

EDEXCEL INTERNATIONAL A LEVEL

WMA11 Pure 1 Classified Questions

179 unique questions grouped by primary topic, with cross-topic placements where a question also belongs in another chapter.

202

topic placements

WMA11

Pure 1

**Question
bank**standalone IAL
route**Dr Eslam Ahmed**

Prepared for Dr Eslam Ahmed - eliteigcse.com

P1

TOPIC

Indices & Surds

Question 2

2. Given $y = 3^x$, express each of the following in terms of y . Write each expression in its simplest form.

(a) 3^{3x} (1)

(b) $\frac{1}{3^{x-2}}$ (2)

(c) $\frac{81}{9^{2-3x}}$ (2)

(Total 5 marks)

Question 3

3. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(i) Show that $\frac{\sqrt{180} - \sqrt{80}}{\sqrt{5}}$ is an integer and find its value.

(2)

(ii) Simplify

$$\frac{4\sqrt{5} - 5}{7 - 3\sqrt{5}}$$

giving your answer in the form $a + b\sqrt{5}$ where a and b are rational numbers.

(3)

(Total 5 marks)

Question 4

4.

In this question you must show detailed reasoning.
Solutions relying on calculator technology are not acceptable.

$$f(x) = x^2(2x + 1) - 15x$$

(a) Solve

$$f(x) = 0 \quad (4)$$

(b) Hence solve

$$y^{\frac{4}{3}}\left(2y^{\frac{2}{3}} + 1\right) - 15y^{\frac{2}{3}} = 0 \quad y > 0$$

giving your answer in simplified surd form. (2)

(Total for Question 4 is 6 marks)

Question 5

5.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(a) By substituting $p = 3^x$, show that the equation

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

can be rewritten in the form

$$9p^2 + 26p - 3 = 0$$

(3)

(b) Hence solve

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

(3)

(Total for Question 5 is 6 marks)

Question 6

6. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

- (a) Expand and simplify

$$\left(r - \frac{1}{r}\right)^2$$

(2)

- (b) Express $\frac{1}{3 + 2\sqrt{2}}$ in the form $p + q\sqrt{2}$ where p and q are integers.

(2)

- (c) Use the results of parts (a) and (b), or otherwise, to show that

$$\sqrt{3 + 2\sqrt{2}} - \frac{1}{\sqrt{3 + 2\sqrt{2}}} = 2$$

(3)

(Total for Question 6 is 7 marks)

Question 2

2. Given that

$$a = \frac{1}{64}x^2 \quad b = \frac{16}{\sqrt{x}}$$

express each of the following in the form kx^n where k and n are simplified constants.

(a) $a^{\frac{1}{2}}$ (1)

(b) $\frac{16}{b^3}$ (1)

(c) $\left(\frac{ab}{2}\right)^{-\frac{4}{3}}$ (2)

(Total for Question 2 is 4 marks)

Question 3

3.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(a) Write $\frac{8 - \sqrt{15}}{2\sqrt{3} + \sqrt{5}}$ in the form $a\sqrt{3} + b\sqrt{5}$ where a and b are integers to be found. (3)

(b) Hence, or otherwise, solve

$$(x + 5\sqrt{3})\sqrt{5} = 40 - 2x\sqrt{3}$$

giving your answer in simplest form.

(3)

(Total for Question 3 is 6 marks)

Question 4

4.

In this question you must show all stages of your working.**Solutions relying on calculator technology are not acceptable.**(a) By substituting $p = 2^x$, show that the equation

$$2 \times 4^x - 2^{x+3} = 17 \times 2^{x-1} - 4$$

can be written in the form

$$4p^2 - 33p + 8 = 0$$

(3)

(b) Hence solve

$$2 \times 4^x - 2^{x+3} = 17 \times 2^{x-1} - 4$$

(3)**(Total for Question 4 is 6 marks)**

Question 2

2. (i) Given that $m = 2^n$, express each of the following in simplest form in terms of m .

(a) 2^{n+3}

(1)

(b) 16^{3n}

(2)

(ii) **In this question you must show all stages of your working.**

Solutions relying on calculator technology are not acceptable.

Solve the equation

$$x\sqrt{3} - 3 = x + \sqrt{3}$$

giving your answer in the form $p + q\sqrt{3}$ where p and q are integers.

(3)

(Total for Question 2 is 6 marks)

Question 2

2.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(i) Simplify fully

$$\frac{3y^3(2x^4)^3}{4x^2y^4} \quad (3)$$

(ii) Find the exact value of a such that

$$\frac{16}{\sqrt{3} + 1} = a\sqrt{27} + 4$$

Write your answer in the form $p\sqrt{3} + q$ where p and q are fully simplified rational constants.

(4)

(Total for Question 2 is 7 marks)

Question 4

4.

In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.

(i) Given that

$$y = a^x \quad \text{where } a \text{ is a positive constant}$$

express, in simplest form, in terms of y and a

(a) a^{3x+1} (1)

(b) $\frac{5}{(3a^{1-x})^{-2}}$ (3)

(ii) (a) Use the substitution $p = 9^t$ to show that the equation

$$3(3^{4t+2} + 1) = 82 \times 9^t$$

can be rewritten as

$$27p^2 - 82p + 3 = 0$$
 (2)

(b) Hence solve

$$3(3^{4t+2} + 1) = 82 \times 9^t$$
 (3)

(Total for Question 4 is 9 marks)

Question 1

1. Given that

$$p = \frac{1}{16}x^4 \quad q = \frac{40}{x^3}$$

express each of the following in the form kx^n where k and n are fully simplified constants.

- (a) $p^{\frac{1}{2}}$ (1)
- (b) $(pq)^{-1}$ (2)
- (c) pq^2 (2)

(Total for Question 1 is 5 marks)

Question 4

4. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

- (i) Using the laws of indices, solve

$$3^{2p-5} = \frac{1}{9}\sqrt{27}$$

(3)

- (ii) Find the real roots of the equation

$$x^2 + 1 = \frac{36}{x^2 - 4}$$

(4)

(Total for Question 4 is 7 marks)

TOPIC

Quadratics

Question 8

8. Solve, using algebra, the equation

$$x - 6x^{\frac{1}{2}} + 4 = 0$$

Fully simplify your answers, writing them in the form $a + b\sqrt{c}$, where a , b and c are integers to be found.

(5)

(Total 5 marks)

Question 5

5. (a) Find, using algebra, all solutions of

$$20x^3 - 50x^2 - 30x = 0 \quad (3)$$

- (b) Hence find all real solutions of

$$20(y + 3)^{\frac{3}{2}} - 50(y + 3) - 30(y + 3)^{\frac{1}{2}} = 0 \quad (4)$$

(Total 7 marks)

Question 2

2. A tree was planted.

Exactly 3 years after it was planted, the height of the tree was 2 m.

Exactly 5 years after it was planted, the height of the tree was 2.4 m.

Given that the height, H metres, of the tree, t years after it was planted, can be modelled by the equation

$$H^3 = pt^2 + q$$

where p and q are constants,

- (a) find, to 3 significant figures where necessary, the value of p and the value of q . (4)

Exactly T years after the tree was planted, its height was 5 m.

- (b) Find the value of T according to the model, giving your answer to one decimal place. (2)

(Total 6 marks)

Question 2

2.

$$f(x) = 11 - 4x - 2x^2$$

- (a) Express $f(x)$ in the form

$$a + b(x + c)^2$$

where a , b and c are integers to be found.

(3)

- (b) Sketch the graph of the curve C with equation $y = f(x)$, showing clearly the coordinates of the point where the curve crosses the y -axis.

(2)

- (c) Write down the equation of the line of symmetry of C .

(1)

(Total 6 marks)

Question 3

3. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(i)

$$f(x) = (x + \sqrt{2})^2 + (3x - 5\sqrt{8})^2$$

Express $f(x)$ in the form $ax^2 + bx\sqrt{2} + c$ where a , b and c are integers to be found. (3)

(ii) Solve the equation

$$\sqrt{3}(4y - 3\sqrt{3}) = 5y + \sqrt{3}$$

giving your answer in the form $p + q\sqrt{3}$ where p and q are simplified fractions to be found. (4)

(Total 7 marks)

Question 6

6. In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

- (a) Given that

$$2xy - 3x^2 = 50$$

and

$$y - x^3 + 6x = 0$$

show that

$$2x^4 - 15x^2 - 50 = 0 \quad (2)$$

- (b) Hence solve the simultaneous equations

$$2xy - 3x^2 = 50$$

$$y - x^3 + 6x = 0$$

Give your answers in fully simplified surd form.

(5)

(Total 7 marks)

Question 4

4. Given that the equation

$$kx^2 + 6kx + 5 = 0 \quad \text{where } k \text{ is a non zero constant}$$

has no real roots, find the range of possible values for k .

(4)

(Total for Question 4 is 4 marks)

Question 8

8.

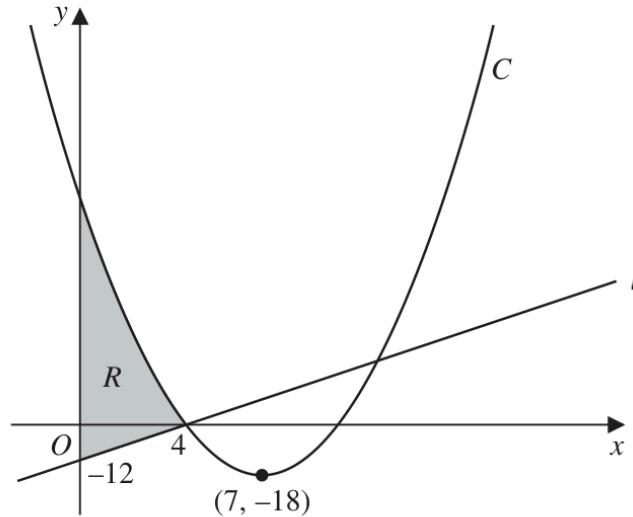


Figure 2

Figure 2 shows a sketch of the straight line l and the curve C .

Given that l cuts the y -axis at -12 and cuts the x -axis at 4 , as shown in Figure 2,

- (a) find an equation for l , writing your answer in the form $y = mx + c$, where m and c are constants to be found.

(2)

Given that C

- has equation $y = f(x)$ where $f(x)$ is a quadratic expression
- has a minimum point at $(7, -18)$
- cuts the x -axis at 4 and at k , where k is a constant

- (b) deduce the value of k ,

(1)

- (c) find $f(x)$.

(3)

The region R is shown shaded in Figure 2.

- (d) Use inequalities to define R .

(2)

(Total for Question 8 is 8 marks)

Question 2

2.

In this question you must show all stages of your working.**Solutions relying entirely on calculator technology are not acceptable.**

A rectangular sports pitch has length x metres and width y metres, where $x > y$

Given that the perimeter of the pitch is 350 m,

(a) write down an equation linking x and y

(1)

Given also that the area of the pitch is 7350m^2

(b) write down a second equation linking x and y

(1)

(c) hence find the value of x and the value of y

(4)

(Total for Question 2 is 6 marks)

Question 3

3. (a) Express $3x^2 + 12x + 13$ in the form

$$a(x + b)^2 + c$$

where a , b and c are integers to be found.

(3)

- (b) Hence sketch the curve with equation $y = 3x^2 + 12x + 13$

On your sketch show clearly

- the coordinates of the y intercept
- the coordinates of the turning point of the curve

(3)

(Total for Question 3 is 6 marks)

Question 6

6.

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

The equation

$$4(p - 2x) = \frac{12 + 15p}{x + p} \quad x \neq -p$$

where p is a constant, has two distinct real roots.

(a) Show that

$$3p^2 - 10p - 8 > 0 \quad (3)$$

(b) Hence, using algebra, find the range of possible values of p (3)

(Total for Question 6 is 6 marks)

Question 11

11.

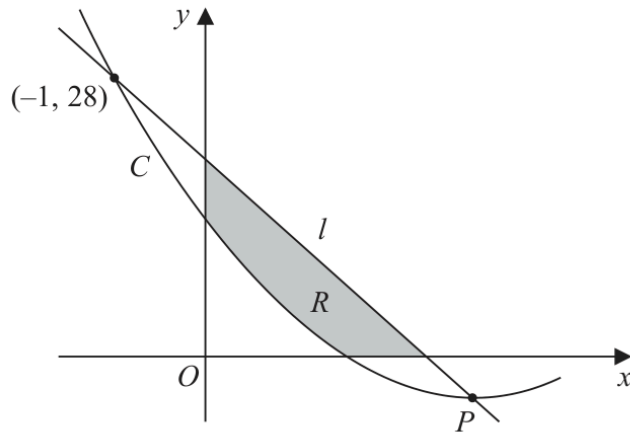


Figure 5

Figure 5 shows part of the curve C with equation $y = f(x)$ where

$$f(x) = 2x^2 - 12x + 14$$

(a) Write $2x^2 - 12x + 14$ in the form

$$a(x + b)^2 + c$$

where a , b and c are constants to be found.

(3)

Given that C has a minimum at the point P

(b) state the coordinates of P

(1)

The line l intersects C at $(-1, 28)$ and at P as shown in Figure 5.

(c) Find the equation of l giving your answer in the form $y = mx + c$ where m and c are constants to be found.

(3)

The finite region R , shown shaded in Figure 5, is bounded by the x -axis, l , the y -axis, and C .

(d) Use inequalities to define the region R .

(3)

(Total for Question 11 is 10 marks)

Question 9

9. The curve C_1 has equation $y = f(x)$.

Given that

- $f(x)$ is a quadratic expression
- C_1 has a maximum turning point at $(2, 20)$
- C_1 passes through the origin

(a) sketch a graph of C_1 showing the coordinates of any points where C_1 cuts the coordinate axes,

(2)

(b) find an expression for $f(x)$.

(3)

The curve C_2 has equation $y = x(x^2 - 4)$

Curve C_1 and C_2 meet at the origin, and at the points P and Q

Given that the x coordinate of the point P is negative,

(c) using algebra and showing all stages of your working, find the coordinates of P

(5)

(Total for Question 9 is 10 marks)

Question 4

4. The curve C_1 has equation

$$y = x^2 + kx - 9$$

and the curve C_2 has equation

$$y = -3x^2 - 5x + k$$

where k is a constant.

Given that C_1 and C_2 meet at a single point P

(a) show that

$$k^2 + 26k + 169 = 0 \quad (3)$$

(b) Hence find the coordinates of P

(3)

(Total for Question 4 is 6 marks)

Question 10

10.

**In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

$$(k-1)x^6 + 4x^3 + (k-4) = 0 \quad \text{where } k \text{ is a constant}$$

- (a) Find the exact solutions to the given equation for $k = 4.5$ (3)
- (b) Find the set of possible values of k for which the given equation has no real roots. (4)

(Total for Question 10 is 7 marks)

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10 marks

Question 5

Quadratics

5.

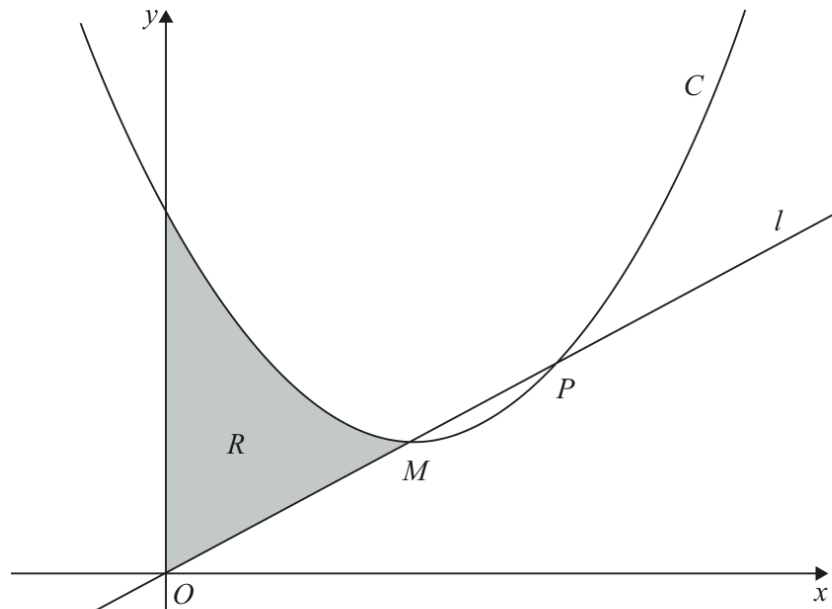


Figure 1

**In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

(a) Express $2x^2 - 16x + 50$ in the form

$$a(x + b)^2 + c$$

where a , b and c are constants to be found.

(3)

Figure 1 shows a sketch of the curve C with equation $y = 2x^2 - 16x + 50$

Given that in Figure 1

- M is the minimum point on C
- line l passes through the origin and intersects C at the points M and P

(b) find, using algebra and showing your working, the x coordinate of P .

(5)

The region R is shown shaded in Figure 1.

(c) Use inequalities to fully define R .

(2)

(Total for Question 5 is 10 marks)

TOPIC

Simultaneous Equations

Question 8

Simultaneous Equations

8. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

The curve C_1 has equation

$$xy = \frac{15}{2} - 5x \quad x \neq 0$$

The curve C_2 has equation

$$y = x^3 - \frac{7}{2}x - 5$$

(a) Show that C_1 and C_2 meet when

$$2x^4 - 7x^2 - 15 = 0 \quad (2)$$

Given that C_1 and C_2 meet at points P and Q

(b) find, using algebra, the exact distance PQ (5)

(Total for Question 8 is 7 marks)

Question 3**Simultaneous Equations**

3. The population of a town was monitored.

Exactly 5 years after monitoring began, the population was 58 000

Exactly 10 years after monitoring began, the population was 65 000

Given that the population of the town, P thousand, t years after monitoring began can be modelled by the equation

$$P^2 = a + bt^3$$

where a and b are constants,

- (a) find the value of a and the value of b .

(3)

According to the model, exactly T years after monitoring began, the population was 85 000

Making your method clear,

- (b) find the value of T , giving your answer to one decimal place.

(Solutions relying entirely on calculator technology are not acceptable.)

(2)

(Total for Question 3 is 5 marks)

Question 2**Simultaneous Equations**

2.

**In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

(a) Given

$$y - x = 4$$

and

$$2x^2 - xy = 8$$

show that

$$x^2 - 4x - 8 = 0$$

(2)

(b) Hence solve the simultaneous equations

$$y - x = 4$$

$$2x^2 - xy = 8$$

writing the answers in the form $p + q\sqrt{3}$, where p and q are integers to be found.**(4)**

(Total for Question 2 is 6 marks)

TOPIC

Inequalities

Question 8

8. The straight line l has equation $y = k(2x - 1)$, where k is a constant.

The curve C has equation $y = x^2 + 2x + 11$

Find the set of values of k for which l does not cross or touch C .

(6)

(Total 6 marks)

Question 1

1. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

Solve the inequality

$$4x^2 - 3x + 7 \geq 4x + 9$$

(4)

(Total for Question 1 is 4 marks)

Question 7

7.

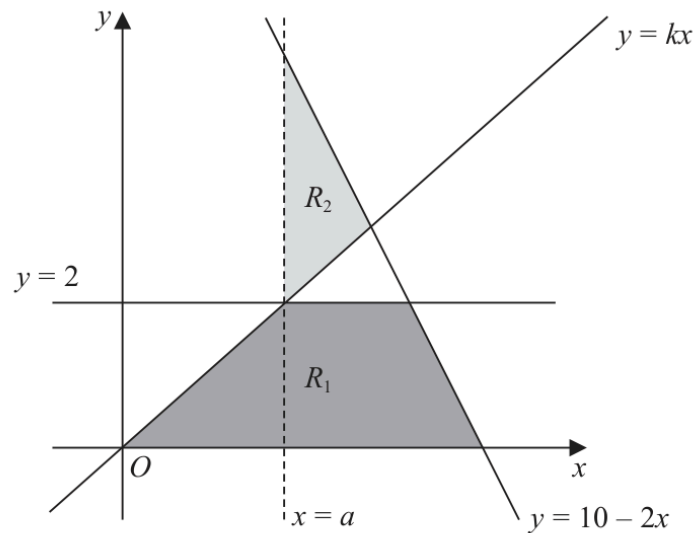


Figure 2

The region R_1 , shown shaded in Figure 2, is defined by the inequalities

$$0 \leq y \leq 2 \quad y \leq 10 - 2x \quad y \leq kx$$

where k is a constant.

The line $x = a$, where a is a constant, passes through the intersection of the lines $y = 2$ and $y = kx$

Given that the area of R_1 is $\frac{27}{4}$ square units,

(a) find

(i) the value of a

(ii) the value of k

(4)

(b) Define the region R_2 , also shown shaded in Figure 2, using inequalities.

(2)

(Total for Question 7 is 6 marks)

Question 6

6.

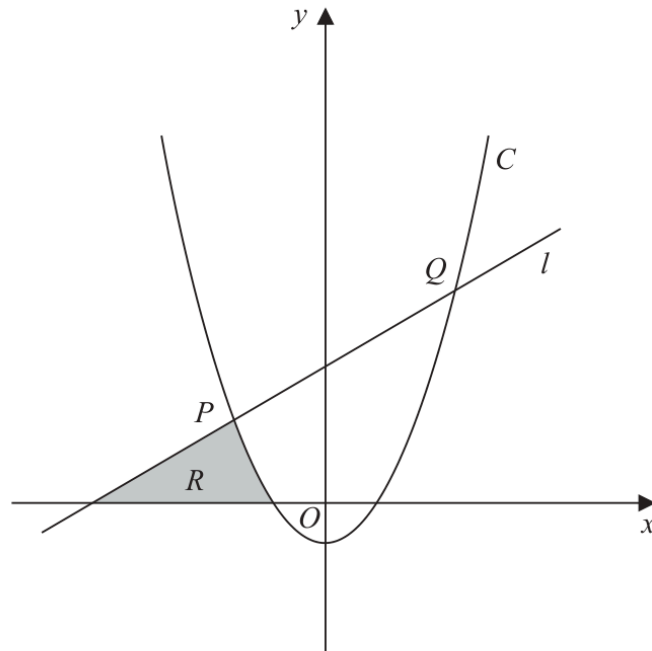


Figure 3

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

Figure 3 shows

- the line l with equation $y - 5x = 75$
- the curve C with equation $y = 2x^2 + x - 21$

The line l intersects the curve C at the points P and Q , as shown in Figure 3.

(a) Find, using algebra, the coordinates of P and the coordinates of Q .

(4)

The region R , shown shaded in Figure 3, is bounded by C , l and the x -axis.

(b) Use inequalities to define the region R .

(3)

(Total for Question 6 is 7 marks)

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5 marks

Question 3

Inequalities

3. (i) Find the range of values of z for which

$$\frac{4}{z} < 8$$

giving the answer in simplest form.

(2)

(ii)

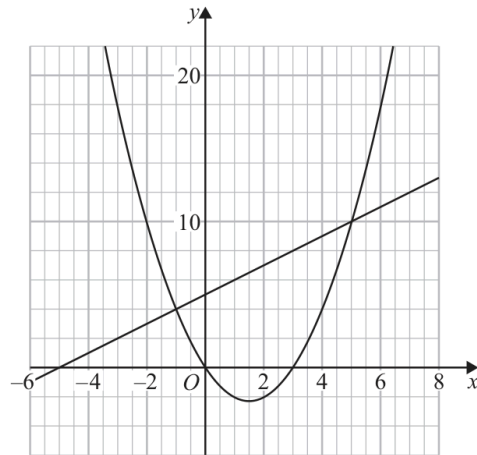


Figure 1

Figure 1 shows a plot of

- the line with equation $y = x + 5$
- the curve with equation $y = x(x - 3)$

On the opposite page there is a copy of Figure 1 labelled Diagram 1.
On Diagram 1 represent the following inequality graphically.

$$x + 5 \leq y \leq x(x - 3) \text{ for } x \geq -2$$

(3)

Question 3 continued

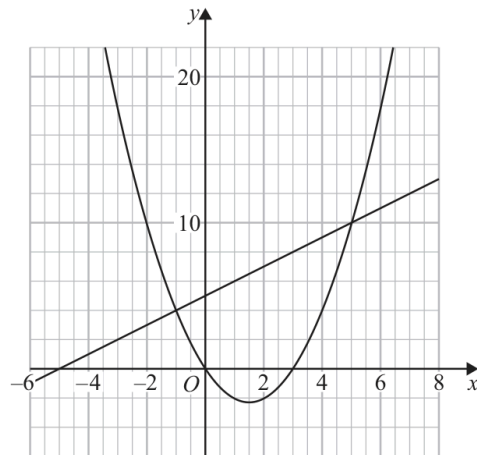


Diagram 1

(Total for Question 3 is 5 marks)

TOPIC

Polynomials

Question 2

2. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

$$f(x) = ax^3 + (6a + 8)x^2 - a^2x$$

where a is a positive constant.

Given $f(-1) = 32$

(a) (i) show that the only possible value for a is 3

(ii) Using $a = 3$ solve the equation

$$f(x) = 0 \tag{5}$$

(b) Hence find all real solutions of

(i) $3y + 26y^{\frac{2}{3}} - 9y^{\frac{1}{3}} = 0$

(ii) $3(9^{3z}) + 26(9^{2z}) - 9(9^z) = 0$ (5)

(Total 10 marks)

Question 8

Polynomials

8. The curve C_1 has equation

$$y = 3x^2 + 6x + 9$$

(a) Write $3x^2 + 6x + 9$ in the form

$$a(x + b)^2 + c$$

where a , b and c are constants to be found.

(3)

The point P is the minimum point of C_1

(b) Deduce the coordinates of P .

(1)

A different curve C_2 has equation

$$y = Ax^3 + Bx^2 + Cx + D$$

where A , B , C and D are constants.

Given that C_2

- passes through P
- intersects the x -axis at -4 , -2 and 3

(c) find, making your method clear, the values of A , B , C and D .

(5)

(Total 9 marks)

WMA11/01 OCTOBER 2024

10 marks

Question 4

Polynomials

4.

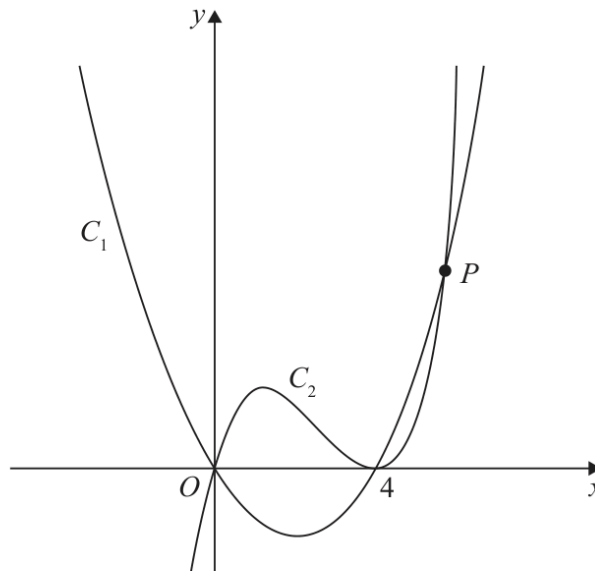


Figure 1

Figure 1 shows a sketch of part of the curves C_1 and C_2

Given that C_1

- has equation $y = f(x)$ where $f(x)$ is a quadratic function
- cuts the x -axis at the origin and at $x = 4$
- has a minimum turning point at $(2, -4.8)$

(a) find $f(x)$

(3)

Given that C_2

- has equation $y = g(x)$ where $g(x)$ is a cubic function
- cuts the x -axis at the origin and meets the x -axis at $x = 4$
- passes through the point $(6, 7.2)$

(b) find $g(x)$

(3)

The curves C_1 and C_2 meet in the first quadrant at the point P , shown in Figure 1.

(c) Use algebra to find the coordinates of P .

(4)

(Total for Question 4 is 10 marks)

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9 marks

Question 6

Polynomials

6.

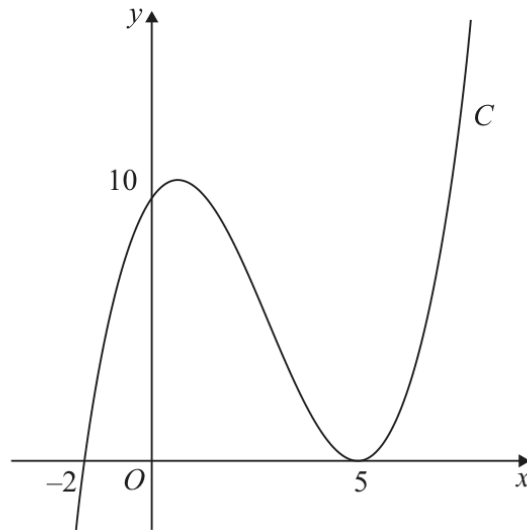


Figure 3

Figure 3 shows a sketch of the curve C with equation $y = f(x)$ where $f(x)$ is a cubic function in x .

The curve C

- cuts the x -axis at $(-2, 0)$ and cuts the y -axis at $(0, 10)$
- touches the x -axis at $(5, 0)$

as shown in Figure 3.

(a) Deduce the roots of the equation

(i) $f\left(\frac{1}{3}x\right) = 0$

(ii) $f(x - 3) = 0$

(2)

(b) Find an expression for $f(x)$. You should leave your answer in factorised form.

(3)

The curve C intersects the straight line $y = 10(x + 2)$ at exactly three points.

(c) Use algebra to find the exact x coordinates of the three points of intersection.

(Solutions based entirely on calculator technology are not acceptable.)

(4)

(Total for Question 6 is 9 marks)

TOPIC

Graphs of Functions

WMA11/01 OCTOBER 2019

10 marks

Question 3

Graphs of Functions

3. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

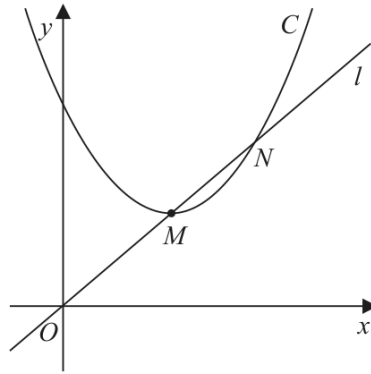


Figure 2

Figure 2 shows a sketch of the curve C with equation $y = x^2 - 5x + 13$

The point M is the minimum point of C .

The straight line l passes through the origin O and intersects C at the points M and N as shown.

Find, showing your working,

(a) the coordinates of M , (3)

(b) the coordinates of N . (5)

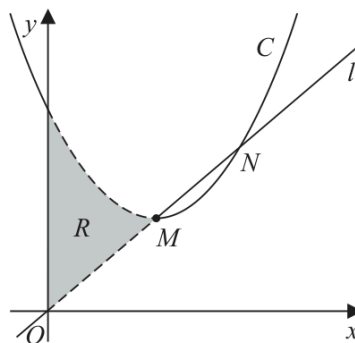


Figure 3

Figure 3 shows the curve C and the line l . The finite region R , shown shaded in Figure 3, is bounded by C , l and the y -axis.

(Total 10 marks)

Question 6**Graphs of Functions**

6. The curve C has equation $y = \frac{4}{x} + k$, where k is a positive constant.

- (a) Sketch a graph of C , stating the equation of the horizontal asymptote and the coordinates of the point of intersection with the x -axis.

(3)

The line with equation $y = 10 - 2x$ is a tangent to C .

- (b) Find the possible values for k .

(5)

(Total 8 marks)

WMA11/01 OCTOBER 2019

10 marks

Question 10

Graphs of Functions

10.

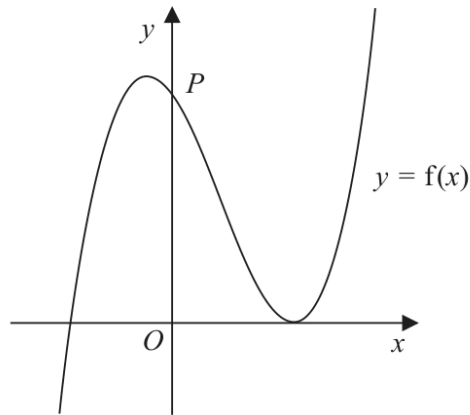


Figure 6

Figure 6 shows a sketch of part of the curve with equation $y = f(x)$, where

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

- (a) Deduce the values of x for which $f(x) \leq 0$ (2)

The curve crosses the y -axis at the point P , as shown.

- (b) Expand $f(x)$ to the form

$$ax^3 + bx^2 + cx + d$$

where a , b , c and d are integers to be found.

(3)

- (c) Hence, or otherwise, find

- (i) the coordinates of P ,
(ii) the gradient of the curve at P .

(2)

The curve with equation $y = f(x)$ is translated two units in the positive x direction to a curve with equation $y = g(x)$.

- (d) (i) Find $g(x)$, giving your answer in a simplified factorised form.

- (ii) Hence state the y intercept of the curve with equation $y = g(x)$.

(3)

(Total 10 marks)

Question 10

Graphs of Functions

10. The curve C_1 has equation $y = f(x)$, where

$$f(x) = (4x - 3)(x - 5)^2$$

(a) Sketch C_1 showing the coordinates of any point where the curve touches or crosses the coordinate axes. (3)

(b) Hence or otherwise

(i) find the values of x for which $f\left(\frac{1}{4}x\right) = 0$

(ii) find the value of the constant p such that the curve with equation $y = f(x) + p$ passes through the origin. (2)

A second curve C_2 has equation $y = g(x)$, where $g(x) = f(x + 1)$

(c) (i) Find, in simplest form, $g(x)$. You may leave your answer in a factorised form.

(ii) Hence, or otherwise, find the y intercept of curve C_2 (3)

(Total 8 marks)

Question 6

Graphs of Functions

6. (a) Sketch the curve with equation

$$y = -\frac{k}{x} \quad k > 0 \quad x \neq 0 \quad (2)$$

- (b) On a separate diagram, sketch the curve with equation

$$y = -\frac{k}{x} + k \quad k > 0 \quad x \neq 0$$

stating the coordinates of the point of intersection with the x -axis and, in terms of k , the equation of the horizontal asymptote.

(3)

- (c) Find the range of possible values of k for which the curve with equation

$$y = -\frac{k}{x} + k \quad k > 0 \quad x \neq 0$$

does not touch or intersect the line with equation $y = 3x + 4$

(5)

(Total 10 marks)

Question 8

Graphs of Functions

8.

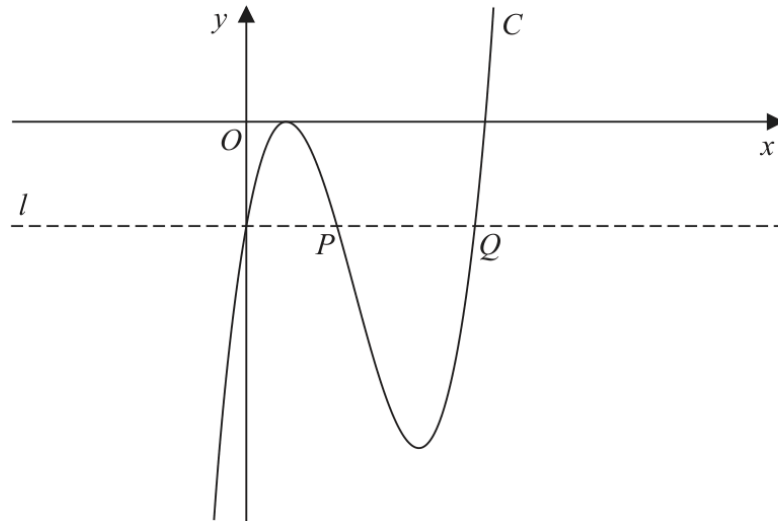


Figure 4

Figure 4 shows a sketch of part of the curve C with equation $y = f(x)$, where

$$f(x) = (3x - 2)^2 (x - 4)$$

(a) Deduce the values of x for which $f(x) > 0$

(1)

(b) Expand $f(x)$ to the form

$$ax^3 + bx^2 + cx + d$$

where a , b , c and d are integers to be found.

(3)

The line l , also shown in Figure 4, passes through the y intercept of C and is parallel to the x -axis.

The line l cuts C again at points P and Q , also shown in Figure 4.

(c) Using algebra and showing your working, find the length of line PQ . Write your answer in the form $k\sqrt{3}$, where k is a constant to be found.

(Solutions relying entirely on calculator technology are not acceptable.)

(5)

(Total 9 marks)

WMA11/01 MAY/JUNE 2021

8 marks

Question 5

Graphs of Functions

5.

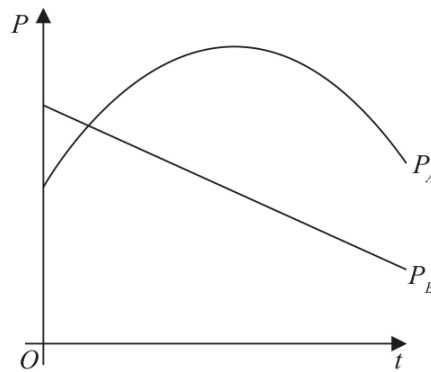


Figure 2

The share value of two companies, company *A* and company *B*, has been monitored over a 15-year period.

The share value P_A of **company A**, in millions of pounds, is modelled by the equation

$$P_A = 53 - 0.4(t - 8)^2 \quad t \geq 0$$

where t is the number of years after monitoring began.

The share value P_B of **company B**, in millions of pounds, is modelled by the equation

$$P_B = -1.6t + 44.2 \quad t \geq 0$$

where t is the number of years after monitoring began.

Figure 2 shows a graph of both models.

Use the equations of one or both models to answer parts (a) to (d).

- (a) Find the difference between the share value of **company A** and the share value of **company B** at the point monitoring began. (2)
- (b) State the maximum share value of **company A** during the 15-year period. (1)
- (c) Find, using algebra and showing your working, the times during this 15-year period when the share value of **company A** was greater than the share value of **company B**. (4)
- (d) Explain why the model for **company A** should not be used to predict its share value when $t = 20$ (1)

(Total 8 marks)

Question 6

Graphs of Functions

6. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

A curve C has equation $y = f(x)$ where

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

(a) Sketch a graph of C .

Show on your graph the coordinates of the points where C cuts or meets the coordinate axes.

(3)

(b) Write $f(x)$ in the form $ax^3 + bx^2 + cx + d$, where a, b, c and d are constants to be found.

(3)

(c) Hence, find the equation of the tangent to C at the point where $x = \frac{1}{3}$

(4)

(Total 10 marks)

Question 4

Graphs of Functions

4.

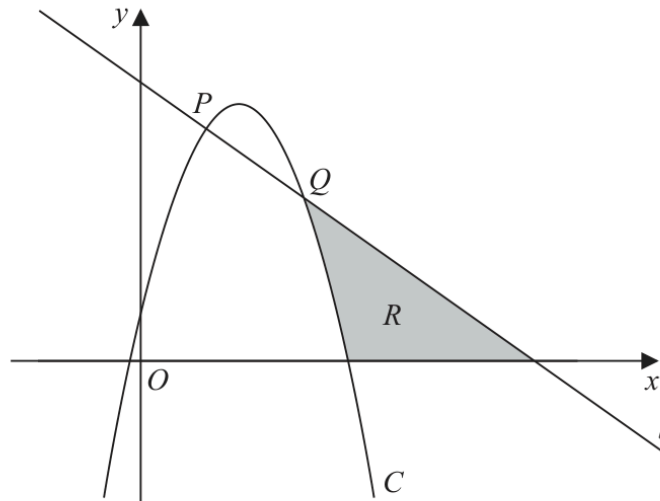


Figure 1

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

Figure 1 shows a line l with equation $x + y = 6$ and a curve C with equation $y = 6x - 2x^2 + 1$

The line l intersects the curve C at the points P and Q as shown in Figure 1.

- (a) Find, using algebra, the coordinates of P and the coordinates of Q . (4)

The region R , shown shaded in Figure 1, is bounded by C , l and the x -axis.

- (b) Use inequalities to define the region R . (3)

(Total 7 marks)

Question 10

Graphs of Functions

10. The curve C has equation

$$y = \frac{1}{x^2} - 9$$

(a) Sketch the graph of C .

On your sketch

- show the coordinates of any points of intersection with the coordinate axes
- state clearly the equations of any asymptotes

(4)

The curve D has equation $y = kx^2$ where k is a constant.

Given that C meets D at 4 distinct points,

(b) find the range of possible values for k .

(5)

(Total 9 marks)

Question 6

Graphs of Functions

6. (a) Given that k is a positive constant such that $0 < k < 4$ sketch, on **separate axes**, the graphs of

(i) $y = (2x - k)(x + 4)^2$

(ii) $y = \frac{k}{x^2}$

showing the coordinates of any points where the graphs cross or meet the coordinate axes, leaving coordinates in terms of k , where appropriate.

(5)

- (b) State, with a reason, the number of roots of the equation

$$(2x - k)(x + 4)^2 = \frac{k}{x^2}$$

(1)

(Total for Question 6 is 6 marks)

WMA11/01 OCTOBER 2023

7 marks

Question 4

Graphs of Functions

4.

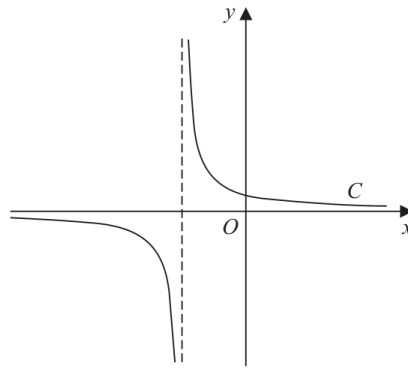


Figure 1

Figure 1 shows a sketch of part of the curve C with equation $y = \frac{1}{x+2}$

(a) State the equation of the asymptote of C that is parallel to the y -axis. (1)

(b) Factorise fully $x^3 + 4x^2 + 4x$ (2)

A copy of Figure 1, labelled Diagram 1, is shown on the next page.

(c) On Diagram 1, add a sketch of the curve with equation

$$y = x^3 + 4x^2 + 4x$$

On your sketch, state clearly the coordinates of each point where this curve cuts or meets the coordinate axes.

(3)

(d) Hence state the number of real solutions of the equation

$$(x+2)(x^3 + 4x^2 + 4x) = 1$$

giving a reason for your answer.

(1)

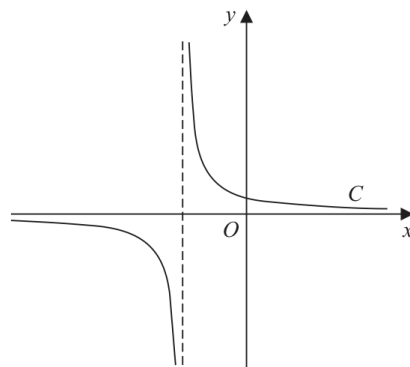
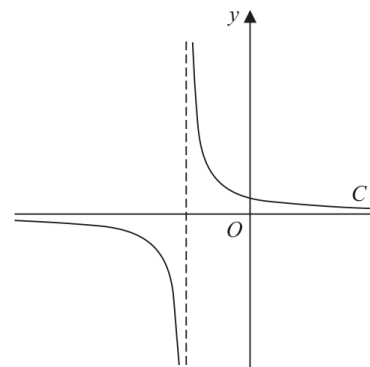


Diagram 1



copy of Diagram 1

Only use the copy of Diagram 1 if you need to redraw your answer to part (c).

(Total for Question 4 is 7 marks)

Question 7

Graphs of Functions

7. (a) Sketch the graph of the curve C with equation

$$y = \frac{4}{x - k}$$

where k is a positive constant.

Show on your sketch

- the coordinates of any points where C cuts the coordinate axes
- the equation of the vertical asymptote to C

(4)

Given that the straight line with equation $y = 9 - x$ does not cross or touch C

(b) find the range of values of k .

(5)

(Total for Question 7 is 9 marks)

Question 8

Graphs of Functions

8. The curve C_1 has equation

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

- (a) Sketch the graph of C_1 showing the coordinates of any points of intersection with the coordinate axes.

(3)

The curve C_2 has equation $y = \frac{A}{x}$ where A is a constant.

- (b) Show that the x coordinates of the points of intersection of C_1 and C_2 satisfy the equation

$$x^4 - 4x^2 + A = 0$$

(1)

- (c) Hence find the range of possible values of A for which C_1 meets C_2 at 4 distinct points.

(3)

(Total for Question 8 is 7 marks)

Question 6

Graphs of Functions

6. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

(a) Sketch the curve C with equation

$$y = \frac{1}{2-x} \quad x \neq 2$$

State on your sketch

- the equation of the vertical asymptote
- the coordinates of the intersection of C with the y -axis

(3)

The straight line l has equation $y = kx - 4$, where k is a constant.

Given that l cuts C at least once,

(b) (i) show that

$$k^2 - 5k + 4 \geq 0$$

(ii) find the range of possible values for k .

(6)

(Total for Question 6 is 9 marks)

Question 7

Graphs of Functions

7.

In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.

The curve C has equation

$$y = \frac{2}{x} - k$$

where k is a **positive** constant.

(a) Sketch the graph of C .

Show on your sketch

- the coordinates of any points of intersection of C with the coordinate axes
- the equation of the horizontal asymptote to C

stating each in terms of k .

(3)

The line l has equation $y = -kx - 6$

Given that l intersects C at 2 distinct points,

(b) find the range of possible values of k .

(5)

(Total for Question 7 is 8 marks)

WMA11/01 MAY/JUNE 2025

10 marks

Question 7

Graphs of Functions

7.

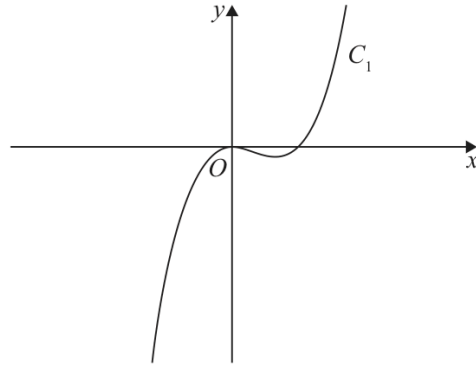


Figure 3

Figure 3 shows a sketch of part of the curve C_1

Given that C_1

- has equation $y = f(x)$ where $f(x)$ is a cubic function
- touches the x -axis at the origin and cuts the x -axis at $x = 4$
- passes through the point $(10, 120)$

(a) find $f(x)$

(3)

The curve C_2 has equation $y = 1.2x(8 - x)$

On the following page there is a copy of Figure 3 called Diagram 1.

(b) On Diagram 1 sketch a graph of the curve C_2

(2)

(c) Use algebra to find the coordinates of the points where C_1 and C_2 intersect.
Show each stage of your working.

(5)

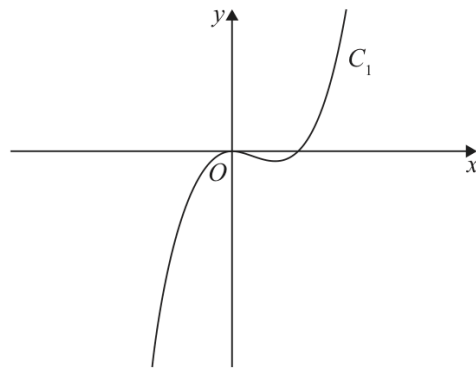


Diagram 1

(Total for Question 7 is 10 marks)

Question 6

Graphs of Functions

6. (a) Sketch the graph of the curve C with equation

$$y = \frac{4k}{x - 2k}$$

where k is a positive constant.

On your sketch show

- the coordinates of any points where C cuts the coordinate axes
- the equation of the vertical asymptote to C

(4)

The straight line l has equation

$$y = 6 - 2x$$

Given that there is at least one point of intersection between l and C ,

(b) find the range of possible values of k .

(5)

(Total for Question 6 is 9 marks)

TOPIC

Transformations

WMA11/01 OCTOBER 2021

9 marks

Question 9

Transformations

9. In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

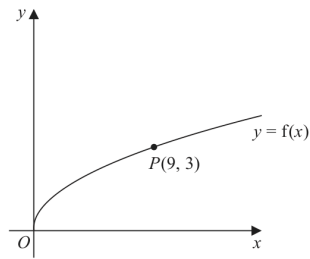


Figure 5

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

$$f(x) = \sqrt{x} \quad x > 0$$

The point $P(9, 3)$ lies on the curve and is shown in Figure 5.

On the next page there is a copy of Figure 5 called Diagram 1.

- (a) On Diagram 1, sketch and clearly label the graphs of

$$y = f(2x) \quad \text{and} \quad y = f(x) + 3$$

Show on each graph the coordinates of the point to which P is transformed.

(3)

The graph of $y = f(2x)$ meets the graph of $y = f(x) + 3$ at the point Q .

- (b) Show that the x coordinate of Q is the solution of

$$\sqrt{x} = 3(\sqrt{2} + 1)$$

(3)

- (c) Hence find, in simplest form, the coordinates of Q .

(3)

Question continues

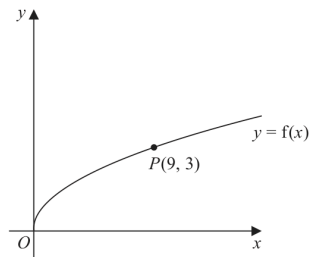
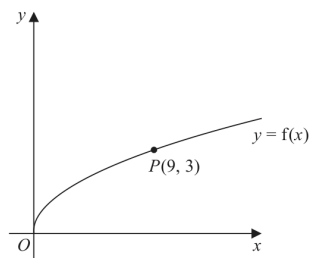


Diagram 1

Turn over for a copy of Diagram 1 if you need to redraw your graphs.

Only use this copy if you need to redraw your graphs.



Copy of Diagram 1

(Total 9 marks)

Question 4

Transformations

4.

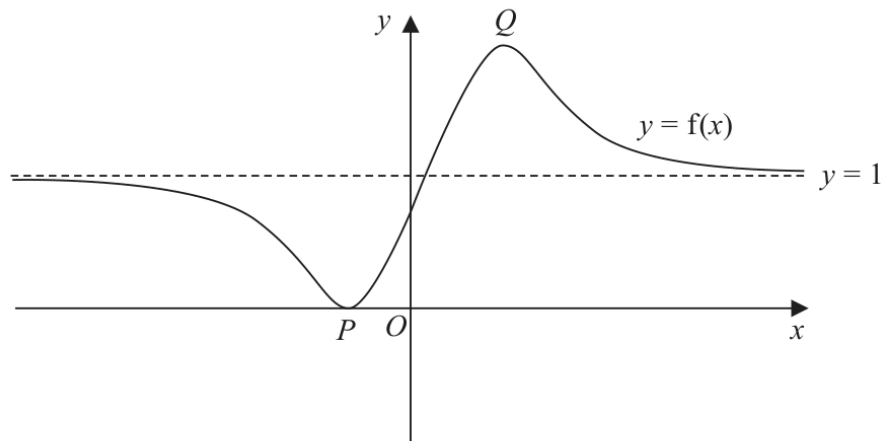


Figure 1

Figure 1 shows a sketch of a curve with equation $y = f(x)$

The curve has a minimum at $P(-1, 0)$ and a maximum at $Q\left(\frac{3}{2}, 2\right)$

The line with equation $y = 1$ is the only asymptote to the curve.

On separate diagrams sketch the curves with equation

(i) $y = f(x) - 2$

(3)

(ii) $y = f(-x)$

(3)

On each sketch you must clearly state

- the coordinates of the maximum and minimum points
- the equation of the asymptote

(Total 6 marks)

Question 7

Transformations

7.

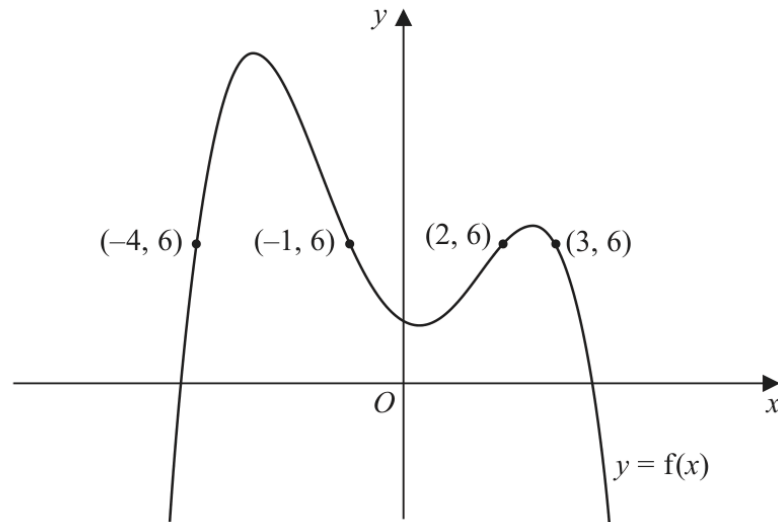


Figure 1

Figure 1 shows the curve with equation $y = f(x)$.

The points $P(-4, 6)$, $Q(-1, 6)$, $R(2, 6)$ and $S(3, 6)$ lie on the curve.

(a) Using Figure 1, find the range of values of x for which

$$f(x) < 6 \quad (3)$$

(b) State the largest solution of the equation

$$f(2x) = 6 \quad (1)$$

(c) (i) Sketch the curve with equation $y = f(-x)$.

On your sketch, state the coordinates of the points to which P , Q , R and S are transformed.

(ii) Hence find the set of values of x for which

$$f(-x) \geq 6 \text{ and } x < 0 \quad (4)$$

(Total for Question 7 is 8 marks)

WMA11/01 JANUARY 2023

10 marks

Question 7

Transformations

7. (a) On Diagram 1, sketch a graph of the curve C with equation

$$y = \frac{6}{x} \quad x \neq 0 \quad (2)$$

The curve C is transformed onto the curve with equation $y = \frac{6}{x-2} \quad x \neq 2$

(b) Fully describe this transformation. (2)

The curve with equation

$$y = \frac{6}{x-2} \quad x \neq 2$$

and the line with equation

$$y = kx + 7 \quad \text{where } k \text{ is a constant}$$

intersect at exactly two points, P and Q .

Given that the x coordinate of point P is -4

(c) find the value of k , (2)

(d) find, using algebra, the coordinates of point Q .

(Solutions relying entirely on calculator technology are not acceptable.)

(4)

Question 7 continued

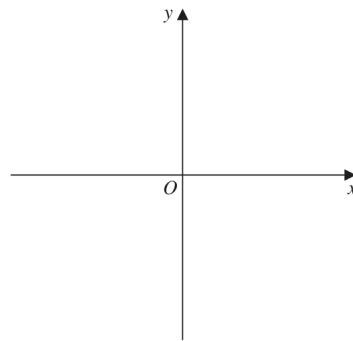
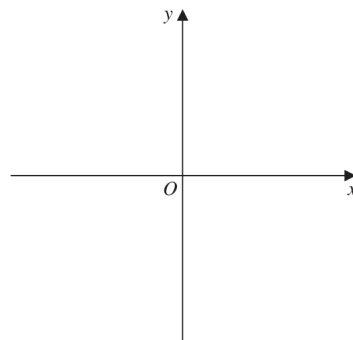


Diagram 1

Only use this copy of Diagram 1 if you need to redraw your graph.



Copy of Diagram 1

(Total for Question 7 is 10 marks)

Question 3

Transformations

3.

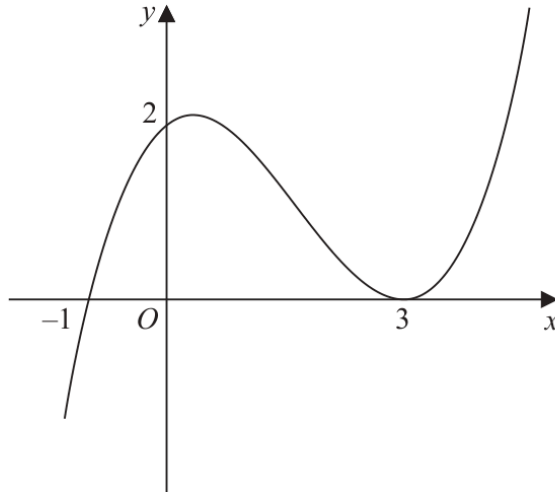


Figure 1

Figure 1 shows a sketch of the curve with equation $y = f(x)$.

The curve passes through the points $(-1, 0)$ and $(0, 2)$ and touches the x -axis at the point $(3, 0)$.

On separate diagrams, sketch the curve with equation

(a) $y = f(x + 3)$ (3)

(b) $y = f(-3x)$ (3)

On each diagram, show clearly the coordinates of all the points where the curve cuts or touches the coordinate axes.

(Total for Question 3 is 6 marks)

Question 9

Transformations

9.

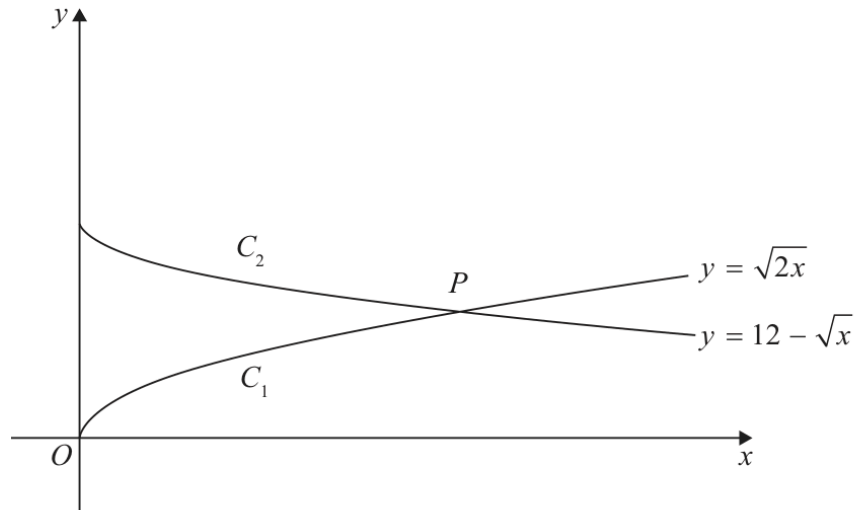


Figure 4

**In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

Figure 4 shows a sketch of

- the graph C_1 with equation $y = \sqrt{2x}$
- the graph C_2 with equation $y = 12 - \sqrt{x}$

(a) Describe fully the single transformation that would transform

- the graph with equation $y = \sqrt{x}$ onto C_1
- the graph with equation $y = -\sqrt{x}$ onto C_2

(4)

The graphs C_1 and C_2 meet at the point P , as shown in Figure 4.

(b) (i) Show that the x coordinate of P is a solution of

$$\sqrt{x} = 12(\sqrt{2} - 1)$$

(ii) Hence find, in simplest form, the exact coordinates of P .

(6)

(Total for Question 9 is 10 marks)

Question 9

Transformations

9.

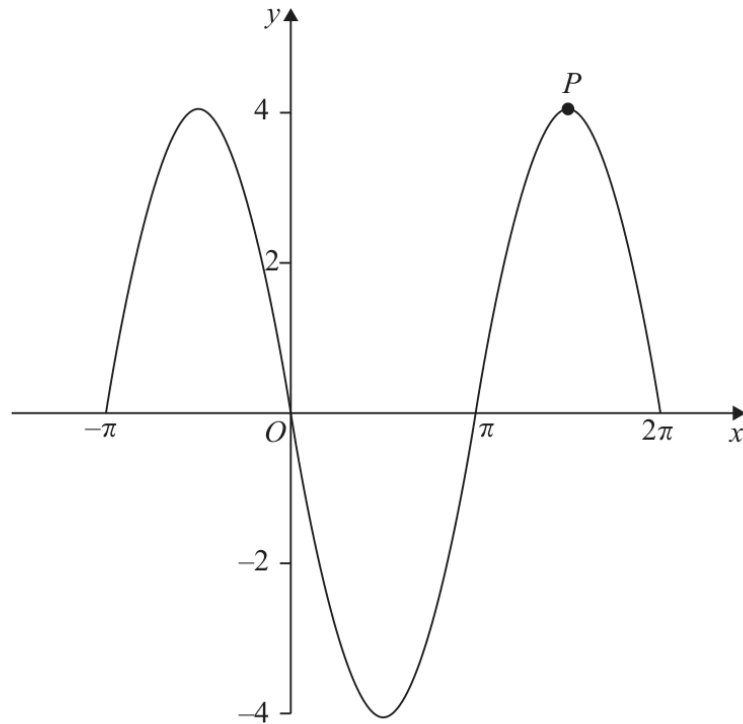


Figure 3

Figure 3 shows a sketch of part of the graph of the trigonometric function with equation $y = f(x)$

(a) Write down an expression for $f(x)$

(2)

The point P lies on $y = f(x)$ and is shown in Figure 3.

(b) State the coordinates of the point to which P is transformed when the graph of $y = f(x)$ is transformed to the graph with equation

(i) $y = f\left(x - \frac{\pi}{6}\right)$

(2)

(ii) $y = -\frac{1}{2}f(x)$

(2)

(Total for Question 9 is 6 marks)

TOPIC

Straight Line

Question 2**Straight Line**

2. A tree was planted in the ground.

Exactly 2 years after it was planted, the height of the tree was 1.85 m.

Exactly 7 years after it was planted, the height of the tree was 3.45 m.

Given that the height, H metres, of the tree, t years after it was planted in the ground, can be modelled by the equation

$$H = at + b$$

where a and b are constants,

- (a) find the value of a and the value of b .

(4)

- (b) State, according to the model, the height of the tree when it was planted.

(1)

(Total 5 marks)

Question 6

Straight Line

6. The line l_1 has equation $3x - 4y + 20 = 0$

The line l_2 cuts the x -axis at $R(8,0)$ and is parallel to l_1

(a) Find the equation of l_2 , writing your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(3)

The line l_1 cuts the x -axis at P and the y -axis at Q .

Given that $PQRS$ is a parallelogram, find

(b) the area of $PQRS$,

(3)

(c) the coordinates of S .

(2)

(Total 8 marks)

Question 4

Straight Line

4.

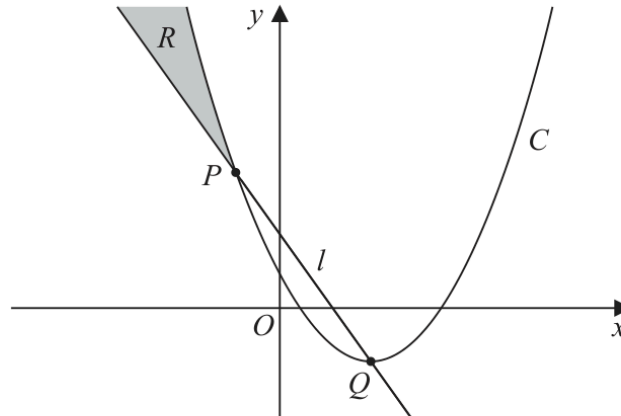


Figure 2

The points P and Q , as shown in Figure 2, have coordinates $(-2, 13)$ and $(4, -5)$ respectively.

The straight line l passes through P and Q .

- (a) Find an equation for l , writing your answer in the form $y = mx + c$, where m and c are integers to be found. (3)

The quadratic curve C passes through P and has a minimum point at Q .

- (b) Find an equation for C . (3)

The region R , shown shaded in Figure 2, lies in the second quadrant and is bounded by C and l only.

- (c) Use inequalities to define region R . (2)

(Total 8 marks)

Question 3

Straight Line

3. (i) Solve

$$\frac{3}{x} > 4$$

(3)

(ii)

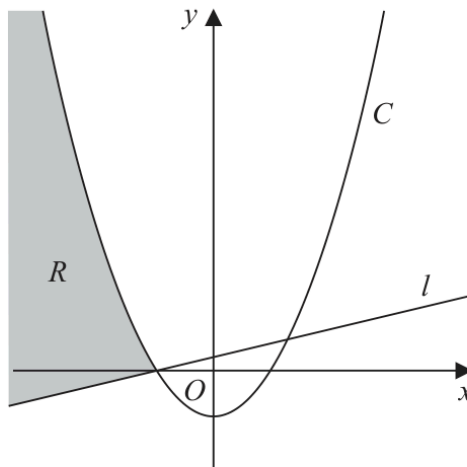


Figure 1

Figure 1 shows a sketch of the curve C and the straight line l .

The infinite region R , shown shaded in Figure 1, lies in quadrants 2 and 3 and is bounded by C and l only.

Given that

- l has a gradient of 3
- C has equation $y = 2x^2 - 50$
- C and l intersect on the negative x -axis

use inequalities to define the region R .

(3)

(Total 6 marks)

Question 5

Straight Line

5. The line l_1 has equation $3y - 2x = 30$

The line l_2 passes through the point $A(24, 0)$ and is perpendicular to l_1

Lines l_1 and l_2 meet at the point P

(a) Find, using algebra and showing your working, the coordinates of P .

(5)

Given that l_1 meets the x -axis at the point B ,

(b) find the area of triangle BPA .

(3)

(Total 8 marks)

Question 8

Straight Line

8.

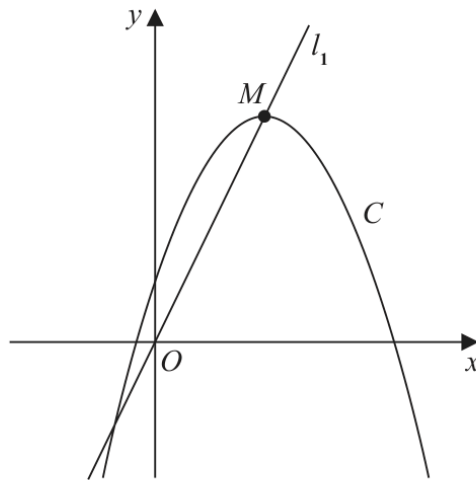


Figure 4

Figure 4 shows a sketch of the curve C with equation

$$y = 4 + 12x - 3x^2$$

The point M is the maximum turning point on C .

(a) (i) Write $4 + 12x - 3x^2$ in the form

$$a + b(x + c)^2$$

where a , b and c are constants to be found.

(ii) Hence, or otherwise, state the coordinates of M .

(5)

The line l_1 passes through O and M , as shown in Figure 4.

A line l_2 touches C and is parallel to l_1

(b) Find an equation for l_2

(5)

(Total 10 marks)

Question 8

Straight Line

8. The line l_1 has equation

$$2x - 5y + 7 = 0$$

(a) Find the gradient of l_1

(1)

Given that

- the point A has coordinates $(6, -2)$
- the line l_2 passes through A and is perpendicular to l_1

(b) find the equation of l_2 giving your answer in the form $y = mx + c$, where m and c are constants to be found.

(3)

The lines l_1 and l_2 intersect at the point M .

(c) Using algebra and showing all your working, find the coordinates of M .

(Solutions relying on calculator technology are not acceptable.)

(3)

Given that the diagonals of a square $ABCD$ meet at M ,

(d) find the coordinates of the point C .

(2)

(Total 9 marks)

WMA11/01 MAY/JUNE 2022

9 marks

Question 5

Straight Line

5. The curve C has equation $y = f(x)$

Given that

- $f(x)$ is a quadratic expression
- the maximum turning point on C has coordinates $(-2, 12)$
- C cuts the negative x -axis at -5

(a) find $f(x)$

(4)

The line l_1 has equation $y = \frac{4}{5}x$

Given that the line l_2 is perpendicular to l_1 and passes through $(-5, 0)$

(b) find an equation for l_2 , writing your answer in the form $y = mx + c$ where m and c are constants to be found.

(3)

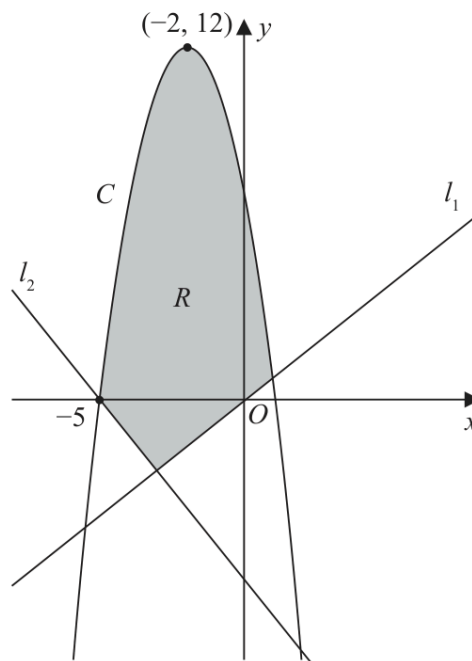


Figure 2

Figure 2 shows a sketch of the curve C and the lines l_1 and l_2

(c) Define the region R , shown shaded in Figure 2, using inequalities.

(2)

(Total 9 marks)

Question 3**Straight Line**

3. The share price of a company is monitored.

Exactly 3 years after monitoring began, the share price was £1.05

Exactly 5 years after monitoring began, the share price was £1.65

The share price, £ V , of the company is modelled by the equation

$$V = pt + q$$

where t is the number of years after monitoring began and p and q are constants.

- (a) Find the value of p and the value of q .

(3)

Exactly T years after monitoring began, the share price was £2.50

- (b) Find the value of T , according to the model, giving your answer to one decimal place.

(2)

(Total for Question 3 is 5 marks)

Question 2**Straight Line**

2. The points P , Q and R have coordinates $(-3, 7)$, $(9, 11)$ and $(12, 2)$ respectively.

(a) Prove that angle $PQR = 90^\circ$

(3)

Given that the point S is such that $PQRS$ forms a rectangle,

(b) find the coordinates of S .

(2)

(Total for Question 2 is 5 marks)

WMA11/01 MAY/JUNE 2023

10 marks

Question 10

Straight Line

10.

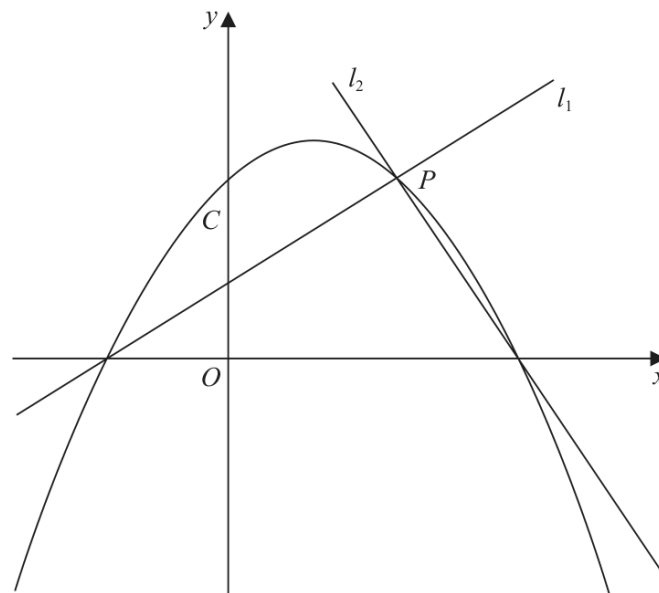


Figure 5

Figure 5 shows a sketch of the quadratic curve C with equation

$$y = -\frac{1}{4}(x+2)(x-b) \quad \text{where } b \text{ is a positive constant}$$

The line l_1 also shown in Figure 5,

- has gradient $\frac{1}{2}$
- intersects C on the negative x -axis and at the point P

(a) (i) Write down an equation for l_1

(1)

(ii) Find, in terms of b , the coordinates of P

(3)

Given that the line l_2 is perpendicular to l_1 and intersects C on the positive x -axis,

(b) find, in terms of b , an equation for l_2

(2)

Given also that l_2 intersects C at the point P

(c) show that another equation for l_2 is

$$y = -2x + \frac{5b}{2} - 4$$

(2)

(d) Hence, or otherwise, find the value of b

(Total for Question 10 is 10 marks)

Question 5

Straight Line

5.

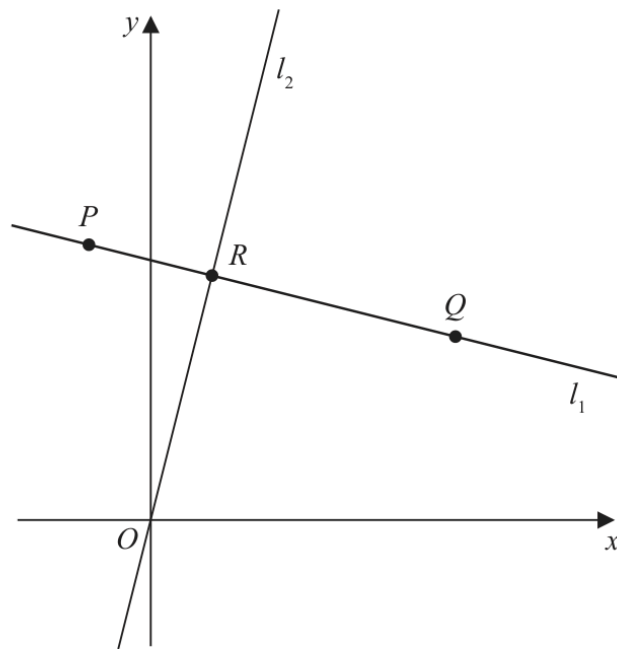


Figure 1

In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

The straight line l_1 , shown in Figure 1, passes through the points $P(-2, 9)$ and $Q(10, 6)$.

- (a) Find the equation of l_1 , giving your answer in the form $y = mx + c$, where m and c are constants to be found.

(3)

The straight line l_2 passes through the origin O and is perpendicular to l_1 .

The lines l_1 and l_2 meet at the point R as shown in Figure 1.

- (b) Find the coordinates of R

(4)

- (c) Find the exact area of triangle OPQ .

(3)

(Total for Question 5 is 10 marks)

Question 9

Straight Line

9. Given that

- the point A has coordinates $(4, 2)$
- the point B has coordinates $(15, 7)$
- the line l_1 passes through A and B

(a) find an equation for l_1 , giving your answer in the form $px + qy + r = 0$ where p , q and r are integers to be found.

(3)

The line l_2 passes through A and is parallel to the x -axis.

The point C lies on l_2 so that the length of BC is $5\sqrt{5}$

(b) Find both possible pairs of coordinates of the point C .

(4)

(c) Hence find the minimum possible area of triangle ABC .

(2)

(Total for Question 9 is 9 marks)

Question 1**Straight Line**

1. The line l_1 passes through the point $A(-5, 20)$ and the point $B(3, -4)$.

- (a) Find an equation for l_1 giving your answer in the form $y = mx + c$, where m and c are constants.

(3)

The line l_2 is perpendicular to l_1 and passes through the midpoint of AB

- (b) Find an equation for l_2 giving your answer in the form $px + qy + r = 0$, where p, q and r are integers.

(3)

(Total for Question 1 is 6 marks)

Question 2

Straight Line

2.

In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

Given that

- the point A has coordinates $(-2\sqrt{3}, 5)$
 - the point B has coordinates $(7\sqrt{3}, 8)$
 - the straight line l_1 passes through A and B
- (a) show that the gradient of l_1 is $p\sqrt{3}$, where p is a rational constant to be found.
You must show each step of your working.

(2)

The straight line l_2 is perpendicular to l_1 and passes through A .

- (b) Find the equation of l_2 , giving your answer in the form $y = mx + c$, where m and c are constants.

(3)

(Total for Question 2 is 5 marks)

Question 5

Straight Line

5.

**In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

The line l_1 has equation

$$x - 2y + 25 = 0$$

The line l_2 passes through the origin and is perpendicular to l_1

(a) Find an equation for l_2 (2)

The lines l_1 and l_2 intersect at the point P .

(b) Use algebra to find the coordinates of P . (3)

(c) Hence find the shortest distance from l_1 to the origin.

Write your answer as a fully simplified surd. (2)

(Total for Question 5 is 7 marks)

Question 4

Straight Line

4.

**In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

The point $A(-1, 8)$ and the point $B(7, 2)$ lie on the line L_1

(a) Find an equation for L_1 in the form $ax + by + c = 0$, where a , b and c are integers. (3)

The line L_2

- passes through A and is perpendicular to L_1
- cuts the x -axis at the point C

(b) Find the coordinates of C . (3)

(c) Hence find the area of triangle ABC . (3)

(Total for Question 4 is 9 marks)

TOPIC

Basic Trigonometry

Question 4**Basic Trigonometry**

4. A parallelogram $ABCD$ has area 40 cm^2

Given that AB has length 10 cm , BC has length 6 cm and angle DAB is obtuse, find

- (a) the size of angle DAB , in degrees, to 2 decimal places, (3)

- (b) the length of diagonal BD , in cm, to one decimal place. (2)

(Total 5 marks)

Question 3

Basic Trigonometry

3. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

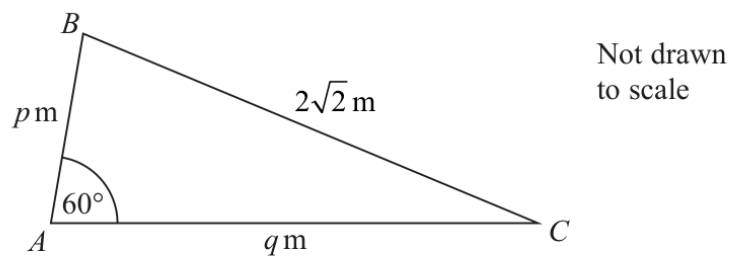


Figure 1

Figure 1 shows the plan view of a flower bed.
The flowerbed is in the shape of a triangle ABC with

- $AB = p$ metres
- $AC = q$ metres
- $BC = 2\sqrt{2}$ metres
- angle $BAC = 60^\circ$

(a) Show that

$$p^2 + q^2 - pq = 8 \quad (2)$$

Given that side AC is 2 metres longer than side AB , use algebra to find

(b) (i) the exact value of p ,

(ii) the exact value of q .

(5)

Using the answers to part (b),

(c) calculate the exact area of the flower bed.

(2)

(Total 9 marks)

Question 2

Basic Trigonometry

2. In the triangle ABC ,

- $AB = 21$ cm
- $BC = 13$ cm
- angle $BAC = 25^\circ$
- angle $ACB = x^\circ$

(a) Use the sine rule to find the value of $\sin x^\circ$, giving your answer to 4 decimal places. (2)

Given also that AB is the longest side of the triangle,

(b) find the value of x , giving your answer to 2 decimal places. (3)

(Total 5 marks)

Question 5

Basic Trigonometry

5.

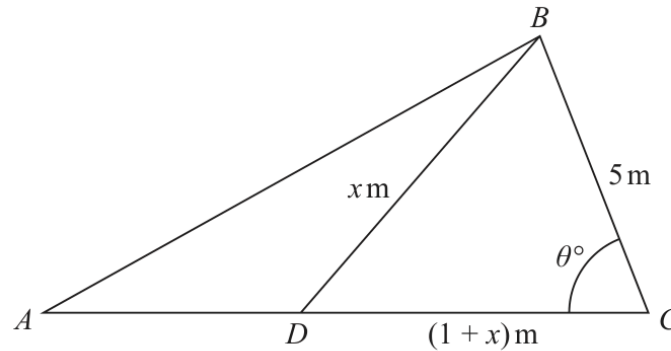
Diagram **NO**
accurately dr

Figure 2

Figure 2 shows the plan view of a frame for a flat roof.

The shape of the frame consists of triangle ABD joined to triangle BCD .

Given that

- $BD = x$ m
- $CD = (1 + x)$ m
- $BC = 5$ m
- angle $BCD = \theta^\circ$

(a) show that $\cos \theta^\circ = \frac{13 + x}{5 + 5x}$

(2)

Given also that

- $x = 2\sqrt{3}$
- angle $BAC = 30^\circ$
- ADC is a straight line

(b) find the area of triangle ABC , giving your answer, in m^2 , to one decimal place.

(5)

(Total for Question 5 is 7 marks)

Question 2

Basic Trigonometry

2. The triangle ABC is such that

- $AB = 15$ cm
- $AC = 25$ cm
- angle $BAC = \theta^\circ$
- area triangle $ABC = 100$ cm²

(a) Find the value of $\sin \theta^\circ$

(2)

Given that $\theta > 90$

(b) find the length of BC , in cm, to 3 significant figures.

(3)

(Total for Question 2 is 5 marks)

Question 3

Basic Trigonometry

3. The sides of a triangle are in the ratio 2:4:5

(a) Find the size of the **largest** angle of the triangle, in degrees, to one decimal place.

(2)

Given that the area of the triangle is 140 cm^2

(b) find the length of the **shortest** side, in cm, to one decimal place.

(3)

(Total for Question 3 is 5 marks)

TOPIC

Radians

Question 1

1.

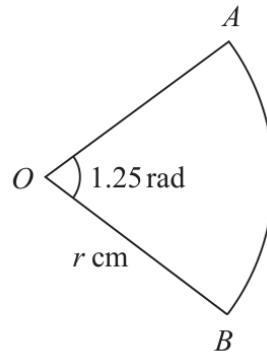


Figure 1

Figure 1 shows a sector AOB of a circle with centre O and radius r cm.

The angle AOB is 1.25 radians.

Given that the area of the sector AOB is 15 cm^2

(a) find the exact value of r ,

(2)

(b) find the exact length of the perimeter of the sector. Write your answer in simplest form.

(3)

(Total 5 marks)

Question 4

4.

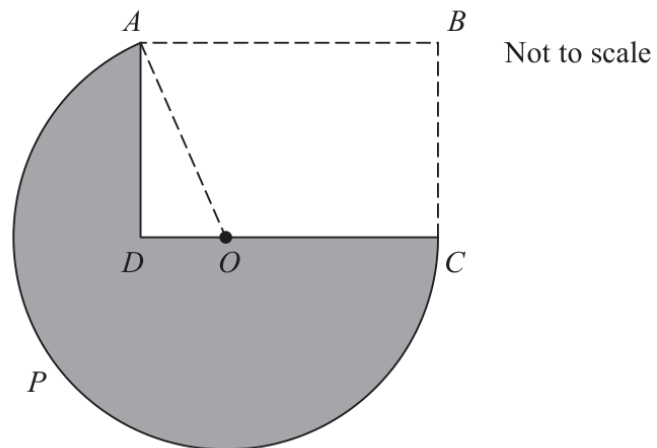


Figure 2

Figure 2 shows the plan view of a house $ABCD$ and a lawn $APCDA$.

$ABCD$ is a rectangle with $AB = 16$ m.

$APCOA$ is a sector of a circle centre O with radius 12 m.

The point O lies on the line DC , as shown in Figure 2.

(a) Show that the size of angle AOD is 1.231 radians to 3 decimal places.

(2)

The lawn $APCDA$ is shown shaded in Figure 2.

(b) Find the area of the lawn, in m^2 , to one decimal place.

(4)

(c) Find the perimeter of the lawn, in metres, to one decimal place.

(3)

(Total 9 marks)

Question 5

5.

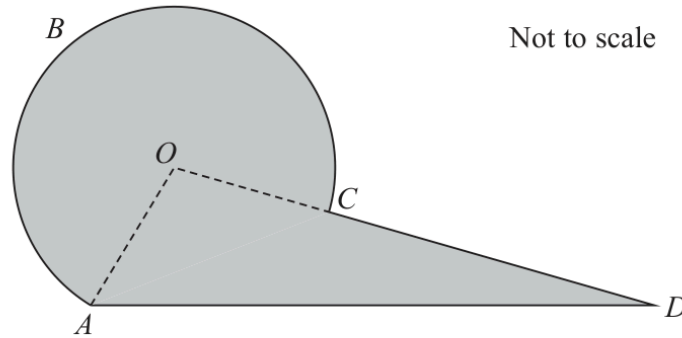


Figure 3

Figure 3 shows the plan view of a viewing platform at a tourist site.

The shape of the viewing platform consists of a sector $ABCOA$ of a circle, centre O , joined to a triangle AOD .

Given that

- $OA = OC = 6$ m
- $AD = 14$ m
- angle $ADC = 0.43$ radians
- angle AOD is an obtuse angle
- OCD is a straight line

find

- (a) the size of angle AOD , in radians, to 3 decimal places, (3)
- (b) the length of arc ABC , in metres, to one decimal place, (2)
- (c) the total area of the viewing platform, in m^2 , to one decimal place. (4)

(Total 9 marks)

WMA11/01 MAY/JUNE 2021

10 marks

Question 7

Radians

7.

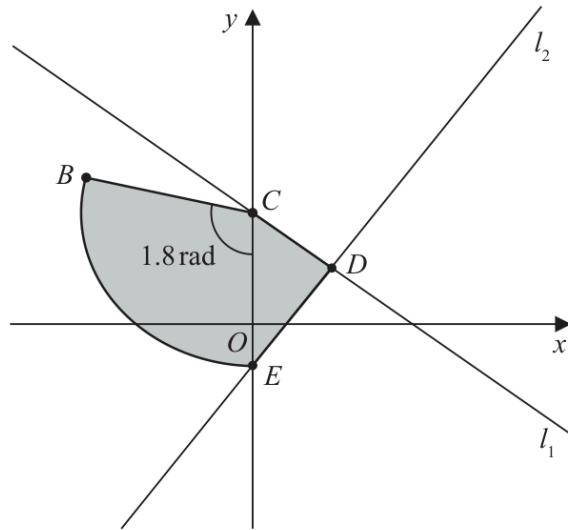


Figure 3

The line l_1 has equation $4y + 3x = 48$

The line l_1 cuts the y -axis at the point C , as shown in Figure 3.

(a) State the y coordinate of C .

(1)

The point $D(8, 6)$ lies on l_1

The line l_2 passes through D and is perpendicular to l_1

The line l_2 cuts the y -axis at the point E as shown in Figure 3.

(b) Show that the y coordinate of E is $-\frac{14}{3}$

(3)

A sector BCE of a circle with centre C is also shown in Figure 3.

Given that angle BCE is 1.8 radians,

(c) find the length of arc BE .

(3)

The region $CBED$, shown shaded in Figure 3, consists of the sector BCE joined to the triangle CDE .

(d) Calculate the exact area of the region $CBED$.

(3)

(Total 10 marks)

Question 7

7.

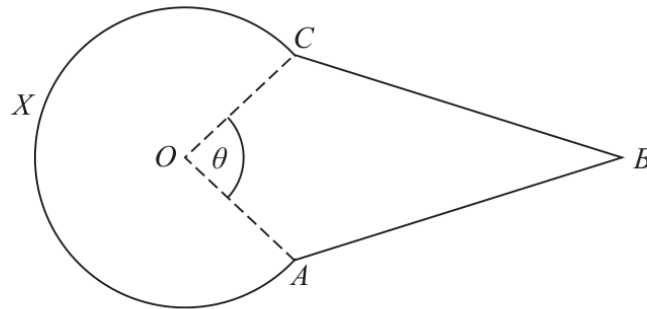


Figure 3

Figure 3 shows the design for a sign at a bird sanctuary.

The design consists of a kite $OABC$ joined to a sector $OCXA$ of a circle centre O .

In the design

- $OA = OC = 0.6\text{ m}$
- $AB = CB = 1.4\text{ m}$
- Angle $OAB = \text{Angle } OCB = 2\text{ radians}$
- Angle $AOC = \theta\text{ radians}$, as shown in Figure 3

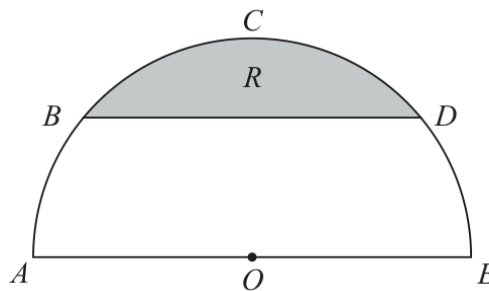
Making your method clear,

- (a) show that $\theta = 1.64\text{ radians}$ to 3 significant figures, (4)
- (b) find the perimeter of the sign, in metres to 2 significant figures, (2)
- (c) find the area of the sign, in m^2 to 2 significant figures. (4)

(Total 10 marks)

Question 5

5.



Not to scale

Figure 2

Figure 2 shows a plan view of a semicircular garden $ABCDEOA$

The semicircle has

- centre O
- diameter AOE
- radius 3 m

The straight line BD is parallel to AE and angle BOA is 0.7 radians.

(a) Show that, to 4 significant figures, angle BOD is 1.742 radians.

(1)

The flowerbed R , shown shaded in Figure 2, is bounded by BD and the arc BCD .

(b) Find the area of the flowerbed, giving your answer in square metres to one decimal place.

(3)

(c) Find the perimeter of the flowerbed, giving your answer in metres to one decimal place.

(3)

(Total 7 marks)

WMA11/01 MAY/JUNE 2022

10 marks

Question 8

Radians

8.

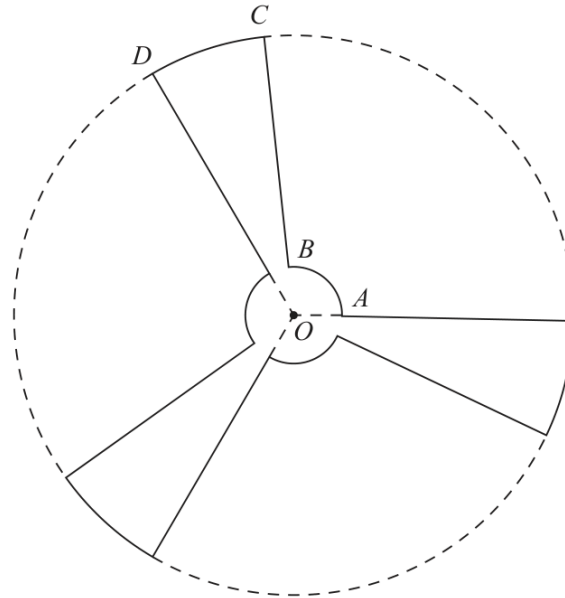


Figure 3

Figure 3 shows a sketch of the outline of the face of a ceiling fan viewed from below.

The fan consists of three identical sections congruent to $OABCD O$, shown in Figure 3, where

- $OABO$ is a sector of a circle with centre O and radius 9 cm
- $OBCDO$ is a sector of a circle with centre O and radius 84 cm
- angle $AOD = \frac{2\pi}{3}$ radians

Given that the length of the arc AB is 15 cm,

- (a) show that the length of the arc CD is 35.9 cm to one decimal place. (3)

The face of the fan is modelled to be a flat surface.

Find, according to the model,

- (b) the perimeter of the face of the fan, giving your answer to the nearest cm, (2)
- (c) the surface area of the face of the fan.

Give your answer to 3 significant figures and make your units clear. (5)

(Total 10 marks)

Question 8

Radians

8.

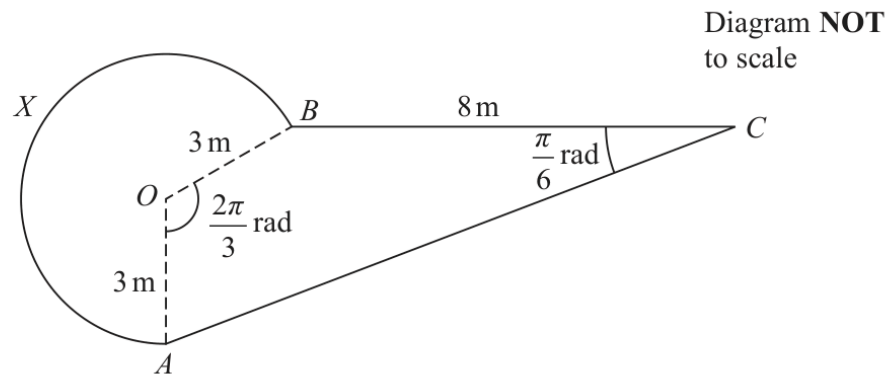


Figure 2

Figure 2 shows the plan view of a design for a pond.

The design consists of a sector $AOBX$ of a circle centre O joined to a quadrilateral $AOBC$.

- $BC = 8\text{ m}$
- $OA = OB = 3\text{ m}$
- angle AOB is $\frac{2\pi}{3}$ radians
- angle BCA is $\frac{\pi}{6}$ radians

- (a) Calculate (i) the exact area of the sector $AOBX$,
(ii) the exact perimeter of the sector $AOBX$. (5)
- (b) Calculate the exact area of the triangle AOB . (2)
- (c) Show that the length AB is $3\sqrt{3}\text{ m}$. (2)
- (d) Find the total surface area of the pond. Give your answer in m^2 correct to 2 significant figures. (5)

(Total for Question 8 is 14 marks)

Question 6

Radians

6.

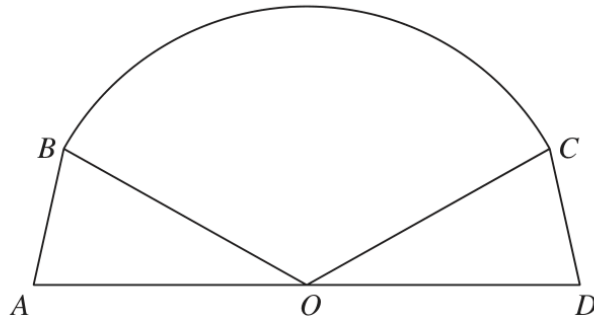
Diagram **NO**
accurately dr

Figure 1

Figure 1 shows the plan view for the design of a stage.

The design consists of a sector BOC of a circle, with centre O , joined to two congruent triangles OAB and ODC .

Given that

- angle $BOC = 2.4$ radians
- area of sector $BOC = 40 \text{ m}^2$
- AOD is a straight line of length 12.5 m

(a) find the radius of the sector, giving your answer, in m , to 2 decimal places, (2)

(b) find the size of angle AOB , in radians, to 2 decimal places. (1)

Hence find

(c) the total area of the stage, giving your answer, in m^2 , to one decimal place, (3)

(d) the total perimeter of the stage, giving your answer, in m , to one decimal place. (4)

(Total for Question 6 is 10 marks)

Question 5

5.

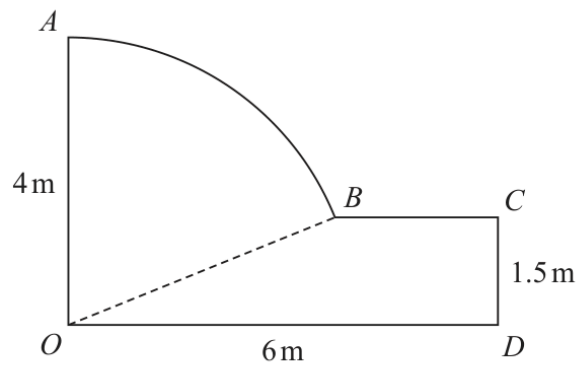


Figure 1

Figure 1 shows the plan for a garden.

In the plan

- OA and CD are perpendicular to OD
- AB is an arc of the circle with centre O and radius 4 metres
- BC is parallel to OD
- OD is 6 metres, OA is 4 metres and CD is 1.5 metres

(a) Show that angle AOB is 1.186 radians to 4 significant figures.

(2)

(b) Find the perimeter of the garden, giving your answer in metres to 3 significant figures.

(4)

(c) Find the area of the garden, giving your answer in square metres to 3 significant figures.

(4)

(Total for Question 5 is 10 marks)

WMA11/01 OCTOBER 2023

7 marks

Question 9

Radians

9.

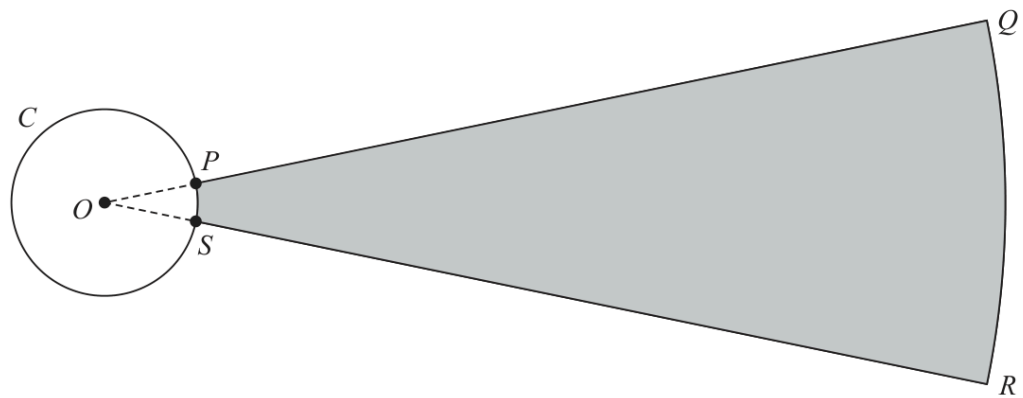
Diagram NO
accurately dr

Figure 3

Figure 3 shows the plan view of the area being used for a ball-throwing competition.

Competitors must stand within the circle C and throw a ball as far as possible into the target area, $PQRS$, shown shaded in Figure 3.

Given that

- circle C has centre O
- P and S are points on C
- $OPQRSO$ is a sector of a circle with centre O
- the length of arc PS is 0.72 m
- the size of angle POS is 0.6 radians

(a) show that $OP = 1.2$ m

(1)

Given also that

- the target area, $PQRS$, is 90 m²
- length $PQ = x$ metres

(b) show that

$$5x^2 + 12x - 1500 = 0$$

(3)

(c) Hence calculate the total perimeter of the target area, $PQRS$, giving your answer to the nearest metre.

(3)

(Total for Question 9 is 7 marks)

Question 8

8.

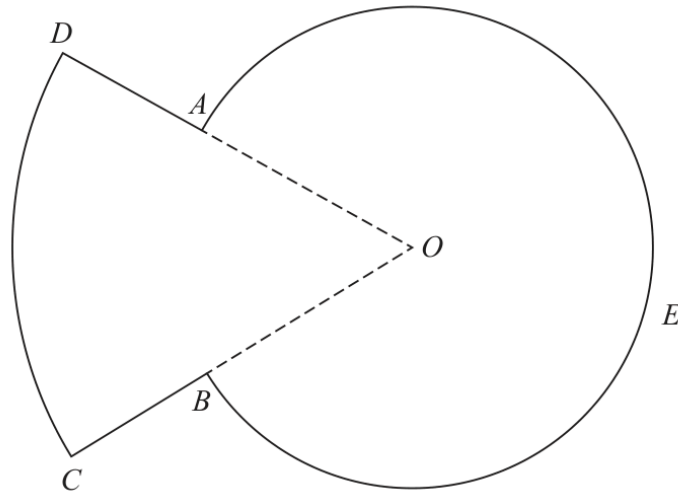


Figure 3

Figure 3 shows a sketch of the plan view of a platform.

The plan view of the platform consists of a sector DOC of a circle centre O joined to a sector $AOBEA$ of a different circle, also with centre O .

Given that

- angle $AOB = 0.8$ radians
- arc length $CD = 9$ m
- $DA : AO = 3 : 5$

(a) show that $AO = 7.03$ m to 3 significant figures.

(3)

(b) Find the perimeter of the platform, in m, to 3 significant figures.

(3)

(c) Find the total area of the platform, giving your answer in m^2 to the nearest whole number.

(3)

(Total for Question 8 is 9 marks)

Question 5

5.

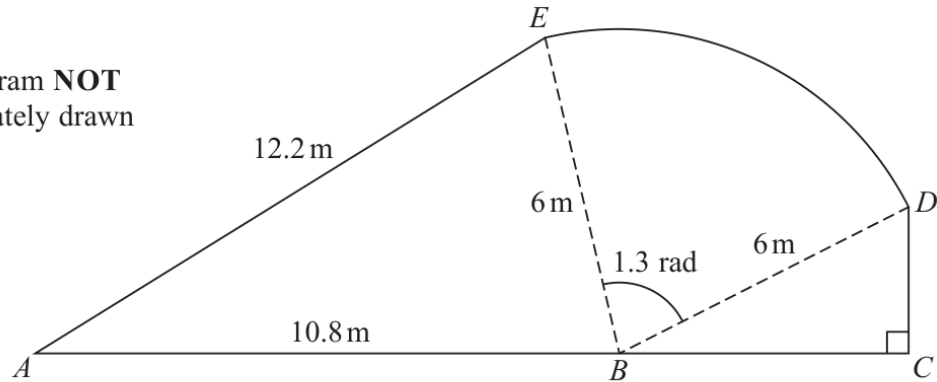
Diagram NOT
accurately drawn

Figure 2

Figure 2 shows the plan view of a garden.

The shape of the garden $ABCDEA$ consists of a triangle ABE and a right-angled triangle BCD joined to a sector BDE of a circle with radius 6 m and centre B .

The points A , B and C lie on a straight line with $AB = 10.8$ m

Angle $BCD = \frac{\pi}{2}$ radians, angle $EBD = 1.3$ radians and $AE = 12.2$ m

- (a) Find the area of the sector BDE , giving your answer in m^2 (2)
- (b) Find the size of angle ABE , giving your answer in radians to 2 decimal places. (2)
- (c) Find the area of the garden, giving your answer in m^2 to 3 significant figures. (3)

(Total for Question 5 is 7 marks)

Question 5

5. A plot of land OAB is in the shape of a sector of a circle with centre O .

Given

- $OA = OB = 5$ km
- angle $AOB = 1.2$ radians

(a) find the perimeter of the plot of land.

(2)

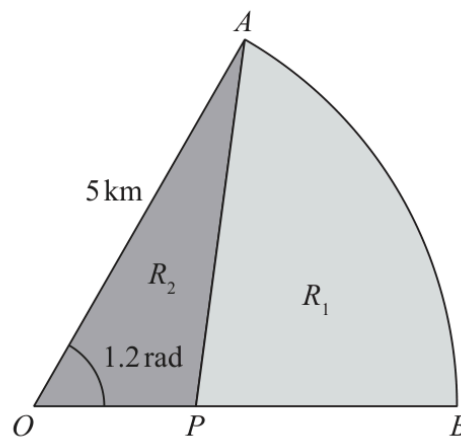


Diagram **NO**
accurately dr

Figure 2

A point P lies on OB such that the line AP divides the plot of land into two regions R_1 and R_2 as shown in Figure 2.

Given that

$$\text{area of } R_1 = 3 \times \text{area of } R_2$$

(b) show that the area of $R_2 = 3.75 \text{ km}^2$

(3)

(c) Find the length of AP , giving your answer to the nearest 100 m.

(4)

(Total for Question 5 is 9 marks)

Question 8

Radians

8.

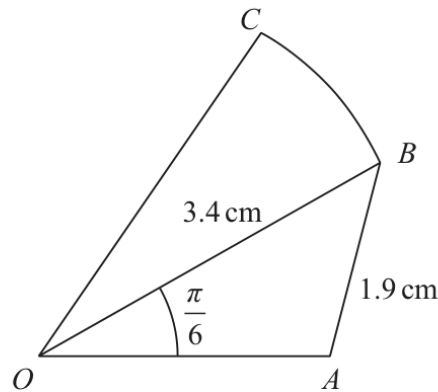


Figure 1

Figure 1 shows a sketch of a design for a badge.

The design consists of a triangle OAB joined to a sector OBC of a circle with centre O . In the design

- $OB = 3.4$ cm
- $AB = 1.9$ cm
- angle $AOB = \frac{\pi}{6}$ radians
- angle $OAB > \frac{\pi}{2}$ radians

Making your method clear,

(a) find the size of angle OAB , giving your answer in radians to 4 significant figures, (3)

(b) find the area of triangle OAB , in cm^2 , giving your answer to 3 significant figures. (2)

Given that the ratio of the area of sector OBC to the area of triangle OAB is 3 : 2

(c) show that angle BOC is 0.462 radians to 3 significant figures. (3)

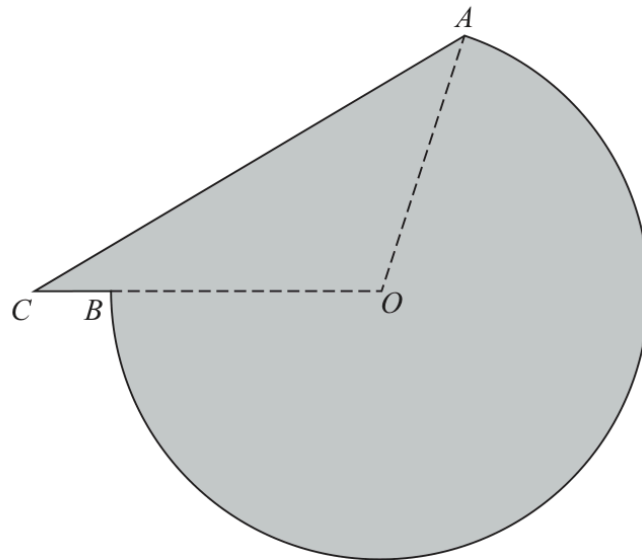
(d) Hence find the perimeter of the badge, in cm, to the nearest integer. (5)

(Total for Question 8 is 13 marks)

Question 6

Radians

6.



Not to scale

Figure 2

The shaded area in Figure 2 shows the plan view of a helicopter landing pad.

The area consists of the major sector AOB of a circle centre O joined to a triangle AOC .

Given that

- $AO = OB = 15$ m
- $BC = 2$ m
- CBO is a straight line
- angle $ACO = 0.6$ radians

(a) show that angle COA is 1.847 radians to 3 decimal places.

(3)

(b) Find the total area of the helicopter landing pad.
Give your answer in m^2 to 3 significant figures.

(3)

(c) Find the perimeter of the helicopter landing pad.
Give your answer in metres to 3 significant figures.

(3)

(Total for Question 6 is 9 marks)

Question 7

Radians

7.

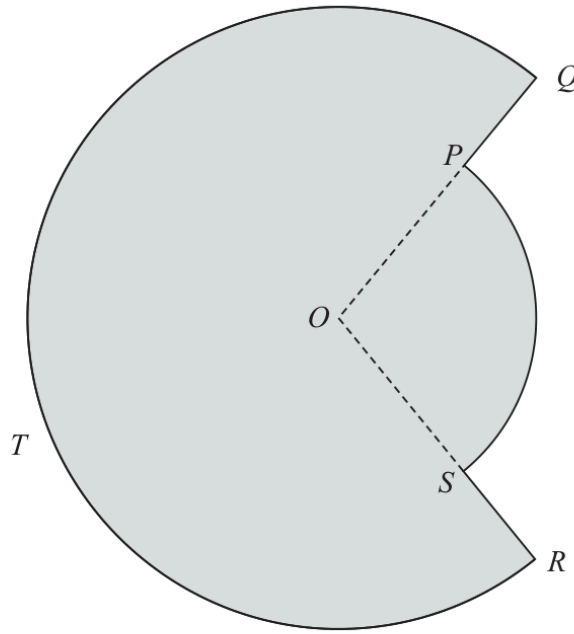


Figure 2

**In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.**

Figure 2 shows the plan view of a design for a swimming pool.

The design consists of a sector POS of a circle centre O joined to a major sector $QORTQ$ of a different circle, also with centre O .

Given that

- angle POS is 1.65 radians
- the area of sector POS is 30 m^2
- $PQ = 2.8 \text{ m}$

- (a) show that, to 3 significant figures, $OQ = 8.83 \text{ m}$ (3)
- (b) Find the total surface area of the swimming pool in m^2 to the nearest integer. (3)
- (c) Find the total perimeter of the swimming pool in metres to 2 significant figures. (3)

(Total for Question 7 is 9 marks)

Question 5

Radians

5.

In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.

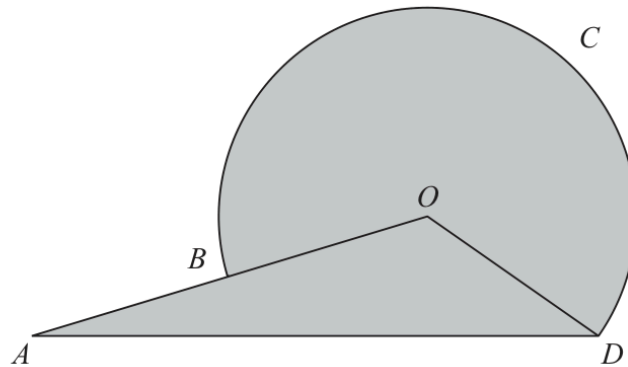


Diagram NOT
to scale

Figure 2

Figure 2 shows the logo for the tourist board of an island.

The logo consists of a sector $BODCB$ of a circle centre O joined to a triangle AOD .

Given that

- ABO is a straight line
- $OD = 3$ cm
- $AD = 8$ cm
- angle $AOD = 2.5$ radians

- (a) show that angle ODA is 0.415 radians to 3 significant figures. (3)
- (b) Find the total area of the logo, in cm^2 , to one decimal place. (3)
- (c) Find the perimeter of the logo, $ABCD$, in cm, to one decimal place. (3)

(Total for Question 5 is 9 marks)

TOPIC

Trigonometric Functions

Question 9

Trigonometric Functions

9.

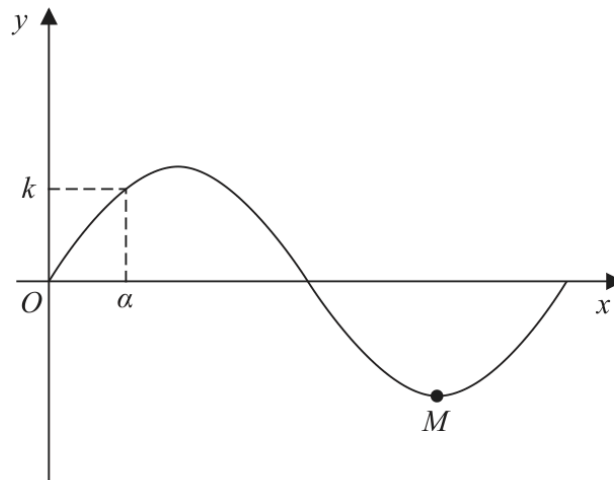


Figure 5

Figure 5 shows a sketch of part of the curve C with equation $y = \sin\left(\frac{x}{12}\right)$, where x is measured in radians. The point M shown in Figure 5 is a minimum point on C .

(a) State the period of C .

(1)

(b) State the coordinates of M .

(1)

The smallest positive solution of the equation $\sin\left(\frac{x}{12}\right) = k$, where k is a constant, is α .

Find, in terms of α ,

(c) (i) the negative solution of the equation $\sin\left(\frac{x}{12}\right) = k$ that is closest to zero,

(ii) the smallest positive solution of the equation $\cos\left(\frac{x}{12}\right) = k$.

(2)

(Total 4 marks)

Question 7

Trigonometric Functions

7.

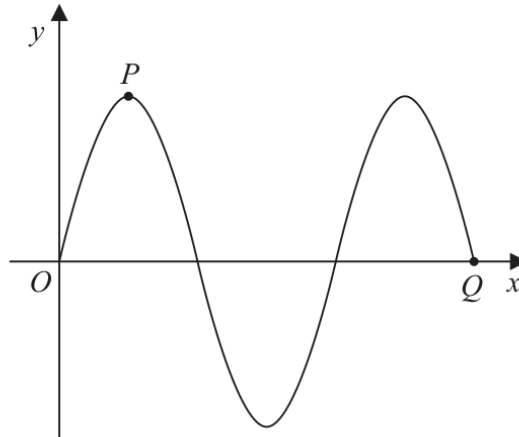


Figure 3

Figure 3 shows part of the curve C_1 with equation $y = 3 \sin x$, where x is measured in degrees.

The point P and the point Q lie on C_1 and are shown in Figure 3.

(a) State

- (i) the coordinates of P ,
- (ii) the coordinates of Q .

(3)

A different curve C_2 has equation $y = 3 \sin x + k$, where k is a constant.

The curve C_2 has a maximum y value of 10

The point R is the minimum point on C_2 with the smallest positive x coordinate.

(b) State the coordinates of R .

(2)

(Total 5 marks)

Question 3

Trigonometric Functions

3.

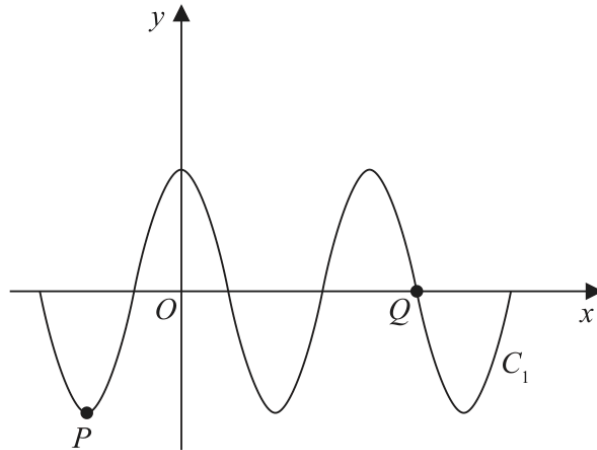


Figure 1

Figure 1 shows a sketch of part of the curve C_1 with equation $y = 4 \cos x^\circ$

The point P and the point Q lie on C_1 and are shown in Figure 1.

(a) State

(i) the coordinates of P ,

(ii) the coordinates of Q .

(3)

The curve C_2 has equation $y = 4 \cos x^\circ + k$, where k is a constant.

Curve C_2 has a minimum y value of -1

The point R is the maximum point on C_2 with the smallest positive x coordinate.

(b) State the coordinates of R .

(2)

(Total 5 marks)

WMA11/01 MAY/JUNE 2021

7 marks

Question 9

Trigonometric Functions

9.

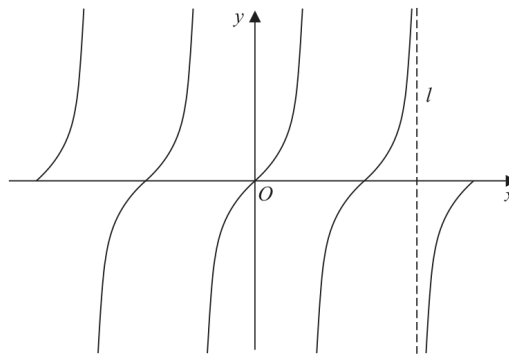


Figure 4

Figure 4 shows a sketch of the curve with equation

$$y = \tan x \quad -2\pi \leq x \leq 2\pi$$

The line l , shown in Figure 4, is an asymptote to $y = \tan x$

(a) State an equation for l .

(1)

A copy of Figure 4, labelled Diagram 1, is shown on the next page.

(b) (i) On Diagram 1, sketch the curve with equation

$$y = \frac{1}{x} + 1 \quad -2\pi \leq x \leq 2\pi$$

stating the equation of the horizontal asymptote of this curve.

(ii) Hence, **giving a reason**, state the number of solutions of the equation

$$\tan x = \frac{1}{x} + 1$$

in the region $-2\pi \leq x \leq 2\pi$

(4)

(c) State the number of solutions of the equation $\tan x = \frac{1}{x} + 1$ in the region

(i) $0 \leq x \leq 40\pi$

(ii) $-10\pi \leq x \leq \frac{5}{2}\pi$

(2)

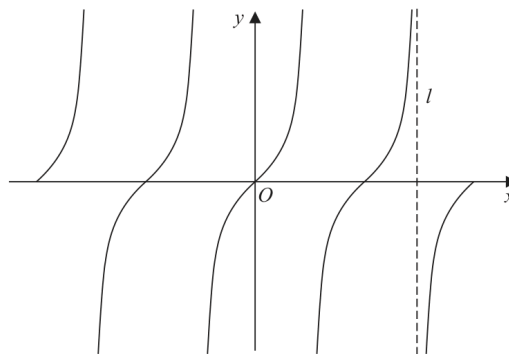


Diagram 1

(Total 7 marks)

Question 4

Trigonometric Functions

4.

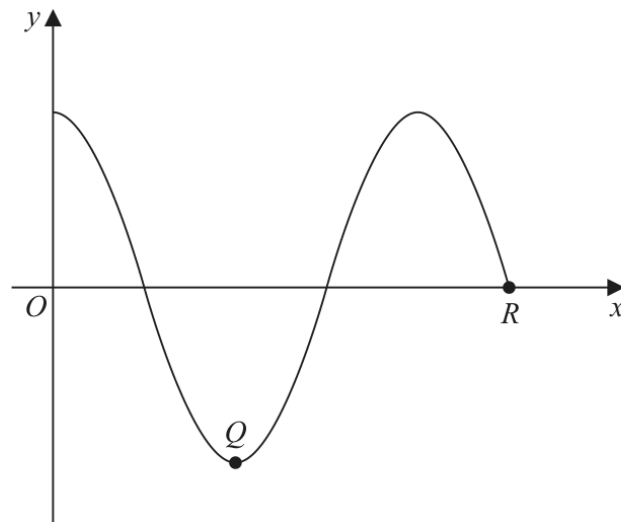


Figure 2

Figure 2 shows a sketch of the curve with equation $y = f(x)$, where

$$f(x) = \cos 2x^\circ \quad 0 \leq x \leq k$$

The point Q and the point $R(k, 0)$ lie on the curve and are shown in Figure 2.

(a) State

- (i) the coordinates of Q ,
- (ii) the value of k .

(3)

(b) Given that there are exactly two solutions to the equation

$$\cos 2x^\circ = p \quad \text{in the region } 0 \leq x \leq k$$

find the range of possible values for p .

(2)

(Total 5 marks)

Question 9

Trigonometric Functions

9.

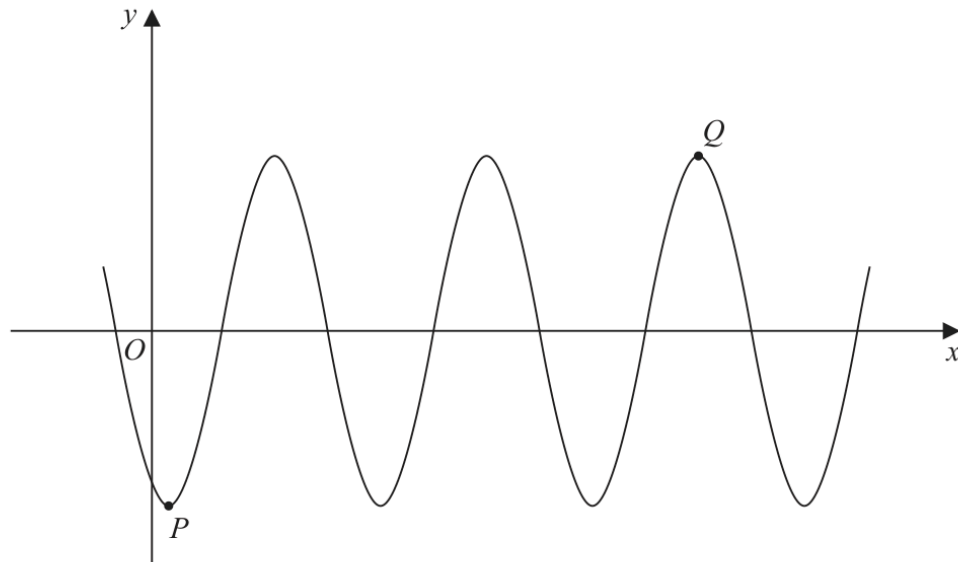


Figure 4

Figure 4 shows part of the curve with equation

$$y = A \cos(x - 30)^\circ$$

where A is a constant.

The point P is a minimum point on the curve and has coordinates $(30, -3)$ as shown in Figure 4.

(a) Write down the value of A .

(1)

The point Q is shown in Figure 4 and is a maximum point.

(b) Find the coordinates of Q .

(3)

(Total 4 marks)

WMA11/01 MAY/JUNE 2022

8 marks

Question 9

Trigonometric Functions

Question 9

Trigonometric Functions

9.

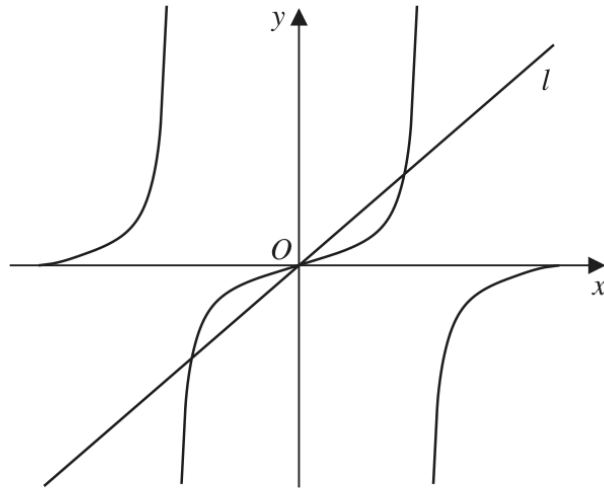


Figure 3

Figure 3 shows a sketch of

- the curve with equation $y = \tan x$
- the straight line l with equation $y = \pi x$

in the interval $-\pi < x < \pi$

(a) State the period of $\tan x$

(1)

(b) Write down the number of roots of the equation

(i) $\tan x = (\pi + 2)x$ in the interval $-\pi < x < \pi$

(1)

(ii) $\tan x = \pi x$ in the interval $-2\pi < x < 2\pi$

(1)

(iii) $\tan x = \pi x$ in the interval $-100\pi < x < 100\pi$

(1)

(Total for Question 9 is 4 marks)

WMA11/01 MAY/JUNE 2023

9 marks

Question 9

Trigonometric Functions

9. (i)

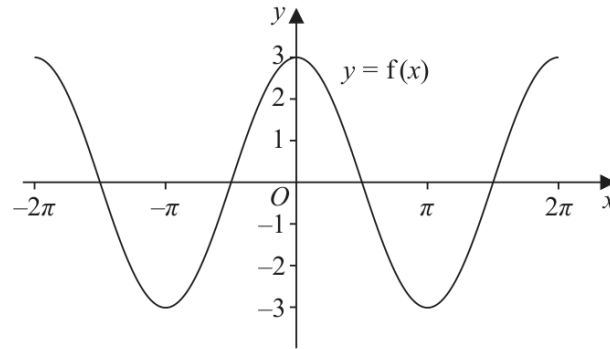


Figure 3

Figure 3 shows part of the graph of the trigonometric function with equation $y = f(x)$

(a) Write down an expression for $f(x)$ (2)

On a separate diagram,

(b) sketch, for $-2\pi < x < 2\pi$, the graph of the curve with equation $y = f\left(x + \frac{\pi}{4}\right)$

Show clearly the coordinates of all the points where the curve intersects the coordinate axes.

(3)

(ii)

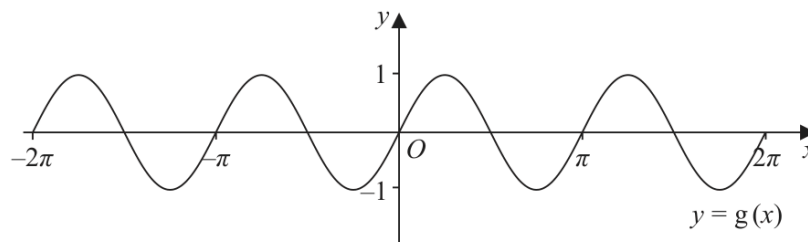


Figure 4

Figure 4 shows part of the graph of the trigonometric function with equation $y = g(x)$

(a) Write down an expression for $g(x)$ (2)

On a separate diagram,

(b) sketch, for $-2\pi < x < 2\pi$, the graph of the curve with equation $y = g(x) - 2$

Show clearly the coordinates of the y intercept.

(3)

(Total for Question 9 is 9 marks)

Question 10

Trigonometric Functions

10.

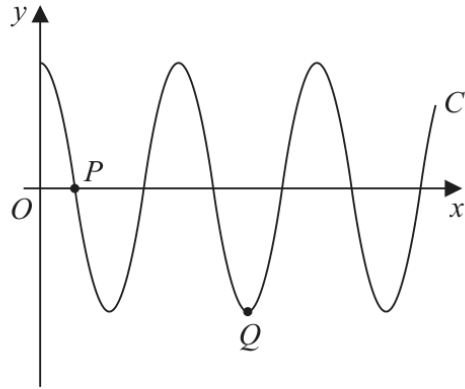


Figure 4

Figure 4 shows a sketch of part of the curve C_1 with equation

$$y = 3 \cos\left(\frac{x}{n}\right)^\circ \quad x \geq 0$$

where n is a constant.

The curve C_1 cuts the positive x -axis for the first time at point $P(270, 0)$, as shown in Figure 4.

(a) (i) State the value of n

(ii) State the period of C_1

(2)

The point Q , shown in Figure 4, is a minimum point of C_1

(b) State the coordinates of Q .

(2)

The curve C_2 has equation $y = 2 \sin x^\circ + k$, where k is a constant.

The point $R\left(a, \frac{12}{5}\right)$ and the point $S\left(-a, -\frac{3}{5}\right)$, both lie on C_2

Given that a is a constant less than 90

(c) find the value of k .

(2)

(Total for Question 10 is 6 marks)

WMA11/01 JANUARY 2024

6 marks

Question 6

Trigonometric Functions

6.

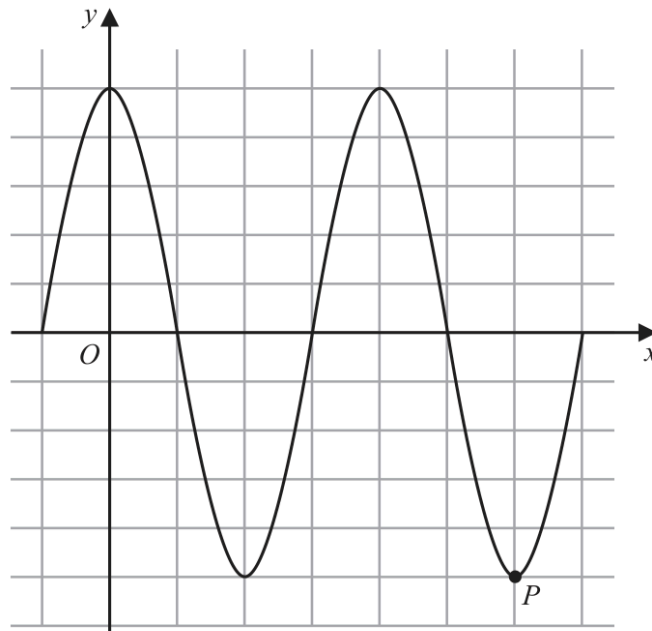


Figure 2

Figure 2 shows a plot of part of the curve C_1 with equation

$$y = 5 \cos x$$

with x being measured in degrees.

The point P , shown in Figure 2, is a minimum point on C_1

(a) State the coordinates of P

(2)

The point Q lies on a different curve C_2

Given that point Q

- is a maximum point on the curve
- is the maximum point with the **smallest** x coordinate, $x > 0$

(b) find the coordinates of Q when

(i) C_2 has equation $y = 5 \cos x - 2$

(ii) C_2 has equation $y = -5 \cos x$

(4)

(Total for Question 6 is 6 marks)

WMA11/01 MAY/JUNE 2024

6 marks

Question 11

Trigonometric Functions

11.

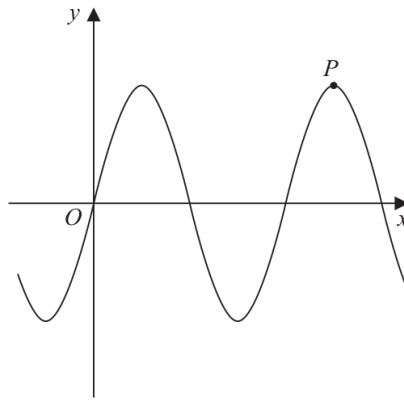


Figure 4

Figure 4 shows a sketch of part of the curve C_1 with equation

$$y = 12 \sin x$$

where x is measured in radians.

The point P shown in Figure 4 is a maximum point on C_1

(a) Find the coordinates of P .

(2)

The curve C_2 has equation

$$y = 12 \sin x + k$$

where k is a constant.

Given that the **maximum** value of y on C_2 is 3

(b) find the coordinates of the **minimum** point on C_2 which has the **smallest** positive x coordinate.

(2)

The curve C_3 has equation

$$y = 12 \sin(x + B)$$

where B is a positive constant.

Given that $\left(\frac{\pi}{4}, A\right)$, where A is a constant, is the **minimum** point on C_3 which has the **smallest** positive x coordinate,

(c) find

(i) the value of A ,

(ii) the smallest possible value of B .

(2)

(Total for Question 11 is 6 marks)

TOTAL FOR PAPER IS 75 MARKS

WMA11/01 OCTOBER 2024

8 marks

Question 7

Trigonometric Functions

7.

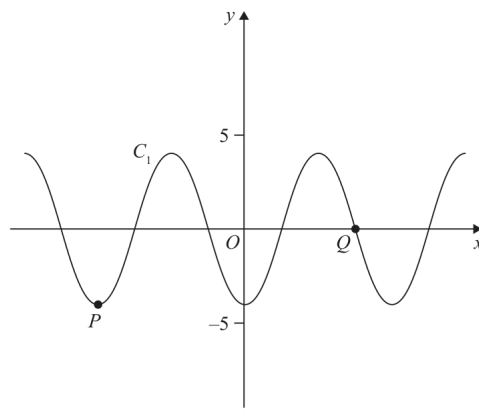


Figure 3

Figure 3 shows a plot of part of the curve C_1 with equation

$$y = -4 \cos x$$

where x is measured in radians.

Points P and Q lie on the curve and are shown in Figure 3.

(a) State

- (i) the coordinates of P
- (ii) the coordinates of Q

(3)

The curve C_2 has equation $y = -4 \cos x + k$ where x is measured in radians and k is a constant.

Given that C_2 has a maximum y value of 11

(b) (i) state the value of k

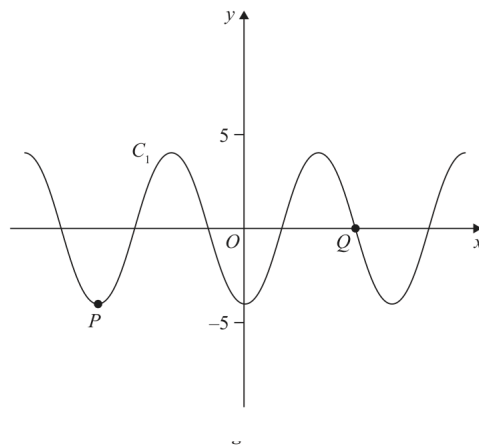
- (ii) state the coordinates of the minimum point on C_2 with the smallest positive x coordinate.

(3)

On the opposite page there is a copy of Figure 3 labelled Diagram 1.

(c) Using Diagram 1, state the number of solutions of the equation

$$-4 \cos x = 5 - \frac{10}{\pi} x$$



(Total for Question 7 is 8 marks)

WMA11/01 JANUARY 2025

13 marks

Question 9

Trigonometric Functions

9.

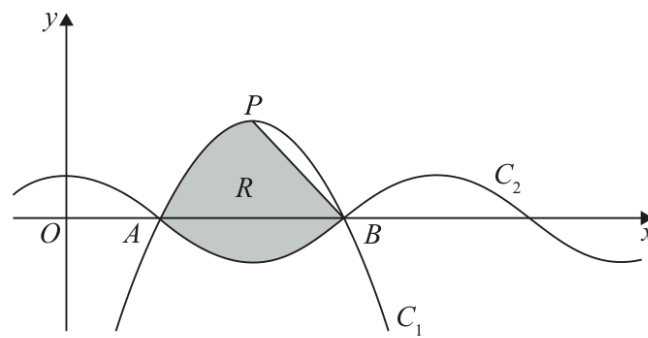


Figure 2

- (a) Express $6x - \frac{27}{4} - x^2$ in the form $a + b(x + c)^2$ where a , b and c are constants to be found.

(3)

Figure 2 shows part of a sketch of curve C_1 with equation

$$y = 6x - \frac{27}{4} - x^2$$

Given that the point P is the maximum point on C_1

- (b) state the coordinates of P

(2)

Figure 2 also shows part of a sketch of curve C_2 with equation

$$y = \cos(kx)$$

where k is a constant and x is measured in radians.

Given that C_1 and C_2 intersect on the x -axis at point A and at point B , as shown in Figure 2,

- (c) (i) state the x coordinate of B
 (ii) state the value of k
 (iii) state the period of C_2

(3)

The line segment L joins P and B .

The region R , shown shaded in Figure 2, is bounded by L , C_1 and C_2

- (d) Use inequalities to define R .

(5)

(Total for Question 9 is 13 marks)

Question 4

Trigonometric Functions

4.

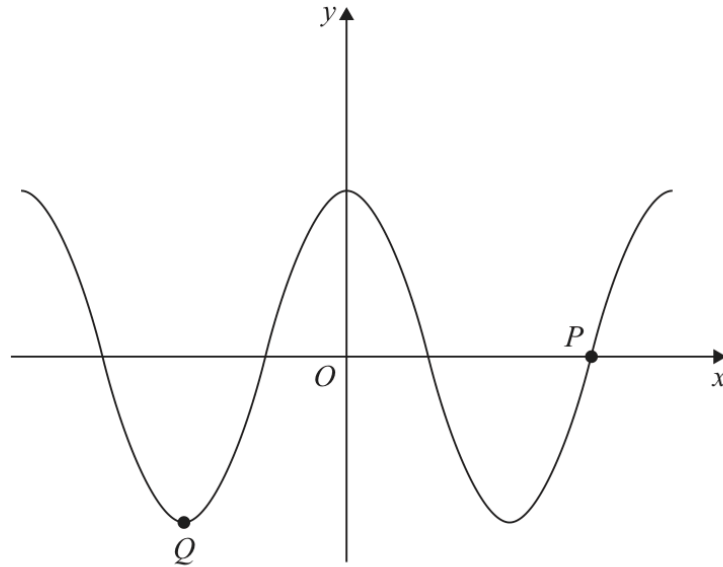


Figure 1

Figure 1 shows a sketch of part of the curve with equation

$$y = 4 \cos x$$

where x is measured in degrees.

The points P and Q lie on the curve and are shown in Figure 1.

- (a) State the coordinates of P . (1)
- (b) State the coordinates of Q . (2)
- (c) State the **number** of solutions of the equation
- (i) $4 \cos x = 3$ in the interval $0 < x \leq 18000^\circ$
 - (ii) $5 + 4 \cos x = 1$ in the interval $-720^\circ < x \leq 720^\circ$
 - (iii) $4 \cos x - 3 = 1$ in the interval $-1080^\circ \leq x \leq 1080^\circ$ (3)

(Total for Question 4 is 6 marks)

WMA11/01 JANUARY 2026

9 marks

Question 9

Trigonometric Functions

9.

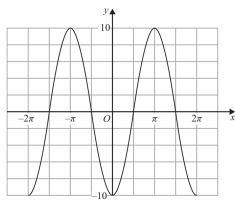


Figure 4

Figure 4 shows a sketch of part of the graph of the trigonometric function with equation $y = f(x)$.

(a) Write down an expression for $f(x)$. (2)

Copies of Figure 4 (labelled Diagram 1 and Diagram 2) can be found on the following pages.

(b) (i) On Diagram 1 sketch a graph of the curve with equation $y = 10 - x^2$

(ii) Hence find the **number** of solutions of the equation $f(x) = 10 - x^2$ in the interval $-100\pi \leq x \leq 100\pi$. (3)

(c) (i) On Diagram 2 sketch a graph of the curve with equation $y = \tan x$ $-2\pi \leq x \leq 2\pi$

(ii) Hence find the **number** of solutions of the equation $f(x) = \tan x$ in the interval $-100\pi \leq x \leq 100\pi$ giving a reason for your answer. (4)

(a) _____

(b)(i)

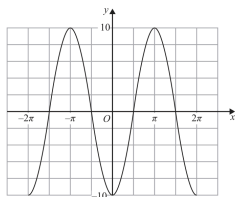
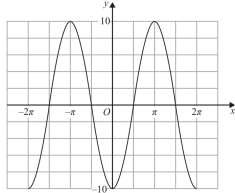


Diagram 1



Copy of Diagram 1

Only use this copy if you need to redraw your graph.

(b)(ii) _____

(c)(i)

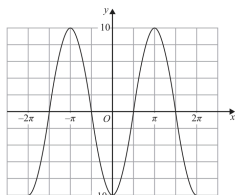
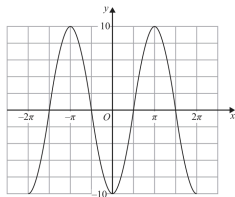


Diagram 2



Copy of Diagram 2

Only use this copy if you need to redraw your graph.

(c)(ii) _____

(Total for Question 9 is 9 marks)

TOPIC

Differentiation

Question 5

Differentiation

5. A curve has equation

$$y = \frac{x^3}{6} + 4\sqrt{x} - 15 \quad x \geq 0$$

- (a) Find $\frac{dy}{dx}$, giving the answer in simplest form. (3)

The point $P\left(4, \frac{11}{3}\right)$ lies on the curve.

- (b) Find the equation of the normal to the curve at P . Write your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found. (4)

(Total 7 marks)

Question 7

Differentiation

7.

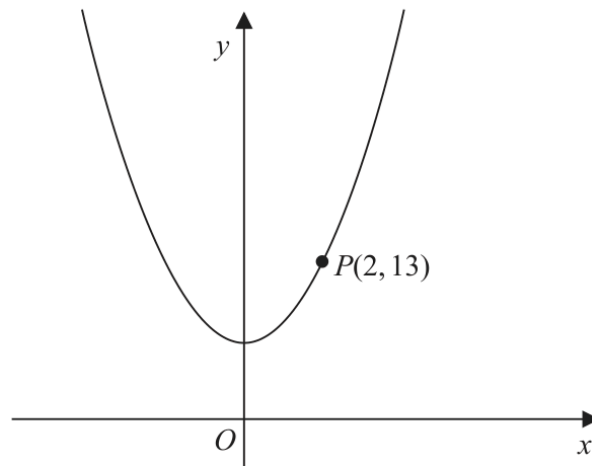


Figure 4

Figure 4 shows part of the curve with equation $y = 2x^2 + 5$

The point $P(2, 13)$ lies on the curve.

- (a) Find the gradient of the tangent to the curve at P . (2)

The point Q with x coordinate $2 + h$ also lies on the curve.

- (b) Find, in terms of h , the gradient of the line PQ . Give your answer in simplest form. (3)

- (c) Explain briefly the relationship between the answer to (b) and the answer to (a). (1)

(Total 6 marks)

Question 3

Differentiation

3.

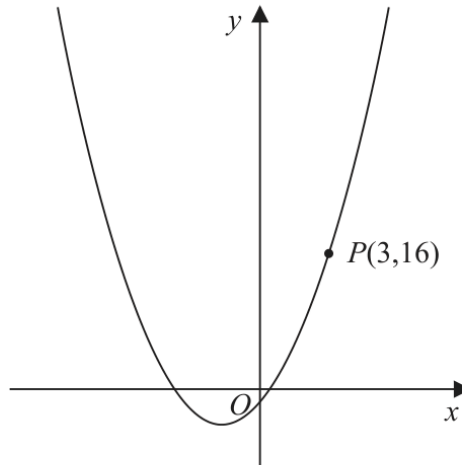


Figure 1

Figure 1 shows part of the curve with equation $y = x^2 + 3x - 2$

The point $P(3,16)$ lies on the curve.

(a) Find the gradient of the tangent to the curve at P .

(2)

The point Q with x coordinate $3 + h$ also lies on the curve.

(b) Find, in terms of h , the gradient of the line PQ . Write your answer in simplest form.

(3)

(c) Explain briefly the relationship between the answer to (b) and the answer to (a).

(1)

(Total 6 marks)

Question 9**Differentiation**

9. **In this question you must show all stages of your working.**

Solutions relying on calculator technology are not acceptable.

A curve has equation

$$y = \frac{4x^2 + 9}{2\sqrt{x}} \quad x > 0$$

Find the x coordinate of the point on the curve at which $\frac{dy}{dx} = 0$

(6)

(Total 6 marks)

Question 1

Differentiation

1. A curve has equation

$$y = 2x^3 - 5x^2 - \frac{3}{2x} + 7 \quad x > 0$$

- (a) Find, in simplest form, $\frac{dy}{dx}$ (3)

The point P lies on the curve and has x coordinate $\frac{1}{2}$

- (b) Find an equation of the normal to the curve at P , writing your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found. (5)

(Total 8 marks)

Question 7**Differentiation**

7. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

$$f(x) = 2x - 3\sqrt{x} - 5 \quad x > 0$$

- (a) Solve the equation

$$f(x) = 9 \quad (4)$$

- (b) Solve the equation

$$f''(x) = 6 \quad (5)$$

(Total 9 marks)

Question 1

Differentiation

1. The curve C has equation

$$y = \frac{x^2}{3} + \frac{4}{\sqrt{x}} + \frac{8}{3x} - 5 \quad x > 0$$

- (a) Find $\frac{dy}{dx}$, giving your answer in simplest form.

(4)

The point $P(4,3)$ lies on C .

- (b) Find the equation of the normal to C at the point P . Write your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(4)

(Total 8 marks)

Question 2**Differentiation**

2. **In this question you must show all stages of your working.**

Solutions relying on calculator technology are not acceptable.

A curve has equation

$$y = 3x^5 + 4x^3 - x + 5$$

The points P and Q lie on the curve.

The gradient of the curve at both point P and point Q is 2

Find the x coordinates of P and Q .

(5)

(Total 5 marks)

Question 7

Differentiation

7.

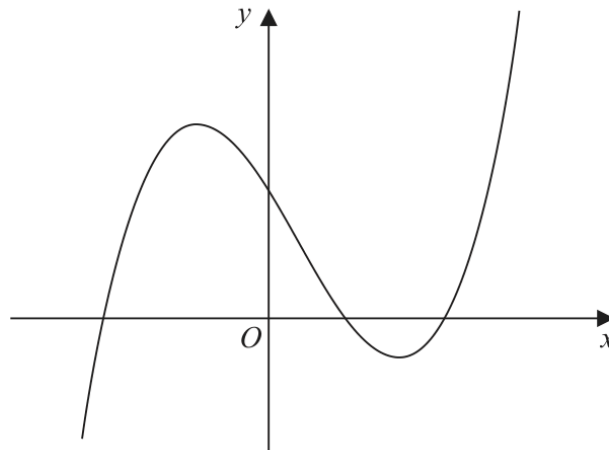


Figure 3

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

$$f(x) = (x + 4)(x - 2)(2x - 9)$$

Given that the curve with equation $y = f(x) - p$ passes through the point with coordinates $(0, 50)$

- (a) find the value of the constant p . (2)

Given that the curve with equation $y = f(x + q)$ passes through the origin,

- (b) write down the possible values of the constant q . (2)

- (c) Find $f'(x)$. (4)

- (d) Hence find the range of values of x for which the gradient of the curve with equation $y = f(x)$ is less than -18 (3)

(Total 11 marks)

WMA11/01 MAY/JUNE 2022

12 marks

Question 10

Differentiation

10.

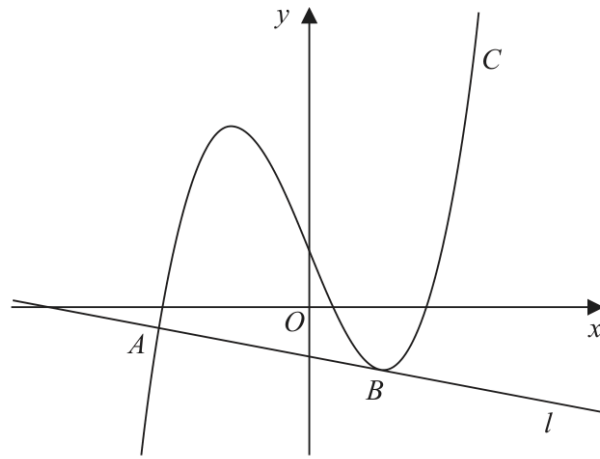


Figure 5

Figure 5 shows a sketch of the curve C with equation

$$y = \frac{2}{7}x^3 + \frac{1}{7}x^2 - \frac{5}{2}x + k$$

where k is a constant.

- (a) Find $\frac{dy}{dx}$ (2)

The line l , shown in Figure 5, is the normal to C at the point A with x coordinate $-\frac{7}{2}$

Given that l is also a tangent to C at the point B ,

- (b) show that the x coordinate of the point B is a solution of the equation

$$12x^2 + 4x - 33 = 0 \quad (4)$$

- (c) Hence find the x coordinate of B , justifying your answer. (2)

Given that the y intercept of l is -1

- (d) find the value of k . (4)

(Total 12 marks)

Question 1

Differentiation

1. The curve C has equation

$$y = \frac{x^3}{4} - x^2 + \frac{17}{x} \quad x > 0$$

- (a) Find $\frac{dy}{dx}$, giving your answer in simplest form.

(3)

The point $R\left(2, \frac{13}{2}\right)$ lies on C .

- (b) Find the equation of the tangent to C at the point R . Write your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(3)

(Total for Question 1 is 6 marks)

WMA11/01 OCTOBER 2022

14 marks

Question 9

Differentiation

9.

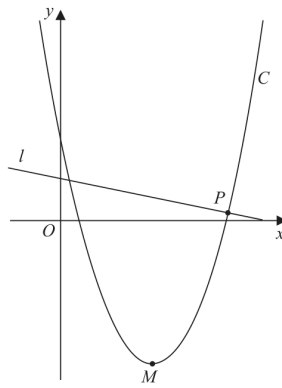


Figure 3

Figure 3 shows a sketch of the curve C with equation

$$y = \frac{1}{2}x^2 - 10x + 22$$

(a) Write $\frac{1}{2}x^2 - 10x + 22$ in the form

$$a(x + b)^2 + c$$

where a , b and c are constants to be found.

(3)

The point M is the minimum turning point of C , as shown in Figure 3.

(b) Deduce the coordinates of M

(2)

The line l is the normal to C at the point P , as shown in Figure 3.

Given that l has equation $y = k - \frac{1}{8}x$, where k is a constant,

(c) (i) find the coordinates of P

(ii) find the value of k

(6)

Question 9 continues on the next page

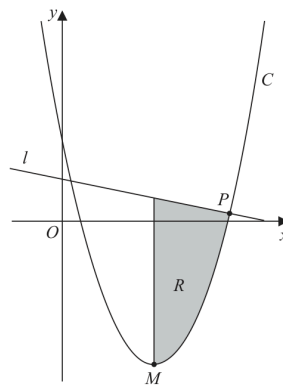


Figure 4

Figure 4 is a copy of Figure 3. The finite region R , shown shaded in Figure 4, is bounded by l , C and the line through M parallel to the y -axis.

(d) Identify the inequalities that define R .

(3)

(Total for Question 9 is 14 marks)

Question 1**Differentiation**

1. A curve C has equation

$$y = 2 + 10x^{\frac{1}{2}} - 2x^{\frac{3}{2}} \quad x > 0$$

(a) Find $\frac{dy}{dx}$ giving your answer in simplest form. (3)

(b) Hence find the exact value of the gradient of the tangent to C at the point where $x = 2$ giving your answer in simplest form.

(Solutions relying on calculator technology are not acceptable.) (2)

(Total for Question 1 is 5 marks)

Question 10

10.

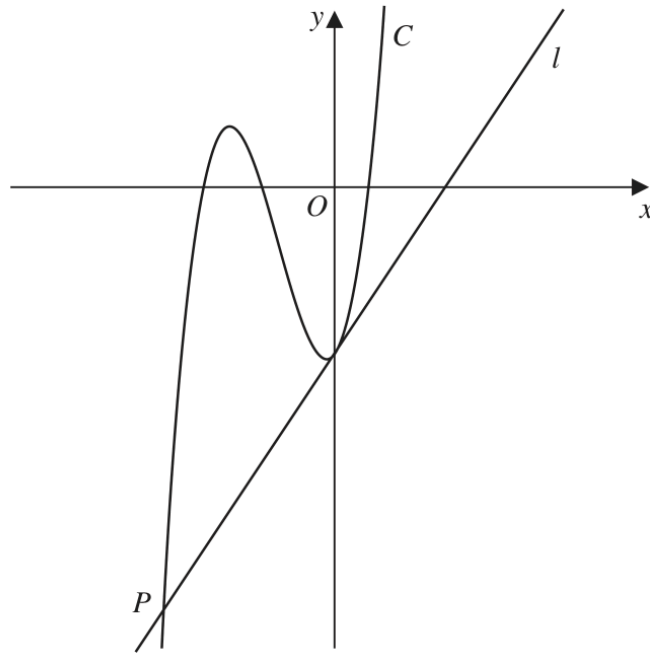


Figure 4

Figure 4 shows a sketch of part of the curve C with equation $y = f(x)$, where

$$f(x) = (3x + 20)(x + 6)(2x - 3)$$

(a) Use the given information to state the values of x for which

$$f(x) > 0$$

(2)

(b) Expand $(3x + 20)(x + 6)(2x - 3)$, writing your answer as a polynomial in simplest form.

(3)

The straight line l is the tangent to C at the point where C cuts the y -axis.

Given that l cuts C at the point P , as shown in Figure 4,

(c) find, using algebra, the x coordinate of P

(Solutions based on calculator technology are not acceptable.)

(5)

(Total for Question 10 is 10 marks)

Question 4**Differentiation**

4. **In this question you must show all stages of your working.**

(a) Write

$$y = \frac{5x^2 + \sqrt{x^3}}{\sqrt[3]{8x}}$$

in the form

$$y = Ax^p + Bx^q$$

where A , B , p and q are constants to be found.

(4)

(b) Hence find $\frac{dy}{dx}$ giving each coefficient in simplest form.

(3)

(Total for Question 4 is 7 marks)

Question 1**Differentiation**

1. Given that

$$y = 5x^3 + \frac{3}{x^2} - 7x \quad x > 0$$

find, in simplest form,

(a) $\frac{dy}{dx}$ (3)

(b) $\frac{d^2y}{dx^2}$ (2)

(Total for Question 1 is 5 marks)

Question 3

Differentiation

3. The curve C has equation

$$y = \frac{5x^3 - 8}{2x^2} \quad x > 0$$

- (a) Find $\frac{dy}{dx}$ writing your answer in simplest form. (4)

The point $P(2, 4)$ lies on C .

- (b) Find an equation for the tangent to C at P writing your answer in the form $ax + by + c = 0$, where a , b and c are integers. (3)

(Total for Question 3 is 7 marks)

Question 7

Differentiation

7. The curve C has equation $y = f(x)$ where

$$f(x) = 2x^3 - kx^2 + 14x + 24$$

and k is a constant.

(a) Find, in simplest form,

(i) $f'(x)$

(ii) $f''(x)$

(3)

The curve with equation $y = f'(x)$ intersects the curve with equation $y = f''(x)$ at the points A and B .

Given that the x coordinate of A is 5

(b) find the value of k .

(2)

(c) Hence find the coordinates of B .

(3)

(Total for Question 7 is 8 marks)

Question 9

Differentiation

9.

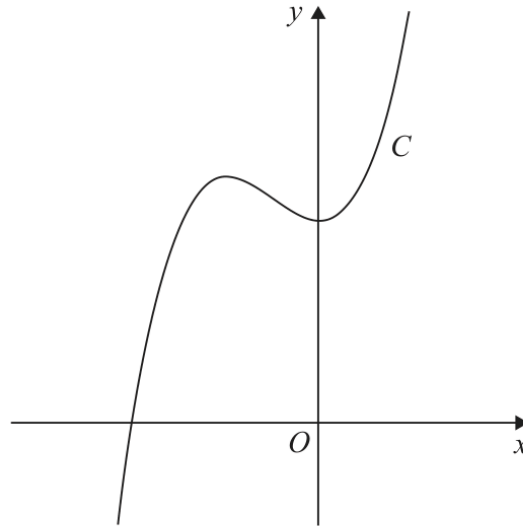


Figure 4

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

$$f(x) = (x + 5)(3x^2 - 4x + 20)$$

- (a) Deduce the range of values of x for which $f(x) \geq 0$ (1)
- (b) Find $f'(x)$ giving your answer in simplest form. (3)

The point $R(-4, 84)$ lies on C .

Given that the tangent to C at the point P is parallel to the tangent to C at the point R

- (c) find the x coordinate of P . (4)
- (d) Find the point to which R is transformed when the curve with equation $y = f(x)$ is transformed to the curve with equation,
- (i) $y = f(x - 3)$
- (ii) $y = 4f(x)$ (2)

(Total for Question 9 is 10 marks)

Question 5

Differentiation

5.

In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

The curve C has equation

$$y = 4x^3 + \frac{2}{x} + 9 \quad x > 0$$

(a) Find $\frac{dy}{dx}$, giving your answer in simplest form.

(2)

Given that

- the point P lies on C
- the line with equation $y = k - 5x$, where k is a constant, is the tangent to C at P

(b) show that the x coordinate of P satisfies the equation

$$12x^4 + 5x^2 - 2 = 0$$

(2)

(c) Hence find the value of k .

(4)

(Total for Question 5 is 8 marks)

Question 2

Differentiation

2. The curve C has equation

$$y = 2x^{\frac{5}{2}} - 4x + 3$$

(a) Find $\frac{dy}{dx}$ writing your answer in simplest form.

(2)

The point P lies on C .

Given that

- the x coordinate of P is 2^k where k is a constant
- the gradient of C at the point P is 16

(b) find the value of k .

(3)

(Total for Question 2 is 5 marks)

Question 1

Differentiation

1. The curve C has equation

$$y = 6x^2 + 3\sqrt{x} + \frac{5}{8} \quad x > 0$$

- (a) Find $\frac{dy}{dx}$ writing the answer in simplest form.

(3)

The point $P\left(\frac{1}{4}, \frac{5}{2}\right)$ lies on C .

- (b) Find the equation of the tangent to C at P , writing your answer in the form $y = mx + c$ where m and c are integers.

(3)

(Total for Question 1 is 6 marks)

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10 marks

Question 10

Differentiation

10.

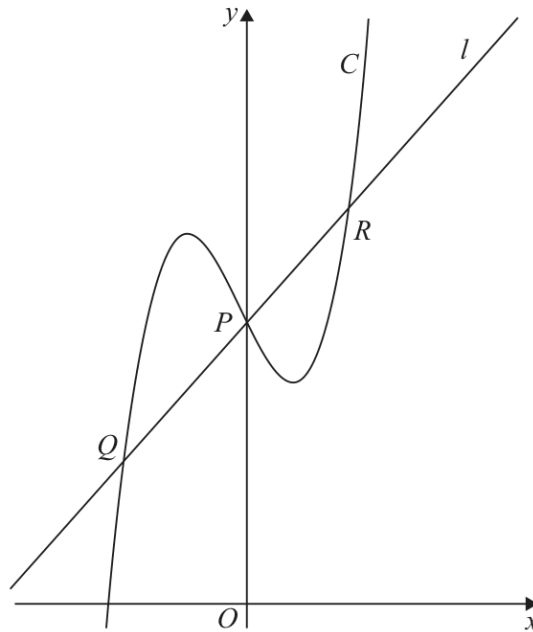


Figure 4

**In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.**

Figure 4 shows a sketch of the curve C with equation

$$y = 2x^3 + \frac{1}{2}x^2 - 2x + 5$$

The line l is the normal to C at the point P where $x = 0$

The line l also intersects C at points Q and R as shown in Figure 4.

(a) Find, using algebra, the x coordinate of point Q .

(6)

The point T lies on C .

Given that

- the tangent to C at T is parallel to l
- the x coordinate of T is positive

(b) find, using algebra, the exact x coordinate of T .

(4)

(Total for Question 10 is 10 marks)

Question 7

Differentiation

7. The curve C has equation

$$y = \frac{2}{3}x^3 - 8x^2 + 43x - \frac{20}{3}$$

(a) Show that $\frac{dy}{dx}$ can be written in the form

$$p(x + q)^2 + r$$

where p , q and r are constants to be found.

(5)

(b) Hence state

(i) the minimum value of $\frac{dy}{dx}$

(ii) the value of x at which this minimum value occurs.

(2)

Given that S is the point on C at which the gradient is a minimum,

(c) find the equation of the tangent to C at S , giving your answer in the form $y = mx + c$, where m and c are constants.

(3)

(Total for Question 7 is 10 marks)

10 marks

WMA11/01 OCTOBER 2019

Differentiation

Question 10

Also in Differentiation

Primary: Graphs of Functions

10.

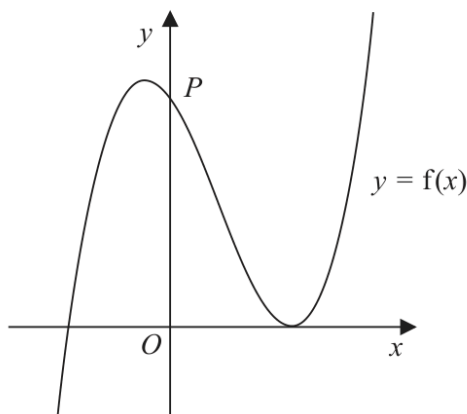


Figure 6

Figure 6 shows a sketch of part of the curve with equation $y = f(x)$, where

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

- (a) Deduce the values of x for which $f(x) \leq 0$ (2)

The curve crosses the y -axis at the point P , as shown.

- (b) Expand $f(x)$ to the form

$$ax^3 + bx^2 + cx + d$$

where a , b , c and d are integers to be found.

(3)

- (c) Hence, or otherwise, find

- (i) the coordinates of P ,
(ii) the gradient of the curve at P .

(2)

The curve with equation $y = f(x)$ is translated two units in the positive x direction to a curve with equation $y = g(x)$.

- (d) (i) Find $g(x)$, giving your answer in a simplified factorised form.
(ii) Hence state the y intercept of the curve with equation $y = g(x)$.

(3)

(Total 10 marks)

10 marks

WMA11/01 OCTOBER 2019

Question 11

Differentiation

Also in Differentiation

Primary: Integration

11. A curve has equation $y = f(x)$.

The point $P\left(4, \frac{32}{3}\right)$ lies on the curve.

Given that

- $f''(x) = \frac{4}{\sqrt{x}} - 3$
- $f'(x) = 5$ at P

find

(a) the equation of the tangent to the curve at P , writing your answer in the form $y = mx + c$, where m and c are constants to be found, (2)

(b) $f(x)$. (8)

(Total 10 marks)

11 marks

WMA11/01 JANUARY 2020

Differentiation

Question 11

Also in Differentiation

Primary: Integration

11. A curve has equation $y = f(x)$, where

$$f''(x) = \frac{6}{\sqrt{x^3}} + x \quad x > 0$$

The point $P(4, -50)$ lies on the curve.

Given that $f'(x) = -4$ at P ,

(a) find the equation of the normal at P , writing your answer in the form $y = mx + c$, where m and c are constants,

(3)

(b) find $f(x)$.

(8)

(Total 11 marks)

11 marks

WMA11/01 JANUARY 2021

Differentiation

Question 9

Also in Differentiation

Primary: Integration

9. (i) Find

$$\int \frac{(3x + 2)^2}{4\sqrt{x}} dx \quad x > 0$$

giving your answer in simplest form.

(5)

(ii) A curve C has equation $y = f(x)$.

Given

- $f'(x) = x^2 + ax + b$ where a and b are constants
- the y intercept of C is -8
- the point $P(3, -2)$ lies on C
- the gradient of C at P is 2

find, in simplest form, $f(x)$.

(6)

(Total 11 marks)

8 marks

WMA11/01 MAY/JUNE 2021

Differentiation

Question 6

Also in Differentiation

Primary: Integration

6. The curve C has equation $y = f(x)$, $x > 0$

Given that

- C passes through the point $P(8, 2)$

- $f'(x) = \frac{32}{3x^2} + 3 - 2(\sqrt[3]{x})$

(a) find the equation of the tangent to C at P . Write your answer in the form $y = mx + c$, where m and c are constants to be found.

(3)

(b) Find, in simplest form, $f(x)$.

(5)

(Total 8 marks)

10 marks

WMA11/01 OCTOBER 2021

Differentiation

Question 6

Also in Differentiation

Primary: Graphs of Functions

6. In this question you must show all stages of your working.

Solutions relying on calculator technology are not acceptable.

A curve C has equation $y = f(x)$ where

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

(a) Sketch a graph of C .

Show on your graph the coordinates of the points where C cuts or meets the coordinate axes.

(3)

(b) Write $f(x)$ in the form $ax^3 + bx^2 + cx + d$, where a, b, c and d are constants to be found.

(3)

(c) Hence, find the equation of the tangent to C at the point where $x = \frac{1}{3}$

(4)

(Total 10 marks)

10 marks

WMA11/01 OCTOBER 2021

Question 8

Differentiation

Also in Differentiation

Primary: Straight Line

8.

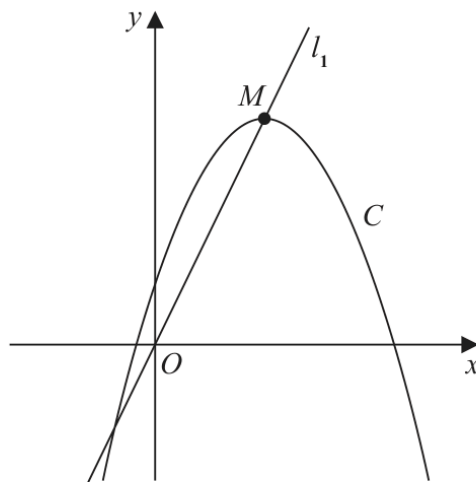


Figure 4

Figure 4 shows a sketch of the curve C with equation

$$y = 4 + 12x - 3x^2$$

The point M is the maximum turning point on C .

(a) (i) Write $4 + 12x - 3x^2$ in the form

$$a + b(x + c)^2$$

where a , b and c are constants to be found.

(ii) Hence, or otherwise, state the coordinates of M .

(5)

The line l_1 passes through O and M , as shown in Figure 4.

A line l_2 touches C and is parallel to l_1

(b) Find an equation for l_2

(5)

(Total 10 marks)

7 marks

WMA11/01 OCTOBER 2021

Question 10

Differentiation

Also in Differentiation

Primary: Integration

10. A curve has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = ax - 12x^{\frac{1}{3}}$, where a is a constant
- $f''(x) = 0$ when $x = 27$
- the curve passes through the point $(1, -8)$

(a) find the value of a .

(3)

(b) Hence find $f(x)$.

(4)

(Total 7 marks)

11 marks

WMA11/01 JANUARY 2022

Differentiation

Question 6

Also in Differentiation

Primary: Integration

6. The curve C has equation $y = f(x)$ where $x > 0$

Given that

- $f'(x) = \frac{(x+3)^2}{x\sqrt{x}}$

- the point $P(4, 20)$ lies on C

(a) (i) find the value of the gradient at P

(ii) Hence find the equation of the tangent to C at P , giving your answer in the form $ax + by + c = 0$ where a , b and c are integers to be found.

(4)

(b) Find $f(x)$, simplifying your answer.

(7)

(Total 11 marks)

9 marks

WMA11/01 MAY/JUNE 2022

Differentiation

Question 7

Also in Differentiation

Primary: Integration

7. The curve C has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = \frac{2}{\sqrt{x}} + \frac{A}{x^2} + 3$, where A is a constant
- $f''(x) = 0$ when $x = 4$

(a) find the value of A .

(4)

Given also that

- $f(x) = 8\sqrt{3}$, when $x = 12$

(b) find $f(x)$, giving each term in simplest form.

(5)

(Total 9 marks)

9 marks

WMA11/01 OCTOBER 2022

Differentiation

Question 5

Also in Differentiation

Primary: Integration

5.

**In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.**

The curve C has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = \frac{12}{\sqrt{x}} + \frac{x}{3} - 4$
- the point $P(9, 8)$ lies on C

(a) find, in simplest form, $f(x)$

(5)

The line l is the normal to C at P

(b) Find the coordinates of the point at which l crosses the y -axis.

(4)

(Total for Question 5 is 9 marks)

8 marks

WMA11/01 JANUARY 2023

Differentiation

Question 11

Also in Differentiation

Primary: Integration

11. A curve C has equation $y = f(x)$, $x > 0$

Given that

- $f''(x) = 4x + \frac{1}{\sqrt{x}}$
- the point P has x coordinate 4 and lies on C
- the tangent to C at P has equation $y = 3x + 4$

(a) find an equation of the normal to C at P

(2)

(b) find $f(x)$, writing your answer in simplest form.

(6)

(Total for Question 11 is 8 marks)

10 marks

WMA11/01 MAY/JUNE 2023

Differentiation

Question 8

Also in Differentiation

Primary: Integration

8. In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

(a) Find the equation of the tangent to the curve with equation

$$y = \frac{1}{4}x^3 - 8x^{-\frac{1}{2}}$$

at the point $P(4, 12)$

Give your answer in the form $ax + by + c = 0$ where a , b and c are integers.

(5)

The curve with equation $y = f(x)$ also passes through the point $P(4, 12)$

Given that

$$f'(x) = \frac{1}{4}x^3 - 8x^{-\frac{1}{2}}$$

(b) find $f(x)$ giving the coefficients in simplest form.

(5)

(Total for Question 8 is 10 marks)

10 marks

WMA11/01 OCTOBER 2023

Differentiation

Question 7

Also in Differentiation

Primary: Integration

7. The curve C has equation $y = f(x)$ where $x > 0$

Given that

- $f'(x) = \frac{4x^2 + 10 - 7x^{\frac{1}{2}}}{4x^{\frac{1}{2}}}$

- the point $P(4, -1)$ lies on C

(a) (i) find the value of the gradient of C at P

(ii) Hence find the equation of the normal to C at P , giving your answer in the form $ax + by + c = 0$ where a , b and c are integers to be found.

(4)

(b) Find $f(x)$.

(6)

(Total for Question 7 is 10 marks)

8 marks

WMA11/01 JANUARY 2024

Differentiation

Question 10

Also in Differentiation

Primary: Integration

10. In this question you must show all stages of your working.

The curve C has equation $y = f(x)$, $x > 0$

Given that

- the point $P(2, 8\sqrt{2})$ lies on C
- $f'(x) = 4\sqrt{x^3} + \frac{k}{x^2}$ where k is a constant
- $f''(x) = 0$ at P

(a) find the exact value of k ,

(4)

(b) find $f(x)$, giving your answer in simplest form.

(4)

First released on AP - Edexcel Discord
<https://sites.google.com/view/ap-edexcel>

(Total for Question 10 is 8 marks)

10 marks

WMA11/01 MAY/JUNE 2024

Differentiation

Question 10

Also in Differentiation

Primary: Integration

10. The curve C has equation $y = f(x)$ where $x > 0$

Given that

- $f'(x) = 6x - \frac{(2x-1)(3x+2)}{2\sqrt{x}}$

- the point $P(4, 12)$ lies on C

(a) find the equation of the normal to C at P , giving your answer in the form $y = mx + c$ where m and c are integers to be found,

(4)

(b) find $f(x)$, giving each term in simplest form.

(6)

(Total for Question 10 is 10 marks)

9 marks

WMA11/01 OCTOBER 2024

Differentiation

Question 3

Also in Differentiation

Primary: Integration

3.

In this question you must show all stages of your working.

$$f(x) = \frac{(x+5)^2}{\sqrt{x}} \quad x > 0$$

(a) Find $\int f(x) \, dx$

(4)

(b) (i) Show that when $f'(x) = 0$

$$3x^2 + 10x - 25 = 0$$

(ii) Hence state the value of x for which

$$f'(x) = 0$$

(5)

(Total for Question 3 is 9 marks)

WMA11/01 OCTOBER 2024

Question 8

7 marks

Differentiation

Also in Differentiation

Primary: Integration

8. A curve C has equation $y = f(x)$.

The point P with x coordinate 3 lies on C

Given

- $f'(x) = 4x^2 + kx + 3$ where k is a constant
- the normal to C at P has equation $y = -\frac{1}{24}x + 5$

(a) show that $k = -5$

(3)

(b) Hence find $f(x)$.

(4)

(Total for Question 8 is 7 marks)

10 marks

WMA11/01 JANUARY 2025

Differentiation

Question 6

Also in Differentiation

Primary: Integration

6. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

The curve C has equation $y = f(x)$, $x > 0$

Given that

- the point $P(4, -5)$ lies on C
- $f'(x) = \frac{2x^2 + ax + b}{4\sqrt{x}}$, where a and b are constants
- the gradient of the tangent to C at P is 7

(a) show that

$$4a + b = 24 \quad (2)$$

Given also that $a + b = -9$

(b) find, in simplest form, $f(x)$ (7)

Curve C is transformed to the curve with equation $y = f(x - 3)$

Given that point P is transformed to the point Q ,

(c) state the coordinates of Q . (1)

(Total for Question 6 is 10 marks)

11 marks

WMA11/01 MAY/JUNE 2025

Differentiation

Question 8

Also in Differentiation

Primary: Integration

8. **In this question you must show all stages of your working.**
Solutions relying entirely on calculator technology are not acceptable.

A curve has equation $y = f(x)$, $x > 0$

The point $P(4, 12)$ lies on the curve.

Given that

- $f'(x) = 3\sqrt{x} + kx^2$ where k is a constant
- the equation of the tangent to the curve at P has equation $y = 10x + c$ where c is a constant

(a) (i) show that $k = \frac{1}{4}$

(ii) find the value of c

(4)

(b) Hence find the value of $f''(x)$ at P .

(3)

(c) Find $f(x)$.

(4)

(Total for Question 8 is 11 marks)

8 marks

WMA11/01 OCTOBER 2025

Differentiation

Question 8

Also in Differentiation

Primary: Integration

8. **In this question you must show all stages of your working.**
Solutions relying on calculator technology are not acceptable.

A curve has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = 2x + \frac{8}{x^2} + k$, where k is a constant
- the equation of the tangent to the curve at $x = \sqrt{2}$ is $y = 5x - 3\sqrt{2}$

- (a) find the exact value of k . (2)
- (b) Find an equation of the normal to the curve at $x = \sqrt{2}$ (2)
- (c) Find $f(x)$, writing your answer in simplest form. (4)

(Total for Question 8 is 8 marks)

6 marks

WMA11/01 JANUARY 2026

Differentiation

Question 1

Also in Differentiation

Primary: Integration

1. $y = 4x^3 + \frac{3}{2\sqrt{x}} - 8 \quad x > 0$

Find, in simplest form,

(a) $\frac{dy}{dx}$ (3)

(b) $\int y dx$ (3)

(Total for Question 1 is 6 marks)

12 marks

WMA11/01 JANUARY 2026

Differentiation

Question 8

Also in Differentiation

Primary: Integration

8. **In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

A curve C has equation $y = f(x)$, $x > 0$

A point P lies on C .

Given that

- $f'(x) = 4x^2 + \frac{6}{x^2} - 4$
- the equation of the tangent to C at P is $y = 10x - 6\sqrt{3}$

- (a) (i) verify that $\sqrt{3}$ is a possible x coordinate of P ,
(ii) find, using algebra, the other possible x coordinate of P .

(6)

Given that the x coordinate of P is $\sqrt{3}$

- (b) find an equation of the normal to C at P .

(2)

- (c) Find $f(x)$, writing your answer in simplest form.
You must show each stage of your working.

(4)

(Total for Question 8 is 12 marks)

TOPIC

Integration

Question 11

11. A curve has equation $y = f(x)$.

The point $P\left(4, \frac{32}{3}\right)$ lies on the curve.

Given that

- $f''(x) = \frac{4}{\sqrt{x}} - 3$
- $f'(x) = 5$ at P

find

(a) the equation of the tangent to the curve at P , writing your answer in the form $y = mx + c$, where m and c are constants to be found,

(2)

(b) $f(x)$.

(8)

(Total 10 marks)

Question 1**Integration**

1. Find, in simplest form,

$$\int \left(\frac{8x^3}{3} - \frac{1}{2\sqrt{x}} - 5 \right) dx$$

(4)

(Total 4 marks)

Question 11

11. A curve has equation $y = f(x)$, where

$$f''(x) = \frac{6}{\sqrt{x^3}} + x \quad x > 0$$

The point $P(4, -50)$ lies on the curve.

Given that $f'(x) = -4$ at P ,

(a) find the equation of the normal at P , writing your answer in the form $y = mx + c$, where m and c are constants,

(3)

(b) find $f(x)$.

(8)

(Total 11 marks)

Question 9

Integration

9. (i) Find

$$\int \frac{(3x + 2)^2}{4\sqrt{x}} dx \quad x > 0$$

giving your answer in simplest form.

(5)

(ii) A curve C has equation $y = f(x)$.

Given

- $f'(x) = x^2 + ax + b$ where a and b are constants
- the y intercept of C is -8
- the point $P(3, -2)$ lies on C
- the gradient of C at P is 2

find, in simplest form, $f(x)$.

(6)

(Total 11 marks)

Question 4

Integration

4. Find

$$\int \frac{(3\sqrt{x} + 2)(x - 5)}{4\sqrt{x}} dx$$

writing each term in simplest form.

(6)

(Total 6 marks)

Question 6

6. The curve C has equation $y = f(x)$, $x > 0$

Given that

- C passes through the point $P(8, 2)$

- $f'(x) = \frac{32}{3x^2} + 3 - 2(\sqrt[3]{x})$

(a) find the equation of the tangent to C at P . Write your answer in the form $y = mx + c$, where m and c are constants to be found.

(3)

(b) Find, in simplest form, $f(x)$.

(5)

(Total 8 marks)

Question 1**Integration**

1. Find

$$\int 12x^3 + \frac{1}{6\sqrt{x}} - \frac{3}{2x^4} dx$$

giving each term in simplest form.

(5)

(Total 5 marks)

Question 10

10. A curve has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = ax - 12x^{\frac{1}{3}}$, where a is a constant
- $f''(x) = 0$ when $x = 27$
- the curve passes through the point $(1, -8)$

(a) find the value of a .

(3)

(b) Hence find $f(x)$.

(4)

(Total 7 marks)

Question 1**Integration**

1. Find

$$\int \left(\frac{8x^3}{5} - \frac{2}{3x^4} - 1 \right) dx$$

giving each term in simplest form.

(4)

(Total 4 marks)

Question 6

Integration

6. The curve C has equation $y = f(x)$ where $x > 0$

Given that

- $f'(x) = \frac{(x+3)^2}{x\sqrt{x}}$

- the point $P(4, 20)$ lies on C

(a) (i) find the value of the gradient at P

(ii) Hence find the equation of the tangent to C at P , giving your answer in the form $ax + by + c = 0$ where a , b and c are integers to be found.

(4)

(b) Find $f(x)$, simplifying your answer.

(7)

(Total 11 marks)

Question 1**Integration**

1. Find

$$\int \left(10x^5 + 6x^3 - \frac{3}{x^2} \right) dx$$

giving your answer in simplest form.

(4)

(Total 4 marks)

Question 7

7. The curve C has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = \frac{2}{\sqrt{x}} + \frac{A}{x^2} + 3$, where A is a constant
- $f''(x) = 0$ when $x = 4$

(a) find the value of A .

(4)

Given also that

- $f(x) = 8\sqrt{3}$, when $x = 12$

(b) find $f(x)$, giving each term in simplest form.

(5)

(Total 9 marks)

Question 2

2. Given that

$$(x - 5)(2x + 1)(x + 3) \equiv ax^3 + bx^2 - 32x - 15$$

where a and b are constants,

(a) find the value of a and the value of b .

(2)

(b) Hence find

$$\int \frac{(x - 5)(2x + 1)(x + 3)}{5\sqrt{x}} dx$$

writing each term in simplest form.

(5)

(Total for Question 2 is 7 marks)

Question 5

5.

**In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.**

The curve C has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = \frac{12}{\sqrt{x}} + \frac{x}{3} - 4$
- the point $P(9, 8)$ lies on C

(a) find, in simplest form, $f(x)$

(5)

The line l is the normal to C at P

(b) Find the coordinates of the point at which l crosses the y -axis.

(4)

(Total for Question 5 is 9 marks)

Question 3

Integration

3. Find

$$\int \frac{4x^5 + 3}{2x^2} dx$$

giving your answer in simplest form.

(5)

(Total for Question 3 is 5 marks)

Question 11

Integration

11. A curve C has equation $y = f(x)$, $x > 0$

Given that

- $f''(x) = 4x + \frac{1}{\sqrt{x}}$
- the point P has x coordinate 4 and lies on C
- the tangent to C at P has equation $y = 3x + 4$

(a) find an equation of the normal to C at P

(2)

(b) find $f(x)$, writing your answer in simplest form.

(6)

(Total for Question 11 is 8 marks)

Question 8

8.

In this question you must show all stages of your working.

Solutions relying entirely on calculator technology are not acceptable.

- (a) Find the equation of the tangent to the curve with equation

$$y = \frac{1}{4}x^3 - 8x^{-\frac{1}{2}}$$

at the point $P(4, 12)$

Give your answer in the form $ax + by + c = 0$ where a , b and c are integers.

(5)

The curve with equation $y = f(x)$ also passes through the point $P(4, 12)$

Given that

$$f'(x) = \frac{1}{4}x^3 - 8x^{-\frac{1}{2}}$$

- (b) find $f(x)$ giving the coefficients in simplest form.

(5)

(Total for Question 8 is 10 marks)

Question 7

7. The curve C has equation $y = f(x)$ where $x > 0$

Given that

- $f'(x) = \frac{4x^2 + 10 - 7x^{\frac{1}{2}}}{4x^{\frac{1}{2}}}$
- the point $P(4, -1)$ lies on C

(a) (i) find the value of the gradient of C at P

(ii) Hence find the equation of the normal to C at P , giving your answer in the form $ax + by + c = 0$ where a , b and c are integers to be found.

(4)

(b) Find $f(x)$.

(6)

(Total for Question 7 is 10 marks)

Question 1**Integration**

1. Find

$$\int (2x - 5)(3x + 2)(2x + 5)dx$$

writing your answer in simplest form.

(5)

(Total for Question 1 is 5 marks)

Question 10

10. In this question you must show all stages of your working.

The curve C has equation $y = f(x)$, $x > 0$

Given that

- the point $P(2, 8\sqrt{2})$ lies on C
- $f'(x) = 4\sqrt{x^3} + \frac{k}{x^2}$ where k is a constant
- $f''(x) = 0$ at P

(a) find the exact value of k ,

(4)

(b) find $f(x)$, giving your answer in simplest form.

(4)

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(Total for Question 10 is 8 marks)

Question 1

Integration

1. Find

$$\int \left(10x^4 - \frac{3}{2x^3} - 7 \right) dx$$

giving each term in simplest form.

(3)

(Total for Question 1 is 3 marks)

Question 10

10. The curve C has equation $y = f(x)$ where $x > 0$

Given that

- $f'(x) = 6x - \frac{(2x-1)(3x+2)}{2\sqrt{x}}$

- the point $P(4, 12)$ lies on C

(a) find the equation of the normal to C at P , giving your answer in the form $y = mx + c$ where m and c are integers to be found,

(4)

(b) find $f(x)$, giving each term in simplest form.

(6)

(Total for Question 10 is 10 marks)

Question 3

3.

In this question you must show all stages of your working.

$$f(x) = \frac{(x+5)^2}{\sqrt{x}} \quad x > 0$$

(a) Find $\int f(x) dx$

(4)

(b) (i) Show that when $f'(x) = 0$

$$3x^2 + 10x - 25 = 0$$

(ii) Hence state the value of x for which

$$f'(x) = 0$$

(5)

(Total for Question 3 is 9 marks)

Question 8

8. A curve C has equation $y = f(x)$.

The point P with x coordinate 3 lies on C

Given

- $f'(x) = 4x^2 + kx + 3$ where k is a constant
- the normal to C at P has equation $y = -\frac{1}{24}x + 5$

(a) show that $k = -5$

(3)

(b) Hence find $f(x)$.

(4)

(Total for Question 8 is 7 marks)

Question 1**Integration**

1. Find

$$\int \left(8x^3 - 6\sqrt{x} - \frac{2}{5x^3} \right) dx$$

giving your answer in simplest form.

(4)

(Total for Question 1 is 4 marks)

Question 6

6.

**In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.**

The curve C has equation $y = f(x)$, $x > 0$

Given that

- the point $P(4, -5)$ lies on C
- $f'(x) = \frac{2x^2 + ax + b}{4\sqrt{x}}$, where a and b are constants
- the gradient of the tangent to C at P is 7

(a) show that

$$4a + b = 24 \quad (2)$$

Given also that $a + b = -9$

(b) find, in simplest form, $f(x)$ (7)

Curve C is transformed to the curve with equation $y = f(x - 3)$

Given that point P is transformed to the point Q ,

(c) state the coordinates of Q . (1)

(Total for Question 6 is 10 marks)

Question 3

Integration

3. Find

$$\int \frac{(x+3)^2}{3\sqrt{x}} dx$$

writing your answer in simplest form.

(5)

(Total for Question 3 is 5 marks)

Question 8

8.

**In this question you must show all stages of your working.
Solutions relying entirely on calculator technology are not acceptable.**

A curve has equation $y = f(x)$, $x > 0$

The point $P(4, 12)$ lies on the curve.

Given that

- $f'(x) = 3\sqrt{x} + kx^2$ where k is a constant
- the equation of the tangent to the curve at P has equation $y = 10x + c$ where c is a constant

(a) (i) show that $k = \frac{1}{4}$

(ii) find the value of c

(4)

(b) Hence find the value of $f''(x)$ at P .

(3)

(c) Find $f(x)$.

(4)

(Total for Question 8 is 11 marks)

Question 2

Integration

2. Find

$$\int (x-3)^2(2x+5) dx$$

writing the answer in simplest form.

(5)

(Total for Question 2 is 5 marks)

Question 8

8. **In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.**

A curve has equation $y = f(x)$, $x > 0$

Given that

- $f'(x) = 2x + \frac{8}{x^2} + k$, where k is a constant
- the equation of the tangent to the curve at $x = \sqrt{2}$ is $y = 5x - 3\sqrt{2}$

(a) find the exact value of k .

(2)

(b) Find an equation of the normal to the curve at $x = \sqrt{2}$

(2)

(c) Find $f(x)$, writing your answer in simplest form.

(4)

(Total for Question 8 is 8 marks)

Question 1

Integration

1.
$$y = 4x^3 + \frac{3}{2\sqrt{x}} - 8 \quad x > 0$$

Find, in simplest form,

(a) $\frac{dy}{dx}$ (3)

(b) $\int y dx$ (3)

(Total for Question 1 is 6 marks)

Question 8

8.

In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

A curve C has equation $y = f(x)$, $x > 0$

A point P lies on C .

Given that

- $f'(x) = 4x^2 + \frac{6}{x^2} - 4$
- the equation of the tangent to C at P is $y = 10x - 6\sqrt{3}$

- (a) (i) verify that $\sqrt{3}$ is a possible x coordinate of P ,
(ii) find, using algebra, the other possible x coordinate of P .

(6)

Given that the x coordinate of P is $\sqrt{3}$

- (b) find an equation of the normal to C at P .

(2)

- (c) Find $f(x)$, writing your answer in simplest form.
You must show each stage of your working.

(4)

(Total for Question 8 is 12 marks)
