

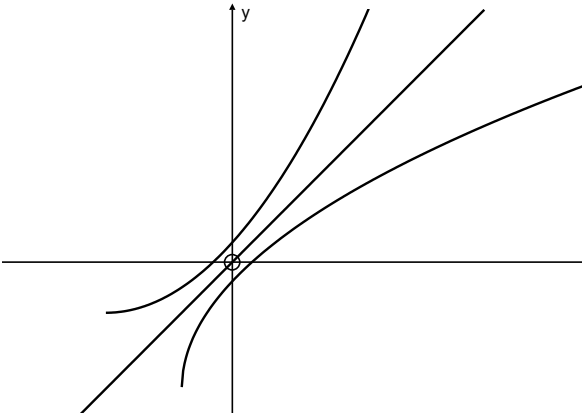
|      |                               |
|------|-------------------------------|
| 4(a) | $\{10\} - (x \{+\} \{3\})^2$  |
|      |                               |
| 4(b) | State reflection in $x$ -axis |
|      | Obtain $m = -3$               |
|      | Obtain $n = 10$               |
|      |                               |

|      |                                                                                             |
|------|---------------------------------------------------------------------------------------------|
| 6(a) | State $f(x)$ $y \geq -3$ or clear equivalent                                                |
|      |                                                                                             |
| 6(b) | Attempt to arrange to $x = \dots$ in terms of $y$ or equivalent                             |
|      | Obtain $-3 + \sqrt{x+12}$                                                                   |
|      |                                                                                             |
| 6(c) | Attempt expression for $gf(x)$                                                              |
|      | Obtain $2(x+3)^2 - 29 = 69$                                                                 |
|      | Attempt solution of quadratic equation to find at least one value of $x$                    |
|      | Obtain $x=4$ only                                                                           |
|      | <b>Alternative Method for Question 6(c)</b>                                                 |
|      | Attempt solution of $g(x) = 69$ or evaluation of $g^{-1}(69)$                               |
|      | Obtain 37                                                                                   |
|      | Attempt solution of $f(x) = \textit{their 37}$ or evaluation of $f^{-1}(\textit{their 37})$ |
|      | Obtain $x=4$ only                                                                           |
|      |                                                                                             |

|      |                                                                                                                                                                |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 3(a) | Translation $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ , or<br>Translation 2 ‘parallel to the $y$ -axis’ or ‘in the $y$ -direction’ or ‘vertically’.               |
|      | {Stretch} {factor $\frac{1}{3}$ } {parallel to $x$ -axis or in $x$ -direction or horizontally}                                                                 |
|      |                                                                                                                                                                |
| 3(b) | $[y =]3g(-x)$                                                                                                                                                  |
|      |                                                                                                                                                                |
| 9(a) | $\frac{4 \times 3 \times (-2)}{(3x-6)^3} + \frac{1 \times 3 \times (-3)}{(3x-6)^4}$ or $4 \times 3 \times (-2)(3x-6)^{-3} + 1 \times 3 \times (-3)(3x-6)^{-4}$ |
|      | Decreasing.                                                                                                                                                    |
|      |                                                                                                                                                                |
| 9(b) | $f^{-1}$ exists because $f$ is a decreasing function<br>Or $f^{-1}$ exists because it is one-to-one, or passes the horizontal line test.                       |
|      |                                                                                                                                                                |

|      |                                                                       |
|------|-----------------------------------------------------------------------|
| 9(c) | $g(x) > 4a - 3$                                                       |
|      |                                                                       |
| 9(d) | <b>Either</b> $4a - 3 > 2$ allow with $x$ or $a$ or $\geq$            |
|      | $a > \frac{5}{4}$ or $a \geq \frac{5}{4}$ oe                          |
|      | <b>Or</b> $3 \times (4a - 3) - 6 > 0$ allow with $x$ or $a$ or $\geq$ |
|      | $a > \frac{5}{4}$ or $a \geq \frac{5}{4}$ oe                          |
|      |                                                                       |

|       |                                                                           |
|-------|---------------------------------------------------------------------------|
| 10(a) | {Stretch} {factor 3} {parallel to $y$ -axis/in $y$ -direction/vertically} |
|       | Translation $\begin{pmatrix} -2 \\ -5 \end{pmatrix}$                      |
|       |                                                                           |
|       | <b>Alternative solution for Question 10(a)</b>                            |
|       | Translation $\begin{pmatrix} -2 \\ 5 \\ -\frac{5}{3} \end{pmatrix}$       |
|       | {Stretch} {factor 3} {parallel to $y$ -axis/in $y$ -direction/vertically} |
|       |                                                                           |

|       |                                                                                                               |
|-------|---------------------------------------------------------------------------------------------------------------|
| 10(b) |                              |
| 10(c) | $y = 3\sqrt{x+2} - 5 \Rightarrow \frac{y+5}{3} = \sqrt{x+2}$ $[g^{-1}(x)] = \left(\frac{x+5}{3}\right)^2 - 2$ |
| 10(d) | $[\text{Range of } g^{-1} \text{ is } g^{-1}(x)] \geq -2$                                                     |

|       |                                                                                                                                               |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| 10(e) | $[g^{-1}h(4) = g^{-1}(2)] = \frac{31}{9}$                                                                                                     |
| 10(f) | $hg^{-1}$ is impossible since the <b>range</b> of $g^{-1}$ is $x \geq -2$ is <b>not within</b> the <b>domain</b> of $h$ , which is $x \geq 0$ |

|          |                                                                                                                                                 |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------------|
| 1        | {Stretch} {factor 2} {'parallel to y-axis' or 'in y-direction' or 'vertically'}                                                                 |
|          | {Translation} $\begin{pmatrix} \{0\} \\ \{-14\} \end{pmatrix}$ or $\{-14\}$ {'parallel to the y-axis' or 'in the y-direction' or 'vertically'.} |
|          | <b>Alternative Method for Question 1</b>                                                                                                        |
|          | {Translation by} $\begin{pmatrix} \{0\} \\ \{-7\} \end{pmatrix}$ or $\{-7\}$ {'parallel to the y-axis' or 'in the y-direction' or 'vertically'} |
|          | {Stretch} {factor 2} {'parallel to y-axis' or 'in y-direction' or 'vertically'}                                                                 |
| 11(a)    | $\{(x+2)^2\} \{-2\}$                                                                                                                            |
|          |                                                                                                                                                 |
| 11(b)(i) | $y = (x+2)^2 - 2 \Rightarrow y+2 = (x+2)^2$                                                                                                     |
|          | $x = [\pm] \sqrt{y+2} - 2$                                                                                                                      |
|          | $[f^{-1}(x) =] - \sqrt{x+2} - 2$                                                                                                                |
|          |                                                                                                                                                 |

11(b)(ii)

$$[gf(x)=] - \{their\ completed\ square\ form\} - 4 \text{ or } -(x^2 + 4x + 2) - 4$$

$$[gf(x)=] - (x+2)^2 - 2$$

$$x = [\pm] \sqrt{-y-2} - 2$$

$$[(gf)^{-1}(x)=] - \sqrt{-x-2} - 2$$

**Alternative Method for Question 11(b)(ii)**

$$(gf)^{-1} = f^{-1}g^{-1}$$

$$g^{-1}(x) = -x - 4$$

$$(gf)^{-1}(x) = -\sqrt{-x-4+2} - 2$$

$$[(gf)^{-1}(x)=] - \sqrt{-x-2} - 2$$