Answer **all** questions.

1 Given that $y = 16x + x^{-1}$, find the two values of x for which $\frac{dy}{dx} = 0$. *(5 marks)*

2 (a) Use the trapezium rule with five ordinates (four strips) to find an approximate value for

$$\int_0^4 \frac{1}{x^2 + 1}\,dx$$

giving your answer to four significant figures. *(4 marks)*

(b) State how you could obtain a better approximation to the value of the integral using the trapezium rule. *(1 mark)*

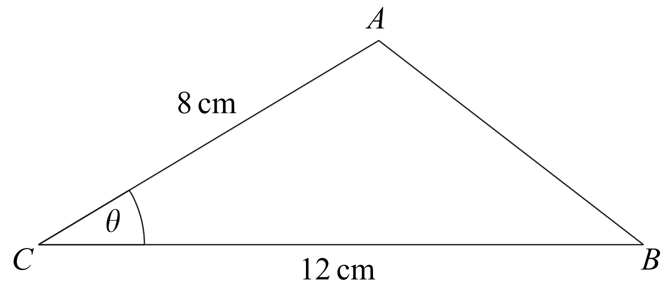
3 (a) Use logarithms to solve the equation $0.8^x = 0.05$, giving your answer to three decimal places. *(3 marks)*

(b) An infinite geometric series has common ratio r. The sum to infinity of the series is five times the first term of the series.

(i) Show that $r = 0.8$. *(3 marks)*

(ii) Given that the first term of the series is 20, find the least value of n such that the nth term of the series is less than 1. *(3 marks)*

4 The triangle ABC, shown in the diagram, is such that $AC = 8$ cm, $CB = 12$ cm and angle $ACB = \theta$ radians.

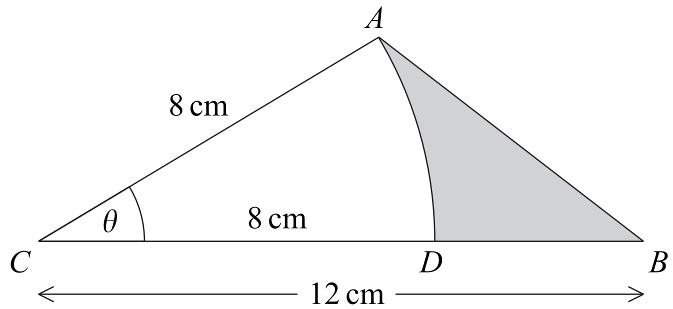


The area of triangle $ABC = 20\,\text{cm}^2$.

(a) Show that $\theta = 0.430$ correct to three significant figures. *(3 marks)*

(b) Use the cosine rule to calculate the length of AB, giving your answer to two significant figures. *(3 marks)*

(c) The point D lies on CB such that AD is an arc of a circle centre C and radius 8 cm. The region bounded by the arc AD and the straight lines DB and AB is shaded in the diagram.



Calculate, to two significant figures:

(i) the length of the arc AD; *(2 marks)*

(ii) the area of the shaded region. *(3 marks)*

5 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

$$u_1 = 200 \qquad u_2 = 150 \qquad u_3 = 120$$

(a) Show that $p = 0.6$ and find the value of q. *(5 marks)*

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

(c) The limit of u_n as n tends to infinity is L. Write down an equation for L and hence find the value of L. *(3 marks)*

6 (a) Describe the geometrical transformation that maps the curve with equation $y = \sin x$ onto the curve with equation:

(i) $y = 2\sin x$; *(2 marks)*

(ii) $y = -\sin x$; *(2 marks)*

(iii) $y = \sin(x - 30°)$. *(2 marks)*

(b) Solve the equation $\sin(\theta - 30°) = 0.7$, giving your answers to the nearest 0.1° in the interval $0° \leqslant \theta \leqslant 360°$. *(3 marks)*

(c) Prove that $(\cos x + \sin x)^2 + (\cos x - \sin x)^2 = 2$. *(4 marks)*

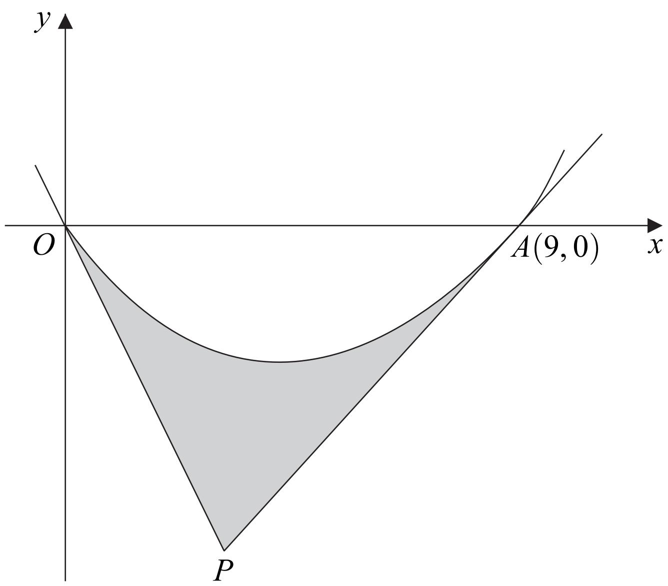
7 It is given that n satisfies the equation

$$2\log_a n - \log_a(5n - 24) = \log_a 4$$

(a) Show that $n^2 - 20n + 96 = 0$. *(3 marks)*

(b) Hence find the possible values of n. *(2 marks)*

8 A curve, drawn from the origin O, crosses the x-axis at the point $A(9, 0)$. Tangents to the curve at O and A meet at the point P, as shown in the diagram.



The curve, defined for $x \geqslant 0$, has equation

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

(a) Find $\dfrac{dy}{dx}$. *(2 marks)*

(b) (i) Find the value of $\dfrac{dy}{dx}$ at the point O and hence write down an equation of the tangent at O. *(2 marks)*

(ii) Show that the equation of the tangent at $A(9, 0)$ is $2y = 3x - 27$. *(3 marks)*

(iii) Hence find the coordinates of the point P where the two tangents meet. *(3 marks)*

(c) Find $\displaystyle\int \left(x^{\frac{3}{2}} - 3x\right) dx$. *(3 marks)*

(d) Calculate the area of the shaded region bounded by the curve and the tangents OP and AP. *(5 marks)*

END OF QUESTIONS

Practice 2

Leave blank

1. (a) Find the remainder when

$$x^3 - 2x^2 - 4x + 8$$

is divided by

(i) $x - 3$,

(ii) $x + 2$.

(3)

(b) Hence, or otherwise, find all the solutions to the equation

$$x^3 - 2x^2 - 4x + 8 = 0.$$

(4)

Leave blank

Question 1 continued

(Total 7 marks)

Q1

Leave blank

2. The fourth term of a geometric series is 10 and the seventh term of the series is 80.

For this series, find

(a) the common ratio,
(2)

(b) the first term,
(2)

(c) the sum of the first 20 terms, giving your answer to the nearest whole number.
(2)

Leave blank

Question 2 continued

Q2

(Total 6 marks)

Leave blank

3. (a) Find the first 4 terms of the expansion of $\left(1+\frac{x}{2}\right)^{10}$ in ascending powers of x, giving each term in its simplest form.

(4)

(b) Use your expansion to estimate the value of $(1.005)^{10}$, giving your answer to 5 decimal places.

(3)

Leave blank

Question 3 continued

Q3

(Total 7 marks)

Leave blank

4. (a) Show that the equation

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

can be written as

$$5\sin^2\theta = 3.$$

(2)

(b) Hence solve, for $0° \leqslant \theta < 360°$, the equation

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

giving your answers to 1 decimal place.

(7)

Leave blank

Question 4 continued

Q4

(Total 9 marks)

Leave blank

5. Given that a and b are positive constants, solve the simultaneous equations

$$a = 3b,$$

$$\log_3 a + \log_3 b = 2.$$

Give your answers as exact numbers.

(6)

Leave blank

Question 5 continued

(Total 6 marks)

Q5

Leave blank

6.

Figure 1

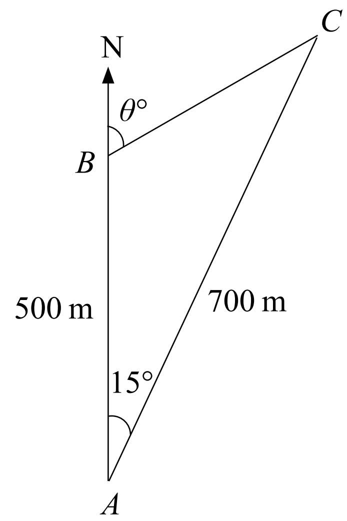


Figure 1 shows 3 yachts A, B and C which are assumed to be in the same horizontal plane. Yacht B is 500 m due north of yacht A and yacht C is 700 m from A. The bearing of C from A is 015°.

(a) Calculate the distance between yacht B and yacht C, in metres to 3 significant figures.

(3)

The bearing of yacht C from yacht B is $\theta°$, as shown in Figure 1.

(b) Calculate the value of θ.

(4)

Leave blank

Question 6 continued

(Total 7 marks)

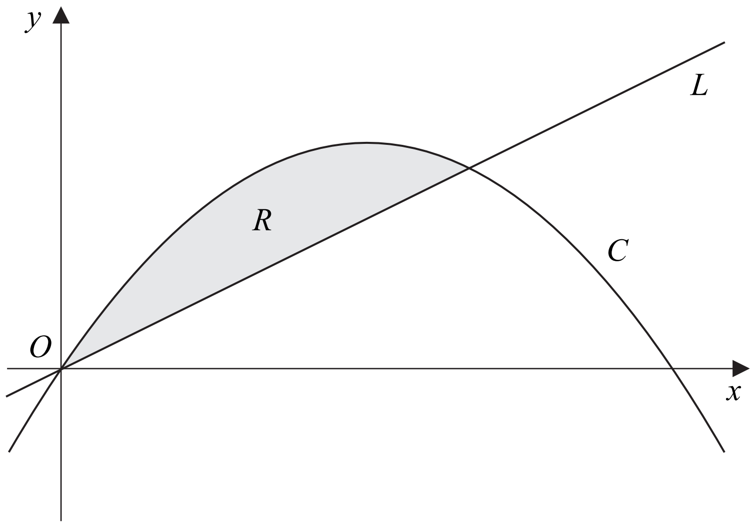
Q6

Turn over

Leave blank

7.

Figure 2



In Figure 2 the curve C has equation $y = 6x - x^2$ and the line L has equation $y = 2x$.

(a) Show that the curve C intersects the x-axis at $x = 0$ and $x = 6$.

(1)

(b) Show that the line L intersects the curve C at the points (0, 0) and (4, 8).

(3)

The region R, bounded by the curve C and the line L, is shown shaded in Figure 2.

(c) Use calculus to find the area of R.

(6)

Leave blank

Question 7 continued

Turn over

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Q7

(Total 10 marks)

Leave blank

8. A circle C has centre M (6, 4) and radius 3.

(a) Write down the equation of the circle in the form

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

(2)

Figure 3

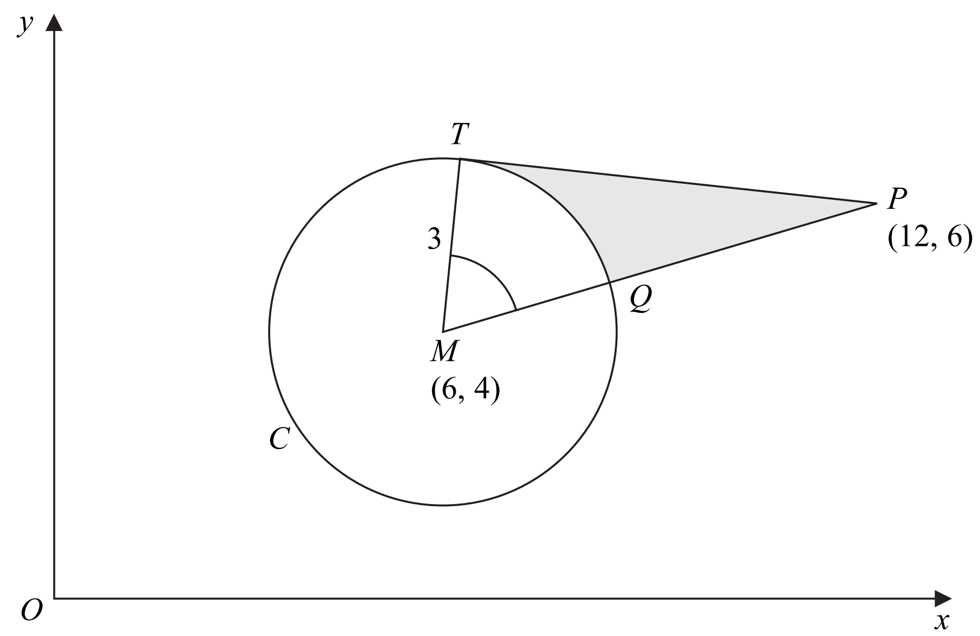


Figure 3 shows the circle C. The point T lies on the circle and the tangent at T passes through the point P (12, 6). The line MP cuts the circle at Q.

(b) Show that the angle TMQ is 1.0766 radians to 4 decimal places.

(4)

The shaded region TPQ is bounded by the straight lines TP, QP and the arc TQ, as shown in Figure 3.

(c) Find the area of the shaded region TPQ. Give your answer to 3 decimal places.

(5)

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Leave blank

Question 8 continued

Q8

(Total 11 marks)

Turn over

Leave blank

9. **Figure 4**

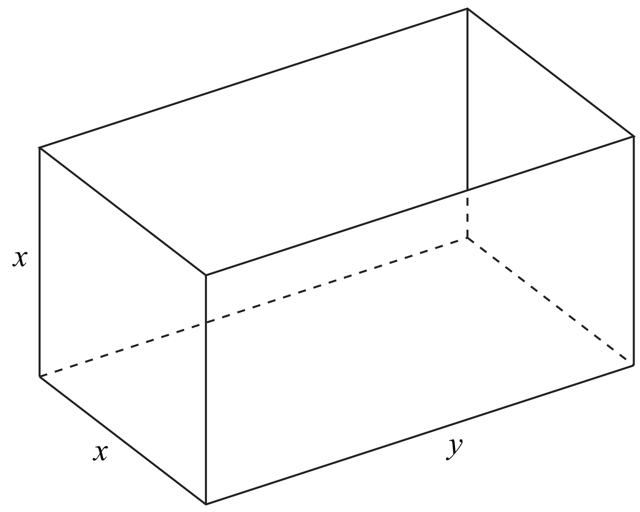


Figure 4 shows an open-topped water tank, in the shape of a cuboid, which is made of sheet metal. The base of the tank is a rectangle x metres by y metres. The height of the tank is x metres.

The capacity of the tank is $100\,\text{m}^3$.

(a) Show that the area A m^2 of the sheet metal used to make the tank is given by

$$A = \frac{300}{x} + 2x^2 .$$

(4)

(b) Use calculus to find the value of x for which A is stationary.

(4)

(c) Prove that this value of x gives a minimum value of A.

(2)

(d) Calculate the minimum area of sheet metal needed to make the tank.

(2)

Leave blank

Question 9 continued

Turn over

Leave blank

Question 9 continued

Q9

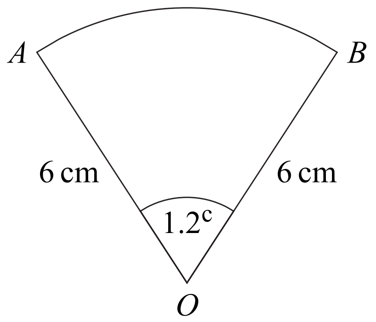
(Total 12 marks)

TOTAL FOR PAPER: 75 MARKS

END

Answer **all** questions.

1 The diagram shows a sector OAB of a circle with centre O.



The radius of the circle is 6 cm and the angle AOB is 1.2 radians.

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

(b) Find the perimeter of the sector OAB. *(3 marks)*

2 Use the trapezium rule with four ordinates (three strips) to find an approximate value for

$$\int_0^3 \sqrt{2^x}\, dx$$

giving your answer to three decimal places. *(4 marks)*

3 (a) Write down the values of p, q and r given that:

(i) $64 = 8^p$;

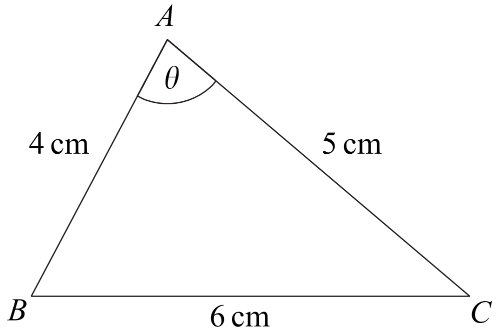
(ii) $\frac{1}{64} = 8^q$;

(iii) $\sqrt{8} = 8^r$. *(3 marks)*

(b) Find the value of x for which

$$\frac{8^x}{\sqrt{8}} = \frac{1}{64}$$ *(2 marks)*

4 The triangle ABC, shown in the diagram, is such that $BC = 6$ cm, $AC = 5$ cm and $AB = 4$ cm. The angle BAC is θ.



(a) Use the cosine rule to show that $\cos\theta = \frac{1}{8}$. *(3 marks)*

(b) Hence use a trigonometrical identity to show that $\sin\theta = \frac{3\sqrt{7}}{8}$. *(3 marks)*

(c) Hence find the area of the triangle ABC. *(2 marks)*

5 The second term of a geometric series is 48 and the fourth term is 3.

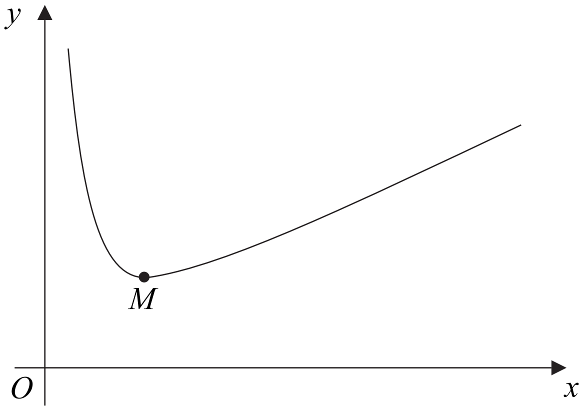
(a) Show that one possible value for the common ratio, r, of the series is $-\frac{1}{4}$ and state the other value. *(4 marks)*

(b) In the case when $r = -\frac{1}{4}$, find:

(i) the first term; *(1 mark)*

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

6 A curve C is defined for $x > 0$ by the equation $y = x + 1 + \frac{4}{x^2}$ and is sketched below.



(a) (i) Given that $y = x + 1 + \frac{4}{x^2}$, find $\frac{dy}{dx}$. *(3 marks)*

(ii) The curve C has a minimum point M. Find the coordinates of M. *(4 marks)*

(iii) Find an equation of the normal to C at the point $(1, 6)$. *(4 marks)*

(b) (i) Find $\int \left(x + 1 + \frac{4}{x^2} \right) dx$. *(3 marks)*

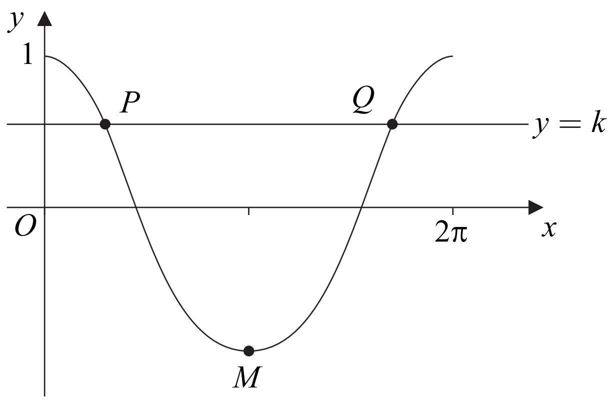
(ii) Hence find the area of the region bounded by the curve C, the lines $x = 1$ and $x = 4$ and the x-axis. *(2 marks)*

7 (a) The first four terms of the binomial expansion of $(1 + 2x)^8$ in ascending powers of x are $1 + ax + bx^2 + cx^3$. Find the values of the integers a, b and c. *(4 marks)*

(b) Hence find the coefficient of x^3 in the expansion of $\left(1 + \frac{1}{2}x\right)(1 + 2x)^8$. *(3 marks)*

8 (a) Solve the equation $\cos x = 0.3$ in the interval $0 \leqslant x \leqslant 2\pi$, giving your answers in radians to three significant figures. *(3 marks)*

(b) The diagram shows the graph of $y = \cos x$ for $0 \leqslant x \leqslant 2\pi$ and the line $y = k$.



The line $y = k$ intersects the curve $y = \cos x$, $0 \leqslant x \leqslant 2\pi$, at the points P and Q. The point M is the minimum point of the curve.

(i) Write down the coordinates of the point M. *(2 marks)*

(ii) The x-coordinate of P is α.

Write down the x-coordinate of Q in terms of π and α. *(1 mark)*

(c) Describe the geometrical transformation that maps the graph of $y = \cos x$ onto the graph of $y = \cos 2x$. *(2 marks)*

(d) Solve the equation $\cos 2x = \cos\dfrac{4\pi}{5}$ in the interval $0 \leqslant x \leqslant 2\pi$, giving the values of x in terms of π. *(4 marks)*

Turn over for the next question

9 (a) Solve the equation $3\log_a x = \log_a 8$. *(2 marks)*

(b) Show that

$$3\log_a 6 - \log_a 8 = \log_a 27$$

(3 marks)

(c) (i) The point $P(3, p)$ lies on the curve $y = 3\log_{10} x - \log_{10} 8$.

Show that $p = \log_{10}\left(\frac{27}{8}\right)$. *(2 marks)*

(ii) The point $Q(6, q)$ also lies on the curve $y = 3\log_{10} x - \log_{10} 8$.

Show that the gradient of the line PQ is $\log_{10} 2$. *(4 marks)*

END OF QUESTIONS

Practice 4

Leave blank

1. Find the first 3 terms, in ascending powers of x, of the binomial expansion of $(3-2x)^5$, giving each term in its simplest form.

(4)

(Total 4 marks)

Q1

Leave blank

2.

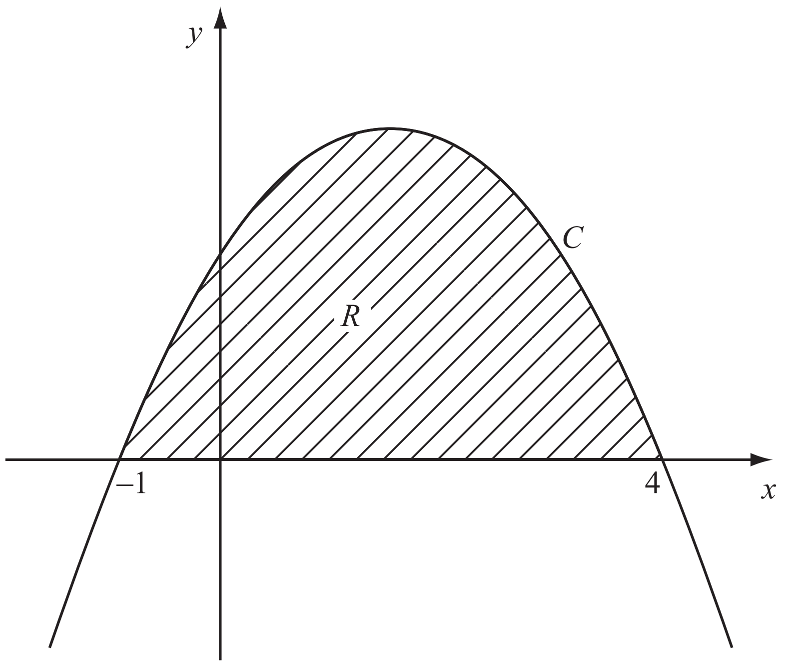


Figure 1

Figure 1 shows part of the curve C with equation $y = (1 + x)(4 - x)$.

The curve intersects the x-axis at $x = -1$ and $x = 4$. The region R, shown shaded in Figure 1, is bounded by C and the x-axis.

Use calculus to find the exact area of R.

(5)

Leave blank

Question 2 continued

Q2

(Total 5 marks)

Leave blank

3. $$y = \sqrt{(10x - x^2)}.$$

(a) Complete the table below, giving the values of y to 2 decimal places.

x	1	1.4	1.8	2.2	2.6	3
y	3	3.47			4.39	

(2)

(b) Use the trapezium rule, with all the values of y from your table, to find an approximation for the value of $\int_1^3 \sqrt{(10x - x^2)}\, dx$.

(4)

Leave blank

Question 3 continued

Q3

(Total 6 marks)

Turn over

Leave blank

4. Given that $0 < x < 4$ and

$$\log_5(4-x) - 2\log_5 x = 1,$$

find the value of x.

(6)

Leave blank

Question 4 continued

(Total 6 marks)

Q4

Leave blank

5.

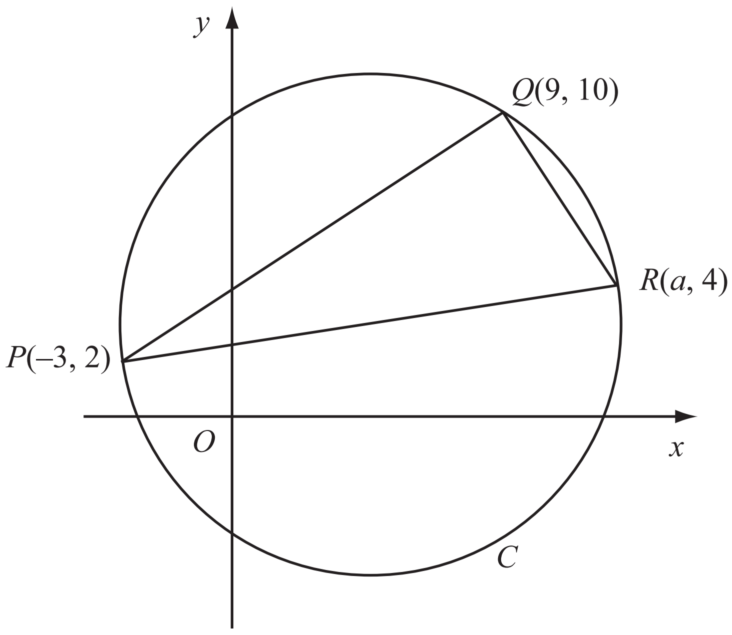


Figure 2

The points $P(-3, 2)$, $Q(9, 10)$ and $R(a, 4)$ lie on the circle C, as shown in Figure 2.
Given that PR is a diameter of C,

(a) show that $a = 13$,

(3)

(b) find an equation for C.

(5)

Leave blank

Question 5 continued

Leave blank

Question 5 continued

Leave blank

Question 5 continued

(Total 8 marks)

Q5

Leave blank

6. $$f(x) = x^4 + 5x^3 + ax + b,$$

where a and b are constants.

The remainder when $f(x)$ is divided by $(x - 2)$ is equal to the remainder when $f(x)$ is divided by $(x + 1)$.

(a) Find the value of a.

(5)

Given that $(x + 3)$ is a factor of $f(x)$,

(b) find the value of b.

(3)

Leave blank

Question 6 continued

Q6

(Total 8 marks)

Turn over

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7.

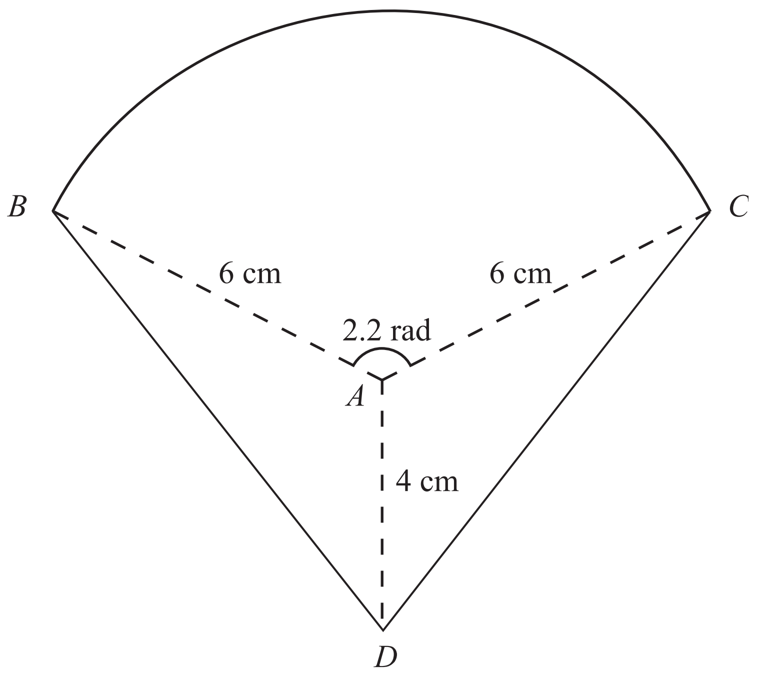


Figure 3

The shape *BCD* shown in Figure 3 is a design for a logo.

The straight lines *DB* and *DC* are equal in length. The curve *BC* is an arc of a circle with centre *A* and radius 6 cm. The size of $\angle BAC$ is 2.2 radians and *AD* = 4 cm.

Find

(a) the area of the sector *BAC*, in cm^2,
(2)

(b) the size of $\angle DAC$, in radians to 3 significant figures,
(2)

(c) the complete area of the logo design, to the nearest cm^2.
(4)

Leave blank

Question 7 continued

Leave blank

Question 7 continued

Leave blank

Question 7 continued

(Total 8 marks)

Q7

Leave blank

8. (a) Show that the equation

$$4\sin^2 x + 9\cos x - 6 = 0$$

can be written as

$$4\cos^2 x - 9\cos x + 2 = 0.$$

(2)

(b) Hence solve, for $0 \leqslant x < 720°$,

$$4\sin^2 x + 9\cos x - 6 = 0,$$

giving your answers to 1 decimal place.

(6)

Leave blank

Question 8 continued

Q8

(Total 8 marks)

Turn over

Leave blank

9. The first three terms of a geometric series are $(k + 4)$, k and $(2k - 15)$ respectively, where k is a positive constant.

(a) Show that $k^2 - 7k - 60 = 0$.
(4)

(b) Hence show that $k = 12$.
(2)

(c) Find the common ratio of this series.
(2)

(d) Find the sum to infinity of this series.
(2)

Leave blank

Question 9 continued

Turn over

Leave blank

Question 9 continued

Leave blank

Question 9 continued

(Total 10 marks)

Q9

Turn over

Leave blank

10. A solid right circular cylinder has radius r cm and height h cm.

The total surface area of the cylinder is 800 cm^2 .

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

$$V = 400r - \pi r^3.$$

(4)

Given that r varies,

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

(6)

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

(2)

Leave blank

Question 10 continued

Leave blank

Question 10 continued

Q10

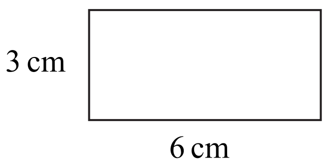
(Total 12 marks)

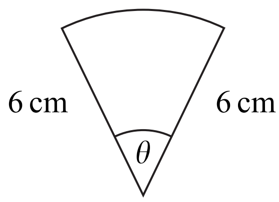
TOTAL FOR PAPER: 75 MARKS

END

Answer **all** questions.

1 The diagrams show a rectangle of length 6 cm and width 3 cm, and a sector of a circle of radius 6 cm and angle θ radians.





The area of the rectangle is twice the area of the sector.

(a) Show that $\theta = 0.5$. *(3 marks)*

(b) Find the perimeter of the sector. *(3 marks)*

2 The arithmetic series

$$51 + 58 + 65 + 72 + \ldots + 1444$$

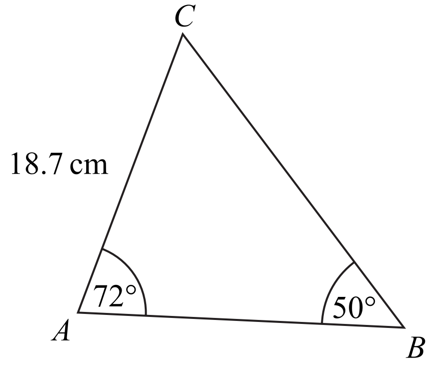
has 200 terms.

(a) Write down the common difference of the series. *(1 mark)*

(b) Find the 101st term of the series. *(2 marks)*

(c) Find the sum of **the last** 100 terms of the series. *(2 marks)*

3 The diagram shows a triangle *ABC*. The length of *AC* is 18.7 cm, and the sizes of angles *BAC* and *ABC* are 72° and 50° respectively.



(a) Show that the length of $BC = 23.2$ cm, correct to the nearest 0.1 cm. *(3 marks)*

(b) Calculate the area of triangle *ABC*, giving your answer to the nearest cm^2. *(3 marks)*

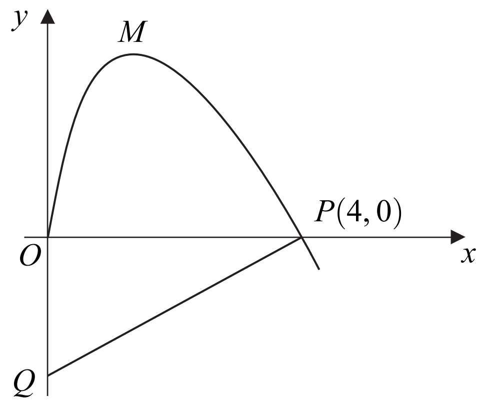
4 Use the trapezium rule with four ordinates (three strips) to find an approximate value for

$$\int_0^3 \sqrt{x^2+3}\,\mathrm{d}x$$

giving your answer to three decimal places. *(4 marks)*

5 A curve, drawn from the origin O, crosses the x-axis at the point $P(4, 0)$.

The normal to the curve at P meets the y-axis at the point Q, as shown in the diagram.



The curve, defined for $x \geqslant 0$, has equation

$$y = 4x^{\frac{1}{2}} - x^{\frac{3}{2}}$$

(a) (i) Find $\dfrac{\mathrm{d}y}{\mathrm{d}x}$. *(3 marks)*

(ii) Show that the gradient of the curve at $P(4, 0)$ is -2. *(2 marks)*

(iii) Find an equation of the normal to the curve at $P(4, 0)$. *(3 marks)*

(iv) Find the y-coordinate of Q and hence find the area of triangle OPQ. *(3 marks)*

(v) The curve has a maximum point M. Find the x-coordinate of M. *(3 marks)*

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

(ii) Find the total area of the region bounded by the curve and the lines PQ and QO. *(3 marks)*

6 (a) Using the binomial expansion, or otherwise:

(i) express $(1+x)^3$ in ascending powers of x; *(2 marks)*

(ii) express $(1+x)^4$ in ascending powers of x. *(2 marks)*

(b) Hence, or otherwise:

(i) express $(1+4x)^3$ in ascending powers of x; *(2 marks)*

(ii) express $(1+3x)^4$ in ascending powers of x. *(2 marks)*

(c) Show that the expansion of

$$(1+3x)^4 - (1+4x)^3$$

can be written in the form

$$px^2 + qx^3 + rx^4$$

where p, q and r are integers. *(2 marks)*

7 (a) Given that

$$\log_a x = \log_a 16 - \log_a 2$$

write down the value of x. *(1 mark)*

(b) Given that

$$\log_a y = 2\log_a 3 + \log_a 4 + 1$$

express y in terms of a, giving your answer in a form **not** involving logarithms. *(3 marks)*

8 (a) Sketch the graph of $y = 3^x$, stating the coordinates of the point where the graph crosses the y-axis. *(2 marks)*

(b) Describe a single geometrical transformation that maps the graph of $y = 3^x$:

(i) onto the graph of $y = 3^{2x}$; *(2 marks)*

(ii) onto the graph of $y = 3^{x+1}$. *(2 marks)*

(c) (i) Using the substitution $Y = 3^x$, show that the equation

$$9^x - 3^{x+1} + 2 = 0$$

can be written as

$$(Y - 1)(Y - 2) = 0$$ *(2 marks)*

(ii) Hence show that the equation $9^x - 3^{x+1} + 2 = 0$ has a solution $x = 0$ and, by using logarithms, find the other solution, giving your answer to four decimal places. *(4 marks)*

9 (a) Given that

$$\frac{3 + \sin^2 \theta}{\cos \theta - 2} = 3 \cos \theta$$

show that

$$\cos \theta = -\frac{1}{2}$$ *(4 marks)*

(b) Hence solve the equation

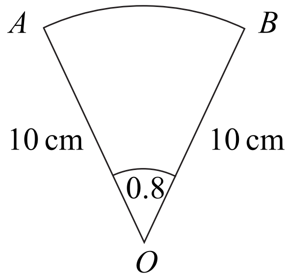
$$\frac{3 + \sin^2 3x}{\cos 3x - 2} = 3 \cos 3x$$

giving all solutions in degrees in the interval $0° < x < 180°$. *(4 marks)*

END OF QUESTIONS

Answer **all** questions.

1 The diagram shows a sector OAB of a circle with centre O and radius 10 cm.



The angle AOB is 0.8 radians.

(a) Find the area of the sector. *(2 marks)*

(b) (i) Find the perimeter of the sector OAB. *(3 marks)*

(ii) The perimeter of the sector OAB is equal to the perimeter of a square. Find the area of the square. *(2 marks)*

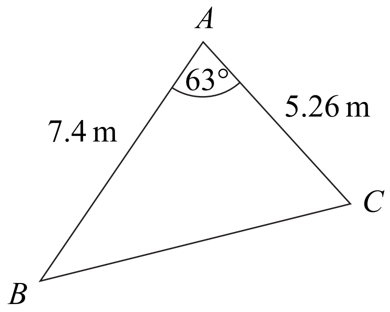
2 (a) Use the trapezium rule with four ordinates (three strips) to find an approximate value for

$$\int_{1.5}^{6} x^2\sqrt{x^2-1}\,dx$$

giving your answer to three significant figures. *(4 marks)*

(b) State how you could obtain a better approximation to the value of the integral using the trapezium rule. *(1 mark)*

3 The diagram shows a triangle ABC.



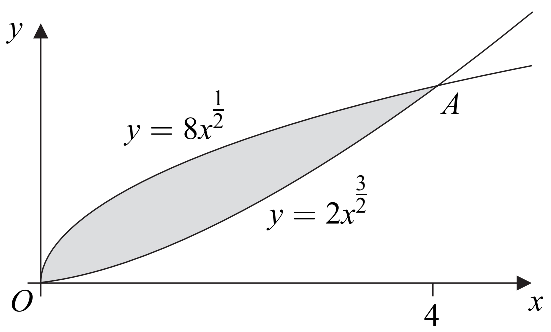
The size of angle A is 63°, and the lengths of AB and AC are 7.4 m and 5.26 m respectively.

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

(b) Show that the length of BC is 6.86 m, correct to three significant figures. *(3 marks)*

(c) Find the value of **sin *B*** to two significant figures. *(2 marks)*

4 The diagram shows a sketch of the curves with equations $y = 2x^{\frac{3}{2}}$ and $y = 8x^{\frac{1}{2}}$.



The curves intersect at the origin and at the point A, where $x = 4$.

(a) (i) For the curve $y = 2x^{\frac{3}{2}}$, find the value of $\frac{dy}{dx}$ when $x = 4$. *(2 marks)*

(ii) Find an equation of the normal to the curve $y = 2x^{\frac{3}{2}}$ at the point A. *(4 marks)*

(b) (i) Find $\int 8x^{\frac{1}{2}}\, dx$. *(2 marks)*

(ii) Find the area of the shaded region bounded by the two curves. *(4 marks)*

(c) Describe a single geometrical transformation that maps the graph of $y = 2x^{\frac{3}{2}}$ onto the graph of $y = 2(x + 3)^{\frac{3}{2}}$. *(2 marks)*

5 (a) By using the binomial expansion, or otherwise, express $(1 + 2x)^4$ in the form

$$1 + ax + bx^2 + cx^3 + 16x^4$$

where a, b and c are integers. *(4 marks)*

(b) Hence show that $(1 + 2x)^4 + (1 - 2x)^4 = 2 + 48x^2 + 32x^4$. *(3 marks)*

(c) Hence show that the curve with equation

$$y = (1 + 2x)^4 + (1 - 2x)^4$$

has just one stationary point and state its coordinates. *(4 marks)*

6 (a) Write each of the following in the form $\log_a k$, where k is an integer:

(i) $\log_a 4 + \log_a 10$; *(1 mark)*

(ii) $\log_a 16 - \log_a 2$; *(1 mark)*

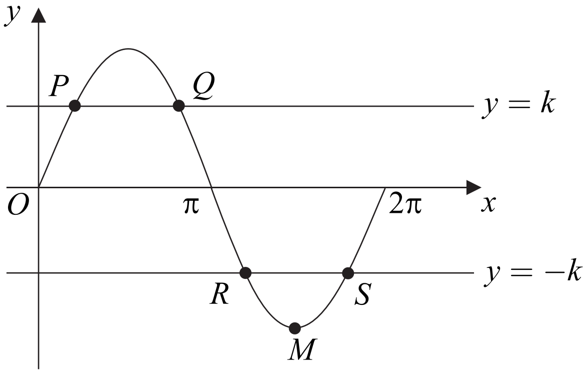
(iii) $3 \log_a 5$. *(1 mark)*

(b) Use logarithms to solve the equation $(1.5)^{3x} = 7.5$, giving your value of x to three decimal places. *(3 marks)*

(c) Given that $\log_2 p = m$ and $\log_8 q = n$, express pq in the form 2^y, where y is an expression in m and n. *(3 marks)*

7 (a) Solve the equation $\sin x = 0.8$ in the interval $0 \leqslant x \leqslant 2\pi$, giving your answers in radians to three significant figures. *(3 marks)*

(b) The diagram shows the graph of the curve $y = \sin x$, $0 \leqslant x \leqslant 2\pi$ and the lines $y = k$ and $y = -k$.



The line $y = k$ intersects the curve at the points P and Q, and the line $y = -k$ intersects the curve at the points R and S.

The point M is the minimum point of the curve.

(i) Write down the coordinates of the point M. *(2 marks)*

(ii) The x-coordinate of P is α.

Write down the x-coordinate of the point Q in terms of π and α. *(1 mark)*

(iii) Find the length of RS in terms of π and α, giving your answer in its simplest form. *(2 marks)*

(c) Sketch the graph of $y = \sin 2x$ for $0 \leqslant x \leqslant 2\pi$, indicating the coordinates of points where the graph intersects the x-axis and the coordinates of any maximum points. *(5 marks)*

8 The 25th term of an arithmetic series is 38.

The sum of the first 40 terms of the series is 1250.

(a) Show that the common difference of this series is 1.5. *(6 marks)*

(b) Find the number of terms in the series which are less than 100. *(3 marks)*

END OF QUESTIONS