3. The curve C is defined by the parametric equations

$$x = \frac{4}{t+2} \qquad y = \frac{6t}{t+4} \qquad t > -1$$

The point P with parameter $t = 2$ lies on C.

(a) Use parametric differentiation to find the equation of the tangent to C at P. Give the answer in the form $y = mx + c$, where m and c are constants.

(5)

(b) Show that the equation of C can be written in the form $y = \mathrm{f}(x)$ where

$$\mathrm{f}(x) = \frac{ax+b}{x+d} \qquad 0 < x < k$$

and where a, b, d and k are integers to be found.

(4)

(c) Hence, or otherwise, find the range of f.

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 3 continued

Question 3 continued

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Question 3 continued

(Total for Question 3 is 11 marks)

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

Water flows at a constant rate into a container.

When the depth of water in the container is h cm, the volume of water in the container, V cm^3, is modelled by the equation

$$V = \frac{1}{3}h^2\sqrt{(h+4)} \qquad 0 \leqslant h \leqslant 21$$

Given that

- the container is initially empty
- water flows into the container at a rate of $30\ \text{cm}^3\text{s}^{-1}$
- the container is full when the depth of the water is 21 cm

find, according to the model,

(a) the time taken to fill the container,

(2)

(b) the exact rate of change of the depth of the water, in cm s^{-1}, when $h = 5$

(5)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA