

單選題 共 40 題 (A) (B) (C) (D) (E) 5 選 1 答錯不倒扣

第 1 至 20 題 每題 2 分，第 21 至 40 題 每題 3 分

1. In higher eukaryotes, which statement about a transcription activator is not true?
  - A. It might direct DNA methylation.
  - B. It might interact with chromatin-remodeling factors.
  - C. It might lead to H3 lysine 4 methylation.
  - D. It might direct histone acetylation.
  - E. The mediator complex forms a molecular bridge between the activator and RNA Pol II.
  
2. What description about micro RNAs (miRNAs) is incorrect?
  - A. Most miRNAs are transcribed by RNA Pol II.
  - B. One type of miRNAs can target to many mRNAs.
  - C. The mature miRNAs are about 21-22 nucleotide, which hybridize perfectly with their target mRNAs.
  - D. They associate with Ago protein to form RISC (RNA-induced silencing complex) complex.
  - E. They can induce mRNA degradation or inhibit mRNA translation.
  
3. The exons of nuclear pre-mRNA have to be removed for mature mRNA synthesis. Which is incorrect?
  - A. One transesterification reaction results in splicing of exons in pre-mRNA.
  - B. The spliceosome is a snRNAs complex to catalyze the exon removals without ATP.
  - C. The splicing is preformed after thtranscription termination.
  - D. Only 1% of human genes undergo alternative splicing to yield different mRNAs that encode distinct proteins.
  - E. SR proteins contribute to exon definition.
  
4. Which part of the ribosome is responsible for peptidyl transfer?
  - A. LSU
  - B. SSU
  - C. mRNA
  - D. tRNA
  - E. siRNA
  
5. Transporting macromolecules to the nucleus through nuclear pores from the cytosol typically requires which one's help?
  - A. Epinephrine
  - B. Exportin
  - C. Importin
  - D. AMPK
  - E. mTOR

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6. Which process mediates protein degradation?
- A. Translation
  - B. Transcription
  - C. Replication
  - D. Ubiquitination
  - E. Photosynthesis
7. The sodium-potassium pump establishes concentration gradients
- A. of higher sodium concentrations inside the cell and higher potassium concentrations outside the cell.
  - B. of sodium and potassium but the area of their concentrations depends on the needs of the cell.
  - C. of higher potassium concentrations inside the cell and higher sodium concentrations outside the cell.
  - D. of ATP inside the cell where it is needed.
  - E. by pumping sodium outside the cell and potassium is cotransported out as well.
8. Which of the following component(s) is NOT required for those proteins to be internalized during endocytosis?
- A. cargo adaptor
  - B. coat protein
  - C. GTPase
  - D. translocon
  - E. All of above are used in the secretory pathway
9. Which of the following pathway(s) is NOT the correct description for secretory proteins during protein transport?
- A. Secretory proteins move to the plasma membrane for protein expression.
  - B. Trans-Golgi network is thought to be the sorting hub for secretory proteins.
  - C. Secretory proteins can be recycled back to ER using the tyrosine-based sorting motif.
  - D. Secretory proteins move to ER by cotranslational transport machinery in mammalian cells.
  - E. All of above are correct.
10. Polymerization of collagen into large collagen fibers occurs
- A. in the endoplasmic reticulum.
  - B. in the Golgi complex.
  - C. in secretory vesicles.
  - D. extracellularly.
  - E. none of the above.
11. Signaling at synapses is usually terminated by
- A. calcium influx.
  - B. potassium influx.
  - C. inhibitory neurotransmitters.
  - D. degradation or reuptake of neurotransmitters.
  - E. none of the above.

12. Which repair is considered as an error-free mechanism?
- A. Homologous recombination
  - B. Non-homologous end-joining
  - C. Microhomology-mediated end-joining
  - D. Single strand annealing
  - E. Transcription-coupled DNA repair
13. Which one participates in the adaptive immune response?
- A. B cell
  - B. NK cell
  - C. T cell
  - D. Neutrophils
  - E. macrophages
14. Apoptosis differs from necrosis in that necrosis \_\_\_\_\_.
- A. requires the reception of an extracellular signal.
  - B. causes DNA to fragment.
  - C. causes cells to swell and burst, whereas apoptotic cells shrink and condense.
  - D. involves a caspase cascade.
  - E. all of the above
15. The following methods can separate proteins based on their mass except?
- A. centrifugation
  - B. ion exchange chromatography
  - C. SDS polyacrylamide gel electrophoresis
  - D. gel filtration chromatography
  - E. native polyacrylamide gel electrophoresis
16. While examining the crystal structure of a membrane protein, you find several phospholipid molecules bound to the protein. You know that these lipids ...
- (1) are thought to help stabilize many membrane proteins.
  - (2) may enhance the crystallization of the bound membrane proteins.
  - (3) interact specifically with the protein.
  - (4) can have head groups of various sizes and charges depending on the protein.
- A. 1, 2 and 3
  - B. 2, 3 and 4
  - C. 1, 3 and 4
  - D. 1 only
  - E. All

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17. Many cells store lipids in droplets of varying sizes. These droplets ...
- A. have mostly protein-free bilayer membranes.
  - B. are composed primarily of charged amphiphilic lipids.
  - C. are produced by and released from the Golgi apparatus.
  - D. are enclosed by a phospholipid monolayer (instead of a bilayer).
  - E. mostly store cholesterol and phospholipids.
18. Which of the following methods provides the most sensitive and accurate way of measuring and comparing mRNA levels of a set of genes expressed at relatively low levels in two different tissues.
- A. PCR
  - B. Ribosome profiling
  - C. ChIP-seq
  - D. DNA microarray analysis
  - E. RNA-seq
19. Epigenetics is most concerned with:
- A. changes in a person's genotype resulting from environmental influences.
  - B. the expression of a particular gene as influenced by external inputs.
  - C. environmental influences on gene expression over experiential influences.
  - D. the heritability of genotypes that have been altered over multiple generations.
  - E. the DNA sequences or the chromatin structures that have been altered by external inputs.
20. An RNA-dependent DNA polymerase that carries the RNA template with it to synthesize repeats at the 3'-ends of chromosomes is called:
- A. DNA ligase
  - B. telomerase
  - C. DNA polymerase  $\gamma$
  - D. topoisomerase
  - E. DNA polymerase  $\beta$
21. The steroid hormone glucocorticoid can enter cells and bind with glucocorticoid receptor (GR) to regulate gene expression. Which is incorrect?
- A. GR is in the cytoplasm in the absence of glucocorticoid.
  - B. GR is a leucine-zipper-containing transcription factor.
  - C. Glucocorticoid-bound GR can form a homodimer to bind to GREs.
  - D. GR serves as a transcription activator or inhibitor depending on the gene context.
  - E. GR inhibits the expression of cytokine genes by tethering other transcription factors such as AP1 and NF- $\kappa$ B.

22. A diverse set of proteins with conserved RNA-binding domains associate with pre-mRNAs to assist RNA processing. Which is incorrect?
- A. RRM (or RBD), KH motif and RGG box are conserved RNA-binding motifs.
  - B. Pre-mRNAs are associated with hnRNP proteins, contributing to splicing, polyadenylation and export.
  - C. To identify hnRNP proteins, first high-dose UV irradiation causes covalent cross-links to form between RNA bases and associated protein, and are recovered by oligo-dT chromatography.
  - D. The specific monoclonal antibodies of identified hnRNP proteins are used to immunoprecipitate the hnRNP proteins complex.
  - E. All hnRNP proteins shuttle between the nucleus and the cytoplasm for RNA processing.
23. There are known mechanisms for translational control associated with mRNA-specific regulation; which statement is incorrect?
- A. The iron-responsive element of the mRNA provides steric hindrance to prevent the recruitment of the pre-initiation complex.
  - B. Maskin and Bicoid are the two mRNA-specific eIF4G-binding proteins that prevent the interaction with eIF4E.
  - C. The cytoplasmic-polyadenylation-element-binding protein binds to the 3' UTR of the mRNA through associations with Maskin.
  - D. Bicoid binds directly to the Bicoid response element located at the 3' UTR of the mRNA.
  - E. Sex-lethal binds to the uridine-rich sequences located at the 3' and 5' UTRs of mRNA that inhibits translation.
24. Regarding the mechanism of nuclear transport, which description is correct?
- A. NLS are protein sequences rich in positively-charged amino acids such as lysine and arginine that regulate protein cargos out of the nucleus.
  - B. NES are oligonucleotides that direct protein cargos out of the nucleus.
  - C. Molecules with a size of more than 5,000 Daltons can enter freely into the nucleus through nuclear pore complexes.
  - D. The energy to transport macromolecules in or out of the nucleus is provided by the RAN ATPase cycle.
  - E. Macromolecules require karyopherins to enter or leave the nucleus.
25. Which of the following statement(s) is correct regarding to intracellular protein trafficking?
- (1) Vesicular transport is tightly regulated by small GTPase that cycles between GDP-bound and GTP-bound state.
  - (2) COPII vesicles transport proteins from ER to Golgi while COPI vesicles transport proteins from Golgi to the plasma membrane.
  - (3) Membrane fusion step is driven by GTP hydrolysis for the dissociation of SNARE protein complexes.
- A. 1 only
  - B. 1 and 2
  - C. 1 and 3
  - D. 2 and 3
  - E. All of above are correct.

26. Which of the following statement(s) is correct regarding to protein endocytosis or exocytosis?

- (1) Clathrin forms the triskelion structure for the polymerization of a polygonal lattice.
- (2) The acidic pH of endosomes causes receptor-ligand complexes to dissociate. The best example to describe the phenomenon is the endocytosis of transferrin receptor.
- (3) Transmission of nerve impulses at chemical synapses depends on the exocytosis of neurotransmitter-filled synaptic vesicles.

- A. 1 and 2
- B. 2 and 3
- C. 1 and 3
- D. 3 only
- E. All of above are correct.

27. Which of the following statements regarding G protein or G protein-mediated signal transduction is incorrect?

- (1) Epinephrine binding to the beta-adrenergic receptor causes an activation of adenylyl cyclase through the activation of a stimulatory G protein.
- (2) Gi alpha subunit of the trimeric G proteins can inhibit adenylyl cyclase
- (3) Gq alpha subunit of the trimeric G proteins can stimulate PI-phospholipase C

- A. 1 and 2
- B. 1 and 3
- C. 2 and 3
- D. all of the above.
- E. none of the above.

28. Which of the following statement about membrane potential and action potential propagation is correct?

- (1) The resting potential of a typical neuron is  $-30$  mV.
- (2) The resting membrane potential of animal neurons depend largely on nongated  $K^+$  channels.
- (3) During an action potential, opening of voltage-gated  $Ca^{2+}$  channels happens first.
- (4) Repolarization during the refractory period is largely due to opening of voltage-gated  $K^+$  channels.

- A. 1 and 3
- B. 2 and 4
- C. 1, 2 and 4
- D. 1, 3 and 4
- E. 2, 3 and 4

29. Which of the following statements regarding stem cells is incorrect?

- (1) Endoderm and ectoderm cells are pluripotent stem cells.
- (2) Cord blood stem cells are multipotent stem cells.
- (3) Lymphoid progenitors are oligopotent stem cells.

- A. 1 only
- B. 2 only
- C. 3 only
- D. 1 and 3
- E. 2 and 3

30. Which method is NOT for detecting dead cells?
- A. Trypan blue
  - B. Annexin V
  - C. Ki67
  - D. Comet assay
  - E. Cleaved caspase-3
31. Which method can determine cells at the S phase?
- A. PARP1 immunoblotting
  - B. Cyclin D immunoblotting
  - C. CFSE staining
  - D. BrdU incorporation
  - E. Cohesion cleavage
32. What kind of treatment does anti-PD1 or anti-PDL1 antibody work for cancer immunotherapy?
- A. mRNA vaccine
  - B. Immune checkpoint blockade
  - C. CAR-T cell therapy
  - D. Precision medicine
  - E. autoimmunity
33. Which of the following repair pathway is mainly a response for repairing DNA double-stranded breaks?
- A. base excision repair
  - B. nucleotide excision repair
  - C. mismatch repair
  - D. homologous recombination repair
  - E. proofreading polymerases
34. In the large-scale production of a particular human protein in insect cells, the cDNA corresponding to the protein was modified so that the expressed protein would have six histidine residues at the C-terminus. The purpose of this modification was to
- A. facilitate transfer of the cDNA into the insect cells.
  - B. provide a promoter for the transcription of the cDNA in insect cells.
  - C. facilitate purification of the expressed protein through binding to an affinity column containing chelated nickel atoms.
  - D. prevent degradation of the expressed protein by insect cell proteases.
  - E. provide the protein solubility
35. What method can be used to functionally inactivate a gene without altering its sequence?
- A. gene knockout
  - B. RNA interference
  - C. dominant negative mutation
  - D. CRISPR-Cas9 genome editing
  - E. only B and C

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36. Which of the following changes is more likely to further confine a membrane protein within a corral established by the cortical cytoskeletal network?
- A. Binding to an extracellular ligand
  - B. Binding of the protein to other transmembrane proteins
  - C. Increased temperature
  - D. Protease cleavage of the cytosolic domain of the protein
  - E. Protease cleavage of the extracellular domain of the protein
37. Which of the following is correct regarding both Cas9 and EcoRI?
- (1) They are both endonucleases.
  - (2) They both create double-strand breaks in DNA.
  - (3) They both recognize their target sequences with the help of guide RNAs.
  - (4) They are both part of bacterial defense mechanisms against foreign DNA.
  - (5) They are both greatly useful in manipulating DNA and studying gene expression.
- A. 1 only
  - B. 1, 2 and 5
  - C. 2, 3 and 5
  - D. 1, 2, 4 and 5
  - E. All
38. All are true for transcription activation except:
- A. takes place when a transcriptional activator protein bound to DNA makes protein : protein contacts with RNA polymerase.
  - B. the degree of transcriptional activation is proportional to the strength of the protein : protein interaction.
  - C. a nucleotide sequence binding site for a DNA-binding protein serves as an activator site if DNA-binding protein can interact with promoter-bound RNA polymerase.
  - D. if the DNA-bound transcriptional activator makes contact with two different components of RNA polymerase, the transcription is markedly elevated.
  - E. All are true.
39. Which one of the following does not contribute to the activation of transcription in eukaryotes?
- A. SWI/SNF chromatin remodeling proteins
  - B. Histone acetyltransferases
  - C. Histone methylases
  - D. Histone deacetylases
  - E. Alterations in histone content
40. Enzymes that acetylate the  $\epsilon$ -amino group of lysine in the histidine tails are called \_\_\_\_\_ and are involved in \_\_\_\_\_.
- A. histone deacetylases; restoring chromatin to a repressed state
  - B. histone acetyltransferases (HATs); initial events in transcriptional activation
  - C. histone activases; formation of the de-repression complex
  - D. Schiff base formation; promoting the formation of closed complexes
  - E. None of the above