

## STEP II, 2017, Q3

- 3 (i) Sketch, on  $x$ - $y$  axes, the set of all points satisfying  $\sin y = \sin x$ , for  $-\pi \leq x \leq \pi$  and  $-\pi \leq y \leq \pi$ . You should give the equations of all the lines on your sketch.

- (ii) Given that

$$\sin y = \frac{1}{2} \sin x$$

obtain an expression, in terms of  $x$ , for  $y'$  when  $0 \leq x \leq \frac{1}{2}\pi$  and  $0 \leq y \leq \frac{1}{2}\pi$ , and show that

$$y'' = -\frac{3 \sin x}{(4 - \sin^2 x)^{\frac{3}{2}}}.$$

Use these results to sketch the set of all points satisfying  $\sin y = \frac{1}{2} \sin x$  for  $0 \leq x \leq \frac{1}{2}\pi$  and  $0 \leq y \leq \frac{1}{2}\pi$ .

Hence sketch the set of all points satisfying  $\sin y = \frac{1}{2} \sin x$  for  $-\pi \leq x \leq \pi$  and  $-\pi \leq y \leq \pi$ .

- (iii) Without further calculation, sketch the set of all points satisfying  $\cos y = \frac{1}{2} \sin x$  for  $-\pi \leq x \leq \pi$  and  $-\pi \leq y \leq \pi$ .



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