

Please choose the most appropriate terms/phrases/statements that complete or answer the questions.

Attention: More than one of the choices provided may be correct.

(2.5 points for each question)

1. Which of the following techniques can be used to edit gene?

- (A) RT-PCR
- (B) ELISA
- (C) CRISPR/Cas9
- (D) Electrophoresis
- (E) Gel shift

2. Which of the following models are always used in studying biology in vivo?

- (A) Human
- (B) Monkey
- (C) Mouse
- (D) Zebra fish
- (E) Fruit fly

3. Which one is **NOT** the class of pathogen?

- (A) Spider
- (B) Snake
- (C) Virus
- (D) Beetle
- (E) Fungus

4. Which of the following organs are involved in immune system?

- (A) Gut
- (B) Ear
- (C) Skin
- (D) Spleen
- (E) All right above

5. Which of the following cell types are **NOT** immune cells?

- (A) Adipocyte
- (B) B cell
- (C) Macrophage
- (D) T cell
- (E) Neuron cell

6. Which of the following responses are **NOT** immune responses?

- (A) Mitosis
- (B) Killing cancer cells
- (C) Nutrition transport
- (D) Production of antibody
- (E) Secretion of inflammatory cytokine

7. Which one is the isotype of antibody?

- (A) IgD

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- (B) IgH
  - (C) IgB
  - (D) IgE
  - (E) IgA
8. Which of the following techniques can be used to detect gene?
- (A) HPLC
  - (B) PCR
  - (C) Gel filtration
  - (D) Western blot
  - (E) Southern blot
9. Which of the following techniques need to use monoclonal antibody?
- (A) Northern blot
  - (B) Flow cytometry
  - (C) PCR
  - (D) ELISpot
  - (E) Southern blot
10. Which of the following strategies can be used to control cancer?
- (A) CAR-T
  - (B) Immune checkpoint blockade
  - (C) Radiation therapy
  - (D) Dendritic cell vaccine
  - (E) Chemical therapy
11. Which of the following experimental approaches are used to determine gene expression?
- (A) Affinity chromatography
  - (B) Chromatin immunoprecipitation
  - (C) Gene array analysis
  - (D) RNA interference (RNAi)
  - (E) RNA sequencing.
12. The Nobel Prize in Physiology or Medicine 2019 was awarded jointly to William G. Kaelin Jr, Sir Peter J. Ratcliffe and Gregg L. Semenza "for their discoveries of how cells sense and adapt to the availability of 'X'." What is the 'X'?
- (A) Amino acid
  - (B) Fatty acid
  - (C) Glucose
  - (D) Oxygen
  - (E) Protein.
13. Which of the following techniques are used for targeted genome editing?
- (A) Clustered Regularly Interspaced Short Palindromic Repeats-CRISPR-Associated 9 (CRISPR-Cas9)
  - (B) ELISA
  - (C) Flow Cytometry
  - (D) Transcription-Activator Like Effector Nucleases (TALEN)
  - (E) Zinc Finger Nuclease (ZFN).

14. Which of the followings are inflammatory mediators/molecules?
- (A) IL-1 $\beta$
  - (B) IL-2
  - (C) iNOS
  - (D) PD-1
  - (E) TNF $\alpha$
15. What are the properties of stem cells?
- (A) They are capable of dividing and renewing themselves for long periods
  - (B) They are specialized
  - (C) They can give rise to specialized cell types
  - (D) They can be used for cell-based therapies
  - (E) They can be used for drug screening.
16. Microbiota are "ecological communities of commensal, symbiotic and pathogenic microorganisms" Which of the following description about microbiota are **CORRECT**?
- (A) Microbiota are found in and on all multicellular organisms from plants to animals.
  - (B) Microbiota includes bacteria, archaea, protists, fungi and viruses.
  - (C) Microbiota are crucial for immunologic homeostasis of their host.
  - (D) Microbiota are dispensable for hormonal homeostasis of their host.
  - (E) Microbiota play an important role for metabolic homeostasis of their host.
17. Autophagy is the natural, regulated mechanism of the cell that removes unnecessary or dysfunctional components. Which of the following description about autophagy are **CORRECT**?
- (A) Autophagy allows the orderly degradation and recycling of cellular components.
  - (B) Autophagy has been seen as an adaptive response to stress, promoting survival of the cell
  - (C) Autophagy, in some cases, promotes cell death and morbidity.
  - (D) Lysosomes are the sites of intracellular autophagy
  - (E) 2016 Nobel Prize in Physiology or Medicine was awarded to Yoshinori Ohsumi for his great work on autophagy research.
18. Neurodegeneration is the progressive loss of structure or function of neurons, including death of neurons. What are the neurodegenerative diseases?
- (A) Alzheimer's disease
  - (B) Asthma
  - (C) Huntington's disease
  - (D) Multiple myeloma
  - (E) Parkinson's disease.
19. The citric acid cycle (CAC) has also been known as the TCA cycle (tricarboxylic acid cycle) or the Krebs cycle. Which of the following molecules are involved in the CAC?
- (A) Acetyl CoA
  - (B)  $\alpha$ -Keto-glutarate
  - (C) Citrate
  - (D) Lactate
  - (E) Pyruvate
20. Which of the following statement for cell culture are **CORRECT**?
- (A) Culture of animal cells requires nutrient-rich media

- (B) Culture of animal cells requires special solid surfaces
- (C) Culture of animal cells in three-dimensional environments can mimic their situation *in vivo*
- (D) Primary cell cultures have an infinite life span
- (E) Transformed cells can grow indefinitely in culture.

21. Which of the following statements is/are **CORRECT**?

- (A) After telophase I of meiosis, the chromosomal makeup of each daughter cell is haploid, and the chromosomes are each composed of two chromatids.
- (B) Sister chromatids separate from each other during mitosis and meiosis II.
- (C) Condensation of chromosomes occurs in meiosis but not in mitosis
- (D) The human X and Y chromosomes include genes that determine an individual's sex.
- (E) Homologous chromosomes are identical.

22. Which of the following statements is/are **CORRECT**?

- (A) In the cross  $AaBbCc \times AaBbCc$ , the probability of producing the genotype  $AABBCC$  is  $1/8$ .
- (B) In certain plants, tall is dominant to short. If a heterozygous plant is crossed with a homozygous tall plant, the probability that the offspring will be short is  $1/2$ .
- (C) Black fur in mice ( $B$ ) is dominant to brown fur ( $b$ ). Short tails ( $T$ ) are dominant to long tails ( $t$ ).  $1/2$  of the progeny of crosses  $BbTt \times BBtt$  will be expected to have black fur and long tails.
- (D) When Mendel crossed yellow-seeded and green-seeded pea plants, all the offspring were yellow seeded. When he took these  $F_1$  yellow-seeded plants and crossed them to green-seeded plants, the genotypic ratio was expected to be 1:1.
- (E) Phenylketonuria is an inherited disease caused by a recessive autosomal allele. If a woman and her husband are both carriers, the probability that their first child will be a phenotypically normal girl is  $1/4$ .

23. Sex determination in mammals is due to the  $SRY$  gene. Which of the following could allow a person with an XX karyotype to develop a male phenotype?

- (A) the loss of the  $SRY$  gene from an autosome.
- (B) translocation of  $SRY$  to a X chromosome.
- (C) a person with one normal and one shortened (deleted) X.
- (D) a person with an extra autosomal chromosome.
- (E) translocation of  $SRY$  to an autosomal chromosome.

24. Which of the following statements is/are **TRUE**?

- (A) In an analysis of the nucleotide composition of DNA,  $G + C = T + A$  will be found.
- (B) A new DNA strand elongates only in the 5' to 3' direction because DNA polymerase can add nucleotides only to the free 3' end.
- (C) DNA is synthesized through a process known as conservative replication.
- (D) In *E. coli*, the function of DNA polymerase III is to add nucleotides to the 3' end of a growing DNA strand.
- (E) Prokaryotic chromosomes have a single origin of replication, whereas eukaryotic chromosomes have many.

25. Which of the following statements is/are **TRUE**?

- (A) A single antibody gene can code for different related proteins, depending on the splicing that takes place post-transcriptionally.
- (B) In eukaryotes there are several different types of RNA polymerase. RNA polymerase I is involved in transcription of mRNA for a globin protein?
- (C) The TATA box in eukaryotic promoters is the recognition site for a specific transcription factor.

- (D) The capping of the 5' end of the mRNA does not occur in prokaryotic gene expression, but does occur in eukaryotic gene expression.
- (E) Translation requires mRNA, tRNA, and rRNA.
26. Which of the following mechanisms is/are used to coordinate the expression of multiple, related genes in eukaryotic cells?
- (A) The genes share a single common enhancer, which allows appropriate activators to turn on their transcription at the same time.
- (B) The genes are organized into a large operon, allowing them to be coordinately controlled as a single unit.
- (C) Environmental signals enter the cell and bind directly to promoters.
- (D) A single repressor is able to turn off several related genes.
- (E) None of the above.
27. Which of the following statements about "Virus" is/are **TRUE**?
- (A) Viruses use the host cell to copy themselves and then viruses synthesize their own proteins.
- (B) Enveloped viruses have a phospholipid membrane outside their capsid, whereas nonenveloped viruses do not have a phospholipid membrane.
- (C) The host range of a virus is determined by the proteins on its surface and that of the host.
- (D) RNA viruses have higher rates of mutation because RNA viruses can incorporate a variety of nonstandard bases.
- (E) Retroviruses have single-stranded RNA that acts as a template for DNA synthesis.
28. Which of the following would help a virus avoid triggering an effective adaptive immune response?
- (A) having frequent mutations in genes for surface proteins
- (B) building the viral shell from host proteins
- (C) producing proteins very similar to those of other viruses
- (D) infecting and killing helper T cells
- (E) none of the above
29. Which of the following statements about "Hormones and the Endocrine System" is/are **TRUE**?
- (A) Growth factors are local regulators that bind to cell-surface receptors and stimulate growth and development of target cells.
- (B) Steroid and peptide hormones typically have in common the building blocks from which they are synthesized.
- (C) A cluster of tumor cells produce and secrete growth factors to induce surrounding cells to grow and divide. This type of cell-to-cell signaling is called "autocrine".
- (D) If a portion of the pancreas is surgically removed from a rat and the rat subsequently loses its appetite, one explanation is that the removed portion contains cells that secrete a chemical signal that somehow stimulates appetite. This type of chemical signaling is called "paracrine".
- (E) When adenylyl cyclase is activated cAMP is created.
30. Which of the following statements about "Neurons" is/are **TRUE**?
- (A) Most of the neurons in the human brain are sensory neurons.
- (B) The motor (somatic nervous) system can alter the activities of its targets, the skeletal muscle fibers, because its signals reach the muscles via the blood.
- (C) The point of connection between two communicating neurons is called the synapse.
- (D) In a simple synapse, neurotransmitter chemicals are released by axon hillocks.
- (E) The operation of the sodium-potassium "pump" moves sodium ions out of the cell and potassium ions

into the cell.

31. Which of following bonds do **NOT** belong to covalent bonds:

- (A) disulfide bond.
- (B) hydrogen bond.
- (C) phosphodiester bond.
- (D) peptide bond
- (E) Ionic bond

32. Which of the following molecules are nonpolar molecular?

- (A) H<sub>2</sub>O
- (B) NaCl
- (C) CH<sub>4</sub>
- (D) N<sub>2</sub>
- (E) CO<sub>2</sub>

33. Which of the following amino acid residues have hydrophobic side chain:

- (A) R
- (B) I
- (C) D
- (D) V
- (E) Y

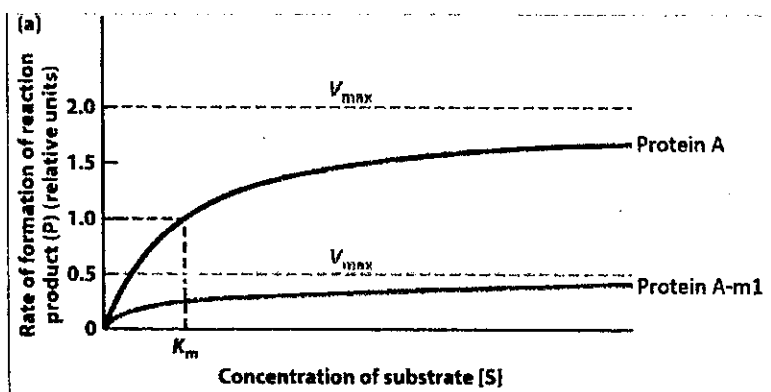
34. Which of the following descriptions for nucleic acid are **TRUE**:

- (A) Heterochromatin is composed of DNA, whereas euchromatin is made of DNA and RNA.
- (B) DNA sequence '5'-ATCCGTAGTATC-3'' has 5 purines and 6 pyrimidines
- (C) Pyrophosphates are the by-products during both DNA and RNA polymerization
- (D) '5'-GCTATAGGAAAGAAA-3'' has higher T<sub>m</sub> than '5'-TTTTCTTTCCTATAGC-3''
- (E) Prior to additional enzymatic processing, tri-phosphate group is found at 5' end of newly transcribed RNA

35. Which of the following descriptions for RNA are **TRUE**:

- (A) Most RNAs in cells are messenger RNA (mRNA).
- (B) tRNA are transcribed by RNA polymerase III
- (C) precursor microRNA and mRNA both are transcribed by RNA polymerase II
- (D) In eukaryotic cells, RNAs are transcribed in cytoplasm
- (E) 5' capped and 3' poly A tail are the signature for most of mRNAs

36. Which of the following descriptions for graph below are **TRUE**:



- (A) The curves above are Michaelis-Menten saturation curve for enzymes
- (B)  $K_m$  reflects the speed that an enzyme catalyzes the reaction
- (C) Protein A and protein A-m1 has similar substrate binding ability
- (D) For any given enzyme with their kinetics curve fit into curve above, the catalytic speed increases with their substrate amount increases
- (E) Regardless the concentration of substrate, the catalytic speed for an enzyme kept in constant if the substrate concentration is close to  $K_m$

37. Which of the following statements are **TRUE**?

- (A) A transcription factor is a protein that recognizes part of the promoter sequence close to the start site of transcription.
- (B) As in eukaryotic nucleus, multiple genes can be transcribed from one common transcriptional promoter
- (C) The template that the mRNA transcribed from is the complementary strand of the coding strand.
- (D) Polycistronic mRNA only observed in eukaryotic nucleus
- (E) Different serine is phosphorylated at C terminal domain of RNA polymerase II correlates with different transcriptional statuses

38. Which of the following statements are **TRUE**?

- (A) The advantage of wobble in the codon-anticodon recognition is to incorporate more than one kind of amino acid from the same coding sequence.
- (B) There are 64 different tRNAs are present in human cell
- (C) Though the sequences for different tRNAs are very different, they all share similar structure
- (D) The amino acid is charged on tRNA at their 3' end
- (E) The third position of the anticodon sequence on tRNA is the wobble base

39. Which of the following statements are **TRUE**?

- (A) Polypeptide are composed of covalently linked amino acids
- (B) Majority of Ribosome is made by proteins
- (C) E site is the first positions on ribosome for tRNA entry
- (D) 5' capped structure on mRNA is recognized by eukaryotic translation initiation factors to initiate the translation
- (E) polyA binding protein associates with eIF proteins to initiate translation

40. Which of the following statements regarding biomembrane is/are **CORRECT**?

- (A) It consists of a lipid bilayer with embedded proteins.
- (B) Mitochondria have double membrane namely inner and outer membrane.
- (C) ER, p-body, Golgi apparatus and nucleus are all membrane-bound organelles.
- (D) The distribution of phospholipid in the inner and outer leaflet of the plasma membrane is symmetric.
- (E) When cells undergo apoptosis phosphatidyl choline will exposed to outer leaflet of plasma membrane and thus serves as a marker for dying cells.