۱- $g'(x) = (2\tan x - \sqrt{2}\ln x) f'(\tan^2 x + \sqrt{2}\ln x)$

$g'(\frac{\pi}{4}) = (2 - (2\sqrt{2})(\frac{\sqrt{2}}{2}))\, f'(1 + \frac{(\sqrt{2})(\frac{\sqrt{2}}{2})}{2}) = \sqrt{3}$

$\Rightarrow \boxed{f'(2) = \sqrt{3}}$

۲- $f(x) - 2g(x) \rightsquigarrow \frac{8 + a^3x^3 - (12 + a^3x - 2a^2x)}{4 - a^2x} = \frac{a^3x - 2a^2x}{2 - ax}$

$\frac{(2-ax)(4+2ax+a^2x^2)}{2-ax} = 4 + 2ax + a^2x^2$

$\Rightarrow f(x) - 2g(x) = \frac{a^2x - 2ax}{2 - ax} = -ax$

$\Rightarrow h(x) = -ax \rightsquigarrow h'(x) = \ln x$

$\Rightarrow h'(\frac{\sqrt{3}\pi}{4}) = \ln(\frac{\sqrt{3}\pi}{4}) = \boxed{-\frac{1}{2}}$

۳- if $x > \frac{3}{4} \Rightarrow f(x) = (4x - 3)\sqrt{ax}$

$f'(x) = 4\sqrt{ax} \rightsquigarrow f'(\frac{3}{4}) = 4\sqrt{\frac{3a}{4}} = 2\sqrt{3a}$

if $x < \frac{3}{4} \Rightarrow f(x) = (3 - 4x)\sqrt{ax}$

$f'(x) = -4\sqrt{ax} \rightsquigarrow f'(\frac{3}{4}) = -2\sqrt{3a}$

$\Rightarrow 2\sqrt{3a} - (-2\sqrt{3a}) = 2\sqrt{9} \rightsquigarrow 4\sqrt{3a} = 2\sqrt{9}$

$\Rightarrow (16)(3a) = (4)(9) \rightsquigarrow \boxed{a = \frac{1}{4}}$

۴- $y = -ax + 2 \rightsquigarrow f'(4) = -a$

$f(4) = -4a + 2$

$f(4) + f'(4) = -4a + 2 - a = -1$

$\Rightarrow a = \frac{3}{5} \rightsquigarrow \boxed{f'(4) = -\frac{3}{5}}$

۵- $f(x) = x^3 + ax - b \rightsquigarrow f'(x) = 3x^2 + a$

$f'(2) = 0 \Rightarrow 12 + a = 0 \rightarrow a = -12$

$f(2) = 0 \rightsquigarrow 8 + 2a - b = 0 \rightsquigarrow 8 + 2(-12) - b = 0$

$\Rightarrow b = -16$

$b - a = -16 - (-12) = \boxed{-4}$

۶- $f(x) = \ln^n(x^2) \rightsquigarrow f'(x) = n\ln^{n-1}(x^2)\cdot\frac{2}{x^2}$

$\frac{f(x)f'(x)}{(1-\ln x)^m} = 2^{\frac{11}{4}}$

$(1 - \ln x)^m = 2 \rightarrow \ln x = -1$

۷- $f^{-1}(x) = 2 \Rightarrow x = \frac{\sqrt{y}+1}{\sqrt{y}-1} \rightsquigarrow f^{-1}(x) = (\frac{x+1}{x-1})^2$

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

$(2)(3)(4) = \boxed{24}$

۸- $f(x) = (x^2+1)^3(ax+1) \rightsquigarrow f(0) = 1$

$\hookrightarrow f(-1) = 8 - 8a$

$\rightsquigarrow \frac{f(0) - f(-1)}{0 - (-1)} = -11 \rightarrow \frac{1 + 8a - 8}{1} = -11$

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

$\Rightarrow f'(1) = (3)(4)(2)(\frac{1}{2}) + (\frac{1}{2})(8) = \boxed{8}$

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$\Rightarrow f'(1) = (3)(4)(2)(\frac{1}{2}) + (-\frac{1}{2})(8) = \boxed{8}$

- b

$$\frac{\dfrac{f(\frac{\pi}{2}) - f(\frac{\pi}{4})}{\frac{\pi}{2} - \frac{\pi}{4}}}{\dfrac{g(\frac{\pi}{2}) - g(\frac{\pi}{4})}{\frac{\pi}{2} - \frac{\pi}{4}}} \Rightarrow \frac{\sin\frac{\pi}{2}\overset{-1}{\cos\pi} - \sin\frac{\pi}{4}\overset{0}{\cos\frac{\pi}{2}}}{(\sin^4\frac{\pi}{2} - \cos^4\frac{\pi}{2}) - (\sin^4\frac{\pi}{4} - \cos^4\frac{\pi}{4})}$$

$$\qquad\qquad 1 \qquad\qquad\qquad 0$$

$$= \frac{-1}{1} = \boxed{-1}$$