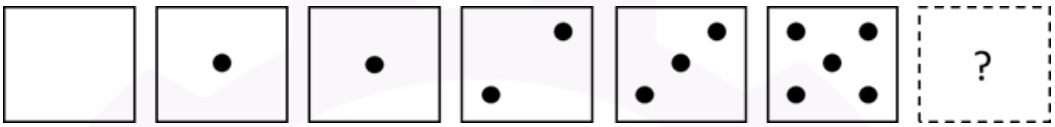
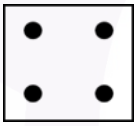
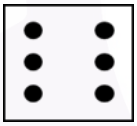
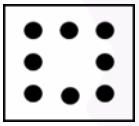
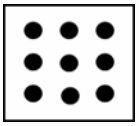
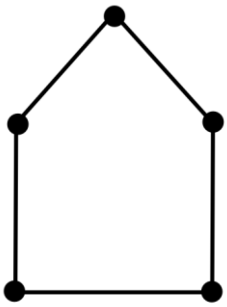
General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

Q.1	Suresh said, “I did it yesterday.” Which one of the following options is the correct form of this sentence in indirect speech?
(A)	Suresh said that I did it yesterday.
(B)	Suresh says I did it yesterday.
(C)	Suresh says that he did it the day before.
(D)	Suresh said that he had done it the day before.

Q.2	To continue the sequence of tiles shown, the tile indicated by the question mark should be 
(A)	
(B)	
(C)	
(D)	

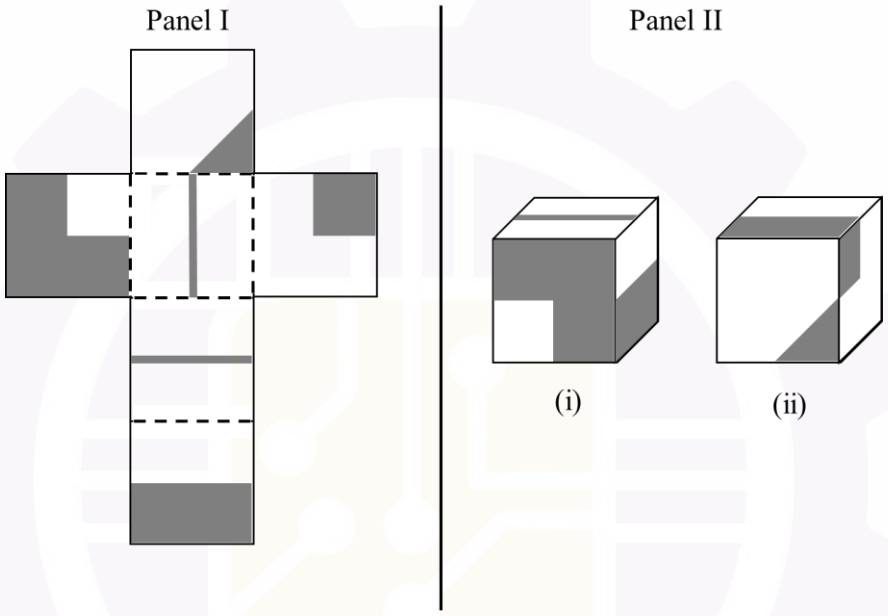
Q.3	Consider an art gallery whose walkways are shown as lines in the diagram. A black dot represents a junction of two walkways. A guard may be placed at a junction to watch over the walkways that join at that junction. The minimum number of guards needed to watch all the walkways is _____. 
(A)	2
(B)	3
(C)	4
(D)	5

Q.4	The 2nd of June is a Thursday in a certain year. Which day of the week is the 3rd of July in that year?
(A)	Thursday
(B)	Friday
(C)	Saturday
(D)	Sunday

Q.5	A coin with heads facing up is shown as (H) and a coin with tails facing up is shown as (T) . Six coins are placed in the Starting Arrangement, as shown in the figure below. A "step" is defined as interchanging a pair of adjacent coins without flipping them. The minimum number of steps needed to go from the Starting Arrangement to the Final Arrangement, as shown in the figure, is _____. Starting Arrangement  Final Arrangement 
(A)	3
(B)	6
(C)	9
(D)	12

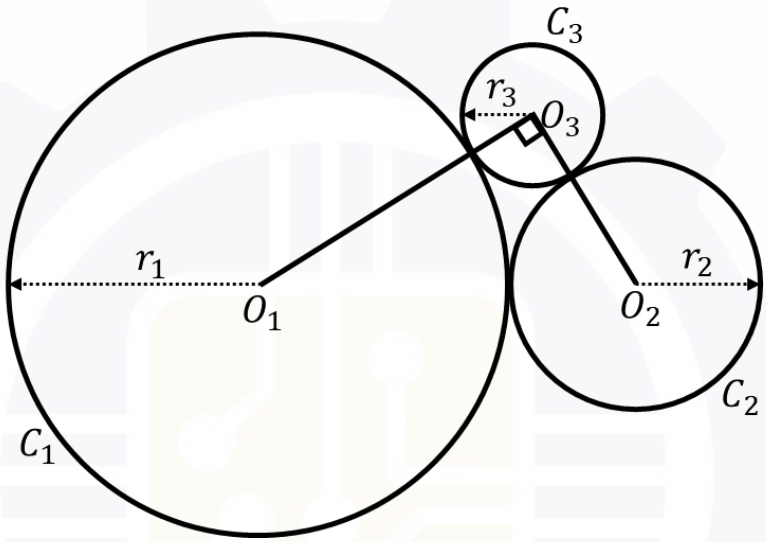
Q.6 – Q.10 Carry TWO marks Each

Q.6	Exacerbate : Mitigate :: _____ Choose the option with the correct pair of words to fill the blank.
(A)	Aggravate : Alleviate
(B)	Alleviate : Precipitate
(C)	Aggravate : Precipitate
(D)	Emancipate : Exonerate

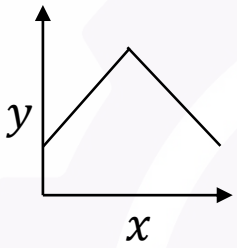
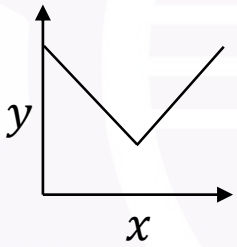
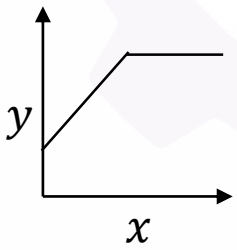
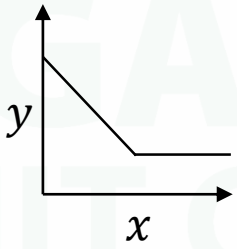
Q.7	A paper shown in Panel I is folded along the dashed lines (- - -) to construct a cube. The shaded regions shown in Panel I appear on the outer surface of the cube. Referring to cubes shown in Panel II, which one of the options is correct? 
(A)	Only (i) can correspond to the unfolded cube in Panel I.
(B)	Only (ii) can correspond to the unfolded cube in Panel I.
(C)	Both (i) and (ii) can correspond to the unfolded cube in Panel I.
(D)	Neither (i) nor (ii) can correspond to the unfolded cube in Panel I.

Q.8	In a population, patients who have high cholesterol also have high blood-pressure (BP). Some patients with high BP also have diabetes. There are no patients who have both high cholesterol and diabetes. Furthermore, 1. the total number of patients with at least one of these conditions is 75, 2. the number of patients with high cholesterol is 10, 3. the number of patients with high BP is 45, and 4. the number of patients with only high BP and no other conditions is 20. Then the number of patients who have both diabetes and high BP is _____
(A)	0
(B)	15
(C)	20
(D)	10

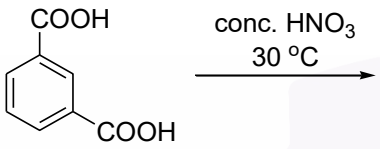
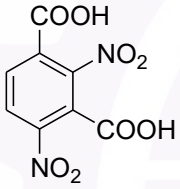
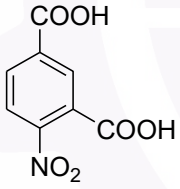
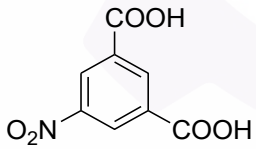
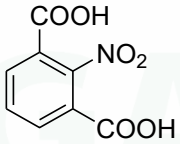
Q.9	Four people P, Q, R, and S, of different ages, make the following observations. P – I am younger than S. Q – I am neither the youngest nor the oldest. R – P is older than me. Based on these observations, the youngest person is _____.
(A)	P
(B)	Q
(C)	R
(D)	S

Q.10	Circles C_1, C_2, and C_3, with centers O_1, O_2, and O_3 , and radii r_1 , r_2, and r_3, respectively, touch each other as shown in the following figure. Given $r_1 = 2$ cm, $r_2 = 1$ cm and the angle $\angle O_1O_3O_2$ is 90°, r_3 = _____ cm. 
(A)	$\frac{1}{2}(-3+\sqrt{17})$
(B)	$\frac{1}{2}(3+\sqrt{17})$
(C)	$\frac{1}{2}(-2+\sqrt{17})$
(D)	$\frac{1}{2}(-3+2\sqrt{17})$

Q.11 – Q.19 Carry ONE mark Each

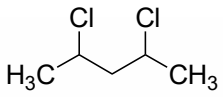
Q.11	10 mM aqueous HCl is added dropwise to 10 mL of 1 mM aqueous NaOH. The qualitative plot of conductivity (y) against the number of drops of HCl (x) is
(A)	
(B)	
(C)	
(D)	

Q.12	Upon hydrolysis of the pentapeptide Glu-Arg-Gly-Phe-Ala (represented from N- to C- terminus) with trypsin, the peptide fragments obtained are
(A)	Glu-Arg and Gly-Phe-Ala
(B)	Glu-Arg-Gly-Phe and Ala
(C)	Glu and Arg-Gly-Phe-Ala
(D)	Glu-Arg-Gly and Phe-Ala

Q.13	The major product formed in the following reaction is 
(A)	
(B)	
(C)	
(D)	

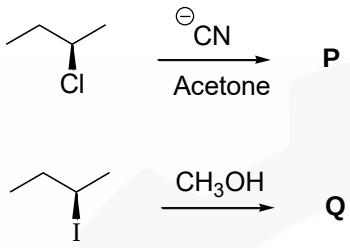
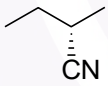
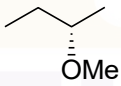
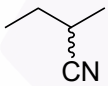
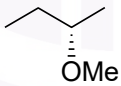
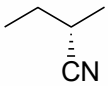
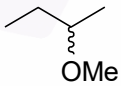
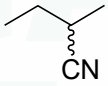
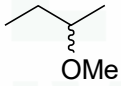
Q.14	The CORRECT order of ionic character (in percentage) among the following is
(A)	NaCl < HCl < HBr
(B)	HCl < NaCl < HBr
(C)	HCl < HBr < NaCl
(D)	HBr < HCl < NaCl

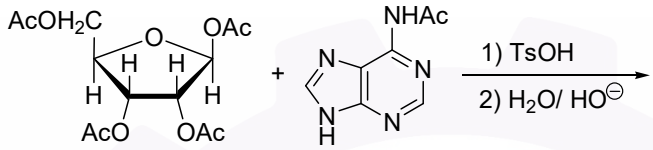
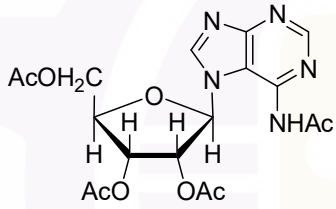
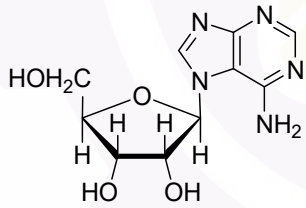
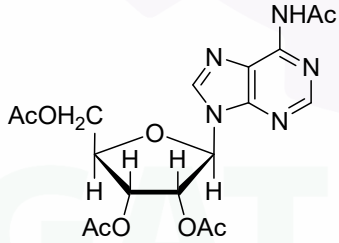
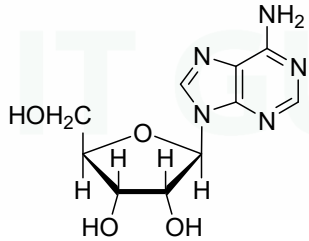
Q.15	The CORRECT combination(s) of element and their ground state electronic configuration is/are (Atomic Numbers: Ar-18, Sc-21, Cr-24, Mn-25 and Fe-26)
(A)	Sc – [Ar] $4s^2$ $3d^1$
(B)	Cr – [Ar] $4s^2$ $3d^4$
(C)	Mn – [Ar] $4s^2$ $3d^5$
(D)	Fe – [Ar] $4s^2$ $3d^6$
Q.16	The major component(s) of phosphate buffer at physiological pH of 7.4 is/are
(A)	H_3PO_4
(B)	$H_2PO_4^-$
(C)	HPO_4^{2-}
(D)	PO_4^{3-}

Q.17	The total number of distinct stereoisomers for the following compound is _____ (in integer). 
Q.18	For the reaction A → products, the half-life is independent of the initial concentration of A. The order of the reaction is _____ (in integer).
Q.19	Among the following, the number of molecules possessing one or more lone pairs on the central atom is _____ (in integer). $BeCl_2$ $SnCl_2$ BF_3 NH_3 SF_4 PF_5 and SF_6

Q.20 – Q.27 Carry TWO marks Each

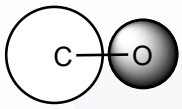
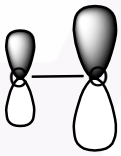
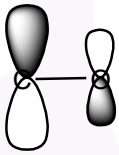
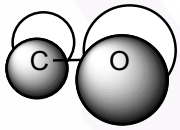
Q.20	An ideal gas in an insulated container expands against zero external pressure. For this expansion, the CORRECT statement is
(A)	Work is done by the gas
(B)	Work is done on the gas
(C)	Pressure of the gas remains unchanged
(D)	Temperature of the gas remains unchanged

Q.21	The major products **P** and **Q** obtained in the following reactions are 
(A)	**P** =  ; **Q** = 
(B)	**P** =  racemic ; **Q** = 
(C)	**P** =  ; **Q** =  racemic
(D)	**P** =  racemic ; **Q** =  racemic

Q.22	The major product formed in the following two-step transformation is (Note: Ts = tosyl and Ac = acetyl) 
(A)	
(B)	
(C)	
(D)	

Q.23	Match the coordination complexes given in **Column I** with their most appropriate properties in **Column II**. (Given: Atomic number of Mn-25; Co-27; Cu-29): **Column I** **Coordination Complexes** E. $[CuCl_5]^{3-}$ F. $[Co(NH_3)_3Cl_3]$ G. $[Co(NH_3)_4Cl_2]$ H. $[Mn(H_2O)_6]^{2+}$ **Column II** **Properties** I. Facial and meridonal isomerism II. $\mu_{spin\text{-}only}$ = 3.87 BM III. Very faintly coloured IV. Trigonal bipyramidal
(A)	E-IV, F-III, G-II, H-I
(B)	E-II, F-IV, G-I, H-III
(C)	E-IV, F-I, G-II, H-III
(D)	E-I, F-III, G-IV, H-II

Q.24	The CORRECT statement(s) about a competitive inhibitor of an enzyme is/are
(A)	The competitive inhibitor binds to the substrate-binding site of the enzyme
(B)	The competitive inhibitor binds to the substrate
(C)	The competitive inhibitor is less effective at higher substrate concentration
(D)	The competitive inhibitor is more effective at higher substrate concentration

Q.25	Among the following, the occupied molecular orbital(s) of carbon monoxide is/are
(A)	
(B)	
(C)	
(D)	

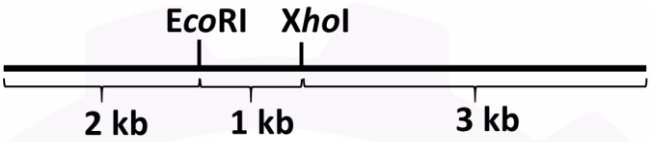
Q.26	The option(s) with the CORRECT order of ionisation energy is/are
(A)	$Al^{+} < Al^{2+} < Al^{3+} < Al^{4+}$
(B)	$Al^{4+} < Al^{3+} < Al^{2+} < Al^{+}$
(C)	$Cl^{-} < Cl < Cl^{+}$
(D)	$Cl^{+} < Cl < Cl^{-}$
Q.27	The pH of 10^{-8} M HCl ($aq.$) is _____ (rounded off to two decimal places). Given, $pK_w = 14$.

Q.28 – Q.35 Carry ONE mark Each

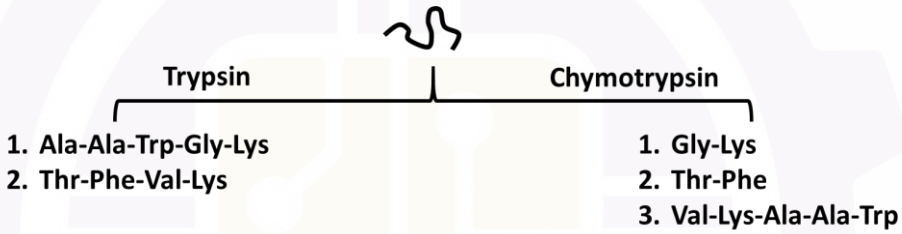
Q.28	Which one of the following immunoglobulins is known for its role in both allergy and asthma?
(A)	IgA
(B)	IgM
(C)	IgD
(D)	IgE
Q.29	In which kind of organism, the glycerol moiety of lipid is found primarily in the R-configuration?
(A)	Bacteria
(B)	Mammals
(C)	Archaea
(D)	Yeast

Q.30	The Kennedy pathway of cellular phospholipid biosynthesis is associated with _____ .
(A)	peroxisome
(B)	mitochondria
(C)	nucleus
(D)	endoplasmic reticulum
Q.31	Which of the following options show(s) the correct pairing of a complement protein with its function?
(A)	C5a : inflammation
(B)	C3b : opsonization
(C)	C3a : opsonization
(D)	C5b : inflammation

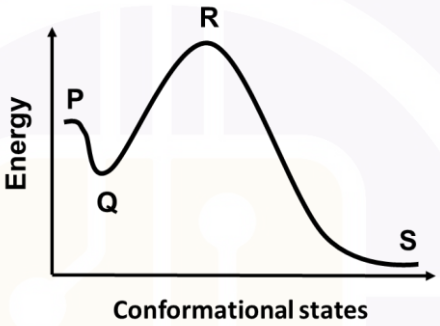
Q.32	Fluorescence is a result of which one or more of the following?
(A)	The transition of electrons from singlet ground state to singlet transition state.
(B)	The transition of electrons from lower singlet excited state to singlet ground state.
(C)	The release of energy in the form of light of wavelength higher than the incident wavelength.
(D)	The release of energy in the form of light of lower wavelength than the incident wavelength.
Q.33	A 25 amino acid α-helical protein is spanning the thickness of a mammalian cell membrane. Using the average dimensional parameters of a typical α-helix, the thickness of the membrane will be _____ Å *(rounded off to one decimal place).*
Q.34	The oxidative phase of the hexose monophosphate pathway generates _____ moles of NADPH per mole of glucose 6-phosphate *(answer in integer).*

Q.35	Partial double digestion of the DNA shown below with E*co*RI, and X*ho*I will yield _____ bands after gel electrophoresis *(answer in integer).* 

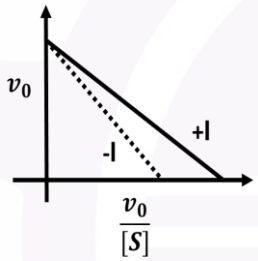
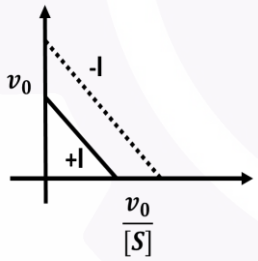
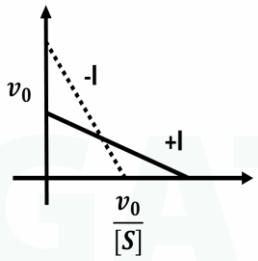
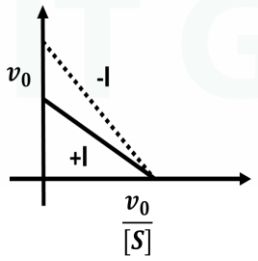
Q.36 – Q.46 Carry TWO marks Each

Q.36	Chymotrypsin cleaves polypeptides preferentially on the carbonyl side of aromatic, and some other bulky nonpolar residues. Trypsin cleaves on the carbonyl side of positively charged residues. Digestion of a polypeptide having the composition- Ala_2, Gly, Lys_2, Phe, Thr, Trp, Val, independently by these two proteases yielded peptide fragments as shown in the figure below.  Which one of the following is the correct primary structure of the polypeptide?
(A)	Ala-Ala-Trp-Gly-Lys-Lys-Thr-Phe-Val
(B)	Thr-Phe-Val-Lys-Ala-Ala-Trp-Gly-Lys
(C)	Val-Lys-Ala-Ala-Trp- Gly-Lys-Thr-Phe
(D)	Thr-Phe-Ala-Ala-Trp-Val-Lys-Gly-Lys

Q.37	Which one of the following enzymes is NOT inhibited by glucose-6-phosphate?
(A)	Hexokinase I
(B)	Hexokinase II
(C)	Hexokinase III
(D)	Hexokinase IV

Q.38	The following diagram represents energy states of different protein folding steps, which includes- 1. Folded 2. Transition 3. Molten globule 4. Unfolded  Find the correct match of folding steps (1 to 4) with the energy state (P to S) in the diagram.
(A)	1-S, 2-R, 3-Q, 4-P
(B)	1-S, 2-R, 3-P, 4-Q
(C)	1-R, 2-Q, 3-S, 4-P
(D)	1-P, 2-Q, 3-R, 4-S

Q.39	The correct path of transfer of electrons in the light harvesting photosystems in vascular plants is _____.
(A)	$H_2O \rightarrow$ Photosystem II $\rightarrow$ Cyt $b_6f \rightarrow$ Photosystem I $\rightarrow NADP^+$
(B)	$H_2O \rightarrow$ Photosystem I $\rightarrow$ Cyt $b_6f \rightarrow$ Photosystem II $\rightarrow O_2$
(C)	$H_2O \rightarrow$ Photosystem II $\rightarrow$ Cyt $b_6f \rightarrow$ Photosystem I $\rightarrow O_2$
(D)	$H_2O \rightarrow$ Photosystem I $\rightarrow$ Cyt $b_6f \rightarrow$ Photosystem II $\rightarrow NADP^+$

Q.40	For a simple enzyme that follows Michaelis-Menten kinetics, kinetic data was collected in the absence (dotted line, -I), or presence (solid line, +I) of an uncompetitive inhibitor (I). Which one of the following Eadie-Hofstee plots best describes the expected result? (v_o = *initial velocity*, [S] = *free substrate concentration*)
(A)	
(B)	
(C)	
(D)	

Q.41	Which statement(s) is/are true about the 5′-capping of eukaryotic mRNA?
(A)	Triphosphatase enzyme removes the γ-phosphate from the 5′-terminal nucleotide.
(B)	A transferase links ATP to the dephosphorylated nucleotide of mRNA at its 5′-end.
(C)	Methyl transferase adds a $–CH_3$ group to the N-7 position of the newly added guanine base.
(D)	5′-capping happens shortly after mRNA emerges from the exit tunnel of RNA polymerase.
Q.42	Which of the following statements about pertussis toxin is/are NOT true?
(A)	It causes whooping cough.
(B)	It is a heterodimeric protein.
(C)	It causes ADP-ribosylation of the α-subunit of G_i.
(D)	It inhibits adenylate cyclase.

Q.43	Telomerase has which one or more of the following activities?
(A)	DNA-dependent RNA polymerase
(B)	Reverse transcriptase
(C)	RNA-dependent DNA polymerase
(D)	5′→3′ exoribonuclease
Q.44	To a $10 \times 10^{-9}\,M$ solution of a receptor, its specific ligand was added, and incubated. At equilibrium, the concentration of the free ligand was $5 \times 10^{-9}\,M$, and the concentration of the receptor-ligand complex was $6 \times 10^{-9}\,M$. The dissociation constant for the receptor-ligand interaction is _____$\times 10^{-9}\,M$ *(rounded off to two decimal places).*
Q.45	Assuming that there are 5×10^{13} cells in the human body, and that ATP is turning over at a rate of 10^{9} ATP molecules per minute in each cell, then the human body is utilizing _____ watts *(rounded off to two decimal places).* [Assume that hydrolysis of ATP yields 12 kcal per mole. 1 watt = 1 joule/sec, 1 calorie = 4.18 joules, Avogadro's number = 6.023×10^{23}]

Q.46	A solution shows a transmittance of 20% when taken in a cuvette of 2.5 cm path length. If the molar absorption coefficient of the solution is 12000 $dm^3/mol.cm$, the concentration of the solution is _____ $\times 10^5$ mol/dm^3 *(rounded off to two decimal places).*

Q.47 – Q.54 Carry ONE mark Each

Q.47	Which one of the following plant families is characterized by the **gynobasic style** of female reproductive organ?
(A)	*Lamiaceae*
(B)	*Euphorbiaceae*
(C)	*Malvaceae*
(D)	*Poaceae*
Q.48	Which one of the following plant organs typically exhibits all the four features listed below? (i) Starch-enriched endodermis (ii) Conjoint, collateral and open vascular bundle (iii) Endarch xylem (iv) Presence of medullary rays
(A)	Dicot root
(B)	Monocot root
(C)	Dicot leaf
(D)	Dicot stem

Q.49 Correctly match the following molecules/methods in **Group-I** with their major uses in **Group-II**.

Group-I		**Group-II**	
(P)	CRISPR-Cas9	(1)	Global gene expression analysis
(Q)	DNA Microarray	(2)	Molecular marker
(R)	*Vir* genes	(3)	Targeted gene editing
(S)	RAPD	(4)	*Agrobacterium*-mediated plant transformation

(A) P−1; Q−3; R−2; S−4

(B) P−3; Q−1; R−4; S−2

(C) P−3; Q−1; R−2; S−4

(D) P−1; Q−3; R−4; S−2

Q.50 Which one of the following commercial products is used as a **systemic fungicide** to control plant diseases?

(A) Captan

(B) Phaltan

(C) Thiram

(D) Benomyl

Q.51	Which one of the following terms best describes the plants that are adapted to grow in acidic soil?
(A)	Halophytes
(B)	Oxylophytes
(C)	Lithophytes
(D)	Chasmophytes
Q.52	Which of the following plant genera is/are example(s) of partial stem parasite?
(A)	*Striga*
(B)	*Orobanche*
(C)	*Viscum*
(D)	*Cuscuta*
Q.53	Which of the following amino acids contain(s) only one chiral center?
(A)	Serine
(B)	Threonine
(C)	Isoleucine
(D)	Leucine
Q.54	If an endosperm cell of a typical diploid angiosperm species has 15 chromosomes, then the number of chromosomes in a microspore mother cell of this species under normal circumstances would be_____ (*in integer*).

Q.55 – Q.65 Carry TWO marks Each

<table>
<tr><td>Q.55</td><td>Which one of the following class(es) of genes, when deleted, would result in sepal formation in all the floral whorls of Arabidopsis, as per the rules of the typical ABC model of floral organ patterning?</td></tr>
<tr><td></td><td></td></tr>
<tr><td>(A)</td><td>Class A only</td></tr>
<tr><td>(B)</td><td>Class A and class B</td></tr>
<tr><td>(C)</td><td>Class B and class C</td></tr>
<tr><td>(D)</td><td>Class B only</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Q.56</td><td>Correctly match the following molecular assemblies in Group-I with their functions in Group-II.
<table>
<tr><th colspan="2">Group-I</th><th colspan="2">Group-II</th></tr>
<tr><td>(P)</td><td>Photosystem I</td><td>(1)</td><td>Utilizes proton gradient for ATP synthesis</td></tr>
<tr><td>(Q)</td><td>Photosystem II</td><td>(2)</td><td>Transfers electron from reduced plastoquinone to oxidized plastocyanin</td></tr>
<tr><td>(R)</td><td>Cytochrome b_6f complex</td><td>(3)</td><td>Drives transfer of electron from plastocyanin to ferredoxin</td></tr>
<tr><td>(S)</td><td>$CF_0 - CF_1$ complex</td><td>(4)</td><td>Oxidises H_2O and reduces plastoquinone</td></tr>
</table></td></tr>
<tr><td></td><td></td></tr>
<tr><td>(A)</td><td>P−3; Q−4; R−1; S−2</td></tr>
<tr><td>(B)</td><td>P−3; Q−4; R−2; S−1</td></tr>
<tr><td>(C)</td><td>P−2; Q−4; R−3; S−1</td></tr>
<tr><td>(D)</td><td>P−4; Q−1; R−2; S−3</td></tr>
<tr><td></td><td></td></tr>
</table>

Q.57 Correctly match the following secondary metabolites in **Group-I** with their chemical classes in **Group-II**.

Group-I		**Group-II**	
(P)	Codeine	(1)	Flavones
(Q)	Podophyllotoxin	(2)	Alkaloids
(R)	Resveratrol	(3)	Lignans
(S)	Linamarin	(4)	Monoterpenes
(T)	Limonene	(5)	Cyanogenic glycosides
		(6)	Stilbenes

(A) P−1; Q−2; R−6; S−5; T−4

(B) P−2; Q−5; R−6; S−3; T−4

(C) P−2; Q−3; R−5; S−4; T−1

(D) P−2; Q−3; R−6; S−5; T−4

Q.58 Correctly match the following plant diseases in **Group-I** with their causal organisms in **Group-II**.

Group-I		Group-II	
(P)	Red rot of sugarcane	(1)	*Albugo candida*
(Q)	Tikka disease of groundnut	(2)	*Cercospora personata*
(R)	Late blight of potato	(3)	*Plasmodiophora brassicae*
(S)	White rust of mustard	(4)	*Phytophthora infestans*
		(5)	*Colletotrichum falcatum*

(A) P−1; Q−2; R−4; S−3

(B) P−5; Q−1; R−4; S−2

(C) P−5; Q−2; R−4; S−1

(D) P−5; Q−3; R−1; S−2

Q.59 Correctly match the following plant species in **Group-I** with their main economically important products in **Group-II**.

Group-I		**Group-II**	
(P)	*Gossypium arboreum*	(1)	Rubber
(Q)	*Dalbergia sissoo*	(2)	Spices
(R)	*Hevea brasiliensis*	(3)	Fibre
(S)	*Pelargonium graveolens*	(4)	Timber
		(5)	Essential oil

(A) P−3; Q−4; R−1; S−5

(B) P−3; Q−4; R−1; S−2

(C) P−2; Q−4; R−1; S−3

(D) P−3; Q−1; R−2; S−5

Q.60	Two genes *X* and *Y* are involved in root development in such a way that all the following three homozygous mutants show rootless phenotype. (i) Gain-of-function mutant of *X* (ii) Loss-of-function mutant of *Y* (iii) Double mutant of gain-of-function of *X* and loss-of-function of *Y* Which one of the following genetic pathways best describes these observations?
(A)	*X* suppresses *Y* and *Y* promotes root development
(B)	*X* promotes *Y* and *Y* promotes root development
(C)	*X* suppresses *Y* and *Y* supresses root development
(D)	*X* promotes *Y* and *Y* supresses root development
Q.61	Which of the following combinations of **photosynthetic carbon cycle** in plants, and its matched biochemical reaction is/are correct?
(A)	**C3 pathway :** Ribulose 1,5-bisphosphate + CO_2 + H_2O → 2 3-phosphoglycerate
(B)	**C2 pathway :** 2 Glycolate + 2 O_2 → 2 glyoxylate + 2 H_2O_2
(C)	**C4 pathway :** 2 2-Phosphoglycolate + 2 H_2O → 2 glycolate + 2 P_i
(D)	**CAM pathway :** Phosphoenolpyruvate + HCO_3^- → oxaloacetate + P_i

Q.62	Choose the correct combination(s) of alkaloid, source plant, and their main commercial use.
(A)	Vincristine – *Catharanthus roseus* – anticancer drug
(B)	Scopolamine – *Hyoscyamus niger* – anticholinergic drug
(C)	Cocaine – *Conium maculatum* – antimalarial drug
(D)	Pilocarpine – *Eschscholzia californica* – antidepressant drug
Q.63	Which of the following statements is/are correct about plant movement?
(A)	Diaheliotropic refers to orienting the leaves perpendicular to the rays of the sun to maximize light interception.
(B)	Paraheliotropic refers to orienting the leaves parallel to the rays of the sun to minimize light interception.
(C)	Diaheliotropic refers to orienting the leaves parallel to the rays of the sun to minimize light interception.
(D)	Paraheliotropic refers to orienting the leaves perpendicular to the rays of the sun to maximize light interception.
Q.64	Two completely linked genes *A* and *B* regulate plant height and flower colour, respectively, wherein the recessive mutant *aa* is dwarf bearing red flowers and the recessive mutant *bb* is tall bearing white flowers. If an F1 individual of the *aaBB* × *AAbb* cross is crossed to the mutant *aabb*, then the probability of an individual in the next generation bearing white flower would be _____ (*Round off to two decimal places*).
Q.65	An enzyme following Michaelis-Menten kinetics, catalyses a reaction with an initial velocity (V_0) of 2 µM s^{-1} at the substrate concentration of 10 µM. If the turnover number (k_{cat}) of the enzyme for the given substrate is 500 s^{-1} and the enzyme concentration in the reaction is 0.01 µM, then the value of the Michaelis-Menten constant (K_m) would be_____ × 10^{-6} M (*in integer*).

Q.66 – Q.73 Carry ONE mark Each

Q.66	Which one of the following statements about microbiological stains is **CORRECT**?
(A)	Acid-fast stain is a simple stain.
(B)	Gram stain is used to visualize endospores.
(C)	Methylene blue is an acidic dye.
(D)	India ink is used to visualize capsules.
Q.67	The genome of which one of the following viruses encodes reverse transcriptase?
(A)	Human immunodeficiency virus
(B)	Influenza virus
(C)	Poliovirus
(D)	Rabies virus

Q.68	Protoplasts can be generated from
(A)	*Streptococcus pneumoniae.*
(B)	*Brucella abortus.*
(C)	*Pasteurella multocida.*
(D)	*Shigella flexneri.*
Q.69	Which one of the following molecules is the master regulator of the planktonic-surface transition in *Pseudomonas aeruginosa* during biofilm formation?
(A)	Cyclic thiolactone
(B)	Cyclic dimeric guanosine monophosphate
(C)	Cyclic triadenylate
(D)	Cyclohexamide

Q.70	Which one of the following is a protozoal disease?
(A)	Cholera
(B)	Gonorrhea
(C)	Kala-azar
(D)	Syphilis
Q.71	Which one of the following drugs is a viral protease inhibitor?
(A)	Acyclovir
(B)	Nevirapine
(C)	Ritonavir
(D)	Zidovudine

Q.72	In *Escherichia coli*, the minimum number of crossovers required between F^- genome and the linear DNA transmitted by Hfr to form a viable recombinant is _____. (*Answer in integer*)
Q.73	The decimal reduction time of *Escherichia coli* at a particular temperature is one minute. Assuming no bacterial growth and constant death rate, the time required for one million bacteria to get reduced to one viable bacterium is _____minutes. (*Answer in integer*)

Q.74 – Q.84 Carry TWO marks Each

<table>
<tr><td>Q.74</td><td>Which one of the following options correctly matches the microbial names in Column I with their corresponding sources of epithet in Column II?

Column I Column II

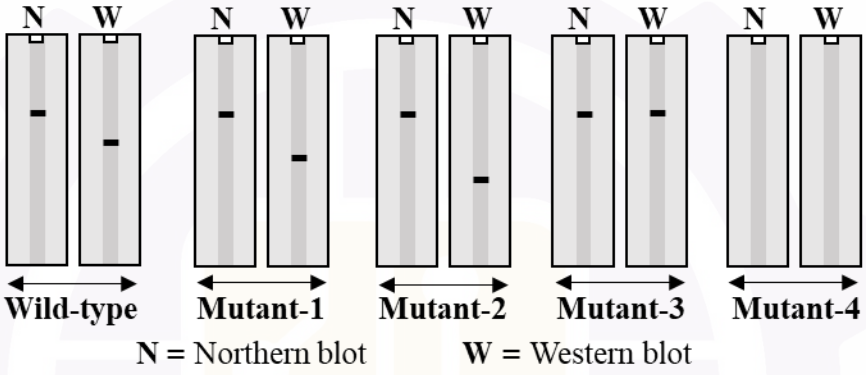
(P) Klebsiella pneumoniae (i) causes stupor in mice

(Q) Penicillium chrysogenum (ii) forms pus

(R) Salmonella typhimurium (iii) the disease it causes

(S) Streptococcus pyogenes (iv) produces a yellow pigment</td></tr>
<tr><td></td><td></td></tr>
<tr><td>(A)</td><td>P-i; Q-ii; R-iii; S-iv</td></tr>
<tr><td>(B)</td><td>Q-i; R-ii; S-iii; P-iv</td></tr>
<tr><td>(C)</td><td>R-i; S-ii; P-iii; Q-iv</td></tr>
<tr><td>(D)</td><td>S-i; Q-ii; P-iii; R-iv</td></tr>
<tr><td></td><td></td></tr>
</table>

Q.75	Determine the correctness or otherwise of the following Assertion [a] and the Reason [r]. Assertion [a]: Silver and copper display bacteriocidal or antiseptic activity. Reason [r]: Silver and copper effectively demonstrate oligodynamic action.
(A)	Both [a] and [r] are true and [r] is the correct reason of [a].
(B)	Both [a] and [r] are true but [r] is not the correct reason of [a].
(C)	Both [a] and [r] are false.
(D)	[a] is true but [r] is false.
Q.76	When tryptophan level is low in *Escherichia coli*, the expression of tryptophan biosynthesis genes is turned on through an antiterminator stem-loop formation between
(A)	regions 1 and 2 of the leader sequence (*trp*L) of mRNA.
(B)	regions 2 and 3 of the leader sequence (*trp*L) of mRNA.
(C)	regions 2 and 4 of the leader sequence (*trp*L) of mRNA.
(D)	regions 3 and 4 of the leader sequence (*trp*L) of mRNA.

Q.77	The effect of mutations in a gene at their transcriptional and translational levels were analyzed using Northern (N) and Western (W) blot techniques, respectively. The following figure shows the schematic representation of mRNA and protein expression profiles of the wild-type and its four different mutants. Which one of the following mutants contains mutation in the upstream regulatory region of the gene? 
(A)	Mutant-1
(B)	Mutant-2
(C)	Mutant-3
(D)	Mutant-4

Q.78	Which one of the following leukocytes is the most abundant in a healthy human?
(A)	Basophils
(B)	Eosinophils
(C)	Monocytes
(D)	Neutrophils
Q.79	DNA amplification in the polymerase chain reaction is
(A)	linear.
(B)	parabolic.
(C)	sigmoidal.
(D)	exponential.

Q.80	In bacteriophage lambda (λ) life cycle, binding of Cro protein to *cI* gene operator region
(A)	activates *cI* gene expression.
(B)	directs towards the lysogenic state.
(C)	directs towards the lytic cycle.
(D)	prevents *cI* gene expression.
Q.81	Which of the following is/are ring(s) of bacterial flagellum?
(A)	C ring
(B)	L ring
(C)	P ring
(D)	Z ring

Q.82	Which of the following bacteria is/are uncultivable?
(A)	*Borrelia burgdorferi*
(B)	*Leptospira interrogans*
(C)	*Mycobacterium leprae*
(D)	*Treponema pallidum*
Q.83	Which of the following antibiotic(s) inhibit(s) bacterial protein synthesis?
(A)	Erythromycin
(B)	Tetracycline
(C)	Bacitracin
(D)	Vancomycin

Q.84	Scientist(s) who contributed in disproving the theory of spontaneous generation is/are
(A)	Ferdinand Cohn.
(B)	John Needham.
(C)	John Tyndall.
(D)	Louis Pasteur.

Q.85 – Q.92 Carry ONE mark Each

Q.85	A researcher sets up ten large outdoor tanks, each containing the same amount of algae and the same number of guppies (herbivorous fish). In five of these tanks, she also adds gourami fish, which are predators of guppies. Tanks were covered in mesh so no new species could enter. After 2 months, the researcher counted the number of guppies and gouramies, and measured the amount of algae. She found that the amount of algae was much higher in the tanks with gourami fish compared to those without gourami fish. Which one of the following processes best explains the differences in amounts of algae between these tanks?
(A)	Competition-colonisation trade-off
(B)	Competitive exclusion principle
(C)	Interference competition
(D)	Trophic cascade
Q.86	Immunoglobulins are classified into the following isotypes: IgG, IgM, IgA, IgD, IgE. What region of the immunoglobulin is used to determine this classification?
(A)	The constant region of the heavy chain only
(B)	The constant region of the light chain only
(C)	The variable region of both the heavy and light chains
(D)	The constant region of both the heavy and light chains

Q.87 Correctly match the cell types in Column I to their primary function in Column II.

Column I	**Column II**
P) Melanocyte	1) Muscle contraction
Q) Myocyte	2) Pigment production
R) Granulosa	3) Antibody production
S) B-cell	4) Estrogen secretion

(A) P – 1; Q – 3; R – 2; S – 4

(B) P – 2; Q – 1; R – 4; S – 3

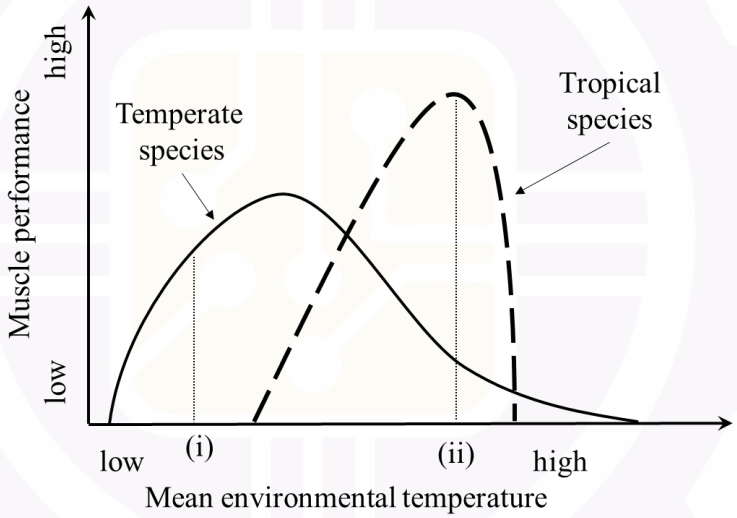
(C) P – 1; Q – 2; R – 3; S – 4

(D) P – 2; Q – 3; R – 4; S – 1

Q.88	Which one of the following groups includes at least one animal that is NOT an arthropod?
(A)	Group 1: crustaceans, scorpions, mites, insects
(B)	Group 2: trilobites, horseshoe crabs, centipedes
(C)	Group 3: millipedes, horseshoe crabs, sponges, earthworms
(D)	Group 4: butterflies, moths, beetles
Q.89	Females of many insect species mate with multiple different males. Which of the following is/are an adaptive explanation(s) for multiple mating in insects?
(A)	Females obtain more resources by mating with multiple males
(B)	Multiple mating increases the genetic variation among the offspring
(C)	Multiple mating increases the probability of fertilization
(D)	Multiple mating increases relatedness among the offspring

Q.90	Which one or more of the following terms describe(s) *Toxoplasma gondii*?
(A)	Virus
(B)	Parasite
(C)	Bacteria
(D)	Fungus
Q.91	Which of the following statements is/are NOT correct about the technique used in molecular biology?
(A)	Southern blotting is used to detect specific DNA sequences
(B)	Northern blotting is used to detect RNA expression levels
(C)	Western blotting is used to detect proteins using antibodies
(D)	ELISA is used to detect specific DNA sequences directly without antibodies
Q.92	Assume that in the oxidative branch of the pentose phosphate pathway, each glucose-6-phosphate molecule generates the following products: 2 molecules of NADPH, 1 molecule of CO_2 and 1 molecule of ribulose-5-phosphate. If 30 molecules of glucose-6-phosphate enter this pathway, and you randomly draw one molecule from the products of the pathway, the probability that this molecule is NADPH is _____ (*round off to one decimal place*).

Q.93 – Q.103 Carry TWO marks Each

Q.93	Muscle performance is positively correlated with Darwinian fitness. The graph below describes the relationship between mean environmental temperature and muscle performance for two closely related lizard species, one living in temperate areas (solid line) and another living in tropical areas (dashed line). Current mean environmental temperatures are marked with vertical dotted lines at (i) for the temperate species and (ii) for the tropical species. If mean environmental temperatures at both locations increase at a steady rate over time, which one of the following is most likely to occur in the near future? 
(A)	Temperate and tropical species will be negatively impacted to the same extent
(B)	Temperate species may be positively impacted but tropical species will be negatively impacted
(C)	Temperate species will be negatively impacted but tropical species will be positively impacted
(D)	Neither temperate nor tropical species will be impacted

Q.94	In eukaryotic cells, a mutation reduces the enzymatic activity of pyruvate dehydrogenase by 90%, without affecting expression. Under aerobic conditions, which one of the following metabolic changes is most expected in cells with the mutation compared to cells without?
(A)	Mutated cells will accumulate pyruvate and increase lactate production, despite oxygen being available
(B)	Mutated cells will have higher metabolic flux through Krebs cycle, resulting in higher NADH yield
(C)	This mutation will have no effect on metabolism
(D)	Mutated cells will have depleted levels of pyruvate and lactate, despite oxygen being available

Q.95	Which one of the following describes the role of enhancers in eukaryotic gene regulation?
(A)	Enhancers always lie immediately upstream of the promoter and function only in a fixed orientation
(B)	Enhancers can act at variable distances from the promoters and may function upstream, downstream, or within introns of genes
(C)	Enhancers directly bind to RNA polymerase II to initiate transcription
(D)	Enhancers overlap with the RNA polymerase II binding site
Q.96	Retes are networks of outgoing arteries and returning veins that create a counter-current pattern. Retes in the flippers of seals that live in temperate areas function as
(A)	sensitivity enhancers to increase pain sensitivity in the flippers.
(B)	metabolism blockers to prevent excess nutrients from being made in the flippers.
(C)	heat blocks to prevent body heat from being lost to the flippers.
(D)	pressure enhancers to spike blood pressure in the flippers.

Q.97	Researchers measure the activity of an enzyme in the presence of an inhibitor. They observe that • V_{max} of the enzyme remains unchanged at saturating substrate concentration • K_m increases compared to uninhibited enzyme Which type of inhibition is most consistent with these observations?
(A)	Competitive inhibition
(B)	Non-competitive inhibition
(C)	Irreversible inhibition
(D)	Substrate inhibition

Q.98

Below are the numbers of individuals of migratory green warblers and the frequencies of three genotypes at a single locus for this species. **F** refers to the allele for faster migration and **S** to the allele for slower migration.

	FF	**FS**	**SS**	Total
Number of individuals	35	20	10	65
Genotype frequencies	0.54	0.30	0.16	1

What are the allele frequencies of F and S? (*round off to 2 decimal places*)

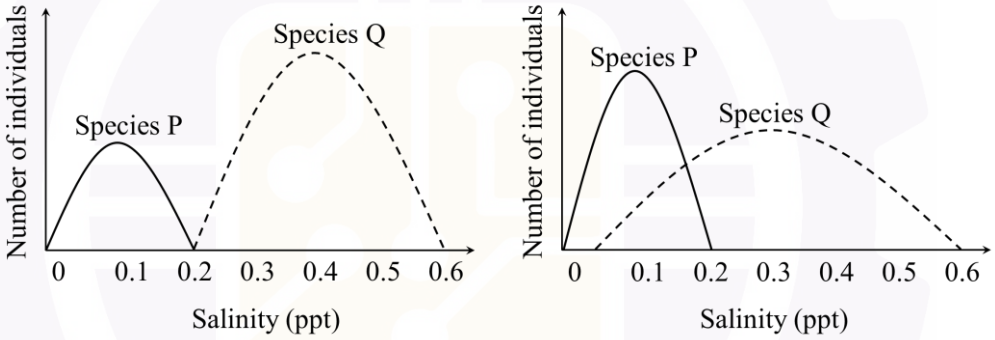
(A) Allele frequency of F = 0.69 and allele frequency of S = 0.31

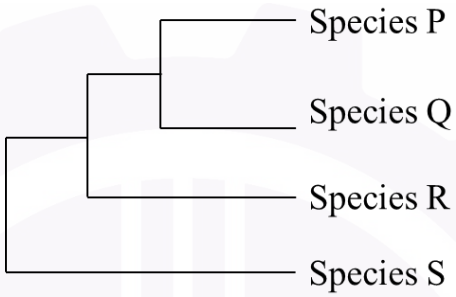
(B) Allele frequency of F = 0.59 and allele frequency of S = 0.41

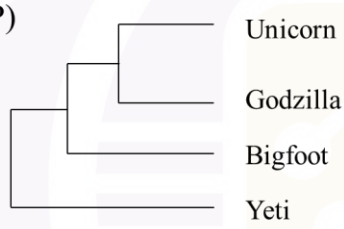
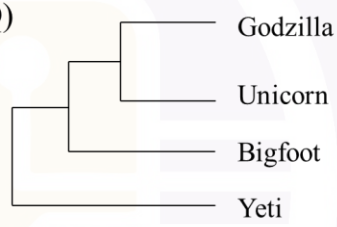
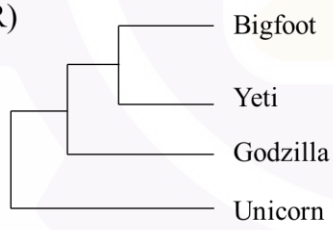
(C) Allele frequency of F = 0.31 and allele frequency of S = 0.69

(D) Allele frequency of F = 0.50 and allele frequency of S = 0.50

Q.99	A drug was developed to inhibit histone acetyl transferase in eukaryotic cells. Cells treated with this drug have more compact chromatin and show reduction in transcription of several genes. Which one of the following statements best explains why the drug has this effect?
(A)	Histone acetylation increases positive charge on histones, thereby tightening DNA binding and repressing transcription
(B)	Histone H1 directly binds the nucleosome core and its acetylation directly causes nucleosome disassembly
(C)	Histone acetylation neutralizes positive charge on histones, thereby loosening DNA-histone interactions and promoting transcription
(D)	Euchromatin is normally condensed, so reduced acetylation of histones converts it into a transcriptionally active state
Q.100	Two species of snakes, Species P and Species Q, have overlapping geographic distributions. Species P mainly eats rodents, whereas Species Q mainly eats invertebrates. Which one or more of the following terms describe(s) the process of speciation for these two species?
(A)	Sympatric speciation
(B)	Parapatric speciation
(C)	Allopatric speciation
(D)	Niche differentiation

Q.101	In rivers that range in salinity (ppt) from low to high, researchers found that the aquatic snail species P (solid curve) and Q (dashed curve) were distributed according to the pattern illustrated in figure (i) when the species are together. The researchers then conducted a manipulative experiment in similar rivers with the same salinity range, where they removed either species P or Q. Figure (ii) illustrates the number of individuals of species P and Q when they were allowed to live alone. These snails have no other competitors or predators. Which one or more conclusions can be drawn from these two figures? (i) (ii) 
(A)	Fundamental niche of P is larger than fundamental niche of Q
(B)	Fundamental niche of Q is larger than realized niche of Q
(C)	Fundamental niche of P is larger than realized niche of P
(D)	Fundamental and realized niches of P are the same

Q.102	Which of the following statements is/are correct for the phylogenetic tree depicted below? 
(A)	Species R and Species S are reciprocally monophyletic
(B)	Species R is sister to a clade comprised of Species P and Q
(C)	Species P and Species Q are reciprocally monophyletic
(D)	Species P, Q, R and S share a common ancestor

Q.103	In her exploration of the Western Ghats, Dora finds four new species of fungi. Below is the DNA sequence alignment for a single locus from these new species that she calls Yeti, Unicorn, Bigfoot and Godzilla. Using the principle of parsimony and the DNA sequence alignment information below, which one or more of the following tree topologies represent(s) the relationship between these species? Yeti: ATGC Unicorn: ATGT Bigfoot: ATGA Godzilla: ATGT (P)  (Q)  (R)  (S) 
(A)	P
(B)	Q
(C)	R
(D)	S

Q.104 – Q.111 Carry ONE mark Each

Q.104	Ergotism is caused by ingestion of grains infected with
(A)	*Clostridium perfringens*
(B)	*Rhizopus stolonifer*
(C)	*Lactococcus lactis*
(D)	*Claviceps purpurea*

Q.105 Match the bacteria in **Column I** with their respective characteristic features in **Column II.**

Column I	Column II
(P) *E. coli*	(1) Gram-positive, round-shaped and non-spore formers
(Q) *B. subtilis*	(2) Gram-negative, rod-shaped and non-spore formers
(R) *S. aureus*	(3) Gram-positive, rod-shaped and spore formers
(S) *L. monocytogenes*	(4) Gram-positive, rod-shaped and non-spore formers

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

(B) P-2; Q-1; R-3; S-4

(C) P-2; Q-3; R-1; S-4

(D) P-2; Q-4; R-1; S-3

Q.106	Carmine, a food colorant, is derived from
(A)	*Curcuma longa*
(B)	*Dactylopius coccus*
(C)	*Beta vulgaris*
(D)	*Monascus purpureus*
Q.107	Which one of the following carbohydrates is **NOT** a storage polysaccharide?
(A)	Starch
(B)	Glycogen
(C)	Chitin
(D)	Dextran

Q.108	Which one of the following statements is true for a high-pressure homogenizer?
(A)	Homogenization takes place only due to uniform mixing of solid and liquid
(B)	Solid particles in the suspension are disintegrated due to the high shear rate exerted by the liquid
(C)	High pressure steam is injected to dissolve the solids
(D)	Solid particles in the suspension are compressed into a cake under high pressure
Q.109	Coconut oil contains a small fraction of unsaturated fatty acids, but still has a low melting point due to the presence of
(A)	large amounts of long chain saturated fatty acids
(B)	mostly medium chain saturated fatty acids such as lauric acid
(C)	few hydrogen bonds per fatty acid chain
(D)	higher cholesterol content

Q.110	Which of the following amines, produced as a result of protein degradation, is/are foul smelling?
(A)	Histamine
(B)	Cadaverine
(C)	Tyramine
(D)	Putrescine
Q.111	Water is flowing at 100 litres/min through a pipe with a diameter of 5 cm. Assume the coefficient of viscosity of water to be 0.001 Pa.s and the density to be 1000 kg/m^3. The Reynolds number for this flow is _____ (*Round off to nearest integer*)

Q.112 – Q.122 Carry TWO marks Each

Q.112 Match the toxins in **Column I** with their respective sources in **Column II.**

Column I	Column II
P. Aflatoxin	1. *Fusarium verticilloides*
Q. Nisin	2. Enterohemorrhagic *E. coli*
R. Fumonisin	3. *Lactococcus lactis*
S. Shiga-like toxin	4. *Aspergillus flavus*

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

(B) P-4; Q-1; R-2; S-3

(C) P-4; Q-3; R-1; S-2

(D) P-1; Q-3; R-2; S-4

Q.113 Match the vitamins in **Column** I with their respective coenzyme forms listed in **Column II.**

Column I	**Column II**
P. Vitamin B_1	1. Tetrahydrofolate
Q. Vitamin B_2	2. Methylcobalamin
R. Pantothenic acid	3. Thiamine pyrophosphate
S. Vitamin B_{12}	4. Flavin adenine dinucleotide
T. Folic acid	5. Coenzyme A

(A) P-3; Q-4; R-5; S-2; T-1

(B) P-4; Q-3; R-1; S-5; T-2

(C) P-1; Q-5; R-4; S-2; T-3

(D) P-5; Q-2; R-4; S-3; T-1

Q.114	Which one of the following proteins brings about the coagulation of milk in the stomach of calves?
(A)	Rennin
(B)	Alpha-lactalbumin
(C)	Beta-lactoglobulin
(D)	Lactoferrin

Q.115 Match the class of additives used for food preservation listed in **Column I** with their specific examples in **Column II.**

Column I	Column II
P. Antioxidants	1. Rice bran wax
Q. Anti-foaming agent	2. Tricalcium phosphate
R. Anti-caking agent	3. Mineral oil
S. Glazing agent	4. Butylated hydroxy anisole (BHA)

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

(B) P-4; Q-3; R-1; S-2

(C) P-4; Q-3; R-2; S-1

(D) P-2; Q-3; R-1; S-4

Q.116 Match the food items listed in **Column I** with their respective flavoring agents in **Column II.**

Column I	Column II
P. Cloves	1. Diacetyl
Q. Butter	2. Limonene
R. Orange	3. Eugenol
S. Lemon	4. Diallyl disulfide
T. Garlic	5. Citral

(A) P-1; Q-3; R-2; S-4; T-5

(B) P-3; Q-2; R-1; S-5; T-4

(C) P-4; Q-2; R-5; S-1; T-3

(D) P-3; Q-1; R-2; S-5; T-4

Q.117	Vegetable oils resist oxidation and maintain their quality for a long period due to the presence of
(A)	tocopherols
(B)	hydrolytic enzyme such as lipases
(C)	microorganisms such as molds and yeast
(D)	carbohydrates
Q.118	For a given temperature difference between the top and bottom surfaces of a flat metal plate, Fourier's law of heat conduction implies that
(A)	temperature gradient increases with increase in heat transfer area
(B)	heat flux is proportional to the thermal conductivity of the metal
(C)	heat flux increases with increase in thickness of the metal plate
(D)	temperature gradient decreases with increase in thickness of the metal plate

Q.119	Xylooligosaccharides can be produced by
(A)	hydrolytic degradation of xylan by hydrochloric acid
(B)	hydrolysis of starch
(C)	enzymatic hydrolysis of lactose
(D)	enzymatic hydrolysis of xylan containing lignocellulosic material
Q.120	In a α-helix, the R-groups on the amino acid residues
(A)	are found on the outside of the helix
(B)	participate in the backbone H-bonding that stabilize the helix
(C)	allow formation of right-handed helices
(D)	allow formation of left-handed helices

Q.121	During constant pressure cake filtration, for an incompressible cake deposited uniformly over a constant filter surface area,
(A)	the cake resistance remains constant
(B)	the cake resistance increases in proportion to the cake thickness
(C)	the filtration rate remains constant
(D)	the filtration rate decreases with time

Q.122	Hot oil is being cooled in a countercurrent, double-pipe heat exchanger from 410 K to 340 K by chilled water entering at 290 K and exiting the exchanger at 330 K. The Log Mean Temperature Difference (LMTD) for this heat transfer is _____K. (*Round off to one decimal place*)