Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE in Mathematics

9MA0 (Public release version)

Resource Set 1: Topic 2

Algebra and Functions (Test 2)

Pearson: helping people progress, everywhere

Pearson aspires to be the world's leading learning company. Our aim is to help everyone progress in their lives through education. We believe in every kind of learning, for all kinds of people, wherever they are in the world. We've been involved in education for over 150 years, and by working across 70 countries, in 100 languages, we have built an international reputation for our commitment to high standards and raising achievement through innovation in education. Find out more about how we can help you and your students at: www.pearson.com/uk

Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an optional part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

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

Given that $(x + 2)$ is a factor of f (x), find the value of the constant a.

(Total for Question 1 is 3 marks)

---

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

(a) Find gg(5).

(2)

(b) State the range of g.

(1)

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

(3)

(Total for Question 2 is 6 marks)

3.

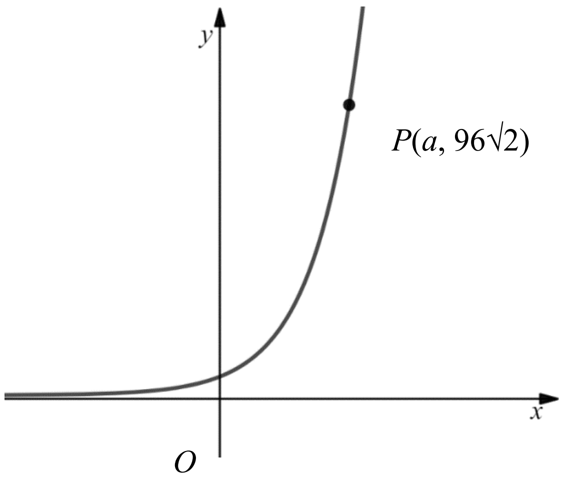

Figure 6

In this question you must show all stages of your working.
Solutions relying on calculator technology are not acceptable.

Figure 6 shows a sketch of part of the curve with equation

$$y = 3 \times 2^{2x}.$$

The point $P(a, 96\sqrt{2})$ lies on the curve.

Find the exact value of a.

(3)

(Total for Question 3 is 3 marks)

---

4. 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)

(Total for Question 4 is 4 marks)

---

5. A curve C has equation $y = f(x)$

Given that

- $f'(x) = 6x^2 + ax - 23$ where a is a constant
- the y intercept of C is -12
- $(x + 4)$ is a factor of $f(x)$

find, in simplest form, $f(x)$

(6)

(Total for Question 5 is 6 marks)

---

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

(a) (i) Calculate f(2).

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

(3)

Using the answer to part (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)

(Total for Question 6 is 6 marks)

---

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

(*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

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

(ii)Find the range of the function

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

(4)

(Total for Question 7 is 10 marks)

---

8. $$\frac{1 + 11x - 6x^2}{(x-3)(1-2x)} \equiv A + \frac{B}{(x-3)} + \frac{C}{(1-2x)}.$$

(a) Find the values of the constants *A*, *B* and *C*.

(4)

$$f(x) = \frac{1 + 11x - 6x^2}{(x-3)(1-2x)}, \quad x > 3.$$

(b) Prove that f (*x*) is a decreasing function.

(3)

(Total for Question 8 is 7 marks)

---

9. (a) Sketch the curve with equation

$$y = k - \frac{1}{2x},$$

where k is a positive constant.

State, in terms of k, the coordinates of any points of intersection with the coordinate axes and the equation of the horizontal asymptote.

(3)

The straight line l has equation $y = 2x + 3$.

Given that l cuts the curve in two distinct places,

(b) find the range of values of k, writing your answer in set notation.

(6)

(Total for Question 9 is 9 marks)

10.

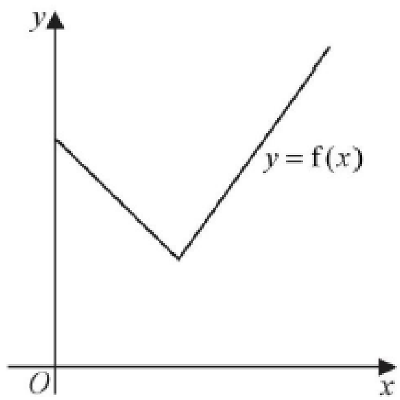

Figure 2

Figure 2 shows a sketch of part of the graph $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = 2|3 - x| + 5, \quad x \geq 0$$

(*a*) State the range of f.

(1)

(*b*) Solve the equation

$$\mathrm{f}(x) = \frac{1}{2}x + 30$$

(3)

Given that the equation $\mathrm{f}(x) = k$, where k is a constant, has two distinct roots,

(*c*) state the set of possible values for k.

(2)

(Total for Question 10is 6 marks)

11.

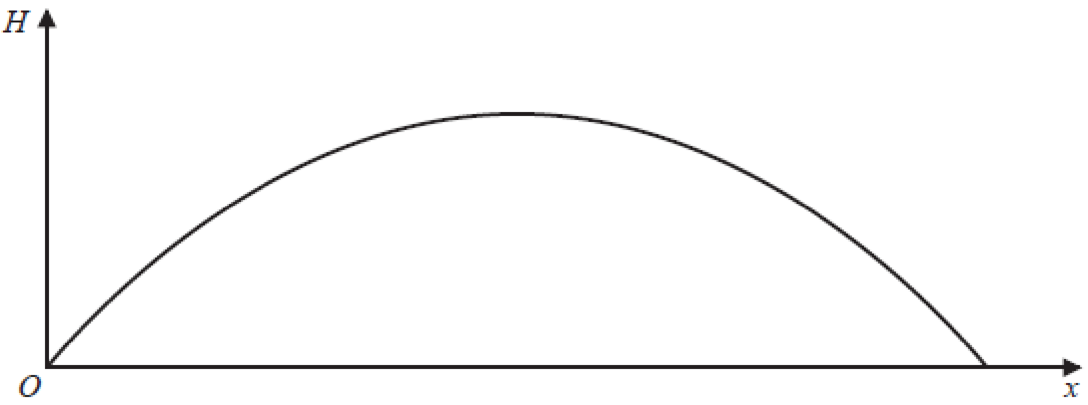

Figure 1

Figure 1 is a graph showing the trajectory of a rugby ball.

The height of the ball above the ground, H metres, has been plotted against the horizontal distance, x metres, measured from the point where the ball was kicked.

The ball travels in a vertical plane.

The ball reaches a maximum height of 12 metres and hits the ground at a point 40 metres from where it was kicked.

(a) Find a quadratic equation linking H with x that models this situation.

(3)

The ball passes over the horizontal bar of a set of rugby posts that is perpendicular to the path of the ball. The bar is 3 metres above the ground.

(b) Use your equation to find the greatest horizontal distance of the bar from O.

(3)

(c) Give one limitation of the model.

(1)

(Total for Question 11 is 7 marks)