AQA

Please write clearly in block capitals.

Centre number | | | | | |

Candidate number | | | | |

Surname ____________________

Forename(s) ____________________

Candidate signature ____________________

AS
MATHEMATICS

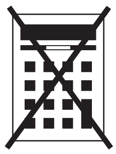
Unit Pure Core 1 Non-Calculator

Wednesday 16 May 2018 Morning Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- the blue AQA booklet of formulae and statistical tables.

You must **not** use a calculator.



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

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.
- Write the question part reference (eg (a), (b)(i) etc) in the left-hand margin.
- You must answer each question in the space provided for that question. If you require extra space, use an AQA supplementary answer book; do **not** use the space provided for a different question.
- Do not write outside the box around each page.
- Show all necessary working; otherwise marks for method may be lost.
- Do all rough work in this book. Cross through any work that you do not want to be marked.
- The use of calculators is **not** permitted.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Advice
- Unless stated otherwise, you may quote formulae, without proof, from the booklet.
- You do not necessarily need to use all the space provided.

Answer **all** questions.

Answer each question in the space provided for that question.

1 (a) Simplify $\sqrt{98} - \sqrt{32}$, giving your answer in the form $k\sqrt{2}$, where k is an integer.

[2 marks]

(b) Hence, or otherwise, express $\dfrac{\sqrt{98} - \sqrt{32}}{2 + 3\sqrt{2}}$ in the form $p + q\sqrt{2}$, giving the rational numbers p and q in their simplest form.

[4 marks]

QUESTION PART REFERENCE

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QUESTION PART REFERENCE	Answer space for question 1

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2 The point P has coordinates $(-2, 3)$. The line QR has equation $7x + 5y - 2 = 0$.

(a) (i) Find the gradient of the line QR.

[1 mark]

(ii) Find the equation of the line which passes through the point P and which is perpendicular to the line QR. Give your answer in the form $ax + by + c = 0$, where a, b and c are integers.

[3 marks]

(b) The line with equation $5x - 3y + 15 = 0$ intersects the line QR at the point S. Find the coordinates of S in their simplest form.

[3 marks]

(c) The point T with coordinates $(k + 3, 5 - k)$ is such that PT has length 13. Find the possible values of k.

[4 marks]

QUESTION PART REFERENCE

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3 The polynomial $\mathrm{p}(x)$ is given by $\mathrm{p}(x) = x^3 - 7x^2 - 5x + 26$.

(a) (i) Use the Factor Theorem to show that $x + 2$ is a factor of $\mathrm{p}(x)$.

[2 marks]

(ii) Express $\mathrm{p}(x)$ in the form $(x+2)(x^2 + bx + c)$, where b and c are integers.

[2 marks]

(b) A curve has equation $y = x^3 - 7x^2 - 5x + 26$.

(i) Use the result from part **(a)(ii)** to determine the number of times the curve crosses the x-axis.

[2 marks]

(ii) Find $\frac{\mathrm{d}y}{\mathrm{d}x}$ and $\frac{\mathrm{d}^2y}{\mathrm{d}x^2}$.

[3 marks]

(iii) Hence show that the curve has a maximum point when $x = -\frac{1}{3}$.

[3 marks]

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QUESTION PART REFERENCE

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4 The quadratic equation

$$(k+1)x^2 + (5k-3)x + 3k = 0$$

has equal roots. Find the possible values of k.

[5 marks]

QUESTION PART REFERENCE

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5 A circle with centre $C(7, -8)$ passes through the point $P(2, -2)$.

(a) Find the gradient of the normal to the circle at the point P.

[2 marks]

(b) Find the equation of the circle in the form

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

[3 marks]

(c) The point Q is the point on the circle that is closest to the x-axis.
Find the exact value of the y-coordinate of Q.

[2 marks]

(d) The point R also lies on the circle. The length of the chord PR is 8. Show that the shortest distance from C to PR is $n\sqrt{5}$, where n is an integer.

[3 marks]

QUESTION PART REFERENCE

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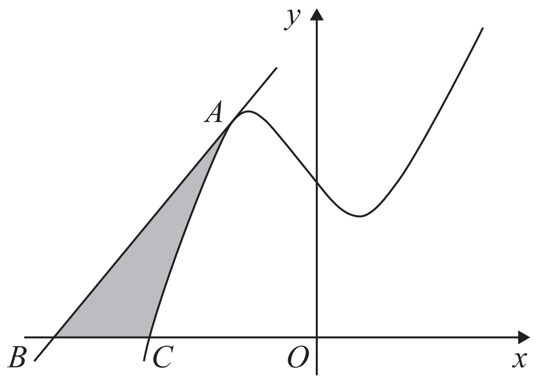
6 The diagram shows the sketch of a curve and the tangent to the curve at A.



The curve has equation $y = 3x^3 - 7x + 10$ and the point $A(-1,\ 14)$ lies on the curve. The tangent at A crosses the x-axis at B.

(a) (i) Find an equation of the tangent to the curve at the point A.

[5 marks]

(ii) Hence find the coordinates of B.

[1 mark]

(b) (i) Find the value of $\int_{-2}^{-1} (3x^3 - 7x + 10)\,dx$.

[5 marks]

(ii) The curve crosses the x-axis at the point $C(-2,\ 0)$. Calculate the area of the shaded region bounded by the curve between A and C and the lines AB and BC.

[3 marks]

QUESTION PART REFERENCE

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7 A curve C has equation $y = 2x^2 - 5x + 4$.

(a) (i) Express $2x^2 - 5x + 4$ in the form $2(x-p)^2 + q$ where p and q are rational numbers.

[2 marks]

(ii) Write down the equation of the line of symmetry of the curve C.

[1 mark]

(iii) Write down the equation of the tangent to the curve C at its vertex.

[1 mark]

(b) The curve C is mapped onto the curve with equation $y = 2x^2 + ax + b$ by the translation with vector $\begin{bmatrix} 3 \\ -8 \end{bmatrix}$. Find the values of a and b.

[4 marks]

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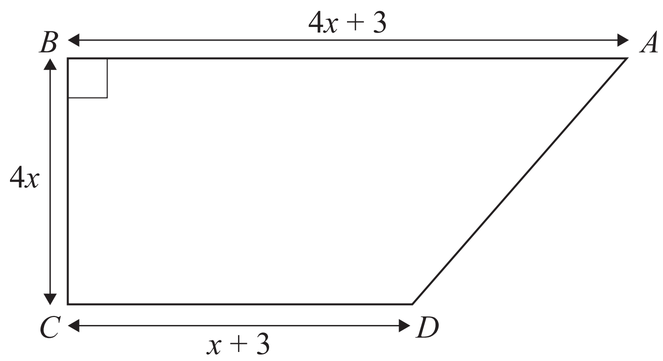
8 (a) Solve the inequality $5x^2 + 6x < 63$.

[4 marks]

(b) The diagram below shows a garden $ABCD$ in the shape of a trapezium.



The sides BA and CD are parallel and angle ABC is a right angle. The sides AB, BC and CD have lengths $(4x + 3)$ metres, $4x$ metres and $(x + 3)$ metres, respectively, as indicated on the diagram.

The area of the garden must be less than 126 square metres.

(i) Show that $5x^2 + 6x < 63$.

[1 mark]

(ii) Find an expression for the perimeter of the garden, giving your answer in the form $(ax + b)$ metres.

[1 mark]

(iii) In addition to the constraint on the area, the perimeter of the garden must be at least 30 metres. Find the possible values of x.

[3 marks]

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END OF QUESTIONS