3.

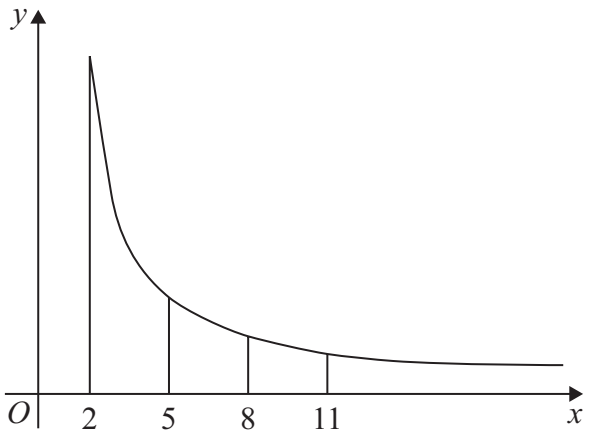

Figure 1

Figure 1 shows a sketch of part of the graph of $y = \dfrac{12}{\sqrt{x^2 - 2}} \quad x \geqslant 2$

The table below gives values of y rounded to 3 decimal places.

x	2	5	8	11
y	8.485	2.502	1.524	1.100

(a) Use the trapezium rule with all the values of y from the table to find an approximate value, to 2 decimal places, for

$$\int_2^{11} \frac{12}{\sqrt{x^2 - 2}} \, dx$$

(3)

(b) Use your answer to part (a) to estimate a value for

$$\int_2^{11} \left(1 + \frac{6}{\sqrt{x^2 - 2}} \right) dx$$

(3)

(Total for Question 3 is 6 marks)

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

$$f(x) = 13 + 3x + (x + 2)(x + k)^2 \qquad \text{where } k \text{ is a constant}$$

Given that $(x + 3)$ is a factor of $f(x)$,

(a) (i) show that a possible value of k is 5

(ii) find the other possible value of k.

(3)

Given that $k = 5$

(b) (i) write $f(x)$ as the product of two algebraic factors

(ii) show that the equation $f(x) = 0$ has only one real solution.

(6)

(Total for Question 4 is 9 marks)

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

(i) Given that

$$\log_a x + \log_a 3 = \log_a 27 - 1 \qquad \text{where } a \text{ is a positive constant}$$

find, in its simplest form, an expression for x in terms of a.

(4)

(ii) Solve the equation

$$(\log_5 y)^2 - 7(\log_5 y) + 12 = 0$$

showing each step of your working.

(4)

(Total for Question 5 is 8 marks)

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6. A circle C has equation $x^2 + y^2 - 6x - 14y + k = 0$ where k is constant.

(a) Find the coordinates of the centre of C.

(2)

(b) Find the radius of C when $k = -32$

(2)

(c) Find the range of values of k for which C lies completely within the first quadrant.

(4)

(Total for Question 6 is 8 marks)