Dear Year 12 Mathematicians,

Well done for the work you have put in during this period of uncertain times, and your excellent engagement with the live lessons. We have begun the Year 2 Pure content, and in preparation for what is to come in Year 13, you need to prepare by completing the tasks in this pack.

The tasks have the purpose of recapping Year 1 content for both Pure and Applied, as well as being the foundations for the Year 2 content that you are yet to learn. Mastering the Year 1 content will allow you to be in the strongest possible position in Year 13.

Task 1 – Mastering Pure Year 1 (starts on page 2)
Task 2 – Mastering Applied Statistics Year 1 (starts on page 72)
Task 3 – Mastering Applied Mechanics Year 1 (starts on page 96)

Each week you should complete the following:

- From Task 1 – any 2 of the Pure topic-based questions
- From Task 2 – at least 1 of the Statistics topic-based questions
- From Task 3 – at least 1 of the Mechanics topic-based questions

There are a lot of questions for Pure, so as a minimum, the below must be completed:

Algebra 1	Page 3	All **even** questions
Algebra 2	Page 9	All **even** questions
Binomial Expansion	Page 15	All **odd** questions
Coordinate Geometry	Page 20	All **even** questions
Differentiation 1	Page 29	All **odd** questions
Differentiation 2	Page 37	All **odd** questions
Exponentials and Logarithms	Page 44	All **even** questions
Graphs and Transformations	Page 49	All **odd** questions
Integration	Page 59	All **odd** questions
Trigonometry	Page 68	All questions

Please complete all your work on paper, or feel free to print out the pack and work directly on there. Your work should be completed, ready to fully submit via email, or the Teams Assignment to your class teachers at the start of the September term.

If you need a recap of any Year 1 teaching for either Pure or Applied, there are fantastic videos you can view to support you with these tasks on YouTube as follows:
https://www.youtube.com/channel/UCyyRmnmtgVy5Sm7_UiCLFgQ/playlists?view=50&sort=dd&shelf_id=9

Thank you for all your hard work and efforts this year. It has been a pleasure teaching you all and we look forward to seeing you soon.

Mrs Bayar

Task 1 – Mastering Pure Year 1

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.
- 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 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 $\dfrac{2}{\sqrt{12}-\sqrt{8}}$ 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 $\left(\dfrac{25x^4}{4}\right)^{-\frac{1}{2}}$

(2)

(Total 4 marks)

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

(2)

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

(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*. $\text{f}(x) = x^2 - 8x + 19$

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

(2)

The curve C with equation $y = \text{f}(x)$ 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*. $\text{f}(x) = x^2 + (k + 3)x + k$,

where k is a real constant.

(a) Find the discriminant of $\text{f}(x)$ in terms of k.

(2)

(b) Show that the discriminant of $\text{f}(x)$ 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 $\text{f}(x) = 0$ 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)

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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)

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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

- 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 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)

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2. Solve the simultaneous equations

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

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

(Total 6 marks)

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3. Solve the simultaneous equations

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

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

(Total 7 marks)

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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)

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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)

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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)

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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

$$k^2 + 2k - 3 > 0$$

(3)

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

(4)

(Total 7 marks)

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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

$$k^2 - 2k - 24 < 0.$$

(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)

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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.

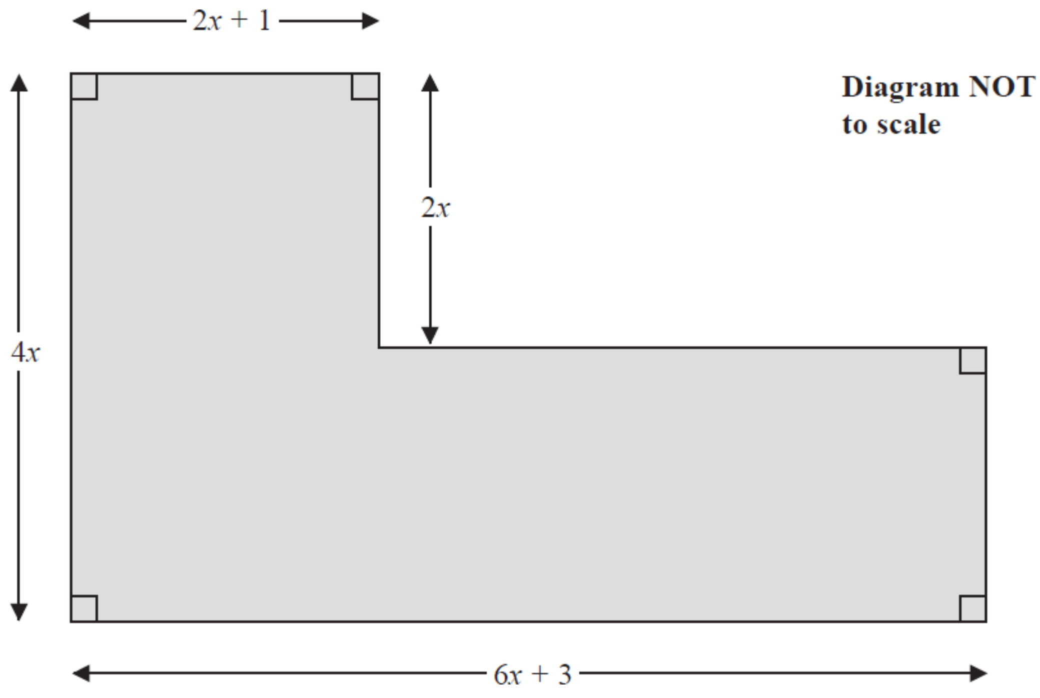

Figure 1

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

- 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 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)

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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)

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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)

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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)

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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)

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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)

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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)

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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)

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

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.
- 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 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*.

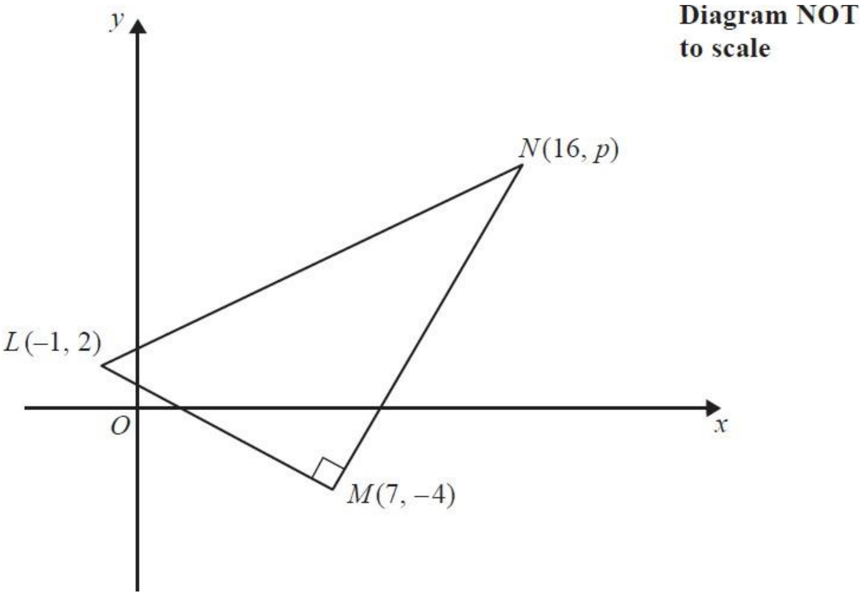

Figure 1

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 $LMN = 90°$,

(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*.

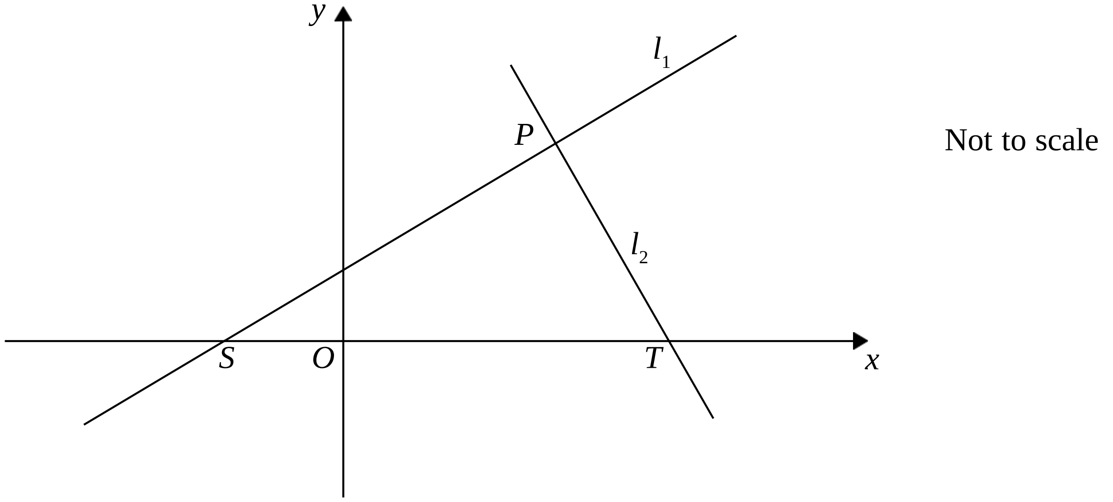

Figure 1

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*.

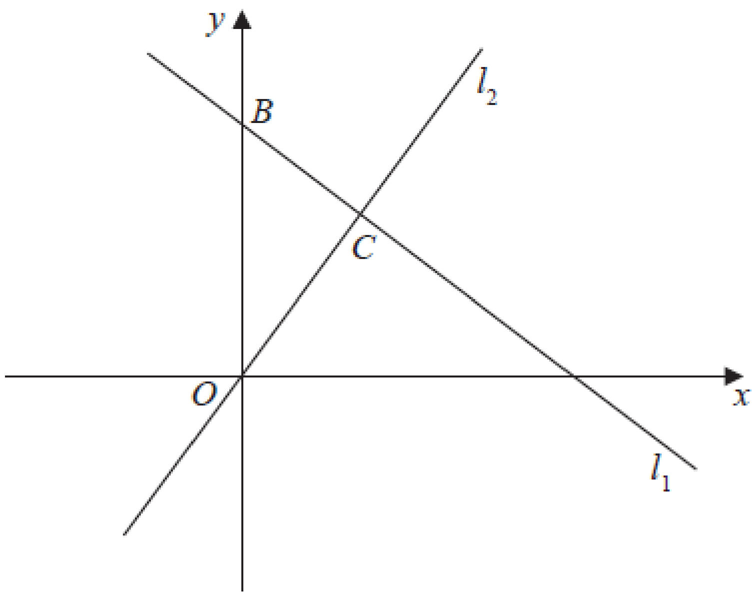

Figure 2

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*.

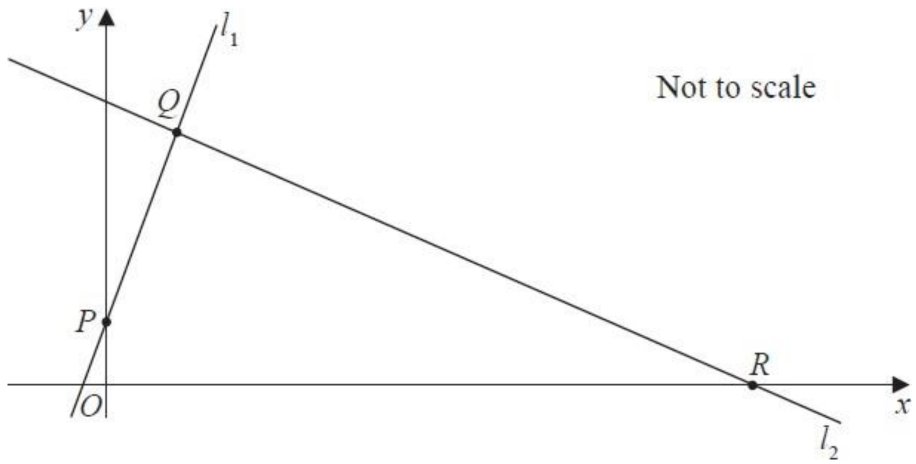

Figure 3

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)

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

(Total 4 marks)

8.

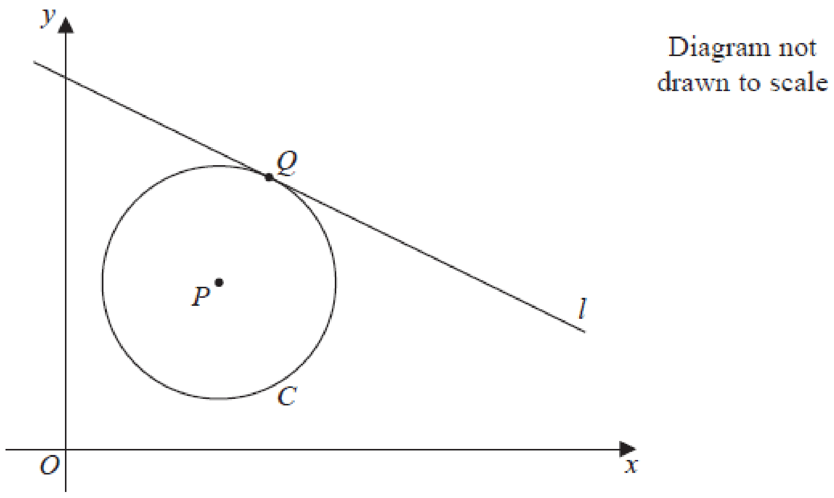

Figure 4

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)

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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.

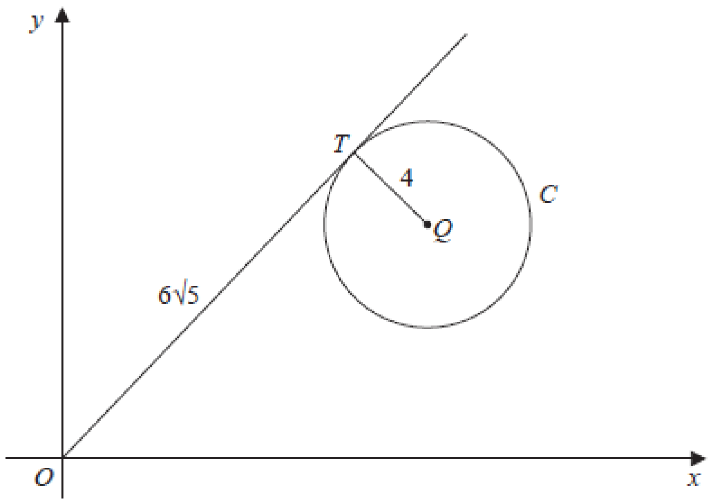

Figure 5

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

Pearson Edexcel GCE

Centre Number	Candidate Number

AS and A level Mathematics

Practice Paper
Pure Mathematics - Differentiation 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.
- 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 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.
- 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*. Given

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

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

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

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.

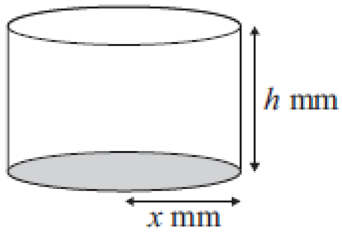

Figure 1

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 mm^2, of a tablet is given by $A = 2\pi x^2 + \dfrac{120}{x}$.

(3)

The manufacturer needs to minimise the surface area A 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.

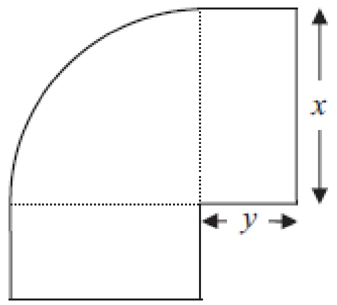

Figure 2

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

$$y = \frac{16 - \pi x^2}{8x}.$$

(3)

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

$$P = \frac{8}{x} + 2x.$$

(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.

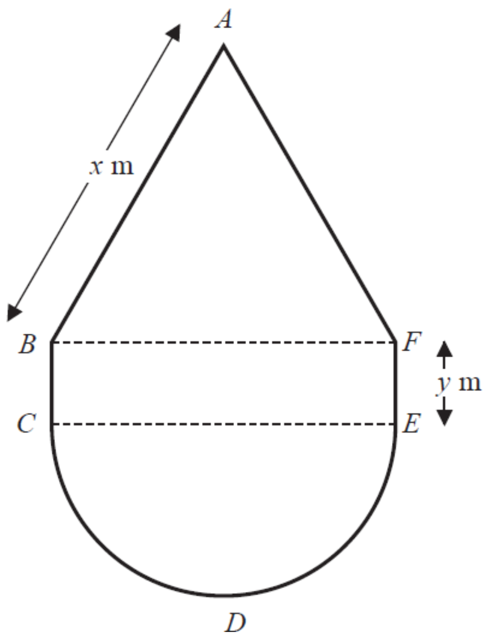

Figure 3

Figure 3 shows the plan of a pool.

The shape of the pool *ABCDEFA* 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

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

(3)

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

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

(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 cm^3 of a box, of height x cm, is given by

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

(a) Find $\dfrac{dV}{dx}$.

(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 $k = \dfrac{1}{5} \ln 2$.

(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 2

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 $\dfrac{dy}{dx}$.

(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 $\dfrac{dy}{dx} = 3x^2 + 14x + 15$.

(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

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

(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*.

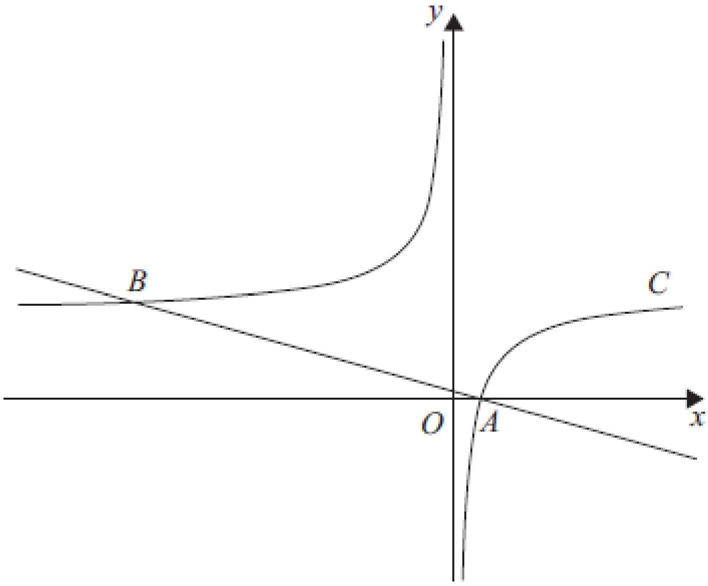

Figure 1

Figure 1 shows a sketch of the curve C with equation

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

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*.

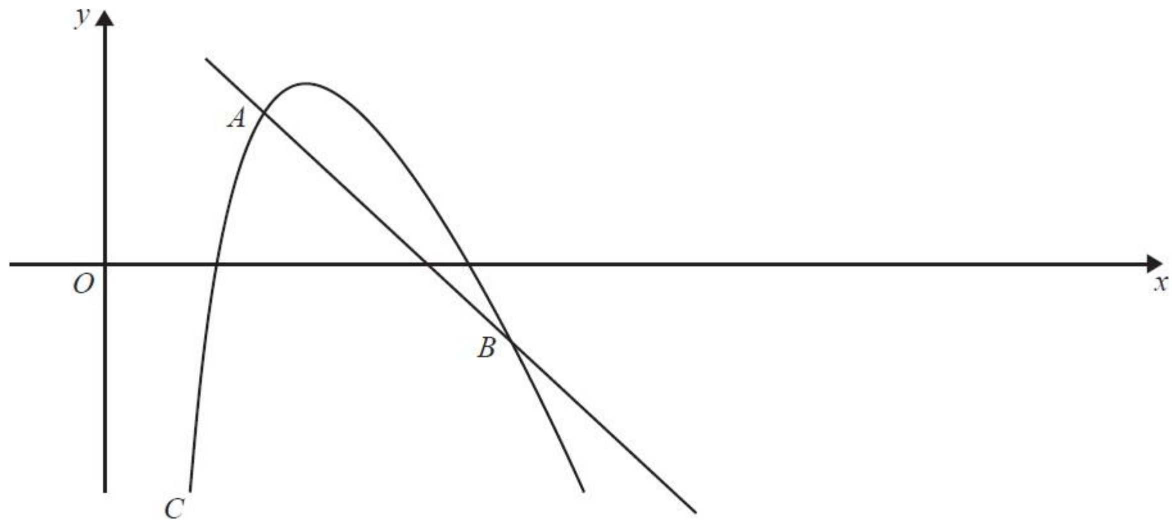

Figure 2

A sketch of part of the curve C with equation

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

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.

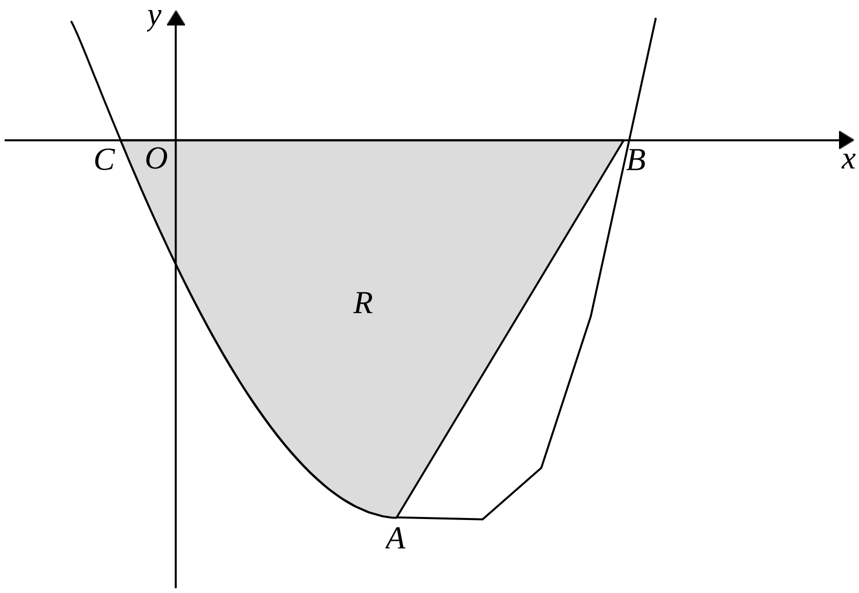

Figure 3

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

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

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.
- 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 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

$$\log_2 (11y - 3) - \log_2 3 - 2 \log_2 y = 1, \qquad y > \frac{3}{11}$$

(6)

(Total 9 marks)

---

10. (i) Given that

$$\log_3(3b + 1) - \log_3(a - 2) = -1, \qquad a > 2,$$

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

- 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 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.

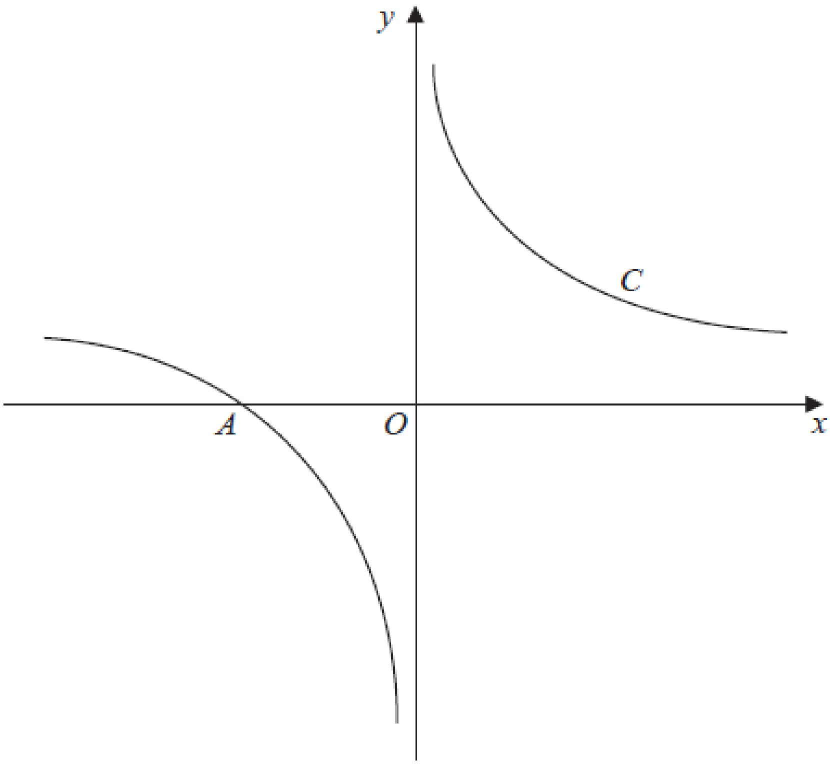

Figure 1

Figure 1 shows a sketch of the curve C with equation

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

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.

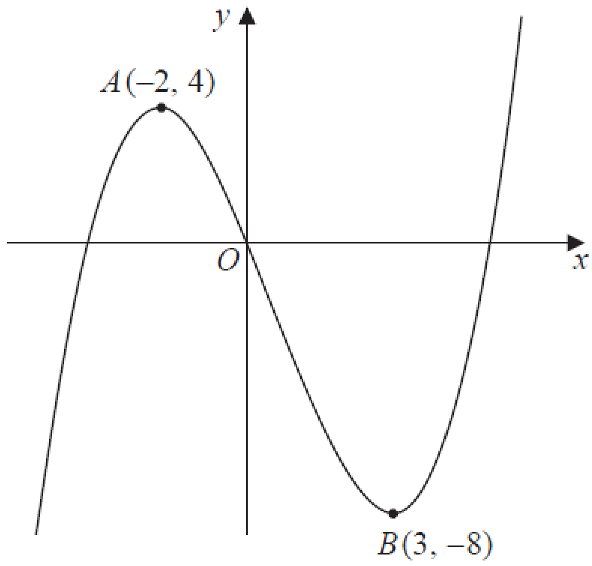

Figure 2

Figure 2 shows a sketch of part of the curve with equation $y = \mathrm{f}(x)$. 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) $y = 3\mathrm{f}(x)$,

(2)

(b) $y = \mathrm{f}(x) - 4$.

(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.

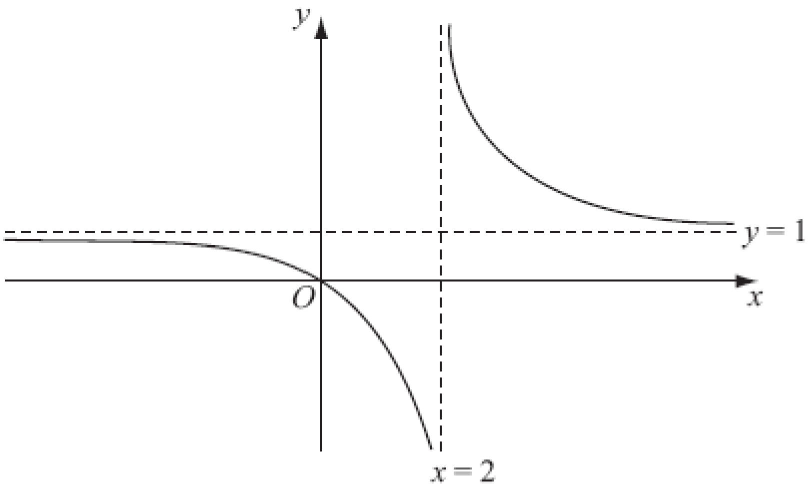

Figure 3

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

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

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 $y = \mathrm{f}(x - 1)$ and state the equations of the asymptotes of this curve.

(3)

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

(4)

(Total 7 marks)

4.

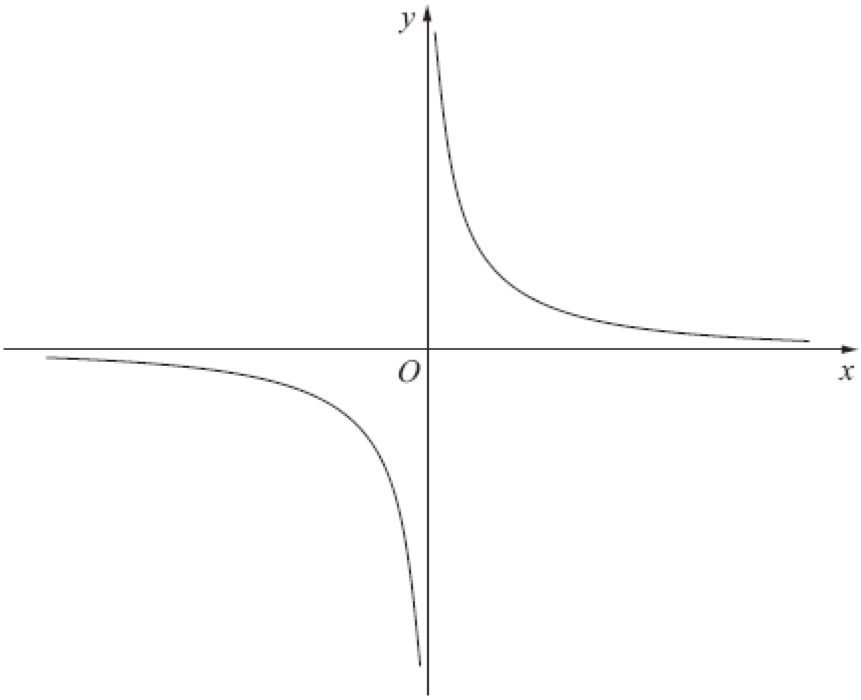

Figure 4

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.

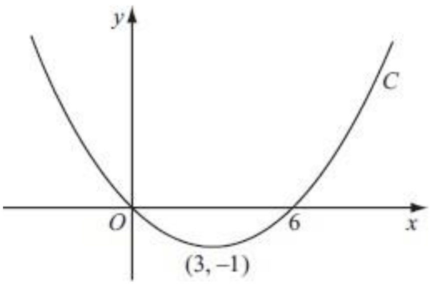

Figure 5

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.

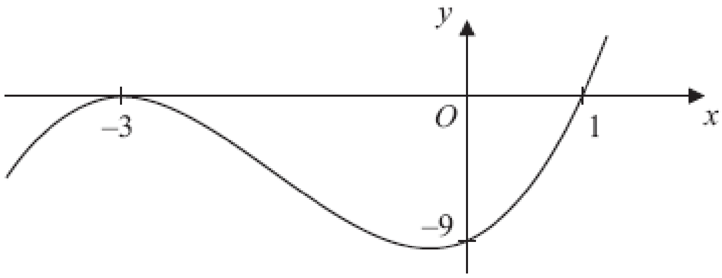

Figure 6

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

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

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 $y = \mathrm{f}(x + 2)$ 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) $y = \dfrac{1}{x} + 5$

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 $y = \dfrac{1}{x} + 5$ 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.

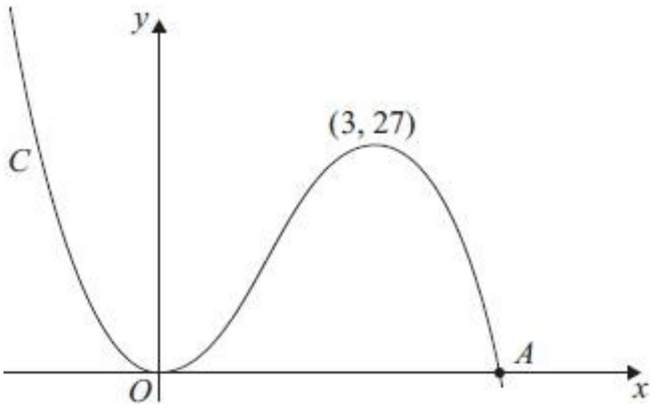

Figure 7

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

$$\mathrm{f}(x) = x^2(9 - 2x).$$

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) $y = \mathrm{f}(x + 3)$,

(ii) $y = \mathrm{f}(3x)$.

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.

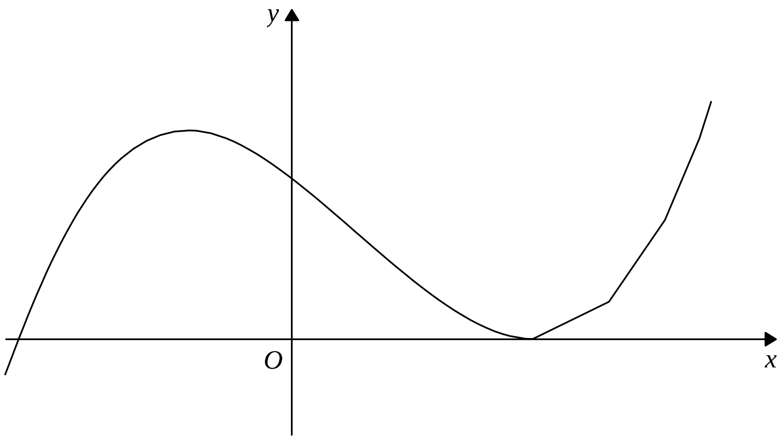

Figure 8

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

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

giving each term in its simplest form.

(4)

(Total 4 marks)

2*. Find

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

giving each term in its simplest form.

(Total 4 marks)

3*. Find

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

giving each term in its simplest form.

(Total 4 marks)

---

4. Use integration to find

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

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

(Total 5 marks)

5.

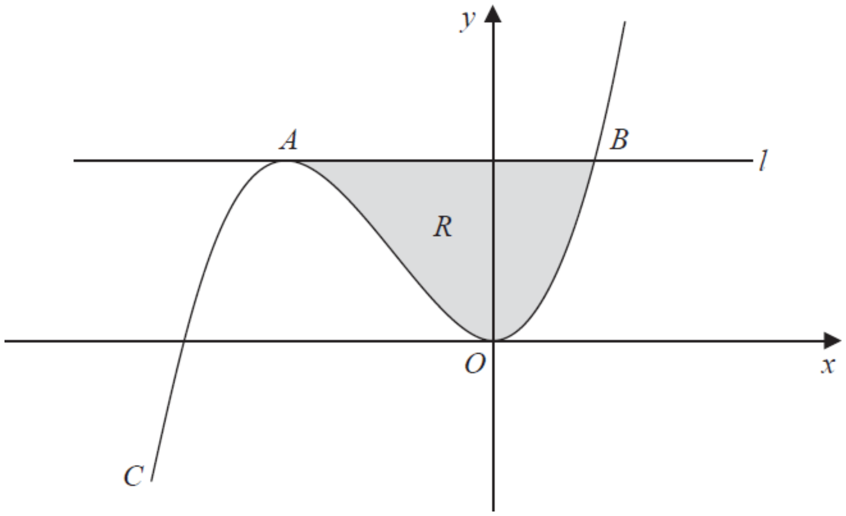

Figure 1

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

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

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*.

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

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).

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.

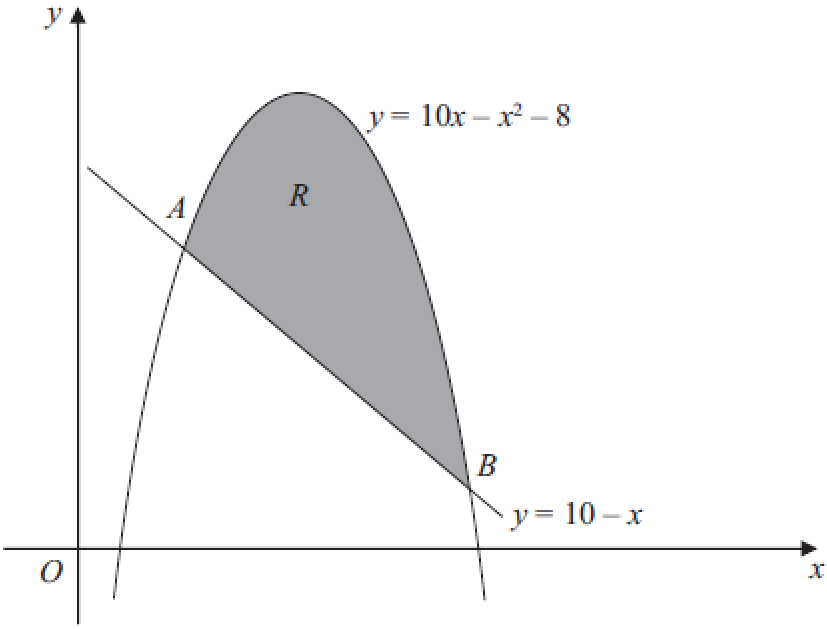

Figure 2

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

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

giving each term in its simplest form.

(4)

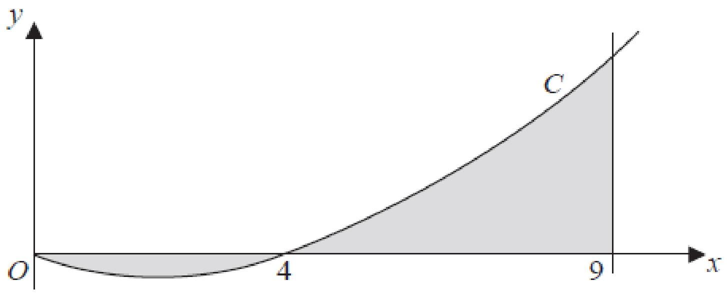

Figure 2

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

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

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.

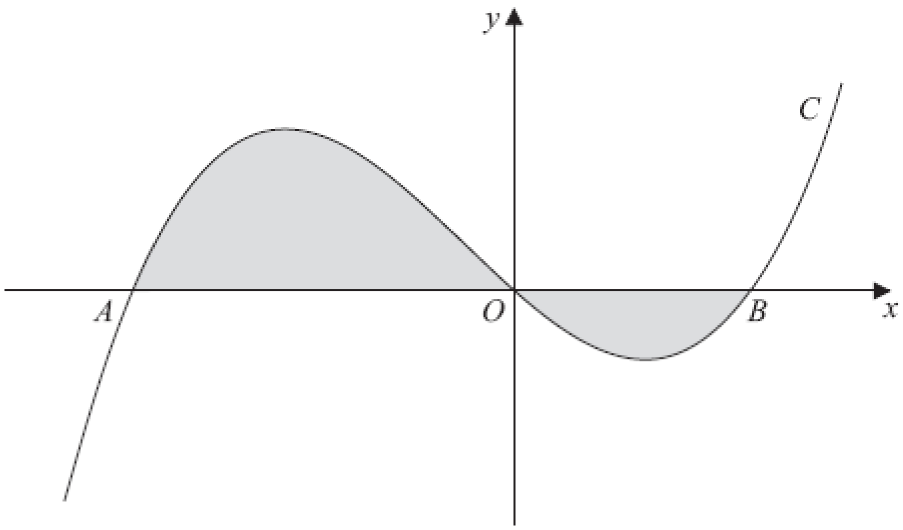

Figure 3

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.

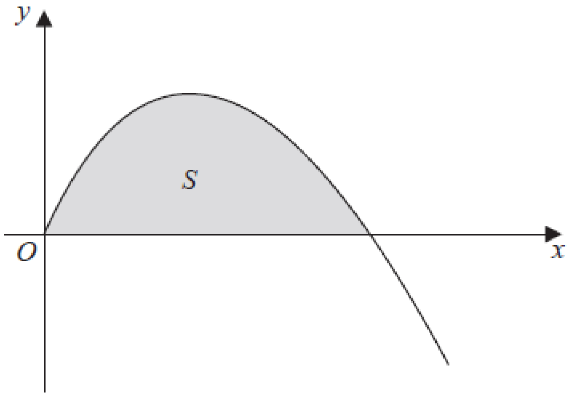

Figure 3

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

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

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

(a) Find

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

(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

- 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 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 $0 \leq x < 180°$

$$\cos (3x - 10°) = -0.4$$

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

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

(3)

(b) Hence solve, for $0 \leqslant x < 360°$,

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

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

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

(2)

(b) Hence solve, for $0 \leq x \leq 180°$

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

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 $0 \leq x < 360°$

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

giving your answers to 1 decimal place where appropriate.

(5)

(Total 7 marks)

---

5. (i) Solve, for $0 \leq \theta < 360°$, the equation $9\sin(\theta + 60°) = 4$, 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 $-180° \leq x < 180°$,

$$\tan(x - 40°) = 1.5,$$

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 $0 \leq \theta < 360°$,

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

showing each stage of your working.

(5)

(Total 11 marks)

TOTAL FOR PAPER: 49 MARKS

Task 2 – Mastering Applied Statistics Year 1

Write your name here

Surname	Other Names

AS/A Level Mathematics

Sampling

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

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- You should show sufficient working to make your methods clear. Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

Information

- 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.

1 Here are some descriptions of sampling methods.

A: The population is split into groups and a proportional representation of the different groups is selected.

B: Every member of the population has an equal chance of being selected.

C: A convenient sample is taken from any members of the population at any time.

D: A repetitive system used to select a sample from the population.

E: The population is split into groups and a certain number from each group is chosen in any order.

In the table below, match each sampling method with the letter of its description.

Method	**Letter**
Quota Sampling	
Stratified Sampling	
Simple Random Sampling	
Opportunity Sampling	
Systematic Sampling	

(Total for question 1 is 2 marks)

---

2 The headteacher of a school wants to find out what students think about the school. She decides to take a census rather than a sample.

(a) What is the population for the census? **(1)**

(b) Give one advantage and one disadvantage of using a census. **(2)**

(Total for question 2 is 3 marks)

---

3 A gym wants to find out what its members think about the gym's opening times and decides to carry out a survey.

(a) Suggest a suitable sampling frame for the survey **(1)**

(b) Identify the sampling units **(1)**

The gym decides to ask the first 20 members that come into the gym one morning to complete the survey.

(c) State the sampling technique the gym used. **(1)**

(d) Give one advantage and one disadvantage of this technique. **(2)**

(Total for question 3 is 3 marks)

4 Kwame wants to investigate how much time year 7 students in his school spend playing sport.
He gets a list of year 7 students and selects every 5^{th} student on the list to add to his sample.

(a) Write down the name of the sampling method Kwame has chosen. **(1)**

(b) Give one advantage and one disadvantage of this sampling method. **(2)**

(Total for question 4 is 3 marks)

---

5 Frank wants to find out how much time students in his school spend listening to music.

He asks students entering the school until he has asked 25 boys and 25 girls.

(a) Write down the name of the sampling method Frank has chosen. **(1)**

(b) Give one advantage and one disadvantage of this sampling method. **(2)**

(Total for question 5 is 3 marks)

---

6 The table shows information about the number of students in a school.

	Year Group					**Total**
	7	**8**	**9**	**10**	**11**	
Boys	71	65	59	55	48	298
Girls	65	54	53	50	53	275
Total	136	119	112	105	101	573

A teacher wants to find out what students think about the school's canteen. They decide to take a sample of 60 students stratified by age and by year group.

Calculate the number of year 11 girls in the sample.

(Total for question 6 is 2 marks)

---

7 There are 550 students in a school They all study either French or German or Spanish.

Language	French	Spanish	German
Number of Students	181	146	223

An inspector decides to take a sample of 40 students stratified by the language they study.

Calculate the number of students who study German in the sample.

(Total for question 7 is 2 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Interpolation and Standard Deviation

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

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.
• Answers should be given to three significant figures unless otherwise stated.

Information

• 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.

1 Adam is measuring the heights in cm of his tomato plants.

Height (cm)	**Frequency**
140 < h □ 150	7
150 < h □ 160	10
160 < h □ 170	15
170 < h □ 180	19
180 < h □ 200	9

(a) Use linear interpolation to estimate the median height. **(2)**

(b) Estimate the mean height. **(2)**

(c) Estimate the standard deviation. **(2)**

(Total for question 1 is 6 marks)

---

2 A company is investigating how long it takes employees, *t* minutes, to get to an event.
They produce a table below of coded times, *x* minutes, for a random sample of 50 employees.

Coded Time (minutes)	**Frequency**
0 < *x* □ 5	1
5 < *x* □ 10	9
10 < *x* □ 15	19
15 < *x* □ 25	14
25 < *x* □ 40	7

(a) Use linear interpolation to estimate the median of the coded times. **(2)**

(b) Estimate the standard deviation of the coded times. **(2)**

The coded data was calculated sing the formula: $x = \frac{t - 20}{2}$

(c) Calculate the median and the standard deviation of *t*. **(1)**

(Total for question 2 is 7 marks)

3 The distance travelled by 100 people to an event is summarised below.

Distance (nearest mile)	Frequency
0 – 9	4
10 – 19	19
20 – 29	41
30 – 39	26
40 – 49	9
50 – 59	1

You may use: $\sum fx = 2651$ $\sum fx^2 = 80434.25$

(a) Use linear interpolation to estimate the median height. **(2)**

(b) Estimate the mean height. **(2)**

(c) Estimate the standard deviation. **(2)**

(Total for question 3 is 6 marks)

---

4 The times 12 athletes took to run 400m is summarised in the table below.

Athlete	A	B	C	D	E	F	G	H	A	I	J	K
Time (s)	45.2	46.9	46.1	46.2	45.4	45.1	47.8	45.4	45.5	46.1	46.4	45.7

(a) Find the mean time taken **(2)**

(b) Find the standard deviation for these times **(2)**

(c) Find the median, upper and lower quartiles of these data. **(3)**

(Total for question 4 is 7 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Box Plots and Outliers

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

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

Information

- 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.

1 In a study of how students use their mobile telephones, the phone usage of a random sample of 11 students was examined for a particular week.

The total length of calls, y minutes, for the 11 students were

17, 23, 35, 36, 51, 53, 54, 55, 60, 77, 110

(a) Find the median and quartiles for these data. **(3)**

A value that is greater than Q3 + 1.5 × (Q3 – Q1) or smaller than Q1 – 1.5 × (Q3 – Q1) is defined as an outlier.

(b) Show that 110 is the only outlier. **(2)**

(c) Draw a box plot for these data indicating clearly the position of the outlier. **(3)**

(Total for question 1 is 8 marks)

---

2 In a study of how much time students spend on social media, usage of a random sample of 15 students was examined for a particular day.

The total time of usage, *x* minutes, for the 15 students were

6, 25, 39, 62, 65, 74, 80, 94, 125, 127, 154, 159, 184, 210, 251

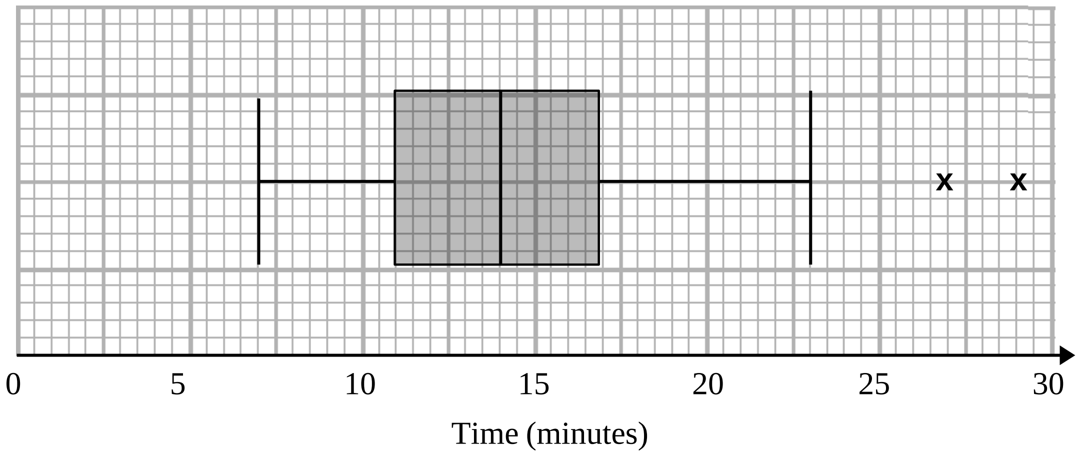
(a) Find the median and quartiles for these data. **(3)**

(b) Show that there are no outliers. **(2)**

(c) Draw a box plot for these data. **(3)**

(Total for question 2 is 8 marks)

3 Children from two schools A and B took part in a competition to complete a puzzle. The distribution of times taken, to the nearest minute, by children in school A are shown in the box plot below.



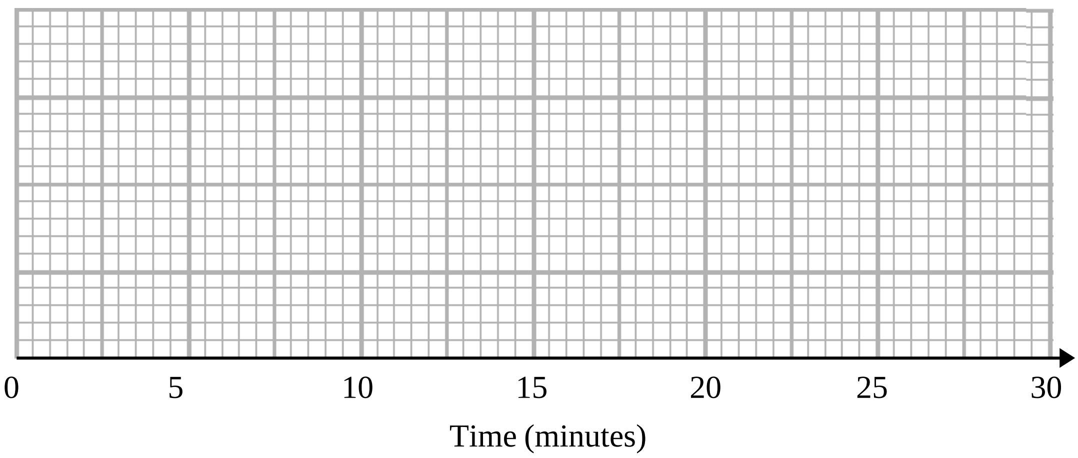
(a) Write down the time by which 75% of the children in school A had completed the puzzle. **(1)**

(b) State what the two crosses (**x**) represent on the box plot above. Interpret these in context. **(2)**

For school B the shortest time taken was 6 minutes, the longest time taken was 22 minutes and the quartiles were 12, 15 and 17 minutes respectively.

(c) Determine if there are any outliers. **(3)**

(d) Draw a box plot for this information. **(3)**



(e) Compare the two distributions. **(3)**

(Total for question 3 is 12 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Histograms

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

Instructions

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- You should show sufficient working to make your methods clear.
Answers without working may not gain full credit.
- Answers should be given to three significant figures unless otherwise stated.

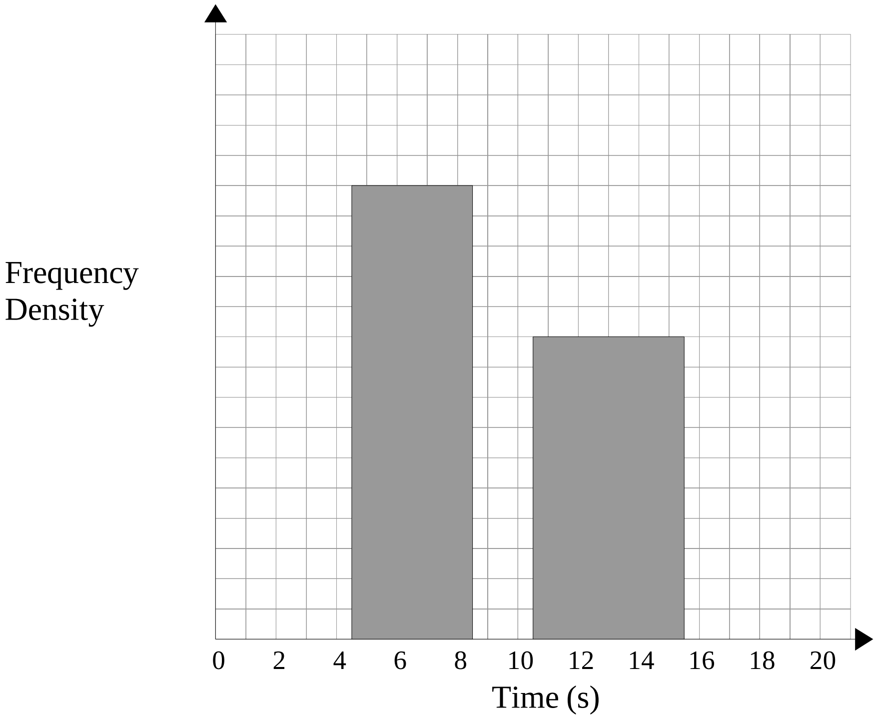
Information

- 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.

1 The partially completed histogram and the partially completed table show the times taken, to the nearest second, for a group of people to complete a puzzle.



Time (seconds)	**Frequency**
1 – 4	2
5 – 8	12
9 – 10	8
11 – 15	
16 – 20	3

(a) Complete the table.

(b) Complete the histogram

One of the participants is selected at random.

(c) Estimate the probability that this participant completed the puzzle in under 10 seconds.

(Total for question 1 is 5 marks)

2 A variable x was measured to the nearest whole number. 50 observations are given in the table below.

x	5 – 8	9 – 13	14 – 20	21 – 24
Frequency	10	9	14	17

A histogram was drawn and the bar representing the 9 – 13 class has a width of 2 cm and a height of 2.7 cm.

Find the width and height of the bar representing the 14 – 20 class.

(Total for question 2 is 3 marks)

---

3 A variable y was measured to the nearest whole number. 40 observations are given in the table below.

y	10 – 19	20 – 24	25 – 28	29 – 30
Frequency	13	7	15	5

A histogram was drawn and the bar representing the 10 – 19 class has a width of 2.5 cm and a height of 2.6 cm.

(a) Find the width and height of the bar representing the 20 – 24 class. **(3)**

(b) Find the width and height of the bar representing the 25 – 28 class. **(3)**

(Total for question 3 is 6 marks)

---

4 The distance travelled by 100 people to an event is summarised below.

Distance (nearest mile)	**Frequency**
0 – 9	4
10 – 14	19
15 – 18	41
19 – 20	26
21 – 25	9

A histogram was drawn and the bar representing the 10 – 14 class has a width of 3 cm and a height of 1.9 cm.

(a) Find the width and height of the bar representing the 15 – 18 class. **(3)**

(b) Find the width and height of the bar representing the 19 – 20 class. **(3)**

(Total for question 4 is 6 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Correlation and Regression

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Information

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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.

1 Using the large data set Colin studied the relationship between rainfall (r) and temperature (t) in Camborne. He took a sample of 12 days from May and June 1987 and obtained the following results.

Rainfall (cm)	3.1	0.1	6	2.2	0.3	4.2	1.7	7.5	0.1	7.1	3.9	3.1
Temperature (ºC)	10.7	8.9	8.8	9.2	11.1	10.2	12.6	10.4	11.3	11.6	12.8	13.5

(a) Use your knowledge of the large data set to explain why it is unlikely that Colin used a random sample.

Colin used a computer program to obtain the following statistics for Rainfall

$Q_1 = 1.35$ $Q_2 = 3.1$ $Q_3 = 4.65$

(b) Determine whether there are any outliers in the sample.

(c) Plot the information on a scatter graph

(d) Explain why a linear regression model may not be suitable for this data.

(Total for question 1 is 4 marks)

---

2 A football coach measured the heights and weights of 12 players, The data is shown below.

Height (cm)	188	194	178	175	185	175	188	193	180	190	181	169
Weight (kg)	70	100	83	69	77	58	90	86	71	94	68	61

(a) Draw a scatter graph for this information.

(b) Give an interpretation of the correlation between the height and weight of the footballers.

The equation of the regression line is $w = 1.37h – 173$

(c) Give an interpretation of the gradient of this regression line.

(d) Use the equation of the regression line to estimate the weight of a player who is 170cm tall.

(e) Comment on the reliability of your estimate in part (d), giving a reason for your answer.

(Total for question 1 is 4 marks)

---

3 Ross did an investigation into the relationship between study into temperature (t) and total hours of sunshine (s) at Heathrow. He finds that the equation of the regression line is $s = 0.25t + 1.3$.

Give an interpretation of the figure 0.25 figure in this regression line.

(Total for question 1 is 4 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Probability

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Advice

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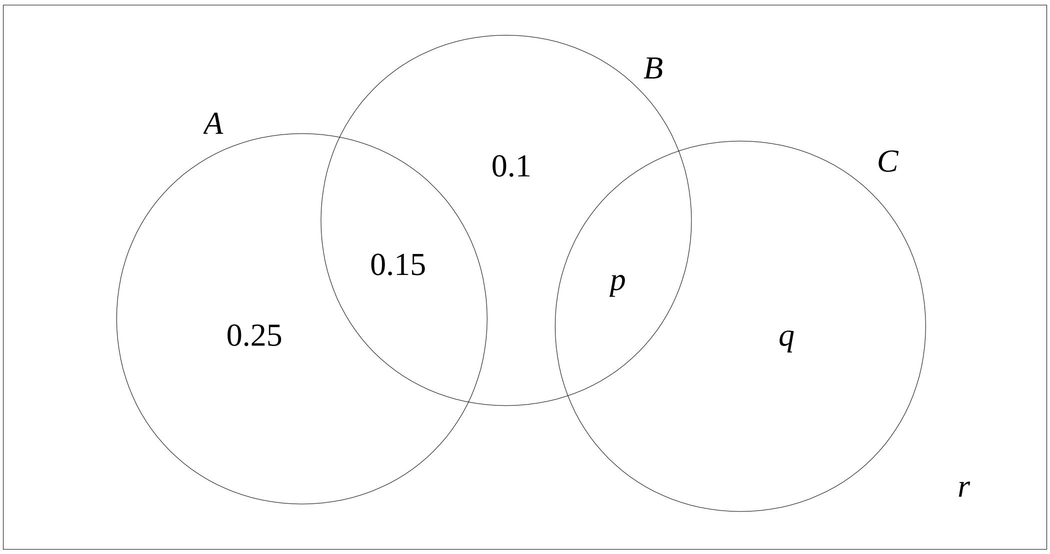
1 The Venn diagram below shows three events A, B and C.



(a) Write down two of the events that are mutually exclusive. **(1)**

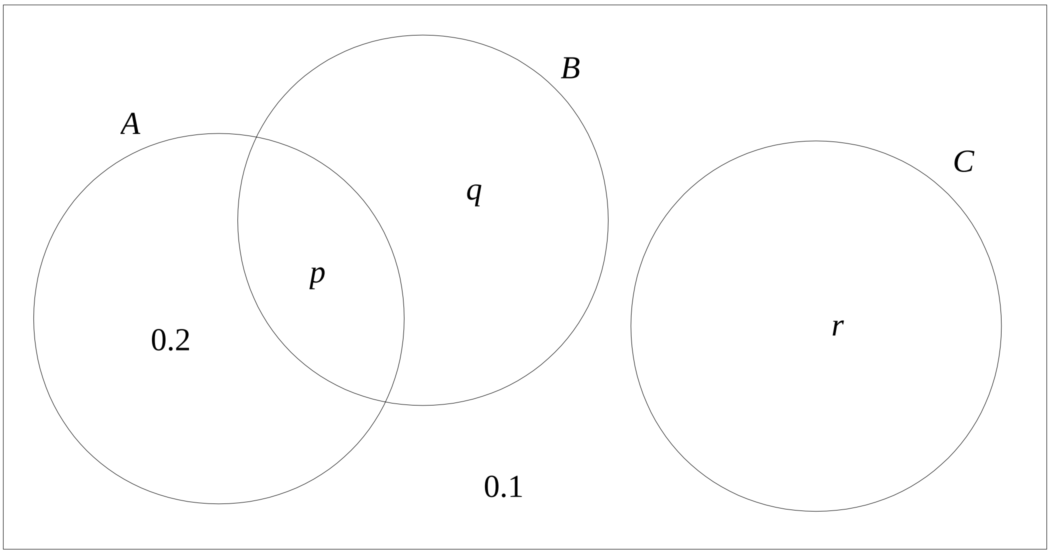
Events A and B are independent.
The probability of C is 0.3

(b) Find the values of p, q and r. **(5)**

(Total for question 1 is 6 marks)

---

2 The Venn diagram below shows three events A, B and C.



(a) Write down two of the events that are mutually exclusive. **(1)**

The probability of A is 0.4
The probability of A or B is 0.7

(b) Find the values of p, q and r. **(2)**

(c) State, giving a reason, whether of not the events A and B are statistically independent. **(2)**

(Total for question 2 is 5 marks)

3 Raheem asks 50 people which sports they watch. The can chose from football, golf and hockey.

5 people watch all three sports.
8 people watch football and golf
7 people watch golf and hockey
9 people watch football and hockey
31 people watch football
13 people watch golf
17 people watch hockey.

(a) Draw a Venn diagram for this information. **(1)**

(b) Two people are selected at random find the probability they both watch football. **(2)**

(Total for question 3 is 5 marks)

---

4 For the events A and B.

The probability of A is 0.6
The probability of B is 0.5
The probability of neither A or B is 0.1.

(a) Find P(A and B) **(2)**

(b) Draw a Venn diagram for this information. **(2)**

(c) Determine whether A and B are independent. **(2)**

(Total for question 4 is 6 marks)

---

5 Two events A and B are independent and P(A) = 0.4 and P(B) = 0.3

(a) Find P(A and B) **(3)**

(b) Draw a Venn diagram for this information. **(2)**

(Total for question 5 is 5 marks)

---

6 Two events A and B are mutually exclusive and P(A) = 0.4 and P(B) = 0.3

(a) Write down P(A and B) **(1)**

(b) Draw a Venn diagram for this information. **(3)**

(Total for question 6 is 4 marks)

---

7 Two events A and B are such that P(A) = 0.6 and P(B) = 0.5 and P(A and B) = 0.4

Draw a Venn diagram for this information.

(Total for question 7 is 3 marks)

---

1 A box contains 10 milk chocolates and 8 dark chocolates. Connor takes two chocolates at random.
Find the probability Connor takes

(a) Two dark chocolates **(2)**

(b) One milk chocolate and one dark chocolate. **(2)**

(Total for question 1 is 4 marks)

---

2 A bag contains 10 blue counters, 8 red counters and 6 green counters.
Two counters are removed from the bag at random.
Find the probability that the two counters removed are:

(a) both red **(2)**

(b) different colours **(2)**

(Total for question 2 is 4 marks)

---

3 The probability a tennis player gets her first serve in court is 65%.
If she gets her first serve in court the probability of winning the point is 81%.
The chance of getting her second serve in court is 84% and if she gets he second serve in court the chance of winning the point is 59%.
If the tennis player fails to get her second serve in court she loses the point.

(a) Draw a tree diagram to show this information. **(3)**

(b) Find the probability of the tennis player winning the point. **(2)**

(Total for question 3 is 5 marks)

---

4 A company has three machines that produce a component. Machine A produces 40% of the components.
Machine B produces 35% of the components and machine C produces 25% of the components.

If a component is produced by machine A the chance that it will be faulty is 3%.
If a component is produced by machine B the chance that it will be faulty is 2%.
If a component is produced by machine C the chance that it will be faulty is 1%.

(a) Draw a tree diagram to show this information. **(3)**

A component is selected at random. Find the probability:

(b) it is from machine A and faulty. **(2)**

(c) it is faulty. **(2)**

(Total for question 4 is 7 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Discrete Random Variables

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Information

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Advice

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

1 A discrete random variable X has the probability function:

x	0	1	2	3
$P(X = x)$	0.2	a	0.3	0.25

(a) Find the value of a **(1)**

(b) Find $P(X > 1.2)$ **(1)**

(c) Construct a table for the cumulative distribution $F(x)$ **(2)**

(Total for question 1 is 4 marks)

---

2 A random variable X has the probability function:

$$P(X = x) = \frac{(2x - 1)}{36} \qquad x = 1, 2, 3, 4, 5, 6$$

(a) Construct a table giving the probability function of X. **(2)**

(b) Find $P(1.4 < X < 3.9)$ **(1)**

(c) Construct a table for the cumulative distribution $F(x)$ **(2)**

(Total for question 2 is 5 marks)

---

3 A fair 6 sided die is rolled. The random variable Y represents the score on the die.

(a) Construct a table giving the probability function of Y. **(2)**

(b) Write down the name of this distribution **(1)**

(Total for question 3 is 3 marks)

---

4 A discrete random variable X has the probability distribution:

x	0	1	2	3
$P(X = x)$	0.2	a	0.3	b

Where a and b are constants.

The cumulative distribution $F(x)$ of X is given below.

x	0	1	2	3
$F(x)$	c	d	0.78	e

Where c, d and e are constants.

Find the values of a, b, c, d and e.

(Total for question 4 is 3 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

The Binomial Distribution and Hypothesis Testing

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Advice

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1 The discrete random variable $X \sim B(15, 0.35)$

Find:

(a) $P(X = 5)$

(b) $P(X < 4)$

(c) P(X □ 10)

(Total for question 1 is 3 marks)

---

2 The probability of Harry being late for school is 0.1. Over a term of 30 days find the probability that Harry is late:

(a) Exactly one time

(b) More than four times

(c) Less than three times

(Total for question 2 is 3 marks)

---

3 The discrete random variable $X \sim B(20, 0.41)$

(a) Find P(3 < X □ 7) **(2)**

Previous research by a restaurant found that 30% of customers will order a starter.
One one day a random sample of 40 customers is taken and 7 order a starter.

(b) Test at the 5% significance level whether the proportion of customers ordering a starter has decreased. **(5)**

(c) State the conclusion you would have reached if you tested at the 10% significance level. **(1)**

(Total for question 3 is 8 marks)

---

4 The discrete random variable $X \sim B(30, 0.58)$

(a) Find P(X □ 12) **(2)**

A cafe expects 30% of customers to order a coffee with their breakfast.

On one particular day a random sample of 40 customers that ordered breakfast is taken and 19 of them ordered a coffee.

(b) Test at the 1% significance level whether the proportion of customers ordering a coffee had Increased. State your hypotheses clearly. **(5)**

(c) State the conclusion you would have reached if a 5% significance level had been used for this test. **(1)**

(Total for question 4 is 8 marks)

5 A company produces pens. The probability that any pen is defective is 0.08.

(a) A sample of 15 pens is taken. Find the probability that 2 or more pens are defective. **(2)**

An employee claims that the probability that a pen is defective is more than 0.08. They take a sample of 20 pens and 3 are defective.

(b) Stating your hypothesis clearly, test the employee's claim at the 5% significance level. **(5)**

(Total for question 5 is 7 marks)

---

6 Andy plays tennis. The probability that Andy will get one of his serves in court is 60%.

Andy serves 20 times.

(a) Find the probability Andy gets:

(i) exactly 15 serves in court
(ii) more than 15 of the serves will be in court.

(b)Andy's coach thinks that the probability of Andy getting a serve in court has changed.
Andy serves 50 times in a set and 35 are in court.
Stating your hypothesis clearly, test the coach's claim at the 10% significance level.

(Total for question 6 is 7 marks)

---

7 The probability of a bias dice landing on 6 is 0.4. The dice is going to be rolled 20 times.

(a) Find the probability that the dice will land on 6 exactly 5 times.

Polly thinks that the probability that the dice will land on 6 is incorrect.

(b) Write down the hypotheses that should be used to test Polly's suspicion

(c) Using a 10% significance level find the critical region for a two tailed test to test Polly's suspicion.
You should state the probability of rejection in each tail, which should be less than 0.05

(d) Find the actual significance level of a test based on your critical region from part (c)

Polly rolls the dice 20 times. The dice lands on six 11 times.

(e) Comment on Polly's suspicion in light of he experiment

Task 3 – Mastering Applied Mechanics Year 1

Write your name here

Surname	Other Names

AS/A Level Mathematics

Velocity-Time Graphs

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Information

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Advice

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1 A train accelerates from rest at station A to a velocity of $32ms^{-1}$. It maintains this speed for 72 seconds, until it decelerates uniformly to station B. The total journey time is 112 seconds and the magnitudes of the acceleration and deceleration are equal.
Find

(a) the time it takes the train to accelerate from rest to $32ms^{-1}$, **(2)**

(b) sketch a velocity-time graph for the motion of the train between station A and station B, **(2)**

(c) calculate the distance between the two stations. **(1)**

(Total for question 1 is 7 marks)

---

2 A train moves along a straight horizontal track between two stations, A and B. The train starts from rest and moves with acceleration of 0.6 ms^{-2} for 40 seconds. The train moves at constant acceleration before decelerating at a rate of $0.4ms^{-2}$ until it reaches B.

The total distance between the two station is 4 km.

(a) sketch a velocity-time graph for the motion of the train between A and B, **(3)**

(b) find the total time taken by the train to travel from A to B. **(3)**

(Total for question 2 is 6 marks)

---

3 A particle, moving in a straight line with speed 5U ms^{-1}, decelerates uniformly for 6 seconds which reduces its speed to 2U ms^{-1}. It maintains this speed for a further 16 seconds before decelerating uniformly to rest in a further 2 seconds.

(a) sketch a velocity-time graph for this information, **(2)**

(b) find an expression for each of the decelerations in terms of U. **(2)**

Given the total distance is 220m

(c) find the value of U. **(6)**

(Total for question 3 is 12 marks)

---

4 A car starts from rest and accelerates at a constant rate to the speed of V ms^{-1} in 6 seconds.
The car maintains this speed for 50 seconds before decelerating to rest.
The magnitude of the deceleration is 1.5 times this magnitude of the acceleration.

(a) show the total time taken for the journey is 60 seconds, **(3)**

(b) sketch a velocity-time graph for this information, **(3)**

Given the total distance is 1320m

(c) find the value of V. **(3)**

(Total for question 4 is 9 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

SUVAT

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Advice

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1 A particle moves from A to B under constant acceleration.
The distance between A and B is s.
The speed at A is u. The speed at B is v.
The time taken is t.
The acceleration is a.

(a) Given $s = 50$ m $u = 0$ ms^{-1} $v = 20$ ms^{-1} Find a and t. **(2)**

(b) Given $s = 200$ m $a = 2$ ms^{-2} $v = 30$ ms^{-1} Find t and u. **(2)**

(c) Given $s = 85$ m $t = 5$ s $v = 20$ ms^{-1} Find a and u. **(2)**

(d) Given $s = 100$ m $a = 2$ ms^{-2} $t = 4$ s Find u and v. **(2)**

(e) Given $v = 10$ ms^{-1} $a = 1.5$ ms^{-2} $t = 3$ s Find s and u. **(2)**

(Total for question 1 is 10 marks)

---

2 A ball is projected vertically upwards with a speed of 20 m s^{-1} from a point h metres above the ground. The ball hits the ground 5 s later. Find

(a) the value of h, **(3)**

(b) the speed of the ball as it hits the ground. **(3)**

(Total for question 2 is 6 marks)

---

3 A car passes point A with a speed of 20 km/h. The car accelerates at a constant rate and 10 seconds later it passes point B with a speed of 70 km/h. Find

(a) the acceleration of the car in ms^{-1}, **(3)**

(b) the distance AB. **(3)**

(Total for question 3 is 6 marks)

---

4 A stone is dropped from a point 120 m from the ground. Find

(a) the time it takes for the stone to reach the ground, **(3)**

(b) the speed at which the stone hits the ground. **(3)**

(Total for question 4 is 6 marks)

---

5 A particle moves along a straight line, from point X to point Y, with constant acceleration.
The distance XY is 120 m. The particle takes 8 seconds to move from X to Y and the speed of the particle at Y is double the speed of the particle at X.
Find

(a) the speed of the particle at X, **(3)**

(b) the acceleration of the particle. **(3)**

(Total for question 5 is 6 marks)

6 A car passes point A with a speed of $5ms^{-1}$. The car accelerates at a constant rate and 8 seconds later it passes point B with a speed of $20ms^{-1}$. Find

(a) the acceleration of the car, **(3)**

(b) the distance AB, **(3)**

(c) the time it takes the car to reach the midpoint of AB. **(4)**

(Total for question 6 is 10 marks)

---

7 A train, moving with constant acceleration, passes through three points A, B and C, where AB = 40m and BC = 60m. The train passes through A with a speed of $10ms^{-1}$ and 6 seconds later passes through C. Find

(a) the acceleration of the train, **(3)**

(b) the speed at which the train passes though B. **(3)**

(c) The time it take for the train to move between B and C. **(3)**

(Total for question 7 is 9 marks)

---

8 A stone is projected vertically upwards with a speed 18 ms^{-1} from a point 2 m above the ground. Find

(a) the greatest height reached by the stone, **(3)**

(b) the speed at which the stone hits the ground. **(3)**

(c) the time between the instant the stone is projected and when it hits the ground. **(3)**

(Total for question 8 is 6 marks)

---

9 A car passes three posts P, Q and R, on a straight horizontal road. The distance PQ = 50m. The distance QR = 100m. The car, moving with constant acceleration, takes 2 seconds to travel from P to Q and 3 seconds to travel from Q to R.

(a) the acceleration of the car, **(3)**

(b) the speed car at the instant it passes Q. **(3)**

(Total for question 9 is 6 marks)

---

10 A particle is projected vertically upwards from a point 1.5 m above the ground with a speed of 10 ms^{-1}. Find

(a) the greatest height reached by the particle, **(3)**

(b) the time for which the particle is more than 3 m above the ground. **(3)**

(Total for question 10 is 6 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

2D Vectors

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Advice

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1 Three forces $(3\mathbf{i} + 2p\mathbf{j})$ N, $(-2\mathbf{i} + 5\mathbf{j})$ N and $(4q\mathbf{i} + 5\mathbf{j})$ N act on a particle A.

Given A is in equilibrium find the values of p and q.

(Total for question 1 is 4 marks)

---

2 A particle P of mass 0.8kg moves under the action of a force F N.
The acceleration of P is $(-3\mathbf{i} + 5\mathbf{j})$.

(a) Find the angle between the acceleration and the vector $\mathbf{i}$. **(2)**

(b) Find the magnitude of F. **(3)**

(Total for question 2 is 5 marks)

---

3 A particle P of mass 2kg moves with constant acceleration under the action of a force F N.
The initial velocity of P is $(-2\mathbf{i} + 6\mathbf{j})$ ms^{-1} and after 4 seconds the velocity of P is $(7\mathbf{i} + 2\mathbf{j})$ ms^{-1}.

Find, to three significant figures:

(a) the magnitude of the acceleration, **(3)**

(b) the angle between F and the vector $\mathbf{i}$. **(3)**

(Total for question 3 is 6 marks)

---

4 The resultant of two forces F_1 and F_2 is $(\mathbf{i} - 14\mathbf{j})$ N.

Given that $F_1 = (2p\mathbf{i} - 4q\mathbf{j})$ N and $F_2 = (3q\mathbf{i} + 4p\mathbf{j})$ N find the values of p and q.

(Total for question 4 is 5 marks)

---

5 A particle P moves with a constant velocity of $(4\mathbf{i} - \mathbf{j})$ ms^{-1}.

(a) Find the speed of P. **(2)**

(b) Find the direction of motion of P, giving your answer as a bearing. **(3)**

(Total for question 2 is 5 marks)

---

6 A particle P moves with constant acceleration $(3\text{i} - 4\text{j})$ ms^{-2}.
At time $t = 0$, P has speed u ms^{-1}
At time $t = 3$, P has velocity $(-5\text{i} + 2\text{j})$ ms^{-1}
Find the value of u.

(Total for question 6 is 5 marks)

---

7 The resultant of two forces F_1 and F_2 is parallel to $\mathbf{i} + \mathbf{j}$.
Given that $F_1 = (3\mathbf{i} - 2\mathbf{j})$ N and $F_2 = (p\mathbf{i} + 2p\mathbf{j})$ N, where p is a positive constant.

Find the value of p.

(Total for question 7 is 5 marks)

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Surname	Other Names

AS/A Level Mathematics

F = ma

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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.
• Answers should be given to three significant figures unless otherwise stated.

Information

• The marks for **each** question are shown in brackets
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Advice

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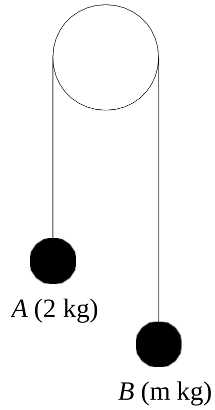
1 Two particles *A* and *B* have mass of 2 kg and *m* kg respectively, where $m < 2$. The particles are connected by a light inextensible string which passes over a smooth, fixed pulley. Initially *A* is 3 m above horizontal ground.
The string is released from rest with the string taut and the hanging parts of the string vertical.
After *A* has been descending for 2.5 s it strikes the ground.
Particle *A* reaches the ground before *B* reaches the pulley.



(a) Show that the acceleration of *A* as it descends is 0.96 ms^{-2} **(3)**

(b) Show that the mass of *B* is 1.64 kg **(7)**

(c) State how you have used the information that the string is inextensible. **(1)**

(Total for question 1 is 11 marks)

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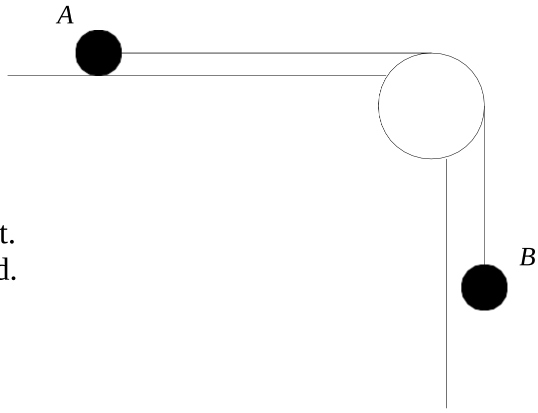
2 A particle *A* of mass 5 kg rests on a smooth horizontal table. Particle *A* is attached to one end of a light inextensible string which passes over a smooth pulley fixed to the edge of the table. The other end of the string is attached to particle *B* of mass 4 kg which hangs freely below the pulley 1.4 m above the ground. The system is released from rest with the string taut. Particle *A* does not reach the pulley before *B* reaches the ground.



(a) Find the tension in the string before *B* hits the ground. **(4)**

(b) Find the time taken by *B* to reach the ground. **(5)**

(Total for question 2 is 9 marks)

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3 A car of mass 750 kg pulls a trailer of mass 300 kg along a straight horizontal road using a light towbar which is parallel to the road. The horizontal resistances to motion of the car and the trailer have magnitudes 250 N and 100 N respectively. The engine of the car produces a constant horizontal driving force on the car of magnitude 1600 N. Find

(a) the acceleration of the car and trailer, **(3)**

(b) the magnitude of the tension in the towbar. **(3)**

The car is moving along the road when the driver sees a hazard ahead. He reduces the force produced by the engine to zero and applies the brakes. The brakes produce a force on the car of magnitude F newtons and the car and trailer decelerate. Given that the resistances to motion are unchanged and the magnitude of the thrust in the towbar is 80 N,

(c) find the value of F. **(7)**

(Total for question 3 is 13 marks)

4 A car is towing a trailer along a straight horizontal road by means of a horizontal tow-rope.
The mass of the car is 1400 kg. The mass of the trailer is 700 kg. The car and the trailer are modelled as particles and the tow-rope as a light inextensible string. The resistances to motion of the car and the trailer are assumed to be constant and of magnitude 630 N and 280 N respectively.
The driving force on the car, due to its engine, is 2380 N. Find

(a) the acceleration of the car, **(3)**

(b) the tension in the tow-rope **(3)**

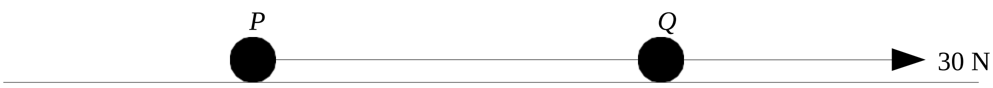
(c) state how you have used the assumption that the car and trailer are modelled as particles. **(1)**

When the car and trailer are moving at 12 m s^{-1}, the tow-rope breaks. Assuming that the driving force on the car and the resistances to motion are unchanged,

(d) find the distance moved by the car in the first 4 s after the tow-rope breaks. **(6)**

(Total for question 4 is 13 marks)

5



Two particles *P* and *Q*, of mass 4 kg and 6 kg respectively, are joined by a light horizontal rod.
The particles are initially at rest when a constant force F of magnitude 30 N is applied to *Q*, as shown in the diagram. The force is applied for 5 s.
During the motion, the resistance to *P* has a constant magnitude of 2 N and the resistance to *Q* has a constant magnitude of 4 N. Find

(a) the acceleration of the particles as the system moves under the action of the 30 N force. **(3)**

(b) the speed of the particles after 5 seconds. **(1)**

(c) the tension in the string as the system moves under the action of the 30 N force. **(2)**

After 5 seconds the force is removed and the system decelerates to rest.
The resistances to motion are unchanged.

(d) Find the distance moved by *P* as the system decelerates. **(3)**

(e) Find the thrust in the rod as the system decelerates. **(3)**

(Total for question 5 is 15 marks)

Write your name here

Surname	Other Names

AS/A Level Mathematics

Variable Acceleration

Candidates may use any calculator allowed by the regulations of the Joint Council for Qualifications. Calculators must not have the facility for symbolic algebra manipulation, differentiation and integration, or have retrievable mathematical formulae stored in them.

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1 The acceleration of a particle after t seconds is given by $(4t - 8)$ ms^{-2}.
Given the velocity (v) of the particle is 6 ms^{-1} when $t = 0$.

(a) Find v in terms of t. **(3)**

(b) Find the distance between the two points the particle is instantaneously at rest. **(7)**

(Total for question 1 is 10 marks)

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2 The velocity of a particle after t seconds is given by $v = (6t - 2)$ m s^{-1}.
After 5 seconds the displacement is 75m from O.

(a) Find an expression for the displacement. **(3)**

(b) Find the displacement after 10 seconds. **(2)**

(Total for question 2 is 5 marks)

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3 A particle P moves in a straight line so that, at time t seconds, its acceleration a m s^{-2} is given by

$$a = \begin{cases} \dfrac{27}{t^2} & t > 3 \\ 4t - t^2 & 0 \leqslant t \leqslant 3 \end{cases}$$

At $t = 0$, P is at rest. Find the speed of P when

(a) $t = 3$ **(3)**

(b) $t = 6$ **(4)**

(Total for question 3 is 8 marks)

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4 A particle P moves in a straight line so that, at time t seconds, its velocity v m s^{-1} is given by

$$v = \begin{cases} 7t - t^2 & 0 \leqslant t \leqslant 5 \\ 10 - 2t & t > 5 \end{cases}$$

(a) Find the acceleration of P when t = 4 **(3)**

(b) Find the total distance traveled by P in the first 10 seconds. **(7)**

(Total for question 4 is 10 marks)

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5 The velocity of a particle after t seconds is given by $v = (6t - 2t^2)$ m s^{-1}.

Find the time at which the acceleration of the particle is zero.

(Total for question 5 is 3 marks)

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6 A particle P moves on the x axis. The acceleration of P at time t seconds is $(6t - 24)$ m s^{-2} measured in the positive x direction. Initially the particle is at O with a velocity of 60 m s^{-1}.

(a) Show that the particle will never travel in the negative x direction. **(3)**

(b) Find the distance travelled by the particle in the first 10 seconds. **(3)**

(Total for question 6 is 6 marks)

7 A particle P moves in a straight line such that at t seconds, $t \geq 0$, its velocity, v ms^{-1} is given by:

$$v = 12 - 2t^2$$

Find:

(a) the distance travelled by P in the first second, **(3)**

(b) the value of t when P changes direction of motion, **(2)**

(c) the value of t at the instant P returns to its starting point. **(3)**

(Total for question 7 is 8 marks)

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8 A particle P travels along a straight line through a point O so that at time t s after passing through O its displacement from O is x m, where $x = t^3 - 15t^2 + 62t$

Find

(a) the initial velocity of P, **(3)**

(b) the value of t for which P has zero acceleration. **(2)**

(Total for question 8 is 5 marks)

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9 A particle P travels along a straight line through a point O so that at time t s after passing through O its displacement from O is x m, where $x = 2t^3 - 18t^2 + 48t$

Find

(a) the times when P is instantaneously at rest, **(3)**

(b) the total distance travelled in the first 5 seconds. **(5)**

(Total for question 9 is 8 marks)

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10 A particle P moves on the x axis.
The acceleration of P at time t seconds, $t \geq 0$, is $(3t + 5)$ m s^{-2} in the positive x direction.
When $t = 0$, the velocity of P is 2 m s^{-1} in the positive x direction.
When $t = $ T, the velocity of P is 6 m s^{-1} in the positive x direction.
Find the value of T.

(Total for question 10 is 6 marks)

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11 The displacement of a particle P from the origin after t seconds is given by s = $t^2(t + k)$ m
Given P is at instantaneous rest when $t = 4$.

Find the acceleration of P when $t = 10$.

(Total for question 11 is 8 marks)

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12 The velocity of a particle after t seconds is given by $v = (6t - 2t^2)$ m s^{-1}.
When $t = 0$ the particle is at the origin O.

Find an the distance of the particle from O when the particle comes to instantaneous rest.

(Total for question 12 is 5 marks)