[2] $\lim_{x\to 1^+} \cos(f(x)-3) = \boxed{\cos\left(\lim_{x\to 1^+}(f(x)-3)\right)}$ $\frac{1}{2}$

WATCH OUT FOR
LIMITS FROM ONE SIDE ONLY

$\frac{1}{2}$ SINCE COS X IS CONTINUOUS EVERYWHERE

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

so $\lim_{x\to 1^+} \cos(f(x)-3) = \boxed{\cos 1}$ $\frac{1}{2}$

$\lim_{x\to 1^-} \cos(f(x)-3) = \boxed{\cos\left(\lim_{x\to 1^-}(f(x)-3)\right)}$ $\frac{1}{2}$

SINCE COS X IS CONTINUOUS EVERYWHERE

$\lim_{x\to 1^-}(f(x)-3) = \boxed{\lim_{x\to 1^-} f(x) - \lim_{x\to 1^-} 3} = \boxed{2-3} = \boxed{-1}$ $\frac{1}{2}$ $\frac{1}{2}$ $\frac{1}{2}$

so $\lim_{x\to 1^-} \cos(f(x)-3) = \boxed{\cos(-1)} = \cos 1$ $\frac{1}{2}$ SINCE $\boxed{\cos(-x) = \cos x}$ $\frac{1}{2}$ FOR ALL X

so $\boxed{\lim_{x\to 1} \cos(f(x)-3) = \cos 1}$ $\frac{1}{2}$

[3] arctan x IS CONTINUOUS EVERYWHERE $\frac{1}{2}$

$1+\ln x$ IS CONTINUOUS AT ALL $x > 0$ 1

SO $\dfrac{\arctan x}{1+\ln x}$ IS CONTINUOUS AT ALL $x > 0$ 1

EXCEPT WHERE $1+\ln x = 0$ 1

$\ln x = -1$

$x = e^{-1} = \frac{1}{e}$ 1

[4] $$\lim_{x\to -3} \frac{\frac{27}{x^2} - \frac{18}{x^2+x}}{x+3} = \boxed{\lim_{x\to -3} \frac{\frac{27}{x^2} - \frac{18}{x(x+1)}}{x+3} \cdot \frac{x^2(x+1)}{x^2(x+1)}}$$ 1

$$\frac{\frac{27}{9} - \frac{18}{9-3}}{-3+3} \to \frac{3-3}{0} \to \frac{0}{0}$$

$$= \lim_{x\to -3} \frac{27(x+1) - 18x}{x^2(x+1)(x+3)}$$

1 $$= \boxed{\lim_{x\to -3} \frac{9x+27}{x^2(x+1)(x+3)}} = \lim_{x\to -3} \frac{9(x+3)}{x^2(x+1)(x+3)}$$

$\frac{1}{2}$ $$= \boxed{\lim_{x\to -3} \frac{9}{x^2(x+1)}} = \frac{9}{9(-2)} = \boxed{-\frac{1}{2}}$$ $\frac{1}{2}$

$$\lim_{x\to -3} \sin^{-1} \frac{\frac{27}{x^2} - \frac{18}{x^2+x}}{x+3} = \boxed{\sin^{-1}\left(-\frac{1}{2}\right)} = \boxed{-\frac{\pi}{6}}$$ $\frac{1}{2}$ $\frac{1}{2}$

SINCE $\sin^{-1} x$ IS CONTINUOUS

$\frac{1}{2}$ AT ALL X SUCH THAT $-1 < x < 1$

[5] $\frac{1}{2}$ $\boxed{\text{B2 IS CORRECT}}$ $f(x) = \dfrac{4x}{3+2x-x^2}$ HAS INFINITE

DISCONTINUITIES WHERE $3+2x-x^2=0$ (1)

IE. $(3-x)(1+x)=0$

$\frac{1}{2}$ $\boxed{x=3 \text{ OR } x=-1}$ IN $(-2,4)$

(1) SO $\boxed{f \text{ IS NOT CONTINUOUS ON } (-2,4)}$ AND IVT DOES NOT APPLY

[6][a] $\lim_{x\to 1} \frac{2x^2-3x-2}{2+x-x^2} = \boxed{\frac{\lim_{x\to 1}(2x^2-3x-2)}{\lim_{x\to 1}(2+x-x^2)}}$ $\frac{1}{2}$

$$= \boxed{\frac{\lim_{x\to 1} 2x^2 - \lim_{x\to 1} 3x - \lim_{x\to 1} 2}{\lim_{x\to 1} 2 + \lim_{x\to 1} x - \lim_{x\to 1} x^2}}$$ 1

$$= \boxed{\frac{(\lim_{x\to 1} 2)(\lim_{x\to 1} x)(\lim_{x\to 1} x) - (\lim_{x\to 1} 3)(\lim_{x\to 1} x) - 2}{2 + 1 - (\lim_{x\to 1} x)(\lim_{x\to 1} x)}}$$ 1

$$= \boxed{\frac{2\cdot 1\cdot 1 - 3\cdot 1 - 2}{2+1-1\cdot 1}} = \frac{2-3-2}{2+1-1} = \boxed{-\frac{3}{2}}$$ $\frac{1}{2}$ $\frac{1}{2}$

MUST SHOW ALL FACTORS

[b] $f(2) = -\frac{5}{3}$

$$\lim_{x\to 2^+} f(x) = \boxed{\lim_{x\to 2^+} \frac{\sqrt{4x+1}-\sqrt{x+7}}{4-2x}} \cdot \boxed{\frac{\sqrt{4x+1}+\sqrt{x+7}}{\sqrt{4x+1}+\sqrt{x+7}}}$$

1 1

$$\frac{\sqrt{9}-\sqrt{9}}{4-4} \to \frac{0}{0}$$

MUST HAVE "$\lim_{x\to 2^+}$" ON EACH LINE AS SHOWN

$$= \lim_{x\to 2^+} \frac{4x+1-(x+7)}{-2(x-2)(\sqrt{4x+1}+\sqrt{x+7})}$$

$$= \boxed{\lim_{x\to 2^+} \frac{3x-6}{-2(x-2)(\sqrt{4x+1}+\sqrt{x+7})}}$$

$1\frac{1}{2}$

$$= \lim_{x\to 2^+} \frac{3\cancel{(x-2)}}{-2\cancel{(x-2)}(\sqrt{4x+1}+\sqrt{x+7})}$$

$$= \boxed{\lim_{x\to 2^+} \frac{3}{-2(\sqrt{4x+1}+\sqrt{x+7})}} = \frac{3}{-2(\sqrt{9}+\sqrt{9})} = \frac{3}{-2(3+3)}$$

$\frac{1}{2}$

$$= \frac{\cancel{3}}{-2(\cancel{6})_{2}} = \boxed{-\frac{1}{4}}$$

$\frac{1}{2}$

1

$$\lim_{x\to 2^-} f(x) = \boxed{\lim_{x\to 2^-} \frac{2x^2-3x-2}{2+x-x^2}} = \boxed{\lim_{x\to 2^-} \frac{\cancel{(x-2)}(2x+1)}{\cancel{(x-2)}(-x-1)}}$$

$\frac{1}{2}$

MUST HAVE "$\lim_{x\to 2^-}$" ON EACH LINE AS SHOWN

$$\frac{8-6-2}{2+2-4} \to \frac{0}{0}$$

$$= \boxed{\lim_{x\to 2^-} \frac{2x+1}{-x-1}} = \frac{4+1}{-2-1} = \boxed{-\frac{5}{3}}$$

$\frac{1}{2}$ $\frac{1}{2}$

$\frac{1}{2}$ $\boxed{\lim_{x\to 2^+} f(x) \text{ AND } \lim_{x\to 2^-} f(x) \text{ EXIST}}$, BUT $\boxed{\text{DO NOT EQUAL}}$ $\frac{1}{2}$

SO f HAS A $\boxed{\text{JUMP DISCONTINUITY}}$ AT $x=2$

1

AND f IS $\boxed{\text{NOT CONTINUOUS}}$ AT $x=2$ SINCE $\boxed{\lim_{x\to 2} f(x) \text{ DOES NOT EXIST}}$

$\frac{1}{2}$ $\frac{1}{2}$