

CE 421/521 Environmental Biotechnology - Sample Exam 2

Name: _____

Directions: Circle the letter corresponding to the best answer for the following questions (2 points each).

- When the spread of disease is across continents, it is called
 - epidemic
 - endemic
 - histemic
 - pandemic
- In reference to public health microbiology, MID refers to the
 - most immunodeficient disease
 - maximum ingestive disease
 - minimum infective dose
 - mild ingestive disorder
- Bacterial content of fecal matter is approximately;
 - 0.09%
 - 0.9%
 - 9%
 - 90%
- Yersinia* are bacteria that
 - are thermophilic
 - have snails as intermediate hosts
 - are well correlated with indicator organisms
 - cause liver damage
 - swine act as major reservoirs
 - all of the above
- The infective dose for *Giardia* and *Cryptosporidium* is typically
 - one organism
 - 1-10
 - greater than 10^1 but fewer than 10^2
 - greater than 10^2 but fewer than 10^4
- The helminth that affects nearly 200 million people worldwide, has part of its life cycle in snails, burrows through the skin, matures in the liver, and is excreted in urine is:
 - Ascaris*
 - Dracunculiasis*
 - Guinea Worm
 - Schistosoma*
- The physician typically credited with the discovery of the epidemiological evidence that cholera was spread through contaminated drinking water was
 - John Snow
 - Antonie van Leewenhoek
 - Louis Pasteur
 - C. Everett Coop

8. Conventional water treatment plants typically have poor removal of
 - a. radium
 - b. arsenic
 - c. pharmaceuticals and endocrine disruptors
 - d. all of the above

9. The bacteria involved in biological phosphorus removal and biological nitrogen removal often compete for:
 - a. available electron acceptor
 - b. available electron donor
 - c. available nutrients
 - d. all of the above

10. Disinfection causes inactivation of pathogens by:
 - a. destruction of cellular components
 - b. interference with energy yielding metabolism
 - c. interference with biosynthesis and growth
 - d. all of the above

11. Which of the following would not typically be found in water treatment plant filters?
 - a. sand with a uniformity coefficient of 1.2
 - b. gravel
 - c. vermiculite
 - d. anthracite coal
 - e. none of the above

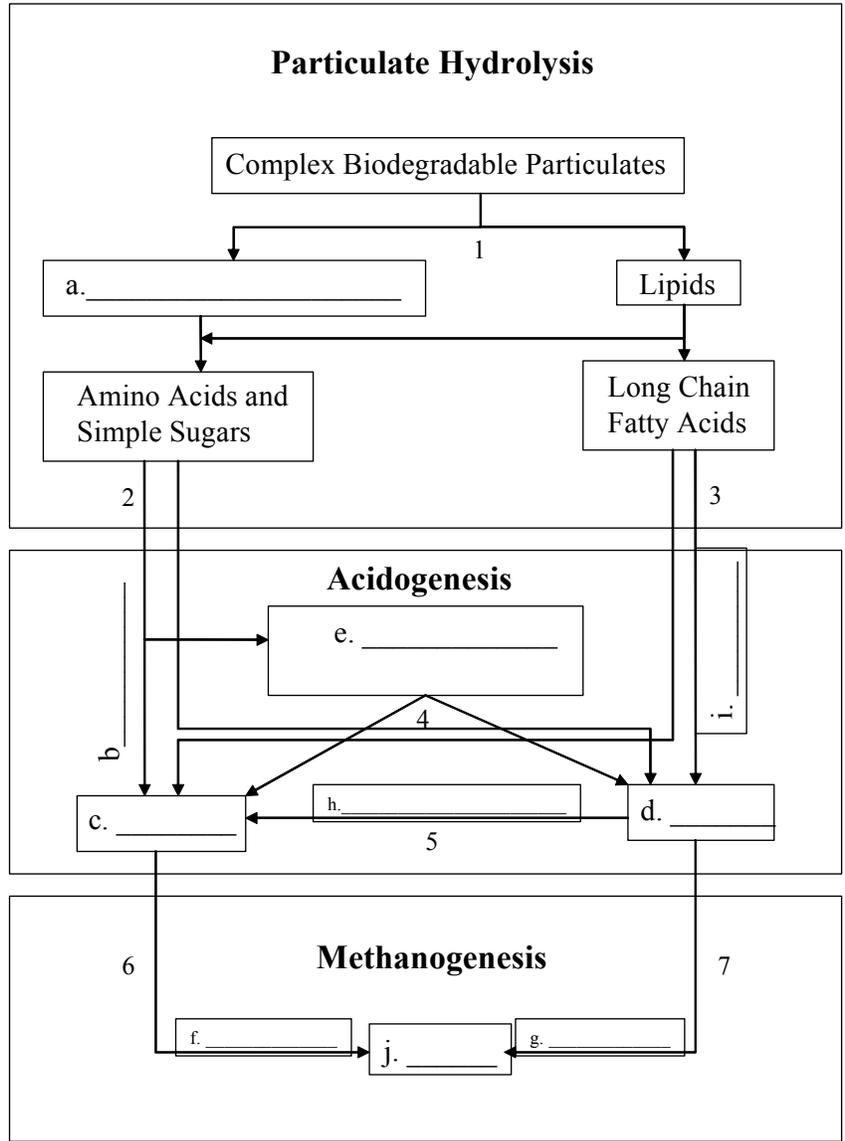
12. A treatment system consisting of rotating plastic media, with substantial biofilm attachment, partially submerged in a basin containing wastewater is termed a:
 - a. trickling filter
 - b. rotating biological contactor
 - c. vertical loop reactor
 - d. fluidized bed reactor

13. A large basin with a surface aerator followed by a clarifier for solids settling with a long SRT would be an example of a:
 - a. extended aeration activated sludge
 - b. facultative lagoon
 - c. anaerobic lagoon
 - d. trickling filter

14. Which of the following sludge treatment processes does not result in significant reduction in the volume of sludge to be subsequently handled:
 - a. thickening
 - b. digestion
 - c. conditioning
 - d. dewatering

15. If the ratio of fecal coliform/fecal strep in an environmental sample is 0.7, it is an indication that the contamination originated from
- human origin
 - animal origin
 - mixture of human and animal origin
 - not possible to tell if human or animal origin
16. Desirable sites for biocides to attack include all but which of the following:
- cytoplasmic membrane
 - nucleic acids
 - flagella
 - structural proteins
17. Turbidity affects disinfection by
- shielding pathogens
 - increasing the osmotic pressure of a solution
 - increasing the conductivity of a water sample
 - all of the above
18. The strength of disinfectants generally ranges as follows:
- ozone < chlorine dioxide < chlorine < chloramines
 - ozone > chlorine dioxide > chloramines > chlorine
 - ozone > chlorine dioxide > chlorine > chloramines
 - chlorine dioxide > ozone > chlorine > chloramines
19. During activated sludge treatment, theory suggests that the primary parameter controlling biological treatment performance is
- solids retention time
 - hydraulic retention time
 - clarifier surface area
 - recycle rate
 - none of the above
20. Fixed film processes have an advantage over suspended growth processes in that they have
- higher biomass concentrations
 - longer solids retention times
 - can handle variable loading
 - lower sludge production
 - all of the above

II. Short answer



List the letter from the diagram above that corresponds best to the following (2 points each):

- | | |
|--------------------------------------|---|
| _____ aceticlastic methanogens | _____ volatile acids (propionic, butyric, etc.) |
| _____ proteins and carbohydrates | _____ hydrogen oxidizing acetogens |
| _____ hydrogen | _____ fermentation |
| _____ methane | _____ acetic acid |
| _____ hydrogen oxidizing methanogens | _____ anaerobic oxidation |

III. Short answer

A. (20 points) Use the following arrangement of tanks to provide the treatment objectives indicated. For each of the arrangements provide:

- a. the official name of the process,
 - b. what the major reactions are,
 - c. whether the basin is aerated,
 - d. what the recycle and recirculation streams are
1. two basin system for phosphorus removal
 2. two basin system for nitrogen removal
 3. five basin system for combined nitrogen and phosphorus removal
 4. three basin system for combined nitrogen and phosphorus removal

B. (10 points) What volume storage tank would be required to achieve 3 log inactivation of giardia cysts for a water treatment facility operating at 6 mgd (million gallons per day)? Assume a free chlorine residual concentration of 1.1 mg/L, pH = 8.5, and temperature = 10°C. Use the attached Table for your calculation.

TABLE 3-20
CT values (in mg/L · min) for inactivation of *Giardia* cysts by free chlorine at 10°C

Chlorine concentration mg/L	pH = 6.0						pH = 7.0						pH = 8.0						pH = 9.0					
	Log inactivations						Log inactivations						Log inactivations						Log inactivations					
	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0	0.5	1.0	1.5	2.0	2.5	3.0
≤0.4	11	23	34	46	57	69	18	33	33	70	82	105	25	51	76	101	126	152	35	70	105	140	175	210
0.6	12	25	37	49	62	74	19	38	56	75	94	113	27	54	81	109	136	163	38	75	113	150	188	225
0.8	13	26	39	52	65	78	20	40	59	79	99	119	29	57	86	114	143	171	40	79	119	153	198	237
1.0	13	27	40	54	67	81	21	41	62	82	103	123	30	59	89	119	149	178	41	82	123	164	205	247
1.2	14	28	42	56	69	83	21	42	64	85	106	127	31	61	93	126	161	194	42	85	127	170	212	255
1.4	14	29	43	57	71	86	22	44	65	87	109	131	32	63	95	126	158	189	44	87	131	174	218	262
1.6	15	29	44	58	73	88	22	45	67	89	112	134	32	65	97	129	161	194	45	89	134	179	223	268
1.8	15	30	45	60	75	90	23	46	68	91	114	137	33	66	99	132	165	198	46	91	137	182	228	273
2.0	15	30	46	61	76	91	23	46	70	93	116	139	34	67	101	134	168	201	46	93	139	186	232	278
2.2	15	31	46	62	77	93	24	47	71	95	118	142	34	68	102	137	171	205	47	94	142	189	236	283
2.4	16	31	47	63	79	94	24	48	72	96	120	144	35	69	104	139	173	208	47	94	142	189	236	283
2.6	16	32	48	64	80	96	24	49	73	97	122	146	35	70	105	141	176	211	49	97	146	194	243	292
2.8	16	32	48	65	81	97	25	49	74	99	123	148	36	71	107	142	178	214	49	98	148	197	246	295
3.0	16	33	49	65	82	98	25	50	75	100	125	150	36	72	108	144	180	216	50	100	150	199	249	299

Source: U.S. Environmental Protection Agency, *Guidance Manual for Compliance with Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*, Criteria and Standards Division, Office of Drinking Water (U.S.E.P.A. NTIS Publication No. PB 90-148016), Washington, DC: U.S. Government Printing Office, October, 1979.

C. (10 points) Calculate the MPN/100 mL for the following:

	1.0 mL	0.1 mL	0.01 mL	0.001 mL	0.0001	MPN
a	4/5	2/5	0/5	1/5		
b	5/5	4/5	3/5	1/5	0/5	
c	5/5	5/5	2/5	0/5	0/5	

D MOST PROBABLE NUMBER OF COLIFORMS PER 100 mL OF SAMPLE

Number of positive tubes																							
10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN
0	0	0		1	0	0	2.0	2	0	0	4.5	3	0	0	7.8	4	0	0	13	5	0	0	23
0	0	1	1.8	1	0	1	4.0	2	0	1	6.8	3	0	1	11	4	0	1	17	5	0	1	31
0	0	2	3.6	1	0	2	6.0	2	0	2	9.1	3	0	2	13	4	0	2	21	5	0	2	43
0	0	3	5.4	1	0	3	8.0	2	0	3	12	3	0	3	16	4	0	3	25	5	0	3	58
0	0	4	7.2	1	0	4	10	2	0	4	14	3	0	4	20	4	0	4	30	5	0	4	76
0	0	5	9.0	1	0	5	12	2	0	5	16	3	0	5	23	4	0	5	36	5	0	5	95
0	1	0	1.8	1	1	0	4.0	2	1	0	6.8	3	1	0	11	4	1	0	17	5	1	0	33
0	1	1	3.6	1	1	1	6.1	2	1	1	9.2	3	1	1	14	4	1	1	21	5	1	1	46
0	1	2	5.5	1	1	2	8.1	2	1	2	12	3	1	2	17	4	1	2	26	5	1	2	64
0	1	3	7.3	1	1	3	10	2	1	3	14	3	1	3	20	4	1	3	31	5	1	3	84
0	1	4	9.1	1	1	4	12	2	1	4	17	3	1	4	23	4	1	4	36	5	1	4	110
0	1	5	11	1	1	5	14	2	1	5	19	3	1	5	27	4	1	5	42	5	1	5	130
0	2	0	3.7	1	2	0	6.1	2	2	0	9.3	3	2	0	14	4	2	0	22	5	2	0	49
0	2	1	5.5	1	2	1	8.2	2	2	1	12	3	2	1	17	4	2	1	26	5	2	1	70
0	2	2	7.4	1	2	2	10	2	2	2	14	3	2	2	20	4	2	2	32	5	2	2	95
0	2	3	9.2	1	2	3	12	2	2	3	17	3	2	3	24	4	2	3	38	5	2	3	120
0	2	4	11	1	2	4	15	2	2	4	19	3	2	4	27	4	2	4	44	5	2	4	150
0	2	5	13	1	2	5	17	2	2	5	22	3	2	5	31	4	2	5	50	5	2	5	180

nued)

APPENDIX D (Continued)

Number of positive tubes																							
10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN	10 mL	1 mL	0.1 mL	MPN
0	3	0	5.6	1	3	0	8.3	2	3	0	12	3	3	0	17	4	3	0	27	5	3	0	79
0	3	1	7.4	1	3	1	10	2	3	1	14	3	3	1	21	4	3	1	33	5	3	1	110
0	3	2	9.3	1	3	2	13	2	3	2	17	3	3	2	24	4	3	2	39	5	3	2	140
0	3	3	11	1	3	3	15	2	3	3	20	3	3	3	28	4	3	3	45	5	3	3	180
0	3	4	13	1	3	4	17	2	3	4	22	3	3	4	31	4	3	4	52	5	3	4	210
0	3	5	15	1	3	5	19	2	3	5	25	3	3	5	35	4	3	5	59	5	3	5	250
0	4	0	7.5	1	4	0	11	2	4	0	15	3	4	0	21	4	4	0	34	5	4	0	130
0	4	1	9.4	1	4	1	13	2	4	1	17	3	4	1	24	4	4	1	40	5	4	1	170
0	4	2	11	1	4	2	15	2	4	2	20	3	4	2	28	4	4	2	47	5	4	2	220
0	4	3	13	1	4	3	17	2	4	3	23	3	4	3	32	4	4	3	54	5	4	3	280
0	4	4	15	1	4	4	19	2	4	4	25	3	4	4	36	4	4	4	62	5	4	4	350
0	4	5	17	1	4	5	22	2	4	5	28	3	4	5	40	4	4	5	69	5	4	5	430
0	5	0	9.4	1	5	0	13	2	5	0	17	3	5	0	25	4	5	0	41	5	5	0	240
0	5	1	11	1	5	1	15	2	5	1	20	3	5	1	29	4	5	1	48	5	5	1	350
0	5	2	13	1	5	2	17	2	5	2	23	3	5	2	32	4	5	2	56	5	5	2	540
0	5	3	15	1	5	3	19	2	5	3	26	3	5	3	37	4	5	3	64	5	5	3	920
0	5	4	17	1	5	4	22	2	5	4	29	3	5	4	41	4	5	4	72	5	5	4	1600
0	5	5	19	1	5	5	24	2	5	5	32	3	5	5	45	4	5	5	81				