

HALL TICKET NUMBER

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M.Sc. Entrance Examination

JUNE 2017

Booklet Code: A

Time: 2hrs

Code No-N-11 (M.Sc. Biochemistry)

Max Marks: 100

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 three sections: Part A, Part B and Part C together with 85 questions for 100 marks. **Part A contains 25 questions, each question carries one mark. Part B contains 45 questions, each question carries one mark. Part C contains 15 questions, each question carries two marks.**
  3. **Part A will be used for tie breaking.**
  4. **In Part A there is negative marking. 0.33 marks will be deducted for each wrong answer. In Part B there is no negative marking. In Part C there is negative marking. 0.66 marks will be deducted for each wrong answer.**
  5. Answers have to be marked on the OMR sheet as per the instructions provided.
  6. Apart from OMR sheet, the question paper contains 16 (sixteen) pages including the instructions and rough work sheets.
  7. **Please return the OMR answer sheet at the end of examination.**
  8. No additional sheet will be provided.
  9. Rough work can be carried out in the question paper itself in the space provided at the end of the booklet.
  10. Non programmable calculators are allowed.
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### PART A

[Each question has only one right answer. Mark the right answer]

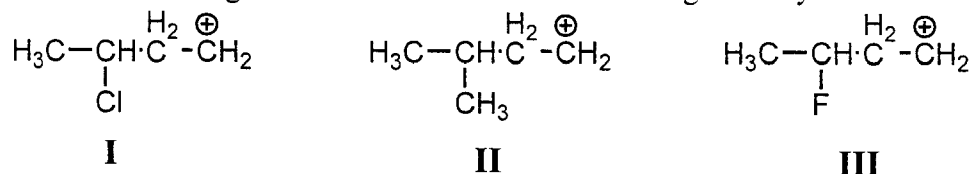
1. The development of embryos from the cells of nucellus is known as
  - A) Apospory
  - B) Apomixis
  - C) Apogamy
  - D) Parthenogenesis
2. During photorespiration, the reactive oxygen species,  $H_2O_2$  is produced in
  - A) Glyoxysome
  - B) Lysosome
  - C) Dictyosome
  - D) Peroxisome
3. The scientist who received Nobel Peace Prize in 1970 in recognition of his contribution to World Peace through increasing food supply is
  - A) H. G. Khorana
  - B) N. Bourlag
  - C) M. S. Swaminathan
  - D) C. Subramaniam

4. Which of the following statements about 'Kinetin' is INCORRECT?
  - A) Tryptophan is a precursor for *de novo* biosynthesis of kinetin
  - B) Adenine-type cytokinins such as kinetin are synthesized in roots or actively dividing cells
  - C) Kinetin was discovered as a breakdown product of DNA
  - D) Kinetin enhances leaf senescence
  
5. *Cinnamomum camphora*, a source of camphor that is a component of incense and used as medicine, belongs to the family
  - A) Lamiaceae
  - B) Lauraceae
  - C) Malvaceae
  - D) Apocynaceae
  
6. What atoms are linked (N- $\beta$ -glycosidic linkage) in the adenine base with the sugar?
  - A) N-9 atom of adenine ring is covalently attached with C-1' of sugar
  - B) N-1 atom of adenine ring is covalently attached with C-1' of sugar
  - C) C-5 in the adenine ring is covalently attached to with C-1' of sugar
  - D) N-5 of adenine ring is covalently attached to with C-1' of sugar
  
7. What activities are associated with RNA enzymes?
  - A) Nuclease activity
  - B) Polymerase activity
  - C) Nuclease and polymerase activity
  - D) Topoisomerase activity
  
8. How do drugs known as statins lower blood cholesterol concentrations?
  - A) Inhibit HMG CoA reductase
  - B) Inhibit acetyl CoA carboxylase
  - C) Inhibit fatty acid synthase
  - D) Inhibit cyclooxygenase
  
9. The action potential in a nerve cell results from the movement of
  - A) Na<sup>+</sup> ions from extracellular to intracellular fluid
  - B) Na<sup>+</sup> ions from intracellular to extracellular fluid
  - C) K<sup>+</sup> ions from extracellular to intracellular fluid
  - D) K<sup>+</sup> ions from intracellular to extracellular fluid
  
10. The formation of a peptide bond between two amino acids is an example of a
  - A) cleavage reaction
  - B) condensation reaction
  - C) isomerisation reaction
  - D) oxidation reduction reaction

11. Which one among the following is the correct expression of Henderson-Hasselbalch equation?
- A)  $pK_a = pH + \log [A^-] / [HA]$
  - B)  $pH = pK_a + \log [HA] / [A^-]$
  - C)  $pH = pK_a - \log [A^-] / [HA]$
  - D)  $pH = pK_a + \log [A^-] / [HA]$
12. A weak acid, HA having pH 4.7, dissociates exactly half of its original concentration, what will be the pKa of the weak acid?
- A) 2.3
  - B) 4.7
  - C) 9.4
  - D) 5.7
13. Consider two univalent elements A and B. A is strongly electropositive and B is strongly electronegative. Which of the following compounds is most likely to form?
- A)  $A^+B^-$
  - B)  $A^-B^+$
  - C) A-B
  - D) A=B
14. In  $\beta$ -decay, the total number of particles in the nucleus
- A) decreases by four
  - B) decreases by two
  - C) remains the same
  - D) decreases by one
15. What should be the age of a fossil for meaningful determination of age by carbon-14 dating?
- A) 6 years
  - B) 6 million years
  - C) 10000 years
  - D) any age
16. Which of the following classes of phylum Arthropoda is characterized by a lack of respiratory and circulatory systems?
- A) Branchiopoda
  - B) Pycnogonidia
  - C) Merostoma
  - D) Arachnida
17. Where is the biological clock that controls circadian rhythms in mammals located?
- A) suprachiasmatic nuclei of the hypothalamus
  - B) suprachiasmatic nuclei of the pineal gland
  - C) bunch of neurons in posterior pituitary gland
  - D) axonic nuclei of diencephalon

18. Antigen-presenting cells (APCs) are a heterogeneous group of immune cells that mediate the cellular immune response by processing and presenting antigens for recognition by certain lymphocytes. Which of the following is NOT a 'classical' antigen presenting cell?
- T cells
  - Langerhans cells
  - B cells
  - dendritic cells
19. Galapagos finches are closely-related species but they differed in beak size and beak depth, exemplifying the phenomenon referred to as 'character displacement'. This phenomenon known as character displacement is associated with
- sympatric species
  - allopatric species
  - peripatric species
  - pioneer species in a primary succession
20. What is the  $[OH^-]$  in M for a solution with  $pH = 8$
- 8
  - 6
  - $10^{-6}$
  - $10^{-8}$

21. List the following carbocations in order of increasing stability



- $\text{III} < \text{II} < \text{I}$
  - $\text{III} < \text{I} < \text{II}$
  - $\text{II} < \text{I} < \text{III}$
  - $\text{I} < \text{II} < \text{III}$
22. Which one of the following receptor types mediates both odorant and bitter taste signals?
- G-protein coupled receptors
  - EGFR
  - nuclear receptors
  - Receptors with tyrosine kinase activity
23. If an enzymatic reaction has a standard free energy change ( $\Delta G^\circ$ ) of  $-5 \text{ kcal/mol}$ , the equilibrium constant is
- Greater than one
  - Less than one
  - Zero
  - Not determinable from the value of  $\Delta G^\circ$

24. Increased protein use is accompanied by an increased dietary requirement for
- A) Ascorbic acid
  - B) Cobalamin
  - C) Pyridoxine
  - D) Riboflavin
25. In biological membranes, integral proteins and lipids interact mainly by
- A) Hydrophobic interactions
  - B) Ionic bonds
  - C) Covalent bonds
  - D) Hydrogen bonding

### PART B

**[These questions may have more than one right answer. Mark all the correct answers. For eg. If there are three right answers for a particular question, all three options must be marked otherwise it will be considered incorrect]**

26. Which of the following are the end products of anaerobic respiration in humans?
- A) CO<sub>2</sub>
  - B) Lactic acid
  - C) Ethyl alcohol
  - D) Pyruvate
27. Which of the following statements about the control of glycogen synthase regulation by insulin is/ are correct?
- A) Glycogen synthase kinase 3 is activated in the presence of insulin
  - B) The phosphorylation by glycogen synthase kinase 3 is inhibited by insulin
  - C) Insulin activates protein kinase B that phosphorylates glycogen synthase
  - D) Glycogen synthase kinase 3 is inactivated by a protein phosphatase
28. Which of the following statements about one-carbon transfer reactions in purine and pyrimidine nucleotide synthesis are correct?
- A) Tetrahydrofolate is used for the one-carbon transfer in purine nucleotide synthesis
  - B) N<sup>10</sup>-formyltetrahydrofolate is used as the one-carbon donor in purine nucleotide synthesis
  - C) N<sup>5</sup>-methyl tetrahydrofolate is used for the one-carbon transfer in purine nucleotide synthesis
  - D) N<sup>5</sup>, N<sup>10</sup>-methylene tetrahydrofolate is used in the synthesis of dTMP from dUMP
29. Which of the following statements about the carbon skeletons of amino acids are correct? Please select all that apply.
- A) Ketogenic amino acids can give rise to acetyl-CoA
  - B) Glucogenic amino acids can give rise to glucose in starvation
  - C) Ketogenic amino acids are converted to ketone bodies
  - D) Some amino acids are both glucogenic and ketogenic

30. Absorption of UV-visible light by a compound brings about the transition from
- A)  $n$  to  $\sigma^*$
  - B)  $n$  to  $\pi^*$
  - C)  $\sigma$  to  $\sigma^*$
  - D)  $\pi$  to  $\pi^*$
31. According to Beer-Lambert Law, on which of the following absorbance does not depend?
- A) Colour of the solution
  - B) Solution concentration
  - C) Size of the sample
  - D) Distance that the light has travelled through the sample
32. A number which is assigned to each atom or ion in a compound which explains its degree of oxidation is called
- A) oxidation degree
  - B) oxidation number
  - C) oxidation state
  - D) redox degree
33. Which of the following statements about genes are CORRECT?
- A) A gene can exist as more than one allele.
  - B) Organisms inherit two alleles for each trait.
  - C) Allele pairs separate with a single allele for each trait during gamete formation.
  - D) Meiotic recombination brings both alleles to the same chromosome
34. Which of the following statements are CORRECT?
- A) In test cross, the F1 hybrid is crossed only to recessive parent
  - B) In a back cross, the F1 hybrid is crossed to either of the two parents
  - C) One can determine the homozygosity or heterozygosity of the parent by a test cross
  - D) Both types of crosses are performed to confirm independent segregation
35. Which of the following compound(s) have both covalent and ionic bonds?
- A) KCN
  - B)  $\text{AlCl}_3$
  - C)  $\text{H}_2\text{SO}_4$
  - D)  $\text{CH}_3\text{Cl}$
36. Rate constant of a chemical reaction depends on the
- A) initial concentration of reactant
  - B) concentration of product
  - C) temperature
  - D) time of reaction

37. Which of the following decreases vapour pressure of water kept in a sealed vessel?
- A) Decreasing quantity of water
  - B) adding salt to water
  - C) decreasing volume of vessel by half
  - D) decreasing temperature of water
38. The change in Gibbs energy ( $\Delta G$ ) and entropy ( $\Delta S$ ) can be used to predict the thermodynamic nature of a reaction. Which of the following statement(s) are correct?
- A) when  $\Delta G$  is zero, the reaction is in equilibrium
  - B) spontaneous reactions have a  $\Delta G$  in the negative
  - C) spontaneous reactions have a  $\Delta G$  in the positive range
  - D) temperature of the reaction does not influence  $\Delta G$
39. Choose all the correct statements:
- A) Microspore is a haploid cell that will develop into a male gametophyte
  - B) Megasporocyte is a diploid cell that will give rise to female gametes
  - C) Integument develops into seed coat
  - D) Calyx and corolla collectively refer to petals and sepals respectively
40. Chordata is a large and diverse group of animals. Which of the following characteristics distinguish chordates from other animals?
- A) mammary glands
  - B) a dorsal hollow nerve cord
  - C) external ears called Pinnae
  - D) a post anal tail
41. In an autoimmune disease, antibodies and immune cells target body's own healthy tissues. Which of the following disorders / diseases can develop when immune system destroys body's own cells?
- A) type 1 diabetes
  - B) Hashimoto's thyroiditis
  - C) erythroblastosis fetalis
  - D) systemic lupus erythematosus
42. Given below are some statements related to antigens. Select all the statements that are correct.
- A) An epitope is a region of an antigen against which only one kind of antibody is produced.
  - B) The difference between the immune response of two individuals to the same antigenic epitope may be because of their MHC molecules.
  - C) The T cell epitopes should be on surface so that they can be easily available to T-cell receptors.
  - D) B-cell epitopes lose their immunogenicity when a protein antigen is denatured by heat.

43. A group of scientists measures the circumference of acorns in a population of oak trees. After calculations, they observed that the most common circumference is 2 cm. Considering that stabilizing selection is operating on this population, which of the following statement(s) will be correct?

- A) Even after 10 generations, the most common circumference of the acorns in the population will be around 2 cm.
- B) The oak trees with acorn sizes much greater than 2 and much lesser than 2 will contribute high number of offsprings to the next generations
- C) The oak trees with acorn sizes much greater than 2 and much lesser than 2 will contribute fewer offsprings to the next generations
- D) The oak trees with acorn sizes much lesser than 2 will contribute maximum offsprings to the next generations

44. Two species of ants live in a stratified distribution in the soil of farmland. It was observed that ants of species A were concentrated in the lower stratum of the soil that was more moist than the upper stratum, while the ant of species B concentrated in the upper drier soil stratum. When you removed species B from the upper stratum, you observed that species A did not attempt to occupy the empty upper stratum. However, when you removed species A from lower stratum, species B occupied the lower soil stratum as well. With these observations, which of the following inferences may be considered correct?

- A) The realized niche of species A was the same as its fundamental niche.
- B) The realized niche of species B was much smaller than its fundamental niche.
- C) The realized niche of species A was much smaller than its fundamental niche.
- D) Species A was a more successful competitor in the lower moister soil stratum.

45. Which of the following animals is a brood parasite?

- A) Anolis lizards
- B) Fruit flies
- C) cuckoo catfish (*Synodontis multipunctatus*)
- D) cyprinid minnow (*Pungtungia herzi*)

46. Which of the following are non-parametric tests:

- A) Student's *t*-test
- B) Spearman's rank correlation test
- C) Wilcoxon rank sum test
- D) Kruskal-Wallis test

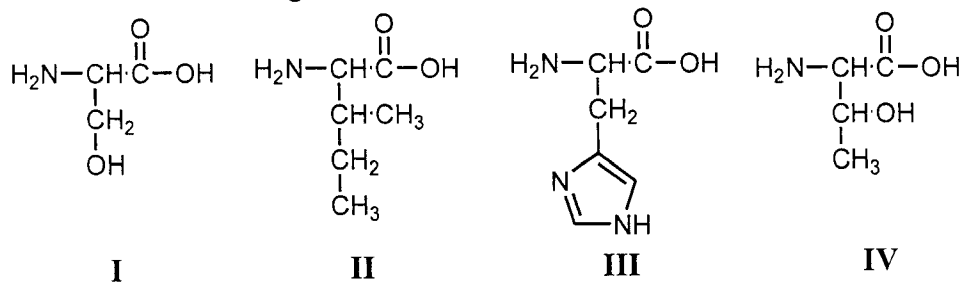
47. In order to compare means and variances with statistically significant differences between more than two groups, which test is suitable:

- A) Student's *t*-test
- B) ANOVA
- C) Chi-square test
- D) None of the above



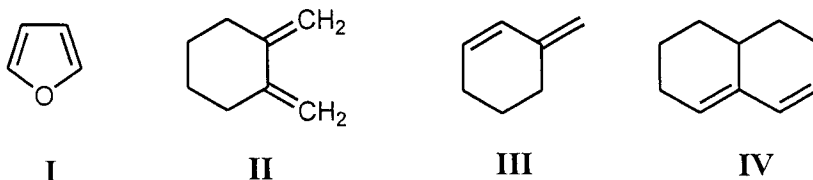
48. Which of the following radiations have higher energy than the visible light?
- IR and UV
  - UV and microwave
  - X-rays and UV
  - $\gamma$ -rays and X-rays
49. Chromatography is a technique used to
- Separate components in a mixture
  - Identify the components in a mixture
  - Modify the components in a mixture
  - Quantitate the components in a mixture
50. Reactions that have positive standard free energy changes ( $\Delta G_o > 0$ ) can be made to occur in cells by
- coupling them with exergonic reactions via a common intermediate
  - coupling them with endergonic reactions via a common intermediate
  - coupling them to the hydrolysis of ATP
  - doubling the concentration of the reactants

51. Which of the following molecules will have maximum number of stereoisomers?



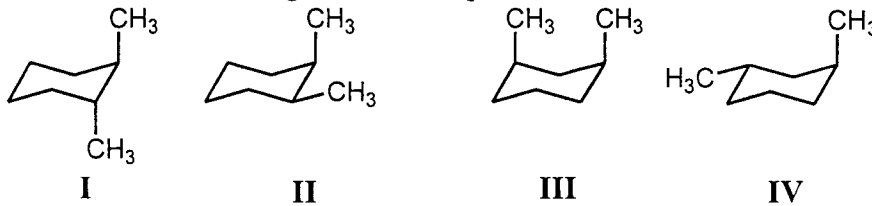
- I
- II
- III
- IV

52. Which of the following conjugated dienes would not react with a dienophile in a Diels-Alder reaction?



- I
- II
- III
- IV

53. Which of the following structures represents a cis isomer?



- A) I  
B) II  
C) III  
D) IV

54. DNA synthesis occurs in limited portion of the cell cycle in

- A) mouse cells  
B) cyanobacteria  
C) *Escherichia coli*  
D) HeLa cells

55. The Maxim-Gilbert method of determining a DNA sequence involves the use of

- A) restriction endonuclease  
B) electrophoresis  
C) electron microscopy  
D) end labeling

56. Catabolite repression, a mechanism of gene control in prokaryotes.

- A) is mediated through cAMP  
B) is mediated through CAP  
C) Results in de novo synthesis of positive activator protein  
D) is caused by several sugars

57. The glycolytic pathway requires one or more of the following allosteric regulatory enzymes?

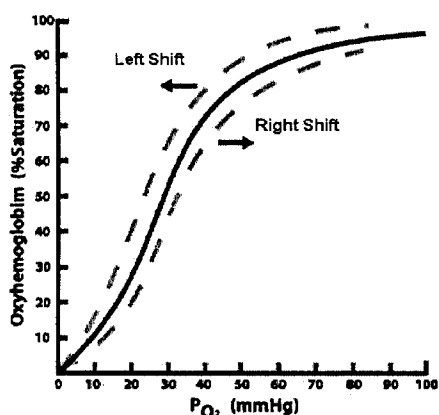
- A) Hexokinase  
B) Phosphofructokinase  
C) Aldolase  
D) Pyruvate kinase

58. Which of the following compounds has a higher group transfer potential than adenosine triphosphate?

- A) Glucose 6 phosphate  
B) Phosphoenolpyruvate  
C) Phosphocreatine  
D) Fructose 6 phosphate

59. Which of the following are monomers in RNA?
- A) Thymidine
  - B) Guanosine
  - C) Uridine
  - D) Adenosine monophosphate
60. Which of the following statements are true for bacterial DNA replication?
- A) RNA primer required to initiate synthesis
  - B) Both 5' to 3' and 3' to 5' strands are replicated simultaneously
  - C) initiates at multiple sites in the genome
  - D) Okazaki fragments are produced during leading strand synthesis
61. During fasting, liver glycogen is the source of glucose for other tissues, however muscle glycogen is not. What is the explanation for this?
- A) Muscle glycogen is highly branched
  - B) Muscle does not have a debranching enzyme
  - C) Muscle lacks glucose-6-phosphatase
  - D) Muscle lacks glucose-1-phosphatase
62. Which of the following extraembryonic membranes give rise to fetal placenta and umbilical cord in placental mammals?
- A) chorion
  - B) allantois
  - C) yolk sac
  - D) maternal uterine tissue
63. A new species of bacteria was isolated from marshy land near your house. You subjected the bacteria to staining. For staining, the bacterial smear was first flooded with crystal violet, followed by iodine. This was followed by treating the bacterial smear with 95% ethyl alcohol or acetone. At the end, the smear was flooded with red coloured dye safranin, washed and viewed using a light-microscope under oil-immersion. You observed that the new species of bacteria appeared red or pinkish. Which of the following statements may be true for the new found bacteria?
- A) It is Gram negative
  - B) It is Gram positive
  - C) It may be expected to have a very thick peptidoglycan layer in the cell wall
  - D) It may be expected to have high lipopolysaccharide (LPS) in the outer membrane
64. Which of the following hormones respond to hypoglycemia?
- A) Ghrelin hormone
  - B) glucagon
  - C) cortisol
  - D) epinephrine

65. Which one of the following statements is true for DNA?
- is more susceptible than RNA to degradation at high pH.
  - can hybridize with other DNA and RNA molecules.
  - is a polymer of nucleotides containing a 6-carbon sugar
  - has fewer hydroxyl groups than RNA
66. The major products of the hydrolysis of starch by amylase are
- Maltose, lactose and limit dextrans
  - Maltotriose, limit dextrans, and glucose
  - Glucose, maltose and maltotriose
  - Maltose, maltotriose and limit dextrans
67. Which of the following play a role in the formation of quaternary structure of proteins?
- Hydrogen bonds
  - Disulfide linkages
  - Hydrophobic interactions
  - Electrostatic interactions
68. Which of the following lipids are present in the plasma membrane of mammalian cell?
- Cholesterol
  - Phosphotidylcholine
  - Cardiolipin
  - Phosphotidylethanolamine
69. During DNA replication if base analogues are present, mutations are introduced. What types of mutations are most likely to be produced by these mutagens?
- transition
  - transversion
  - inversion
  - duplication
70. Oxygen saturation curve of hemoglobin is shown below. Which of the following will shift the oxygen saturation curve to the right?



- increased  $[H^+]$
- decreased  $CO_2$
- decreased 2,3-bisphosphoglycerate (2,3-BPG)
- increased 2,3-bisphosphoglycerate (2,3-BPG)

## PART C

[Each Question has only one right answer. Mark the right answer]

71. The blood calcium levels are lowered by the deficiency of which of the following hormone?  
 A) Calcitonin  
 B) Parathormone  
 C) Cortisol  
 D) Thyroxine
72. An uncoupler of oxidative phosphorylation would most likely lead to:  
 A) Inability to produce heat by the operation of the electron transport chain.  
 B) Operation of the electron transport chain without ATP production.  
 C) A dependence on ADP for the electron transport chain to operate.  
 D) Inability to oxidize NADH by the electron transport chain.
73. In *Drosophila*, normal wings are dominant over curly wings (C) and brown body colour (B) is dominant over yellow body colour. What types of gametes will be produced by a *Drosophila* fly that has normal wings and brown body colour with a genotype of homozygous normal wings and heterozygous brown body colour.  
 A) 50% CB and 50% cb  
 B) All Cb  
 C) 50% each of Cb and cB  
 D) 50% CB and 50% Cb
74. Oxidation number of phosphorous in  $\text{Ba}(\text{H}_2\text{PO}_4)_2$  is  
 A) +3  
 B) +2  
 C) +5  
 D) +4

75. Match the blood clotting factors given in column 1 with their role in blood clotting cascade/event in column 2

Column 1	Column 2
1. Factor X	a. causes platelets to aggregate in positive-feedback fashion
2. Plasmin	b. fibrinolytic enzyme
3. Factor XII	c. a co-factor in prothrombinase complex
4. Factor VIII	d. first factor to be activated in intrinsic clotting pathway
5. Factor XIII	e. stabilizes thrombin clot in presence of $\text{Ca}^{2+}$
6. Prostacyclin	f. inhibits platelet aggregation
	g. activates thrombin
	h. helps in activation of factor X in intrinsic pathway

- A) 1-c; 2-b; 3-d; 4-h; 5-g; 6-f  
 B) 1-g; 2-h; 3-c; 4-a; 5-e; 6-f  
 C) 1-g; 2-b; 3-d; 4-h; 5-e; 6-f  
 D) 1-g; 2-b; 3-d; 4-h; 5-e; 6-a

76. If cholecystokinin B receptors are completely blocked using a ligand, which of the following hormones associated with gastro-intestinal physiology will display increased circulating levels?

- A) insulin
- B) cholecystokinin
- C) gastrin
- D) secretin

77. Which of the following statements about antigenic determinants on immunoglobulins is INCORRECT?

- A) Isotypic determinants are located in constant regions of heavy and light chains
- B) Idiotypic determinants are located within variable regions of heavy and light chains
- C) Injection of antibodies from one animal to another animal of the same species induces generation of allotypic antibodies
- D) Allotypic determinants are located only in constant regions of heavy chains

78. The set of numbers 10.5, P, 15, 16.5, 13.5, 20, 21, 14, 16, 16.5, 11, 11.5, 14, 15, 21, 21, Q, 13.5, 14 has an arithmetic mean of 16 and mode of 14. Then,  $P \times Q =$

- A) 224
- B) 264
- C) 336
- D) 364

79. OD of a benzaldehyde solution measured in spectrophotometer was found to be 0.527. Given the molar absorption coefficient as  $1.38 \times 10^2 \text{ M}^{-1} \text{ cm}^{-1}$ , find out the number of micromoles of benzaldehyde present in a 200  $\mu\text{L}$  solution? (path length=0.57 cm)

- A) 0.134
- B) 0.67
- C) 6.7
- D) 1.34

80. In some mammalian cells the rate of addition of nucleotide is about 5% of that of *E. coli*. How many replication origins must fire in a mammalian cell containing 3 pg of DNA per cell and replicating in 6 hours? [Given: the molecular weight of *E. coli* genome is  $2 \times 10^9$  Da. It takes 40 minutes to replicate *E. coli* genome].

- A) 160
- B) 1600
- C) 16000
- D) 160000

81. One cell of *E. coli* contains about  $10^{-14}$  g of DNA. A DNA strand is 20 Å wide and has a mass of about  $2 \times 10^6$  Da for each micrometer of length. What fraction of the volume of *E. coli* is DNA? [Given: the volume of *E. coli* is about  $2.4 \times 10^{-12} \text{ cm}^3$ ]

- A) 0.0004
- B) 0.004
- C) 0.04
- D) 0.4

82. Mountain goats usually come in three colours: Black, white or grey. Trait is encoded by a single locus "B" that shows incomplete dominance. Black is "BB", white is "bb" and grey are "Bb". What would be the genotype and phenotype of offsprings when a black goat mates with a white goat?

- |                         |                                  |
|-------------------------|----------------------------------|
| A) Genotype: BB, Bb, bb | Phenotype: black, grey and white |
| B) Genotype: BB, bb     | Phenotype: black and white       |
| C) Genotype: Bb         | Phenotype: grey                  |
| D) Genotype: Bb         | Phenotype: black and white       |

83. A bag contains 5 red marbles, 4 green marbles and 1 blue marble. A marble is chosen at random from the bag and is not replaced. A second marble is chosen after that. What is the probability that neither marble is blue?

- A)  $2/15$
- B)  $4/15$
- C)  $2/5$
- D)  $9/10$

84. What is the probability of drawing a king first and then drawing a king again the second time, from a deck of 52 cards?

- A)  $4/52$
- B)  $2/52$
- C)  $1/221$
- D)  $2/221$

85. The pKa of acetic acid is 4.76. What is the pH of a 0.1 M solution of acetic acid?

- A) 5.76
- B) 2.88
- C) 2.43
- D) 4.76

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ROUGH WORK