# MARKSCHEME

**1.** (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)

**Note:** At least one of the above lines must be seen to award the *M* marks.

$\Rightarrow\ x = -0.898$ A1

**OR**

$8x^3 - 2x + 4 = (2x)^3 - 2x + 4 = 0$ (M1)
$\Rightarrow\ 2x = -1.796$ (M1)

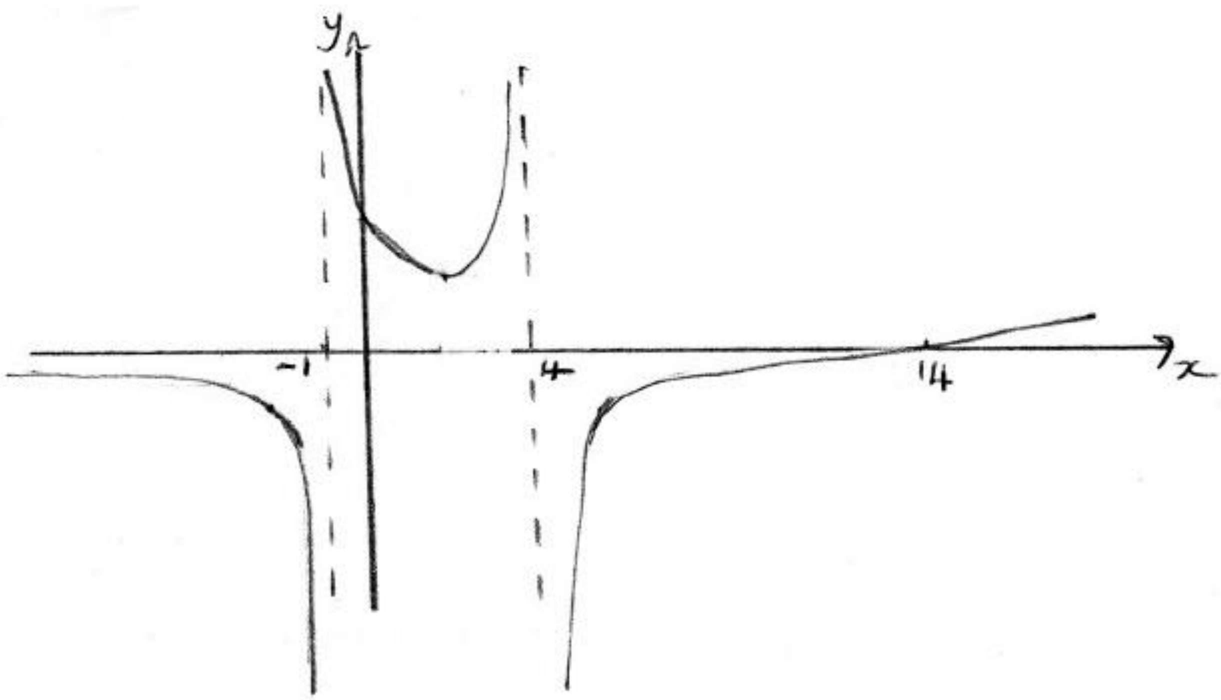
**Note:** At least one of the above lines must be seen to award the *M* marks.

$\Rightarrow\ x = -0.898$ A1

**[5]**

**2.** **METHOD 1**

Graph of $f(x) - g(x)$ M1




A1A1A1

**Note:** Award A1 for each branch.

$x < -1$ or $4 < x \leq 14$ A1A1 N3

**Note:** Each value and inequality sign must be correct.

**METHOD 2**

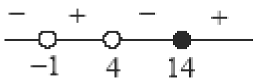
$\dfrac{x+4}{x+1} - \dfrac{x-2}{x-4} \leq 0$ M1

$\dfrac{x^2 - 16 - x^2 + x + 2}{(x+1)(x-4)} \leq 0$

$\dfrac{x-14}{(x+1)(x-4)} \leq 0$ A1

Critical value of $x = 14$ A1

Other critical values $x = -1$ and $x = 4$ A1




$x < -1$ or $4 < x \leq 14$ A1A1 N3

**Note:** Each value and inequality sign must be correct.

**[6]**

**3.** (a) $f : x \mapsto e^x \Rightarrow f^{-1} : x \mapsto \ln x$

$\Rightarrow f^{-1}(3) = \ln 3$ A1

$g : x \mapsto x + 2 \Rightarrow g^{-1} : x \mapsto x - 2$

$\Rightarrow g^{-1}(3) = 1$ A1

$f^{-1}(3) \times g^{-1}(3) = \ln 3$ A1 N1

(b) **EITHER**

$f \circ g(x) = f(x + 2) = e^{x+2}$ A1

$e^{x+2} = 3 \Rightarrow x + 2 = \ln 3$ M1

$x = \ln 3 - 2$ A1 N0

**OR**

$f \circ g(x) = e^{x+2}$

$f \circ g^{-1}(x) = \ln(x) - 2$ A1

$f \circ g^{-1}(3) = \ln(3) - 2$ M1

$x = \ln 3 - 2$ A1 N0

**[6]**

**4.** Attempting to find $f(2) = 8 + 12 + 2a + b$ (M1)

$= 2a + b + 20$ A1

Attempting to find $f(-1) = -1 + 3 - a + b$ (M1)

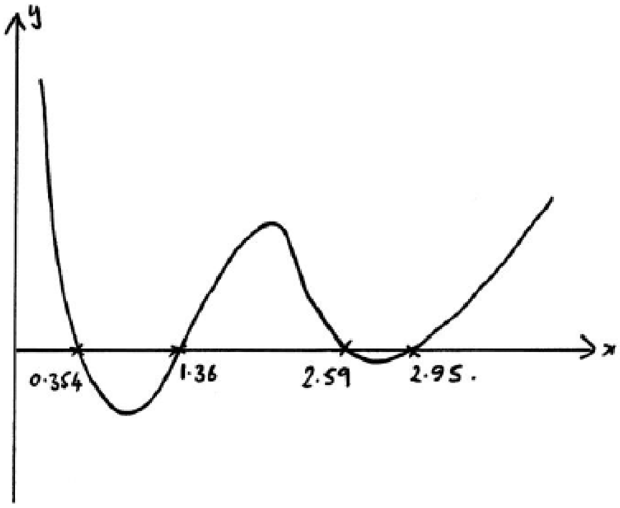
$= 2 - a + b$ A1

Equating $2a + 20 = 2 - a$ A1

$a = -6$ A1 N2

**[6]**

**5.** (a)




A1

**Note:** Award A1 for shape.

$x$ intercepts 0.354, 1.36, 2.59, 2.95 A2

**Note:** Award A1 for three correct, A0 otherwise.

maximum = (1.57, 0.352) = $\left(\frac{\pi}{2}, 0.352\right)$ A1

minimum = (1, –0.640) and (2.77, –0.0129) A1

(b) $0 < x < 0.354$, $1.36 < x < 2.59$, $2.95 < x < 4$ A2

**Note:** Award A1 if two correct regions given.

**[7]**

**6.** (a) $h(x) = g \circ f(x) = \frac{1}{e^{x^2}+3}, (x \geq 0)$ (M1)A1

(b) $0 < x \leq \frac{1}{4}$ A1A1

**Note:** Award A1 for limits and A1 for correct inequality signs.

(c) $y = \frac{1}{e^{x^2}+3}$

$ye^{x^2} + 3y = 1$ M1

$e^{x^2} = \frac{1-3y}{y}$ A1

$x^2 = \ln\frac{1-3y}{y}$ M1

$x = \pm\sqrt{\ln\frac{1-3y}{y}}$

$\Rightarrow h^{-1}(x) = \sqrt{\ln\frac{1-3x}{x}}$ $\left(= \sqrt{\ln\left(\frac{1}{x} - 3\right)}\right)$ A1

**[8]**

**7.** (a) $\frac{dy}{dx} = 24x^2 + 2bx + c$ (A1)

$24x^2 + 2bx + c = 0$ (M1)

$\Delta = (2b)^2 - 96(c)$ (A1)

$4b^2 - 96c > 0$ A1

$b^2 > 24c$ AG

(b) $1 + \frac{1}{4}b + \frac{1}{2}c + d = -12$

$6 + b + c = 0$

$-27 + \frac{9}{4}b - \frac{3}{2}c + d = 20$

$54 - 3b + c = 0$ A1A1A1

**Note:** Award A1 for each correct equation, up to 3, not necessarily simplified.

$b = 12$, $c = -18$, $d = -7$ A1

**[8]**