

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 molecule(s) is/are needed to convert fibroblast into pleural stem cells.
 - (A) fos
 - (B) Sox
 - (C) actin
 - (D) nanog
 - (E) tubulin
2. Which of the following gene therapy vectors belong to DNA virus.
 - (A) Lentivirus
 - (B) AAV
 - (C) Adenovirus
 - (D) Sindbis virus
 - (E) Retrovirus
3. Which of the following is/are able to determine whether A gene can regulate B gene transcription.
 - (A) Measure B protein expression by forcing A gene expression in cells
 - (B) Measure the mRNA expression of B gene by silencing A gene expression
 - (C) Sequence B gene
 - (D) Test the promoter activity of B gene
 - (E) Measure the mRNA expression of B gene by forcing A gene expression.
4. Which of the following statements are **INCORRECT**.
 - (A) CRISPR is eukaryotic immune system.
 - (B) CRISPR is used to edit genome.
 - (C) CRISPR system contains gRNA and Cas9.
 - (D) CRISPR system should involve integrase and protease molecules.
 - (E) CRISPR system involves in DNA repair.
5. Which of the following statements are **CORRECT**.
 - (A) Fibronectin in extracellular matrix is a glycoprotein
 - (B) Cytoskeleton-actin is located inside cell
 - (C) Collagen in extracellular matrix is a glycoprotein
 - (D) Integrin is located in lipid membrane.
 - (E) Gap junction is the process that molecules and ions enter into cells through diffusion or active transport.
6. Which of the following is/are **NOT** post-translation modification.
 - (A) 5' end capping
 - (B) Glycosylation
 - (C) Ubiquitination
 - (D) Sumolation
 - (E) Deletion
7. About DNA replication, select the **FALSE** statements.
 - (A) Leading strand synthesis needs DNA polymerase.
 - (B) Nucleotides contain ribose sugar, phosphate and nucleobase.
 - (C) The leading strand needs a RNA primer.
 - (D) It occurs in the M phase of the cell cycle.
 - (E) DNA replication needs helicase.

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8. About cytoskeletons, select the **FALSE** statements.
- (A) Microfilaments are the polymers of actin.
 - (B) Microtubules are the polymers of actin.
 - (C) Intermediate filaments maintain cell shape.
 - (D) Microtubules are organized at centrosome.
 - (E) Intermediate filament functions for mitotic spindle
9. Select the **FALSE** statements.
- (A) Human cells contain 46 chromosomes.
 - (B) Human cells contain 46 chromatids.
 - (C) Chromatin is decondensed.
 - (D) Mitosis helps cells pass on a perfect set of DNA to each daughter cell during division.
 - (E) Meiosis can produce gametes.
10. Select the **FALSE** statements.
- (A) RNA transcription starts at DNA polymerase with coactivator to DNA promoter site.
 - (B) RNA transcription starts at DNA template at 3' to 5' Strand.
 - (C) Bacteria RNA transcription termination is Rho-dependent or -independent manner.
 - (D) RNA transcription has higher fidelity than DNA replication.
 - (E) RNA transcription starting point needs open complex formation.
11. Select the **CORRECT** statements.
- (A) Micro RNA is a small non-coding RNA.
 - (B) Micro RNA contains 10 nucleotides.
 - (C) Micro RNA is the small interfering RNA (siRNA).
 - (D) Micro RNA silences RNA functions as post-transcriptional regulation.
 - (E) RNA polymerase III transcribes some micro RNA.
12. Select the **FALSE** statements.
- (A) RNA splicing can remove introns.
 - (B) Reverse transcriptase can convert DNA to RNA.
 - (C) The consensus for the intron donor site is AG and the acceptor site is GU.
 - (D) Spliceosome is a RNA-protein complex to remove introns.
 - (E) Splicing can occurs in bacteria and viruses.
13. Select the **FALSE** statements.
- (A) Most proteins use co-translation/translocation pathways.
 - (B) The secretory protein contains a signal peptide.
 - (C) The chaperon protein functions for secretory protein translocation.
 - (D) The transmembrane G-protein coupled receptors have an amino-terminal signal sequence.
 - (E) Most the targeting sequence of peroxisome matrix proteins is on the C-terminal extension to import them to the organelle.
14. Select the **CORRECT** statements.
- (A) Mitochondria can generate the chemical energy (ATP) source for cells.
 - (B) Mitochondria contain their own genome.
 - (C) Mitochondria can store calcium for cell homeostasis of calcium.
 - (D) Mitochondria process glycolysis.
 - (E) Mitochondria cristae are derived from the folding of outer membrane.
15. Which of the following is/are tumor suppressor genes.
- (A) Rb
 - (B) Myc

- (C) p21
- (D) Jun
- (E) EGFR

16. Select the **CORRECT** statements.

- (A) Golgi apparatus processes protein glycosylation.
- (B) Proteins are synthesized at Golgi and then fused with ER.
- (C) Trans Golgi can package proteins into vesicles destined to lysosome.
- (D) Antibody containing vesicles are predominant in B cells.
- (E) Mitochondria contain signal membrane.

17. Select the **FALSE** statements.

- (A) During interphase, for chromosome segregation.
- (B) G0 is resting phase.
- (C) During S phase, nuclear DNA contents are duplicated.
- (D) Cyclin A and Cdc2 can be used as markers for G1/S.
- (E) p16 is a cell proliferation marker

18. Select the **CORRECT** statements.

- (A) Apoptosis is the process of programmed cell death.
- (B) Necrosis is the process of programmed cell death.
- (C) Necroptosis is the process of programmed cell death.
- (D) Autophagy is caspase-dependent.
- (E) TUNEL assay is for apoptosis detection.

19. Select the **CORRECT** statements.

- (A) Epigenetic trait means the changes in DNA sequences.
- (B) Nucleosome is the DNA wrapped around eight histones (H2A, H2B, H3, H4)
- (C) Histone H3 can be methylated at serine.
- (D) Histone H3 can be acetylated at threonine.
- (E) An imbalance in the equilibrium of histone acetylation is associated with tumorigenesis and cancer progression.

20. Select the **FALSE** statements.

- (A) Ligands bind to membrane receptors to activate downstream signaling.
- (B) Steroid hormone is a lipid-soluble molecule, and can cross the plasma membrane to reach nuclear receptor.
- (C) Her2/neu is a ligand and also an oncogene.
- (D) The mutated EGFR can constitutively activate the downstream signaling.
- (E) In case of Wnt signaling, beta-catenin phosphorylation is for survival.

21. Which of the following is **NOT** a component of a ribonucleotide?

- (A) Glucose
- (B) Ribose
- (C) Uracil
- (D) Thymine
- (E) Adenine

22. Which of the following modifications found on amino acids is also used to modify nucleic acids?

- (A) Phosphorylation
- (B) Glycosylation
- (C) Methylation
- (D) Acetylation

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(E) Hydroxylation

23. Which of the following describe an instance in which **weak chemical bonds** are useful in biological systems?

- (A) The bonding of antibodies to the antigens they recognize
- (B) Folding of proteins into their active conformation
- (C) Stabilization of DNA double-stranded helices
- (D) Formation of polypeptide chains through amide bond
- (E) A gecko's ability to climb surfaces such as glass

24. Which of the following is **NOT** a feature of the DNA helix proposed by Watson and Crick?

- (A) Double-stranded
- (B) Right-handed
- (C) Antiparallel
- (D) Complementary base pairing
- (E) Two grooves of equal dimensions

25. Which of the following is a function of RNA?

- (A) Catalytic roles in translation and splicing
- (B) As transient carriers of genetic information.
- (C) As a carrier of amino acids to the site of protein synthesis.
- (D) Viral genomes having double-stranded RNA helices.
- (E) Targeting specificity in CRISPR-Cas9 genome-editing system

26. Why is green fluorescent protein (GFP) so useful in visualizing fusion proteins in eukaryotes?

- (A) The reaction is only dependent on the presence of GFP and one other cofactor.
- (B) It is easily cloned and expressed in eukaryotes.
- (C) The presence of just a few molecules of GFP fusion proteins can be sufficient for observing the proteins microscopically allowing the study of its location and movements in the cell.
- (D) It is derived from fire flies, which are easy to cultivate in the lab.
- (E) The GFP protein recognizes and binds to fusion proteins allowing the location of the fusion protein to be determined.

27. Which of the following is correct regarding yeast three-hybrid analysis?

- (A) A useful tool in analyzing RNA-protein interactions
- (B) It contain a fusion protein of LexA, which binds the reporter construct, and MS2 which specifically binds an RNA tag that has been added to every RNA produced by the plasmid library.
- (C) It needs a plasmid library that contains random sequences from the genome tagged with a unique hairpin sequence that MS2 will bind.
- (D) It requires a reporter construct that contains a LexA operator (binding site) and a reporter gene.
- (E) It needs a fusion protein of the protein of interest and two tags – the calmodulin binding site and protein A.

28. Which of the following is a function of telomeres?

- (A) Serve as an attachment site for the proteins of the kinetochore.
- (B) They are sequences at the ends of the linear eukaryotic chromosome that protect the ends from proteases.
- (C) They are sequences of the eukaryotic chromosome that ensure proper distribution during mitosis.
- (D) In most eukaryotes, telomeres are protected from shortening by a protein-RNA complex called telomere terminal transferase.
- (E) *Drosophila* species maintain telomere lengths by the regulated insertion of retrotransposons into

telomeres.

29. Which of the following is the function of histone H1?
- (A) Stabilizing nucleosomes
 - (B) Promoting higher order chromosome structure
 - (C) Modulating the repression of transcription by nucleosomes
 - (D) Binding to regions undergoing active RNA synthesis
 - (E) Mediating epigenetic regulation
30. Which of the following is affected by the presence of epigenetic marks?
- (A) Development
 - (B) Imprinting
 - (C) X-chromosome inactivation
 - (D) Maturation of RNA
 - (E) Unique expression patterns in different cells
31. Point mutations in the DNA sequence can cause:
- (A) silent mutation
 - (B) missense mutation
 - (C) nonsense mutation
 - (D) frameshift mutations
 - (E) none of the above
32. Which of the following is/are a step in nonhomologous end joining?
- (A) Phosphorylation of the Ku70-Ku80 complex
 - (B) Degradation of any single-strand overhangs or hairpins from the broken ends of the chromosomes to be repaired
 - (C) Binding of the Ku70-Ku80 complex to the broken chromosome ends
 - (D) Binding of a kinase and a nuclease to the Ku70-Ku80 complex on the DNA
 - (E) None of the above
33. Which of the following is/are coded for by the retroviral genome?
- (A) Viral coat proteins
 - (B) tRNA
 - (C) Reverse transcriptase
 - (D) Integrase
 - (E) Envelope protein
34. Which of the following transcription factors is/are utilized by all three eukaryotic RNA polymerases?
- (A) TFIID
 - (B) TBP
 - (C) DNA helicase
 - (D) THIIIC
 - (E) THIIF
35. Which of the following is **NOT** usually involved in the processing of primary mRNA transcripts?
- (A) Addition of multiple adenosines to the 3' end
 - (B) Insertion of intron sequences
 - (C) Covalent joining of exons

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- (D) Methylation of nucleotides at the 5' end
- (E) None of the above

36. Which of the following statements is/are FALSE?

- (A) A transcription factor that enhances gene expression is called enhancer.
- (B) A transcription factor that enhances gene expression is called activator.
- (C) A transcription factor that reduces gene expression is called repressor.
- (D) A transcription factor that enhances gene expression is called operator.
- (E) Insulator is a regulatory DNA site.

37. Which of the following is/are FALSE about the *E. coli* Lac operon?

- (A) Transcription produces a single polycistronic mRNA containing the *lacZ*, *lacY*, and *lacA* genes.
- (B) The *lacI* gene is controlled from the same promoter as the *lacZ* gene.
- (C) The Lac repressor protein is constitutively expressed.
- (D) The operator region regulates transcription through interaction with the Lac repressor protein.
- (E) The amount of glucose in the growth medium does not affect the level of gene expression activated by lactose.

38. Which of the following is NOT true of the genes encoding the enzymes required for transporting and metabolizing galactose in yeast?

- (A) Each of the *GAL* genes is transcribed separately.
- (B) The *GAL* genes are arranged in an operon.
- (C) All of the *GAL* genes have similar promoters.
- (D) All of the *GAL* genes are coordinately regulated by a common set of proteins.
- (E) The upstream activator sequence for the *GAL* genes (UAS_{GAL}) is recognized by Gal3p.

39. Which of the following is NOT true of miRNA processing?

- (A) Drosha processes primary miRNA transcripts to precursor miRNAs.
- (B) RISC binds to pre-miRNA in the cytoplasm.
- (C) RNA helicase is necessary for unwinding the miRNA duplex.
- (D) Dicer completes the processing by cleaving the single-stranded form of the miRNA.
- (E) Precursor miRNAs are approximately 60-70 nucleotides long.

40. Which of the following statements about the genetic code is/are TRUE?

- (A) A bacterial mRNA of 800 nucleotides could code for a 300 amino acid protein.
- (B) There are at least three codons for each amino acid.
- (C) A new codon begins every three nucleotides.
- (D) The fourth codon establishes the reading frame.
- (E) The genetic code is degenerate because one particular amino acid can be encoded by more than one codon.

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