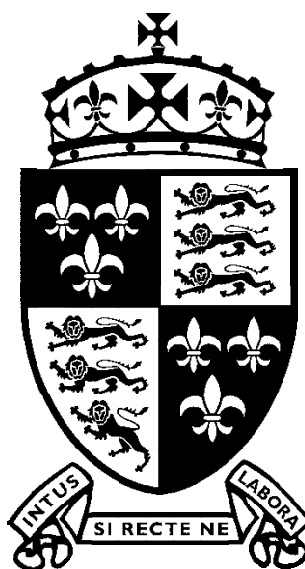


Do NOT open this paper until instructed to do so.
While you are waiting to start write your name in the box directly below.

Name _____

Set _____



SHREWSBURY SCHOOL
ADDITIONAL MATHEMATICS
PAPER 2

Constructed from recent official OCR examination resources (6993)

Wednesday 26th May 2021

11.30 am – 12.50 pm (80 minutes)

Extra Time finish : 13.10 pm

Year 11

(Fifth form top sets)

- ◇ There are 60 marks available in this paper.
- ◇ You should attempt as many questions as you can.
- ◇ You must show full working, where appropriate, in order to gain full marks.
- ◇ You are expected to use a calculator in this paper.

Formulae

FSMQ Additional Maths (6993)

Binomial series

$$(a + b)^n = a^n + {}^nC_1 a^{n-1} b + {}^nC_2 a^{n-2} b^2 + \dots + {}^nC_r a^{n-r} b^r + \dots + b^n$$

for positive integers, n , where ${}^nC_r = {}_nC_r = \binom{n}{r} = \frac{n!}{r!(n-r)!}$, $r \leq n$

The binomial distribution

$$\text{If } X \sim B(n, p) \text{ then } P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$$

Numerical methods

$$\text{Trapezium rule: } \int_a^b y \, dx = \frac{1}{2} h ((y_0 + y_n) + 2(y_1 + y_2 + \dots + y_{n-1}))$$

Kinematics

Variable acceleration formulae

$$v = \frac{ds}{dt}$$

$$a = \frac{dv}{dt} = \frac{d^2s}{dt^2}$$

$$s = \int v \, dt \text{ and } v = \int a \, dt$$

Constant acceleration formulae

$$v = u + at$$

$$s = ut + \frac{1}{2} a t^2$$

$$s = \frac{1}{2} (u + v) t$$

$$v^2 = u^2 + 2as$$

$$s = vt - \frac{1}{2} a t^2$$

Question 1

In this question you must show detailed reasoning.

You are given that $a = 6\sqrt{2}$ and $b = 2\sqrt{6}$

Express the following as simply as possible,

(a) ab

[2 marks]

(b) $\frac{a}{b}$

[2 marks]

Question 2

Express $x^3 - 3x^2 + 3x - 2$ as the product of a linear and a quadratic expression.

[3 marks]

Question 3

The tangent to the curve $y = 3 - x^3$ at $(1, 2)$ cuts the y -axis at a point A
Determine the coordinates of A

[5 marks]

Question 4

A triangle ABC is such that $AB = 5$ cm, $BC = 8$ cm and $CA = 7$ cm
Show that one angle is 60°

[4 marks]

Question 5

In this question you must show detailed reasoning.

Find the values of x in the range $0^\circ < x < 360^\circ$ that satisfy the following equations, giving your answers correct to 1 decimal place.

(a) $\sin 2x = 0.4$

[3 marks]

(b) $\sin^2 x = 2 \cos x - 1$

[5 marks]

Question 6

In this question you must show detailed reasoning.

Find the coordinates of the minimum point on the curve $y = x^3 - 6x^2 + 9x + 7$ justifying your answer.

[6 marks]

Question 7

The points A and B have coordinates $(1, 2)$ and $(5, 8)$ respectively.

(a) Find the exact value of the length AB

[2 marks]

The point M is the midpoint of the line segment AB

(b) Find

(i) the coordinates of M

[1 mark]

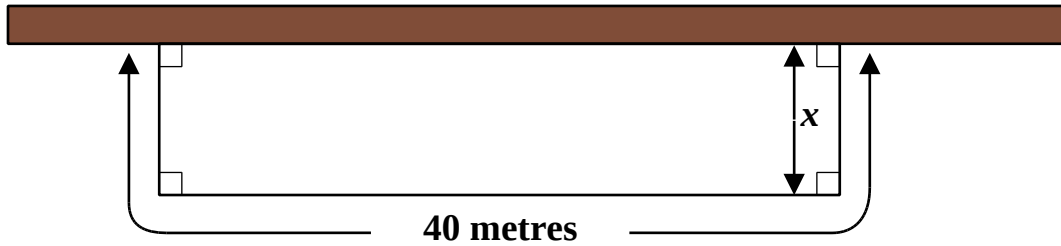
(ii) the equation of the line through M which is perpendicular to AB

[4 marks]

Question 8

A farmer wishes to enclose an area of his land. Against a long straight wall he makes a rectangular shape with a fence that is 40 metres long.

The width of the rectangle is x metres.



- (a) Find an expression for the area of the enclosure, giving your answer in the form $a(x + b)^2 + c$ where a , b and c are integers to be determined.

[4 marks]

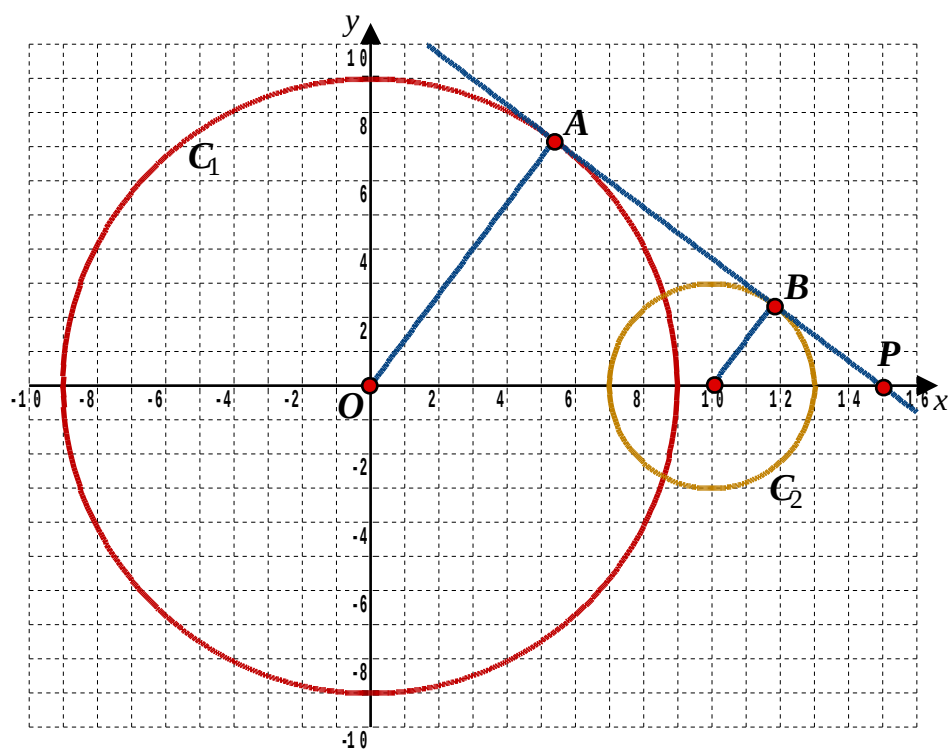
- (b) Without using calculus, determine the maximum area which the farmer can enclose.

[2 marks]

- (c) Determine the values of x that will give an area of exactly 150 m^2

[3 marks]

Question 9



The circle C_1 has equation $x^2 + y^2 = 81$

The circle C_2 has centre $(10, 0)$ and radius 3

(a) Write down the equation of C_2

[1 mark]

The line ABP is a tangent to C_1 at A and is also a tangent to C_2 at B

It cuts the x -axis at the point P

(b) By considering similar triangles, show that the coordinates of P are $(15, 0)$

[4 marks]

Question 10

In this question you must show detailed reasoning.

The equation $x^3 - 3x + k = 0$, where k is a constant, has a root $x = 2$.

Find the numerical value(s) of the other roots of this equation.

[5 marks]

Question 11

You are given that the line $y = 2x + k$ cuts the circle $x^2 + y^2 = 5$ in two points, A and B .

(a) Show that the x -coordinates of A and B satisfy the equation,

$$5x^2 + 4kx + (k^2 - 5) = 0$$

[2 marks]

(b) Hence find the values of k for which the line is a tangent to the circle.

[2 marks]