

YEAR 12 TO YEAR 13 TRANSITION BOOKLET

Preparation for Y13 Mathematics

Bridging the Gap from Year 12 to Year 13

This booklet contains a structured collection of supplementary practice questions focusing on all AS content. Mastering these topics is essential for establishing fluency and maintaining a confident start to Year 13.



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Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Algebra (part 1)	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
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- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 17 questions in this question paper. The total mark for this paper is 80.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

- 1*. Show that $\frac{2}{\sqrt{12}-\sqrt{8}}$ can be written in the form $\sqrt{a} + \sqrt{b}$, where a and b are integers.

(Total 5 marks)

- 2*. (a) Simplify

$$\sqrt{50} - \sqrt{18}$$

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

(2)

- (b) Hence, or otherwise, simplify

$$\frac{12\sqrt{3}}{\sqrt{50} - \sqrt{18}}$$

giving your answer in the form $b\sqrt{c}$, where b and c are integers and $b \neq 1$

(3)

(Total 5 marks)

- 3*. (a) Write down the value of $32^{\frac{1}{5}}$

(1)

- (b) Simplify fully $(32x^5)^{-\frac{2}{5}}$

(3)

(Total 4 marks)

- 4*. (a) Evaluate $81^{\frac{3}{2}}$

(2)

- (b) Simplify fully $x^2 \left(4x^{\frac{1}{2}} \right)^2$

(2)

(Total 4 marks)

5*. (a) Find the value of $16^{-\frac{1}{4}}$

(2)

(b) Simplify $x\left(2x^{-\frac{1}{4}}\right)^4$

(2)

(Total 4 marks)

6*. (a) Evaluate $(32)^{\frac{3}{5}}$, giving your answer as an integer.

(2)

(b) Simplify fully $\left(\frac{25x^4}{4}\right)^{-\frac{1}{2}}$

(2)

(Total 4 marks)

7*. (a) Find the value of $8^{\frac{5}{3}}$

(2)

(b) Simplify fully $\frac{(2x^{\frac{1}{2}})^3}{4x^2}$

(3)

(Total 5 marks)

8*. Express 8^{2x+3} in the form 2^y , stating y in terms of x .

(Total 2 marks)

9*. Express 9^{3x+1} in the form 3^y , giving y in the form $ax + b$, where a and b are constants.

(Total 2 marks)

10*. $f(x) = x^2 - 8x + 19$

- (a) Express $f(x)$ in the form $(x + a)^2 + b$, where a and b are constants. (2)

The curve C with equation $y = f(x)$ crosses the y -axis at the point P and has a minimum point at the point Q .

- (b) Sketch the graph of C showing the coordinates of point P and the coordinates of point Q . (3)

- (c) Find the distance PQ , writing your answer as a simplified surd. (3)

(Total 8 marks)

11*. $f(x) = x^2 + (k + 3)x + k$,

where k is a real constant.

- (a) Find the discriminant of $f(x)$ in terms of k . (2)

- (b) Show that the discriminant of $f(x)$ can be expressed in the form $(k + a)^2 + b$, where a and b are integers to be found. (2)

- (c) Show that, for all values of k , the equation $f(x) = 0$ has real roots. (2)

(Total 6 marks)

12*.

$$4x - 5 - x^2 = q - (x + p)^2,$$

where p and q are integers.

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

(3)

(b) Calculate the discriminant of $4x - 5 - x^2$.

(2)

(c) Sketch the curve with equation $y = 4x - 5 - x^2$, showing clearly the coordinates of any points where the curve crosses the coordinate axes.

(3)

(Total 8 marks)

13*. Given that $y = 2^x$,

(a) express 4^x in terms of y .

(1)

(b) Hence, or otherwise, solve

$$8(4^x) - 9(2^x) + 1 = 0.$$

(4)

(Total 5 marks)

14*. Factorise completely $x - 4x^3$

(Total 3 marks)

15*. Factorise fully $25x - 9x^3$

(Total 3 marks)

16. $f(x) = 2x^3 - 7x^2 - 10x + 24$.

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

(2)

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

(4)

(Total 6 marks)

17. $f(x) = 2x^3 - 7x^2 + 4x + 4$.

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

(2)

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

(4)

(Total 6 marks)

TOTAL FOR PAPER: 80 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Algebra (part 2)	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

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- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 12 questions in this question paper. The total mark for this paper is 85.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for all questions.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. Solve the simultaneous equations

$$x + y = 2$$

$$4y^2 - x^2 = 11$$

(Total 7 marks)

2. Solve the simultaneous equations

$$y + 4x + 1 = 0$$

$$y^2 + 5x^2 + 2x = 0$$

(Total 6 marks)

3. Solve the simultaneous equations

$$y - 2x - 4 = 0$$

$$4x^2 + y^2 + 20x = 0$$

(Total 7 marks)

4. Given the simultaneous equations

$$2x + y = 1$$

$$x^2 - 4ky + 5k = 0$$

where k is a non zero constant,

- (a) show that $x^2 + 8kx + k = 0$.

(2)

Given that $x^2 + 8kx + k = 0$ has equal roots,

- (b) find the value of k .

(3)

- (c) For this value of k , find the solution of the simultaneous equations.

(3)

(Total 8 marks)

5. Find the set of values of x for which

(a) $4x - 5 > 15 - x$,

(2)

(b) $x(x - 4) > 12$.

(4)

(Total 6 marks)

6. Find the set of values of x for which

(a) $2(3x + 4) > 1 - x$,

(2)

(b) $3x^2 + 8x - 3 < 0$.

(4)

(Total 6 marks)

7. Find the set of values of x for which

(a) $3x - 7 > 3 - x$,

(2)

(b) $x^2 - 9x \leq 36$,

(4)

(c) **both** $3x - 7 > 3 - x$ **and** $x^2 - 9x \leq 36$.

(1)

(Total 7 marks)

8. The equation $x^2 + (k - 3)x + (3 - 2k) = 0$, where k is a constant, has two distinct real roots.

(a) Show that k satisfies

$$k^2 + 2k - 3 > 0 \quad (3)$$

(b) Find the set of possible values of k .

(4)

(Total 7 marks)

9. The equation

$$(k + 3)x^2 + 6x + k = 5, \text{ where } k \text{ is a constant,}$$

has two distinct real solutions for x .

(a) Show that k satisfies

$$k^2 - 2k - 24 < 0. \quad (4)$$

(b) Hence find the set of possible values of k .

(3)

(Total 7 marks)

10. The equation

$$(p - 1)x^2 + 4x + (p - 5) = 0, \text{ where } p \text{ is a constant,}$$

has no real roots.

(a) Show that p satisfies $p^2 - 6p + 1 > 0$.

(3)

(b) Hence find the set of possible values of p .

(4)

(Total 7 marks)

- 11.** The straight line with equation $y = 3x - 7$ does not cross or touch the curve with equation $y = 2px^2 - 6px + 4p$, where p is a constant.

(a) Show that $4p^2 - 20p + 9 < 0$.

(4)

(b) Hence find the set of possible values of p .

(4)

(Total 8 marks)

12.

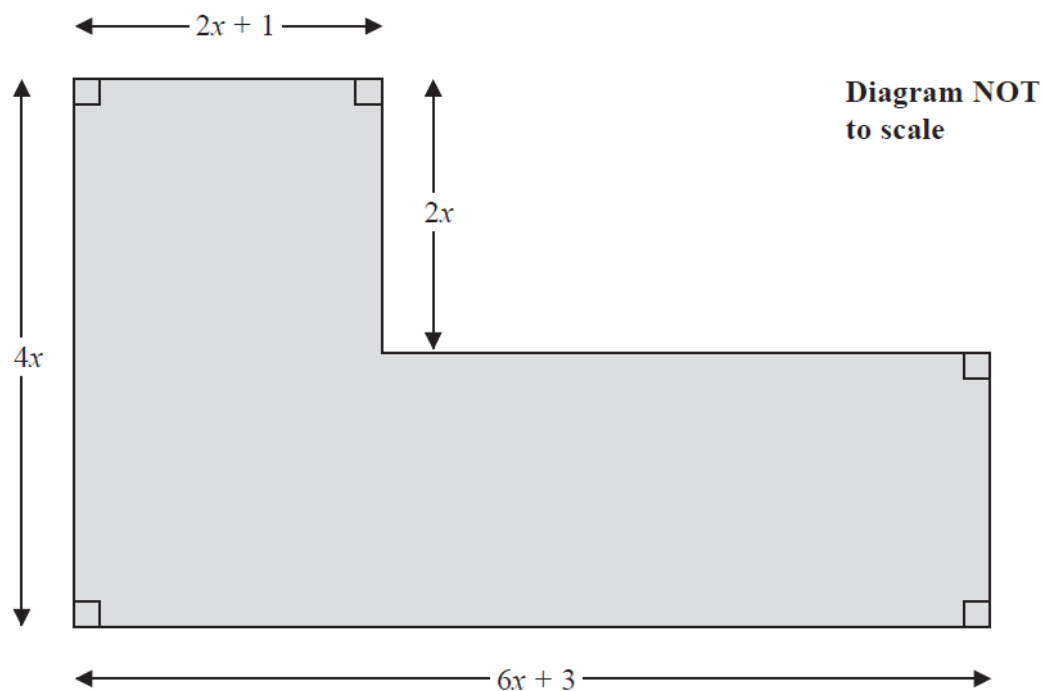


Figure 1

Figure 1 shows the plan of a garden. The marked angles are right angles.

The six edges are straight lines.

The lengths shown in the diagram are given in metres.

Given that the perimeter of the garden is greater than 40 m,

(a) show that $x > 1.7$.

(3)

Given that the area of the garden is less than 120 m^2 ,

(b) form and solve a quadratic inequality in x .

(5)

(c) Hence state the range of the possible values of x .

(1)

(Total 9 marks)

TOTAL FOR PAPER: 85 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Binomial expansion	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

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- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 9 questions in this question paper. The total mark for this paper is 49.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. Find the first 3 terms, in ascending powers of x , of the binomial expansion of

$$(2 - 3x)^5,$$

giving each term in its simplest form.

(4)

(Total 4 marks)

2. Find the first 4 terms, in ascending powers of x , of the binomial expansion of

$$\left(3 - \frac{1}{3}x\right)^5$$

giving each term in its simplest form.

(Total 4 marks)

3. Find the first 3 terms, in ascending powers of x , of the binomial expansion of

$$\left(2 - \frac{x}{4}\right)^{10},$$

giving each term in its simplest form.

(Total 4 marks)

4. Find the first 4 terms, in ascending powers of x , of the binomial expansion of

$$\left(1 + \frac{3x}{2}\right)^8$$

giving each term in its simplest form.

(Total 4 marks)

5. (a) Find the first 3 terms, in ascending powers of x , of the binomial expansion of

$$(3 + bx)^5$$

where b is a non-zero constant. Give each term in its simplest form.

(4)

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

- (b) find the value of b .

(2)

(Total 6 marks)

6. (a) Find the first 4 terms of the binomial expansion, in ascending powers of x , of

$$\left(1 + \frac{x}{4}\right)^8,$$

giving each term in its simplest form.

(4)

- (b) Use your expansion to estimate the value of $(1.025)^8$, giving your answer to 4 decimal places.

(3)

(Total 7 marks)

7. (a) Find the first 3 terms, in ascending powers of x , of the binomial expansion of $(2 - 3x)^6$, giving each term in its simplest form.

(4)

- (b) Hence, or otherwise, find the first 3 terms, in ascending powers of x , of the expansion of

$$\left(1 + \frac{x}{2}\right)(2 - 3x)^6.$$

(3)

(Total 7 marks)

8. Given that $\binom{40}{4} = \frac{40!}{4!b!}$,

- (a) write down the value of b .

(1)

In the binomial expansion of $(1 + x)^{40}$, the coefficients of x^4 and x^5 are p and q respectively.

- (b) Find the value of $\frac{q}{p}$.

(3)

(Total 4 marks)

9. (a) Find the first 3 terms, in ascending powers of x , of the binomial expansion of

$$(2 - 9x)^4,$$

giving each term in its simplest form.

(4)

$$f(x) = (1 + kx)(2 - 9x)^4, \text{ where } k \text{ is a constant.}$$

The expansion, in ascending powers of x , of $f(x)$ up to and including the term in x^2 is

$$A - 232x + Bx^2,$$

where A and B are constants.

- (b) Write down the value of A .

(1)

- (c) Find the value of k .

(2)

- (d) Hence find the value of B .

(2)

(Total 9 marks)

TOTAL FOR PAPER: 49 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Coordinate geometry	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 12 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

- 1*. The points P and Q have coordinates $(-1, 6)$ and $(9, 0)$ respectively.

The line l is perpendicular to PQ and passes through the mid-point of PQ .

Find an equation for l , giving your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(Total 5 marks)

2*.

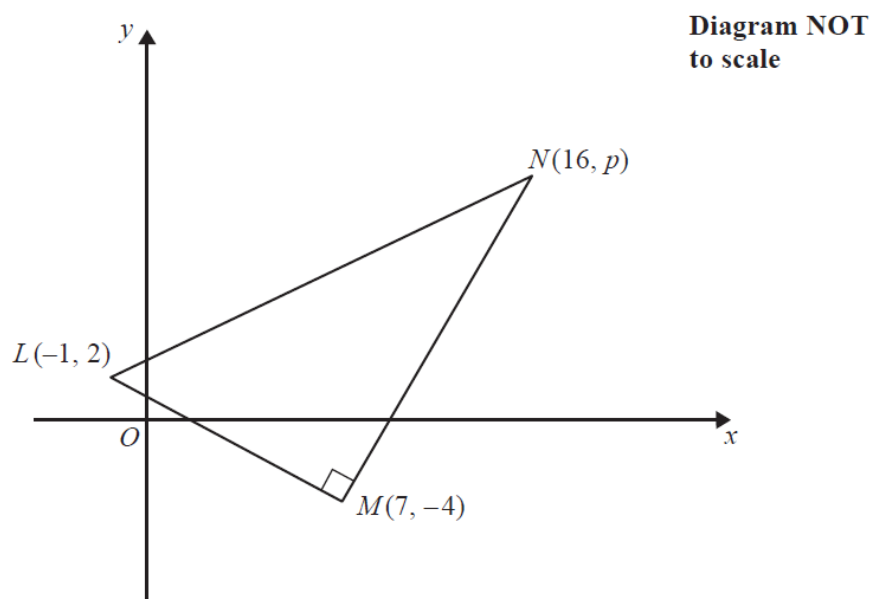


Figure 1

Figure 1 shows a right angled triangle LMN .

The points L and M have coordinates $(-1, 2)$ and $(7, -4)$ respectively.

- (a) Find an equation for the straight line passing through the points L and M .

Give your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(4)

Given that the coordinates of point N are $(16, p)$, where p is a constant, and angle $LMN = 90^\circ$,

- (b) find the value of p .

(3)

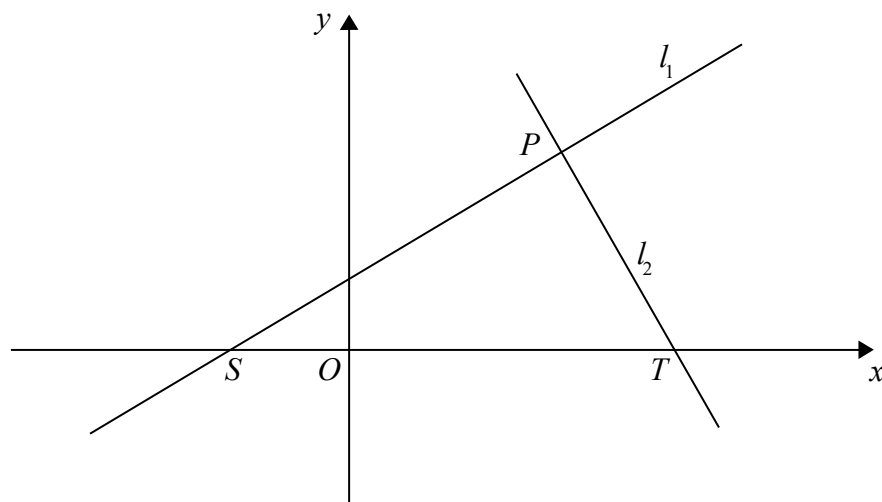
Given that there is a point K such that the points L , M , N , and K form a rectangle,

- (c) find the y coordinate of K .

(2)

(Total 9 marks)

3*.



Not to scale

Figure 1

The straight line l_1 , shown in Figure 1, has equation $5y = 4x + 10$

The point P with x coordinate 5 lies on l_1

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

- (a) Find an equation for l_2 , writing your answer in the form $ax + by + c = 0$ where a , b and c are integers.

(4)

The lines l_1 and l_2 cut the x -axis at the points S and T respectively, as shown in Figure 1.

- (b) Calculate the area of triangle SPT .

(4)

(Total 8 marks)

4*.

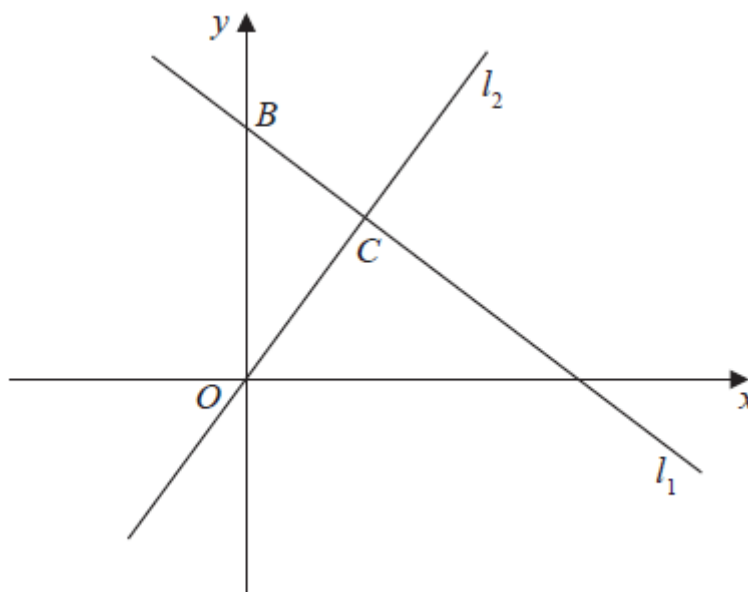


Figure 2

The line l_1 , shown in Figure 2 has equation $2x + 3y = 26$.

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

(a) Find an equation for the line l_2 .

(4)

The line l_2 intersects the line l_1 at the point C . Line l_1 crosses the y -axis at the point B as shown in Figure 2.

(b) Find the area of triangle OBC . Give your answer in the form $\frac{a}{b}$, where a and b are integers to be determined.

(6)

(Total 10 marks)

5*. The line L_1 has equation $4y + 3 = 2x$.

The point $A(p, 4)$ lies on L_1 .

(a) Find the value of the constant p .

(1)

The line L_2 passes through the point $C(2, 4)$ and is perpendicular to L_1 .

(b) Find an equation for L_2 giving your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(5)

The line L_1 and the line L_2 intersect at the point D .

(c) Find the coordinates of the point D .

(3)

(d) Show that the length of CD is $\frac{3}{2}\sqrt{5}$.

(3)

A point B lies on L_1 and the length of $AB = \sqrt{80}$.

The point E lies on L_2 such that the length of the line $CDE = 3$ times the length of CD .

(e) Find the area of the quadrilateral $ACBE$.

(3)

(Total 15 marks)

6*.

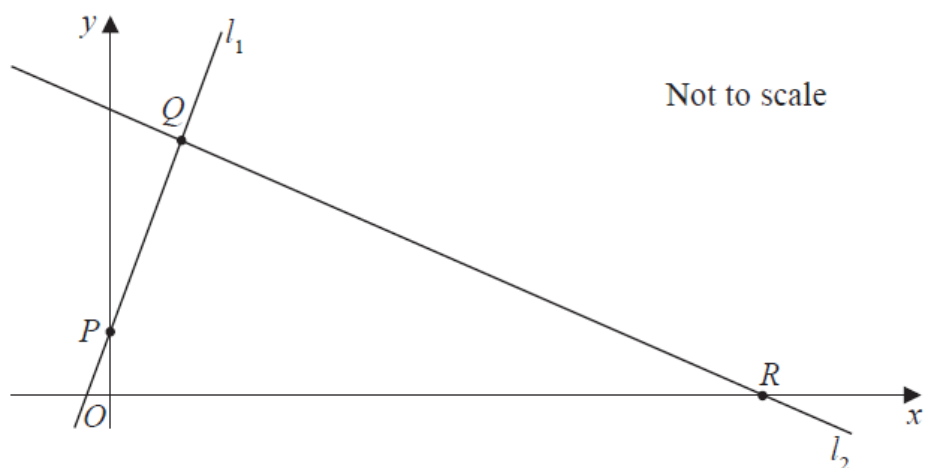


Figure 3

The points $P(0, 2)$ and $Q(3, 7)$ lie on the line l_1 , as shown in Figure 3.

The line l_2 is perpendicular to l_1 , passes through Q and crosses the x -axis at the point R , as shown in Figure 3.

Find

- (a) an equation for l_2 , giving your answer in the form $ax + by + c = 0$, where a , b and c are integers, (5)
- (b) the exact coordinates of R , (2)
- (c) the exact area of the quadrilateral $ORQP$, where O is the origin. (5)

(Total 12 marks)

7. A circle C has centre $(-1, 7)$ and passes through the point $(0, 0)$. Find an equation for C .

(Total 4 marks)

8.

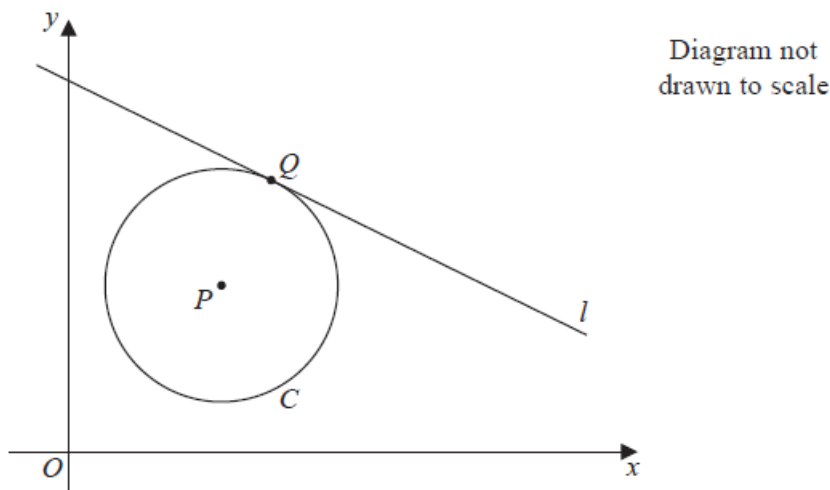


Figure 4

The circle C has centre $P(7, 8)$ and passes through the point $Q(10, 13)$, as shown in Figure 4.

- (a) Find the length PQ , giving your answer as an exact value. **(2)**
- (b) Hence write down an equation for C . **(2)**

The line l is a tangent to C at the point Q , as shown in Figure 4.

- (c) Find an equation for l , giving your answer in the form $ax + by + c = 0$, where a , b and c are integers. **(4)**

(Total 8 marks)

9. The circle C has equation

$$x^2 + y^2 + 4x - 2y - 11 = 0.$$

Find

- (a) the coordinates of the centre of C ,
(2)
- (b) the radius of C ,
(2)
- (c) the coordinates of the points where C crosses the y -axis, giving your answers as simplified surds.
(4)

(Total 8 marks)

10. The circle C has equation

$$x^2 + y^2 - 10x + 6y + 30 = 0$$

Find

- (a) the coordinates of the centre of C ,
(2)
- (b) the radius of C ,
(2)
- (c) the y coordinates of the points where the circle C crosses the line with equation $x = 4$, giving your answers as simplified surds.
(3)

(Total 7 marks)

11.

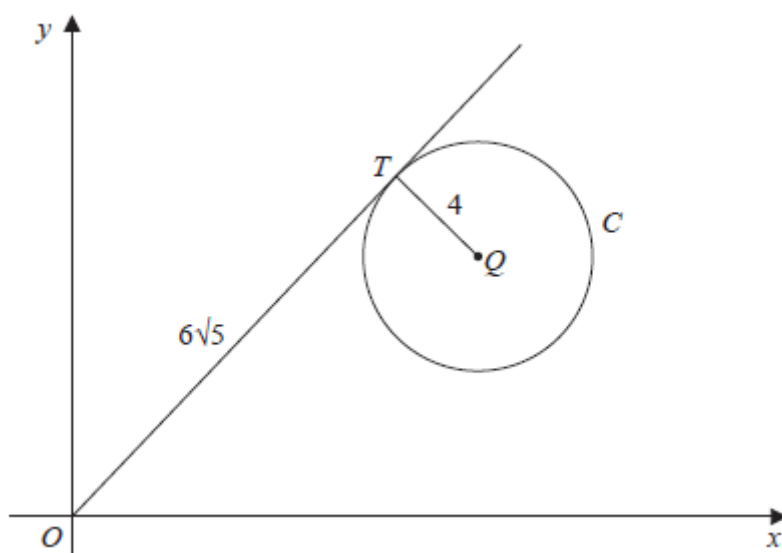


Figure 5

Figure 5 shows a circle C with centre Q and radius 4 and the point T which lies on C . The tangent to C at the point T passes through the origin O and $OT = 6\sqrt{5}$.

Given that the coordinates of Q are $(11, k)$, where k is a positive constant,

(a) find the exact value of k ,

(3)

(b) find an equation for C .

(2)

(Total 5 marks)

12. The circle C , with centre A , passes through the point P with coordinates $(-9, 8)$ and the point Q with coordinates $(15, -10)$.

Given that PQ is a diameter of the circle C ,

- (a) find the coordinates of A ,

(2)

- (b) find an equation for C .

(3)

A point R also lies on the circle C .

Given that the length of the chord PR is 20 units,

- (c) find the length of the shortest distance from A to the chord PR .

Give your answer as a surd in its simplest form.

(2)

- (d) Find the size of the angle ARQ , giving your answer to the nearest 0.1 of a degree.

(2)

(Total 9 marks)

TOTAL FOR PAPER: 100 MARKS

Write your name here	
Surname	Other names
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AS and A level Mathematics Practice Paper Pure Mathematics - Differentiation	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 11 questions in this question paper. The total mark for this paper is 99.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
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Advice

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- Try to answer every question.
- Check your answers if you have time at the end.
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1*. Given

$$y = \sqrt{x} + \frac{4}{\sqrt{x}} + 4, \quad x > 0$$

find the value of $\frac{dy}{dx}$ when $x = 8$, writing your answer in the form $a\sqrt{2}$, where a is a rational number.

(Total 5 marks)

2*. Given that

$$y = 3x^2 + 6x^{\frac{1}{3}} + \frac{2x^3 - 7}{3\sqrt{x}}, \quad x > 0,$$

find $\frac{dy}{dx}$. Give each term in your answer in its simplified form.

(Total 6 marks)

3*. Differentiate with respect to x , giving answer in its simplest form

$$\frac{x^5 + 6\sqrt{x}}{2x^2}$$

(Total 4 marks)

4*.

$$y = 5x^3 - 6x^{\frac{4}{3}} + 2x - 3.$$

(a) Find $\frac{dy}{dx}$, giving each term in its simplest form.

(4)

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

(2)

(Total 6 marks)

5.

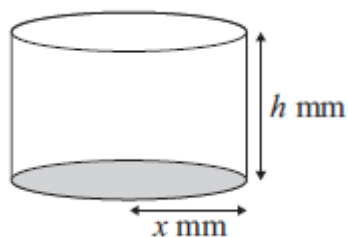


Figure 1

A manufacturer produces pain relieving tablets. Each tablet is in the shape of a solid circular cylinder with base radius x mm and height h mm, as shown in Figure 1.

Given that the volume of each tablet has to be 60 mm^3 ,

(a) express h in terms of x , (1)

(b) show that the surface area, $A \text{ mm}^2$, of a tablet is given by $A = 2\pi x^2 + \frac{120}{x}$. (3)

The manufacturer needs to minimise the surface area $A \text{ mm}^2$, of a tablet.

(c) Use calculus to find the value of x for which A is a minimum. (5)

(d) Calculate the minimum value of A , giving your answer to the nearest integer. (2)

(e) Show that this value of A is a minimum. (2)

(Total 13 marks)

6. A solid glass cylinder, which is used in an expensive laser amplifier, has a volume of $75\pi \text{ cm}^3$.

The cost of polishing the surface area of this glass cylinder is £2 per cm^2 for the curved surface area and £3 per cm^2 for the circular top and base areas.

Given that the radius of the cylinder is r cm,

- (a) show that the cost of the polishing, £ C , is given by

$$C = 6\pi r^2 + \frac{300\pi}{r}.$$

(4)

- (b) Use calculus to find the minimum cost of the polishing, giving your answer to the nearest pound.

(5)

- (c) Justify that the answer that you have obtained in part (b) is a minimum.

(1)

(Total 10 marks)

7.

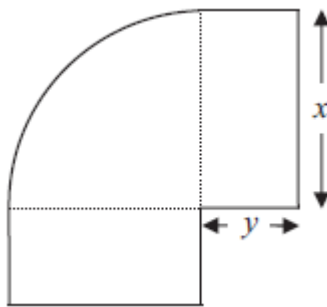


Figure 2

Figure 2 shows a flowerbed. Its shape is a quarter of a circle of radius x metres with two equal rectangles attached to it along its radii. Each rectangle has length equal to x metres and width equal to y metres.

Given that the area of the flowerbed is 4m^2 ,

(a) show that

$$y = \frac{16 - \pi x^2}{8x}. \quad (3)$$

(b) Hence show that the perimeter P metres of the flowerbed is given by the equation

$$P = \frac{8}{x} + 2x. \quad (3)$$

(c) Use calculus to find the minimum value of P .

(5)

(d) Find the width of each rectangle when the perimeter is a minimum.

Give your answer to the nearest centimetre.

(2)

(Total 13 marks)

8.

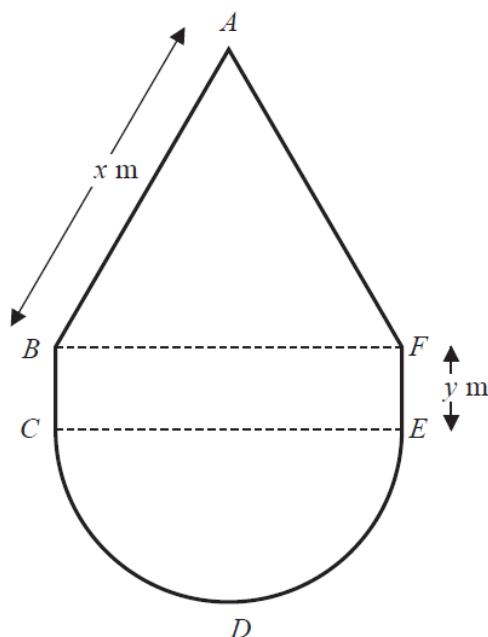


Figure 3

Figure 3 shows the plan of a pool.

The shape of the pool $ABCDEF$ consists of a rectangle $BCEF$ joined to an equilateral triangle BFA and a semi-circle CDE , as shown in Figure 3.

Given that $AB = x$ metres, $EF = y$ metres, and the area of the pool is 50 m^2 ,

(a) show that

$$y = \frac{50}{x} - \frac{x}{8}(\pi + 2\sqrt{3}) \quad (3)$$

(b) Hence show that the perimeter, P metres, of the pool is given by

$$P = \frac{100}{x} + \frac{x}{4}(\pi + 8 - 2\sqrt{3}) \quad (3)$$

(c) Use calculus to find the minimum value of P , giving your answer to 3 significant figures.

(5)

(d) Justify, by further differentiation, that the value of P that you have found is a minimum.

(2)

(Total 13 marks)

9. The volume $V \text{ cm}^3$ of a box, of height $x \text{ cm}$, is given by

$$V = 4x(5 - x)^2, \quad 0 < x < 5.$$

- (a) Find $\frac{dV}{dx}$.

(4)

- (b) Hence find the maximum volume of the box.

(4)

- (c) Use calculus to justify that the volume that you found in part (b) is a maximum.

(2)

(Total 10 marks)

10. Joan brings a cup of hot tea into a room and places the cup on a table. At time t minutes after Joan places the cup on the table, the temperature, θ °C, of the tea is modelled by the equation

$$\theta = 20 + Ae^{-kt},$$

where A and k are positive constants.

Given that the initial temperature of the tea was 90 °C,

- (a) find the value of A .

(2)

The tea takes 5 minutes to decrease in temperature from 90 °C to 55 °C.

- (b) Show that $k = \frac{1}{5} \ln 2$.

(3)

- (c) Find the rate at which the temperature of the tea is decreasing at the instant when $t = 10$.
Give your answer, in °C per minute, to 3 decimal places.

(3)

(Total 8 marks)

11. The mass, m grams, of a leaf t days after it has been picked from a tree is given by

$$m = pe^{-kt},$$

where k and p are positive constants.

When the leaf is picked from the tree, its mass is 7.5 grams and 4 days later its mass is 2.5 grams.

- (a) Write down the value of p .

(1)

- (b) Show that $k = \frac{1}{4} \ln 3$.

(4)

- (c) Find the value of t when $\frac{dm}{dt} = -0.6 \ln 3$.

(6)

(Total 11 marks)

TOTAL FOR PAPER: 100 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Differentiation	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 9 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1*. The curve C_1 has equation

$$y = x^2(x + 2).$$

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

(b) Sketch C_1 , showing the coordinates of the points where C_1 meets the x -axis. (3)

(c) Find the gradient of C_1 at each point where C_1 meets the x -axis. (2)

The curve C_2 has equation

$$y = (x - k)^2(x - k + 2),$$

where k is a constant and $k > 2$.

(d) Sketch C_2 , showing the coordinates of the points where C_2 meets the x and y axes. (3)

(Total 10 marks)

2*. The curve C has equation

$$y = (x + 1)(x + 3)^2.$$

(a) Sketch C , showing the coordinates of the points at which C meets the axes. (4)

(b) Show that $\frac{dy}{dx} = 3x^2 + 14x + 15$. (3)

The point A , with x -coordinate -5 , lies on C .

(c) Find the equation of the tangent to C at A , giving your answer in the form $y = mx + c$, where m and c are constants. (4)

Another point B also lies on C . The tangents to C at A and B are parallel.

(d) Find the x -coordinate of B . (3)

(Total 14 marks)

3*. The curve C has equation

$$y = \frac{(x^2 + 4)(x - 3)}{2x}, \quad x \neq 0.$$

(a) Find $\frac{dy}{dx}$ in its simplest form.

(5)

(b) Find an equation of the tangent to C at the point where $x = -1$.

Give your answer in the form $ax + by + c = 0$, where a , b and c are integers.

(5)

(Total 10 marks)

4*. The curve C has equation $y = 2x^3 + kx^2 + 5x + 6$, where k is a constant.

(a) Find $\frac{dy}{dx}$.

(2)

The point P , where $x = -2$, lies on C .

The tangent to C at the point P is parallel to the line with equation $2y - 17x - 1 = 0$.

Find

(b) the value of k ,

(4)

(c) the value of the y coordinate of P ,

(2)

(d) 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.

(2)

(Total 10 marks)

5*. The curve C has equation

$$y = 2x - 8\sqrt{x} + 5, \quad x \geq 0.$$

- (a) Find $\frac{dy}{dx}$, giving each term in its simplest form.

(3)

The point P on C has x -coordinate equal to $\frac{1}{4}$.

- (b) Find the equation of the tangent to C at the point P , giving your answer in the form $y = ax + b$, where a and b are constants.

(4)

The tangent to C at the point Q is parallel to the line with equation $2x - 3y + 18 = 0$.

- (c) Find the coordinates of Q .

(5)

(Total 12 marks)

6*. The curve C has equation

$$y = \frac{1}{2}x^3 - 9x^{\frac{3}{2}} + \frac{8}{x} + 30, \quad x > 0.$$

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

(4)

- (b) Show that the point $P(4, -8)$ lies on C

(2)

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

(6)

(Total 12 marks)

7*.

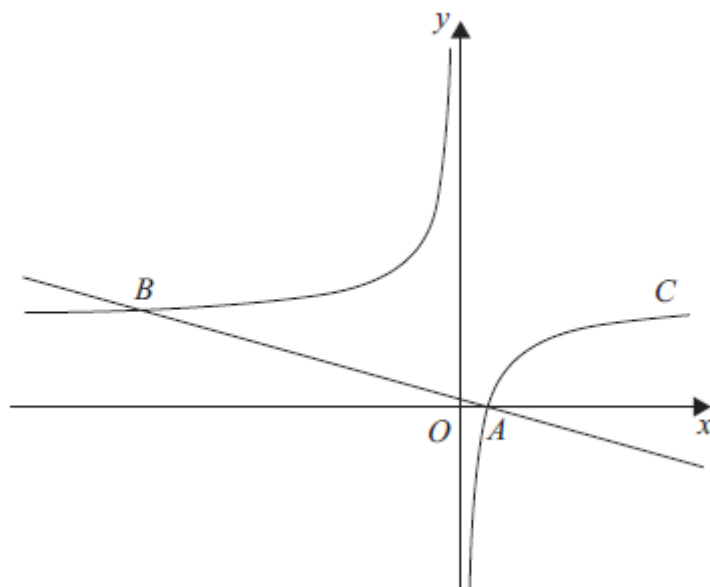


Figure 1

Figure 1 shows a sketch of the curve C with equation

$$y = 2 - \frac{1}{x}, \quad x \neq 0.$$

The curve crosses the x -axis at the point A .

(a) Find the coordinates of A .

(1)

(b) Show that the equation of the normal to C at A can be written as

$$2x + 8y - 1 = 0.$$

(6)

The normal to C at A meets C again at the point B , as shown in Figure 1.

(c) Find the coordinates of B .

(4)

(Total 11 marks)

8*.

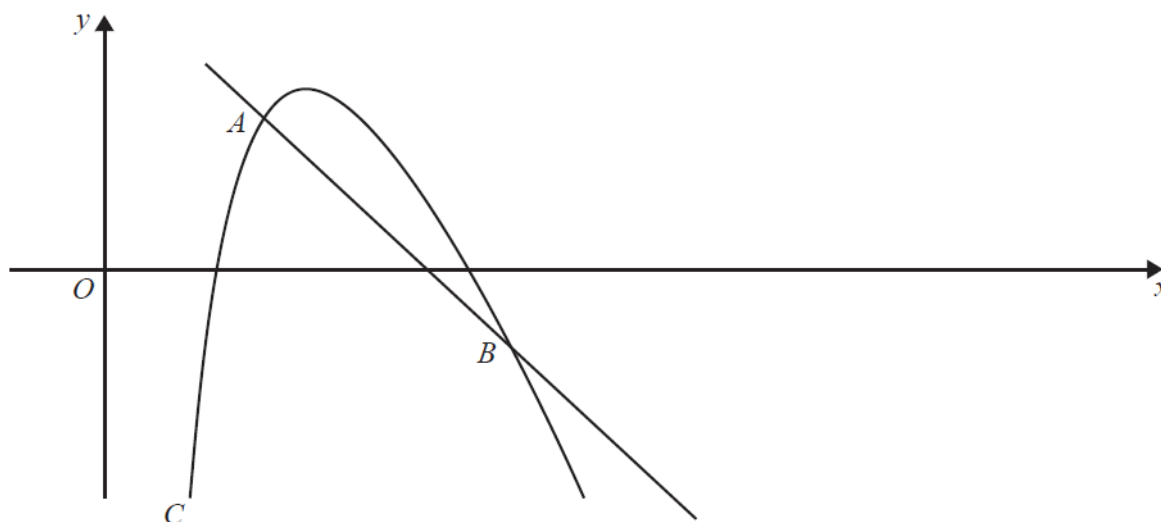


Figure 2

A sketch of part of the curve C with equation

$$y = 20 - 4x - \frac{18}{x}, \quad x > 0$$

is shown in Figure 2.

Point A lies on C and has an x coordinate equal to 2.

(a) Show that the equation of the normal to C at A is $y = -2x + 7$.

(6)

The normal to C at A meets C again at the point B , as shown in Figure 2.

(b) Use algebra to find the coordinates of B .

(5)

(Total 11 marks)

9.

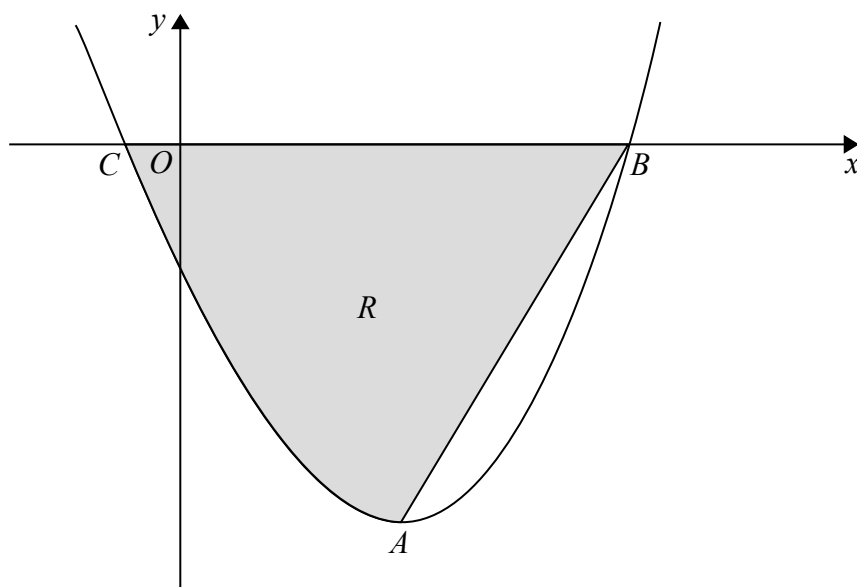


Figure 3

Figure 3 shows a sketch of part of the curve with equation

$$y = 4x^3 + 9x^2 - 30x - 8, \quad -0.5 \leq x \leq 2.2$$

The curve has a turning point at the point A .

(a) Using calculus, show that the x coordinate of A is 1

(3)

The curve crosses the x -axis at the points $B(2, 0)$ and $C\left(-\frac{1}{4}, 0\right)$

The finite region R , shown shaded in Figure 3, is bounded by the curve, the line AB , and the x -axis.

(b) Use integration to find the area of the finite region R , giving your answer to 2 decimal places.

(7)

(Total 10 marks)

TOTAL FOR PAPER: 100 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Exponentials and logarithms	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
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- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 12 questions in this question paper. The total mark for this paper is 79.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. Find the values of x such that

$$2 \log_3 x - \log_3(x - 2) = 2$$

(Total 5 marks)

2. Given that $y = 3x^2$,

(a) show that $\log_3 y = 1 + 2 \log_3 x$.

(3)

(b) Hence, or otherwise, solve the equation

$$1 + 2 \log_3 x = \log_3 (28x - 9).$$

(3)

(Total 6 marks)

3. Given that $2 \log_2 (x + 15) - \log_2 x = 6$,

(a) show that $x^2 - 34x + 225 = 0$.

(5)

(b) Hence, or otherwise, solve the equation $2 \log_2 (x + 15) - \log_2 x = 6$.

(2)

(Total 7 marks)

4. (i) Find the exact value of x for which

$$\log_2 (2x) = \log_2 (5x + 4) - 3.$$

(4)

- (ii) Given that

$$\log_a y + 3 \log_a 2 = 5,$$

express y in terms of a .

Give your answer in its simplest form.

(3)

(Total 7 marks)

5. (i) $2 \log(x + a) = \log(16a^6)$, where a is a positive constant

Find x in terms of a , giving your answer in its simplest form.

(3)

- (ii) $\log_3(9y + b) - \log_3(2y - b) = 2$, where b is a positive constant

Find y in terms of b , giving your answer in its simplest form.

(4)

(Total 7 marks)

6. Find, giving your answer to 3 significant figures where appropriate, the value of x for which

(a) $5^x = 10$,

(2)

(b) $\log_3(x - 2) = -1$.

(2)

(Total 4 marks)

7. Find the exact solutions, in their simplest form, to the equations

(a) $e^{3x-9} = 8$

(Total 3 marks)

8. $f(x) = -6x^3 - 7x^2 + 40x + 21$
- (a) Use the factor theorem to show that $(x + 3)$ is a factor of $f(x)$ (2)
- (b) Factorise $f(x)$ completely. (4)
- (c) Hence solve the equation
- $$6(2^{3y}) + 7(2^{2y}) = 40(2^y) + 21$$
- giving your answer to 2 decimal places. (3)
- (Total 9 marks)**
-

9. (i) Use logarithms to solve the equation $8^{2x+1} = 24$, giving your answer to 3 decimal places. (3)
- (ii) Find the values of y such that
- $$\log_2(11y - 3) - \log_2 3 - 2 \log_2 y = 1, \quad y > \frac{3}{11}$$
- (6)
- (Total 9 marks)**
-

10. (i) Given that
- $$\log_3(3b + 1) - \log_3(a - 2) = -1, \quad a > 2,$$
- express b in terms of a . (3)
- (ii) Solve the equation
- $$2^{2x+5} - 7(2^x) = 0,$$
- giving your answer to 2 decimal places.
- (Solutions based entirely on graphical or numerical methods are not acceptable.)* (4)
- (Total 7 marks)**
-

11. (i) Solve

$$5^y = 8$$

giving your answers to 3 significant figures.

(2)

- (ii) Use algebra to find the values of x for which

$$\log_2(x+15) - 4 = \frac{1}{2} \log_2 x$$

(6)

(Total 8 marks)

-
12. (a) Sketch the graph of

$$y = 3^x, x \in \mathbb{R},$$

showing the coordinates of any points at which the graph crosses the axes.

(2)

- (b) Use algebra to solve the equation $3^{2x} - 9(3^x) + 18 = 0$, giving your answers to 2 decimal places where appropriate.

(5)

(Total 7 marks)

TOTAL FOR PAPER: 79 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Graphs and transformations	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 12 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- **Calculators must not be used for all questions.**

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1.

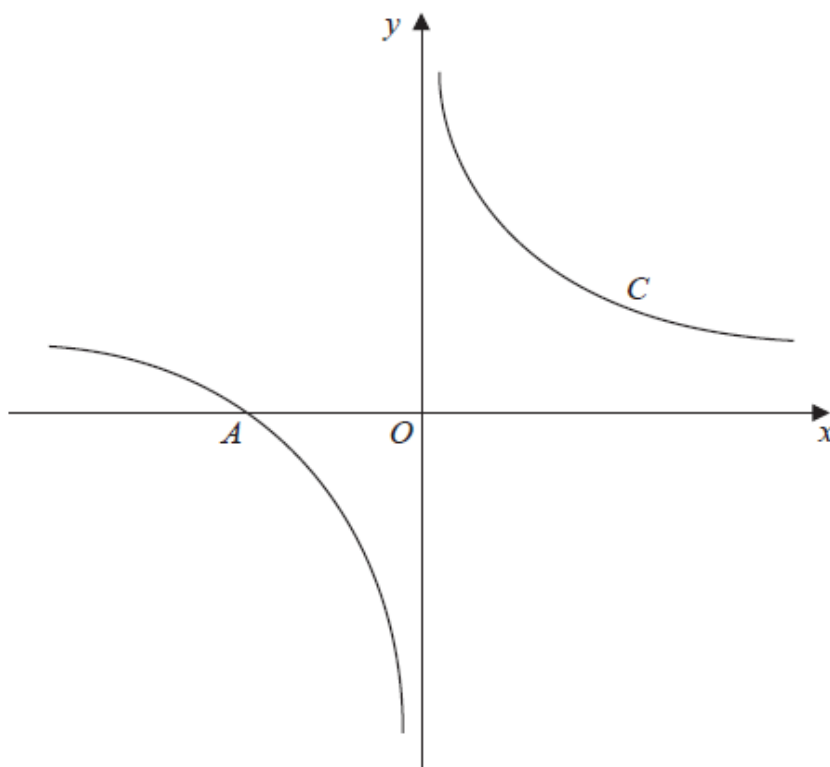


Figure 1

Figure 1 shows a sketch of the curve C with equation

$$y = \frac{1}{x} + 1, \quad x \neq 0.$$

The curve C crosses the x -axis at the point A .

(a) State the x -coordinate of the point A .

(1)

The curve D has equation $y = x^2(x - 2)$, for all real values of x .

(b) On a copy of Figure 1, sketch a graph of curve D . Show the coordinates of each point where the curve D crosses the coordinate axes.

(3)

(c) Using your sketch, state, giving a reason, the number of real solutions to the equation

$$x^2(x - 2) = \frac{1}{x} + 1$$

(1)

(Total 5 marks)

2.

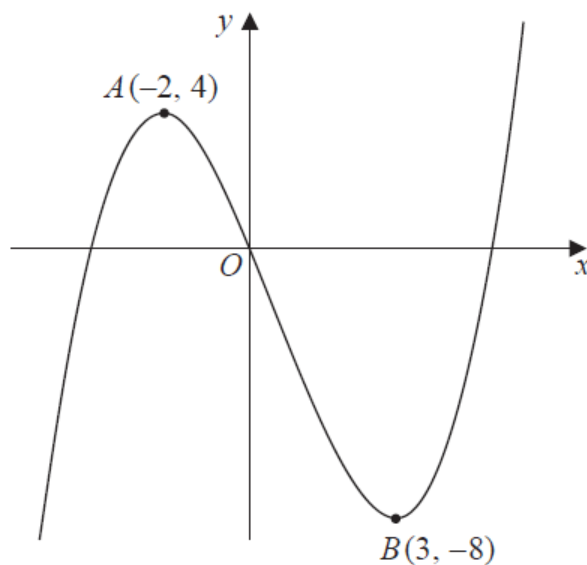


Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = f(x)$. The curve has a maximum point A at $(-2, 4)$ and a minimum point B at $(3, -8)$ and passes through the origin O .

On separate diagrams, sketch the curve with equation

(a) $y = 3f(x)$, (2)

(b) $y = f(x) - 4$. (3)

On each diagram, show clearly the coordinates of the maximum and the minimum points and the coordinates of the point where the curve crosses the y -axis.

(Total 5 marks)

3.

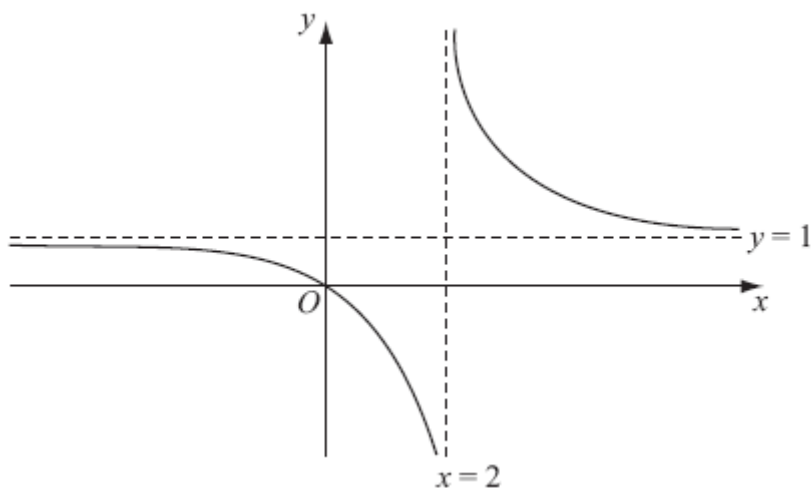


Figure 3

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

$$f(x) = \frac{x}{x-2}, \quad x \neq 2.$$

The curve passes through the origin and has two asymptotes, with equations $y = 1$ and $x = 2$, as shown in Figure 1.

- (a) In the space below, sketch the curve with equation $y = f(x - 1)$ and state the equations of the asymptotes of this curve.

(3)

- (b) Find the coordinates of the points where the curve with equation $y = f(x - 1)$ crosses the coordinate axes.

(4)

(Total 7 marks)

4.

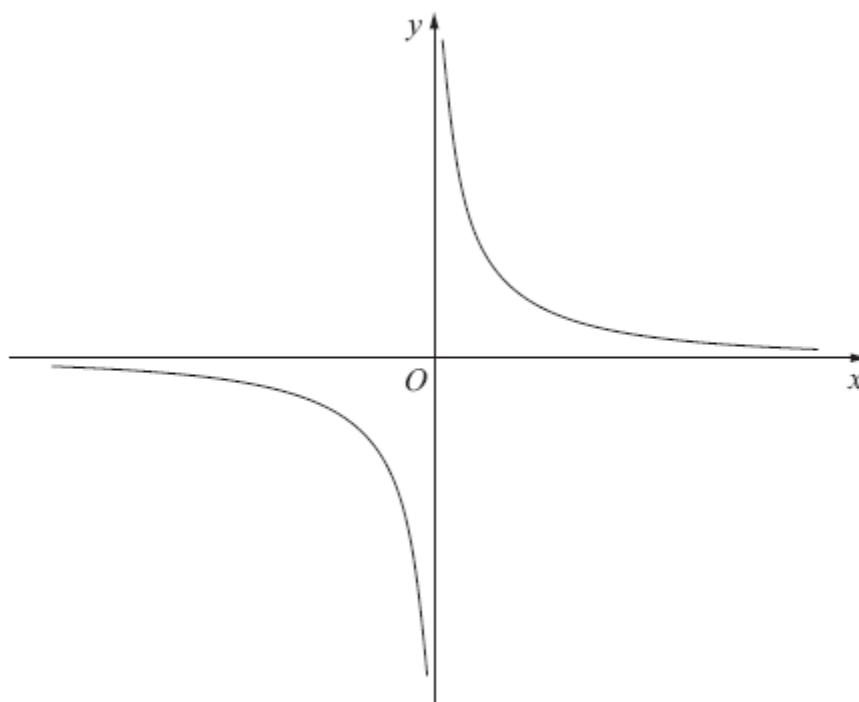


Figure 4

Figure 4 shows a sketch of the curve with equation $y = \frac{2}{x}$, $x \neq 0$.

The curve C has equation $y = \frac{2}{x} - 5$, $x \neq 0$, and the line l has equation $y = 4x + 2$.

- (a) Sketch and clearly label the graphs of C and l on a single diagram.

On your diagram, show clearly the coordinates of the points where C and l cross the coordinate axes.

(5)

- (b) Write down the equations of the asymptotes of the curve C .

(2)

- (c) Find the coordinates of the points of intersection of $y = \frac{2}{x} - 5$ and $y = 4x + 2$.

(5)

(Total 12 marks)

5. (a) Factorise completely $9x - 4x^3$.

(3)

- (b) Sketch the curve C with equation

$$y = 9x - 4x^3.$$

Show on your sketch the coordinates at which the curve meets the x -axis.

(3)

The points A and B lie on C and have x coordinates of -2 and 1 respectively.

- (c) Show that the length of AB is $k\sqrt{10}$, where k is a constant to be found.

(4)

(Total 10 marks)

6.

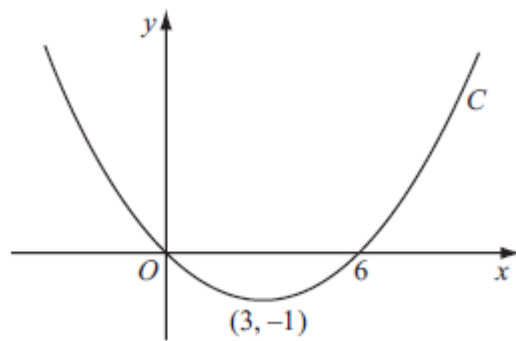


Figure 5

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

The curve C passes through the origin and through $(6, 0)$.

The curve C has a minimum at the point $(3, -1)$.

On separate diagrams, sketch the curve with equation

(a) $y = f(2x)$, (3)

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

(c) $y = f(x + p)$, where p is a constant and $0 < p < 3$. (4)

On each diagram show the coordinates of any points where the curve intersects the x -axis and of any minimum or maximum points.

(Total 10 marks)

7.

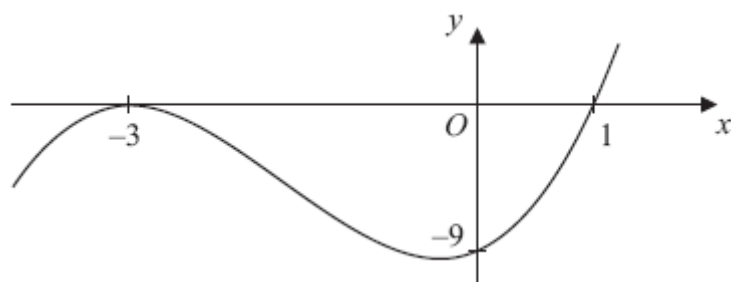


Figure 6

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

$$f(x) = (x + 3)^2 (x - 1), \quad x \in \mathbb{R}.$$

The curve crosses the x -axis at $(1, 0)$, touches it at $(-3, 0)$ and crosses the y -axis at $(0, -9)$.

- (a) Sketch the curve C with equation $y = f(x + 2)$ and state the coordinates of the points where the curve C meets the x -axis.

(3)

- (b) Write down an equation of the curve C .

(1)

- (c) Use your answer to part (b) to find the coordinates of the point where the curve C meets the y -axis.

(2)

(Total 6 marks)

8. (a) On separate axes sketch the graphs of
- (i) $y = -3x + c$, where c is a positive constant,
- (ii) $y = \frac{1}{x} + 5$

On each sketch show the coordinates of any point at which the graph crosses the y -axis and the equation of any horizontal asymptote.

(4)

Given that $y = -3x + c$, where c is a positive constant, meets the curve $y = \frac{1}{x} + 5$ at two distinct points,

- (b) show that $(5 - c)^2 > 12$

(3)

- (c) Hence find the range of possible values for c .

(4)

(Total 11 marks)

9. $4x^2 + 8x + 3 \equiv a(x + b)^2 + c$

- (a) Find the values of the constants a , b and c .

(3)

- (b) Sketch the curve with equation $y = 4x^2 + 8x + 3$, showing clearly the coordinates of any points where the curve crosses the coordinate axes.

(4)

(Total 7 marks)

10.

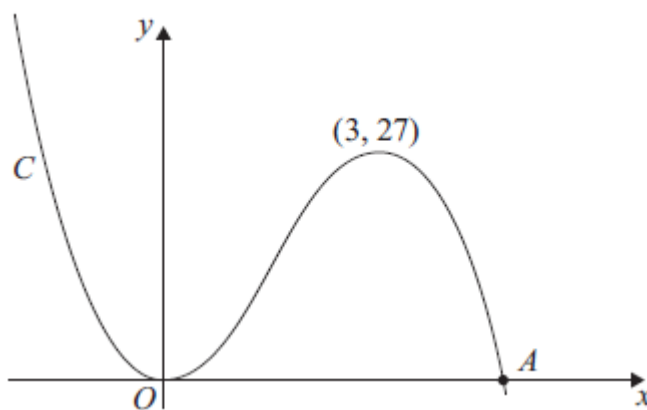


Figure 7

Figure 7 shows a sketch of the curve C with equation $y = f(x)$, where

$$f(x) = x^2(9 - 2x).$$

There is a minimum at the origin, a maximum at the point $(3, 27)$ and C cuts the x -axis at the point A .

(a) Write down the coordinates of the point A .

(1)

(b) On separate diagrams sketch the curve with equation

(i) $y = f(x + 3)$,

(ii) $y = f(3x)$.

On each sketch you should indicate clearly the coordinates of the maximum point and any points where the curves cross or meet the coordinate axes.

(6)

The curve with equation $y = f(x) + k$, where k is a constant, has a maximum point at $(3, 10)$.

(c) Write down the value of k .

(1)

(Total 8 marks)

11.

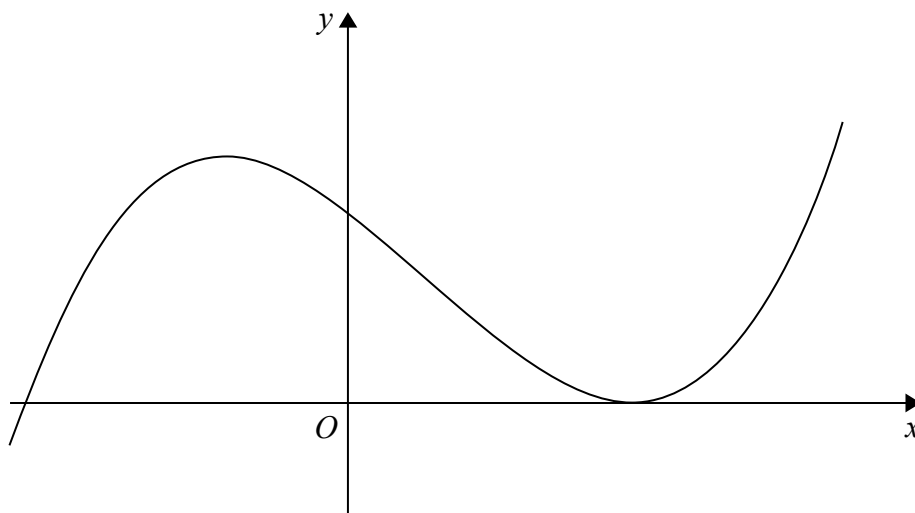


Figure 8

Figure 8 shows a sketch of part of the curve $y = f(x)$, $x \in \mathbb{R}$, where

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

(a) Given that

- (i) the curve with equation $y = f(x) - k$, $x \in \mathbb{R}$, passes through the origin, find the value of the constant k ,
- (ii) the curve with equation $y = f(x + c)$, $x \in \mathbb{R}$, has a minimum point at the origin, find the value of the constant c .

(3)

(b) Show that $f'(x) = 12x^2 - 16x - 35$

(3)

Points A and B are distinct points that lie on the curve $y = f(x)$.

The gradient of the curve at A is equal to the gradient of the curve at B .

Given that point A has x coordinate 3

(c) find the x coordinate of point B .

(5)

(Total 11 marks)

12. (a) Sketch the graphs of

(i) $y = x(x + 2)(3 - x)$,

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

showing clearly the coordinates of all the points where the curves cross the coordinate axes.

(6)

(b) Using your sketch state, giving a reason, the number of real solutions to the equation

$$x(x + 2)(3 - x) + \frac{2}{x} = 0.$$

(2)

(Total 8 marks)

TOTAL FOR PAPER: 100 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Integration	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 14 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.
- Calculators must not be used for questions marked with a * sign.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1*. Find

$$\int \left(6x^2 + \frac{2}{x^2} + 5 \right) dx,$$

giving each term in its simplest form.

(4)

(Total 4 marks)

2*. Find

$$\int \left(2x^4 - \frac{4}{\sqrt{x}} + 3 \right) dx$$

giving each term in its simplest form.

(Total 4 marks)

3*. Find

$$\int \left(2x^5 - \frac{1}{4x^3} - 5 \right) dx$$

giving each term in its simplest form.

(Total 4 marks)

4. Use integration to find

$$\int_1^{\sqrt{3}} \left(\frac{x^3}{6} + \frac{1}{3x^2} \right) dx,$$

giving your answer in the form $a + b\sqrt{3}$, where a and b are constants to be determined.

(Total 5 marks)

5.

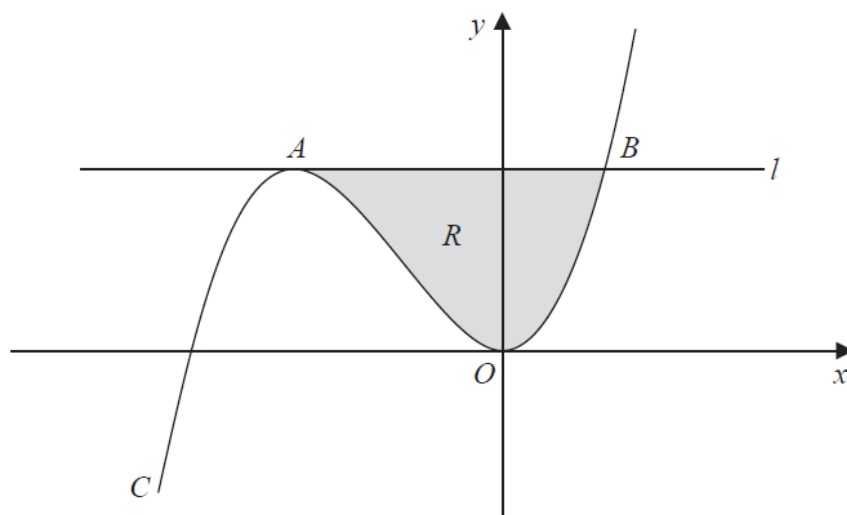


Figure 1

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

$$y = \frac{1}{8}x^3 + \frac{3}{4}x^2, \quad x \in \mathbb{R}$$

The curve C has a maximum turning point at the point A and a minimum turning point at the origin O .

The line l touches the curve C at the point A and cuts the curve C at the point B .

The x coordinate of A is -4 and the x coordinate of B is 2 .

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

Use integration to find the area of the finite region R .

(Total 7 marks)

6*.

$$\frac{dy}{dx} = 6x^{-\frac{1}{2}} + x\sqrt{x}, \quad x > 0$$

Given that $y = 37$ at $x = 4$, find y in terms of x , giving each term in its simplest form.

(Total 7 marks)

7*. A curve with equation $y = f(x)$ passes through the point $(2, 10)$. Given that

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

find the value of $f(1)$.

(Total 5 marks)

8*. A curve with equation $y = f(x)$ passes through the point $(4, 25)$.

$$\text{Given that } f'(x) = \frac{3}{8}x^2 - 10x^{-\frac{1}{2}} + 1, \quad x > 0,$$

(a) find $f(x)$, simplifying each term.

(5)

(b) Find an equation of the normal to the curve at the point $(4, 25)$. Give your answer in the form $ax + by + c = 0$, where a , b and c are integers to be found.

(5)

(Total 10 marks)

9*. The curve C has equation $y = f(x)$, $x > 0$, where

$$f'(x) = 30 + \frac{6 - 5x^2}{\sqrt{x}}$$

Given that the point $P(4, -8)$ lies on C ,

- (a) find the equation of the tangent to C at P , giving your answer in the form $y = mx + c$, where m and c are constants.

(4)

- (b) Find $f(x)$, giving each term in its simplest form.

(5)

(Total 9 marks)

10*. A curve with equation $y = f(x)$ passes through the point $(4, 9)$.

Given that

$$f'(x) = \frac{3\sqrt{x}}{2} - \frac{9}{4\sqrt{x}} + 2, \quad x > 0,$$

- (a) find $f(x)$, giving each term in its simplest form.

(5)

Point P lies on the curve.

The normal to the curve at P is parallel to the line $2y + x = 0$.

- (b) Find the x -coordinate of P .

(5)

(Total 10 marks)

11.

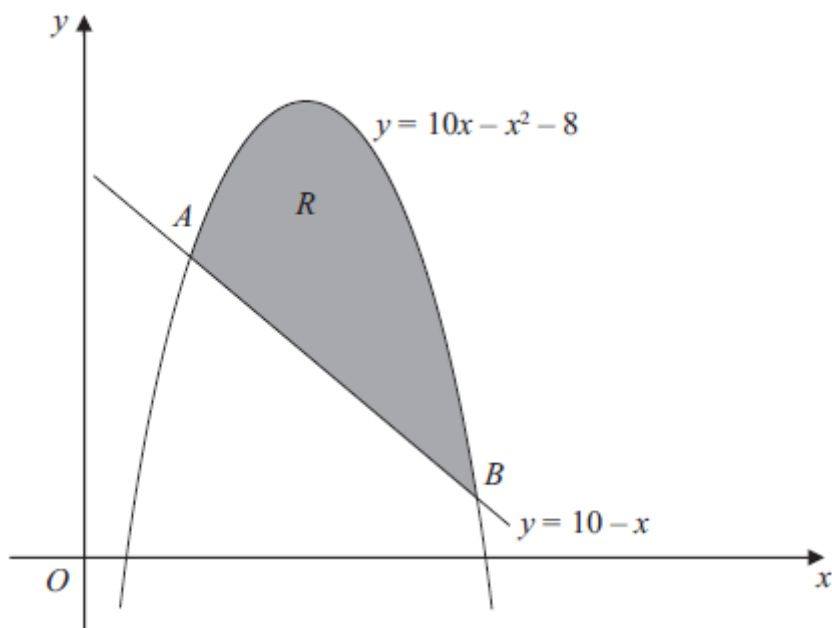


Figure 2

Figure 2 shows the line with equation $y = 10 - x$ and the curve with equation $y = 10x - x^2 - 8$. The line and the curve intersect at the points A and B , and O is the origin.

(a) Calculate the coordinates of A and the coordinates of B .

(5)

The shaded area R is bounded by the line and the curve, as shown in Figure 2.

(b) Calculate the exact area of R .

(7)

(Total 12 marks)

12. (a) Find

$$\int 10x(x^{\frac{1}{2}} - 2) \, dx,$$

giving each term in its simplest form.

(4)

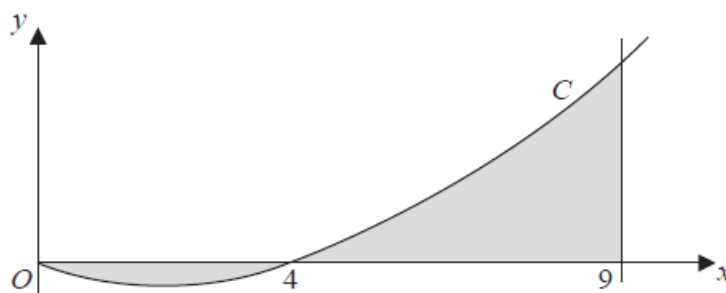


Figure 2

Figure 2 shows a sketch of part of the curve C with equation

$$y = 10x(x^{\frac{1}{2}} - 2), \quad x \geq 0.$$

The curve C starts at the origin and crosses the x -axis at the point $(4, 0)$.

The area, shown shaded in Figure 2, consists of two finite regions and is bounded by the curve C , the x -axis and the line $x = 9$.

(b) Use your answer from part (a) to find the total area of the shaded regions.

(5)

(Total 9 marks)

13.

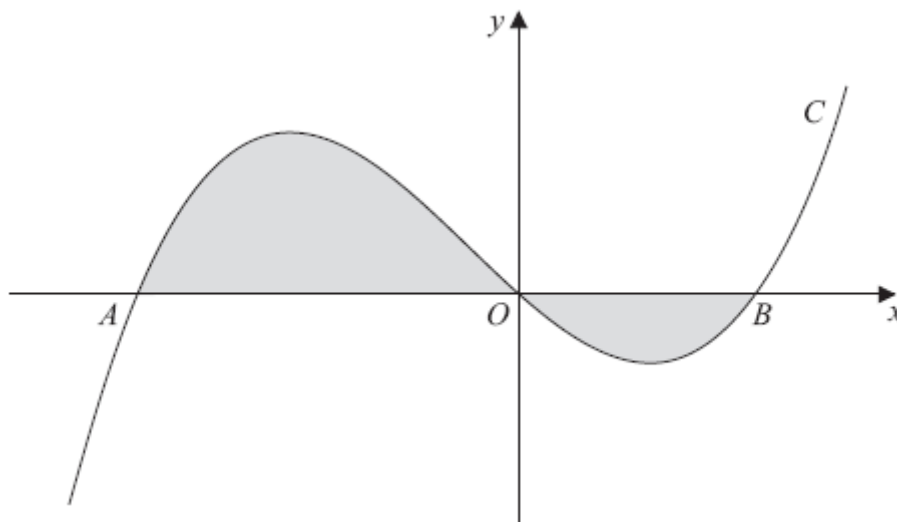


Figure 3

Figure 3 shows a sketch of part of the curve C with equation

$$y = x(x + 4)(x - 2).$$

The curve C crosses the x -axis at the origin O and at the points A and B .

(a) Write down the x -coordinates of the points A and B .

(1)

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

(b) Use integration to find the total area of the finite region shown shaded in Figure 3.

(7)

(Total 8 marks)

14.

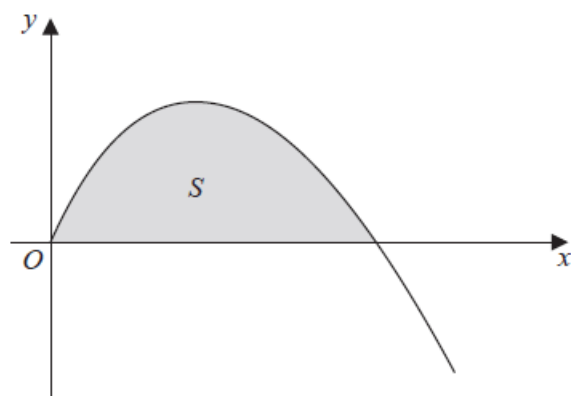


Figure 3

Figure 3 shows a sketch of part of the curve with equation

$$y = 3x - x^{\frac{3}{2}} \quad x \geq 0.$$

The finite region S , bounded by the x -axis and the curve, is shown shaded in Figure 3.

(a) Find

$$\int \left(3x - x^{\frac{3}{2}} \right) dx.$$

(3)

(b) Hence find the area of S .

(3)

(Total 6 marks)

TOTAL FOR PAPER: 100 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Pure Mathematics - Trigonometry	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 6 questions in this question paper. The total mark for this paper is 49.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. Solve, for $0 \leq x < 180^\circ$

$$\cos(3x - 10^\circ) = -0.4$$

giving your answers to 1 decimal place. You should show each step in your working.

(Total 7 marks)

2. (a) Show that the equation

$$\cos^2 x = 8\sin^2 x - 6\sin x$$

can be written in the form

$$(3\sin x - 1)^2 = 2 \quad (3)$$

- (b) Hence solve, for $0 \leq x < 360^\circ$,

$$\cos^2 x = 8\sin^2 x - 6\sin x$$

giving your answers to 2 decimal places.

(5)

(Total 8 marks)

3. (a) Show that the equation

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

can be written in the form

$$(1 - 5 \cos 2x) \sin 2x = 0 \quad (2)$$

- (b) Hence solve, for $0 \leq x \leq 180^\circ$

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

giving your answers to 1 decimal place where appropriate.

You must show clearly how you obtained your answers.

(5)

(Total 7 marks)

4. (a) Show that the equation

$$3 \sin^2 x + 7 \sin x = \cos^2 x - 4$$

can be written in the form

$$4 \sin^2 x + 7 \sin x + 3 = 0$$

(2)

- (b) Hence solve, for $0 \leq x < 360^\circ$

$$3 \sin^2 x + 7 \sin x = \cos^2 x - 4$$

giving your answers to 1 decimal place where appropriate.

(5)

(Total 7 marks)

5. (i) Solve, for $0 \leq \theta < 360^\circ$, the equation $9 \sin(\theta + 60^\circ) = 4$, giving your answers to 1 decimal place. You must show each step of your working.

(4)

- (ii) Solve, for $-\pi \leq x < \pi$, the equation $2 \tan x - 3 \sin x = 0$, giving your answers to 2 decimal places where appropriate.

[Solutions based entirely on graphical or numerical methods are not acceptable.]

(5)

(Total 11 marks)

6. (i) Solve, for $-180^\circ \leq x < 180^\circ$,

$$\tan(x - 40^\circ) = 1.5,$$

giving your answers to 1 decimal place.

(3)

- (ii) (a) Show that the equation

$$\sin \theta \tan \theta = 3 \cos \theta + 2$$

can be written in the form

$$4 \cos^2 \theta + 2 \cos \theta - 1 = 0.$$

(3)

- (b) Hence solve, for $0 \leq \theta < 360^\circ$,

$$\sin \theta \tan \theta = 3 \cos \theta + 2,$$

showing each stage of your working.

(5)

(Total 11 marks)

TOTAL FOR PAPER: 49 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Statistics	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
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Information

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- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

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Section A – Representation and summary of data (26 marks)

1. The mark, x , scored by each student who sat a statistics examination is coded using

$$y = 1.4x - 20$$

The coded marks have mean 60.8 and standard deviation 6.60.

Find the mean and the standard deviation of x .

(Total 4 marks)

2. Keith records the amount of rainfall, in mm, at his school, each day for a week. The results are given below.

2.8 5.6 2.3 9.4 0.0 0.5 1.8

Jenny then records the amount of rainfall, x mm, at the school each day for the following 21 days. The results for the 21 days are summarised below.

$$\sum x = 84.6$$

- (a) Calculate the mean amount of rainfall during the whole 28 days.

(2)

Keith realises that he has transposed two of his figures. The number 9.4 should have been 4.9 and the number 0.5 should have been 5.0.

Keith corrects these figures.

- (b) State, giving your reason, the effect this will have on the mean.

(2)

(Total 4 marks)

3. The histogram in Figure 1 shows the time, to the nearest minute, that a random sample of 100 motorists were delayed by roadworks on a stretch of motorway.

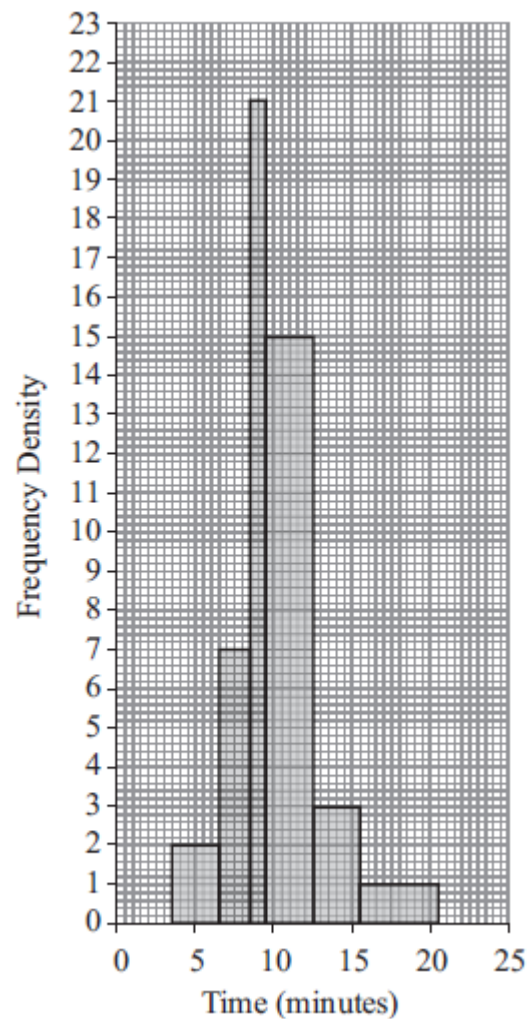


Figure 1

- (a) Complete the table.

Delay (minutes)	Number of motorists
4 – 6	6
7 – 8	
9	21
10 – 12	45
13 – 15	9
16 – 20	

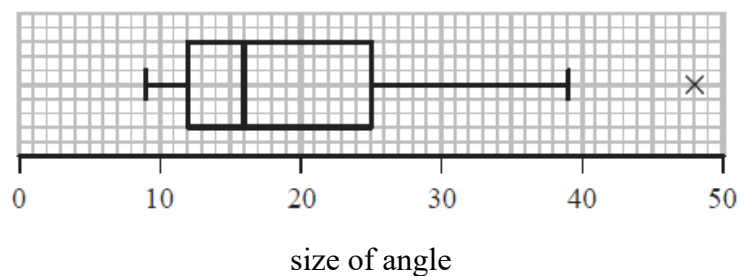
(2)

- (b) Estimate the number of motorists who were delayed between 8.5 and 13.5 minutes by the roadworks.

(2)

(Total 4 marks)

4. Each of 60 students was asked to draw a 20° angle without using a protractor. The size of each angle drawn was measured. The results are summarised in the box plot below.



- (a) Find the range for these data.

(1)

- (b) Find the interquartile range for these data.

(1)

The students were then asked to draw a 70° angle.

The results are summarised in the table below.

Angle, a , (degrees)	Number of students
$55 \leq a < 60$	6
$60 \leq a < 65$	15
$65 \leq a < 70$	13
$70 \leq a < 75$	11
$75 \leq a < 80$	8
$80 \leq a < 85$	7

- (c) Use linear interpolation to estimate the size of the median angle drawn. Give your answer to 1 decimal place.

(2)

- (d) Show that the lower quartile is 63° .

(2)

For these data, the upper quartile is 75° , the minimum is 55° and the maximum is 84° .

An outlier is an observation that falls either

more than $1.5 \times (\text{interquartile range})$ above the upper quartile or

more than $1.5 \times (\text{interquartile range})$ below the lower quartile.

- (e) (i) Show that there are no outliers for these data.
(ii) On graph paper, draw a box plot for these data.

(5)

- (f) State which angle the students were more accurate at drawing. Give reasons for your answer.

(3)

(Total 14 marks)

TOTAL FOR PAPER: 26 MARKS

Section B – Binomial distribution and hypothesis testing (50 marks)

1. A potter believes that 20% of pots break whilst being fired in a kiln. Pots are fired in batches of 25.
- (a) Let X denote the number of broken pots in a batch. A batch is selected at random. Using a 10% significance level, find the critical region for a two tailed test of the potter's belief. You should state the probability in each tail of your critical region. (4)

The potter aims to reduce the proportion of pots which break in the kiln by increasing the size of the batch fired. He now fires pots in batches of 50. He then chooses a batch at random and discovers there are 6 pots which broke whilst being fired in the kiln.

- (b) Test, at the 5% level of significance, whether or not there is evidence that increasing the number of pots in a batch has reduced the percentage of pots that break whilst being fired in the kiln. State your hypotheses clearly. (5)
- (Total 9 marks)
-

2. Before Roger will use a tennis ball he checks it using a "bounce" test. The probability that a ball from Roger's usual supplier fails the bounce test is 0.2. A new supplier claims that the probability of one of their balls failing the bounce test is less than 0.2. Roger checks a random sample of 40 balls from the new supplier and finds that 3 balls fail the bounce test.
- Stating your hypotheses clearly, use a 5% level of significance to test the new supplier's claim.
- (Total 5 marks)
-

3. A test statistic has a distribution $B(25, p)$.
- Given that
- $$H_0 : p = 0.5, \quad H_1 : p \neq 0.5,$$
- (a) find the critical region for the test statistic such that the probability in each tail is as close as possible to 2.5%. (3)
- (b) State the probability of incorrectly rejecting H_0 using this critical region. (2)
- (Total 5 marks)
-

4. David claims that the weather forecasts produced by local radio are no better than those achieved by tossing a fair coin and predicting rain if a head is obtained or no rain if a tail is obtained. He records the weather for 30 randomly selected days. The local radio forecast is correct on 21 of these days.

Test David's claim at the 5% level of significance.

State your hypotheses clearly.

(Total 7 marks)

5. A student takes a multiple choice test. The test is made up of 10 questions each with 5 possible answers. The student gets 4 questions correct. Her teacher claims she was guessing the answers. Using a one tailed test, at the 5% level of significance, test whether or not there is evidence to reject the teacher's claim.

State your hypotheses clearly.

(Total 6 marks)

6. The proportion of houses in Radville which are unable to receive digital radio is 25%. In a survey of a random sample of 30 houses taken from Radville, the number, X , of houses which are unable to receive digital radio is recorded.

(a) Find $P(5 \leq X < 11)$.

(3)

A radio company claims that a new transmitter set up in Radville will reduce the proportion of houses which are unable to receive digital radio. After the new transmitter has been set up, a random sample of 15 houses is taken, of which 1 house is unable to receive digital radio.

(b) Test, at the 10% level of significance, the radio company's claim. State your hypotheses clearly.

(5)

(Total 8 marks)

7. In a manufacturing process 25% of articles are thought to be defective. Articles are produced in batches of 20.
- (a) A batch is selected at random. Using a 5% significance level, find the critical region for a two tailed test that the probability of an article chosen at random being defective is 0.25.
- You should state the probability in each tail, which should be as close as possible to 0.025.

(5)

The manufacturer changes the production process to try to reduce the number of defective articles. She then chooses a batch at random and discovers there are 3 defective articles.

- (b) Test at the 5% level of significance whether or not there is evidence that the changes to the process have reduced the percentage of defective articles. State your hypotheses clearly.

(5)

(Total 10 marks)

TOTAL FOR PAPER: 50 MARKS

Section C – Sampling (36 marks)

1. A gym club has 400 members of which 300 are males.

Explain clearly how a stratified sample of size 60 could be taken.

(Total 3 marks)

2. A company director decides to survey staff about changes to the company calendar. The company has staff in 4 different job roles

72 managers, 108 drivers, 180 administrators and 360 warehouse staff.

The director decides to take a stratified sample.

- (a) Write down one advantage of using a stratified sample rather than a simple random sample for this survey.

(1)

- (b) Find the number of staff in each job role that will be included in a stratified sample of 40 staff.

(3)

- (c) Describe how to choose managers for the stratified sample.

(2)

(Total 6 marks)

3. (a) State two reasons why stratified sampling might be a more suitable sampling method than simple random sampling.

(2)

- (b) State two reasons why stratified sampling might be a more suitable sampling method than quota sampling.

(2)

(Total 4 marks)

4. (a) Explain what you understand by a random sample from a finite population. (1)
- (b) Give an example of a situation when it is not possible to take a random sample. (1)

A college lecturer specialising in shoe design wants to change the way in which she organises practical work.

She decides to gather ideas from her 75 students.

She plans to give a questionnaire to a random sample of 8 of these students.

- (c) (i) Describe the sampling frame that she should use.
- (ii) Explain in detail how she should use a table of random numbers to obtain her sample. (3)

(Total 5 marks)

5. A lake contains 3 species of fish. There are estimated to be 1400 trout, 600 bass and 450 pike in the lake. A survey of the health of the fish in the lake is carried out and a sample of 30 fish is chosen.
- (a) Give a reason why stratified random sampling cannot be used. (1)
- (b) State an appropriate sampling method for the survey. (1)
- (c) Give one advantage and one disadvantage of this sampling method. (2)
- (d) Explain how this sampling method could be used to select the sample of 30 fish. You must show your working. (4)
- (Total 8 marks)**
-

6. A college manager wants to survey students' opinions of enrichment activities.

She decides to survey the students on the courses summarised in the table below.

Course	Number of students enrolled
Leisure and Sport	420
Information Technology	337
Health and Social Care	200
Media Studies	43

Each student takes only one course.

The manager has access to the college's information system that holds full details of each of the enrolled students including name, address, telephone number and their course of study. She wants to compare the opinions of students on each course and has a generous budget to pay for the cost of the survey.

- (a) Give one advantage and one disadvantage of carrying out this survey using

- (i) quota sampling,
- (ii) stratified sampling.

(2)

The manager decides to take a stratified sample of 100 students.

- (b) Calculate the number of students to be sampled from each course.

(3)

- (c) Describe how to choose students for the stratified sample.

(2)

(Total 7 marks)

7. A factory produces components. Each component has a unique identity number and it is assumed that 2% of the components are faulty. On a particular day, a quality control manager wishes to take a random sample of 50 components.

(a) Identify a sampling frame.

(1)

The statistic F represents the number of faulty components in the random sample of size 50.

(b) Specify the sampling distribution of F .

(2)

(Total 3 marks)

TOTAL FOR PAPER: 36 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Mechanics - Dynamics of a particle moving in a straight line or plane	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 5 questions in this question paper. The total mark for this paper is 40.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
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1.

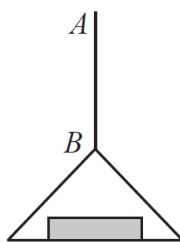


Figure 1

A vertical rope AB has its end B attached to the top of a scale pan. The scale pan has mass 0.5 kg and carries a brick of mass 1.5 kg , as shown in Figure 1. The scale pan is raised vertically upwards with constant acceleration 0.5 m s^{-2} using the rope AB . The rope is modelled as a light inextensible string.

(a) Find the tension in the rope AB . (3)

(b) Find the magnitude of the force exerted on the scale pan by the brick. (3)

(Total 6 marks)

2. A woman travels in a lift. The mass of the woman is 50 kg and the mass of the lift is 950 kg . The lift is being raised vertically by a vertical cable which is attached to the top of the lift. The lift is moving upwards and has constant deceleration of 2 m s^{-2} . By modelling the cable as being light and inextensible, find

(a) the tension in the cable, (3)

(b) the magnitude of the force exerted on the woman by the floor of the lift. (3)

(Total 6 marks)

3. A car of mass 1000 kg is towing a caravan of mass 750 kg along a straight horizontal road. The caravan is connected to the car by a tow-bar which is parallel to the direction of motion of the car and the caravan. The tow-bar is modelled as a light rod. The engine of the car provides a constant driving force of 3200 N. The resistances to the motion of the car and the caravan are modelled as constant forces of magnitude 800 newtons and R newtons respectively.

Given that the acceleration of the car and the caravan is 0.88 m s^{-2} ,

- (a) show that $R = 860$,

(3)

- (b) find the tension in the tow-bar.

(3)

(Total 6 marks)

4.

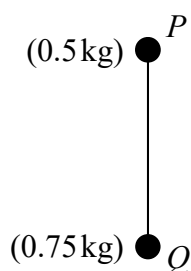


Figure 3

A vertical light rod PQ has a particle of mass 0.5 kg attached to it at P and a particle of mass 0.75 kg attached to it at Q , to form a system, as shown in Figure 3. The system is accelerated vertically upwards by a vertical force of magnitude 15 N applied to the particle at Q . Find the thrust in the rod.

(Total 6 marks)

5.

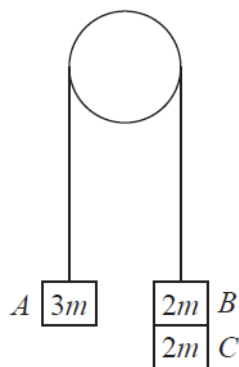


Figure 4

Three particles A , B and C have masses $3m$, $2m$ and $2m$ respectively. Particle C is attached to particle B . Particles A and B are connected by a light inextensible string which passes over a smooth light fixed pulley. The system is held at rest with the string taut and the hanging parts of the string vertical, as shown in Figure 4. The system is released from rest and A moves upwards.

(a) (i) Show that the acceleration of A is $\frac{g}{7}$.

(ii) Find the tension in the string as A ascends.

(7)

At the instant when A is 0.7 m above its original position, C separates from B and falls away. In the subsequent motion, A does not reach the pulley.

(b) Find the speed of A at the instant when it is 0.7 m above its original position.

(2)

(c) Find the acceleration of A at the instant after C separates from B .

(4)

(d) Find the greatest height reached by A above its original position.

(3)

(Total 16 marks)

TOTAL FOR PAPER: 40 MARKS

Write your name here	
Surname	Other names
Pearson Edexcel GCE	Centre Number Candidate Number
AS and A level Mathematics Practice Paper Mechanics - Kinematics of a particle moving in a straight line	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

- Use black ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- Fill in the boxes at the top of this page with your name, centre number and candidate number.
- Answer all the questions and ensure that your answers to parts of questions are clearly labelled.
- Answer the questions in the spaces provided – there may be more space than you need.
- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Inexact answers should be given to three significant figures unless otherwise stated.

Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 10 questions in this question paper. The total mark for this paper is 100.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.
- If you change your mind about an answer, cross it out and put your new answer and any working underneath.

1. At time $t = 0$ a ball is projected vertically upwards from a point O and rises to a maximum height of 40 m above O . The ball is modelled as a particle moving freely under gravity.
- (a) Show that the speed of projection is 28 m s^{-1} .

(3)

- (b) Find the times, in seconds, when the ball is 33.6 m above O .

(5)

(Total 8 marks)

2. A small stone is projected vertically upwards from a point O with a speed of 19.6 m s^{-1} . Modelling the stone as a particle moving freely under gravity,

- (a) find the greatest height above O reached by the stone,

(2)

- (b) find the length of time for which the stone is more than 14.7 m above O .

(5)

(Total 7 marks)

3. At time $t = 0$, a particle is projected vertically upwards with speed u from a point A . The particle moves freely under gravity. At time T the particle is at its maximum height H above A .

- (a) Find T in terms of u and g .

(2)

- (b) Show that $H = \frac{u^2}{2g}$.

(2)

The point A is at a height $3H$ above the ground.

- (c) Find, in terms of T , the total time from the instant of projection to the instant when the particle hits the ground.

(4)

(Total 8 marks)

4. A car starts from rest and moves with constant acceleration along a straight horizontal road. The car reaches a speed of $V \text{ m s}^{-1}$ in 20 seconds. It moves at constant speed $V \text{ m s}^{-1}$ for the next 30 seconds, then moves with constant deceleration $\frac{1}{2} \text{ m s}^{-2}$ until it has speed 8 m s^{-1} . It moves at speed 8 m s^{-1} for the next 15 seconds and then moves with constant deceleration $\frac{1}{3} \text{ m s}^{-2}$ until it comes to rest.

(a) Sketch a speed-time graph for this journey.

(3)

In the first 20 seconds of this journey the car travels 140 m.

Find

(b) the value of V ,

(2)

(c) the total time for this journey,

(4)

(d) the total distance travelled by the car.

(4)

(Total 13 marks)

5. At time $t = 0$, two balls A and B are projected vertically upwards. The ball A is projected vertically upwards with speed 2 m s^{-1} from a point 50 m above the horizontal ground. The ball B is projected vertically upwards from the ground with speed 20 m s^{-1} . At time $t = T$ seconds, the two balls are at the same vertical height, h metres, above the ground. The balls are modelled as particles moving freely under gravity.

Find

(a) the value of T ,

(5)

(b) the value of h .

(2)

(Total 7 marks)

6. A lorry is moving along a straight horizontal road with constant acceleration. The lorry passes a point A with speed $u \text{ m s}^{-1}$, ($u < 34$), and 10 seconds later passes a point B with speed 34 m s^{-1} . Given that $AB = 240 \text{ m}$, find

(a) the value of u ,

(3)

(b) the time taken for the lorry to move from A to the mid-point of AB .

(6)

(Total 9 marks)

7. Two trains M and N are moving in the same direction along parallel straight horizontal tracks. At time $t = 0$, M overtakes N whilst they are travelling with speeds 40 m s^{-1} and 30 m s^{-1} respectively. Train M overtakes train N as they pass a point X at the side of the tracks.

After overtaking N , train M maintains its speed of 40 m s^{-1} for T seconds and then decelerates uniformly, coming to rest next to a point Y at the side of the tracks.

After being overtaken, train N maintains its speed of 30 m s^{-1} for 25 s and then decelerates uniformly, also coming to rest next to the point Y .

The times taken by the trains to travel between X and Y are the same.

- (a) Sketch, on the same diagram, the speed-time graphs for the motions of the two trains between X and Y .

(4)

Given that $XY = 975 \text{ m}$,

- (b) find the value of T .

(8)

(Total 12 marks)

8. A car is moving on a straight horizontal road. At time $t = 0$, the car is moving with speed 20 m s^{-1} and is at the point A . The car maintains the speed of 20 m s^{-1} for 25 s. The car then moves with constant deceleration 0.4 m s^{-2} , reducing its speed from 20 m s^{-1} to 8 m s^{-1} . The car then moves with constant speed 8 m s^{-1} for 60 s. The car then moves with constant acceleration until it is moving with speed 20 m s^{-1} at the point B .

(a) Sketch a speed-time graph to represent the motion of the car from A to B . (3)

(b) Find the time for which the car is decelerating. (2)

Given that the distance from A to B is 1960 m,

(c) find the time taken for the car to move from A to B . (8)

(Total 13 marks)

9. A girl runs a 400 m race in a time of 84 s. In a model of this race, it is assumed that, starting from rest, she moves with constant acceleration for 4 s, reaching a speed of 5 m s^{-1} . She maintains this speed for 60 s and then moves with constant deceleration for 20 s, crossing the finishing line with a speed of $V \text{ m s}^{-1}$.

(a) Sketch a speed-time graph for the motion of the girl during the whole race. (2)

(b) Find the distance run by the girl in the first 64 s of the race. (3)

(c) Find the value of V . (5)

(d) Find the deceleration of the girl in the final 20 s of her race. (2)

(Total 12 marks)

10. A car is travelling along a straight horizontal road. The car takes 120 s to travel between two sets of traffic lights which are 2145 m apart. The car starts from rest at the first set of traffic lights and moves with constant acceleration for 30 s until its speed is 22 m s^{-1} . The car maintains this speed for T seconds. The car then moves with constant deceleration, coming to rest at the second set of traffic lights.

(a) Sketch a speed-time graph for the motion of the car between the two sets of traffic lights. (2)

(b) Find the value of T . (3)

A motorcycle leaves the first set of traffic lights 10 s after the car has left the first set of traffic lights. The motorcycle moves from rest with constant acceleration, $a \text{ m s}^{-2}$, and passes the car at the point A which is 990 m from the first set of traffic lights. When the motorcycle passes the car, the car is moving with speed 22 m s^{-1} .

(c) Find the time it takes for the motorcycle to move from the first set of traffic lights to the point A . (4)

(d) Find the value of a . (2)

(Total 11 marks)

TOTAL FOR PAPER: 100 MARKS

Write your name here	
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AS and A level Mathematics Practice Paper Mechanics - Kinematics of a particle moving in a straight line	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

Instructions

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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 8 questions in this question paper. The total mark for this paper is 98.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

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1.

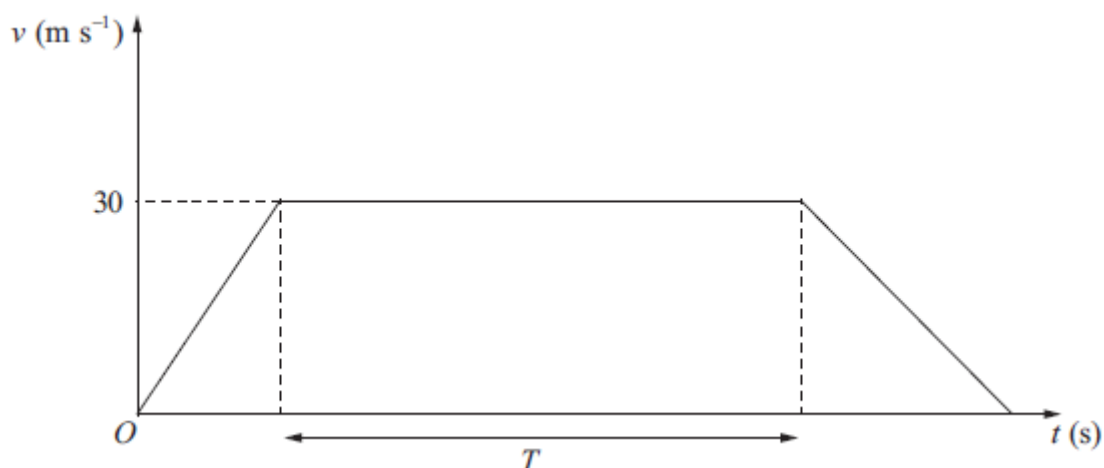


Figure 4

The velocity-time graph in Figure 4 represents the journey of a train P travelling along a straight horizontal track between two stations which are 1.5 km apart. The train P leaves the first station, accelerating uniformly from rest for 300 m until it reaches a speed of 30 m s^{-1} . The train then maintains this speed for T seconds before decelerating uniformly at 1.25 m s^{-2} , coming to rest at the next station.

(a) Find the acceleration of P during the first 300 m of its journey. (2)

(b) Find the value of T . (5)

A second train Q completes the same journey in the same total time. The train leaves the first station, accelerating uniformly from rest until it reaches a speed of $V \text{ m s}^{-1}$ and then immediately decelerates uniformly until it comes to rest at the next station.

(c) Sketch on the diagram above, a velocity-time graph which represents the journey of train Q . (2)

(d) Find the value of V . (6)

(Total 15 marks)

2. A stone is projected vertically upwards from a point A with speed $u \text{ m s}^{-1}$. After projection the stone moves freely under gravity until it returns to A . The time between the instant that the stone is projected and the instant that it returns to A is $3\frac{4}{7}$ seconds.

Modelling the stone as a particle,

- (a) show that $u = 17\frac{1}{2}$, (3)
- (b) find the greatest height above A reached by the stone, (2)
- (c) find the length of time for which the stone is at least $6\frac{3}{5}$ m above A . (6)

Total 11 marks)

3. A car accelerates uniformly from rest for 20 seconds. It moves at constant speed $v \text{ m s}^{-1}$ for the next 40 seconds and then decelerates uniformly for 10 seconds until it comes to rest.

- (a) For the motion of the car, sketch
- (i) a speed-time graph,
- (ii) an acceleration-time graph. (6)

Given that the total distance moved by the car is 880 m,

- (b) find the value of v . (4)

(Total 10 marks)

4. A cyclist is moving along a straight horizontal road and passes a point A . Five seconds later, at the instant when she is moving with speed 10 m s^{-1} , she passes the point B . She moves with constant acceleration from A to B .

Given that $AB = 40 \text{ m}$, find

- (a) the acceleration of the cyclist as she moves from A to B , (4)
- (b) the time it takes her to travel from A to the midpoint of AB . (5)

(Total 9 marks)

5. A car moves along a straight horizontal road from a point A to a point B , where $AB = 885$ m. The car accelerates from rest at A to a speed of 15 m s^{-1} at a constant rate $a \text{ m s}^{-2}$.

The time for which the car accelerates is $\frac{1}{3}T$ seconds. The car maintains the speed of 15 m s^{-1} for T seconds. The car then decelerates at a constant rate of 2.5 m s^{-2} stopping at B .

- (a) Find the time for which the car decelerates. (2)
- (b) Sketch a speed-time graph for the motion of the car. (2)
- (c) Find the value of T . (4)
- (d) Find the value of a . (2)
- (e) Sketch an acceleration-time graph for the motion of the car. (3)

(Total 13 marks)

6. A train travels along a straight horizontal track between two stations, A and B . The train starts from rest at A and moves with constant acceleration 0.5 m s^{-2} until it reaches a speed of $V \text{ m s}^{-1}$, ($V < 50$). The train then travels at this constant speed before it moves with constant deceleration 0.25 m s^{-2} until it comes to rest at B .

- (a) Sketch a speed-time graph for the motion of the train between the two stations A and B . (2)

The total time for the journey from A to B is 5 minutes.

- (b) Find, in terms of V , the length of time, in seconds, for which the train is
 - (i) accelerating,
 - (ii) decelerating,
 - (iii) moving with constant speed.(5)

Given that the distance between the two stations A and B is 6.3 km,

- (c) find the value of V . (6)

(Total 13 marks)

7. A particle P is projected vertically upwards from a point A with speed $u \text{ m s}^{-1}$. The point A is 17.5 m above horizontal ground. The particle P moves freely under gravity until it reaches the ground with speed 28 m s^{-1} .

(a) Show that $u = 21$.

(3)

At time t seconds after projection, P is 19 m above A .

(b) Find the possible values of t .

(5)

The ground is soft and, after P reaches the ground, P sinks vertically downwards into the ground before coming to rest. The mass of P is 4 kg and the ground is assumed to exert a constant resistive force of magnitude 5000 N on P .

(c) Find the vertical distance that P sinks into the ground before coming to rest.

(4)

(Total 12 marks)

8.



Figure 3

Two particles P and Q , of mass 0.3 kg and 0.5 kg respectively, are joined by a light horizontal rod. The system of the particles and the rod is at rest on a horizontal plane.

At time $t = 0$, a constant force $\mathbf{F}$ of magnitude 4 N is applied to Q in the direction PQ , as shown in Figure 3. The system moves under the action of this force until $t = 6 \text{ s}$. During the motion, the resistance to the motion of P has constant magnitude 1 N and the resistance to the motion of Q has constant magnitude 2 N .

Find

- (a) the acceleration of the particles as the system moves under the action of $\mathbf{F}$, (3)
- (b) the speed of the particles at $t = 6 \text{ s}$, (2)
- (c) the tension in the rod as the system moves under the action of $\mathbf{F}$. (3)

At $t = 6 \text{ s}$, $\mathbf{F}$ is removed and the system decelerates to rest. The resistances to motion are unchanged. Find

- (d) the distance moved by P as the system decelerates, (4)
- (e) the thrust in the rod as the system decelerates. (3)

(Total 15 marks)

TOTAL FOR PAPER: 98 MARKS

Write your name here	
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AS and A level Mathematics Practice Paper Mechanics - Kinematics of a particle moving in a straight line or plane	
You must have: Mathematical Formulae and Statistical Tables (Pink)	Total Marks

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Information

- A booklet ‘Mathematical Formulae and Statistical Tables’ is provided.
- There are 5 questions in this question paper. The total mark for this paper is 52.
- The marks for each question are shown in brackets – use this as a guide as to how much time to spend on each question.

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
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1. A particle P moves on the x -axis. At time t seconds the velocity of P is $v \text{ m s}^{-1}$ in the direction of x increasing, where

$$v = 2t^2 - 14t + 20, \quad t \geq 0$$

Find

- (a) the times when P is instantaneously at rest, (3)
- (b) the greatest speed of P in the interval $0 \leq t \leq 4$, (5)
- (c) the total distance travelled by P in the interval $0 \leq t \leq 4$. (5)

(Total 13 marks)

2. A particle P moves along a straight line in such a way that at time t seconds its velocity $v \text{ m s}^{-1}$ is given by

$$v = \frac{1}{2}t^2 - 3t + 4$$

Find

- (a) the times when P is at rest, (4)
- (b) the total distance travelled by P between $t = 0$ and $t = 4$. (5)

(Total 9 marks)

3. A particle moves along the x -axis. At time $t = 0$ the particle passes through the origin with speed 8 m s^{-1} in the positive x -direction. The acceleration of the particle at time t seconds, $t \geq 0$, is $(4t^3 - 12t) \text{ m s}^{-2}$ in the positive x -direction.

Find

(a) the velocity of the particle at time t seconds, (3)

(b) the displacement of the particle from the origin at time t seconds, (2)

(c) the values of t at which the particle is instantaneously at rest. (3)

(Total 8 marks)

4. A particle P moves on the positive x -axis. The velocity of P at time t seconds is $(2t^2 - 9t + 4) \text{ m s}^{-1}$. When $t = 0$, P is 15 m from the origin O .

Find

(a) the values of t when P is instantaneously at rest, (3)

(b) the acceleration of P when $t = 5$, (3)

(c) the total distance travelled by P in the interval $0 \leq t \leq 5$. (5)

(Total 11 marks)

5. A particle P moves on the x -axis. The acceleration of P at time t seconds is $(t - 4) \text{ m s}^{-2}$ in the positive x -direction. The velocity of P at time t seconds is $v \text{ m s}^{-1}$. When $t = 0$, $v = 6$.

Find

- (a) v in terms of t ,

(4)

- (b) the values of t when P is instantaneously at rest,

(3)

- (c) the distance between the two points at which P is instantaneously at rest.

(4)

(Total 11 marks)

TOTAL FOR PAPER: 52 MARKS