※ 考生請注意：本試題不可使用計算機。　請於答案卷(卡)作答，於本試題紙上作答者，不予計分。

1. Please define the terminology below and their possible relationships.

    (a) *Nitrosomonas* and *Nitrobacter* (6 %)

    (b) Co-metabolism and Methane Monooxygenase (6 %)

    (c) Polymerase Chain Reaction and Agarose Gel Electrophoresis (6 %)

    (d) Acetogenesis and Methanogenesis (6 %)

    (e) NADH and Aerobic Respiration (6 %)

2. A microbial ecologist wants to know the distribution of Anammox bacteria, *Brocadia* in the wastewater treatment plant. This question can be addressed by using several molecular tools, such as FISH, DGGE, and quantitative PCR.

    (a) What is FISH? How does it work? (3%+5%)

    (b) What is DGGE? How does it work? (3%+5%)

    (c) Please show the microbial ecologist how to use these methods to address the question? (10%).

3. Please describe how to use the streak plate technique and the serial dilution method to obtain a pure bacterial culture for degrading benzene pollutant from soil (10 %), and (b) how do you justify the "purity" of the culture (10 %).

4. In 1977, Carl Woese and Fox George proposed a "Three Domains of Life" concept, that is *Bacteria*, *Archaea* and *Eucarya*, for grouping the living cellular organisms on Earth based on the sequences of small subunit ribosomal RNA (SSU rRNA) gene. This revolutionary concept together with advance of molecular biological tools has brought about a paradigm shift in microbiology and microbial ecology. Please compare the cellular characteristics among microorganisms within *Bacteria*, *Archaea* and *Eucarya* in terms of

    (a) SSU rRNA size (6%),

    (b) plasma membrane lipids (9%),

    (c) presence/absence of peptidoglycan in cell walls (3%), and

    (d) presence/absence of endoplasmic reticulum (3%).

    (e) chloroplast and mitochondria are the energy-conserving organelles of the eukaryotic cell, and have their own ribosomes, different from the eukaryotic ones . What are the sizes of SSU rRNA in these organelles? (3%)