

## STEP II, 2022, Q1

- 1 (i) By integrating one of the two terms in the integrand by parts, or otherwise, find

$$\int \left( 2\sqrt{1+x^3} + \frac{3x^3}{\sqrt{1+x^3}} \right) dx.$$

- (ii) Find

$$\int (x^2 + 2) \frac{\sin x}{x^3} dx.$$

- (iii) (a) Sketch the graph with equation  $y = \frac{e^x}{x}$ , giving the coordinates of any stationary points.

- (b) Find  $a$  if

$$\int_a^{2a} \frac{e^x}{x} dx = \int_a^{2a} \frac{e^x}{x^2} dx.$$

- (c) Show that it is not possible to find distinct integers  $m$  and  $n$  such that

$$\int_m^n \frac{e^x}{x} dx = \int_m^n \frac{e^x}{x^2} dx.$$



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