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科目： 分子生物學(B)  
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1. \_\_\_\_\_ only transcribes ribosomal RNAs  
(A) RNA polymerase I  
(B) RNA polymerase II  
(C) RNA polymerase III  
(D) RNA polymerase IV  
(E) DNA polymerase I
2. What is Shine-Dalgarno sequence?  
(A) A transcription binding site in bacterial and archaeal DNA  
(B) A ribosomal binding site in bacterial and archaeal RNA  
(C) A ribosomal binding site in eukaryotic RNA  
(D) An RNA polymerase binding site in bacterial and archaeal DNA  
(E) A transcription binding site in eukaryotic RNA
3. Which is not an epigenetic regulation?  
(A) DNA methylation  
(B) Acetylation on histone  
(C) Methylation on histone  
(D) Non-coding RNA coating on chromatin  
(E) A change of DNA sequence
4. The 3' end of most eukaryotic mRNAs contains a \_\_\_\_\_, and the 5' end has a \_\_\_\_\_.  
(A) poly(A) tail, methylated guanosine cap  
(B) poly(U) tail, methylated guanosine cap  
(C) methylated guanosine cap, poly(A) tail  
(D) poly(A) tail, sulfonated guanosine cap  
(E) methylated guanosine cap, poly(U) tail
5. What is the role of siRNA in destroying the target mRNA?  
(A) It stabilizes the target mRNA.  
(B) It activates the target mRNA's binding to proteosomes.  
(C) It guides the RISC that cleaves the target mRNA to that target mRNA due to its complementarity to that molecule.  
(D) It activates the reverse transcriptase.  
(E) It methylates RISC complex
6. The mechanical changes that ribosomes undergo are driven by energy from \_\_\_\_\_.  
(A) a chemical gradient  
(B) ADP hydrolysis  
(C) ATP hydrolysis  
(D) an electrochemical gradient  
(E) GTP hydrolysis
7. What is the name of the gene that makes the RNA thought to be responsible for the inactivation of the X chromosome in mammalian cells?  
(A) HOTAIR  
(B) JPX

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- (C) XIST  
(D) PIWI  
(E) TNF alpha
8. What is operator?  
(A) The site on the DNA where the repressor binds  
(B) The site on the DNA where DNA polymerase binds  
(C) The site on the DNA where reverse transcriptase binds  
(D) The repressor  
(E) The activator
9. Extending the DNA sequences of the end of chromosomes requires \_\_\_\_\_?  
(A) Endonuclease  
(B) Telomerase  
(C) Kinase  
(D) RNA helicase  
(E) RNA polymerase II
10. The RNA editing includes \_\_\_\_\_ to \_\_\_\_\_ and \_\_\_\_\_ to \_\_\_\_\_.  
(A) cytidine, inosine, adenosine, uridine  
(B) cytidine, uridine, adenosine, inosine  
(C) cytidine, uridine, adenosine, uridine  
(D) uridine, adenosine, cytidine, uridine  
(E) uridine, cytidine, inosine, adenosine
11. Which of the following CANNOT be detected by In Situ hybridization?  
(A) The localization of a specific RNA  
(B) The localization of a gene in cells  
(C) The expression of RNA  
(D) The expression of protein  
(E) Telomere
12. What is more important for UV induced lesions?  
(A) nucleotide excision repair  
(B) base excision repair  
(C) mismatch repair  
(D) nonhomologous end joining  
(E) homologous recombination
13. Which description is INCORRECT for cell cycle?  
(A) The cycle is ceased at G0 phase  
(B) Chromosome is condensed at M-phase  
(C) DNA synthesis is at S phase  
(D) Cells stop growing at G1 phase  
(E) Cells have duplicated chromosomes at G2 phase

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14. Which statement of SARS-CoV-2 is INCORRECT?
- (A) It is an RNA virus with positive strand RNA genome
  - (B) It requires RNA-dependent RNA polymerase to synthesize the virus genome
  - (C) Spike proteins on surface is important for the infection
  - (D) Remdesivir targets spike protein to inhibit virus replication
  - (E) The SARS-Cov2 produces subgenomic RNAs
15. Which statement of CRISPR (clustered regularly interspaces short palindromic repeats) is INCORRECT?
- (A) CRISPR are DNA sequences found in prokaryotic organisms
  - (B) Cas9 enzymes together with CRISPR sequences known as CRISPR-Cas9 can be used to edit genes
  - (C) CRISPR are derived from DNA fragments of bacteriophage genome
  - (D) CRISPR are DNA sequences found in mammalian cells
  - (E) CRISPR play a key role in antiviral defense system
16. A mutation that changes a serine codon to a stop codon is called a \_\_\_\_\_.
- (A) Missense mutation
  - (B) Silence mutation
  - (C) Nonsense mutation
  - (D) Frameshift mutation
  - (E) Suppressor mutation
17. Which can be determined by NGS (next generation sequencing)?
1. Genomic DNA sequence
  2. Expression of non-coding RNA
  3. DNA methylation
  4. Histone modification
  5. Chromosome conformation
  6. Protein structure
- (A) 1, 2,3,4
  - (B) 1,2,3,4,5
  - (C) 1,2,3,4,5,6
  - (D) 1,2
  - (E) 1,2,3
18. Which of the following can be determined by Western blotting (PAGE)?
1. Protein size
  2. The amount of proteins
  3. The presence of particular proteins
  4. Enzyme activity
  5. Interaction of protein and DNA
  6. Protein structure
- (A) 1, 2,3,4
  - (B) 1,2,3,4,5
  - (C) 1,2,3,4,5,6

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- (D) 1,2
- (E) 1,2,3

19. Which description is CORRECT for exosomes (vesicles)?

1. Membrane-bound extracellular vesicles
2. Contain RNA and proteins
3. Transfer molecules from one cell to another cell
4. Are produced in the endosomal compartment
5. Contain metabolites
6. The diameter is typically below 100 nm

- (A) 1, 2,3,4
- (B) 1,2,3,4,5
- (C) 1,2,3,4,5,6
- (D) 1,2
- (E) 1,2,3

20. Most protein kinases transfer phosphate groups to which amino acid(s)?

1. Glutamate
2. Threonine
3. Serine
4. Tyrosine
5. Lysine
6. Arginine

- (A) 1, 2,3,4
- (B) 2,3,5
- (C) 1,2,3
- (D) 2,3,4
- (E) 1,2,6

21. Following a nerve impulse, what triggers the opening of plasma membrane voltage-gated  $Ca^{2+}$  channels?

- (A) Membrane hyperpolarization
- (B) Endocytosis
- (C) Membrane depolarization
- (D) Membrane potential becomes more negative
- (E) Binding of glucose

22. Which description is INCORRECT for oncogene?

- (A) A gene that has potential to cause cancer
- (B) RAS and MYC are oncogenes
- (C) BRCA1 and p53 are oncogenes
- (D) The pro-oncogene can become an oncogene by a small modification of its original function.
- (E) Proto-oncogenes code for proteins that help cell proliferation

23. Which description is CORRECT for DNA double-strand break?

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1. It can induce non-homologous end joining repair
  2. It can induce homologous recombination
  3. It involves in VDJ recombination, the process that generates diversity on T cell receptors
  4. Massive DNA double-strand breaks can lead to cell death
  5. It induces H2AX phosphorylation
- (A) 1, 2,3,4  
(B) 2,3,5  
(C) 1,2,3  
(D) 1,3,4  
(E) 1,2,3,4,5,6
24. Which methods can analyze the interaction of DNA and proteins?
1. EMSA (electrophoretic mobility shift assay)
  2. Chromatin Immunoprecipitation
  3. Yeast two-hybrid system
  4. ChIP-seq
  5. RNA-seq
- (A) 1, 2,3,4  
(B) 2,3,5  
(C) 1,2,3  
(D) 1,2,4  
(E) 1,2,3,4,5,6
25. Mullis amplified a DNA sequence from genomic DNA by polymerase Chain Reaction (PCR), but he got different sizes of PCR products. Which of the following can improve the specificity?
- (A) Increase the melting temperate  
(B) Increase the amount of Taq polymerase  
(C) Increase the amount of dNTP  
(D) Increase the concentration of genomic DNA  
(E) Decrease the temperature of the initial denaturation step
26. George would like to clone X gene into a plasmid. The length of cDNA sequences of X gene, a protein coding gene, is 3000 bp. X protein has \_\_\_\_ amino acids, and its mass is about \_\_\_\_ kDa. Note: Average molecular weight of an amino acid is about 110 daltons.
- (A) 3000, 30  
(B) 1000, 110  
(C) 1000, 33  
(D) 1000, 330  
(E) 3000, 330
27. Jennifer ordered the primers for the PCR reaction and received dried oligos in the tubes. She got 30 nanomoles (nmol) oligos of the forward primer, and 25 nanomoles (nmol) oligos of the reverse primer. She would like to the prepare stock solution in 100 nM. How much water should be added into the tubes to make the stock solutions for these primers?
- (A) 300  $\mu$ l for the forward primer, 250  $\mu$ l for the reverse primer

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- (B) 30  $\mu$ l for the forward primer, 25  $\mu$ l for the reverse primer  
(C) 3 ml for the forward primer, 2.5 ml for the reverse primer  
(D) 3  $\mu$ l for the forward primer, 2.5  $\mu$ l for the reverse primer  
(E) 30 ml for the forward primer, 25 ml for the reverse primer
28. Which statement of post-translational modification is INCORRECT?  
(A) Phosphorylation is very common mechanism for regulating the activity of enzymes.  
(B) Ubiquitylation is usually associated with protein degradation.  
(C) SUMOylation plays a role in the major DNA repair pathways.  
(D) O-linked glycosylation is the attachment of a sugar molecule to the oxygen atom of serine or threonine residues in a protein.  
(E) Acetylation is usually on a glycine residue.
29. Which statement of enhancer is INCORRECT?  
(A) A region of DNA that can be bound by activators to increase the transcription.  
(B) It only can be found in eukaryotes.  
(C) Enhancers can be transcribed into RNAs called enhancer RNAs.  
(D) The active enhancers are usually in euchromatin.  
(E) H3K27ac is usually found in an active enhancer.
30. What statement of autophagy is INCORRECT?  
(A) Apoptosis is associated with the appearance of autophagosomes.  
(B) Autophagy is the nature, conserved degradation mechanism that removes dysfunctional components.  
(C) It goes through a lysosome-dependent mechanism.  
(D) Nutrient starvation usually represses autophagy.  
(E) Autophagy can contribute to cancer by promoting survival of tumor cells.
31. Which statement of ribosome is INCORRECT?  
(A) Ribosomes are composed of rRNA and ribosomal proteins  
(B) tRNA can enter the ribosome and bind to the messenger RNA via an anti-codon stem loop  
(C) The start codon in all mRNA molecules has the sequence UAG  
(D) The A-site binds to an aminoacyl-tRNA  
(E) The ribosome assembles on the start codon, located within the Kozak sequence in eukaryotes.
32. What statement of transposon is INCORRECT?  
(A) Transposable elements make up a large fraction of the genome in eukaryotic cells  
(B) Retrotransposons (Class I) are transcribed from DNA to RNA, and the RNA is then reversed transcribed to DNA  
(C) DNA transposons (Class II) function via reverse transcription  
(D) DNA transposons encode the protein transposase  
(E) A DNA sequence that can change its position within a genome
33. What statement of non-coding RNA is INCORRECT?  
(A) miRNA, piRNA and ribosomal RNAs are non-coding RNAs  
(B) The size of long non-coding RNA is above 200 bp  
(C) Non-coding RNAs are not found in prokaryotes  
(D) Genes encoding non-coding RNAs are not as conserved as coding genes  
(E) Non-coding RNAs can regulate gene expression

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34. What statement of mitosis is INCORRECT?
- (A) Prophase—chromatin fibers condense into chromosomes
  - (B) Prometaphase—microtubules begin to search and attach to kinetochores
  - (C) Metaphase—chromosomes are aligned along the metaphase plate
  - (D) Anaphase—the cohesins that bind sister chromatids together are cleaved
  - (E) The mitosis phase is a relatively long period of the cell cycle
35. Which of the following is a neurotransmitter?
- (A) Glutamate
  - (B) GABA
  - (C) Acetylcholine
  - (D) Dopamine
  - (E) All of above
36. What are minimal features of yeast artificial chromosomes (YAC)?
1. Centromere
  2. Promoter
  3. Coding genes
  4. Telomere
  5. Replication origin
- (A) 1, 2, 3
  - (B) 1, 4, 5
  - (C) 2, 3
  - (D) 1, 4
  - (E) 1, 2, 3, 4
37. Which statement of DNA replication is INCORRECT?
- (A) Okazaki fragments are short DNA fragments that bind to lagging strand
  - (B) Primase add RNA primers onto lagging strand
  - (C) DNA ligase I connects Okazaki fragments
  - (D) Proliferating cell nuclear antigen (PCNA) is a DNA clamp that acts as a processivity factor for DNA polymerase in eukaryotic cells
  - (E) Flap endonuclease 1 (FEN1) is responsible for removing RNA primer of an Okazaki fragment
38. What statement of mitochondrion is INCORRECT?
- (A) Mitochondrial DNA is circular
  - (B) A double-membrane-bound organelle
  - (C) Mitochondrial DNA is inherited from mother
  - (D) ATP is produced by oxidizing pyruvate and NADH in mitochondria
  - (E) One mitochondrion only contains one copy of its DNA
39. G protein-coupled receptors (GPCRs) have \_\_\_\_\_ transmembrane-domains. When the GPCR binds to a ligand, it activates an associated G protein by exchanging the \_\_\_\_\_ bound to the G protein for a \_\_\_\_\_.
- (A) Seven, GTP, GDP

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- (B) Five, GTP, GDP
- (C) Seven, GDP, GTP
- (D) Five, GDP, GTP
- (E) Three, GTP, GDP

40. Which of the following is not involved in RNA splicing?

- (A) U1 RNA
- (B) Small nuclear ribonucleoproteins
- (C) Ribozyme
- (D) Transesterification
- (E) Nonsense-mediated mRNA decay

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