

#1

$$\int x \cos 2x \, dx$$

$$\text{Let } u = x \\ du = dx$$

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

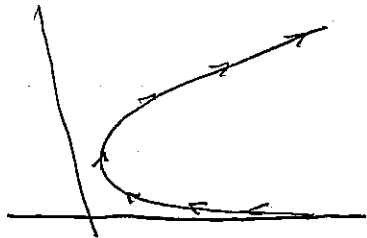
$$\begin{aligned} \int x \cos 2x \, dx &= -\frac{1}{2} x \cos 2x + \int \frac{1}{2} \cos 2x \, dx \\ &= -\frac{1}{2} x \cos 2x + \frac{1}{4} \sin 2x + C \end{aligned}$$

#2

$$x = e^t - t \\ \frac{dx}{dt} = e^t - 1$$

$$y = 4e^{2t} \\ \frac{dy}{dt} = 8e^{2t} = 2 \cdot 4e^{2t}$$

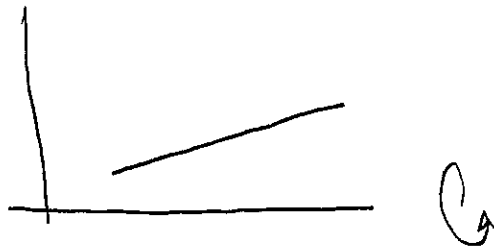
$$L = \int_{-8}^3 \sqrt{(e^t - 1)^2 + (2e^{2t})^2} \, dt$$



#3

$$y = x + \sqrt{x}$$

$$1 \leq x \leq 2$$



$$S = \int_1^2 2\pi(x + \sqrt{x}) \sqrt{1 + (1 + \frac{1}{2\sqrt{x}})^2} dx$$

#4

when $t=1$

$$x = e^{\sqrt{t}} = e$$

$$y = 1 - \ln t^2 = 1$$

point is $(e, 1)$

$$\text{slope} = \frac{dy}{dx} = \frac{dy/dt}{dx/dt} = \frac{1 - \frac{1}{t^2} \cdot 2t}{e^{\sqrt{t}} \cdot \frac{1}{2\sqrt{t}}} = \frac{1 - 2/t}{e^{\sqrt{t}} / 2\sqrt{t}}$$

when $t=1$

$$\text{slope} = \frac{1-2}{e^{1/2}} = -2/e$$

tangent line

$$y - 1 = -2/e(x - e)$$

$$y - 1 = -2x/e + 2$$

#5

horizontal tangent when

$$dy/dt = 0$$

$$6t^2 + 6t = 0$$

$$6t(t+1) = 0$$

$$t = 0, -1$$

vertical tangent when

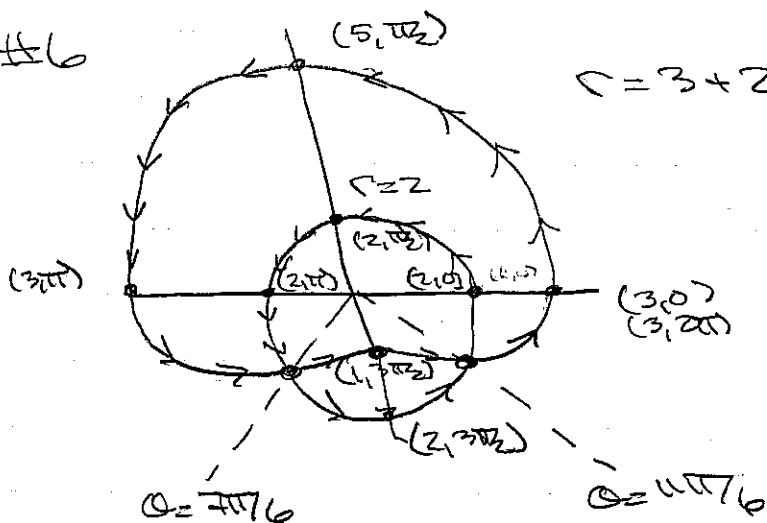
$$dx/dt = 0$$

$$6t^2 + 6t - 12 = 0$$

$$6(t^2 + t - 2) = 0$$

$$6(t+2)(t-1) = 0 \quad t = -2, 1$$

#6



$$r = 3 + 2 \cos \theta$$

intersections

$$3 + 2 \cos \theta = r = 2$$

$$2 \cos \theta = -1$$

$$\cos \theta = -1/2$$

$$\theta = 2\pi/3, 4\pi/3$$

area

=

$$\int_{-\pi/6}^{7\pi/6} \frac{1}{2} (2)^2 d\theta$$

+

$$\int_{7\pi/6}^{11\pi/6} \frac{1}{2} (3 + 2 \cos \theta)^2 d\theta$$

