1.

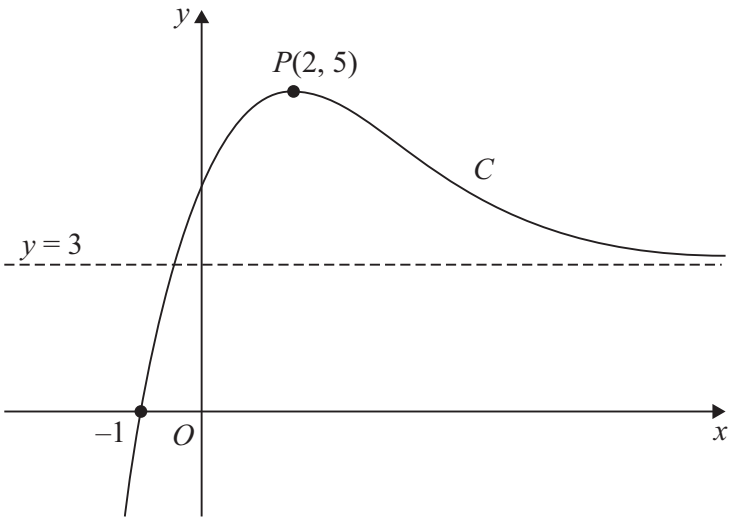

Figure 1

The curve C, shown in Figure 1,

- has equation $y = f(x), x \in \mathbb{R}$
- cuts the x-axis at -1
- has a maximum turning point at $P(2, 5)$
- has a horizontal asymptote with equation $y = 3$

The curve C has no other turning points or asymptotes.

(a) Find the coordinates of the point to which P is transformed when the curve with equation $y = f(x)$ is transformed to the curve with equation

(i) $y = f(x) + 7$

(ii) $y = 3f(x)$

(2)

Given that the line with equation $y = k$, where k is a constant, cuts or meets C exactly once,

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

(2)

(c) Write down the solution of the equation

$$f(x + 4) = 0$$

(1)

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Question 1 continued

(Total for Question 1 is 5 marks)

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

A vessel that contained some water started to leak from a hole in its base.

The volume of water in the vessel 25 minutes after the leak started was $6\,m^3$

The volume of water in the vessel 64 minutes after the leak started was $3.3\,m^3$

The volume of water, $V\,m^3$, in the vessel t minutes after the leak started, is modelled by the equation

$$V = a\sqrt{t} + b$$

where a and b are constants.

(a) Find the value of a and the value of b.

(4)

(b) Using the equation of the model,

(i) find the initial volume of water in the vessel,

(ii) find the time taken, after the leak started, for the vessel to empty.
Give your answer to the nearest minute.

(3)

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