Please choose the most appropriate terms/phrases/statements that complete or answer the questions.
Attention: <u>More than one</u> of the choices provided may be correct.
(2.5 points for each question)

1. According to the fluid mosaic model of cell membranes, phospholipids _____.
   (A) have hydrophilic tails in the interior of the membrane.
   (B) frequently flip-flop from one side of the membrane to the other.
   (C) occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane
   (D) can move laterally along the plane of the membrane.
   (E) have hydrophobic heads in the exterior of the membrane.

2. The genetic code is essentially the same for all organisms. From this, what can be assumed?
   (A) The same codons in different organisms translate into the same amino acids.
   (B) A gene from an organism can theoretically be expressed by any other organism.
   (C) Different organisms have the same types of amino acids.
   (D) The sequence of amino acids could be predicted according to their DNA sequence.
   (E) The same genetic code could be translated into different amino acids.

3. Which of the following contradicts the one-gene, one-enzyme hypothesis?
   (A) Alkaptonuria results when individuals lack a single enzyme involved in the catalysis of homogentisic acid.
   (B) Sickle-cell anemia results in defective hemoglobin.
   (C) A mutation in a single gene can result in a defective protein.
   (D) A single antibody gene can code for different related proteins, depending on the alternative splicing.
   (E) No case contradicts the one-gene, one-enzyme hypothesis.

4. In 1928, English microbiologist Frederic Griffith demonstrated that DNA is the genetic material to determine the virulence of bacteria cells; what observations helped this conclusion?
   (A) The heat-killed pathogenic bacteria + live non-pathogenic bacteria → pathogenic.
   (B) The heat-killed non-pathogenic bacteria+ live pathogenic bacteria → pathogenic.
   (C) The transformation of bacteria was carried by a heat-stable genetic material.
   (D) Pathogenicity reflects the action of the non-capsule gene.
   (E) Non-pathogenic bacteria could uptake the capsule gene from the bead pathogenic bacteria.

5. What is (are) the mechanism of information transfer in eukaryotes?
   (A) Messenger RNA is transcribed from a single gene and transfers information from the DNA in the nucleus to the cytoplasm, where protein synthesis takes place.
   (B) Transfer RNA takes information from RNA directly to a ribosome, where protein synthesis takes place.
   (C) RNA from a single gene is synthesized and transferred to the cytoplasm, where it serves as a template for protein synthesis.
   (D) Proteins transfer information from the nucleus to the ribosome, where protein synthesis takes place.
   (E) A single gene of eukaryote only makes one mRNA.

6. Which of the following occurs in prokaryotes but not in eukaryotes?
   (A) Post-transcriptional splicing
   (B) Translation in the absence of a ribosome
   (C) Concurrent transcription and translation
   (D) Gene regulation
   (E) Operon system

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7. A ribozyme is _____.
   (A) a catalyst that uses RNA as a substrate
   (B) an enzyme that synthesizes RNA as part of the transcription process
   (C) an enzyme that catalyzes the association between the large and small ribosomal subunits
   (D) an RNA with catalytic activity
   (E) Group II intron could be one example of ribozyme.

8. A mutant bacterial cell has a defective aminoacyl-tRNA synthetase that attaches a lysine to tRNAs with the anticodon AAA instead of the normal phenylalanine. The consequence of this for the cell will be that _____.
   (A) the positions of phenylalanine in proteins will still encode phenylalanine.
   (B) the cell will compensate for the defect by attaching phenylalanine to tRNAs with lysine-specifying anticodons.
   (C) proteins in the cell will include lysine instead of phenylalanine at amino acid positions specified by the codon UUU.
   (D) the ribosome will skip a codon every time a UUU is encountered.
   (E) No phenylalanine will be encoded.

9. A mutation that inactivates a regulatory gene of a repressible operon in an *E. coli* cell would result in _____.
   (A) continuous transcription of the structural gene controlled by that regulator.
   (B) no binding of the repressor to the operator.
   (C) complete activation of transcription of the structural gene controlled by that regulator.
   (D) continuous translation of the mRNA because of alteration of its structure.
   (E) no gene will be affected.

10. The primary difference between enhancers and promoter-proximal elements is that enhancers _____.
   (A) enhance transcription; promoter-proximal elements inhibit transcription.
   (B) are transcription factors; promoter-proximal elements are DNA sequences.
   (C) are at considerable distances from the promoter; promoter-proximal elements are close to the promoter.
   (D) are DNA sequences; promoter-proximal elements are also DNA sequences.
   (E) are regulated by RNA for their functions.

11. To introduce a particular piece of DNA into a mouse, you would most likely be successful with which of the following methods?
   (A) electroporation followed by recombination.
   (B) introducing a plasmid into the cell.
   (C) infecting the mouse cell with a Ti plasmid.
   (D) transcription and translation.
   (E) intravenous injection.

12. Which of the following status may reflect what we know about how the flu virus moves between species?
   (A) An animal such as a pig is infected with more than one virus, genetic recombination occurs, the new virus mutates, the virus is passed to a new species such as a bird, and the virus mutates again and can now be transmitted to humans.
   (B) The flu virus in a pig is mutated and replicated in alternate arrangements so that humans who eat the pig products can be infected.
   (C) An influenza virus gains new sequences of DNA from another virus, such as a herpesvirus; this enables it to be transmitted to a human host.
   (D) A farmer is infected by human flu and chicken flu virus at the same time and the recombinant virus could

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become highly contagious and virulent for human.
(E) Two influenza virus exchange their genomes in soil.

13. Please select all the **CORRECT** description about M phase of cell cycle.
(A) Cyclin dependent kinase 2 (Cdk2) is the key kinase regulate the progression of M phase.
(B) Cellular DNA starts to replicate at M phase.
(C) The nuclear envelope starts to break down at prophase.
(D) The nuclear envelope starts to reorganize at nuclear port complex at telophase.
(E) Chromosomes are separated.

14. The product of the *p53* gene _____.
(A) causes cells to reduce expression of genes involved in DNA repair.
(B) promotes the cell cycle.
(C) allows cells to pass on mutations due to DNA damage.
(D) slows down the rate of DNA replication by interfering with the binding of DNA polymerase.
(E) interacts with p52 to form a heterodimer that regulates cell cycle.

15. Which of the following statements describes the lysogenic cycle of lambda (λ) phage is (are) **NOT CORRECT**?
(A) The phage DNA is copied and exits the cell as a phage.
(B) Most of the prophage genes are activated by the product of a particular prophage gene.
(C) The phage genome does not replicate along with the host genome.
(D) After infection, the viral genes immediately turn the host cell into a lambda-producing factory, and the host cell then lyses.
(E) The lambda phage never pops out from host genome.

16. Bacterial cells protect their own DNA from restriction enzymes (endonucleases) by _____.
(A) using DNA ligase to seal the bacterial DNA into a closed circle.
(B) adding methyl groups to adenines and cytosines.
(C) adding histones to protect the double-stranded DNA.
(D) forming "sticky ends" of bacterial DNA to prevent the enzyme (endonuclease) from attaching.
(E) inhibiting enzyme activity.

17. What information is critical to the success of polymerase chain reaction (PCR) itself?
(A) The sequence of restriction-enzyme recognition sites in the DNA to be amplified must be known.
(B) The sequence of restriction-enzyme recognition sites in the DNA to be amplified and in the plasmid where the amplified DNA fragment will be cloned must be known.
(C) The complete DNA sequence of the DNA to be amplified must be known.
(D) The DNA sequence of the ends of the DNA to be amplified must be known.
(E) The Tm of primers must be known.

18. Which descriptions is (are) **CORRECT** for DNA replication.
(A) The specific sites at which DNA unwinding and initiation of replication occur are called origins of replication.
(B) The DNA replicated form a particular origin of the replication is a “replicon”.
(C) Replicator sequences include initiator binding sites and easily unwound DNA.
(D) Helicase loading is the first step in the initiation of replication in eukaryotes.
(E) The DNA replication proceeds in a semiconservative manner.

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19.RNAi methodology uses double-stranded pieces of RNA to trigger breakdown of a specific mRNA or inhibit its translation. For which of the following might this technique be useful?
(A) To destroy an unwanted allele in a homozygous individual.
(B) To decrease the concentration of a desired protein in cells.
(C) To form a knockout organism that will not pass the deleted sequence to its progeny.
(D) To decrease the production from a harmful mutated gene.
(E) To modify a specific gene at the DNA levels.

20.Okazaki fragments are _____.
(A) short stretches of DNA formed on the lagging strand.
(B) short RNA primers needed for initiation of polymerization.
(C) the smallest subunits of DNA polymerase III.
(D) fragments of DNA polymerase I that lack 5' → 3' exonuclease activity.
(E) ligated together when replication is completed.

21.Which of the following conditions are required to assure production of a protein when a plasmid is being designed to express a eukaryotic protein in a bacterium?
(A) Introns must be deleted from the gene.
(B) The cloning site must include an RNA polymerase promoter.
(C) The mRNA product must contain a ribosome-binding site.
(D) The poly-A tail must be added to the 3' end of the gene.
(E) Differences in the genetic code between eukaryotes and prokaryotes must be accommodated.

22.Which of following statements describes a difference between replication of DNA and transcription of RNA?
(A) Nucleoside triphosphates are the precursors for replication, but ribonucleoside diphosphates are used for transcription.
(B) The DNA strands become separated during replication and transcription.
(C) Base pairing is used to copy the sequence in replication, but not in transcription.
(D) Both strands of DNA are copied in replication, but only one is copied in transcription
(E) The chain grows from the 5' to the 3' end in replication and transcription.

23.The best primers for the PCR reaction have the following feature:
(A) They have a high A-T content.
(B) They have a high G-C content.
(C) They should be palindromic.
(D) They should not have internal hairpin structure.
(E) They should anneal rapidly, before the larger DNA strands reanneal.

24.Which of the following statement(s) about intracellular second messengers is (are) **TRUE**?
(A) Cyclic GMP can act as secondary messengers.
(B) It is a hormone that affects the DNA of the target cell.
(C) Adenosine triphosphate can act as secondary messengers.
(D) It is a specialized form of RNA.
(E) Ca^{2+} can function as a secondary messenger by controlling the flow of Ca^{2+} into the cells.

25.Which property of DNA is (are) crucial for the conservation of genetic information?
(A) anti-parallelism
(B) the ability to form a circular DNA
(C) the amount of C is the same as the amount of G

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(D) semiconservative replication
(E) base-pair complementarity

26. What happens to the DNA copy of the retroviral RNA genome after it is produced?
(A) It is wrapped in a capsid for export from the cell.
(B) It is degraded after the synthesis of retroviral genomic RNA.
(C) It is incorporated into the host's DNA.
(D) It is used as a template to synthesize retroviral RNA in the 5' → 3' direction.
(E) It is transcribed to produce mRNAs.

27. Which of the following statements concerning the genetic code is **FALSE**?
(A) Each codon can interact with more than one tRNA.
(B) It is based on triplets.
(C) Wobble allows a single codon to code for more than one amino acid.
(D) It is non-overlapping.
(E) It is degenerate.

28. Which of the following is (are) an activity of DNA Polymerase I?
(A) DNA ligase activity.
(B) Polymerase activity.
(C) 5' → 3' exonuclease activity.
(D) 3' → 5' endonuclease activity.
(E) Ability to nick intact double strand DNA

29. The following reactions are all common parts of some hormone processes:
1. Binding of the hormone to a receptor.
2. Synthesis of cyclic AMP.
3. Phosphorylation of the target enzyme.
4. Release of a G-protein from the interior cell membrane.
5. Activation of a protein kinase.
A typical path of reactions would follow this sequence:
(A) 1 → 2 → 4 → 3 → 5.
(B) 1 → 4 → 2 → 3 → 5.
(C) 2 → 1 → 4 → 5 → 3.
(D) 1 → 4 → 2 → 5 → 3.
(E) 1 → 2 → 4 → 5 → 3.

30. Which of the following is (are) the **CORRECT** description of an operon?
(A) An enhancer that positively regulates gene expression.
(B) A single operon usually contains all the enzymes that are specific for the synthesis of a special biomolecule.
(C) A silencer that negatively regulates gene expression.
(D) It occurs in both prokaryotes and eukaryotes.
(E) A group of genes under the control of a common promoter.

31. Which amino acid is (are) hydrophobic?
(A) Aspartic acid
(B) Tryptophan
(C) Leucine

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(D) Glutamine
(E) Serine

32. Which of the following description is (are) **CORRECT** regarding chemical bonds?
(A) Van der Waals interactions are weak attractive interactions caused by transient dipoles.
(B) Covalent bonds are much weaker than noncovalent interactions.
(C) Hydrogen bonds are covalent bonds that determine the water solubility of uncharged molecules.
(D) Molecular complementarity due to noncovalent interaction leads to a lock-and-key fit between biomolecules.
(E) Ionic interactions are attraction between oppositely charged molecules.

33. Which of the following description is (are) **CORRECT** regarding protein structure and function?
(A) Secondary structures are the core elements of protein architecture, including α helix, β sheet, and β turn.
(B) Protein tertiary structure are resulted from hydrophobic interactions, hydrogen bonds and ionic interactions.
(C) Folding of proteins in vivo is promoted by chaperones, which utilize ATP hydrolysis to assist protein folding.
(D) Abnormally folded proteins can form amyloids and lead to human diseases, such as Alzheimer's disease and Parkinson's disease.
(E) The structure and function of a protein is only determined by its amino acid sequence.

34. Which of the following description for regulating protein function is (are) **CORRECT**?
(A) Regulated synthesis and degradation of proteins is a fundamental property of cells.
(B) Protein functions could be regulated by covalent or noncovalent modification.
(C) Many of the regulations for protein activity are reversible.
(D) Noncovalent binding of calcium and GTP are widely used as allosteric switches to control protein activity.
(E) Proteolytic cleavage irreversibly activates or inactivates some proteins.

35. 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

36. Which of the following description about topoisomerase is (are) **CORRECT**?
(A) Both prokaryotes and eukaryotes have topoisomerases that are capable of removing supercoilds from DNA.
(B) Topoisomerases use a covalent protein-DNA linkage to cleave and rejoin DNA strands.
(C) Topoisomerase are of two general types. In contrast to type II, type I topoisomerase do not require the energy of ATP hydrolysis.
(D) Topoisomerase can also decatenate, disentangle and unknot DNA.
(E) Topoisomerases are required in many cellular processes, such as transcription, replication and recombination, and are the target of several cancer chemotherapeutic agents.

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37. Which of the following description about RNAs is (are) **CORRECT**?
(A) Non-coding RNAs constitute the majority of the transcripts and are mostly non-functional, representing merely as evolutionary remnants in gene expression.
(B) Messenger RNAs (mRNAs) are mainly synthesized by RNA polymerase II in eukaryotic cells.
(C) microRNAs mainly function in the transcriptional or post-transcriptional regulation of gene expression by a sequence mis-match mechanism
(D) RNA cannot serve as carriers of genetic information. Only DNA does.
(E) RNA can act as an enzyme.

38. Which of the following description about viruses is (are) **CORRECT**?
(A) Viruses are small parasites that can replicate only in host cells.
(B) Viral genomes could be either DNA, RNA, or RNA: DNA hybrid.
(C) Viruses that infect bacteria are called phages, and are studied as alternative agents to antibiotics.
(D) Enveloped viruses are viruses covered by external membranes that consist mainly of phospholipid bilayer and virus-encoded proteins.
(E) Retroviruses are enveloped animal viruses containing a RNA genome which could integrate into host chromosomal DNA after penetrating into cells and reverse transcribed into DNA.

39. Which of the following is (are) **NOT** a component of a ribonucleotide?
(A) Glucose
(B) Ribose
(C) Uracil
(D) Thymine
(E) Adenine

40. Which of the following statements is (are) **TURE** of histone tails?
(A) They protrude between the two DNA strands that supercoil around the nucleosome.
(B) They can be modified by acetylation, methylation, phosphorylation and ubiquitinylation.
(C) They experience changes in net charge, shape, and other properties of histones in response to modifications.
(D) The reversible acetylation and deacetylation of lysine residues in the tails of the core histones regulate chromatin condensation.
(E) They have enzymatic properties that can covalently modify DNA.

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