

STEP III, 1998, Q1

1 Let

$$f(x) = \sin^2 x + 2 \cos x + 1$$

for $0 \leq x \leq 2\pi$. Sketch the curve $y = f(x)$, giving the coordinates of the stationary points.
Now let

$$g(x) = \frac{af(x) + b}{cf(x) + d} \quad ad \neq bc, \quad d \neq -3c, \quad d \neq c.$$

Show that the stationary points of $y = g(x)$ occur at the same values of x as those of $y = f(x)$, and find the corresponding values of $g(x)$.

Explain why, if $d/c < -3$ or $d/c > 1$, $|g(x)|$ cannot be arbitrarily large.



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