**116**

QUESTION PAPER
SERIES CODE

**A**

Registration No. :

Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

## COMBINED ENTRANCE EXAMINATION, 2018

M.Sc. BIOTECHNOLOGY

[ Field of Study Code : BIT ]

Time Allowed : 3 hours

Maximum Marks : 240

### INSTRUCTIONS FOR CANDIDATES

Candidates must read carefully the following instructions before attempting the Question Paper :

(i) Write your Name and Registration Number in the space provided for the purpose on the top of this Question Paper and in the Answer Sheet.

(ii) **Please darken the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

(iii) The Question Paper is divided into two Parts : Part—A and Part—B. Both Parts have multiple-choice questions. All answers are to be entered in the Answer Sheet provided with the Question Paper for the purpose by darkening the correct choice, i.e., (a) or (b) or (c) or (d) with BLUE/BLACK BALLPOINT PEN only against each question in the corresponding circle.

(iv) Part—A consists of 60 questions and all are compulsory. Answer all the questions in the Answer Sheet provided for the purpose. Each correct answer carries 1½ marks. **There will be negative marking and ⅓ mark will be deducted for each wrong answer.**

(v) Part—B consists of 100 questions consisting Biological and Physical Sciences. **Answer any 60 questions.** Each correct answer carries 2½ marks. **There will be negative marking and 1 mark will be deducted for each wrong answer.**
In case any candidate answers more than the required 60 questions, the first 60 questions attempted will be evaluated.

(vi) Answer written by the candidates inside the Question Paper will not be evaluated.

(vii) Calculators and Log Tables may be used.

(viii) Pages at the end have been provided for Rough Work.

(ix) Return the Question Paper and Answer Sheet to the Invigilator at the end of the Entrance Examination. **DO NOT FOLD THE ANSWER SHEET.**

### INSTRUCTIONS FOR MARKING ANSWERS

1. Use only Blue/Black Ballpoint Pen (do not use pencil) to darken the appropriate Circle.
2. Please darken the whole Circle.
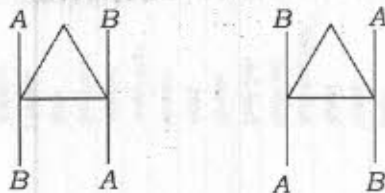3. Darken ONLY ONE CIRCLE for each question as shown in example below :

| Wrong | Wrong | Wrong | Wrong | Correct |
|-------|-------|-------|-------|---------|
| ● ⓑ ⓒ ● | Ⓧ ⓑ ⓒ ⓓ | Ⓧ ⓑ ⓒ Ⓧ | ⦿ ⓑ ⓒ ● | ⓐ ⓑ ⓒ ● |

4. Once marked, no change in the answer is allowed.
5. Please do not make any stray marks on the Answer Sheet.
6. Please do not do any rough work on the Answer Sheet.
7. Mark your answer only in the appropriate space against the number corresponding to the question.
8. **Ensure that you have darkened the appropriate Circle of Question Paper Series Code on the Answer Sheet.**

/116-A

## PART—A

### Answer **all** questions

1. Arrange the following compounds in the decreasing order of dipole moment :

    (i) $NH_3$           (ii) $H_2O$

    (iii) $NF_3$          (iv) $CH_4$

    (a) ii > i > iii > iv

    (b) i > ii > iii > iv

    (c) i > iii > ii > iv

    (d) ii > iii > i > iv

2. Which of the following compounds can form intramolecular hydrogen bonds?

    (a) Dimethyl sulphide

    (b) Pentachloro ethanol

    (c) Diethyl ether

    (d) Acetone

3. Which of the following statements is correct with respect to carbanion stability?

    (a) It increases with increase in s-character

    (b) It decreases with increase in s-character

    (c) It increases with decrease in s-character

    (d) It has no relation with s-character

4. With regards to rate of the reactions, which one of the following is correct?



    (a) $r_1 > r_2$

    (b) $r_1 < r_2$

    (c) $r_1 = r_2$

    (d) Cannot predict due to insufficient information

5. What is the relationship between the following pair of compounds?



(a) Anomers

(b) Diastereomers

(c) Same compound

(d) Enantiomers

6. Which of the following describes the main characteristics of the inductive effect?

(a) A permanent effect

(b) A temporary effect

(c) Sigma bond is weakened

(d) Both (a) and (b)

7. Which of the following statements is correct?

(a) Radicals can be oxidized to carbanions.

(b) Carbocations can be reduced to carbanions.

(c) Radicals can be reduced to carbocations.

(d) Radicals can be converted to carbenes.

8. Which of the following techniques *cannot* detect free radicals?

(a) Electron spin resonance

(b) UV and visible spectroscopy

(c) NMR (Nuclear Overhauser effect)

(d) X-ray crystallography

9. Which of the following compounds will undergo radical addition reaction with an alkene in the presence of hydrogen peroxide (anti-Markovnikov rule)?
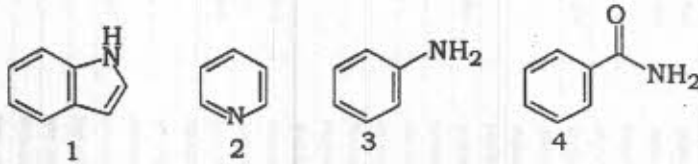
(a) HCl

(b) HBr

(c) HI

(d) HF

10. Which of the following compounds are optically active?



     1              2                3
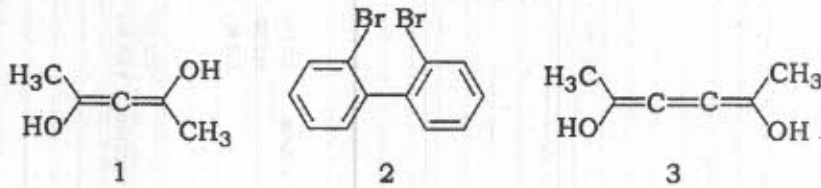
(a) 1, 2 and 3

(b) 1 and 2 only

(c) 1 and 3 only

(d) 2 and 3 only

11. Which of the following compounds are basic?



    1          2          3          4

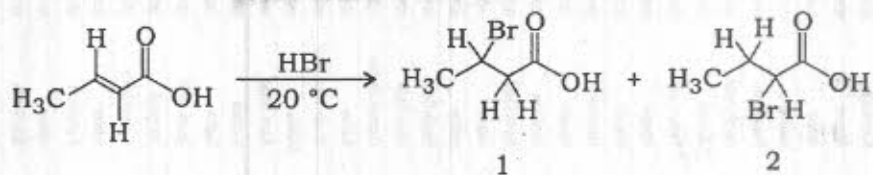(a) 1, 2, 3 and 4

(b) 2, 3 and 4

(c) 2 and 3

(d) 1, 2 and 3

12. How many isomeric products are produced when isobutane is chlorinated with two equivalents of chlorine gas?

(a) 2

(b) 3

(c) 4

(d) 6

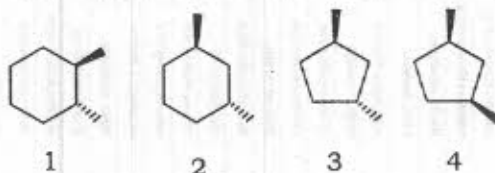13. Which of the following compounds can react with Grignard reagent (R-MgX)?

(a) Ammonia

(b) Water

(c) Carbon dioxide

(d) All of the above

14. Identify the product for the following addition reaction :



(a) No reaction

(b) 1 only

(c) 2 only

(d) 1 and 2

15. Which of the following compound(s) has/have plane of symmetry?



(a) 1, 2 and 3

(b) 4 only

(c) 2 and 3

(d) 1, 2, 3 and 4

16. In electrophysiology, membranes are thought to be capacitors. The reason why they are considered to be so is because

(a) they harbor ion channels

(b) they harbor voltage-gated channels

(c) there is an electric potential gradient across the membrane
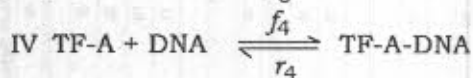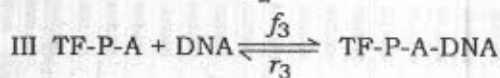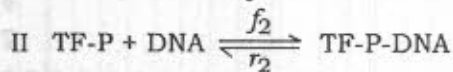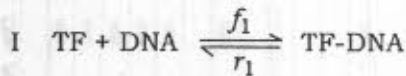
(d) they are made up of lipids

17. Which of the following amino acids can act as general acid-base catalyst at physiological pH?

(a) Alanine

(b) Aspartic acid

(c) Serine

(d) Histidine

18. Which of the following statements is correct regarding the entropy change during protein folding?

(a) Entropy of the protein chain increases while that of the solvent decreases

(b) Entropy of the protein chain decreases while that of the solvent increases

(c) Both the entropies of the protein chain and the solvent increase

(d) Both the entropies of the protein chain and the solvent decrease

19. The process of protein synthesis is accompanied by release of one water molecule per peptide bond formed. In which of the following steps of protein synthesis does the actual release of water take place?

(a) Amino-acylation of t-RNA

(b) Peptide bond formation in the ribosome

(c) Entry of charged t-RNA in the ribosome

(d) Release of the de-aminoacylated t-RNA from the ribosome

20. Enzymes interact with the substrate to form an enzyme-substrate complex. Which of the following factors determines the rate of enzyme-substrate complex formation?

(a) $K_m$ of the enzyme

(b) $V_{max}$ of the enzyme

(c) The ratio $V_{max} / K_m$

(d) The concentrations of the enzyme and the substrate

21. Which of the following statements regarding enzyme catalysis is wrong?

(a) They decrease the activation barrier of the reaction

(b) They increase the forward reaction rate

(c) They increase the reverse reaction rate

(d) They decrease the free energy change ($\Delta G$) between the substrate and the product

22. Life in a different planet has evolved to use a reaction $A + B \rightarrow C$. This reaction releases a lot of energy that sustains life. $A$ and $B$ are both naturally abundant and are found in air. What is the nature of this reaction $A + B \rightarrow C$ in nature for life to be sustainable?

    (a) The reaction should be thermodynamically favourable but kinetically hindered

    (b) The reaction should be kinetically favourable but thermodynamically hindered

    (c) The reaction should be thermodynamically and kinetically favourable

    (d) The reaction should be thermodynamically and kinetically hindered

23. Secondary structure content of proteins cannot be determined by

    (a) CD spectroscopy

    (b) NMR spectroscopy

    (c) X-ray crystallography

    (d) Förster resonance energy transfer based fluorescence spectroscopy

24. Ionic interactions inside protein cores are not very common. The probable reason is

    (a) they are weaker inside the core

    (b) they are between charged residues, which are rarely found within protein cores

    (c) they are between hydrophobic amino acids

    (d) water is required for ionic interaction

25. D-fructose can be enzymatically converted to D-Psicose. The free energy change ($\Delta G$) of the reaction as well as the net change in entropy ($\Delta S$) is exactly equal to zero. Hence the maximum expected conversion in a batch process is 50%. In order to design an industrial process that will efficiently convert fructose to Psicose, which one of the following strategies will be best?

    (a) Protein engineering of the enzyme so as to make the free energy change ($\Delta G$) highly negative

    (b) Adding enzyme in two steps, first time at the start of the reaction and the second time after 50% conversion has been achieved

    (c) Designing a process that will efficiently remove D-Psicose from the reaction mixture

    (d) Doing the reaction at a lower temperature which will make the free energy change ($\Delta G$) highly negative

26. You have isolated two enzymes $E_1$ and $E_2$ from two different organisms that catalyze the same reaction. $E_1$ has a higher $K_m$ and $V_{max}$ than $E_2$. In which of the following industrial applications would enzyme $E_2$ be preferable over enzyme $E_1$?

    (a) When the substrates of the enzymatic reaction cannot be obtained at a high concentration

    (b) When the substrate to product conversion needs to be as fast as possible

    (c) When the product may inhibit the enzyme

    (d) When the substrate is easily obtained at very high concentration

**27.** The genetic code of a particular organism uses 4 base codons, out of which the 3rd base is completely unimportant and not informative. If each codon is associated with just one amino acid and there exists a single stop codon, how many amino acids can possibly be used by the organism for protein synthesis?

(a) 63

(b) 255

(c) 32

(d) 20

**28.** Transcription factors (TF), in their native state, or in their phosphorylated form (TF-P) or when bound to an activator protein (TF-A) can bind to DNA. The overall reaction can be described by the following schemes :

I    $\text{TF} + \text{DNA} \underset{r_1}{\overset{f_1}{\rightleftharpoons}} \text{TF-DNA}$

II   $\text{TF-P} + \text{DNA} \underset{r_2}{\overset{f_2}{\rightleftharpoons}} \text{TF-P-DNA}$

III  $\text{TF-P-A} + \text{DNA} \underset{r_3}{\overset{f_3}{\rightleftharpoons}} \text{TF-P-A-DNA}$

IV   $\text{TF-A} + \text{DNA} \underset{r_4}{\overset{f_4}{\rightleftharpoons}} \text{TF-A-DNA}$

Given that $f_4 = f_1 > f_2 = f_3$; $r_4 = r_3 < r_1 = r_2$.

Which of the schemes given above is most likely to initiate transcription downstream of the binding site?

(a) I

(b) II

(c) III

(d) IV

**29.** A large segment of DNA was PCR amplified using a pair of primers. When the amplified product was run on a gel, 3 distinct bands were obtained. The largest band was cut out from the gel and again PCR amplified using the same pair of primers as before. Again 3 bands were observed when the amplified product was run on a gel. What is the most probable reason for this?

(a) The segment of DNA is unstable and tends to break down into three fragments.

(b) The segment of DNA is made up of 3 identical repeats.

(c) The polymerase used for PCR amplication was a trimer with 3 identical subunits, hence the three bands in the amplified product.

(d) The segment of DNA can associate with itself to form dimers or trimers.

30. Choose the correct option with respect to figures given below :
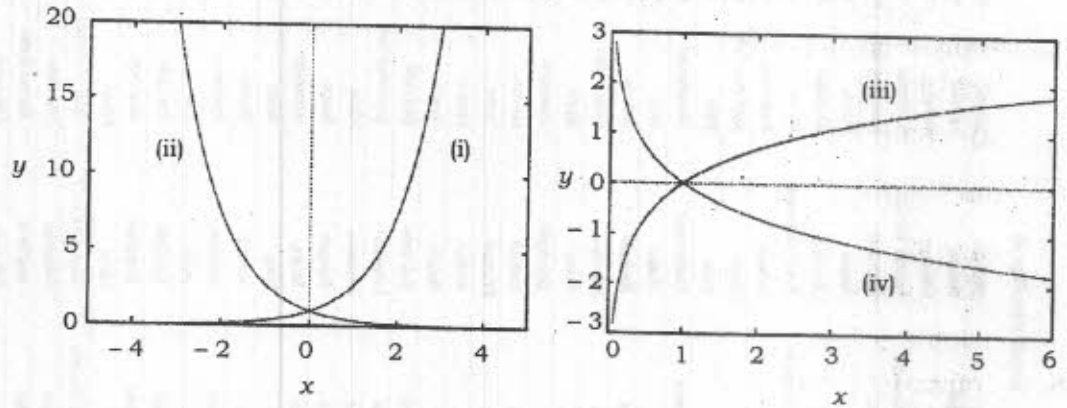


(a)  (i) → $e^x$,  (ii) → $e^{-x}$,  (iii) → $\log(1/x)$,  (iv) → $\log(x)$

(b)  (i) → $e^{-x}$,  (ii) → $e^x$,  (iii) → $\log(1/x)$,  (iv) → $\log(x)$

(c)  (i) → $e^x$,  (ii) → $e^{-x}$,  (iii) → $\log(x)$,  (iv) → $\log(1/x)$

(d)  (i) → $e^{-x}$,  (ii) → $e^x$,  (iii) → $\log(x)$,  (iv) → $\log(1/x)$

31. If two squares of sides 300 mm and 400 mm are merged together to form a new square having area equal to the sum of given squares, what will be its side?

(a)  500 mm

(b)  600 mm

(c)  700 mm

(d)  1200 mm

32. It is given that the ratio of the circumference and diameter of a circle of radius 2 cm is $r$. How will the ratio change if it is calculated for a larger circle of radius 4 cm?

(a)  It will become $4r$

(b)  It will become $2r$

(c)  It will remain $r$

(d)  It will become $r/2$

33. Against two available vacancies, four students (two females $F_1$, $F_2$; two males $M_1$, $M_2$) are to be interviewed by a Biotech Company. What is the probability that both the selected candidates will not be of the same gender?

(a)  1/2

(b)  2/3

(c)  3/4

(d)  4/5

34. If a dice is designed such that 50% of the times it is rolled, it returns 6. What will be the probability of getting a 5 on one of its random roll?

   (a) 1/2

   (b) 1/5

   (c) 1/6

   (d) 1/10

35. Legendary Indian mathematician Bhaskaracharya posed the following problem to his daughter Lilavati :

   "A fifth part of a swarm of bees comes to rest on the flowers of the Kadamba, a third on the flowers of the Silinda. Three times the difference between these two numbers flew over the flower of a Krutaja and one bee along attracted by the perfume of a Jasmine in bloom remained in the air. Tell me beautiful girl, how many bees were there in the swarm?"

   (a) 5

   (b) 10

   (c) 15

   (d) 20

36. Suppose an RNA sequence of 8 nucleotides is to be designed in such a way that it contains each of the A, U, G, C exactly twice. In how many ways such RNA sequence may be designed?

   (a) 28

   (b) 50

   (c) 2520

   (d) 40320

37. A population of insects hatched in the spring ($t = 0$) has an initial size of 10 million and a specific death rate of 0·5/month. What will be the population size after 2 months?

   (a) 3·67 million

   (b) 1·35 million

   (c) 6·06 million

   (d) 5 million

38. A dice is thrown twice. What is the probability of getting a sum greater than 3?

   (a) 8/9

   (b) 11/12

   (c) 1/12

   (d) 1/9

39. Two bodies having masses $m_1$ and $m_2$ have equal kinetic energies. What will be the ratio of their momenta?

    (a)  $\dfrac{m_1}{m_2}$

    (b)  $\dfrac{m_2}{m_1}$

    (c)  $\left(\dfrac{m_1}{m_2}\right)^{1/2}$

    (d)  $\left(\dfrac{m_2}{m_1}\right)^{1/2}$

40. What is the arithmetic mean of first 1000 natural numbers?

    (a)  500

    (b)  50500

    (c)  500·5

    (d)  501

41. A ball is dropped from a height $H$. It rebounds to 9/10th of its height after striking the floor each time. What is the total distance travelled by the ball before coming to rest?

    (a)  16 $H$

    (b)  18 $H$

    (c)  19 $H$

    (d)  20 $H$

42. If $2x - y = 5$, what is the value of $9^x / 3^y$?

    (a)  $3^5$

    (b)  $9^5$

    (c)  3

    (d)  9

43. A person sells two items at the same price, one at loss of 5% and the other at a gain of 5%. In the overall transaction, the person will have

    (a)  neither profit nor loss

    (b)  profit

    (c)  loss

    (d)  Depending on the price sometimes profit and sometimes loss

44. The probability of occurrence of event $A$ is 0·2 and the probability of occurrence of event $B$ is 0·4. Probability of both events occurring together is 0·1. What is the probability that exactly one event occurs?

    (a) 0·1                       (b) 0·2

    (c) 0·3                       (d) 0·4

45. The unit digit in the number $289^{3763}$ is

    (a) 1                        (b) 3

    (c) 6                        (d) 9

46. Typical velocity magnitudes of some of the moving objects are enlisted in the following table :

    | (A) | Moving bacterium | (i) | $2 \times 10^6$ m/sec |
    |-----|------------------|------|-----------------------|
    | (B) | A snail's pace | (ii) | $3 \times 10^8$ m/sec |
    | (C) | Olympic runner | (iii) | 1 mm/sec |
    | (D) | Electron orbiting in a hydrogen atom | (iv) | 100 μm/sec |
    | (E) | Light travelling in vacuum | (v) | 10 m/sec |

    Which of the following represents the most appropriate match between above two columns?

    (a)  A    B    C    D    E
        (iii)  (iv)  (v)  (i)  (ii)

    (b)  A    B    C    D    E
        (iv)  (iii)  (v)  (ii)  (i)

    (c)  A    B    C    D    E
        (iv)  (iii)  (i)  (v)  (ii)

    (d)  A    B    C    D    E
        (iv)  (iii)  (v)  (i)  (ii)

47. A 5-rupee coin of weight 20 gm is dropped from the top of the Qutub Minar (height of 73 metres). Assuming that it falls freely from rest, what will be its position after 1·0 second? (Given $g = 9·8$ m/s$^2$)

    (a) 4·9 m

    (b) 9·8 m

    (c) 19·6 m

    (d) 29·4 m

48. If a kangaroo jumps to a height of 4·9 m, what would be his take-off speed? (Given, value of $g = 9·8$ m/s$^2$)

    (a) 96·04 m/s

    (b) 48·02 m/s

    (c) 9·8 m/s

    (d) 4·9 m/s

49. While doing chin-ups, an exerciser lifts his body (70·0 kg) to 0·3 meters in 2 seconds. Calculate the power delivered by his biceps. (Given, value of $g = 10$ m/s$^2$)

    (a) 52·5 watts

    (b) 105 watts

    (c) 210 watts

    (d) 700 watts

50. Which of the following is **not** true?

    (a) If a gas expands adiabatically and reversibly, there will be no change in its entropy, i.e., $\Delta S = 0$

    (b) If the left and right hands of a person are at the same temperature, then rubbing these together to warm them is an irreversible process

    (c) No mechanical engine can be more efficient than a Carnot engine operating between the same two temperatures

    (d) The heart as a natural biological engine is more efficient than a Carnot engine

51. A block of mass 200 g attached with a hanging ideal spring oscillates with a time period of 20 sec on earth. If the system is taken to Venus where the acceleration due to gravity is about 50% of that of earth, what will be the time period of oscillations?

    (a) 10 sec

    (b) 20 sec

    (c) 30 sec

    (d) 40 sec

52. Two lightweight metal bobs are attached to insulating nylon threads and are hanging very close to each other. If one is negatively charged and other is neutral, then select the correct option.

    (a) If they touch, they will attract each other

    (b) If they touch, they will repel each other

    (c) If they touch, they will not exert any force on each other

    (d) If they do not touch, they will not exert any force on each other

53. If the two protons are travelling with the same speed parallel to each other and in the opposite direction, which of the following will be true regarding the electric force ($F_E$) and magnetic force ($F_B$) between these two protons?

    (a) $F_E$ will be attractive, $F_B$ will be repulsive

    (b) $F_E$ will be repulsive, $F_B$ will be attractive

    (c) $F_E$ and $F_B$ both will be attractive

    (d) $F_E$ and $F_B$ both will be repulsive

54. A proton has the mass ($1 \cdot 673 \times 10^{-27}$ kg) and a neutron has the mass ($1 \cdot 675 \times 10^{-27}$ kg). If both have the de Broglie wavelength $\lambda = 0 \cdot 2$ nm (Planck's constant $h = 6 \cdot 626 \times 10^{-34}$ J-s ), which of the following statements is true?

   (a)  Proton will have more kinetic energy than neutron.

   (b)  Neutron will have more kinetic energy than proton.

   (c)  Both will have identically same kinetic energy.

   (d)  Both will have identically same velocity.

55. To completely melt 50·0 grams of ice, what will be the minimum amount of liquid water required at 30 degrees? (Specific heat capacity of liquid water = 4·18 J/g/°C, specific heat of fusion of ice is 333 J/g)

   (a)  133 g

   (b)  150 g

   (c)  175 g

   (d)  110 g

56. Consider the following functions of time ($t$) :

   (i)  $\sin \omega t$

   (ii)  $\sin \omega t + \cos \omega t$

   (iii)  $t^3 + t^2$

   (iv)  $\tan \omega t + \sec \omega t$

   (v)  $\log_e (\omega t)$

   Which of the above represents periodic motion?

   (a)  Only (i)

   (b)  Only (i) and (ii)

   (c)  Only (i), (ii) and (iv)

   (d)  Only (iii) and (v)

57. Which of the following is the best approximation of heat that is required to raise the temperature of 500 g of water from 30 °C to 90 °C? (Given, the specific heat capacity of water = 4·18 J/g/°C)

   (a)  126 kJ

   (b)  63 kJ

   (c)  188 kJ

   (d)  12·6 kJ

58. In the following figure, ABCD is a square of side 20 cm. Area of the shaded region is (take $\pi = 3 \cdot 14$)
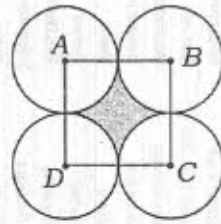


   (a)   314 cm$^2$

   (b)   400 cm$^2$

   (c)   86 cm$^2$

   (d)   100 cm$^2$

59. Identify the correct option. Given the following assertions :

   (i)   The value of $C_p - C_v$ for a monatomic ideal gas is equal to the value of $C_p - C_v$ for a diatomic ideal gas.

   (ii)   On a monatomic ideal gas, if a process is performed such that $\Delta V = 0$, change in work done $\Delta W = 0$.

   (a)   (i) is correct and (ii) is wrong

   (b)   (i) is wrong and (ii) is correct

   (c)   (i) and (ii) both are correct

   (d)   (i) and (ii) both are wrong

60. Which of the following are the examples of linear system? ($m$ and $c$ are constants)

   (i)   $y = mx + c$

   (ii)   $y = mx + 3x + c$

   (iii)   $y = mx + \ln(x) + c$

   (iv)   $y = mx + \sqrt{x} + c$

   (a)   Only (i)

   (b)   (i) and (ii)

   (c)   (i), (ii) and (iii)

   (d)   (i), (iii) and (iv)

## PART—B

### Answer *any* **sixty** questions

61. Cellulose, hemicellulose and pectin together make up to form

    (a) primary wall            (b) secondary wall

    (c) middle wall             (d) tertiary wall

62. Clathrin, a member of the coating protein family, is responsible for

    (a) pinching off of the vesicle from the donor compartment

    (b) bending the membrane into a pit

    (c) directing the vesicles to the proper compartment

    (d) fusing the vesicle to the target compartment

63. Which of the second messengers listed below remains bound to the plasma membrane?

    (a) $Ca^{2+}$

    (b) IP3

    (c) Diacylglycerol

    (d) cAMP

64. The enzyme responsible for continuing DNA replication in prokaryotes, once it is initiated, is

    (a) polymerase beta

    (b) polymerase delta

    (c) DNA polymerase–I

    (d) DNA polymerase–III

65. mRNA will form hybrids only with the coding strand of DNA because

    (a) DNA contains phosphate group at 5′ end that will not reanneal at high temperatures

    (b) DNA contains hydroxy group at 3′ end that will not reanneal at low temperatures

    (c) RNA : DNA hybridization follows the base-pairing rules

    (d) denatured DNA is helical structure and will not reanneal to form hybrid

66. Trypsinogen is a typical example of

    (a) coenzyme

    (b) proenzyme

    (c) apoenzyme

    (d) holoenzyme

67. The cell wall of *Archaebacteria* does not contain

   (a) protein       (b) polysaccharides

   (c) peptidoglycan       (d) pseudomurein

68. Which one of the following radiations is the most lethal one?

   (a) Ultraviolet–A (UV-A)       (b) Ultraviolet–B (UV-B)

   (c) Ultraviolet–C (UV-C)       (d) Both UV-A and UV-B

69. Which one of the following genes is involved in the conversion of proto-oncogenes into oncogenes causing cancer?

   (a) *Angiogenesis* genes

   (b) Tumour suppressor genes

   (c) Transposons

   (d) Metastasis gene

70. Which of the following is a false statement?

   (a) *Archaebacteria* mostly grow in harsh habitat

   (b) Several bacteria are pathogenic

   (c) Viruses are cellular organism

   (d) *Anabaena* belongs to the group cyanobacteria

71. Which of the following is mismatched?

   (a) *Oscillatoria*—Cyanobacterium

   (b) TMV—RNA virus

   (c) *E. coli*—Photosynthetic bacterium

   (d) Plasmid—Extra chromosomal DNA

72. Which one of the following side chains of an amino acid is responsible for fluorescence in proteins?

   (a) Indole ring

   (b) Guanidino group

   (c) Epsilon amino group

   (d) Imidazole group

73. In animals, the inability to make the pigment melanin results in albinism, a recessive condition. Two unaffected parents, who have decided to have three children, have a first child that has albinism (genotype aa). What is the probability that the second and third children will also have albinism?

    (a) 1/4

    (b) 1/2

    (c) 1/16

    (d) 9/16

74. Which of the following crosses would produce a 1 : 1 ratio of phenotypes in the next generation?

    (a) AA × AA

    (b) AA × aa

    (c) Aa × Aa

    (d) Aa × aa

75. You are interested in a particular segment of rhinoceros DNA and would like to clone it into a cloning plasmid. You have the following restriction map of the region that includes the DNA of interest and the plasmid (E = EcoRI, H = HindIII, X = XbaI, S = SphI, N = NotI).
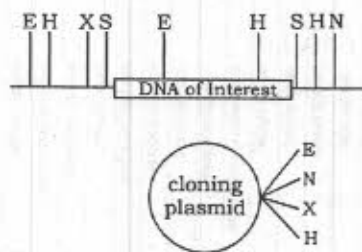


    Which of the following restriction enzymes would you choose to clone the DNA of interest into the cloning vector?

    (a) E and H

    (b) S

    (c) X and N

    (d) S and N

76. Antigen-presenting cells that activate helper T (TH1) cells do not activate which one of the following?

    (a) IL-12 cytokine

    (b) Gamma interferon

    (c) Class II MHC antigens

    (d) Class I MHC antigens

77. Which of the following is a component of innate immunity?
   (a) B cells
   (b) T lymphocytes
   (c) Natural killer cell
   (d) Antibody

78. Which of the following flows through an ecosystem but not as a cycle?
   (a) Water
   (b) Carbon
   (c) Nitrogen
   (d) Energy

79. The study of evolutionary relationships between organisms is known as
   (a) Phylogenetics
   (b) Genetics
   (c) Genomics
   (d) Proteomics

80. The rate of migration of the DNA fragments through an agarose gel is determined by the
   (a) number of nucleotides in the fragment
   (b) ratio of adenine to cytosine in the fragment
   (c) hydrogen bonds between base pairs
   (d) volume of the sample

81. The undifferentiated and unorganized mass of cells in tissue culture is known as
   (a) callus
   (b) tissue
   (c) organ
   (d) crown

82. In recombinant DNA technology, a DNA probe is used to
   (a) detect specific nucleotide sequence
   (b) insert foreign genes
   (c) digest genomic DNA
   (d) clone extra piece of DNA

83. The Widal test is used for detecting

(a) hormone deficiency syndrome, which occurs after menopause

(b) filariasis, which is caused by the worms *Wuchereria bancrofti*

(c) typhoid, which is caused by the bacteria *Salmonella typhii*

(d) malaria, which is caused by *Plasmodium falciparum*

84. A student prepared 98·7 ml of LB-agar medium in 250 ml volumetric flask. To this flask, he mixed 100 µl of ampicillin from 100 mg/ml stock, 1 ml of 2% x-gal and 200 µl of 20% IPTG (final volume is 100 ml). What was the nearest final concentration of ampicillin, x-gal and IPTG in the flask?

(a) Ampicillin = 1 mg/ml, x-gal = 0·1% and IPTG = 4%

(b) Ampicillin = 100 µg/ml, x-gal = 0·1% and IPTG = 4%

(c) Ampicillin = 100 µg/ml, x-gal = 0·02% and IPTG = 0·04%

(d) Ampicillin = 10 µg/ml, x-gal = 0·2% and IPTG = 0·4%

85. A researcher did the following steps in an experiment :

I. Isolated the genomic DNA from a micro-organism and purified it

II. Digested the DNA sample with HindIII restriction enzyme for overnight

III. Performed the agarose gel electrophoresis of the digested sample

IV. After electrophoresis, transferred the separated bands to a nitrocellulose membrane

V. Prepared the gene-based radioactive-probe and hybridized with nitrocellulose membrane

VI. Checked his result with autoradiography

Which experiment he was conducting?

(a) Southern hybridization

(b) Northern hybridization

(c) Western hybridization

(d) Subtractive hybridization

86. During the formation of hybrid cells (B-cells and myeloma cells) for the production of monoclonal antibodies, polyethylene glycol (PEG) is used. What is the role of PEG?

(a) It helps in the blocking of de novo pathway, and activate the cells to utilize the salvage pathway

(b) It helps in the synthesis of nucleotides and converts purines and pyrimidines directly into DNA

(c) It helps in the fusion of B-cells and myeloma cells

(d) It helps in maintaining the immortal growth of hybrid

87. Synapsis and chiasmata formation occur during which stage of cell division?

   (a) Zygotene and diplotene, respectively

   (b) Both occur during pachytene

   (c) Zygotene and pachytene, respectively

   (d) Pachytene and diakinesis, respectively

88. A haploid set of chromosome, i.e., the number of chromosomes in the gamete is known as

   (a) idiogram

   (b) genotype

   (c) karyotype

   (d) genome

89. Balbiani ring formation is a characteristic feature of

   (a) polytene chromosome

   (b) lampbrush chromosome

   (c) X chromosome

   (d) satellite chromosome

90. Which of the following antibiotics is an inhibitor of RNA synthesis?

   (a) Tetracycline

   (b) Streptomycin

   (c) Bacitracin

   (d) Rifamycin

91. Which of the following **cannot** excrete hypertonic urine but can considerably reduce water loss in urine?

   (a) Marsupial rat

   (b) Camel

   (c) Birds

   (d) Horse

92. In the genetic code, a stop codon (or termination codon) is a nucleotide triplet within messenger RNA that signals a termination of translation into proteins. Identify the correct pairs of termination codons from the following :

   (a) UAA, UGA, UAG

   (b) UAG, UUU, UGU

   (c) UAA, UUG, UAC

   (d) UGA, UUC, UGG

93. Closing of stomata happens due to secretion of abscisic acid by dehydrated mesophyll cells. If you allow transpiration of a plant in 1% glycerol containing water and another plant in only water as control then

    (a) stomata will remain open for longer time compared to control

    (b) stomata will close early compared to control

    (c) No effect on stomata closing

    (d) stomata will never open

94. High fluidity of the thylakoid membrane compared to cell membrane in plant is due to

    (a) more rhamnolipids and less phospholipids

    (b) more phospholipids and less rhamnolipids

    (c) more rhamnolipids, less phospholipids and more unsaturated fatty acids

    (d) chlorophyll

95. Which of the following phospholipids is preferentially distributed in the outer leaflet of plasma membrane?

    (a) Phosphatidyl ethanolamine

    (b) Phosphatidyl serine

    (c) Phosphatidyl choline

    (d) Phosphatidyl inositol

96. According to Chargaff's rule, the concentration of guanine always equalled to that of the concentration of cytosine. A segment of double-stranded DNA has 120 adenine and 120 cytosine bases. What will be the total number of nucleotides present in the segment?

    (a) 60

    (b) 480

    (c) 120

    (d) 240

97. Which of the following cannot be used for determination of enzyme kinetics constants ($K_m$ and $V_{max}$)?

    (a) Lineweaver-Burk plot

    (b) Eadie-Hofstee plot

    (c) Dixon-Scatchard plot

    (d) Hanes-Woolf plot

98. Which of the following statements is untrue about enzymes?

    (a) These increase the rate of reaction

    (b) These affect reaction equilibrium to make more product

    (c) These are proteins

    (d) These sometime require cofactors for their functions

99. A protein solution after 1000 fold dilution gave an absorbance of 0·4 in 1 cm path length cuvette at 280 nm. Its molar extinction coefficient is 44000 $M^{-1}$ $cm^{-1}$. Find out the approximate concentration of stock solution.

    (a) 0·91 M

    (b) 0·91 mM

    (c) 9·9 mM

    (d) 9·1 mM

100. Which of the following is the correct operational relationship between pH and $pK_a$?

    (a) $pK_a$ is that pH in which 100% of the titratable solute exists in a dissociated state

    (b) $pK_a$ is the logarithm of pH

    (c) $pK_a$ is that pH in which 50% of the titratable solute exists in a dissociated state

    (d) pH is the logarithm of $pK_a$

101. S. cerevisiae has a maximum specific growth rate of 0·5 h-1 on a glucose-based medium. If grown in a chemostat with a dilution rate of 0·6 h-1, then at steady state the concentration of S. cerevisiae in the same medium will

    (a) fluctuate

    (b) increase

    (c) decrease

    (d) be zero

102. The equipment French press is used for

    (a) high-pressure filtration

    (b) high-pressure cell lysis

    (c) low-pressure filtration

    (d) low-pressure cell lysis

103. Which of the following is **not** a type of impeller for agitation in a bioreactor?

    (a) Anchor

    (b) Paddle

    (c) Helical screw

    (d) Basket

104. Which of the following antibiotics inhibits peptidyl transferase in bacterial protein synthesis?

    (a) Streptomycin

    (b) Puromycin

    (c) Erythromycin

    (d) Cycloheximide

105. 0·1 ml of a bacterial culture is diluted into 9·9 ml of buffer; 0·1 ml of this dilution is again diluted in 9·9 ml of fresh buffer. Plating 0·1 ml from the second dilution tube yields an average of 72 colonies on the plate. What is the cell density of the culture?

    (a) $7·2 \times 10^6$ cells per ml

    (b) $7·2 \times 10^5$ cells per ml

    (c) $7·2 \times 10^8$ cells per ml

    (d) $7·2 \times 10^7$ cells per ml

106. The order of glucose, urea, $H_2O$, $CO_2$ and steroid hormones according to their ability to diffuse through the lipid bilayer, beginning with the one that crosses the bilayer most readily is

    (a) $CO_2$, steroid hormone, $H_2O$, urea, glucose

    (b) $CO_2$, $H_2O$, urea, glucose, steroid hormone

    (c) $H_2O$, $CO_2$, glucose, urea, steroid hormone

    (d) steroid hormone, $CO_2$, $H_2O$, urea, glucose

107. Chemo-organoautotrophs will use which one of the following as food source?

    (a) Organic compounds

    (b) Inorganic compounds not containing carbon

    (c) Carbon dioxide

    (d) Inorganic compounds not containing oxygen

108. DNA hybridization of less than 25% between two organisms indicates that they are of

    (a) different genera and different species

    (b) same species but different genera

    (c) same genera but different species

    (d) same family and same genera

109. Which of the following methods will you use to differentiate between species and strain?

    (a) 16S rRNA sequence

    (b) DNA footprinting

    (c) Whole cell protein profiling

    (d) DNA fingerprinting

110. Which of the following marine bacteria is capable of bioluminescence?

    (a) *Pseudomonas fluorescens*

    (b) *Salmonella typhii*

    (c) *Vibrio fisheri*

    (d) *Thiothrix nivea*

111. How does fertilized egg prevent the entry of another sperm?

    (a) Sudden rise in $Ca^{2+}$ concentration on the egg cell surface

    (b) Sudden modulation in the cell surface glycoprotein on the cell surface

    (c) Sudden change in the sialylation level of cell surface proteins changes overall charge of membrane protein

    (d) Sudden change in G-protein conformation prevents binding of sperm to the fertilized egg

112. Which bacterial gene transfer would be inhibited by extracellular exonucleases?

    (a) Conjugation

    (b) Transduction

    (c) Transformation

    (d) Transposition

113. What is the concentration of $H^+$ in the solution of $0.2\ M$ NaOH?

   (a) $10^{-2}\ M$

   (b) $10^{-12}\ M$

   (c) $10^{-14}\ M$

   (d) $10^{-7}\ M$

114. How many times pH = $1.0$ has more hydrogen than that is in pH = 14?

   (a) 1 million

   (b) 1 trillion

   (c) 10 million

   (d) 10 trillion

115. The given $1.8$ g of glucose is equivalent to which of the following?

   (a) $0.1$ mol of glucose

   (b) $0.01$ mol of glucose

   (c) 1 mol of glucose

   (d) $1.8$ mol of glucose

116. Arrange the following taxonomic levels in the order of increasing similarity (from least to most) of the microorganisms in each taxonomic group :

   (i) Family

   (ii) Genus

   (iii) Kingdom

   (iv) Order

   (v) Species

   (a) (i)–(ii)–(iii)–(iv)–(v)

   (b) (ii)–(i)–(iv)–(iii)–(v)

   (c) (v)–(ii)–(i)–(iv)–(iii)

   (d) (ii)–(v)–(i)–(iv)–(iii)

117. The bacterial genomic DNA occurs as a

   (a) single linear molecule attached to membrane

   (b) pair of linear molecules attached to membrane

   (c) single circular molecule not attached to membrane

   (d) single circular molecule attached to membrane

118. The linear genomic DNA of phage T2 is 52 μm long. The DNA is double stranded with 0·34 nm distance between each base pair. How many base pairs does the entire genomic DNA of T2 contain?

    (a) 34000 bp

    (b) 52000 bp

    (c) 152941 bp

    (d) 520000 bp

119. Following is the titration curve of acetic acid. Choose the correct answer.
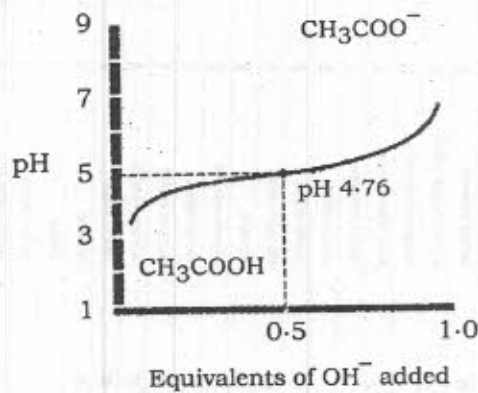
    

    (a) Acetic acid has a buffering range from pH 1·0 to pH 5·0

    (b) The $OH^-$ 0 to 0·5 is the $pK_a$ of acetic acid

    (c) pH 4·76 is the $pK_a$ of acetic acid

    (d) pH value increases to 7 and $OH^-$ value to 1·0

120. The relative molecular masses of water and ammonia are 18 and 17 respectively. However, their boiling points are 100 °C and −33 °C respectively. The vast difference in the boiling points is because

    (a) ammonia is volatile and kept in a dark stoppered bottle

    (b) ammonia has enough lone pairs of electron to form hydrogen bonds

    (c) hydrogen atoms of water form hydrogen bonds with surrounding water molecules

    (d) water is non-polar and kept in any vessicle

121. An absorption spectrum for a solution is given below. Choose the correct statement regarding the solution.
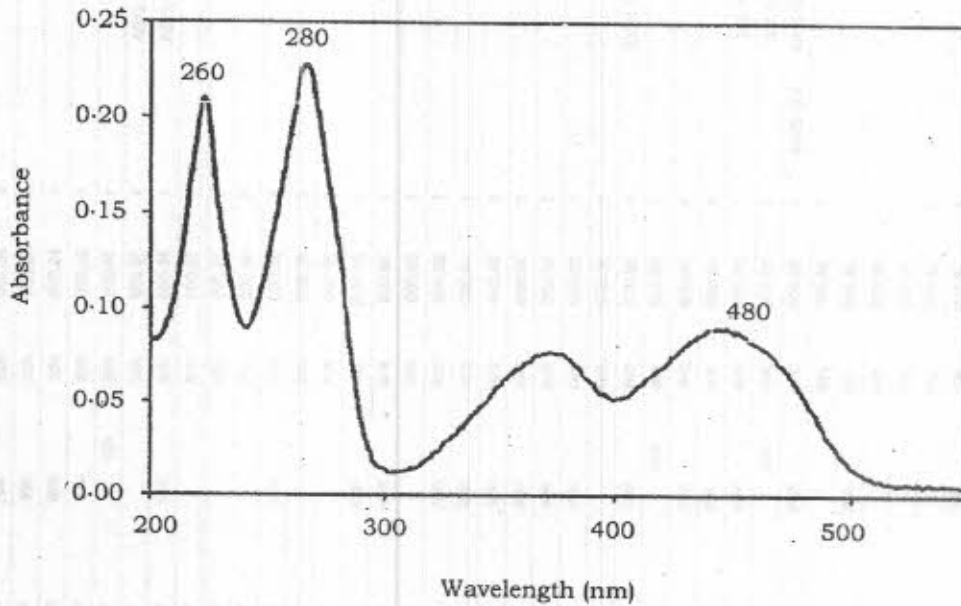


(a) The solution has only DNA.

(b) The solution has DNA or RNA, protein and is violet in colour.

(c) The solution has DNA or RNA, protein and is blue in colour.

(d) The solution has DNA or RNA, protein and is red in colour.

122. Pick the correct order of the evolutionary timescale in ascending order.

(a) Cretaceous, Jurassic, Triassic

(b) Cretaceous, Triassic, Jurassic

(c) Permian, Silurian, Devonian

(d) Cambrian, Silurian, Devonian

123. Pick out the correct statement.

(a) Eukaryotes have single origin of replication while prokaryotes have multiple origins per chromosome.

(b) Eukaryotes and prokaryotes have multiple origins of replication per chromosome.

(c) Eukaryotes have multiple origins while prokaryotes have a single origin of replication per chromosome.

(d) Prokaryotes do not have single origin while eukaryotes have single origin of replication per chromosome.

124. The resolving power of a microscope can be increased by

   (a) increasing the diameter of the eyepiece

   (b) decreasing the diameter of the eyepiece

   (c) increasing the diameter of the objective

   (d) decreasing the diameter of the objective

125. Polypeptides with identical molecular weights can be separated by

   (a) gel filtration

   (b) SDS-PAGE

   (c) isoelectric focussing

   (d) Western blot

126. Philadelphia chromosome is an abnormality associated with

   (a) liver cancer

   (b) blood cancer

   (c) lung cancer

   (d) skin cancer

127. Which of the following is *not* used for end-modification of DNA?

   (a) T4 polynucleotide kinase

   (b) Alkaline phosphatase

   (c) Terminal deoxynucleotidyl transferase

   (d) T4 ligase

128. Which is the correct order of events?

   (a) Leptotene, Zygotene, Pachytene, Diplotene

   (b) Leptotene, Pachytene, Diplotene, Zygotene

   (c) Leptotene, Diplotene, Pachytene, Zygotene

   (d) Zygotene, Pachytene, Diakinesis, Diplotene

129. Which of the following enzymes is activated by cyclic AMP, passing on the hormonal signal?

    (a)   Protein kinase A

    (b)   Protein kinase B

    (c)   Protein kinase C

    (d)   G protein receptor kinase

130. Precipitins are

    (a)   insoluble antigens

    (b)   antibodies that aggregate soluble antigens

    (c)   aggregates of antigen-antibody reactions

    (d)   insoluble antibodies

131. Tunicamycin is an inhibitor of

    (a)   glycosylation

    (b)   transcription

    (c)   translation

    (d)   fatty acid biosynthesis

132. O-linked glycosylation takes place at

    (a)   serine or threonine residue of a polypeptide

    (b)   asparagine or aspartic acid residue of a polypeptide

    (c)   methionine or lysine residue of a polypeptide

    (d)   glycine or aspartic acid residue of a polypeptide

133. Differentiation of shoot in plant tissue culture is controlled by

    (a)   high auxin : cytokinin ratio

    (b)   high cytokinin : auxin ratio

    (c)   high auxin : gibberellin ratio

    (d)   high gibberellin : auxin ratio

134. For a character $X$, there exist 12 alleles in a population of rice plants. How many alleles for the same character would be present in diploid rice plant?

    (a) 12

    (b) 8

    (c) 6

    (d) 2

135. Which of the following parts of plant would be most suitable for the production of virus-free plants for micropropagation?

    (a) Nodes

    (b) Meristem

    (c) Vascular tissue

    (d) Leaves

136. In plant transformation, the term T-DNA is used for

    (a) plant chromosomal DNA where foreign DNA is integrated

    (b) DNA segment that is transferred from agrobacterium to plant genome

    (c) DNA segment that is responsible for replication of agrobacterium genome

    (d) DNA segment of Ti plasmid that is transferred to agrobacterium genome

137. Which of the following methods was used to sequence the human genome?

    (a) Cytogenic mapping

    (b) Shotgun sequencing

    (c) Chromosome walking

    (d) Radiation hybrid mapping

138. Raman spectroscopy deals with the changes in

    (a) electronic states

    (b) molecular rotational and vibrational states

    (c) rotational state of nuclear spin

    (d) electronegativity of amino acids

139. During synthesis of DNA by DNA polymerases, which of the following phosphate groups of the deoxynucleotide triphosphates (dNTPs) is incorporated into the DNA?

    (a) Alpha

    (b) Beta

    (c) Gamma

    (d) Delta

140. Terminal electron acceptor in electron transport chain is

    (a) cytochrome a

    (b) cytochrome b

    (c) cytochrome c

    (d) oxygen

141. During the carboxylation phase of Calvin cycle, $CO_2$ combines with

    (a) ribulose 1,5-bis-phosphate

    (b) phosphoglyceraldehyde

    (c) pyruvic acid

    (d) oxaloacetic acid

142. In a DNA molecule, the guanosine content is 40%, the adenine content will be

    (a) 10%

    (b) 20%

    (c) 30%

    (d) 40%

143. The mRNA is complementary to the nucleotide sequence of which of the following of DNA?

    (a) Coding strand

    (b) Antitemplate strand
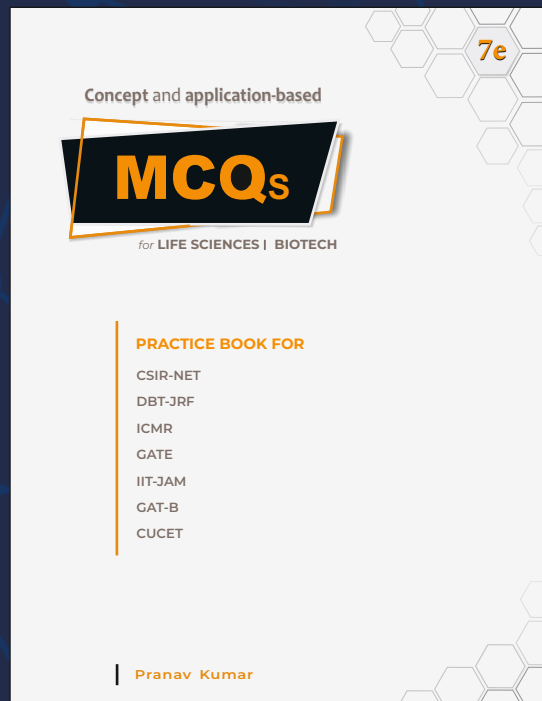
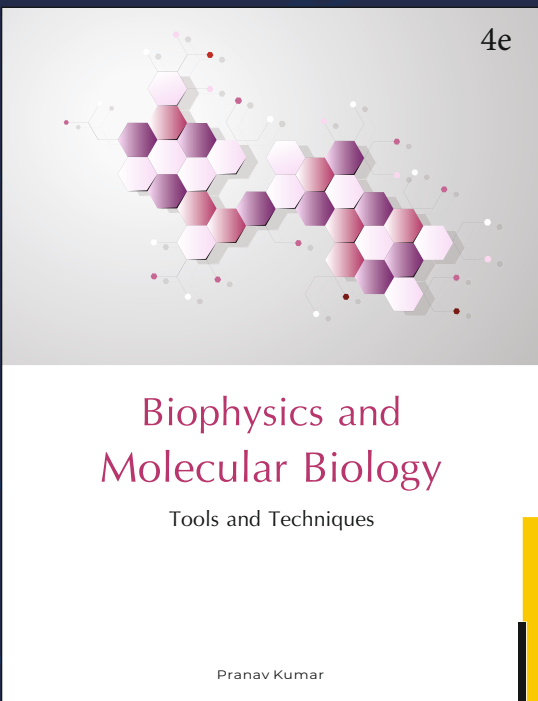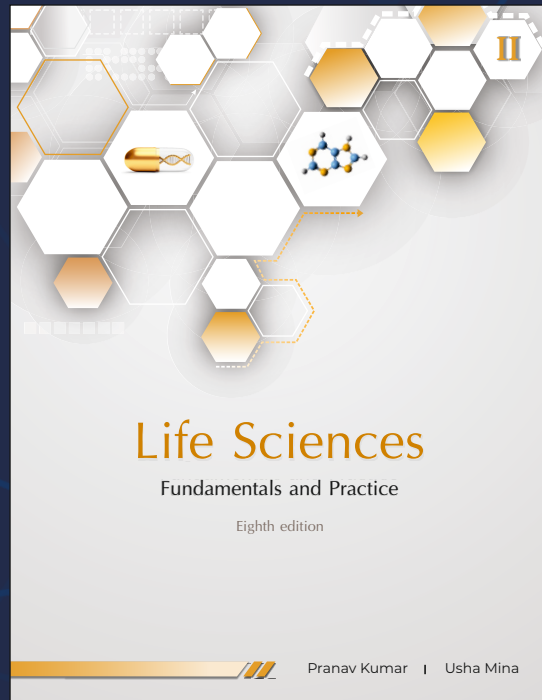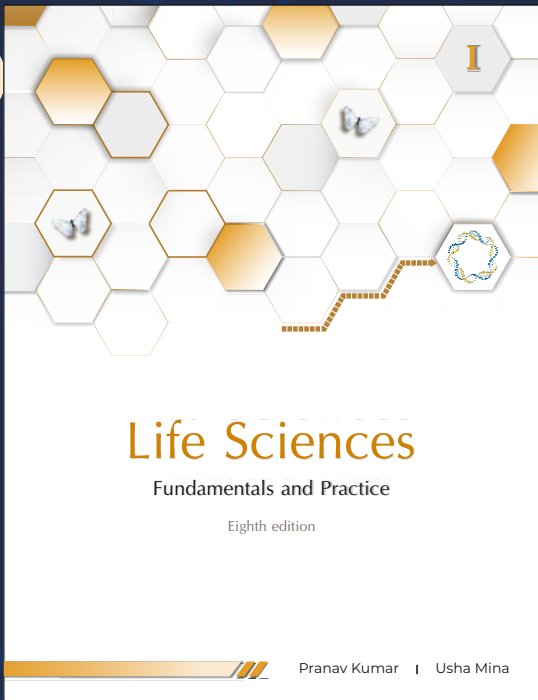    (c) Sense strand

    (d) Antisense strand

144. Substitution of a thymine base by adenine in DNA is known as

    (a) transposition

    (b) transition

    (c) transversion

    (d) frameshift

145. A polypeptide has a molecular mass of about 200000. The most probable number of amino acids that the polypeptide has is

    (a) 1000

    (b) 2000

    (c) 3000

    (d) 4000

146. Transport of molecules against concentration gradient is called

    (a) osmosis

    (b) active transport

    (c) diffusion

    (d) passive transport

147. What would happen if human blood becomes acidic?

    (a) Oxygen-carrying capacity of haemoglobin is increased

    (b) Oxygen-carrying capacity of haemoglobin is decreased

    (c) It will remain same

    (d) It will be unpredictable

148. The region of DNA known as TATA box is the site for binding of

    (a) DNA polymerase

    (b) DNA topoisomerase

    (c) DNA dependent RNA polymerase

    (d) polynucleotide phosphorylase

149. Ames assay is a rapid method for detection of

    (a) oncoviruses

    (b) retroviruses

    (c) chemical carcinogens

    (d) typhoid

150. A new *Penicillium* mutant was tested for auxotrophy. The mutant grows on minimal medium (M) + arginine (A) + proline (P) + histidine (H) but not on M or on M + A + H. The mutant requires

   (a) arginine

   (b) histidine and arginine

   (c) histidine

   (d) proline

151. Turner's syndrome in female is due to the presence of

   (a) 44 + XXY chromosomes

   (b) 44 + X chromosomes

   (c) 44 + XYY chromosomes

   (d) 44 + XXX chromosomes

152. A major class of non-translated RNA functions in the regulation of gene expression by base pairing to mRNA is

   (a) ribosomal RNA

   (b) antisense RNA

   (c) regulatory RNA

   (d) small nuclear RNA

153. Sometimes reactions may not easily take place even though the standard free energy change is highly negative. Which one of the following is a possible explanation?

   (a) The statement itself is false, therefore needs no explanation

   (b) The reverse reaction is very fast as compared to forward reaction

   (c) The reaction is highly endothermic

   (d) The free energy of activation is very high

154. What will be the value of free energy change $\Delta G$ at equilibrium?

   (a) Greater than 1

   (b) Less than 1

   (c) Equal to zero

   (d) Equal to $\infty$

155. If cells are treated with an inhibitor of the glucosidase I enzyme of the endoplasmic reticulum, it can be expected that the glycosylated proteins will show a change in

   (a) molecular weight and increased hydrophobicity

   (b) molecular weight and increased hydrophilicity

   (c) molecular weight and no change in hydrophobicity

   (d) hydrophobicity without any change in the molecular weight

156. VNTRs represent

    (a)  variable new terminal regions with tandem repeats

    (b)  functional genes with tandem repeats

    (c)  split genes in tandem repeats

    (d)  on-coding sequences with tandem repeats

157. Expressed Sequence Tags (ESTs) allow researchers to identify

    (a)  genes that encode rRNA

    (b)  genes that encode proteins

    (c)  the start of an intron

    (d)  protein sequences that bind to mRNA during expression

158. Which of the following is *not* intensive variables as per properties of matter?

    (a)  Temperature

    (b)  Density

    (c)  Mole fractions

    (d)  Energy

159. After an overnight fast, which of the following enzymes would be expected to have little, if any physiological activity?

    (a)  Malate dehydratase

    (b)  $\alpha$-ketoglutarate dehydrogenase

    (c)  Phosphofructokinase

    (d)  Glucokinase

160. Cytochrome P-450 is found in the membranes of

    (a)  Golgi

    (b)  endoplasmic reticulum

    (c)  peroxisomes

    (d)  lysosomes

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