

1. RNA molecules that exhibit catalytic activities are called

- (A) mRNAs
- (B) rRNAs
- (C) ribosomes
- (D) ribonucleotides
- (E) ribozymes

2. Cellular proteins destined for secretion are sorted and packaged in

- (A) nucleolus
- (B) endosomes
- (C) endoplasmic reticulum
- (D) *trans* Golgi network
- (E) lysosomes

3. Which of the following is true about a circular double-stranded DNA genome that is determined by chemical means to be 23 percent adenosine?

- (A) The genome is 11.5% guanosine.
- (B) The genome is 23% guanosine.
- (C) The genome is 27% guanosine.
- (D) The genome is 54% guanosine.
- (E) The base percent composition of guanosine in the genome cannot be determined from the information given.

4. In the classical model of transcriptional control, a repressor protein binds to

- (A) an AUG sequence
- (B) an operator
- (C) a TATA box
- (D) a Shine-Dalgarno sequence
- (E) an enhancer

5. "Zinc fingers" are important in cellular functions because they are

- (A) at the catalytic site of many kinases
- (B) structures with high redox potential
- (C) introduce double-stranded DNA breaks
- (D) a structural motif of many DNA-binding proteins
- (E) characteristic of palindromic stretches of unique-sequence DNA

6. CRISPR/Cas9 is the most talked about techniques in the past few years for targeted genome editing. Which of the following statement about CRISPR/Cas9 is NOT correct?

- (A) An RNA molecule, called guide RNA, directs Cas9 to the target
- (B) Cas9 is an exonuclease that cut double-stranded DNA
- (C) The system was originally discovered as part of adaptive immunity in bacteria
- (D) The system has been shown to work in many organisms.
- (E) The system can be used to control gene expression.

7. Which of the following is NOT required by DNA polymerase for *in vitro* synthesis of DNA?

- (A) tRNA

見背面

- (B) ATP
- (C) primer
- (D) dATP
- (E) DNA template

8. The “2018 Nobel Prize in Chemistry” was awarded to scientists who pioneered directed evolution. Which of the following statement about directed evolution is NOT correct?

- (A) It mimics natural evolution and directs protein engineering toward a user-defined goal.
- (B) It involves iterative rounds mutagenesis, selection and amplification.
- (C) High fidelity DNA polymerases are used for random mutagenesis *in vitro*.
- (D) The fidelity of the Taq DNA polymerase can be modulated by alteration of the composition of the reaction buffer.
- (E) DNA shuffling is another powerful method for directed evolution, which generates diversity by recombination.

9. Which of the following restrict enzymes will produce a blunt end (the cutting site is indicated with * in the recognition sequence)?

- (A) HaeIII (GG*CC)
- (B) EcoRI (G*AATTC)
- (C) NotI (GC*GGCCGC)
- (D) XbaI (T*CTAGA)
- (E) PstI (CTGCA*G)

10. Which of the following can NOT be determined by NGS (next-generation sequencing)?

- (A) the genome of a cell.
- (B) the transcriptome of a cell.
- (C) the lncRNA of a cell.
- (D) the proteome of a cell.
- (E) the genome of chloroplast.

11. Transcriptionally inactive genes

- (A) are always located within euchromatin.
- (B) are often methylated.
- (C) are often ubiquitinated.
- (D) are not located within nucleosomes.
- (E) are not resistant to DNase I.

12. Which of the following technique is usually used to detect genome-wide chromatin accessibility?

- (A) Yeast two-hybrid
- (B) SDS-PAGE
- (C) ATAC-seq
- (D) Co-immunoprecipitation
- (E) Electroporation

13. Which of the following type of bonds or interactions are LEAST likely to be involved in stabilizing the three-dimensional folding of most proteins?

- (A) Ester bonds
- (B) Hydrogen bonds

- (C) Electrostatic bonds
- (D) Hydrophobic interactions
- (E) Disulfide bonds

14. The amino acid sequence of a novel membrane protein contains six immunoglobulin-like domains and four fibronectin-like repeats. This protein is most likely a

- (A) G protein
- (B) transcriptional factor
- (C) motor protein
- (D) cell adhesion molecule
- (E) serine/threonine protein kinase

15. Which of the following is most likely to lead to a loss of gene function?

- (A) A missense mutation in the open reading frame
- (B) A change from TAA codon to TAG codon in the coding region
- (C) A change from C to T in the promoter region
- (D) A sequence change in the 5' untranslated region
- (E) A frameshift mutation in the coding region

16. Which of the following best describes the function of the sigma subunit of the RNA polymerase in *E. coli*?

- (A) It is required for transcriptional termination.
- (B) It is required for elongation of the RNA transcript.
- (C) It increases the accessibility of RNA polymerase to any DNA template.
- (D) It is essential for the recognition and binding to the promoter sequence.
- (E) It keeps the core complex from dissociating.

17. Which of the following is the most likely mechanism for the origin of multigene families?

- (A) Endosymbiosis
- (B) Horizontal gene transfer
- (C) Gene duplication
- (D) Bacterial conjugation
- (E) Convergent evolution of dissimilar genes

18. Which of the following is NOT required for Rec-A dependent recombination between two DNA molecules?

- (A) ATP hydrolysis
- (B) Mismatch repair
- (C) Ligation
- (D) Strand migration
- (E) DNA synthesis

19. The ribosome is involved in all of the following EXCEPT

- (A) peptide bond formation
- (B) tRNA aminoacylation
- (C) binding of aminoacyl-tRNA to mRNA
- (D) binding of mRNA at an initiation codon
- (E) binding to Shine-Dalgarno sequence

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20. Operator constitutive mutants of the *lac* operon would
- (A) express the *lac* repressor constitutively.
 - (B) block the binding of RNA polymerase to the promoter.
 - (C) enhance the binding of RNA polymerase to the promoter.
 - (D) prevent the inducer from binding to the repressor.
 - (E) express β -galactosidase constitutively.
21. Which of the following elements can function as eukaryotic promoters?
- a. a TATA box.
 - b. an initiator element.
 - c. CpG islands.
 - d. start codon.
- (A) only a.
 - (B) a and b.
 - (C) a and c.
 - (D) a, b and c.
 - (E) a, b, c and d.
22. Which of the following elements are typical features of prokaryotic genes?
- a. polycistronic messenger RNAs
 - b. complex transcription units
 - c. introns
- (A) only a.
 - (B) b and c.
 - (C) a and c.
 - (D) a, b and c.
 - (E) none of the above.
23. Short micro RNAs (miRNAs)
- a. code for proteins.
 - b. are common in bacteria but not eukaryotes.
 - c. can lead to mRNA degradation.
 - d. can lead to translational repression.
- (A) only a.
 - (B) only c.
 - (C) b and c.
 - (D) c and d.
 - (E) none of the above.
24. Which of the following statements about mitochondrial DNA are true?
- a. Mammalian mitochondrial DNA contains introns.
 - b. Mitochondrial DNA encodes rRNAs and tRNAs.
 - c. The human mitochondrial DNA is circular.
- (A) only a.
 - (B) only b.

- (C) only c.
- (D) b and c.
- (E) a, b and c.

25. A small molecule that binds directly to the active site of an enzyme and disrupts its catalytic reaction is called

- (A) an allosteric inhibitor.
- (B) a competitive inhibitor.
- (C) a noncompetitive inhibitor.
- (D) RNAi.
- (E) ATP binding pocket.

26. Which of the following plays a role in the degradation of proteins?

- a. RNAi
 - b. ubiquitin
 - c. proteasome
 - d. nuclease
- (A) a and b.
 - (B) b and c.
 - (C) a and c.
 - (D) a, b and c.
 - (E) a, c and d.

27. Which of the followings are constituents of deoxyribonucleotides?

- a. phosphate moieties
 - b. deoxyribose
 - c. ribose
 - d. organic bases
- (A) a and b.
 - (B) a and c.
 - (C) b and d.
 - (D) a, b and d.
 - (E) a, b, c and d.

28. Which of the following are removed from mRNAs during processing?

- a. exons
 - b. introns
 - c. noncoding sequences
 - d. RNA cap structure
 - e. poly(A) tail
- (A) only a.
 - (B) only c.
 - (C) b and c.
 - (D) a and c.
 - (E) all of the above.

29. Which of the following is a protein that is involved in translation?

見背面

- a. topoisomerase
- b. ribosomal RNA
- c. RNA polymerase
- d. aminoacyl-tRNA synthetase

- (A) only a.
- (B) only b.
- (C) only d.
- (D) b and d.
- (E) all of the above.

30. Cellular protein synthesis proceeds in which direction?

- a. carboxyl to amino terminus
- b. amino to carboxyl terminus
- c. 3' to 5'
- d. 5' to 3'

- (A) only a.
- (B) only b.
- (C) only c.
- (D) only d.
- (E) b and d.

31. DNA replication begins at sequences called

- a. promoters.
- b. initiators.
- c. origins.
- d. operons.
- e. Okazaki fragments.

- (A) only a.
- (B) only c.
- (C) a and b.
- (D) c and e.
- (E) b and d.

32. A mutation that changes a cysteine codon to a tryptophan codon is called a

- (A) missense mutation.
- (B) nonsense mutation.
- (C) frameshift mutation.
- (D) silent mutation.
- (E) suppressor mutation.

33. DNA ligase

- a. synthesizes DNA from a template.
- b. forms a phosphodiester bond.
- c. forms a peptide bond.
- d. joins Okazaki fragments.

- (A) only b.

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- (B) only c.
- (C) only d.
- (D) a and b.
- (E) b and d.

34. Which of the following evidence is indicative of the presence of a gene in an unknown DNA sequence?

- a. alignment to a partial cDNA sequence
- b. sequence similarity to genes of other organisms
- c. ORF consistent with the rules for exon and intron sequences

- (A) only a.
- (B) only b.
- (C) only c.
- (D) b and c.
- (E) a, b and c.

35. Telomeres

- a. consist of repetitive sequences with high G content.
- b. are a few hundred base-pairs long in vertebrates.
- c. have specific proteins bound at the DNA ends.

- (A) only a.
- (B) only b.
- (C) only c.
- (D) a and c.
- (E) a, b and c.

36. Splice sites in pre-mRNA are marked by two universally conserved sequences contained

- (A) in the middle of the intron.
- (B) in the middle of the exon.
- (C) at the ends of the exons.
- (D) at the ends of the introns.
- (E) none of the above.

37. Which type of RNA participates in nuclear export of mRNA?

- (A) hnRNA
- (B) snRNA
- (C) tRNA
- (D) rRNA
- (E) miRNA

38. Which of the following about prokaryotes is correct?

- (A) lack of cell walls
- (B) lack of nucleus
- (C) most of prokaryotic chromosomes is linear
- (D) they contain mitochondria
- (E) all of the above

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39. The polymerase chain reaction (PCR) technique can be used for

- a. direct isolation of a specific segment of genomic DNA.
- b. preparation of probes.
- c. synthesis of RNA from genomic DNA.
- d. introduction of mutations in a DNA fragment.

- (A) only a.
- (B) only b.
- (C) a and b.
- (D) a and c.
- (E) a, b and d.

40. The ability of DNA to denature is important for which process?

- a. DNA synthesis
- b. nucleic acid hybridization experiments
- c. RNA synthesis
- d. Protein synthesis

- (A) only a.
- (B) only b.
- (C) a and b.
- (D) a, b and c.
- (E) all of the above.

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