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# MATHEMATICS

## AS PAPER 1

# CM

Bronze Set C (Edexcel Version)

Time allowed: 2 hours

**Instructions to candidates:**

• In the boxes above, write your centre number, candidate number, your surname, other names and signature.

• Answer ALL of the questions.

• You must write your answer for each question in the spaces provided.

• You may use a calculator.

**Information to candidates:**

• Full marks may only be obtained for answers to ALL of the questions.

• The marks for individual questions and parts of the questions are shown in round brackets.

• There are 15 questions in this question paper. The total mark for this paper is 100.

**Advice to candidates:**

• You should ensure your answers to parts of the question are clearly labelled.

• You should show sufficient working to make your workings clear to the Examiner.

• Answers without working may not gain full credit.





1 0 3 3 2 1 3 2 8 0 0 0 4

**1** (a) Showing all of your working, simplify

$$\sqrt{28}+\sqrt{343}$$

giving your answer in the form $a\sqrt{7}$, where $a$ is an integer. **(2)**

(b) Hence, or otherwise, show all of your working and simplify

$$\frac{9+3\sqrt{7}}{\sqrt{28}+\sqrt{343}}$$

giving your answer in the form $b+c\sqrt{7}$, where $b$ and $c$ are rational. **(3)**

**Question 1 continued**

**TOTAL 5 MARKS**

**2**

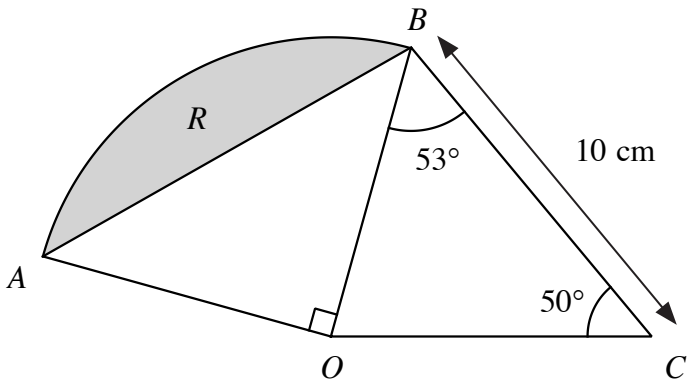


**Figure 1**

Figure 1 above shows the shape *OABCO*. The shape consists of the triangle *OBC* joined to a sector *OAB* of a circle with centre *O*.

Angle *OBC* = 53°, angle *OCB* = 50° and *BC* = 10 cm.

(a) Find the length of *OB*. **(2)**

(b) Find the area of the shaded region *R*. **(3)**

**Question 2 continued**

**TOTAL 5 MARKS**

**3** The points $A$, $B$ and $C$ lie on a straight line such that $B$ is the midpoint of $AC$.

Relative to a fixed origin $O$, the position vector of $A$ is $5\mathbf{i} - 3\mathbf{j}$ and the position vector of $B$ is $-2\mathbf{i} + \mathbf{j}$.

(a) Find the position vector of $C$ relative to $O$. **(4)**

(b) Hence, find the distance of $C$ from $O$. **(2)**

**Question 3 continued**

**TOTAL 6 MARKS**

**4** Find the equation of the tangent to the curve $y = x^2(3 - x)$ when $x = 1$.

Give your answer in the form $y = mx + c$, where $m$ and $c$ are constants to be found. **(6)**

**Question 4 continued**

**TOTAL 6 MARKS**

**5** A tank is initially completely filled with water. An outlet is opened at the bottom of the tank and water begins to drain from the tank until the tank is empty.

The volume, $V$ m$^3$, is modelled to vary according to

$$V = 5e^{-0.14t}, \quad t \geq 0$$

where $t$ is the time in minutes after opening the outlet.

(a) Using the model, find

(i) the initial volume of water in the tank,

(ii) the time taken for the volume of water in the tank to equal 2 m$^3$.

**(3)**

(b) Suggest how the model can be refined so that

(i) the initial volume of water in the tank is double its current value,

(ii) the rate of flow of water out of the tank is slower.

**(2)**

(c) State **one** limitation of the model. **(1)**

**Question 5 continued**

**TOTAL 6 MARKS**

**6**

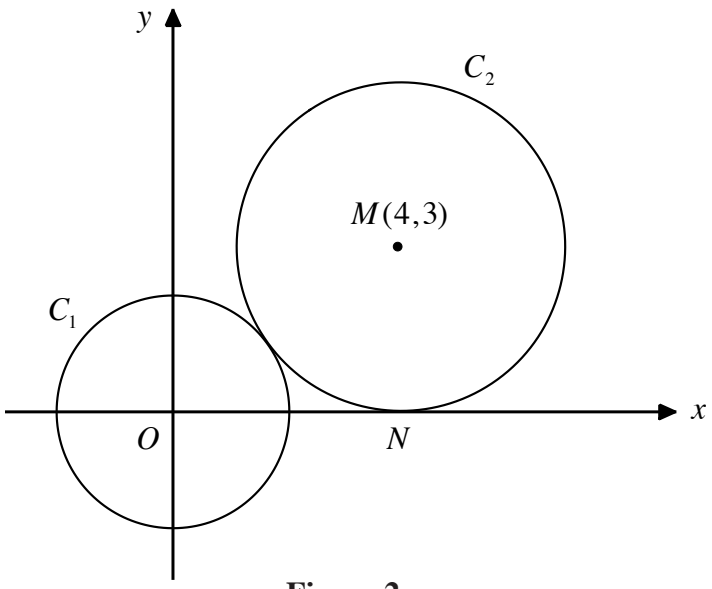


**Figure 2**

Figure 2 above shows a sketch of the circles $C_1$ and $C_2$.

The circle $C_1$ has the equation $x^2 + y^2 = 4$.

The circle $C_2$ has centre $M(4, 3)$ and **touches** $C_1$ externally, as shown in the figure.

(a) Show that the radius of $C_2$ is 3. **(3)**

(b) Hence, find the equation of the circle $C_2$, giving your answer in the form

$$(x - a)^2 + (y - b)^2 = k$$

where $a$, $b$ and $k$ are constants to be found. **(2)**

The circle $C_2$ meets the $x$ axis at the point $N$.

(c) Write down the coordinates of $N$. **(1)**

**Question 6 continued**

**TOTAL 6 MARKS**

**7**

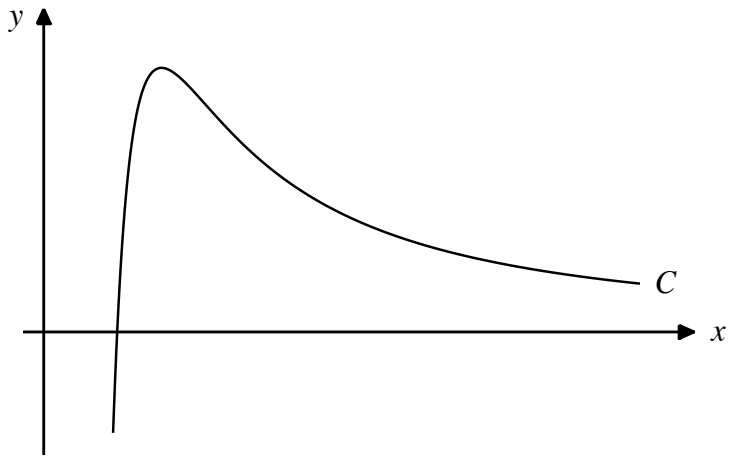


**Figure 3**

Figure 3 above shows a sketch of the curve $C$ with equation $y = f(x)$, where

$$f(x) = \frac{10x^2 - 5\sqrt{x}}{\sqrt{x^7}}, \quad x > 0$$

(a) Express $f(x)$ in the form $10x^p - 5x^q$, where $p$ and $q$ are rational numbers to be found. **(2)**

(b) Hence, find the coordinates of the maximum point on $C$.
Show your working clearly. **(5)**

The line $L$ has the equation $y = k$, where $k$ is a constant.

(c) Find the set of values of $k$ for which the curve $C$ and the line $L$ intersect once. **(2)**

**Question 7 continued**

**Question 7 continued**

**Question 7 continued**

**TOTAL 9 MARKS**

**8** (a) In ascending powers of $x$, find the first three terms of the binomial expansion of

$$\left(1+\frac{x}{3}\right)^{10}$$

up to and including the term in $x^2$, giving each term in its simplest form. **(4)**

(b) **Hence**, find an estimate for the value of $(1.021)^{10}$.
Give your answer to five significant figures. **(3)**

(c) State how you could make your estimate in part (b) more accurate. **(1)**

**Question 8 continued**

**TOTAL 8 MARKS**

**9**

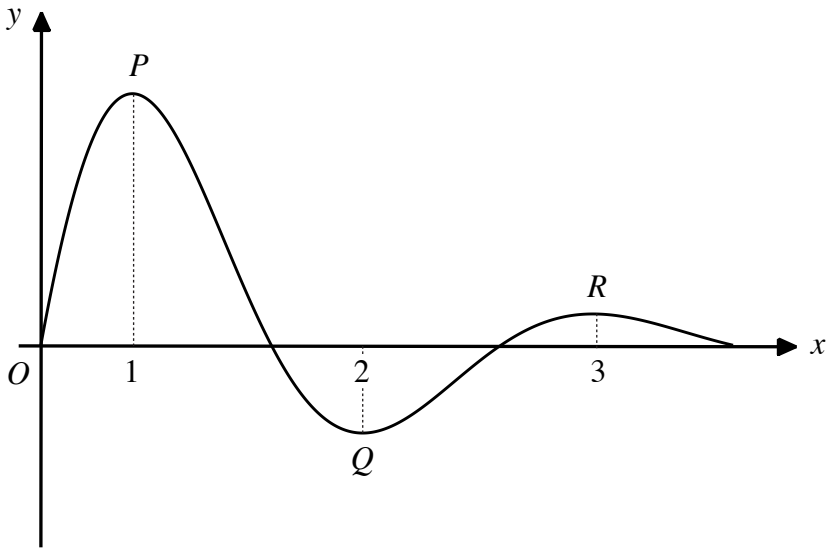


**Figure 4**

Figure 4 above shows a sketch of the curve $C$ with equation $y = f(x)$.

The curve $C$ has turning points $P$, $Q$ and $R$ which have $x$ coordinates 1, 2 and 3 respectively.

Sketch the curve with equation $y = f'(x)$ for $0 \leq x \leq 3$.
On your sketch, show clearly any points where the curve crosses or meets the $x$ axis.

**(2)**

**Question 9 continued**

**TOTAL 2 MARKS**

**10** **Part** of a student's attempt at the question

"Find any real values of $x$ that satisfy $\log_2(x^2+1)-2\log_2(x)=3$."

is set out below.

$$\log_2(x^2+1)-2\log_2(x)=3$$

$$\log_2(x^2+1)-\log_2(2x)=3$$

$$\log_2\left(\frac{x^2+1}{2x}\right)=3$$

$$\frac{x^2+1}{2x}=3^2$$

$$x^2+1=18x$$

The student's solution is incorrect and contains two errors.

(a) Identify the two errors made by the student. **(2)**

(b) Solve the question correctly. **(2)**

**Question 10 continued**

**TOTAL 4 MARKS**

**11** The function f is defined such that

$$f(x) = x^3 + 2x^2 - x - 2, \quad x \in \mathbb{R}$$

(a) Use the factor theorem to show that $(x - 1)$ is a factor of $f(x)$. **(2)**

(b) Hence, express $f(x)$ as the product of three linear factors. **(3)**

The point with coordinates $(0, 0)$ lies on the curve with equation

$$y = (x + a)^3 + 2(x + a)^2 - (x + a) - 2$$

where $a$ is a constant.

(c) Find the possible values of $a$. **(2)**

**Question 11 continued**

**TOTAL 7 MARKS**

**12** (i) By considering the case of odd and even numbers separately, prove that

$$n(n+2)(n^2-1)$$

is divisible by 4 for any integer $n$. **(5)**

(ii) (a) Without explicit calculation, show that $40^2 + 40 + 41 = 41 \times 41$. **(1)**

(b) Jyoti claims that,

"$p^2 + p + 41$ is a prime for each integer $p$"

Show that Jyoti's statement is false. **(1)**

**Question 12 continued**

**TOTAL 7 MARKS**

**13** The points $A$ and $B$ have coordinates $(3, 6)$ and $(-2, p)$ respectively, where $p < 0$.

Given that the length of the line segment $AB$ is $5\sqrt{5}$ units,

(a) find the value of $p$. **(3)**

(b) Hence, find the equation of the perpendicular bisector of $AB$. **(5)**

The perpendicular bisector of $AB$ intersects the coordinate axes at the points $C$ and $D$.

(c) Find the area of the triangle $OCD$, where $O$ is the origin. **(3)**

**Question 13 continued**

**Question 13 continued**

**Question 13 continued**

**TOTAL 11 MARKS**

**14** (i) The function h is defined such that

$$h(x) = 3 - 4\sin(x), \quad -180^\circ \leq x \leq 180^\circ$$

Find the maximum value of h and the value(s) of $x$ at which this occurs. **(3)**

(ii) For $0 < \theta \leq 360^\circ$, solve the equation

$$\sin^2\theta + 4\sin\theta\cos\theta - 5\cos^2\theta = 0$$

giving your answers to one decimal place where appropriate.
*(Solutions based entirely on graphical or numerical methods are not acceptable.)* **(5)**

**Question 14 continued**

**Question 14 continued**

**Question 14 continued**

**TOTAL 8 MARKS**

**15**

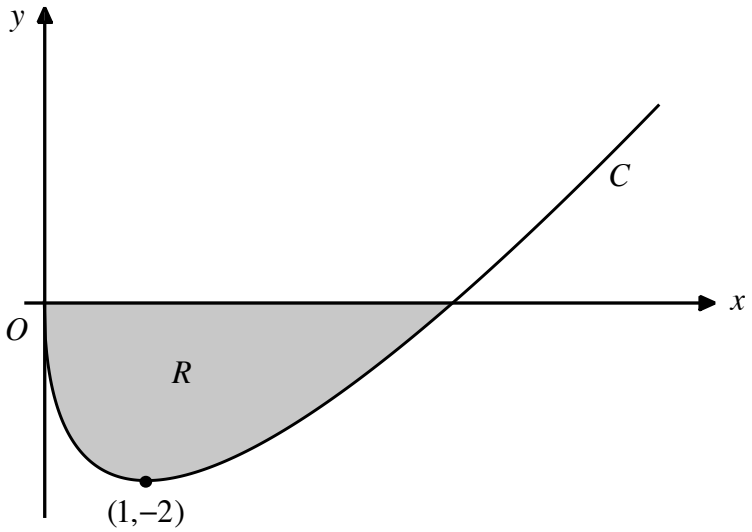


**Figure 5**

Figure 5 above shows a sketch of the curve $C$ with equation $y = f(x)$, where

$$f'(x) = 2 - \frac{2}{\sqrt{x}}, \quad x > 0$$

The finite region $R$, shown shaded in Figure 5, is bounded by the curve $C$ and the $x$ axis.

Given that $C$ passes through $(1, -2)$, find the area of $R$. **(10)**

**Question 15 continued**

**Question 15 continued**

**Question 15 continued**

**END OF PAPER** **TOTAL 10 MARKS**

**TOTAL FOR PAPER IS 100 MARKS**