

STEP II, 2014, Q7

- 7 (i) The function f is defined by $f(x) = |x - a| + |x - b|$, where $a < b$. Sketch the graph of $f(x)$, giving the gradient in each of the regions $x < a$, $a < x < b$ and $x > b$. Sketch on the same diagram the graph of $g(x)$, where $g(x) = |2x - a - b|$.

What shape is the quadrilateral with vertices $(a, 0)$, $(b, 0)$, $(b, f(b))$ and $(a, f(a))$?

- (ii) Show graphically that the equation

$$|x - a| + |x - b| = |x - c|,$$

where $a < b$, has 0, 1 or 2 solutions, stating the relationship of c to a and b in each case.

- (iii) For the equation

$$|x - a| + |x - b| = |x - c| + |x - d|,$$

where $a < b$, $c < d$ and $d - c < b - a$, determine the number of solutions in the various cases that arise, stating the relationship between a , b , c and d in each case.



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