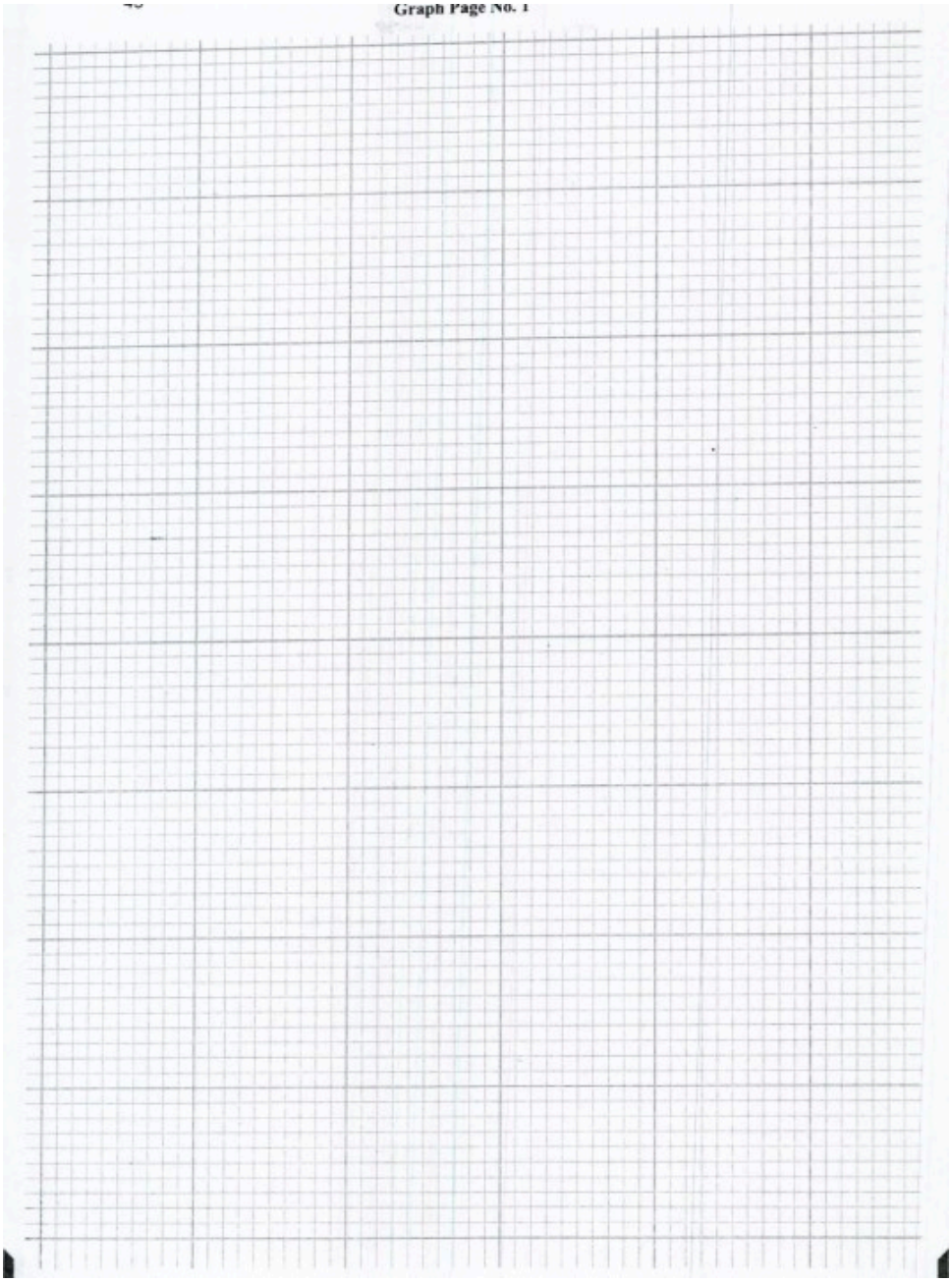
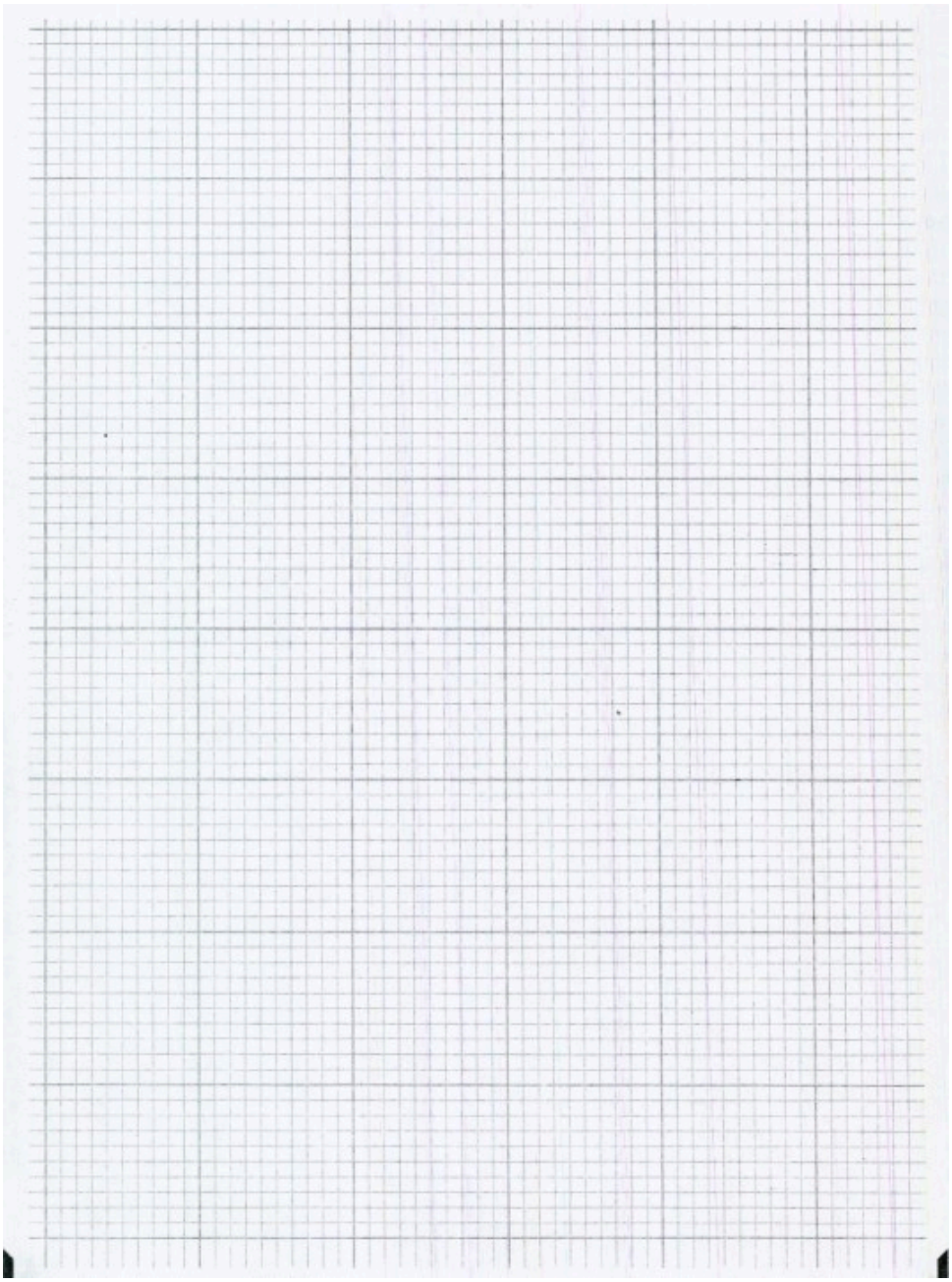
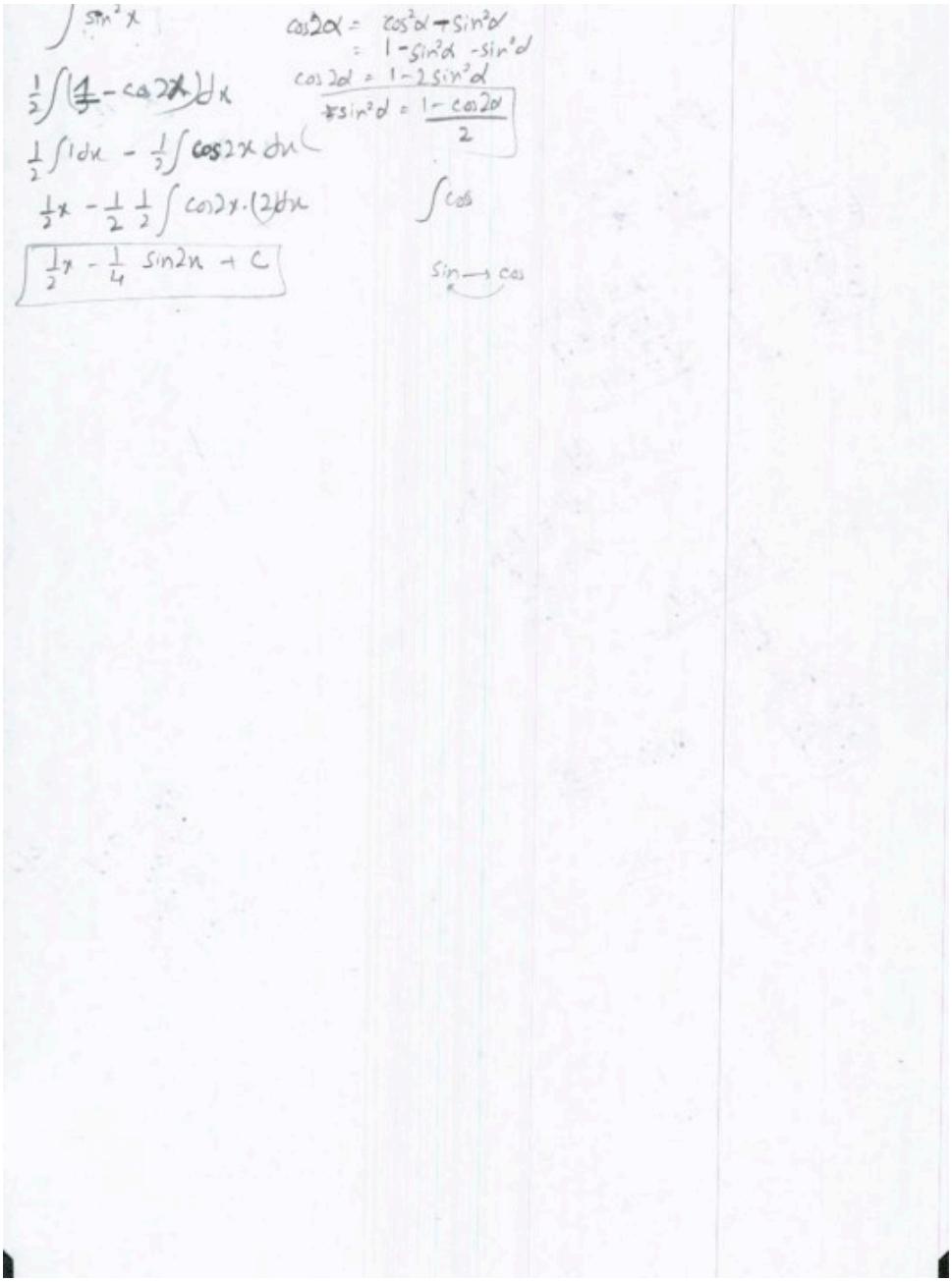
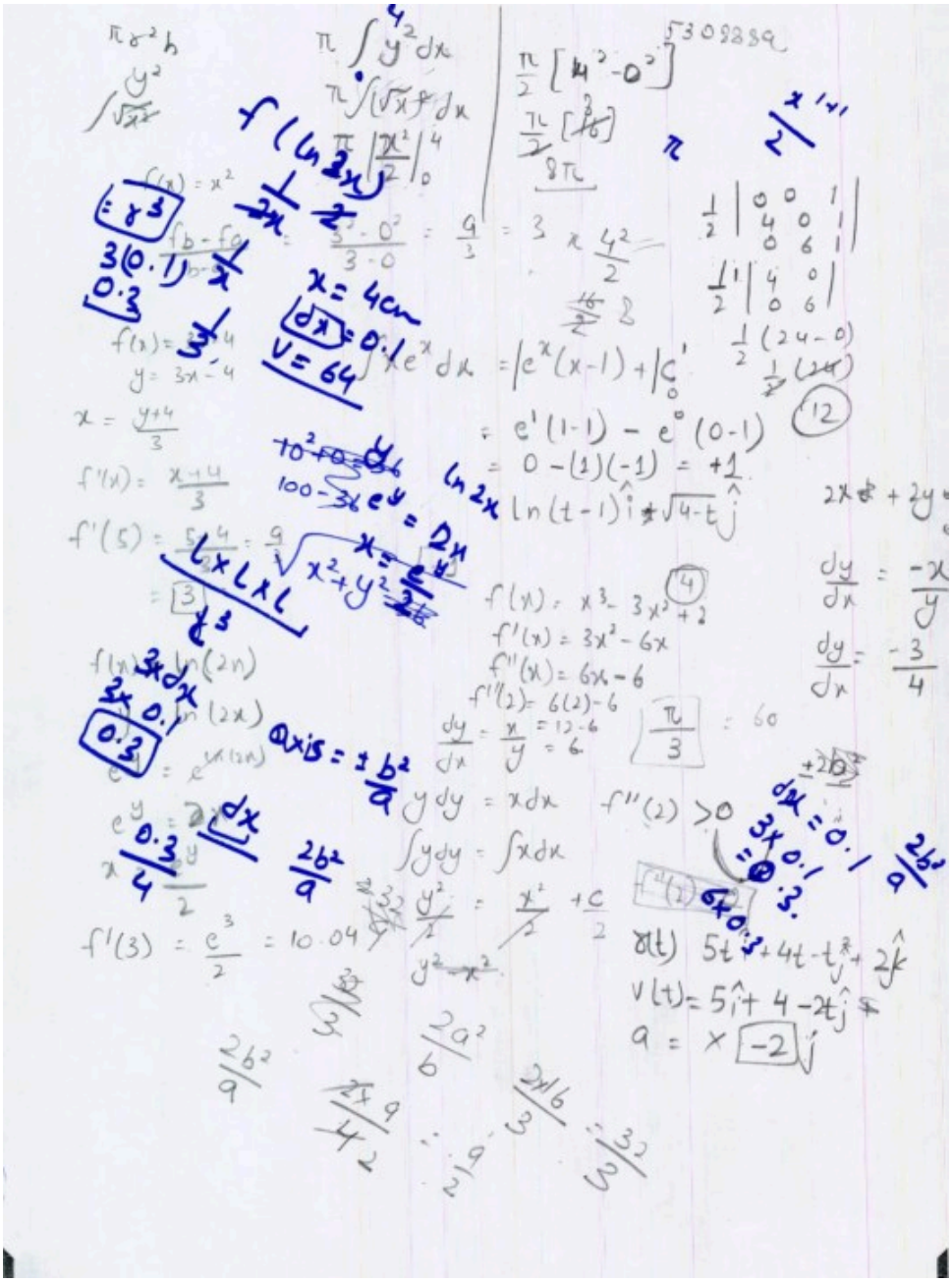

Graph Page No. 1




$\int \sin^2 x$
$\frac{1}{2}\int (1 - \cos 2x)\,dx$
$\frac{1}{2}\int 1\,dx - \frac{1}{2}\int \cos 2x\,dx$
$\frac{1}{2}x - \frac{1}{2}\cdot\frac{1}{2}\int \cos 2x \cdot (2)\,dx$
$\frac{1}{2}x - \frac{1}{4}\sin 2x + C$
$\cos 2\alpha = \cos^2\alpha - \sin^2\alpha$
$= 1 - \sin^2\alpha - \sin^2\alpha$
$\cos 2\alpha = 1 - 2\sin^2\alpha$
$\sin^2\alpha = \frac{1 - \cos 2\alpha}{2}$
$\int \cos$
$\sin \rightarrow \cos$



**Q. No. 2 Part (i) (Page 1)**

Given

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

let $y = f(x) \Rightarrow x = f^{-1}(y)$ — (i)

$$\Rightarrow y = \frac{2x-3}{x+1}$$

$$y(x+1) = 2x-3$$

$$xy + y = 2x-3$$

$$y+3 = 2x - xy$$

$$y+3 = x(2-y)$$

$$\Rightarrow \frac{y+3}{2-y} = x$$

OR $$x = \frac{y+3}{2-y}$$

from (i)

$$f^{-1}(y) = \frac{y+3}{2-y}$$

Replacing y by x

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

Domain of $f^{-1}(x)$

$$\boxed{dom(f^{-1}(x)) = R - \{2\}}$$ OR $(-\infty, 2) \cup (2, \infty)$

Range of $f^{-1}(x)$

$$\boxed{range(f^{-1}(x)) = R - \{-1\}}$$ OR $(-\infty, -1) \cup (-1, \infty)$

Q. No. 2 Part (i) (Page 2)

**Q. No. 2 Part (ii) (Page 1)**

$$y = e^{2x} \ln(x)$$

Diff. w.r.t 'x' on both sides

$$\frac{dy}{dx} = \frac{d}{dx}\left[e^{2x} \cdot \ln(x)\right]$$

by using "product rule"

$$\frac{dy}{dx} = e^{2x} \cdot \frac{d}{dx}(\ln(x)) + \ln(x) \cdot \frac{d}{dx} e^{2x} \quad \because \left\{\frac{d}{dx}[f(x).g(x)] = f(x).g'(x) + g(x).f'(x)\right.$$

$$\frac{dy}{dx} = e^{2x} \cdot \frac{1}{x} + \ln x \cdot e^{2x} \cdot \frac{d}{dx}(2x) \quad \because \left\{\begin{array}{l}\frac{d}{dx}(\ln(x)) = \frac{1}{a} \\ \frac{d}{dx} e^{ax} = e^{ax} \cdot \frac{d}{dx} ax\end{array}\right.$$

$$\frac{dy}{dx} = \frac{e^{2x}}{x} + \ln(x) \cdot e^{2x} \cdot (2)$$

$$\boxed{\frac{dy}{dx} = \frac{e^{2x}}{x} + 2e^{2x} \cdot \ln(x)}$$

**Q. No. 2 Part (ii) (Page 2)**

**Q. No. 2 Part (iii) (Page 1)**

$= \int \sin^2 x \cdot 1 \, dx$

(II) (I)

by 'ILATE'

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

$= \int \sin^2 x \, dx - 0$

let

$I = \int \sin^2 x \, dx$

$= \int \left( \frac{1 - \cos 2x}{2} \right) dx$ $\because \cos 2\alpha = 1 - 2\sin^2 \alpha$

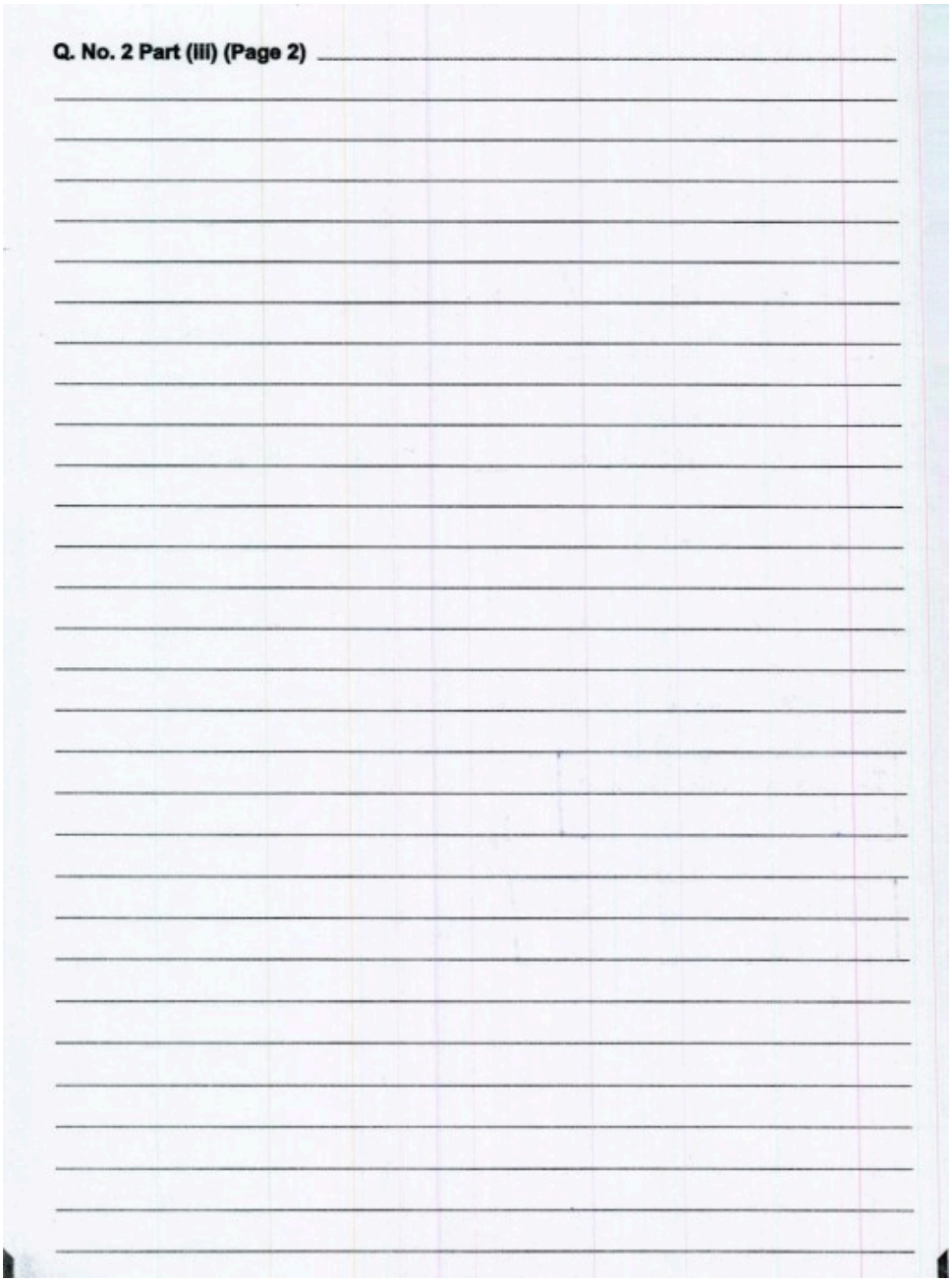
$= \frac{1}{2} \int (1 - \cos 2x) \, dx$

$= \frac{1}{2} \int 1 \, dx - \frac{1}{2} \int \cos 2x \, dx$

$= \frac{1}{2} x - \frac{1}{2} \cdot \frac{1}{2} \int (\cos 2x)(2) \, dx$

$\boxed{I = \frac{1}{2} x - \frac{1}{4} \sin 2x + C}$ Ans.

$\boxed{\int \sin^2 x \, dx = \frac{1}{2} x - \frac{1}{4} \sin 2x + C}$ Ans.


Q. No. 2 Part (iii) (Page 2)

(Section B)

**Q. No. 2 Part (iv) (Page 1)**

$$\frac{dy}{dx} = \frac{y+1}{x-2}$$

$$\frac{dy}{y+1} = \frac{dx}{x-2}$$

Integrating both sides.

$$\int \frac{1\,dy}{y+1} = \int \frac{1.dx}{x-2}$$

$\because \left\{ \int \frac{f'(x)}{f(x)} = \ln|f(x)| \right.$

$$\ln|y+1| = \ln|x-2| + \ln c$$

$$\ln|y+1| - \ln|x-2| = \ln c$$

$$\ln\left|\frac{y+1}{x-2}\right| = \ln c$$

$\because \left\{ \log a - \log b = \log \frac{a}{b} \right.$ Similarly $\ln a - \ln b = \ln\left(\frac{a}{b}\right)$

Taking exponential on both sides

$$e^{\ln\left|\frac{y+1}{x-2}\right|} = e^{\ln c}$$

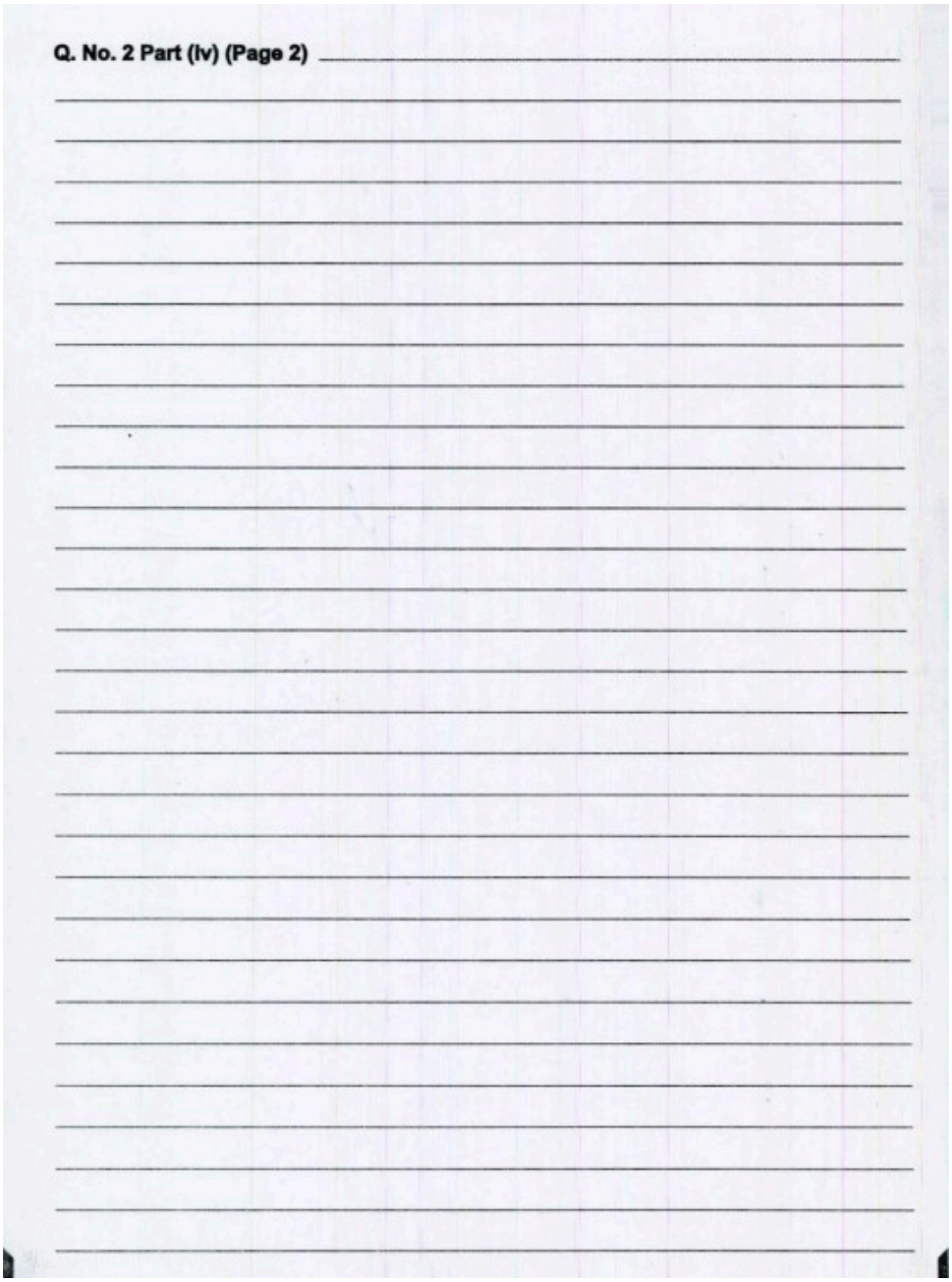
$\because e^{\ln x} = x$

$$\frac{y+1}{x-2} = c$$

or

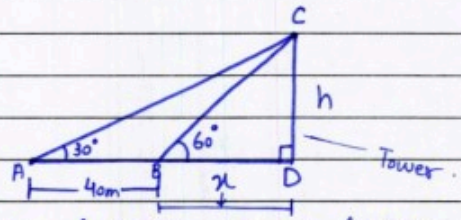
$$\boxed{c = \frac{y+1}{x-2}}$$

Ans.


Q. No. 2 Part (iv) (Page 2)

**Q. No. 2 Part (v) (Page 1)**

Given




At point A angle of elevation to top of tower is 30° and At point B is 40m away from A, the angle of elevation to top is 60°.

(a) height of towes = ?

let $\overline{BD} = x$ and $\overline{AD} = 40+x$. and $\overline{CD} = h$

In $\Delta ACD$

$$\tan 30 = \frac{h}{40+x} \qquad \because \tan\theta = \frac{P}{B}$$

$$0.58 = \frac{h}{40+x}$$

$$h = 0.58(40+x)$$

$$h = 23.2 + 0.58x \quad \text{---(i)}$$

In $\Delta BCD$

$$\tan 60 = \frac{h}{x} \qquad \because \tan\theta = \frac{P}{B}$$

$$1.73 = \frac{h}{x}$$

$$h = 1.73x \quad \text{---(ii)}$$

Put h in (i)

$$1.73x = 23.2 + 0.58x$$

$$1.73x - 0.58x = 23.2$$

**Q. No. 2 Part (v) (Page 2)**

$1.15x = 23.2$

$x = \frac{23.2}{1.15}$

$\boxed{x = 20.17 \text{ m}}$ — (iii)

Put $x$ in (ii)

$h = 1.73 \times 20.17$

$\boxed{h = 34.89 \text{ m}}$

Hence height of tower is 34.89 m.

(b) Original distance from base of tower = ?

Original distance $= 40 + x$

$= 40 + 20.17$

$\boxed{\text{Original distance} = 60.17 \text{ m}}$

Hence the original distance from base of tower is 60.17 m.

**Q. No. 2 Part (vi) (Page 1)**

Given:

$2\cos x + 1 = 0$ for $x \in [0, 2\pi)$

$\Rightarrow 2\cos x = -1$

$\cos x = \frac{-1}{2}$

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

for reference angle

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

$\text{ref}\angle = \cos^{-1}\left(\frac{1}{2}\right)$

As from table $\cos^{-1}\left(\frac{1}{2}\right) = \frac{\pi}{3}$

$\Rightarrow \text{ref}\angle = \frac{\pi}{3}$

$\because \cos x$ is negative in ~~interval~~ QII, QIII

QII

$\Rightarrow x = \pi - \text{ref}\angle$

$= \pi - \frac{\pi}{3}$

$$\boxed{x = \frac{2\pi}{3}}$$

QIII

$\Rightarrow x = \pi + \text{ref}\angle$

$= \pi + \frac{\pi}{3}$

$$\boxed{x = \frac{4\pi}{3}}$$

$$\boxed{S.S = \left\{\frac{2\pi}{3}, \frac{4\pi}{3}\right\}}$$

**Q. No. 2 Part (vi) (Page 2)**

**Q. No. 2 Part (vii) (Page 1)**

Given

$y^2 = -12x$

Comparing it by general equation

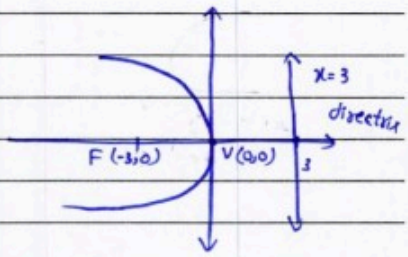
$(y-k)^2 = -4a(x-h)$

$\Rightarrow$ Vertex $= (h,k) = (0,0)$

$\Rightarrow \quad -4a = -12$

$a = \frac{12}{4} = 3$

$a = 3$




focus $= (-a, 0) = (-3, 0)$ — $-a$, as parabola opens towards left.

Directrix $\Rightarrow x = a$

$x = 3$

Directrix: $x - 3 = 0$

Length of latus rectum $= 4a$

$= 4(3)$

Length of latus Rectum $= 12$ units

**Q. No. 2 Part (vii) (Page 2)**

**Q. No. 2 Part (viii) (Page 1)**

$f(x) = x^3 - 2x - 5 \qquad x \in [2,3]$

$f(x_1) = (2)^3 - 2(2) - 5 = -1$

$f(x_2) = (3)^3 - 2(3) - 5 = 16$

$\Rightarrow f(x_1) \cdot f(x_2) < 0$

criteria satisfied

Iteration # 1 $\qquad [x_1, x_2] = [2,3]$

$c_1 = \frac{x_1 + x_2}{2}$

$= \frac{2+3}{2}$

$c_1 = 2.5$

$f(c_1) = (2.5)^3 - 2(2.5) - 5 = 5.625$

$\Rightarrow f(x_1) \cdot f(c_1) < 0$

criteria satisfied

updated interval is $[2, 2.5]$

Iteration # 2 $\qquad [x_1, c_1] = [2, 2.5]$

$c_2 = \frac{x_1 + c_1}{2} = \frac{2+2.5}{2}$

$c_2 = 2.25$

$f(c_2) = (2.25)^3 - 2(2.25) - 5 = 1.89$

**Q. No. 2 Part (viii) (Page 2)**

$\Rightarrow f(x_1) \cdot f(c_2) < 0$ criteria satisfied

Updated interval is $[2, 2.25]$

(Section B)

**Q. No. 2 Part (ix) (Page 1)**

$$I = \int_0^1 \underset{I}{x}\ \underset{II}{e^x}\,dx$$

Integrating by parts

$$I = \left| x \int e^x - \int \left( \left( \int e^x dx \right) \cdot \frac{dx}{dx} \right) dx \right|_0^1$$

$$I = \left| xe^x - \int e^x \cdot 1\, dx \right|_0^1$$

$$\left( xe^x - e^x \right)_0^1$$

$$(1e^1 - e^1) - (0e^0 - e^0)$$

$$(e^1 - e^1) - (-1)$$

$$= +1 \quad \text{Ans}$$

**Q. No. 2 Part (ix) (Page 2)**

**Q. No. 2 Part (x) (Page 1)**

Given

$f(x) = \sin^{-1}(2x-1)$

$\because$ dom of $\sin^{-1}x$ is $[-1, 1]$

$\Rightarrow -1 \leq x \leq 1$

~~$-1-1 \leq x$~~

$-1 \times 2 \leq 2 \times x \leq 1 \times 2$

$-2 \leq 2x \leq 2$

$-2-1 \leq 2x-1 \leq 2-1$

$-3 \leq 2x-1 \leq 1$

$\Rightarrow$ Domain of $\sin^{-1}(2x-1) = [-3, 1]$

dom of $\sin^{-1}x$ is $[-1, 1]$

dom of $\sin^{-1}(2x-1) \Rightarrow |x| \geq 1$

~~$= [-1, 1]$~~ $|2x-1| \geq 1$

Range of $\sin^{-1}(2x-1) = \mathbb{R}$

Domain of $\sin^{-1}(2x-1)$

$-1 \leq 2x-1 \leq 1$

$-1+1 \leq 2x \leq 1+1$

$0 \leq 2x \leq 2$

$\frac{0}{2} \leq \frac{x}{2} \leq \frac{2}{2}$

$0 \leq x \leq 1$

**Q. No. 2 Part (x) (Page 2)**

Domain of $\sin^{-1}(2x-1) = [0, 1]$

**Q. No. 2 Part (xl) (Page 1)**

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

Diff. w.r.t 'x'

$$f'(x) = \frac{d}{dx}\left[\frac{x^2+1}{x^2-1}\right]$$

by using quotient rule

$$\because \left\{\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x) - f(x)g'(x)}{g(x)^2}\right.$$

$$f'(x) = \frac{\left[(x^2-1)\frac{d}{dx}(x^2+1) - (x^2+1)\frac{d}{dx}(x^2-1)\right]}{(x^2-1)^2}$$

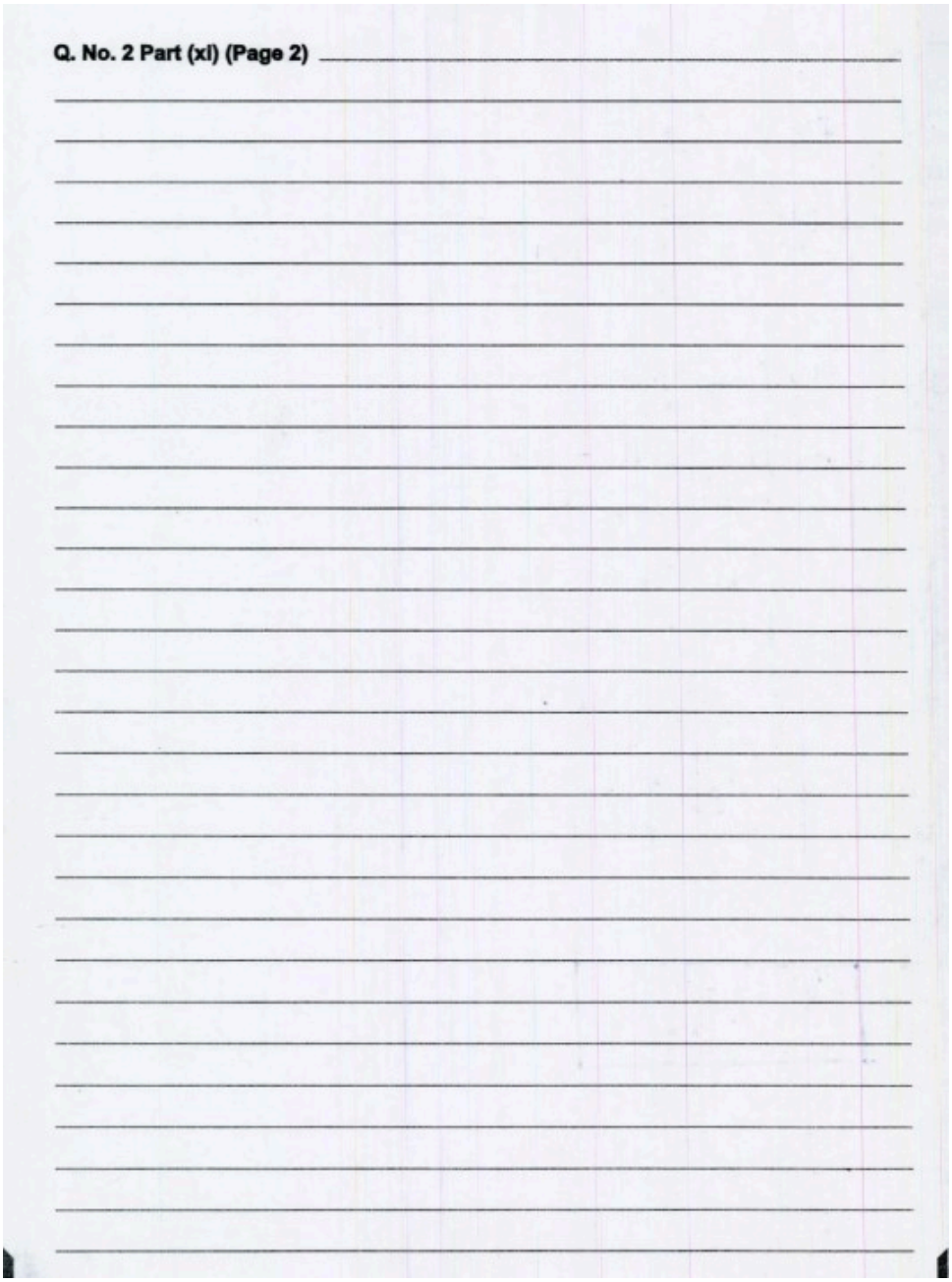
$$= \frac{(x^2-1)[2x+0] - (x^2+1)(2x-0)}{(x^2-1)^2}$$

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

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

$$= \frac{2x(-2)}{(x^2-1)^2}$$

$$\boxed{f'(x) = \frac{-4x}{(x^2-1)^2}}$$


Q. No. 2 Part (xi) (Page 2)

(Section B)

**Q. No. 2 Part (xii) (Page 1)**

Given

$f(x) = \sqrt{x-1}$ for $x \geq 1$.

let $y = f(x) \Rightarrow x = f^{-1}(y)$ —(i)

$y = \sqrt{x-1}$

Squaring on both sides

$y^2 = x - 1$

$x = y^2 + 1$

from (i)

$f^{-1}(y) = y^2 + 1$

Replace 'y' by 'x'

$$\boxed{f^{-1}(x) = x^2 + 1}$$

Verification

$f(f^{-1}(x)) = x$

L.H.S $= f$

$f(f^{-1}(x)) = \sqrt{(x^2+1) - 1}$

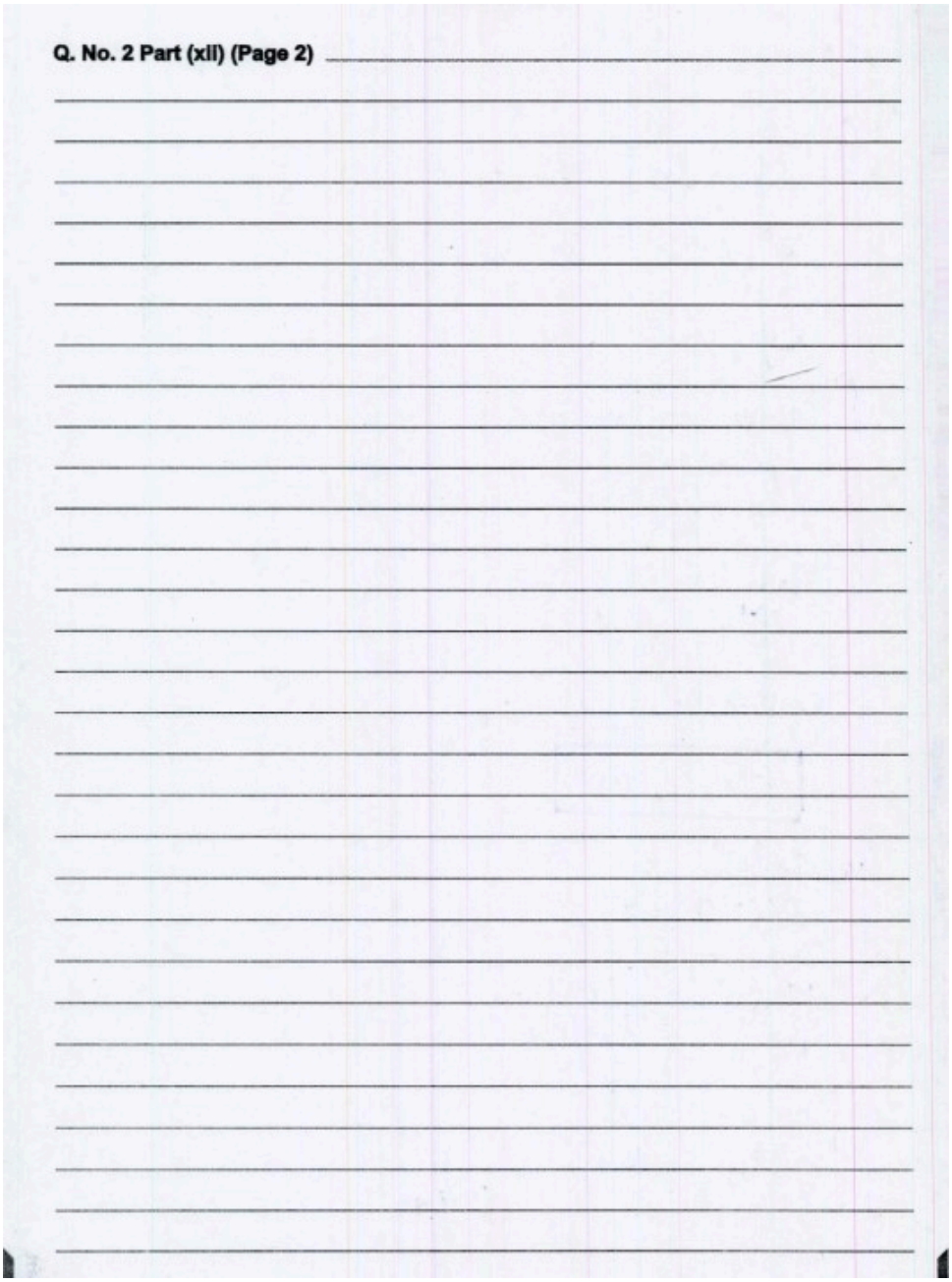
$= \sqrt{x^2 + 1 - 1}$

$= \sqrt{x^2}$

$= x$

$=$ R.H.S

Verified


Q. No. 2 Part (xii) (Page 2)

(Section C)

**Q. No. 3 (Page 1)**

Given

$$f(x) = \begin{cases} ax^2+bx+2 & x \leq 1 \\ 3x+a & 1 < x < 3 \\ \frac{2x^2+b}{x} & x \geq 3 \end{cases}$$

and $f(x)$ is continuous at $x=1$, $x=3$.

$\Rightarrow a, b = ?$

$\because \lim_{x \to a^-} f(x) = \lim_{x \to a^+} f(x)$ ——— (i)

$\Rightarrow \lim_{x \to 1^-} f(x) = \lim_{x \to 1^+} f(x)$

$\lim_{x \to 1^-} (ax^2+bx+2) = \lim_{x \to 1^+} (3x+a)$

$a(1)^2+b(1)+2 = 3(1)+a$

$a+b+2 = 3+a$

$b = 3-2$

$\boxed{b = 1}$

Again by using (i)

$\lim_{x \to 3^-} f(x) = \lim_{x \to 3^+} f(x)$

$\lim_{x \to 3^-} (3x+a) = \lim_{x \to 3^+} \frac{2x^2+b}{x}$

$3(3)+a = \frac{2(3)^2+b}{3}$

$9+a = \frac{2(9)+b}{3}$

**Q. No. 3 (Page 2)**

$\Rightarrow \quad 3(9+a) = 18+b$

$27+3a = 18+b$

put $b=1$ from (ii)

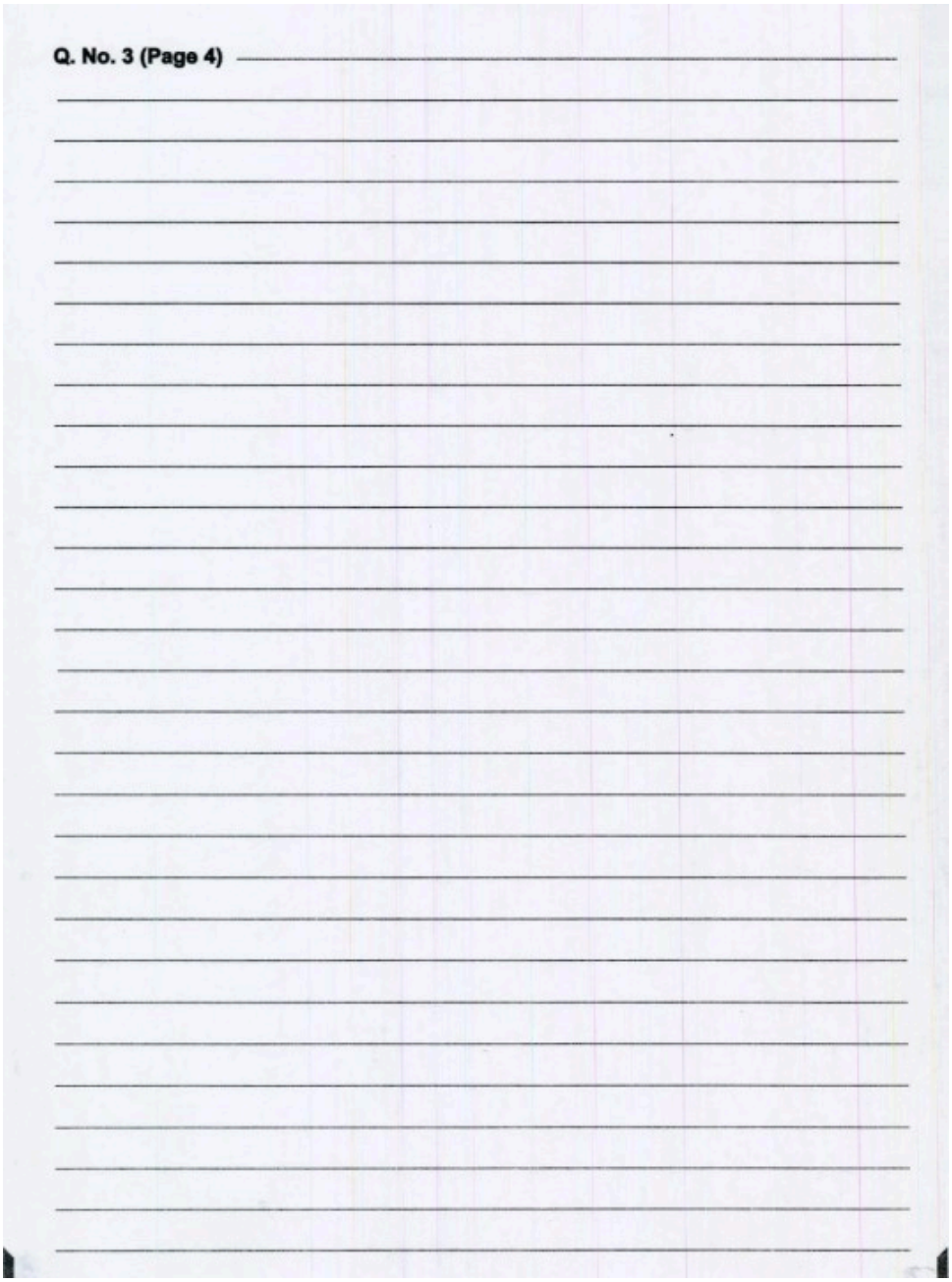
$27+3a = 18+1$

$3a = 19-27$

$3a = -8$

$$a = \frac{-8}{3}$$

Q. No. 3 (Page 3)


Q. No. 3 (Page 4)

**Q. No. 4 (Page 1)**

$f(x) = 2\sin x + \cos 2x \quad , \quad x \in [0, \pi]$.

(a) Critical points of $f(x) = ?$

$$f'(x) = \frac{d}{dx}[2\sin x + \cos 2x]$$

$$= 2\cos x + (-\sin 2x \cdot \frac{d}{dx} 2x)$$

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

for critical values

Set $f'(x) = 0$.

$$2\cos x - 2\sin 2x = 0$$

$$\cos x - \sin 2x = 0$$

$$\cos x - 2\sin x \cos x = 0 \qquad \because \sin 2\alpha = 2\sin\alpha\cos\alpha$$

$$\cos x (1 - 2\sin x) = 0$$

$\Rightarrow \cos x = 0$ , $1 - 2\sin x = 0$.

$x = \cos^{-1} 0$ | $-2\sin x = -1$

$\boxed{x = \frac{\pi}{2}} \in [0, \pi]$ | $\sin x = \frac{1}{2}$

And $\cos x$ is +ve in QIV $\notin [0, \pi]$ | $x = \sin^{-1}\left(\frac{1}{2}\right)$

$\boxed{x = \frac{\pi}{6}} \in [0, \pi]$

$\because \sin x$ is +tive in QII

$\Rightarrow x = \pi - \frac{\pi}{6}$

$\boxed{x = \frac{5\pi}{6}}$

**Q. No. 4 (Page 2)**

$\Rightarrow$ critical values in interval $[0,\pi]$ are $\frac{\pi}{6}, \frac{\pi}{2}, \frac{5\pi}{6}$

**(b)** $f''(x) = \frac{d}{dx}[2\cos x - 2\sin 2x]$

$= 2(-\sin x) - 2(\cos 2x)(2)$

$f''(x) = -2\sin x - 4\cos 2x$

Now for local maxima and minimum

$f''(c) = f''\left(\frac{\pi}{6}\right) = -2\sin\frac{\pi}{6} - 4\cos\left(2\left(\frac{\pi}{6}\right)\right)$

$f''\left(\frac{\pi}{6}\right) = -3 < 0$

$f\left(\frac{\pi}{6}\right)$ is local maximum

$f''\left(\frac{\pi}{2}\right) = -2\sin\left(\frac{\pi}{2}\right) - 4\cos\left(2\left(\frac{\pi}{2}\right)\right)$

$= 2 > 0$

$f\left(\frac{\pi}{2}\right) = 2$ is local minimum

$f''\left(\frac{5\pi}{6}\right) = -2\sin\left(\frac{5\pi}{6}\right) - 4\cos\left(2\left(\frac{5\pi}{6}\right)\right)$

$= -3 < 0$

$f\left(\frac{5\pi}{6}\right) = -3$ is local minmums

**Q. No. 4 (Page 3)**

(c) Absolute Maxima / minima.

$f''(0) = -2\sin 0 - 4\cos 2(0)$

$f''(0) = -4 < 0$

$\Rightarrow$ Absolute maximum

$f''$

$f''(\pi) = -2\sin\pi - 4\cos 2\pi$

$f''(0) = -4$

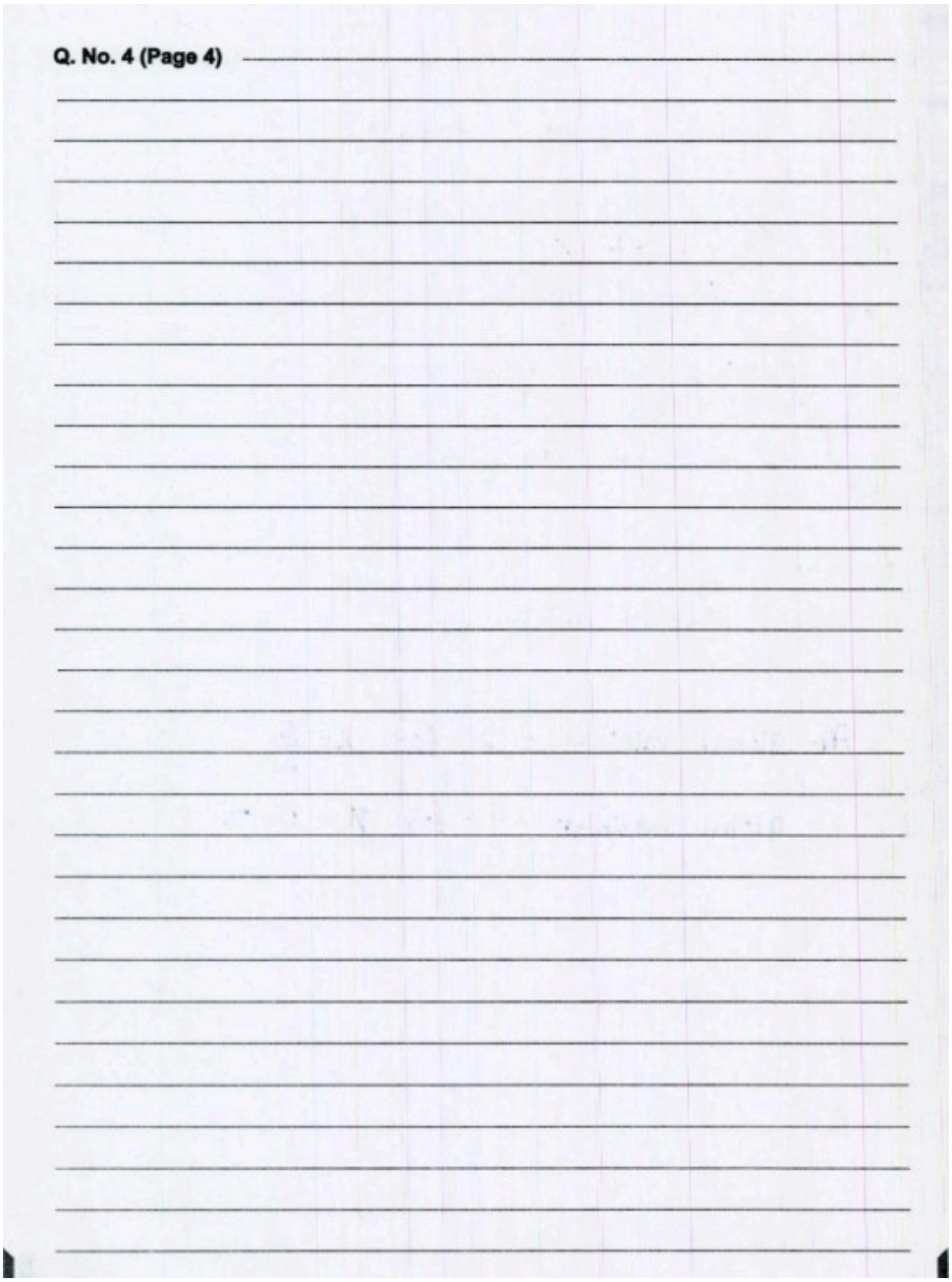
$\Rightarrow$ Absolute maximum.

$\because f''(\frac{\pi}{2}) > 0$

$\Rightarrow$ Absolute minimum

Ab global minima = 2 for $x = \frac{\pi}{2}$

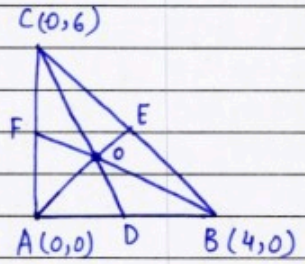
global maxima = $-4$ for $\pi = 0, \pi$


Q. No. 4 (Page 4)

**Q. No. 5 (Page 1)**

Given

$\triangle ABC$ is a triangle with vertices $A(0,0)$, $B(4,0)$, $C(0,6)$.




let the three Medians $\overline{AE}$, $\overline{BF}$ & $\overline{CD}$ intersecting sides $\overline{BC}$, $\overline{AC}$ and $\overline{AB}$ at E, F & D respectively.

Point E

by using midpoint formula, B(4,0), C(0,6)

$$E(x,y) = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

$$= \left(\frac{4+0}{2}, \frac{0+6}{2}\right)$$

$$\boxed{E = (2,3)}$$

Point F:

by using midpoint formula, points A(0,0), C(0,6)

$$F = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

$$= \left(\frac{0+0}{2}, \frac{0+6}{2}\right)$$

$$\boxed{F = (0,3)}$$

**Q. No. 5 (Page 2)**

Point D: by mid-point formula and points A(0,0), B(4,0)

$$D = \left(\frac{x_1+x_2}{2}, \frac{y_1+y_2}{2}\right)$$

$$= \left(\frac{0+4}{2}, \frac{0+0}{2}\right)$$

$$\boxed{D = (2,0)}$$

Equations of Medians:

Equation $\overline{AE}$

by 2 point formula, A(0,0), E(2,3)

$$\overline{AE} \Rightarrow \frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x_2-x_1}$$

$$\frac{y-0}{3-0} = \frac{x-0}{2-0}$$

$$\frac{y}{3} = \frac{x}{2}$$

$$2y = 3x$$

$$\Rightarrow 3x-2y = 0$$

$$\boxed{\overline{AE} = 3x-2y = 0}$$

Equation $\overline{BF}$

by 2 point formula, B(4,0), F(0,3)

$$\overline{BF} \Rightarrow \frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x_2-x_1}$$

$$\frac{y-0}{3-0} = \frac{x-4}{0-4}$$

**Q. No. 5 (Page 3)**

$$\frac{y}{3} = \frac{x-4}{-4}$$

$$-4y = 3x - 12$$

$$\Rightarrow 3x + 4y - 12 = 0$$

$$\boxed{BF \Rightarrow 3x + 4y - 12 = 0}$$

Equation $\overline{CD}$

by 2 point formula and $C(0,6)$, $D(2,0)$

$$\overline{CD} \Rightarrow \frac{y - y_1}{y_2 - y_1} = \frac{x - x_1}{x_2 - x_1}$$

$$\frac{y-6}{0-6} = \frac{x-0}{2-0}$$

$$\frac{y-6}{-6} = \frac{x}{2}$$

$$2y - 12 = -6x$$

$$\Rightarrow 6x + 2y - 12 = 0$$

$$\boxed{\overline{CD} \Rightarrow 6x + 2y - 12 = 0}$$

For concurrency of three medians $3x - 2y = 0$, $3x + 4y - 12 = 0$, $6x + 2y - 12 = 0$. Their det should be equal to zero

$$\begin{vmatrix} 3 & -2 & 0 \\ 3 & 4 & -12 \\ 6 & 2 & -12 \end{vmatrix} = 3\begin{vmatrix} 4 & -12 \\ 2 & -12 \end{vmatrix} - (-2)\begin{vmatrix} 3 & -12 \\ 6 & -12 \end{vmatrix} + 0$$

$$= 3[-48 - (-24)] + 2[-36 - (-72)]$$

**Q. No. 5 (Page 4)**

$= 3[-48+24] + 2[-36+72]$

$= 3[-24] + 2[36]$

$= -72 + 72$

$= 0$

$\because$ Determinant $= 0$ so medians are concurrent

verified

Point of Concurrency (centroid.

$3x - 2y = 0$ — (i)

$3x + 4y - 12 = 0$ — (ii)

$6x + 2y - 12 = 0$ — (iii)

Subtract (i) & (ii)

$3x - 2y = 0$

$\ominus 3x \ominus 4y \oplus 12 = 0$

$-6y + 12 = 0$

$y = \frac{-12}{-6}$ 2

$\boxed{y = 2}$

Put $y$ in (iii)

$6x + 2(2) - 12 = 0$

$6x + 4 - 12 = 0$

$6x = 8$

$x = \frac{8}{6}$ $\frac{4}{3}$

$\boxed{x = \frac{4}{3}}$

$\Rightarrow$ Centroid $(4/3, 2)$

(Section C)

**Q. No. 6 (Page 1)**

Given Homogeneous differential equation is

$$\frac{dy}{dx} = \frac{x^2+y^2}{xy}$$

Let $y = ux \Rightarrow u = \frac{y}{x}$

$$\frac{dy}{du} = x + u\frac{dx}{du} \qquad \frac{dy}{dx} = x + u\frac{dx}{du}$$

$$x + u\frac{dx}{dy} = \frac{x^2 + (ux)^2}{x(ux)}$$

$$x + u\frac{dx}{du} = \frac{x^2(1+u^2)}{x^2(u)}$$

$$u\frac{dx}{du} = \frac{1+u^2}{u} - x$$

$$\vec{r}(t) = 4\cos(2t)\hat{i} + 4\sin(2t)\hat{j}$$

$$\frac{d}{dt}(\vec{r}(t)) = \frac{d}{dt}\left[4\cos(2t)\hat{i} + 4\sin(2t)\hat{j}\right]$$

$$V(t) = 4(-\sin 2t)(2)\hat{i} + 4(\cos 2t)(2)\hat{j}$$

$$\boxed{V(t) = -8\sin 2t\,\hat{i} + 8\cos 2t\,\hat{j}}$$

**Q. No. 6 (Page 2)**

$$\frac{d}{dt}(v(t)) = \frac{d}{dt}\left[-8\sin(2t)\hat{i} + 8\cos(2t)\hat{j}\right]$$

$$A(t) = -8(\cos(2t))(2)\hat{i} + 8(-\sin(2t))(2)\hat{j}$$

$$= -16\cos 2t\,\hat{i} + 16$$

$$A(t) = -16\cos(2t)\hat{i} - 16\sin(2t)\hat{j}$$

(b)

$$\because A(t) = -16\cos(2t)\hat{i} - 16\sin(2t)\hat{j}$$

$$= -4\left[4\cos(2t)\hat{i} + 4\sin(2t)\hat{j}\right]$$

$$A(t) = -4\left[r(t)\right]$$

This relation shows that Acceleration is directed oppose to position vector.

(c) Speed $= \sqrt{x^2 + y^2}$.

$$|v(t)| = \sqrt{(-8\sin 2t)^2 + (8\cos 2t)^2}$$

$$= \sqrt{16\sin^2 2t + 16\cos^2 2t}$$

$$= \sqrt{16(\sin^2 2t + \cos^2 2t)}$$

$$= \sqrt{16(1)} \qquad \because \sin^2\theta + \cos^2\theta = 1$$

(Section C)

**Q. No. 6 (Page 3)**

Speed $= \sqrt{16}$

Speed $= 4$ unit

Magnitude of acceleration $= \sqrt{x^2 + y^2}$

$= \sqrt{(-16\cos 2t)^2 + (-16\sin 2t)^2}$

$= \sqrt{(256\cos^2 2t) + (256\sin^2 2t)}$

$= \sqrt{256(\cos^2 2t + \sin^2 2t)}$

$= \sqrt{256(1)}$

$= \sqrt{256}$

$|A(t)| = 16$ unit

Magnitude of acceleration $= 16$ unit.

Q. No. 6 (Page 4)