## Section B (36 marks)

- 7 A curve is defined by the equation  $y = 2x \ln(1 + x)$ .
  - (i) Find  $\frac{dy}{dx}$  and hence verify that the origin is a stationary point of the curve. [4]
  - (ii) Find  $\frac{d^2y}{dx^2}$ , and use this to verify that the origin is a minimum point. [5]
  - (iii) Using the substitution u = 1 + x, show that  $\int \frac{x^2}{1+x} dx = \int \left(u 2 + \frac{1}{u}\right) du$ .

Hence evaluate 
$$\int_{0}^{1} \frac{x^2}{1+x} dx$$
, giving your answer in an exact form. [6]

(iv) Using integration by parts and your answer to part (iii), evaluate  $\int_0^1 2x \ln(1+x) dx$ . [4]

8 Fig. 8 shows the curve y = f(x), where  $f(x) = 1 + \sin 2x$  for  $-\frac{1}{4}\pi \le x \le \frac{1}{4}\pi$ .





- (i) State a sequence of two transformations that would map part of the curve  $y = \sin x$  onto the curve y = f(x). [4]
- (ii) Find the area of the region enclosed by the curve y = f(x), the x-axis and the line  $x = \frac{1}{4}\pi$ . [4]
- (iii) Find the gradient of the curve y = f(x) at the point (0, 1). Hence write down the gradient of the curve  $y = f^{-1}(x)$  at the point (1, 0). [4]
- (iv) State the domain of  $f^{-1}(x)$ . Add a sketch of  $y = f^{-1}(x)$  to a copy of Fig. 8. [3]
- (v) Find an expression for  $f^{-1}(x)$ . [2]

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