Biotechnology Paper
2007

1. Which one of the following is considered to be the first biological catalyst when life originated on earth?

(A) RNA
(B) DNA
(C) Protein
(D) Lipid

2. According to the Linnean system of biological classification, the term "Hominidae" indicates

(A) class
(B) order
(C) family
(D) genus

3. "Portuguese man-of-war" belongs to the phylum

(A) Porifera
(B) Cnidaria
(C) Annelida
(D) Arthropoda

4. The endosperm in an angiosperm plant is

(A) haploid
(B) diploid
(C) triploid
(D) tetraploid

5. If an animal has biradial symmetry, then it has

(A) only one plane of symmetry
(B) two axes of rotational symmetry
(C) two planes of symmetry; these two planes have no specific relationship to each other
(D) two planes of symmetry; these two planes are at right angles to each other

6. The technique appropriate for sterilizing animal tissue culture media is

(A) filtering through a 0.45 μm filter
(B) autoclaving at 120 °C
(C) boiling at atmospheric pressure
(D) using chemical agents

7. A population is isolated by a geographical barrier. The resulting speciation known as

(A) parapatric
(B) allopatric
(C) sympatric
(D) pseudopatric

8. Which two of the following statements are **TRUE** in relation to human pregnancy?

P : The blastocyst consists of trophoblast, an inner cell mass and a central cavity

Q : The morula becomes embedded in the endometrium during implantation

R : The placenta acts as an exchange mechanism between the mother and the fetus

S : Maternal and fetal blood are mixed while passing through the placenta

(A) **P** and **Q**

(B) **R** and **S**

(C) **Q** and **S**

(D) **P** and **R**

9. Consider the following Groups:

Group I : Class of compounds

Group II : Typical examples for **Group I**

Group III : Organism / cell associated with the production of these compounds

Group I	**Group II**	**Group III**
P1. Primary metabolite	**Q1.** Antibiotic	**R1.** Bacteria
P2. Secondary metabolite	**Q2.** Amino acid	**R2.** Yeast
P3. Enzyme	**Q3.** Cellulose	**R3.** Fungus
P4. Polysaccharide	**Q4.** Lignin	**R4.** B Lymphocytes
P5. Recombinant protein	**Q5.** Lipase	**R5.** Plant Cells
P6. Immunoglobulins	**Q6.** Human insulin	
	Q7. IgG	

Choose the correct match.

(A) **P1-Q2-R2, P2-Q1-R1, P3-Q5-R3, P4-Q4-R5, P5-Q3-R3, P6-Q7-R4**

(B) **P1-Q1-R1, P2-Q2-R2, P3-Q3-R3, P4-Q4-R5, P5-Q5-R1, P6-Q6-R4**

(C) **P1-Q2-R1, P2-Q1-R3, P3-Q6-R4, P4-Q3-R5, P5-Q7-R5, P6-Q1-R4**

(D) **P1-Q2-R1, P2-Q1-R3, P3-Q5-R2, P4-Q3-R5, P5-Q6-R1, P6-Q7-R4**

10. In *Drosophila melanogaster*, cherub wings (ch), black body (b) and cinnabar eyes (cn) are recessive to their corresponding alleles (represented as ch+, b+ and cn+, respectively) and are all located on chromosome 2. Homozygous wild type flies were mated with cherub, black and cinnabar flies and the resulting F1 females were test crossed with cherub, black and cinnabar males. The following progeny were produced from the test cross:

ch	b+	cn	110
ch+	b+	cn+	780
ch+	b	cn	70
ch+	b+	cn	6
ch	b	cn	769
ch	b+	cn+	60
ch+	b	cn+	111
ch	b	cn+	9
Total			1915

Of these three genes, which one is in the middle?

(A) The locus that determines cherub wings

(B) The locus that determines cinnabar eyes

(C) The locus that determines black body

(D) Cannot be determined from the given data

11. Which one of the following modifications targets the proteins selectively to lysosomes?

(A) Addition of N-acetylgalactosamine to a serine residue of the protein

(B) Addition of a precise number of mannose residues to the protein

(C) Phosphorylation of a specific mannose residue to mannose-6-phosphate

(D) Addition of a peptide signal sequence to the N-terminus of the protein

12. The enzyme that is used to make the first strand cDNA from mRNA is

(A) Reverse transcriptase

(B) Restriction endonuclease

(C) DNA polymerase

(D) T4 DNA ligase

13. Consider the following three groups:

Group I: Viruses

Group II: Associated diseases

Group III: Nature of genetic material – single stranded (ss) or double stranded (ds) DNA/RNA

Group I		Group II		Group III	
P1.	HIV	**Q1.**	Common cold	**R1.**	ssRNA
P2.	Herpes virus	**Q2.**	Cancer	**R2.**	ssDNA
P3.	Rhinovirus	**Q3.**	Diarrhea	**R3.**	dsRNA
P4.	Rotavirus	**Q4.**	AIDS	**R4.**	dsDNA
P5.	Human papilloma virus	**Q5.**	Chickenpox		

Choose the correct match.

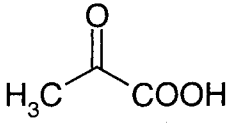
(A) **P1-Q2-R1**; **P2-Q3-R2**; **P3-Q1-R3**; **P4-Q5-R4**; **P5-Q4-R4**

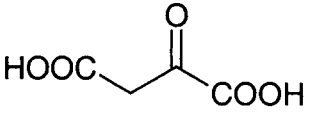
(B) **P1-Q4-R1**; **P2-Q5-R4**; **P3-Q1-R1**; **P4-Q3-R3**; **P5-Q2-R4**

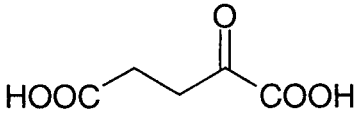
(C) **P1-Q4-R1**; **P2-Q5-R2**; **P3-Q1-R3**; **P4-Q3-R4**; **P5-Q2-R2**

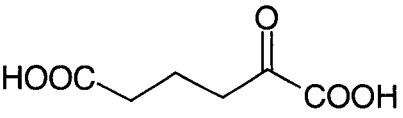
(D) **P1-Q2-R3**; **P2-Q3-R1**; **P3-Q4-R2**; **P4-Q1-R1**; **P5-Q5-R4**

14. Which one of the following compounds, on transamination, **DOES NOT** result in one of the genetically-coded 20 amino acids?

(A) 

(B) 

(C) 

(D) 

15. A class of spermicides (used for contraception) inhibits the flagellar motion of the sperm thereby preventing it from swimming towards the egg. This is achieved by

(A) inhibiting the motor protein dynein

(B) inhibiting the motor protein kinesin

(C) disrupting the microfilaments

(D) depolymerizing microtubules

16. Choose the correct set of words denoted by **(P)**, **(Q)**, **(R)**, **(S)** and **(T)** to fill in the blanks.

__(P)__ use __(Q)__ for antigen presentation. These antigen-displaying MHC molecules are recognized by __(R)__, which express a unique co-receptor on their cell surface called as __(S)__. On interaction with the antigen presenting cells, T cells respond by producing cytokines such as __(T)__.

(A) **P.** All nucleated cells; **Q.** MHC I; **R.** Cytotoxic T Cells; **S.** CD4; **T.** Perforins

(B) **P.** Macrophages; **Q.** MHC II; **R.** Cytotoxic T Cells; **S.** CD4; **T.** γ-Interferon

(C) **P.** B Lymphocytes; **Q.** MHC II; **R.** Helper T Cells (TH2); **S.** CD4; **T.** Interleukin-4

(D) **P.** Dendritic Cells; **Q.** MHC I; **R.** Helper T Cells (TH1); **S.** CD8; **T.** GMCSF

17. Which one of the following signaling pathways is **CORRECT**?

(A) Signal → GPCR → G-Protein → Adenyl cyclase → cAMP → Protein kinase A → Cellular response

(B) Signal → G-Protein → GPCR → Phospholipase C → Inositol triphosphate (IP3) → IP3-gated calcium channel → Release of Ca^{2+} ions

(C) Hormone diffusion → Hormone-receptor (HR) complex → Nuclear transport of HR complex → G-protein modification of HR complex (Transcription Factor) → Binding of Transcription Factor to DNA → Transcription of a gene

(D) Signal → GPCR → G-Protein → Tyrosine kinase → Protein phosphorylation → cAMP → Cellular response

18. **Group I** lists relationships that can exist between two organisms. Their descriptions are given in **Group II**. Find the correct set of matches between **Groups I** and **II**.

	Group I		**Group II**
P.	Ammensalism	**1.**	One population is benefited and the other is harmed
Q.	Commensalism	**2.**	Two dissimilar species living together in close association
R.	Symbiosis	**3.**	Heterotrophic organisms that ingest other organisms
S.	Parasitism	**4.**	One population is inhibited but the other is not affected
		5.	One population is benefited but the other is not affected

(A) **P-4, Q-1, R-2, S-3**

(B) **P-3, Q-5, R-4, S-1**

(C) **P-5, Q-4, R-3, S-5**

(D) **P-4, Q-5, R-2, S-1**

19. Which one of the following can be used to transfect DNA into mammalian cells?

P. Liposomes

Q. Cholesterol

R. $CaCl_2$ + HEPES buffer (calcium phosphate)

S. Magnesium chloride

(A) Only **P** (B) **P** and **Q**

(C) **P** and **R** (D) **P** and **S**

20. Choose the correct set of matches between **Groups I** and **II**.

	Group I		**Group II**
P.	Embryoid	**1.**	An unorganized growth of plant cells in a culture medium
Q.	Callus	**2.**	A localized group of actively dividing cells from which permanent tissue systems such as root, shoot, leaf, and flower are derived
R.	Meristem	**3.**	A process whereby specialized, non-dividing cells begin to proliferate by mitotic division, presumed to involve regression to an undifferentiated state
S.	Scutellum	**4.**	Mass of cells which has an external morphology resembling a proembryo
		5.	The embryonic cotyledon of monocot plants

(A) **P-4, Q-2, R-3, S-5** (B) **P-4, Q-1, R-2, S-5**

(C) **P-3, Q-4, R-2, S-1** (D) **P-2, Q-1, R-3, S-4**

21. Choose the correct set of matches between **Groups I** and **II**.

	Group I		**Group II**
P.	One extra copy of chromosome 13	**1.**	Edwards syndrome
Q.	XO	**2.**	Klinefelter syndrome
R.	XXY	**3.**	Patau syndrome
S.	One extra copy of chromosome 21	**4.**	Down syndrome
		5.	Turner syndrome

(A) **P-1, Q-5, R-3, S-2** (B) **P-3, Q-5, R-2, S-4**

(C) **P-2, Q-1, R-3, S-4** (D) **P-4, Q-1, R-2, S-5**

22. Match the hormones (**Group I**) to the glands producing them (**Group II**).

Group I		**Group II**	
P1.	Oxytocin	**R1.**	Ovary
P2.	Insulin	**R2.**	Pituitary
P3.	Calcitonin	**R3.**	Testis
P4.	Estrogen	**R4.**	Pancreas
P5.	Epinephrine	**R5.**	Thyroid
P6.	Testosterone	**R6.**	Pineal
		R7.	Adrenal

(A) **P1-R5, P2-R4, P3-R2, P4-R1, P5-R6, P6-R3**

(B) **P1-R4, P2-R6, P3-R5, P4-R3, P5-R7, P6-R1**

(C) **P1-R2, P2-R4, P3-R5, P4-R1, P5-R7, P6-R3**

(D) **P1-R1, P2-R4, P3-R7, P4-R1, P5-R6, P6-R5**

23. Which one of the following events **DOES NOT** take place in the lumen of the endoplasmic reticulum in a eukaryotic cell?

(A) Translation of a mRNA to the corresponding polypeptide chain

(B) Folding of the polypeptide chain

(C) Post-translational modifications of the polypeptide chain

(D) Phospholipid synthesis

24. The G_0 phase of the animal cell cycle can occur

(A) just before the G_1 phase

(B) just before the mitotic (M) phase

(C) during the G_2 phase

(D) late in the G_1 phase

25. Rowland and Molina were awarded the Nobel Prize in Chemistry for the year 1995 for their model which states that

(A) chlorine monoxide, monoatomic chlorine and monoatomic oxygen produced from chlorofluorocarbons react with atmospheric ozone to cause destruction of ozone layer

(B) ocean's capacity to absorb additional carbon dioxide is limited, resulting in global warming

(C) acid rains are the major problems to countries which burn more coal and gasoline in the process of industrialization

(D) UV light damages DNA

26. Which one of the following options correctly describes the import of P_i and ADP into the mitochondria?

(A) By ADP – H^+ antiport and P_i – H^+ antiport

(B) By ADP – ATP antiport and P_i – OH^- antiport

(C) By ADP – OH^- antiport and P_i – OH^- antiport

(D) By ADP – ATP antiport and P_i – H^+ antiport

27. In some goats, the presence of horns is produced by an autosomal allele that is dominant in males and recessive in females. A horned female is crossed with a hornless male. One of the resulting F1 females is crossed with a hornless male. Then,

(A) all male progeny and none of the female progeny will be horned

(B) all female progeny and none of the male progeny will be horned

(C) 50% of the male progeny and none of the female progeny will be horned

(D) 50% of the female progeny and none of the male progeny will be horned

28. If the genotypes **Aa Bb Cc dd Ee** and **Aa bb Cc Dd Ee** are crossed, what will be the proportion of **AA BB CC DD EE** genotype among the progeny?

(A) 1/32 (B) 1/64

(C) 1/256 (D) Zero

29. An enzymatic reaction following Michaelis-Menten kinetics (K_m = 50 μM) converts 10% of the substrate (initial concentration S_o = 1 mM) to the product in 5 minutes. The maximum reaction velocity (in μM/minute) of the enzyme is approximately

(A) 10 (B) 20

(C) 50 (D) 180

30. An enzymatic reaction following Michaelis-Menten kinetics (K_m = 50 μM) converts 10% of the substrate (initial concentration S_o = 1 mM) to the product in 5 minutes. If the enzyme concentration is doubled and the substrate concentration is brought down to 0.1 mM in the initial reaction mixture, the time (in minutes) taken for 50% conversion will be approximately

(A) 1 (B) 2

(C) 2.5 (D) 12.5

31. Four mutant strains of *E. coli* having the following characteristics were isolated:

Mutant strain 1 : lac-repressor is not able to bind to operator because of a mutation in the operator region of the *lac* operon

Mutant strain 2 : Allolactose is not able to bind to repressor because of a mutation in the repressor-encoding gene

Mutant strain 3 : Catabolite activator protein (CAP) is not able to bind to the promoter because of a mutation in the promoter region

Mutant strain 4 : cAMP is not able to bind to CAP because of a mutation in the CAP-encoding gene

lac Genes are expressed in strain(s)

(A) **1** only

(B) **1**, **3**, and **4** only

(C) **1** and **4** only

(D) **1** and **2** only, but in the presence of IPTG

32. Which one of the following statements regarding mitochondria is **FALSE**?

(A) Oxidation of NADH present in the mitochondrial matrix is coupled to proton transport out of the matrix

(B) Hydrolysis of ATP present in the mitochondrial matrix is coupled to proton transport out of the matrix

(C) Cytochrome *c* mediates electron transfer from cytochrome bc_1 complex to cytochrome aa_3 complex

(D) Cytosolic NADH is delivered to the mitochondrial NADH dehydrogenase complex by the glycerol-3-phosphate shuttle pathway

33. 8 M urea solution became cold when it was prepared by dissolving an appropriate amount of urea in water at room temperature. This is because the dissolution of urea is

(A) exothermic and exergonic

(B) exothermic and endergonic

(C) endothermic and exergonic

(D) endothermic and endergonic

34. The shape of cholesterol is

(A) planar

(B) globular

(C) cylindrical

(D) helical

35. In the pentose phosphate pathway, glucose is first converted to ribulose-5-phosphate by oxidative decarboxylation. Then, ribulose-5-phosphate undergoes

(A) further oxidation

(B) reduction

(C) further decarboxylation

(D) only rearrangements of carbon skeleton

36. The vitamin, whose derivative is **NOT** a coenzyme of *E. coli* pyruvate dehydrogenase complex, is

(A) pyridoxal

(B) thiamine

(C) niacin

(D) riboflavin

37. Which one of the following statements is **TRUE**?

(A) All microarrays are DNA microarrays

(B) Complete genome sequence should be known to make a microarray

(C) All the microarrays use radioisotopes

(D) Microarrays can be used to measure mRNA levels

38. For a given unicellular organism, which one of the following needs to be characterized only once?

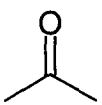
(A) Genome

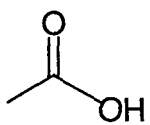
(B) Transcriptome

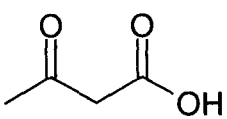
(C) Proteome

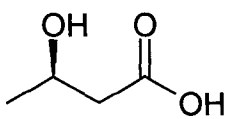
(D) Metabolome

39. The metabolite that is **NOT** used by brain as a source of energy under conditions of prolonged low blood-glucose levels is

(A) 

(B) 

(C) 

(D) 

40. A certain purified DNA sample was cut with two restriction endonucleases E1 and E2. The following results were obtained from agarose gel electrophoresis

Sample cut with E1 alone: two bands of size 35 kb and 15 kb

Sample cut with E2 alone: two bands of size 40 kb and 10 kb

Sample cut simultaneously with E1 and E2: three bands of size 35 kb, 10 kb and 5 kb

From these data, it can be inferred that the DNA has

(A) two sites for E1 and one site for E2

(B) one site for E1 and two sites for E2

(C) one site each for E1 and E2

(D) three sites for E1 and one site for E2

41. Which one of the following protects membrane lipids against damage by reactive oxygen species produced in the chloroplast?

(A) Carotenoids

(B) Chlorophyll *a*

(C) Chlorophyll *b*

(D) Phycocyanin

42. Which one of the following elements **NEED NOT** be present in an expression vector?

(A) Selection marker to select for host cells containing the vector

(B) Two different origins of replication

(C) Promoter sequence upstream of the cloned gene

(D) Unique restriction enzyme sites for insertional cloning

43. A DNA sequencing reaction was performed with the fragment 5'-XXXXGCGATCGYYYY-3' as the template, dideoxy GTP, all the four dNTPs, and the required primers and enzyme. XXXX and YYYY in the given DNA fragment represent primer binding sites. The set of fragments obtained during the reaction will be (the primers are not shown in the amplified fragments)

(A) 5′-CGATCGC-3′ only

(B) 5′-CG-3′, 5′-CGCTAG-3′, 5′-CGCTAGC-3′

(C) 5′-CG-3′, 5′-CGATCG-3′, 5′-CGATCGC-3′

(D) 5′-G-3′, 5′-GCG-3′, 5′-GCGATCG-3′

44. $\Delta G^{\circ\prime}$ for the hydrolysis of ATP to ADP and P_i is -32 kJ/mol. This means that when ATP is hydrolyzed to ADP and P_i in a cell,

(A) -32 kJ/mol of free energy becomes available to the cell for utilization

(B) free energy available to the cell cannot be more than -32 kJ/mol

(C) at least -32 kJ/mol of free energy becomes available to the cell for utilization

(D) free energy available to cell cannot be determined solely by the value of $\Delta G^{\circ\prime}$

45. Let $1 < x < \infty$ and $f(x) = \log\left(\frac{x+1}{x-1}\right)$. Then $f\left(\frac{x^3+3x}{1+3x^2}\right)$ equals

(A) $f(x+3)$ (B) $f(x^2+3)$

(C) $2f(x)$ (D) $3f(x)$

46. Let $z = x + iy$ and $|z-i| = |z+1|$. Then x and y satisfy the equation

(A) $x - y = 1$ (B) $x + y = 1$

(C) $x + y = 0$ (D) $x - y = 0$

47. Let $P(x)$ be the polynomial of least degree with rational coefficients and $1+\sqrt{5}$ is a root of $P(x) = 0$. Then $P(x)$ is

(A) $x^2 - 2x + 4$ (B) $x^2 + 2x + 4$

(C) $x^2 + 2x - 4$ (D) $x^2 - 2x - 4$

48. The value of $\cos^4\left(\frac{\pi}{8}\right) + \cos^4\left(\frac{3\pi}{8}\right)$ is

(A) 1/4 (B) 1/2

(C) 3/4 (D) 1

49. Let C be the circle passing through the origin with its centre lying on the straight lines $3x - 2y = 0$ and $x + y - 5 = 0$. Then the equation of C is

(A) $x^2 + y^2 + 4x + 6y = 0$ (B) $x^2 + y^2 + 4x - 6y = 0$

(C) $x^2 + y^2 - 4x - 6y = 0$ (D) $x^2 + y^2 - 4x + 6y = 0$

50. If $n \geq 2$ and $(1+x)^n = a_0 + a_1 x + a_2 x^2 + \ldots + a_n x^n$, then the value of the expression $a_0 + 2a_1 + 3a_2 + 4a_3 + \ldots + (n+1)a_n$ equals

(A) $2^{n-1}(n+2)$ (B) $2^n n$

(C) $2^{n-1}(n+1)$ (D) $2^{n-2}(n+7)$

51. The range of a random variable X is $\{0, 1, 2, 3, \ldots\}$ and the probabilities of X are given by $P(X=0) = \frac{1}{e}$, $P(X=k) = \frac{c^k}{k!\, e}$, $k = 1, 2, 3, \ldots$, where c is a constant. Then $P(0 < X < 2)$ is

(A) $1/e$ (B) $4/e$

(C) $2/e$ (D) $3/e$

52. The distance of the point $(1, 2, 1)$ from the plane $3x - 6y + 2z + 7 = 0$ is

(A) 1 (B) 0

(C) 1/7 (D) 2/7

53. Let x, y be real numbers, $\vec{a} = \hat{i} + \hat{j} - \hat{k}$, $\vec{b} = \hat{i} - \hat{j} + \hat{k}$ and $\vec{c} = x\hat{i} + y\hat{j} - \hat{k}$. If $\vec{c}$ is perpendicular to $\vec{a}$ and $\vec{c} \cdot \vec{b} = -4$, then which one of the following is **TRUE**?

(A) $x = 2, y = 1$ (B) $x = -2, y = -1$

(C) $x = 2, y = -1$ (D) $x = -2, y = 1$

54. The value of the determinant $\begin{vmatrix} 1+xy & 1 & 1 \\ 1 & 1+yz & 1 \\ 1 & 1 & 1+zx \end{vmatrix}$ equals

(A) $(x+y+z)(x+y+z+xyz)$ (B) $xyz\,(x+y+z+xyz)$

(C) $xyz\,(x+y+z)$ (D) $xyz\,(xy+yz+zx)$

55. The value of $\lim\limits_{x \to 2} \frac{2^{x+1} + 2^{4-x} - 12}{2^{6-x} - 2^{3+x} + 16}$ is

(A) $-1/12$ (B) 1/12

(C) $-1/6$ (D) 1/6

56. The value of the derivative of $y = \tan^{-1}\left[\frac{\sqrt{1+x^2}-1}{x}\right], x \neq 0$ at $x = 1$ is

(A) $\frac{1}{4-2\sqrt{2}}$ (B) $\frac{1}{4+2\sqrt{2}}$

(C) 1/2 (D) 1/4

57. A wire of length 50 cm is to be cut into two pieces for making a square and a circle. For their combined area to be a minimum, one of the pieces must have a length (in cm.) of

(A) $\frac{200\pi}{\pi+4}$ (B) $\frac{100\pi}{\pi+4}$

(C) $\frac{200}{\pi+4}$ (D) $\frac{100}{\pi+4}$

58. The value of the definite integral $\int_0^{2\pi} x\,|\sin x|\,dx$ is

(A) 2π (B) 3π

(C) 4π (D) π

59. The solution of the differential equation $x\frac{dy}{dx} - y = 2x \ln x, x > 0$ subject to the condition $y(1) = 0$ is

(A) $x^2 \ln x$ (B) $x\ (\ln x)^2$

(C) $x^2 (\ln x)^2$ (D) $x \ln x$

60. A particle is projected at an angle of elevation 45° with a velocity of 1 unit. Then the horizontal distance covered is (g denotes the acceleration due to gravity)

(A) g (B) $2/g$

(C) $g/2$ (D) $1/g$

61. A force of magnitude 50 N acts in a direction making an angle of 30° with the positive x – axis. Then the components (in N) along the coordinate axes OX and OY are

(A) $25, 25$ (B) $25\sqrt{3}, 25$

(C) $25, 25/2$ (D) $25\sqrt{3}/2, 25/2$

62. The maximum value of $7x+10y$ subject to the constraints $x+3y \geq 3$, $x+y \leq 2$ and $x \geq 0, y \geq 0$ is

(A) 20 (B) 10

(C) 14 (D) 15.5

63. The product obtained by heating an equimolar mixture of adipic acid and hexamethylenediamine is

(A) Nylon 6 (B) Nylon 66

(C) Polyurethane (D) Terylene

64. The correct match between the items of **Group I** and **Group II** is

Group I	**Group II**
P. Fehling's solution	**1.** Detection of aldehyde
Q. Ferric chloride solution	**2.** Detection of glucose
R. Schiff's base formation	**3.** Detection of phenol
S. Iodoform test	**4.** Detection of $-COCH_3$

(A) **P–2, Q–1, R–3, S–4**

(B) **P–4, Q–3, R–1, S–2**

(C) **P–3, Q–2, R–4, S–4**

(D) **P–2, Q–3, R–1, S–4**

65. A mixture of $CH_3–CH_2–CH=CH_2$ and HBr (slight excess) in ether **DOES NOT** show optical activity because

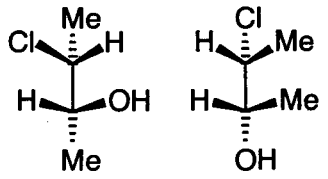
(A) an achiral product is formed

(B) a single chiral product is formed

(C) the product formed is a racemic mixture

(D) $CH_3–CH_2–CH=CH_2$ and HBr do not react in ether

66. The two compounds given below are



(A) identical

(B) enantiomeric

(C) diastereomeric

(D) meso compounds

67. The correct match between the items of **Group I** and **Group II** is

Group I	**Group II**
P. Phosphatidic acid	**1.** Zwitterionic
Q. Triacylglycerol	**2.** Hydrophilic
R. Glycogen	**3.** Hydrophobic
	4. Amphiphatic

(A) **P–4, Q–2, R–3**

(B) **P–4, Q–3, R–2**

(C) **P–1, Q–4, R–2**

(D) **P–2, Q–3, R–1**

68. The correct match between the items of **Group I** and **Group II** is

Group I	**Group II**
P. Preparation of alkanes	**1.** Reimer–Tiemann
Q. $C_6H_6 + C_2H_5Cl + AlCl_3$	**2.** Elimination reaction
R. $C_6H_5OH + CHCl_3 + NaOH$	**3.** Friedel–Crafts
S. $C_2H_5Br + KOH$ (alcoholic)	**4.** Wurtz

(A) **P–3, Q–2, R–1, S–4**

(B) **P–4, Q–3, R–1, S–2**

(C) **P–1, Q–3, R–2, S–4**

(D) **P–4, Q–2, R–1, S–3**

69. The correct match between the items of **Group I** and **Group II** is

Group I	**Group II**
P. McLafferty rearrangement	**1.** UV–Vis spectroscopy
Q. Chemical shift	**2.** IR spectroscopy
R. Molar extinction coefficient	**3.** NMR spectroscopy
S. R_f values	**4.** Mass spectrometry
	5. Thin layer chromatography
	6. Gel electrophoresis

(A) **P–1, Q–3, R–6, S–4**

(B) **P–3, Q–4, R–2, S–6**

(C) **P–4, Q–2, R–3, S–5**

(D) **P–4, Q–3, R–1, S–5**

70. The acidity of

P : C_2H_5COOH **Q :** $C_2H_5NH_2$ **R :** C_2H_5OH **S :** C_2H_5SH

follows the order

(A) **P > S > R > Q**

(B) **P > R > S > Q**

(C) **S > Q > R > P**

(D) **R > Q > P > S**

71. Which one of the following is paramagnetic?

(A) CO

(B) N_2

(C) NO

(D) $[NO]^+$

72. The basic oxide amongst the following is

(A) Cl_2O

(B) Na_2O

(C) P_4O_{10}

(D) SO_3

73. Which one of the following molecules has zero dipole moment?

(A) BF_3

(B) H_2O

(C) $CHCl_3$

(D) HF

74. The shape of $[BrF_4]^+$ ion is

(A) regular tetrahedron

(B) square planar

(C) trigonal pyramidal

(D) see–saw OR irregular tetrahedron

75. Which one of the following complex ions has a square planar geometry?

(A) $[PtCl_4]^{2-}$ (B) $[NiCl_4]^{2-}$

(C) $[Zn(CN)_4]^{2-}$ (D) $[Cd(CN)_4]^{2-}$

76. **Assertion [a]:** Dilute liquid ammonia solution of alkali metals (M) conduct electricity.

Assertion [b]: The electrical conductivity is due to the formation of solvated electrons and M^+ ions.

Which one of the following is **CORRECT**?

(A) **[a]** is true but **[b]** is false

(B) Both **[a]** and **[b]** are false

(C) Both **[a]** and **[b]** are true and **[b]** is the correct reason for **[a]**

(D) Both **[a]** and **[b]** are true but **[b]** is not the correct reason for **[a]**

77. The set of quantum numbers, $n = 2$, $\ell = 2$, $m_\ell = 0$,

(A) is forbidden

(B) describes an electron in a $2d$ orbital

(C) describes an electron in a $2p$ orbital

(D) describes one of the five orbitals of similar type

78. A zero order reaction is 50% complete in 30 minutes. The time (in minutes) from the start of the reaction required for 80% completion is

(A) 42 (B) 48

(C) 52 (D) 60

79. The rate equation for the reaction $2X + 3Y \rightarrow Z$ is $rate = k[X][Y]$. Consider the following statements

P : The unit of k is mol $L^{-1} s^{-1}$

Q : The value of k is independent of the initial concentrations of X and Y

R : By doubling the concentrations of both X and Y, the rate is doubled

Then, which one of the following is **CORRECT**?

(A) **P** is true, **Q** is false, **R** is false

(B) **P** is true, **Q** is true, **R** is false

(C) **P** is false, **Q** is true, **R** is true

(D) **P** is false, **Q** is true, **R** is false

80. The following data are given.

$N_2 (g) + 3H_2 (g) \rightarrow 2NH_3 (g)$, ΔH_1

$2NH_3 (g) + (5/2)O_2 (g) \rightarrow 2NO (g) + 3H_2O (l)$, ΔH_2

$2H_2 (g) + O_2 (g) \rightarrow H_2O (l)$, ΔH_3

The ΔH_{net} for the reaction $N_2 (g) + O_2 (g) \rightarrow 2NO (g)$ is

(A) $\Delta H_{net} = \Delta H_1 + \Delta H_2 + \Delta H_3$

(B) $\Delta H_{net} = \Delta H_1 + \Delta H_2 - \Delta H_3$

(C) $\Delta H_{net} = -(3/2)\Delta H_1 + \Delta H_2 - \Delta H_3$

(D) $\Delta H_{net} = \Delta H_1 + \Delta H_2 - (3/2)\Delta H_3$

81. Consider the equilibrium reaction $N_2O_4 (g) \rightleftarrows 2NO_2 (g)$. If the total pressure of the equilibrium mixture is p and the degree of dissociation of $N_2O_4 (g)$ is x at 300 K, the partial pressure of $NO_2 (g)$ is

(A) $\left(\frac{2x}{1+x}\right)p$

(B) $\left(\frac{2x}{1-x}\right)p$

(C) $\frac{2}{3}xp$

(D) $2xp$

82. From the data given below

$A \rightarrow A^{2+} + 2e$, $E^o = +0.80$ V

$A \rightarrow A^{3+} + 3e$, $E^o = +0.99$ V

the calculated E^o for $A^{2+} \rightarrow A^{3+} + e$ is

(A) +0.19 V

(B) +0.73 V

(C) +1.37 V

(D) +1.79 V

83. A simple pendulum of mass m and length l is given a horizontal velocity v when it is at rest in the equilibrium position. Let $v^2 = gl$, where g is the acceleration due to gravity. The angle from the vertical at the turning point is

(A) $\pi/3$

(B) $\pi/4$

(C) $\pi/6$

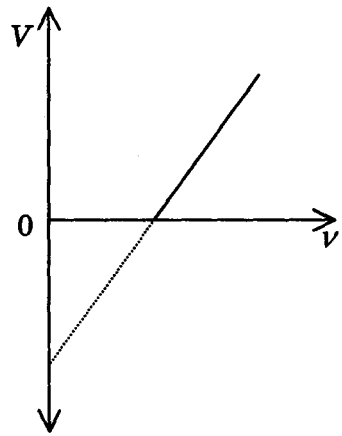
(D) $\pi/2$

84. A force $\vec{F}$ is applied to a block of mass M resting on a surface, as shown in the figure. The coefficient of static friction between M and the surface is μ_s. If the mass **DOES NOT** move, then

(A) $F > \mu_s Mg$ (B) $F < \mu_s Mg$

(C) $F = Mg$ (D) $F < Mg$

85. Figure below shows the variation of stopping potential (V) as a function of frequency (ν) of the incident radiation in a photoelectric experiment. If the intensity of the incident radiation is increased, then in the graph



(A) the slope alone changes

(B) the V-intercept alone changes

(C) both the slope and V-intercept remain the same

(D) both the slope and V-intercept change

86. When an ideal gas is compressed adiabatically to one-fourth of its original volume, the pressure increases by 8 times. The ratio of the molar heat capacities (C_p / C_v) of the gas can be

(A) 1.4 (B) 1.67

(C) 1.45 (D) 1.5

87. A hydrogen atom in the 3rd excited state can have

(A) 3 Lyman, 2 Balmer and 1 Paschen transitions

(B) 2 Balmer and 1 Paschen transitions

(C) 2 Lyman and 1 Paschen transitions

(D) 2 Lyman, 3 Balmer and 1 Paschen transitions

88. Consider two simple harmonic motions represented by $x_1 = A_0 \cos(\omega t + \delta)$ and $x_2 = A_0 \cos(\omega t)$. At $t = 0$, $x_1 = -A_0$. If these two simple harmonic motions are combined, the amplitude of the resultant motion is

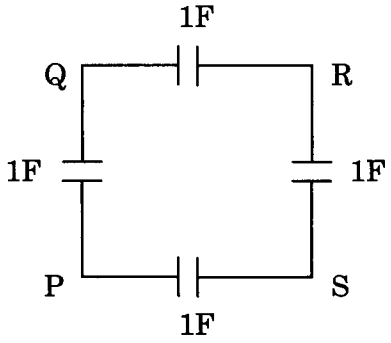
(A) zero

(B) $2A_0$

(C) $\frac{A_0}{2}$

(D) $\sqrt{2}A_0$

89. Four capacitors (each of 1 F) are connected as shown in the figure. If the capacitor assembly is charged to V volts by connecting to the points P and R, the total energy stored in the assembly is



(A) $2\ V^2$

(B) $\frac{1}{2} V^2$

(C) $4\ V^2$

(D) V^2

90. When the resistance R in an LCR circuit is increased, the resonance frequency of the circuit

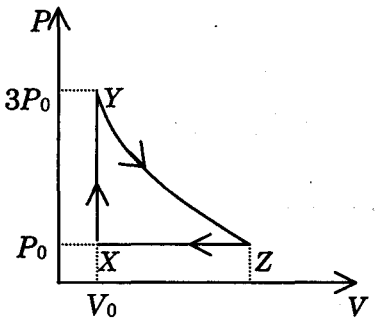
(A) increases, but the resonance becomes broader

(B) decreases, but the resonance becomes sharper

(C) remains the same, but the resonance becomes sharper

(D) remains the same, but the resonance becomes broader

91. Figure shows the P-V diagram for an ideal gas. If the system has a temperature T_0 at X, the temperature at Y is



(A) T_0 (B) $2T_0$

(C) $3T_0$ (D) $4T_0$

92. When the temperature of water is increased from 0°C, its

(A) volume decreases and then increases

(B) volume increases and then decreases

(C) volume increases

(D) volume remains constant

93. The first overtone of an open organ pipe of length l was found to be the same as that of the fundamental frequency of a closed organ pipe when the pipe was immersed in water upto a certain level. Then, the water fills the tube upto a level of

(A) $\frac{1}{4}l$ (B) $\frac{3}{4}l$

(C) $\frac{1}{2}l$ (D) $\frac{2}{3}l$

94. A projectile is launched at an angle θ with respect to the horizontal with an initial velocity u. The coordinates of the moving projectile at the highest point are

(A) $\left(\frac{u^2 \sin 2\theta}{g}, \frac{u^2 \sin^2 \theta}{2g}\right)$ (B) $\left(\frac{u^2 \sin 2\theta}{2g}, \frac{u^2 \sin^2 \theta}{g}\right)$

(C) $\left(\frac{u^2 \sin 2\theta}{2g}, \frac{u^2 \sin^2 \theta}{2g}\right)$ (D) $\left(\frac{u^2 \sin 2\theta}{g}, \frac{u^2 \sin^2 \theta}{g}\right)$

95. For obtaining a **REAL** image using a biconvex lens of focal length f, the distance d between the object and the image must satisfy the condition

(A) $d = \infty$ only

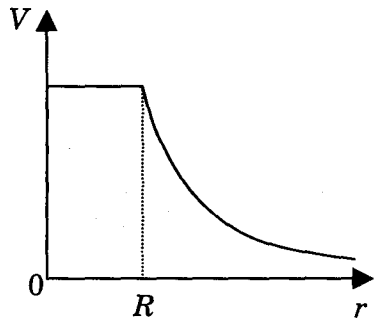
(B) $2f < d < 4f$

(C) $0 < d < 2f$

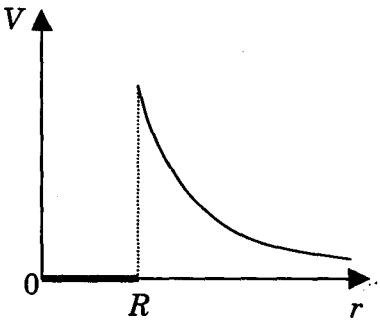
(D) $d \geq 4f$

96. If a conducting sphere of radius R is given a charge Q, which one of the following graphs represents the variation of potential (V) as a function of distance (r) from the centre of the sphere

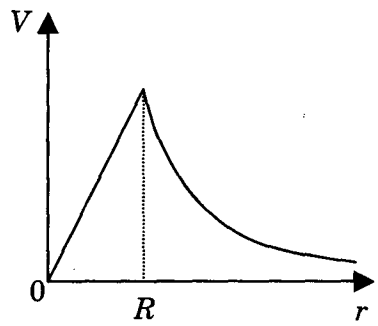
(A)



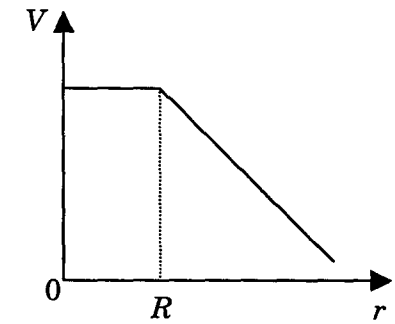
(B)



(C)



(D)



97. An electron having initial velocity v_0 and momentum p_0 is accelerated in a constant electric field $\vec{E}$. After a time t, it acquires velocity v and momentum p. The change in the wavelength of the electron is

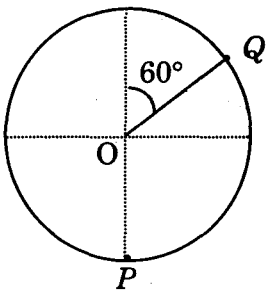
(A) $\dfrac{h|v - v_0|}{p_0}$

(B) $\dfrac{h}{p}$

(C) $\dfrac{h|v - v_0|}{p_0 v}$

(D) $\dfrac{h}{p_0}$

98. A particle of mass m tied to a string is made to move in a circular path of radius R in a VERTICAL plane. Neglect the air friction and mass of the string. Total work done on the particle when the particle moves from P to Q is



(A) mgR

(B) $\frac{3}{2}mgR$

(C) $\left(1+\frac{\sqrt{3}}{2}\right)mgR$

(D) Zero

99. If the biasing is changed from forward to reverse across a semiconductor p-n junction, the width of the depletion layer

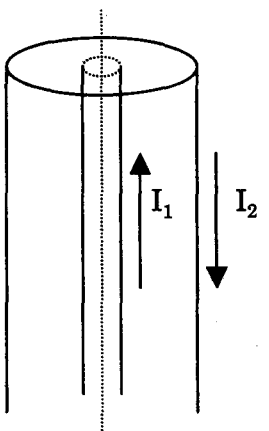
(A) decreases

(B) does not change

(C) vanishes

(D) increases

100. Currents I_1 and I_2 flow in opposite directions along two long coaxial tubes as shown in the figure. The magnetic field at any point in the annular region depends on



(A) I_2 only

(B) I_1 only

(C) $I_1 - I_2$

(D) $I_1 + I_2$