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

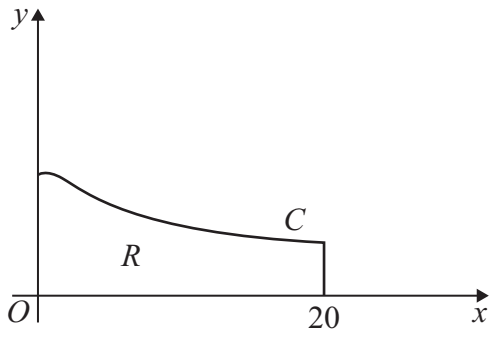

Figure 2

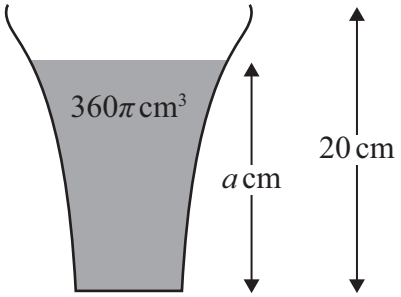

Figure 3

The curve C has equation

$$y = 12\left(\frac{2x+3}{x^2+3x+5}\right)^{\frac{1}{2}}$$

The finite region, R, shown in Figure 2, is bounded by the curve C, the line with equation $x = 20$, the x-axis and the y-axis.

The region R is rotated through 2π radians about the x-axis to form a solid, S.

(a) Use algebraic integration to find the exact volume of S.

Give your answer in the form $k\ln\lambda$ where k and λ are constants.

(4)

Figure 3 shows a hollow vase with identical shape to solid S.

The vase is made of glass, which has negligible thickness.

When the vase is full of water,

volume of water in the vase = volume of S

When the vase contains $360\pi\,\text{cm}^3$ of water, the depth of the water is a cm, as shown in Figure 3.

(b) Use algebra to find the value of a, giving your answer to one decimal place.

(3)

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Question 9 continued

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Question 9 continued

(Total for Question 9 is 7 marks)

10: [*In this question you may assume that if n is an integer and n^2 is even, then n is even.*]

Given that p and q are integers, use proof by contradiction to show that

$$p^2 - 4q + 2 \neq 0$$

(5)

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