Project 2 Work

1- a) Github!

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2. Round & Round we go!

a) Points = {(8.9264, 28.6412), (-29.5313, 5.28231), (-5.28231, -29.5313), (29.5313, -5.28231)}

Circle EQ: $x^2 + y^2 = 900$

CEQ': $\frac{d}{dx}[x^2] + \frac{d}{dx}[y^2] = \frac{d}{dx}[900]$

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

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

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

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

b) $m_i = -\frac{x_i}{y_i}$

P1: $m_i = -\left(\frac{8.9264}{28.6412}\right)$

P2: $m_i = -\left(\frac{-29.5313}{5.28231}\right)$

P3: $m_i = -\left(\frac{-5.28231}{-29.5313}\right)$

P4: $m_i = -\left(\frac{29.5313}{-5.29231}\right)$

P_2 P_1

$(-29.5313, 5.28231)$ $(8.9264, 28.6412)$

P_3 P_4

$(-5.28231, -29.5313)$ $(29.5313, -5.28231)$

$P_{1m} \approx -.3117$

$P_{2m} \approx 5.5906$

$P_{3m} \approx -.1789$

$P_{4m} \approx 5.5906$

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

P1: $y - 28.6412 = \left(-\left(\frac{8.9264}{28.6412}\right)\right)(x - 8.9264)$

$y = -.3117(x - 8.9264) + 28.6412$

$y = -.3117x + 2.7824 + 28.6412$

$y = -.3117x + 31.4236$

P2: $y - 5.28231 = 5.5906(x - (-29.5313))$

$y = 5.5906(x - (-29.5313)) + 5.28231$

$y = 5.5966x + 165.2749 + 5.28231$

$y = 5.5966x + 170.5572$

P3: $y - (-29.5313) = -.1789(x - (-5.28231))$

$y = -.1789(x - (-5.28231)) - 29.5313$

$y = -.1789x - .9449 - 29.5313$

$y = -.1789x - 30.4762$

P4: $y - (-5.28231) = 5.5906(x - 29.5313)$

$y = 5.5906(x - 29.5313) - 5.28231$

$y = 5.5906x - 165.0977 - 5.28231$

$y = 5.5906x - 170.3800$

d) ✓

e) ✓

3) $x(t) = 32\sin^3(t)$

4) Find $\frac{dx}{dt}$ $y(t) = 26\cos(t) - 10\cos(2t) - 9\cos(3t) - 2\cos(4t)$

$x(t) = 32 \cdot \sin^3(t)$

$y(t) = 26\cos(t) - 10\cos(2t) - 4\cos(3t) - 2\cos(4t)$

$\frac{dx}{dt} = 96\sin^2(t) \cdot \cos(t)$

$\frac{d}{dt}[x(t)] = \frac{dx}{dt}$

$= 32 \cdot 3\sin^2(t) \cdot \cos(t)$

Chain rule $= \underline{96\sin^2(t) \cdot \cos(t)}$

b) Find when $\frac{dx}{dt} = 0$, $\frac{dy}{dt} \neq 0$

$96\sin^2(t) \cdot \cos(t) = 0$

- $\sin(t) = 0$ on interval $[0, 2\pi]$ when $t = 0, \pi, 2\pi$
- $\cos(t) = 0$ on interval $[0, 2\pi]$ when $t = \pi/2, 3\pi/2$

$\frac{dy}{dt} = -26\sin(t) + 20\sin(2t) + 12\sin(3t) + 8\sin(4t)$

Critical Points: $[0, \pi]$; $[\pi/2, 3\pi/2]$

P_1: $\sin(0) = 0$, $\frac{dy}{dt} = 0$ (X)

P_2: $\sin(\pi) = 0$, $\frac{dy}{dt} = 0$ (X)

→ P_3: $\sin(\pi/2) = 1$; $\cos(\pi/2) = 0$, $\frac{dy}{dt} \neq 0$ (✓) because $\sin(\pi/2) \neq 0$

→ P_4: $\sin(3\pi/2) = -1$; $\cos(3\pi/2) = 0$, $\frac{dy}{dt} \neq 0$ (✓) because $\sin(3\pi/2) \neq 0$

Vertical tangent points must occur @ $t = \pi/2, 3\pi/2$

c) Plugging t vals into $x(t)$ & $y(t)$ $t = \pi/2, 3\pi/2$

$\pi/2$

$x = 32\sin^3(\pi/2) = 32 \cdot 1^3 = 32$

$y = 26\cos(\pi/2) - 10\cos(2(\pi/2)) - 4\cos(3(\pi/2)) - 2\cos(4(\pi/2))$

$= 8$

$Pt_1(32, 8)$

$3\pi/2$

$x = 32\sin^3(3\pi/2) = 32 \cdot -1^3 = \underline{-32}$

$y = 26\cos(3\pi/2) - 10\cos(2(3\pi/2)) - 4\cos(3(3\pi/2)) - 2\cos(4(3\pi/2))$ 58

$Pt_2(-32, 8)$