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M.Tech. (Civil Engg.)   (Sem.–3)

GROUND WATER AND CONTAMINATION HYDROLOGY
Subject Code : MTCE -217
M.Code : 74766

Time : 3 Hrs.   Max. Marks : 100

INSTRUCTIONS TO CANDIDATES :
1.   **Attempt any FIVE questions out of EIGHT questions.**
2.   **Each question carries TWENTY marks.**
3.   **Use of Non-Programmable Scientific Calculator is allowed.**

1. The following field notes were taken at a nest of piezometers installed side by side at a single site :

Piezometer	a	b	c
Elevation at surface (m.a.s.l.)	450	450	450
Depth of piezometer (m)	150	100	50
Depth of water (m)	27	47	36

Let A, B and C refer to the points of measurement of piezometers a, b and c. Calculate :

a) The hydraulic head at A, B and C (m).

b) The pressure head at A, B and C (m).

c) The elevation head at A, B and C (m).

d) The fluid pressure at B (N/m^2).

2. a) Groundwater at 5°C has a pH of 7.1. Is the water acidic or alkaline?

b) Does precipitation of calcite in zones below the water table (i.e., closed-system conditions) cause the pH of the water to rise or fall? Explain.

3. Two piezometers, 500 m apart, bottom at debits of 100m and 120m in an unconfined aquifer. The elevation of the water level is 170m above the horizontal impermeable, basal boundary in the shallow piezometer and 150m in the deeper piezometer. Utilize the dupuit-Forchheimer assumptions to calculate the height of the water table midway between the piezometers, and to calculate the quantity of seepage throught a 10-m section in which $K = 10^{-3}$ m/s.

4. Water with a dissolved oxygen concentration of 4 mg /ell moves below the water table into geologic materials that contain 0.5%, by weight pyrite (FeS_2). In this zone the dissolved oxygen is consumed by oxidation of pyrite. Estimate the pH of the water after the oxidation has occurred. The initial pH of the water is 7.9. Assume that the water reacts with no other solid phases and that the groundwater zone is at 10°C.

5. A fully penetrating well pumps water from an infinite, horizontal, confined, homogeneous, isotropic aquifer at a constant rate of 25 l/s. If T is 1.2×10^{-2} m^2/s and S is 2.0×10^{-4}, make the following calculations :

   a) Calculate the drawdown that would occur in an observation well 60 m from the pumping well at times of 1, 5, 10, 50 and 210 min after the start of pumping. Plot these values on a log-log graph of h_0 – h *versus* t.

   b) Calculate the drawdown that would occur in a set of observation wells at distances 1 m, 3 m, 15 m, 60 m, and 300 m from the pumping well at a time 210 min after the start of pumping. Plot these values on a semilog graph of h_0 – h *versus* r.

6. A chemical analysis of groundwater yields the following results (mg/) ; K^+ = 3, Na+ = 110, Ca^{2+} = 80, Mg^{2+} = 55, HCO_3 = 420, Cl$^-$ = 220, SO_4^{2-} = 35, N =15, Fe(total) = 0.8, Mn(total) = 0.2, F^- = 0.6, As = 0.03, Pb = 0.08, B = 0.9. Comment on the suitability of this water for H following uses :

   a. Municipal water supply.

   b. Irrigation of vegetable crops.

   c. Livestock.

   d. Brewing of beer.

7. A ground water basin has a surface area of 125 km^2 The following long term annual averages has been measured

   Precipitation 60.6 cm

   Evaporation 46.3 cm

   Overland flow 3.4 cm

   Base flow 10.6 cm

   There is no stream flow into the basin and no ground water flow either into or out of the basin.

   a) Prepare an annual water budget for the system.

   b) What is the annual runoff from the basin expressed in centimeter?

8. Discuss mechanical dispersion and hydrodynamic dispersion of ground water in detail.

NOTE : Disclosure of Identity by writing Mobile No. or Making of passing request on any page of Answer Sheet will lead to UMC against the Student.