1. The SMC proteins (for *s*tructural *m*aintenance of *c*hromosomes) include cohesins and condensins, and are known to have all of the following properties *except*:
   A) a complete ATP binding site.
   B) a hinge region.
   C) topoisomerase activity to produce positive supercoils.
   D) the ability to condense DNA.
   E) two coiled-coil domains.

2. B-form DNA in vivo is a _____-handed helix, _____ Å in diameter, with a rise of ____ Å per base pair.
   A) left; 20; 3.9
   B) right; 18; 3.4
   C) right; 18; 3.6
   D) right; 20; 3.4
   E) right; 23; 2.6

3. Lactose operon is regulated by following factors **except**
   A) glucose concentration
   B) lactose concentration
   C) lac I repressor
   D) cGMP
   E) catabolite gene activator protein

4. Which polymerase is critical for the biosynthesis of ribosomal RNA in eukaryotes?
   A) Pol I
   B) Pol II
   C) Pol III
   D) reverse transcriptase
   E) telomerase

5. Which small nuclear RNA (snRNA) binds to the intron at a position encompassing the A residue?
   A) U1
   B) U2
   C) U4
   D) U5
   E) U6

6. Which transcriptional factor recognizes TATA box in eukaryotes?
   A) TFIIA
   B) TFIIB
   C) TFIID
   D) TFIIE
   E) TFIIH

7. Sickle cell anemia is a molecular disease of hemoglobulin. The altered properties of hemoglobin S result from a single amino acid mutation. The following statement which is right?
   A) a Leu instead of a Asp residue
   B) a Val instead of a Glu residue

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C) a Ile instead of a Asn residue
D) a Leu instead of a Gln residue
E) a Met instead of a Asn residue

8. What is the name given to the type of chemical bond that forms between the slightly electropositive hydrogen atom in a polar group and an electronegative atom ?
A) Covalent bond
B) Electrostatic bond
C) Hydrogen bond
D) Van der Walls bond
E) Disulfide bond

9. The peptide bond:
A) Results from condensation of any R-group or side chain of different amino acids with each other
B) Results from the condensation reaction between the α-carboxyl group of one amino acid with the α-amino group of a second amino acid
C) Results from the condensation reaction between the α-carboxyl group of one amino acid with the α-carboxyl group of a second amino acid
D) Results from the condensation reaction between the α-carboxyl group of one amino acid and ammonia
E) Results from the condensation reaction between the α-carboxyl group of one amino acid and ammonium ion

10. For the study of a protein in detail, an effort is usually made to first:
A) conjugate the protein to a known molecule.
B) determine its amino acid composition.
C) determine its amino acid sequence.
D) determine its molecular weight.
E) purify the protein.

11. Phosphatidylinositol derivatives and its metabolites are involved in which of the following events?
A) activation of Janus kinase
B) opening of sodium channel
C) activation of protein kinace A
D) inhibition of cell wall systhesis
E) association of kinase to membrane

12. Which compound in the following contains three carboxylic groups?
A) citrate
B) lactate
C) aspartate
D) glutamate
E) arachidonate

13. Geranylgeranyl pyrophosphate is involved in which of the following biochemical processes?
A) N-link glycosylation
B) leukotriene formation
C) synthesis of cholesterol
D) phosphorylation of enzyme

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E) phosphatidylinositol turnover

14. Leptin can activate which of the following proteins in the signaling pathway?
A) Src
B) SOS
C) STAT
D) SMAD
E) SREBP

15. Which of the following can induce activation of hormone sensitive lipase?
A) adenosine
B) epinephrine
C) glucose
D) insulin
E) nicotinic acid

16. Apolipoprotein A-I deficiency is often associated with
A) high LDL-cholesterol
B) low LDL-cholesterol
C) high HDL-cholesterol
D) low HDL-cholesterol
E) hyperglycemia

17. Which of the following produces more energy from β-oxidation?
A) one mole of C16:0
B) one mole of C18:0
C) one mole of ω9, C18:1
D) one mole of ω6, C18:2
E) one mole of ω3, C18:3

18. Which of the following can inhibit HMG-CoA reductase?
A) bile acid
B) cholesterol
C) mevalonate
D) simvastatin
E) all of above

19. Which of the following amino acid residues in principle can NOT participate in acid-base catalysis?
A) serine
B) aspartatic acid
C) cysteine
D) phenylalanine
E) glutamic acid

20. Kinetic analysis revealed that the presence of enzyme inhibitor "X" increases the K_m but does NOT affect V_{max} of an enzymatic reaction. Based on this finding, we can conclude that the inhibitor "X" should be a(an) _____.
A) competitive inhibitor

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B) uncompetitive inhibitor
C) mixed inhibitor
D) allosteric inhibitor
E) noncompetitive inhibitor

21. "Catalytic antibodies" **mainly** accelerate the rate of a chemical reaction by _____.
A) acid base catalysis
B) stabilization of transition state
C) covalent catalysis
D) metal ion catalysis
E) alteration of the reaction pathway

22. For a human enzyme, the highest reaction rate is usually observed at which of the following temperature?
A) 10°C
B) 20°C
C) 30°C
D) 40°C
E) 50°C

23. Which following factor can activate phosphorylase kinase?
A) selenium
B) Q_{10}
C) Fe^{++}
D) Ca^{++}
E) Fe^{3+}

24. Which following enzyme product is required for bilirubin metabolism?
A) hexokinase
B) phosphofrutokinase-1
C) UDP-glucose dehydrogenase
D) glucose 6-phosphate dehydrogenase
E) phosphofructokinase-2.

25. When human cells synthesize cysteine amino acid, there are two amino acids needed for the biosynthesis. What are these two amino acids?
A) methionine and alanine
B) methionine and serine
C) glutamine and glycine
D) serine and glycine
E) arginine and aspartate.

26. Which following factor is an important reactant for human asparagine synthetase to generate asparagine?
A) NH_4^+
B) arginine
C) glutamate
D) lysine
E) glutamine.

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27. A) U2 snRNA B) U3 snRNA C) U4 snRNA D) U5 snRNA E) U6 snRNA is **NOT** involved in intron removal and the processing of mRNA precursors into mRNA.

28. A mutation is any change in the base sequence of the DNA. Which one of the following descriptions about mutations is **WRONG**?
A) An adenosine replaced by a cytidine is a "transversion" mutation
B) An adenosine replaced by a guanosine is a "transition" mutation
C) A nonsense mutation results in a different amino acid being inserted in the protein
D) Silent mutation means a change at the DNA level that does not result in any change of amino acid in the encoded protein.
E) All are right.

29. In leucine zipper motifs, leucine residues occur at every
A) 4th position
B) 5th position
C) 6th position
D) 7th position
E) 8th position.

30. Oncologists employ 5-fluorouracil (5-FU) in chemotherapy. Which one of the following 5-FU derivates can inhibit thymidylate synthase?
A) 5-FUTP
B) 5-FdUTP
C) 5-FUDP
D) 5-FUMP
E) 5-FdUMP

31. Transamination requires which of the cofactors
A) Mg,
B) B12,
C) Fe,
D) PLP,
E) NAD

32. S-adenosylmethionine is involved in the transfer of
A) CH_3,
B) CH_2OH,
C) CHO,
D) COOH,
E) NH_2

33. Which of the following methods was NOT invented to increase the throughput of DNA deep sequencing?
A) Pyrosequencing,
B) Sequencing by ligation,
C) Sequencing by synthesis,
D) Sanger sequencing,
E) semiconductor sequencing

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34. The corresponding alpha-keto acid after aspartate deamination is
A) fumarate,
B) oxaloacetate,
C) pyruvate,
D) alpha-ketoglutarate,
E) citrate

35. One turn of the citric acid cycle produces
A) 2 NADH, 2 $FADH_2$, 2 ATP.
B) 3 NADH, 1 $FADH_2$, 1 ATP.
C) 1 NADH, 3 $FADH_2$, 2 ATP.
D) 3 NADH, 2 $FADH_2$, 1 ATP.
E) 2 NADH, 2 $FADH_2$, 1 ATP.

36. The anaerobic conversion of 1 mol of glucose to 2 mol of lactate by fermentation is accompanied by a net gain of:
A) 2 mol of ATP+ 1 mol of NADH
B) 2 mol of ATP + 2 mol of NADH
C) 2 mol of NADH
D) 1 mol of NADH
E) 2 mol of ATP

37. Which of the following enzyme does not take part in the TCA cycle?
A) Citrate synthase
B) Malate dehydrogenase
C) Aconitase
D) Pyruvate dehydrogenase
E) Succinate dehydrogenase

38. Which of the following statements about the reactions of glycolysis is correct?
A) glucose-6-phosphate is split into glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.
B) fructose 1,6-bisphosphate is split into glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.
C) fructose-6-phosphate is split into glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.
D) glucose-6-phosphate is isomerized to fructose 1,6-bisphosphate.
E) glucose 2,6-bisphosphate is split into glyceraldehyde-3-phosphate and dihydroxyacetone phosphate.

39. All are true for translation in eukaryotic cells EXCEPT:
A) transcription and translation are spatially separated.
B) mRNAs are monocistronic.
C) transcription occurs in the nucleus.
D) primary transcripts undergo processing to mature mRNAs.
E) all are true.

40. Most eukaryotic RNA consists of coding regions, called ____, and noncoding regions, called ____.
A) introns; exons
B) exons; introns
C) spliceons; codons

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D) codons; spliceons
E) introns; codons

41. The adapter molecule that interacts specifically with both nucleic acids and amino acids is:
A) rRNA.
B) tRNA.
C) mRNA.
D) ssRNA.
E) all are true.

42. Which of the following statements is true regarding ribosomes?
A) they are found in the cytosol and nucleus of all cells
B) prokaryotic ribosomes consist of a 30S and a 50S subunit while eukaryotic ribosomes consist of a 60S and an 80S subunit
C) ribosomes consist of both protein and ribonucleic acid with the majority of the mass from the protein component
D) since the peptidyl transferase activity is perfomed by RNA, it can be considered a ribozyme
E) all are true

43. Which of the following is an irreversible post-translational modification?
A) Palmitoylation
B) Proteolysis
C) Sumoylation
D) Glycolysis
E) Glycosylation

44. Which of the following compound is suitable for Nick translation to label the substrates?
A) alpha-[32P]-CTP
B) gamma-[32P]-UTP
C) S-Adenosyl-methionine
D) S-Adenosyl-L-homocysteine
E) L-[35S]-Methionine

45. To study the function of a phospho-protein, which of the amino acid substitution is commonly used in the laboratory?
A) Alanine substituted by Glycine
B) Lysine substituted by Arginine
C) Leucine substituted by Isoleucine
D) Glutamic acid substituted by Aspartic acid
E) Threonine substituted by Glutamic acid

46. Which of the following description for Polymerase Chain Reaction is not true?
A) The length of the primers controls amplification specificity.
B) The Tm of the primers controls amplification specificity.
C) High Mg2+ concentration in the reaction increases the amplification specificity.
D) The Klenow fragment of DNA polymerase I retains the 5'→3' polymerase activity and the 3'→5' exonuclease activity.
E) The Klenow fragment of DNA polymerase I loses its 5'→3' exonuclease activity.

47. the following description about proteoglycans is not correct
A) the glycosylation site in the protein core sequence is X-Ser/Thr-X-X

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B) highly negative charges glycoprotein
C) protein core modified by glycosaminoglycans
D) syndecan, a membrane receptor type proteoglycan
E) the glycosylation site in the protein core sequence is Gly-X-Ser/Thr-X-X

48. which enzyme is not involved in the medial Golgi oligosaccharides processing
A) N-acetyl glucosaminyltransferase I
B) N-acetyl glucosaminyltransferase II
C) Golgi apparatus alpha mannosidase II
D) oligosaccharide:protein transferase
E) Fucosyltransferase

49. which integrin can connect to inter-media filaments which connect to nucleus membrane and control gene expression and cell differentiations
A) α2β1
B) α3β1
C) α6β1
D) α6β4
E) αvβ3

50. the following glycosaminoglycans which one is without protein core
A) heparan sulfate
B) dermatan sulfate
C) keratin sulfate
D) hyaluronic acid
E) chondroitin sulfate

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