |
| | |

# Mathematical Formulae

## 1. ALGEBRA

*Quadratic Equation*

For the equation $ax^2 + bx + c = 0$ ,

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

Binomial expansion

$$(a+b)^n = a^n + \binom{n}{1} a^{n-1} b + \binom{n}{2} a^{n-2} b^2 + \ldots + \binom{n}{r} a^{n-r} b^r + \ldots + b^n$$

where $n$ is a positive integer and $\binom{n}{r} = \frac{n!}{(n-r)!\,r!} = \frac{n(n-1)\ldots(n-r+1)}{r!}$

## 2. TRIGONOMETRY

*Identities*

$$\sin^2 A + \cos^2 A = 1$$

$$\sec^2 A = 1 + \tan^2 A$$

$$\text{cosec}^2 A = 1 + \cot^2 A$$

$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$

$$\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$$

$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \mp \tan A \tan B}$$

$$\sin 2A = 2 \sin A \cos A$$

$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$

$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

*Formulae for* $\Delta ABC$

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

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

$$\Delta = \frac{1}{2} bc \sin A$$

**1** Given that $\tan A = \frac{5}{12}$, $\cos B = -\frac{4}{5}$ and that $A$ and $B$ are in the same quadrant, calculate without the use of calculator, the value of

**(i)** $\cos A$, [2]

**(ii)** $\sin(A+B)$. [2]

**2** Express $\dfrac{2x-5}{x^2-2x-3}$ in partial fractions. [5]

**3** **(i)** On the same diagram sketch the curves $y^2 = 121x$ and $y = \frac{11}{x}$. [2]

**(ii)** Find the coordinates of the point of intersection of the two curves [3]

**4** The area of a rectangle is $(8+7\sqrt{2})$ cm$^2$. Given that its breadth is $(5-2\sqrt{2})$ cm, without using a calculator, show that its length can be expressed in the form $(a+b\sqrt{2})$ cm, where $a$ and $b$ are integers. [4]

**5** **(i)** Solve $\log_x\left(5x^2+7x-8\right)=1$ [4]

**(ii)** Given that $\log_3 a-\log_9 b=2$, express $b$ in terms of $a$. [3]

**6** **(i)** Use the substitution $u = 2^x$ to express the equation $8^x - 2^{x+2} = 15$ as a cubic equation in *u*. [3]

**(ii)** Show that $u = 3$ is the only real solution of this equation [4]

**(iii)** Hence solve the equation $8^x - 2^{x+2} = 15$. [3]

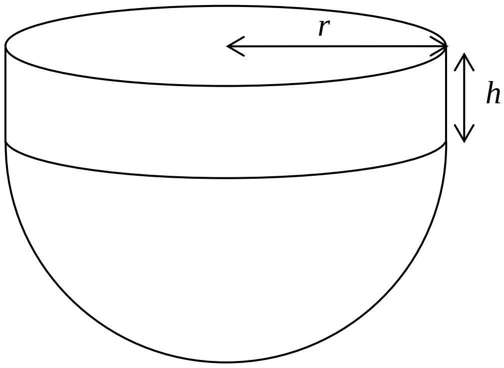
**7** A viscous liquid is poured onto a flat surface. It forms a circular patch which grows at a steady rate of 48 $cm^2$/s

**(i)** Show that the radius of the patch after pouring for 12 seconds is $\frac{24}{\sqrt{\pi}}$ cm/s. [3]

**(ii)** Find in terms of $\pi$, the rate of the increase of the radius at this instant. [3]

**8** A manufacturer makes jellies using the jelly mould which is made of a hollow hemisphere of radius $r$ cm attached to a hollow cylinder of radius $r$ cm with height $h$ cm as shown in the figure. The thickness of the mould is negligible.

$$\begin{bmatrix} \text{Volume of a sphere} = \dfrac{4}{3}\pi r^3 \\ \text{Surface area of a sphere} = 4\pi r^2 \end{bmatrix}$$

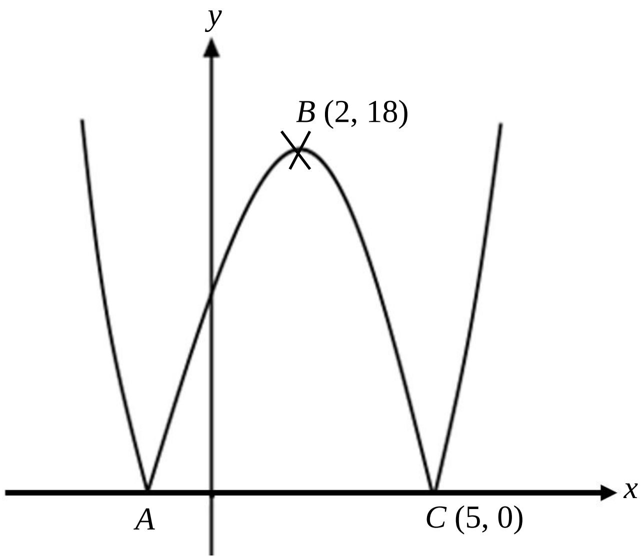



**(i)** Given that the volume of the jelly mould is 3200 $cm^3$, express $h$ in terms of $r$. [2]

**(ii)** Hence, show that the total external surface area of the jelly mould, $A$ $cm^2$, is given by $A = \dfrac{6400}{r} + \dfrac{2}{3}\pi r^2$. [2]

**(iii)** Find the value of $r$ for which $A$ has a stationary value and determine whether this value of $A$ is a maximum or a minimum. [5]

**9**




The diagram shows part of the curve $y = \left|ax^2 + bx + c\right|$ where $a > 0$.

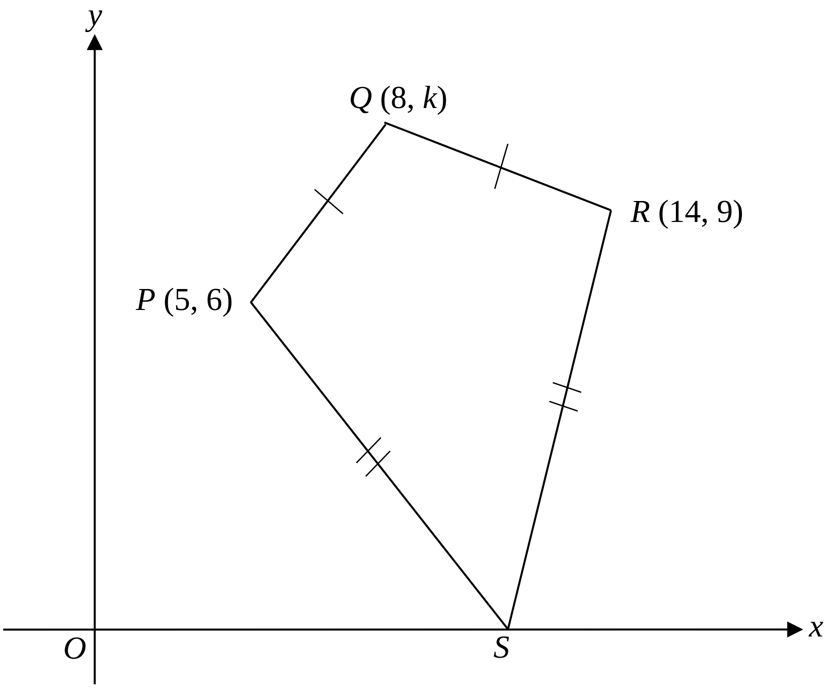
The curve touches the $x$ – axis at $A\ (k, 0)$ and $C\ (5, 0)$ and has a turning point $B\ (2, 18)$.

**(i)** Explain why $k = -1$. [1]

**(ii)** Determine the value of $a$, $b$ and $c$. [4]

**(iii)** State the number of solutions for which $\left|ax^2+bx+c\right|=18$ . [1]

**10** The diagram shows a kite $PQRS$ with $QP = QR$ and $SP = SR$. The point $S$ lies on the $x$-axis. The coordinates of $P$, $Q$, $R$ are (5, 6), (8, $k$) and (14, 9) respectively.




**(i)** Show that the coordinates of $S$ are (12, 0). [5]

**(ii)** Find the value of $k$. [2]

**(iii)** Find the area of $PQRS$. [2]

**11** Given that $\mathrm{f}(x) = 3 - 4\sin^2 x$,

**(i)** express f($x$) in the form $a\cos 2x + b$, stating the value of each of the integers $a$ and $b$, [3]

**(ii)** state the greatest and least values of f($x$), [2]

**(iii)** state the period and amplitude of f($x$), [2]

**(iv)** sketch the graph f($x$) for $0^\circ \leq x \leq 360^\circ$. [3]

**12** A function is defined by the equation $y = \frac{3x+4}{\sqrt{2x-1}}$, where $x > \frac{1}{2}$.

**(i)** Find $\frac{dy}{dx}$. [3]

**(ii)** Hence find the range of values of $x$ for which $y$ is an increasing function. [2]

**END-OF-PAPER**