8.2 Transforming Graphs y=f(x): Test Pack

EDEXCEL 1MA1 · Calculator allowed · about 60 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Write down the equation of the graph obtained by translating the graph y = f(x) up by 3 units.

(Total for Question 1 is 1 mark)

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2 The graph y = g(x) is defined by g(x) = -f(x) - 3. State the two transformations that map y = f(x) to y = g(x).

(Total for Question 2 is 2 marks)

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3 The point (1, 4) lies on y = f(x). Describe the sequence of transformations and find the coordinates of the image of (1, 4) on the graph y = f(-(x - 2)).

(Total for Question 3 is 3 marks)

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4 The function h is defined by $h(x) = x^2 - 8x + 10$.

(a) Find $h(x) + 9$, giving your answer in the form $x^2 + bx + c$. **(2)**

.....

(b) Show that the equation $h(x) + 9 = 0$ has no real roots. **(3)**

(Total for Question 4 is 5 marks)

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5 Transformations can be described using column vectors.

(a) The graph of $y = f(x)$ is translated by the vector $(4, -7)$ to give the graph of $y = g(x)$. Write down an expression for $g(x)$ in terms of $f(x)$. **(2)**

.....

(b) The graph of $y = f(x)$ is translated to give $y = f(x + 3) + 2$. Write down the column vector of this translation. **(2)**

.....

(Total for Question 5 is 4 marks)

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6 The curve y = f(x) has a line of symmetry x = 3.

(a) State the equation of the line of symmetry of the curve y = f(x - 2). **(2)**

(b) State the equation of the line of symmetry of the curve y = f(2x). **(2)**

(c) Explain why the curve y = f(x) + 7 has the same line of symmetry, x = 3, as the original curve. **(1)**

(Total for Question 6 is 5 marks)

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7 Describe fully the single transformation that maps the graph of y = f(x) onto the graph of y = f(-x).

(Total for Question 7 is 2 marks)

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8 The function h is defined by $h(x) = x^2 - 6x + 8$.

(a) Find and simplify an expression for h(x - 3). **(3)**

(b) Hence write down the coordinates of the minimum point of y = h(x - 3). **(2)**

(Total for Question 8 is 5 marks)

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9 The function f is defined for whole number values of x from -3 to 3 by f(-3) = -8, f(-2) = 1, f(-1) = 3, f(0) = 4, f(1) = 9, f(2) = 6, f(3) = -4. Work out the values of y on the graph of y = f(x) + 3 when x = -3, -2, -1. Give the three values in order, separated by commas.

(Total for Question 9 is 3 marks)

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10 $f(x) = x^2 - 2x + 6$. The graph of y = f(x) is transformed to give the graph of y = f(x - 1) + 5. Write the equation of the new graph in the form $y = ax^2 + bx + c$.

(Total for Question 10 is 3 marks)

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11 The curve $y = q(x)$ is given by $q(x) = x^2 + 10x + 30$.

(a) Express $q(x)$ in the form $(x + a)^2 + b$. **(2)**

(b) Hence, or otherwise, find the coordinates of the minimum point of the curve $y = q(x - 4)$. **(3)**

(Total for Question 11 is 5 marks)

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12 The curve $y = f(x)$ has a minimum point at $(-2, 1)$. The curve $y = g(x)$, where $g(x) = f(x + a)$, has a minimum point at $(3, 1)$. The curve $y = h(x)$, where $h(x) = f(x) + b$, has a minimum point at $(-2, 8)$.

(a) Find the value of a. **(2)**

(b) Find the value of b. **(2)**

(c) Using your values of a and b, write down the coordinates of the minimum point of the curve $y = f(x + a) + b$. **(2)**

(Total for Question 12 is 6 marks)

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Mark scheme · 8.2 Transforming Graphs y=f(x): Test Pack

A correct answer earns full marks unless the question asks for working, a method, proof or explanation.

Question 1

y = f(x) + 3 cao **B1**

Answer: y = f(x) + 3

Question 2

reflection in the x-axis oe **B1**

translation down 3 units oe **B1**

Answer: Reflect in the x-axis; then translate down 3 units.

Question 3

correct sequence: reflect in the y-axis, then translate right 2 oe **M1**

apply sequence to x-coordinate: after reflect x -> -1, then right 2 -> -1 + 2 = 1 **M1**

final coordinates (1, 4) cao **A1**

Answer: Sequence: reflect in the y-axis, then translate right 2. Image: (1, 4).

Question 4

(a) adds 9 to the constant term: $x^2 - 8x + 10 + 9$ **M1**

(a) $x^2 - 8x + 19$ cao **A1**

(a) Answer: $x^2 - 8x + 19$

(b) writes $x^2 - 8x + 19 = 0$ and identifies a = 1, b = -8, c = 19 **M1**

(b) correct discriminant calculation: $(-8)^2 - 4(1)(19) = 64 - 76 = -12$ **M1**

(b) cso: since discriminant = -12 < 0, the equation has no real roots **A1**

(b) Answer: Discriminant = -12, no real roots

Question 5

(a) horizontal shift of 4 gives f(x - 4) **M1**

(a) g(x) = f(x - 4) - 7 oe **A1**

(a) Answer: g(x) = f(x - 4) - 7

(b) identifies one correct component: -3 or 2 **M1**

(b) (-3, 2) cao **A1**

(b) Answer: (-3, 2)

Question 6

(a) 3 + 2 oe **M1**

(a) x = 5 cao **A1**

(a) Answer: x = 5

(b) 3 / 2 oe **M1**

(b) x = 1.5 cao **A1**

(b) Answer: x = 1.5

(c) a vertical translation moves every point up but does not change any x-coordinate, so the line of symmetry is unaffected oe **B1**

(c) Answer: Vertical translation does not change x-coordinates

Question 7

correct type of transformation **B1**

fully correct detail (vector, line or scale factor) **B1**

Answer: reflection in the y-axis

Question 8

(a) substitutes (x - 3) for x: $(x-3)^2 - 6(x-3) + 8$ **M1**

(a) expands correctly: $x^2 - 6x + 9 - 6x + 18 + 8$ **M1**

(a) $x^2 - 12x + 35$ oe, simplified **A1**

(a) Answer: $x^2 - 12x + 35$

(b) identifies minimum of h(x) at (3, -1) or completes the square of the part (a) answer as $(x-6)^2 - 1$ **M1**

(b) (6, -1) cao **A1**

(b) Answer: (6, -1)

Question 9

first value correct **B1**

second value correct **B1**

third value correct **B1**

Answer: -5, 4, 6

Question 10

correct substitution into f, expands $(x - 1)^2$ and -2(x - 1) **M1**

expands brackets **M1**

$y = x^2 - 4x + 14$ **A1**

Answer: $y = x^2 - 4x + 14$

Question 11

(a) $(x + 5)^2$ seen or correct method to complete the square **M1**

(a) $(x + 5)^2 + 5$ cao **A1**

(a) Answer: $(x + 5)^2 + 5$

(b) identifies minimum of q(x) as (-5, 5) **M1**

(b) applies horizontal shift of +4: x = -5 + 4 **M1**

(b) (-1, 5) cao **A1**

(b) Answer: (-1, 5)

Question 12

(a) -2 - a = 3 oe **M1**

(a) a = -5 cao **A1**

(a) Answer: a = -5

(b) 1 + b = 8 oe **M1**

(b) b = 7 cao **A1**

(b) Answer: b = 7

(c) applies both shifts to (-2, 1): x = -2 - (-5), y = 1 + 7 **M1**

(c) (3, 8) cao **A1**

(c) Answer: (3, 8)

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