國立清華大學 104 學年度碩士班考試入學試題

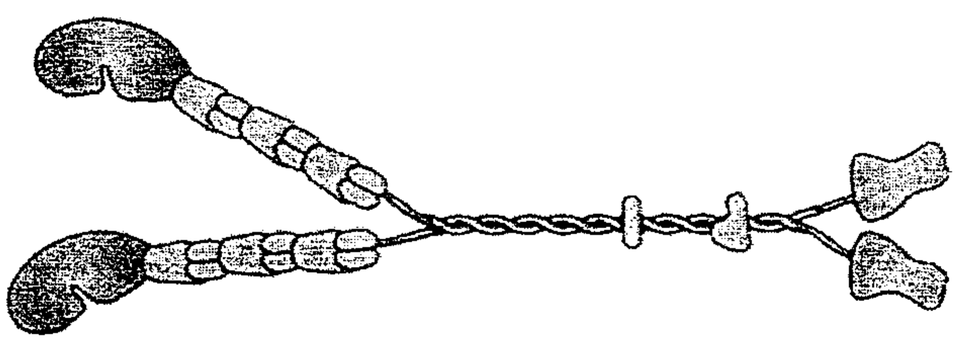
系所班組別：生命科學院甲組、醫學生物科技學程

考試科目（代碼）：生物學(0402、0702)

　　*請在【答案卡】作答

Part 1 **單選題（一題 2 分，請使用答案卡）**

1. Microtubules are composed of (A) globular monomers (B) globular dimers (C) homodimers (D) heterodimers (E) tetradimers
2. Microtubles are composed of _____ protofilaments. (A) 10 (B) 11 (C) 12 (D) 13 (E) 14
3. _____ is a drug that stabilizes microtubules. (A) Colchicine (B) Taxol (C) Nocodazole (D) Vinblastine (E) Phalloidin
4. What is the name of the following molecular motor? (A) Dynein (B) Myosin (C) Actinor (D) Microtubler (E) Kinesin



5. What is the smallest contractile unit of a muscle? (A) Muscle fiber (B) Myofiber (C) Sarcomere (D) Muscle cell (E) Thin filament
6. The protein _____ is important for cell-cell adhesion. (A) Intermediate filament (B) E-cadherin (C) Actin (D) Collagen (E) Lamin
7. The protein _____ is important for the extracellular matrix. (A) Fibronectin (B) P-Selectin (C) ICAM (D) Neurofilament (E) Myclosin
8. Desmosomes are critical for (A) electrical integration of cells (B) cell-matrix connection (C) an impermeable apical seal (D) exchange of small metabolites (E) cell-cell connection
9. In an optical microscope an objective lens has the function to (A) bundle the light from the light source (B) to filter out unspecific scattered light (C) to provide monochrome light (D) to bundle the light within the eyepiece (E) to focus the light that comes from the specimen
10. Atomic force microscope is an (A) optical microscope (B) needs an electron beam (C) has a fine needle that scans on top of a specimen (D) needs a specimen that is fixed with paraformaldehyde (E) needs a sample prepared with an ultra-microtome

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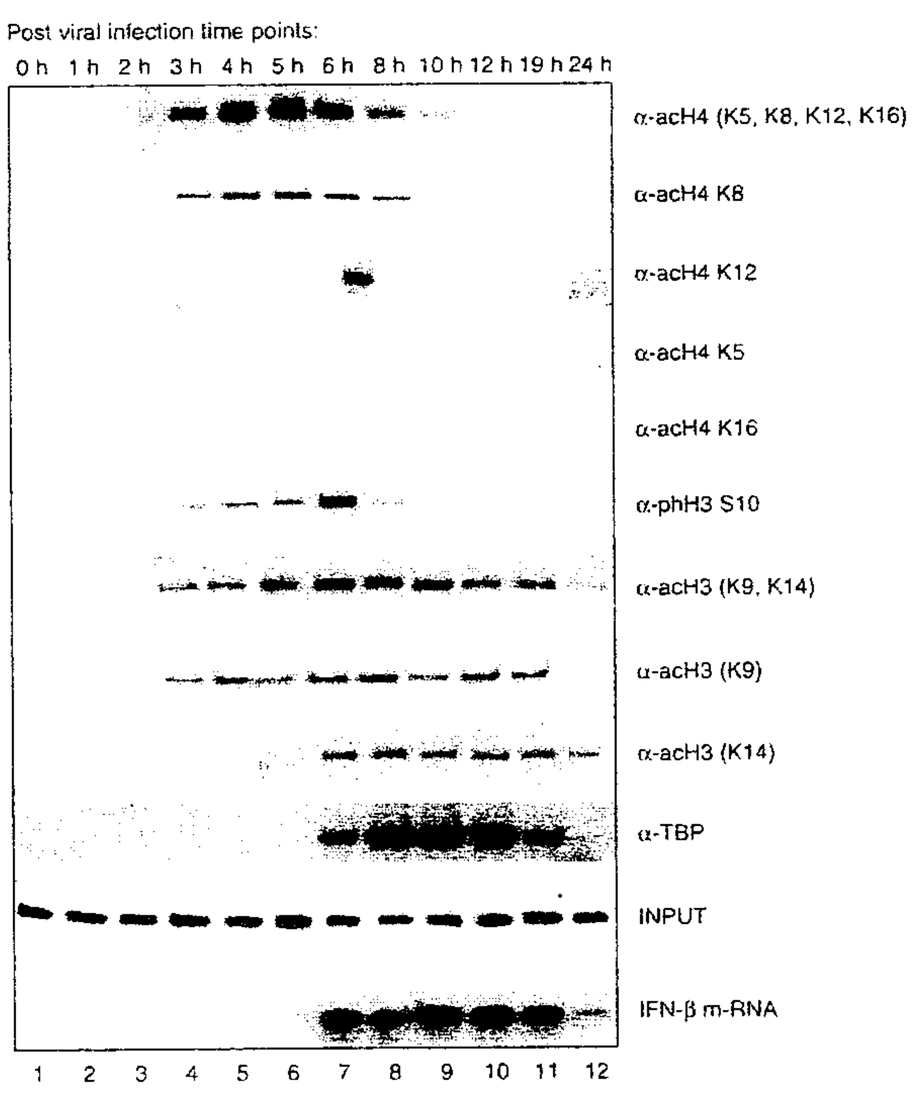
Part2 單選題（一題 2 分，請使用答案卷）

1. Which chromatin folding is **unlikely** to occur in the putative 30-nm chromatin fiber?
   (A) solenoid model
   (B) stem-loop model
   (C) Zig-Zag model
   (D) two-start double helical model

2. What is **NOT** a proposed role of Histone H1?
   (A) nucleosome stabilizer
   (B) inhibitor of transcription
   (C) a linker histone
   (D) a component of the core nucleosome

3. Chromatin Immunoprecipitation (ChIP) analysis shown below revealed the timing of histone acetylation in chromatin at INF-β promoter of HeLa cells after Sendai virus infection. Which hypothesis may **NOT** be true?
   (A) Phosphorylation of H3 histone S10 is necessary for lysine 14 acetylation.
   (B) Acetylation of lysine 8 of histone H4 promotes SWI/SNF complex binding to nucleosome.
   (C) Acetylation of lysine 14 of H3 is required to recruit TBP to INF-beta promoter.
   (D) Acetylation of lysine 16 of H4 is required for phosphorylation on S10 of histone H3.



4. What is the consensus sequence of mammalian pre-mRNA intron?
   (A) exon/**GU-intron-AG**/exon
   (B) exon/**UU-intron-GG**/exon
   (C) exon/**CA-intron-GG**/exon
   (D) exon/**GA-intron-AA**/exon

5. Which of the following enzymes is **NOT** involved in the process of vaccinia virus and reovirus mRNA cap synthesis?
   (A) Methyltransferase
   (B) RNA triphosphatase
   (C) Guanylyl transferase
   (D) RNA dependent protein kinase

6. Which eukaryotic molecule contains a poly(A) tail during their biogenesis?
   (A) 5S rRNA
   (B) tRNA
   (C) U6 snRNA
   (D) mRNA

7. Which of the following descriptions about polyadenylation signal in mammalian cells is true?
   (A) AAUAAA is the most frequent and active sequence.
   (B) Polyadenylation signal is followed 23-24 bp later by a UC-rich motif and then by a C-rich motif.
   (C) The cleavage/ polyadenylation site is within the polyadenylation signal sequence.
   (D) The cleavage/polyadenylation site is within the U-rich motif.

8. Which of the following RNA processing events does **NOT** take place while eukaryotic gene transcription is underway?
   (A) splicing
   (B) capping
   (C) polyadenylation
   (D) cytoplasmic transportation

Part3 簡答題（請使用答案卷）

9. Describe Drosha and Mirtron pathways for human miRNA biogenesis. (4%)
10. Slow infection (2%)
11. What is the source of the middle-east respiratory syndrome Coronavirus? (2%)
12. What are the cell sources of interferon-gamma? (2%)
13. Virus-like particle (2%)
14. Natural killer cells (2%)
15. Viroids (2%)
16. Describe the recombinant vaccine using in rabies (4%)
17. Describe the functions of neuraminidase in influenza virus (4%)
18. Explain the significance of Spemann's organizer in amphibian development. (5%)
19. What are EPSP and IPSP? Use them to explain summation of postsynaptic potentials. (5%)
20. Describe an experiment to demonstrate that a pair of suprachiasmatic nuclei (SCN) in the hypothalamus functions as a biological clock in mammals. (5%)
21. Based on energy transduced, sensory receptors fall into five categories. Which are these five receptor types? (5%)
22. What is imprinting? How to distinguish it from other types of learning? Give an example. (5%)
23. Based on the exponential and logistic models, please make 3 curves in a graph to illustrate the patterns of population growth (below) as a function of time (i.e., Y-axis: Population size (N), X-axis: Number of generations). Note that the carrying capacity (K) is 1,500 in this case. (5%)

$$\frac{dN}{dt} = 1.0N \qquad \frac{dN}{dt} = 0.5N \qquad \frac{dN}{dt} = 1.0N\left(\frac{1{,}500 - N}{1{,}500}\right)$$

24. What is K-selection? What is r-selection? What are their advantages? (5%)

25. Based on this table, briefly explain the experiment, and draw a conclusion. (5%)

Table 55.1 Nutrient Enrichment Experiment for Sargasso Sea Samples

Nutrients Added to Experimental Culture	Relative Uptake of ^{14}C by Cultures*
None (controls)	1.00
Nitrogen (N) + phosphorus (P) only	1.10
N + P + metals (excluding iron)	1.08
N + P + metals (including iron)	12.90
N + P + iron	12.00

*^{14}C uptake by cultures measures primary production.

Source: D. W. Menzel and J. H. Ryther, Nutrients limiting the production of phytoplankton in the Sargasso Sea, with special reference to iron, *Deep Sea Research* 7:276–281 (1961).