5. Find $f'(x)$.

$$f(x) = x - 3\sin x$$

$$f'(x) = 1 - 3\cos x$$

6. Find $f'(x)$.

$$f(x) = 3e^x + \frac{4}{x^{1/3}}$$

$$f(x) = 3e^x + 4x^{-1/3}$$

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

$$= 3e^x - \frac{4}{3} x^{-4/3}$$

or $3e^x - \dfrac{4}{3x^{4/3}}$

7. Find $f'(x)$.

$$f(x) = \sqrt{x}(x-1)$$

$$f(x) = x^{1/2}(x-1) = x^{3/2} - x^{1/2}$$

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

$$\text{or } \frac{3\sqrt{x}}{2} - \frac{1}{2\sqrt{x}} \quad \text{or } \frac{3x}{2\sqrt{x}} - \frac{1}{2\sqrt{x}} = \frac{3x-1}{2\sqrt{x}}$$

8. Find $f'(x)$.

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

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

$$f(x) = 1 - 3x^{-1} + x^{-2}$$

$$f'(x) = +3x^{-2} - 2x^{-3}$$

$$\text{or } \frac{3}{x^2} - \frac{2}{x^3} \quad \text{or } \frac{3x}{x^3} - \frac{2}{x^3} = \frac{3x-2}{x^3}$$

9. Find $f'(x)$.

$$f(x) = (x^3 + 2x)e^x$$

$$f'(x) = (x^3+2x)'e^x + (x^3+2x)(e^x)'$$

$$= (3x^2+2)e^x + (x^3+2x)e^x$$

$$\text{or } (x^3+3x^2+2x+2)e^x$$

10. Find $f'(x)$.

$$f(x) = e^x \cos x$$

$$f'(x) = (e^x)'\cos x + e^x(\cos x)'$$

$$= e^x \cos x + e^x \cdot (-\sin x)$$

$$= e^x \cos x - e^x \sin x$$

$$\text{or } e^x(\cos x - \sin x)$$

11. Find $f'(x)$.

$$f(x) = \frac{x^3}{1-x^2} \qquad \left(\frac{u}{v}\right)' = \frac{u'v - uv'}{v^2}$$

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

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

$$= \frac{3x^2-x^4}{(1-x^2)^2} \text{ or } \frac{x^2(3-x^2)}{(1-x^2)^2}$$

12. Find $f'(x)$.

$$f(x) = \frac{1-xe^x}{x+e^x}$$

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

$$= \frac{(-1e^x - xe^x)(x+e^x) - (1-xe^x)(1+e^x)}{(x+e^x)^2}$$

$$= \frac{(-xe^x - e^{2x} - x^2e^x - xe^{2x}) - (1+e^x - xe^x - xe^{2x})}{(x+e^x)^2}$$

$$= \frac{\underline{-xe^x} - e^{2x} - x^2e^x \underline{- xe^{2x}} - 1 - e^x \underline{+ xe^x} \underline{+ xe^{2x}}}{(x+e^x)^2} = \frac{-e^{2x} - x^2e^x - e^x - 1}{(x+e^x)^2}$$

13. Find $f'(x)$.

$$f(x) = \frac{1 - \sec x}{\tan x}$$

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

$$= \frac{-\sec x \tan x \cdot \tan x - (1-\sec x)\cdot \sec^2 x}{\tan^2 x}$$

$$= \frac{-\sec x \tan^2 x - \sec^2 x + \sec^3 x}{\tan^2 x}$$

which can possibly be written other ways

14. Find $f'(x)$.

$$f(x) = (x^4 + 3x^2 - 2)^5$$

$$f'(x) = 5(x^4+3x^2-2)^4 \cdot (x^4+3x^2-2)'$$

$$= 5(x^4+3x^2-2)^4 \cdot \underbrace{(4x^3+6x)}_{\text{Could factor as } 2x(2x^2+3)}$$

15. Find $f'(x)$.

$$f(x) = \sqrt{1-2x} = (1-2x)^{1/2}$$

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

$$= -(1-2x)^{-1/2} \quad \text{or} \quad -\frac{1}{\sqrt{1-2x}}$$

16. Find $f'(x)$.

$$f(x) = (2x-5)^4(8x^2-5)^{-3}$$

$$f'(x) = \left((2x-5)^4\right)'(8x^2-5)^{-3} + (2x-5)^4\left((8x^2-5)^{-3}\right)'$$

$$= 4(2x-5)^3 \cdot 2 \cdot (8x^2-5)^{-3} + (2x-5)^4 \cdot (-3)(8x^2-5)^{-4} \cdot 16x$$

$$= 8(2x-5)^3(8x^2-5)^{-3} - 48x(2x-5)^4(8x^2-5)^{-4}$$

which can also be written

$$8(2x-5)^3(8x^2-5)^{-4}\underbrace{\Big((8x^2-5) - 6x(2x-5)\Big)}_{}$$

Can then simplify this part to $8x^2 - 5 - 12x^2 + 30x$

$$= -4x^2 + 30x - 5$$

17. Find $f'(x)$.

$$f(x) = e^{x \cos x}$$

$$f = e^u \quad \text{and} \quad u = x\cos x$$

$$\frac{df}{du} = e^u \qquad \frac{du}{dx} = 1\cos x + x\cdot(-\sin x)$$

$$= \cos x - x\sin x$$

$$f'(x) = \frac{df}{dx} = \frac{df}{du}\cdot\frac{du}{dx} = e^u\cdot(\cos x - x\sin x) = e^{x\cos x}(\cos x - x\sin x)$$

18. Find $f'(x)$.

$$f(x) = 10^{1-x^2}$$

$$f = 10^u \quad \text{and} \quad u = 1 - x^2$$

$$\frac{df}{du} = 10^u \ln 10 \qquad \frac{du}{dx} = -2x$$

$$f'(x) = \frac{df}{dx} = \frac{df}{du}\cdot\frac{du}{dx} = 10^u \ln 10\cdot(-2x)$$

$$= 10^{1-x^2}\ln 10\cdot(-2x)$$

$$= -2\ln 10\cdot x\cdot 10^{1-x^2}$$

19. Find $f'(x)$.

$$f(x) = \sec^2 x + \tan^2 x$$

$$f'(x) = 2\sec x(\sec x)' + 2\tan x(\tan x)'$$

$$= 2\sec x \cdot \sec x \tan x + 2\tan x \cdot \sec^2 x$$

$$= 4\tan x \sec^2 x$$

20. Find $f'(x)$.

$$f(x) = \frac{x}{\sqrt{x^2+1}} = \frac{x}{(x^2+1)^{1/2}}$$

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

$$= \frac{1(x^2+1)^{1/2} - x \cdot \frac{1}{2}(x^2+1)^{-1/2} \cdot 2x}{x^2+1}$$

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

Could then factor out $(x^2+1)^{-1/2}$ from top...

21. Find $f'(x)$.

$$f(x) = x \ln x - x$$

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

$$= \ln x + 1 - 1$$

$$= \ln x$$

22. Find $f'(x)$.

$$f(x) = \sin(\ln x)$$

$$f'(x) = \cos(\ln x) \cdot (\ln x)'$$

$$= \cos(\ln x) \cdot \frac{1}{x}$$

or $\dfrac{\cos(\ln x)}{x}$

23. Find $f'(x)$.

$$f(x) = (\ln x)^{1/5}$$

$$f'(x) = \frac{1}{5}(\ln x)^{-4/5} \cdot \frac{1}{x}$$

$$\text{or} \quad \frac{1}{5x(\ln x)^{4/5}}$$

24. Find $f'(x)$.

$$f(x) = \sin x \ln(5x)$$

$$f'(x) = (\sin x)' \ln(5x) + \sin x \cdot (\ln(5x))'$$

$$= \cos x \ln(5x) + \sin x \cdot \frac{1}{5x} \cdot 5$$

$$= \cos x \ln(5x) + \frac{\sin x}{x}$$

25. Find $f'(x)$.

$$f(x) = \left(\ln(1+e^x)\right)^2$$

$$f = u^2 \quad \text{and} \quad u = \ln(1+e^x)$$

$$u = \ln v \quad \text{and} \quad v = 1+e^x$$

$$\frac{df}{du} = 2u \qquad \frac{du}{dv} = \frac{1}{v} \qquad \frac{dv}{dx} = e^x$$

$$f'(x) = \frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dv} \cdot \frac{dv}{dx}$$

$$= 2u \cdot \frac{1}{v} \cdot e^x$$

$$= 2\ln v \cdot \frac{1}{v} \cdot e^x$$

$$= 2\ln(1+e^x) \cdot \frac{1}{1+e^x} \cdot e^x$$

or $\dfrac{2e^x \ln(1+e^x)}{1+e^x}$