1. For each of the following functions, calculate $f'(x)$.

a) $f(x) = \frac{5}{1-x}$

Solution

$$f'(x) = \frac{(1-0)*0-5(-1)}{(1-x)^2} = \frac{5}{(1-x)^2}$$

b) $f(x) = \frac{1-x}{5}$

Solution

$$f'(x) = \frac{5(-1)-(1-x)*0}{5^2} = \frac{-5}{25} = -\frac{1}{5}$$

c) $f(x) = \sin 2x + \cos 3x$

Solution

$$f'(x) = 2cos(2x) - 3sin(3x)$$

d) $f(x) = \sin\left(4x + \frac{\pi}{2}\right)$

Solution

Differentiating $(4x + \frac{\Pi}{2})$ with respect to x we get:

$\Rightarrow 4$

$$\Rightarrow f'(x) = 4cos(4x + \frac{\Pi}{2})$$

e) $f(x) = \sin 2x \cos 3x$

Solution

$$\Rightarrow f'(x) = sin2x * -3sin3x + 2cos3x * 2cos2x$$

$$\Rightarrow f'(x) = -3sin2xsin3x + 2cos3xcos2x$$

f) $f(x) = \sin(2 \cos 3x)$

Solution

$$\Rightarrow f'(x) = -6sin(3x) * cos(2cos(3x))$$

$$\Rightarrow f'(x) = -6sin3xcos(2cos3x)$$

2. For each of the following functions, calculate $\int f(x)dx$

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

Solution

$$\Rightarrow \int f(x)dx = \frac{x^5}{5} - \frac{x^4}{4} + \frac{x^3}{3} + C$$

b) $f(x) = 3/x$

Solution

$$\Rightarrow \int f(x)dx = \int \frac{3}{x}dx = 3\int \frac{1}{x}dx = 3lnx + C$$

c) $f(x) = 2 \sin x + 3 \cos x$

Solution

$$\Rightarrow \int f(x)dx = \int 2sinxdx + \int 3cosxdx + C$$

$$\Rightarrow \int f(x)dx = -2cosx + 3sinx + C$$

d) $f(x) = 5e^x - e$

Solution

$$\Rightarrow \int f(x)dx = \int (5e^x - e) + C = 5e^x - ex + C$$

e) $f(x) = 2x \sin 4x$

Solution

$\Rightarrow$ we use integration by parts,let u=2x and dv=sin4xdx

$\Rightarrow$ differentiating u and integrating dv wrt x we have:

$$\Rightarrow du = 2dx,\ v = -\frac{1}{4}cos4x$$

$$\Rightarrow -\frac{2x}{4}cos4x + \frac{2}{4}\int cos4xdx + C = -\frac{1}{2}xcos4x + \frac{1}{8}sin4x + C$$

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

Solution

$$\Rightarrow \int f(x)dx = \int x^2 e^x dx + C$$

$\Rightarrow$ let $u = x^2, dv = e^x dx$

$\Rightarrow$ differentiating u and integrating dv wrt x we have:

$$\Rightarrow du = 2xdx, v = e^x$$

$$\Rightarrow \int f(x)dx = x^2 e^x - \int 2xdx + C = ?$$

$$\Rightarrow let,\ u = 2x \Rightarrow du = 2dx,\ dv = e^x dx \Rightarrow v = e^x$$

$$\Rightarrow x^2 e^x - 2xe^x + 2e^x + C$$