

# 51

QUESTION PAPER  
SERIES CODE

## A

Registration No. :

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Centre of Exam. :

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Name of Candidate :

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Signature of Invigilator

**ENTRANCE EXAMINATION, 2016**

Pre-Ph.D./Ph.D. BIOTECHNOLOGY

[ Field of Study Code : SBTP (168) ]

Time Allowed : 3 hours

Maximum Marks : 70

### 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 **BALLPOINT PEN** only against each question in the corresponding circle.
- (iv) Part—A consists of 30 questions and all are compulsory.
- (v) Part—B contains 70 questions. **Answer any 40 questions.**  
In case any candidate answers more than the required 40 questions, the first 40 questions attempted will be evaluated.
- (vi) Each correct answer carries 1 mark. **There will be negative marking and ½ mark will be deducted for each wrong answer.**
- (vii) Answer written by the candidates inside the Question Paper will not be evaluated.
- (viii) Simple Calculators and Log Tables may be used.
- (ix) Page at the end has been provided for Rough Work.
- (x) 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 ● (b) (c) ●	Wrong ⊗ (b) (c) (d)	Wrong ⊗ (b) (c) ⊗	Wrong ● (b) (c) ●	Correct (a) (b) (c) ●
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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.**



**PART--A**

Answer **all** questions

1. The amount of heat evolved when  $500 \text{ cm}^3$  of  $0.1 \text{ M HCl}$  is mixed with  $200 \text{ cm}^3$  of  $0.2 \text{ M NaOH}$  is
- (a) 1.345 kJ
  - (b) 2.292 kJ
  - (c) 3.394 kJ
  - (d) 2.712 kJ
2. You wish to determine the concentration of haemoglobin in a blood sample by spectrophotometry. You first create a standard curve of the absorbance at 412 nm of several solutions of known haemoglobin concentrations. The data for the standard curve is shown below :

<i>Absorbance (412 nm)</i>	<i>Concentration of standard solution (<math>\mu\text{g/ml}</math>)</i>
0.069	1
0.113	2
0.201	4
0.730	16

What is the concentration (in  $\mu\text{g/ml}$ ) of haemoglobin in your sample if the absorbance obtained at 412 nm was 0.303?

- (a) 2.51  $\mu\text{g/ml}$
  - (b) 9.27  $\mu\text{g/ml}$
  - (c) 3.61  $\mu\text{g/ml}$
  - (d) 6.31  $\mu\text{g/ml}$
3. Generally enzymes and proteins have
- (a) polyester bonds
  - (b) polycarbonyl bonds
  - (c) polycarboxyl bonds
  - (d) polycarboxamide bonds

4. Formaldehyde reacts with  $\text{CH}_3\text{MgI}$  to yield
- (a) ethanol
  - (b) isopropyl alcohol
  - (c) acetone
  - (d) *t*-butyl alcohol
5. The minimum set of contrasting characters needed to discover Mendel's three laws of inheritance is
- (a) seven
  - (b) four
  - (c) two
  - (d) one

6. Match the following and choose the right answer from the options provided :

*Column—I*

*Column—II*

- |                         |                              |
|-------------------------|------------------------------|
| A. Down syndrome        | 1. Additional sex chromosome |
| B. Cri-du-chat syndrome | 2. 5 p (-)                   |
| C. Klinefelter syndrome | 3. Absence of sex chromosome |
| D. Turner's syndrome    | 4. Trisomy of chromosome 21  |
- 
- (a) A    B    C    D  
      1    3    2    4
  - (b) A    B    C    D  
      2    1    3    4
  - (c) A    B    C    D  
      3    2    4    1
  - (d) A    B    C    D  
      4    2    1    3

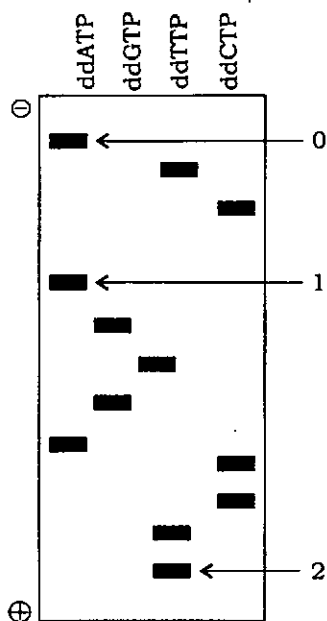
7. Most of the ATPs produced during aerobic respiration comes from
- (a) glycolysis
  - (b) Krebs cycle
  - (c) oxidative phosphorylation
  - (d) Calvin cycle

8. Endoplasmic reticulum (ER) is the site of all of the following, **except**
- (a) drug detoxification by means of mixed function oxidases
  - (b) hydrolytic activities carried out by acid hydrolases
  - (c) N-linked glycosylation of newly formed polypeptides
  - (d)  $\text{Ca}_2^+$  storage in muscle tissues
9. Sodium dodecyl sulphate (SDS) is commonly used in polyacrylamide gel electrophoresis experiment of a mixture of proteins to separate them in the gel by giving them a uniform negative charge. SDS works by binding to
- (a) positively charged side chains
  - (b) negatively charged side chains
  - (c) hydrophobic side chains
  - (d) hydrophilic side chains
10. The value of equilibrium constant for the hydrolysis of ATP to form ADP and inorganic phosphate was found to be  $16.66 \times 10^4$ . The free energy change for the hydrolysis reaction in kcal/mol would be
- (a) -3
  - (b) -5
  - (c) -7
  - (d) -9
11. In *E. coli*, the inability of the lac repressor to bind to an inducer would result in
- (a) no substantial synthesis of  $\beta$ -galactosidase
  - (b) constitutive synthesis of  $\beta$ -galactosidase
  - (c) inducible synthesis of  $\beta$ -galactosidase
  - (d) synthesis of inactive  $\beta$ -galactosidase

12. What event of DNA viral life cycle distinguishes 'early' from 'late' gene expression?
- (a) Expression of non-structural proteins
  - (b) Expression of capsid proteins
  - (c) Replication of viral genome
  - (d) Cleavage of viral genome
13. Unique among viral pathogens of liver that shares several characteristics with both plant viroids and viroid like satellite RNA is
- (a) hepatitis A virus
  - (b) hepatitis B virus
  - (c) hepatitis C virus
  - (d) hepatitis D virus
14. Information, which is **not** encoded in a viral genome, is
- (a) modulation of host defenses
  - (b) spreading to other cells from hosts
  - (c) sugar and lipid metabolism
  - (d) regulation and kinetics of the replication
15. A chronic HIV infected patient on HAART has an elevated level of D-dimer, C-reactive protein, LPS and IL-1 $\beta$ . What could be the most common reason for this inflammatory state?
- (a) High HIV viral load
  - (b) Low CD4 count
  - (c) Toxicity due to antiretroviral drugs
  - (d) Microbial translocation

16. Which of the following statements is correct?
- (a) The TCR  $\alpha\beta$  chains transduce a signal into a T cell
  - (b) A cell depleted of its CD4 molecule would be unable to recognize antigen
  - (c) T cells with fully rearranged  $\alpha\beta$  chains are not found in the thymus
  - (d) Immature CD4+CD8+T cells form the majority of T cells in the thymus
17. The cluster of differentiation protein CD4 is found on the surface of several immune cells. The CD4 protein
- (a) binds directly to peptide antigen
  - (b) binds to an invariant portion of MHC class I molecules
  - (c) binds to an invariant portion of MHC class II molecules
  - (d) binds to CD8 on the T-cell surface
18. If  $y$  is expressed in terms of a variable  $x$  as  $y = f(x)$ , then  $y$  is called
- (a) implicit function
  - (b) explicit function
  - (c) identity function
  - (d) linear function
19. A number  $X$  is chosen at random from the numbers  $-3, -2, -1, 0, 1, 2, 3$ . What is the probability that  $|X| < 2$ ?
- (a)  $3/7$
  - (b)  $1/3$
  - (c)  $5/7$
  - (d)  $3/5$
20. If the order of matrix  $A$  is  $m \times p$  and the order of  $B$  is  $p \times n$ , then the order of  $AB$  is
- (a)  $n \times p$
  - (b)  $m \times n$
  - (c)  $n \times m$
  - (d)  $m \times p$

21. MEME and Weeder are bioinformatics tools specialized for finding
- sequence alignments
  - structure alignments
  - motifs
  - network hubs
22. One of the major limitations of ENCODE data set is that
- data were taken from an inhomogeneous population of cells with genomic instability
  - incomplete data was pooled
  - incorrect annotation methods were used
  - it contains too much redundant data from *E. coli*
23. The figure below shows the results of a DNA sequencing experiment performed with the dideoxy method. An in vitro DNA synthesizing reaction was set up. The mixture contained many identical copies of a short DNA fragment as template molecules and many identical copies of a primer complementary to a region of one strand of the DNA. The mixture was heated at 100 °C and then slowly cooled :



Which of the following DNA sequences one can derive from this figure?

- The sequence of the newly synthesized product is 5'-primer-ATCAGTGACCTT-3'
- The sequence of the newly synthesized product is 5'-ATCAGTGACCTT-primer-3'
- The sequence of the newly synthesized product is 5'-primer-TTCCAGTGACTA-3'
- The sequence of the template is 5'-ATCAGTGACCTT-3'



24. Genes for cytoplasmic male sterility in plants are generally located in

- (a) chloroplast genome
- (b) cytosol
- (c) nuclear genome
- (d) mitochondrial genome

25. Agar-agar frequently used in the lab is obtained from

- (a) gelidium
- (b) laminaria
- (c) polysiphonia
- (d) sponges

26. In a turgid cell, which of the following would be equal to zero?

- (a) Turgor pressure
- (b) Suction pressure
- (c) Osmotic pressure
- (d) Wall pressure

27. If the transmittance is 50.8% in a 1 cm cuvette, then what will be the absorbance in 2 cm cuvette?

- (a) 0.588
- (b) 0.294
- (c) 0.144
- (d) 0.508

28. Calculate the pH of a buffer solution made from 0.20 (M)  $\text{HC}_2\text{H}_3\text{O}_2$  and 0.50 (M)  $\text{C}_2\text{H}_3\text{O}_2$  that has an acid dissociation constant for  $\text{HC}_2\text{H}_3\text{O}_2$  of  $1.8 \times 10^{-5}$ .
- (a) 4.8
- (b) 5.1
- (c) 5.4
- (d) 5.6
29. 400 J heat is required to raise the temperature of one mole of ideal gas by 10 K, when heated at a constant pressure. The change in the internal energy is equal to ( $R = 8.3 \text{ J/mole K}$ )
- (a) 200 J
- (b) 483 J
- (c) 317 J
- (d) 383 J
30. A 10 ml protein solution after 50 fold dilution gave an absorbance of 0.4 in a 1 cm cuvette at 280 nm. Its molar extinction coefficient is given by  $64000 \text{ M}^{-1} \text{ cm}^{-1}$ . Find out the approximate concentration of the stock solution.
- (a) 0.31 M
- (b) 0.31 mM
- (c) 3.1 mM
- (d) 31 mM

**PART—B**

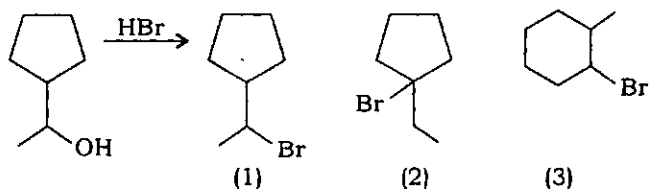
Answer *any forty* questions

31. Phototropic curvature is the result of uneven distribution of
- (a) photosynthetic apparatus
  - (b) cytokinins
  - (c) auxins
  - (d) gibberellins
32. The transport of food material in higher plants takes place through
- (a) companion cells
  - (b) sieve elements
  - (c) tracheids
  - (d) transfusion tissues
33. The enzyme that catalyzes carbon dioxide fixation in C<sub>4</sub> plants is
- (a) RuBP carboxylase
  - (b) carbonic anhydrase
  - (c) carboxydismutase
  - (d) PEP carboxylase
34. The first plant-produced human biologics 'Eleyso' that is approved by US Food and Drug Administration, for the treatment of type 1 Gaucher's disease, is
- (a) an enzyme
  - (b) an antibody
  - (c) a carbohydrate polymer
  - (d) miRNA
35. Moving from pith to bark of the tree, which of the following will you encounter first?
- (a) Phloem
  - (b) Oldest secondary xylem
  - (c) Cork cambium
  - (d) Intrafascicular cambium

36. Which of the following have unevenly thickened walls and if stretched they are capable to retain the new shape after stretching pressure is released?

- (a) Chlorenchyma
- (b) Parenchyma
- (c) Sclerenchyma
- (d) Collenchyma

37. Predict the product(s) for the following reaction :



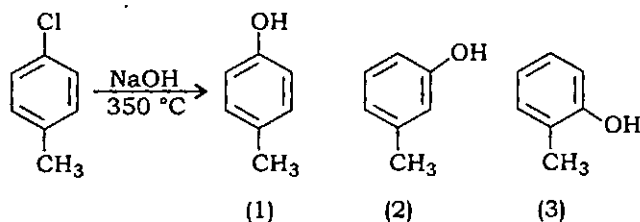
- (a) 1 and 2 only
- (b) 1 and 3 only
- (c) 2 and 3 only
- (d) 1 only

38. The enol content of  $\text{CH}_3\text{COCH}_2\text{CO}_2\text{Et}$  in hexane is much higher (100 times) than that is in water.

The reason for the above observation is

- (a) intermolecular hydrogen bonding is stabilized by hexane
- (b) intramolecular hydrogen bonding is stabilized by water
- (c) intramolecular hydrogen bonding is destabilized by water
- (d)  $\text{CH}_3\text{COCH}_2\text{CO}_2\text{Et}$  dissolves in hexane completely

39. Identify the product(s) of the following transformation :



- (a) 1 and 2 only
- (b) 1 and 3 only
- (c) 2 and 3 only
- (d) 1 only

40. A functional group  $X$  (where  $X$  can be F, Cl, Br or I) is known to affect the NMR spectrum in terms of changes in 'chemical shift' values. For a molecule  $\text{CH}_3X$ , the chemical shift for its proton NMR would be in the order
- (a)  $\text{CH}_3\text{F} > \text{CH}_3\text{Cl} > \text{CH}_3\text{Br} > \text{CH}_3\text{I}$
  - (b)  $\text{CH}_3\text{Cl} > \text{CH}_3\text{F} > \text{CH}_3\text{Br} > \text{CH}_3\text{I}$
  - (c)  $\text{CH}_3\text{Cl} > \text{CH}_3\text{F} > \text{CH}_3\text{I} > \text{CH}_3\text{Br}$
  - (d)  $\text{CH}_3\text{I} > \text{CH}_3\text{Br} > \text{CH}_3\text{Cl} > \text{CH}_3\text{F}$
41. Friedel-Crafts alkylation proceeds in the presence of
- (a) HCl
  - (b)  $\text{HNO}_3$
  - (c)  $\text{H}_2\text{O}_2$
  - (d)  $\text{H}_2\text{SO}_4$
42. Calculate the ratio between the protonated and deprotonated forms of the histidine side chain at pH 7.2 (the protonated form has a  $\text{p}K_a$  of 6.04).
- (a) 10
  - (b) 13.5
  - (c) 19.2
  - (d) 14.5
43. A concentrated ribonuclease solution was diluted 100 times with a buffer at pH 7 and the resulting solution gave an absorbance of 0.362 in a UV spectrometer at 280 nm using a 1 cm path length quartz. Given the extinction coefficient of ribonuclease is 2.64 ml/mg cm and molecular weight is 13.7 kDa, the concentration of the protein in millimolar units would be
- (a) 10
  - (b) 7
  - (c) 1
  - (d) 0.1

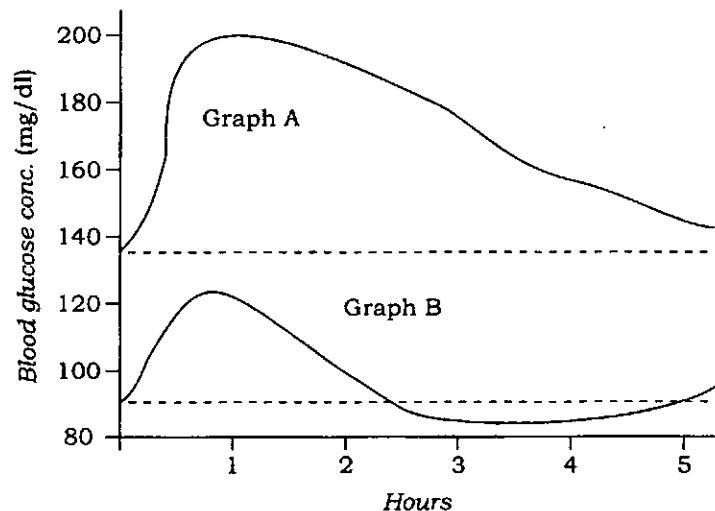
44. Amylo-1,6-glucosidase is called

- (a) branching enzyme
- (b) debranching enzyme
- (c) glucantransferase
- (d) phosphorylase

45. The Ramachandran plot is a

- (a) phi-psi correlation plot
- (b) phi-psi regression plot
- (c) phi-psi scatter plot
- (d) phi-psi energy plot

46. The figure below indicates fasting blood glucose level after oral administration of 1 g of glucose/kg body weight in a person :



From this figure, select one of the correct options.

- (a) Graph B indicates non-insulin dependent diabetes type I condition
- (b) Graph A indicates diabetes condition
- (c) Graph A indicates normal condition
- (d) Graph B indicates insulin dependent diabetes type I condition

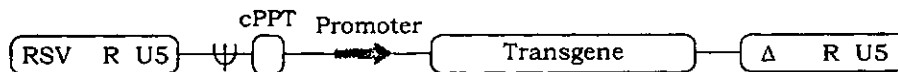
47. A therapeutic small molecule (*A*) has a  $pK_a$  of 6.5. It is absorbed into the bloodstream through the cells lining the stomach and small intestine. Rate of absorption across the plasma membrane is determined by the polarity of the molecule. The pH of the stomach contents is about 1.5 and the pH of the contents of the small intestine is about 6. More *A* will be absorbed into the bloodstream from the
- (a) stomach
  - (b) small intestine
  - (c) equally in both organs
  - (d) Will not absorb in both organs
48. In a microbiology lab, a new membrane protein *X* was discovered in high concentration in an obligate anaerobe. To provide a visual proof for membrane localization of the protein *X*, researcher tagged the gene with GFP. They could not detect fluorescence signal after expression of the protein *X* in the obligate anaerobe. Identify the most likely reason for not detecting the GFP signal.
- (a) GFP fluorophore centre is not matured
  - (b) GFP concentration is low
  - (c) Bacteria is not transformed
  - (d) GFP is degraded
49. If amino acids present in a protein have a random stereochemistry at  $C\alpha$  position instead of the same stereochemistry, such a protein will be
- (a) hyperactive
  - (b) inactive
  - (c) large aggregated
  - (d) During translation protein chain will not elongate
50. How do picornaviruses regulate their gene expression at translation level in order to gain advantage in expression of their own genes over host?
- (a) Alternative open-reading frames
  - (b) Alternative translation initiation codons
  - (c) Alteration of translation on ribosome from cap dependent to independent
  - (d) Ribosomal frameshifting

51. Given below are four transgene constructs made for the production of different viral vectors. Mark the wrong construct which **cannot** be used for that specific viral vector construction.

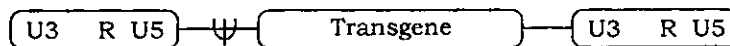
(a) Adenoviral vector



(b) Lentiviral vector



(c) Retroviral vector



(d) Self-inactivating retroviral vector



52. *E. coli* cell is infected with T7 bacteriophage which has linear dsDNA genome. If drug rifampicin which is an inhibitor of host RNA polymerase is added in the middle of T7 bacteriophage "delayed early gene expression", what would be the result?

- (a) "Delayed early viral gene expression" will be shut off
- (b) Late viral gene expression will be shut off
- (c) Leads to host cell lysis
- (d) Replication cycle of phage T7 continues and produces progeny particles

53. Each year around the world there are discussions about new formulations of the vaccine for influenza A virus. Why?

- (a) Mutations occur mainly in the envelope proteins, hemagglutinin and neuraminidase
- (b) The half-life of the vaccine is a few months and degrades quickly in host cells
- (c) The hemagglutinin envelope protein changes but not the neuraminidase protein
- (d) Mutations predominantly take place in the matrix protein that interacts with the host cell receptor



54. Which of the following statements regarding T cells activated by specific antigen is incorrect?
- (a) They receive costimulatory signals through CD28
  - (b) They suppress expression of sphingosine-1-phosphate (S1P)
  - (c) They take days before differentiating into effector T cells
  - (d) They begin to express CTLA4, which serves to limit T-cell proliferation
55. People who cannot produce a complete \_\_\_\_\_ protein, resist HIV infection.
- (a) CD8
  - (b) CCR5
  - (c) cytotoxin
  - (d) AIDS
56. All of the following describe mechanisms that influence tolerance to self-antigens, **except**
- (a) induction of energy in peripheral circulation of T and B cells
  - (b) induction of tissue-specific protein expression in the thymus
  - (c) exclusion of T and B cells from tissues protected by immunological privilege
  - (d) negative selection of T cells in the peripheral circulation
57. Which of the following is a transmembrane glycoprotein that serves as a coreceptor for the T-cell receptor (TCR), and is also known as a cytotoxic T cell (CTC)?
- (a) Cluster of differentiation 8 (CD8)
  - (b) Cluster of differentiation 4 (CD4+)
  - (c) Plasma cells (activated B cells)
  - (d) Monocytes
58. Cells of immune system that cause pore formation in the antigen are
- (a) helper T cells
  - (b) killer T cells
  - (c) suppressor T cells
  - (d) B cells

59. To direct a nuclease to a statistically unique DNA sequence in human macrophages, it must be able to recognize a sequence that is at least
- (a) 7 base pairs long
  - (b) 16 base pairs long
  - (c) 39 base pairs long
  - (d) 29 base pairs long
60. A straight line passes through the points (1, 2) and (3, 1). What is its slope and  $y$ -intercept?
- (a)  $-1/2, -5/2$
  - (b)  $1/2, -5/2$
  - (c)  $-1/2, 5/2$
  - (d)  $1/2, 5/2$
61. The two roots of the equation  $6x^2 + 11x - 35 = 0$  are
- (a)  $-7/2, 5/3$
  - (b)  $7/2, -5/3$
  - (c)  $7/2, 5/3$
  - (d)  $-7/2, -5/3$
62. The determinant of the matrix

$$\begin{bmatrix} 12 & 20 & 16 \\ 2 & 4 & 3 \\ 6 & 10 & 8 \end{bmatrix}$$

is

- (a) 192
- (b) 200
- (c) 1
- (d) 0

63. The numerical value used as a summary measure for a sample, such as sample mean, is known as a
- (a) population parameter
  - (b) sample parameter
  - (c) sample statistic
  - (d) population mean
64. Since the mode is the most frequently occurring data value, it
- (a) may be larger than the mean
  - (b) is always larger than the median
  - (c) is always larger than the mean
  - (d) must have a value below the mean
65. The stages of a malignant disease (cancer) were recorded using the symbols 0, I, II, III and IV. These symbols denote which one of the following scales?
- (a) Alphanumeric
  - (b) Numerical
  - (c) Ordinal
  - (d) Nominal
66. If the average of a series of values is 10 and their variance is 4, then the coefficient of variation (the ratio of standard deviation and average) is
- (a) 40%
  - (b) 20%
  - (c) 80%
  - (d) 10%

67. The confidence interval for the mean, calculated for a series of values, has which one of the following interpretations?
- (a) The true mean, the one that approximates the population's mean, is almost certain inside the confidence interval
  - (b) The true variance is almost certain inside the confidence interval
  - (c) The true median is almost certain inside the confidence interval
  - (d) It is an interval that contains almost all the values of the series
68. Which of the following tools is used to search protein database using a translated nucleotide query?
- (a) tBLASTn
  - (b) tBLASTx
  - (c) BLASTx
  - (d) BLASTn
69. Of the following tools, pick up the odd one.
- (a) PAML
  - (b) PHYLIP
  - (c) PAUP
  - (d) PHYLEMON
70. In bioinformatics, what does the letter E denote in E-value?
- (a) Expectation value
  - (b) Expectant value
  - (c) Exponential value
  - (d) Expert value
71. Sets of genes related by duplication within a genome are called
- (a) orthologs
  - (b) interlogs
  - (c) paralogs
  - (d) intralogs

72. Which of the following methods is best suited for quantitative modelling of gene expression?
- (a) ODE
  - (b) Stochastic
  - (c) Rule based
  - (d) Boolean
73. One of the major limitations of computational systems biology is that
- (a) models cannot effectively capture emergent properties
  - (b) models do not abstract gene expression events
  - (c) models of cell-cell interactions are missing
  - (d) models often lead to false results
74. The April 2014 issue of Science journal published a landmark paper in synthetic biology. The paper described chemical synthesis of a functional chromosome of which of the following organisms?
- (a) *S. cerevisiae*
  - (b) *D. melanogaster*
  - (c) *H. sapiens*
  - (d) *C. elegans*
75. The term 'synthetic biology' denotes
- (a) chemical biology
  - (b) modelling of biological networks
  - (c) construction of biological systems
  - (d) annotation of networks

76. A molecular connectivity map of glycolysis was constructed in the wild type and mutant human cells. Which of the following methods is best suited for studying the flux of metabolites?
- (a) Boolean
  - (b) ODE
  - (c) Petri Net
  - (d) Cellular automata
77. In an ideal CSTR of volume 1 litre at steady state, the feed rate is 500 ml/hr of 10 gm/l glucose. Given, maximum specific growth rate =  $1 \text{ h}^{-1}$  and  $Y_{x/s}$  (biomass yield coefficient) = 0.5 g/g. If the outlet biomass concentration is 4 g/l, then  $K_s$  equals
- (a) 1 g/l
  - (b) 3 g/l
  - (c) 2 g/l
  - (d) 0.5 g/l
78. If the product formation kinetics is given by  $1/x(dp/dt) = q_p = \beta$  (a constant) and the product concentration in a CSTR at steady state is found to be 1 g/l with the biomass concentration = 5 g/l at a dilution rate of  $0.2 \text{ h}^{-1}$ . If the biomass concentration declines to 4 g/l at a dilution rate of  $0.4 \text{ h}^{-1}$ , then the expected product concentration will be
- (a) 0.2 g/l
  - (b) 0.4 g/l
  - (c) 0.8 g/l
  - (d) 1 g/l
79. In a reactor with air sparging and constant agitation rate (hence constant  $kLa$ ), the dissolved oxygen (DO) falls from an initial value of 70% to 30%. If the biomass in the same time period increases fourfold, then the specific growth rate of the cells
- (a) falls to half its earlier value
  - (b) remains the same
  - (c) doubles
  - (d) increases fourfold

80. If the exit gas composition in a bioreactor remains constant for a long time period (no change in outlet oxygen and carbon dioxide concentration), we can say that
- (a) specific growth rate is constant
  - (b) doubling time is constant
  - (c) cells are healthy and stable
  - (d) the specific growth rate falls in proportion to the increase in biomass
81. Yeast cells grow anaerobically on glucose to produce biomass and ethanol. The enthalpy efficiency of this process
- (a) can be estimated to be approximately 0.4
  - (b) can be estimated to be approximately 0.6
  - (c) can be estimated to be close to 1
  - (d) depends on the fraction of ethanol produced
82. NMR signal mainly depends on
- (a) electronegativity of nearby atoms
  - (b) hydrogen bonds of the molecules
  - (c) charge of the atoms
  - (d) mass of the molecules
83. MALDI is *not* suitable for
- (a) <300 Da molecule
  - (b) <300 kDa molecule
  - (c) dimer protein
  - (d) DNA
84. Why is histidine frequently found in protein-active sites?
- (a) It can form a hydrogen bond
  - (b) It can form van der Waals' interactions
  - (c) It is a hydrophobic amino acid
  - (d) Histidine has  $pK_a$  near neutral pH

85. When quantifying proteins from an MS experiment, how do you work out what level a change is likely to be due to biology, and *not* experimental or technical variation?
- (a) Use 3-fold as a generic cut-off
  - (b) Use pathway analysis software
  - (c) Look in the literature to understand the experience of other labs
  - (d) Analyze replicates to measure experimental noise
86. What is a 'proteotypic' peptide?
- (a) A post-translationally modified peptide
  - (b) A stable isotope-containing peptide
  - (c) A peptide which is unique to a specific protein
  - (d) A peptide which is typical of all other peptides in the sample
87. If you require a complex sample preparation workflow to enrich a particular population of proteins from cultured cells, an appropriate method of quantification would be what?
- (a) DiGE
  - (b) SILAC
  - (c) Selected reaction monitoring
  - (d) Label-free method
88. Isobaric tags are
- (a) molecules of equal charge
  - (b) molecules of equal mass
  - (c) fluorescent labels for proteins
  - (d) used in selected reaction monitoring



89. A good way to increase total proteome penetration by gel-free LC-MS/MS method is to
- (a) use two orthogonal types of chromatography
  - (b) enrich for phosphopeptides only
  - (c) analyze whole proteins
  - (d) label the proteins with a chemical tag
90. Which of the following is **not** correct in relation to the *lac* repressor involved in regulation of *lac* operon of *E. coli* ?
- (a) In the absence of inducer, the repressor binds more tightly to operator DNA than to non-specific DNA
  - (b) In the presence of inducer, the repressor binds more tightly to operator DNA than to non-specific DNA
  - (c) Mutations in the DNA binding domain are recessive
  - (d) Mutations in the tetramerization domain are recessive
91. The proteins synthesized, early during infection, from early mRNA of a lytic phage in a susceptible bacterial cells are required for
- (a) attachment of the phage to its host cell
  - (b) entry of the phage nucleic acid into the host cell
  - (c) replication of the phage nucleic acid
  - (d) lysis of the host cell
92. Which one of the following statements is correct?
- (a) Not all lytic phages bring about transduction
  - (b) Mutation in gene encoding RNAi results in uncontrolled replication and unlimited copy number
  - (c) Kil-kor system only helps in getting rid of plasmidless cells
  - (d) Cytidine deaminase encoded by T4 is an essential enzyme

93. Which of the following best describes the F and ColE1 plasmids respectively?
- (a) Conjugative, non-transmissible
  - (b) Conjugative, transmissible
  - (c) Self-transmissible, mobilizable
  - (d) Mobilizable, self-transmissible
94. Which of the following proteins serves as a repressor only in the presence of the small molecule indicated together?
- (a) Tet repressor/Tetracycline
  - (b) AraC protein/Arabinose
  - (c) *Trp* repressor/Tryptophan
  - (d) *Lac* repressor/IPTG
95. During the second step in RNA splicing
- (a) the upstream exon attacks the 3' exon-intron junction
  - (b) the U1snRNP binds to the branchpoint
  - (c) the branchpoint 2'-OH attacks the 5' intron-exon junction
  - (d) formation of the GpppG cap takes place
96. Bacteriophage lambda brings about specialized transduction of either biotin or gal genes from donor to recipient bacteria, as it gets integrated as a specific *int* site between the two. However, occasionally a generalized transducing phage grown on a wild-type biotin+donor, can bring about transduction as well. How would you select transductants of a biotin-requiring mutant recipient when infected with this generalized transducing phage?
- (a) Plate the phage preparation on the recipient host in soft agar to select plaques
  - (b) Generalized phages will never be able to transduce biotin gene
  - (c) Plate the phage-infected recipient cells on glucose plus biotin medium
  - (d) Plate the phage-infected recipient cells on glucose without biotin medium

97. A replicative transposon forms a cointegrate with the target DNA during transposition. The cointegrate is generally highly unstable. However, sometimes the cointegrate becomes stable and cannot come out of this state. This is due to the fact that
- (a) the host cells are defective in the resolvase enzyme
  - (b) the resolvase gene encoded by the transposon is defective
  - (c) both the resolvase enzymes encoded by the host chromosome and the transposon are defective
  - (d) a transposon defective in recombination/resolvase will never enter the cointegrate state
98. Which of the following will be most efficient and effective way to obtain a non-specific transcription from both the strands of a DNA molecule?
- (a) Enriching the extract with sigma factor
  - (b) Including the RNA holoenzyme in the reaction
  - (c) Using the core enzyme of RNA polymerase
  - (d) Including both the RNA holoenzyme and the core enzyme of RNA polymerase in the reaction
99. How would a mutation that inactivates the Shine-Dalgarno sequence in the *trp* leader affect expression of the *trp* operon?
- (a) Expression in high tryptophan would increase
  - (b) Expression in low tryptophan would increase
  - (c) Expression in high tryptophan would decrease
  - (d) Expression in low tryptophan would decrease
100. Which of the following repair systems **does not** require a DNA polymerase?
- (a) Photoreactivation of thymine dimers
  - (b) Error-prone repair
  - (c) Mismatch repair
  - (d) Excision repair

SPACE FOR ROUGH WORK

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