9.

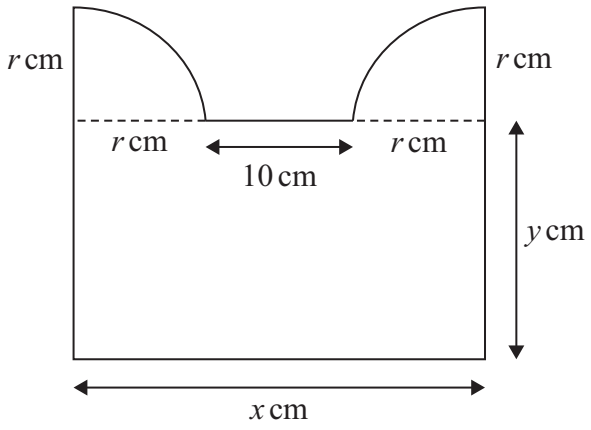

Figure 4

Figure 4 shows a sketch of a design for a logo.

The design consists of a rectangle of base x cm and height y cm with two quarter circles of equal radius r cm joined to the top edge with a gap of 10 cm between the nearest point of each quarter circle, as shown in Figure 4.

(a) Show that the area, A cm^2, of the design is given by

$$A = xy + \frac{\pi}{8}(x - 10)^2$$

(2)

Given that

- the total area of the design is one square metre
- the perimeter, P cm, of the design is given by $P = 2y + \left(2 + \frac{\pi}{2}\right)x - 5\pi$

(b) show that

$$P = \frac{20000 - 25\pi}{x} + \left(2 + \frac{\pi}{4}\right)x$$

(4)

(c) Use algebraic differentiation to find the value of x that gives the minimum value for P, giving the answer to 3 significant figures.

(3)

By considering $\frac{\mathrm{d}^2P}{\mathrm{d}x^2}$

(d) justify that the value for x found in part (c) gives the minimum value for P.

(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 9 continued

Question 9 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 9 continued

Question 9 continued

(Total for Question 9 is 11 marks)

TOTAL FOR PAPER IS 75 MARKS

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA