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 steps are involved in <u>PCR cycle</u>?
   (A) Denature to separate DNA strands
   (B) DNAs are joined by DNA ligases
   (C) DNA Polymerase synthesizes new DNA
   (D) Primers bind to DNA strands
   (E) RNA Polymerase synthesizes new DNA.

2. Which of the following methods are used to demonstrate that <u>a transcription factor binds to a DNA region</u>?
   (A) Chromatin Immuno-precipitation (ChIP) assay
   (B) Co-immunoprecipitation (Co-IP)
   (C) Electrophoretic mobility shift assay (EMSA)
   (D) Gene array (gene-chip) assay
   (E) RNA interference (RNAi).

3. Which of the following statements about "G proteins" is/are TRUE?
   (A) They are integral membrane proteins.
   (B) They are multisubunit proteins consisting of α, β and γ subunits.
   (C) They act as transducers for hormones.
   (D) They are slowly inactivated by their own GTPase activity.
   (E) Activated G protein diffuses away from the receptor.

4. Which of the following covalent modification are involved in <u>histones</u> for gene expression?
   (A) Acetylation
   (B) Glycosylation
   (C) Methylation
   (D) Sumoylation
   (E) Ubiquitination.

5. Which of the following genetic triplet codes are NOT termination codons?
   (A) UAA
   (B) UAG
   (C) UCC
   (D) UCG
   (E) UGG.

6. Which of the following molecules are involved in <u>anti-apoptosis or pro-apoptosis</u>?
   (A) Bad
   (B) Bid
   (C) Bcl-2
   (D) caspase-3
   (E) cytochrome c.

7. Which of the following statements about cancer and oncogenes are correct?
   (A) *c-myc* is an oncogene
   (B) *p53* is an oncogene
   (C) *Rb* is an oncogene
   (D) Transforming viruses carry oncogens
   (E) Tumor cells are transformed and immortalized.

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8. What are the ways to generate metabolic energy?
   (A) Endocytosis
   (B) Glycolysis
   (C) Oxidative metabolism
   (D) Photosynthesis
   (E) Phagocytosis.

9. Which of the following molecules can passively diffuse through phosphorlipid bilayers?
   (A) Amino acids
   (B) Benzene
   (C) CO_2
   (D) H_2O
   (E) Glucose

10. Which of the following molecules are signaling molecules?
   (A) Cytokines
   (B) Growth factors
   (C) Neurotransmitters
   (D) Nitric oxide (NO) and carbon monoxide (CO)
   (E) Steroid hormones.

11. Regarding antibody which statements are correct?
   (A) The main isotype antibody present in milk and intestine is IgA
   (B) IgD has the highest neutralizing activity
   (C) IgG can cross placenta and protect fetus from invasion of pathogens
   (D) IgE is an important indicator for allergy because it can bind to mast cells and induce degranulation
   (E) Complement fixation ability is higher in IgM than IgG

12. Regarding the Nobel Prize 2011 in Physiology or Medicine, which statements are correct?
   (A) The researches belong to innate immunity
   (B) Steinman was awarded for his discovery of a special macrophage
   (C) Hoffmann and Beutler were awarded for their discovery of Toll receptor and Toll-like receptor (TLR), respectively
   (D) So far, TLR is the only known innate receptor
   (E) TLR4 recognizes lipopolysaccharide (LPS)

13. Animal models are very important tools to investigate in vivo functions, which of the followings are commonly used animals?
   (A) Earth worms
   (B) Zebra fish
   (C) Rats
   (D) Xenopus
   (E) Mosquitos

14. Regarding DNA which statements are correct?
   (A) A nucleobase linked to a sugar is called a nucleotide and a base linked to a sugar and one or more phosphate groups is called a nucleoside
   (B) Average molecular weight of a nucleotide is 660 Dalton
   (C) A DNA sequence is called "sense" if its sequence is the same as that of an mRNA
   (D) In general, a dsDNA is heavier than a dsRNA with the same length
   (E) DNA with high GC-content is more stable than DNA with low GC-content because of hydrogen bonds

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15. Regarding mRNA which statements are correct?
(A) Eukaryotic mRNAs have a 5'cap which is critical for proper recognition attachment to ribosome
(B) The poly(A) tail and the protein bound to it aid in protecting mRNA from degradation by exonucleases
(C) Eukaryotic mRNAs are synthesized in the cytoplasm and translate into proteins directly
(D) 5' or 3' untranslated regions (UTRs) are important for regulating mRNA stability, mRNA localization, and translational efficiency
(E) Eukaryotic mRNA molecule can be monocistronic or polycirtronic

16. Genetic approaches are an unbiased method to identify novel molecules of interests. Which of the following methods are genetic approaches?
(A) Microarray analysis
(B) Affinity purification
(C) Yeast-two hybrid
(D) ENU-based gene-driven mutagenesis
(E) Proteomic analysis

17. Regarding signal transduction pathway which statements are correct?
(A) Ligands binding to receptors initiate the pathway
(B) Termination of signaling pathway can be triggered by internalization and degradation of the receptors
(C) Protein recognition motifs such as SH2 or PH domain are involved in recruitment of signal mediators
(D) Signal molecules have to be proteins but not lipids or nucleotides
(E) Completion of a signaling pathway usually results in induction or suppression of special sets of gene

18. Regarding apoptosis, which statements are correct?
(A) This is a normal physiological process that regulates development or differentiation
(B) Apoptotic process will induce inflammation and leukocyte infiltration
(C) Apoptotic cells will have nuclear fragmentation and eventually lose nuclei
(D) Bcl2 family and caspase family proteins are involved in apoptosis
(E) There is no way to differentiate apoptosis from necrosis

19. Regarding amino acids, which statements are correct?
(A) Average molecular weight of an amino acid is roughly 200 Dalton
(B) Only three amino acids can be phosphorylated, namely tyrosine, tryptophan and serine
(C) Negatively charged amino acids are glutamic acid and aspartic acid and their abbreviations are D and E, respectively
(D) In eukaryotic system, the start codon encodes methionine. Therefore, Met is an essential amino acid
(E) Tyrosine and Tryptophan are precursors of neurotransmitters

20. Regarding restriction enzymes, which statements are correct?
(A) They are required for doing recombinant DNA technology
(B) They all recognize palindromic sequences
(C) After digestion, they usually generate either sticky or blunt ends
(D) They are DNA exonuclease and produce double stranded cut in the DNA
(E) They all work at 37 °C and are susceptible to heat inactivation

21. Which of the following statements regarding "stem cells" is/are CORRECT?
(A) Totipotent stem cells can differentiate into any cell type in the body, except embryonic stem cells.
(B) Pluripotent stem cells are descendants of the totipotent stem cells of the embryo.
(C) A fertilized egg is a type of totipotent stem cell.
(D) Pluripotent stem cells can differentiate into any cell type, except for totipotent stem cells and the cells of the placenta.
(E) Adult stem cells are usually pluripotent.

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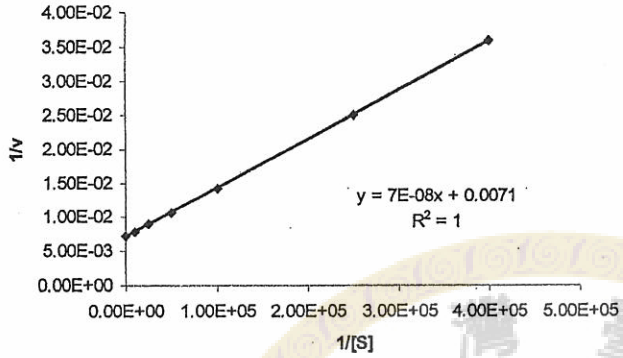
22. What are the calculated Vmax and Km values of the reaction as shown below in the Lineweaver-Burk plot?



(A) Vmax =140μmol/min
(B) Vmax =0.0071μmol/min
(C) Km=9.86x10-6M
(D) Km=7x10-8M
(E) None of the above

23. Which of the following describes a difference between DNA polymerases in eukaryotes and bacteria?
(A) Some eukaryotic polymerases include a primase.
(B) All the eukaryotic enzymes are polymeric.
(C) Eukaryotes require a special enzyme to remove the RNA primer.
(D) Some eukaryotic polymerases include a primase and all are polymeric.
(E) Eukaryotes need more types of DNA polymerases than bacteria.

24. Gluconeogenesis
(A) is the simple reversal of glycolysis.
(B) describes the conversion of glucose to pyruvate.
(C) uses 6 ATP
(D) is not regulated by the hormone, glucagon.
(E) none of the above.

25. Which of the following statements about "Enzyme" is/are TRUE?
(A) In the induced-fit model of substrate binding to enzymes, the active site changes its conformation to fit the substrate.
(B) The Enzyme-Substrate complex often shows as a slight depression in the energy profile for the reaction.
(C) When the substrate concentration is low, an enzyme reaction will display first-order kinetics.
(D) When an enzyme is saturated with substrates, it will display zero-order kinetics.
(E) The Michaelis constant is a measure of how tightly the substrate is bound to the enzyme.

26. In a typical eukaryotic plasma membrane,
(A) proteins can move within the bilayer.
(B) some lipids can rotate within the bilayer.
(C) lipids can move and diffuse through the bilayer.
(D) oligosaccharides face outward, not toward the cytosol.
(E) none of the above.

27. Which of the following statements about "The Citric Acid Cycle" is/are CORRECT?
(A) The Citric Acid Cycle occurs completely in the cytoplasm.
(B) The reaction produces CO2, NADH, FADH2, and GTP upon oxidation of acetyl CoA.

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(C) The immediate electron acceptor for the majority of the oxidative reactions of the citric acid cycle is ATP.
(D) The Citric Acid Cycle Is not regulated by activation and inhibition of enzyme activities..
(E) The order of compounds and intermediates found in the citric acid cycle is as follows:
Aconitate → *iso*-Citrate → α-Ketoglutarate → Fumarate → Malate → Oxaloacetate

28. Which of the following statements about "Histones" is/are CORRECT?
(A) They are positively charged at biological pH.
(B) They occur in both prokaryotes and eukaryotes.
(C) There is wide variation in the amino acid sequences of histones among species.
(D) Most species that have histones contain four different types.
(E) Histone H2 is not part of the histone octamer, but binds to linker DNA and is responsible for higher-order chromatin structure.

29. Which of the following statements concerning "RNA transcription" is/are CORRECT?
(A) RNA is synthesized from the 5' end to the 3' end.
(B) Synthesis of RNA is a very accurate process.
(C) Transcription requires the use of a primer.
(D) DNA to RNA base pairing includes A to U and G to C.
(E) The template strand is read in the 3'→5' direction.

30. Which of the following statements is/are CORRECT?
(A) The sugar derivative found in DNA is an oxidized form of ribose.
(B) Cellulose is not highly branched because it does not have α(1→6) linkages.
(C) Polysaccharide structure can be varied by differences in the kind(s) of sugars in each polysaccharides.
(D) The large number of possible oligosaccharide structures in glycoproteins is limited in cells by the kinds of enzymes available for their synthesis.
(E) All carbohydrates have the empirical formula $(CH_2O)_n$.

31. Which of the following statements is/are CORRECT?
(A) Once inside a cell, glucose is rapidly phosphorylated to glucose-6-phosphate. The main purpose of this phosphorylation is to keep glucose inside the cell.
(B) The enzyme that catalyzes the conversion of pyruvate to lactate is pyruvate kinase.
(C) The net energy gain in glycolysis is due to the production of NAD
(D) During glycolysis, isomerization occurs during Fructose 6-phosphate → fructose 1,6-bisphosphate.
(E) Two molecules of ATP are consumed per glucose during the triose stage of glycolysis.

32. DNA sequence rearrangements is/are INVOLVED in the following processes?
(A) Immunoglobulin gene expression in mammals
(B) Intron splicing in ciliates
(C) Transposition of bacteriophage Mu
(D) Mating type switching in yeast
(E) None of the above

33. Which of the following statements is/are CORRECT?
(A) The major and minor grooves are readily apparent in the B form of DNA.
(B) The Z-form of DNA tends to occur in pyrimidine-only sequences.
(C) Triple-helical DNA can be formed only from polynucleotide strands that contain the same base throughout
(D) The A and B forms of DNA are both left-handed helices.
(E) Histones contain large amounts of lysine.

34. Which of the following statements is/are CORRECT?
(A) The process often thought of as "cell eating" is phagocytosis.
(B) Carrier-mediated transport is also called active transport.

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(C) Cell-walled organisms cannot carry out exocytosis.
(D) The type of diffusion that is specific and passive, and which becomes saturated if all of the protein carriers are in use is facilitated diffusion.
(E) The type of transport that is specific, which requires specific carrier molecules and energy is osmosis.

35. Which of the following statements is/are CORRECT?
(A) Phages are viruses that can infect bacteria.
(B) Prions are strands of nucleic acids encased in a protein coat.
(C) If a virus enters the lytic phase in a host's cell, it will cause the host cell to shrink because of the loss of cytoplasm that has been used in the synthesis of viral DNA.
(D) A virus life cycle that involves the incorporation of the viral DNA into the host chromosome is oncogenic.
(E) Emerging viruses are able to "jump" from one species to another.

36. Which of the following statements is/are CORRECT?
(A) Most of the reactions of electron transport in the mitochondria occur in the mitochondrial matrix.
(B) Electron flow in the mitochondria follows this pathway: NADH → FMN → Coenzyme Q → Cyt B → Cyt C → Cyt A → O2
(C) Electron flow in the mitochondria follows this pathway: Complex I → complex II→ complex III → complex IV.
(D) Complex III of the electron transport chain does NOT contain an ironsulfur cluster.
(E) Transition metals are especially important in electron transport, since they have variable oxidation states.

37. Which of the following statements concerning "β-oxidation of fatty acids" is/are CORRECT?
(A) Initiation occurs at the methyl end of the fatty acid.
(B) β-oxidation is the primary route for degradation of fatty acids.
(C) β-oxidation takes place in the mitochondrial matrix.
(D) Two-carbon units are successively eliminated with each round.
(E) The first three reactions of the β-oxidation cycle of fatty acids produce two moles of $FADH_2$

38. Which of the following statements about "DNA synthesis" is/are CORRECT?
(A) The direction of synthesis of DNA is from the 5' end to the 3' end on one strand and from the 3' end to the 5' end on the other strand.
(B) The strands become separated during synthesis.
(C) Synthesis occurs in both directions from the starting site of synthesis.
(D) Synthesis of DNA is a very accurate process.
(E) Okazaki fragments are RNA primers used for DNA replication.

39. Which of the following is/are associated with pyrimidine synthesis?
(A) Stimulation of synthesis by purines.
(B) Synthesis of the base while ribose is attached.
(C) An orotic acid intermediate.
(D) Argininosuccinate is a key intermediate in pyrimidine biosynthesis
(E) Inhibition by pyrimidines.

40. In which of the following cells might you expect to find the highest level of telomerase?
(A) Muscle cells
(B) Oocytes
(C) Neurons
(D) Cells that replenish the lining of the gut
(E) Cancer cells

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