

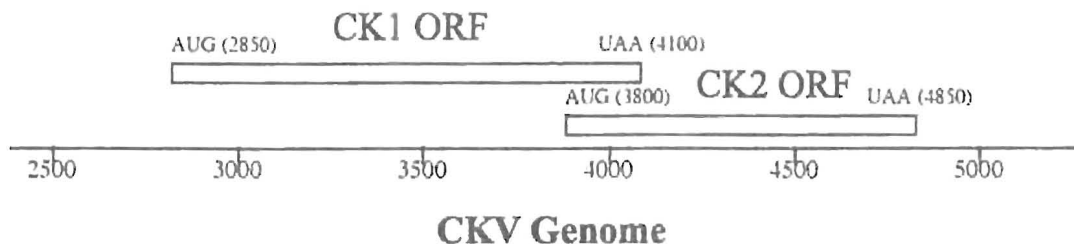
系所組別： □腔醫學研究所甲組

考試科目： 分子生物學

考試日期： 0220 · 節次： 3

※ 考生請注意：本試題 可 不可 使用計算機**Molecular Biology Quiz for admission of NCKU Institute of Oral Medicine**I. Answer the following questions: (total 40 points, select any 5 questions to answer)

You are studying a new class of oncolytic virus that infects and kills cancerous cells that you call CKV (for Cancer Killer Virus). Using a tissue culture model for infection, you identify two proteins (CK1 and CK2) that are strongly-expressed after the virus infected target cancer cells. Suspecting these proteins are responsible for cell killing, you purify both proteins, obtain partial protein sequence, and mapped the coding sequences to two ORFs in the viral genome. Upon further investigation, you find that the CK1 ORF overlaps (but is in a different reading frame) with the CK2 ORF (see diagram below).



(a) You decide that either there must be a RNA Pol II promoter in the CK1 ORF to drive transcription of the CK2 mRNA or the two proteins are being expressed from the same mRNA. Propose an experiment that could distinguish between these two possibilities. You have access to any radiolabeled DNA that you need. (There are more than one answer, describe one of your thought) (8 points)

(b) Suppose your findings indicate that both proteins are expressed from the same mRNA. You decide that there must be an unusual method of translational initiation occurring to drive CK2 translation. You wonder if any ORF downstream of CK1 would be expressed. To test this you insert the LacZ gene at various positions in the mRNA and assay for LacZ activity and DW2 expression. You observe the following results:

(背面仍有題目,請繼續作答)

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<u>Site of LacZ Insertion*</u>	<u>LacZ Activity</u>	<u>CK2 Expression**</u>
3001	-	+++
3500	-	+++
3601	-	+++
3700	-	+++
3751	+++	-
3850	-	-

* LacZ insertions are not in the same reading frame as CK1 or CK2.

** Only full length DW2 protein is measured.

Based on these observations what can you conclude about the number of ORFs that can be expressed from this mRNA? What restrictions are there on the location of the internally expressed ORF? (8 points)

(c) You wonder whether the ability to initiate translation internally is intrinsic to the mRNA or if it requires other viral proteins. Propose an experiment to distinguish between these two possibilities. You have the ability to transform the cancer cells with any portion of the viral genome. Describe the results you would expect for each possibility. (8 points)

(d) You find that at least one viral gene is required for CK2 protein synthesis. After mutating each ORF in the viral genome you find one protein (that you call CK3) that is required for CK2 synthesis. Interestingly, CK3 has a clear RNA binding motif and you find that it binds to a 18 base hairpin sequence located at position 3710 in the viral genome. You wonder whether CK3 might directly recruit the eukaryotic small ribosomal subunit to the mRNA. Propose an experiment to test this possibility. (8 points)

(e) You find no evidence that CK3 binds to pure 40S ribosomal subunits. In contrast, you find that if you perform the same experiment using ribosomes in a crude translation extract, you observe a clear association between CK3 and the 40S subunit. Given your knowledge of the events of eukaryotic translation initiation, why does it make sense that the purified 40S subunit is unable to associate with CK3. (8 points)

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(f) To try and narrow down the mechanism of translation initiation for CK2, you ask whether other translation initiation factors are required for CK2 protein synthesis. You are surprised to find that both CK1 and CK2 translation absolutely require eIF4F function. Propose a model for CK3 function that can explain the requirement of eIF4F to initiate CK2 translation. Describe a simple experimental test of your model. (8 points)

II. Chose the best answer of the following questions: (2 points each, total 60 points)

1. A mamalian cell typically has 1.2 meters (when completely outstretched) of double stranded DNA. The total time to duplicate the DNA is 5 hours. How many origins of replication are there if the rate of duplication is $16\mu\text{meters}/\text{min}$?

- a 250
- b 15000
- c 1
- d 500

2. In the DNA Double Helix, complementary base pairs are held together by :

- a N-glycosidic bonds
- b hydrogen bonds
- c ionic bonds
- d peptide bonds

3. A base sequence that is part of the DNA of an organism and appears to have once coded a gene product, such as a protein or transcription factor but no longer does so is called :

- a A pseudogene
- b A selfish gene
- c A jumping gene
- d An Oncogene

(背面仍有題目,請繼續作答)

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4. A DNA strand has the sequence A-C-A-G-C-C-G-T-A. What would be its complementary strand ?

- a A-C-A-G-C-C-G-T-A
- b U-G-U-C-G-G-C-A-U
- c G-T-G-A-T-T-A-C-G
- d T-G-T-C-G-G-C-A-T

5. Proteins that bind between the promotor region and the section of the gene which is transcribed thus blocking transcription (preventing gene expression) are called :

- a Repressors
- b Activators
- c inducer
- d Operator

6. If the mammalian genetic code were a four letter code, then it would have the potential to encode...

- a 128 amino acids
- b 64 amino acids
- c 216 amino acids
- d 256 amino acids

7. The enzyme (made of proteins and RNA) that elongates chromosomes by adding TTAGGG sequences to the end of existing chromosomes is :

- a Exonuclease
- b Endonuclease
- c Telomerase
- d Amylase

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8. The unit within the nucleus that contains a protein complex (located at the center of the unit) of two H2A, H2B, H3 and H4 histone proteins with DNA wrapped around the complex in two turns, each turn consisting of about 80 base pairs is called a :
- a nucleosome
 - b ribosome
 - c centrosome
 - d histosome
9. The enzyme responsible for initiating the unwinding of double-stranded DNA (eliminating supercoiling) by nicking a single strand of the DNA molecule is :
- a Gyrase
 - b Ligase
 - c. Topoisomerase
 - d Helicase
10. A major difference between DNA replication in prokaryotes and eukaryotes is :
- a there is only one replication origin in prokaryotes.
 - b DNA amylase performs the function of DNA helicase in prokaryotes
 - c replication is conservative in prokaryotes
 - d prokaryotes do not use Topoisomerase in the replication process
11. A repeating DNA sequence at the end of chromosomes that prevents them from losing base pair sequences at their ends and from fusing together is called :
- a A Telomerase
 - b A Telomere
 - c A replicon
 - d None of the above.
12. An enzyme (used by all retroviruses) that transcribes genetic information of the virus from RNA into DNA, is :
- a Reverse transcriptase
 - b RNA polymerase
 - c Restriction nuclease
 - d Methylase

(背面仍有題目,請繼續作答)

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13. In DNA, mutations at G-C sequences occur quite frequently since 5-methyl cytosine easily deaminates to form :

- a Cytosine
- b Adenine
- c Guanine
- d Thymine

14. The sequence of bases located prior to the gene (along the DNA strand), to which a complex of RNA polymerase and sigma factors attaches itself to initiate transcription is called :

- a promotor
- b terminator
- c exon
- d telomere

15. Genes that are expressed at all times and under all conditions of growth are called :

- a regulatable genes
- b antibody genes
- c chimeric genes
- d constitutive genes

16. Sections of DNA within a gene that do not encode part of the protein that the gene produces are called :

- a Exons
- b Transposons
- c Introns
- d Intein

17. An RNA molecule that can catalyze either its own cleavage (self-splicing) or the cleavage of other RNA molecules is :

- a An inducer
- b A ribozyme
- c A spliceosome
- d A chaperone enzyme.

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18. Due to the presence of Introns and Exons, in Eukaryotes the splicing process of pre-mRNA can lead to different ripe mRNA molecules and therefore to different proteins. This phenomenon is called :

- a gene splicing
- b exonic splicing
- c intronic splicing
- d alternative splicing

19. A guanine triphosphate nucleotide that binds to the 5' end of the mRNA thus increasing the stability of the synthesized RNA and enhancing translation efficiency is called a :

- a poly-A-tail
- b Cap
- c leader
- d trailer

20. The series of three consecutive mRNA bases coding for one specific amino acid in a protein is called a :

- a codon
- b intron
- c exon
- d transposon

21. A series of 20 to 200 Adenine ribonucleotides that is added to the 3' end of the transcribed RNA molecule (pre-mRNA) that helps in the transportation of mRNA out of the nucleus is called :

- a trailer
- b cap
- c a Shine-Dalgarno sequence
- d the poly-A-tail

(背面仍有題目,請繼續作答)

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22. A RNA transcript (whose base sequence is complementary to that of the mRNA of a gene) that can inhibit the expression of a gene by forming a duplex with the mRNA strand is called :

- a antisense RNA
- b tRNA
- c dsRNA
- d Ribozyme

23. Prokaryotes use 70S ribosomes which consist of :

- a a (small) 30S and a (large) 50S subunit
- b a (small) 40S and a (large) 60S subunit
- c a (small) 40S and a (large) 30S subunit
- d a (small) 10S and a (large) 60S subunit

24. Infectious self-reproducing agents consisting only of protein, with no nucleic acids (hypothesized in 1982 by Nobel Laureate Stanley B. Prusiner) are called :

- a exteins
- b proteomes
- c proteinoids
- d Prions

25. Every polypeptide chain formed in translation starts with the amino acid :

- a methionine
- b lysine
- c serine
- d alanine

26. Some tRNAs can recognize more than one codon because there is a relaxation of the complementation rule of base pairing between the anticodon and codon in the third position (of the codon sequence). This relaxation is called :

- a the Wobble Hypothesis
- b Sutton-Boveri Hypothesis
- c the Levene's Hypothesis
- d the Monkey-Man Hypothesis

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27. Which of the following is not a stop codon ?

- a GUA
- b UAA
- c UAG
- d UGA

28. A sequence of about 5 to 20 bases separating one stop codon from the next start codon in a polycistronic prokaryotic mRNA molecule is called :

- a a poly-A-tail
- b a transposon
- c a spacer
- d a Shine Dalgarno sequence

29. The Quaternary structure of a protein is :

- a its structure resulting from interactions between amino acid side chains.
- b its structure resulting from the union of more than one protein molecule, called subunit proteins.
- c its structure resulting from hydrogen bonds between the C=O and N-H groups of different amino acids.
- d its amino acid sequence

30. How many amino acids are encoded by the following mRNA sequence :

UAUCAUCCACUUGGUUGA ?

- a 5
- b 6
- c 4
- d 7