Dental Biochemistry Exam 6 questions 2004

Choose the best answer. For those questions with blanks to fill in, choose the response that contains the correct terms to fill in the blanks.

1. Each of the following is a possible component of a nucleotide, EXCEPT:
   a. 2-deoxyribose from DNA.
   b. nitrogenous bases.
   c. amino acids.
   d. phosphoric acid.
   e. ribose from RNA.

2. In phosphoryl group transfer reactions (such as seen in DNA synthesis), it is the ______________ of the nucleotide that serves as an information symbol channeling the appropriate nucleotides to various metabolic activities.
   a. sugar
   b. diphosphate anhydride
   c. sugar-phosphate ester
   d. base

3. All of the following statements are true for the DNA double helix EXCEPT:
   a. The polarity of the two strands is “parallel”.
   b. the two strands are held together by interchain hydrogen bonds.
   c. the two strands have complementary base pairing.
   d. Hydrophobic hydrogen bonds between bases are on the interior of the double helix.

4. All of the following are true for tRNA EXCEPT:
   a. each amino acid in proteins has at least one unique tRNA species dedicated to chauffeuring its delivery to ribosomes for insertion into growing polypeptides.
   b. are molecules containing over 1000 nucleotides.
   c. fold into characteristic secondary structures.
   d. possess a 3’terminal nucleotide sequence that reads –CCA.

5. RNA is _______ stable to alkaline hydrolysis than DNA because RNA’s vicinal _______ group makes the 3’-phosphodiester bond susceptible to nucleophilic chemical cleavage.
   a. less; 3’-OH
   b. less; 2’-OH
   c. more; 2’-OH
   d. more; 3’-OH
6. Which of the following statements correctly identifies a type II restriction endonuclease?
   a. They work on both DNA and RNA.
   b. They recognize a palindromic sequence and always cut outside of the palindromic sequence.
   c. The result of digestion by this endonuclease is always blunt ended molecules.
   d. They degrade DNA by subsequently removing bases from each end.
   e. They cut DNA only at sites within specific palindromic sequences.

7. All are true for DNA polymerase EXCEPT:
   a. requires a primer with a free 5'-OH end, but the 3'-end may be phosphorylated.
   b. copies the sequence of nucleotides of one strand to form a new second strand.
   c. copies the sequence of nucleotides of one strand in a complementary fashion.
   d. generates dsDNA from ssDNA
   e. synthesizes new strands by adding successive nucleotides in the 5' → 3' direction.

8. When we talk about insertional inactivation in a plasmid vector during a cloning experiment, we mean:
   a. restriction endonucleases have cleaved the DNA into small pieces.
   b. a piece of DNA has disrupted the coding sequence of a selectable marker (such as a drug resistance gene)
   c. the plasmid DNA contains a tightly bound protein cofactor
   d. DNA ligase has failed to close a DNA nick.

9. The higher the ________ content of a DNA, the ________ the melting temperature.
   a. G:C; higher
   b. G:C; lower
   c. A:T; higher
   d. A:G; lower

10. DNA ________ is analogous to twisting or untwisting a two stranded rope so that it is torsionally stressed.
    a. buoyant density
    b. hairpin turn
    c. cloverleaf
    d. supercoiling
11. The function of DNA topoisomerases is:
   a. packaging DNA into nucleosomes.
   b. forming cruciform DNA.
   c. unwinding only G:C rich areas in DNA.
   d. breaking one or more strands of covalently-closed circular DNA, allowing one helical turn to be released from the molecule, and rejoining the ends.
   e. promoting DNA hybridization.

12. All are properties of nucleosomes EXCEPT:
   a. DNA is wrapped around the outside of a protein spool.
   b. In the electron microscope, nucleosomes look like "beads on a string".
   c. protein spools made up of pairs of histones H2A, H2B, H3 and H4 octameric aggregates.
   d. DNA binds histones by ionic bonds of positively charged amino acids and the negative charged phosphate groups.
   e. all are true.

13. All are characteristic of plasmids EXCEPT:
   a. naturally occurring, circular extrachromosomal DNA.
   b. able to perpetuate themselves without a host organism.
   c. can be used for gene cloning.
   d. harbor genes for novel metabolic activities, like antibiotic resistance.
   e. an origin of replication must be included in the plasmid to facilitate propagation.

14. A genomic DNA library is:
   a. arrays of synthetic oligonucleotides used to select for a specific DNA.
   b. a set of cloned fragments that collectively represent all the genes of a particular organism.
   c. a short segment of DNA whose sequence is complementary to a portion of the DNA of interest.
   d. a circular DNA molecule of 1 kb to 200 kb found in bacteria and yeast cells.

15. Each cycle of amplification in PCR involves all of the steps EXCEPT:
   a. the addition of more template to the reaction mixture at each step.
   b. annealing of oligodeoxyribonucleotide primers to DNA.
   c. thermal denaturation of the target duplex DNA.
   d. synthesis with DNA polymerase at approximately 70° C.
16. Which of the following is the most appropriate source of the DNA polymerase included in the PCR reaction mixture?
   a. *E. coli*
   b. bacteriophage T4
   c. *Thermus aquaticus*, a thermophilic bacteria
   d. *Drosophila melanogaster*
   e. Human

17. DNA is replicated by a ________________ mechanism.
   a. dispersive
   b. conservative
   c. semiconservative
   d. liberal

18. *E. coli* replication on the lagging strand:
   a. is primarily carried out by DNA polymerase I.
   b. is synthesized continuously.
   c. is performed in a 3'→5' direction of synthesis.
   d. is initially synthesized as Okazaki fragments.

19. *E. coli* DNA polymerase I has all of the following characteristics EXCEPT:
   a. a 5'→3' exonuclease activity.
   b. a 3'→5' exonuclease activity.
   c. a 5'→3' DNA polymerase activity.
   d. does not require a primer for initiation.

20. Removal of the RNA primer and replacement with DNA is carried out by:
   a. DNA polymerase I.
   b. DNA gyrase.
   c. DNA polymerase III.
   d. DNA ligase.
   e. primerase.

21. The enzyme that seals nicks in dsDNA where a 3'-OH and 5'-phosphate are juxtaposed is:
   a. DNA polymerase I.
   b. DNA gyrase.
   c. DNA polymerase III.
   d. DNA ligase.
   e. primerase.
22. Compared to their parents, progeny may have new combinations of traits because of:
   a. reverse transcriptase.
   b. cyclin dependent protein kinase.
   c. genetic recombination.
   d. processivity.

23. One function of the RecA protein in recombination events is to:
   a. produce an endonucleolytic nick on dsDNA.
   b. aid in recognition of Chi site by the RecBCD complex.
   c. initiate recombination.
   d. catalyze the ATP-dependent DNA strand exchange reaction.
   e. drive branch migration and process the Holliday junction into recombinant products.

24. Mutations in DNA may result from all of the following EXCEPT:
   a. spontaneous mutations due to errors in replication.
   b. physical insults on the cell, such as UV light.
   c. errors in transcription.
   d. chemical mutagens.

25. The Ames test:
   a. measures the percent of GC base pairs in a double stranded DNA.
   b. determines the speed at which DNA synthesis occurs.
   c. helps to quickly identify potential carcinogens.
   d. uses mice to determine carcinogenic potential.

26. All are stages in transcription EXCEPT:
   a. binding of RNA polymerase holoenzyme at the promoter sites.
   b. chain elongation.
   c. DNase I activity on RNA polymerase/DNA complex.
   d. initiation of polymerization.
   e. RNA transcript termination.

27. Within bacteria, the _______ consists of two consensus sequence elements, the ______ near -10 and a sequence of TATAAT, and the ______ containing the consensus TTGACA.
   a. termination sequence; rho subunit; sigma subunit
   b. termination sequence; Pribnow box; sigma subunit unit
   c. promoter sequence; rho subunit; Pribnow box
   d. promoter sequence; Pribnow box; -35 region
   e. promoter sequence; rho subunit; -35 region
28. The genetic code has all of the following characteristics EXCEPT:
   a. The code is degenerate.
   b. The code is read 5' to 3'.
   c. The code is overlapping (more than one gene encoded in the same sequence).
   d. A group of three bases codes for one amino acid.

29. All are characteristics of eukaryotic mRNA EXCEPT:
   a. poly (A) tail.
   b. no promoter sequences (no -35 or -10 sequences) are included.
   c. no 5' AUG 3' sequence.
   d. 5'-methyl-GTP cap.

Questions 30 through 35 refer to the following case study:

In Nature Genetics in October, 2001, Philip Stanier and colleagues identified one of many potential genes important for proper development of the lips and palate. X-linked cleft palate with ankyloglossia (CPX), is a rare birth defect, is recessive, and was the first cleft palate developmental defect mapped with molecular markers. The mutations map in the TBX22 gene, a T-box transcription factor and a member of a large family of transcription factors that are important in development. Members of this family of transcription factors have been implicated in facial, cardiac and limb development. The mapping of this gene defect to chromosome X was accomplished from pedigree studies with affected families in Canada and Brazil. The sequencing gels for DNA sequences from part of the TBX22 gene for each of three different patients are shown below:
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**top**

- [DNA sequence for Normal (no cleft palate)]

- [DNA sequence for Brazilian patient]

- [DNA sequence for Patient from British Columbia]

**bottom**

- Normal (no cleft palate)

- Brazilian patient

- Patient from British Columbia
30. Which of the following sequences is most consistent with the actual sequence information shown in the leftmost ladder (marked “Normal”) in panel (a) of the figure?
   a. 5’ GTGCACGTGAGCCCCAAA 3’
   b. 5’ CACGTCACACTGGGTTT 3’
   c. 5’ AAACCGGTACGCTGCAG 3’
   d. 5’ TGGGGGCCTCACGTGCAC 3’

31. If the sequence shown is the same as the sense or coding strand of the DNA, which of the following sequences shows the sequence of the resulting mRNA?
   a. 5’ GUGCAGUGAGCCCCAAA 3’
   b. 5’ CACGUGCACUGCGGGUUU 3’
   c. 5’ AAACCGGTACGCTGCAG 3’
   d. 5’ UUGGGGCUCACGUGCAC 3’

32. When mRNA is translated,
   a. it is translated from the 5’ to 3’ direction and the resulting protein is synthesized from its carboxy-terminus to its amino-terminus.
   b. it is translated from the 5’ to 3’ direction and the resulting protein is synthesized from its amino-terminus to its carboxy-terminus.
   c. it is translated from the 3’ to 5’ direction and the resulting protein is synthesized from its carboxy-terminus to its amino-terminus.
   d. it is translated from the 3’ to 5’ direction and the resulting protein is synthesized from its amino-terminus to its carboxy-terminus.

33. If the open reading frame of the resulting protein starts with the first 3 nucleotides of the sequence shown in the sequencing ladder marked “Normal”, the resulting amino acid sequence is most consistent with which of the following sequences? You can ignore that there is no initiator methionine.
   a. val-his-val-ser-pro-lys
   b. his-val-his-ser-gly-phe
   c. lys-pro-arg-val-his-val
   d. phe-gly-ala-his-val-his.

34. The data from one affected patient with a cleft lip from Brazil is shown in the ladder marked “Brazilian patient”. The amino acid sequence that results from the genetic change shown in this patient’s genetic information is most consistent with the following sequences?
   a. an insertion of a single C to give the sequence phe-gly-arg-ser-ser-ala
   b. a deletion of a single C to give the sequence lys-pro-glu-lys-thr-stop
   c. a deletion of a single G which leaves the sequence unchanged (val-his-val-ser-pro-lys).
   d. an insertion of a single G to give the sequence his-val-his-ser-gly-phe.
35. The data from another patient with a cleft lip from British Columbia is shown in the sequence ladder marked “Patient from British Columbia”. The amino acid sequence that results from the genetic change shown in this patient’s genetic information is most consistent with the following sequences?
   a. a C to G change that alters the encoded protein to the sequence lys-ala-arg-val-his-val.
   b. a single base insertion that alters the encoded protein to the sequence phe-gly-ala-gln-gly-tyr
   c. a C to G change that leaves the amino acid sequence unchanged (val-his-val-ser-pro-lys)
   d. a C to G change that leaves the amino acid sequence unchanged (his-val-his-ser-gly-phe).

36. Examples of uses for Southern blotting techniques include all of the following, except:
   a. detecting persons carrying genetic diseases, such as Tay Sachs or sickle cell anemia
   b. identifying restriction fragment length polymorphisms (RFLPs)
   c. studying the structure of protein in solution.
   d. determining biological relatedness in disputed paternity cases, using a probe common to both parents and the child