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Problem 3)

a) $E = u \times B$

$= -\left(2u_{avg}\left(1-\frac{r^2}{R^2}\right) \times B\right)\hat{e}_y$

$V = -\int E\, dy$

for $\theta = 0°$

$V = 2u_{avg}B\int\left(1-\frac{y^2}{R^2}\right)dy$

$= 2u_{avg}B\left(y-\frac{y^3}{3R^2}\right)+C$

for $y = R\cos\theta$

$V = 2u_{avg}B\left(R\cos\theta - \frac{1}{3}R\cos^3\theta\right)$

$$\boxed{V = 2u_{avg}BR\left(\cos\theta - \frac{1}{3}\cos^3\theta\right)+C}$$

b) for A: $\theta = 180°$

$V_A = 2\times\frac{10}{100}\times 1\times\frac{10}{100}\left(\cos 180° - \frac{1}{3}\cos^3 180°\right)+C$

$V_A = -\frac{1}{75}+C$ V

for B: $\theta = 0°$

$V_B = 2\times\frac{10}{100}\times 1\times\frac{10}{100}\times\left(\cos 0° - \frac{1}{3}\cos^3 0°\right)+C$

$V_B = \frac{1}{75}+C$ V

$$\boxed{V_B - V_A = 0.02\overline{6}\ V}$$

You need to start with the Poisson equation that governs the electric potential (lap (phi) = div(uxB)). Then apply separation of variables wrt r and theta and finally integrate. You missed the Poisson equation to start. This was important.

Right idea, but incorrect formula to start.