Question 1) a)

30 cm diameter well completely penetrates a confined aquifer of permeability 60 m/day. Under steady state of pumping, the drawdown at the well was observed to be 4.5 m and the discharge was 2100 L/min for a radius of influence of 450 m.

If someone says "double the diameter of the well to 60 cm to get double discharge", will it be correct?

Compute the discharge for a 60 cm diameter well and the percentage increase in the discharge. All other data remain the same.

Solution

Use the Thiem (steady-state confined) equation:

$$Q = \frac{2\pi kb(H-h)}{\log_e(R/r)} = \frac{2\pi kb(h_2-h_1)}{\log_e(r_2/r_1)}$$

where T = transmissivity, s = drawdown, R = radius of influence, r_w = well radius.

Given:
- Initial well diameter = 30 cm → r_{w1} = 0.15 m
- New well diameter = 60 cm → r_{w2} = 0.30 m
- Permeability K = 60 m/day
- Drawdown s = 4.5 m
- Radius of influence R = 450 m
- Initial discharge Q1 = 2100 L/min = 3024 m^3/day

Step 1: Compute T from initial data:

$$T = \frac{Q_1 \ln(R/r_{w1})}{2\pi s} = \frac{3024 \ln(450/0.15)}{2\pi \times 4.5} \approx 856.30 \text{ m}^2/\text{day}$$

Step 2: Compute new discharge Q2:

$$Q_2 = \frac{2\pi T s}{\ln(R/r_{w2})} = \frac{2\pi \times 856.30 \times 4.5}{\ln(450/0.30)} \approx 3310.6 \text{ m}^3/\text{day}.$$

Step 3: Percentage increase:

$$\% \text{ increase} = \frac{Q_2 - Q_1}{Q_1} \times 100 = \frac{3310.6 - 3024}{3024} \times 100 \approx 9.4\%.$$

Conclusion:
Doubling the diameter does not double the discharge. The increase is only ≈ 9.4%.