HIGHER

2.6 Transformations of Graphs of Functions: 1-hour Pack

Total Marks

EDEXCEL 4MA1 · Calculator allowed · about 60 minutes

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

1 The graph of $y = x^2$ is translated by the vector [-1; -5].
Find the equation of the new graph. Give your answer in the form y = ... , expanded and simplified.

(Total for Question 1 is 3 marks)

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2 The graph of $y = \cos(x - 45) - 2$ 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 2 is 4 marks)

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3 The point P(2, -1) lies on the curve y = f(x).
Write down the coordinates of the image of P on the curve y = f(x - 3).

(Total for Question 3 is 2 marks)

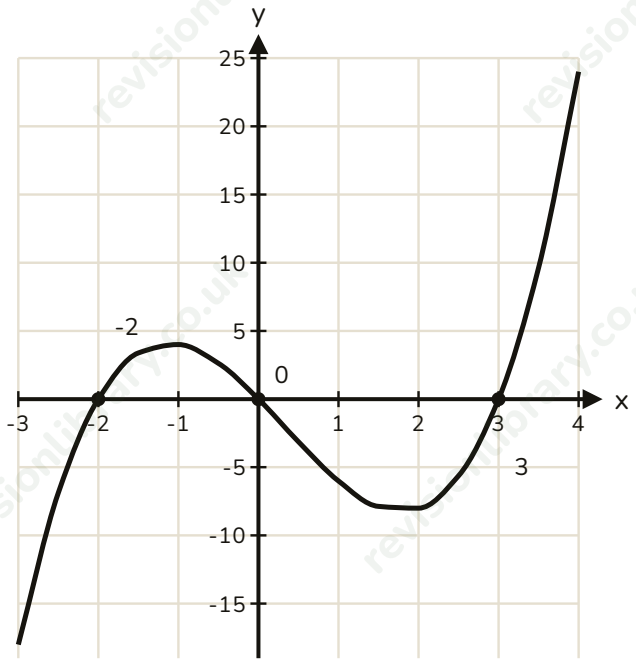
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4 The graph of y = f(x) is transformed to give the graph of y = f(x + 4).
Given that $f(x) = -x^2 - 3$, find the equation of the transformed graph in the form y = ... , with the right-hand side expanded and simplified.

(Total for Question 4 is 3 marks)

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5 A cubic curve y = f(x) has x-intercepts at x = -2, 0 and 3. Sketch the graph of y = f(x - 1) and state the new x-intercepts.



(Total for Question 5 is 2 marks)

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6 The graph of $y = 2x^2$ is translated by the vector [-1; -5].
Find the equation of the new graph. Give your answer in the form y = ... , expanded and simplified.

(Total for Question 6 is 3 marks)

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7 The graph of $y = \cos(3x)$ 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 7 is 3 marks)

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8 The graph of y = f(x) is transformed to give the graph of y = 2f(x) - 3.
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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9 The point P(-2, 5) lies on the curve y = f(x).
Write down the coordinates of the image of P on the curve y = -2f(x) - 1.

(Total for Question 9 is 3 marks)

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

(Total for Question 10 is 3 marks)

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11 The graph of $y = x^2$ is translated by the vector $[5; -3]$.
Find the equation of the new graph. Give your answer in the form $y = ...$, expanded and simplified.

(Total for Question 11 is 3 marks)

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12 The graph of $y = 2\cos(x) - 1$ 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 12 is 3 marks)

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13 The graph of $y = 4\cos(2(x - 30))$ 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 13 is 4 marks)

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14 The graph of $y = f(x)$ is transformed to give the graph of $y = f(x + 2) - 3$.
Describe fully the single transformation that does this.

(Total for Question 14 is 2 marks)

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Mark scheme · 2.6 Transformations of Graphs of Functions: 1-hour Pack

Question 1

a translation of [-1; -5] replaces x by (x - (-1)) and adds -5 to y **M1**

writes y = f(x - (-1)) - 5 with f(x) = x^2 and expands **M1**

y = x^2 + 2x - 4 cao **A1**

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

Question 2

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

solves 1(x - 45) = 0 + 360n for the smallest positive x **M1**

x = 45 **A1**

y = -1, so the point is (45, -1) **A1**

Answer: (45, -1)

Question 3

x-coordinate = 5 **B1**

y-coordinate = -1 **B1**

Answer: (5, -1)

Question 4

replaces x by x + 4 in f(x) **M1**

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

y = -x^2 - 8x - 19 cao **A1**

Answer: y = -x^2 - 8x - 19

Question 5

sketch shows the cubic shifted right by 1, preserving shape and relative turning points **M1**

new x-intercepts written as -1, 1 and 4 cao **A1**

Answer: x-intercepts: -1, 1 and 4

Question 6

a translation of [-1; -5] replaces x by (x - (-1)) and adds -5 to y **M1**

writes y = f(x - (-1)) - 5 with f(x) = 2x^2 and expands **M1**

y = 2x^2 + 4x - 3 cao **A1**

Answer: y = 2x^2 + 4x - 3

Question 7

maximum value = 1 + (0) = 1 **B1**

minimum value = -1 + (0) = -1 **B1**

period = 360/3 = 120 degrees **B1**

Answer: (a) 1; (b) -1; (c) 120 degrees

Question 8

the multiplication is applied first, then the constant is added **M1**

Stretch parallel to the y-axis with scale factor 2 identified **A1**

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

Stretch parallel to the y-axis with scale factor 2, then translation by the vector [0; -3] Also accept: translate down 3/2, then stretch vertically by factor 2 (2(f(x)-3/2) = 2f(x)-3). Award all 4 marks: M1 for the initial translation, A1 for its correct direction and distance, M1 for applying the stretch second, and A1 for its correct scale factor. **A1**

Answer: Stretch parallel to the y-axis with scale factor 2, then translation by the vector [0; -3]

Question 9

identifies the effect of each part of the transformation (the inside of the bracket changes x, the outside changes y) **M1**

x-coordinate = -2 **B1**

y-coordinate = -11 **B1**

Answer: (-2, -11)

Question 10

replaces x by 2x in f(x) **M1**

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

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

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

Question 11

a translation of [5; -3] replaces x by (x - (5)) and adds -3 to y **M1**

writes y = f(x - (5)) - 3 with f(x) = x^2 and expands **M1**

y = x^2 - 10x + 22 cao **A1**

Answer: y = x^2 - 10x + 22

Question 12

maximum value = 2 + (-1) = 1 **B1**

minimum value = -2 + (-1) = -3 **B1**

period = 360 degrees **B1**

Answer: (a) 1; (b) -3; (c) 360 degrees

Question 13

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

solves 2(x - 30) = 0 + 360n for the smallest positive x **M1**

x = 30 **A1**

y = 4, so the point is (30, 4) **A1**

Answer: (30, 4)

Question 14

the bracket gives the horizontal translation and the constant gives the vertical translation **M1**

Translation by the vector [-2; -3] **A1**

Answer: Translation by the vector [-2; -3]

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