1.2 Pure: Algebra and Functions: 1-hour Pack

EDEXCEL 9MA0 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Simplify $\sqrt{75}$, giving your answer in the form $k\sqrt{3}$.

(Total for Question 1 is 1 mark)

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2 The function f is defined by $f(x) = (x - 3)^2 - 4$, x is real.

(a) State the coordinates of the turning point of the graph of $y = f(x)$, and hence state the range of f. **(2)**

(b) The function g is defined by $g(x) = f(x - 2) + 5$, x is real. Describe fully the two geometric transformations that map the graph of $y = f(x)$ onto the graph of $y = g(x)$, and hence state the coordinates of the turning point of $y = g(x)$. **(4)**

(c) Given that $h(x) = |f(x)|$, find the set of values of x for which $h(x) = f(x)$. **(3)**

(Total for Question 2 is 9 marks)

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3 Solve the inequality $3x^2 - 11x - 4 \leq 0$.

(Total for Question 3 is 3 marks)

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4 The line l has equation $y = 7x - 15$ and the curve C has equation $y = x^2 - x - 3$. The line meets the curve at the points A and B.

(a) Show that the x coordinates of A and B satisfy $x^2 - 8x + 12 = 0$. **(2)**

(b) Hence find the coordinates of A and B. **(3)**

(c) Find the exact length of AB. **(3)**

(Total for Question 4 is 8 marks)

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5 Prove each of the following results using an appropriate method of proof.

(a) Prove that $x^2 - 6x + 11 > 0$ for all real values of x. **(3)**

(b) Prove, by contradiction, that there is no smallest positive rational number. **(3)**

(Total for Question 5 is 6 marks)

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6 $f(x) = 2x^3 + x^2 - 13x + 6$.

(a) Use the factor theorem to show that (x - 2) is a factor of f(x). **(2)**

(b) Hence factorise f(x) completely. **(4)**

(c) Solve $f(x) = 0$, and hence find the set of values of x for which $f(x) > 0$. **(4)**

(Total for Question 6 is 10 marks)

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7 The curve C has equation $y = x^2 - 4x + 1$. The line l has equation $y = 2x - 7$. Find the coordinates of the point(s) where l intersects C.

(Total for Question 7 is 4 marks)

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8 $(2x^2 - 3x + 4)/((x-2)^2(x+1)) = A/(x-2) + B/(x-2)^2 + C/(x+1)$

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

(b) Express $(9x + 1)/((x-3)(2x+1))$ in the form $A/(x-3) + B/(2x+1)$, finding integer values of A and B. **(4)**

(Total for Question 8 is 10 marks)

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Mark scheme · 1.2 Pure: Algebra and Functions: 1-hour Pack

Question 1

$5\sqrt{3}$ cao	**B1**

Answer: $5\sqrt{3}$

Question 2

(a) turning point (3, -4)	**B1**
(a) range f(x) ≥ -4 (ft from turning point)	**B1ft**

(a) Answer: turning point (3, -4); range f(x) ≥ -4

(b) translation by vector (2, 0), i.e. 2 units in the positive x-direction	**B1**
(b) translation by vector (0, 5), i.e. 5 units in the positive y-direction	**B1**
(b) both transformations correctly described together (order not required to be justified)	**B1**
(b) turning point of g is (5, 1) (ft from part a translated correctly)	**A1ft**

(b) Answer: translations (2,0) then (0,5); turning point of g is (5, 1)

(c) recognises h(x) = f(x) requires f(x) ≥ 0	**M1**
(c) solves $(x-3)^2 \geq 4$ correctly, e.g. x - 3 ≤ -2 or x - 3 ≥ 2	**M1**
(c) x ≤ 1 or x ≥ 5 cao	**A1**

(c) Answer: x ≤ 1 or x ≥ 5

Question 3

factorises $3x^2 - 11x - 4$ as (3x + 1)(x - 4)	**M1**
critical values x = -1/3 and x = 4	**A1**
-1/3 ≤ x ≤ 4 cao, correct inequality direction	**A1**

Answer: -1/3 ≤ x ≤ 4

Question 4

(a) equates the two expressions for y	**M1**
(a) rearranges to $x^2 - 8x + 12 = 0$ (cso)	**A1**

(a) Answer: $x^2 - 8x + 12 = 0$

(b) solves the quadratic by factorising or the formula	**M1**
(b) x = 2 and x = 6	**A1**
(b) y values -1 and 27, giving (2, -1) and (6, 27)	**A1**

(b) Answer: A(2, -1), B(6, 27)

(c) uses the distance formula	**M1**
(c) $AB^2 = 16 + 784 = 800$	**M1**
(c) $AB = 20\sqrt{2}$	**A1**

(c) Answer: $AB = 20\sqrt{2}$

Question 5

(a) completes the square: $(x - 3)^2 + 2$	**M1**
(a) correct completed square form $(x-3)^2 + 2$	**A1**
(a) valid conclusion: $(x-3)^2 \geq 0$ for all real x, so expression ≥ 2 > 0, cso	**A1**

(a) Answer: $x^2 - 6x + 11 = (x-3)^2 + 2 \geq 2 > 0$ (proved)

(b) states the assumption for contradiction: suppose q is the smallest positive rational number	**M1**
(b) constructs a valid smaller positive rational, e.g. q/2, and justifies it is rational and positive	**M1**
(b) correct contradiction stated: q/2 < q contradicts q being smallest, so no smallest positive rational exists, cso	**A1**

(b) Answer: no smallest positive rational number exists (proved by contradiction)

Question 6

(a) substitutes x = 2 into f(x)	**M1**
(a) f(2) = 0, so (x-2) is a factor, cso	**A1**

(a) Answer: f(2) = 0, so (x-2) is a factor (shown)

(b) divides f(x) by (x-2), or compares coefficients, to obtain quadratic factor $2x^2 + 5x - 3$	**M1**
(b) correct quadratic factor $2x^2 + 5x - 3$	**A1**
(b) factorises the quadratic factor	**M1**
(b) f(x) = (x-2)(2x-1)(x+3) cao, fully factorised	**A1**

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

(c) roots x = -3, x = 1/2, x = 2 identified	**B1**
(c) considers the sign of f(x) in each of the four regions determined by the roots	**M1**
(c) -3 < x < 1/2 identified as part of the solution set	**A1**
(c) x > 2 identified, giving full solution -3 < x < 1/2 or x > 2, oe	**A1**

(c) Answer: -3 < x < 1/2 or x > 2

Question 7

sets $x^2 - 4x + 1 = 2x - 7$	**M1**
rearranges to $x^2 - 6x + 8 = 0$	**M1**
x = 2 and x = 4 (factorises or uses the quadratic formula)	**A1**
coordinates (2, -3) and (4, 1), both correct	**A1**

Answer: (2, -3) and (4, 1)

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Question 8

(a) sets up correct identity $2x^2-3x+4 = A(x-2)(x+1) + B(x+1) + C(x-2)^2$ **M1**

(a) substitutes x = 2 into the identity **M1**

(a) B = 2 **A1**

(a) substitutes x = -1 into the identity **M1**

(a) C = 1 **A1**

(a) A = 1, found by comparing coefficients or a further substitution, cao **A1**

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

(b) sets up correct identity 9x + 1 = A(2x+1) + B(x-3) **M1**

(b) substitutes a suitable value, e.g. x = 3 or x = -1/2 **M1**

(b) A = 4 **A1**

(b) B = 1 **A1**

(b) Answer: A = 4, B = 1

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