

Functions  $f$  and  $g$  are both defined for  $x \in \mathbb{R}$  and are given by

$$f(x) = x^2 - 4x + 9,$$

$$g(x) = 2x^2 + 4x + 12.$$

(a) Express  $f(x)$  in the form  $(x - a)^2 + b$ .

[1]

This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and extend across the width of the page. There are no margins, text, or other markings on the paper.

(b) Express  $g(x)$  in the form  $2[(x + c)^2 + d]$ .

[2]

[illegible]

- (c) Express  $g(x)$  in the form  $kf(x+h)$ , where  $k$  and  $h$  are integers.

[1]

This image shows a full page of white paper with horizontal dashed lines, typical of primary school handwriting practice paper. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

- (d)** Describe fully the two transformations that have been combined to transform the graph of  $y = f(x)$  to the graph of  $y = g(x)$ . [4]

[4]

[illegible]