Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Factors and polynomials

Time allowed: 1 hour 45 minutes

Subject code **0606**

Additional Mathematics

Questions from Paper 1 and Paper 2

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.
Questions 3-7, 10 (Paper 1): no calculator.
Questions 1-2, 8-9 (Paper 2): calculator allowed.

Total marks

/ 70

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.
- Unless a question says otherwise, give answers that are not exact to 3 significant figures, and angles in degrees to 1 decimal place.

Information

- This paper has 10 questions worth 70 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 It is given that $\mathrm{p}(x) = ax^3 - 7x^2 - bx + 9$, where a and b are constants.
$x - 3$ is a factor of $\mathrm{p}(x)$.
When $\mathrm{p}(x)$ is divided by $x + 2$ the remainder is -35.

Find the values of a and b. [5]

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2 DO NOT USE A CALCULATOR IN THIS QUESTION.

The polynomial p is defined by $\mathrm{p}(x) = ax^3 - 3x^2 - 3x + b$, where a and b are constants.

(a) Given that $x = 2$ and $x = -1$ are roots of the equation $\mathrm{p}(x) = 0$, find a and b. [3]

(b) Solve the equation $\mathrm{p}(x) = 0$. [2]

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3 The polynomial p is such that $p(x) = x^3 + Ax + 30$, where A is a constant.
When $p(x)$ is divided by $x + 2$ the remainder is 84.

Write $p(x)$ as a product of linear factors. [5]

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4 The function f is such that $f(x) = 4x^3 - 8x^2 + ax + b$, where a and b are constants. It is given that $2x - 1$ is a factor of $f(x)$ and that when $f(x)$ is divided by $x + 2$ the remainder is 20. Find the remainder when $f(x)$ is divided by $x - 1$. [6]

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5 DO NOT USE A CALCULATOR IN THIS QUESTION.

The polynomial p is such that $\mathrm{p}(x) = 6x^3 - 35x^2 + 34x + 45$.

(a) Find $\mathrm{p}(x)$ in the form $(2x-5)\mathrm{q}(x) + r$, where $\mathrm{q}(x)$ is a polynomial and r is a constant. [3]

(b) Hence write the expression $\mathrm{p}(x) - 5$ as a product of linear factors. [2]

(c) Hence write down the solutions of the equation $\mathrm{p}(x) = 5$. [1]

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6 The polynomial p is such that $\mathrm{p}(x) = ax^3 + 11x^2 + bx + c$, where a, b and c are integers.
It is given that $\mathrm{p}'(0) = 12$.
It is also given that $x + 3$ is a factor of p.
When p is divided by $x - 1$ the remainder is 16.

Find the values of a, b and c. [6]

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7 The polynomial P is given by $\mathrm{P}(x) = ax^3 + bx^2 + 3x + 2$, where a and b are integers. $\mathrm{P}(x)$ has a factor of $2x + 1$. $\mathrm{P}(x)$ has a remainder of -6 when divided by $x + 1$.

(a) Find the values of a and b. [5]

(b) Show that the equation $\mathrm{P}(x) = 0$ has only one real root. [3]

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8 The cubic equation $x^3 + ax^2 + bx - 36 = 0$ has a repeated positive integer root.

(i) If the repeated root is $x = 3$ find the other positive root and the value of a and of b. [4]

(ii) There are other possible values of a and b for which the cubic equation has a repeated positive integer root. In each case state all three integer roots of the equation. [4]

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9 Do not use a calculator in this question.

The line $y = 4x - 6$ intersects the curve $y = 10x^3 - 19x^2 - x$ at the points A, B, and C. Given that C is the point (2, 2), find the coordinates of the midpoint of AB. [10]

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10 A function f is such that $f(x) = 4x^3 + 4x^2 + ax + b$. It is given that $2x - 1$ is a factor of both $f(x)$ and $f'(x)$.

(i) Show that $b = 2$ and find the value of a. [5]

Using the values of a and b from part **(i)**,

(ii) find the remainder when $f(x)$ is divided by $x + 3$, [2]

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(iii) express $f(x)$ in the form $f(x) = (2x - 1)(px^2 + qx + r)$, where p, q and r are integers to be found, [2]

(iv) find the values of x for which $f(x) = 0$. [2]

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