1.

METHOD 1

$5(2a + 9d) = 60$ (or $2a + 9d = 12$)	M1A1
$10(2a + 19d) = 320$ (or $2a + 19d = 32$)	A1
solve simultaneously to obtain	M1
$a = -3, d = 2$	A1
the 15^{th} term is $-3 + 14 \times 2 = 25$	A1

Note: FT the final A1 on the values found in the penultimate line.

METHOD 2

with an AP the mean of an even number of consecutive terms equals the mean of the middle terms	(M1)
$\frac{a_{10} + a_{11}}{2} = 16$ (or $a_{10} + a_{11} = 32$)	A1
$\frac{a_5 + a_6}{2} = 6$ (or $a_5 + a_6 = 12$)	A1
$a_{10} - a_5 + a_{11} - a_6 = 20$	M1
$5d + 5d = 20$	
$d = 2$ and $a = -3$ (or $a_5 = 5$ or $a_{10} = 15$)	A1
the 15^{th} term is $-3 + 14 \times 2 = 25$ (or $5 + 10 \times 2 = 25$ or $15 + 5 \times 2 = 25$)	A1

Note: FT the final A1 on the values found in the penultimate line.

[6]

2.

(a)	(i) $(g \circ f)(x) = \frac{1}{2x+3}, x \neq -\frac{3}{2}$ (or equivalent)	A1
	(ii) $(f \circ g)(x) = \frac{2}{x} + 3, x \neq 0$ (or equivalent)	A1
(b)	**EITHER**	
	$f(x) = (g^{-1} \circ f \circ g)(x) \Rightarrow (g \circ f)(x) = (f \circ g)(x)$	(M1)
	$\frac{1}{2x+3} = \frac{2}{x} + 3$	A1
	OR	
	$(g^{-1} \circ f \circ g)(x) = \frac{1}{\frac{2}{x} + 3}$	A1
	$2x + 3 = \frac{1}{\frac{2}{x} + 3}$	M1
	THEN	
	$6x^2 + 12x + 6 = 0$ (or equivalent)	A1
	$x = -1, y = 1$ (coordinates are $(-1, 1)$)	A1

[6]

3.

(a) **METHOD 1**

$f'(x) = q - 2x = 0$	M1
$f'(3) = q - 6 = 0$	
$q = 6$	A1
$f(3) = p + 18 - 9 = 5$	M1
$p = -4$	A1

METHOD 2

$f(x) = -(x-3)^2 + 5$	M1A1
$= -x^2 + 6x - 4$	
$q = 6, p = -4$	A1A1

(b) $g(x) = -4 + 6(x-3) - (x-3)^2$ $(= -31 + 12x - x^2)$ M1A1

Note: Accept any alternative form that is correct.
Award M1A0 for a substitution of $(x + 3)$.

[6]

Method 1 uses calculus (we haven't covered it yet).

4.

$g(x) = 0$ or 3	(M1)(A1)
$x = -1$ or 4 or 1 or 2	A1A1

Notes: Award A1A1 for all four correct values,
A1A0 for two or three correct values,
A0A0 for less than two correct values.

Award M1 and corresponding *A* marks for correct attempt to find expressions for f and g.

[4]

5.

$2^{2x-2} = 2^x + 8$	(M1)
$\frac{1}{4}2^{2x} = 2^x + 8$	(A1)
$2^{2x} - 4 \times 2^x - 32 = 0$	A1
$(2^x - 8)(2^x + 4) = 0$	(M1)
$2^x = 8 \Rightarrow x = 3$	A1

Notes: Do not award final A1 if more than 1 solution is given.

[5]

6.

(a) attempt at completing the square (M1)

$3x^2 - 6x + 5 = 3(x^2 - 2x) + 5 = 3\ (x-1)^2 - 1 + 5$ (A1)

$= 3(x-1)^2 + 2$ A1

$(a = 3,\ b = -1,\ c = 2)$

(b) definition of suitable basic transformations:

T_1 = stretch in y direction scale factor 3 A1

T_2 = translation $\begin{pmatrix} 1 \\ 0 \end{pmatrix}$ A1

T_3 = translation $\begin{pmatrix} 0 \\ 2 \end{pmatrix}$ A1

[6]

7.

$g(x) = 0$

$\log_5|2\log_3 x| = 0$ (M1)

$|2\log_3 x| = 1$ A1

$\log_3 x = \pm\frac{1}{2}$ (A1)

$x = 3^{\pm\frac{1}{2}}$ A1

so the product of the zeros of g is $3^{\frac{1}{2}} \times 3^{-\frac{1}{2}} = 1$ A1 N0

[5]

8.

(a) **EITHER**

graph of the cubic is shifted horizontally one unit to the right (M1)

$\Rightarrow x = -0.796$ A1

OR

$(x-1) = -1.796$ (M1)

$x = -0.796$ A1

(b) **EITHER**

stretch factor of 0.5 in the x-direction (M1)

$\Rightarrow 2x = -1.796$ (M1)

9.

(a) $h(x) = g\left(\frac{4}{x+2}\right)$ (M1)

$= \frac{4}{x+2} - 1 \quad \left(= \frac{2-x}{2+x}\right)$ A1

(b) **METHOD 1**

$x = \frac{4}{y+2} - 1$ (interchanging x and y) M1

Attempting to solve for y M1

$(y+2)(x+1) = 4 \quad \left(y + 2 = \frac{4}{x+1}\right)$ (A1)

$h^{-1}(x) = \frac{4}{x+1} - 2 \quad (x \neq -1)$ A1 N1

METHOD 2

$x = \frac{2-y}{2+y}$ (interchanging x and y) M1

Attempting to solve for y M1

$xy + y = 2 - 2x \quad (y(x+1) = 2(1-x))$ (A1)

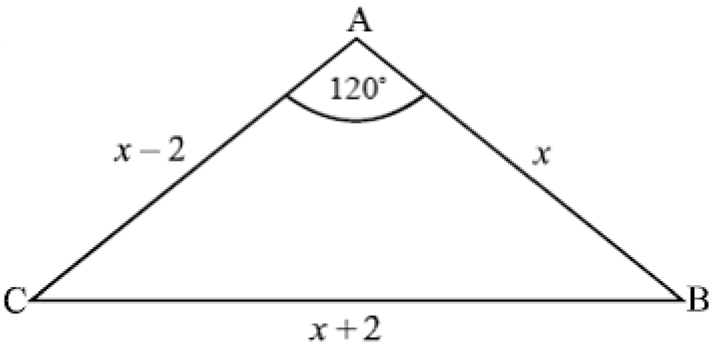
$h^{-1}(x) = \frac{2(1-x)}{x+1} \quad (x \neq -1)$ A1 N1

Note: In either **METHOD 1** or **METHOD 2** rearranging first and interchanging afterwards is equally acceptable.

[6]

10.

(a)



(M1)

$(x+2)^2 = (x-2)^2 + x^2 - 2(x-2)\,x\cos 120°$ M1A1

$x^2 + 4x + 4 = x^2 - 4x + 4 + x^2 + x^2 - 2x$ (M1)

$0 = 2x^2 - 10x$ A1

$0 = x(x-5)$

$x = 5$ A1

(b) Area $= \frac{1}{2} \times 5 \times 3 \times \sin 120°$ M1A1

$= \frac{1}{2} \times 15 \times \frac{\sqrt{3}}{2}$ A1

$= \frac{15\sqrt{3}}{4}$ AG

(c) $\sin A = \frac{\sqrt{3}}{2}$

$\frac{15\sqrt{3}}{4} = \frac{1}{2} \times 5 \times 7 \times \sin B \Rightarrow \sin B = \frac{3\sqrt{3}}{14}$ M1A1

Similarly $\sin C = \frac{5\sqrt{3}}{14}$ A1

$\sin A + \sin B + \sin C = \frac{15\sqrt{3}}{14}$ A1

[13]

11.

(a) $A^2 = \begin{pmatrix} 2a & -2 \\ -a & 2a+1 \end{pmatrix}$ (M1)A1

(b) **METHOD 1**

det $A^2 = 4a^2 + 2a - 2a = 4a^2$ M1

$a = \pm 2$ A1A1 N2

METHOD 2

det $A = -2a$ M1

det $A = \pm 4$

$a = \pm 2$ A1A1 N2

[5]

12.

(a) Use of $\bar{x} = \frac{\sum_{i=1}^{4} x_i}{n}$ (M1)

$\bar{x} = \frac{(k-2)+k+(k+1)+(k+4)}{4}$ (A1)

$\bar{x} = \frac{4k+3}{4} \quad \left(= k+\frac{3}{4}\right)$ A1 N3

(b) Either attempting to find the new mean or subtracting 3 from **their** $\bar{x}$ (M1)

$\bar{x} = \frac{4k+3}{4} - 3 \quad \left(= \frac{4k-9}{4}, k-\frac{9}{4}\right)$ A1 N2

[5]

13.

EITHER

Using $\mathrm{P}(A \mid B) = \frac{\mathrm{P}(A \cap B)}{\mathrm{P}(B)}$ (M1)

$0.6\mathrm{P}(B) = \mathrm{P}(A \cap B)$ A1

Using $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ to obtain
$0.8 = 0.6 + \mathrm{P}(B) - \mathrm{P}(A \cap B)$ A1

Substituting $0.6\mathrm{P}(B) = \mathrm{P}(A \cap B)$ into above equation M1

OR

As $\mathrm{P}(A \mid B) = \mathrm{P}(A)$ then A and B are independent events M1R1

Using $\mathrm{P}(A \cup B) = \mathrm{P}(A) + \mathrm{P}(B) - \mathrm{P}(A) \times \mathrm{P}(B)$ A1

to obtain $0.8 = 0.6 + \mathrm{P}(B) - 0.6 \times \mathrm{P}(B)$ A1

THEN

$0.8 = 0.6 + 0.4\mathrm{P}(B)$ A1

$\mathrm{P}(B) = 0.5$ A1 N1

[6]