1. If $y = x^2 e^x$, then $\frac{dy}{dx} =$

(A) $2xe^x$ (B) $x(x+2e^x)$ (C) $xe^x(x+2)$

(D) $2x+e^x$ (E) $2x+e$

$$y' = 2xe^x + e^x x^2 = xe^x(2+x)$$

8. Let f and g be differentiable functions with the following properties:

(i) $g(x) > 0$ for all x

(ii) $f(0) = 1$

If $h(x) = f(x)g(x)$ and $h'(x) = f(x)g'(x)$, then $f(x) =$

(A) $f'(x)$ (B) $g(x)$ (C) e^x (D) 0 (E) 1

$$h'(x) = f'(x)g(x) + f(x)g'(x)$$

?

$f'(x) = 0$ & $f(0) = 1$ → $f(x) = 1$

14. If $f(x) = x^{\frac{1}{3}}(x-2)^{\frac{2}{3}}$ for all x, then the domain of f' is

(A) $\{x \mid x \neq 0\}$ (B) $\{x \mid x > 0\}$ (C) $\{x \mid 0 \leq x \leq 2\}$

$\boxed{\text{(D)}}$ $\{x \mid x \neq 0 \text{ and } x \neq 2\}$ (E) $\{x \mid x \text{ is a real number}\}$

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

$$= \frac{1}{3}\frac{\sqrt[3]{(x-2)^2}}{\sqrt[3]{x^2}} + \frac{2}{3}\frac{\sqrt[3]{x}}{\sqrt[3]{x-2}}$$

$\rightarrow x \neq 0$ $\rightarrow x \neq 2$

$\sqrt{f(x)} \rightarrow f(x) \geq 0$

$\sqrt[3]{f(x)} \rightarrow f(x) \in \mathbb{R}$

448. Suppose that $u(x)$ and $v(x)$ are differentiable functions of x and that

$$u(1) = 2, \quad u'(1) = 0, \quad v(1) = 5, \quad \text{and} \quad v'(1) = -1.$$

Find the values of the following derivatives at $x = 1$.

a) $\frac{d}{dx}(uv)$

$= u'(1)v(1) + u(1)v'(1)$

$= 0 \cdot 5 + 2(-1)$

$= -2$

d) $\frac{d}{dx}(7v - 2u)$

$= 7v'(1) - 2u'(1)$

$= 7(-1) - 2(0)$

$= -7$

Chain rule.

$f(x) = (x^2-1)^2$, Find $f'(x)$.

$f = x^4 - 2x^2 + 1$

$f' = 4x^3 - 4x$

$f' = 2(x^2-1)$

$= (2x^2-2)2x$

Let $f(x) = f(u)$,

$u = g(x)$.

$$\frac{df}{dx} = \frac{df}{\cancel{du}} \cdot \frac{\cancel{du}}{dx}$$

$f(x) = (x^2-1)^2$

$f(u) = u^2$, $u = x^2-1$

$$\frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dx}$$

$= 2u \cdot 2x = 2(x^2-1)2x$

$= 4x^3 - 4x$

Let $f(x) = e^{3x-1} \rightarrow e^{u} \cdot u = 3x-1$

Find $f'(x) = e^{3x-1} \cdot 3$

$$\frac{df}{dx} = \frac{df}{du} \cdot \frac{du}{dx}$$