

# Topic Test

## Summer 2022

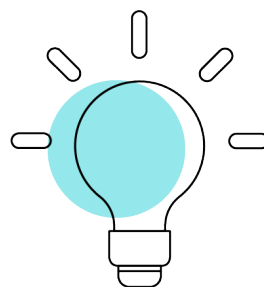
Pearson Edexcel GCE Mathematics (9MA0)

**Paper 1 and Paper 2**

## Topic 2: Algebra and functions

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## Questions

### Question T2\_Q1

**1.**

$$g(x) = \frac{2x+5}{x-3} \quad x \geq 5$$

- (a) Find  $\text{gg}(5)$ . (2)

- (b) State the range of  $g$ . (1)

- (c) Find  $g^{-1}(x)$ , stating its domain. (3)



## Question T2\_Q2

6.

$$f(x) = -3x^3 + 8x^2 - 9x + 10, \quad x \in \mathbb{R}$$

- (a) (i) Calculate  $f(2)$

- (ii) Write  $f(x)$  as a product of two algebraic factors.

(3)

Using the answer to (a)(ii),

- (b) prove that there are exactly two real solutions to the equation

$$-3y^6 + 8y^4 - 9y^2 + 10 = 0$$

(2)

- (c) deduce the number of real solutions, for  $7\pi \leq \theta < 10\pi$ , to the equation

$$3 \tan^3 \theta - 8 \tan^2 \theta + 9 \tan \theta - 10 = 0$$

(1)







**8.**



(3)

(3)

(1)







## Question T2\_Q4

1.  $f(x) = 3x^3 + 2ax^2 - 4x + 5a$

Given that  $(x + 3)$  is a factor of  $f(x)$ , find the value of the constant  $a$ .

(3)



### Question T2\_Q5

**5.**

$$f(x) = 2x^2 + 4x + 9 \quad x \in \mathbb{R}$$

- (a) Write  $f(x)$  in the form  $a(x + b)^2 + c$ , where  $a$ ,  $b$  and  $c$  are integers to be found. (3)

- (b) Sketch the curve with equation  $y = f(x)$  showing any points of intersection with the coordinate axes and the coordinates of any turning point. (3)

- (c) (i) Describe fully the transformation that maps the curve with equation  $y = f(x)$  onto the curve with equation  $y = g(x)$  where

$$g(x) = 2(x - 2)^2 + 4x - 3 \quad x \in \mathbb{R}$$

- (ii) Find the range of the function

$$h(x) = \frac{21}{2x^2 + 4x + 9} \quad x \in \mathbb{R} \quad (4)$$

**Question 5 continued**





Question T2\_Q6

Answer ALL questions. Write your answers in the spaces provided.

1. Given

$$2^x \times 4^y = \frac{1}{2\sqrt{2}}$$

express  $y$  as a function of  $x$ .

(3)

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**Answer ALL questions. Write your answers in the spaces provided.**

1. Given

$$2^x \times 4^y = \frac{1}{2\sqrt{2}}$$

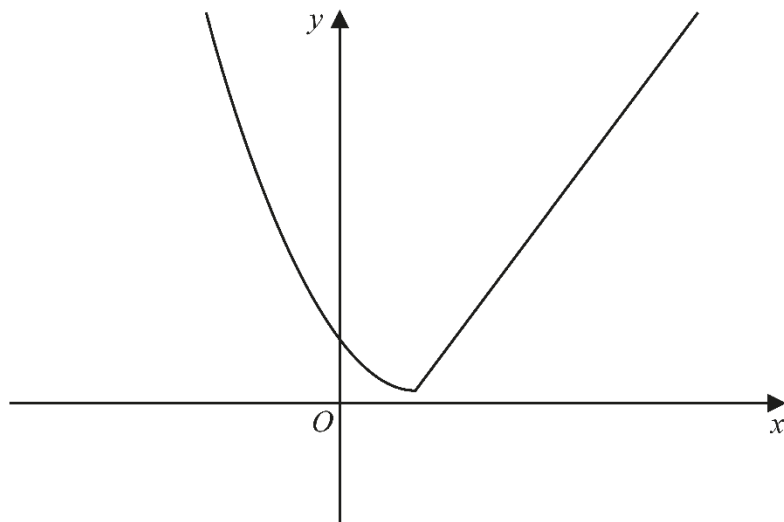
express  $y$  as a function of  $x$ .

(3)



## Question T2\_Q7

6.



**Figure 4**

Figure 4 shows a sketch of the graph of  $y = g(x)$ , where

$$g(x) = \begin{cases} (x-2)^2 + 1 & x \leq 2 \\ 4x - 7 & x > 2 \end{cases}$$

(a) Find the value of  $gg(0)$ .

**(2)**

(b) Find all values of  $x$  for which

$$g(x) > 28$$

**(4)**

The function  $h$  is defined by

$$h(x) = (x-2)^2 + 1 \quad x \leq 2$$

(c) Explain why  $h$  has an inverse but  $g$  does not.

**(1)**

(d) Solve the equation

$$h^{-1}(x) = -\frac{1}{2}$$

**(3)**

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### Question T2\_Q8

4. The function  $f$  is defined by

$$f(x) = \frac{3x-7}{x-2} \quad x \in \mathbb{R}, x \neq 2$$

(a) Find  $f^{-1}(7)$

(2)

(b) Show that  $\text{ff}(x) = \frac{ax+b}{x-3}$  where  $a$  and  $b$  are integers to be found.

(3)



Question T2\_Q9

5. The curve with equation  $y = 3 \times 2^x$  meets the curve with equation  $y = 15 - 2^{x+1}$  at the point  $P$ . Find, using algebra, the exact  $x$  coordinate of  $P$ .

(4)

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**11.**


$$y = 2|x + 4| - 5$$

(a) Find the coordinates of  $P$ .

(2)

$$3x + 40 = 2|x + 4| - 5$$

(2)

Given that  $l$  intersects  $y = 2|x + 4| - 5$  at least once,

(c) find the range of possible values of  $a$ , writing your answer in set notation.

(3)







### Question T2\_Q11

1.  $f(x) = ax^3 + 10x^2 - 3ax - 4$

Given that  $(x - 1)$  is a factor of  $f(x)$ , find the value of the constant  $a$ .

You must make your method clear.

(3)



## Question T2\_Q12

12.

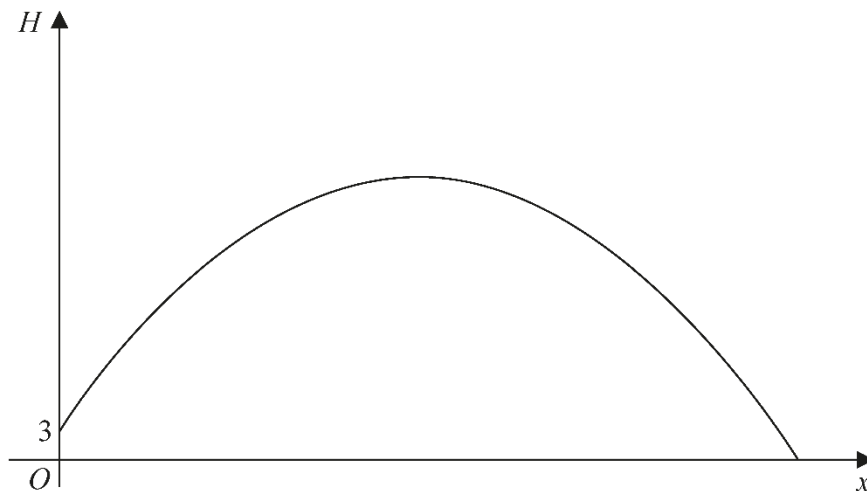


Figure 3

Figure 3 is a graph of the trajectory of a golf ball after the ball has been hit until it first hits the ground.

The vertical height,  $H$  metres, of the ball above the ground has been plotted against the horizontal distance travelled,  $x$  metres, measured from where the ball was hit.

The ball is modelled as a particle travelling in a vertical plane above horizontal ground.

Given that the ball

- is hit from a point on the top of a platform of vertical height 3 m above the ground
- reaches its maximum vertical height after travelling a horizontal distance of 90 m
- is at a vertical height of 27 m above the ground after travelling a horizontal distance of 120 m

Given also that  $H$  is modelled as a **quadratic** function in  $x$

(a) find  $H$  in terms of  $x$

(5)

(b) Hence find, according to the model,

- the maximum vertical height of the ball above the ground,
- the horizontal distance travelled by the ball, from when it was hit to when it first hits the ground, giving your answer to the nearest metre.

(3)

(c) The possible effects of wind or air resistance are two limitations of the model.

Give one other limitation of this model.

(1)

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### Question T2\_Q13

2. The functions  $f$  and  $g$  are defined by

$$f(x) = 7 - 2x^2 \quad x \in \mathbb{R}$$

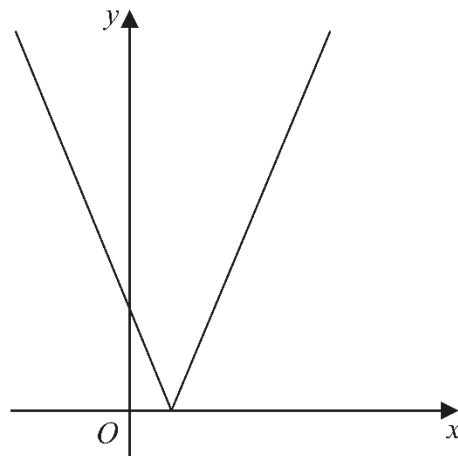
$$g(x) = \frac{3x}{5x-1} \quad x \in \mathbb{R} \quad x \neq \frac{1}{5}$$

- (a) State the range of  $f$  (1)
- (b) Find  $gf(1.8)$  (2)
- (c) Find  $g^{-1}(x)$  (2)



## Question T2\_Q14

11.



**Figure 4**

Figure 4 shows a sketch of the graph with equation

$$y = |2x - 3k|$$

where  $k$  is a positive constant.

(a) Sketch the graph with equation  $y = f(x)$  where

$$f(x) = k - |2x - 3k|$$

stating

- the coordinates of the maximum point
- the coordinates of any points where the graph cuts the coordinate axes

**(4)**

(b) Find, in terms of  $k$ , the set of values of  $x$  for which

$$k - |2x - 3k| > x - k$$

giving your answer in set notation.

**(4)**

(c) Find, in terms of  $k$ , the coordinates of the minimum point of the graph with equation

$$y = 3 - 5f\left(\frac{1}{2}x\right)$$

**(2)**

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