

※ 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. Gut microbiota have been attracting increased attention in many fields of medicine recently. Could you describe some advanced methods which can characterize the gut microbiota? (5%) Could you provide one example for the beneficial of gut microbiota in disease? (5%)
2. 2016's Nobel Laureate discovered and elucidated mechanisms underlying autophagy, a fundamental process for degrading and recycling cellular components. Could you briefly describe the autophagy process? (5%) and it's application in human diseases? (5%)
3. Activation of the inflammasome is a key function mediated by the innate immune system. Could you explain the detail mechanism of the inflammasome activation? (5%)
4. Define "next generation sequencing". State the differences between "next generation sequencing" and "Sanger sequencing" in terms of the experimental principles and procedures. Also, state the advantages of "next generation sequencing" over "Sanger sequencing" in the disease diagnosis and therapies. (10%)

5. **Read carefully the following story and answer the following questions: (15%)**

About 100 families worldwide have the Li-Fraumeni family cancer syndrome. Affected people inherit a germline mutation in an autosomal gene called p53. Cancer develops when the second p53 gene is mutated in somatic tissue. The p53 protein normally functions as a tumor suppressor. In one Li-Fraumeni family, 25-year-old Clint has bone cancer. He had two sisters. One, Martha, died of breast cancer when her son David was 8 years old. Clint's other sister, Tina, died of osteosarcoma at age 19. A brother, Nelson, is healthy. Their father died at age 27, also of bone cancer. Geneticists sequenced Clint's p53 gene and found an insertion of one extra cytosine in a stretch of four cytosines. The result is a p53 protein shortened by 212 amino acids. Clint's young daughter Jill and nephew David, who are healthy, are tested for the mutation. They both have it. Nelson is tested and does not have it.

**Questions:**

- (1) What is the gene function (the involved cellular mechanism) of the p53 tumor suppressor?
  - (2) How can the mutation in this family, involving only one DNA base, cause such a drastic change in the encoded protein?
  - (3) What must happen for Jill or David to develop cancer?
6. Please draw the structure of amino acid and describe its general properties (5%)
  7. Please draw the structure of immunoglobulin G (IgG) and describe its general properties (10%)
  8. Please explain the principle and procedure to perform western blot analysis and its application in clinical diagnosis (10%)
  9. Please describe the application of proteomic techniques in biomedical research (12%)
  10. What is "precision medicine"? (5%) Please describe an example regarding laboratory testing in association with "precision medicine". (8%)