

系所組別： 分子醫學研究所

考試科目： 生命科學

考試日期：0307 · 節次：3

※ 考生請注意：本試題  可  不可 使用計算機**Part 1**1. Here is an article recently published in *Science* journal.

Therapeutic Silencing of MicroRNA-122 in Primates with Chronic Hepatitis C Virus Infection (327, 198, 2010)

The liver-expressed microRNA-122 (miR-122) is essential for hepatitis C virus (HCV) RNA accumulation in cultured liver cells, but its potential as a target for antiviral intervention has not been assessed. We found that treatment of chronically infected chimpanzees with a locked nucleic acid (LNA)-modified oligonucleotide (SPC3649) complementary to miR-122 leads to long-lasting suppression of HCV viremia, with no evidence of viral resistance or side effects in the treated animals. Furthermore, transcriptome and histological analyses of liver biopsies demonstrated derepression of target mRNAs with miR-122 seed sites, down-regulation of interferon-regulated genes, and improvement of HCV-induced liver pathology. The prolonged virological response to SPC3649 treatment without HCV rebound holds promise of a new antiviral therapy with a high barrier to resistance.

Based on the provided knowledge, describe an experiment of your own in the following manner:

- 1) Title
- 2) Background and Significance
- 3) Experimental Design and Predicted Results
- 4) Scientific Impact of the Experiment

(15%)

2. Shown in the graph is a simplified tumor necrosis factor (TNF) pathway. Describe:

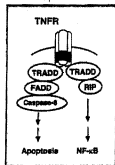
- a) The physiological significance of the pathway (5%).
- b) How the cell decides to survive or undergo apoptosis in response to TNF. (5%)
- c) How protein/protein interactions were determined in the pathway? (5%)

TNFR: TNF receptor

TRADD: TNF receptor-associated death domain

FADD: Fas-associated death domain

RIP: receptor interacting protein



(背面仍有題目,請繼續作答)

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3. What is the definition of stem cells? What is cancer stem cell? Why is the study of cancer stem cell important in cancer biology? 問答題 (10 分)

4. Dominant negative mutants of both Ras and Raf block growth factor-stimulated cell proliferation. The inhibitory effects of dominant negative Ras are overcome by expression of activated Raf. Would you expect activated Ras similarly to overcome the inhibitory of dominant negative Raf? How about activated MEK will overcome the inhibitory of dominant negative Raf? Please briefly give an interpretation for each? (8 points)

5. Consider a mammalian cell that divides every 30 hours. Microscopic observation indicates that 3.3% of the cells are in mitosis at any given time. Analysis in the flow cytometer establishes that 53.3% of the cells have DNA contents of  $2n$ , 16.7% have DNA content of  $4n$ , and 30% have DNA contents ranging between  $2n$  and  $4n$ . What are the approximate lengths of the G1, S, G2, and M phases of the cycle of these cells, respectively? (8 points)

6. Which aspect of cell division would be affected by colchicines: chromosome segregation, cytokinesis, or both? Please briefly explain your choice. (4 points)

### Part 2 : Multiple choice questions: (5 points each)

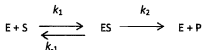
1) Which of the following parts of the IgG molecule are *not* involved in binding to an antigen?

- A. Fab
- B. Fc
- C. Heavy chain
- D. Light chain
- E. Variable domain

2) Which of the following generalizations concerning motor proteins is correct?

- A. They convert chemical energy into kinetic energy.
- B. They convert chemical energy into potential energy.
- C. They convert kinetic energy into chemical energy.
- D. They convert kinetic energy into rotational energy.
- E. They convert potential energy into chemical energy.

3) Michaelis and Menten assumed that the overall reaction for an enzyme-catalyzed reaction could be written as:



E, enzyme; S, substrate and P, product

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Using this reaction, the rate of breakdown of the enzyme-substrate complex can be described by the expression:

- A.  $k_1 ([E_{\text{total}}] - [ES])$ .
- B.  $k_1 ([E_{\text{total}}] - [ES])[S]$ .
- C.  $k_2 [ES]$ .
- D.  $k_{-1} [ES] + k_2 [ES]$ .
- E.  $k_{-1} [ES]$ .

4) Which one of the following statements about eukaryotic gene regulation is correct?

- A. Large polycistronic transcripts are common.
- B. Most regulation is positive, involving activators rather than repressors.
- C. Transcription and translation are mechanistically coupled.
- D. Transcription does not involve promoters.
- E. Transcription occurs without major changes in chromosomal organization.

5) Which one of the following statements about the reverse transcriptases of retroviruses and the RNA replicases of other single-stranded RNA viruses, such as R17 and influenza virus, is correct?

- A. Both enzymes can synthesize either RNA or DNA from an RNA template strand.
- B. Both enzymes can utilize DNA in addition to RNA as a template strand.
- C. Both enzymes carry the specificity for the RNA of their own virus.
- D. Both enzymes have error rates similar to those of cellular RNA polymerases.
- E. Both enzymes require host-encoded subunits for their replication function.

6) Ubiquitin-mediated protein degradation is a complex process, and many of the signals remain unknown. One known signal involves recognition of amino acids in a processed protein that are either stabilizing (Ala, Gly, Met, Ser, etc.) or destabilizing (Arg, Asp, Leu, Lys, Phe, etc.), and are located at:

- A. a helix-turn-helix motif in the protein.
- B. a lysine-containing target sequence in the protein.
- C. a zinc finger structure in the protein.
- D. the amino-terminus of the protein.
- E. the carboxy-terminus of the protein.

(背面仍有題目,請繼續作答)

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**Part 3** 以下為五題單選題，每題 2 分

- The human has 23 pairs of chromosomes. Which one is the largest?
  - Chromosome 1
  - Chromosome X
  - Chromosome 9
  - Chromosome 22
  - Chromosome 23
- How many protein-coding genes are present in the human genome?
  - About 1,800 to 2,600
  - About 5,000 to 8,000
  - About 18,000 to 26,000
  - About 50,000 to 80,000
  - Around 300,000
- The human dystrophin is encoded by a very large gene (*DMD*). Actually it is the second largest gene in human genome. What is the size of the *DMD* gene?
  - About 2.22 Mb
  - About 222 Kb
  - About 22.2 Kb
  - About 2.22 Kb
- The human mitochondrion contains
  - multiple linear chromosomes.
  - a single linear chromosome.
  - multiple circular chromosomes.
  - a single circular chromosome.
- How many protein-coding genes are present in the human mitochondria?
  - 73
  - 37
  - 13
  - 3
- You will be a scientist in life science soon. How do you judge the quality of a published article? (5% bonus!)
  - The article is good because it is published in Science, Nature, or top journals.
  - The article is good because it is published in journals, which have high impact factors.
  - The article is good because it has an outstanding, solid quality.Choose one and explain why?  
(This is an optional question. If you answer, you will have a bonus score up to 5%)