AIIMS Biotechnology

Model Paper

1. Which of the following are properties of both enhancers and silencers?

   P. they are located away from the gene they control

   Q. they are position-independent

   R. they are orientation-independent

   S. they modulate the expression of the gene they control

   a. P and Q
   b. Q only
   c. P and R
   d. P, Q, R and S

2. P. ATP is not required for flagellar motion

   Q. Microtubules elongate by addition of heterodimers to the (+) end

   R. Microtubules elongate by addition of heterodimers to the (–) end

   Which of the choice(s) above are *true*?

   a. P and Q
   b. P only
   c. Q and R
   d. none

3. Which of the followings is *not* a reason why most organisms employ DNA as their primary genetic information storage form?

   P. Because DNA is chemically more stable than RNA

   Q. Because RNA has an extra hydroxyl group on its ribose sugar

   R. Because RNA is more reactive

   a. P and Q
   b. P and R
   c. P only
   d. P, Q and R only

4. A plasmid that has two HindIII sites and two EcoRI sites, was cut with both of the enzymes simultaneously for 5 hrs at 37°C. The analysis of the restriction enzyme digestion was made on a 1% agarose gel. How many bands would one expect to see on the gel?

   a. 3
   b. 4
   c. 5
   d. 16

5. If a mutation in a gene makes the product of the gene defective in binding to its ligand, then the best what can be predicted about the gene and the mutation is:

   a. the gene codes for a receptor and the mutation is a gain-of-function mutation
   b. the gene codes for a kinase and the mutation is a gain-of-function mutation
   c. the gene codes for a receptor and the mutation is a loss-of-function mutation
   d. the gene codes for a kinase and the mutation is a loss-of-function mutation

6. Cell cycle is controlled by:

   a. oscillation for cdks
   b. oscillation of Ca^{2+} levels
   c. cyclins and Cdks
   d. p53 and p21

7. Which of the following amino acids can be phosphorylated?
   P. tyrosine
   Q. serine
   R. phenylalanine
   S. threonine
   a. P only
   b. Q and R
   c. Q and S
   d. P, Q and S

8. Which of the following statements about lambda phage is *not* true?
   a. lambda phages are used because larger DNA fragments can be carried in their genome than in plasmids
   b. too small or too big fragments of DNA cannot be packaged into a phage head
   c. lambda phages enter bacteria much easier than plasmids do
   d. lambda phages have lytic and lysogenic cycles at the same time

9. Which of the following is *true*?
   P. DNA polymerase I – repairs and fills gaps
   Q. DNA polymerase II – restarts DNA synthesis
   R. DNA polymerase III – does most of the DNA replication job
   S. Hexokinase – unwinds the DNA duplex
   a. P only
   b. Q and R
   c. Q and S
   d. P, Q and R

10. Which of the following is *true* about poly(A) tail?
   P. it is synthesized co-transcriptionally
   Q. it is usually shorter than 300nt
   R. one of its functions is to protect the message from cytoplasmic RNases
   S. one of its functions is to stimulate translation
   a. P only
   b. Q and R
   c. Q and S
   d. P, Q, R and S

11. Which of the following molecules *does not* play role carbon fixation by rubisco?
   a. NADH
   b. ribulose-1,5-bisphosphate
   c. 3-phosphoglycerate
   d. ATP

12. Which of the following is/are *true* about actin?
   P. Actin functions in a form of multimer fibers
   Q. Actin can hydrolyze nucleotide triphosphates
   R. Polymerization of actin is spontaneous
   S. Myosin and kinesin walk on actin
   a. P only
   b. P and Q
   c. Q and S
   d. P and R

13. Thioreductase would most likely have a function related with which of the following amino acids?
   a. threonine
   b. tyrosine
   c. tryptophan
   d. cysteine

14. A protein that has been synthesized *not* in cytosol

P. Was most likely synthesized in smooth endoplasmic reticulum

Q. Was most likely synthesized in rough endoplasmic reticulum

R. Will leave through the *trans* side of endoplasmic reticulum

S. Will enter into the *cis* side of Golgi

a. P only
b. P and R
c. Q and S
d. Q and R

15. Which of the following is the most hydrophobic amino acid?

a. glycine
b. arginine
c. serine
d. phenylalanine

16. Which of the following is *true* about sodium dodecyl sulfate?

a. it denatures proteins
b. it forms bilayers in aqueous solutions
c. it denatures lipids
d. it does not form micelles in aqueous solutions

17. Which of the following proteins has the highest pI?

a. ATPase synthase
b. thrombin
c. albumin
d. histone

18. Which of the following is/are *not* true?

P. nucleases cut phosphodiester bonds

Q. nucleases require magnesium ions

R. nucleases are heat-resistant

S. there are no nucleases in the nucleus

a. P only
b. R only
c. Q and S
d. R and S

19. Electrophoretic separation of RNA molecules based on their molecule weights, requires a denaturant such as formaldehyde to be present in the gel system, because

a. RNAs are sensitive to nucleases
b. RNAs are single stranded
c. RNAs are usually present in high amounts
d. RNAs are usually small

20. Which of the following is *not* a property of hemoglobin?

a. it carries CO
b. it carries H^+
c. it carries CO_2
d. it carries HCO_3

21. What would lead to accumulation of ADP in mitochondrial matrix?

a. cytochrome C inhibitor
b. extra NADH supply
c. extra NADPH supply
d. extra O_2 supply

22. What are common properties of chloroplasts and mitochondria?

P. circular DNA
Q. presence of introns
R. presence of stroma
S. special ribosomes

a. P and Q
b. Q and R
c. R and S
d. P, Q and S

23. What is not essential for DNA synthesis?
    a. $5' \rightarrow 3'$ extension
    b. proofreading
    c. nucleotide supply
    d. magnesium supply

24. Upon addition of a drug cytochalasin B, mammalian cell division stops. Cells that were at their anaphase stage of mitosis cannot proceed any further. However, cells that were at their interphase can enter prophase stage even after Cytochalasin B treatment. What cannot be said about cytochalasin B?
    a. cytochalasin B inhibits a cytoskeletal component assembly/disassembly
    b. cytochalasin B inhibits centriole function
    c. cytochalasin B inhibits karyokinesis
    d. cytochalasin B prevents cytokinesis

25. Which of the following molecules are not known to serve as secondary messengers in signal transduction cascades?
    a. calcium
    b. magnesium
    c. cAMP
    d. cGMP

26. Where would green fluorescent protein (GFP) be localized if it was fused to an estradiol receptor?
    a. plasma membrane
    b. mitochondria
    c. Golgi complex
    d. nucleus

27. If *Drosophila* males of genotype AaBb are crossed with females of genotype AABB, what is the percentage of white-eyed wrinkle-winged offspring in the first generation (a-white eye, A-red eye; B-smooth wings, b-wrinkled wings)?
    a. 0%
    b. 10%
    c. 20%
    d. 25%

28. X-chromosome inactivation is
    P. Yielding a completely inactive X-chromosome
    Q. Yielding a mostly inactive X-chromosome
    R. Controlled via two special non-coding RNAs
    S. Controlled via two special proteins
    a. P only
    b. R only
    c. Q and R
    d. P, R and S

29. All of the following statements about actin and myosin are true *except*
    a. the globular head section of myosin has domain for binding ATP and actin
    b. actin is the major protein of the thick filament
    c. binding of ATP to the actin-myosin complex promotes dissociation of actin and myosin
    d. F-actin is stabilized when tropomyosin is bound to it

30. In the cell cycle:
    a. M phase is both the most complex and the longest phase
    b. there is a G_0 phase in equilibrium with the G_1 phase
    c. quiescent cells cannot be induced to re-enter the cell cycle
    d. microtubule spindles form during the S phase

31. The glycerophospholipids and sphingolipids of membranes
    a. all contain phosphorus
    b. all have individual charges but are zwitterious
    c. are all amphipathic
    d. are present in membrane in equal quantities

32. Full expression of the *lac* operon requires
    a. lactose and cAMP
    b. allolactose and cAMP
    c. lactose alone
    d. allolactose alone

33. A technique for defining gene arrangement in very long stretches of DNA (50–100 kb) is:
    a. RFLP
    b. chromosome walking
    c. nick translation
    d. southern blotting

34. The sigma subunit of prokaryotic RNA polymerase
    a. is part of the core enzyme
    b. binds the antibiotic rifampicin
    c. is inhibited by alpha-amanitin
    d. specifically recognizes promoter sites

35. In eukaryotic DNA replication
    a. only one replisome forms because there is a single origin of replication
    b. the Okazaki fragments are 1000 to 2000 nucleotides in length
    c. helicase dissociates from DNA as soon as the initiation bubble forms
    d. FEN1 (flap endonuclease 1) in involved in removing the primer

36. Restriction endonuclease is employed for cutting
    a. a single stranded DNA
    b. double stranded DNA
    c. RNA fragment
    d. mRNA

37. Phenotypic dihybrid ratio is
    a. 9 : 3 : 3 : 1
    b. 15 : 1
    c. 9 : 6 : 1
    d. 1 : 2 : 1

38. Mendel could not find recombination and crossing over as
    a. traits he chose were either present on different chromosomes or were far apart
    b. traits chosen by him were not influenced by genes
    c. he did not have a high power microscope
    d. he selected only pure types.

39. In Mendel's experiments with Garden Pea, round seed shape (RR) was dominant over wrinkled seeds (rr), yellow cotyledons (YY) was dominant over green cotyledons (yy). What are expected phenotypes in F2 generation RRYY x rryy?
    a. only wrinkled seeds with green cotyledons
    b. only wrinkled seeds with yellow cotyledons
    c. only round seeds with green cotyledons
    d. round seeds with yellow cotyledons and wrinkled seeds with yellow cotyledons.

40. In a dihybrid cross $AABB \times aabb$, F2 progeny of AABB, AABb, AaBB and AaBb occurs in the ratio of
    a. 1 : 1 : 1 : 1
    b. 9 : 3 : 3 : 1
    c. 1 : 2 : 2 : 1
    d. 1 : 2 : 2 : 4

41. Blood grouping in human beings is controlled by
    a. 4 alleles in which A is dominant
    b. 3 alleles is which A and B are codominant and *i* is recessive
    c. 3 alleles in which none is dominant
    d. 3 alleles in which A is dominant

42. Which amino acid is substituted in sickle cell anaemia?
    a. glutamic acid by valine in α-chain
    b. glutamic acid by valine in β-chain
    c. valine by glutamic acid in α-chain
    d. valine by glutamic acid in α-chain

43. Protein phosphatases
    a. catalyze the addition of phosphate residues to proteins
    b. catalyze the removal of phosphate residues from proteins
    c. catalyze the addition of glycosylphosphatidylinositol to proteins
    d. are proteins that specifically bind phosphorylated proteins

44. All of the following are common lipid modifications to proteins *except*
    a. N-myristoylation
    b. prenylation
    c. GPl anchor addition
    d. glycosylation

45. Retrovirus and retrotransposon DNA sequences insert into the DNA of the host with the aid of sequences at their ends called
    a. telomeres
    b. long terminal repeats (LTRs)
    c. inverted repeats
    d. J (joining) segments

46. Nuclear localization signals are composed primarily of
    a. hydrophobic amino acids
    b. acidic amino acids
    c. basic amino acids
    d. sulfur-containing amino acids

47. Which of the following lipids is/are synthesized in the Golgi apparatus?
    a. phospholipids
    b. cholesterol
    c. ceramide
    d. glycolipids

48. Factors responsible for a water molecule being a dipole include
    a. the similarity in electron affinity of hydrogen and oxygen
    b. the tetrahedral structure of liquid water
    c. the magnitude of the H—O—H bond angle
    d. the ability of water to hydrogen bond to various chemical structures

49. Which of the following is *not* a commonly observed consequence of binding of a signaling molecule to its cell surface receptor
    a. receptor dimerization
    b. receptor phosphorylation
    c. conformational changes in the receptor
    d. increased synthesis of the receptor

50. Which of the following statements is *false* about short interspersed elements (SINEs)?
    a. the major family of SINEs contains the Alu sequence
    b. they arose by reverse transcription of small RNAs
    c. they are transposable elements
    d. they encode reverse transcriptase

51. The twisting of the parental DNA strands around one another ahead of a replication fork is relieved by enzymes called
    a. DNA helicases
    b. topoisomerases
    c. DNA ligases
    d. DNA polymerases

52. Which of the following is a possible intermediate during pre-rRNA processing?
    a. an RNA molecule containing 18S + 5.8S rRNAs
    b. an RNA molecule containing 5.8S + 28S rRNAs
    c. an RNA molecule containing 5S + 28S rRNAs
    d. an RNA molecule containing 18S + 28S rRNAs

53. mRNA molecules are exported from the nucleus to the cytoplasm via
    a. a consensus sequence located at the 3' terminus
    b. the 7-methylguanosine cap structure
    c. importin
    d. associated proteins that contain export signals

54. The trans Golgi network is
    a. the intermediate compartment between the ER and the Golgi
    b. the part of the Golgi where fusion of vesicles from the ER occurs
    c. where sorting of proteins to the lysosomes, plasma membrane, and cell exterior occur
    d. the network of vesicles that transport proteins between Golgi cisternae

55. The basis for muscle contraction is
    a. rotation of myosin fibers around actin fibers
    b. expansion of the sarcomere
    c. the sliding of myosin and actin fibers past one another
    d. movement of the z discs away from one another

56. In red blood cells, which of the following cytosolic proteins is the link between the plasma membrane and the spectrin/actin network beneath the cell surface?
    a. band 3
    b. glycophorin
    c. dystrophin
    d. ankyrin

57. Infection with which of the following viruses is associated with development of liver cancer in humans?
    a. simian virus 40 (SV40)
    b. papillomaviruses
    c. epstein-Barr virus
    d. hepatitis B viruses

58. Haptens
    a. can function as antigens
    b. strongly bind to antibodies specific for them
    c. may be macromolecules
    d. never act as antigenic determinants

59. Chloroplasts are thought to have originated from symbiotic
    a. acrhaebacteria
    b. cyanobacteria
    c. green algae
    d. aerobic eubacteria

60. Passive transport across a membrane refers to
    a. transport into the interior of a cell
    b. transport out of a cell
    c. transport in the energetically favorable direction
    d. simple diffusion across membranes, without the help of proteins such as channels or carriers

61. Animal cells can synthesize glucose (gluconeogenesis) from all of the following *except*
    a. lactate
    b. amino acids
    c. glycerol
    d. fatty acids

62. The main difference between the genomes of the bacteria *H. influenzae* and *M. genitalium* is
    a. that the genome of *H. influenzae* is a circular molecule and that of *M. genitalium* is linear.
    b. that the *H. influenzae* genome encodes fewer genes
    c. that the *H. influenzae* genome encodes more metabolic enzymes
    d. that the genome of *H. influenzae* encodes more proteins involved in DNA replication

63. Approximately how many genes do human cells contain?
    a. 30,000 to 40,000
    b. 20,000
    c. 4,000
    d. 6,000

64. During nuclear envelope breakdown, the nuclear lamins are phosphorylated by
    a. protein kinase A
    b. protein kinase C
    c. Ca^{2+}/calmodulin-dependent kinase
    d. Cdc2 protein kinase

65. The major site at which membrane lipids are synthesized is
    a. the cytosolic side of the ER membrane
    b. the cytosol
    c. the lumenal side of the ER membrane
    d. the cytosolic side of the Golgi membrane

66. Which of the following are *not* used as markers for the positioning of a gene on a chromosome?
    a. gene mutations that have an observable effect
    b. restriction fragment length polymorphisms (RFLPs)
    c. histones
    d. short tandem-repeat polymorphisms (STRPs)

67. What is the ionic strength of a 0.25 M $CaCl_2$ solution?
    a. 1.0
    b. 1.5
    c. 2.0
    d. 2.5

68. Which of the following is expected to be involved in a methylation of a protein?
    a. NADH
    b. NADPH
    c. Biotin
    d. S-Adenosyl methionine

69. Which of the followings are not phenotypic ratios expected in the F2 generation in the event of epistasis?
    P. 9:7
    Q. 12:3:1
    R. 9:6:1
    S. 9:3:3:1
    a. P only
    b. R only
    c. S only
    d. R and S

70. Proteins that do *not* play role in degradation of other proteins are:

P. proteasome
Q. ubiquitin
R. carboxylase
S. chitin

a. P only
b. P and R
c. Q and S
d. R and S

71. Cycle AMP (cAMP) is generated from which precursor and by which enzyme?

a. ADP, pyrophosphatase
b. ATP, pyrophosphatase
c. ADP, adenylate cyclase
d. ATP, adenylate cyclase

72. Which of the following mutations would be the most devastating to the function of a protein?

a. Leucine $\rightarrow$ Isoleucine
b. Leucine $\rightarrow$ Valine
c. Tyrosine $\rightarrow$ Phenylalanine
d. Alanine $\rightarrow$ Tyrosine

73. Which of the following is/are *not* present in a spliceosome?

P. Proteases
Q. RNA
R. DNA
S. Proteins

a. P and R
b. P and Q
c. P and S
d. P only

74. Which of the followings has the highest melting point (T_m)?

a. TAGTCGATCGTAGCGCTAGC
b. GTAGCTATCTAGCTAGCTAG
c. GGCTGCGCTAGCGCTACGTAT
d. GTGGCGAGCACGCCAGCCAC

75. Functional relationship of kinase to phosphatase is like the relationship of:

a. antibody-antigen
b. ligase-endonuclease
c. ligase-exonuclease
d. receptor-ligand

76. What would be the best term to describe effect of one gene on another in a way that one would hide the effect of another on a phenotype?

a. pleiotropy
b. homeostasis
c. epistasis
d. hyperstasis

77. Which of the following is *not* a protease?

a. trypsin
b. chymotrypsin
c. elastase
d. gastrin

78. Which of the following enzymes converts ATP to a secondary messenger?

a. adenine synthase
b. alkaline phosphatase
c. adenylate cyclase
d. inositol phosphatase

79. Of the below bonding types, which intermolecular bond is the weakest?

a. van der Walls bonds
b. hydrogen bonds
c. ionic bond
d. dipole-dipole bond

80. Which of the followings is a functional part of promoters?

P. TATA box
Q. CAT box
R. GC box
S. Pribnow box

a. Q only
b. R only
c. Q and S
d. P, Q, R and S

81. Cell cycle is controlled by:

P. certain Cyclins
Q. certain Cyclin-dependent kinases
R. certain inhibitory proteins
S. certain phosphatases

a. P and Q
b. R and S
c. P and R
d. P, Q, R and S

82. To degrade a protein via 26S proteasome it must be:

a. small
b. toxic
c. phosphorylated
d. ubiquitilated

83. Gluconeogenesis is mainly done in:

a. brain
b. heart
c. smooth muscle
d. liver

84. If the concentration of sodium ions is suddenly increasing on one side of the plasma membrane and simultaneously suddenly decreasing on the other side of the membrane, which of the followings can be said?

P. a sodium co-transporter carrier protein is being activated
Q. a light-activated sodium channel protein is being activated
R. a potassium channel is being activated
S. the membrane is being polarized

a. Q and R
b. Q and S
c. P and R
d. Q, R and S

85. Myoglobin

P. can carry CO_2
Q. can carry hydrogen ions
R. is allosterically regulated
S. has a hyperbolic binding curve

a. P only
b. S only
c. P, Q and S
d. R and S

86. If 5'-termini of a linear DNA molecule with sticky ends are being modified in a way that the ends cannot be ligated with each other anymore (to form a circular molecule), what enzyme was used to modify the molecule?

a. methylase
b. kinase
c. phosphatase
d. dehydrogenase

87. Which of the followings is *not* required for translation?

a. tRNA
b. aminoacyl synthase
c. mRNA
d. 7S RNA

88. What is the order of the following metabolic reactions in catabolism of a glucose molecule?

P. Pyruvate → Acetyl-CoA

Q. Glucose → Glucose-6-phosphate

R. Citrate → Isocitrate

S. ADP → ATP

a. Q, S, P and R
b. Q, S, R and P
c. P, Q, R and S
d. Q, R, P and S

89. NADH is utilized during:

P. Glycolysis
Q. Krebs cycle
R. Electron transport chain
S. Fermentation

a. P and Q
b. Q and R
c. R and S
d. P and S

90. Change in Gibbs free energy does not depend on:

P. molecular weight

Q. temperature

R. equilibrium constant

S. temperature constant

a. P only
b. R only
c. S only
d. P and S