

**PAPER : IIT-JAM 2008**  
**BIOTECHNOLOGY-BT**

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**INSTRUCTIONS:**

- (i) This test paper has a total of 100 questions.
  - (ii) Each question has **4 choices** for its answer : (a), (b), (c) and (d). Only **one** of them is the correct answer.
  - (iii) For each correct answer, you will be awarded **3 (three)** marks.
  - (iv) For each wrong answer, you will be awarded **-1 (Negative one)** mark.
  - (v) Multiple answers to a question will be treated as a wrong answer.
  - (vi) For each un-attempted question, you will be awarded **0 (zero)** mark.
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1. In cells, cellulose and glycogen function as
    - (a) energy storage components
    - (b) structural and energy storage components, respectively
    - (c) energy storage and structural components, respectively
    - (d) structural components
  2. The structures of myoglobin and hemoglobin are
    - (a) Quaternary
    - (b) Quaternary and tertiary, respectively
    - (c) Tertiary and quaternary, respectively
    - (d) Molten globule
  3. The chromatographic technique for determination of the native molecular weight of proteins is
    - (a) Gel permeation
    - (b) Ion exchange
    - (c) Hydrophobic interaction
    - (d) Chromatofocusing
  4. The affinity of an enzyme to the substrate is indicated by
    - (a)  $pK_a$
    - (b)  $K_i$
    - (c)  $K_{cat}$
    - (d)  $K_m$
  5. Which one of the following compounds is optically INACTIVE?
    - (a) Ala
    - (b) Cys
    - (c) Gly
    - (d) Lys
  6. In O-linked glycoproteins, the glycan part is linked to the polypeptide. The amino acid residues involved in this linkage are
    - (a) Ser and Thr
    - (b) Gln and Tyr
    - (c) Tyr and Thr
    - (d) Asn and Tyr
  7. The cofactor (s) required for the nitrogenase enzyme complex involved in  $N_2$  fixation is /are
    - (a) Fe and Mo
    - (b) Fe
    - (c) Fe and S
    - (d) Fe, S and Mo
  8. The anaplerotic (filling up) reaction to replenish citric acid cycle is
    - (a) decarboxylation of isocitrate to  $\alpha$ -ketoglutarate
    - (b) decarboxylation of  $\alpha$ -ketoglutarate of succinyl CoA
    - (c) carboxylation of phosphoenolpyruvate to oxaloacetate
    - (d) conversion of malate to oxaloacetate
  9. Which one of the following is NOT a neurotransmitter?
    - (a) Glutamine
    - (b) Glutamate
    - (c) Glycine
    - (d) Acetylcholine
  10. Which one of the following is NOT an energy rich compound?
    - (a) Phosphoenolpyruvate
    - (b) Glucose, 6-bisphosphate
    - (c) Acetyl phosphate
    - (d) Phosphoarginine
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11. During photosynthesis, ATP synthesis takes place in  
 (a) stroma (b) thylacoid lumen  
 (c) thylacoid membrane (d) cytoplasm
12. Contact inhibition phenomenon is observed in  
 (a) animal cell culture (b) plant cell culture  
 (c) bacterial cell culture (d) fungal cell culture
13. Choose the correct set of match between **Group I** and **Group II**.
- | <b>Group I</b> | <b>Group II</b>                          |
|----------------|--|
| P. IgM         | 1. Present in various body secretions    |
| Q. IgE         | 2. Antigen presentation                  |
| R. IgA         | 3. Allergic reaction                     |
| S. MHC         | 4. Complement activation                 |
|                | 5. Ten heavy chains and ten light chains |
- (a) P-4, Q-3, R-1, S-5 (b) P-5, Q-3, R-1, S-2  
 (c) P-5, Q-3, R-4, S-1 (d) P-3, Q-2, R-4, S-5
14. Choose the correct set of match between Group I and Group II
- | <b>Group I</b>   | <b>Group II</b>             |
|------------------|-----------------------------|
| P. Gibberellins  | 1. Breaking dormancy        |
| Q. Ethylene      | 2. Apical dominance         |
| R. Cytokines     | 3. Fruit ripening           |
| S. Abscisic acid | 4. Seed germination         |
|                  | 5. Cell division and growth |
- (a) P-1, Q-3, R-2, S-4 (b) P-1, Q-2, R-4, S-5  
 (c) P-2, Q-3, R-4, S-1 (d) P-4, Q-3, R-5, S-1
15. Choose the correct set of match between Group I and Group II.
- | <b>Group I</b>                               | <b>Group II</b>                 |
|--|---------------------------------|
| P. Pyridoxal 5'-phosphate                    | 1. Carboxylation reaction       |
| Q. Biotin                                    | 2. One-carbon transfer reaction |
| R. Thiamine pyrophosphate                    | 3. Decarboxylation reaction     |
| S. $N^5, N^{10}$ -methylene tetrahydrofolate | 4. Oxidation reduction reaction |
|  | 5. C-C bond cleavage            |
- (a) P-1, Q-3, R-5, S-2 (b) P-3, Q-1, R-5, S-4  
 (c) P-3, Q-1, R-5, S-2 (d) P-1, Q-4, R-2, S-3
16. Choose the correct set of match between Group I and Group II.
- | <b>Group I</b> | <b>Group II</b>                           |
|----------------|---|
| P. Calcitonin  | 1. Blood glucose level regulation         |
| Q. Glucagon    | 2. Female reproductive system maintenance |
| R. Adrenalin   | 3. Mammary gland development              |
| S. Prolactin   | 4. Increase in basal metabolic rate       |
|                | 5. Calcium homeostasis                    |
- (a) P-5, Q-1, R-4, S-3 (b) P-2, Q-5, R-3, S-1  
 (c) P-5, Q-1, R-2, S-4 (d) P-4, Q-2, R-3, S-5

17. Microaerophilic bacteria have the ability to grow in  
(a) high concentration of oxygen (b) absence of oxygen  
(c) low concentration of oxygen (d) low concentration of carbondioxide
18. Cocci arranged in the form of chains are classified as  
(a) Sterptococci (b) Micrococci  
(c) Sarcinae (d) Staphylococci
19. The process of Tyndallization requires  
P. Temperature of 100°C Q. Pressure of 15 psi  
R. Time period of 30 min S. Free flow of steam  
(a) P, Q, R (b) P, Q, S (c) P, R, S (d) Q, R, S
20. Choose the correct set of match between Group I and Group II
- | <b>Group I</b>                  | <b>Group II</b>                     |
|---------------------------------|-------------------------------------|
| P. <i>Campylobactor jejuni</i>  | 1. eye infection in human           |
| Q. <i>Neisseria gonorrhoeae</i> | 2. lung disease in human with AIDS  |
| R. <i>Pneumocystis carinii</i>  | 3. intestinal disease with diarrhea |
| S. <i>Haemophilus aegyptius</i> | 4. sexually transmitted disease     |
|                                 | 5. skin infection                   |
- (a) P-3, Q-4, R-2, S-1 (b) P-3, Q-5, R-2, S-1  
(c) P-2, Q-3, R-1, S-4 (d) P-2, Q-4, R-1, S-5
21. Asexual reproductive process of budding occurs in  
(a) all fungi (b) yeasts  
(c) fungi undergoing sexual reproduction (d) *Bacillus subtilis*
22. One mL of *E. coli* culture was diluted to 100 mL and 0.5 mL of the diluted culture was plated on to an agar plate. After 12 h of incubation, 200 colonies were observed. What was the number of bacteria per mL in the original culture?  
(a)  $2 \times 10^4$  (b)  $4 \times 10^4$  (c)  $1 \times 10^5$  (d)  $2 \times 10^5$
23. Phylogeny describes a species  
(a) morphological similarities with other species  
(b) reproductive compatibilities with other species  
(c) evolutionary history  
(d) geographic distribution
24. The term prophage refers to  
(a) an auxotrophic mutant  
(b) a phage DNA incorporated in to bacterial chromosome  
(c) host DNA packed into viral particles  
(d) DNA of lytic phage
25. According to Darwin, two different areas within the same continent have different species because they have different  
(a) evolutionary mechanisms (b) ancestors  
(c) environments (d) evolutionary times

26. A sequence of species through which an organic molecule passes in a community is referred to as  
 (a) pyramid of energy (b) food chain  
 (c) food web (d) nutrient cycle
27. When a number of genes are transcribed as one mRNA, such mRNA is termed as  
 (a) multimeric (b) polymeric (c) polycistronic (d) polysomal
28. The presence and location of a specific gene in a bacterial genome can be detected by  
 (a) Southern blot (b) Western blot (c) Eastern blot (d) Northern blot
29. Match the terms in Group I with their definitions in Group II
- | <b>Group I</b>       | <b>Group II</b>   |
|----------------------|---|
| P. Ammonification    | 1. Conversion of atmospheric nitrogen into ammonia            |
| Q. Denitrification   | 2. Conversion of organic nitrogen into ammonia                |
| R. Nitrification     | 3. Conversion of nitrite or nitrate into atmospheric nitrogen |
| S. Nitrogen fixation | 4. Conversion of ammonium into nitrite and nitrate            |
- (a) P-2, Q-3, R-1, S-4 (b) P-3, Q-2, R-4, S-1  
 (c) P-3, Q-2, R-1, S-4 (d) P-2, Q-3, R-4, S-1
30. Nucleosome is composed of  
 (a) DNA and histone proteins (b) DNA, histone and non-histone proteins  
 (c) DNA, RNA and histone proteins (d) RNA, histone and non-histone proteins
31. Usually there is one specific tRNA for each amino acid but some of the amino acids are recognized by more than one tRNA. The tRNAs that recognize the same amino acid are known as  
 (a) Cognate tRNAs (b) Isoaccepting tRNAs  
 (c) Isoschizomers (d) Catenated tRNAs
32. Shine-Delgarno sequence is a part of  
 (a) Eukaryotic mRNA (b) Prokaryotic mRNA  
 (c) Eukaryotic tRNA (d) Eukaryotic rRNA
33. Which of the following statements are **FALSE** about Palindromes?  
 P. DNA which reads the same sequence from both directions but in antiparallel orientation  
 Q. DNA which reads the same sequence from both directions but in parallel orientation  
 R. It is recognized by a specific restriction endonuclease and causes specific cleavage  
 S. It is recognized by exonucleases and causes non-specific cleavage.  
 (a) P and R (b) P and S (c) Q and R (d) Q and S
34. Which of the following statements are true regarding DNA replication?  
 P. It is semiconservative both in prokaryotes and eukaryotes  
 Q. It is semiconservative in eukaryotes but conservative in prokaryotes  
 R. Both leading and lagging strands are replicated by DNA Pol-III in prokaryotes  
 S. Leading and lagging strands are replicated by two different polymerases in eukaryotes  
 (a) P, R, S (b) P, Q, R (c) Q, R, S (d) P, Q, S

35. Which of the following statements are true about genetic code and translation?  
P. Genetic code is degenerate because more than one codon codes for a particular amino acid  
Q. Genetic code is degenerate because a single codon codes for more than one amino acid  
R. Genetic code degeneracy is due to wobble nature of 3' base  
S. Fidelity exists in translation as there is no proof reading mechanism  
(a) P, Q, S                      (b) Q, R, S                      (c) P, Q, R                      (d) P, R, S
36. Which of the following techniques are used for transfer of a gene into the cells?  
P. Electroporation  
Q. Electroelution  
R. Particle bombardment  
S. Microinjection  
(a) Q, R, S                      (b) P, Q, R                      (c) P, R, S                      (d) P, Q, S
37. Match the terms in Group-I with terms in Group-II
- | Group-I           | Group-II                   |
|-------------------|----------------------------|
| P. RNA-P          | 1. <i>lac</i> operon       |
| Q. Leucine zipper | 2. rRNA gene transcription |
| R. RNA Pol-I      | 3. tRNA gene transcription |
| S. Attenuation    | 4. Transcription factors   |
|                   | 5. Ribozymes               |
|                   | 6. <i>trp</i> operon       |
|                   | 7. mRNA splicing           |
- (a) P-7, Q-5, R-3, S-1                      (b) P-4, Q-5, R-2, T-1  
(c) P-5, Q-4, R-2, S-6                      (d) P-4, Q-5, R-3, T-6
38. Which one of the following modifications leads to protein degradation?  
(a) Methylation                      (b) Acetylation  
(c) Phosphorylation                      (d) Ubiquitination
39. Which one of the following protein is involved in the nucleation step of microtubules *in vivo*?  
(a)  $\alpha$ -Actin                      (b)  $\beta$ -Tubulin                      (c)  $\alpha$ -Tubulin                      (d)  $\gamma$ -Tubulin
40. If a codon in mRNA is UAC, the anticodon on tRNA will be  
(a) 5'AUG3'                      (b) 5'GUA3'                      (c) 5'ATC3'                      (d) 5'CTA3'
41. Which one of the following structure-function pairs is NOT correct?  
(a) Nucleolus - rRNA synthesis                      (b) Lysosome - intracellular digestion  
(c) Endoplasmic reticulum - glycosylation                      (d) Microtubules - muscle contraction
42. Lysosomal protein targeting takes place through  
(a) COP-coated vesicles                      (b) Clathrin coated vesicles  
(c) Liposome                      (d) Receptor mediated endocytosis
43. The release of  $Ca^{2+}$  from endoplasmic reticulum to cytoplasm in response to stimulus is mediated by  
(a) cAMP                      (b) IP3                      (c) DAG                      (d) Calmodulin



44. Match the terms in Group-I with terms in Group-II

**Group-I**

- P. Leucoplast  
Q. Mitochondria  
R. Golgi complex  
S. Centriole

**Group-II**

1. Protein modification and targeting  
2. Microtubule organizing centre  
3. Starch storage  
4. Kreb's cycle  
5. Glycogen storage  
6. Calvin cycle

- (a) P-3, Q-4, R-2, S-1  
(b) P-5, Q-4, R-6, S-5  
(c) P-3, Q-6, R-4, S-5  
(d) P-3, Q-4, R-1, S-2

45. At constant pressure, the internal energy of a gaseous system will always decrease for

- (a) an endothermic process with decrease in the volume  
(b) an endothermic process with increase in the volume  
(c) an exothermic process with decrease in the volume  
(d) an exothermic process with increase in the volume

46. First ionization energy of C, N, O and Si follows the order

- (a)  $\text{Si} < \text{O} < \text{N} < \text{C}$   
(b)  $\text{C} < \text{N} < \text{O} < \text{Si}$   
(c)  $\text{Si} < \text{C} < \text{N} < \text{O}$   
(d)  $\text{Si} < \text{C} < \text{O} < \text{N}$

47. Which one of the following isoelectronic ions has the largest ionic radius?

- (a)  $\text{O}^{2-}$   
(b)  $\text{F}^-$   
(c)  $\text{Mg}^{2+}$   
(d)  $\text{Na}^+$

48. The correct set of match between molecules of Group I and their shapes in Group II is

**Group I**

- P.  $\text{I}_3$   
Q.  $\text{H}_2\text{S}$   
R.  $\text{XeOF}_4$   
S.  $\text{PCl}_5$

**Group II**

1. Square pyramidal  
2. Trigonal bipyramidal  
3. Linear  
4. Angular

- (a) P-3, Q-4, R-1, S-2  
(b) P-4, Q-3, R-1, S-2  
(c) P-3, Q-4, R-2, S-1  
(d) P-4, Q-3, R-2, S-1

49. Thallium (Tl) exhibits monovalency whereas aluminium (Al) exhibits trivalency. This is due to

- (a) the energy required to unpair outer *s*-electrons in Tl exceeds the energy involved in the bond formation  
(b) Tl has only one electron in its outermost orbital  
(c) Al can use its vacant *d*-orbitals for the bond formation  
(d) Tl is a non-metal

50. Which one of the following compounds has non-zero spin-only magnetic moment?

- (a)  $[\text{Fe}(\text{CN})_6]^{4-}$   
(b)  $[\text{Co}(\text{NH}_3)_6]^{3+}$   
(c)  $[\text{Zn}(\text{H}_2\text{O})_6]^{2+}$   
(d)  $[\text{NiF}_6]^{4-}$

51. Isomerism exhibited by the pair of compounds  $[\text{Co}(\text{NH}_3)_6]$   $[\text{Cr}(\text{CN})_6]$  and  $[\text{Cr}(\text{NH}_3)_6]$   $[\text{Co}(\text{CN})_6]$  is

- (a) linkage  
(b) coordination  
(c) ionization  
(d) geometric

52. With increase in pressure, the equilibrium concentration of product will NOT change for

- (a)  $2\text{CO}_2(\text{g}) \rightleftharpoons 2\text{CO}(\text{g}) + \text{O}_2(\text{g})$   
(b)  $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$   
(c)  $\text{SO}_2(\text{g}) \rightleftharpoons \text{S}(\text{s}) + \text{O}_2(\text{g})$   
(d)  $\text{C}_2\text{H}_4(\text{g}) + \text{H}_2(\text{g}) \rightleftharpoons \text{C}_2\text{H}_6(\text{g})$

53. During a cyclic process, which one of the following is NOT always zero?

- (a) Enthalpy change (b) Entropy change  
 (c) Internal energy change (d) Work done by the system
54. The rate of reaction ( $r$ ) is expressed as,  $r = k[A]^m[B]^n$ . The rate constant ( $k$ ) for this reaction is  $2\text{L}^2\text{mol}^{-2}\text{s}^{-1}$ . The possible values of  $m$  and  $n$  are  
 (a) 1 and 1 (b) 1 and 2  
 (c) 1 and 3 (d) 1 and 4
55. Half-cell reaction for the electrode  $\text{Ag}/\text{AgCl}/\text{Cl}^-$  is

- (a)  $\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}(\text{s})$  (b)  $\frac{1}{2}\text{Cl}_2(\text{g}) + \text{e}^- \rightarrow \text{Cl}^-$   
 (c)  $\text{AgCl}(\text{s}) + \text{e}^- \rightarrow \text{Ag}(\text{s}) + \text{Cl}^-$  (d)  $\text{Ag}^+ + \frac{1}{2}\text{Cl}_2(\text{g}) + 2\text{e}^- \rightarrow \text{Ag}(\text{s}) + \text{Cl}^-$

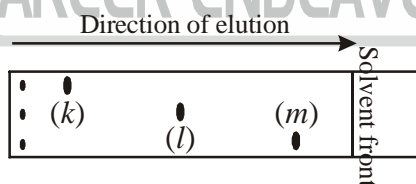
56. Which one of the following is NOT a correct statement for carbohydrates?

- (a) Epimers give the same osazone  
 (b) D(+)-glucose undergoes mutarotation  
 (c)  $\alpha$ -D(+)-glucose and  $\beta$ -D(+)-glucose are anomers  
 (d) Conversion of  $\alpha$ -D(+)-glucose to  $\beta$ -D(+)-glucose is called sugar inversion

57. In an electrophoresis experiment at pH 5 (shown below)  $x$ ,  $y$  and  $z$  refer respectively to



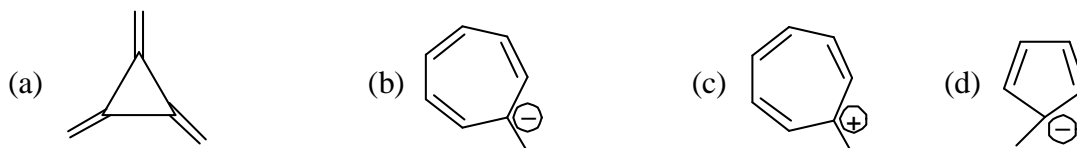
- (a) Lysine, alanine and aspartic acid (b) Alanine, aspartic acid and lysine  
 (c) Lysine, aspartic acid and alanine (d) Aspartic acid, alanine and lysine
58. Which one of the following 0.1 M solutions has the lowest pH?  
 (a)  $\text{NaNO}_2$  (b)  $\text{NH}_4\text{Cl}$  (c)  $\text{NaCl}$  (d)  $\text{NH}_3$
59. In a thin layer chromatography experiment, three spots  $k$ ,  $l$  and  $m$  are detected in an iodine chamber. The spots  $k$ ,  $l$  and  $m$ , respectively are



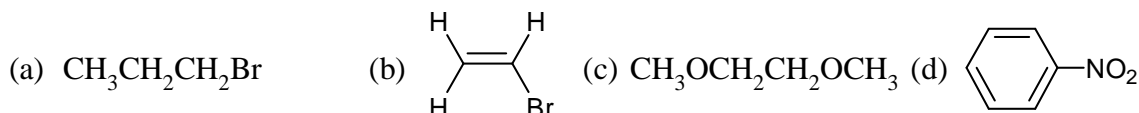
- (a)  $\text{PhCH}_2\text{OH}$ ,  $\text{PhCOOH}$ ,  $\text{PhCH}_2\text{OCOCH}_3$  (b)  $\text{PhCOOH}$ ,  $\text{PhCH}_2\text{OCOCH}_3$ ,  $\text{PhCH}_2\text{OH}$   
 (c)  $\text{PhCOOH}$ ,  $\text{PhCH}_2\text{OH}$ ,  $\text{PhCH}_2\text{OCOCH}_3$  (d)  $\text{PhCH}_2\text{OCOCH}_3$ ,  $\text{PhCH}_2\text{OH}$ ,  $\text{PhCOOH}$
60. IR stretching frequency at  $\sim 2200$ ,  $\sim 1700$ ,  $\sim 1100$  and  $\sim 1600\text{ cm}^{-1}$  corresponds respectively to the functional groups

- (a)  $\text{—C}\equiv\text{N}$ ,  $\text{>C=O}$ ,  $\text{>C—O}$ ,  $\text{>C=N}$  (b)  $\text{>C=O}$ ,  $\text{—C}\equiv\text{N}$ ,  $\text{>C—O}$ ,  $\text{>C=N}$   
 (c)  $\text{>C=N}$ ,  $\text{—C}\equiv\text{N}$ ,  $\text{>C—O}$ ,  $\text{>C=O}$  (d)  $\text{>C=N}$ ,  $\text{>C—O}$ ,  $\text{—C}\equiv\text{N}$ ,  $\text{>C=O}$

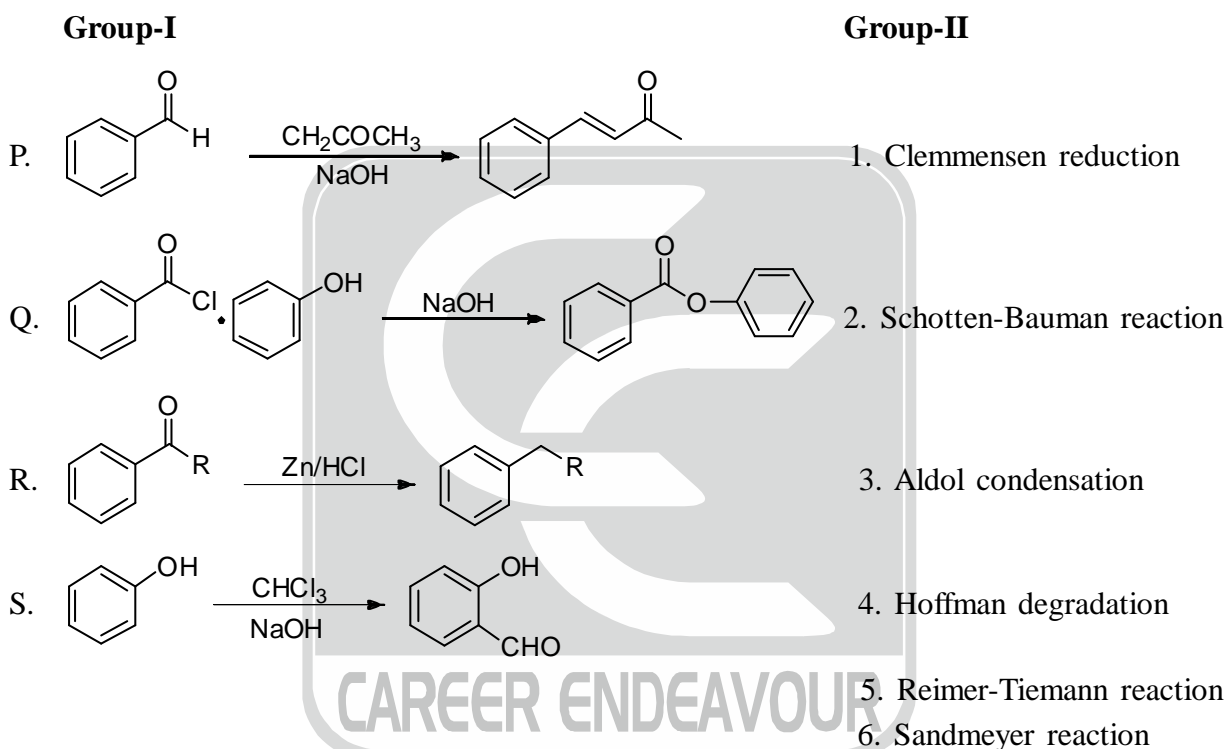
61. Which one of the following species does NOT have  $6\pi$  electrons?



62. Which one of the following compounds will NOT show three signals in its  $^1\text{H}$  NMR spectrum?



63. Choose the correct match between reactions of Group-I and named reactions in Group-II.



(a) P-3, Q-2, R-1, S-5

(b) P-2, Q-3, R-4, S-5

(c) P-3, Q-4, R-5, S-6

(d) P-4, Q-3, R-6, S-5

64. (+)-Mandelic acid has a specific rotation of  $+160^\circ$ . What is the observed specific rotation of a mixture of 40% (-)-mandelic acid and 60% (+)-mandelic acid?

(a)  $-32^\circ$

(b)  $+32^\circ$

(c)  $+64^\circ$

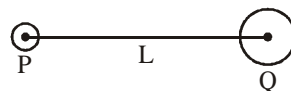
(d)  $-64^\circ$

65. Group-I lists fundamental forces in nature and Group-II lists the particles relevant to these forces. Choose the correct set of match.



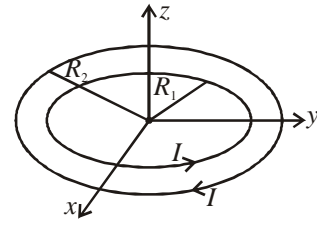


66. A small body of mass 0.2 kg undergoes a uniform circular motion on a frictionless horizontal surface. The body is attached to the centre by a string of length 2m and has a linear speed of 10 m/s. The force exerted by the string on the mass is  
 (a) 1N (b) 5N (c) 10N (d) 50N
67. Resistance ( $R$ ), capacitance ( $C$ ), and inductance ( $L$ ) are connected in series in a circuit. Keeping the resonant frequency same, the quality factor ( $Q$ ) can be doubled if  
 (a)  $L$  is increased to  $2L$  and  $C$  is decreased to  $C/2$   
 (b)  $C$  is increased to  $2C$  and  $L$  is decreased to  $L/2$   
 (c)  $L$  is increased to  $4L$  and  $C$  is decreased to  $C/4$   
 (d)  $C$  is increased to  $4C$  and  $L$  is decreased to  $L/4$
68. de-Broglie wavelengths of two electrons which start from rest and accelerated by potentials  $V$  and  $4V$  are  $\lambda_1$  and  $\lambda_2$  respectively. The ratio  $\lambda_1 : \lambda_2$  is  
 (a) 1 : 2 (b) 1 : 4 (c) 2 : 1 (d) 4 : 1
69. The mass numbers of two nuclei  $M$  and  $N$  are 4 and 8 respectively. The ratio of the volumes of the nuclei,  $V_M : V_N$  is  
 (a) 1 : 2 (b) 1 : 4 (c) 1 : 8 (d) 1 : 16
70. A student is interested in converting a galvanometer into a voltmeter. The student should  
 (a) connect a large resistance in series with the galvanometer  
 (b) connect a large resistance in parallel to the galvanometer  
 (c) connect a small resistance in series with the galvanometer  
 (d) connect a small resistance in parallel to the galvanometer
71. The phase difference between points that are 2m apart along the direction of propagation of a wave having a wavelength of 6m is  
 (a)  $60^\circ$  (b)  $120^\circ$  (c)  $150^\circ$  (d)  $180^\circ$
72. A car moving at a constant speed of 36 km/h in the direction of wind and assisted by the flow of wind which imparts a force of 50N. The frictional force between the tyres and the road is 100N. The engine power required is  
 (a) 50W (b) 100W (c) 500W (d) 1800W
73. The centres of two planets ( $P$  and  $Q$ ) are at a distance  $L$  apart and the ratio of their masses is 1 : 4. What is the distance between the centre of the lighter planet ( $P$ ) and the point on the line  $PQ$  at which the net gravitational force is zero?



- (a)  $L/4$  (b)  $L/3$  (c)  $L/2$  (d)  $3L/4$
74. A charge is placed on a solid conductor. Under static condition, which one of the following statements is FALSE?  
 (a) There is no free charge in the interior of the conductor  
 (b) Potential is constant over the surface of the conductor  
 (c) Electric field is zero inside the conductor  
 (d) Electric field at the surface has both normal and tangential components

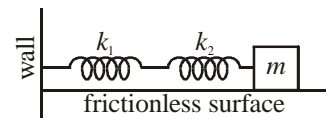
75. A circular wire of radius  $R_1$  carrying a current  $I$  in the anticlockwise direction is concentric with another circular wire of radius  $R_2$  ( $R_2 > R_1$ ) also carrying a current  $I$  in the clockwise direction as shown in the figure



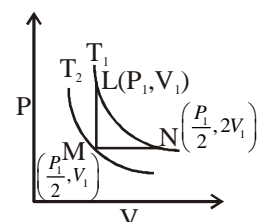
The magnetic field  $\vec{B}$  at the centre is

- (a)  $\frac{\mu_0 I}{2} \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \hat{z}$       (b)  $-\frac{\mu_0 I}{2} \left( \frac{1}{R_1} - \frac{1}{R_2} \right) \hat{z}$
- (c)  $\frac{\mu_0 I}{2} \left( \frac{1}{R_1} + \frac{1}{R_2} \right) \hat{z}$       (d)  $-\frac{\mu_0 I}{2} \left( \frac{1}{R_1} + \frac{1}{R_2} \right) \hat{z}$
76. The ionization energy for a hydrogen atom in its first excited state ( $n=2$ ) is  
 (a) 13.6 eV      (b) 3.4 eV      (c) -3.4 eV      (d) -13.6 eV
77. The volume expansion coefficient for a uniform solid cube is  $\gamma$  and the linear expansion coefficient is  $\alpha$ . For small temperature changes, the relationship between  $\alpha$  and  $\gamma$  is  
 (a)  $\gamma = \sqrt[3]{\alpha}$       (b)  $\gamma = \alpha/3$       (c)  $\gamma = 3\alpha$       (d)  $\gamma = \alpha^3$
78. The velocity ( $v$ ) of a particle moving along positive  $x$ -axis is given by  $v = k\sqrt{x}$  where  $k$  is a positive constant. At time  $t=0$  the particle is at  $x=0$ . The distance of the particle as a function of time is given by  
 (a)  $x = kt^{1/2}$       (b)  $x = k^2 t$       (c)  $x = kt^{3/2}$       (d)  $x = k^2 t^2$
79. Two springs of spring constants,  $k_1$  and  $k_2$  are connected in series where one end is fixed to a wall and other end is connected to a block of mass  $m$ . The arrangement is kept on a frictionless surface. What is the frequency of oscillation when the mass is slightly displaced?

- (a)  $\frac{1}{2\pi} \sqrt{\frac{k_1 k_2}{m(k_1 + k_2)}}$       (b)  $\frac{1}{2\pi} \sqrt{\frac{k_1 + k_2}{m}}$
- (c)  $\frac{1}{2\pi} \sqrt{\frac{k_1 + k_2}{2m}}$       (d)  $\frac{1}{2\pi} \sqrt{\frac{k_1 + k_2}{mk_1 k_2}}$



80. L, M and N are points on the isotherms ( $T_1$  and  $T_2$ ) as shown in the figure. If  $W_{LM}$ ,  $W_{MN}$  and  $W_{LN}$  denote the work done by one mole of an ideal gas along the paths LM, MN and LN respectively, then ( $\ln 2 = 0.693$ )



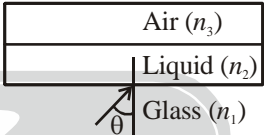
- (a)  $W_{LN} > W_{LM} > W_{MN}$       (b)  $W_{LM} > W_{MN} > W_{LN}$
- (c)  $W_{LN} > W_{MN} > W_{LM}$       (d)  $W_{MN} > W_{LN} > W_{LM}$

81. In Si single crystal, the intrinsic carrier concentration  $n_i$  at temperature  $T_1$  is twice that of at temperature  $T_2$ . Then for an  $n$ -type Si crystal,
- electron concentration  $n$  at  $T_1$  is twice to that of  $n$  at  $T_2$
  - electron concentration  $n$  at  $T_1$  is four times to that of  $n$  at  $T_2$
  - hole concentration  $p$  at  $T_1$  is twice to that of  $p$  at  $T_2$
  - hole concentration  $p$  at  $T_1$  is four times to that of  $p$  at  $T_2$
82. The minimum value of  $\theta$  as shown in the figure for which total internal reflection occurs at the interface between liquid and air is (refractive indices of the media are given in brackets in the figure and  $n_1 > n_2 > n_3$ )
- (a)  $\sin^{-1} \frac{n_2}{n_1}$

(c)  $\sin^{-1} \frac{n_1}{n_2}$

(b)  $\sin^{-1} \frac{n_3}{n_1}$

(d)  $\sin^{-1} \frac{n_1}{n_3}$



Air ( $n_3$ )  
Liquid ( $n_2$ )  
Glass ( $n_1$ )
83. If the vectors  $\vec{a} = \hat{i} + \hat{j} - \hat{k}$ ,  $\vec{b} = 2\hat{i} - \hat{j} - \hat{k}$  and  $\vec{c} = 2\hat{i} + 2\hat{j} + p\hat{k}$  are coplanar, then the value of  $p$  is
- 2
  - 1
  - 1
  - 2
84. A committee of 4 members is to be formed out of 6 men and 4 women. If the committee has to include at least 2 women and a particular woman is always selected, the number of ways it can be formed is
- 36
  - 60
  - 64
  - 90
85. The shortest distance of the point  $(1, 0, 1)$  from the straight line given by  $\frac{x-4}{-2} = \frac{y}{1} = \frac{z-1}{-1}$  is
- $\sqrt{2}$
  - 2
  - $\sqrt{3}$
  - 3
86. The area of the region in the first quadrant bounded by the curves  $y = x^2$  and  $y = x^3$  is
- 1/12
  - 1/6
  - 1/2
  - 3/4
87. The value of  $\lim_{x \rightarrow 0^+} x \ln x$  is
- 1
  - $e$
  - 1
  - 0
88. If  $\theta = \pi/14$ , then the value of  $\frac{\cos 8\theta}{\sin \theta}$  is
- 0
  - 1
  - 1/14
  - 1
89. If  $\tan A$  and  $\tan B$  are the roots of the equation  $x^2 - px + q = 0$ , then the value of  $\tan(A+B)$  is
- $p/q$
  - $q/p$
  - $q/(1-p)$
  - $p/(1-q)$
90. A fair coin is tossed 100 times. The probability of getting tails an odd number of times is
- 1/8
  - 1/4
  - 3/8
  - 1/2



91. If  $y$  is a function of  $x$  given by  $y = \sqrt{x + \sqrt{x + \sqrt{x + \sqrt{x + \dots}}}}$ , then  $\frac{dy}{dx}$  at  $(0, 0)$  is  
 (a)  $-1$  (b)  $0$  (c)  $1$  (d)  $\sqrt{2}$
92. If  $a$  is given by  $a = \frac{1}{2} - \frac{1}{8} + \frac{1}{24} - \frac{1}{64} + \dots$ , then the value of  $e^{-a}$  is  
 (a)  $1/2$  (b)  $2/3$  (c)  $1$  (d)  $3/2$
93. The complex number  $\left(\frac{\sqrt{3}}{2} + i\frac{1}{2}\right)^6$  equals  
 (a)  $-1$  (b)  $1$  (c)  $i - \sqrt{3}$  (d)  $i + \sqrt{3}$
94. If  $\lambda_1$  and  $\lambda_2$  are the values of  $\lambda$  for which  $\begin{vmatrix} 1 & \lambda & 0 \\ \lambda & 2 & 1 \\ 0 & 1 & 1 \end{vmatrix} = 0$ , then  $\lambda_1 + \lambda_2$  equals  
 (a)  $-1$  (b)  $0$  (c)  $1$  (d)  $2$
95. The distance of the point  $(1/2, 0)$  and the line of intersection of the circles  $x^2 + y^2 = 4$  and  $(x+1)^2 + y^2 = 4$  is  
 (a)  $1/\sqrt{2}$  (b)  $\sqrt{2}$  (c)  $1$  (d)  $2$
96. The maximum area of a rectangle inscribed in a circle of radius  $a$  is  
 (a)  $a^2$  (b)  $2a^2$  (c)  $3a^2$  (d)  $4a^2$
97. A missile is projected from the ground at an angle of  $45^\circ$  with the vertical. If it has to hit a target  $50\text{m}$  high at a horizontal distance of  $100\text{ m}$ , the velocity of projection is ( $g$  is the acceleration due to gravity)  
 (a)  $10\sqrt{6g}$  m/s (b)  $10\sqrt{5g}$  m/s (c)  $10\sqrt{3g}$  m/s (d)  $10\sqrt{2g}$  m/s
98. The maximum value of  $3x_1 + 5x_2$  subject to the constraints  
 $0 \leq x_1 \leq 4,$   
 $0 \leq x_2 \leq 6,$   
 $3x_1 + 2x_2 \leq 18$   
 is  
 (a)  $21$  (b)  $27$  (c)  $30$  (d)  $36$
99. The function  $y(x)$  satisfies the differential equation  $\frac{dy}{dx} = \tan x$ . If  $y(\pi/4) = 0$ , then  $y(\pi/3)$  is  
 (a)  $\ln 2$  (b)  $\ln \sqrt{2}$  (c)  $1$  (d)  $e$
100. The sum of the series  $\frac{1}{1.2} + \frac{1}{2.3} + \frac{1}{3.4} + \frac{1}{4.5} + \dots + \frac{1}{n(n+1)} + \dots$  is  
 (a)  $2$  (b)  $0.5$  (c)  $1$  (d)  $0.25$