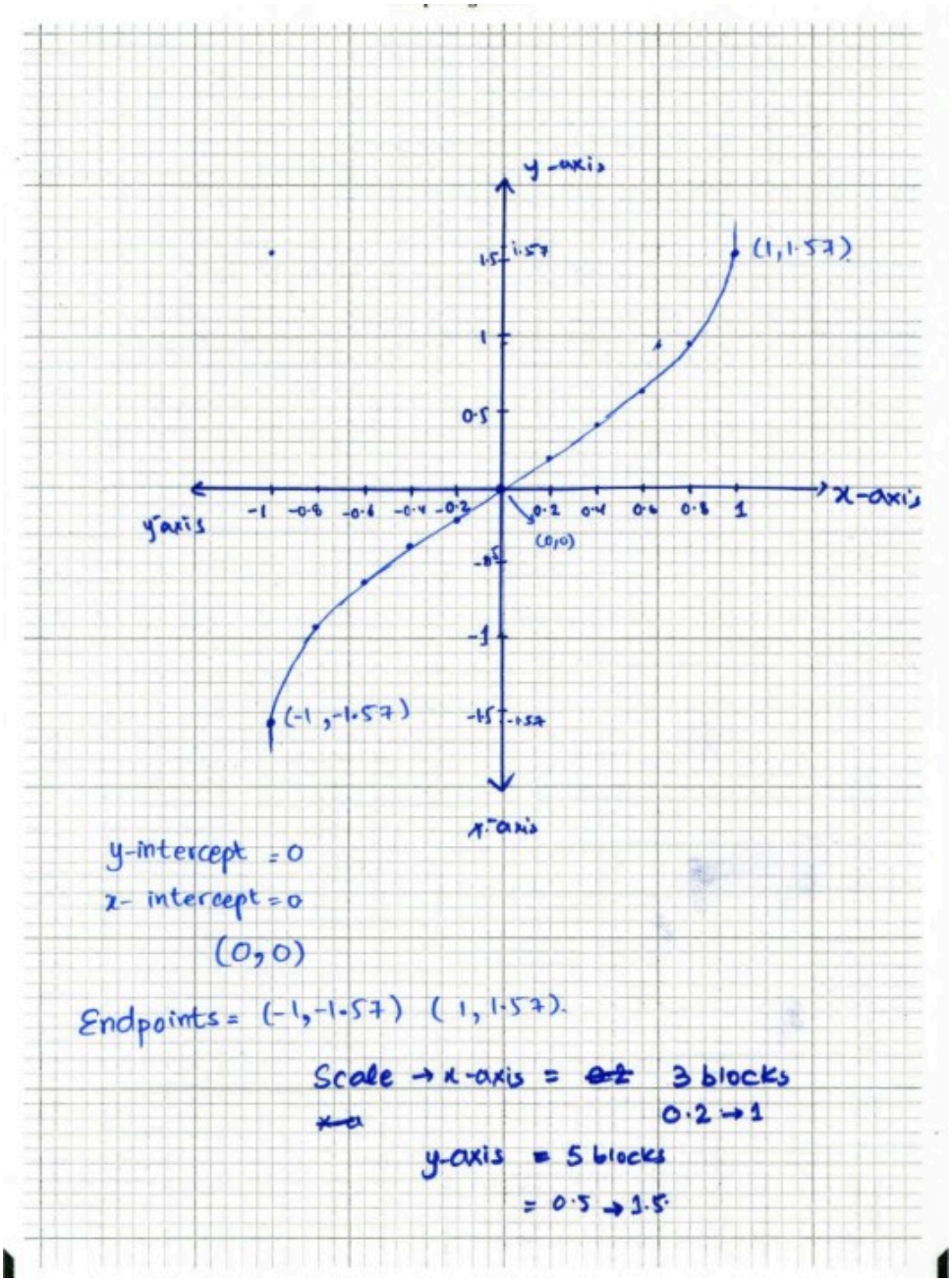


y-intercept = 0

x- intercept = 0

(0, 0)

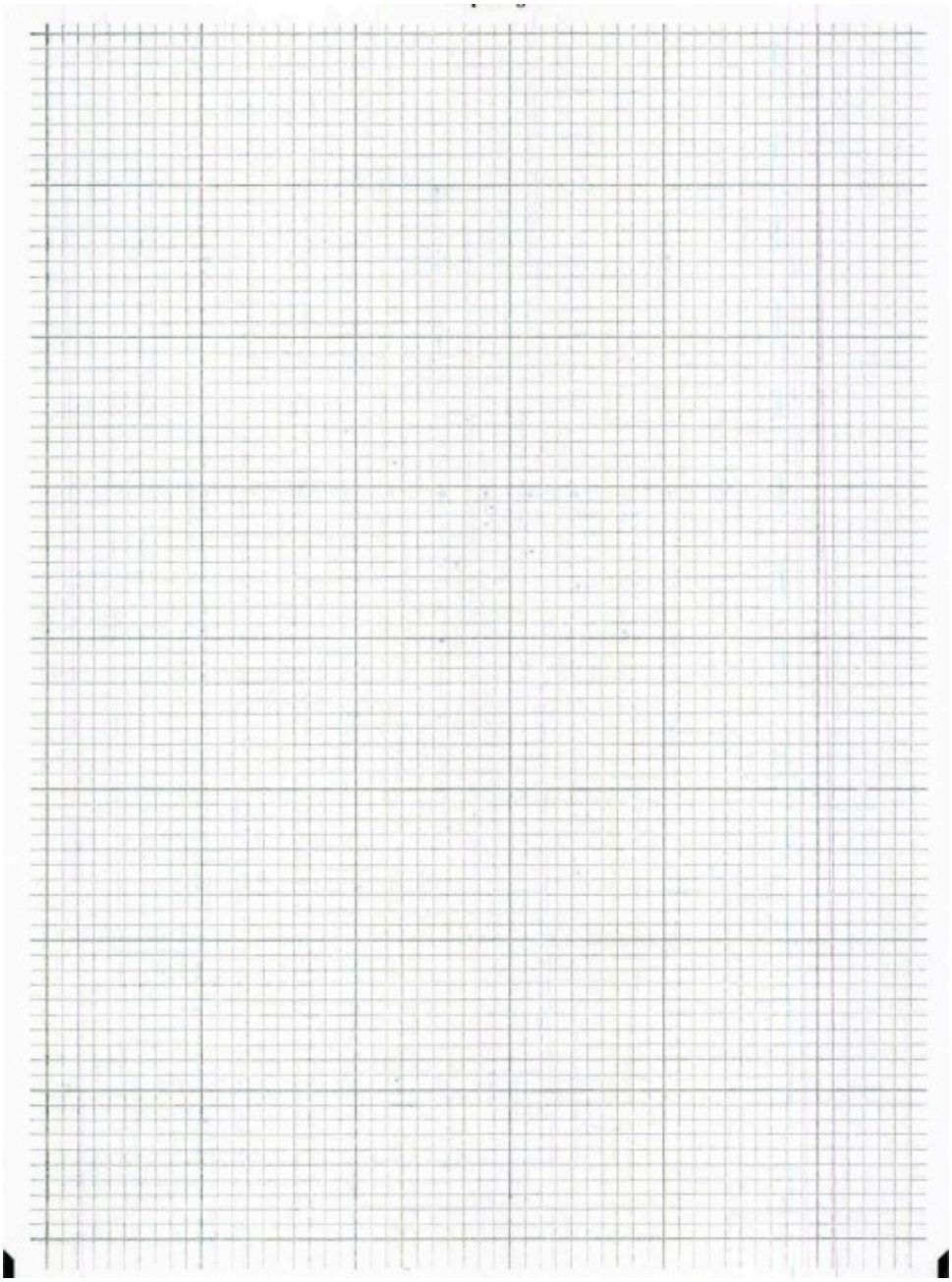
Endpoints = (-1, -1.57) (1, 1.57).

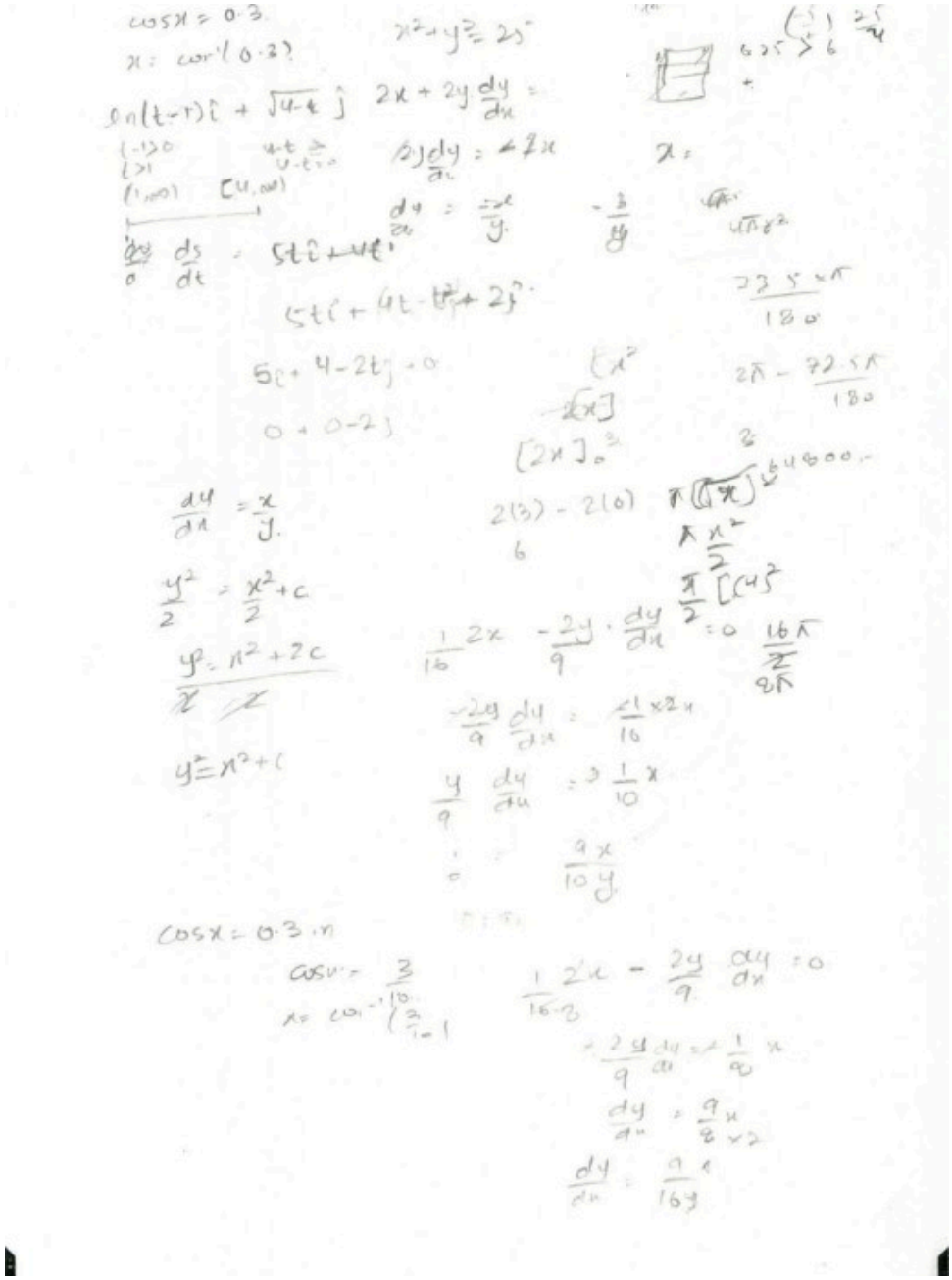
Scale → x-axis = ~~0.2~~ 3 blocks

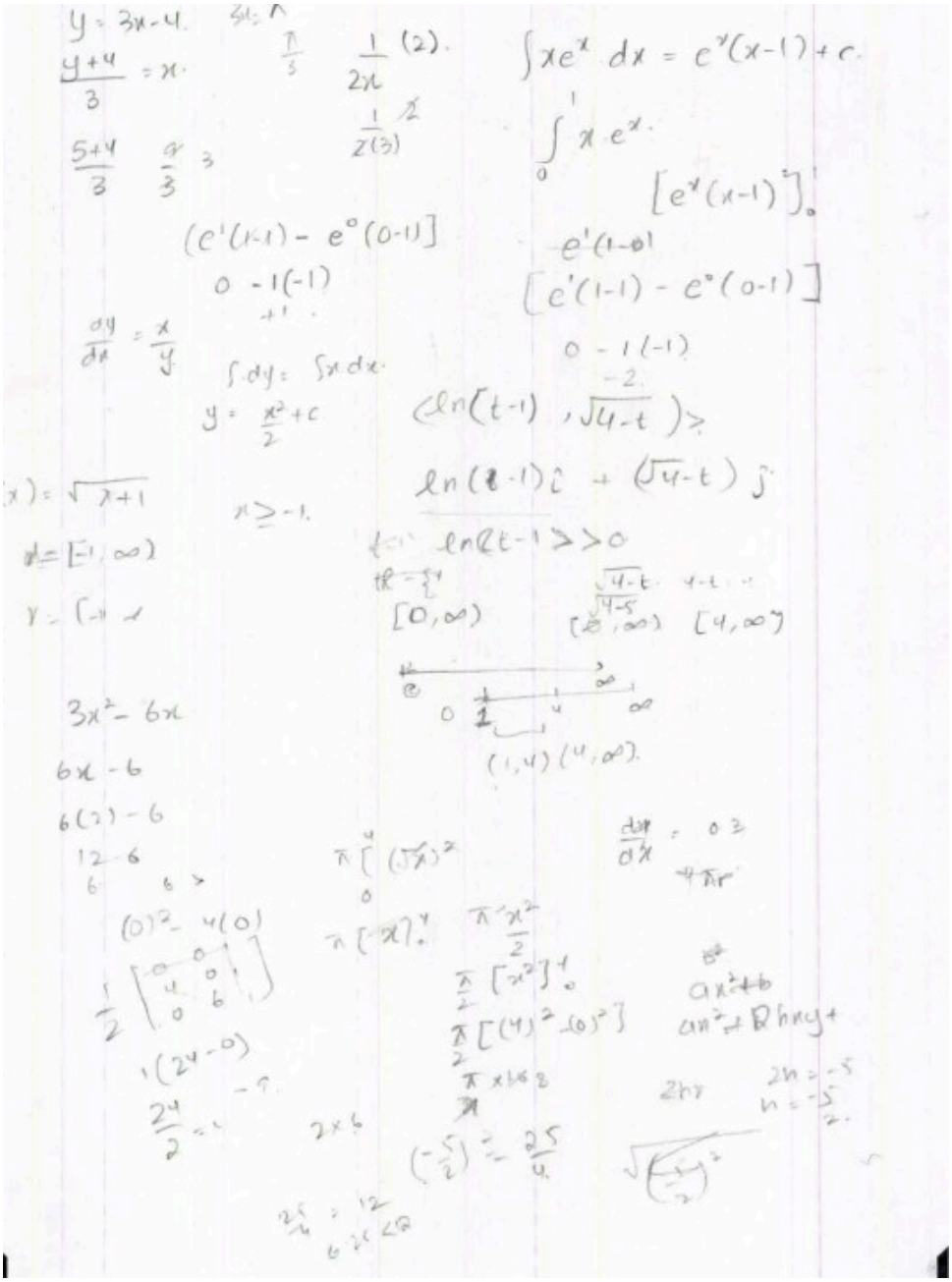
~~x-axis~~ 0.2 → 1

y-axis = 5 blocks

= 0.5 → 1.5







$y = 3x - 4$.

$\frac{y+4}{3} = x$.

$\frac{5+4}{3} \quad \frac{9}{3} \quad 3$

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

$0 - 1(-1)$

$+1$.

$\frac{dy}{dx} = \frac{x}{y}$

$\int dy = \int x\,dx$.

$y = \frac{x^2}{2} + c$

$x) = \sqrt{x+1}$

$x \geq -1$.

$= [-1, \infty)$

$= [-1$

$3x^2 - 6x$

$6x - 6$

$6(2) - 6$

$12 - 6$

6

$(0)^2 - 4(0)$

$\frac{1}{2}$

$1(2^4 - 0)$

$\frac{24}{2} =$

$\frac{1}{5}$ $\frac{1}{2x}$ (2).

$\frac{1}{2(3)}$

$\int x e^x\,dx = e^x(x-1) + c$.

$\int_0^1 x\,e^x$.

$[e^x(x-1)]_0^1$

$e^1(1-0)$

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

$0 - 1(-1)$

-2.

$\langle \ln(t-1), \sqrt{4-t} \rangle$

$\ln(t-1)\,i + (\sqrt{4-t})\,j$

$t = \ln(t-1) > 0$

$[0, \infty)$

$\sqrt{4-t}$ $4-t \geq$

$\sqrt{4-5}$ $[4, \infty)$

$[4, \infty)$

$(1,4)\,(4,\infty)$.

$\pi \int_0^4 (\sqrt{x})^2$

$\pi [x]_0^4$ $\pi \frac{x^2}{2}$

$\frac{\pi}{2}[x^2]_0^4$

$\frac{\pi}{2}[(4)^2 - (0)^2]$

$\pi \times 16 \times 2$

2×6

$\frac{dy}{dx} = 0$ 3

$4\pi r$

$ax^2 + b$

$ax^2 + Bhxy +$

$2hx$ $2h = -5$

$h = \frac{-5}{2}$.

$(-\frac{5}{2}) = \frac{25}{4}$

$\sqrt{(\frac{-y}{2})^2}$

$\frac{25}{4} = 12$

6×12

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

Growth rate

In 2020,

→ $t=0$, $P_0 = 50,000$ $\quad P(t) = 50,000\, e^{kt}$

$P(0) = 50,000$

(i) $\boxed{P(t) = P_0 e^{kt}}$

In 2025, $t = 5$, $P(t) = 60,000$.

$60,000 = 50,000\, e^{k(5)}$

$\frac{6}{5} = e^{5k}$

Taking ln on b/s

$\ln\left(\frac{6}{5}\right) = \ln e^{5k}$

$\ln 6 - \ln 5 = 5k$

$0.1823 = 5k.$

$\boxed{k = 0.036}$ → growth rate constant.

(ii) Population in 2030.

ie, $t = 10$

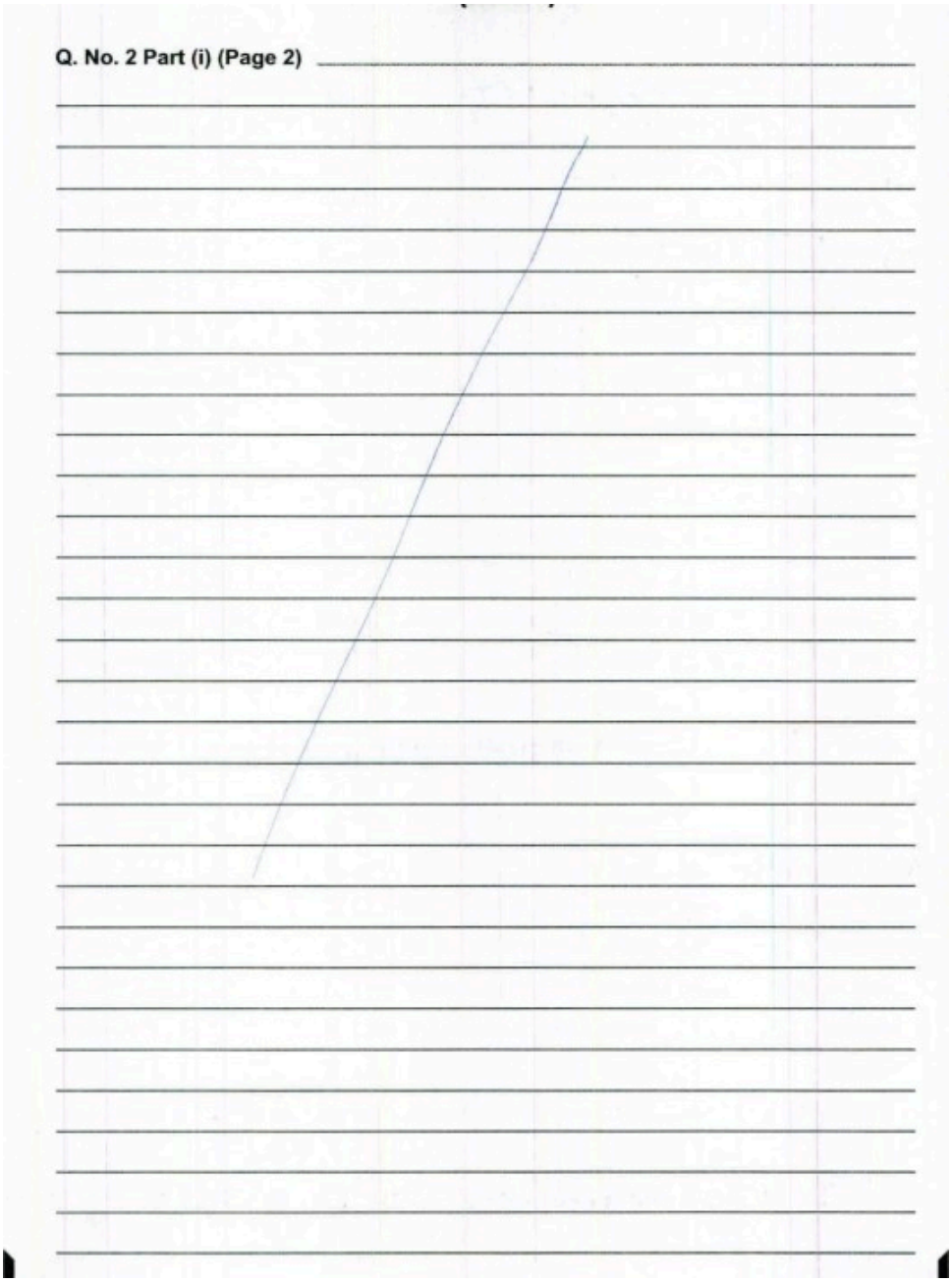
$P(t) = 50,000\, e^{0.036 \times 10.}$

$= 50,000 \times 1.4333$

$P(t) = 71666.4$

In 2030, the population will be $\approx$ 71,666

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



Q. No. 2 Part (II) (Page 1)

Find Derivative.

$\frac{dy}{dx} = ?$

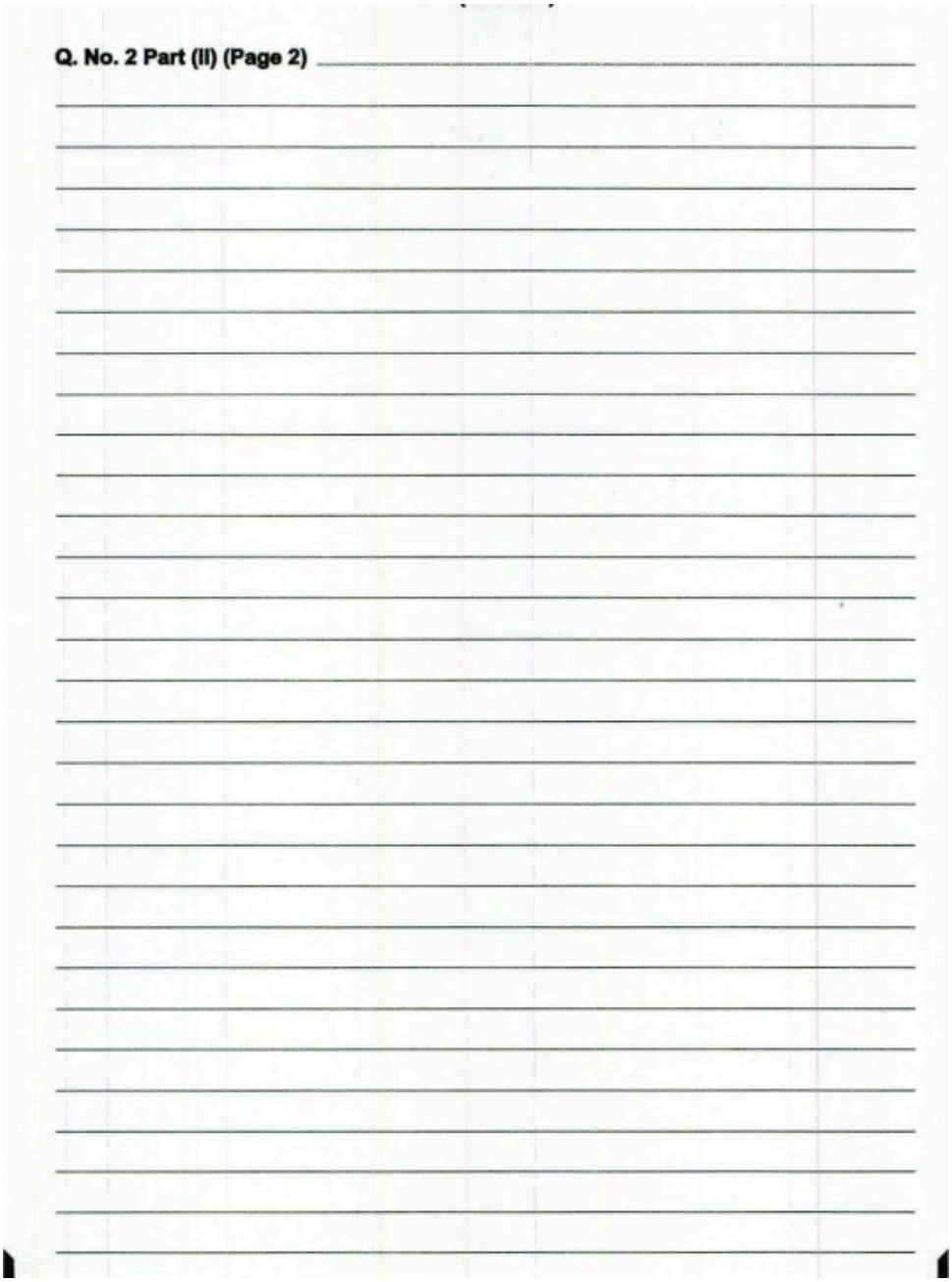
$y = e^{2x} \ln(x)$.

Diff w.r.t 'x'

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

$$(2e^{2x}) \ln x + \frac{1}{x} \cdot e^{2x}$$

$$\boxed{\frac{dy}{dx} = 2e^{2x} \ln x + \frac{1}{x} e^{2x}.}$$


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

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

Evaluate $\int \sin^2 x \, dx$.

Q- $\int \sin^2 x \, dx$

$\int \sin^2 x \rightarrow (1)$

As $\cos 2x = 1 - 2\sin^2 x$.

$1 - \cos 2x = 2\sin^2 x$

$\frac{1 - \cos 2x}{2} = \sin^2 x. \rightarrow (2)$

put in (1)

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

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

$\frac{1}{2} \left[1 \int 1 . dx - \int \cos 2x . dx \right]$

$\frac{1}{2} \left[x - \frac{1}{2} \int 2 \cos 2x . dx \right]$

$\frac{1}{2} \left[x - \frac{1}{2} \sin 2x \right] + c$

$\int \sin^2 x = \frac{1}{2} x - \frac{1}{4} \sin 2x + c.$

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

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

Solve Seperable DE.

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

$y = 2x + 1$.

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

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

- Taking integral on b/s.

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

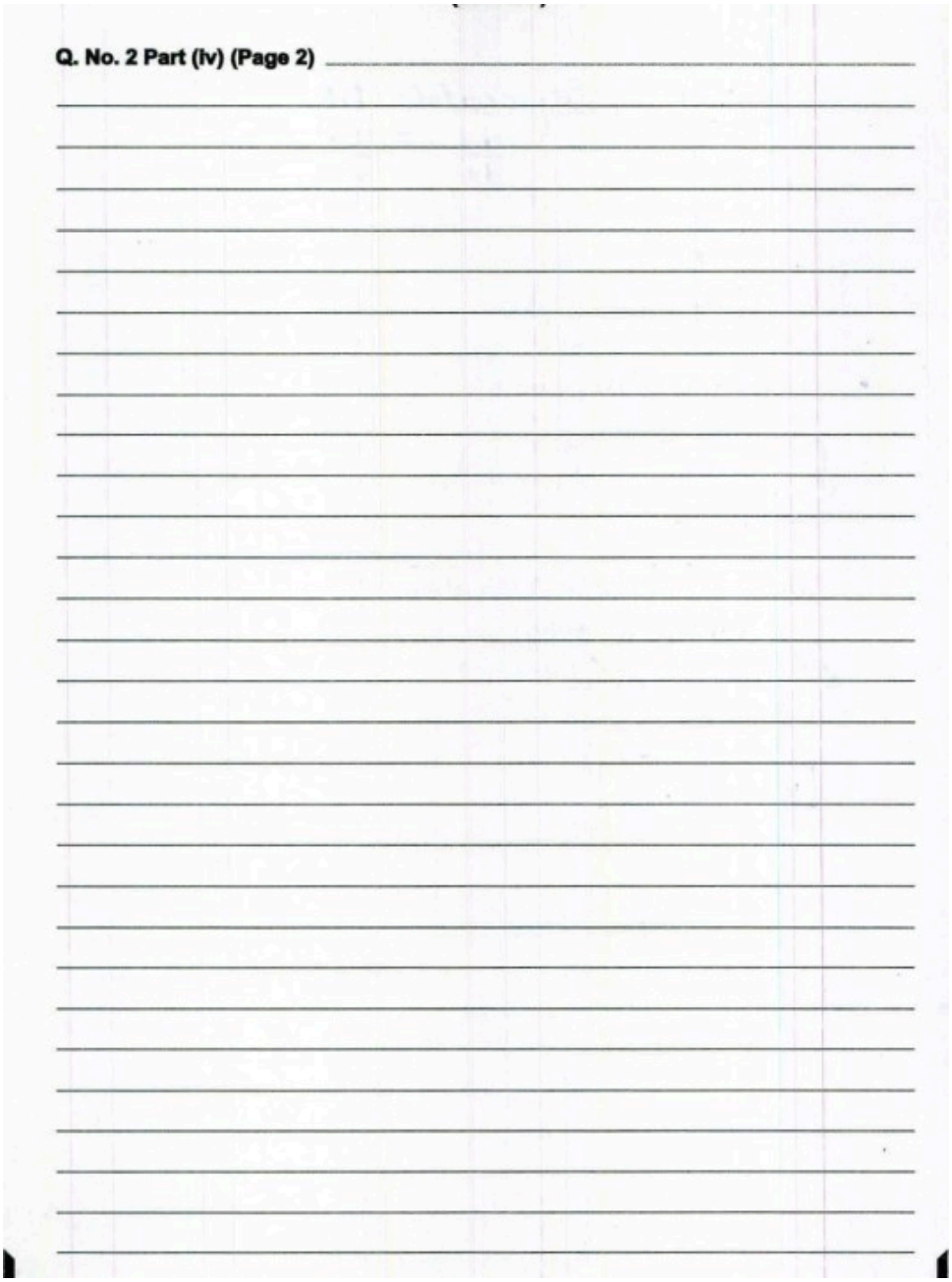
$$\ln(y+1) = \ln(x-2) + \ln c.$$

Taking e on b/s.

$$e^{\ln(y+1)} = e^{\ln(x-2)(c)}.$$

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

$$\boxed{y = (x-2)c - 1}$$


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

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

$$3x^2 - 5xy + 2y^2 = 0$$

$3x^2 - 3xy - 2xy + 2y^2 = 0.$

$3x(x-y) - 2(x-y) = 0.$

$(x-y)(3x-2) = 0.$

Put $x-y=0$ $\quad$ $3x-2y=0.$

$x=y \rightarrow (i)$ $\quad$ $3x = 2y \rightarrow (ii)$

(i) State whether it represents a pair of lines at the origin.

Put $x=y$ in $3x-2y=0.$

$3x - 2x = 0$

$\boxed{x=0}$

as $y=x$ $\quad$ $y=0.$

So the pair of lines are at origin.

(ii) Find Individual line equations:-

from (i) $\quad$ from (ii)

$x=y$ $\quad$ $3x = 2y$

$m=1$ $\quad$ $y = \frac{3}{2}x$

$m_1 = \frac{3}{2}.$

$m' = -1$

$m_1' = -\frac{2}{3}$

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

$y = m'x$ $\quad y = m_1'x$

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

$y = -x$ $\quad 3y + 2x = 0.$

$x + y = 0$

Compare

$(x+y)(3y+2x) = 0.$ Ans.

these are the individual line equations.

If we want joint equation

$3xy + 2x^2 + 3y^2 + 2xy = 0$

$2x^2 + 5xy + 3y^2 = 0.$

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

$r(t) = \langle t^2-1, 3t, \ln(t+1) \rangle$.

$r(t) = (t^2-1)\hat{i} + 3t\hat{j} + \ln(t+1)\hat{k}$

$r'(t) = (2t-0)\hat{i} + 3\hat{j} + \frac{1}{t+1}(1)\hat{k}$

$\boxed{r'(t) = 2t\hat{i} + 3\hat{j} + \frac{1}{t+1}\hat{k}}$ Ans.

At

$t = 2$.

$r'(2) = 2(2)\hat{i} + 3\hat{j} + \frac{1}{2+1}\hat{k}$

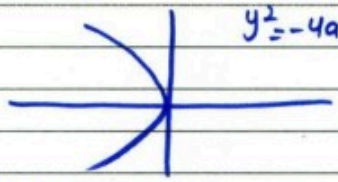
$r'(2) = 4\hat{i} + 3\hat{j} + \frac{1}{3}\hat{k}$

$|r'(2)| = \sqrt{(4)^2 + (3)^2 + \left(\frac{1}{3}\right)^2}$.

$\boxed{r'(2) = \frac{\sqrt{226}}{3}}$ Ans

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

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



Given parabola eq:-

$y^2 = -12x$.

Compare with $y^2 = -4ax$.

$-4a = -12$

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

$a = 3$

Vertex = (0,0)

$F = (-a, 0)$.

$F = (-3, 0)$

directrix = $x = +a$

$x = 3$

$x - 3 = 0$

length of latus rectum = $4a$

$= 4(3)$

$= 12$ units

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

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

Bisection Method

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

$x_0 = 2 \quad x_1 = 3.$

$f(x_0) = (2)^3 - 2(2) - 5$

$f(x_0) = -1$

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

$f(x_1) = 16$

$f(x_0) \cdot f(x_1) < 0$ [2, 3] Interval.

1st Iteration.

$x_2 = \frac{x_0 + x_1}{2}$

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

$x_2 = 2.5$

$f(x_2) = (2.5)^3 - 2(2.5) - 5$

$f(x_2) = 5.625$

$f(x_0) f(x_2) < 0$ [2, 2.5] Interval

2nd Iteration

$x_3 = \frac{x_0 + x_2}{2}$

$x_3 = \frac{3 + 2.5}{2}$

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

$x_3 = 2.75$ Ans. Interval = $[2, 2.75]$

$f(x_3) = 10.29$.

$f(x_3) f(x_0) < 0$

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

Evaluate $\int_0^1 x.e^x.dx$.

$\int_0^1 \underset{①}{x}\,\underset{②}{e^x}.dx$

$[x.e^x - \int e^x.1.dx.]_0^1$

$= [x.e^x - e^x + c.]_0^1$

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

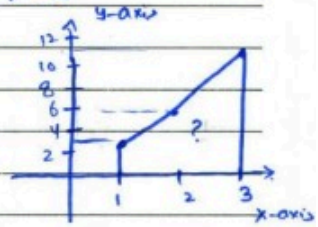
$0 - [0-1]$

$\int_0^1 x.e^x = 1$ Ans

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

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

Find the area bounded by the curve $y = x^2 + 2$, x-axis, lines $x = 1, x = 3$



$$A = \int_a^b f(x) - g(x)\,dx$$

$y = x^2 + 2$ $\quad a = 1$

$y = 0$ $\quad b = 3$

$$A = \int_1^3 (x^2 + 2) - 0\,dx$$

$$\int_1^3 (x^2 + 2)\,dx$$

$$\int_1^3 x^2 + 2\int_1^3 1\,dx$$

$$\left[\frac{x^3}{3}\right]_1^3 + 2[x]_1^3$$

$$\left[\frac{(3)^3}{3} - \frac{(1)^3}{3}\right] + 2[3-1]$$

$$\left(9 - \frac{1}{3}\right) + 2(2)$$

$$\frac{26}{3} + 4$$

$A = \frac{38}{3}$ sq unit

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

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

find derivative $f(x) = \frac{x^2+1}{x^2-1}$ & simplify.

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

$$\begin{array}{r|l} x^2-1 & 1 \\ & x^2+1 \\ & -x^2+1 \\ \hline & 0+2. \end{array}$$

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

$f'(x) = 1.\frac{dx}{dx} + \frac{2}{x^2-1}.\frac{dg}{dx}$

$0 + \frac{0(x^2-1) - (2x)(2)}{(x^2-1)^2}$.

$\frac{0-4x}{(x^2-1)^2}$.

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

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

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

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

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

$f(x) = \sqrt{x-1}$ for $x \geq 1$ Find $f^{-1}(x)$ and verify $f(f^{-1}(x)) = x$

~~$r(t) = \langle t^2 - 2t, t^3 - 3t$~~

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

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

As we know $f(x) = y$

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

$y = \sqrt{x-1}$

Sq b/s.

$y^2 = x - 1$

$y^2 + 1 = x$

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

replace y with x

$\boxed{x^2 + 1 = f^{-1}(x)}$ → Ans.

Verification:

Prove that

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

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

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

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

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

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

$= \pm x$

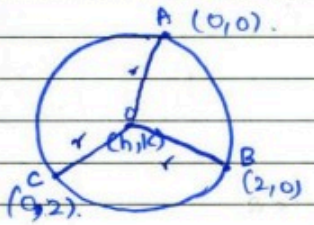
as $x \geq 1$

R.H.S Hence.

$x = x$ proved!

(Section C)

Q. No. 3 (Page 1)



(i) Find the equation:-

Standard eq:- $(x-h)^2+(y-k)^2=r^2$.

Compare $|OA| = |OB|$

$$\sqrt{(h-0)^2+(k-0)^2} = \sqrt{(h-2)^2+(k-0)^2}$$

Sq b/s.

$$\left(\sqrt{(h-0)^2+(k-0)^2}\right)^2 = \left(\sqrt{(h-2)^2+(k-0)^2}\right)^2$$

$$h^2+k^2 = h^2+4-4h+k^2$$

$$\boxed{4-4h=0} \longrightarrow (i)$$

$4=4h$

Compare $|OA| = |OC|$

$$\sqrt{(h-0)^2+(k-0)^2} = \sqrt{(h-0)^2+(k-2)^2}$$

Sq b/s.

$$h^2+k^2 = h^2+k^2+4-4k$$

$$\boxed{4-4k=0} \longrightarrow (ii)$$

$4=4k$

Q. No. 3 (Page 2)

$k = 1$.

$r = \sqrt{h^2 + k^2}$

$r = \sqrt{1^2 + 1^2}$

$r = \sqrt{2}$

from $4 - 4h = 0$.

$4 = 4h$

$h = 1$

$C \Rightarrow (h, k) = (1, 1)$.

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

$x^2 + 1 - 2x + y^2 + 1 - 2y = 2$.

$x^2 + y^2 - 2x - 2y + 2 - 2 = 0$

$x^2 + y^2 - 2x - 2y = 0$

(b) Find tangent at $(0, 2)$

Taking derivative of circle eq.

$x^2 + y^2 - 2x - 2y = 0$.

$2x + 2y \cdot \frac{dy}{dx} - 2 - 2\frac{dy}{dx} = 0$.

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

$\left.\frac{dy}{dx}\right|_{(0,2)} = \frac{2-2x}{2y-2}$.

$m_T = \frac{2 - 2(0)}{2(2) - 2}$

$m_T = \frac{2}{4-2} = \frac{2}{2} = 1$.

Eq of tangent

$y - y_1 = m(x - x_1)$

Q. No. 3 (Page 3)

$(y-2) = 1(x-0)$

$y-2 = x$

$\boxed{x-y+2=0}$

(c) Find the normal at $(0, 2)$

as slope of tangent is $= 1$

and

slope of tangent . slope of normal line $= -1$

as they are perpendicular to each other.

$m_T \cdot m_N = -1$.

$m_N = \frac{-1}{1}$.

$\boxed{m_N = -1}$

$y-y_1 = m(x-x_1)$. at point $(0,2)$

$y-2 = -1(x-0)$

$y-2 = -x$

$\boxed{x+y-2=0}$

Q. No. 3 (Page 4)

Q. No. 4 (Page 1)

Graph

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

$x \in [-2\pi, 2\pi]$

x
y

Domain of $\sin^{-1}(x)$ is $[-\frac{\pi}{2}, \frac{\pi}{2}]$

→ DOMAIN OF $\sin^{-1}(x) = [-1, 1]$

→ RANGE OF $\sin^{-1}(x) = \left[\frac{-\pi}{2}, \frac{\pi}{2}\right]$

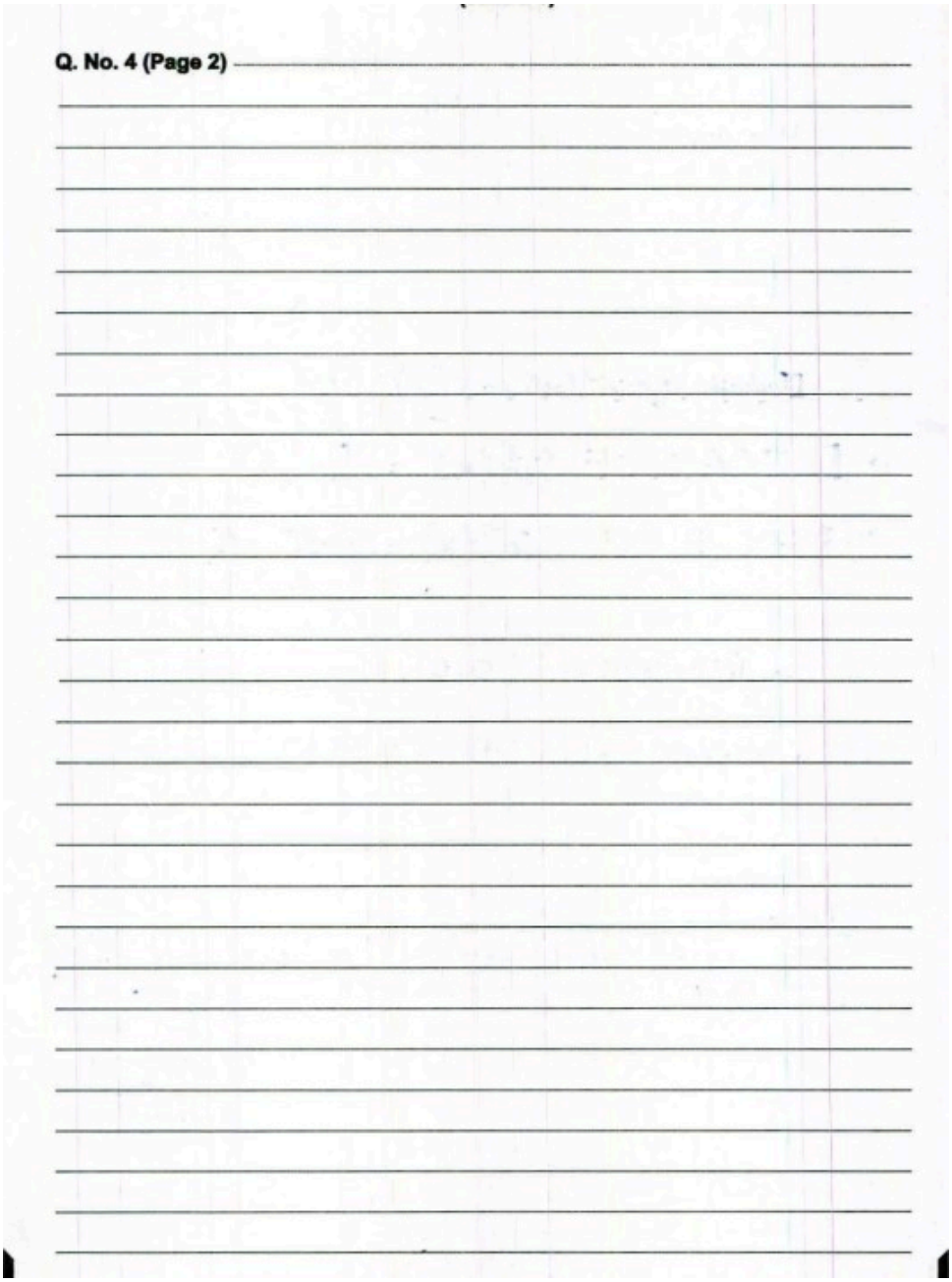
→ intercepts (0,0).

→ endpoint (-1, -1.57) (1, 1.57).

Table.

-1	-0.8	-0.6	-0.4	-0.2	0	0.2	0.4	0.6	0.8
-1.57	-0.92	-0.64	-0.41	-0.2	0	0.2	0.41	0.64	0.92

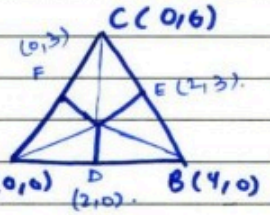
x	1
y	1.57


Q. No. 4 (Page 2)

Q. No. 4 (Page 3)

Q. No. 4 (Page 4)

Q. No. 5 (Page 1)



To find medians equation:-
first find midpoints.

Midpoint of $\overline{AB}$ = D = $\left(\frac{0+4}{2}, \frac{0+0}{2}\right)$

D = (2, 0).

Midpoint of $\overline{BC}$ = E = $\left(\frac{4+0}{2}, \frac{0+6}{2}\right)$

E = (2, 3)

Midpoint of $\overline{CA}$ = F = $\left(\frac{0+0}{2}, \frac{6+0}{2}\right)$

F = (0, 3)

Slope of CD = $\frac{y_2 - y_1}{x_2 - x_1}$

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

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

$m_1 = -3$

Q. No. 5 (Page 2)

$y - y_1 = m(x - x_1)$

$y - 0 = -3(x - 2)$

$y = -3x + 6$

$\boxed{3x + y - 6 = 0}$ → (1)

Slope of AE $= \dfrac{y_2 - y_1}{x_2 - x_1}$

$= \dfrac{0 - 3}{0 - 2}$

$m_2 = \dfrac{3}{2}$

$y - y_1 = m(x - x_1)$

$y - 3 = \dfrac{3}{2}(x - 2)$

$2y - 6 = 3x - 6$

$\boxed{3x - 2y = 0}$ → (2)

Slope of BF $= \dfrac{0 - 3}{4 - 0}$

$m_3 = \dfrac{-3}{4}$

$y - 3 = \dfrac{-3}{4}(x - 0)$

$4y - 12 = -3x$

$\boxed{3x + 4y - 12 = 0}$ → (3)

Q. No. 5 (Page 3)

Condition for concurrency:

for ~~collinear~~ concurrency

Det = 0.

$$\begin{vmatrix} 3 & 1 & -6 \\ 3 & -2 & 0 \\ 3 & 4 & -12 \end{vmatrix}$$

as

$3(+24-0) - 1(-36-0) - 6(12+6) = 0$

$72 + 36 - 108 = 0$

$108 - 108 = 0$

~~$108 - 0$~~ $0 = 0$

To find point of concurrency:

Compare eq (1) & (2)

$3x + y - 6 = 0$

$-3x - 2y + 0 = 0$

$3y - 6 = 0$

$y = \frac{6}{3}$

$\boxed{y = 2}$ → put in (1)

$3x + 2 - 6 = 0$

$3x - 4 = 0$

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

points of concurrency =

$\left(\frac{4}{3}, 2\right)$

(Centroid)

Q. No. 5 (Page 4)

Q. No. 6 (Page 1)

General solution of $\frac{dy}{dx} = \frac{x^2+y^2}{xy}$.

put $y = u.x$

diff w.r.t x.

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

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

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

put $y = ux$.

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

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

$$\text{Put } \frac{dy}{dx} = x.\frac{du}{dx} + u.$$

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

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

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

$$x.\frac{du}{dx} = \frac{1}{u}$$

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$u.du = \frac{1}{x}.dx$

Taking integral on b/s.

$\int u.du = \int \frac{1}{x}.dx$

$\frac{u^2}{2} = \ln x + c.$

Put $u = \frac{y}{x}$

$\frac{\frac{y^2}{x^2}}{2}$

$\frac{2y^2}{x^2} = \ln x + c.$

$\frac{y^2}{x^2} = \frac{1}{2}\ln x + c.$

$\frac{y^2}{x^2} = \ln x^{\frac{1}{2}} + C$

$\boxed{y^2 = x^2 \ln\sqrt{x} + c}$ Ans.

Q. No. 6 (Page 3)


Q. No. 6 (Page 4)