Pearson Edexcel

A Level Mathematics 9MA0

Unit Test

3 Functions Modelling

Time allowed: 50 **minutes**

School:

Name:

Teacher:

Question	Points	Score
1	10	
2	6	
3	7	
4	6	
5	9	
6	8	
7	4	
Total:	50	

1. $f(x) = |2x + 3| - 4, x \in \mathbb{R}$

   (a) Sketch the graph of $y = f(x)$, labelling its vertex and any points of intersection with the [5]

   coordinate axes.

   (b) Find the coordinates of the points of intersection of [5]

$$y = |2x + 3| - 4 \quad \text{and} \quad y = -\frac{1}{4}x + 2$$

Total: 10

2. The functions p and q are defined by

$$p \colon x \to x^2 \quad \text{and} \quad q \colon x \to 5 - 2x$$

(a) Given that $pq(x) = qp(x)$, show that [4]

$$3x^2 - 10x + 10 = 0.$$

(b) Explain why $3x^2 - 10x + 10 = 0$ has no real solutions. [2]

Total: 6

3. The functions f and g are defined by

$$f(x) = e^{2x} + 4, x \in \mathbb{R} \quad \text{and} \quad g(x) = \ln(x+1), x \in \mathbb{R}, x > -1$$

(a) Find $fg(x)$ and state its range. [4]

(b) Solve $fg(x) = 85$. [3]

Total: 7

4. The function $g(x)$ is defined by   [6]
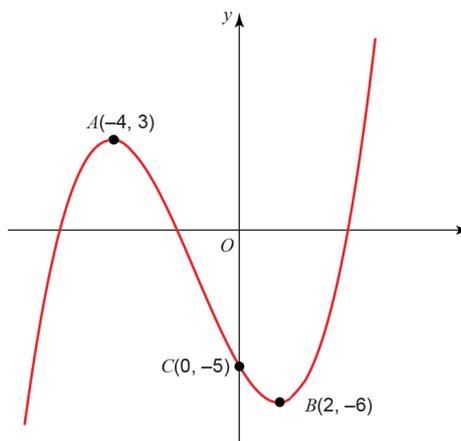
$$g(x) = x^2 - 8x + 7, x \in \mathbb{R}, x > 4.$$

Find $g^{-1}(x)$ and state its domain and range.

5. The diagram shows the graph of $h(x)$.

The points $A(-4, 3)$ and $B(2, -6)$ are turning points on the graph and $C(0, -5)$ is the y-intercept.

Sketch on separate diagrams, the graphs of

(a) $y = |f(x)|$. [3]
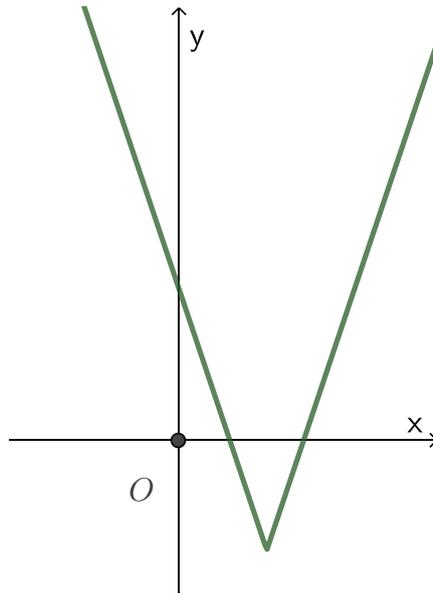
(b) $y = f(|x|)$. [3]

(c) $y = 2f(x + 3)$. [3]

Where possible, label clearly the transformations of the points A, B and C on your new diagrams

and give their coordinates. Total: 9

6. The diagram shows a sketch of part of the graph $y = f(x)$ where

$$f(x) = 3|x - 4| - 5.$$

(a) State the range of f. [1]

(b) Given that $f(x) = -\frac{1}{3}x + k$, where k is a constant has two distinct roots, state the possible values of k. [7]

Total: 8

7. The temperature of a mug of coffee at time t can be modelled by the equation

$$T(t) = T_R (90 - T_R) \, \mathrm{e}^{-\frac{1}{20}t}$$

   where $T(t)$ is the temperature, in °C, of the coffee at time t minutes after the coffee was poured into the mug and T_R is the room temperature in °C.

   (a) Using the equation for this model, explain why the initial temperature of the coffee is independent of the initial room temperature.   [2]

   (b) Calculate the temperature of the coffee after 10 minutes if the room temperature is 20°C.   [2]

Total: 4