

Question	Scheme	Marks	AOs
9(a)	$k = -4$ or $x > -4$	B1	2.2a
		(1)	
(b)	$\frac{d}{dx}[\ln(x+4)] = \frac{1}{(x+4)}$	B1	1.2
	$\frac{d}{dx}\left[\frac{(x+5)(x+1)}{(x+4)}\right] = \frac{(x+4)(2x+6) - (x+5)(x+1)}{(x+4)^2}$	M1 A1	1.1b 1.1b
	$f'(x) = \frac{2x^2 + 14x + 24 - x^2 - 6x - 5 - x - 4}{(x+4)^2}$ $= \frac{x^2 + 7x + 15}{(x+4)^2}$	A1	2.1
		(4)	
(c)	$b^2 - 4ac = 49 - 4 \times 15 = -11 < 0 \Rightarrow x^2 + 7x + 15 > 0$ or $x^2 + 7x + 15 = (x + 3.5)^2 - 3.5^2 + 15 = (x + 3.5)^2 + 2.75 \Rightarrow x^2 + 7x + 15 > 0$	M1	2.1
	The numerator and denominator are both > 0 Therefore $f'(x) > 0 \Rightarrow f$ is increasing	A1	2.4
		(2)	

(7 marks)

Notes

- (a)
B1: Deduces the correct value for k
- (b)
B1: Recalls the correct derivative of $\ln(x+4)$
M1: For the correct application of the quotient rule
A1: Correct differentiation for the fraction
A1: Fully correct expression
- (c)
M1: Considers the discriminant of the numerator or e.g. completes the square in order to show numerator is positive
A1: Suitable conclusion following fully correct work and refers to numerator and denominator being positive