YUSOF ISHAK SECONDARY SCHOOL
PRELIMINARY EXAMINATION 2020

CANDIDATE NAME

CLASS

INDEX NUMBER

ADDITIONAL MATHEMATICS 4044/02
4 Normal (Academic)
Paper 2

19 August 2020

Candidates answer on the question paper.

1 hour 45 minutes

READ THESE INSTRUCTIONS FIRST

Do not open the booklet until you are told to do so.
Write your name, register number and class on all the work you hand in.
Write in dark blue or black pen on both sides of the paper.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Answer **all** questions.

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.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 70.

For Examiner's Use
70

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

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

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

2. TRIGONOMETRY

Identities

$$\sin^2 A + \cos^2 A = 1$$
$$\sec^2 A = 1 + \tan^2 A$$
$$\operatorname{cosec}^2 A = 1 + \cot^2 A$$
$$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$$
$$\cos(A \pm B) = \cos A \cos B \,\mu\, \sin A \sin B$$
$$\tan(A \pm B) = \frac{\tan A \pm \tan B}{1 \,\mu\, \tan A \tan B}$$
$$\sin 2A = 2 \sin A \cos A$$
$$\cos 2A = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$$
$$\tan 2A = \frac{2 \tan A}{1 - \tan^2 A}$$

Formulae for ΔABC

$$\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$$
$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$\Delta = \frac{1}{2} bc \sin A$$

Answer **all** the questions.

1 **(i)** Sketch the graph of $y^2 = 9x$. [2]

(ii) Given that the line $x = 4$ intersects the graph of $y^2 = 9x$ at points *P* and *Q*, find the distance of the line segment *PQ*. [2]

[4]

2 Given that $\frac{\mathrm{d}}{\mathrm{d}x}\left(\frac{kx}{\sqrt{x^2-8}}\right)=\frac{40}{\sqrt{\left(x^2-8\right)^3}}$, find the value of k. [4]

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3 Given that the constant term in the expansion of $\left(ax+\frac{1}{x}\right)^8$ is 5670, find the value of the positive integer a. [5]

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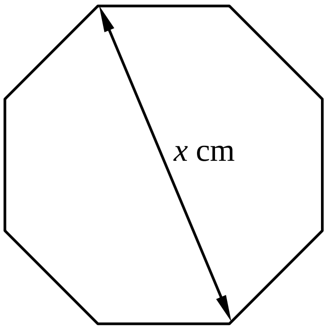
[5]

4 Solve $(3x-2)\left(\sqrt{2}-1\right)=x\sqrt{2}+1$ giving your answer in the form $a+b\sqrt{2}$, where a and b are integers. [5]

5 Find the set of values of x for which $y = -x^3 + 2x^2 - x + 17$ is a decreasing function. [5]

6



The diagram shows a regular octagon with diagonal length x cm.

(i) By dividing the octagon into eight congruent triangles, show that its area, A cm^2, can be expressed as $A = \frac{\sqrt{2}}{2}x^2$. [3]

(ii) The area of the octagon increases at a constant rate of 10 cm^2/s.

Find the rate of change of the diagonal length of the octagon when $x = 5$. [4]

7 A circle with the equation $x^2 + y^2 + mx + ny - 4 = 0$ passes through the points $(-1, 0)$ and $(4, -4)$.

(i) Find the value of *m* and of *n*. [4]

(ii) Hence, find the radius and the coordinates of the centre of the circle. [4]

8 The quadratic equation $3x^2 - 6x + 5 = 0$ has roots 2α and 2β.

(i) Evaluate

(a) $\alpha + \beta$ and $\alpha\beta$, [4]

(b) $\alpha^2 + \beta^2$. [2]

(ii) Find a quadratic equation with roots $2\alpha + \beta$ and $\alpha + 2\beta$. [4]

9 **(i)** **(a)** Prove that

$$\sec\theta\left(2\cos 2\theta+\sin 2\theta+2\right)=4\cos\theta+2\sin\theta\,.$$ [4]

(b) Express $\sqrt{2}\cos\left(\theta-45°\right)$ in terms of $\sin\theta$ and $\cos\theta$. [2]

(ii) Hence solve $\sec\theta\left(2\cos 2\theta+\sin 2\theta+2\right)=\sqrt{2}\cos\left(\theta-45°\right)$ for $0\le\theta\le 360°$. [4]

10 The equation of line l is given by $2y = x - 3$.

l is a normal to the quadratic curve $y = 2x^2 - 6x + 3$ at point P and intersects the same curve again at point Q.

(i) Show that the coordinates of P is $(1, -1)$. [4]

(ii) Find the coordinates of Q. [3]

(iii) At point P, l is a tangent to the graph of $y = \mathrm{f}(x)$, where it is known that

$$\mathrm{f}''(x) = \frac{3}{\sqrt{19-3x}}.$$

Find the gradient of the graph of $y = \mathrm{f}(x)$ at $x = 6$. [5]

End of Paper