6.

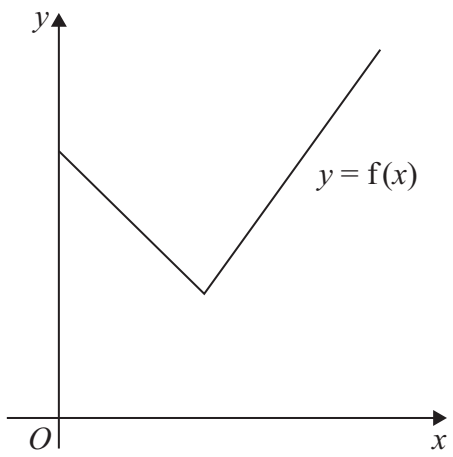


Figure 1

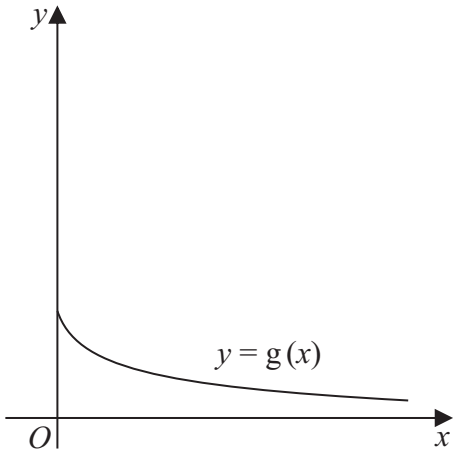


Figure 2

Figure 1 shows a sketch of part of the graph $y = \mathrm{f}(x)$, where

$$\mathrm{f}(x) = 2|3 - x| + 5 \qquad x \geqslant 0$$

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

$$\mathrm{g}(x) = \frac{x+9}{2x+3} \qquad x \geqslant 0$$

(a) Find the value of $\mathrm{fg}(1)$

(2)

(b) State the range of g

(2)

(c) Find g^{-1}

(3)

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

(d) state the range of possible values of k.

(3)

(Total for Question 6 is 10 marks)

7.

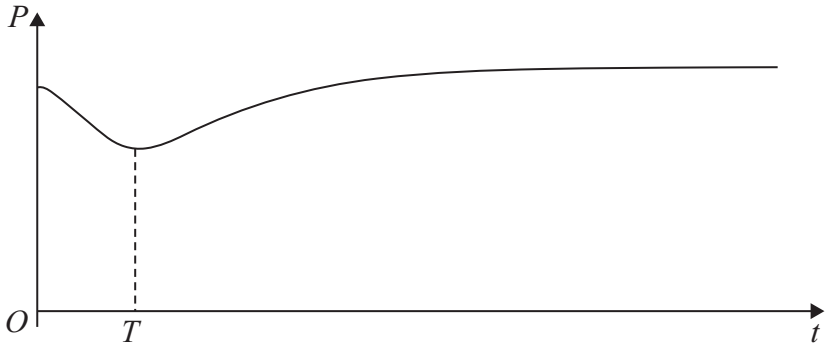


Figure 3

A colony of bees is being studied. The number of bees in the colony is modelled by the equation

$$P = 200 - \frac{160e^{0.6t}}{15 + e^{0.8t}} \qquad t \in \mathbb{R} \qquad t \geqslant 0$$

where P is the number of bees, measured in thousands, t years after the study started.
A sketch of the graph of P against t is shown in Figure 3

(a) Calculate the number of bees in the colony at the start of the study.

(2)

(b) Find $\frac{dP}{dt}$

(3)

The population of bees initially decreases, reaching a minimum value after T years, as shown in Figure 3

(c) Using your answer to part (b), calculate the value of T to 2 decimal places.

(*Solutions relying entirely on calculator technology are not acceptable.*)

(4)

(Total for Question 7 is 9 marks)