

八十四學年度 生物醫學研究所 組碩士班研究生入學考試

科目 微生物學 科號 1105 共 三 頁第 一 頁 *請在試卷【答案卷】內作答

There are two sets of questions in this test. The questions in set A are 10 points each and those in set B are 15 points each. Select and answer four questions from each set.

Set A (10 points each)

1. You are asked to isolate from a water sample, taken from a pond, a fungus, a protozoan, and an algae and to identify each organism isolated.
 - a. List the steps you would take to isolate each type of microorganism.
 - b. What characteristics would you use to identify the fungus, the protozoan, and the algae?
2. Describe how you would isolate a mutant that required tryptophan for growth and was resistant to penicillin.
3. Discuss the major ecological and medical contributions of the genus *Streptomyces*.
4. Describe briefly the Gram-stain procedure and its outcome. What features of the microorganisms might account for the differences seen in the bacteria? Draw a graph to illustrate the structures of Gram-positive and Gram-negative bacterial cell walls.
5. If you wanted to isolate from nature a microorganism with the following set of characteristics, identify what natural environment you might choose to sample and what cultural conditions you would use.
 - (a) A thermophilic acidophile; (b) An anaerobic psychrophile
 - (c) A halophilic thermophile; (d) An obligately barophilic psychrophile.

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Set B (15 points each)

6. In certain fields in the midwestern United States in which herbicides have been used for the last 6 years to control weeds in soy beans, it was found that the usually dosage of the herbicides had a greatly reduced effect last summer and this summer did not control the weeds at all.

(a) Can you offer two possible hypotheses to explain this observation?

(b) How would you test each hypothesis?

7. I have given you an unknown organism isolated from yoghurt that degrades glucose anaerobically to organic molecules. You have available the following tools:

---a culture chamber capable of growing the organism anaerobically;

---a spectrophotometer;

---an HPLC and the proper column for identifying and quantitating organic acids and alcohols.

---radiolabelled [1-¹⁴C]-, [6-¹⁴C]-glucose;

---a scintillation counter to detect radioactivity of organic compounds (or CO₂ trapped by hyamine hydroxide);

---chemicals for carrying out enzymatic analyses for all glycolytic-related enzymes.

How would you identify the glycolytic pathway used by this organism? What are all of the possibilities that you might expect to find? What would you look for?

8. Suppose you were given a mixture of the following organisms: *Bacillus cereus*, *Mycoplasma pneumonia*, *Nitrosomonas europea*, *Sulfolobus acidocaldarius*, and *Xanthomonas campestris*. What general types of treatments, cultural conditions, or media could you use that would allow you to grow each organism from this mixture without growing any of the other organisms?

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9. Name the pathway that *E. coli* would use for the complete catabolism of the following molecules under the described conditions. Where appropriate, describe briefly the operation or inoperation of key enzymes.

- (a) Glucose; aerobic conditions; phosphate-limited chemostat;
- (b) Acetate; aerobic conditions; (c) Gluconic acid (gluconate); aerobic conditions; (d) Ribose; aerobic conditions; no apparent limitations; (e) Glucose; anaerobic conditions; phosphate limited; 50% of D- and L-lactate formed.

10. Suppose that you have the following two strains of *E. coli*: (1) an Hfr strain that is susceptible to streptomycin and has genes *leu*⁺, *lac*⁺ and *gal*⁺ and (2) an F⁻ strain that is resistant to streptomycin and has the allelic genes *leu*⁻, *lac*⁻, and *gal*⁻. Describe an experiment that would enable you to determine the location of *leu*, *lac*, and *gal* on *E. coli* chromosome.