Molecular Biology (Final)

Batch of 019

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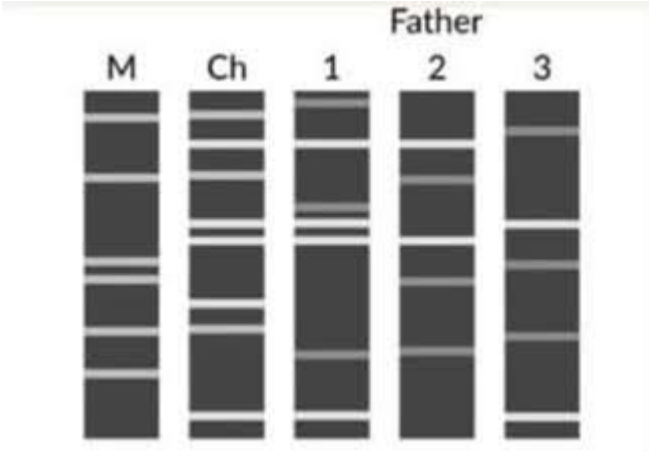
1) A child (Ch) wants to know his father (1-3). M represents the mother's genetic profile. The father is:

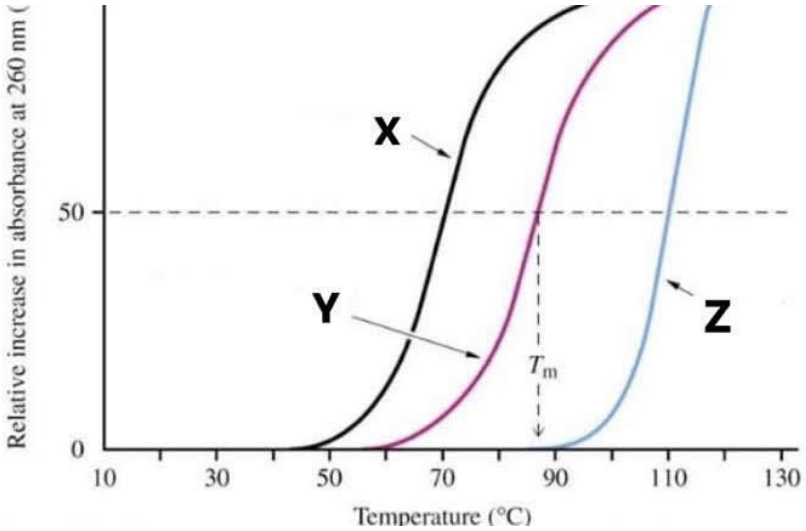


a) Individual 3
b) Individual 2
c) Individual 1 or 2
d) Individual 1
e) Individual 2 or 3

2) A non-coding RNA is one of the following:

a) It has a repetitive sequence
b) It is produced from another RNA
c) It does not have a specific gene
d) It does not produce proteins
e) It is not expressed

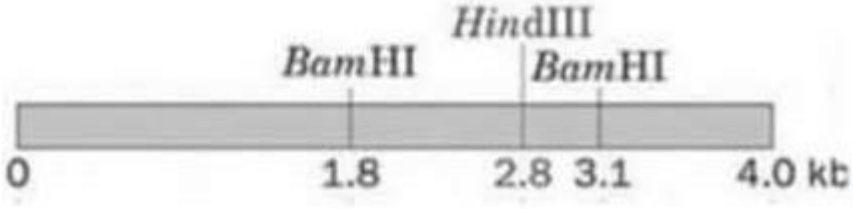
3) The plot shown illustrates the denaturation curve of three DNA samples, (X, Y and Z). One of the following is or can be a true statement:



a) Sample Y has higher CT content than sample Z
b) At 50% absorbance, half of the DNA molecules are FULLY denatured and half are FULLY double-stranded
c) At 80°c, the majority of DNA in samples X and Y are denatured
d) The melting temperature of all samples is approximately 120°c
e) The increase in the absorbance at higher temperature is because DNA becomes single stranded

4) The shown 4-Kb DNA fragment is COMPLETELY digested by two endonucleases, BamHI and HindIII, added together. The fragments generated have the following sizes (in Kb):

a) 0.3, 0.9, 1.0, 1.8, 2.8, 3.1
b) 0.3, 0.9, 1.0, 1.8
c) 0.3, 0.9
d) 8, 2.8, 3.1
e) 0.1, 0.8



5) STRs and VNTRs are useful genetic markers (for forensic medicine, for example) because:

a) Their sequences are variable among individuals
b) They are gene-related sequences
c) They are located within or nearby active genes
d) Probes are easy to be made for them
e) Their sizes are unique among individuals

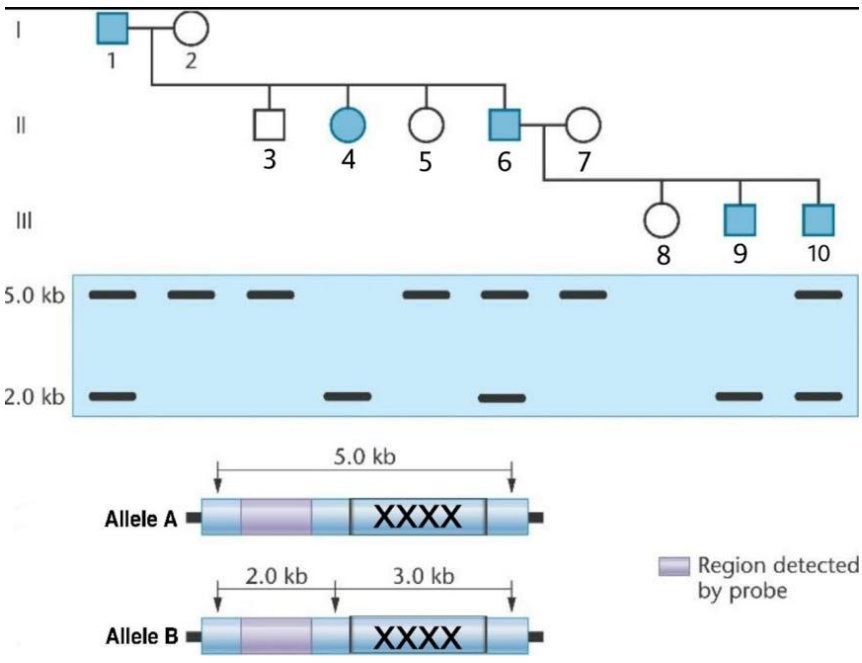
6) Which of the following is NOT correct about intergenic DNA?

a) Mini-satellites and micro-satellites are variable among individuals
b) The majority of the human genome is composed of intergenic DNA
c) The repetitive DNA in the intergenic DNA can be dispersed or tandemly repetitive
d) Intergenic DNA does not code for proteins
e) Centromere is a type of tandem repeats that is identical among different chromosomes

7) A certain nucleotide outside the regulatory or coding region of gene X was analyzed in 1000 healthy individuals (controls) and 1000 cancer patients (cases). G was found in 94% and A was found in 6% of healthy individuals. On the other hand, 61% of cancer patients were found to have G and 39% had A. Based on these results, which of the following in NOT correct?

a) This is a linked, not causative, genetic variation
b) This genetic position is a single nucleotide polymorphism (SNP)
c) Gene X can be used to predict the susceptibility of individuals to cancer
d) This is a genetic variation in gene X among the population
e) Gene X is involved in the pathogenesis of cancer

8) RFLP was performed on a family to understand the association of a mutation with a disease. There are two possible alleles, A and B. Southern blotting was performed and the results are shown as pedigree (circles are females and squares are males; dark squares or circles indicate an affected individual). The genetic pattern for each individual is shown exactly below it in the gel. The probe used to recognize the region is shown in black on the DNA. One of the following is TRUE?



a) If a probe covering the region marked XXXXX is used, you can reach the same conclusion
b) To have a disease, an individual must carry two copies of allele B
c) It is expected that individual 8 is heterozygous
d) If individual 3 is married to a normal female, all children will be affected
e) Individual 2 is homozygous for the mutated gene

9) A human genomic DNA is cut by a restriction endonuclease and then analyzed by Southern blotting, you can know the following:

a) The numbers, but not sizes and sequences, of the fragments
b) The sizes and numbers, but not sequences, of the fragments
c) The sequences, but not the numbers or sizes, of the fragments
d) The sizes, but not the numbers or sequences, of the fragments
e) The sequences, sizes and numbers of the fragments

10) A nucleosome contains all of the following EXCEPT:

a) A DNA free of histones
b) A DNA complexed with histones
c) H2A and H2B
d) A histone octamer
e) Histone H1

11) A DNA sample has a concentration of 250 µg/ml. It was diluted 1:50. What do you expect the absorbance of the diluted sample to be at 260 nm of light?

a) 5
b) 50
c) 1
d) 0.1
e) 0.5

12) The sequence GCAGGCCTAGT exists in a human genome. One of the following is TRUE:

a) It is a part of a minor groove
b) It exists in a telomere
c) It is made of ribonucleotides
d) The opposite strand is CGTCCGGATCA
e) The last (T) in the sequence exists in a monophosphate form

13) Which of the following double stranded DNA sequences needs higher temperature to separate into single-stranded DNA?

a) 5’-GGGCCATTGC-3’
b) 5’-ATTATTCTGC-3’
c) 5’-GGGCCATTTC-3’
d) 5’-GGGCCGTTGC-3’
e) 5’-GGGCCCCTGC-3’

14) Complementarity is a feature of DNA that indicates the following:

a) Bases are almost perpendicular to the side chains
b) DNA is anti-parallel
c) A minor groove is opposite to a major groove
d) DNA is helical
e) Number of (A+G) = number of (T+C)

15) One of the following is TRUE in regard to transposons:

a) They are 20-base pair long regions
b) They are examples of interspersed repetitive DNA sequences
c) Most of them can move
d) The majority of them originate from DNA viruses
e) They have to be inserted the coding region of genes to be pathogenic

16) A template of DNA is 5’-ATCGGCTACAATGTA-3’; what is the complementary DNA sequence that is created during DNA replication?

a) 5’-TAGCCGATGTTACAT-3’
b) 5’-TACAAAGTAGCCGAT-3’
c) 5’-ATCGGCTACAATGTA-3’
d) 5’-TACATTGTAGCCGAT-3’
e) 5’-UACAUUGUAGCCGAU-3’

17) Ionized 5-bromouracil results in:

a) Depurination
b) Intercalation into DNA
c) Pairing with guanine
d) Single-strand breaks
e) Thymine dimers

18) DNA polymerase Gamma (Pol γ) is characterized by all of the following EXCEPT:

a) It is found in eukaryotes
b) It is highly possessive
c) It is found in the mitochondria and replicates the mitochondrial DNA
d) It has the 3'- to -5' exonuclease activity
e) It has low proofreading capability

19) Photolyases are known to:

a) Correct base mismatches in DNA
b) Join DNA ends
c) Exist in human cells
d) Remove pyrimidine dimers
e) Remove intercalating agents

20) A chemical that causes deamination of cytosine results in its conversion to:

a) Uracil
b) Methyl-thymine
c) Thymine
d) 5-bromouracil
e) Methyl-uracil

21) When there is a base mispairing in bacterial DNA, this is how bacteria can distinguish the wrong base:

a) They activate special DNA polymerase
b) They recognize the replicating DNA
c) They recognize the damaged base
d) They change either base randomly
e) They recognize which DNA is unmethylated

22) The presence of O6-methylguanine is corrected by:

a) Mismatch repair system
b) Nucleotide excision repair system
c) BRCA1
d) A special enzyme
e) Transcription factor II H

23) DNA glycosylases have the following effect on DNA:

a) They remove pyrimidine dimers
b) They form phosphodiester bonds
c) They create AP sites
d) They add bases to DNA
e) They join broken DNA strands

24) Which of the following is NOT correct about prokaryotic DNA polymerase I?

a) It has 5'- to -3' exonuclease activity
b) It plays roles in repairing damaged DNA
c) It fills in the gaps between the leading strand fragments
d) It removes RNA primers of each Okazaki fragment
e) It participates in the prokaryotic DNA replication

25) One strand of a DNA segment contains 33 A, 25 G, 12 T, and 41 C. How many each base is found in the original double-stranded DNA molecule?

a) A=46, G=50, C=50, T=46
b) A=45, G=50, C=50, T=45
c) A=66, G=53, C=53, T=66
d) A=66, G=24, C=24, A=66
e) A=45, G=66, C=66, T=45

26) Inhibition of Topoisomerases results in:

a) Interrupting the fidelity of DNA replication
b) Suppressing the synthesis of primers during DNA replication
c) Inability to remove the winding of DNA that arises during replication
d) Breakage of chromosomes
e) Inhibiting the formation of the replication fork

27) Strand breaks mainly results from:

a) Alkylation
b) Depurination
c) Replicating repeated sequences
d) Ionizing radiation
e) Deamination

28) Which of the following is NOT correct about DNA replication?

a) The direction of synthesis is from 5'- to -3'
b) DNA polymerases require 5'-OH provided by the RNA primer
c) Single-stranded DNA-binding proteins help in protecting the ssDNA from degradation
d) DNA replication is semiconservative
e) Lagging strand results from joining Okazaki fragments by ligase enzyme

29) Which of the following steps is NOT correct about producing mature RNA (mRNA)?

a) Adding a cap to the 5'- untranslated region (5'-UTR) of the RNA
b) Introns are removed from RNA
c) A poly-A-tail is added to the 3'- end of the RNA
d) Exons are joined together
e) Binding of miRNA to the 3'-untranslated region of mRNA

30) In eukaryotes, which of the following molecules can tell you the sequence of introns and exons?

a) Polypeptide
b) Complementary DNA (cDNA)
c) miRNA
d) mRNA
e) Pre-mRNA

31) In bacteria, which of the following RNA polymerase enzyme subunits is responsible for promoter recognition?

a) The beta (β) subunit
b) The epsilon (ε) subunit
c) The delta (δ) subunit
d) The sigma (σ) subunit
e) The gamma (γ) subunit

32) Which of the following is NOT correct about transcription?

a) In eukaryotes, the mRNA carries only one gene (Monocistronic)
b) The consequences of an error in the RNA synthesis is less significant than that in the DNA replication
c) In prokaryotes, the termination signal usually consists of a GC-rich sequence followed by T residues
d) In eukaryotes, the termination signal determined by a consensus sequence followed by a downstream GU-rich sequence
e) In prokaryotes, several genes may be carried on the same mRNA (Polycistronic)

33) Which of the following sentences does best describe the core promoter?

a) Region of DNA in front (downstream) of a structural gene mainly composed of proximal-elements
b) Consensus sequences that bind activator proteins and enhance the transcription
c) Region of DNA usually in front (upstream) of a gene that binds RNA polymerase and initiates gene expression
d) A cluster of prokaryotic genes that are transcribed together
e) Region of an mRNA between the 5'- end and the translation start site

34) In eukaryotes, which of the following general transcription factors bind to the TATA box?

a) TFIID
b) TFIIE
c) TFIIB
d) TFIIF
e) TFIIA

35) A gene normally expresses a 130-amino acid-long protein. A point mutation occurred in the coding DNA of this protein that results in the production of an abnormal protein with 112 amino acids. The mutation is:

a) Missense mutation
b) Nonsense mutation
c) Silent mutation
d) Conversion of a stop codon into Methionine codon
e) Insertion of three nucleotides in the promoter region

36) Which of the following is NOT correct about tRNA?

a) tRNA contains a three-nucleotide sequence known as an anticodon
b) The match between tRNA anticodon and the mRNA codon ensures the fidelity of translation
c) Some tRNAs can bind to more than one codon due to wobble base pairing in the second base of the codon
d) Charging tRNAs with amino acids is mediated by aminoacyl-tRNA synthetases
e) tRNA is a short single-stranded RNA (ssRNA)

37) What is the anticodon that is complementary to the codon UAC (directions from 5'- to -3')?

a) GUA
b) GAU
c) GTA
d) UTG
e) UAG

38) In eukaryotes, all of the following steps happen during translation elongation stage EXCEPT:

a) Hydrolysis of GTP into GDP to provide energy
b) Translocation of tRNA from A site to P site
c) Binding of aminoacyl-tRNA to the A site
d) Exit of aminoacyl-tRNA from E site
e) Formation of a peptide bond

39) Regarding the regulation of protein expression and cellular signaling, which of the following pairs does not match?

a) mTOR: Coupling growth to energy stores
b) Glucocorticoids: Diffuse across the plasma membrane
c) Notch intracellular domain: Proteolytic cleavage of Notch by γ-secretase
d) TGF- β: Activation of Smad protein through phosphorylation
e) Low iron: Decreases ferritin and transferrin expression

40) How long is the peptide that is generated from this eukaryotic mRNA knowing that the first U is the 5'-end of the mRNA

UGUGUGUCACUUAUAAUGGCGCAUAUGAGG

a) 4
b) 3
c) 10
d) 5
e) 2

41) One of the following in NOT a cis-acting element:

a) Iron response element binding protein
b) GC-rich box (-35 sequence)
c) Enhancer
d) Shine-Dalgarno sequence
e) Iron-response element

42) The following mutation would cause constitutive expression of the Lac operon:

a) Constant binding of the RNA polymerase to the promoter
b) Deletion of the promoter
c) Deletion of the LacI gene
d) Inability of allolactose to bind to the lac repressor
e) Constant binding of catabolic-activating protein (CAP) upstream of the promoter

43) What is the action of cyclic AMP (cAMP) on the lac operon?

a) It binds to and stabilize the polycistronic mRNA
b) It binds to and activates beta-galactosidase
c) It binds catabolic activating protein (CAP) stimulating its binding upstream of the promoter
d) It binds the RNA polymerase stabilizing its binding to the promoter
e) It binds the repressor preventing its binding to the promoter

44) One of the following is NOT a regulation by epigenetics:

a) Methylation of cytosines within promoter regions
b) Conversion of heterochromatin to euchromatin
c) A point mutation of the promoter regions
d) Binding of noncoding RNAs to promoters regions
e) Methylation of histones

45) This is NOT a mechanism we discussed by which non-coding RNA molecules can ultimately regulate proteins:

a) Phosphorylation of translation initiation factor
b) Binding to the 3'-end of mRNA causing its degradation
c) Binding to mRNA blocking translation
d) Coating and condensation of DNA
e) Recruitment of transcriptional regulatory proteins to the promoter region

46) Changing the position of this sequence from upstream of a gene to its downstream would not affect the expression of this gene:

a) Enhancer
b) Promoter
c) A CpG island
d) A transcription initiation site
e) Promoter proximal element

47) In situ hybridization done on a tissue section reveals staining in one region, and immunohistochemistry reveals staining in another. This indicates:

a) A pre-mRNA exists in one region of the tissue, but it is modified somewhere else
b) A protein exists in one region of the tissue, but it is modified somewhere else
c) A gene is expressed in one region, but its protein product is localized somewhere else
d) A gene is expressed, but the protein is degraded
e) Both mRNA and protein are modified

48) The reason behind analyzing the expression of a housekeeping gene in Northern blotting is:

a) To ensure equal loading of total RNA of a sample
b) To measure the stability of mRNA in a sample
c) To determine the splicing of mRNA molecules
d) To ensure the expression of all genes is a sample
e) To estimate the length (size) of mRNA molecules

Answers:

1	d
2	d
3	e
4	b
5	e
6	e
7	e
8	a
9	b
10	e

11	d
12	e
13	e
14	e
15	b
16	d
17	c
18	e
19	d
20	a

21	e
22	d
23	c
24	c
25	e
26	c
27	d
28	b
29	e
30	e

31	d
32	c
33	c
34	a
35	b
36	c
37	a
38	c
39	e
40	d

41	e
42	b
43	c
44	c
45	a
46	a
47	c
48	a

Good luck ❤️