1. Differentiate: $f(x) = x^2 \log_4 x$
2. Differentiate: $f(x) = x^2(3^x)$
3. Differentiate: $f(x) = e^x \log_5 x$
4. Differentiate: $f(x) = e^x(2^x)$
5. Differentiate: $f(x) = x \log_4 x$
6. Differentiate: $f(x) = e^x \log x$
7. Differentiate: $f(x) = \sin x(5^x)$
8. Differentiate: $f(x) = \sin x \log x$
9. Differentiate: $f(x) = x^2(10^x)$
10. Differentiate: $f(x) = \sin x(2^x)$

Answers: 1. $f'(x) = 2x \log_4 x + \dfrac{x^2}{(\ln 4)x}$ 2. $f'(x) = 2x(3^x) + x^2(\ln 3)3^x$

3. $f'(x) = e^x \log_5 x + \dfrac{e^x}{(\ln 5)x}$ 4. $f'(x) = e^x(2^x) + e^x(\ln 2)2^x$

5. $f'(x) = \log_4 x + \dfrac{x}{(\ln 4)x}$ 6. $f'(x) = e^x \log x + \dfrac{e^x}{(\ln 10)x}$

7. $f'(x) = \cos x(5^x) + \sin x(\ln 5)5^x$ 8. $f'(x) = \cos x \log x + \dfrac{\sin x}{(\ln 10)x}$

9. $f'(x) = 2x(10^x) + x^2(\ln 10)10^x$ 10. $f'(x) = \cos x(2^x) + \sin x(\ln 2)2^x$

Solutions:

1. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[x^2 \log_4 x]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x}f(x)\right)g(x) + f(x)\dfrac{\mathrm{d}}{\mathrm{d}x}g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x}x^2\right)\log_4 x + x^2\dfrac{\mathrm{d}}{\mathrm{d}x}\log_4 x$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}x^2 = 2x$ $\dfrac{\mathrm{d}}{\mathrm{d}x}\log_b x = \dfrac{1}{(\ln b)x}$

$= 2x\log_4 x + x^2\dfrac{1}{(\ln 4)x}$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[x^2 \log_4 x] = 2x\log_4 x + \dfrac{x^2}{(\ln 4)x}$

2. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[x^2(3^x)]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x}f(x)\right)g(x) + f(x)\dfrac{\mathrm{d}}{\mathrm{d}x}g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x}x^2\right)(3^x) + x^2\dfrac{\mathrm{d}}{\mathrm{d}x}(3^x)$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}x^2 = 2x$ $\dfrac{\mathrm{d}}{\mathrm{d}x}b^x = (\ln b)b^x$

$= 2x(3^x) + x^2(\ln 3)3^x$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[x^2(3^x)] = 2x(3^x) + x^2(\ln 3)3^x$

3. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[e^x \log_5 x]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x}f(x)\right)g(x) + f(x)\dfrac{\mathrm{d}}{\mathrm{d}x}g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x}e^x\right)\log_5 x + e^x\dfrac{\mathrm{d}}{\mathrm{d}x}\log_5 x$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}e^x = e^x$ $\dfrac{\mathrm{d}}{\mathrm{d}x}\log_b x = \dfrac{1}{(\ln b)x}$

$= e^x\log_5 x + e^x\dfrac{1}{(\ln 5)x}$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[e^x \log_5 x] = e^x\log_5 x + \dfrac{e^x}{(\ln 5)x}$

4. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[e^x(2^x)]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x}f(x)\right)g(x) + f(x)\dfrac{\mathrm{d}}{\mathrm{d}x}g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x}e^x\right)(2^x) + e^x\dfrac{\mathrm{d}}{\mathrm{d}x}(2^x)$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}e^x = e^x$ $\dfrac{\mathrm{d}}{\mathrm{d}x}b^x = (\ln b)b^x$

$= e^x(2^x) + e^x(\ln 2)2^x$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[e^x(2^x)] = e^x(2^x) + e^x(\ln 2)2^x$

5. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[x \log_4 x]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x}f(x)\right)g(x) + f(x)\dfrac{\mathrm{d}}{\mathrm{d}x}g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x}x\right)\log_4 x + x\dfrac{\mathrm{d}}{\mathrm{d}x}\log_4 x$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}x = 1$ $\dfrac{\mathrm{d}}{\mathrm{d}x}\log_b x = \dfrac{1}{(\ln b)x}$

$= 1\log_4 x + x\dfrac{1}{(\ln 4)x}$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[x \log_4 x] = \log_4 x + \dfrac{x}{(\ln 4)x}$

6. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[e^x \log x]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x}f(x)\right)g(x) + f(x)\dfrac{\mathrm{d}}{\mathrm{d}x}g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x}e^x\right)\log x + e^x\dfrac{\mathrm{d}}{\mathrm{d}x}\log x$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}e^x = e^x$ $\dfrac{\mathrm{d}}{\mathrm{d}x}\log x = \dfrac{1}{(\ln 10)x}$

$= e^x \log x + e^x \dfrac{1}{(\ln 10)x}$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[e^x \log x] = e^x \log x + \dfrac{e^x}{(\ln 10)x}$

7. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x} f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[\sin x(5^x)]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x} f(x)\right) g(x) + f(x) \dfrac{\mathrm{d}}{\mathrm{d}x} g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x} \sin x\right)(5^x) + \sin x \dfrac{\mathrm{d}}{\mathrm{d}x}(5^x)$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x} \sin x = \cos x$ $\dfrac{\mathrm{d}}{\mathrm{d}x} b^x = (\ln b) b^x$

$= \cos x(5^x) + \sin x(\ln 5)5^x$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[\sin x(5^x)] = \cos x(5^x) + \sin x(\ln 5)5^x$

8. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x} f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[\sin x \log x]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x} f(x)\right) g(x) + f(x) \dfrac{\mathrm{d}}{\mathrm{d}x} g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x} \sin x\right) \log x + \sin x \dfrac{\mathrm{d}}{\mathrm{d}x} \log x$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x} \sin x = \cos x$ $\dfrac{\mathrm{d}}{\mathrm{d}x} \log x = \dfrac{1}{(\ln 10)x}$

$= \cos x \log x + \sin x \dfrac{1}{(\ln 10)x}$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[\sin x \log x] = \cos x \log x + \dfrac{\sin x}{(\ln 10)x}$

9. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x} f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[x^2(10^x)]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x} f(x)\right) g(x) + f(x) \dfrac{\mathrm{d}}{\mathrm{d}x} g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x} x^2\right)(10^x) + x^2 \dfrac{\mathrm{d}}{\mathrm{d}x}(10^x)$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x} x^2 = 2x$ $\dfrac{\mathrm{d}}{\mathrm{d}x} 10^x = (\ln 10)10^x$

$= 2x(10^x) + x^2(\ln 10)10^x$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[x^2(10^x)] = 2x(10^x) + x^2(\ln 10)10^x$

10. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x} f(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}[\sin x(2^x)]$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}[f(x)g(x)] = \left(\dfrac{\mathrm{d}}{\mathrm{d}x} f(x)\right) g(x) + f(x) \dfrac{\mathrm{d}}{\mathrm{d}x} g(x)$

$= \left(\dfrac{\mathrm{d}}{\mathrm{d}x} \sin x\right)(2^x) + \sin x \dfrac{\mathrm{d}}{\mathrm{d}x}(2^x)$ ◀ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x} \sin x = \cos x$ $\dfrac{\mathrm{d}}{\mathrm{d}x} b^x = (\ln b) b^x$

$= \cos x(2^x) + \sin x(\ln 2)2^x$ ◀ Simplify, if necessary.

$\therefore \dfrac{\mathrm{d}}{\mathrm{d}x}[\sin x(2^x)] = \cos x(2^x) + \sin x(\ln 2)2^x$

