119

QUESTION PAPER SERIES CODE
A

Registration No. : | | | | | | |

Centre of Exam. : _____

Name of Candidate : _____

_____

Signature of Invigilator

COMBINED ENTRANCE EXAMINATION, 2017
M.Tech. BIOTECHNOLOGY

INSTRUCTIONS FOR CANDIDATES

The Question Paper consists of two Sections. Section—I is for those opting for Technology/Engineering Stream and Section—II is for those opting for Science Stream. Depending upon their backgrounds, candidates are required to **attempt** questions from **ONE of the Sections only.**

SECTION—I
TECHNOLOGY/ENGINEERING STREAM
(Part—A, Part—B, Part—C)
[Field of Study Code : MTB]

Time Allowed : 3 hours *Maximum Marks* : 120

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 organized and answers are valued as follows :

Part—A : Basic Engineering and Technology including Pharmacology (Marks : 45)
Answer any **45** questions out of 90 questions

Note : (In case any candidate answers more than the required 45 questions, the first 45 questions attempted will be evaluated)

Part—B : Physics, Chemistry and Mathematics (Marks : 40)
Answer **all** questions

Part—C : Fundamentals of Life Sciences and Informatics (Marks : 35)
Answer **all** questions

(iv) Each question carries *1* mark. **There will be negative marking and ¼ mark will be deducted for each wrong answer.**

(v) Answer the questions in the Answer Sheet provided separately by darkening the correct choice, i.e., (a) or (b) or (c) or (d) (as the case may be) against each question in the corresponding circle.

(vi) Answers 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 don't 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.**

SECTION—I

(TECHNOLOGY/ENGINEERING STREAM)

PART—A

(*Marks* : 45)

(Basic Engineering and Technology including Pharmacology)

Answer *any* **forty-five** questions

1. A pressure of 2×10^5 Pa will be equal to ____ height of Hg (density of Hg is $13{\cdot}6\ g/cm^3$).

(a) 1·5 m

(b) 1·5 mm

(c) 1·5 cm

(d) 2 m

2. Match the following :

	List—I	*List—II*
A.	$ND^2\rho/\mu$	1. Power number
B.	$P/(N^3D^5\rho)$	2. Froude number
C.	N^2D^3/ρ	3. Impeller Reynolds number
D.	N^2D/g	4. Weber number

	A	B	C	D
(a)	2	3	1	4
(b)	3	1	4	2
(c)	1	2	4	3
(d)	4	2	3	1

3. A furnace wall of thickness 1 m and of surface area 2 m^2 is made of a material whose thermal conductivity is 1 kJ/hr/m/°C. The temperatures of inner and outer surfaces of the wall are 1000 °C and 200 °C respectively. Heat flow through the wall in kJ/hr will be

(a) 2000

(b) 1600

(c) 1200

(d) 80

4. Half-life time ($t_{1/2}$) for a second-order reaction is

(a) independent of the concentration of reactant(s)

(b) proportional to the initial concentration of reactant(s)

(c) inversely proportional to the initial concentration of reactant(s)

(d) inversely proportional to the square of the initial concentration of reactant(s)

5. Widely used cryoprotectant additive for biopharmaceuticals is

(a) mannitol

(b) lactitol

(c) sorbitol

(d) xylitol

6. For reversible isobaric process with relationship PV^n = constant, the exponent n will be equal to

(a) 1

(b) −1

(c) 0

(d) 0·5

7. At what temperature, do the Celsius and Fahrenheit temperature scales intersect?

(a) −60 °C

(b) −40 °C

(c) −60 °F

(d) −40 °F

8. Which one of the following hormones present in urine of women is used to confirm pregnancy?

(a) Follicle stimulating hormone (FSH)

(b) Luteinizing hormone (LH)

(c) Human chorionic gonadotropin (hCG)

(d) Human menopausal gonadotropin (hMG)

9. Scoping marine impeller is primarily used for

(a) creating downward force

(b) reduction of foam formation

(c) improved mass transfer

(d) creating large interfacial surface area

10. Which reaction process can produce polyester?

(a) Addition polymerization of a dicarboxylic acid

(b) Condensation polymerization of a diol and a dicarboxylic acid

(c) Addition polymerization of a diol and a dicarboxylic acid

(d) Condensation polymerization of a dicarboxylic acid

11. Which of the following mixtures would form two phases?

(a) Methanol, acetonitrile and water

(b) Formaldehyde, formic acid and water

(c) Acetonitrile, sodium chloride and water

(d) Acetic acid, acetone and water

12. Laminar flow of a Newtonian fluid ceases to exist, when the Reynolds number exceeds

(a) 4000

(b) 2100

(c) 1500

(d) 3000

13. The daily earnings of 15 workers in a factory are 8, 12, 7, 8, 6, 9, 10, 12, 11, 13, 6, 7, 10, 14, 9. The median of earnings is

(a) 8

(b) 9

(c) 10

(d) 12

14. LAL test is used for the detection/quantification of

(a) exotoxins

(b) endotoxins

(c) serotoxins

(d) auxins

15. From the Lineweaver-Burk plot of Michaelis-Menten equation, K_m and V_{max} can be determined, where v is the reaction velocity at substrate concentration [S]. The X-axis experimental data is expressed as

(a) $1/v$

(b) $1/[S]$

(c) v

(d) $[S]$

16. Modification of protein biopharmaceuticals such as _____ is generally carried out to affect receptor binding and drug delivery.

(a) transesterification

(b) pegylation

(c) methylation

(d) transetherification

17. Crude sample containing five proteins namely A, B, C, D and E having molecular weights 33 kD, 150 kD, 24 kD, 18·5 kD and 5·4 kD respectively was run on gel permeation column. Order of elution of the proteins will be

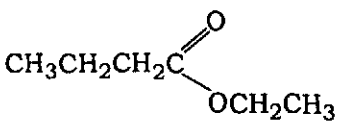
(a) EDCAB

(b) BACDE

(c) ACDEB

(d) CDEBA

18. Structural formula of an ester is given below :



On hydrolysis, it will produce

(a) propanoic acid and propan-1-ol

(b) butanoic acid and ethanol

(c) ethanoic acid and butan-1-ol

(d) propanoic acid and ethanol

19. Distribution coefficient for a base from aqueous solution into organic solvent increases with increasing pH because

(a) more of the bases would be in dissociated form

(b) more of the bases would be in undissociated form

(c) pH does not affect the distribution coefficient for base

(d) base gets hydrolyzed

20. Metabolic uncoupling in fermentation causes

(a) high biomass, low product yield

(b) low biomass, low product yield

(c) low biomass, high product yield

(d) high biomass, high product yield

21. Downstream processing of recombinant enzyme is carried out using Immobilized Metal Affinity Chromatography (IMAC). Before and after chromatography, the enzyme activities are 200 U/mL and 400 U/mL. Sample and eluent are of same volume. The total protein concentrations before and after chromatography are 4 mg/mL and 1 mg/mL. Fold purification in this step will be

(a) 2

(b) 4

(c) 8

(d) 0·5

22. In cation exchange chromatography, the protein of interest is eluted by which of the following?

(I) Increasing the salt concentration

(II) Decreasing the salt concentration

(III) Increasing the pH

(IV) Decreasing the pH

(a) I and III

(b) I and IV

(c) II and III

(d) II and IV

23. In competitive inhibition, an inhibitor

(a) binds at several different sites on an enzyme

(b) binds reversibly at the active site

(c) binds only to the ES complex

(d) binds covalently to the enzyme

24. Given an enzyme with a $K_m = 10$ mM and $V_{max} = 100$ mmol/min. If $[S] = 100$ mM, which of the following will be true?

(a) A 10-fold increase in $[S]$ would increase velocity by 10 folds

(b) A 10-fold decrease in K_m would increase velocity by 10 folds

(c) A 10-fold increase in $[S]$ would not increase velocity

(d) A 10-fold increase in $[S]$ would decrease velocity by 20 folds

25. In 10 m^3 working volume fermentor, 0·5 vvm air is to be sparged. The volumetric rate of air required is

(a) 10000 L/min

(b) 5000 L/min

(c) 1000 L/min

(d) 500 L/min

26. For scaling up of shear sensitive organisms in bioreactor, the criteria of scale-up which will be used is

(a) impeller tip speed

(b) Reynolds number

(c) power by volume

(d) constant mixing time

27. Fed batch cultivation is used to

(a) increase productivity in substrate inhibited cultivation

(b) increase productivity in product inhibited cultivation

(c) decrease productivity in substrate inhibited cultivation

(d) decrease productivity in metabolite inhibited cultivation

28. Turnover number of an enzyme means

(a) number of substrate molecules acted upon by an enzyme per second

(b) number of substrate molecules acted upon by one molecule of an enzyme per minute

(c) number of enzyme molecules acting on one molecule of substrate per minute

(d) number of molecules of end product produced by an enzyme in one minute

29. In continuous fermentation with the reactor volume of 2·0 L, if you wish to run continuous cultivation at the dilution rate of $0{\cdot}2\ h^{-1}$, the feed rate should be

(a) 0·4 L/h

(b) 0·2 L/h

(c) 10 L/h

(d) 0·1 L/h

30. Which protein estimation method is preferred for analysis of proteins in acidic solution?

(a) Bicinchoninic acid

(b) Bradford

(c) Biuret

(d) Folin-Lowry

31. Match the following and select the correct answer :

List—I		*List—II*	
A.	Infrared analyzer	1.	Temperature measurement
B.	Paramagnetic analyzer	2.	Exhaust CO_2 gas measurement
C.	Pt100 probe	3.	Exhaust O_2 gas measurement
D.	Bourdon gauge	4.	Pressure measurement

(a) A B C D
3 2 1 4

(b) A B C D
2 3 1 4

(c) A B C D
3 2 4 1

(d) A B C D
2 3 4 1

32. The doubling time of the organism is 0·693 h. Then the maximum growth rate will be

(a) $1\ h^{-1}$

(b) $1\ min^{-1}$

(c) $0{\cdot}1\ h^{-1}$

(d) $10\ min^{-1}$

33. Match the following and select the correct answer :

List—I		*List—II*	
A.	Gel filtration chromatography	1.	DEAE Sepharose
B.	Hydrophobic interaction chromatography	2.	CM Sepharose
C.	Anion exchange chromatography	3.	Sephadex G-25
D.	Cation exchange chromatography	4.	Phenyl Sepharose

(a) A B C D
4 3 1 2

(b) A B C D
3 4 2 1

(c) A B C D
3 4 1 2

(d) A B C D
4 3 2 1

34. Sodium chloride weighing 600 kg is mixed with 200 kg potassium chloride. Find the composition of the mixture in weight % and mole % for potassium chloride.

(a) 15 and 25

(b) 12 and 33·4

(c) 25 and 20·7

(d) 18·2 and 29

35. The equation for Bragg's law is

(a) $n\lambda = 2d\sin\theta$

(b) $n\lambda = 2d\cos\theta$

(c) $n = 2\lambda d\tan\theta$

(d) $n = 2\lambda d\sin\theta$

36. Each cycle of β-oxidation produces

(a) 1 FAD, 1 NADH and 1 acetyl CoA

(b) 1 $FADH_2$, 1 NADH and 1 acetyl CoA

(c) 1 FAD, 1 NAD^+ and 2 CO_2 molecules

(d) 1 $FADH_2$, 1 NADH and 2 CO_2 molecules

37. A DNA microarray exploits which of the following properties of nucleic acid?

(a) Supercoiling

(b) Complementarity

(c) GC content

(d) Hydrophobicity

38. What is the natural function of restriction enzymes?

(a) Protecting bacteria by cleaving the DNA of infecting viruses

(b) Protecting bacteria by methylating the DNA of infecting viruses

(c) Protecting bacteria by cleaving their own DNA

(d) Protecting bacteria by methylating their own DNA

39. Dideoxynucleoside triphosphates (ddNTPs) are used in sequencing DNA, because

(a) ddNTPs are fluorescent

(b) ddNTPs are incorporated very efficiently into DNA by DNA polymerase

(c) ddNTPs cannot be incorporated into DNA by DNA polymerase

(d) ddNTPs prevent further DNA synthesis once they are incorporated into the DNA sequence

40. RNAi stands for which of the following?

(a) RNA inducer

(b) RNA insertion

(c) RNA interference

(d) RNA intron

41. Which one of the following mechanisms is involved in the production of variety of immunoglobulins for a specific antigen?

(a) Class switching

(b) Genes shuffling

(c) RNA editing

(d) Translation

42. First generation biofuels were based on

(a) cellulosic biomass

(b) municipal waste

(c) algae

(d) corn starch

43. Which amino acid contains sulfur?

(a) Tyrosine

(b) Lysine

(c) Cysteine

(d) Alanine

44. Hexokinase activity in glycolysis is inhibited by

(a) fructose 6-phosphate

(b) glucose 6-phosphate

(c) fructose 1,6-biphosphate

(d) glyceraldehyde 3-phosphate

45. Which of the following ***does not*** allow blood to coagulate inside the body?

(a) Fibrin

(b) Heparin

(c) Hemoglobin

(d) Thromboplastin

46. Which one of the following conditions results from excess growth hormone (GH) in adults?

(a) Cushing's disease

(b) Acromegaly

(c) Hyperthyroidism

(d) Diabetes mellitus

47. What is serum?

(a) Blood without corpuscles and fibrinogen

(b) Lymph without corpuscles

(c) Blood without fibrinogen

(d) Lymph

48. _____ is an anticancer antibiotic.

(a) Erythromycin

(b) Cephalosporin

(c) Penicillin

(d) Mitomycin

49. Antidote for atropine poisoning is

(a) *d*-tubocurarine

(b) physostigmine

(c) cyclopentolate

(d) pralidoxime

50. The mineral which aids in the utilization of iron and in hemoglobin synthesis is

(a) calcium

(b) phosphorus

(c) cobalt

(d) copper

51. Which molecule has a part of riboflavin?

(a) Ferredoxin

(b) FAD

(c) Pyridoxal phosphate

(d) Pyrophosphate

52. A benzodiazepine used as an antianxiety agent is

(a) diazepam

(b) barbiturate

(c) haloperidol

(d) risperidone

53. Mechanism of action of propranolol is

(a) blocking β-receptors

(b) blocking *M*-receptors

(c) blocking α-receptors

(d) blocking I_2-receptors

54. In the wetting of hydrophilic solids with water, the contact angle is

(a) 180°

(b) 150°

(c) >90°

(d) <90°

55. Which kind of flow is observed with shear thickening system?

(a) Plastic flow

(b) Pseudoplastic flow

(c) Dilatant flow

(d) Newtonian flow

56. Which of the following is the best to sterilize heat labile solutions?

(a) Dry heat

(b) Autoclave

(c) Filtration using 0·2 micron filter

(d) Pasteurization

57. How many litres of 0·9% saline solution can be prepared with 30 g of sodium chloride?

(a) 0·03

(b) 0·3

(c) 3·33

(d) 33

58. A digestible linear polysaccharide abundantly found in cereals having α-1, 4-linkage in its structure is

(a) pectin

(b) amylopectin

(c) amylose

(d) inulin

59. A common medium chain fatty acid found in coconut oil is

(a) caproic acid

(b) lauric acid

(c) palmitic acid

(d) stearic acid

60. Which one of the following is an omega-3 fatty acid?

(a) Oleic acid

(b) α-linolenic acid

(c) Linoleic acid

(d) Arachidonic acid

61. Identify the ***mismatch.***

(a) Lipase—cheese ripening

(b) Pectinase—fruit and vegetable processing

(c) Lactase—bakery products

(d) Papain—meat tenderization

62. Minimum intake of dietary fiber conducive for long-term good health is

(a) 30–35 g

(b) 3–3·5 g

(c) 60–70 g

(d) 100 g

63. Deficiency of which vitamin causes fragile capillary walls, easy bleeding of gums and loosing of teeth?

(a) Thiamine

(b) Ascorbic acid

(c) Vitamin A

(d) Vitamin D

64. The conversion of glucose to pyruvic acid is carried out by which one of the following biochemical pathways?

(a) Glycogenesis

(b) Krebs' cycle

(c) HMP pathway

(d) Glycolysis

65. The key regulatory enzyme in the *de novo* synthesis of cholesterol from acetyl CoA by the mevalonate pathway is

(a) geranyltransferase

(b) squalene synthase

(c) HMG CoA reductase

(d) acetoacetyl CoA thiolase

66. Which one of the following enzymes ***does not*** belong to the class oxidoreductase?

(a) Catalase

(b) Succinate dehydrogenase

(c) Cellulase

(d) Lipoxygenase

67. In reverse-phase chromatography, the stationary phase is

(a) non-polar

(b) polar

(c) chiral

(d) chelating

68. The conversion factor used to convert %nitrogen to %protein in the Kjeldahl's method of total protein estimation in a food sample is

(a) 6·50

(b) 5·60

(c) 6·25

(d) 5·26

69. A person suffering from severe lactose intolerance can consume which one of the given food items?

(a) Yoghurt

(b) Cheese

(c) Ice cream

(d) Tofu

70. Which amongst the given options is a non-nutritive peptide sweetener for use in food?

(a) Stevia

(b) Saccharin

(c) Sucralose

(d) Aspartame

71. The enzyme activity used to check adequacy of pasteurization of milk is

(a) catalase

(b) urease

(c) phosphatase

(d) peroxidase

72. TSS of a food sample is measured as degree Brix and a sugar solution of 15 degree Brix represents which one of the following?

(a) 15 g of sugar in 100 mL solution

(b) 15 g of sugar in 100 g solution

(c) 15 g of sugar in 85 mL solution

(d) 15 g of sugar in 85 g solution

73. An approved biosimilar product must

I. be highly similar to an FDA-approved reference product

II. demonstrate that they have no clinically meaningful differences from the reference product in terms of safety, purity and potency

III. demonstrate improved stability compared to reference product

Which of the above are true?

(a) I and II

(b) I, II and III

(c) I and III

(d) II and III

74. In the QSAR equation

$$\log(1/C) = 2{\cdot}4\log P + 0{\cdot}005\sigma + 8{\cdot}34$$

(a) the hydrophobic and electronic parameters are significant

(b) the electronic and steric parameters are significant

(c) only the electronic parameter is significant

(d) only the hydrophobic parameter is significant

75. Which one of the following statements is true about a peptide bond (RCONHR')?

(a) The *cis*-configuration is favoured over the *trans*-configuration.

(b) Single bond rotation is not permitted between nitrogen and the carbonyl group.

(c) It is non-planar.

(d) It is incapable of forming a hydrogen bond.

76. Which one of the following viruses depends on reverse transcriptase for its genome replication?

(a) Rotavirus

(b) Influenza A virus

(c) Hepatitis A virus

(d) Hepatitis B virus

77. The statement 'store in cool place' as per Indian pharmacopoeia means

(a) store at room temperature

(b) store between 2 °C to 8 °C

(c) store at any temperature between 8 °C to 25 °C

(d) store at 0 °C

78. In centrifugal pumps, cavitation occurs when the pressure of the impeller eye or vane becomes

(a) less than atmospheric pressure

(b) more than liquid vapour pressure

(c) less than liquid vapour pressure

(d) more than atmospheric pressure

79. One molar solution of sodium hydroxide is

(a) 1% w/v NaOH in water

(b) 5·8% w/w NaOH in water

(c) 1% w/w NaOH in water

(d) 4% w/v NaOH in water

80. Penicillin inhibits bacterial growth by

(a) blocking synthesis of peptidoglycan

(b) combining with sterols in cell membrane

(c) blocking synthesis of proteins on 70S ribosomes

(d) blocking DNA synthesis

81. A stick partially immersed in water appears broken due to

(a) reflection

(b) refraction

(c) total internal reflection

(d) *dispersion*

82. The concentration of $[H^+]$ ions is 4×10^5 in a solution. Then pH of the solution will be

(a) 2·4

(b) 4·4

(c) 4·0

(d) 5

83. In chemical equilibrium, a principle states that if a stress (for example, a change in concentration, pressure, temperature or volume of the vessel) is applied to a system in equilibrium, the equilibrium will shift in such a way as to lessen the effect of the stress. This principle is called

(a) Le Chatelier's principle

(b) Robert principle

(c) Hess principle

(d) Aufbau principle

84. HLB system is used to classify

(a) surfactants

(b) preservatives

(c) antioxidants

(d) sequestering agents

85. Which one of the following body fluids is least acidic?

(a) Pancreatic juice

(b) Gastric juice

(c) Saliva

(d) Blood plasma

86. Molarity of 0·2 N H_2SO_4 is

(a) 0·2

(b) 0·4

(c) 0·6

(d) 0·1

87. The most widely used affinity ligand for purification of monoclonal antibody in industry is

(a) *p*-aminobenzamidine

(b) protein A

(c) protein G

(d) concanavalin A

88. For the filtration of particulate matter, which one of the following types of membrane filtration operation can be used?

(a) Microfiltration

(b) Ultrafiltration

(c) Nanofiltration

(d) Dialysis

89. When water freezes into solid, its density

(a) increases

(b) decreases

(c) remains unchanged

(d) is not predictable

90. Extractants having _____ are preferred for extraction of carboxylic acids.

(a) carbon bonded oxygen

(b) phosphorous bonded oxygen

(c) sulfur bonded oxygen

(d) nitrogen bonded oxygen

PART—B

(*Marks* : 40)

(Physics, Chemistry and Mathematics)

Answer **all** questions

91. The energy range of photons belonging to the visible range is between

(a) 4·7 eV to 3·25 eV

(b) 3·1 eV to 1·55 eV

(c) 6·3 eV to 4·95 eV

(d) 5·4 eV to 3·85 eV

92. Spontaneous adsorption of gas on platinum is an exothermic process because

(a) ΔH increases for the system

(b) ΔS increases for the gas

(c) ΔG increases for the gas

(d) ΔS decreases for the gas

93. A protein in a buffer at pH > pI

(a) will be negatively charged and will be able to bind to an anion exchange resin

(b) will be positively charged and will be able to bind to an cation exchange resin

(c) will have net zero charge and can bind to a mixed resin

(d) will be charged but cannot bind to ion exchange resin

94. In CD spectra, α-helical proteins are characterized by

(a) negative bands at 222 nm and 208 nm

(b) positive bands at 222 nm and 208 nm

(c) negative band at 218 nm

(d) negative bands at 226 nm and 218 nm

95. A technique which can differentiate polymorphs is

(a) X-ray diffraction

(b) UV-spectroscopy

(c) mass spectrometry

(d) fluorimetry

96. A mass spectrometric technique, commonly used for analysis of proteins, is

(a) electron impact ionization

(b) MALDI

(c) HETCOR

(d) chemical ionization

97. Fragmentation pathway in mass spectrometry for a cyclohexane is through

(a) α-fission

(b) β-fission

(c) McLafferty rearrangement

(d) retro Diels-Alder rearrangement

98. IR value at 1740 cm^{-1} is observed due to

(a) C—O stretch

(b) C=O stretch

(c) C=C stretch

(d) C≡C stretch

99. An interface used in LC-MS is

(a) chemical ionization

(b) electron capture interface

(c) electron impact ionization

(d) electrospray

100. Zinc in insulin injection can be quantified by

(a) atomic absorption spectroscopy

(b) flame photometry

(c) IR spectroscopy

(d) polarimetry

101. Splitting pattern for methyl protons of *n*-propane in NMR spectrum is

(a) singlet

(b) doublet

(c) triplet

(d) quartet

102. Hess' law is an application of

(a) first law of thermodynamics

(b) second law of thermodynamics

(c) entropy change

(d) Gibbs' free energy change

103. IR spectra appear as dips in the curve rather than maxima as in UV-visible spectra because it is a plot of

(a) % absorbance against wave number

(b) % transmittance against concentration

(c) % absorbance against concentration

(d) % transmittance against wave number

104. A conductance cell is calibrated by using a solution of known conductivity, i.e., usually a solution of

(a) NaCl

(b) $HgCl_2$

(c) KCl

(d) Na_2SO_4

105. Which spectroscopic method is the best suited to distinguish between *A* and *B*?

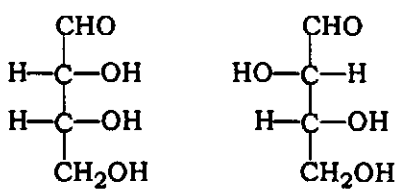
(a) IR

(b) UV

(c) Visible spectra

(d) MS

106. Following two compounds are example of



(a) enantiomers

(b) diastereomers

(c) identical compounds

(d) epimers

107. In Van Deemter equation, the term 'C' describes

(a) eddy diffusion

(b) axial diffusion

(c) mass transfer

(d) intraparticle diffusion

108. Liquid water is injected into an oven at 400 K. What are the signs for ΔG, ΔH and ΔS for the physical transformation that occurs?

	ΔG	ΔH	ΔS
A	+	–	–
B	+	–	0
C	–	+	+
D	–	+	0

(a) *A*

(b) *B*

(c) *C*

(d) *D*

109. How many moles of CO_2 would be produced from 56 moles of O_2 according to the following balanced equation?

$$2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$$

(a) 16·5 mol

(b) 32 mol

(c) 224 mol

(d) 48 mol

110. Which one of the following is strong in holding two polypeptides together?

(a) Disulphide bond

(b) Ionic interaction

(c) Hydrophobic interaction

(d) Hydrogen bond

111. Two cars of mass M_1 and M_2 are moving in circles of radii r_1 and r_2. Their speeds are such that they complete one revolution in the same time. The ratio of their angular speeds is

(a) $M_1 : M_2$

(b) $r_1 : r_2$

(c) 1 : 1

(d) $M_1r_1 : M_2r_2$

112. An oil of specific gravity 0·87 when filled in a vessel shows the height of 20 m. If same vessel is filled with water, then the height of water in vessel will be

(a) 20 m

(b) 17·4 m

(c) 16 m

(d) 23 m

113. The order of Lewis acid strength of different boron halides is

(a) $BF_3 < BCl_3 < BBr_3$

(b) $BCl_3 < BF_3 < BBr_3$

(c) $BBr_3 < BCl_3 < BF_3$

(d) $BBr_3 = BCl_3 = BF_3$

114. A wet paper pulp contains 60% water. After 100 kg of water is removed in a dryer, it is found that the pulp is now containing 25% water. The weight of the original pulp is

(a) 125 kg

(b) 155·55 kg

(c) 214·28 kg

(d) 75·12 kg

115. How much quantity of a stock solution of 1 M of tris buffer of pH 7·5 will be required to prepare 100 mL of 2·5 mM tris buffer of pH 7·5?

(a) 2·5 mL

(b) 0·25 mL

(c) 0·025 mL

(d) 25 mL

116. The molecule which has zero dipole moment is

(a) CH_2Cl_2

(b) BF_3

(c) NF_3

(d) ClO_2

117. _____ is used as an indicator in complexometric titrations.

(a) Erichrome black T

(b) Phenol red

(c) Phenolphthalein

(d) Methylene blue

118. One kg/m^2 is equal to ____ mm water column.

(a) 1

(b) 10

(c) 100

(d) 1000

119. What is the most stable conformation of cyclohexane?

(a) Boat

(b) Twist-boat

(c) Planar-hexagonal

(d) Chair

120. A carbon atom in ethylene is of what hybridization?

(a) sp

(b) sp^3

(c) sp^2

(d) sp^3d^2

121. The bond between sulfur (electronegativity : 2·58) and chlorine (electronegativity : 3·16) is

(a) polar covalent

(b) non-polar covalent

(c) electrostatic

(d) not formed

122. Acid rain chemically reacts with calcium carbonate, the major component of limestone and marble, which are used to make buildings and statues. What are the chemical products formed when calcium carbonate reacts with nitric acid?

(a) Carbonic acid and calcium hydroxide

(b) Calcium carbonate and nitric acid

(c) Carbon dioxide, water and calcium nitrate

(d) Nitrous oxide and calcium hydroxide

123. Tesla is a unit of

(a) electric flux

(b) magnetic flux

(c) electric field

(d) magnetic field

124. Sound waves having which one of the following frequencies are audible to human beings?

(a) 5 cycles/sec

(b) 27000 cycles/sec

(c) 5000 cycles/sec

(d) 50000 cycles/sec

125. Two heater wires of equal length are first connected in series and then in parallel. The ratio of heat produced in the two cases is

(a) 2 : 1

(b) 1 : 2

(c) 4 : 1

(d) 1 : 4

126. Focal length of plane mirror is

(a) zero

(b) one

(c) infinite

(d) ten

127. Composition of stainless steel type 316 is

(a) 16–13% Cr, 10–14% Ni and 2–3% Mo

(b) 20–22% Cr and 8–10% Ni

(c) 2–4% Cr, 22% Ni and 2–4% Mo

(d) 20–22% Cr and 2–3% Mo

128. Gold has a density of 19·3 g/cc. What will be the mass of a gold bar that is 6 cm long, 3 cm broad and 1 cm thick?

(a) 239·7 g

(b) 356·2 g

(c) 401·2 g

(d) 347·4 g

129. Zeta potential of protein dissolved in aqueous solution is determined by ____ technique.

(a) dynamic light scattering

(b) FTIR

(c) colorimetric

(d) ELISA

130. pK_a of acids and bases can be determined by using retention time of acids and bases in

(a) chiral chromatography

(b) affinity chromatography

(c) reverse-phase chromatography

(d) metal chelate chromatography

PART—C

(*Marks* : 35)

(Fundamentals of Life Sciences and Informatics)

Answer **all** questions

131. The organelle responsible for photosynthesis is

(a) Golgi apparatus

(b) nucleus

(c) chloroplast

(d) mitochondria

132. In swimming pool, which of the following organisms is most likely to be found?

(a) *E. coli*

(b) Algae

(c) *Lactobacillus*

(d) *Helicobacter pylori*

133. Carrageenan is obtained from

(a) Spirulina microalgae

(b) Ulva macroalgae

(c) Kappaphycus macroalgae

(d) Chlorella microalgae

134. Which one of the following hormones is necessary for normal functioning of the female reproductive system?

(a) Testosterone

(b) Progesterone

(c) Cortisone

(d) Estrogen

135. Which one of the following processes is used to produce biodiesel?

(a) Transesterification

(b) Transetherification

(c) Transglycosylation

(d) Transamidation

136. Plants receive their nutrition mainly from

(a) rain

(b) pesticides

(c) soil

(d) air

137. The disease caused by deficiency of protein in children is called

(a) beriberi

(b) marasmus

(c) scurvy

(d) rickets

138. The largest organ in human is

(a) bones

(b) liver

(c) intestine

(d) skin

139. Alternate forms of genes are called as

(a) chromosomes

(b) cistrons

(c) allelomorphs

(d) exons

140. The chromosomes are aligned midway in which stage of cell division?

(a) Anaphase

(b) Telophase

(c) Prophase

(d) Metaphase

141. The stop codon in eukaryotic system is

(a) AUG

(b) UUU

(c) UGA

(d) UUC

142. The shorter arm in an autonomous human chromosome is called as

(a) s

(b) t

(c) p

(d) q

143. Which amino acid has a pK_a close to pH 7·0?

(a) Alanine

(b) Histidine

(c) Arginine

(d) Glycine

144. Tinea infection such as in athlete's foot is caused by

(a) ringworm

(b) mold-like fungi

(c) yeast

(d) bacteria

145. Prokaryotes lack

(a) ribosome

(b) nuclear membrane

(c) DNA

(d) RNA

146. Movement of alleles in a population is called

(a) mutation

(b) genetic drift

(c) inbreeding

(d) gene flow

147. Which one of the following is polymer of C5 sugar?

(a) Hemicellulose

(b) Cellulose

(c) Starch

(d) Guar gum

148. Which one of the following is tree-borne oil?

(a) Soybean oil

(b) Cottonseed oil

(c) Karanja oil

(d) Rapeseed oil

149. Crude biogas primarily consists of

(a) CH_4, CO_2 and H_2S

(b) C_2H_2, CO_2 and N_2

(c) C_2H_6, CO and H_2S

(d) C_2H_4, CO and N_2

150. Abzymes can be classified under

(a) catalytic antibodies

(b) muscles

(c) antigens

(d) natural enzymes

151. An example of an anionic, non-sulphated glycosaminoglycan is

(a) chitin

(b) starch

(c) hyaluronic acid

(d) hemoglobin

152. An octapeptide has

(a) 8 amino acids and 7 peptide bonds

(b) 8 amino acids and 8 peptide bonds

(c) 8 amino acids and 9 peptide bonds

(d) 7 amino acids and 8 peptide bonds

153. A biome composed of trees that shed their leaves seasonally is

(a) desert plant

(b) temperate deciduous forest

(c) tropical tree

(d) taiga

154. Which one of the following is a prokaryote?

(a) *Escherichia coli*

(b) *Saccharomyces cerevisiae*

(c) *Mus domesticus*

(d) *Oryza sativa*

155. Which one of these has RNA as the genetic material?

(a) TMV

(b) *Escherichia coli*

(c) GMV

(d) CaMV

156. In which one of the following will you find a double-stranded structure?

(a) tRNA

(b) iRNA

(c) mRNA

(d) sRNA

157. Wind pollination is preponderant in

(a) rose

(b) bulbous plants

(c) ixora

(d) grass

158. The number of chromosomes in human is

(a) 46

(b) 44

(c) 23

(d) 22

159. Which one of the following is the correct order?

(a) Cells, organs, tissues

(b) Cells, tissues, organs

(c) Organs, tissues, cells

(d) Animals, tissues, organs

160. Egg white is rich source of which one of the following enzymes?

(a) Lysozyme

(b) Lecithin

(c) Immunoglobulin Y

(d) Cholesterol

161. The deficiency of which of the following vitamins is responsible for megaloblastic anemia?

(a) Vitamin B_6

(b) Vitamin B_{12}

(c) Vitamin B_1

(d) Vitamin D

162. In an object-oriented programming language like JAVA, binding together of data and methods in a class is called

(a) encapsulation

(b) polymorphism

(c) overloading

(d) interfacing

163. In Java, an operator dynamically allocates memory for an object and returns a reference to it is known as

(a) size

(b) new

(c) calloc

(d) alloc

164. The process of reducing redundancy in a database management system is called

(a) normalization

(b) reduction

(c) join

(d) merge

165. Stream classes in JAVA perform

(a) inheriting subclasses from superclasses

(b) input and output operations

(c) overloading

(d) string manipulation

SPACE FOR ROUGH WORK

SPACE FOR ROUGH WORK

119

QUESTION PAPER SERIES CODE

A

Registration No. :

Centre of Exam. :

Name of Candidate :

Signature of Invigilator

COMBINED ENTRANCE EXAMINATION, 2017

M.Tech. BIOTECHNOLOGY

INSTRUCTIONS FOR CANDIDATES

SECTION—II

SCIENCE STREAM

(Part—A, Part—B, Part—C)

[Field of Study Code : MTB]

Time Allowed : 3 hours *Maximum Marks* : 120

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 organized and answers are valued as follows :

Part—A : Life Sciences (Marks : 50)
Answer any **50** questions out of 60 questions

Note : (In case any candidate answers more than the required 50 questions, the first 50 questions attempted will be evaluated)

Part—B : Physics and Chemistry (Marks : 40)
Answer **all** questions

Part—C : Mathematics, Computer and Information Sciences (Marks : 30)
Answer **all** questions

(iv) Each question carries *1* mark. **There will be negative marking and ¼ mark will be deducted for each wrong answer.**

(v) Answer the questions in the Answer Sheet provided separately by darkening the correct choice, i.e., (a) or (b) or (c) or (d) (as the case may be) against each question in the corresponding circle.

(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 or the Answer Sheet.
6. Please don't 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.**

SECTION—II

(SCIENCE STREAM)

PART—A

(*Marks* : 50)

(Life Sciences)

Answer *any* **fifty** questions

1. The deficiency of which of the following enzymes leads to glycogen storage disease type I?

(a) Glucokinase

(b) Glycogen phosphorylase

(c) Lactate dehydrogenase

(d) Glucose-6-phosphatase

2. The disease caused by defective ion channel is

(a) acute pancreatitis

(b) emphysema

(c) cystic fibrosis

(d) Huntington's disease

3. Trans-fatty acids are produced in the process of

(a) hydrogenation of oil

(b) saponification of oil

(c) frying of oil

(d) prolonged storage of oil

4. Which one of the following separation techniques is ***not*** based on molecular weight?

(a) SDS-PAGE

(b) Affinity chromatography

(c) Isoelectric focusing

(d) Centrifugation

5. The hormone that binds to receptor tyrosine kinase is

(a) insulin

(b) epinephrine

(c) estrogen

(d) norepinephrine

6. Which one of the following is ***not*** a vasodilator?

(a) Endothelium-derived hyperpolarizing factor

(b) Nitric oxide

(c) Histamine

(d) Thromboxane

7. Transport of glucose through GLUT4 occurs by

(a) facilitated diffusion

(b) simple diffusion

(c) active transport

(d) endocytosis

8. Which one of the following deficiencies is ***not*** the major cause for anaemia?

(a) Folic acid

(b) Erythropoietin

(c) Cyanocobalamin

(d) Pantothenic acid

9. The portion of transmembrane protein occupied within the cell membrane is rich in

(a) polar amino acids

(b) non-polar amino acids

(c) basic amino acids

(d) acidic amino acids

10. The cell organelle primarily responsible for the source of reactive oxygen species is

(a) nucleus

(b) mitochondria

(c) endoplasmic reticulum

(d) Golgi apparatus

11. Which one of the following cells primarily depends on glucose for energy?

(a) Lymphocyte

(b) Matured RBC

(c) Differentiated adipocyte

(d) Muscle cell

12. Having hypoglycemia within few hours after a high carbohydrate diet is

(a) reactive hypoglycemia

(b) chronic hypoglycemia

(c) delayed hypoglycemia

(d) idiopathic hypoglycemia

13. The colour of red meat is due to presence of the pigment called

(a) haemoglobulin

(b) cytoglobin

(c) leghaemoglobin

(d) myoglobin

14. Large size molecules are taken by the cells by the process of

(a) active transport

(b) passive transport

(c) endocytosis

(d) facilitated diffusion

15. The diagnostic marker for hypothyroidism is

(a) decreased levels of TSH

(b) an elevated TSH level

(c) an elevated GHRH level

(d) decreased levels of CRH

16. Which one of the following is strong in holding two polypeptides together?

(a) Disulphide bond

(b) Ionic interaction

(c) Hydrophobic interaction

(d) Hydrogen bond

17. D-amino acids are found primarily in

(a) human

(b) bacteria

(c) plants

(d) insects

18. In mammalian cells, cyclin D is active during which stage of the cell cycle?

(a) G_1

(b) S

(c) G_2

(d) M

19. Anaphase-promoting complex is a

(a) protein kinase

(b) protein phosphatase

(c) ubiquitin ligase

(d) deubiquitinating enzyme

20. Facilitated diffusion involves

(a) carriers but no energy

(b) receptors and energy

(c) enzymes and energy

(d) carriers and energy

21. Protein modification and targeting involve the activity of

(a) nucleus

(b) ribosome

(c) Golgi

(d) lysosome

22. 47, XXY is the karyotype for

(a) Down's syndrome

(b) Klinefelter's syndrome

(c) Patau syndrome

(d) Edwards' syndrome

23. A→G change is an example of

(a) tautomerization

(b) transition

(c) transversion

(d) translocation

24. Which molecule provides the stimulation to a cell to enter into cell cycle?

(a) Cyclins

(b) Cyclin-dependent kinases

(c) Cytokines and growth factors

(d) Tyrosine kinases

25. Number of mitotic divisions required to produce 128 cells from a single-cell is

(a) 7

(b) 8

(c) 16

(d) 32

26. JAK-STAT pathway is associated with signal transduction through

(a) direct diffusion

(b) enzyme-linked receptor

(c) G-protein linked receptor

(d) intracellular receptor

27. Antisense gene therapy involves blocking at the

(a) DNA level

(b) RNA level

(c) translational level

(d) post-translation level

28. Genes that are inactive for long periods of time tend to be bound to

(a) each other

(b) methyl groups

(c) actin and myosin

(d) the nucleolus

29. The name of Kary Mullis is associated with

(a) PCR

(b) RFLP

(c) Chain Termination Method

(d) RAPD

30. Deoxy position of deoxyribose in DNA is at

(a) 1st carbon

(b) 3rd carbon

(c) 2nd carbon

(d) 5th carbon

31. Which one of the following modifications leads to protein degradation?

(a) Methylation

(b) Acetylation

(c) Phosphorylation

(d) Ubiquitination

32. RNAs that catalyze biological reactions such as self-splicing introns are known as

(a) micro-RNAs

(b) ribozymes

(c) spliceozymes

(d) small nucleolar RNAs

33. If a man of blood group AB marries a woman of blood group A whose father was of blood group O, to what different blood groups can this man and woman ***expect***, their children to belong?

(a) A, O, B

(b) A, AB

(c) AB, O

(d) A, AB, B

34. Cytosine comprises 20% of the chicken genome. What percent of the chicken genome is composed of adenosine?

(a) 80%

(b) 40%

(c) 30%

(d) 20%

35. *A* is a signaling molecule that regulates the expression of gene *X* via a pathway given below showing *A* positively regulates *B*, *B* negatively regulates *C*, *D* and *X* is formed from *C* and *D* respectively. The pathway can be schematically represented as follows. What will be the effect on *X* in a cell line having homozygous null mutations for both *B* and *C*?

$$A \xrightarrow{(+)} B \xrightarrow{(-)} C \longrightarrow D \longrightarrow X$$

(a) There will be no effect at all

(b) *X* will be expressed only in presence of *A*

(c) *X* will be constitutively expressed even in absence of *A*

(d) *X* will not be expressed even in presence of *A*

36. Which of the following techniques would you use to determine the copy number of a particular gene in a genome?

(a) Polymerase chain reaction

(b) Western blotting

(c) Southern blotting

(d) Northern blotting

37. CD4 a surface antigen commonly found in T helper cells is a

(a) glycoprotein

(b) phospholipid

(c) nucleoprotein

(d) polysaccharide

38. The cytokine with an antiviral response is

(a) lymphokine

(b) interleukin

(c) chemokine

(d) interferon

39. In which of the following has less risk of severe graft-versus-host-disease?

(a) Cord blood (CB) transplantation

(b) Bone marrow transplantation (BMT)

(c) Stem cell transplantation

(d) Whole blood transplantation

40. Antimicrobial peptides are the major molecules involved in the immune responses of

(a) fishes

(b) *Drosophila melanogaster*

(c) *Brugia malayi*

(d) avians

41. The mechanism of action of aminopterin in HAT medium is

(a) dihydrofolate reductase inhibitor

(b) microtubule inhibitor

(c) topoisomerase inhibitor

(d) DNA intercalating agent

42. The second most abundant immunoglobulin is

(a) IgG

(b) IgA

(c) IgM

(d) IgE

43. Which of the following is a macrolide calcineurin inhibitor used in T-cell suppression therapies?

(a) Methotrexate

(b) Azathioprine

(c) Tacrolimus

(d) Mycophenolic acid

44. 'Flush, Flare and Wheal' are characteristically associated with what type of hypersensitive reaction?

(a) Type I

(b) Type II

(c) Type III

(d) Type IV

45. Double-stranded DNA has lower absorption (A_{260}) than single-stranded DNA due to

(a) increased base stacking

(b) decreased base stacking

(c) deoxyribose

(d) thymine

46. In DNA replication, the helix is unwound by which type of enzyme?

(a) Topoisomerase

(b) Primase

(c) DNA Polymerase

(d) Helicase

47. _____ is responsible for relieving supercoils in eukaryotic DNA by charge neutralization of lysine residues in histones.

(a) Histone acetylase

(b) Histone deacetylase

(c) DNA topoisomerase

(d) DNA ligase

48. The minimum number of tRNA (i.e., anticodon) required recognizing all six codons of leucine or serine is

(a) one

(b) two

(c) three

(d) six

49. Wobble base pairing

(a) increases the effect of mutation

(b) increases the rate of translation

(c) occurs between 3'-end of codon with 5'-end of anticodon

(d) increases the rate of transcription

50. _____ is an example of template independent ordered addition of nucleotides.

(a) Addition of 3'-CCA in tRNA

(b) Synthesis of telomeres in DNA

(c) Synthesis of primer in DNA replications

(d) Replication of plasmid DNA

51. Replication in DNA ligase deficient cells is used to demonstrate which one of the following characteristics of replication?

(a) Semiconservative

(b) Semidiscontinuous

(c) Bidirectional

(d) Discontinuous

52. Pulse labelling study is used to demonstrate _____ characteristics of replication.

(a) semiconservative

(b) semidiscontinuous

(c) bidirectional

(d) discontinuous

53. _____ is used to demonstrate protein binding sites in DNA.

(a) DNA fingerprinting

(b) DNA footprinting

(c) Southern hybridization

(d) Fluorescence *in situ* hybridization

54. Which one of the following cannot serve as a host in genetic engineering?

(a) Presence of restriction and modification system

(b) Presence of restriction but absence of modification system

(c) Absence of restriction but presence of modification system

(d) Absence of both restriction and modification systems

55. Alkaline phosphatase is used for the following in recombinant DNA technology ***except*** that it

(a) removes 5'-phosphate

(b) prevents self-ligation

(c) preserves orientation

(d) enhances the production of recombinant DNA

56. Yeast two hybrid (Y2H) system involves transcription and translation of fused genes and is used to detect

(a) protein-protein interaction

(b) protein-DNA interaction

(c) protein-RNA interaction

(d) DNA-RNA interaction

57. Which of the following strategies is the best to clone an unknown DNA?

(a) Single enzyme digestion based cloning

(b) Double digestion based cloning

(c) Homopolymer tail based cloning

(d) TA cloning

58. Spi selection allows the propagation of appropriate size lambda DNA without

(a) *red* and *gam* region

(b) *cos* site

(c) *loxP* site

(d) restriction site

59. Of the 64 codons, how many code for amino acids?

(a) 20

(b) 22

(c) 43

(d) 61

60. A polypeptide is assembled on a

(a) DNA molecule

(b) nuclear membrane

(c) nuclear pore

(d) ribosome

PART—B

(*Marks* : 40)

(Physics and Chemistry)

Answer **all** questions

61. A general purpose glass electrode (somewhat permeable to sodium ions) is used for pH measurement. If Na^+ ions are present in the solution whose pH is to be measured, the pH measured

(a) decreases as Na^+ concentration increases

(b) increases as Na^+ concentration increases

(c) does not have any appreciable differences

(d) will be affected only when basic NaOH is present and not when neutral NaCl is present

62. For phosphate buffers, which of the following statements is ***not*** correct?

(a) They have very high buffering capacity.

(b) High ionic strength can be obtained with lower molarity.

(c) They do not affect mammalian cells.

(d) They are useful buffers for the pH range of 12·0–12·5.

63. de Broglie equation is applicable to

(a) supersonic particles

(b) raindrops

(c) microscopic particles

(d) macroscopic particles

64. If the uncertainty in the position of electron is 0·33 pm, what will be the uncertainty in its velocity?

(a) $1{\cdot}75 \times 10^8$ m sec^{-1}

(b) $1{\cdot}75 \times 10^9$ m sec^{-1}

(c) $3{\cdot}30 \times 10^8$ m sec^{-1}

(d) $2{\cdot}75 \times 10^8$ m sec^{-1}

65. Calculate the oxidation state of the metal and the number of *d* electrons in the following coordination complex :

$Cr(CO)_6$

(a) +3, 6

(b) 0, 6

(c) −3, 3

(d) +2, 4

66. Predict the magnetic moments and the number of unpaired electrons at 25 °C for the following :

$[Fe(CN)_6]^{4-}$

(a) 0, 0

(b) 1·73, 1

(c) 4·9, 4

(d) 2·83, 2

67. Calculate the energy of a green light photon of wavelength 525 nm.

(a) $2{\cdot}28 \times 10^{-19}$ J

(b) $3{\cdot}57 \times 10^{-19}$ J

(c) $3{\cdot}78 \times 10^{-19}$ J

(d) $1{\cdot}97 \times 10^{-19}$ J

68. The quantum number ***not*** obtained by Schrödinger's wave equation is

(a) *n*

(b) *l*

(c) *m*

(d) *s*

69. The speed of the electron in the first orbit of hydrogen atom in the ground state [c is the velocity of light] is

(a) $c/137$

(b) $c/13 \cdot 7$

(c) $c/1 \cdot 37$

(d) $c/1370$

70. In the following reaction

$$_3Li^6 + ? \rightarrow {}_2He^4 + {}_1H^3$$

the missing particle is

(a) fermion

(b) proton

(c) electron

(d) neutron

71. A dye absorbs a photon of wavelength λ and re-emits the same energy in 2 photons of wavelength λ_1 and λ_2 respectively. The wavelength λ is related to λ_1 and λ_2 as

(a) $\lambda = \dfrac{\lambda_1 + \lambda_2}{\lambda_1 \lambda_2}$

(b) $\lambda = \dfrac{\lambda_1 \lambda_2}{\lambda_1 + \lambda_2}$

(c) $\lambda = \dfrac{(\lambda_1 \lambda_2)^2}{\lambda_1 + \lambda_2}$

(d) $\lambda = \dfrac{\lambda_1 \lambda_2}{(\lambda_1 + \lambda_2)^2}$

72. The presence of 3 unpaired electrons in N atom can be explained by

(a) Aufbau principle

(b) Pauli's exclusion principle

(c) Heisenberg's uncertainty principle

(d) Hund's rule

73. Any *p*-orbital can accommodate

(a) 4 electrons

(b) 2 electrons with anti-parallel spin

(c) 2 electrons with parallel spin

(d) 6 electrons

74. *X* mL of hydrogen gas effuses through a hole in a container in 10 sec. The time taken for the effusion of the same volume of gas specified below under identical condition is

(a) 20 sec for He

(b) 40 sec for oxygen

(c) 50 sec for CO

(d) 70 sec for CO_2

75. Helium atom is twice as heavy as hydrogen molecule. At 27 °C, the average kinetic energy of Helium atom is

(a) two times that of hydrogen molecule

(b) same as that of hydrogen molecule

(c) four times as that of hydrogen molecule

(d) half that of hydrogen molecule

76. At a particular temperature

$$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}; \quad \Delta H = -57{\cdot}1 \text{ kJ}$$

the approximate heat liberated when 200 mL of 0·5 M H_2SO_4 is mixed with 400 mL of 0·2 M KOH solution will be

(a) 5·20 kJ

(b) 4·57 kJ

(c) 3·49 kJ

(d) 45·7 kJ

77. The heats of formation of $CO_2(g)$, CO(g) and $H_2O(g)$ are −393·5, −110·5 and −241·8 kJ mol^{-1} respectively. Find out the standard enthalpy change for the following transformation :

$$CO_2(g) + H_2(g) \rightarrow CO(g) + H_2O(g)$$

(a) 52·3 kJ

(b) 41·2 kJ

(c) −52·3 kJ

(d) −41·2 kJ

78. A process is thermodynamically reversible when

(a) it is an open system

(b) it is a closed system

(c) surrounding is in equilibrium with the system

(d) surrounding and system change into each other

79. The nucleophilicity changes for CH_4, NH_3, H_2O and HF as

(a) $CH_4 > NH_3 > H_2O > HF$

(b) $CH_4 < NH_3 < H_2O < HF$

(c) $CH_4 = NH_3 > H_2O > HF$

(d) $CH_4 > NH_3 = H_2O > HF$

80. Generally HBr is ***not*** used for dehydration of alcohols, because

(a) substitution reaction competes

(b) Br^- is a poor nucleophile

(c) Br^- is a good leaving group

(d) OH^- is a good leaving group

81. The energy of the lowest state in a one-dimensional potential box of length a is

(a) $2h\pi / 8\ ma^2$

(b) $2h^2 / 8\ ma^2$

(c) $h^2 / 8\ ma^2$

(d) $2h\pi^2 / 8\ ma^2$

82. Two particles of masses 2 mg and 6 mg are separated by a distance of 6 cm. The distance of their centre of mass from the heavier particle is

(a) 1·5 cm

(b) 2 cm

(c) 3 cm

(d) 4 cm

83. A point object is placed at the centre of a glass sphere of radius 6 cm and refractive index 1·5. The distance of the virtual image from the surface of the sphere is

(a) 2 cm

(b) 4 cm

(c) 6 cm

(d) 12 cm

84. Detrimental property of a material for shock load applications is

(a) high density

(b) low toughness

(c) high strength

(d) low hardness

85. The number of Bravais space lattices with two lattice points is

(a) 2

(b) 1

(c) 6

(d) 5

86. When a monatomic gas is placed in a uniform electric field E, the displacement of the nucleus is proportional to

(a) E^2

(b) E

(c) E^3

(d) $\sqrt{E}$

[P.T.O.

87. The miller indices of the plane parallel to y and z axes are

(a) (1 0 0)

(b) (0 1 0)

(c) (0 0 1)

(d) (1 1 1)

88. If the Fermi energy of silver at 0 K is 5 eV, the mean energy of electron in silver at 0 K is

(a) 6 eV

(b) 12 eV

(c) 1·5 eV

(d) 3 eV

89. A superconducting material when placed in magnetic field will

(a) attract magnetic field towards its centre

(b) repel all the magnetic lines of forces passing through it

(c) attract the magnetic field to a particular zone

(d) not affected by the magnetic field

90. Which of the following materials ***does not*** have permanent magnetic dipoles?

(a) Paramagnetic

(b) Diamagnetic

(c) Ferrimagnetic

(d) Antiferromagnetic

91. Optical fiber operates on the principle of

(a) total internal reflectance

(b) Tyndall effect

(c) photoelectric effect

(d) laser technology

92. If 0·28 nm is the spacing between the nearest neighbouring ions in the NaCl lattice, the unit cell parameter is

(a) 1·4 nm

(b) 5·6 Å

(c) 0·9 Å

(d) 1 Å

93. Donor type impurity is formed by adding impurity of valency

(a) 3

(b) 4

(c) 5

(d) 2

94. The nature of binding for a crystal with alternate and evenly spaced positive and negative ions is

(a) ionic

(b) covalent

(c) metallic

(d) dipole

95. The third subshell of an atom can have a maximum of

(a) 2 electrons

(b) 14 electrons

(c) 10 electrons

(d) 6 electrons

96. An automobile traveling with a speed of 60 km/hr can brake to stop within a distance of 20 m. If the car is going twice as fast, i.e., 120 km/hr, the stopping distance will be

(a) 20 m

(b) 40 m

(c) 60 m

(d) 80 m

97. A point object is placed at the centre of a glass sphere of radius 6 cm and refractive index 1·5. The distance of the virtual image from the surface of the sphere is

(a) 2 cm

(b) 4 cm

(c) 6 cm

(d) 12 cm

98. At the top of the trajectory of projectile, the acceleration is

(a) maximum

(b) minimum

(c) zero

(d) g

99. If the kinetic energy of a free electron doubles, its de Broglie wavelength changes by the factor

(a) 2

(b) $1/2$

(c) $\sqrt{2}$

(d) $1/\sqrt{2}$

100. The cold junction of thermocouple is kept at 10 °C. Calculate the temperature at which thermo e.m.f. would be maximum. [Given that the thermo e.m.f. changes sign at 800 K].

(a) 268·5 °C

(b) 268 °C

(c) 0 °C

(d) 273 °C

PART—C

(*Marks* : 30)

(Mathematics, Computer and Information Sciences)

Answer **all** questions

101. In JAVA, int, float, double and char are

(a) data types

(b) functions

(c) variables

(d) access modifiers

102. In JAVA, which is used to allocate memory to variables?

(a) mem

(b) new

(c) alloc

(d) getmem

103. Which one of the following is ***not*** a JAVA access modifier?

(a) private

(b) public

(c) pause

(d) protected

104. An un-ordered group of key-value pairs in Perl is known as

(a) hash

(b) array

(c) sequence

(d) pair

105. Which one of the following Perl functions will remove and return the last element of an array?

(a) push

(b) shift

(c) pop

(d) unshift

106. There are two sorted files a1.txt and a2.txt. The Linux command used to find lines unique to each of these files along with the lines common to both the files is

(a) find

(b) comm

(c) unique

(d) not unique

107. The command in Linux to find lines matching a pattern in a file is

(a) grep

(b) comm

(c) find

(d) pipe

108. In Linux, if the output of a command becomes the input of another command, it is called as a

(a) pipe

(b) change

(c) connect

(d) merge

109. In Linux, which serves as an interface between the user and the kernel?

(a) inter

(b) hardware

(c) shell

(d) pipe

110. In Perl programming language, singular values are

(a) numbers only

(b) strings only

(c) both numbers and strings

(d) hashes

111. The binary addition of 1010 and 1010 will be

(a) 10110

(b) 10100

(c) 10101

(d) 11110

112. Linux command "tail-5 dna.txt>>test" will

(a) display the first 5 lines of dna.txt file

(b) display the last 5 lines of dna.txt file

(c) store the last 5 lines of dna.txt file to test

(d) store the first 5 lines of dna.txt file to test

113. On a spreadsheet graph, lines which extend above and below the plotted point are known as

(a) fill handle

(b) cookies

(c) points

(d) error bars

114. Which one of the following statements is ***not*** true about random access memory (RAM)?

(a) Amount of RAM affects the speed of the system.

(b) RAM is non-volatile.

(c) Data and programs can be written to and deleted from RAM as needed.

(d) RAM is temporary memory.

115. The Linux command 'mv' is used to

(a) concatenate two files

(b) rename a file

(c) delete a file

(d) find location of a file

116. To store key value pairs in Perl, which data type is used?

(a) hash

(b) list

(c) scalar

(d) array

117. An array in Perl programming language

(a) can store strings only

(b) can store numbers only

(c) can store strings and numbers

(d) cannot store strings or numbers

118. In SQL, the set of data manipulation commands is

(a) Insert, Delete, Create

(b) Insert, Grant, Revoke

(c) Select, Commit, Rollback

(d) Insert, Delete, Update

119. The process of reducing redundancy in a database management system is called

(a) normalization

(b) reduction

(c) join

(d) merge

120. A device used to forward data packets between computer networks is

(a) connector

(b) bus

(c) router

(d) cable

121. If for the equation $x^3 + 3x^2 + kx + 3 = 0$, one root is the negative of another, then the value of k is

(a) 3

(b) –3

(c) 1

(d) –1

122. Which of the following equations has $x + 2$ as a factor?

(a) $x^4 + 2$

(b) $x^4 - x^2 + 12$

(c) $x^4 - 2x^3 - x + 2$

(d) $x^4 - 2x^3 - x - 2$

123. In three dimensions, the equation $x^2 + y^2 = a^2$ represents a

(a) pair of straight lines

(b) hyperbola

(c) cylinder

(d) cone

124. A line makes angles α, β, γ with the coordinate axes. Then

$$\sin^2\alpha + \sin^2\beta + \sin^2\gamma$$

is

(a) 1

(b) 2

(c) 3

(d) 4

125. The differential equation $(dy/dx)^2 + 5y^{1/3} = x$ is

(a) linear of degree 3

(b) non-linear of order 1 and degree 6

(c) non-linear of order 1 and degree 2

(d) non-linear of order 1 and degree 3

126. The particular integral of $(D^2 + 6D + 5)y = 4e^{-x}$ is

(a) xe^{x}

(b) xe^{-x}

(c) x^2

(d) x^3

127. The number $(i)^i$ is

(a) a purely imaginary number

(b) an irrational number

(c) a rational number

(d) an integer

128. The function $y = \cos(1/x)$ as $x \to 0$ has a

(a) limit tending to zero

(b) limit tending to 1

(c) limit tending to ½

(d) Limit is not defined

129. The relation $|3 - z| + |3 + z| = 5$ represents

(a) a circle

(b) a parabola

(c) an ellipse

(d) a hyperbola

130. The differential equation $y(dx/dy) + 1 = y$, $y(0) = 1$ has

(a) two solutions

(b) infinite number of solutions

(c) a unique solution

(d) no solution

★★★

SPACE FOR ROUGH WORK

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