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. Which of the following amino acids in a protein can be phosphorylated?
(A) Serine
(B) Arginine
(C) Glutamic acid
(D) Tyrosine
(E) Lysine

2. Regarding DNA and RNA which descriptions is/are **CORRECT**?
(A) The polymerization of each nucleotide in DNA is in 5' to 3' order, but 3' to 5' order in RNA
(B) DNA 5' end has a terminal phosphate group and the 3' end a terminal hydroxyl group
(C) The sugar in DNA and RNA is a pentose
(D) DNA with high GC content is more stable than that with high AT content
(E) The backbone of the DNA strand is made from alternating phosphate and sugar residue

3. X-linked severe combined immunodeficiency (X-SCID) is caused by deficiency in a gene that is required for signaling of multiple cytokines. If a mother is a carrier of X-SCID, what would be the probability of her kids to show symptoms of X-SCID?
(A) 100% for all baby boys
(B) 50% for all baby boys
(C) 100 % for baby girls
(D) 50 % for baby girls
(E) 0 % for baby girls

4. Regarding reverse transcriptase, which statements is/are **CORRECT?**
(A) It has DNA-dependent RNA polymerase activity
(B) It has RNA-dependent DNA polymerase activity
(C) It has DNA-dependent DNA polymerase activity
(D) It has no proof-reading activity and therefore is error-prone
(E) It was originally identified in adenovirus

5. Regarding the technology for genetic modified mice, which statements is/are **CORRECT?**
(A) The method for making knockout and knockin mice is essentially the same.
(B) Conditional knockout mice technique allows you to ablate a gene of interest in a tissue- or time-dependent manner.
(C) To generate a transgenic or a knockout mouse you all need to introduce gene of interest into embryonic stem (ES) cells, followed by microinjection of them into embryos.

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(D) Traditional way of making knockout mice is to use homologous recombination to target gene of interest.
(E) Genetically modified mice are commonly used for research or as animal models of human diseases.

6. Which of the following statements regarding cell cycle is/are **CORRECT?**
(A) There are four different phases, including G1, S, G2, and M.
(B) DNA replication occurs in G2 phase.
(C) There are main two checkpoints namely G1/S and G2/M checkpoints.
(D) Cells increase in size in G1 phase
(E) G1 checkpoint control mechanism ensures that everything is ready for DNA synthesis.

7. Which of the following statements regarding cancers is/are **CORRECT?**
(A) A dysregulation of the cell cycle components such as tumor suppressors may lead to tumor formation.
(B) Tumor suppressors, including RB and P53, are usually inhibitors of cell cycle progression, resulting in cell arrest at G2/M phase.
(C) Chronic inflammation may contribute to tumor formation by inducing cell proliferation, survival and migration.
(D) Tumor cells which are actively undergoing cell cycle are targeted in cancer therapeutic drugs or radiation.
(E) Cancers are usually caused by environmental factors such as infection and radiation and not by hereditary factors.

8. Which of the following statements regarding electron transport chain (ETC) is/are **CORRECT?**
(A) An ETC couples electron transfer between an electron donor (such as NAD^+) and an electron acceptor (such as O2) with the transfer of H^+ ions across a membrane.
(B) The resulting electrochemical proton gradient is used to generate chemical energy in the form of ATP.
(C) There are three proton pumps: I, III, and IV.
(D) These events occur in Golgi apparatus and ER.
(E) The electron transport pathways are only present in eukaryotic but not prokaryotic system.

9. Which of the following statements regarding biomembrane is/are **CORRECT?**
(A) It consists of a lipid bilayer with embedded proteins.
(B) Mitochodria have double membrane namely inner and outer membrane.
(C) The distribution of phospholipid in the inner and outer leaflet of the plasma membrane is asymmetric.
(D) ER, lysosome, Golgi apparatus and cytoskeleton are all membrane-bound organelles.
(E) When cells undergo apoptosis phosphatidyl choline will exposed to outer leaflet of plasma membrane and thus serves as a marker for dying cells.

10. Which of the following statements regarding signal transduction is/are **CORRECT?**
(A) It usually involves the binding of an extracellular signal to the receptor on cell membrane.
(B) Intracellular signals are triggered by proteins with enzyme activity such as kinase or phosphatases.
(C) Scaffolding proteins usually possess specialized protein domains to recruit other proteins.
(D) Adaptor proteins are usually undergo phosphorylation and provide a docking sites for other signal mediators.
(E) Src homology domain 2 (SH2) binds to proline-rich containing proteins.

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11. Which of the following organisms are employed as experimental models?
(A) Arabidopsis thaliana
(B) Saccharomyces cerevisiae
(C) Caenorhabditis elegans
(D) Drosophila melanogaster
(E) E. coli

12. Which of the following molecule, organelles and process are involved in protein degradation?
(A) Autophagy
(B) Lysosome
(C) Methylation
(D) Proteasome
(E) Ubiquitin.

13. Which of the following components are involved in protein export through the nuclear complex?
(A) Exportin
(B) Ran/CTP
(C) Ran/GTP
(D) Nuclear localization sequence (NLS)
(E) Nuclear export sequence (NES).

14. Which of the following cellular stress leads to accumulation of unfolded proteins in the ER?
(A) Acid
(B) Chemical insult
(C) Cold
(D) Heat
(E) Viral infection.

15. What are the components of lipid rafts?
(A) Cholesterol
(B) Glucose
(C) Glycolipids
(D) Myoglobin
(E) Sphingomyelin.

16. What are the tight junction proteins?
(A) Cadherin
(B) Claudin
(C) Connexin
(D) Junctional adhesion molecule (JAM)
(E) Occludin.

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17. What are the hormones in animals?
(A) Abscisic acid
(B) Ethylene
(C) Glucagon
(D) Growth hormone
(E) Insulin.

18. Which are the proapoptotic proteins in the Bcl-2 family?
(A) Bad
(B) Bax
(C) Bcl-2
(D) Bim
(E) Noxa.

19. Which are the tumor viruses?
(A) Hepatitis B viruses
(B) Hepatitis C virues
(C) Herpesviruses
(D) Papillomaviruses
(E) Retroviruses.

20. DNA synthesis is often measured by using radioactive
(A) thiamine.
(B) thymine.
(C) biotin.
(D) thymidine.
(E) none of the above.

21. The activity of glycogen phosphorylase can be controlled by
(A) ATP.
(B) Glucose 6-phosphate.
(C) Protein subunit separation.
(D) Phosphorylation.
(E) None of the above.

22. Which is/are the molecule used to conserve energy?
(A) ATP
(B) QH_2
(C) FAD
(D) NADH
(E) Acetyl CoA

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23. Which are membrane-associated pathways?
(A) Electron transport chain in eukaryotes.
(B) Citric acid cycle in bacteria.
(C) Photosynthesis.
(D) Glycolysis.
(E) None of the above.

24. Which of the following is/are a secondary messenger?
(A) Cyclic AMP
(B) GTP-binding proteins.
(C) Proteins kinases.
(D) Phospholipase C.
(E) None of the above.

25. Which of the following statements about "The Citric Acid Cycle" is/are **TRUE**?
(A) Dehydrogenases that act on α-ketoglutarate (in the citric acid cycle) and on branch chain alpha-keto acids (in amino acid metabolism) closely resemble pyruvate dehydrogenase in structure and function.
(B) ATP is consumed by the pyruvate dehydrogenase complex during the synthesis of acetyl CoA.
(C) The only reaction in the citric acid cycle to generate a carbon-carbon bond is catalyzed by citrate synthase.
(D) Socitrate is more easily oxidized than citrate because it has a secondary alcohol group, whereas citrate's alcohol group is tertiary.
(E) The carbon atoms that enter the citric acid cycle via acetyl CoA are the same ones released as carbon dioxide during one round of the citric acid cycle.

26. Which of the following cell types engulf invaders and display portions of their proteins to other cells?
(A) NK cells
(B) Dendritic cells
(C) T-cells
(D) B-cells
(E) Macrophages

27. Which of the following statements about "Carbohydrates" is/are **TRUE**?
(A) A monosaccharide is a compound with one carbonyl group and two or more hydroxyl groups.
(B) A furanose is a sugar that is a five-carbon open-chain sugar.
(C) The conversion of a sugar's carbonyl to an alcohol is a reduction reaction.
(D) Sucrose is composed of galactose and fructose
(E) Glucose is also called blood sugar.

28. Which of the following enzymes of glycolysis is/are INVOLVED in regulation of the pathway?
(A) Hexokinase
(B) Phosphofructokinase
(C) Aldolase
(D) Pyruvate kinase

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(E) None of these proteins regulate glycolysis.

29. Which of the following molecules DIRECTLY REGULATE the activity of glycogen synthase?
(A) Glucose.
(B) Glucose-6-phosphate.
(C) AMP.
(D) ATP.
(E) None of the above affects glycogen synthase.

30. Which of the following statements concerning β-oxidation of fatty acids is/are **TRUE**?
(A) β-oxidation is the primary route for degradation of fatty acids.
(B) β-oxidation takes place in the mitochondrial matrix.
(C) Initiation occurs at the methyl end of the fatty acid.
(D) Two-carbon units are successively eliminated with each round.
(E) None of the above.

31. Which of the following statements is/are **FALSE**?
(A) Prokaryotic cells do not have a well defined nucleus.
(B) All eukaryotic organisms are multicellular.
(C) Energy-yielding oxidation reactions take place in eukaryotic mitochondria.
(D) Eukaryotic DNA is found in the chloroplast
(E) Lysosome does not have a double membrane.

32. Which of the following statements is/are **TRUE**?
(A) A transcription factor is the part of the promoter sequence closest to the start of transcription.
(B) As in prokaryotes, the regulatory regions for eukaryotic genes are always right next to the genes they control.
(C) Response elements are enhancers of transcription activated by metabolic factors.
(D) RNA transcribed from the coding strand instead of the template strand is called antisense RNA.
(E) Polyadenylation of eukaryotic mRNA occurs at the 3' end.

33. Which of the following statements is/are **INCORRECT**?
(A) The advantage of wobble in the codon-anticodon reaction is to make more than one protein from the same coding sequence.
(B) The third position (3' letter) on tRNA is the wobble base of the triplet anticodon.
(C) The advantage of degeneracy in the genetic code is that each tRNA can bind to more than one codon.
(D) All 64 of the codons code for an amino acid.
(E) The only exceptions to the universality of the genetic code have been observed in mitochondria.

34. Which of the following statements is/are **INCORRECT**?
(A) The flow of genetic information is DNA → RNA in retroviruses.
(B) In the original Central Dogma, the ordinary flow of genetic information is replication → transcription → translation.

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(C) Semiconservative replication implies that each of the new double stranded DNA molecules contains strands that are composed of segments of original and newly synthesized material.
(D) *E. coli* replication on the lagging strand is initially synthesized as Okazaki fragments.
(E) Prokaryotes have several origins of replication, while eukaryotes typically have one.

35. The human genome has 3 X 10^9 base pairs (bp) of DNA. If this were one continuous molecule and extended such that each nucleotide was separated from the adjacent nucleotide by 4 Å, as proposed in the Watson and Crick model, what would the end-to-end distance be?
(A) 1 meter
(B) 1 centimeter
(C) 1000 centimeters
(D) 1014 Å
(E) 1.2 x 10^6 micrometers

36. Which of the following statements is/are **TRUE**?
(A) Membrane lipids in a lipid bilayer are held together by electrostatic forces.
(B) The two leaves of a bilayer contain different collections of lipids and proteins.
(C) Phosphatidylcholine is an amphipathic molecule.
(D) The presence of *cis* double bonds in fatty acids doesn't have any specific effect on fluidity.
(E) When a membrane reaches its transition temperature, phospholipids readily flip from one face to the other.

37. Which of the following statements is/are **FALSE**?
(A) Homotrophic effects for allosteric enzymes involve different molecules binding to the same site in an enzyme.
(B) Enzyme kinetics falls into two general categories, simple saturation and cooperative kinetics.
(C) Allosteric effectors typically bind at a site unique from the active site.
(D) Negative cooperativity is best described that binding of one substrate molecule inhibits the binding of a second substrate.
(E) The main distinguishing feature of the concerted model for the behavior of allosteric enzymes is that the conformation of all subunits changes sequentially.

38. Which of the following statements about protein purification is/are **TRUE**?
(A) In affinity chromatography, a protein which binds to the ligand will elute from the cloumn.
(B) Cation exchange is most affected by the shape of the protein.
(C) Elution of proteins by means of a pH gradient would work best with cation or anion exchange.
(D) When a protein is purified, the percent recovery increases and the fold purification decreas
(E) In gel filtration chromatography, materials are separated based on their size, the larger ones eluting first.

39. Which of the following statements about protein degradation is/are **CORRECT**?
(A) Ubiquitin marks protein for degradation.
(B) Frequently makes use of proteasomes
(C) Happens randomly.
(D) Lysosomes are the only place to degrade cellular proteins.

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(E) Can regulate cellular processes by removing enzymes and regulatory proteins that are no longer needed.

40. Which of the following statements about coenzymes is/are **TRUE**?
(A) They are commonly derived from vitamins.
(B) They bind to the active site region on specific types of enzymes.
(C) They can be metal ions, such as Zn(II).
(D) NAD^+, FAD and biotin are all examples of coenzymes.
(E) All of these statements are untrue.