OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

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I declare this is my own work.

INTERNATIONAL AS
MATHEMATICS

(9660/MA01) Unit P1 Pure Mathematics

Monday 3 January 2022 07:00 GMT Time allowed: 1 hour 30 minutes

Materials
- For this paper you must have the Oxford International AQA Booklet of Formulae and Statistical Tables (enclosed).
- You may use a graphical calculator.

Instructions
- Use black ink or black ball-point pen. Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- Show all necessary working; otherwise marks may be lost.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

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Answer **all** questions in the spaces provided.

1 The curve C with equation $y = (x-7)^2 - 35$ has a vertex at the point (p, q)

1 (a) (i) State the value of p

Circle your answer.

[1 mark]

-35 -7 7 35

1 (a) (ii) State the value of q

Circle your answer.

[1 mark]

-35 -7 7 35

1 (b) The curve C is mapped onto the curve D by a reflection in the y-axis.

Find the equation of D

Give your answer in the form $y = x^2 + bx + c$ where b and c are integers.

[2 marks]

Answer _____

4

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2 (a) The constants a and b satisfy the equations

$$\left(7^4\right)^a = 49 \quad \text{and} \quad \frac{3^{13a}}{3^{8b}} = 81$$

Find the value of a and the value of b

[3 marks]

$a =$ _____ $b =$ _____

2 (b) Simplify

$$3x^5 \times \frac{2}{y^9} \times \sqrt[4]{16x^{12}y^8}$$

Give your answer in the form $kx^m y^n$ where k, m and n are constants.

[3 marks]

Answer _____

6

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3 It is given that

$$f(x) = x^3 + 9x^2 + 15x + k$$

where k is a constant.

When $f(x)$ is divided by $(x-6)$ the remainder is 605

3 (a) Use the Remainder Theorem to show that $k = -25$

[2 marks]

3 (b) $f(x)$ can be written in the form $f(x) = (x-1)(x^2 + bx + c)$, where b and c are constants and $b > 0$

3 (b) (i) Write down the value of c

[1 mark]

$c =$ _____

3 (b) (ii) The discriminant of $x^2 + bx + c$ is zero.

Use this to find the value of b

[2 marks]

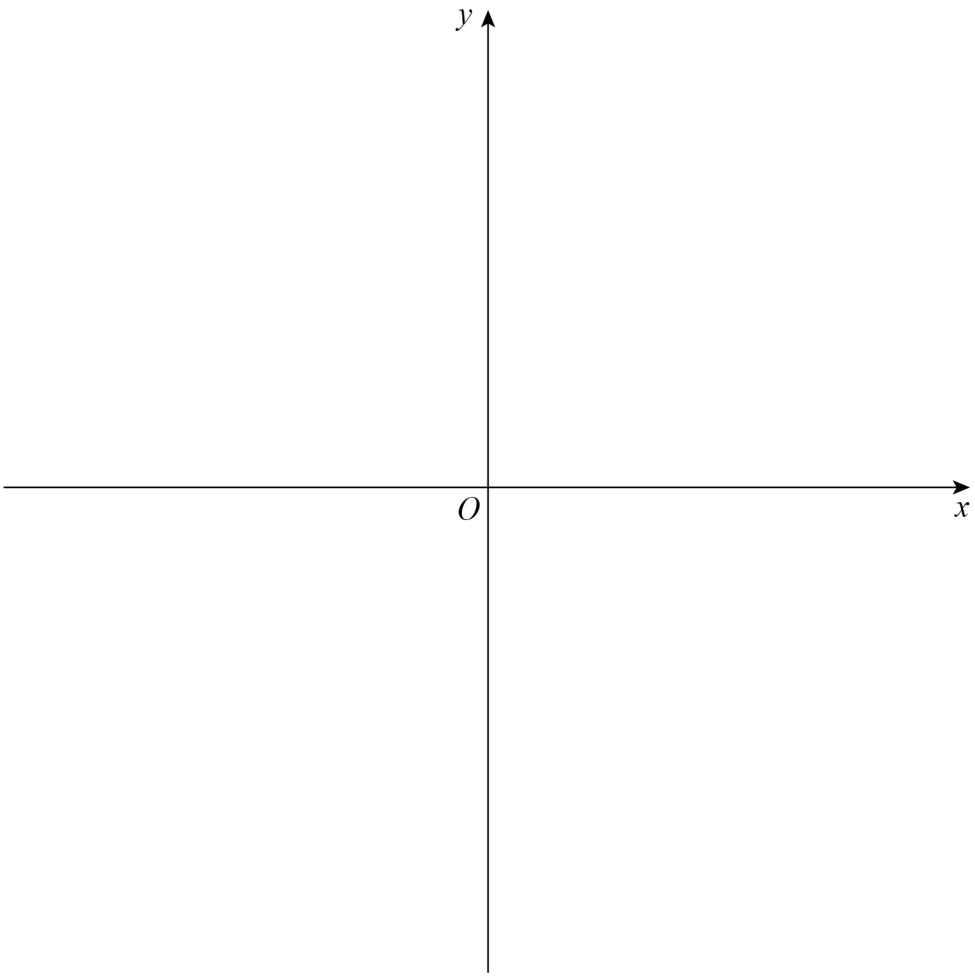
$b =$ _____

Do not write outside the box

3 (c) Sketch the graph of $y = \mathrm{f}(x)$ on the axes below.

Include on your sketch the coordinates of any points where the curve cuts or touches the axes.

[3 marks]



8

Turn over for the next question

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4 A car manufacturer produced electric cars as part of a project.

Production of cars started in Month 1 in which a cars were produced.

The number of cars produced each month forms an arithmetic sequence with first term a and common difference d

The number of cars produced in Month 19 is equal to half the number of cars produced in Month 3

There were 252 cars produced in Month 14

4 (a) Find the value of a and the value of d

[4 marks]

$a =$ _____ $d =$ _____

Do not write outside the box

4 (b) Production of cars stopped at the end of Month 34

Find the total number of cars produced over the 34-month period.

[2 marks]

Answer _____

6

Turn over for the next question

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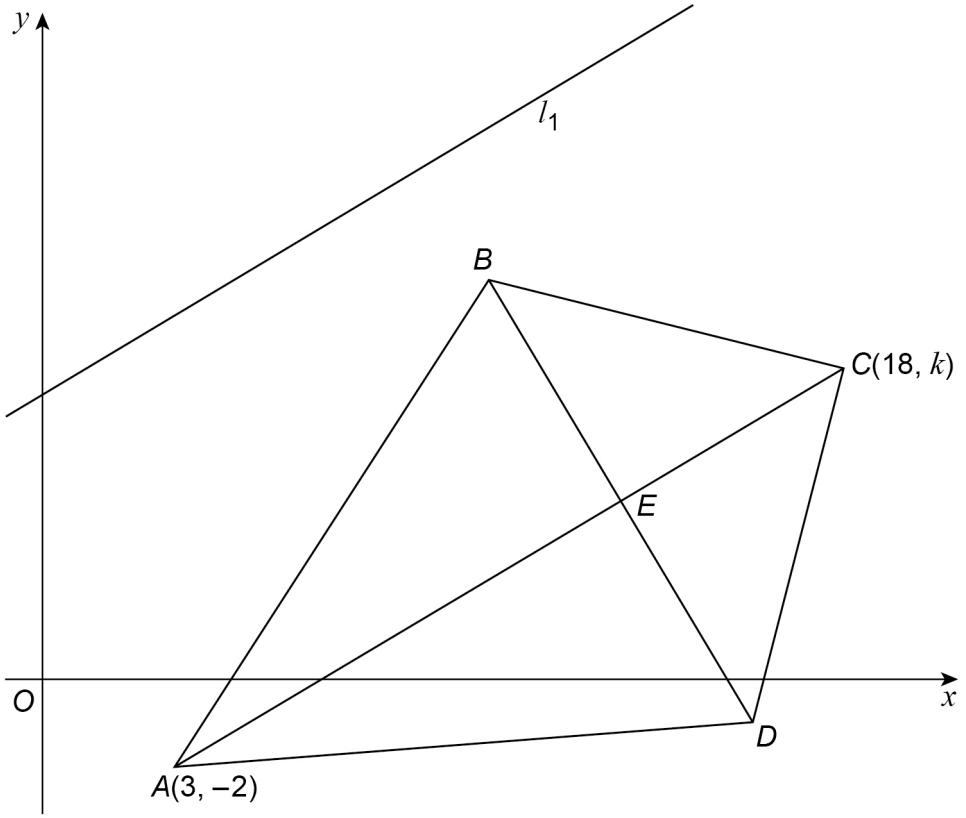
5 The line l_1 and the kite with vertices at the points A, B, C and D are shown in the diagram below.



The coordinates of A are $(3, -2)$

The coordinates of C are $(18, k)$ where k is a constant.

The line segments AC and BD intersect at the point E

The line l_1 has equation $5y - 3x = 32$

The line segment AC is parallel to l_1

5 (a) Show that $k = 7$

[3 marks]

Do not write outside the box

5 (b) The point E has coordinates $(13, 4)$ and the line BC has length $2\sqrt{17}$

[AC is the perpendicular bisector of BD for the kite $ABCD$]

5 (b) (i) Show that the lines BE and CE are equal in length.

[3 marks]

5 (b) (ii) Find the coordinates of B and the coordinates of D

[3 marks]

B _____ D _____

Question 5 continues on the next page

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5 (b) (iii) The line l_2 passes through the points B and D

Find the coordinates of the point at which l_1 and l_2 intersect.

[5 marks]

Answer _____

14

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Turn over for the next question

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6 The curve C is such that any point (x, y) on C satisfies the equation

$$\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 4x - 5$$

6 (a) The point P lies on C

P is a stationary point and at P, $\frac{\mathrm{d}^2y}{\mathrm{d}x^2} = 11$

6 (a) (i) State with a reason whether P is a minimum point or a maximum point.

[1 mark]

6 (a) (ii) It is given that $\frac{\mathrm{d}y}{\mathrm{d}x} = 2x^2 - 5x + d$

Show that $d = -12$

[2 marks]

Do not write outside the box

6 (b) The point $Q(a, 14)$, where $a > 0$, lies on C

The normal to C at Q has gradient $-\frac{1}{30}$

Find the equation of C

[7 marks]

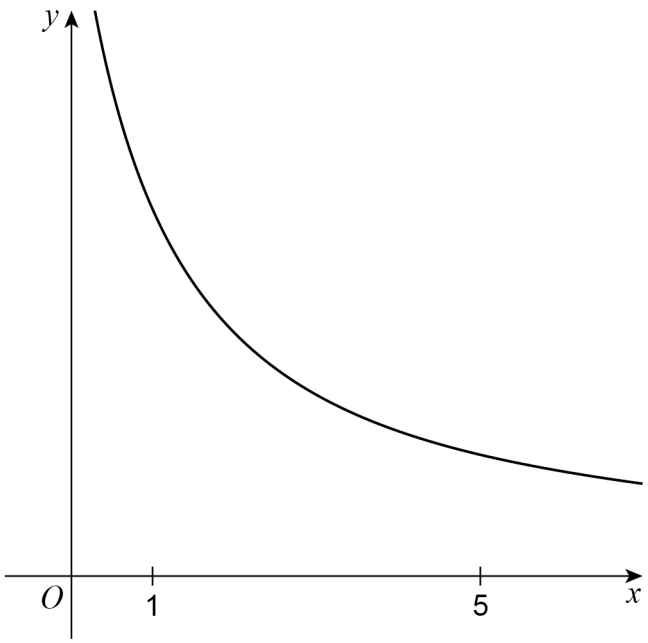
Answer _____

10

Turn over ►

Do not write outside the box

7 The diagram shows part of the curve with equation $y = \dfrac{k}{x+1}$ where $k > 0$



When the trapezium rule with five ordinates (four strips) is used the value obtained for $\displaystyle\int_1^5 \frac{k}{x+1}\,\mathrm{d}x$ is 14.07

7 (a) Find the value of k

[4 marks]

Do not write outside the box

$k =$ _____

7 (b) (i) State with a reason whether the value of 14.07 is an over-estimate or an under-estimate of the actual value of $\int_1^5 \frac{k}{x+1}\,\mathrm{d}x$

[2 marks]

7 (b) (ii) Explain how, while still using the trapezium rule, a better approximation to the actual value of $\int_1^5 \frac{k}{x+1}\,\mathrm{d}x$ could be found.

[1 mark]

7

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8 (a) The function f is defined by

$$\mathrm{f}(x) = x^3 - 6x^2 + 57x - 9$$

8 (a) (i) Find $\mathrm{f}'(x)$

[1 mark]

$\mathrm{f}'(x) =$ _____

8 (a) (ii) By writing your expression for $\mathrm{f}'(x)$ in the form $a(x+b)^2 + c$, where a, b and c are integers, prove that f is an increasing function for all real values of x

[5 marks]

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8 (b) The point $P(16, 13)$ lies on the curve with equation

$$y = \frac{1}{4}x^{\frac{3}{2}} + 16x^{-\frac{1}{2}} - 7 \quad \text{where} \quad x > 0$$

Find the exact coordinates of the point where the tangent to the curve at P intersects the x-axis.

[5 marks]

Answer _____

11

Turn over ►

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9 The first four terms in ascending powers of x in the expansion of $(1+ax)^n$ are

$$1-\frac{14}{5}x+\frac{84}{25}x^2-bx^3$$

where a and b are non-zero constants and n is a positive integer.

Show that $n=7$ and find the value of a and the value of b

[7 marks]

Do not write outside the box

$a =$ _____ $b =$ _____

7

Turn over for the next question

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10 In a geometric series the first term is 12 and the second term is $8 - x$

The sum to infinity of this geometric series has a finite value.

10 (a) Find the possible values of x

[3 marks]

Answer _____

10 (b) In the case when x must also be positive, find the possible values of the sum to infinity of the geometric series.

[4 marks]

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Answer _____

7

END OF QUESTIONS

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