## Ans. to the Q. No: 1

$f(x) = \sqrt{x}\, g(x)$

$g(4) = 2$

$g'(4) = 3$

$f'(x) = \sqrt{x} \frac{d}{dx} \cdot g(x) + g(x) \frac{1}{2\sqrt{x}}$

$f'(4) = \sqrt{4}\ g'(x) + g(x) \cdot \frac{1}{2\sqrt{4}}$

$= \sqrt{4} . 3 + 2 \cdot \frac{1}{2\sqrt{4}}$

$= 6 + \frac{1}{2}$

$= \frac{13}{2}$ Ans.

## Ans. to the Q. No: 2

$\ln(x^9 + x^{-9})$

$= \ln x^9 \cdot \ln x^{-9}$

$= 9 \ln x \cdot -9 \ln x$

$= (-9)^2 \cdot (\ln x)^2$

$= 9^2 \cdot \frac{d}{dx} (\ln x)^2$

$= 9^2 \cdot 2 \ln(x) \frac{d}{dx} (\ln x)$

$= 9^2 \cdot 2 \ln(x) \cdot \frac{1}{x}$

$= \dfrac{2 \cdot 9^2 \ln(x)}{x}$

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# Ans. to the Q. No: 3

$$f(x) = \begin{cases} x^2 - 4x - 2 & x < 2 \\ -2x^2 + 4x & x > 2 \end{cases}$$

for, $x > 2$

$$= \lim_{h \to 2^+} \frac{f(x+h) - f(x)}{h}$$

$$= \lim_{h \to 2^+} \frac{-2(x+h)^2 + 4(x+h) + 2x^2 - 4x}{h}$$

$$= \lim_{h \to 2^+} \frac{-2x^2 - 4xh - 2h^2 + 4x + 4h + 2x^2 - 4x}{h}$$

$$= \lim_{h \to 2^+} \frac{4h - 4xh - 2h^2}{h}$$

$$= \lim_{h \to 2^+} \frac{h(4 - 4x - 2h}{h}$$

$$= \lim_{h \to 2^+} 4 - 4x - 2h$$

$$= 4 - 4x - 2 \times 2$$

$$= -4x$$

$$= -4 \times 2 \quad [\because x = 2]$$

$$= -8$$

for, $x<2$

$$= \lim_{h\to 2^-} \frac{f(x+h)-f(x)}{h}$$

$$= \lim_{h\to 2^-} \frac{(x+h)^2-4(x+h)-2-x^2+4x+2}{h}$$

$$= \lim_{h\to 2^-} \frac{x^2+2xh+h^2-4x-4h-2-x^2+4x+2}{h}$$

$$= \lim_{h\to 2^-} \frac{2xh+h^2-4h}{h}$$

$$= \lim_{h\to 2^-} \frac{h(2x+h-4)}{h}$$

$$= \lim_{h\to 2^-} 2x+h-4$$

$= 2x+(-2)-4$

$= 2x-2-4$

$= 2x-6$

$= 2\times 2-6 \quad [\because x=2]$

$= 4-6$

$= -2$

Ans. to the Q. No: 4(a)

$$f(x) = \cos\left(\ln\frac{2}{x^3}\right)$$

$$= \frac{d}{dx}\left[\cos\left(\ln\left(\frac{2}{x^3}\right)\right)\right]$$

$$= \left(-\sin\left(\ln\frac{2}{x^3}\right)\right)\cdot\frac{d}{dx}\left(\ln\left(\frac{2}{x^3}\right)\right)$$

$$= -\sin\left(\ln\frac{2}{x^3}\right)\cdot\frac{x^3}{2}\,\frac{d}{dx}\left(\frac{2}{x^3}\right)$$

$$= -\sin\left(\ln\frac{2}{x^3}\right)\cdot\frac{x^3}{2}\cdot 2\frac{d}{dx}\left(\frac{1}{x^3}\right)$$

$$= -\sin\left(\ln\frac{2}{x^3}\right)\cdot\frac{x^3}{2}\cdot 2(-3)\,x^{-4}$$

$$= \frac{\sin\left(\ln\frac{2}{x^3}\right).x^3.2.3}{2.x^{-4}}$$

$$= \frac{3\sin\left(\ln\frac{2}{x^3}\right)}{x}$$ Ans.

## Ans. to the Q. No: 4(b)

$$h(x) = (\cosh x^3).(\sinh^2 x + 3).$$

$$h'(x) = \frac{d}{dx}\left[\cosh x^3 (\sinh^2 x + 3)\right]$$

$$= (\cosh x^3)\frac{d}{dx}(\sinh^2 x + 3) + (\sinh^2 x + 3)\frac{d}{dx}\left[\cosh(x^3)\right]$$

$$= \cosh(x^3)\left(\frac{d}{dx}[\sinh^2(x)] + \frac{d}{dx}[3]\right) + (\sinh^2(x) + 3)\ \sinh x^3 . \frac{d}{dx}[x^3]$$

$$= \cosh(x^3)\left(2\sinh(x).\frac{d}{dx}[\sinh(x)] + 0\right) + (\sinh^2(x)+3)\ \sinh(x)^3 . 3x^2$$

$$= 2\cosh(x^3).\sinh(x).\cosh(x) + (\sinh^2(x) + 3).\sinh(x)^3.3x^2$$

## Ans. to the Q. No: 5

$$y = Ax^2 + Bx + C$$

$$y' = 2Ax + B$$

$$y'' = 2A$$

We have that,

$$x^2 = y'' + y' - 2y$$

$$= 2A + (2Ax + B) - 2(Ax^2 + Bx + C).$$

Re-arrang the terms,

$$x^2 = -2Ax^2 + (2A - 2B)x + (2A + B - 2C)$$

$$A = -\frac{1}{2}$$

We have that,

$$0 = 2A - 2B$$

$$= 2\left(-\frac{1}{2}\right) - 2B$$

$$= -1 - 2B$$

So, $2B = -1$

$B = -\frac{1}{2}$

$\therefore 0 = 2A + B - 2c$

$= 2(-\frac{1}{2}) + (-\frac{1}{2}) - 2c$

$= -\frac{3}{2} - 2c$

therefore, $2c = -\frac{3}{2}$

$\therefore c = -\frac{3}{4}$

$\therefore y = \frac{1}{2}x^2 - \frac{1}{2}x - \frac{3}{4}.$

# Ans. to the Q. No: 6

$$\cos\left(\frac{\pi}{2}\left\{\frac{b^4}{4}\left(1-\frac{2\sinh^2(8\pi l_s Q)}{\sinh^2(9\pi l_s Q)}\right)\right\}^{\frac{1}{4}}\right)$$

$$=\cos\left(\frac{\pi}{2}\left[\frac{b^4}{4}\left(1-\frac{2\sinh^2 x}{\sinh^2 y}\right)\right]^{\frac{1}{4}}\right) \qquad \begin{bmatrix} x=8\pi l_s Q \\ y=9\pi l_s Q \end{bmatrix}$$

$$=\cos\left(\frac{\pi}{2}\left[(b^4)^{\frac{1}{4}}\left(\frac{1}{4}-\frac{2\sinh^2 x}{\sinh^2 y}\right)^{\frac{1}{4}}\right]\right)$$

$$=\cos\left(\frac{\pi}{2}\cdot b\cdot (z)^{\frac{1}{4}}\right) \qquad \left[z=\frac{1}{4}-\frac{2\sinh^2 x}{\sinh^2 y}\right]$$

$$f'(x) = -\sin\left[\frac{\pi}{2}\times b\times z^{\frac{1}{4}}\right]\left(\frac{\pi}{2}\times\frac{1}{4}\cdot z^{-\frac{3}{4}}\right)$$

$$f'(x) = -\sin\left[\frac{\pi}{2}\times b\times\left(\frac{1}{4}-\frac{2\sinh^2 x}{\sinh^2 y}\right)^{\frac{1}{4}}\right]\left[\frac{\pi}{2}\times\left(\frac{1}{4}-\frac{2\sinh^2 x}{\sinh^2 y}\right)^{-\frac{3}{4}}\right]$$