

Registration No. :

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Centre of Exam. : _____

Name of Candidate : _____

Signature of Invigilator

**COMBINED ENTRANCE EXAMINATION, 2014
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 ● (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 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. If corresponding to the Michaelis-Menten constant the rate of enzyme reaction was found to be 50 millimole/lit.hr, then V_{\max} of the enzyme reaction is
 - (a) 75
 - (b) 100
 - (c) 50
 - (d) 200
2. Doubling time in cell growth kinetics is similar to
 - (a) zero-order kinetics
 - (b) second-order kinetics
 - (c) first-order kinetics
 - (d) half-order kinetics
3. If a liquid flows at velocity V_1 through a pipe of ID = d_1 and then through a pipe of ID = d_2 , its velocity in the second pipe is calculated using
 - (a) Bernoulli's equation
 - (b) equation of continuity
 - (c) momentum equation
 - (d) energy-balance equation
4. For the stoichiometry $(C_6H_{12}O_{11}) + a.O_2 + b.NH_3 \rightarrow c.(biomass) + d.CO_2 + e.H_2O$, respiratory quotient (RQ) is
 - (a) e/b
 - (b) c/a
 - (c) d/a
 - (d) d/b

5. In the equation $\tau = K \cdot (d\mu/dy)^n$, the apparent viscosity is
- K
 - $K \cdot (d\mu/dy)^n$
 - $K \cdot (d\mu/dy)^{n-1}$
 - $(d\mu/dy)$
6. If fermentation broth is pseudoplastic
- viscosity will be low near the rotating impeller
 - viscosity will be high near the rotating impeller
 - viscosity will not be affected by the rotating impeller
 - viscosity will fluctuate near the rotating impeller
7. For an impeller of dia Da , rotating at n (r.p.s.) in a liquid of density ρ and viscosity μ , Reynolds number is
- $nDa\rho/\mu$
 - $nDa^2\rho/\mu$
 - $n^2 Da\rho/\mu$
 - $n^2 Da^2\rho/\mu$
8. If inside and outside heat transfer coefficients in a double-pipe heat exchanger are 200 and 100, overall heat transfer coefficient μ is
- $(1/0.015)$
 - (0.015)
 - $(0.015)^{0.5}$
 - $1/(0.015)^{0.5}$
9. Power required to pump a liquid at $Q \text{ m}^3/\text{s}$ at $\Delta P (\text{N/m}^2)$ is
- $\Delta P \cdot Q$
 - $\Delta P/Q$
 - $Q/\Delta P$
 - $(\Delta P^2) Q$
10. Analog controls deal with
- discrete variable
 - any variable
 - continuous variable
 - No variable

11. Design of packed absorber involves
- (a) HTU and NTU
 - (b) HTU
 - (c) NTU
 - (d) number of stages
12. Drying of a wet solid using hot air involves
- (a) heat transfer
 - (b) mass transfer
 - (c) momentum transfer
 - (d) heat and mass transfer
13. In a refrigerator, freezer compartment is at top to aid
- (a) natural convection heat transfer
 - (b) forced convection heat transfer
 - (c) natural convection mass transfer
 - (d) forced convection mass transfer
14. In a static-fluid
- (a) shear effect is absent
 - (b) pressure gradient is small
 - (c) gravity effect is small
 - (d) no force is acting

15. If a centrifugal separator rotates at 3000 r.p.m., its angular velocity is
- (a) 100π radians/s
 - (b) 200π radians/s
 - (c) 300π radians/s
 - (d) 400π radians/s
16. Recycle reactor is suitable for
- (a) series reactions
 - (b) parallel reactions
 - (c) autocatalytic reactions
 - (d) series-parallel reactions
17. In the equation $Q/A = K \cdot \Delta T/\Delta X$ for heat transfer by conduction, the resistance R is
- (a) $1/\Delta X$
 - (b) $\Delta X/K$
 - (c) $1/K$
 - (d) $K/\Delta X$
18. Which one of the following is a correct statement?
- (a) Wet-bulb temperature of air is always less than dry-bulb temperature
 - (b) Wet-bulb temperature of air is always equal to dry-bulb temperature
 - (c) Wet-bulb temperature of air is always greater than dry-bulb temperature
 - (d) Wet-bulb temperature of air is always less than dry-bulb temperature except 100% saturation

19. If a 100 cc volume hollow ball is floating in water (water density 1000 kg/m^3) with 50% volume immersed, then the weight of the floating ball is
- (a) 0.981 N
 - (b) 0.4905 N
 - (c) 9.81 N
 - (d) 9810 N
20. High value of Henry's law constant indicates
- (a) high solubility of gas in liquid
 - (b) high volatility of gas from liquid
 - (c) low solubility of gas in liquid
 - (d) low volatility of gas from liquid
21. A first-order reaction requires two equal sized CSTR, the conversion is
- (a) less when they are connected in series
 - (b) more when they are connected in series
 - (c) more when they are connected in parallel
 - (d) same whether they are connected in series or parallel
22. Which of the following is an autocatalytic reaction?
- (a) Photochemical reaction
 - (b) Microbial fermentation reaction
 - (c) Enzyme reaction
 - (d) Ammonia synthesis reaction

23. Which of the following statements about fed batch is true?

- (a) It is used for increasing cell concentration
- (b) It is used for product-inhibited growth
- (c) It is suitable only for viscous culture
- (d) Constant specific growth rate cannot be maintained

24. Which of the following cells is most shear sensitive?

- (a) Mammalian
- (b) Plant
- (c) Bacteria
- (d) Fungi

25. Maintenance energy is significant during microbial growth

- (a) if specific growth rate is high
- (b) if specific growth rate is low
- (c) if specific substrate uptake rate is high
- (d) at μ_{\max} (maximum specific growth rate)

26. Sterilization of oil using steam is

- (a) dry sterilization
- (b) wet sterilization
- (c) both dry and wet sterilization
- (d) Not used at all

27. The unit of mass transfer coefficient is
- (a) m^2s^{-1}
 - (b) m^3s^{-1}
 - (c) s^{-1}
 - (d) ms^{-1}
28. Baffles are provided in CSTR for — of the velocity of fluid flow.
- (a) retarding the radial component
 - (b) retarding the axial component
 - (c) retarding the circular component
 - (d) improving the radial component
29. The term $k_L a$ during operation of bioreactors refers to mass transfer coefficient across
- (a) barrier between gas and liquid phase
 - (b) liquid film
 - (c) gas film
 - (d) gas-liquid interface
30. Arrhenius equation used for sterilization of medium shows the variation of — with temperature.
- (a) reaction rate
 - (b) rate constant
 - (c) energy of activation
 - (d) frequency factor

31. The major impeding factor in operating high cell density anaerobic fermentation for production of organic acids would be
- (a) increased heat generation
 - (b) increase in viscosity
 - (c) increase in concentration of CO_2
 - (d) increase in product concentration
32. When compared to anaerobic fermentation, unaerated fermentation process is preferred in the industrial scale fermentation, because
- (a) anaerobic fermentation generates flammable H_2
 - (b) costlier nitrogen gas needs to be sparged
 - (c) sparging N_2 leads to increased gas holdup
 - (d) removal of heat will be more in anaerobic process
33. The major drawback of using external heat exchanger in fermentors is
- (a) increased chances of contamination
 - (b) decreased concentration of dissolved oxygen
 - (c) decreased heat removal efficiency
 - (d) decreased mixing efficiency
34. Which of the following states exist(s) in the pulse and shift method of medium optimization in chemostat?
- (a) Steady state
 - (b) Unsteady state
 - (c) Quasi-steady state and unsteady state
 - (d) Transient state and steady state

35. If K_s value for a particular substrate in an organism is large in a chemostat, then
- (a) critical dilution rate will be greater than maximum specific growth rate
 - (b) critical dilution rate will be lesser than maximum specific growth rate
 - (c) critical dilution rate will be equal to the maximum specific growth rate
 - (d) critical dilution rate and maximum specific growth rate are not related at all
36. In a batch cultivation during logarithmic phase, specific growth rate
- (a) can be controlled by altering initial substrate concentration
 - (b) cannot be controlled by altering initial substrate concentration
 - (c) can be controlled by altering DO concentration if it is always maintained above critical DO value
 - (d) can be controlled if the product produced is inhibitory in nature
37. During sterilization of fermentor, the air in the head space would cause
- (a) lowered steam pressure than what is needed
 - (b) increased steam pressure than what is needed
 - (c) increased partial pressure of steam in the head space
 - (d) Does not affect steam pressure at all
38. For cultivation of recombinant *E. coli* using fed-batch techniques, if feed rate is kept at a linearly increasing value, the specific growth rate
- (a) increases
 - (b) decreases
 - (c) remains constant
 - (d) Not related to feed rate

39. Identify which of the following is **not** used in scale up of a fermentation process.
- (a) $k_L a$ (volumetric oxygen coefficient)
 - (b) Dissolved oxygen tension
 - (c) Impeller tip speed
 - (d) Degradation of medium due to sterilization
40. In transient flow regime, power number is — the impeller Reynolds number.
- (a) directly proportional to
 - (b) inversely proportional to
 - (c) independent of
 - (d) non-linearly related to
41. In depth filtration, the size of the bacterium is
- (a) smaller than the pore size of filter medium
 - (b) greater than the pore size of filter medium
 - (c) same as that of the pore size of filter medium
 - (d) bigger than that of fibre thickness of the filter
42. When the carbon source used for cultivation is changed from glucose to more reduced compound in a bioprocess, you would definitely expect
- (a) lower specific oxygen uptake
 - (b) higher specific heat production
 - (c) higher specific growth rate
 - (d) lower product yield

43. On increasing the enzyme concentration by few folds, the kinetic parameter(s) that increase(s) is/are
- (a) K_m
 - (b) K_{cat}
 - (c) V_{max}
 - (d) both K_m and K_{cat}
44. In several microorganisms during deceleration phase of growth, the specific productivity of antibiotics synthesized is
- (a) more than that in stationary phase
 - (b) equal as that in stationary phase
 - (c) less than that in stationary phase
 - (d) Not produced at all
45. Average volumetric productivity for a given size of reactor is maximum for
- (a) batch culture
 - (b) chemostat culture
 - (c) fed-batch culture
 - (d) repeated fed-batch culture
46. Which one of the following is best suited to sterilize a heat-labile solution?
- (a) Ultrahigh temperature sterilization
 - (b) UV irradiation
 - (c) Membrane filtration
 - (d) Pasteurization

47. Which one of the following traits is most critical for a microorganism to be used in production of recombinant protein?
- (a) Ability to achieve high cell concentrations
 - (b) Low biomass yield
 - (c) Low substrate consumption rate
 - (d) Tolerance to product inhibition
48. Identify which one of the following recombinant organisms is considered as good ethanol producer.
- (a) *P. putida*
 - (b) *B. subtilis*
 - (c) *E. coli*
 - (d) *P. pastoris*
49. The major advantage of using silicone as an antifoaming agent is due to
- (a) increased gas holdup caused by silicone
 - (b) decreased gas holdup caused by silicone
 - (c) cheaper than vegetable oils
 - (d) silicone acting also as a carbon source
50. Which of the following reactors has got the maximum heat removing capability?
- (a) Continuous stirred tank reactor
 - (b) Cell-immobilized reactor
 - (c) Solid substrate reactor
 - (d) Airlift reactor
51. The Rushton turbine as bottommost impeller is used for
- (a) breaking and dispersing the solid components in the medium
 - (b) creating axial movement of medium along the shaft of the fermentor
 - (c) breaking and dispersing air bubbles from the sparger
 - (d) removing maximum amount of heat generated from the bottom of the reactor

52. Which of the following filtration devices produces very clear filtrate?
- (a) Rotary vacuum filter
 - (b) Plate and frame filter press
 - (c) Leaf filter
 - (d) Microfilter
53. The solubility of sparingly soluble gases like oxygen in the medium is a function of
- (a) temperature alone
 - (b) temperature and nature of the medium components
 - (c) temperature and pressure
 - (d) temperature, pressure and nature of the medium components
54. The viscosity of the fermentation broth Newtonian in nature can be compared to viscosity of
- (a) oil
 - (b) glycerol
 - (c) water
 - (d) methyl alcohol
55. The centrifugal pumps used in biochemical plants are used for transferring
- (a) sterile medium
 - (b) sterile oil in the reactor
 - (c) non-sterile medium
 - (d) flammable liquids
56. Which one of the following valves is used in the fermentation plant for transfer of sterile fluids?
- (a) Gate valve
 - (b) Globe valve
 - (c) Butterfly valve
 - (d) Diaphragm valve

57. Highly viscous fluids and pastes are agitated by
- (a) propellers
 - (b) turbine agitators
 - (c) multiple blade paddles
 - (d) inclined blade agitators
58. Which one of the following is a continuous filter?
- (a) Plate and frame filter
 - (b) Cartridge filter
 - (c) Shell and leaf filter
 - (d) Rotary drum vacuum filter
59. For which one of the following agitator devices, the power number is maximum?
- (a) Concave disc turbine
 - (b) Rushton turbine
 - (c) Propellers
 - (d) High efficiency impellers
60. In ideal continuous flow stirred tank reactor, the composition of the exit stream is
- (a) same as that in the reactor
 - (b) different as that in the reactor
 - (c) same if steady state is achieved
 - (d) different during transient state
61. The alkaloid strychnine exhibits the following action with the given neurotransmitter.
- (a) Antagonist of phenylalanine
 - (b) Antagonist of glutamate
 - (c) Antagonist of glycine
 - (d) Antagonist of tyrosine

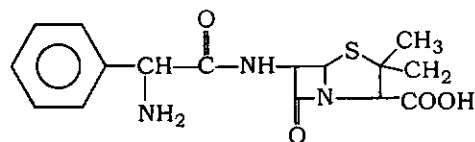
62. Gentamicin with a half-life of 12 hours is administered by continuous intravenous infusion. How long will it take for the same to reach 90% of its final steady-state level?
- (a) 40 hours
 - (b) 24 hours
 - (c) 18 hours
 - (d) 30 hours
63. The site for rRNA synthesis in eukaryotic cell is
- (a) rough endoplasmic reticulum
 - (b) Golgi bodies
 - (c) smooth endoplasmic reticulum
 - (d) nucleolus
64. Non-enzymatic browning of carbohydrates and amino acids is known as
- (a) caramelization
 - (b) Maillard reaction
 - (c) tautomerization
 - (d) racemization
65. Which of the following drugs is used for reactivation of acetylcholinesterase?
- (a) Pralidoxime
 - (b) Isoflurophate
 - (c) Sarin
 - (d) Edrophonium
66. Dietary restrictions for MAO inhibitors like isocarboxazid include abstinence from tyramine-rich foods such as
- (a) apples
 - (b) milk
 - (c) cheese
 - (d) cabbage leaves

67. Synthesis of anticancer cisplatin utilizes which of the following intermediates?
- (a) $[\text{PtBr}_4]^{2-}$
 - (b) $[\text{PtI}_4]^{2-}$
 - (c) $[\text{PtCl}_4]^{2-}$
 - (d) $[\text{PtF}_4]^{2-}$
68. The drug of choice for testicular cancer is
- (a) misoprostol
 - (b) methotrexate
 - (c) vincristine
 - (d) bleomycin
69. Ephedrine causes
- (a) miosis
 - (b) bronchodilation
 - (c) hypotension
 - (d) bradycardia
70. Which of the following antiseizure drugs acts directly on the GABA receptor-chloride channel complex?
- (a) Vigabatrin
 - (b) Diazepam
 - (c) Gabapentin
 - (d) Valproate
71. In which of the following rheograms, flow curve does **not** pass through the origin?
- (a) Plastic flow
 - (b) Pseudoplastic flow
 - (c) Dilatant flow
 - (d) Newtonian flow

72. Which one is **not** semisynthetic?
- (a) Methicillin
 - (b) Cloxacillin
 - (c) Ampicillin
 - (d) Phenoxymethylpenicillin
73. Exactly 200 g of moist solid is brought to a constant dry weight of 120 g. Calculate the moisture content and loss on drying.
- (a) 40% and 66.7% respectively
 - (b) 66.7% and 40% respectively
 - (c) 60% and 40% respectively
 - (d) 40% and 60% respectively
74. Which of the following compression processes expends maximum energy in manufacturing tablets from unlubricated granules?
- (a) Compression
 - (b) Overcoming die wall friction
 - (c) Upper punch withdrawal
 - (d) Tablet ejection
75. A superdisintegrant in tablet formulation is
- (a) sodium starch glycolate
 - (b) PVP
 - (c) starch
 - (d) magnesium-aluminium silicates
76. Which is **not** a film-coating defect?
- (a) Roughness
 - (b) Blistering
 - (c) Capping
 - (d) Cracking

77. What should be the contact angle between the particles and the liquid to have complete wetting of the particles?
- 180°
 - 120°
 - 90°
 - 0°
78. Which machine can successfully fill dry powder into a soft gelatin capsule?
- Plate process machine
 - Rotary die process machine
 - Reciprocating die machine
 - Accogel machine
79. Which one of the following is a cationic surfactant?
- Sodium dodecyl sulfate
 - Diocetyl sodium sulfosuccinate
 - Cetyltrimethylammonium bromide
 - Perfluorononanoate
80. A rectal suppository is used to treat a fever. This would represent what type of drug delivery?
- Parenteral and local
 - Parenteral and systemic
 - Enteral and local
 - Enteral and systemic

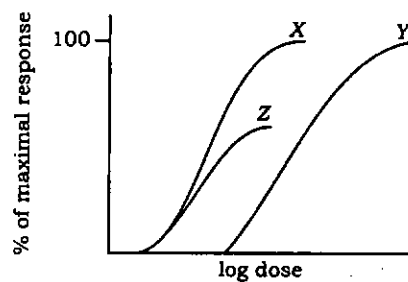
81. The following structure may be modified to produce amoxicillin by attaching a/an



- hydroxyl group
- amide
- aldehyde
- hydroxyl group and carboxylic group

82. A patient has a serum potassium level of 6 mmol/L. The amount of potassium in milligram in a 20 mL sample of the patient's serum is (relative atomic mass of potassium = 39)
- 3.08 mg
 - 4.68 mg
 - 30.8 mg
 - 46.8 mg
83. What is the unit of area under the plasma concentration-time curve (AUC)?
- mg.L^{-1}
 - $\text{mg.L}^{-1}.\text{hr}$
 - $\text{mL.hr}^{-1}.\text{kg}^{-1}$
 - $\text{mg.L}^{-1}.\text{hr}^{-1}$
84. Lignocaine has a pK_a of 7.9 at pH 6.9. The percentage ionized is
- 5%
 - 10%
 - 50%
 - 90%

85. Find out from the graph, which is correct about drug X, Y and Z.



- X is the most potent and efficient drug
- Y is the most potent and efficient drug
- Z is the most potent and efficient drug
- X and Z are both equally potent and efficient drugs

86. Indicate the anesthetic which is used intravenously.
- (a) Propofol
 - (b) Halothane
 - (c) Desflurane
 - (d) Nitrous oxide
87. Select the drug which inhibits peristalsis.
- (a) Castor oil
 - (b) Bisacodyl
 - (c) Loperamide
 - (d) Sorbitol
88. Which of the following substances is synthesized within vessel walls and inhibits thrombogenesis?
- (a) Thromboxane A₂ (TXA₂)
 - (b) Prostacyclin (PGI₂)
 - (c) Prostaglandin (PGE)
 - (d) Misoprostol
89. Indicate the drug belonging to antagonists of heparin.
- (a) Aspirin
 - (b) Dicumarol
 - (c) Dalteparin
 - (d) Protamine sulfate
90. The non-glycoside positive inotropic drug is
- (a) digoxin
 - (b) strophanthin K
 - (c) dobutamine
 - (d) digitoxin

PART—B

(Marks : 40)

(**Physics, Chemistry and Mathematics**)

Answer **all** questions

91. As a planet orbits the sun, which of the following must remain constant?
- (a) Velocity
 - (b) Angular momentum
 - (c) Gravitational force
 - (d) Radius of the orbit
92. An electric field can deflect
- (a) X-rays
 - (b) α -particles
 - (c) neutrons
 - (d) γ -rays
93. The horizontal range of a projectile is R , when the angle of projection is 30° . The value of another angle of projection for the same range is
- (a) 60°
 - (b) 50°
 - (c) 45°
 - (d) 30°
94. A satellite is moving round the earth. In order to make it move to infinity, its speed must be increased by
- (a) 20%
 - (b) 41.4%
 - (c) It is not possible to do so
 - (d) a factor of 2

95. A bullet is fired from a gun. The gun recoils. The KE of the recoil will be
- (a) greater than the KE of the bullet
 - (b) equal to the KE of the bullet
 - (c) less than the KE of the bullet
 - (d) four times that of the KE of the bullet
96. An object is projected upwards with a velocity of 100 m/s. It will strike the ground in approximately ($g = 10 \text{ m/s}^2$)
- (a) 10 s
 - (b) 20 s
 - (c) 15 s
 - (d) 5 s
97. Two particles *A* and *B* initially at rest, move towards each other under a mutual force of attraction. At the instant when the speed of *A* is V and the speed of *B* is $2V$, the speed of the centre of mass of the system is
- (a) zero
 - (b) V
 - (c) $1.5V$
 - (d) $3V$
98. During the melting of a slab of ice at 273 K at atmospheric pressure
- (a) positive work is done by the ice-water system on the atmosphere
 - (b) no positive work is done by the ice-water system on the atmosphere
 - (c) the internal energy of the ice-water system increases
 - (d) the internal energy of the ice-water system decreases

99. Ice starts forming in a lake with water at $0\text{ }^{\circ}\text{C}$ when the atmospheric temperature is $-10\text{ }^{\circ}\text{C}$. If the time taken for 1 cm of ice to be formed is 7 hours, the time taken for the thickness of ice to change from 1 cm to 2 cm is
- (a) 7 hr
 - (b) < 7 hr
 - (c) > 14 hr
 - (d) > 7 hr but < 14 hr
100. An open pot is filled with air at $60\text{ }^{\circ}\text{C}$. What is the temperature of heating so that $\frac{1}{4}$ th part of this air goes outside?
- (a) $171\text{ }^{\circ}\text{C}$
 - (b) $100\text{ }^{\circ}\text{C}$
 - (c) $0\text{ }^{\circ}\text{C}$
 - (d) $-73\text{ }^{\circ}\text{C}$
101. A litre of an ideal gas at $27\text{ }^{\circ}\text{C}$ is heated at constant pressure to $297\text{ }^{\circ}\text{C}$. Final volume is approximately equal to
- (a) 1.2 litres
 - (b) 1.9 litres
 - (c) 19 litres
 - (d) zero
102. A gas at 300 K, enclosed in a container, is placed in a fast-moving train. When the train is in motion, the temperature of the gas
- (a) rises above 300 K
 - (b) falls below 300 K
 - (c) remains unchanged
 - (d) becomes unsteady

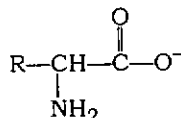
103. A man inside an artificial satellite feels weightlessness, because the force of attraction due to the earth is
- (a) zero at that place
 - (b) balanced by the force of attraction due to the moon
 - (c) equal to the centripetal force
 - (d) non-effective due to particular design of the satellite
104. A thermodynamic cycle of diesel engine works at
- (a) constant pressure
 - (b) constant volume
 - (c) constant temperature
 - (d) constant heat
105. Two point charges q_1 and q_2 are separated by a distance r . What happens to the force on q_2 , if the charge on q_1 is doubled?
- (a) It is doubled
 - (b) It is halved
 - (c) It is quadrupled
 - (d) It becomes $\frac{1}{4}$ th of the original
106. Refractive index of materials is approximately equal to square root of
- (a) electrical permittivity
 - (b) magnetic permeability
 - (c) electrical permittivity \times magnetic permeability
 - (d) electrical permittivity/magnetic permeability
107. Among the following acids, which has the lowest pK_a value?
- (a) CH_3COOH
 - (b) HCOOH
 - (c) $(\text{CH}_3)_2\text{COOH}$
 - (d) $\text{CH}_3\text{CH}_2\text{COOH}$

108. The highest electrical conductivity of the following aqueous solutions is of
- (a) 0.1 M acetic acid
 - (b) 0.1 M chloroacetic acid
 - (c) 0.1 M fluoroacetic acid
 - (d) 0.1 M difluoroacetic acid
109. Which type of isomerism is shown by 2,3-dichlorobutane?
- (a) Diastereo
 - (b) Optical
 - (c) Geometric
 - (d) Structural
110. Which of the following is fully fluorinated polymer?
- (a) Neoprene
 - (b) Teflon
 - (c) Thiokol
 - (d) PVC
111. How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion?
- (a) Six
 - (b) Three
 - (c) One
 - (d) Eight
112. What color of visible light has the highest energy?
- (a) Violet
 - (b) Yellow
 - (c) Red
 - (d) Green

113. Of the following, which radiation has the longest wavelength and which radiation has the greatest energy?
- (a) Ultraviolet, gamma
 - (b) Visible, ultraviolet
 - (c) Gamma, gamma
 - (d) Visible, gamma
114. What color of visible light has the longest wavelength?
- (a) Blue
 - (b) Violet
 - (c) Red
 - (d) Yellow
115. Gold and platinum group metals are found in nature in metallic form, because they are
- (a) solids at room temperature
 - (b) highly reactive
 - (c) relatively inert
 - (d) relatively abundant
116. A mineral is
- (a) a solid inorganic compound that contains one or more metals
 - (b) a source of carbon
 - (c) a metal in its elemental form
 - (d) a transition metal ion
117. What is the purpose of adding EDTA to prepared foods?
- (a) To keep ions such as Ca^{2+} in solution so the foods look good
 - (b) To complex trace metal ions that catalyze decomposition reactions
 - (c) To complex iron (III) ions so they can catalyze protein decomposition on cooking
 - (d) To aid in browning of the surface during cooking

- 118.** A complex that absorbs light at 700 nm will appear
- (a) red
 - (b) green
 - (c) yellow
 - (d) orange
- 119.** A metal complex absorbs light mainly at 420 nm. What is the color of the complex?
- (a) Green
 - (b) Yellow
 - (c) Red
 - (d) Orange
- 120.** The attraction of a metal to a neutral ligand is due to
- (a) ionic interaction
 - (b) hydrophobic interaction
 - (c) ion-dipole interaction
 - (d) dipole-dipole interaction
- 121.** Which of the following atoms has four electrons available for covalent bonding and can form rings, long chains and double bonds—making it the building block of the most versatile complex biological molecules?
- (a) Carbon
 - (b) Hydrogen
 - (c) Oxygen
 - (d) Nitrogen
- 122.** The level of protein structure that involves interactions between the side chains of the amino acids rather than the interactions between molecules within the backbone is
- (a) primary
 - (b) helical
 - (c) secondary
 - (d) tertiary

123. An amino acid has the form shown at



- (a) a pH greater than its isoelectric point
 - (b) a pH less than its isoelectric point
 - (c) any pH other than 7.0
 - (d) its isoelectric point
124. Which one of the following microorganisms is commonly used as a biological indicator in autoclave?
- (a) *Bacillus megaterium*
 - (b) *Pseudomonas aeruginosa*
 - (c) *Bacillus stearothermophilus*
 - (d) *Staphylococcus aureus*
125. Which pair of amino acids can have ionic interactions?
- (a) Glutamic acid and serine
 - (b) Glycine and asparagine
 - (c) Leucine and alanine
 - (d) Asparagine and lysine
126. The state in which protein primary structure is destroyed, thus destroying the other aspects of its structure, is
- (a) denatured
 - (b) ionized
 - (c) esterified
 - (d) hydrolyzed

127. Good sources of carbohydrate are
- (a) fats, oils, butter and margarine
 - (b) fish, eggs, beef, pork and poultry
 - (c) cereals, fruits, vegetables and milk
 - (d) green-leafy vegetables, seafood and water
128. Cooked starch is more digestible, because
- (a) it has been partially hydrolyzed during cooking
 - (b) the amylopectin is converted to amylose during cooking
 - (c) the enzymes that hydrolyze the starch are only active when the starch is hot
 - (d) the starch granules take up water, swell and are more accessible to the enzymes
129. What are the selection rules for FTIR absorption?
- (a) Absorption only occurs for symmetrical molecules
 - (b) Absorption only occurs with a dipole change
 - (c) Absorption requires an odd vibrational quantum number
 - (d) All of the above
130. In what region of the spectrum does infrared radiation occur?
- (a) At the low-energy end
 - (b) Between the visible and ultraviolet regions
 - (c) Between the visible and microwave regions
 - (d) Between the visible and X-ray regions

PART—C

(Marks : 35)

(**Fundamentals of Life Sciences and Informatics**)

Answer **all** questions

- 131.** The respiratory quotient during cellular respiration depends upon
- (a) nature of substrate
 - (b) nature of enzyme
 - (c) amount of CO₂ released
 - (d) amount of oxygen utilized
- 132.** Which blood vessel brings oxygenated blood?
- (a) Pulmonary artery
 - (b) Right ventricle
 - (c) Superior vena cava
 - (d) Pulmonary vein
- 133.** Sodium and potassium balance is regulated by
- (a) aldosterone
 - (b) testosterone
 - (c) estradiol
 - (d) cholesterol
- 134.** If two black rabbits are crossed, ten black and three white rabbits result. The parents are
- (a) homozygous
 - (b) heterozygous
 - (c) incompletely dominant
 - (d) codominant
- 135.** The individual in a pedigree from whom the pedigree was ascertained by the clinician is referred as
- (a) proband
 - (b) affected
 - (c) sibling
 - (d) phenocopy

136. Loci carried on the same chromosome are called
- (a) alleles
 - (b) non-allelic
 - (c) linked
 - (d) recombinants
137. Trisomy 21 is also referred to as
- (a) Edward's syndrome
 - (b) David's syndrome
 - (c) Patau's syndrome
 - (d) Down's syndrome
138. Codons that do not code for amino acids are
- (a) phosphates
 - (b) antisense
 - (c) nonsense
 - (d) start codons
139. Markers for the identification of disease-causing genes can be obtained from
- (a) cDNA
 - (b) SNP
 - (c) retroviruses
 - (d) RFLP
140. In which of the following, recombination does **not** occur?
- (a) Human males
 - (b) Human females
 - (c) *Drosophila* males
 - (d) *Drosophila* females

- 141.** Cancer drug methotrexate
- (a) inhibits dihydrofolate reductase
 - (b) inhibits meiosis
 - (c) causes B₁₂ deficiency
 - (d) inhibits uric acid formation
- 142.** Which of the following enzymes does aspirin inhibit?
- (a) Dehydrogenase
 - (b) Protease
 - (c) Cyclooxygenase
 - (d) Acetylase
- 143.** Which of the following coenzymes is required for one carbon transfer?
- (a) NAD⁺
 - (b) FAD
 - (c) Tetrahydrofolate
 - (d) Biotin
- 144.** Nitrogen in terrestrial animal is excreted as
- (a) ammonia
 - (b) uric acid
 - (c) allantoinic acid
 - (d) urea
- 145.** In a biotic community, the primary consumers are
- (a) carnivores
 - (b) herbivores
 - (c) omnivores
 - (d) detritivores

146. The major plant hormone important in regulating plant's response towards salt stress is
- (a) auxin
 - (b) abscisic acid
 - (c) gibberellin
 - (d) cytokinin
147. Water loss through the stomata of leaves is termed as
- (a) transpiration
 - (b) translocation
 - (c) osmosis
 - (d) evaporation
148. The net number of ATP generated from one molecule of glucose by the process of glycolysis is
- (a) 16
 - (b) 2
 - (c) 8
 - (d) 32
149. In the electron transport system, the final acceptor of proton is
- (a) cytochrome b
 - (b) cytochrome a₃
 - (c) oxygen
 - (d) ubiquinone
150. Most vitamins function as
- (a) lubricants for active transport
 - (b) a foundation for building bones
 - (c) transport molecules within plasma membranes
 - (d) coenzymes
151. All alleles originate from
- (a) mutations
 - (b) crossovers
 - (c) gene flow
 - (d) nondisjunction

152. Which one of the following does involve genetic engineering?
- (a) Conjugation
 - (b) Deamination
 - (c) Cloning
 - (d) Mutation
153. T cells mature in the
- (a) thyroid gland
 - (b) spleen
 - (c) bone marrow
 - (d) lymph nodes
154. Initiation of new strand of DNA during replication requires
- (a) DNA primer
 - (b) RNA primer
 - (c) RNA polymerase
 - (d) DNA polymerase
155. Plasmids are
- (a) non-circular DNA segments in bacteria
 - (b) small self-replicating DNA molecules in bacteria
 - (c) made of RNA
 - (d) necessary for bacteria to reproduce

- 156.** What protocol is used for file transfer?
- (a) TELNET
 - (b) FTP
 - (c) HTTP
 - (d) UDP
- 157.** The UNIX command used to search files for lines matching a regular expression is called as
- (a) sort
 - (b) grep
 - (c) cat
 - (d) search
- 158.** TCP/IP protocol used for remote terminal connection service is
- (a) TELNET
 - (b) FTP
 - (c) HTTP
 - (d) UDP
- 159.** The Linux command `grep gccatg dna.txt` will
- (a) join two files `gccatg` and `dna.txt`
 - (b) search the file `dna.txt` for lines containing the text string `gccatg`
 - (c) append the text `gccatg` to `dna.txt`
 - (d) overwrite `dna.txt` with `gccatg`
- 160.** The Linux command used to count the number of characters in a given file is
- (a) `wc-l`
 - (b) `wc-c`
 - (c) `wc-a`
 - (d) `wc-w`

- 161.** The Linux command used to convert a group of files into an archive is
- (a) find
 - (b) cat
 - (c) tar
 - (d) grep
- 162.** A device used to forward data packets between computer networks and operates at the OSI model network layer is
- (a) router
 - (b) connector
 - (c) bus
 - (d) bridge
- 163.** The Internet protocol for sending e-mail messages is
- (a) FTP
 - (b) HTTP
 - (c) SMTP
 - (d) TELNET
- 164.** The SQL command used to provide privileges on a given database objects to the users is
- (a) revoke
 - (b) grant
 - (c) commit
 - (d) update
- 165.** The SQL command `Select * from protein where pdbid = 2apl` will display
- (a) all the columns which are having pdbid 2apl
 - (b) all the records of the table protein
 - (c) all the records which are having a * symbol
 - (d) all the records which are having pdbid 2apl

Registration No. :

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Centre of Exam. :

Name of Candidate :

Signature of Invigilator

**COMBINED ENTRANCE EXAMINATION, 2014
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 ● (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 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. An allele is best defined as
 - (a) an alternative form of gene
 - (b) the position of a gene on a chromosome
 - (c) a cellular structure composed of DNA and protein
 - (d) the place on a chromosome where spindle fibres attach

2. Upon which two major features of chromosomes does their cytological identification depend?
 - (a) Length of chromosome and position of centromere
 - (b) Amount of DNA and intensity of staining
 - (c) Numbers of nucleoli and centromeres
 - (d) Number of chromatids and length of arms

3. If an individual of genotype AaBbCc are intercrossed, how many different phenotypes can appear in their offspring?
 - (a) 3
 - (b) 6
 - (c) 8
 - (d) 16

4. A mutation in the codon UCG to UAG is described as
 - (a) missense mutation
 - (b) neutral mutation
 - (c) silent mutation
 - (d) nonsense mutation

5. A treatment often used to induce polyploidy experimentally in plants is
 - (a) colchicine
 - (b) gibberellic acid
 - (c) acridine dyes
 - (d) X-rays

6. If during synapsis a certain kind of abnormal chromosome is always forced to bulge away from its normal homologue, the abnormality is classified as
- (a) an inversion
 - (b) a duplication
 - (c) an isochromosome
 - (d) a deficiency
7. If four chromosomes synapse into a cross-shaped configuration during meiotic prophase, the organism is heterozygous for a
- (a) pericentric inversion
 - (b) translocation
 - (c) deletion
 - (d) paracentric inversion
8. The physiologically receptive state in which a bacterial cell is able to be transformed is called
- (a) sensitized
 - (b) activated
 - (c) competence
 - (d) lysogenic
9. The distances between bacterial genes, as determined from interrupted conjugation experiments, are measured in units of
- (a) morgan
 - (b) nucleotide pairs
 - (c) minutes
 - (d) micrometers
10. Identify the correct statement on stability of nucleic acids.
- (a) RNA is labile in alkali but DNA is not
 - (b) DNA is labile in alkali but RNA is not
 - (c) Both RNA and DNA are labile in alkali
 - (d) Neither RNA nor DNA is labile in alkali

11. Restriction-modification systems of bacteria exist to
- protect bacteria from invading foreign DNA
 - promote conjugation
 - help the bacterial chromosome replicate
 - promote complementation
12. Among all known phages reproducing vegetatively, the only one that neither kills nor lyses its host cell is
- M13
 - T4
 - Mu
 - P1
13. Bacterial cells are rendered more permeable to uptake of foreign DNA by treatment with
- heat
 - calcium chloride
 - alkali
 - ultrasound
14. The melting temperature of a DNA molecule is determined by using
- electrophoresis
 - change in electrical conductivity
 - spectrophotometric study
 - ultracentrifugation
15. Which of the following differentiates eukaryotic DNA replication from prokaryotic replication?
- Multiple origins of replication
 - Bidirectional replication forks
 - Use of only one DNA polymerase
 - No use of RNA primer
16. The DNA fingerprinting process involves
- VNTR loci
 - RFLPs
 - chain termination
 - cDNA

17. Hormones are thought to regulate gene activity primarily at the level of
- (a) transcription
 - (b) mRNA processing
 - (c) translation
 - (d) post-translation processing of protein
18. Which of the following molecules moves regularly from the nucleus to the cytoplasm?
- (a) Glycogen
 - (b) RNA
 - (c) DNA
 - (d) Cholesterol
19. DNA migrates in an electric field, because
- (a) it is positively charged
 - (b) it is negatively charged
 - (c) it carries both negative and positive charges at different locations
 - (d) it is neutral
20. Which of the following is a type of intercellular junction between animal cells?
- (a) Middle lamella
 - (b) Plasmodesma
 - (c) Desmosome
 - (d) Glycocalyx
21. Which of the following methods for transporting substances across a membrane does **not** involve a change in shape of the transport protein?
- (a) Facilitated diffusion
 - (b) Active transport
 - (c) Simple diffusion
 - (d) Sodium-potassium pump

22. How many carbon atoms are in an oxaloacetic acid molecule, which join with an acetyl group step 1 of the Krebs citric acid cycle?
- (a) 2
 - (b) 3
 - (c) 4
 - (d) 6
23. In the electron transport system, the final acceptor of proton is
- (a) cytochrome b
 - (b) cytochrome a₃
 - (c) oxygen
 - (d) ubiquinone
24. The place in the mitochondrion where the pH is lowest is the
- (a) ribosomal complex
 - (b) intermembrane space
 - (c) cytosol
 - (d) matrix
25. In a eukaryotic cell, glycolysis takes place
- (a) within the nucleus
 - (b) on the rough endoplasmic reticulum
 - (c) in the cytoplasm, but outside the organelles
 - (d) within the mitochondria
26. How long ago did the first photosynthetic organisms appear?
- (a) 7 billion years
 - (b) 3 billion years
 - (c) 1 billion years
 - (d) 500 million years

- 27.** An isolated population of humans with approximately equal numbers of blue-eyed and brown-eyed individuals was decimated by an earthquake. Only a few brown-eyed people remained to form the next generation. This kind of change in the gene pool is called a
- (a) Hardy-Weinberg equilibrium
 - (b) blocked gene flow
 - (c) bottleneck effect
 - (d) founder effect
- 28.** The regions of an antibody that determine its general role or effector function, are its
- (a) variable (V) regions
 - (b) constant (C) regions
 - (c) mutated (M) regions
 - (d) bifurcated (B) regions
- 29.** Lymphocytes that activate B cells and T cells are
- (a) activator B cells
 - (b) cytotoxic T cells
 - (c) macrophages
 - (d) helper T cells
- 30.** An allergic reaction is initiated by antibodies of the
- (a) IgG group
 - (b) IgM group
 - (c) IgA group
 - (d) IgE group
- 31.** The symptoms of an allergic reaction develop in response to
- (a) interferons
 - (b) interleukins
 - (c) histamine
 - (d) complement

32. The virus that causes acquired immunodeficiency syndrome (AIDS) parasitizes
- (a) B cells
 - (b) cytotoxic T cells
 - (c) helper T cells
 - (d) the membranes of lymph nodes
33. White blood cells that are non-specific killers of microbes are
- (a) B cells
 - (b) phagocytes
 - (c) killer T cells
 - (d) helper T cells
34. Most vitamins function as
- (a) lubricants for active transport
 - (b) a foundation for building bones
 - (c) transport molecules within plasma membranes
 - (d) coenzymes
35. About how many nephrons are there in each kidney of a human?
- (a) 160
 - (b) 2000
 - (c) 10000
 - (d) 1000000
36. Which of the following statements is **not** true?
- (a) Genotype determines phenotype
 - (b) A phenotype is the physical appearance of a trait in an organism
 - (c) Phenotype determines genotype
 - (d) Alleles are different forms of the same gene

37. A large rise in body temperature of a human is corrected mainly by
- constricting the skin arteries and sweating
 - constricting the skin arteries and shivering
 - dilating the skin arteries and sweating
 - dilating the skin arteries and shivering
38. The wobble effect is the
- lack of precision in pairing with regard to the third base in the codon and anticodon
 - instability of the DNA molecule when unwound
 - instability of pairing when a purine pairs with another pyrimidine
 - undulating movements of mRNA
39. The Northern technique involves
- the detection of RNA fragments on membranes by specific radioactive DNA probe
 - the detection of DNA fragments on membranes by a radioactive DNA probe
 - the detection of proteins on membranes using a radioactive DNA probe
 - the detection of proteins on membranes using specific radioactive antibodies
40. Restriction endonuclease generated DNA fragments separated by gel electrophoresis and blot transferred onto a membrane filter are probed with a radioactive DNA fragment. This procedure is called
- gene cloning
 - the Southern technique
 - the polymerase chain reaction
 - recombinant DNA
41. 'Gene library' is a term used to describe
- a computerized listing of known DNA sequences
 - bacteria with plasmids containing DNA fragments representing the majority of the genetic information from a plant or animal
 - a collection of books about recombinant DNA technology
 - a compilation of the amino acid sequences of protein coding genes
42. One of the most significant discoveries, which allowed the development of recombinant DNA technology, was
- the discovery of antibiotics used for selecting transformed bacteria
 - the identification and isolation of restriction endonucleases permitting specific DNA cutting
 - the discovery of DNA and RNA polymerase allowing workers to synthesize any DNA sequence
 - the development of the polymerase chain reaction

43. A key feature of insertional mutagenesis for the identification of plasmids containing recombinant DNA is
- (a) the production of nutritional auxotrophs
 - (b) the DNA sequencing of recombinant plasmids
 - (c) the production of restriction endonuclease maps of recombinant plasmids
 - (d) the disruption of a gene on the plasmid by the inserted recombinant DNA
44. If a particular DNA molecule has 20% adenine (A), what is the percentage of cytosine (C) in the same molecule?
- (a) 10%
 - (b) 20%
 - (c) 30%
 - (d) 40%
45. Bacterial resistance to antibiotic is a genetic trait carried in the bacterial
- (a) plasmid
 - (b) chromosome
 - (c) intron
 - (d) centromere
46. Klenow fragment of DNA Pol I lacks which of the following activities?
- (a) 5' → 3' exonuclease
 - (b) 3' → 5' exonuclease
 - (c) 5' → 3' polymerase
 - (d) 3' → 5' polymerase
47. Huntington's disease is caused by
- (a) inability to metabolize maltose
 - (b) lack of vitamin C
 - (c) expansion of triplet repeats
 - (d) lack of vitamin D
48. 5-bromouracil is a base analogue of
- (a) uracil
 - (b) thymine
 - (c) adenine
 - (d) guanine

49. Which of the following are **not** found in DNA binding protein?
- (a) Homeodomains
 - (b) Zinc fingers
 - (c) Leucine zippers
 - (d) CpG islands
50. The strength of a typical hydrogen bond in DNA is about
- (a) 2–3 kcal/mole
 - (b) 10–15 kcal/mole
 - (c) 2–3 eV
 - (d) 5–10 eV
51. The unique property of the Taq DNA polymerase enzyme that is absolutely essential for the polymerase chain reaction is
- (a) processivity
 - (b) ability to make phosphodiester bonds
 - (c) ability to repair mistakes
 - (d) thermostability
52. The polymerase chain reaction (PCR) is useful in
- (a) cutting DNA into many small pieces
 - (b) allowing restriction enzymes to cut DNA at palindromes
 - (c) creating recombinant plasmids
 - (d) making many copies of a small amount of DNA
53. Of the 64 codons, how many code for amino acids?
- (a) 20
 - (b) 22
 - (c) 43
 - (d) 61
54. The first human hormone produced by recombinant DNA technology was
- (a) estrogen
 - (b) testosterone
 - (c) androgen
 - (d) insulin

55. Which of the following statements is incorrect in the context of CpG island?
- (a) It frequently occurs in the promoter regions of mammalian genes
 - (b) A large number of mammalian genes have CpG islands
 - (c) The G residue is generally methylated at position 5
 - (d) It has often been associated with cancer and aging
56. In SDS-PAGE, the proteins are separated according to their
- (a) charge density
 - (b) amino acid composition
 - (c) molecular weight
 - (d) isoelectric point
57. Which one of the following amino acids has only one codon?
- (a) Glycine
 - (b) Alanine
 - (c) Arginine
 - (d) Methionine
58. In DNA replication, the helix is unwound by which type of enzyme?
- (a) Topoisomerase
 - (b) Primase
 - (c) DNA polymerase
 - (d) Helicase
59. Bacterial cells protect their own DNA from degradation by restriction endonucleases by
- (a) deleting all recognition sites from the genome
 - (b) degrading the endonuclease after formation
 - (c) methylating the DNA at the sites that the enzyme recognizes
 - (d) not producing any restriction endonucleases
60. In a B-form DNA, the number of residues per turn is
- (a) ~10
 - (b) ~12
 - (c) ~14
 - (d) ~8

PART—B

(Marks : 40)

(**Physics and Chemistry**)

Answer **all** questions

61. As a planet orbits the sun, which of the following must remain constant?
- (a) Velocity
 - (b) Angular momentum
 - (c) Gravitational force
 - (d) Radius of the orbit
62. When yellow light is incident on a surface, no electrons are emitted while green light can emit. If red light is incident on the surface, then
- (a) no electrons are emitted
 - (b) photons are emitted
 - (c) electrons of higher energy are emitted
 - (d) electrons of lower energy are emitted
63. The horizontal range of a projectile is R , when the angle of projection is 30° . The value of another angle of projection for the same range is
- (a) 60°
 - (b) 50°
 - (c) 45°
 - (d) 30°
64. A satellite is moving round the earth. In order to make it move to infinity, its speed must be increased by
- (a) 20%
 - (b) 41.4%
 - (c) It is not possible to do so
 - (d) a factor of 2

65. A bullet is fired from a gun. The gun recoils. The KE of the recoil will be
- (a) greater than the KE of the bullet
 - (b) equal to the KE of the bullet
 - (c) less than the KE of the bullet
 - (d) four times that of the KE of the bullet
66. An object is projected upwards with a velocity of 100 m/s. It will strike the ground in approximately ($g = 10 \text{ m/s}^2$)
- (a) 10 s
 - (b) 20 s
 - (c) 15 s
 - (d) 5 s
67. Two particles A and B initially at rest, move towards each other under a mutual force of attraction. At the instant when the speed of A is V and the speed of B is $2V$, the speed of the centre of mass of the system is
- (a) zero
 - (b) V
 - (c) $1.5V$
 - (d) $3V$
68. During the melting of a slab of ice at 273 K at atmospheric pressure
- (a) positive work is done by the ice-water system on the atmosphere
 - (b) no positive work is done by the ice-water system on the atmosphere
 - (c) the internal energy of the ice-water system increases
 - (d) the internal energy of the ice-water system decreases

69. Ice starts forming in a lake with water at 0°C when the atmospheric temperature is -10°C . If the time taken for 1 cm of ice to be formed is 7 hours, the time taken for the thickness of ice to change from 1 cm to 2 cm is
- (a) 7 hr
 - (b) < 7 hr
 - (c) > 14 hr
 - (d) > 7 hr but < 14 hr
70. An open pot is filled with air at 60°C . What is the temperature of heating so that $\frac{1}{4}$ th part of this air goes outside?
- (a) 171°C
 - (b) 100°C
 - (c) 0°C
 - (d) -73°C
71. A litre of an ideal gas at 27°C is heated at constant pressure to 297°C . Final volume is approximately equal to
- (a) 1.2 litres
 - (b) 1.9 litres
 - (c) 19 litres
 - (d) zero
72. A gas at 300 K, enclosed in a container, is placed in a fast-moving train. When the train is in motion, the temperature of the gas
- (a) rises above 300 K
 - (b) falls below 300 K
 - (c) remains unchanged
 - (d) becomes unsteady

73. A man inside an artificial satellite feels weightlessness, because the force of attraction due to the earth is
- (a) zero at that place
 - (b) balanced by the force of attraction due to the moon
 - (c) equal to the centripetal force
 - (d) non-effective due to particular design of the satellite
74. A thermodynamic cycle of diesel engine works at
- (a) constant pressure
 - (b) constant volume
 - (c) constant temperature
 - (d) constant heat
75. Two point charges q_1 and q_2 are separated by a distance r . What happens to the force on q_2 , if the charge on q_1 is doubled?
- (a) It is doubled
 - (b) It is halved
 - (c) It is quadrupled
 - (d) It becomes $\frac{1}{4}$ th of the original
76. Refractive index of materials is approximately equal to square root of
- (a) electrical permittivity
 - (b) magnetic permeability
 - (c) electrical permittivity \times magnetic permeability
 - (d) electrical permittivity/magnetic permeability
77. An electric field can deflect
- (a) X-rays
 - (b) neutrons
 - (c) α -particles
 - (d) γ -rays

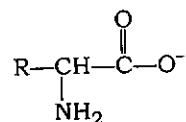
78. Fast neutrons can easily be slowed down by
- (a) the use of lead shielding
 - (b) passing them through water
 - (c) elastic collisions with heavy nuclei
 - (d) applying a strong electric field
79. A magnet moves into a coil of wire inducing a current in the wire. If the magnet is pulled back out of the coil in the opposite direction as it went into the coil, which of the following will occur?
- (a) There will be current produced in the coil in the same direction as before
 - (b) There will be current produced in the coil in the opposite direction as before
 - (c) No current will be generated since the direction of motion of the magnet cancels out
 - (d) Instead of current being produced on the coil of wire, it will be produced on the magnet
80. An electric lamp is marked 220 V and 100 W. The resistance of its filament is
- (a) 48.4 ohm
 - (b) 4.84 ohm
 - (c) 484 ohm
 - (d) 0.484 ohm
81. Among the following acids, which has the lowest pK_a value?
- (a) CH_3COOH
 - (b) HCOOH
 - (c) $(\text{CH}_3)_2\text{COOH}$
 - (d) $\text{CH}_3\text{CH}_2\text{COOH}$
82. The highest electrical conductivity of the following aqueous solutions is of
- (a) 0.1 M acetic acid
 - (b) 0.1 M chloroacetic acid
 - (c) 0.1 M fluoroacetic acid
 - (d) 0.1 M difluoroacetic acid

83. Which type of isomerism is shown by 2,3-dichlorobutane?
- (a) Diastereo
 - (b) Optical
 - (c) Geometric
 - (d) Structural
84. Which of the following is fully fluorinated polymer?
- (a) Neoprene
 - (b) Teflon
 - (c) Thiokol
 - (d) PVC
85. How many EDTA (ethylenediaminetetraacetic acid) molecules are required to make an octahedral complex with a Ca^{2+} ion?
- (a) Six
 - (b) Three
 - (c) One
 - (d) Eight
86. What color of visible light has the highest energy?
- (a) Violet
 - (b) Yellow
 - (c) Red
 - (d) Green

87. Of the following, which radiation has the longest wavelength and which radiation has the greatest energy?
- (a) Ultraviolet, gamma
 - (b) Visible, ultraviolet
 - (c) Gamma, gamma
 - (d) Visible, gamma
88. What color of visible light has the longest wavelength?
- (a) Blue
 - (b) Violet
 - (c) Red
 - (d) Yellow
89. Gold and platinum group metals are found in nature in metallic form, because they are
- (a) solids at room temperature
 - (b) highly reactive
 - (c) relatively inert
 - (d) relatively abundant
90. A mineral is
- (a) a solid inorganic compound that contains one or more metals
 - (b) a source of carbon
 - (c) a metal in its elemental form
 - (d) a transition metal ion
91. What is the purpose of adding EDTA to prepared foods?
- (a) To keep ions such as Ca^{2+} in solution so the foods look good
 - (b) To complex trace metal ions that catalyze decomposition reactions
 - (c) To complex iron (III) ions so they can catalyze protein decomposition on cooking
 - (d) To aid in browning of the surface during cooking

92. A complex that absorbs light at 700 nm will appear
- (a) red
 - (b) green
 - (c) yellow
 - (d) orange
93. A metal complex absorbs light mainly at 420 nm. What is the color of the complex?
- (a) Green
 - (b) Yellow
 - (c) Red
 - (d) Orange
94. The attraction of a metal to a neutral ligand is due to
- (a) ionic interaction
 - (b) hydrophobic interaction
 - (c) ion-dipole interaction
 - (d) dipole-dipole interaction
95. Which of the following atoms has four electrons available for covalent bonding and can form rings, long chains and double bonds—making it the building block of the most versatile complex biological molecules?
- (a) Carbon
 - (b) Hydrogen
 - (c) Oxygen
 - (d) Nitrogen
96. The level of protein structure that involves interactions between the side chains of the amino acids rather than the interactions between molecules within the backbone is
- (a) primary
 - (b) helical
 - (c) secondary
 - (d) tertiary

97. An amino acid has the form shown at



- (a) a pH greater than its isoelectric point
 - (b) a pH less than its isoelectric point
 - (c) any pH other than 7.0
 - (d) its isoelectric point
98. Which amino acid can form covalent sulfur-sulfur bonds?
- (a) Phenylalanine
 - (b) Cysteine
 - (c) Proline
 - (d) Methionine
99. Which pair of amino acids can have ionic interactions?
- (a) Glutamic acid and serine
 - (b) Glycine and asparagine
 - (c) Leucine and alanine
 - (d) Asparagine and lysine
100. The state in which protein primary structure is destroyed, thus destroying the other aspects of its structure, is
- (a) denatured
 - (b) ionized
 - (c) esterified
 - (d) hydrolyzed

PART—C

(Marks : 30)

(**Mathematics, Computer and Information Sciences**)

Answer **all** questions

- 101.** If $f(x) = \frac{x}{\sin x}$, $0 < x \leq \pi/4$, where x is measured in radians, then in this interval as x is decreased, $f(x)$ is
- (a) constant
 - (b) decreasing
 - (c) increasing
 - (d) oscillating
- 102.** If $f(x) = x^3 - 3x - 2$ in $[-2, 3]$ by the mean value theorem, then the value of C is
- (a) $\pm\sqrt{2}$
 - (b) $\pm\sqrt{7/3}$
 - (c) $\sqrt{3}$
 - (d) $\sqrt{3/2}$
- 103.** A tube is expanded in such a way that its edge is changing at a rate of 5 cm/s. If its edge is 4 cm long, then the rate of change of its volume is
- (a) $100 \text{ cm}^3/\text{s}$
 - (b) $200 \text{ cm}^3/\text{s}$
 - (c) $360 \text{ cm}^3/\text{s}$
 - (d) $240 \text{ cm}^3/\text{s}$

104. The value of integral $\int_{-\pi/4}^{\pi/4} x^3 \sin^4 x dx$ is

(a) $\pi/4$

(b) 0

(c) $\pi/2$

(d) 2π

105. The area bounded by the curve $y = 2x - x^2$ and the straight line $y = -x$ is

(a) $9/2$ sq. unit

(b) $10/3$ sq. unit

(c) $7\pi/8$ sq. unit

(d) $5\pi/2$ sq. unit

106. The value of integral $\int_0^{\pi/2} \frac{\sqrt{\sin x}}{\sqrt{\sin x} + \sqrt{\cos x}} dx$ is

(a) $\pi/2$

(b) $\pi/4$

(c) $\pi/8$

(d) π

107. The vectors $2i - 3j$ and $ai + 5j$ are perpendicular to each other. Then the value of a is
- 3
 - $15/2$
 - 5
 - 0
108. The differential equation $y = x \frac{dy}{dx} + 2\sqrt{1 + \left(\frac{dy}{dx}\right)^2}$ is of
- order 2, degree 2
 - order 2, degree 1
 - order 1, degree 2
 - order 1, degree 1
109. The integrating factor of differential equation $(1 + y^2) dx = (\tan^{-1} y - x) dy$ is
- y^3
 - $\frac{1}{y^2}$
 - $\tan^{-1} y$
 - $e^{\tan^{-1} y}$
110. The solution of the differential equation $\frac{dy}{dx} = e^{x-y} + x^2 e^{-y}$ is
- $e^y = e^x + x^2 + C$
 - $e^y = e^x + \frac{1}{3} x^3 + C$
 - $x + y = e^{x+y} + C$
 - $x - y = e^{x-y} + C$

111. The SQL command to modify the contents of records in a database table is
- (a) change
 - (b) update
 - (c) modify
 - (d) alter
112. Which of the following are a set of data control language commands in SQL?
- (a) Insert, Delete, Select
 - (b) Drop, Alter, Create
 - (c) Grant, Commit, Rollback
 - (d) Delete, Commit, Create
113. The integrity of each entity in a database table is maintained through
- (a) primary key
 - (b) foreign key
 - (c) duplicate key
 - (d) Not null constraint
114. In PERL programming language, singular values are stored in the following kind of variable
- (a) Arrays
 - (b) Lists
 - (c) Hashes
 - (d) Scalars
115. Which of the following is a command interpreter in Linux?
- (a) ls
 - (b) comm
 - (c) grep
 - (d) shell

116. In Linux operating system, the output of one command can become the input of another command through
- (a) pipe
 - (b) grep
 - (c) listing
 - (d) comm
117. The output of the Linux command `grep "^test" f1.txt` is
- (a) lines matching the pattern test in the file f1.txt
 - (b) lines not matching the pattern test in the file f1.txt
 - (c) lines beginning with the pattern test in the file f1.txt
 - (d) lines matching the pattern test in the file f1.txt displayed along with the line number
118. The following Linux command takes you to your home directory from any directory in the system
- (a) cd
 - (b) chd home
 - (c) chdir home
 - (d) home
119. You can login and execute programs in remote computers through
- (a) ftp
 - (b) rftp
 - (c) telnet
 - (d) remoteftp
120. The Internet addressing system that connects a domain name to a specified numeric IP address is
- (a) TCP
 - (b) DNS
 - (c) IDP
 - (d) UDP

121. The number system which uses a positional notation with a radix of 2 is
- (a) octal
 - (b) decimal
 - (c) binary
 - (d) hexadecimal
122. The SQL command `Select * from protein where pdbid = 2apl` will display
- (a) all the columns which are having `pdbid 2apl`
 - (b) all the records of the table `protein`
 - (c) all the records which are having a `*` symbol
 - (d) all the records which are having `pdbid 2apl`
123. The SQL command to remove a record from a table is
- (a) Erase
 - (b) Delete
 - (c) Alter
 - (d) Drop
124. In relational model, data are presented in the form of
- (a) entities and their relationships
 - (b) objects
 - (c) tables
 - (d) network
125. The C library function used to find out whether two strings are identical is
- (a) `strcat()`
 - (b) `strcmp()`
 - (c) `strlen()`
 - (d) `strrev()`

126. What will be the output of the following C program segment?

```
for(j = 1; j <= 4; j++) printf("%d", j);
```

- (a) 4
- (b) 1 2 3
- (c) 5
- (d) 1 2 3 4

127. In C language switch-case control statement, case keyword will **not** be followed by

- (a) float value
- (b) integer value.
- (c) constant expression
- (d) character value

128. In C language, the output of the expression $x = 22\%3$ will be

- (a) 0
- (b) 1
- (c) 2
- (d) 3

129. In Java, the keyword used for inheritance is

- (a) this
- (b) upper
- (c) extends
- (d) inherit

130. In Java, the keyword used to define a class is

- (a) new
- (b) class
- (c) object
- (d) member
