國立成功大學

115學年度碩士班招生考試試題

編　號：100

系　所：環境工程學系

科　目：衛生工程

日　期：0203

節　次：第 1 節

注　意：1.可使用計算機
2.請於答案卷(卡)作答，於試題上作答，不予計分。

1. If a well of radius $r_w = 0.2$ m produces water at a rate $Q = 1500$ m^3/day from a confined aquifer with a coefficient of transmissivity $T = 600$ m^2/day and a storage coefficient $S = 0.0004$, determine the drawdown after 1 year of pumping at a radius of 1 km. (15%)

   Well function

u	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0
$\times 1$	0.219	0.049	0.013	0.0038	0.0011	0.00036	0.000038	0.000012	0.000012
$\times 10^{-1}$	1.82	1.22	0.91	0.7	0.56	0.45	0.37	0.31	0.26
$\times 10^{-2}$	4.04	3.35	2.96	2.68	2.47	2.3	2.15	2.03	1.92
$\times 10^{-3}$	6.33	5.64	5.23	4.95	4.73	4.54	4.39	4.26	4.14
$\times 10^{-4}$	8.63	7.94	7.53	7.25	7.02	6.84	6.69	6.55	6.44
$\times 10^{-5}$	10.94	10.24	9.84	9.55	9.33	9.14	8.99	8.86	8.74
$\times 10^{-6}$	13.24	12.55	12.14	11.85	11.63	11.45	11.29	11.16	11.04
$\times 10^{-7}$	15.54	14.85	14.44	14.15	13.93	13.75	13.6	13.46	13.34
$\times 10^{-8}$	17.84	17.15	16.74	16.46	16.23	16.05	15.9	15.76	15.65
$\times 10^{-9}$	20.15	19.45	19.05	18.76	18.54	18.35	18.2	18.07	17.95
$\times 10^{-10}$	22.45	21.76	21.35	21.06	20.84	20.66	20.5	20.37	20.25
$\times 10^{-11}$	24.75	24.06	23.65	23.36	23.14	22.96	22.81	22.67	22.55
$\times 10^{-12}$	27.05	26.36	25.96	25.67	25.44	25.26	25.11	24.97	24.86
$\times 10^{-13}$	29.36	28.66	28.26	27.97	27.75	27.56	27.41	27.28	27.16
$\times 10^{-14}$	31.66	30.97	30.56	30.27	30.05	29.87	29.71	29.58	29.46
$\times 10^{-15}$	33.96	33.27	32.86	32.58	32.35	32.17	32.02	31.88	31.76

2. DLVO theory describes the inter-particle forces of colloidal particles. Please draw the interaction energy of respective forces (label each force) and the total energy as a function of particle distance when two particles approach each other for UNFAVORABLE aggregation. (10%)

3. Given the following average hourly demand rates in gallons per minute, find the uniform 24-h pumping rate and the required storage. (15%)

Time	1am	2am	3am	4am	5am	6am	7am	8am	9am	10am	11am	noon
Demand rates (gallon/min)	1900	1800	1795	1700	1800	1910	3200	5000	5650	6000	6210	6300

Time	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	midnight
Demand rates (gallon/min)	6500	6460	6430	6500	6700	7119	9000	8690	5220	2200	2100	2000

4. A flow of 1.5 m^3/s is divided into three parallel pipes of diameters 25 cm, 35 cm, and 50 cm and lengths of 50 m, 30 m, and 40 m, respectively. Find the head loss and distribution of flow. Assume $f = 0.015$. (15%)

5. In coagulation, alum [$Al_2(SO_4)_3 \cdot 14.3\ H_2O$] reacts with natural alkalinity or can be reacted with soda ash (Na_2CO_3), so that the floc properly forms. Assuming that the water lacks natural alkalinity, calculate the soda ash concentration (in mg/L) that is required to react with 1.0 mg/L alum. (15%) Al: 27 g/mole, S: 32 g/mole, Na: 23 g/mole.

6. Calculate the initial head loss for a 0.61 m-deep bed of the filter sand at a filtration rate of 2 L/m$^2 \cdot$s using a grain sphericity of 0.8 and porosity of 0.4. The size analysis of the sand is shown in the table below. Kinematic viscosity of water is 1.306×10^{-6} m^2/s. (20%)

   Hint: $\frac{h}{L} = \frac{36k\nu}{g} \frac{(1-\varepsilon)^2 V}{\varepsilon^3 \psi^2} \sum_{i=1}^{n} \frac{Pi}{d_i^2}$

Distribution	d_{100}	d_{90}	d_{70}	d_{50}	d_{30}	d_{10}	d_0
Size (mm)	1	0.87	0.8	0.73	0.66	0.54	0.48

7. Assume that a 4-log removal of pathogens in raw water requires a $c \cdot t$ value of 6 mg/L$\cdot$min, try to determine the size of the disinfection chamber, given the residual chlorine level of 0.6 mg/L and a flow rate of 2 m^3/min. (10%)