Biochemistry 2280A
Final Exam - 333

In the following questions mark the one best answer.

1. Which statement describes DNA but **not** RNA?

a) It features base pairing by hydrogen bonding
b) It folds into a wide variety of shapes
c) It is used to hold or transmit information
d) It can be millions of bases long in the cell
e) It uses a five-carbon sugar in its structure

2. Which of the following statements about RNA is **false**?

a) The phosphodiester bond of RNA is stable at high pH
b) Two bases that are hundreds of bases apart on a single RNA strand can form Watson-Crick base pairs with each other
c) RNA can contain modified bases
d) RNA is usually a single stranded molecule
e) RNA contains uracil instead of thymine

3. The "polarity" of a nucleic acid strand refers to:

a) The negative charges on the phosphate groups
b) The difference between the 5' and 3' ends
c) The fact that the bases accept protons at neutral pH
d) The way the strand orients itself during cell division
e) The distance between a given point on the strand and the centromere.

4. The phosphodiester bonds in DNA

a) join the 3' hydroxyl of one nucleotide to the 5' hydroxyl of the next
b) are packed in the centre of the double helix
c) always join A to T and C to G
d) carry a positive charge at physiological pH
e) are unstable at high pH

5. What is the ratio of width to length of a DNA double helix 2 meters long?

a) $1:10^5$
b) $1:10^6$
c) $1:10^7$
d) $1:10^8$
e) $1:10^9$

6. Suppose the cell tried to make RNA with a ribose derivative that was missing the hydroxyl group on the 1' carbon. What would be the most likely consequence?

a) The cell would be unable to add a nitrogenous base to the sugar.
b) The resulting RNA would be stable to alkaline solutions.
c) The cell would be unable to phosphorylate the sugar at the appropriate carbon.
d) The phosphodiester bond would not form during transcription, because there would be no hydroxyl to displace PP_i from the incoming ribonucleotide triphosphate.
e) There would be no significant consequence.

7. Cytosine is to thymine as adenine is to:

a) Adenine
b) Cytosine
c) Guanine
d) Thymine
e) Uracil

8. In DNA, base stacking:

a) Involves ionic bonds between phospate groups
b) Involves two nitrogenous bases oriented perpendicular to each other
c) Is sequence-specific
d) Involves two or three hydrogen bonds between complementary bases
e) Involves van der Waals interactions between adjacent bases

9. Suppose a eukaryotic cell carried a mutation that prevented expression of histone H1. Assuming the cell was able to survive, what effect would this have on DNA packaging?

a) The cell would form smaller nucleosome core particles, containing fewer protein molecules.
b) One of the other histones would replace histone H1 in the nucleosome core particle.
c) The cell would be unable to form nucleosome core particles.
d) The cell would be able to form normal nuclesome core particles, but these would not be able to form 30-nm chromatin fibres.
e) The cell would be able to form 30-nm chromatin fibres, but these would not be able to form higher order structures.

10. How many separate polypeptide chains (i.e., individual protein molecules) are present in a nucleosome core particle?

a) 3 b) 4 c) 5 d) 8 e) 10

11. Which sentence about chromatin is **true**?

a) Histones from different organisms have very different sequences.
b) In a nucleosome core particle, histones are arranged around a core of DNA.
c) Each nucleosome core particle contains a randomly assembled group of histone proteins.
d) Once a nucleosome core particle has formed at a certain piece of DNA, it will remain intact until DNA replication occurs.
e) Nucleosome formation decreases the length of double-stranded DNA by a factor of approximately three.

12. How many nucleosome core particles would you expect to find in a gene of 9000 base pairs?

a) about 36
b) about 45
c) about 60
d) about 75
e) about 90

13. Under the right conditions, scientists studying chromatin have taken electron micrographs showing structures that look like beads on a string. What are the "beads" composed of?

a) DNA only
b) DNA and RNA
c) DNA and protein
d) RNA and protein
e) DNA, RNA and protein

14. How can the cell efficiently transcribe DNA in the presence of nucleosome core particles?

a) Nucleosome core particles do not form on open reading frames.
b) Transcription does not occur at times in the cell cycle when DNA is packaged by nucleosome core particles.
c) RNA polymerase can transcribe DNA that is bound to nucleosome core particles.
d) Chromatin remodeling complexes rearrange nucleosome core particles to allow RNA polymerase to access the DNA.
e) Nucleosome core particles help unwind DNA to prepare it for transcription.

15. Which of the following situations would occur if DNA helicase were missing from the replication machinery?

a) Primers would be synthesized but no replication would take place.
b) Primers would not be synthesized because it would be impossible to separate the DNA strands at replication origins.
c) RNA would remain covalently attached to the newly synthesized DNA fragment.
d) Polymerase would begin to function, but would stall because the template strands would not be separated further.
e) The DNA strands would separate but no primers would be synthesized.

16. Telomeres

a) are found at various places throughout each human chromosome.
b) are mainly found during embryo development, and in germ line cells.
c) are the same length before and after DNA replication, in somatic cells.
d) contain a repeating nucleotide sequence.
e) are the blunt ends of chromosomes.

17. DNA replication begins at

a) G-C rich sequences
b) Replication origins
c) Start codons
d) Primase binding sites
e) Telomeres

18. Which one of the following statements is **true**?

a) Humans and *E. coli* have the same number of replication forks per double helix.
b) Each replication fork contains exactly one helicase.
c) Okazaki fragments are removed by an RNA endonuclease.
d) At each replication fork, leading strand synthesis is completed before lagging strand synthesis begins.
e) The replication fork is asymmetrical because it contains two DNA polymerase enzymes that are structurally distinct.

19. From where does DNA polymerase get the energy required for DNA synthesis?

a) It hydrolyzes ATP to ADP and P_i
b) It hydrolyzes ATP to AMP and PP_i
c) It uses the energy from the phosphoanhydride bonds of the nucleotide to be added.
d) It uses the energy from phosphoanhydride bonds present at the end of the growing strand.
e) From nowhere; DNA synthesis does not require the input of energy.

20. Suppose DNA replication were conservative. In their isotopic labeling experiment, how many different DNA bands would Meselson and Stahl have seen in their cesium chloride density gradient after 3 rounds of replication?

a) 1 b) 2 c) 3 d) 4 e) 8

21. You have discovered mutant form of the replicative DNA polymerase in which the 3' to 5' exonuclease function has been destroyed but the ability to join nucleotides together is unchanged. Which of the following properties would the mutant polymerase have?

a) It would polymerize in both the 5' to 3' direction and the 3' to 5' direction.
b) To replicate the same amount of DNA, it would hydrolyze fewer deoxyribonucleotides than would the normal polymerase.
c) It would polymerize more slowly than the normal polymerase.
d) It would fall off the template more frequently than the normal polymerase.
e) It would introduce fewer mutations into new strands than the normal polymerase.

22. What is the function of telomerase?

a) Telomerase is a component of telomeres that helps stabilize the DNA at the end of chromosomes.
b) Telomerase adds nucleotides to the ends of mRNA molecules to stabilize them.
c) Telomerase adds repeat sequences to the ends of chromosomes to make the chromosomes longer.
d) Telomerase helps repair double strand breaks in DNA.
e) Telomerase replicates DNA in embryonic cells and germ line cells.

23. Which of the following proteins or protein complexes are most abundant on DNA within 200 bases of a replication fork?

a) Single-strand binding protein
b) Sliding clamp protein
c) DNA polymerase
d) Helicase
e) Primase

24. Which of the following statements is **false**?

a) Each time the genome is replicated, half of the newly synthesized DNA is made as Okazaki fragments.
b) When replication forks from adjacent replication origins meet, a leading strand always runs into a lagging strand.
c) In a replication bubble, a single DNA strand is the template for leading strand synthesis at one replication fork and is also the template for lagging strand synthesis at the other replication fork.
d) Okazaki fragments are synthesized on the lagging strand.
e) When read in the same direction (5' to 3'), the sequence of nucleotides in a newly synthesized DNA strand is the same as in the template strand.

25. Suppose a mutation suddenly inactivated the sliding clamp protein involved in DNA replication. What would be the result?

a) RNA primers would be synthesized, but no DNA synthesis would take place.
b) The replication bubble would not form.
c) DNA would be synthesized in shorter fragments than normal.
d) The replication bubble would form, but the replication fork would not be able to move along the double helix.
e) Okazaki fragments would not be joined together.

26. What would happen if dideoxycytidine monophosphate (ddCMP) were added, at large excess over available nucleotides, to a DNA replication reaction in a test tube?

a) Replication would stop when the polymerase reached an A on the template strand.
b) Replication would stop when the polymerase reached a T on the template strand.
c) Replication would stop when the polymerase reached a C on the template strand.
d) Replication would stop when the polymerase reached a G on the template strand.
e) Replication would continue without disruption.

27. Which statement about priming of DNA replication is **true**?

a) Primase can join nucleotides to create a polynucleotide strand, using single-stranded DNA as a template, without the need for its own primer.
b) The primer remains as a permanent part of the new DNA molecule.
c) Replication of the leading strand does not require primase.
d) Longer primers are required to synthesize longer DNA fragments.
e) The primer is synthesized in the 3' to 5' direction.

28. Xeroderma pigmentosum is caused by a defect in what type of DNA repair?

a) Mismatch repair
b) Base excision repair
c) Nucleotide excision repair
d) Homologous recombination
e) Non-homologous end joining

29. Mismatch repair is most likely to occur after

a) DNA polymerase makes a mistake
b) formation of a pyrimidine dimer
c) a double strand break occurs
d) a depurination event
e) deamination of cytosine

30. Which statement about the mechanism for repairing cytosine deamination and the mechanism for repairing thymine dimers is **true**?

a) Repair of thymine dimers requires base pairing to DNA on the undamaged copy of the chromosome; repair of cytosine deamination does not.
b) Repair of thymine dimers requires the DNA backbone to be broken; repair of cytosine deamination does not.
c) Repair of thymine dimers requires a DNA polymerase; repair of cytosine deamination does not.
d) Repair of thymine dimers uses the undamaged DNA strand as a template; repair of cytosine deamination does not.
e) Repair of thymine dimers requires synthesis of as many as 30 nucleotides; repair of cytosine deamination does not.

31. Translesion DNA polymerases are used to continue replication past what type of DNA damage?

a) Deamination
b) Depurination
c) Double-strand breaks
d) Single-strand breaks
e) Copying mistakes by the replicative DNA polymerase

32. Which statement about pyrimidine dimers is **true**?

a) Repair of pyrimidine dimers does not require DNA ligase.
b) Pyrimidine dimers are caused by ultraviolet light.
c) Pyrimidine dimers can involve thymine but not cytosine.
d) Pyrimidine dimers do not affect the rate of DNA replication.
e) Pyrimidine dimers are repaired by the long-patch base excision repair pathway.

33. Which of the following DNA repair mechanisms is most expensive in terms of deoxynucleotide triphosphates consumed per base repaired?

a) Proofreading during DNA synthesis
b) Mismatch repair
c) Short-patch base excision repair
d) Long-patch base excision repair
e) Nucleotide excision repair

34. Which statement is **true**?

a) Non-homologous end-joining can be used to repair double-strand breaks at which one DNA strand is overhanging the other.
b) Non-homologous end-joining is the most accurate way to repair a double-strand break.
c) Double-strand breaks are indistinguishable from the ends of chromosomes.
d) Most DNA repair processes require re-synthesis of both strands of DNA.
e) Single-strand breaks are usually repaired by homologous recombination.

35. Which statement about deamination of DNA is **true**?

a) A pyrimidine is converted to a purine.
b) It can form uracil.
c) It is caused by spontaneous hydrolysis of a glycosidic bond.
d) It is caused mainly by x-rays.
e) A purine is converted to a pyrimidine.

36. The binding of cAMP to the catabolite activator protein (CAP) results in:

a) A change in the 3D structure of cAMP
b) A change in the 3D structure of CAP
c) The degradation of cAMP
d) The degradation of CAP
e) The repression of the lac operon

37. Which statement is false? The bacterial RNA polymerase core enzyme

a) Is able to use NTPs and a DNA template to synthesize RNA.
b) Is only able to recognize promoters when coupled with sigma factor.
c) Is only involved in the synthesis of mRNA.
d) Is a multi subunit enzyme.
e) Uses the energy from NTPs to form phosphodiester bonds.

38. Which statement is true for gene regulation in eucaryotic cells?

a) Gene regulation occurs only in the nucleus
b) A component of gene regulation involves the co-ordination between protein synthesis and degradation.
c) Translational control principally occurs in the nucleus.
d) All proteins are synthesized in an active form.
e) Histones play a minor role in gene regulation in eucaryotic cells.

39. Which of the following is false?

a) Catabolite repression is a general property of all cells.
b) Glucose is the principle carbon source for all cells.
c) cAMP is the second messenger for glucose in all cells.
d) Glucose is always metabolized before lactose.
e) The lac operon is regulated by catabolite repression.

40. The Trp operon is an example of negative regulation because:

a) The operon is expressed when the Trp repressor is bound to the operator
b) The operon responds to environmental signals
c) The operon is expressed in the absence of the Trp repressor
d) The operon is expressed in the absence of sigma factor
e) The operon is always expressed

41. Open complex formation in bacterial transcription requires which of the following?

a) NTPs
b) dNTPs
c) RNA
d) DNA Helicase
e) RNA polymerase

42. Which reason explains why a typical eucaryotic gene can respond to a greater variety of regulatory signals than a typical procaryotic gene?

a) The protein-coding regions of eucaryotic genes are longer than those of procaryotic genes.
b) Eucaryotes have three types of RNA polymerase.
c) The transcription of a eucaryotic gene can be influenced by a greater number of proteins that bind to the promoter.
d) Eucaryotic RNA polymerase require general transcription factors.
e) Procaryotic genes are packaged into nucleosomes.

43. The operon structure of bacterial genes implies which of the following?

a) Translational control is a key step in bacterial gene expression.
b) Transcriptional control is the only important step in coordinating gene expression.
c) RNA splicing is key in regulating gene expression.
d) All genes in an operon are expressed at the same level.
e) Each operon uses a unique sigma factor.

44. The smallest living unit is:

a) a cell
b) a protein
c) an organelle
d) a virus
e) a DNA molecule

45. Which statement about the basic chemistry of eucaryotic cells from any one organism is most **true**?

a) All cells contain the same number of proteins.
b) All proteins are constructed from the same 22 amino acids.
c) All cells contain the same amount of genetic information.
d) All genetic instructions are stored in the form of DNA.
e) All genetic information is transcribed into RNA.

46. Which of the following statements is correct?

a) All mouse cells are the same size.
b) All human cells contain the same mass of DNA.
c) Bacteria do not have mitochondria.
d) All bacteria grow faster than eucaryotic cells.
e) Eucaryotic cells do not have cell walls.

47. You have grown a culture of bacterial cells and discover that they are heavily contaminated with yeast. Which of the following procedures is most likely to eliminate the yeast without killing the bacterial cells?

a) Treating the culture with a drug that causes microtubules to fall apart.
b) Diluting a small portion of the contaminated culture with 1000 times as much fresh nutrient broth and regrowing the cells.
c) Treating the culture with a drug that damages DNA.
d) Treating the culture with a drug that dissolves cell walls.
e) Treating the culture with a detergent that destroys cell membranes.

48. The nucleic acids are extracted from a culture of liver cells and then mixed with resin beads to which the polynucleotide 5'–TTTTTTTTTTTTTTTTTTTTTTTTT – 3' has been covalently coupled. After a short incubation, the beads are washed. When you analyze the nucleic acids that have stuck to the beads, which would be most abundant?

a) Primary transcript RNA
b) rRNA
c) DNA
d) tRNA
e) mRNA

49. Which is the most appropriate reason for why related amino acids are coded for by similar codons?

a) The peptidyl transferase activity of the ribosome can then substitute the correct amino acid.
b) To maintain the universality of the genetic code.
c) So single base changes as the result of mutagenesis result in conservative amino acid changes.
d) So that the genetic code is nonoverlapping.
e) To avoid the inappropriate insertion of stop codons.

50. The 5' terminal cap is important for:

a) lariat formation at the branch point
b) the termination of transcription
c) transport of the mRNA into the nucleus
d) the initiation of translation
e) initiation of transcription

51. Splicing increases the complexity of the genome because:

a) It enables the synthesis of related but distinct gene products from a single gene
b) It ensures a function for unique splicing factors
c) It results in genes with a higher A:T content
d) It necessitates chromatin in eucaryotic organisms
e) It facilitates the use of multiple transcription start sites

52. A radioactively labeled cDNA for your favorite gene is used to probe RNA isolated from kidney by Northern blotting. Two bands are seen on the blot. Which of the following reasons is least possible?

a) These are two related genes expressed in kidney
b) There is a single mRNA produced but some is not 5' capped
c) A single pre mRNA is spliced into two different messages
d) The mRNA is cleaved in the cytoplasm as part of its degradation
e) There are two transcriptional start sites for the gene

53. In eucaryotes, but not procaryotes, ribosomes find the start site of translation by:

a) Binding directly to a ribosome-binding site preceding the initiation codon.
b) Recognizing an AUG codon as the start of translation.
c) Scanning along the mRNA from the 5' end.
d) Recognizing a UAA codon as the start site for translation.
e) Binding an initiator tRNA to the large subunit.

54. Which reason does **not** explain why tRNAs have similar structure?

a) All tRNAs are coupled to amino acids by aa-tRNA synthetases
b) All tRNAs interact with the A site on the ribosome
c) All tRNAs interact with the P site on the ribosome
d) All tRNAs have evolved from a common ancestor
e) All tRNAs are coded for by the same gene

55. Poly UG (UGUGUGUGUGUG) is added to a cell free extract able to translate RNA. What peptides are produced?

a) poly cys-val
b) poly thr-his
c) poly asp-lys
d) poly cys
e) none

56. Which amino acid would you expect a tRNA with the anticodon 5'-UUG-3' to carry? The table of codons is given in **Fig. 272**.

a) Lysine (Lys)
b) Glutamate (Glu)
c) Glutamine (Gln)
d) Leucine (Leu)
e) Phenylalanine (Phe)

fig. 272

GCA GCC GCG GCU	AGA AGG CGA CGC CGG CGU	GAC GAU	AAC AAU	UGC UGU	GAA GAG	CAA CAG	GGA GGC GGG GGU	CAC CAU	AUA AUC AUU	UUA UUG CUA CUC CUG CUU	AAA AAG	AUG	UUC UUU	CCA CCC CCG CCU	AGC AGU UCA UCC UCG UCU	ACA ACC ACG ACU	UGG	UAC UAU	GUA GUC GUG GUU	UAA UAG UGA
Ala	Arg	Asp	Asn	Cys	Glu	Gln	Gly	His	Ile	Leu	Lys	Met	Phe	Pro	Ser	Thr	Trp	Tyr	Val	stop
A	R	D	N	C	E	Q	G	H	I	L	K	M	F	P	S	T	W	Y	V	

57. Spiderman's cellular components were analyzed in detail. His proteins were found to contain 30 different amino acids and his DNA to contain 6 types of nucleotides. What would be the minimum number of base pairs in each codon to allow coding for these 30 amino acids?

a) one b) two c) three d) four e) five

58. Which of the following characteristics is a feature of the Wobble hypothesis?

a) A tRNA can read only one codon
b) Some tRNAs can read codons which specify more than one amino acid
c) The third base in the codon must form a Watson-Crick base pair
d) The "wobble" occurs only at the 3' end of the codon
e) The base in the middle position of the tRNA anticodon can permit "wobble"

59. Which of the following is a limitation on the use of PCR to detect and isolate genes?

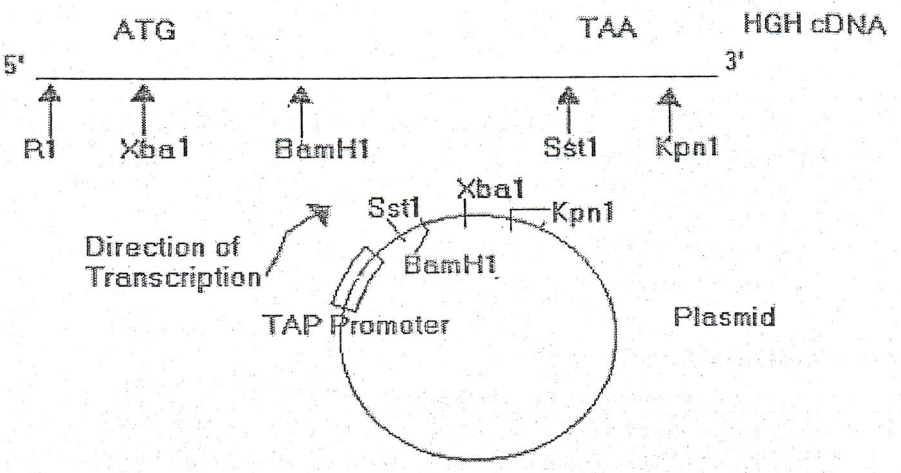
a) It also produces large numbers of copies of sequences beyond the 5' and 3' end of the desired sequence.
b) It cannot be used to amplify a particular sequence from a mixture of mRNAs.
c) The sequence at the beginning and end of the DNA to be amplified must be known.
d) It will amplify only sequences present in multiple copies in the DNA sample.
e) It cannot be used to amplify cDNAs.

60. Cysteine can be linked to its appropriate tRNA (tRNAcys). The amino acid on the tRNA can subsequently be chemically reduced to alanine. If the resultant tRNA were added to a mixture of ribosomes, factors, cofactors, amino acids, tRNAs, and messenger RNA capable of synthesizing proteins, where would the alanine from the reduced aminoacyl tRNA be found in the product?

a) Wherever Ala occurs normally
b) Wherever the dipeptide Ala-Cys normally occurs
c) Wherever either Ala or Cys occur normally
d) Alanine would not be incorporated into protein from the reduced aminoacyl tRNA
e) Wherever Cys occurs normally

61. Which pairs of restriction enzymes would allow the cloning of the HGH cDNA 3' (downstream) of the TAP promoter in the plasmid shown to allow its expression in bacteria?

a) Xba1 BamH1
b) Xba1 Kpn1
c) R1 Sst1
d) BamH1 Kpn1
e) R1 Kpn1



62. One nucleotide has a mass of ~300 Daltons. Which is the mass of 1 Mole of an RNA of 100 bases?

a) 30 kg
b) 30 g
c) 30 mg
d) 30 ug
e) 30 pg

63. Given the single stranded DNA shown below (written 5' to 3') and the genetic code, which primer(s) could be used to alter the gene to allow a glu to ala change?

ACG	ATG	CCC	ATC	GAA	GGC	TTG	TTC	GCG
Arg	Met	Pro	Ile	Glu	Gly	Trp	Ser	Ala

a) 5' ATGCCCATCGAAGGCTTGT 3'
b) 5' ATGCCCATCGCAGGCTTG 3'
c) 5' CGCGAACAAGCCTG 3'
d) 5' CAAGCCTGCGATGG 3'
e) More than one of the above.

64. The polymerase chain reaction can be used in forensic investigations because:

a) Criminals contain different genes than the rest of the population
b) Traces of DNA sufficient for PCR amplification can often be recovered from biological material
c) The complete sequence of the human genome is known, allowing the design of primers for every gene
d) Only human DNA can be amplified by PCR
e) Human repeat sequences can be amplified with a single primer

65. Which approach would be the best to verify a DNA clone that had been altered by site directed mutagenesis?

a) PCR
b) hybridization
c) restriction mapping
d) sequencing
e) all of the above

66. The best temperature to renature DNA is:

a) 10 – 15 degrees C below the melting temperature
b) 10 – 15 degrees above the melting temperature
c) At its melting temperature
d) 30 degrees C above the melting temperature
e) 30 degrees C below the melting temperature

67. Which of the following sequences would most likely be recognized and cut by a restriction endonuclease? (assume the DNA to be double stranded)

a) GCAACG
b) ATCCGC
c) CTTAAG
d) TCTGAG
e) TGTTGA

In the following questions

Mark A if 1, 2 and 3 are correct
Mark B if 1 and 3 are correct
Mark C if 2 and 4 are correct
Mark D if 4 only is correct
Mark E is all answers are correct

68. A PCR reaction using primers flanking a human VNTR locus yields a single band when analyzed by gel electrophoresis. Which reason(s) is/are possible to explain the result?

1. Both maternal and paternally derived copies have the same number of repeats.
2. The electrophoretic analysis was not sensitive enough to reveal a second copy.
3. The subject is a male and the locus is linked to the X chromosome.
4. The PCR sample was contaminated.

69. Which factor(s) influence(s) the melting temperature of DNA?

1. length of the molecule
2. counterions in the solution
3. the solvent in which the DNA is dissolved
4. base composition of the DNA

70. Essential features of a plasmid vector to be used for gene cloning are:

1. EcoR1 site
2. origin of replication
3. oligo-dT tail
4. selectable marker

71. Which of the following statements is/are **true**?

1. Cancer is a genetic disease
2. Cancerous cells contain multiple mutations
3. DNA damaging agents cause cancer
4. Cancerous cells progress essentially unchanged from birth

72. Which of the following is/are **true** about cancer cells?

1. They differentiate into normal tissues but at abnormal locations
2. They evade normal growth control signals
3. They appear normal under the microscope
4. They fail to undergo programmed cell death

73. Which statement(s) about the electrophoresis of DNA is/are **NOT** true?

1. Acrylamide gels allow the separation of single stranded DNA differing in size by one base
2. At neutral pH DNA migrates towards the negative pole
3. Autoradiography is a tool to visualize DNA after separation by electrophoresis
4. The smaller DNA fragments migrate slower on an agarose gel

74. This feature(s) is/are **NOT** found in a plasmid for expression of cloned genes in bacteria.

1. promoter
2. polyadenylation site
3. ribosome binding site
4. TATA element

In the following questions

Mark A if 1, 2 and 3 are correct
Mark B if 1 and 3 are correct
Mark C if 2 and 4 are correct
Mark D if 4 only is correct
Mark E is all answers are correct

75. Which statement(s) is/are true about the expression of human proteins in bacteria?

1. The protein can be produced at high abundance
2. The protein can be easily purified
3. The protein may be insoluble
4. The protein can be modified correctly

In the following questions mark the one best answer.

76. RNA molecules can be separated by agarose gel electrophoresis, subsequently transferred to a membrane and then detected by a complementary radioactive probe. This method relies upon:

a) base pairing of complementary sequences
b) restriction enzyme digestion
c) cDNA synthesis of the RNA molecule
d) DNA cloning of the RNA molecule
e) dideoxynucleotide sequencing

77. The first effect upon heating a solution of double stranded DNA to a high temperature would be:

a) a change in the sequence of nucleotides
b) breakdown of the strands into individual nucleotides
c) removal of bases from the sugar-phosphate backbone
d) separation of the two strands
e) nicks appear in the backbone

78. Codon bias refers to which of the following?

a) Some codons for an amino acid are more frequently used in all species.
b) Some amino acids are rarely used in the proteins of some organisms.
c) Some codons for an amino acid are more frequently used and the bias varies in different species.
d) Some codons code for rare amino acids such as selenocysteine in some species.
e) None of the above.

79. Certain restriction endonucleases produce "sticky" ends. This means that they:

a) Cut in regions of high G + C content
b) Make a double-strand cut leaving non base-paired ends
c) Cut both DNA strands at the same base pair
d) Stick tightly to the ends of the DNA it has cut
e) Act as DNA ligases

80. DNA ligase can **not** join which of the following types of DNA?

a) phosphorylated sticky ends
b) 5' overhangs
c) phosphorylated blunt ends
d) dephosphorylated blunt ends
e) 3' overhangs

81. Why is inactivation a useful technique to determine the function of a gene?

a) Gene inactivation provides information about the expression of a gene.
b) Gene inactivation provides information about the cellular location of a gene product.
c) Gene inactivation provides an opportunity to identify phenotypic changes associated with the loss of the functional gene.
d) Gene inactivation provides information on the structure of the gene product.
e) None of the above.

82. What is the purpose of performing a homology search with a DNA sequence?

a) To determine if any genes with similar sequences are present in the DNA database.
b) To determine if the sequence is already in the database.
c) To search for consensus exon-intron boundaries.
d) To determine the codon bias for a specific gene.
e) None of the above.

83. A plasmid is cut with the restriction enzyme BamH1 giving fragments of 3000 and 1000 bp as identified by gel electrophoresis and ethidium bromide staining. In a seperate restriction digest the enzyme EcoR1 gives fragments of 1000 and 1500 bp that are apparent on the agarose gel. What is the most likely size of the plasmid in bp?

a) 4000
b) 5000
c) 6000
d) 11 000
e) None of the above.

84. What would happen if the concentration of dideoxynucleotides was too high in a chain termination sequencing reaction?

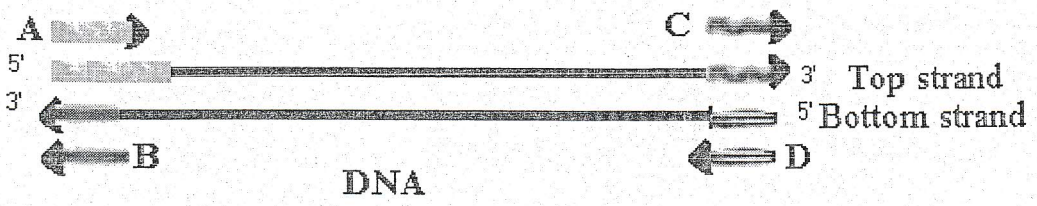
a) The reactions would yield very long molecules and there would be little sequence data close to the primer.
b) The reactions would yield very short molecules.
c) The reactions would not proceed as the high concentrations of the dideoxynucleotides would inhibit the DNA polymerase.
d) The fluorescence of the sequencing products would be too high and difficult to read.
e) None of the above.

85. What is an open reading frame (ORF)?

a) All of the nucleotides of a gene that are transcribed into mRNA.
b) The nucleotides of a gene that make up the codons specifying amino acids.
c) The nucleotides of an mRNA molecule before the introns have been removed.
d) The amino acid sequence of a polypeptide.
e) None of the above.

86. Which two pairs of primers will allow the amplification of the indicated DNA fragment by polymerase chain reaction? The 3' end of each strand is defined by an arrow. Identical sequences are indicated by common shading.

a) A, C
b) B, D
c) D, C
d) A, D
e) A, B



87. What is a genomic library?

a) A collection of recombinant molecules with inserts that contain all of the RNA of an organism.
b) A collection of recombinant molecules with inserts that contain all of an organism's genome.
c) A collection of recombinant molecules that express all of the genes of an organism.
d) A collection of recombinant molecules that have been sequenced.
e) None of the above.

88. A circular DNA containing 2 restriction enzyme sites for BamH1 is cut for 5 minutes with BamH1. The gel (after electrophoresis) shows only a single band corresponding to the exact size of the singly cut plasmid. The probable reason is:

a) One of the DNA fragments does not stain with ethidium bromide
b) The 2 DNA fragments run at the same position on the gel
c) There was insufficient time for the enzyme to cut at the second site
d) The restriction enzyme was left out of the reaction
e) You would expect only 1 band on the electrophoresis gel

89. A DNA binding protein is shown to bind to the following DNA sequences:
(assume double stranded DNA)

TGTACA AATACA TACACA TCTAAA TATAAA TATACG	What can be said about the consensus sequence required for its binding?

a) More sequences are required to obtain the consensus sequence.
b) The consensus sequence contains more base pairs than those above.
c) The consensus sequence is TCTAAA
d) The consensus sequence contains two possibilities at the first position
e) The consensus sequence is TATACA

90. You have purified DNA from your recently deceased goldfish. Which of the following restriction nucleases would you use if you wanted to end up with DNA fragments of average size around 70 kilo base pairs after complete digestion of the DNA? The recognition sequence for each enzyme is as indicated in the right hand column. "N" indicates that any nucleotide may be in this position and the enzyme will still cleave the site.

a) Ram I	GCGGCCGC
b) Man I	GATC
c) Dan I	GGATCC
d) Fam I	GAAGGATCCTTC
e) Can I	CCNNGG

91. The single most significant preventable cause of cancer is

a) smoking
b) UV radiation
c) diet
d) genetic inheritance
e) viral infection

92. You have sequenced a short piece of DNA (by chain termination sequencing) and produced the gel shown in Fig. 263. What is the sequence of the DNA (starting from the 5 end)?

a) 5GACCTGACTGTA3
b) 5ATGTCAGTCCAG3
c) 5TACAGTCAGGTC3
d) none of the above

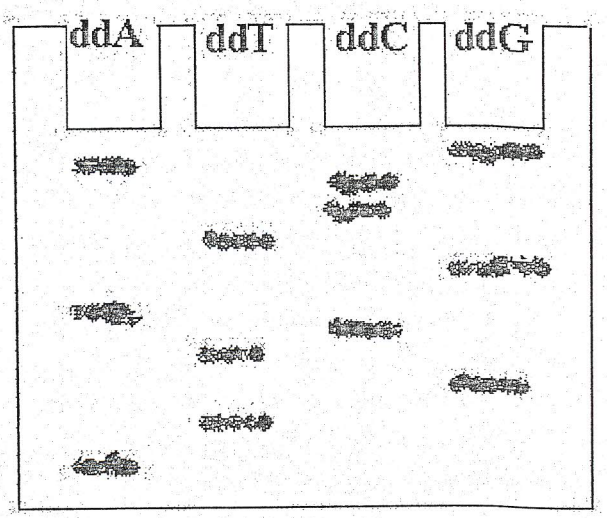


fig. 263

93. Which is a common function for the protein product of a cancer-causing gene?

a) a role in DNA repair
b) a role in cell cycle control
c) a role in transcriptional regulation
d) a role in cell signaling
e) all of the above

94. There have been some recent reports suggesting that a small amount of translation of specific genes occurs in the nucleus. If this is indeed correct, which of the following is most likely also true?

a) eucaryotic genes are transcribed in the cytoplasm
b) eucaryotic cells contain no genetic information
c) splicing cannot be important for the expression of these specific genes
d) ribosomes are present in the nucleus
e) RNA is not always required for translation

95. In yeast, induction of genes required for the metabolism of galactose are under the control of a transcriptional activator called GAL4. Which statement is most likely false?

a) Gal4 is a DNA binding protein that binds upstream of genes required for the metabolism of galactose.
b) Gal4 recruits sigma factor to the promoters of galactose induced genes.
c) The genes required for the metabolism of galactose are subject to catabolite repression.
d) Gal4 binding to DNA directly or indirectly affects chromatin structure.
e) Gal4 functions as a dimer and makes contacts with bases within the major groove of DNA.

96. The primary sequence of histone H4 is highly conserved in eucaryotic organisms. Which of the following statements is most likely false?

a) The proteins regulating expression of histone H4 in yeast and humans have similar sequences.
b) Histone H4 has a similar function in yeast and humans.
c) The nucleic acid sequences encoding yeast and human histone H4 are similar.
d) Histone H3 in yeast and humans is also similar.
e) Plant histone H4 has a similar sequence as human histone H4.

97. Drugs currently used to treat cancer act on what basis?

a) block cell differentiation
b) stimulate cell growth
c) result in breakdown of the cell membrane
d) inhibit cell division
e) enhance cellular transcription

98. Assume the average amino acid residue in a protein has a molar mass of 100g. You have a protein which has an estimated molecular mass of 100 kilodaltons. The encoding region for this gene would be approximately how many base pairs?

a) 1 000 base pairs
b) 30 000 base pairs
c) 10 000 base pairs
d) 3 000 base pairs
e) it cannot be estimated with this information

99. Which is not true about cancer causing genes?

a) They have been inherited from viruses
b) They resemble normal cellular genes
c) Their lack of expression can cause cancer
d) Their over-expression can cause cancer
e) They can be found in multiple copies in the cell