Question	Scheme	Marks
2(a)	Either $\mathrm{f}(x) < 5$ or $\mathrm{f}(x) \ldots 3$	**M1**
	$3 ,, \ \mathrm{f}(x) < 5$	**A1**
		(2)
(b)	(i) $y = 5 - \dfrac{4}{3x+2} \Rightarrow \dfrac{4}{3x+2} = 5 - y \Rightarrow \dfrac{4}{5-y} = 3x + 2 \Rightarrow x = ...$	**M1**
	$\left(\mathrm{f}^{-1}(x)\right) = \dfrac{1}{3}\left(\dfrac{4}{5-x} - 2\right)$ oe such as $\dfrac{4}{15-3x} - \dfrac{2}{3}$ or $\dfrac{2x-6}{15-3x}$	**A1**
	(ii) Domain is $3 ,, \ x < 5$	**B1ft**
		(3)
(c)	$\mathrm{fg}(-\pi) = \mathrm{f}\left(\left\lvert 4\sin\left(-\dfrac{\pi}{3} + \dfrac{\pi}{6}\right)\right\rvert\right) = \mathrm{f}\left(\left\lvert 4\sin\left(-\dfrac{\pi}{6}\right)\right\rvert\right) = \mathrm{f}(2) = ...$	**M1**
	$= 5 - \dfrac{4}{6+2} = \dfrac{9}{2}$	**A1**
		(2)
		(7 marks)

Notes:

(a)

M1: One correct end of range, though allow with „ or < and … or > (in correct direction) at the respective ends, and accept with *y* instead of f(*x*), or even with *x* for the M1.

A1: Correct range, allow with *y* instead of f(*x*) or with other correct set notation (but use of *x* is A0 unless in formal set notation). Accept as two separate inequalities.

(b)(i)

M1: Attempts to make *x* or a swapped *y* the subject of the equation. Allow sign slips, but there should be a correct order of operations.

A1: Correct rule, must be in terms of *x*, accept equivalents and isw after a correct answer is seen. Do not be concerned with the lhs (accept *y* = … and even condone f(*x*) =...)

(b)(ii)

B1ft: Follow through on their answer to (a). Accept intervals or set notation answers. Do not accept e.g. $3 ,, \ \mathrm{f}^{-1}(x) < 5$ or with *y*

(c)

M1: Attempts to evaluate g at $-\pi$ and substitutes into f. (Allow even if a negative value is found.) Evaluation of $\mathrm{g}(-\pi)$ must be attempted, not just substitution into the expression. They may find the expression for fg(*x*) first and substituted, in which case the trigonometric expression must be evaluated before the mark is awarded.

A1: Correct answer. Accept as decimal. Dot not isw if they try to change to degrees.

Question	Scheme	Marks
3(a)	$f'(x) = 2(x-2)\times e^{3x} + (x-2)^2 \times 3e^{3x}$	**M1 A1**
	$f'(x) = 0 \Rightarrow e^{3x}(x-2)(2+3(x-2)) = 0 \Rightarrow x = ...$	**M1**
	$\Rightarrow x = \frac{4}{3}$	**A1**
	$y = \frac{4}{9}e^4 \quad \left(\text{so } A \text{ is } \left(\frac{4}{3}, \frac{4}{9}e^4\right)\right)$	**A1**
		(5)
(b)	$k > 0$ or k „ their $\frac{4}{9}e^4$ or with … or < respectively.	**M1**
	$0 < k$„ their $\frac{4}{9}e^4$	**A1ft**
		(2)
		(7 marks)

Notes:

(a)

M1: Differentiates using the product rule reaching the form $\alpha(x-2)\times e^{3x} + (x-2)^2 \times \beta e^{3x}$

A1: Correct derivative, need not be simplified.

M1: Sets their derivative equal to zero and attempts to cancel or factorise out the exponential term and the $(x-2)$ term (or multiple thereof) and solve for *x*. Alternatively, they may expand to a 3 term quadratic $(3x^2 - 10x + 8)$ and attempt to solve this via correct method. Allow recovery on slips in the exponent for this mark (and the A's if a correct quadratic expression is solved).

A1: Correct *x* value.

A1: Correct simplified *y* value. Allow if seen in part (b). Isw, after a correct answer, but the follow through in (b) will not apply on an incorrectly simplified answer if this mark has been awarded.

(b)

M1: Identifies one correct boundary for *k* (the direction of inequality must be correct). Accept in terms of *y* or f(*x*) for this mark.

A1ft: Correct range for *k* following their **positive** *y* coordinate in (a). Must have correct inequalities. Accept awrt 24.3 for the upper bound. Allow as separate inequalities, or set or interval notation.