

系所組別： 生物資訊與訊息傳遞研究所乙組

考試科目： 普通生物學

考試日期： 0226，節次： 2

請勿在本試題紙上作答，否則不予計分

一、選擇題：每題 1.5 分，共計 48 分

1. How many different types of gametes could be produced by an individual of the *AaBBCcDDEe*?  
(a) 2. (b) 4. (c) 6. (d) 8. (e) 16.
2. An X-linked recessive gene produces red-green color blindness in humans. A woman with normal color vision whose father was color-blind marries a color-blind man. What is the probability that their son will be color-blind?  
(a) 0. (b) 1/4. (c) 1/2. (d) 3/4. (e) 1.
3. Why do erythrocytes swell and burst when placed in water?  
(a) Since water concentration is higher outside the cell, water moves inward by passive diffusion.  
(b) Since hemoglobin concentration is higher inside the cell, hemoglobin moves outward by exocytosis.  
(c) Since potassium ions are more concentrated inside the cells, potassium ions move outward by osmosis.  
(d) Erythrocytes pump water inward by active transport to balance osmotic gradients.  
(e) Water is a universal solvent and simply dissolves the erythrocyte membranes.
4. An infectious agent that appears to have no nucleic acid is a  
(a) Virus. (b) Viroid. (c) Bacteriophage. (d) Prion. (e) Bacterium.
5. Which of the following is NOT a correct statement about the process of meiosis?  
(a) Meiosis I separates chromosomes; meiosis II separates chromatids.  
(b) Synapsis and crossing-over occur during meiosis I.  
(c) Kinetochores are responsible for aligning chromatids during meiosis I.  
(d) Karyokinesis occurs before cytokinesis.  
(e) Segregation of unlinked alleles occurs during meiosis.
6. In organisms with closed circulatory systems, fluid leaves the blood of capillary networks at the arterial end and returns to blood at the venous end for which of the following reasons?  
(a) Osmotic pressure increases prior to dehydration.  
(b) Osmotic pressure difference dominates at the arterial end; hydrostatic pressure difference dominates at the venous end.  
(c) Hydrostatic pressure difference dominates at the arterial end; osmotic pressure difference dominates at the venous end.  
(d) Hydrostatic pressure drops during diastole.  
(e) Hydrostatic pressure difference dominates at both the arterial and the venous ends.

(背面仍有題目,請繼續作答)

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7. Which of the following mineral nutrients is directly involved in light absorption during photosynthesis?
- (a)  $Mn^{2+}$ . (b)  $Mg^{2+}$ . (c)  $Cu^{2+}$ . (d)  $Ca^{2+}$ . (e)  $Zn^{2+}$ .
8. Some chemoautotrophic bacteria living around deep-sea vents obtain their energy by converting
- (a) alcohols to aldehydes.  
(b) hydrogen sulfide to elemental sulfur.  
(c) carbon dioxide and hydrogen to methane.  
(d) iron oxides to iron.  
(e) nitrogen to ammonia.
9. Acid rain damage depends on the buffering capacity of the soils in a given region. Damage has been greatest where the soil layer is
- (a) thin and contains little calcium and magnesium.  
(b) thin and contains abundant calcium and magnesium.  
(c) thin and contains abundant calcium but little magnesium.  
(d) thick and contains abundant calcium and magnesium.  
(e) thick and contains little calcium and magnesium.
10. In the DNA sequence 5' CGA TCG GCT 3', which of the following is considered a transition type mutation?
- (a) 5' CGA CCG GCT 3'. (b) 5' CGA TCG CCU 3'. (c) 5' CGA TCG CCT 3'.  
(d) 5' CGA TCG GCA 3'. (e) 5' CGA TCG GT 3'.
11. Additions or deletions of bases in the nucleotide sequence of a structural gene most often result in
- (a) decreased histone binding.  
(b) insertion of a new intron into the coding sequence of the gene.  
(c) an altered sequence of amino acids in the protein that the gene encodes.  
(d) decreased excision repair.  
(e) increased levels of mRNA production.
12. Which of the following is LEAST likely to cause a proto-oncogene to become an oncogene?
- (a) A gene is incorporated into a retroviral genome.  
(b) A gene is expressed at an inappropriate time.  
(c) A gene is moved close to an enhancer, causing excess product to be made.  
(d) A gene is truncated, yielding a protein with modified activity.  
(e) A gene is moved into centromeric heterochromatin, silencing its transcription.

13. Which of the following pathways is most likely taken by newly synthesized histones?

- (a) Rough endoplasmic reticulum → Golgi complex → secretory vesicle.
- (b) Rough endoplasmic reticulum → Golgi complex → nucleus.
- (c) Rough endoplasmic reticulum → smooth endoplasmic reticulum → nucleus.
- (d) Cytoplasm → nucleus.
- (e) Cytoplasm → rough endoplasmic reticulum → Golgi complex → nucleus.

14. Which of the following is true of the polymerase chain reaction?

- (a) It involves the addition of a poly-A sequence to mRNA.
- (b) It cuts DNA into numerous small fragments for analysis.
- (c) It enables a small amount of DNA to be amplified.
- (d) It separates DNA fragments according to size.
- (e) It requires RNA in order to proceed.

15. Separation of molecules according to size can be achieved by which of the following?

- (a) Affinity chromatography.
- (b) Ion-exchange chromatography.
- (c) X-ray diffraction.
- (d) Isoelectric focusing.
- (e) Gel-filtration chromatography.

16. Humoral immunity is characterized by all of the following EXCEPT

- (a) a memory response.
- (b) antigen-antibody interaction.
- (c) the synthesis of immunoglobulins.
- (d) the production of cytotoxic T cells.
- (e) the production of plasma cells.

17. The physiological role of restriction endonucleases is to

- (a) methylate host DNA.
- (b) allow the in vitro construction of recombinant.
- (c) remove RNA primer during DNA synthesis.
- (d) cleave foreign DNA molecules that enter the cell.
- (e) allow mapping of gene location.

18. Which one does NOT belong to second messenger?

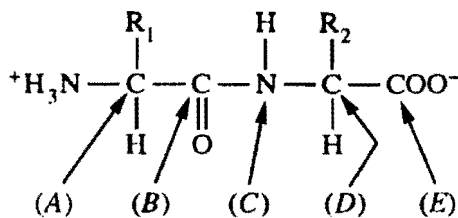
- (a) Nitric oxide. (b) cAMP. (c) diacylglycerol. (d) Epinephrine. (e)  $Ca^{2+}$ .

19. Which one is NOT a part of RNA interference?

- (a) siRNA. (b) miRNA. (c) snRNA. (d) Dicer. (e) shRNA.

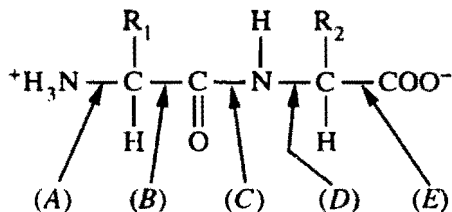
20. A protease is an enzyme that hydrolyzes the peptide bonds in the protein. The mechanism used to cleave a peptide bond involves making a nucleophile to attack the electrophilic carbon of the peptide bond. In the dipeptide shown below, which electrophilic carbon would be attacked by the nucleophile?

- (a) A. (b) B. (c) C. (d) D. (e) E.



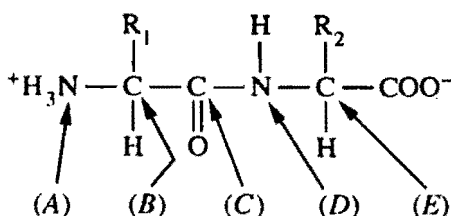
21. Following the previous question, which bond in the dipeptide shown below would be hydrolyzed by the protease?

- (a) A. (b) B. (c) C. (d) D. (e) E.



22. The Edman degradation is a very important reaction for protein sequencing. The Edman reagent, Phenylisothiocyanate (PITC), is used in the reaction. However, some post-translational modifications in eukaryotes would prevent the peptide from the Edman degradation. In the dipeptide shown below, which atom could be modified by such modifications?

- (a) A. (b) B. (c) C. (d) D. (e) E.



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23. Which one does NOT belong to post-translational modification?  
(a) Myristoylation. (b) Glycosylation. (c) Phosphorylation. (d) Ubiquitination. (e) DNA methylation.
24. Which one does NOT contain RNA?  
(a) Ribosome. (b) Riboswitch. (c) Retrovirus. (d) Viroid. (e) Ribonuclease.
25. For protein expression in *E. coli*, Isopropyl- $\beta$ -D-thio-galactoside (IPTG) is frequently used as an inducer of the lac operon because IPTG binds to:  
(a) beta-galactosidase. (b) RNA polymerase. (c) the operator. (d) the repressor. (e) ribosome.
26. Which one is NOT commonly used reporter gene system that is often used as an indication of whether a certain gene has been expressed in the cell?  
(a) Green fluorescent protein. (b) Luciferase. (c) beta-glucuronidase. (d) beta-lactamase. (e) beta-galactosidase.
27. The cDNA fragment that includes the IKK kinase gene is 2.4 kilobases. If the entire fragment codes for the kinase protein, the approximate molecular weight of the kinase would be  
(a) 88 kDa. (b) 44 kDa. (c) 24 kDa. (d) 0.8 kDa. (e) 800 kDa.
28. Which one is non-infectious disease?  
(a) AIDS. (b) Tuberculosis. (c) Pneumonia. (d) Carcinoma. (e) Hepatitis B.
29. Which one does NOT have the adaptive immune system?  
(a) *Drosophila*. (b) Zebra fish. (c) Guinea pig. (d) Chimpanzee. (e) Pigeon.
30. Cloned cDNA of human IKK kinase mRNA can direct the synthesis of a complete and correct polypeptide in *E. coli*, whereas the corresponding cloned chromosomal gene cannot because  
(a) *E. coli* lacks the polymerase to transcribe the sequence.  
(b) *E. coli* lacks the tRNA for translation.  
(c) *E. coli* lacks the ribosome for translation.  
(d) *E. coli* lacks the enzyme for splicing.  
(e) *E. coli* lacks the enzyme for detoxification.

(背面仍有題目,請繼續作答)

31. The rate at which a linear DNA fragment moves in an electrophoretic gel is primarily a function of the fragment's

- (a) cytosine content. (b) length. (c) degree of methylation. (d) radioactivity.  
(e) double helical structure.

32. When DNA extracted from cells is analyzed for base composition, it is found that 30 percent of the bases are adenine. What percentage of the bases are cytosine?

- (a) 30%. (b) 15% (c) 0% (d) 20% (e) 70%

二、簡答題：每題 4 分，共計 40 分

- |                            |                                   |
|----------------------------|-----------------------------------|
| 1. Cell Cycle              | 6. Human Genome Project           |
| 2. Cell Membrane Structure | 7. Cytoskeleton                   |
| 3. Apoptosis               | 8. Innate and Adaptive Immunity   |
| 4. Signal Transduction     | 9. Single Nucleotide Polymorphism |
| 5. DNA, RNA                | 10. Dominant Negative             |

三、問答題：共計 12 分

1. Please describe four levels of protein structure.