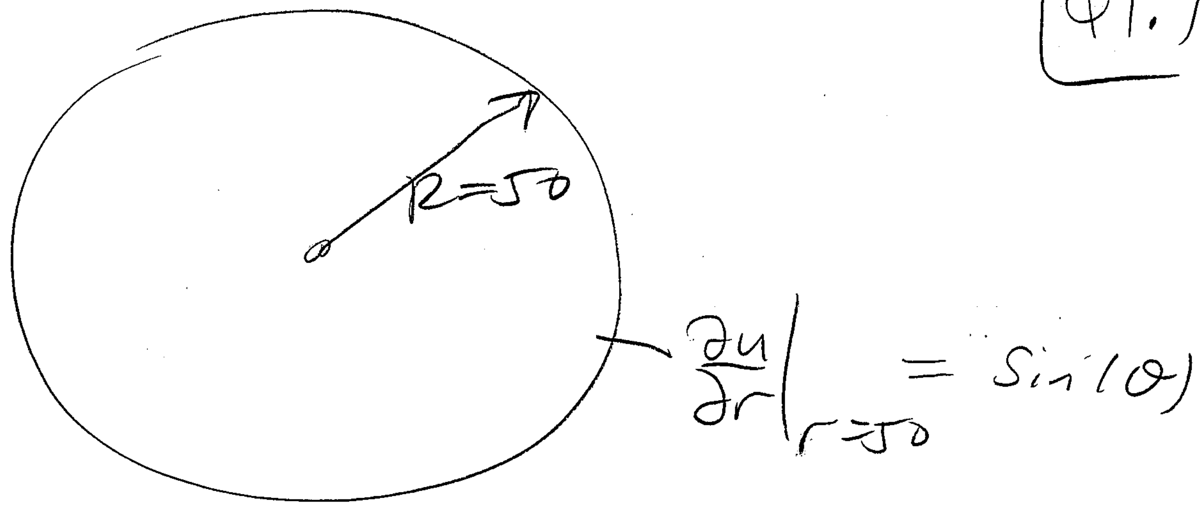
Q1.1



$$\frac{\partial^2 u}{\partial r^2} + \frac{1}{r}\frac{\partial u}{\partial r} + \frac{1}{r^2}\frac{\partial^2 u}{\partial \theta^2} = 0$$

$\nabla^2 u = 0$ in polar coords

As done in class

$$u(r,\theta) = a_0 + \sum_{n=1}^{\infty} r^n \left(a_n \cos(n\theta) + b_n \sin(n\theta)\right)$$

– 2π periodic & satisfies $\nabla^2 u = 0$ –

Need to set our B.C's

$$\left.\frac{\partial}{\partial r} u(r,\theta)\right|_{r=50} = 0 + \sum_{n=1}^{\infty} n(50)^{n-1}\left(a_n \cos(n\theta) + b_n \sin n\theta\right)$$

$$= \sin\theta$$

Q1.2

$$1\,(50)^{1-1}\,b_1 = 1 \qquad n=1$$

$$n\,(50)^{n-1}\,b_n = 0 \qquad \forall n > 1$$

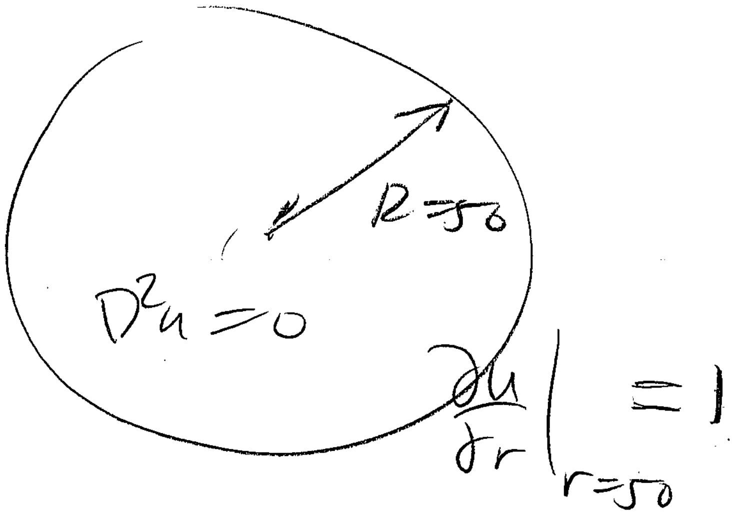
$$n\,(50)^{n-1}\,a_n = 0 \qquad \forall n \geq 1$$

and no info. at all about a_0.

$$\boxed{u(r,\theta) = a_0 + r\sin(\theta)}$$

(Notice This soln is not unique because a_0 can be any real number.

Q2.1



Neumann Problem with no solution

As done in class

$$u(r,\theta) = a_0 + \sum_{n=1}^{\infty} r^n (a_n \cos n\theta + b_n \sin n\theta)$$

2π periodic & satisfies $\nabla^2 u = 0$

Need to satisfy our B.C.s.

$$\left.\frac{\partial u}{\partial r}\right|_{r=50} = a_0 \cdot 0 \cdot 1 + \sum_{n=1}^{\infty} n(50)^{n-1}(a_n \cos n\theta + b_n \sin n\theta)$$

$$= 1 \cdot 1$$

$a_n, b_n = 0 \;\; \forall n \geq 1$

$a_0 \cdot 0 = 1$

no way to solve for a_0

There is no solution here.