JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- MATHEMATICS
CLASS :- 12th **PAPER CODE :- CWT-6**
CHAPTER :- METHOD OF DIFFERENTIATION

ANSWER KEY

1.	(D)	**2.**	(B)	**3.**	(A)	**4.**	(D)	**5.**	(C)	**6.**	(B)	**7.**	(B)
8.	(B)	**9.**	(D)	**10.**	(D)	**11.**	(B)	**12.**	(C)	**13.**	(B)	**14.**	(D)
15.	(C)	**16.**	(B)	**17.**	(A)	**18.**	(D)	**19.**	(D)	**20.**	(D)	**21.**	6
22.	0	**23.**	1	**24.**	3	**25.**	17	**26.**	4	**27.**	8	**28.**	48
29.	9	**30.**	8										

SOLUTIONS

1. (D)

Sol. $x = \sin\theta$; $x = \sin^2\phi$

$y = \sin^{-1}(\sin\theta\cos\phi + \sin\phi\cos\theta) = \sin^{-1}((\sin(\theta + \phi)) = \theta + \phi = \sin^{-1}x + \sin^{-1}\sqrt{x}$

$$Dy = \frac{1}{\sqrt{1-x^2}} + \frac{1}{2\sqrt{x(1-x)}} \quad \text{assuming } x^2 + x \le 1 \text{ i.e. } 0 \le x < \frac{\sqrt{5}-1}{2}\ ]$$

Note: $\sin^{-1}\left(x\sqrt{1-y^2} + y\sqrt{1-x^2}\right)$

$= \sin^{-1}x + \sin^{-1}y \qquad (\text{ if } x^2 + y^2 \le 1)$

$= \pi - (\sin^{-1}x + \sin^{-1}y) \quad (\text{ if } x^2 + y^2 \ge 1)$

2. (B)

Sol.

$f[g(x)] = x$

$\Rightarrow f'[g(x)] . [g'(x)] = 1$

$\Rightarrow f'[g(2)]\, g'(2) = 12$

$\Rightarrow f'(a)\, g'(2)$

putting $x = 2$

given, $f'(a) = \dfrac{a^{10}}{1+a^2} \Rightarrow g'(2) = \dfrac{1+a^2}{a^{10}}$

3. (A)

Sol. Let $\sqrt{a^2-1} = C_1$ and $a + \sqrt{a^2-1} = C_2 \Rightarrow C_2 - C_1 = a$

$$\therefore \quad y = \frac{x}{C_1} - \frac{2}{C_1}\tan^{-1}\left(\frac{\sin x}{C_2 + \cos x}\right)$$

$$= \frac{1}{C_1} - \frac{2}{C_1}\cdot\frac{C_2\cos x + 1}{(C_2 + \cos x)^2 + \sin^2 x}$$

$$\left.\frac{dy}{dx}\right]_{x=\frac{\pi}{2}} = \frac{1}{C_1} - \frac{2}{C_1}\cdot\frac{1}{C_2^2+1}$$

$$= \frac{1}{C_1}\left[\frac{C_2^2+1-2}{C_2^2+1}\right] = \frac{1}{C_1}\cdot\frac{C_2^2-1}{C_2^2+1}$$

$$\therefore \left.\frac{dy}{dx}\right]_{x=\frac{\pi}{2}}$$

$$= \frac{2a^2 + 2a\sqrt{a^2-1} - 2}{\sqrt{a^2-1}\left(2a^2 - 1 + 2a\sqrt{a^2-1} + 1\right)}$$

$$= \frac{2a^2 + 2a\sqrt{a^2-1} - 2}{\sqrt{a^2-1}\left(2a\left(a + \sqrt{a^2-1}\right)\right)}$$

$$= \frac{2(a^2-1) + 2a\sqrt{a^2-1}}{\sqrt{a^2-1}\left(2a\left(a + \sqrt{a^2-1}\right)\right)}$$

$$= \frac{2\sqrt{a^2-1}\left(\sqrt{a^2-1} + a\right)}{\left(\sqrt{a^2-1}\right)(2a)\left(a + \sqrt{a^2-1}\right)} = \frac{1}{a} \quad \textbf{Ans.]}$$

4. (D)

Sol. $$y = \frac{(a+x) + \sqrt{a-x}\cdot\sqrt{a+x}}{(a-x) + \sqrt{a-x}\cdot\sqrt{a+x}}$$

$$y = \frac{\sqrt{a+x}\left(\sqrt{a+x} + \sqrt{a-x}\right)}{\sqrt{a-x}\left(\sqrt{a+x} + \sqrt{a-x}\right)} = \left(\frac{a+x}{a-x}\right)^{1/2}$$

$$\frac{dy}{dx} = \frac{1}{2}\sqrt{\frac{a-x}{a+x}}\left(\frac{(a-x)+(a+x)}{(a-x)^2}\right)$$

$$= \frac{1}{2}\frac{\sqrt{a-x}}{\sqrt{a+x}} \times \frac{2a}{(a-x)^2};$$

$$\therefore \left.\frac{dy}{dx}\right|_{x=0} = \frac{1}{a} \quad \text{Ans.}$$

5. (C)

Sol. $\tan y = \dfrac{x\sin\alpha}{1 - x\cos\alpha}$

On differentiating wrt x, we get

$$\frac{dy}{dx} = \frac{\sin\alpha}{(1 - x\cos\alpha)}$$

$\Rightarrow m = \sin\alpha$, $n = -\cos\alpha$

$m^2 + n^2 = 1$

6. (B)

Sol. $\dfrac{x+a}{2} = b\cot^{-1}(b\,\ell n\, y);$

$$\cot\left(\frac{x+a}{2b}\right) = b\,\ell n\, y$$

$$\therefore -\text{cosec}^2\left(\frac{x+a}{2b}\right)\frac{1}{2b} = \frac{b}{y}y';$$

$$\therefore -\frac{1}{2b^2}\left(1+\cot^2\left(\frac{x+a}{2b}\right)\right) = \frac{y'}{y}$$

$$\therefore -\frac{1}{2b^2}\left((1+(b\,ln\, y))^2\right) = \frac{y'}{y};$$

$$\therefore -\frac{1}{2b^2}\left(2(b\,ln\, y)\frac{b}{y}y'\right) = \frac{yy''-y'^2}{y^2}$$

$\therefore -ln\, y\, y' = y\, y'' - y'^2;$

$\therefore y\, y'' = y'^2 - y'\, y\, \ell n\, y$

$\therefore y\, y'' + y\, y'\, \ell n\, y = y'^2 - y'\, y\, \ell n\, y + y\, y'\, \ell n\, y$

$= y'^2$ Ans.

7. (B)

Sol. $y = \dfrac{1}{x} \Rightarrow \dfrac{dy}{dx} = -\dfrac{1}{x^2} \Rightarrow x^2dy + dx = 0$

$$\Rightarrow \frac{x^2}{\sqrt{1+x^4}}dy + \frac{dx}{\sqrt{1+x^4}} = 0$$

$$\Rightarrow \frac{dy}{\sqrt{\frac{1}{x^4}+1}} + \frac{dx}{\sqrt{1+x^4}} = 0$$

$$\Rightarrow \frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} = 0$$

$$\Rightarrow \frac{dy}{\sqrt{1+y^4}} + \frac{dx}{\sqrt{1+x^4}} + 3 = 3$$

8. (B)

Sol. We have $ln\,(3\sin x - 4\cos x + 7 + 5y) = (\sin x)\, y$ .... (1)

Put $x = \pi$ in equation (1), we get $ln\,(11 + 5y) = 0 \Rightarrow 11 + 5y = 1 \Rightarrow 5y = -10$

$\therefore y = -2.$ So, $(\pi, -2)$ lies on the given curve.

Now on differentiating both the sides of equation (1) w.r.t. x, we get

$$\frac{1}{(3\sin x - 4\cos x + 7 + 5y)} \times \left(3\cos x + 4\sin x + 5\frac{dy}{dx}\right)$$

$$= (\sin x)\frac{dy}{dx} + (\cos x)y$$

As $(\pi, -2)$ satisfy it, we get

$$1\times\left(-3+0+5\frac{dy}{dx}\right) = 2$$

$\dfrac{dy}{dx} = \dfrac{5}{5} = 1.$ **Ans.**]

9. (D)

Sol. $I = \displaystyle\lim_{x\to 2}\frac{-2x\, f'(x^2)}{(-1)} \Rightarrow$

$I = \dfrac{-4f'(4)}{(-1)} = 20$ Ans.]

10. (D)

Sol. Use L'Hospital's rule

$$\lim_{y\to 0}\left(\cos y - 1 + \frac{y^2}{2}\right)\frac{1}{y^4}$$

$$= \lim_{y\to 0}\left(\frac{2\cos y - 2 + y^2}{2y^4}\right)$$

$$\lim_{y\to 0}\left(\frac{-2\sin y + 2y}{8y^3}\right) = \lim_{y\to 0}\left(\frac{y - \sin y}{4y^3}\right)$$

$$= \lim_{y\to 0}\left(\frac{1-\cos y}{12y^2}\right) = \frac{1}{24}\ ]$$

11. (B)

Sol. f(x)

$= \sqrt{(x-1)+4-4\sqrt{x-1}} + \sqrt{(x-1)+9-6\sqrt{x-1}}$

$= \left|\sqrt{x-1}-2\right| + \left|\sqrt{x-1}-3\right|$

at x = 1.5

$f(x) = \left(2-\sqrt{x-1}\right) + \left(3-\sqrt{x-1}\right)$

$= 5 - 2\sqrt{x-1}$

$f'(x) = \dfrac{-2}{2\sqrt{x-1}}$

$f'(1.5) = \dfrac{-1}{\sqrt{\frac{3}{2}-1}} = -\sqrt{2}$

12. (C)

Sol. f (x) = $\sqrt{x+2\sqrt{2x-4}} + \sqrt{x-2\sqrt{2x-4}}$

$\therefore$ f (x) = $\sqrt{\left(\sqrt{x-2}+\sqrt{2}\right)^2} + \sqrt{\left(\sqrt{x-2}-\sqrt{2}\right)^2} = \left|\sqrt{x-2}+\sqrt{2}\right| + \left|\sqrt{x-2}-\sqrt{2}\right|$

for $\sqrt{x-2}$ to exist $x \geq 2$

Also, $\sqrt{x-2} + \sqrt{2} > 0$ (always true, think ! why?)

but $\sqrt{x-2} - \sqrt{2} \geq 0$ only if $x \geq 4$

< 0 only if $x < 4$

$\therefore$ now f (x) becomes

f (x) = $\sqrt{x-2} + \sqrt{2} - \sqrt{x-2} + \sqrt{2}$ for $2 \leq x < 4$

= $\sqrt{x-2} + \sqrt{2} + \sqrt{x-2} - \sqrt{2}$ for $x \geq 4$

$\therefore$ f (x) = $2\sqrt{2}$, for $2 \leq x < 4$

= $2\sqrt{x-2}$, for $4 \leq x < \infty$

$\because$ f is continuous [2, 4) $\cup$ [4, ∞) (verify)

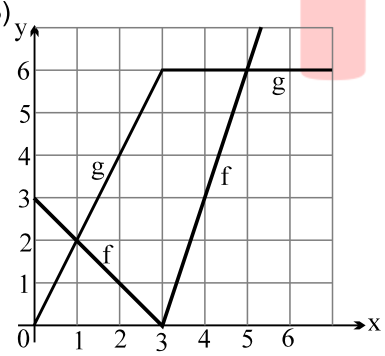
$\therefore$ f ' (x) = 0, $2 \leq x < 4$

= $\dfrac{1}{\sqrt{x-2}}$, $4 \leq x < \infty$

$\therefore$ f ' (102_+) = $\dfrac{1}{\sqrt{102-2}} = \dfrac{1}{10}$

$\therefore$ 10 f ' (102_+) = 1 Ans.]

13. (B)



Sol. P' (x) = f (x) g ' (x) + g (x) f ' (x)

P' (2) = f (2) g ' (2) + g (2) f ' (2)

= (1) (2) + 4 (–1)

= – 2

$$Q'(x) = \frac{g(x)f'(x) - f(x)g'(x)}{g^2(x)}$$

$$Q'(2) = \frac{(4)(-1)-(1)(2)}{16} = -\frac{6}{16} = -\frac{3}{8}$$

C' (x) = $f'(g(x))g'(x)$

C ' (2) = f ' (4) · 2 = 3 · 2 = 6

$\therefore$ (P'(2) – C'(2)) Q'(2) = $(-2-6)\left(\frac{-3}{8}\right)$

= $(-8)\left(\frac{-3}{8}\right) = 3$

14. (D)

Sol. Let f (x) = $px^2 + qx + r$

f (1) = f (–1) gives p + q + r = p – q + r

hence q = 0

Hence f (x) = $px^2 + r$

f ' (x) = 2px ....(1)

Given a, b, c are in A.P.

hence 2pa, 2pb, 2pc will also be in A.P.

or f ' (a), f ' (b), f ' (c) will also be in A.P.

$\Rightarrow$ (D)]

15. (C)

Sol. x sinα cos y + x cosα sin y = sin y

x sinα cot y + x cosα = 1

cot y = $\dfrac{1-x\cos\alpha}{x\sin\alpha}$

tan y = $\dfrac{x\sin\alpha}{1-x\cos\alpha}$

$\sec^2 y . \dfrac{dy}{dx} = \dfrac{\sin\alpha(1-x\cos\alpha)-x\sin\alpha(-\cos\alpha)}{(1-x\cos\alpha)^2}$

$\sec^2 y . \dfrac{dy}{dx} = \dfrac{\sin\alpha - x\sin\alpha\cos\alpha + x\sin\alpha\cos\alpha}{(1-x\cos\alpha)^2}$

$\sec^2 y \dfrac{dy}{dx} = \dfrac{\sin\alpha}{(1-x\cos\alpha)^2}$

m = sin αn   n = – cosα

$m^2 + n^2 = 1$

16. (B)

Sol. $g' = \dfrac{dx}{dy}$ hence $1 = 2x\dfrac{dx}{dy} - \dfrac{dx}{dy} \Rightarrow \dfrac{dx}{dy} = \dfrac{1}{2x-1}$; when f(x) = 14

$\Rightarrow x^2 - x - 20 = 0 \Rightarrow$ x = 5 or – 4 (rejected)

$\Rightarrow g' = \dfrac{1}{2.5-1} = \dfrac{1}{9}$]

17. (A)

Sol. $y = (A + Bx)e^{mx} + (m-1)^{-2} \cdot e^x$

$y \cdot e^{-mx} = (A + Bx) + (m-1)^{-2} \cdot e^{(1-x)x}$

$e^{-mx} \cdot y_1 - my + e^{-mx} = B - (m-1)^{-1} \cdot e^{-(m-1)x}$

$e^{-mx} \cdot y_2 - y_1 e^{-mx} \cdot m - m[e^{-mx} \cdot y_1 - y e^{-mx} \cdot m] = e^{-(m-1)x}$

$e^{-mx} \cdot y_1 - m_2 y_1 e^{-mx} + my \cdot e^{-mx} = e^{-(m-1)x}$

$y_2 - 2my_1 + my = e^x$ Ans.]

18. (D)

Sol. $ln(2a - a^2) \geq 0 \Rightarrow 2a - a^2 \geq 1$

$0 \geq (a-1)^2$ or $(a-1)^2 \leq 0 \Rightarrow$ a = 1, hence f (x) can be defined only when a = 1.

Now f ' (x) = $12x^2$ – 12 x cos 2 + 3 sin 2 sin 6

f ' $\left(\dfrac{1}{2}\right)$ = 3 – 6 cos 2 + 3 sin 2 sin 6 = 3 (1 + sin 2 sin 6) – 6 cos 2.

Note that cos 2 < 0 and 1 + sin 2 sin 6 > 0

$\Rightarrow$ D]

19. (D)

Sol. Degree of $f(x) = n$; degree of $f'(x) = n - 1$
degree of $f''(x) = (n - 2)$
hence $n = (n - 1) + (n - 2) = 2n - 3$
$\therefore n = 3$
hence $f(x) = ax^3 + bx^2 + cx + d$,
$(a \neq 0)$
$f'(x) = 3ax^2 + 2bx + c$
$f''(x) = 6ax + 2b$
$\therefore ax^3 + bx^2 + cx + d = (3ax^2 + 2bx + c)(6ax + 2b)$
$\therefore 18a^2 = a \Rightarrow a = \frac{1}{18}$ Ans.]

20. (D)

Sol. We have $g(x) = x^3 \, ln\left(x^2 f(x)\right)$
$\therefore$ On differentiating b.t.s. w.r.t. x, we get

$$g'(x) = \frac{x^3}{x^2 f(x)}\left(x^2 f'(x) + 2x\, f(x)\right) + 3x^2 \, ln\left(x^2 f(x)\right)$$

Hence $g'(2) = \frac{2}{f(2)}\left(4f'(2) + 4f(2)\right) + 12\, ln\left(4f(2)\right)$

$= 8\left(4 \times -3 + 4 \times \frac{1}{4}\right) + 12 ln\left(4 \times \frac{1}{4}\right) = 8(-12 + 1) = -88$. **Ans.**]

21. 6

Sol. $g(x) = f\left(-x + f\left(f(x)\right)\right)$; $f(0) = 0$;
$f'(0) = 2$ $g'(x) =$
$f'\left(-x + f\left(f(x)\right)\right) \cdot \left[-1 + f'\left(f(x)\right) \cdot f'(x)\right]$
$g'(0) = f'\left(f(0)\right) \cdot \left[-1 + f'(0) \cdot f'(0)\right]$
$= f'(0)\,[-1 + (2)(2)]$
$= (2)(3) = 6$ **Ans.**]

22. 0

Sol. $y = 2\, ln(1 + \cos x)$

$$y_1 = \frac{-2\sin x}{1 + \cos x}$$

$$y_2 = -2\left[\frac{(1 + \cos x)\cos x - \sin x(-\sin x)}{(1 + \cos x)^2}\right]$$

$$= -2\left[\frac{\cos x + 1}{(1 + \cos x)^2}\right] = \frac{-2}{(1 + \cos x)}$$

$$\therefore 2e^{-y/2} = 2 \cdot e^{-\frac{ln(1+\cos x)^2}{2}} = \frac{2}{(1 + \cos x)}$$

$$\therefore y_2 + \frac{2}{e^{y/2}} = 0 \text{ Ans.]}$$

23. 1

Sol. We have : $\log(x + y) - 2xy = 0$ ... (1)

Diff. w.r.t. x, $\frac{1}{x + y}\left(1 + \frac{dy}{dx}\right) - 2x\frac{dy}{dx} - 2y = 0$

$\Rightarrow \left(\frac{1}{x + y} - 2x\right)\frac{dy}{dx} = 2y - \frac{1}{x + y}$

$\Rightarrow \frac{dy}{dx} = \frac{2y(x + y) - 1}{1 - 2x(x + y)}$.

When x = 0, from (1), log (y) = 0 ==> y = e0 = 1.

$$\left.\frac{dy}{dx}\right]_{x=0} = \frac{2(1)(0 + 1) - 1}{1 - 0} = \frac{1}{1} = 1.$$

24. 3

Sol. $(a - 1)x^2 = x(2b + 3)$

The above equation is satisfied by three distinct values of x therefore it is an identity
$\therefore 2 - 2a = 0 \Rightarrow a = 1$ and $2b + 3 = 0$

$\Rightarrow b = \frac{-3}{2}$

Now, $f(x) = 2x + 1$,
Let $g(x) = px + q \Rightarrow g'(x) = p$
$f\left(g(x)\right) = 6x - 7 \Rightarrow 2(px + q) + 1 = 6x - 7$
$\Rightarrow 2px + 2q + 1 = 6x - 7$
$\Rightarrow 2p = 6 \Rightarrow p = 3$ and $q = -4$
$\therefore g'(2012) = 3$ **Ans.**]

25. 17

Sol. We have $\frac{dy}{dx} = 5x^4\left(\cos(ln\, x) + \sin(ln\, x)\right) + x^5\left(\frac{-\sin(ln\, x)}{x} + \frac{\cos(ln\, x)}{x}\right)$,

$\Rightarrow xy_1 = 5y + x^5\left(\cos(ln\, x) - \sin(ln\, x)\right)$

$\Rightarrow xy_2 + y_1 = 5y_1 + 5x^4\left(\cos(ln\, x) - \sin(ln\, x)\right) + x^5\left(\frac{-\sin(ln\, x)}{x} - \frac{\cos(ln\, x)}{x}\right)$

$\Rightarrow x^2y_2 + xy_1 = 5xy_1 + 5x^5\left(\cos(ln\, x) - \sin(ln\, x)\right) - x^5\left(\sin(ln\, x) + \cos(ln\, x)\right)$

$\Rightarrow x^2y_2 - 4xy_1 = 5(xy_1 - 5y) - y$
$\Rightarrow x^2y_2 - 4xy_1 = 5xy_1 - 26y$
$\Rightarrow x^2y_2 - 9xy_1 + 26y = 0$
$\equiv x^2y_2 + axy_1 + by = 0$
$\therefore a = -9$ and $b = 26$
Hence $(a + b) = 17$ **Ans.**]

26. 4

Sol. When $f(x) = \pi$, then $x = \frac{\pi}{2}$.

[As f(x) is an increasing function on R, so f(x) is invertible.]

We have to find $\frac{dx}{dy}$ at $y = \pi$.

Now $\frac{dx}{dy} = \frac{1}{\frac{dy}{dx}}$ and $\frac{dy}{dx}$

$= 6(2x-\pi)^2 + 2 + \sin x$.

Now $\left.\frac{dy}{dx}\right]_{x=\pi/2} = 0 + 2 + 1 = 3$.

Hence $\left.\frac{dx}{dy}\right]_{y=\pi} = \frac{1}{\left.\frac{dy}{dx}\right]_{x=\pi/2}} = \frac{1}{3} = \frac{p}{q}$.

$\therefore$ p = 1 and q = 3

Hence (p + q) = 4. **Ans.**]

27. 8

Sol. $f(x) = 2\tan^{-1}x$ & $g(x) = x + 2 \Rightarrow f(g(x)) = 2\tan^{-1}(x+2)$ solution of inequality $f^2(g(x)) - 5f(g(x)) + 4 > 0$ is $f(g(x)) < 1$ or $f(g(x)) > 4 \Rightarrow \tan^{-1}(x+2) < \frac{1}{2}$ or $\tan^{-1}(x+2) > 2$

$\Rightarrow \tan^{-1}(x+2) < \frac{1}{2}$ [As $\tan^{-1}(x+2) < \frac{\pi}{2}$]

or $x + 2 < \tan\left(\frac{1}{2}\right)$

$\Rightarrow x \in \left(-10, \tan\left(\frac{1}{2}\right) - 2\right)$

As $\frac{1}{2} < \frac{\pi}{6} \Rightarrow \tan\frac{1}{2} < \frac{1}{\sqrt{3}}$

$\Rightarrow \tan\frac{1}{2} - 2 < \frac{1}{\sqrt{3}} - 2$

Hence total integer in the range are {– 9, – 8, – 7, – 6, – 5, – 4, – 3, – 2} $\Rightarrow$ 8 integer]

28. 48

Sol. As f (x) is derivable at x = 0, so f (x) is also continuous at x = 0.

$\therefore f(0^+) = \lim_{h\to 0} \frac{\ln(1-ch)}{h} \left(\frac{0}{0}\right)$

$= \lim_{h\to 0} \frac{-c \times \ln(1-ch)}{-ch} = -c$

$\Rightarrow -c = 2 \Rightarrow c = -2$ ....(1)

Now $f'(0^+) = \lim_{h\to 0} \frac{\frac{\ln(1+2h)}{h} - 2}{h} = \lim_{h\to 0} \frac{\ln(1+2h) - 2h}{h^2}$

$= \lim_{h\to 0} \frac{\left(2h - \frac{(2h)^2}{2} + ...\right) - 2h}{h^2} = -2$

Also $f'(0^-) = \lim_{h\to 0} \frac{a\cot^{-1}\left(\frac{b-h}{4}\right) - 2}{-h} \left(\frac{0}{0}\right)$

$= \lim_{h\to 0} \frac{\frac{-a}{1+\left(\frac{b-h}{4}\right)^2} \times \frac{-1}{4}}{-1} = \frac{-4a}{b^2+16}$

As $f'(0^-) = f'(0^+)$, so $\frac{-4a}{b^2+16} = -2$

$\Rightarrow 2a = b^2 + 16$

$\therefore b^2 - 2a = -16$ ....(2)

Using equation (1) and equation (2)

Hence $(b^2 - 2a + c^6) = -16 + 64 = 48$ **Ans.**

29. 9

Sol. $y^{2/3} - 2xy^{1/3} + 1 = 0$

$y^{1/3} = \left(x \pm \sqrt{x^2-1}\right)$

$\Rightarrow \ln y = 3\ln\left(x \pm \sqrt{x^2-1}\right)$

$\frac{y_1}{y} = \frac{\pm 3}{\sqrt{x^2-1}} \Rightarrow (x^2-1)y_1^2 = 9y^2$

$2xy_1^2 + (x^2-1)2y_1y_2 = 18yy_1$

$xy_1 + (x^2-1)y_2 = 9y$ (As y_1 is not equal to 0, because y is not constant)

Dividing by y, we get

$\therefore x\frac{y_1}{y} + (x^2-1)\frac{y_2}{y} = 9$ **Ans.**

30. 8

Sol. $\ln(x+y) = 2xy$

x = 0, y = 1

$\frac{1+y'}{x+y} = 2(xy' + y)$

Put x = 0, y = 1

$1 + y' = 2(0 + 1) = 2$

$\Rightarrow y' = 1$

$\frac{(x+y)y'' - (1+y')^2}{(x+y)^2} = 2(xy'' + 2y')$

x = 0, y = 1, y' = 1

$\frac{y''-4}{1} = 2(0+2) = 4$

$\Rightarrow y''(0) = 8$]