A2 iii)

$f'(x) = \ln(x) + \frac{x}{x} = \ln(x) + 1$

$f'(x) = 0 \Leftrightarrow \ln(x) + 1 = 0 \Leftrightarrow \ln(x) = e^{-1} = \frac{1}{e}$

$x = \frac{1}{e}$ is the only critical point.

| interval | | behaviour |
|---|---|---|
| $(0, 1/e)$ | $f'(x) < 0$ | decreasing |
| $(\frac{1}{e}, \infty)$ | $f'(x) > 0$ | dincreasing |

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A2 (iv)

$f'(x) = 1 - \sin(x)$

$f'(x) = 0 \Leftrightarrow 1 - \sin(x) = 0 \Leftrightarrow 1 = \sin x \Leftrightarrow x = \frac{\pi}{2} + 2k\pi$ , k an integer

On the interval $0, 2\pi$ we have

| interval | sign | behaviour |
|---|---|---|
| $(0, \frac{\pi}{2})$ | $f'(\frac{\pi}{4}) > 0$ | inc |
| $(\frac{\pi}{2}, 2\pi)$ | $f'(\pi) > 0$ | inc |

Since sin(x) is cyclic. f(x) is always increasing

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A2(ii)

$$f'(x) = \frac{1 - x^2}{(x^2+1)^2}$$

critical points are $x = \pm 1$

| interval | sign | behaviour |
|---|---|---|
| $(-\infty, -1)$ | $-$ | dec |
| $(-1, 1)$ | $+$ | inc |
| $(1, \infty)$ | $-$ | dec. |

BI(i)

$y' = 4x - 4$

$y' = 0 \iff x = 1$

critical point is $x=1$

$f(1) = 0$
$f(0) = 2$
$f(3) = 8$

max is $f(3) = 8$
min is $f(1) = 0$

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BI (iv)

$f'(x) = 1 - \frac{4}{(x+1)^2} = \frac{(x-1)(x+3)}{(x+1)^2}$

$f'(x) = 0 \iff x = 1 \text{ or } x = -3$

critical points are $1, -3, -1$

only $x=1$ is in the interval

$f(1) = -1 \qquad f(0) = 0 \qquad f(3) = 0$

max is $f(0) = f(3) = 0$
min is $f(1) = -1$

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BIv $f'(x) = \sec^2 x - 2$

$f'(x) = 0 \iff \sec(x) = \pm\sqrt{2} \iff \frac{1}{\cos(x)} = \pm\sqrt{2} \iff \cos(x) = \pm\frac{1}{\sqrt{2}}$

$\iff x = \frac{\pi}{4}, \frac{3\pi}{4}, \frac{5\pi}{4}, \frac{7\pi}{4}$

only $\frac{\pi}{4}$ is in $[0,1]$

$f(0) = 0$
$f(\frac{\pi}{4}) \simeq -0.57$
$f(1) \simeq -0.44$

so min is $f(\frac{\pi}{4}) = 1 - \frac{\pi}{2}$, max is $f(0) = 0$