HIGHER

2.6 Transformations of Graphs of Functions: 30-minute Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 30 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 Graph of y = f(x) has a minimum at (0, -5). State the coordinates of the minimum of y = f(2x).

(Total for Question 1 is 1 mark)

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2 The graph of y = f(x) has an x-intercept at (4, 0). State the x-intercept of y = f(x + 3).

(Total for Question 2 is 1 mark)

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3 The graph of $y = -x^2$ is translated by the vector [-2; -2].
Find the equation of the new graph. Give your answer in the form y = ... , expanded and simplified.

(Total for Question 3 is 3 marks)

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4 The graph of y = 5sin(2x) + 1 is drawn for $0 \leq x \leq 360$ (x in degrees).
Write down (a) the maximum value of y, (b) the minimum value of y, (c) the period of the graph in degrees.

(Total for Question 4 is 3 marks)

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5 The graph of $y = 4\cos(x - 20) + 2$ is drawn for $x \geq 0$ (x in degrees).
Find the coordinates of the first maximum point of the graph for $x > 0$.

(Total for Question 5 is 4 marks)

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6 The curve $y = f(x)$ crosses the y-axis at (0, 0).
Write down the coordinates of the point where the curve crosses the y-axis on the curve $y = f(-x)$.

(Total for Question 6 is 2 marks)

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7 The graph of $y = f(x)$ is transformed to give the graph of $y = -2f(x) - 2$.
Given that $f(x) = -x^2 - 4x + 5$, find the equation of the transformed graph in the form $y = \ldots$, with the right-hand side expanded and simplified.

(Total for Question 7 is 3 marks)

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8 The graph of $y = f(x)$ is transformed to give the graph of $y = -f(x) + 1$.
Describe fully the two transformations that do this, in the order they are applied.

(Total for Question 8 is 4 marks)

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Mark scheme · 2.6 Transformations of Graphs of Functions: 30-minute Pack

Question 1

minimum remains at x = 0 with same y, so (0, -5) cao **B1**

Answer: (0, -5)

Question 2

x-intercept is at (1, 0) cao **B1**

Answer: (1, 0)

Question 3

a translation of [-2; -2] replaces x by (x - (-2)) and adds -2 to y **M1**

writes y = f(x - (-2)) - 2 with $f(x) = -x^2$ and expands **M1**

$y = -x^2 - 4x - 6$ cao **A1**

Answer: $y = -x^2 - 4x - 6$

Question 4

maximum value = 5 + (1) = 6 **B1**

minimum value = -5 + (1) = -4 **B1**

period = 360/2 = 180 degrees **B1**

Answer: (a) 6; (b) -4; (c) 180 degrees

Question 5

maximum of cos occurs when its argument is 0 degrees (plus multiples of 360) **M1**

solves 1(x - 20) = 0 + 360n for the smallest positive x **M1**

x = 20 **A1**

y = 6, so the point is (20, 6) **A1**

Answer: (20, 6)

Question 6

x-coordinate = 0 **B1**

y-coordinate = 0 **B1**

Answer: (0, 0)

Question 7

applies the change outside the function to f(x) **M1**

expands brackets and collects like terms (applying any multiplier and constant) **M1**

$y = 2x^2 + 8x - 12$ cao **A1**

Answer: $y = 2x^2 + 8x - 12$

Question 8

the sign change is applied first, then the constant is added **M1**

Reflection in the x-axis identified **A1**

second transformation identified correctly and in the correct order **M1**

Reflection in the x-axis, then translation by the vector [0; 1] Also accept: translate down 1, then reflect in the x-axis (-(f(x)-1) = -f(x)+1). Award all 4 marks: M1 for the initial translation, A1 for its correct direction and distance, M1 for applying the reflection second, and A1 for its correct axis. **A1**

Answer: Reflection in the x-axis, then translation by the vector [0; 1]

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