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)

---

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)

---

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)

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

(i) Solve, for $0 \leqslant \theta < 180°$, the equation

$$7\sin 2\theta = 5\cos 2\theta$$

giving your answers, in degrees, to one decimal place.

(4)

(ii) Solve, for $0 \leqslant x < 2\pi$, the equation

$$24\tan x = 5\cos x$$

giving your answers, in radians, to 3 decimal places.

(5)

(Total for Question 7 is 9 marks)

---

8. A curve has equation $y = (x + 2)^2(4 - x)$

The finite region R is bounded by the curve and the x-axis.

(a) Using algebraic integration and showing each step of your working, find the exact area of R.

(5)

(b) Using the answer to part (a) and explaining your reasoning, find the area of the finite region bounded by the curve with equation $y = (3x + 6)^2\left(2 - \frac{1}{2}x\right)$ and the x-axis.

(2)

(Total for Question 8 is 7 marks)