Section B (36 marks)

3

8 Fig. 8 shows the curve y = f(x), where $f(x) = \frac{1}{1 + \cos x}$, for $0 \le x \le \frac{1}{2}\pi$.

P is the point on the curve with x-coordinate $\frac{1}{3}\pi$.





(i) Find the *y*-coordinate of P. [1]

- (ii) Find f'(x). Hence find the gradient of the curve at the point P. [5]
- (iii) Show that the derivative of $\frac{\sin x}{1 + \cos x}$ is $\frac{1}{1 + \cos x}$. Hence find the exact area of the region enclosed by the curve y = f(x), the x-axis, the y-axis and the line $x = \frac{1}{3}\pi$. [7]
- (iv) Show that $f^{-1}(x) = \arccos(\frac{1}{x} 1)$. State the domain of this inverse function, and add a sketch of $y = f^{-1}(x)$ to a copy of Fig. 8. [5]

[Question 9 is printed overleaf.]

- 9 The function f(x) is defined by $f(x) = \sqrt{4 x^2}$ for $-2 \le x \le 2$.
 - (i) Show that the curve $y = \sqrt{4 x^2}$ is a semicircle of radius 2, and explain why it is not the whole of this circle. [3]

Fig. 9 shows a point P(a, b) on the semicircle. The tangent at P is shown.



Fig. 9

- (ii) (A) Use the gradient of OP to find the gradient of the tangent at P in terms of a and b.
 - (B) Differentiate $\sqrt{4-x^2}$ and deduce the value of f'(a).
 - (*C*) Show that your answers to parts (*A*) and (*B*) are equivalent. [6]

The function g(x) is defined by g(x) = 3f(x-2), for $0 \le x \le 4$.

(iii) Describe a sequence of two transformations that would map the curve y = f(x) onto the curve y = g(x).

Hence sketch the curve y = g(x). [6]

[3]

(iv) Show that if y = g(x) then $9x^2 + y^2 = 36x$.

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