Question Number	Scheme	Marks
2. (a)	$0 < f(x) < \frac{4}{5}$	M1A1
		(2)
(b)	$y = \frac{4}{3x+5} \quad \Rightarrow (3x+5)y = 4 \Rightarrow x = h(y)$	M1
	$\Rightarrow x = \frac{4-5y}{3y}$ or $\Rightarrow y = \frac{4-5x}{3x}$ o.e.	A1
	$f^{-1}(x) = \frac{4-5x}{3x} \quad 0 < x < \frac{4}{5}$	A1ft
		(3)
(c)	$fg(x) = \frac{4}{\frac{3}{x}+5}$	B1
		(1)
(d)	$\frac{3x+5}{4} = \frac{4}{\frac{3}{x}+5} \rightarrow ax^2+bx+c=0$	M1
	$15x^2+18x+15=0$ or $5x^2 + 6x + 5 = 0$ oe	A1
	E.g. Uses $18^2-4\times15\times15$ or completing square, or applies formula.	dM1
	E.g. Discriminant < 0 hence there are no real solutions.	A1
		(4)
		(10 marks)

Notes

(a)

M1: One end correct, condoning $\leqslant$ instead of <. Accept alternative forms, e.g. interval notation. Condone use of x for this mark.

A1: Completely correct. Accept with f(x), f or y or Range, but A0 with x used. If interval notation is used, brackets must be correct for this mark, ie $\left(0, \frac{4}{5}\right)$.

(b)

M1: Sets y = f(x), multiplies both sides by denominator and reaches x as a function of y. Condone slips in expanding or in signs when rearranging after cross multiplying.
Alternatively swaps x any y and proceeds to y as a function of x.

A1: Correct expression for x in terms of y, or if swapping first, y in terms of x. E.g. $y = \frac{4-5x}{3x}$,

$y = \frac{4}{3x} - \frac{5}{3}$ or $x = \frac{\frac{4}{y}-5}{3}$

A1ft: A fully correct definition for f^{-1} with the correct rule and a correct domain or follow through domain for their (a). Must be in terms of x but accept with "y ="

E.g. $f^{-1}(x) = \frac{1}{3}\left(\frac{4}{x}-5\right) \quad 0 < x < \frac{4}{5}$ Accept equivalent forms for the rule as long as it is unambiguous e.g. $\frac{\frac{4}{x}-5}{3}$ is acceptable. You may isw after an acceptable answer has been seen.

(c)

B1: $\text{fg}(x) = \dfrac{4}{\dfrac{3}{x}+5}$ - allow any correct form then isw.

(d)

M1: Sets their fg(x) from (c) equal to their attempt at 1/f(x) (condone a slip if intent is clear), and attempt at simplification to give a quadratic. Alternatively, sets $g^{-1}\text{fg}(x) = \text{f}(x)$ or $\text{gfg}^{-1}(x) = \text{f}(x)$ with $g^{-1}(x) = \dfrac{1}{x}$ and attempts the simplification to a quadratic, e.g. $\dfrac{3+5x}{4x} = \dfrac{4}{3x+5}$ or $\dfrac{3\left(\dfrac{1}{x}\right)+5}{4} = \dfrac{4}{3x+5}$ leading to a quadratic in x.

A1: Correct 3TQ formed (any multiple). The "=0" may be implied.

dM1: Uses discriminant or completes the square to e.g. $5(x+b)^2 - c + "15"$ or $\left(\sqrt{5}x+b\right)^2 - c + "15"$ or attempts formula on their quadratic. There must be some working or indication of what they are doing to show the result, not just a value or solutions stated.

For example, stating the value −576 (or −576 < 0) with no context is dM0 but writing "Discriminant = −576" is sufficient for dM1 as they have said what the −576 is. Similarly, if they state "Discriminant =…" for an incorrect quadratic without "$b^2 - 4ac$" the value would need to be correct for their quadratic to imply correct method but just a value with no context will be dM0 even if correct.

Simply stating the complex roots with no working is dM0, as is going direct to a factorisation $\left(x - \dfrac{-3+4\text{i}}{5}\right)\left(x - \dfrac{-3-4\text{i}}{5}\right) = 0$.

A1: Completely correct work with reason and conclusion. Accept for the reason

- Correct discriminant < 0 (−576 < 0 or −64 < 0 for the quadratic shown in scheme) oe
- Correct completed square > 0 for all x
- Correct formula with correct complex (hence not real) roots stated with reference to "complex" or "not real" or contradiction due to square root of negative.

The conclusion may be minimal, e.g. // or QED.

Question Number	Scheme		Marks
3.(i)(a)	$\begin{array}{r} x-5 \\ x+2\overline{)\,x^2-3x+6} \\ \underline{x^2+2x} \\ -5x+6 \\ \underline{-5x-10} \\ 16 \end{array}$	$\dfrac{x^2-3x+6}{x+2}=Ax+B+\dfrac{C}{x+2}$ $\Rightarrow x^2-3x+6=(Ax+B)(x+2)+C$ $\Rightarrow 1=A,-3=2A+B,6=2B+C$ $\Rightarrow A=\ldots,\ B=\ldots,\ C=\ldots$	M1
	Quotient = $x-5$ and Remainder = 16		A1
			(2)
(b)	$\displaystyle\int\frac{x^2-3x+6}{x+2}\,\mathrm{d}x=\int x-5+\frac{16}{x+2}\,\mathrm{d}x=\frac{1}{2}x^2-5x+16\ln(x+2)+c$		M1, B1ft, A1
			(3)
(ii)	$\displaystyle\int_0^{\frac{\pi}{6}}(\cos\theta-\sin\theta)^2\mathrm{d}\theta=\int_0^{\frac{\pi}{6}}(\cos^2\theta-2\sin\theta\cos\theta+\sin^2\theta)\mathrm{d}\theta$ **and** one of $\displaystyle\int\sin^2\theta+\cos^2\theta\ \mathrm{d}\theta=\int 1\ \mathrm{d}\theta\to\theta$ or $\displaystyle\int 2\sin\theta\cos\theta\ \mathrm{d}\theta=\int\sin 2\theta\ \mathrm{d}\vartheta\to k\cos 2\theta$ or other valid integration approaches for one of these		M1
	E.g. $\to\displaystyle\int 1-\sin 2\theta\ \mathrm{d}\theta\to\theta+k\cos 2\theta$ (oe)		dM1
	$\displaystyle\int_0^{\frac{\pi}{6}}(\cos\theta-\sin\theta)^2\mathrm{d}\theta=\left[\theta+\frac{1}{2}\cos 2\theta\right]_0^{\frac{\pi}{6}}$ oe		A1
	$\displaystyle=\left(\frac{\pi}{6}+\frac{1}{2}\times\frac{1}{2}\right)-\left(0+\frac{1}{2}\right)=\frac{\pi}{6}-\frac{1}{4}$		ddM1 A1
			(5)
			(10 marks)

Notes

(i)(a)

M1: Full method to find the quotient and remainder. May use long division to produce a linear quotient and a constant remainder or use a partial fraction method to set up correct form and find the constants.

A1: Correct quotient and remainder seen anywhere – even in the division. If using partial fractions with correct form shown allow for the correct constants found.

(b)

M1: $\displaystyle\int\frac{K}{x+2}\,\mathrm{d}x\to A\ln(x+2)$ (A constant) condoning a missing bracket.

B1ft: Correct integration of their linear quotient. Note $(x-5)\to\dfrac{1}{2}(x-5)^2$ is an equivalent correct expression.

A1: Fully correct answer including the constant. Note $\ln|x+2|$ is fine.