

Higher Mathematics

Graph Transformations - Solutions - 2013-2017

Marks are indicated in brackets after each question number

2013 Paper 1 Question 4, (2)

The graph of this function has an amplitude of 4, a period of 180° , and is shifted down by 1 unit.

So, the solution is A.

2013 Paper 1 Question 11, (2)

$$y = -f(x - k)$$

Compared to the graph of $y = f(x)$ this graph is inverted and shifted 'k' units to the right

By inspection B is the correct solution

2014 Paper 1 Question 11, (2)

The co-ordinates given on $f(x)$ are (2, 3) (5, 0)

Consider transforming these using $y = 2f(x) + 1$

This transformation tells us to multiply the y co-ordinate by 2 and add 1

So, (2, 3) becomes (2, 7)

And (5, 0) becomes (5, 1)

By inspection graph C has these points present

2015 Paper 1 Question 4, (3)

The amplitude is 3 so $p = 3$

The period is 180° so $q = 2$

The graph has been shifted up by '1' unit after p has been applied, so $r = 1$

2015 Paper 1 Question 13, (1) (1) (3) (2)

a) $f(x) = 2^x + 3$

Substitute $x = 1$ to give

$$f(1) = 2^1 + 3 = 5$$

So, $b = 5$

b) i) The graph would be mirrored in the 45° line $y = x$ with all of the x and y co-ordinates swapped

ii) The image of $P = (5, 1)$

The co-ordinate of $Q = (0, 4)$ so the image of $Q = (4, 0)$

c) $y = 4 - f(x + 1)$

$$= -f(x + 1) + 4$$

The x co-ordinate of the image of R is 2

The y co-ordinate of the image of R is $-11 + 4 = -7$

So, the co-ordinates of the image of R = $(2, -7)$

2016 Paper 1 Question 15, (3) (1)

a) $f(x) = k(x - a)(x - b)^2$

By inspection of the roots we have

$$f(x) = k(x - 4)(x + 5)^2$$

Substituting the point $(1, 9)$ gives

$$9 = k(1 - 4)(1 + 5)^2$$

Rearranging and solving for k gives

$$k = -\frac{1}{12}$$

b) $g(x) = f(x) - d$

Since d is positive the graph of $g(x)$ is the graph of $f(x)$ moved down by ' d ' units

By considering the graph of $f(x)$ it must be moved down by at least 9 units to give only one root - in other words to move the point (1, 9) below the x axis.

So, $d > 9$