

系所組別： 分子醫學研究所

考試科目： 生命科學

考試日期：0220，節次：3

※ 考生請注意：本試題 ☐ 可 ☒ 不可 使用計算機

請勿在本試題紙上作答，否則不予計分

試題共分單選題(60%)與簡答題(40%)兩部份

Section I. Single Choice Questions (60%): Each of the questions is followed by 5 suggested answers or completions. Choose one that is best in each case. (2 points/question)

1. 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 red parent is:
(A) All red (Red: Yellow = 1: 0)
(B) Red:Yellow=1:1
(C) Red:Yellow=2:1
(D) Red:Yellow=3:1
(E) All yellow (Red:Yellow=0:1)
2. 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 their two children will be group A?
(A) 1/32
(B) 1/16
(C) 1/8
(D) 1/4
(E) 1/2
3. The position of a gene on chromosome is called
(A) Locus
(B) Gene
(C) Genotypes
(D) Phenotypes
(E) Alleles
4. 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
5. 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
6. 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.

(背面仍有題目,請繼續作答)

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7. Which of the following is found in mammals during male gamete formation?

- (A) Two successive centrosome duplications during meiosis
- (B) Accumulation of yolk during gamete formation
- (C) Generation of a polar body during meiosis I
- (D) Formation of four functional gametes from a primary germ cell
- (E) Temporary arrest of meiosis at the metaphase I stage

8. Exons of a gene are defined as

- (A) the untranslated regions of the corresponding mRNA
- (B) regions in the corresponding mRNA that are involved in initiation of transcription
- (C) regions that are not transcribed by RNA polymerase
- (D) regions that are excised from the corresponding protein after it is synthesized
- (E) regions that remain in the corresponding mRNA after splicing

9. 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

- (A) differentiated
- (B) motile
- (C) transformed
- (D) transduced
- (E) totipotent

10. Additions or deletions of bases in the nucleotide sequence of a structural gene most often result in

- (A) an altered sequence of amino acids in the protein that the gene encodes
- (B) Insertion of a new intron into the coding sequence of the gene
- (C) decreased histone binding
- (D) decreased excision repair
- (E) increased levels of mRNA production

11. If a given population of diploid organisms contains three, and only three alleles of a particular gene (i.e., alleles 1, 2, and 3), how many different genotypes are possible in the population?

- (A) 2
- (B) 4
- (C) 6
- (D) 8
- (E) 10

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.

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13. All proteins contain carbon, hydrogen, oxygen and what other element?
(A) Sulphur
(B) Fluorin
(C) Nitrogen
(D) Chlorine
(E) Potassium
14. The addition of α -amanitin, a known inhibitor of DNA-dependent mRNA synthesis, to growing cells will most likely cause protein synthesis to
(A) stop immediately
(B) stop as mRNA becomes depleted
(C) stop as thymidine becomes depleted
(D) stop as the ribosomes become inactivated
(E) be unaffected
15. 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.
16. Separation of molecules according to size can be achieved by which of the following?
(A) Gel-filtration chromatography
(B) Ion-exchange chromatography
(C) Affinity chromatography
(D) Isoelectric focusing
(E) X-ray diffraction
17. Which of the following is an anticodon?
(A) The part of a DNA molecule that codes for chain termination
(B) A 3-nucleotide sequence of an mRNA molecule
(C) A specific part of a tRNA molecule
(D) A nucleotide triplet of an rRNA molecule
(E) 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?
(A) Centrioles
(B) Microtubules
(C) Microfilaments
(D) Z discs
(E) The spindle apparatus
19. A short segment of DNA produced by discontinuous replication elongating in 5' - 3' direction away from replication fork is
(A) Lagging strand
(B) Leading strand
(C) Random primer
(D) Okazaki fragment
(E) Suzuki fragment
20. 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 plasma cells
(E) the production of cytotoxic T cells

(背面仍有題目,請繼續作答)

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21. A reasonable directional flow for membrane

components in a eukaryotic cell is

- (A) golgi apparatus → rough ER → smooth ER → nuclear envelope
- (B) nuclear envelope → rough ER → smooth ER → golgi apparatus → secretory vesicles → plasma membrane.
- (C) nuclear envelope → mitochondria → rough ER → smooth ER → secretory vesicles → plasma membrane.
- (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) Ionic bonds
- (B) Hydrogen 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) Ca^{2+} 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.

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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.

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 concerning 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

Section II. Short Essay Questions (40%):

1. What do you know about Apoptosis and Necrosis (8 points):
2. What do you know about Antigen Presenting Cells (APCs)? What are MHC class I and class II presentation pathways? (10 points)
3. What do you know about Toll-like receptors and type-I interferon response? (12 points)
4. Influenza A virus (IAV), Hepatitis C virus (HCV), and Human Immunodeficiency virus (HIV) are three life-threatening viruses that cause many international concerns. Describe your understandings on ONE of the viruses. (10 points)