Entrance Examinations – 2020

Int. M.Sc.-Ph.D. Biochemistry and Molecular Biology

Hall Ticket No. [ ]

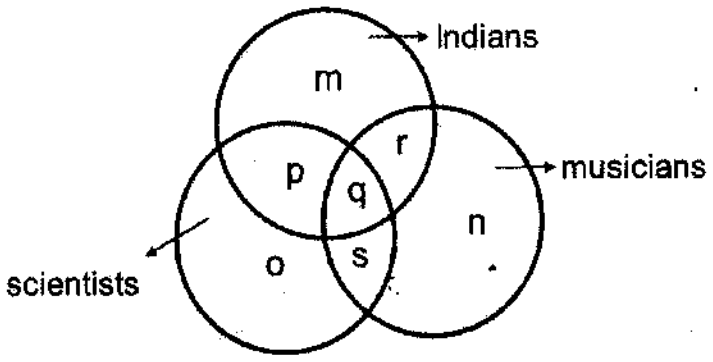
Time : 2 hours **Max. Marks : 70**

Please read the following instructions carefully before answering:

1. Enter Hall Ticket number in the space provided above and also on OMR sheet.
2. Paper contains two sections: Part A and Part B together with 60 questions for 70 marks. **Part A contains 25 questions. Questions 1 to 15 carry one mark each. Questions 16 to 25 carry 2 marks each. Part B contains 35 questions; each question carries one mark.**
3. **In Part A, there is no negative marking. In Part B, there is negative marking. 0.33 marks will be deducted for each wrong answer.**
4. Answers have to be marked on the OMR sheet as per the instructions provided.
5. Apart from OMR sheet, the question paper contains **11 (Eleven)** pages including the instructions and rough work sheets.
6. **Please return the OMR answer sheet at the end of examination.**
7. No additional sheet will be provided.
8. Rough work can be carried out in the question paper itself in the space provided at the end of the booklet.
9. Non programmable calculators are allowed.

PART-A

1. Which of the options has the correct combination of letters representing Indian musicians who are not scientists, and musician scientists who are not Indians on the basis of these three circles?



A) p and q respectively
B) q and r respectively
C) p and s respectively
D) r and s respectively

2. If FOUR is written as 1234, CARE is written as 5647 and RAIL is written as 4689, what will be the code for FAIR?

A) 1685 B) 1784 C) 1684 D) 1674

3. Given are two sentences based on which an inference is drawn. From the given options, select the option that best justifies the inference drawn.

(a) Either he is handsome or he is fat.
(b) He is handsome.
Inference: He is fat.

A. the inference is definitely true
B. the inference is definitely false
C. the inference is probably false or true
D. inference cannot be drawn

4. If 30% of X = Y, then Y% of 30 will be:
A. 9 B. 4 C. 6 D. 18

5. Cards with numbers 1 to 20 were shuffled and then one card was taken out from the deck. What is the percentage of chances that the card drawn will have a number which is a multiple of 3 or 5?
A) 40% B) 45% C) 50% D) 65%

6. A researcher is studying the migratory behaviour of normal cells and cancer cells. He noted that cancer cells could travel at an average rate of 50 micrometers per hour and complete a trip between two points in 6 hours, whereas normal cell could cover the same distance at the rate of 45 micrometers per hour. How many more minutes needed for normal cell to cover the same distance as cancer cell?
A) 30 minutes B) 40 minutes C) 10 minutes D) 60 minutes

7. Which one of the following treatments is UNLIKELY to destabilize DNA helix?
A) Raising the temperature
B) Treatment with 2N NaOH
C) Addition of 300mM NaCl
D) Addition of DMSO

8. Select the odd one out
A) inconsequential B) insignificant C) vital D) trivial

9. A box contains 10 good items and 6 defective items. One item is drawn at random. The probability that it is either good or has a defect is:
A) 64/64 B) 49/64 C) 40/64 D) 24/64

10. According to the law of LaPlace, the magnitude of the inward-directed collapsing pressure (P) is directly proportional to the surface tension (T) and inversely proportional to the radius (r) of the bubble, P=2T/r. Considering that alveoli are like bubbles, if there are there are two alveoli of unequal size, where alveolus A has radius 1 and surface tension 1/2T and alveolus B has radius 2 and surface tension T, what will happen to collapsing pressure?
A) Collapsing pressure of alveolus A > Collapsing pressure of alveolus B
B) Collapsing pressure of alveolus A < Collapsing pressure of alveolus B
C) Collapsing pressure of alveolus A ≤ Collapsing pressure of alveolus B
D) Collapsing pressure of alveolus A = Collapsing pressure of alveolus B

11. In pea plants, tall (T) is dominant over dwarf (t). In a cross-pollinated cross where 217 progeny were obtained, 103 plants were tall and the rest were dwarf. The genotype of the parents is most likely to be
A) TT and tt B) Tt and tt C) Tt and Tt D) Tt and TT

12. When two tall pea plants were crossed, one obtained 75% tall and 25% were short. The genotype of the parents was most likely:
A) Both homozygous
B) Both heterozygous

C) One heterozygous and one homozygous D) Both hemizygous

13. According to the Michaelis-Menten equation of enzyme kinetics, what is the v_o/V_{max} ratio when [S] = 5 K_M?

A) 6/5 B) 6/4 C) 5/6 D) 3/6

14. What is the enthalpy change of a system if 1.0 J of heat is transferred into it at constant pressure?

A) Enthalpy change of the system will be twice that as the heat transferred
B) Enthalpy change of the system decreases
C) Enthalpy change of the system will be same as heat transferred
D) Enthalpy will remain the same

15. Find the mean, median, mode respectively of: 2, 3, 6, 3, 2, 5, 2, 3, 5, 5, 6, 5, 5

A) 5, 4, 5 B) 5, 5, 4 C) 4, 5, 5 D) 4, 5, 4

16. Consider Meselson-Stahl experiment. If *E. coli* culture grown over-night in N^{15} ammonium chloride medium is shifted to N^{14} ammonium chloride medium and further grown for <u>one and half generation (1.5) time</u>, what would be the relative proportions of N^{15}-N^{15}, N^{15}-N^{14} and N^{14}-N^{14} DNA at the end of the experiment?

A) 33.33%, 33:33%, 33.33%. B) 0%, 66.66%, 33.33%.
C) 0%, 33.33%, 66.66%. D) 0%, 100%, 0%.

17. Acetic acid is a weak acid with a pKa of 4.75. What is the pH of a solution prepared by adding 0.1 mol of acetic acid and 0.03 mol of NaOH to water at a final volume of 1 litre?

A) 3.5 B) 4.38 C) 5.8 D) 7.2

18. In eukaryotes, protein synthesis occurs in

a) cytoplasm b) mitochondria c) peroxisomes d) endosomes e) vacuoles f) chloroplast

A) a only B) a, b and f C) c, b ,d and e D) a, b, e and f

19. Given below are some reactions that takes place either in RBCs in systemic circulation (the tissue blood capillaries) or in RBCs in the pulmonary circulation (alveolar capillaries in lungs). Select the option that is NOT a correct match of the reaction and the site of the reaction.

A) $CO_2 + H_2O$ is converted into H^+ and HCO_3^- by carbonic anhydrase in RBCs in the systemic circulation
B) Outward diffusion of Cl^- causes inward diffusion of HCO^-_3 in RBCs from tissues in the systemic circulation
C) H^+ and HCO_3^- is converted into $CO_2 + H_2O$ by carbonic anhydrase in RBCs in pulmonary circulation
D) Outward diffusion of HCO_3^- from RBCs causes inward diffusion of Cl^- (chloride shift) into RBCs in the systemic circulation

20. A reaction buffer, apart from substrate, required the following composition for an enzyme activity: 200 mM Tris.HCl (pH 9.5); 50mM $MgCl_2$ and 10mM NaCl. You are given three stock solutions: (i) 2M Tris.HCl (pH 9.5), (ii) 0.5M $MgCl_2$ and (iii) 0.1 M NaCl. How much volume from each stock solution will you mix to prepare 10 ml of reaction buffer?

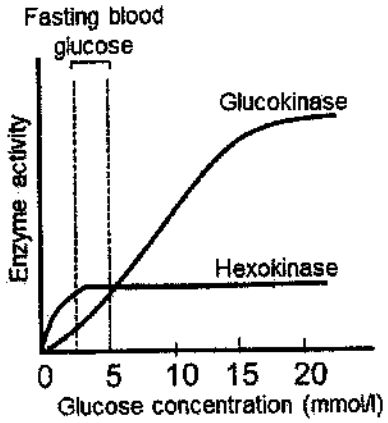
A) 2ml of Tris.HCl (pH 9.5) + 2ml of 0.5M $MgCl_2$ + 2ml of 0.1 M NaCl

B) 2ml of Tris.HCl (pH 9.5) + 1ml of 0.5M $MgCl_2$ + 0.1ml of 0.1 M NaCl
C) 1ml of Tris.HCl (pH 9.5) + 1ml of 0.5M $MgCl_2$ + 1ml of 0.1 M NaCl
D) 1ml of Tris.HCl (pH 9.5) + 0.5ml of 0.5M $MgCl_2$ + 0.5ml of 0.1 M NaCl

21. Four proteins of the molecular weights, 15, 29, 46 and 70 kDa respectively, are present in a mixture. Each of these proteins need to be separated and isolated from the mixture. Given this information, which of the following options would be your strategy of choice to separate and isolate each of these proteins?

A) Mass spectroscopy
B) Affinity chromatography
C) Combination of Anion and Cation exchange chromatography
D) Gel Filtration chromatography

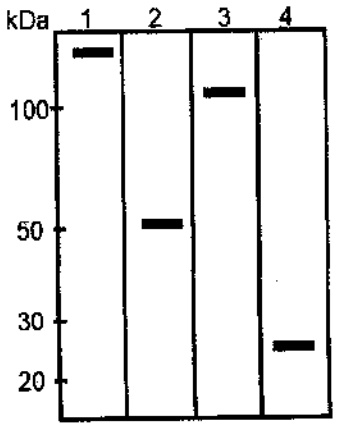
22. Given are kinetics plots for two isozymes: Glucokinase and Hexokinase.



Which of the following statements can be made by studying the plots?

A) At fasting glucose concentrations, glucokinase will be able to phosphorylate glucose at a higher rate than Hexokinase
B) Glucokinase has higher affinity for glucose than hexokinase and therefore higher Vmax
C) Hexokinase reaches its maximum velocity only upon increasing blood glucose beyond fasting concentrations
D) Glucokinase has lower affinity for glucose than hexokinase and its enzyme activity varies with glucose concentration

23. Purified immunoglobulin G (IgG) was either papain digested or trypsin digested and digestion products were resolved by SDS-PAGE under non-reducing conditions.



Identify the lane which represents papain digested IgG.

A) Lane 1 B) Lane 2 C) Lane 3 D) Lane 4

24. A researcher was studying the activity of an enzyme in cells. The following observations were made in this study:

i. Treatment with chloroquine induced the activity of the enzyme
ii. Addition of RNA polymerase II inhibitor along with chloroquine did not induce activity.
iii. Addition of cycloheximide up to 2 hours after the addition of chloroquine reduced the activity of the enzyme but had no effect if added later

Based on these observations, identify which one of the following statements CANNOT be made about the enzyme.

A) The synthesis of the enzyme from the mRNA continues up to 2 hours
B) Addition of chloroquine probably induced the expression of the gene encoding the enzyme
C) Enzyme is rapidly degraded
D) The RNA is present atleast up to 2hrs

25. Given below are some compounds:

(i) CH_3-CH=CH-CH_2CH_3 (ii) $(CH_3)_2C$=CH-CH_3
(iii) CH_3-CH=CH-CH_3 (iv) $CH_3CH_2CH=CH_2$

From the options given below, select the combination that has all the compound(s) that can exist in cis-trans isomers.

A) (i) and (iv) B) (ii) and (i) C) (ii) and (iv) D) (iii) and (i)

Part B

26. The major factor (s) determining the flux of glucose oxidation by aerobic or anaerobic glycolysis is/are:

A) High Glucose and AMP B) NADH and ATP
C) $FADH_2$ and high AMP D) NADH and low ADP

27. Correct order of four events during mitosis of a normal cell are:

i. Replication of bulk DNA
ii. Separation of sister chromatids
iii. Replication of telomeric DNA
iv. Attachment of centromere to spindle fibre

A) i, ii, iii & iv B) i, ii, iv & iii
C) i, iii, iv & ii D) i, iii, ii & iv

28. The fluidity of the plasma membrane increases with which of the following

a. Increase in unsaturated fatty acids in the membrane
b. Increase in glycolipid content in the membrane
c. Increase in phospholipid content in the membrane

A) a and b B) a only C) b only D) a, b and c

29. If v is the variance and σ is the standard deviation, then:
A) $v = 1/\sigma^2$ B) $v = 1/\sigma$ C) $v = \sigma^2$ D) $v^2 = \sigma$

30. Which one of the following statements about the nucleus is INCORRECT?
A) Nucleus is surrounded by a double-membraned envelope
B) Nuclear pore complexes support bidirectional transport across the nuclear membrane
C) Proton pumps in the nuclear membrane maintain intranuclear pH
D) Nuclear envelope remains intact during mitosis in many fungi

31. Biological nitrogen fixation requires
A) Nitrogenase enzyme complex B) Glutamate synthases
C) Nitrate reductase complex D) Urease

32. Which of the following are unifying features of Cephalochordates, Urochordates and Vertebrates?
A) Presence of a skull at some stage of life
B) Hollow nerve cord dorsal to the notochord
C) Presence of mammary glands, even if vestigial, in all adult forms
D) Absence of pharyngeal gill slits in all

33. Which of the following combinations represent all negative interspecific interactions in an ecosystem?
A) Commensalism and Amensalism B) Parasitism and Mutualism
C) Predation and Commensalism C) Competition and Amensalism

34. Hamilton's rule rB > C (*B* is the benefit gained by the recipient of the altruism, *C* is the cost suffered by the donor while undertaking the altruistic behaviour, and *r* is the genetic relatedness of the altruist to the beneficiary) predicts that natural selection should favour altruistic acts under certain circumstances. Which of the following circumstances are likely to lead to selection favouring altruism?
A) B is small B) r is small but B is large
C) C is large D) when only r is small

35. Which of the phosphates in ATP is attached with the -OH group of an amino acid in a protein when the latter is phosphorylated by its kinase?
A) Alpha phosphate B) Beta phosphate
C) Gamma phosphate D) Delta phosphate

36. Tautomerization to the imino form of cytosine would lead to
A) Transition B) Transversion
C) DNA strand break due to replication blockage D) No change

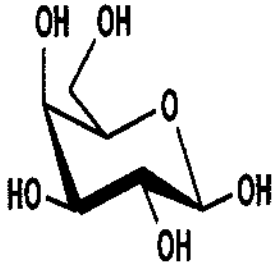
37. Which of the following statements about ecological pyramids is INCORRECT?
A) Pyramid of energy for a freshwater ecosystem is inverted
B) Pyramid of energy flow through a forest ecosystem is upright
C) Pyramids of numbers in a parasitic food chain is inverted
D) Pyramid of biomass in sea is generally inverted

38. Which of the following is an example of 2nd class lever functioning through our skeleton-muscles system in humans?

A) Lifting weight with hands by bending forearm and the force applied by the biceps muscle
B) Standing on tiptoes (metatarsophalangeal joints) with the force pulling across the heel of the foot
C) Tilting head backward using the joint between the head and the first vertebra (the atlantooccipital joint)
D) Flexion and extension at the knee joint during jumping

39. What type(s) of hybridization of the carbon atoms are found in 2-butyne?
A) sp and sp2 B) sp2 and sp3 C) sp and sp3 D) only sp3

40. Name of the carbohydrate structure given below is



A) β-D-galactopyranose B) β-D-glucopyranose
C) β-L-galactopyranose D) β-L-glucopyranose

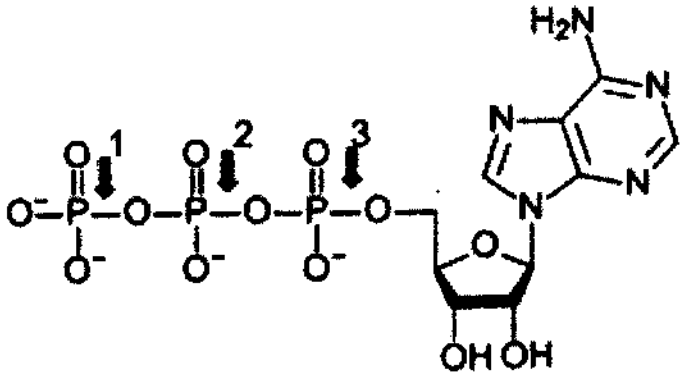
41. Which of the following two amino acids can have 4 stereoisomers?
A) Lysine, Glycine B) Glycine, Threonine
C) Threonine, Isoleucine D) Isoleucine, Lysine

42. Match the contents of the Column A to the correct contents of Column B

	Column A		Column B
i	Darwin	a	population tends to multiply more rapidly than food supply
ii	Malthus	b	Evolution progresses through discontinuous variations or mutations
iii	Lamarck	c	inheritance of acquired characters as basis of evolution
iv	De Vries	d	Survival of the fittest

A) i:d; ii:c; iii:a; iv:b B) i:d; ii:a; iii:c; iv:b
C) i:d; ii:a; iii:b; iv:c D) i:d; ii:c; iii:a; iv:b

43. Hydrolysis of the bonds (shown by arrows and numbered) in ATP results in release of free energy. Choose the correct answer from the following options regarding the amount of free energy release upon hydrolysis of these bonds.



A) 1 = 2 = 3 B) 1 > 2 > 3 C) 1 = 2 > 3 D) 1 > 2 = 3

44. Which of the following statement is correct for Anabolism and Catabolism?
A) Exergonic Breakdown and Endergonic Synthesis respectively
B) Endergonic Breakdown and Exergonic Synthesis respectively
C) Exergonic Synthesis and Endergonic Breakdown respectively
D) Endergonic Synthesis and Exergonic Breakdown respectively

45. Given below are symbols that are used in floral formula and their meaning.

Symbol		Meaning	
1	C A	a	Hypogyny
2	G	b	Epigyny
3	P A	c	Epipetalous stamens
4	♀	d	Epiphyllous stamens
5	$\overline{G}$		

Select the option that has all the correct matches.
A) 5-c; 4-a; 3-d; 1-b B) 1-c; 4-a; 3-d; 5-b
C) 1-d; 2-b; 3-c; 5-a D) 1-c; 2-a; 3-d; 5-b

46. Formation of D-fructose-1,6-bisphosphate from the combination of dihydroxyacetone phosphate and D-glyceraldehyde-3-phosphate is an example of which one of the following biological reactions?
A) Aldol addition B) Claisen condensation
C) Aldol condensation D) Decarboxylation

47. Which of the following organic compounds would be the most acidic?
A) C_6H_5OH B) NO_2-C_6H_4OH

C) $C_6H_5CH_2OH$ D) $C_6H_{13}OH$

48. Which of the following amino acids is considered as both ketogenic and glucogenic?
A) Tryptophan B) Valine
C) Lysine D) Glycine

49. Mammalian cells are maintained in flasks with liquid media and stored in an incubator with proper CO_2 levels. If flasks are taken out of the CO_2 incubator, the liquid media will show which of the following changes over time:
A) Increase in pKa of sugar
B) Decrease in pH of media
C) Increase in the mole fraction of CO_2 in the media
D) Increase in pH of media

50. Which of the following pair of ions DOES NOT have an incompletely filled d orbitals?
A) Cu^{2+}, Zn^{2+} B) Cu^{2+}, Mn^{2+} C) Sc^{3+}, Zn^{2+} D) Sc^{2+}, Cu^{2+}

51. A solution has $[H^+] = 7 \times 10^{-7}$ M. Which one of the following is true for this solution:
A) The solution is neutral B) The solution is acidic
C) The solution is basic D) The solution is weakly basic

52. Glutamate dehydrogenase enzyme is present in
A) Only cytosol B) Cytosol and in mitochondria
C) Only mitochondria D) Lysosomes

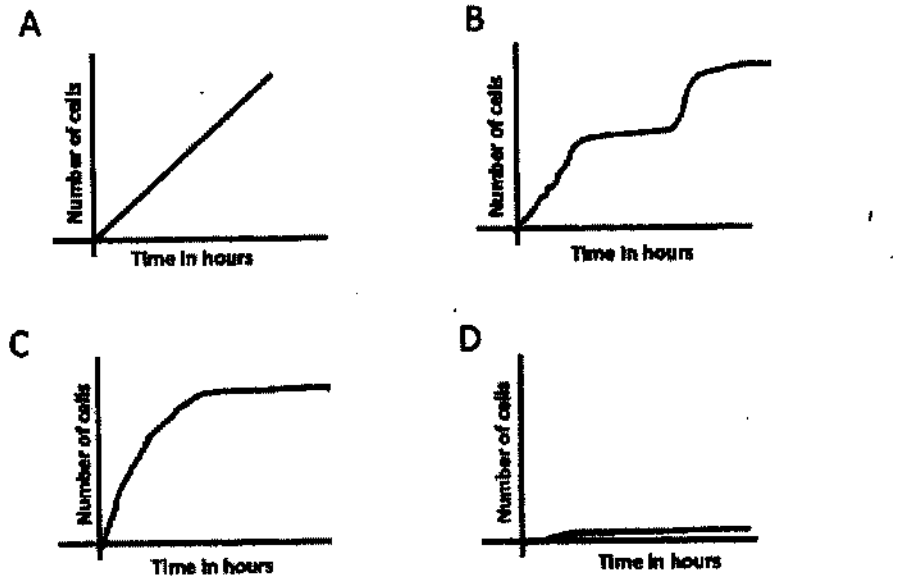
53. Which of the following is NOT an enzyme-catalyzed reaction in metabolism?
A) Sorbitol synthesis B) Isomerization
C) O-linked glycosylation D) Maillard Reaction

54. What is the number of proton NMR peaks observed for 1,3 dinitrobenzene?
A) One B) Two C) Three D) Four

55. When a G_2 phase cell is fused with an M phase cell, which one of the following events occur?
A) gene transcription B) chromosome aggregation
C) premature chromosome compaction D) inhibition of transcription

56. An open reading frame (ORF) is a
A) Ribosomal RNA coding region in DNA
B) Protein coding region in DNA
C) Transfer RNA coding region in DNA
D) Protein coding regions of DNA including 5'UTR and 3'UTR

57. *E. coli* with a mutation in lacY gene was isolated. This strain was grown in a medium containing glucose and lactose. Which of the following graphs correctly represents the most likely growth pattern of this mutant *E. coli*?



58. The -10 box sequence of a gene that is transcribed by sigma 70 in *E. coli* is 5'TCTAAT3'. Which one of the following changes is likely to increase transcription maximally from this promoter?
    A) 5'TCAGAT3'
    B) 5'TATGAT3'
    C) 5'TATTAT3'
    D) 5'TATAAT3'

59. A cation exchange resin was used to separate a mixture of charged proteins. All of the following statements about the experiment are correct EXCEPT:
    A) Proteins that carry a negative charge in the experimental conditions will flow through and not retained
    B) Strongly positively charged proteins will require higher ionic strength buffer to elute
    C) Larger molecular weight proteins will be eluted first
    D) Uncharged proteins will not bind to the column

60. Which one of the following is NOT generally a part of eukaryotic transcription?
    A) Capping of the 5' end of the RNA with methyl guanine
    B) Multiple initiation and termination codons per RNA molecule
    C) Addition of a non-templated string of poly A
    D) Removal of intervening sequences and splicing of the exons.