

系所組別：分子醫學研究所

考試科目：生命科學

考試日期：0223，節次：3

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This test contains 2 sections.

Section I (70%) plus Section II (30%)

Section I. Single Choice Questions (70%): Each of the questions is followed by 5 suggested answers or completions. Choose one that is best in each case. (2 points/question)

- Exons of a gene are defined as
 - the untranslated regions of the corresponding mRNA
 - regions in the corresponding mRNA that are involved in initiation of transcription
 - regions that are not transcribed by RNA polymerase
 - regions that are excised from the corresponding protein after it is synthesized
 - regions that remain in the corresponding mRNA after splicing
- The position of a gene on chromosome is called
 - Locus
 - Gene
 - Genotypes
 - Phenotypes
 - Alleles
- Chimeric mice can be generated by injecting a cell from an early embryo into a blastocyst of another genotype. The fact that the single injected cell can contribute to many tissues of the chimeric mouse has led to the conclusion that cells of the early

- embryo are
- differentiated
 - motile
 - transformed
 - transduced
 - totipotent

- Additions or deletions of bases in the nucleotide sequence of a structural gene most often result in
 - an altered sequence of amino acids in the protein that the gene encodes
 - insertion of a new intron into the coding sequence of the gene
 - decreased histone binding
 - decreased excision repair
 - increased levels of mRNA production
- Which of the following is found in mammals during male gamete formation?
 - Two successive centrosome duplications during meiosis
 - Formation of four functional gametes from a primary germ cell
 - Generation of a polar body during meiosis I
 - Accumulation of yolk during gamete formation
 - Temporary arrest of meiosis at the metaphase I stage
- In tomatoes, red fruit color (R) is dominant to yellow (Y). Suppose a tomato plant homozygous for red is crossed with one homozygous for yellow. The color ratio of offspring from a cross of the F1 back to the yellow parent is:
 - All red (Red: Yellow = 1: 0)
 - Red:Yellow=1:1
 - Red:Yellow=2:1
 - Red:Yellow=3:1
 - All yellow (Red:Yellow=0:1)

(背面仍有題目，請繼續作答)

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7. In human the three alleles I^A , I^B , and i constitute a multiple allelic series that determine the ABO blood group system. A woman of blood group AB marries a man of blood group B whose father was group O. What is the probability that one son will be group B?

- (A) 1/32
- (B) 1/16
- (C) 1/8
- (D) 1/4
- (E) 1/2

8. 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) 1/1

9. How many different types of gametes could be produced by an individual with the arbitrary genotype of $AabbCCDdEe$?

- (A) 2
- (B) 4
- (C) 6
- (D) 8
- (E) 16

10. When mature mRNA produced by the insulin gene is hybridized with denatured chromosomal DNA, which of the following will most likely be observed?

- (A) No hybridization would occur under any conditions.

(B) Hybridization of mRNA would occur with random sections of chromosomal DNA.

(C) Hybridization of mRNA with DNA would occur in a continuous stretch that is equal to the length of the mRNA.

(D) Hybridization of mRNA with DNA would occur but with many single-stranded loops of DNA.

(E) Hybridization of mRNA with DNA would occur but with many single-stranded loops of mRNA.

11. Which of the following bacteria is the pathogen of gastric ulcer?

- (A) *Helicobacter pylori*
- (B) *Mycobacterium tuberculosis*
- (C) *Vibrio Cholerae*
- (D) *E. coli*
- (E) *Salmonella typhi*

12. Radioactive cytosine was added to an actively growing culture of *E. coli* bacteria. Which of the following would be the result if a cell replicated once in the presence of this radioactive base?

- (A) One of the daughter cells, but not the other, would have radioactive DNA.
- (B) Neither of the two daughter cells would have radioactive DNA.
- (C) Both daughter cells would have radioactive DNA.
- (D) Radioactive cytosine would pair with nonradioactive adenine during DNA replication.
- (E) DNA replication would not occur, because two radioactive bases are required for proper pairing.

13. All proteins contain carbon, hydrogen, oxygen and what other element?

- (A) Sulphur
- (B) Fluorin
- (C) Nitrogen
- (D) Chlorine
- (E) Potassium

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14. The addition of -amanitin, a known inhibitor of DNA-dependent mRNA synthesis, to growing cells will most likely cause protein synthesis to
- stop immediately
 - stop as mRNA becomes depleted
 - stop as thymidine becomes depleted
 - stop as the ribosomes become inactivated
 - be unaffected
15. Which of the following is LEAST likely to cause a proto-oncogene to become an oncogene?
- A gene is incorporated into a retroviral genome.
 - A gene is expressed at an inappropriate time.
 - A gene is moved close to an enhancer, causing excess product to be made.
 - A gene is truncated, yielding a protein with modified activity.
 - A gene is moved into centromeric heterochromatin, silencing its transcription.
16. Separation of molecules according to size can be achieved by which of the following?
- Gel-filtration chromatography
 - Ion-exchange chromatography
 - Affinity chromatography
 - Isoelectric focusing
 - X-ray diffraction
17. Which of the following is an anticodon?
- The part of a DNA molecule that codes for chain termination
 - A 3-nucleotide sequence of an mRNA molecule
 - A specific part of a tRNA molecule
 - A nucleotide triplet of an rRNA molecule
 - The portion of a ribosomal subunit that interacts with aminoacyl-tRNA synthetase

18. During cytokinesis in an animal cell, a constricting ring pinches the dividing cell into the two daughter cells. This contractile ring is formed by which of the following structures?
- Centrioles
 - Microtubules
 - Microfilaments
 - Z discs
 - The spindle apparatus
19. A short segment of DNA produced by discontinuous replication elongating in 5' – 3' direction away from replication fork is
- Lagging strand
 - Leading strand
 - Random primer
 - Okazaki fragment
 - Suzuki fragment
20. Humoral immunity is characterized by all of the following EXCEPT
- a memory response
 - antigen-antibody interaction
 - the synthesis of immunoglobulins
 - the production of plasma cells
 - the production of cytotoxic T cells
21. A reasonable directional flow for membrane components in a eukaryotic cell is
- golgi apparatus → rough ER → smooth ER → nuclear envelope
 - nuclear envelope → rough ER → smooth ER → golgi apparatus → secretory vesicles → plasma membrane.
 - nuclear envelope → mitochondria → rough ER → smooth ER → secretory vesicles → plasma membrane.

(背面仍有選項，請繼續作答)

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(D) plasma membrane → secretory vesicles → rough ER → smooth ER → nuclear envelope.

(E) plasma membrane → smooth ER → rough ER → secretory vesicles → nuclear envelope.

22. In *Escherichia coli*, the synthesis of tryptophan is controlled by the tryptophan operon that is repressed in the presence of excessive tryptophan. When a mutant strain that has lost the regulatory gene of the tryptophan operon is placed in a medium that contains all nutrients the cells need to grow except tryptophan, which of the following will occur?

(A) The cells will continue to grow even though excess tryptophan is synthesized.

(B) The cells will grow until excessive tryptophan arrests the expression of the operon.

(C) The cells will not grow until enough tryptophan has been synthesized to activate the corepressor.

(D) The cells will never grow unless tryptophan is added to the medium.

(E) The cells will not grow even when tryptophan is added to the medium.

23. In the formation of the secondary structure of a protein, which of the following are most responsible for holding an alpha-helix region in its helical form?

(A) Hydrogen bonds

(B) Ionic bonds

(C) Disulfide bonds

(D) Hydrophobic interactions

(E) van der Waals interactions

24. Endoplasmic reticulum (ER) is the site of all of the following EXCEPT

(A) drug detoxification by means of mixed function oxidases

(B) synthesis of proteins that are secreted from the cell

(C) N-linked glycosylation of newly formed polypeptides

(D) Ca²⁺ storage in muscle tissues

(E) hydrolytic activities carried out by acid Hydrolases

25. Which of the following is the most truthful statement?

(A) Transfection is the term to describe the process of deliberately introducing nucleic acids into cells through the use of viruses.

(B) Episome is defined as a stable DNA molecule that persists in the nucleus without integrating into the cellular genome

(C) Xenotropic virus refers to a retrovirus that can reproduce only in the host of the species in which it originated

(D) Hepatitis C viruses have a single-stranded negative-sense RNA genome.

(E) Influenza A viruses are DNA viruses.

26. Which of the following is a truthful statement?

(A) Histones are acidic proteins associated with eukaryotic nuclear DNA.

(B) Eukaryotes have 80S ribosomes, each consisting of a small (30S) and a large (60S) subunit.

(C) Both 5' cap addition and 3' polyadenylation of mRNAs are required for mRNA biogenesis.

(D) "Epistasis" describes a situation in which expression of one gene wipes out the phenotypic effects of another gene.

(E) "Y banding" is a technique for generating stained regions around centromeres.

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27. Which of the following is true regarding the characteristics of antibodies?

- (A) IgG and IgA can cross placenta.
- (B) Mast cells have membrane receptors for the Fc region of IgA
- (C) The light chain of IgG is made by V-D-J joining
- (D) There are 3 hypervariable regions in both heavy and light chains
- (E). The Heavy chain of IgM is made by V-J joining

28. Which of the following is true regarding animal retroviruses?

- (A) They must replicate during the S phase of the cell cycle.
- (B) They require an RNA-dependent DNA polymerase.
- (C) They are nonenveloped viruses.
- (D) The virions have double-stranded RNA genomes.
- (E) Replication of their genome occurs entirely within the host nucleus.

29. Increased calcium influx across the membranes of presynaptic neurons has which of the following effects on synaptic transmission?

- (A) Increased release of neurotransmitter
- (B) Increase in voltage-dependent potassium efflux
- (C) Decreased release of neurotransmitter
- (D) Decrease in voltage-dependent potassium efflux
- (E) Closure of the acetylcholine-gated channel

30. In adult mammals, the primary site for the final stage of differentiation of T lymphocytes is the

- (A) spleen
- (B) bone marrow
- (C) bursa of Fabricius

- (D) thymus
- (E) liver

31. Which of the following is **not true** regarding cellular apoptosis or necrosis?

- (A) Apoptosis is defined as morphological changes associated with programmed cell death
- (B) Apoptotic cells have characteristics of nuclear fragmentation, membrane blebbing, and releasing of apoptotic bodies.
- (C) Apoptosis would result in severe damage or death of surrounding cells
- (D) Necrosis is generally caused by factors external to the cell or tissue, such as infection, toxins, or trauma.
- (E) While apoptosis often provides beneficial effects to the organism, necrosis is almost always detrimental and can be fatal.

32. Which of the following is **not** a truthful statement regarding interferons (IFN)?

- (A) IFN- α and IFN- β are type-I interferons
- (B) IFN- α is produced by monocytes/macrophages, lymphoblastoid cells, fibroblasts, and a number of different cell types following induction by pathogenic substance
- (C) IFN- β is produced mainly by fibroblasts and some epithelial cell types
- (D) IFN- γ is mainly produced by antigen activated Th1 cells and is called immune interferon to modulate immune cells for Th1-biased immune response and to inhibit the development of Th2 cells.
- (E) Activated Th1 cells secrete IFN- α to activate Macrophages to kill microbes located within the macrophages' phagosome.

(背面仍有題目，請繼續作答)

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33. Which of the followings is **not** a truthful statement?

- (A) Thymus and adult bone marrow are central lymphoid organs
- (B) Fetus liver belongs to peripheral lymphoid system
- (C) Spleen is a peripheral lymphoid organ
- (D) Central lymphoid organs are the place from where T and B cells derived.
- (E) Peripheral lymphoid organs are the place where most T and B cells react with foreign antigens and become immune effectors or memory cells.

34. Which of the followings is **not** a truthful statement?

- (A) Human have at least 10 Toll-like receptors (TLRs). They are important parts in innate immune recognition of pathogen-associated immunostimulants.
- (B) Many of the TLR mediated signaling involve the NF- κ B signaling pathway.
- (C) TLR activation stimulates the expression of molecules that both initiate an inflammatory response and help induce adaptive immune responses.
- (D) TLR are abundant on the surface of macrophages and neutrophils, as well as on the epithelial cells lining the lung and gut.
- (E) Lipopolysaccharide (LPS) recognizes TLR2 and the associated signaling requires the participation of MyD88 adaptor.

35. Which of the followings is **not** a truthful statement?

- (A)The lymphocytes developed in a central lymphoid organ are already committed to react with a particular antigen before ever being exposed to the antigen.

- (B) A single antigenic determinant is likely to activate many lymphocyte clones, and each of which produces an antigen-binding site with its own characteristic affinity for the determinant
- (C)The tolerance of self antigen by lymphocytes is a learning process occurred in the early stage of lymphocytes development. There will be no escape of lymphocytes to the peripheral lymphoid organs.
- (D)Receptor editing occurs only in the developing B cells in central lymphoid organ
- (E) For a lymphocyte to be activated in a peripheral lymphoid organ, it must not only bind its antigen but must also receive a costimulatory signals. Without a costimulatory signal, an antigen tends to kill or inactivate a lymphocyte rather than activate it.

Section II. Short Essay Questions (30%):

1. Describe the role and mechanism of microRNA in cells. (10 points)
2. What are Professional Antigen Presenting Cells (APCs)? What are MHC class I and class II presentation pathways? (10 points)
3. **Influenza A virus (IAV), Hepatitis C virus (HCV), Human immunodeficiency virus (HIV), and Enterovirus (EV)** are RNA viruses that cause life-threatening diseases. Describe your understandings on ONE of the viruses. (10 points)