1.11 Pure: Algebra and Functions Depth: 1-hour Pack

EDEXCEL 9MA0 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Find the remainder when $g(x) = 2x^3 - 5x^2 + 3$ is divided by $(x + 2)$.

(Total for Question 1 is 2 marks)

2 $f(x) = (x - 3)^2 + 5$, for $x \geq 3$. State the range of f.

(Total for Question 2 is 2 marks)

3 State the values of x for which $7 / ((x-2)(x+5))$ is not defined.

(Total for Question 3 is 1 mark)

4 Solve $|x - 4| = 7$.

(Total for Question 4 is 1 mark)

5 Simplify fully $(x^2 - 9) / (x - 3)$, for $x \neq 3$.

(Total for Question 5 is 1 mark)

6 $f(x) = x^3 - 2x^2 - 5x + 6$.

(a) Show that $(x - 1)$ is a factor of f(x). **(2)**

(b) Hence fully factorise f(x). **(2)**

(Total for Question 6 is 4 marks)

7 $h(x) = x^3 + kx^2 - 7x - 2$, where k is a constant. Given that $(x + 2)$ is a factor of h(x), find the value of k.

(Total for Question 7 is 3 marks)

8 Solve the equation $|3x - 2| = x + 4$.

(Total for Question 8 is 3 marks)

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9 $f(x) = 2x^2 - 12x + 7$, for $x \leq 1$.

(a) Express $f(x)$ in the form $a(x-p)^2 + q$, stating the values of a, p and q. **(2)**

(b) State the range of f, given the domain $x \leq 1$. **(2)**

(Total for Question 9 is 4 marks)

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10 $(x + 1)/(x - 1) - (x - 1)/(x + 1)$, x not equal to 1 or -1.

(a) Show that $(x + 1)/(x - 1) - (x - 1)/(x + 1)$ can be written as $4x/(x^2 - 1)$. **(4)**

(b) Hence solve $(x + 1)/(x - 1) - (x - 1)/(x + 1) = 3$, giving your answer(s) as exact simplified surds. **(4)**

(Total for Question 10 is 8 marks)

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11 $f(x) = x^3 + px^2 + qx - 4$, where p and q are constants. When $f(x)$ is divided by $(x - 1)$ the remainder is -10, and when $f(x)$ is divided by $(x - 3)$ the remainder is -16.

(a) Show that p and q satisfy the simultaneous equations $p + q = -7$ and $9p + 3q = -39$. **(3)**

(b) Hence find the values of p and q. **(3)**

(c) Find the remainder when $f(x)$ is divided by $(x - 1)$. **(2)**

(Total for Question 11 is 8 marks)

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12 $(3x^2 - x + 4) / ((x + 1)(x - 1)^2) = A/(x + 1) + B/(x - 1) + C/(x - 1)^2$.

(a) Find the values of the constants A, B and C. **(6)**

(b) Explain why the partial fraction expression requires no additional polynomial term. **(2)**

(c) Find the exact value of $(3x^2 - x + 4) / ((x + 1)(x - 1)^2)$ when $x = 2$, using the partial fraction form, and verify using the original expression. **(3)**

(Total for Question 12 is 11 marks)

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Mark scheme · 1.11 Pure: Algebra and Functions Depth: 1-hour Pack

Question 1

substitutes x = -2 into g(x) **M1**

remainder = -33 cao **A1**

Answer: -33

Question 2

recognises the vertex of f is at (3, 5) **M1**

f(x) ≥ 5 cao **A1**

Answer: f(x) ≥ 5

Question 3

x = 2 and x = -5 **B1**

Answer: x = 2, x = -5

Question 4

x = 11 or x = -3, both values **B1**

Answer: x = 11 or x = -3

Question 5

x + 3 cao **B1**

Answer: x + 3

Question 6

(a) substitutes x = 1 into f(x) **M1**

(a) f(1) = 0, so (x-1) is a factor, cso **A1**

(a) Answer: f(1) = 0, so (x-1) is a factor

(b) divides f(x) by (x-1) (or uses inspection) to find the quadratic factor $x^2 - x - 6$ **M1**

(b) f(x) = (x-1)(x-3)(x+2) cao **A1**

(b) Answer: f(x) = (x-1)(x-3)(x+2)

Question 7

substitutes x = -2 into h(x) and sets the result equal to 0 **M1**

forms the equation 4k + 4 = 0 oe **A1**

k = -1 cao **A1**

Answer: k = -1

Question 8

solves 3x - 2 = x + 4 to get x = 3 **M1**

solves 3x - 2 = -(x + 4) to get x = -0.5 **M1**

both values checked as valid in the original equation, x = 3 or x = -0.5 cao **A1**

Answer: x = 3 or x = -0.5

Question 9

(a) completes the square: $2(x^2-6x) + 7 = 2[(x-3)^2-9] + 7$ **M1**

(a) $2(x-3)^2 - 11$, so a=2, p=3, q=-11 **A1**

(a) Answer: $f(x) = 2(x-3)^2 - 11$

(b) evaluates f(1) = -3 (or uses the vertex form) and recognises f is decreasing throughout x ≤ 1, since the vertex is at x=3 **M1**

(b) f(x) ≥ -3 cao **A1**

(b) Answer: f(x) ≥ -3

Question 10

(a) writes over the common denominator (x-1)(x+1): $[(x+1)^2 - (x-1)^2] / [(x-1)(x+1)]$ **M1**

(a) expands both squares: $(x^2+2x+1) - (x^2-2x+1)$ **M1**

(a) numerator simplifies to 4x **A1**

(a) denominator (x-1)(x+1) = x^2-1, giving $4x/(x^2-1)$, cso **A1**

(a) Answer: $4x / (x^2 - 1)$, as required

(b) uses the result from part (a) to form $4x/(x^2-1) = 3$ **M1**

(b) rearranges to $3x^2 - 4x - 3 = 0$ oe **M1**

(b) applies the quadratic formula: $x = (4 \pm \sqrt{16+36}) / 6$ **M1**

(b) $x = (2 \pm \sqrt{13}) / 3$ oe cao, both values valid since neither equals 1 or -1 **A1**

(b) Answer: $x = (2 + \sqrt{13})/3$ or $x = (2 - \sqrt{13})/3$

Question 11

(a) uses the remainder theorem: f(1) = -10 **M1**

(a) p + q = -7 **A1**

(a) f(3) = -16 gives 9p + 3q = -39 (cso) **A1**

(a) Answer: equations as stated

(b) solves the pair of simultaneous equations (elimination or substitution) **M1**

(b) p = -3 **A1**

(b) q = -4 **A1**

(b) Answer: p = -3, q = -4

(c) evaluates f(1) **M1**

(c) remainder = -10 **A1**

(c) Answer: -10

Question 12

(a) forms the identity $3x^2 - x + 4 = A(x-1)^2 + B(x+1)(x-1) + C(x+1)$ **M1**

(a) substitutes x = 1 to find C **M1**

(a) C = 3 **A1**

(a) substitutes x = -1 to find A **M1**

(a) A = 2 **A1**

(a) B = 1 oe, found by comparing coefficients of x^2 (or a further substitution) **A1**

(a) Answer: A = 2, B = 1, C = 3

(b) identifies that the numerator has degree 2 and the denominator has degree 3 **B1**

(b) states that, since 2 < 3, the fraction is already proper, so no polynomial division / extra term is needed oe **B1**

(b) Answer: The numerator $3x^2 - x + 4$ has degree 2 and the denominator $(x+1)(x-1)^2$ has degree 3; since 2 < 3, the fraction is proper and no extra polynomial term is required

(c) substitutes x = 2 into the partial fraction form $2/(x+1) + 1/(x-1) + 3/(x-1)^2$ **M1**

(c) value = 14/3 cao **A1**

(c) verifies using the original expression: (3(4)-2+4)/((3)(1)) = 14/3 **B1**

(c) Answer: 14/3

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