Answer **all** questions.

1 (a) Simplify:

(i) $x^{\frac{3}{2}} \times x^{\frac{1}{2}}$; *(1 mark)*

(ii) $x^{\frac{3}{2}} \div x$; *(1 mark)*

(iii) $\left(x^{\frac{3}{2}}\right)^2$. *(1 mark)*

(b) (i) Find $\int 3x^{\frac{1}{2}}\, \mathrm{d}x$. *(3 marks)*

(ii) Hence find the value of $\int_1^9 3x^{\frac{1}{2}}\, \mathrm{d}x$. *(2 marks)*

2 The nth term of a geometric sequence is u_n, where

$$u_n = 3 \times 4^n$$

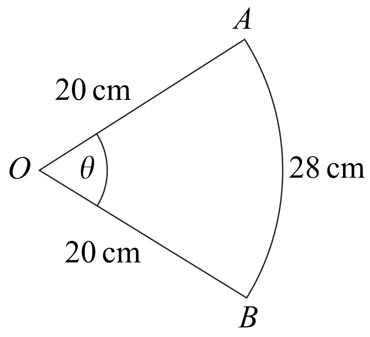
(a) Find the value of u_1 and show that $u_2 = 48$. *(2 marks)*

(b) Write down the common ratio of the geometric sequence. *(1 mark)*

(c) (i) Show that the sum of the first 12 terms of the geometric sequence is $4^k - 4$, where k is an integer. *(3 marks)*

(ii) Hence find the value of $\sum_{n=2}^{12} u_n$. *(1 mark)*

3 The diagram shows a sector OAB of a circle with centre O and radius 20 cm. The angle between the radii OA and OB is θ radians.

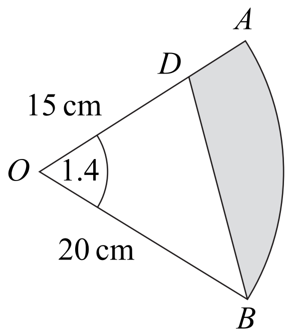


The length of the arc AB is 28 cm.

(a) Show that $\theta = 1.4$. *(2 marks)*

(b) Find the area of the sector OAB. *(2 marks)*

(c) The point D lies on OA. The region bounded by the line BD, the line DA and the arc AB is shaded.



The length of OD is 15 cm.

(i) Find the area of the shaded region, giving your answer to three significant figures. *(3 marks)*

(ii) Use the cosine rule to calculate the length of BD, giving your answer to three significant figures. *(3 marks)*

4 An arithmetic series has first term a and common difference d.

The sum of the first 29 terms is 1102.

(a) Show that $a + 14d = 38$. *(3 marks)*

(b) The sum of the second term and the seventh term is 13.

Find the value of a and the value of d. *(4 marks)*

5 A curve is defined for $x > 0$ by the equation

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

The point P lies on the curve where $x = 2$.

(a) Find the y-coordinate of P. *(1 mark)*

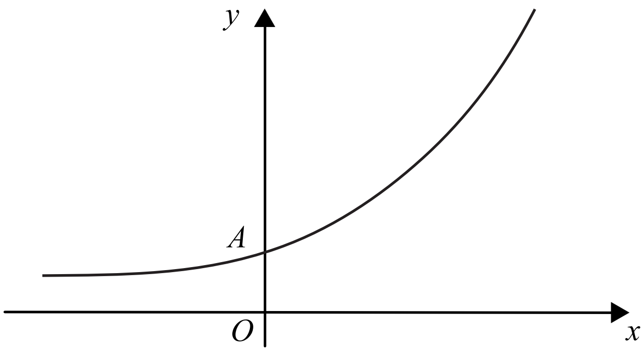
(b) Expand $\left(1 + \frac{2}{x}\right)^2$. *(2 marks)*

(c) Find $\frac{dy}{dx}$. *(3 marks)*

(d) Hence show that the gradient of the curve at P is -2. *(2 marks)*

(e) Find the equation of the normal to the curve at P, giving your answer in the form $x + by + c = 0$, where b and c are integers. *(4 marks)*

6 The diagram shows a sketch of the curve with equation $y = 3(2^x + 1)$.



The curve $y = 3(2^x + 1)$ intersects the y-axis at the point A.

(a) Find the y-coordinate of the point A. *(2 marks)*

(b) Use the trapezium rule with four ordinates (three strips) to find an approximate value for $\int_0^6 3(2^x + 1)\,dx$. *(4 marks)*

(c) The line $y = 21$ intersects the curve $y = 3(2^x + 1)$ at the point P.

(i) Show that the x-coordinate of P satisfies the equation

$$2^x = 6$$ *(1 mark)*

(ii) Use logarithms to find the x-coordinate of P, giving your answer to three significant figures. *(3 marks)*

Turn over for the next question

7 (a) Sketch the graph of $y = \tan x$ for $0° \leqslant x \leqslant 360°$. *(3 marks)*

(b) Write down the **two** solutions of the equation $\tan x = \tan 61°$ in the interval $0° \leqslant x \leqslant 360°$. *(2 marks)*

(c) (i) Given that $\sin\theta + \cos\theta = 0$, show that $\tan\theta = -1$. *(1 mark)*

(ii) Hence solve the equation $\sin(x - 20°) + \cos(x - 20°) = 0$ in the interval $0° \leqslant x \leqslant 360°$. *(4 marks)*

(d) Describe the single geometrical transformation that maps the graph of $y = \tan x$ onto the graph of $y = \tan(x - 20°)$. *(2 marks)*

(e) The curve $y = \tan x$ is stretched in the x-direction with scale factor $\frac{1}{4}$ to give the curve with equation $y = \mathrm{f}(x)$. Write down an expression for $\mathrm{f}(x)$. *(1 mark)*

8 (a) It is given that n satisfies the equation

$$\log_a n = \log_a 3 + \log_a(2n - 1)$$

Find the value of n. *(3 marks)*

(b) Given that $\log_a x = 3$ and $\log_a y - 3\log_a 2 = 4$:

(i) express x in terms of a; *(1 mark)*

(ii) express xy in terms of a. *(4 marks)*

END OF QUESTIONS

Practice 2

Leave blank

1. Evaluate $\int_1^8 \frac{1}{\sqrt{x}}\,dx$, giving your answer in the form $a + b\sqrt{2}$, where a and b are integers.

(4)

Q1

(Total 4 marks)

Leave blank

2.

$$f(x) = 3x^3 - 5x^2 - 16x + 12.$$

(a) Find the remainder when f(x) is divided by (x – 2).

(2)

Given that (x + 2) is a factor of f(x),

(b) factorise f(x) completely.

(4)

Q2

(Total 6 marks)

Leave blank

3. (a) Find the first four terms, in ascending powers of x, in the binomial expansion of $(1+kx)^6$, where k is a non-zero constant.

(3)

Given that, in this expansion, the coefficients of x and x^2 are equal, find

(b) the value of k,

(2)

(c) the coefficient of x^3 .

(1)

Leave blank

Question 3 continued

(Total 6 marks)

Q3

Turn over

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4.

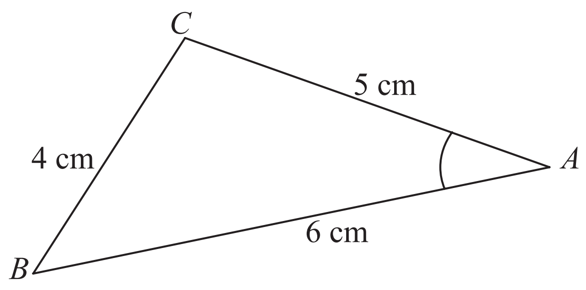

Figure 1

Figure 1 shows the triangle *ABC*, with *AB* = 6 cm, *BC* = 4 cm and *CA* = 5 cm.

(a) Show that $\cos A = \frac{3}{4}$.

(3)

(b) Hence, or otherwise, find the exact value of sin *A*.

(2)

Leave blank

Question 4 continued

Q4

(Total 5 marks)

Turn over

Leave blank

5. The curve C has equation

$$y = x\sqrt{(x^3 + 1)}, \qquad 0 \leqslant x \leqslant 2.$$

(a) Complete the table below, giving the values of y to 3 decimal places at $x = 1$ and $x = 1.5$.

x	0	0.5	1	1.5	2
y	0	0.530			6

(2)

(b) Use the trapezium rule, with all the y values from your table, to find an approximation for the value of $\int_0^2 x\sqrt{(x^3+1)}\,dx$, giving your answer to 3 significant figures.

(4)

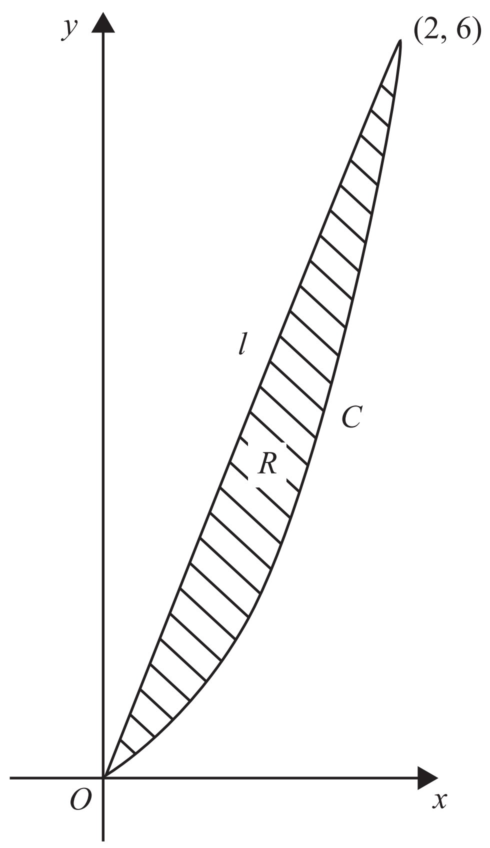

Figure 2

Figure 2 shows the curve C with equation $y = x\sqrt{(x^3 + 1)}$, $0 \leqslant x \leqslant 2$, and the straight line segment l, which joins the origin and the point (2, 6). The finite region R is bounded by C and l.

(c) Use your answer to part (b) to find an approximation for the area of R, giving your answer to 3 significant figures.

(3)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Q5

(Total 9 marks)

Leave blank

6. (a) Find, to 3 significant figures, the value of x for which $8^x = 0.8$.

(2)

(b) Solve the equation

$$2\log_3 x - \log_3 7x = 1.$$

(4)

Leave blank

Question 6 continued

Q6

(Total 6 marks)

Turn over

Leave blank

7.

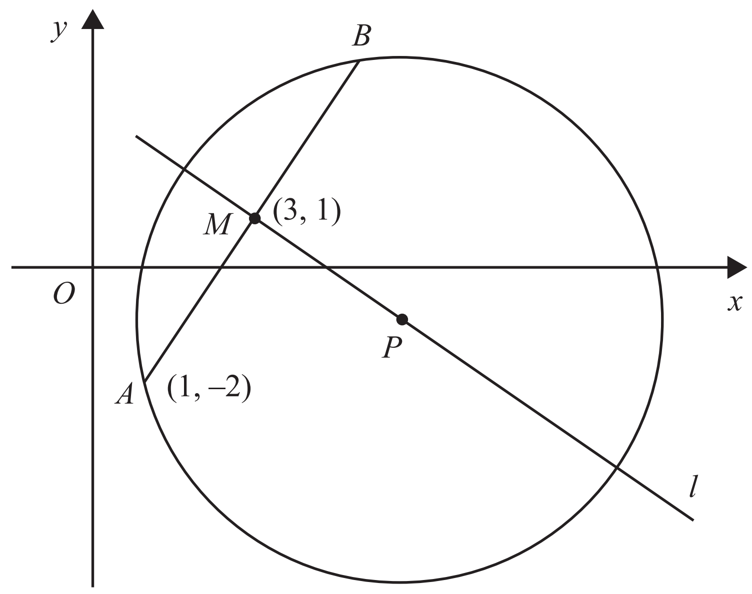

Figure 3

The points A and B lie on a circle with centre P, as shown in Figure 3.
The point A has coordinates $(1, -2)$ and the mid-point M of AB has coordinates $(3, 1)$.
The line l passes through the points M and P.

(a) Find an equation for l.

(4)

Given that the x-coordinate of P is 6,

(b) use your answer to part (a) to show that the y-coordinate of P is -1,

(1)

(c) find an equation for the circle.

(4)

Leave blank

Question 7 continued

Turn over

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Q7

(Total 9 marks)

Turn over

Leave blank

8. A trading company made a profit of £50 000 in 2006 (Year 1).

A model for future trading predicts that profits will increase year by year in a geometric sequence with common ratio r, $r > 1$.

The model therefore predicts that in 2007 (Year 2) a profit of £50 000r will be made.

(a) Write down an expression for the predicted profit in Year n.

(1)

The model predicts that in Year n, the profit made will exceed £200 000.

(b) Show that $n > \frac{\log 4}{\log r} + 1$.

(3)

Using the model with $r = 1.09$,

(c) find the year in which the profit made will first exceed £200 000,

(2)

(d) find the total of the profits that will be made by the company over the 10 years from 2006 to 2015 inclusive, giving your answer to the nearest £10 000.

(3)

Leave blank

Question 8 continued

(Total 9 marks)

Q8

Leave blank

9. (a) Sketch, for $0 \leqslant x \leqslant 2\pi$, the graph of $y = \sin\left(x + \frac{\pi}{6}\right)$.

(2)

(b) Write down the exact coordinates of the points where the graph meets the coordinate axes.

(3)

(c) Solve, for $0 \leqslant x \leqslant 2\pi$, the equation

$$\sin\left(x + \frac{\pi}{6}\right) = 0.65 ,$$

giving your answers in radians to 2 decimal places.

(5)

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Question 9 continued

(Total 10 marks)

Q9

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10.

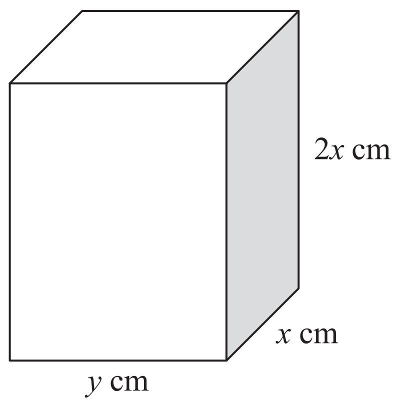


Figure 4

Figure 4 shows a solid brick in the shape of a cuboid measuring $2x$ cm by x cm by y cm.

The total surface area of the brick is 600 cm^2.

(a) Show that the volume, V cm^3, of the brick is given by

$$V = 200x - \frac{4x^3}{3}.$$

(4)

Given that x can vary,

(b) use calculus to find the maximum value of V, giving your answer to the nearest cm^3.
(5)

(c) Justify that the value of V you have found is a maximum.
(2)

Leave blank

Question 10 continued

Turn over

Leave blank

Question 10 continued

Q10

(Total 11 marks)

TOTAL FOR PAPER: 75 MARKS

END

1 A geometric progression $u_1, u_2, u_3, \ldots$ is defined by

$$u_1 = 15 \qquad \text{and} \qquad u_{n+1} = 0.8u_n \text{ for } n \geqslant 1.$$

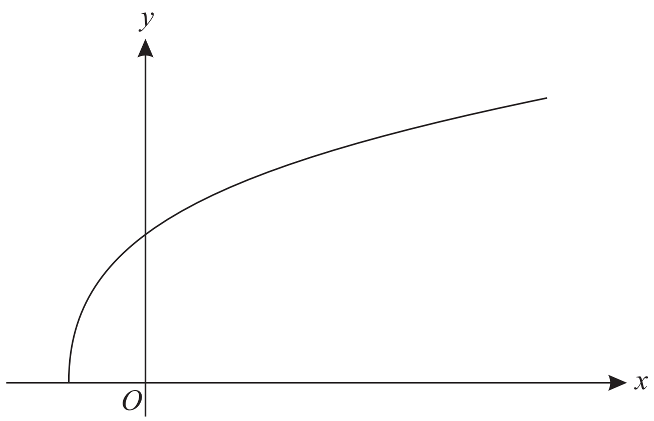
(i) Write down the values of u_2, u_3 and u_4. [2]

(ii) Find $\sum_{n=1}^{20} u_n$. [3]

2 Expand $\left(x + \frac{2}{x}\right)^4$ completely, simplifying the terms. [5]

3 Use logarithms to solve the equation $3^{2x+1} = 5^{200}$, giving the value of x correct to 3 significant figures. [5]

4



The diagram shows the curve $y = \sqrt{4x + 1}$.

(i) Use the trapezium rule, with strips of width 0.5, to find an approximate value for the area of the region bounded by the curve $y = \sqrt{4x + 1}$, the x-axis, and the lines $x = 1$ and $x = 3$. Give your answer correct to 3 significant figures. [4]

(ii) State with a reason whether this approximation is an under-estimate or an over-estimate. [2]

5 **(i)** Show that the equation

$$3\cos^2\theta = \sin\theta + 1$$

can be expressed in the form

$$3\sin^2\theta + \sin\theta - 2 = 0.$$ [2]

(ii) Hence solve the equation

$$3\cos^2\theta = \sin\theta + 1,$$

giving all values of θ between 0° and 360°. [5]

6 **(a)** **(i)** Find $\int x(x^2 - 4)\,dx$. [3]

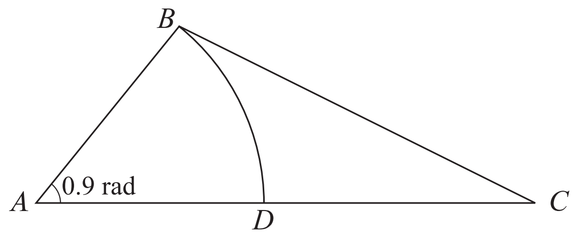
(ii) Hence evaluate $\int_1^6 x(x^2 - 4)\,dx$. [2]

(b) Find $\int \frac{6}{x^3}\,dx$. [3]

7 **(a)** In an arithmetic progression, the first term is 12 and the sum of the first 70 terms is 12 915. Find the common difference. [4]

(b) In a geometric progression, the second term is −4 and the sum to infinity is 9. Find the common ratio. [7]

8



The diagram shows a triangle ABC, where angle BAC is 0.9 radians. BAD is a sector of the circle with centre A and radius AB.

(i) The area of the sector BAD is $16.2\,\text{cm}^2$. Show that the length of AB is 6 cm. [2]

(ii) The area of triangle ABC is twice the area of sector BAD. Find the length of AC. [3]

(iii) Find the perimeter of the region BCD. [6]

9 The polynomial $f(x)$ is given by

$$f(x) = x^3 + 6x^2 + x - 4.$$

(i) **(a)** Show that $(x + 1)$ is a factor of $f(x)$. [1]

(b) Hence find the exact roots of the equation $f(x) = 0$. [6]

(ii) **(a)** Show that the equation

$$2\log_2(x + 3) + \log_2 x - \log_2(4x + 2) = 1$$

can be written in the form $f(x) = 0$. [5]

(b) Explain why the equation

$$2\log_2(x + 3) + \log_2 x - \log_2(4x + 2) = 1$$

has only one real root and state the exact value of this root. [2]

Answer **all** questions.

1 (a) Write $\sqrt{x^3}$ in the form x^k, where k is a fraction. *(1 mark)*

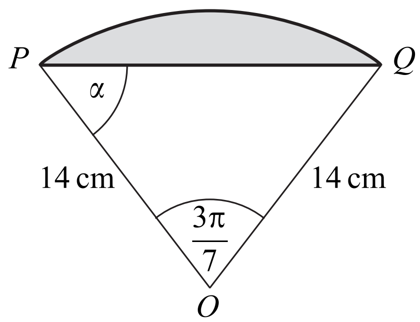
(b) A curve, defined for $x \geqslant 0$, has equation

$$y = x^2 - \sqrt{x^3}$$

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

(ii) Find the equation of the tangent to the curve at the point where $x = 4$, giving your answer in the form $y = mx + c$. *(5 marks)*

2 The diagram shows a shaded segment of a circle with centre O and radius 14 cm, where PQ is a chord of the circle.



In triangle OPQ, angle $POQ = \frac{3\pi}{7}$ radians and angle $OPQ = \alpha$ radians.

(a) Find the length of the arc PQ, giving your answer as a multiple of π. *(2 marks)*

(b) Find α in terms of π. *(2 marks)*

(c) Find the **perimeter** of the shaded segment, giving your answer to three significant figures. *(2 marks)*

3 A geometric series begins

$$20 + 16 + 12.8 + 10.24 + \ldots$$

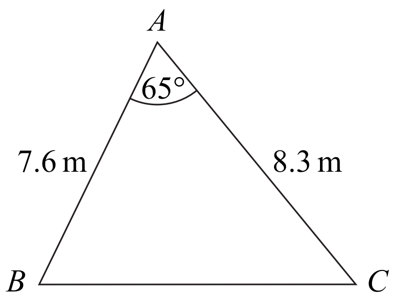
(a) Find the common ratio of the series. *(1 mark)*

(b) Find the sum to infinity of the series. *(2 marks)*

(c) Find the sum of the first 20 terms of the series, giving your answer to three decimal places. *(2 marks)*

(d) Prove that the nth term of the series is 25×0.8^n. *(2 marks)*

4 The diagram shows a triangle ABC.



The size of angle BAC is 65°, and the lengths of AB and AC are 7.6 m and 8.3 m respectively.

(a) Show that the length of BC is 8.56 m, correct to three significant figures. *(3 marks)*

(b) Calculate the area of triangle ABC, giving your answer in m^2 to three significant figures. *(2 marks)*

(c) The perpendicular from A to BC meets BC at the point D.

Calculate the length of AD, giving your answer to the nearest 0.1 m. *(3 marks)*

5 (a) Write down the value of:

(i) $\log_a 1$; *(1 mark)*

(ii) $\log_a a$. *(1 mark)*

(b) Given that

$$\log_a x = \log_a 5 + \log_a 6 - \log_a 1.5$$

find the value of x. *(3 marks)*

6 The nth term of a sequence is u_n.

The sequence is defined by

$$u_{n+1} = pu_n + q$$

where p and q are constants.

The first three terms of the sequence are given by

$$u_1 = -8 \qquad u_2 = 8 \qquad u_3 = 4$$

(a) Show that $q = 6$ and find the value of p. *(5 marks)*

(b) Find the value of u_4. *(1 mark)*

(c) The limit of u_n as n tends to infinity is L.

(i) Write down an equation for L. *(1 mark)*

(ii) Hence find the value of L. *(2 marks)*

7 (a) The expression $\left(1 + \dfrac{4}{x^2}\right)^3$ can be written in the form

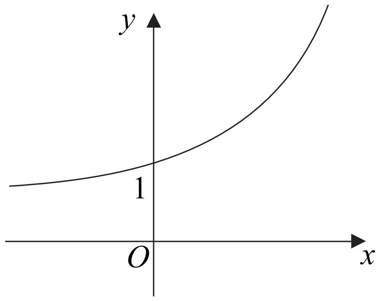
$$1 + \frac{p}{x^2} + \frac{q}{x^4} + \frac{64}{x^6}$$

By using the binomial expansion, or otherwise, find the values of the integers p and q. *(3 marks)*

(b) (i) Hence find $\displaystyle\int \left(1 + \frac{4}{x^2}\right)^3 \mathrm{d}x$. *(4 marks)*

(ii) Hence find the value of $\displaystyle\int_1^2 \left(1 + \frac{4}{x^2}\right)^3 \mathrm{d}x$. *(2 marks)*

8 The diagram shows a sketch of the curve with equation $y = 6^x$.



(a) (i) Use the trapezium rule with five ordinates (four strips) to find an approximate value for $\int_0^2 6^x \, dx$, giving your answer to three significant figures. *(4 marks)*

(ii) Explain, with the aid of a diagram, whether your approximate value will be an overestimate or an underestimate of the true value of $\int_0^2 6^x \, dx$. *(2 marks)*

(b) (i) Describe a single geometrical transformation that maps the graph of $y = 6^x$ onto the graph of $y = 6^{3x}$. *(2 marks)*

(ii) The line $y = 84$ intersects the curve $y = 6^{3x}$ at the point A. By using logarithms, find the x-coordinate of A, giving your answer to three decimal places. *(4 marks)*

(c) The graph of $y = 6^x$ is translated by $\begin{bmatrix} 1 \\ -2 \end{bmatrix}$ to give the graph of the curve with equation $y = f(x)$. Write down an expression for $f(x)$. *(2 marks)*

9 (a) Solve the equation $\sin 2x = \sin 48°$, giving the values of x in the interval $0° \leqslant x < 360°$. *(4 marks)*

(b) Solve the equation $2\sin\theta - 3\cos\theta = 0$ in the interval $0° \leqslant \theta < 360°$, giving your answers to the nearest $0.1°$. *(4 marks)*

END OF QUESTIONS

Practice 5

Leave blank

1. $$f(x) = 2x^3 - 3x^2 - 39x + 20$$

(a) Use the factor theorem to show that $(x + 4)$ is a factor of $f(x)$.

(2)

(b) Factorise $f(x)$ completely.

(4)

Leave blank

Question 1 continued

Q1

(Total 6 marks)

Turn over

Leave blank

2. $y = \sqrt{(5^x + 2)}$

(a) Complete the table below, giving the values of y to 3 decimal places.

x	0	0.5	1	1.5	2
y			2.646	3.630	

(2)

(b) Use the trapezium rule, with all the values of y from your table, to find an approximation for the value of $\int_0^2 \sqrt{(5^x + 2)}\, dx$.

(4)

Leave blank

Question 2 continued

(Total 6 marks)

Q2

Leave blank

3. (a) Find the first 4 terms, in ascending powers of x, of the binomial expansion of $(1 + ax)^{10}$, where a is a non-zero constant. Give each term in its simplest form.

(4)

Given that, in this expansion, the coefficient of x^3 is double the coefficient of x^2,

(b) find the value of a.

(2)

Leave blank

Question 3 continued

Q3

(Total 6 marks)

Turn over

Leave blank

4. (a) Find, to 3 significant figures, the value of x for which $5^x = 7$.

(2)

(b) Solve the equation $5^{2x} - 12(5^x) + 35 = 0$.

(4)

Leave blank

Question 4 continued

(Total 6 marks)

Q4

Leave blank

5. The circle C has centre (3, 1) and passes through the point $P(8, 3)$.

(a) Find an equation for C.

(4)

(b) Find an equation for the tangent to C at P, giving your answer in the form $ax + by + c = 0$, where a, b and c are integers.

(5)

Leave blank

Question 5 continued

Q5

(Total 9 marks)

Leave blank

6. A geometric series has first term 5 and common ratio $\frac{4}{5}$.

Calculate

(a) the 20th term of the series, to 3 decimal places,

(2)

(b) the sum to infinity of the series.

(2)

Given that the sum to k terms of the series is greater than 24.95,

(c) show that $k > \frac{\log 0.002}{\log 0.8}$,

(4)

(d) find the smallest possible value of k.

(1)

Leave blank

Question 6 continued

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Question 6 continued

Leave blank

Question 6 continued

Q6

(Total 9 marks)

Leave blank

7.

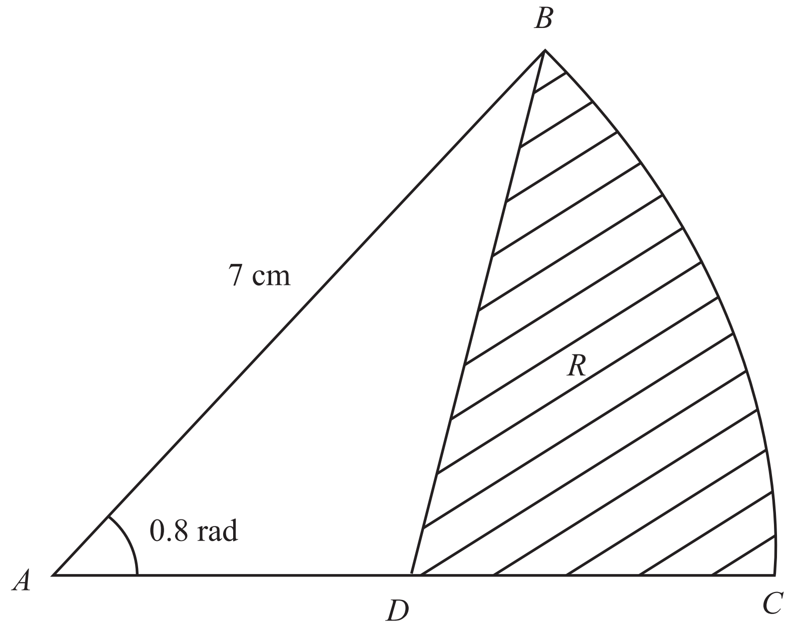

Figure 1

Figure 1 shows *ABC*, a sector of a circle with centre *A* and radius 7 cm.

Given that the size of $\angle BAC$ is exactly 0.8 radians, find

(a) the length of the arc *BC*,
(2)

(b) the area of the sector *ABC*.
(2)

The point *D* is the mid-point of *AC*. The region *R*, shown shaded in Figure 1, is bounded by *CD*, *DB* and the arc *BC*.

Find

(c) the perimeter of *R*, giving your answer to 3 significant figures,
(4)

(d) the area of *R*, giving your answer to 3 significant figures.
(4)

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Question 7 continued

Leave blank

Question 7 continued

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Question 7 continued

(Total 12 marks)

Q7

Leave blank

8.

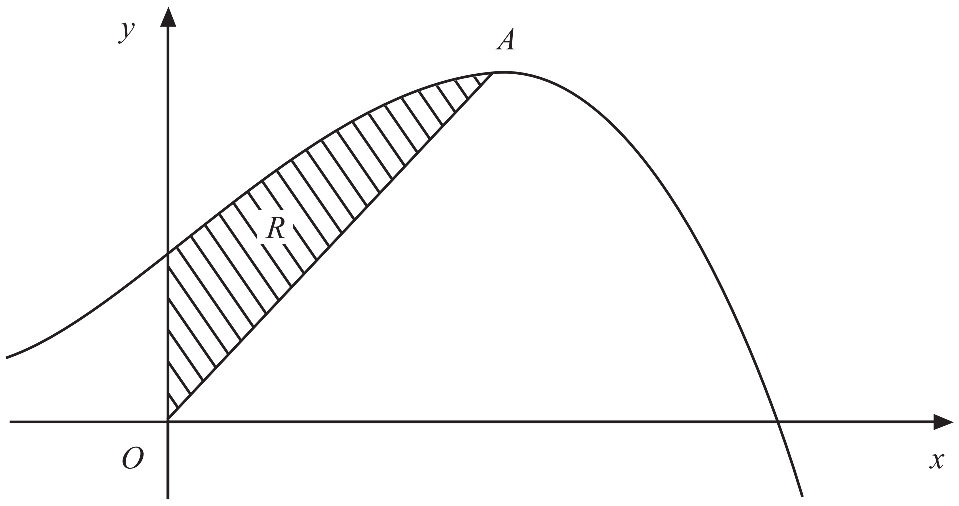


Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = 10 + 8x + x^2 - x^3$.

The curve has a maximum turning point A.

(a) Using calculus, show that the x-coordinate of A is 2.
(3)

The region R, shown shaded in Figure 2, is bounded by the curve, the y-axis and the line from O to A, where O is the origin.

(b) Using calculus, find the exact area of R.
(8)

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Q8

(Total 11 marks)

Leave blank

9. Solve, for $0 \leqslant x < 360°$,

(a) $\sin(x - 20°) = \frac{1}{\sqrt{2}}$ **(4)**

(b) $\cos 3x = -\frac{1}{2}$ **(6)**

Leave blank

Question 9 continued

Turn over

Leave blank

Question 9 continued

Leave blank

Question 9 continued

Q9

(Total 10 marks)

TOTAL FOR PAPER: 75 MARKS

END

1 Find and simplify the first three terms in the expansion of $(2-3x)^6$ in ascending powers of x. [4]

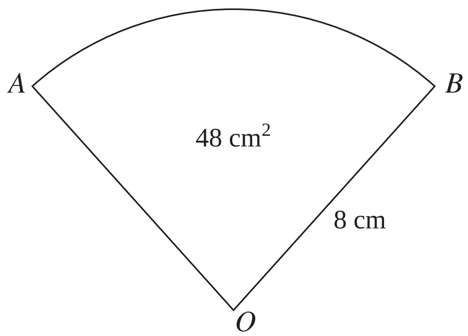
2 A sequence $u_1, u_2, u_3, \ldots$ is defined by

$$u_1 = 3 \quad \text{and} \quad u_{n+1} = 1 - \frac{1}{u_n} \text{ for } n \geqslant 1.$$

(i) Write down the values of u_2, u_3 and u_4. [3]

(ii) Describe the behaviour of the sequence. [1]

3



The diagram shows a sector AOB of a circle with centre O and radius 8 cm. The area of the sector is 48 cm^2.

(i) Find angle AOB, giving your answer in radians. [2]

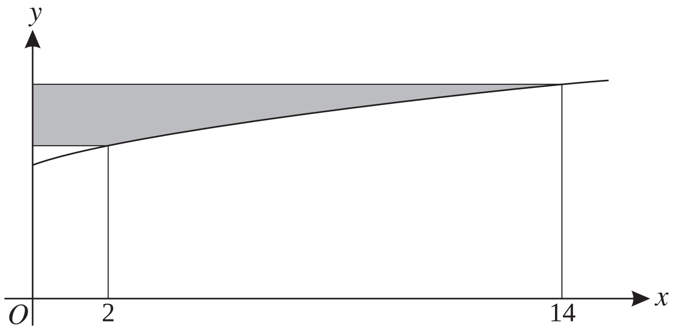
(ii) Find the area of the segment bounded by the arc AB and the chord AB. [3]

4 The cubic polynomial $ax^3 - 4x^2 - 7ax + 12$ is denoted by $f(x)$.

(i) Given that $(x-3)$ is a factor of $f(x)$, find the value of the constant a. [3]

(ii) Using this value of a, find the remainder when $f(x)$ is divided by $(x+2)$. [2]

5



The diagram shows the curve $y = 3 + \sqrt{x+2}$.

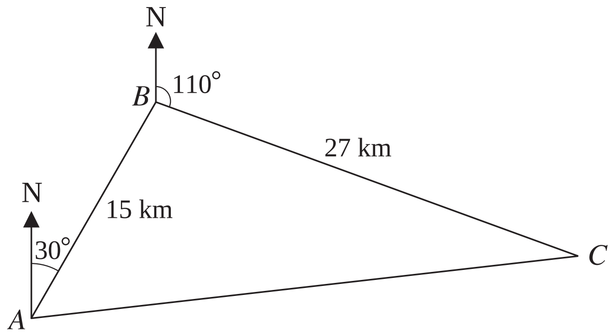
The shaded region is bounded by the curve, the y-axis, and two lines parallel to the x-axis which meet the curve where $x = 2$ and $x = 14$.

(i) Show that the area of the shaded region is given by

$$\int_5^7 (y^2 - 6y + 7)\,dy. \qquad [3]$$

(ii) Hence find the exact area of the shaded region. [4]

6



In the diagram, a lifeboat station is at point A. A distress call is received and the lifeboat travels 15 km on a bearing of 030° to point B. A second call is received and the lifeboat then travels 27 km on a bearing of 110° to arrive at point C. The lifeboat then travels back to the station at A.

(i) Show that angle ABC is 100°. [1]

(ii) Find the distance that the lifeboat has to travel to get from C back to A. [2]

(iii) Find the bearing on which the lifeboat has to travel to get from C to A. [4]

7 **(a)** Find $\int x^3(x^2 - x + 5)\,dx$. [4]

(b) **(i)** Find $\int 18x^{-4}\,dx$. [2]

(ii) Hence evaluate $\int_2^{\infty} 18x^{-4}\,dx$. [2]

[Turn over

8 **(i)** Sketch the curve $y = 2 \times 3^x$, stating the coordinates of any intersections with the axes. [3]

(ii) The curve $y = 2 \times 3^x$ intersects the curve $y = 8^x$ at the point P. Show that the x-coordinate of P may be written as

$$\frac{1}{3 - \log_2 3}.$$ [5]

9 **(a)** **(i)** Show that the equation

$$2\sin x \tan x - 5 = \cos x$$

can be expressed in the form

$$3\cos^2 x + 5\cos x - 2 = 0.$$ [3]

(ii) Hence solve the equation

$$2\sin x \tan x - 5 = \cos x,$$

giving all values of x, in radians, for $0 \leqslant x \leqslant 2\pi$. [4]

(b) Use the trapezium rule, with four strips each of width 0.25, to find an approximate value for

$$\int_0^1 \cos x \, dx,$$

where x is in radians. Give your answer correct to 3 significant figures. [4]

10 Jamie is training for a triathlon, which involves swimming, running and cycling.

- On Day 1, he swims 2 km and then swims the same distance on each subsequent day.
- On Day 1, he runs 2 km and, on each subsequent day, he runs 0.5 km further than on the previous day. (Thus he runs 2.5 km on Day 2, 3 km on Day 3, and so on.)
- On Day 1 he cycles 2 km and, on each subsequent day, he cycles a distance 10% further than on the previous day.

(i) Find how far Jamie runs on Day 15. [2]

(ii) Verify that the distance cycled in a day first exceeds 12 km on Day 20. [3]

(iii) Find the day on which the total distance cycled, up to and including that day, first exceeds 200 km. [4]

(iv) Find the total distance travelled, by swimming, running and cycling, up to and including Day 30. [4]