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Unconfined Aquifer Formulas

Calculators! Examples! Conversions!

List of 42 Unconfined Aquifer Formulas

Unconfined Aquifer

Aquifer Discharge

1) Discharge from Two Wells with Base 10

Open Calculator

$$Q = \frac{1.36 \cdot K_{WH} \cdot \left(h_2^2 - h_1^2\right)}{\log\left(\left(\frac{r_2}{r1'}\right), 10\right)}$$

$$0.699431 \text{m}^3/\text{s} = \frac{1.36 \cdot 10.00 \text{cm/s} \cdot \left((17.8644 \text{m})^2 - (17.85 \text{m})^2\right)}{\log\left(\left(\frac{10.0 \text{m}}{0.000000001 \text{m}}\right), 10\right)}$$

2) Discharge given Length of Strainer

Open Calculator

$$Q = \frac{2.72 \cdot K_{WH} \cdot s_t \cdot \left(L + \left(\frac{s_t}{2}\right)\right)}{\log\left(\left(\frac{R_w}{r''}\right), 10\right)}$$

$$1.83534 \text{m}^3/\text{s} = \frac{2.72 \cdot 10.00 \text{cm/s} \cdot 0.83 \text{m} \cdot \left(2 \text{m} + \left(\frac{0.83 \text{m}}{2}\right)\right)}{\log\left(\left(\frac{8.6 \text{m}}{0.0037 \text{m}}\right), 10\right)}$$

3) Discharge in Unconfined Aquifer

Open Calculator

fx $$Q = \frac{\pi \cdot K_{WH} \cdot \left(H^2 - h_w^2\right)}{\log\left(\left(\frac{R_w}{r}\right), e\right)}$$

ex $$0.818911\text{m}^3/\text{s} = \frac{\pi \cdot 10.00\text{cm/s} \cdot \left((5\text{m})^2 - (2.44\text{m})^2\right)}{\log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), e\right)}$$

4) Discharge in Unconfined Aquifer with Base 10

Open Calculator

fx $$Q = \frac{1.36 \cdot K_{WH} \cdot \left(b_w^2 - h_w^2\right)}{\log\left(\left(\frac{R_w}{r}\right), 10\right)}$$

ex $$1.570364\text{m}^3/\text{s} = \frac{1.36 \cdot 10.00\text{cm/s} \cdot \left((14.15\text{m})^2 - (2.44\text{m})^2\right)}{\log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), 10\right)}$$

5) Discharge when Two Observation Well is Taken

Open Calculator

fx $$Q = \frac{\pi \cdot K_{WH} \cdot \left(h_2^2 - h_1^2\right)}{\log\left(\left(\frac{r_2}{r_1}\right), e\right)}$$

ex $$0.361093\text{m}^3/\text{s} = \frac{\pi \cdot 10.00\text{cm/s} \cdot \left((17.8644\text{m})^2 - (17.85\text{m})^2\right)}{\log\left(\left(\frac{10.0\text{m}}{1.07\text{m}}\right), e\right)}$$

6) Rate of Flow given Coefficient of Permeability

Open Calculator

fx $$Q = K_w \cdot i_e \cdot A_{xsec}$$

ex $$1.22472\text{m}^3/\text{s} = 1125\text{cm/s} \cdot 17.01 \cdot 6400\text{mm}^2$$

7) Rate of Flow given Flow Velocity

Open Calculator

fx $$Q = (V_{wh'} \cdot A_{sec})$$

ex $$1.54368\text{m}^3/\text{s} = (24.12\text{m/s} \cdot 64000\text{mm}^2)$$

Aquifer Thickness

8) Cross-section Area of Soil Mass given Flow Velocity

Open Calculator

fx $$A_{xsec} = \left(\frac{V_{aq}}{V_f}\right)$$

ex $$6400\text{mm}^2 = \left(\frac{64\text{m}^3/\text{s}}{0.01\text{m/s}}\right)$$

9) Length of Strainer given Discharge

Open Calculator

fx $$l_{st} = \left(\frac{Q \cdot \log\left(\left(\frac{R_w}{r}\right), 10\right)}{2.72 \cdot K_{WH} \cdot S_{tw}}\right) - \left(\frac{S_{tw}}{2}\right)$$

ex $$10.20706\text{m} = \left(\frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), 10\right)}{2.72 \cdot 10.00\text{cm/s} \cdot 4.93\text{m}}\right) - \left(\frac{4.93\text{m}}{2}\right)$$

10) Thickness of Aquifer for Discharge in Unconfined Aquifer with Base 10

Open Calculator

$$b = \sqrt{h_w^2 + \frac{Q \cdot \log\left(\left(\frac{R_w}{r}\right), 10\right)}{1.36 \cdot K_s}}$$

$$2.729791\text{m} = \sqrt{(2.44\text{m})^2 + \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), 10\right)}{1.36 \cdot 8.34}}$$

11) Thickness of Aquifer given Discharge in Unconfined Aquifer

Open Calculator

$$H = \sqrt{h_w^2 + \frac{Q \cdot \log\left(\left(\frac{R_w}{r}\right), e\right)}{\pi \cdot K_{WH}}}$$

$$5.426268\text{m} = \sqrt{(2.44\text{m})^2 + \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), e\right)}{\pi \cdot 10.00\text{cm}/\text{s}}}$$

12) Thickness of Aquifer given Drawdown Value measured at Well

Open Calculator

$$b = s_t + h_w$$

$$3.27\text{m} = 0.83\text{m} + 2.44\text{m}$$

Coefficient of Permeability

13) Coefficient of Permeability given Discharge and Length of Strainer

Open Calculator

fx
$$K_{WH} = \frac{Q}{\frac{2.72 \cdot S_{tw} \cdot \left(l_{st} + \left(\frac{S_{tw}}{2}\right)\right)}{\log\left(\left(\frac{R_w}{r}\right), 10\right)}}$$

ex
$$10.00558 \text{cm/s} = \frac{1.01 \text{m}^3/\text{s}}{\frac{2.72 \cdot 4.93 \text{m} \cdot \left(10.20 \text{m} + \left(\frac{4.93 \text{m}}{2}\right)\right)}{\log\left(\left(\frac{8.6 \text{m}}{7.5 \text{m}}\right), 10\right)}}$$

14) Coefficient of Permeability given Discharge from Two Wells with Base 10

Open Calculator

fx
$$K_{WH} = \frac{Q}{\frac{1.36 \cdot \left(h_2^2 - h_1^2\right)}{\log\left(\left(\frac{r_2}{r1}\right), 10\right)}}$$

ex
$$14.44031 \text{cm/s} = \frac{1.01 \text{m}^3/\text{s}}{\frac{1.36 \cdot \left((17.8644 \text{m})^2 - (17.85 \text{m})^2\right)}{\log\left(\left(\frac{10.0 \text{m}}{0.000000001 \text{m}}\right), 10\right)}}$$

15) Coefficient of Permeability given Discharge in Unconfined Aquifer

Open Calculator

fx $$K_{WH} = \frac{Q}{\frac{\pi \cdot \left(H^2 - h_w^2\right)}{\log\left(\left(\frac{R_w}{r}\right), e\right)}}$$

ex $$12.33345 \text{cm/s} = \frac{1.01 \text{m}^3/\text{s}}{\frac{\pi \cdot \left((5\text{m})^2 - (2.44\text{m})^2\right)}{\log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), e\right)}}$$

16) Coefficient of Permeability given Discharge in Unconfined Aquifer with Base 10

Open Calculator

fx $$K_{WH} = \frac{Q}{\frac{1.36 \cdot \left(b_w^2 - h_{well}^2\right)}{\log\left(\left(\frac{R_w}{r}\right), 10\right)}}$$

ex $$12.46691 \text{cm/s} = \frac{1.01 \text{m}^3/\text{s}}{\frac{1.36 \cdot \left((14.15\text{m})^2 - (10.000\text{m})^2\right)}{\log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), 10\right)}}$$

17) Coefficient of Permeability given Discharge of Two Wells under Consideration

Open Calculator

fx $$K_{WH} = \frac{Q}{\frac{\pi \cdot \left(h_2^2 - h_1^2\right)}{\log\left(\left(\frac{r_2}{r1''}\right), e\right)}}$$

ex $$10.76102 \text{cm/s} = \frac{1.01 \text{m}^3/\text{s}}{\frac{\pi \cdot \left((17.8644\text{m})^2 - (17.85\text{m})^2\right)}{\log\left(\left(\frac{10.0\text{m}}{0.03\text{m}}\right), e\right)}}$$

18) Coefficient of Permeability given Flow Velocity

Open Calculator

fx $$K'' = \left(\frac{V_{fwh}}{i_e} \right)$$

ex $$6.584362\text{cm/s} = \left(\frac{1.12\text{m/s}}{17.01} \right)$$

19) Coefficient of Permeability given Radius of Influence

Open Calculator

fx $$K_{soil} = \left(\frac{R_w}{3000 \cdot s_t} \right)^2$$

ex $$0.001193\text{cm/s} = \left(\frac{8.6\text{m}}{3000 \cdot 0.83\text{m}} \right)^2$$

20) Coefficient of Permeability given Rate of Flow

Open Calculator

fx $$k' = \left(\frac{Q}{i_e \cdot A_{xsec}} \right)$$

ex $$927.7631\text{cm/s} = \left(\frac{1.01\text{m}^3\text{/s}}{17.01 \cdot 6400\text{mm}^2} \right)$$

Depth of Water in Well

21) Depth of Water at Point 1 given Discharge from Two Wells with Base 10

Open Calculator

$$h_1 = \sqrt{h_2^2 - \frac{Q \cdot \log\left(\left(\frac{r_2}{r_1}\right), 10\right)}{1.36 \cdot K_{WH}}}$$

$$17.64895\text{m} = \sqrt{(17.8644\text{m})^2 - \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{10.0\text{m}}{1.07\text{m}}\right), 10\right)}{1.36 \cdot 10.00\text{cm}/\text{s}}}$$

22) Depth of Water at Point 1 given Discharge of Two Wells under Consideration

Open Calculator

$$h_1 = \sqrt{h_2^2 - \frac{Q \cdot \log\left(\left(\frac{r_2}{r_1}\right), e\right)}{\pi \cdot K_{WH}}}$$

$$17.82409\text{m} = \sqrt{(17.8644\text{m})^2 - \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{10.0\text{m}}{1.07\text{m}}\right), e\right)}{\pi \cdot 10.00\text{cm}/\text{s}}}$$

23) Depth of Water at Point 2 given Discharge from Two Wells with Base 10

Open Calculator

$$h_2 = \sqrt{h_1^2 + \frac{Q \cdot \log\left(\left(\frac{r_2}{r_1}\right), 10\right)}{1.36 \cdot K_{WH}}}$$

$$18.06305\text{m} = \sqrt{(17.85\text{m})^2 + \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{10.0\text{m}}{1.07\text{m}}\right), 10\right)}{1.36 \cdot 10.00\text{cm}/\text{s}}}$$

24) Depth of Water at Point 2 given Discharge of Two Wells under Consideration

Open Calculator

fx $$h_2 = \sqrt{h_1^2 + \frac{Q \cdot \log\left(\left(\frac{r_2}{r_1}\right), e\right)}{\pi \cdot K_{WH}}}$$

ex $$17.89025\text{m} = \sqrt{(17.85\text{m})^2 + \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{10.0\text{m}}{1.07\text{m}}\right), e\right)}{\pi \cdot 10.00\text{cm}/\text{s}}}$$

25) Depth of Water in Well given Discharge in Unconfined Aquifer

Open Calculator

fx $$h'' = \sqrt{H^2 - \frac{Q \cdot \log\left(\left(\frac{R_w}{r}\right), e\right)}{\pi \cdot K_{WH}}}$$

ex $$1.2285\text{m} = \sqrt{(5\text{m})^2 - \frac{1.01\text{m}^3/\text{s} \cdot \log\left(\left(\frac{8.6\text{m}}{7.5\text{m}}\right), e\right)}{\pi \cdot 10.00\text{cm}/\text{s}}}$$

26) Depth of Water in Well given Drawdown Value measured at Well

Open Calculator

fx $$h_{d'} = H - s_t$$

ex $$4.17\text{m} = 5\text{m} - 0.83\text{m}$$

27) Drawdown at Well given Radius of Influence

Open Calculator

fx $$s_t = \frac{R_w}{3000 \cdot \sqrt{K_{dw}}}$$

ex $$0.90652\text{m} = \frac{8.6\text{m}}{3000 \cdot \sqrt{0.00001\text{cm/s}}}$$

Flow Velocity

28) Flow Velocity given Coefficient of Permeability

Open Calculator

fx $$V_{fwh} = (K_{WH} \cdot i_e)$$

ex $$1.701\text{m/s} = (10.00\text{cm/s} \cdot 17.01)$$

29) Flow Velocity given Rate of Flow

Open Calculator

fx $$V_{wh'} = \left(\frac{V_{uaq}}{A_{xsec}}\right)$$

ex $$25\text{m/s} = \left(\frac{0.16\text{m}^3\text{/s}}{6400\text{mm}^2}\right)$$

30) Flow Velocity when Reynold's Number is Unity

Open Calculator

fx $$V_f = \left(\frac{\mu_{viscosity}}{\rho \cdot D_p}\right)$$

ex $$0.003665\text{m/s} = \left(\frac{0.19\text{P}}{997\text{kg/m}^3 \cdot 0.0052\text{m}}\right)$$

31) Hydraulic Gradient given Flow Velocity

Open Calculator

fx $$i = \left(\frac{V_{wh'}}{K_w} \right)$$

ex $$2.144 = \left(\frac{24.12\text{m/s}}{1125\text{cm/s}} \right)$$

32) Hydraulic Gradient given Rate of Flow

Open Calculator

fx $$i = \left(\frac{V_{uaq}}{K_w \cdot A_{xsec}} \right)$$

ex $$2.222222 = \left(\frac{0.16\text{m}^3/\text{s}}{1125\text{cm/s} \cdot 6400\text{mm}^2} \right)$$

Radial Distance and Radius of well

33) Diameter or Particle Size when Reynold's Number is Unity

Open Calculator

fx $$D = \left(\frac{\mu_{viscosity}}{\rho \cdot V_f} \right)$$

ex $$0.019057\text{m} = \left(\frac{0.19\text{P}}{997\text{kg/m}^3 \cdot 0.01\text{m/s}} \right)$$

34) Dynamic Viscosity when Reynold's Number is Unity

Open Calculator

fx $$\mu_{viscosity} = \rho \cdot V_f \cdot D$$

ex $$0.1994\text{P} = 997\text{kg/m}^3 \cdot 0.01\text{m/s} \cdot 0.02\text{m}$$

35) Mass Density when Reynold's Number is Unity

Open Calculator

$$\rho = \frac{\mu_{viscosity}}{V_f \cdot D}$$

$$950\text{kg/m}^3 = \frac{0.19\text{P}}{0.01\text{m/s} \cdot 0.02\text{m}}$$

36) Radial Distance of Well 1 based on Discharge from Two Wells with Base 10

Open Calculator

$$R_1 = \frac{r_2}{10^{\frac{1.36 \cdot K_{soil} \cdot \left(h_2^2 - h_1^2\right)}{Q}}}$$

$$9.999841\text{m} = \frac{10.0\text{m}}{10^{\frac{1.36 \cdot 0.001\text{cm/s} \cdot \left((17.8644\text{m})^2 - (17.85\text{m})^2\right)}{1.01\text{m}^3/\text{s}}}}$$

37) Radial Distance of Well 1 based on Discharge of Two Wells under Consideration

Open Calculator

$$R_1 = \frac{r_2}{\exp\left(\frac{\pi \cdot K_{soil} \cdot \left(h_2^2 - h_1^2\right)}{Q}\right)}$$

$$9.99984\text{m} = \frac{10.0\text{m}}{\exp\left(\frac{\pi \cdot 0.001\text{cm/s} \cdot \left((17.8644\text{m})^2 - (17.85\text{m})^2\right)}{1.01\text{m}^3/\text{s}}\right)}$$

38) Radial Distance of Well 2 based on Discharge from Two Wells with Base 10

Open Calculator

fx $$R_2 = r_1 \cdot 10^{\frac{1.36 \cdot K_{soil} \cdot \left(h_2^2 - h_1^2\right)}{Q}}$$

ex $$1.070017\text{m} = 1.07\text{m} \cdot 10^{\frac{1.36 \cdot 0.001\text{cm/s} \cdot \left((17.8644\text{m})^2 - (17.85\text{m})^2\right)}{1.01\text{m}^3/\text{s}}}$$

39) Radial Distance of Well 2 based on Discharge of Two Wells under Consideration

Open Calculator

fx $$R_2 = r_1 \cdot \exp\left(\frac{\pi \cdot K_{soil} \cdot \left(h_2^2 - h_1^2\right)}{Q}\right)$$

ex $$1.070017\text{m} = 1.07\text{m} \cdot \exp\left(\frac{\pi \cdot 0.001\text{cm/s} \cdot \left((17.8644\text{m})^2 - (17.85\text{m})^2\right)}{1.01\text{m}^3/\text{s}}\right)$$

40) Radius of Well based on Discharge in Unconfined Aquifer

Open Calculator

fx $$r_w = \frac{R_w}{\exp\left(\frac{\pi \cdot K_{soil} \cdot \left(H_i^2 - h_w^2\right)}{Q}\right)}$$

ex $$8.599947\text{m} = \frac{8.6\text{m}}{\exp\left(\frac{\pi \cdot 0.001\text{cm/s} \cdot \left((2.48\text{m})^2 - (2.44\text{m})^2\right)}{1.01\text{m}^3/\text{s}}\right)}$$

41) Radius of Well based on Discharge in Unconfined Aquifer with Base 10

Open Calculator

fx $$r_w = \frac{R_w}{10^{\frac{1.36 \cdot K_{soil} \cdot \left(H_i^2 - h_w^2\right)}{Q}}}$$

ex $$8.599948\text{m} = \frac{8.6\text{m}}{10^{\frac{1.36 \cdot 0.001\text{cm/s} \cdot \left((2.48\text{m})^2 - (2.44\text{m})^2\right)}{1.01\text{m}^3/\text{s}}}}$$

42) Radius of Well given Discharge and Length of Strainer

Open Calculator

fx $$r_w = \frac{R_w}{10^{\frac{2.72 \cdot K_{soil} \cdot s_t \cdot \left(L + \left(\frac{s_t}{2}\right)\right)}{Q}}}$$

ex $$8.598931\text{m} = \frac{8.6\text{m}}{10^{\frac{2.72 \cdot 0.001\text{cm/s} \cdot 0.83\text{m} \cdot \left(2\text{m} + \left(\frac{0.83\text{m}}{2}\right)\right)}{1.01\text{m}^3/\text{s}}}}$$

Variables Used

- **A_{sec}** Area of Cross Section *(Square Millimeter)*
- **A_{xsec}** Area of Cross Section in Enviro. Engin. *(Square Millimeter)*
- **b** Thickness of Aquifer *(Meter)*
- **b_w** Aquifer Thickness *(Meter)*
- **D** Diameter for Unconfined Aquifer *(Meter)*
- **D_p** Diameter of Particle *(Meter)*
- **h''** Depth of Water in Well given Discharge *(Meter)*
- **H** Thickness of Unconfined Aquifer *(Meter)*
- **h_1** Depth of Water 1 *(Meter)*
- **h_2** Depth of Water 2 *(Meter)*
- **$h_{d'}$** Depth of Water in Well given Drawdown *(Meter)*
- **H_i** Initial Aquifer Thickness *(Meter)*
- **h_w** Depth of Water *(Meter)*
- **h_{well}** Depth of Water in Well *(Meter)*
- **i** Hydraulic Gradient
- **i_e** Hydraulic Gradient in Envi. Engi.
- **k'** Coefficient of Permeability given Rate of Flow *(Centimeter per Second)*
- **K''** Coefficient of Permeability given Flow Velocity *(Centimeter per Second)*
- **K_{dw}** Coefficient of Permeability at Drawdown *(Centimeter per Second)*
- **K_s** Standard Coefficient of Permeability at 20°C
- **K_{soil}** Coefficient of Permeability of Soil Particle *(Centimeter per Second)*
- **K_w** Coefficient of Permeability *(Centimeter per Second)*

- K_{WH} Coefficient of Permeability in Well Hydraulics *(Centimeter per Second)*
- L Length of Strainer *(Meter)*
- l_{st} Strainer Length *(Meter)*
- Q Discharge *(Cubic Meter per Second)*
- r Radius of Well *(Meter)*
- r_1 Radial Distance at Observation Well 1 *(Meter)*
- R_1 Radial Distance 1 *(Meter)*
- r_2 Radial Distance at Observation Well 2 *(Meter)*
- R_2 Radial Distance at Well 2 *(Meter)*
- r_w Radius of Well given Discharge *(Meter)*
- R_w Radius of Influence *(Meter)*
- r'' Radius of Well in Well Hydraulics *(Meter)*
- $r1'$ Radial Distance at Well 1 *(Meter)*
- $r1''$ Observation Well 1 Radial Distance *(Meter)*
- s_t Total Drawdown *(Meter)*
- S_{tw} Total Drawdown in Well *(Meter)*
- V_{aq} Rate of Flow in Aquifer *(Cubic Meter per Second)*
- V_f Flow Velocity for Unconfined Aquifer *(Meter per Second)*
- V_{fwh} Flow Velocity *(Meter per Second)*
- V_{uaq} Rate of Flow in Unconfined Aquifer *(Cubic Meter per Second)*
- $V_{wh'}$ Velocity of Flow *(Meter per Second)*
- $\mu_{viscosity}$ Dynamic Viscosity for Aquifer *(Poise)*
- ρ Mass Density *(Kilogram per Cubic Meter)*

Constants, Functions, Measurements used

- Constant: **pi**, 3.14159265358979323846264338327950288
  Archimedes' constant
- Constant: **e**, 2.71828182845904523536028747135266249
  Napier's constant
- Function: **exp**, exp(Number)
  n an exponential function, the value of the function changes by a constant factor for every unit change in the independent variable.
- Function: **log**, log(Base, Number)
  Logarithmic function is an inverse function to exponentiation.
- Function: **sqrt**, sqrt(Number)
  A square root function is a function that takes a non-negative number as an input and returns the square root of the given input number.
- Measurement: **Length** in Meter (m)
  Length Unit Conversion
- Measurement: **Area** in Square Millimeter (mm^2)
  Area Unit Conversion
- Measurement: **Speed** in Centimeter per Second (cm/s), Meter per Second (m/s)
  Speed Unit Conversion
- Measurement: **Volumetric Flow Rate** in Cubic Meter per Second (m^3/s)
  Volumetric Flow Rate Unit Conversion
- Measurement: **Dynamic Viscosity** in Poise (P)
  Dynamic Viscosity Unit Conversion
- Measurement: **Mass Concentration** in Kilogram per Cubic Meter (kg/m^3)
  Mass Concentration Unit Conversion

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