GATE BT 2017

EE25BTECH11044 - Pappula Sai Hasini

1) an enzyme catalyses a reaction by
   a) decreasing the energy of the substrate
   b) decreasing the activation energy of the reaction
   c) decreasing the product stability
   d) increasing the activation barrier of the reaction

(GATE BT 2017)

2) Natural protiens are composed primarily of 20 α amino acids. Which of the following statements is true for any of these amino acids in a solution of pH 1.5?
   a) only the amino group is ionized
   b) only the carboxylic group is ionized
   c) both amino and carboxylic groups are ionized
   d) both amino and carboxylic groups are neutral

(GATE BT 2017)

3) which one of the following organisms is an indicator of fecal contamination?
   a) Escherichia cell
   b) Streptococus lactis
   c) Bacillus subtilis
   d) Lactobacillus acidophilus

(GATE BT 2017)

4) The surface area (in m^2) of the largest sphere that can fit into a hollow cube with edges of length 1 meter is (GATE BT 2017)

5) In a thin layer chromatography experiment using a silical gel plate, a compund showed migration of 12.5cm and the solvent front showed migration of 18cm . The Rf value for the compound is (GATE BT 2017)

6)
$$\lim_{x \to 0} \frac{\sin x}{x} = 1$$

(GATE BT 2017)

7) Which one of the following mechanisms is used by human pathogens to evade host immune responses?
   a) Somatic hypermutation
   b) Antibody production
   c) Antigenic variation
   d) Complement activation

(GATE BT 2017)

8) If the nucleotide composition (%) of a viral genome is $A = 10$, $U = 20$, $C = 40$, and $G = 30$, which one of the following is this genome?
   a) Double stranded RNA
   b) Single stranded RNA
   c) Single stranded DNA
   d) Double stranded DNA

(GATE BT 2017)

9) Which one of the following techniques can be used to determine the structure of a 15 kDa globular protein at atomic resolution?
   a) Raman spectroscopy
   b) IR spectroscopy
   c) UV spectroscopy
   d) NMR spectroscopy

(GATE BT 2017)

10) Assertion [a]: Gram negative bacteria show staining with saffranin.
   Reason [r]: Gram negative bacteria have an outer membrane with lipopolysaccharides.
   a) Both [a] and [r] are true and [r] is the correct reason for [a].
   b) Both [a] and [r] are true but [r] is not the correct reason for [a].
   c) Both [a] and [r] are false.
    a is true but [r] is false.

(GATE BT 2017)

11) Enzyme-linked immunosorbent assay (ELISA) is used for
   a) quantifying antibody levels in blood
   b) determining the molecular weight of an antigen
   c) purifying proteins from biological fluids
   d) determining the molecular weight of an antibody

(GATE BT 2017)

12) Macrophages eliminate pathogenic bacteria upon activation by
   a) NK cells
   b) basophils
   c) CD4+ T cells
   d) plasma cells

(GATE BT 2017)

13) If a protein contains four cysteine residues, the number of different ways they can simultaneously form two intra-molecular disulphide bonds is   (GATE BT 2017)

14) Secretory proteins synthesized by ER-associated ribosomes traverse through
   a) mitochondria
   b) peroxisomes
   c) the Golgi apparatus
   d) the nucleus

(GATE BT 2017)

15) For $y = f(x)$, if $\dfrac{d^2y}{dx^2} = 0$, $\dfrac{dy}{dx} = 0$ at $x = 0$, and $y = 1$ at $x = 1$, the value of y at $x = 2$ is

(GATE BT 2017)

16) During protein synthesis, tRNAs are NOT involved in
   a) termination
   b) elongation
   c) charging
   d) initiation

(GATE BT 2017)

17) In eukaryotes, cytokinesis is inhibited by
   a) cytochalasin D
   b) vinblastine
   c) nocodazole
   d) colchicine

18) A proto-oncogene is suspected to have undergone duplication in a certain type of cancer. Of the following techniques, which one would verify the gene duplication?

a) Northern blotting
b) Southern blotting
c) South western blotting
d) Western blotting

19) A polymerase chain reaction (PCR) was set up with the following reagents: DNA template, *Taq* polymerase, buffer, dNTPs, and Mg^{2+}. Which one of the following is missing in the reaction mixture?

a) Helicase
b) Single-stranded binding proteins
c) Primers
d) Reverse transcriptase

20) An enzymatic reaction exhibits Michaelis–Menten kinetics. For this reaction, on doubling the concentration of enzyme while maintaining $[S] \gg [E_0]$, the maximum velocity V_{max} is doubled, while the Michaelis constant K_m remains unchanged.

a) both K_m and V_{max} will remain the same.
b) K_m will remain the same but V_{max} will increase.
c) K_m will increase but V_{max} will remain the same.
d) both K_m and V_{max} will increase.

21) A 5 liter chemostat is fed fresh medium at 0.2 liters/minute having a substrate concentration of 25 grams/liter. At steady state, the outgoing stream has substrate concentration of 2.5 grams/liter. The rate of consumption (grams/liter/minute) of the substrate in the reactor is ———————. (GATE BT 2017)

22) The transcription factor X binds a 10 base pair DNA stretch. In the DNA of an organism, X was found to bind at 20 distinct sites. An analysis of these 20 binding sites showed the following distribution:

Base	Position in the binding site									
	1	2	3	4	5	6	7	8	9	10
A	11	0	0	0	16	2	4	0	4	3
T	3	0	19	0	1	3	4	20	2	4
G	4	20	0	0	2	4	6	0	12	2
C	2	0	1	20	1	11	6	0	2	11

Fig. 22. Distribution of bases at each position of the binding site

What is the consensus sequence for the binding site of X?

a) NGTCNNNTNN
b) AGTCACNTGC
c) CACCTANCTG
d) ANNNACGNGC

23) A bacterium has a genome of size 6 million base pairs. If the average rate of DNA synthesis is 1000 base pairs/second, the time taken (in minutes) for replication of the genome will be ———————.

(GATE BT 2017)

24) At the transcription start site of a gene, any of the four nucleotides can occur with equal probability p. The Shannon Entropy S, given by $S = - \sum_{i=1}^{4} p_i \ln p_i$, for this start site is _____.   (GATE BT 2017)

25) The distribution of marks scored by a large class in an exam can be represented as a normal distribution with mean μ and standard deviation σ. In a follow-up exam in the same class, everyone scored 5 marks more than their respective score in the earlier exam. For this follow-up exam, the distribution of marks can be represented as a normal distribution with mean μ_2 and standard deviation σ_2. Which one of the following is correct?

a) $\mu = \mu_2$; $\sigma > \sigma_2$
b) $\mu < \mu_2$; $\sigma > \sigma_2$
c) $\mu > \mu_2$; $\sigma < \sigma_2$
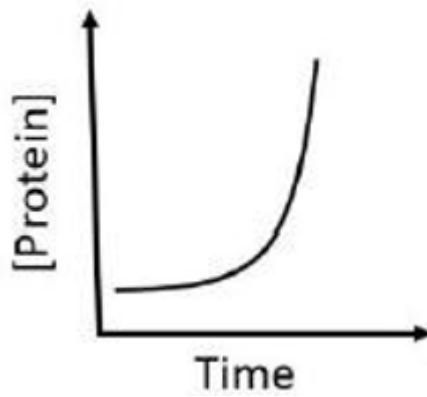d) $\mu < \mu_2$; $\sigma = \sigma_2$

(GATE BT 2017)

Which one of the following graphs represents the kinetics of protein precipitation by addition of ammonium sulphate? On the Y-axis, [Protein] represents the concentration of free protein in solution.
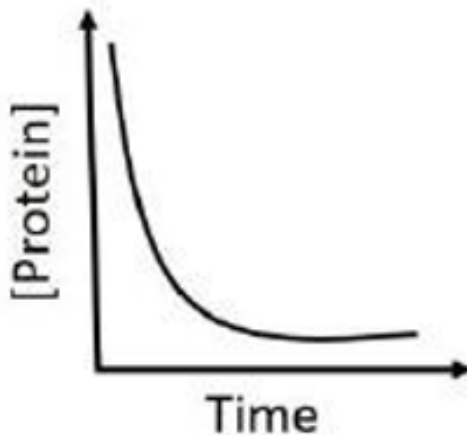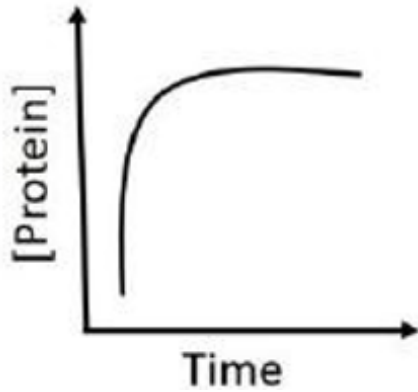

a)
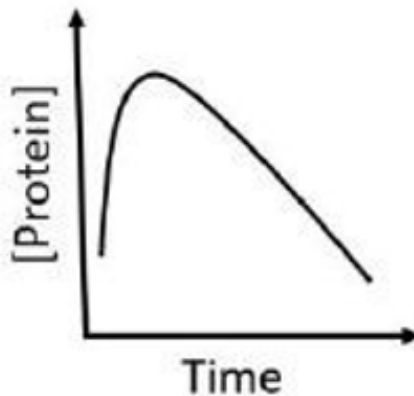
b)

c)

d)

(GATE BT 2017)

26) The angle (in degrees) between the vectors $\mathbf{x} = \hat{i} - \hat{j} + 2\hat{k}$ and $\mathbf{y} = 2\hat{i} - \hat{j} - 1.5\hat{k}$ is (GATE BT 2017)

27) Match the proteins in Group I with cellular processes in Group II.

Group I	Group II
P. p53	1. DNA packaging
Q. Lysozyme	2. Apoptosis
R. Tubulins	3. Hydrolysis of polysaccharides
S. Histones	4. Chromosome segregation

a) P-4, Q-2, R-3, S-1
b) P-2, Q-3, R-1, S-4
c) P-4, Q-3, R-1, S-2
d) P-2, Q-3, R-4, S-1

(GATE BT 2017)

28) Match the organisms in Column I with the characteristics in Column II.

Column I	Column II
P. *Methanococcus*	1. Halophile
Q. *Dunaliella*	2. Acidophile
R. *Sulfolobus*	3. Mesophile
S. *Escherichia*	4. Barophile

a) P-4, Q-3, R-2, S-1
b) P-3, Q-2, R-4, S-1
c) P-2, Q-1, R-4, S-3
d) P-4, Q-1, R-2, S-3

(GATE BT 2017)

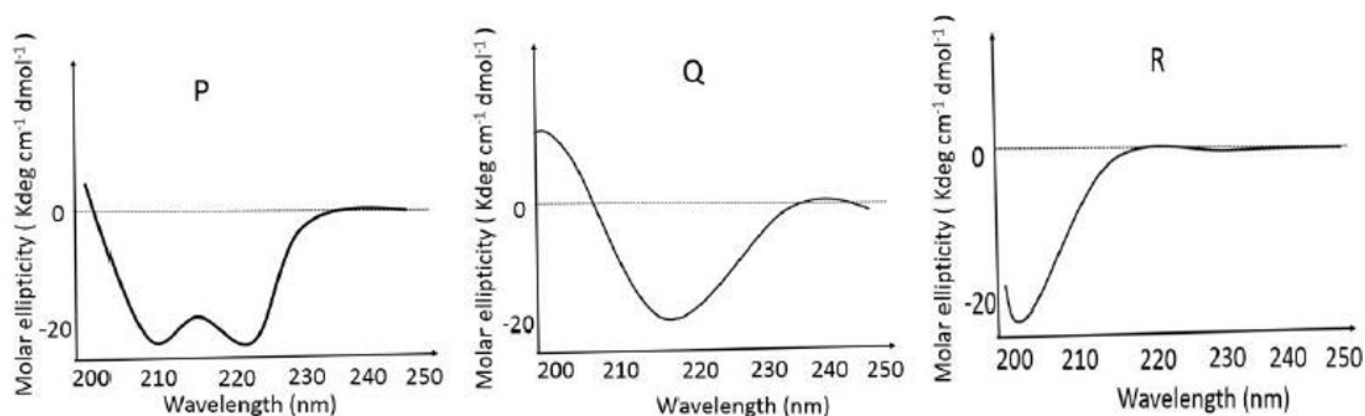29) secretory protiens synthesised by ER-associated ribosomes transverse through

Fig. 30. CD spectra of proteins P, Q, and R

    a) mitochondria
    b) peroxisomes
    c) the Golgi apparatus
    d) the nucleus

<div align="right">(GATE BT 2017)</div>

30) The circular dichroism spectra of three proteins P, Q, and R are shown below:
    Choose the correct combination.
    a) P: α-helix, Q: β-sheet, R: Random coil
    b) P: β-sheet, Q: α-helix, R: Random coil
    c) P: α-helix, Q: Random coil, R: β-sheet
    d) P: Random coil, Q: α-helix, R: β-sheet

31) Which one of the following amino acids has three ionizable groups?
    a) Glycine
    b) Leucine
    c) Valine
    d) Lysine

<div align="right">(GATE BT 2017)</div>

32) Consider an infinite number of cylinders. The first cylinder has a radius of 1 meter and height of 1 meter. The second one has a radius of 0.5 meter and height of 0.5 meter. Every subsequent cylinder has half the radius and half the height of the preceding cylinder. The sum of the volumes (in cubic meters) of these infinite number of cylinders is
    Given data: $\pi = 3.14$. <div align="right">(GATE BT 2017)</div>

33) The concentration (in micromolar) of NADH in a solution with $A_{340} = 0.50$ is
    Given data: Path length $= 1cm$; Molar extinction coefficient of NADH $\varepsilon_{340} = 6220\ M^{-1}\,cm^{-1}$. (GATE BT 2017)

34) The specific activity of an enzyme in a crude extract of *E. coli* is 9.5 units/mg of protein. The specific activity increased to 68 units/mg of protein upon ion-exchange chromatography. The fold purification is <div align="right">(GATE BT 2017)</div>

35) Which one of the following organisms is responsible for crown gall disease in plants?
    a) Xanthomonas campestris
    b) Rhizobium etli
    c) Agrobacterium tumefaciens
    d) Erwinia stewartii

36) In eukaryotes, cytokinesis is inhibited by

   a) cytochalasin D
   b) vinblastine
   c) nocodazole
   d) colchicine

37) The value of c for which the following system of linear equations has an infinite number of solutions is _____.

$$\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix} \mathbf{x} = \begin{bmatrix} c \\ 4 \end{bmatrix}$$

38) Match the plant hormones in Column I with functions in Column II

   Column I   Column II
   P. Gibberellic acid 1. Seed and bud dormancy
   Q. Zeatin 2. Fruit ripening
   R. Ethylene 3. Delaying leaf senescence
   S. Abscisic acid 4. Regulation of plant height

   a) P-4, Q-3, R-2, S-1
   b) P-4, Q-2, R-3, S-1
   c) P-3, Q-1, R-2, S-4
   d) P-2, Q-1, R-4, S-3
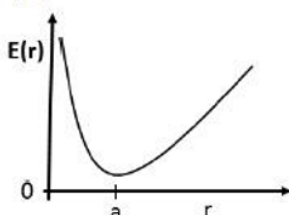
39) For an *E. coli* culture in the exponential phase of growth, optical density (OD_{540}) is 0.3 at 2 hours and 0.6 at 4 hours. Assuming that the measured OD is linearly proportional to the number of *E. coli* cells, the growth rate (per hour) for this culture is
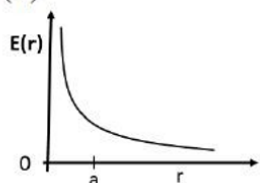
40) The interaction energy E between two spherical particles is plotted as a function of the distance r between them. When $r < a$, where a is a constant, the net force between the spherical particles is repulsive. When $r \geq a$, they attract via van der Waals attraction. Which one of the following plots correctly represents the interaction energy between the above two particles?
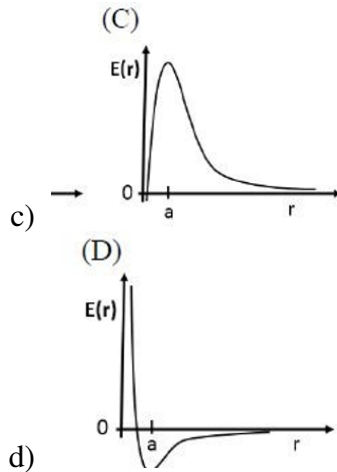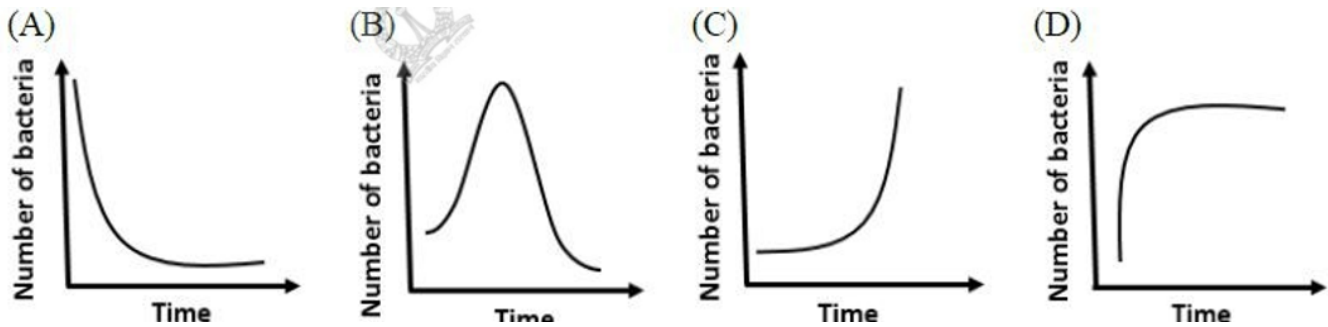
(A)

a)

(B)

b)

(A)

Number of bacteria

Time

(B)

Number of bacteria

Time

(C)

Number of bacteria

Time

(D)

Number of bacteria

Time

(C)

E(r)

0

a

r

c)

(D)

E(r)

0

a

r

d)

41) The genome is diploid at the end of which phases of a human mitotic cell cycle?

a) G2 & S
b) G1 & M
c) M & S
d) G1 & G2

(GATE BT 2017)

42) An immunocompetent person becomes infected with a pathogenic strain of bacteria. Which one of the following graphs correctly depicts bacterial load in this person over time

(GATE BT 2017)

43) A recombinant protein is to be expressed under the control of the lac promoter and operator in a strain of *E. coli* having the genotype $lacI^+$ crp^+. Even in the absence of inducer IPTG, low levels of expression of the recombinant protein are seen (leaky expression). Which one of the following should be done to minimize such leaky expression?

a) Addition of lactose to the medium
b) Removal of all glucose from the medium
c) Addition of excess glucose to the medium
d) Addition of *allo*-lactose to the medium

(GATE BT 2017)

44) Shown below is a plasmid vector (P) and an insert (Q). The insert was cloned into the *BamHI* site of the vector. The recombinant plasmid was isolated and digested with *BamHI* or *XhoI*. The results from the digestion experiments are shown in (R).
Which one of the following explains the digestion results shown in (R)?

a) The insert did not ligate to the vector.
b) One copy of the insert ligated to the vector.
c) The insert ligated to the vector as two tandem copies.
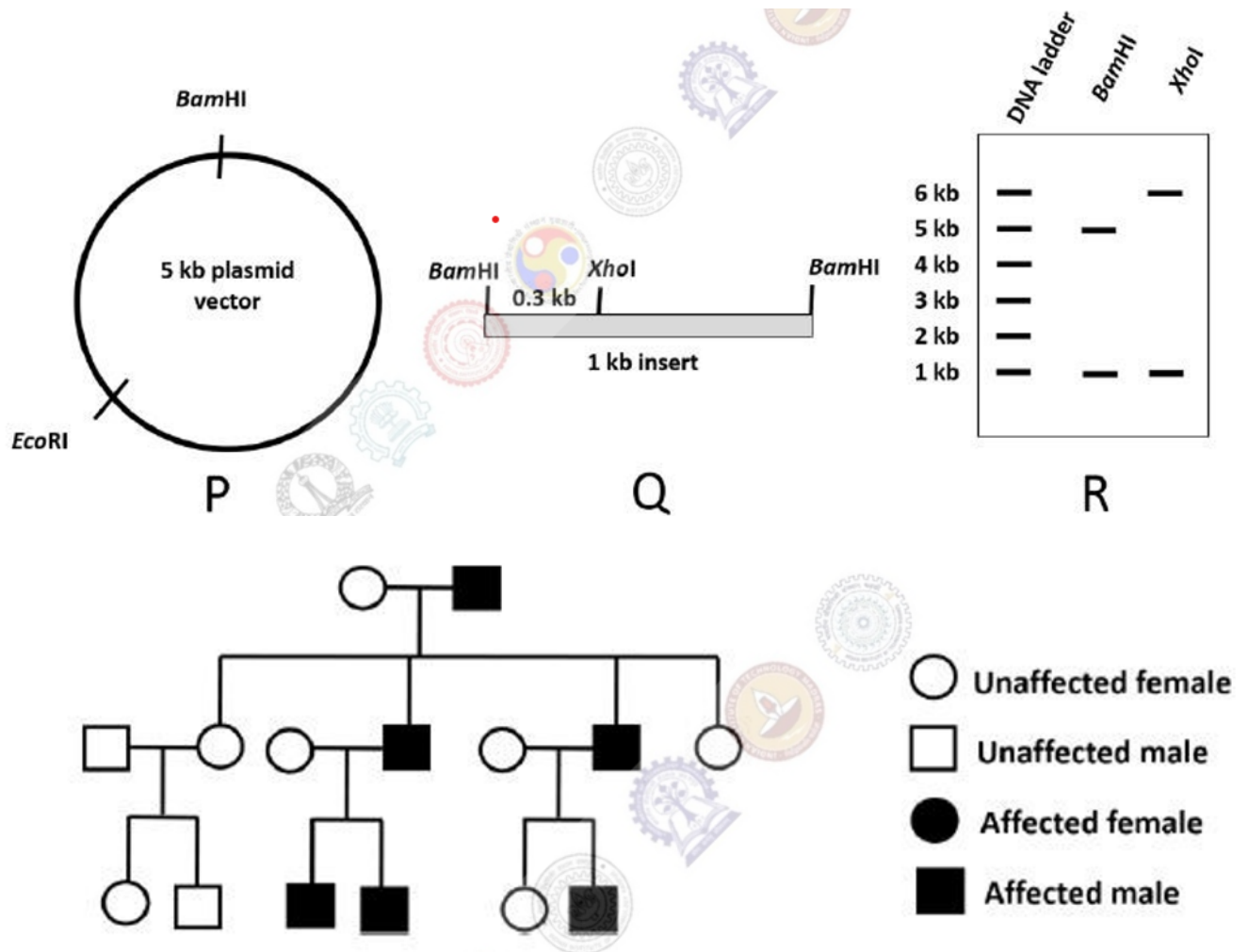d) The insert ligated to the vector as two copies but not in tandem.

Fig. 46. Pedigree for an inheritable disease.

(GATE BT 2017)

45) Which one of the following CANNOT be a recognition sequence for a Type II restriction enzyme?
   a) GAATTC
   b) AGCT
   c) GCGGCCGC
   d) ATGCCT

46) Which one of the given options is appropriate to fill the blank?
   a) starve
   b) reject
   c) feast
   d) deny

(GATE BT 2017)

47) A pedigree of an inheritable disease is shown in Fig. 46. This inheritable disease is
   a) X-linked dominant
   b) X-linked recessive or Y-linked
   c) only Y-linked
   d) only X-linked recessive

Fig. 51. Map of *EcoRI* sites on a 10 kb fragment

(GATE BT 2017)

48) If the chemical composition of proteins in an organism is $CH_{1.5}O_{0.3}N_{0.3}S_{0.004}$, the mass percentage of carbon in the proteins is
Given data: Atomic weights (Da) of C = 12, H = 1, O = 16, N = 14, and S = 32.

(GATE BT 2017)

49) For the probability density $P(x) = 0.5e^{-0.5x}$, the integral $\int_0^\infty P(x)\,dx$ is

(GATE BT 2017)

50) A zero-order liquid phase reaction $A \rightarrow B$ is being carried out in a batch reactor with $k = 10^{-3}$ mol/min. If the starting concentration of A is 0.1 moles/liter, the time (in minutes) taken by the system before A is exhausted in a 100 liter reactor is _____.

(GATE BT 2017)

51) *EcoRI* restriction sites on a 10 kb DNA fragment are shown below.
Upon partial digestion, what are the lengths (in kb) of all the possible DNA fragments obtained?
a) 2, 3, 4, 5, 6, 7, 8, and 10
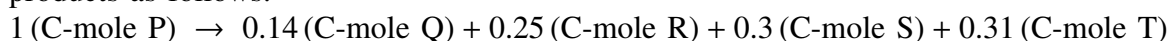b) 2, 3, 4, 5, 6, and 7
c) 2, 3, 4, and 7
d) 2 and 3

(GATE BT 2017)

52) A DNA strand of length 25 nm wraps diametrically around the circumference of a spherical histone–octamer once. The radius (in nm) of the histone–octamer is
Given data: $\pi = 3.14$. (GATE BT 2017)

53) One hundred *E. coli* cells are each infected by a single λ phage particle. The ratio of the number of phage particles committing to lysogeny to those committing to lysis is 4 : 1. Assuming that the average burst size is 80, the number of free phage particles released after one round of infection is (GATE BT 2017)

54) During anaerobic growth, an organism converts glucose (P) into biomass (Q), ethanol (R), acetalde-hyde (S), and glycerol (T). Every mole of carbon present in glucose gets distributed among the products as follows:
$1\,(\text{C-mole P}) \rightarrow 0.14\,(\text{C-mole Q}) + 0.25\,(\text{C-mole R}) + 0.3\,(\text{C-mole S}) + 0.31\,(\text{C-mole T})$
From 1800 grams of glucose fed to the organism, the ethanol produced (in grams) is
Given data: Atomic weights (Da) of $C = 12$, $H = 1$, $O = 16$, and $N = 14$.

(GATE BT 2017)

55) Which of the following conditions promote the development of human autoimmune disorders?
P. Inability to eliminate self-reactive lymphocytes Q. Generation of auto-antibodies R. Ability to eliminate self-reactive T-cells S. Induction of regulatory T-cells in the thymus

a) (A) P, R
b) (B) Q, S
c) (C) P, Q
d) (D) R, S

56) She has a sharp tongue and it can occasionally turn _ _ _
   a) hurtful
   b) left
   c) methodical
   d) vital

57) I _ _ _ made arrangements had I _ _ _ informed earlier.
   a) could have, been
   b) would have, being
   c) had, have
   d) had been, been

58) In the summer, water consumption is known to decrease overall by 25%. A Water Board official states that in the summer household consumption decreases by 20%, while other consumption increases by 70%.
   Which of the following statements is correct?
   a) The ratio of household to other consumption is 8/17
   b) The ratio of household to other consumption is 1/17
   c) The ratio of household to other consumption is 17/8
   d) There are errors in the official's statement.

59) 40% of deaths on city roads may be attributed to drunken driving. The number of degrees needed to represent this as a slice of a pie chart is
   a) 120
   b) 144
   c) 160
   d) 212

60) Some tables are shelves. Some shelves are chairs. All chairs are benches. Which of the following conclusions can be deduced from the preceding sentences? i . Atleast one bench is a table ii . Atleast one shelf is a bench iii. Atleast one chair is a table iv . All benches are chairs
   a) Only i
   b) Only ii
   c) Only ii and iii
   d) Only iv

61) If you are looking for a history of India, or for an account of the rise and fall of the British Raj, or for the reason of the cleaving of the subcontinent into two mutually antagonistic parts and the effects this mutilation will have in the respective sections, and ultimately on Asia, you will not find it in these pages; for though I have spent a lifetime in the country, I lived too near the seat of events, and was too intimately associated with the actors, to get the perspective needed for the impartial recording of these matters
   Here, the word antagonistic is closest in meaning to

a) impartial
b) argumentative
c) separated
d) hostile

62) S, T, U, V, W, X, Y, and Z are seated around a circular table. Ts neighbours are Y and V. Z is seated third to the left of T and second to the right of S. Us neighbours are S and Y; and T and W are not seated opposite each other. Who is third to the left of V?

a) X
b) W
c) U
d) T

63) Trucks (10 m long) and cars (5 m long) go on a single lane bridge. There must be a gap of at least 20 m after each truck and a gap of at least 15 m after each car. Trucks and cars travel at a speed of 36 km/h. If cars and trucks go alternately, what is the maximum number of vehicles that can use the bridge in one hour?

a) 1440
b) 1200
c) 720
d) 600

64) There are 3 Indians and 3 Chinese in a group of 6 people. How many subgroups of this group can we choose so that every subgroup has at least one Indian?

a) 56
b) 52
c) 48
d) 44

65) A contour line joins locations having the same height above the mean sea level. The following is a contour plot of a geographical region. Contour lines are shown at 25 m intervals in this plot. The path from P to Q is best described by

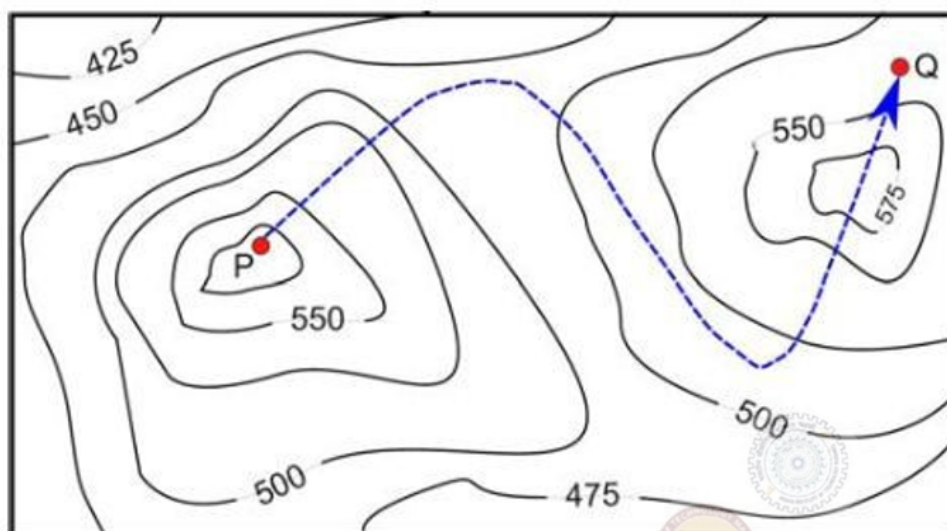a) Up–Down–Up–Down
b) Down–Up–Down–Up
c) Down–Up–Down
d) Up–Down–Up

Fig. 65. Contour plot showing the path from P to Q