g. **i.** domain: $[4, \infty)$ A1

ii. $d(x) = (\sqrt{x+4} + 2)^2 - (x - 4\sqrt{x})$

$= (\sqrt{x+4} + 2)^2 - x + 4\sqrt{x}$ A1

iii. $d(x) = (\sqrt{x+4} + 2)^2 - x + 4\sqrt{x}$

$= 4\sqrt{x+4} + 4\sqrt{x} + 8$ M1

$4\sqrt{x+4} > 0$ and $4\sqrt{x} > 0$ for $x \in [4, \infty)$.

$\Rightarrow d(x) > 0$ for $x \in [4, \infty)$.

$\therefore$ vertical distance > 0 and graphs do not intersect A1

h. The minimum vertical distance between $h(x)$ and $h^{-1}(x)$ occurs at the end point of $h(x)$, where $x = 4$.

$d(4) = 16 + 8\sqrt{2}$

$q(x)$ is a transformation of the graph of $y = h(x)$ by $-c$ units upwards.

$\therefore c \leq -16 - 8\sqrt{2}$ A1

Question 5 (11 marks)

a. **i.** $f'(x) = (x - k + 1)e^x$ A1

ii. Let $f'(x) = 0$.

$\Rightarrow x = k - 1$ A1

$f(k-1) = -e^{k-1}$

$\therefore$ stationary point: $(k-1, -e^{k-1})$ A1

b. Two solutions occur between the stationary point and x-axis, which is an asymptote for $f(x)$.

$n \in (-e^{k-1}, 0)$ A1

c. **i.** $\frac{d}{dx}[xe^x] = x \times e^x + 1 \times e^x$ *use product rule* M1

$= (x+1)e^x$ as required