GA - General Aptitude

Q1 - Q5 carry one mark each.

Q.No. 1 Rajiv Gandhi Khel Ratna Award was conferred_____Mary Kom, a six-time world champion in boxing, recently in a ceremony_____the Rashtrapati Bhawan (the President's official residence) in New Delhi.

(A) with, at
(B) on, in
(C) on, at
(D) to, at

Q.No. 2 Despite a string of poor performances, the chances of K. L. Rahul's selection in the team are_____.

(A) slim
(B) bright
(C) obvious
(D) uncertain

Q.No. 3 Select the word that fits the analogy:

Cover : Uncover :: Associate : _____

____

(A) Unassociate
(B) Inassociate
(C) Misassociate
(D) Dissociate

Q.No. 4 Hit by floods, the kharif (summer sown) crops in various parts of the country have been affected. Officials believe that the loss in production of the kharif crops can be recovered in the output of the rabi (winter sown) crops so that the country can achieve its food-grain production target of 291 million tons in the crop year 2019-20 (July-June). They are hopeful that good rains in July-August will help the soil retain moisture for a longer period, helping winter sown crops such as wheat and pulses during the November-February period.

Which of the following statements can be inferred from the given passage?

(A) Officials declared that the food-grain production target will be met due to good rains.
(B) Officials want the food-grain production target to be met by the November-February period.
(C) Officials feel that the food-grain production target cannot be met due to floods.
(D) Officials hope that the food-grain production target will be met due to a good rabi produce.

Q.No. 5 The difference between the sum of the first $2n$ natural numbers and the sum of the first n odd natural numbers is _____.

(A) $n^2 - n$
(B) $n^2 + n$
(C) $2n^2 - n$
(D) $2n^2 + n$

Q6 - Q10 carry two marks each.

Q.No. 6 Repo rate is the rate at which Reserve Bank of India (RBI) lends commercial banks, and reverse repo rate is the rate at which RBI borrows money from commercial banks.

Which of the following statements can be inferred from the above passage?

(A) Decrease in repo rate will increase cost of borrowing and decrease lending by commercial banks.

(B) Increase in repo rate will decrease cost of borrowing and increase lending by commercial banks.

(C) Increase in repo rate will decrease cost of borrowing and decrease lending by commercial banks.

(D) Decrease in repo rate will decrease cost of borrowing and increase lending by commercial banks.

Q.No. 7 P, Q, R, S, T, U, V, and W are seated around a circular table.

I. S is seated opposite to W.
II. U is seated at the second place to the right of R.
III. T is seated at the third place to the left of R.
IV. V is a neighbour of S.

Which of the following must be true?

(A) P is a neighbour of R.

(B) Q is a neighbour of R.

(C) P is not seated opposite to Q.

(D) R is the left neighbour of S.

Q.No. 8 The distance between Delhi and Agra is 233 km. A car P started travelling from Delhi to Agra and another car Q started from Agra to Delhi along the same road 1 hour after the car P started. The two cars crossed each other 75 minutes after the car Q started. Both cars were travelling at constant speed. The speed of car P was 10 km/hr more than the speed of car Q. How many kilometers the car Q had travelled when the cars crossed each other?

(A) 66.6

(B) 75.2

(C) 88.2

(D) 116.5

Q.No. 9 For a matrix $M = [m_{ij}];\ i,j = 1,2,3,4$, the diagonal elements are all zero and $m_{ij} = -m_{ji}$. The minimum number of elements required to fully specify the matrix is_____.

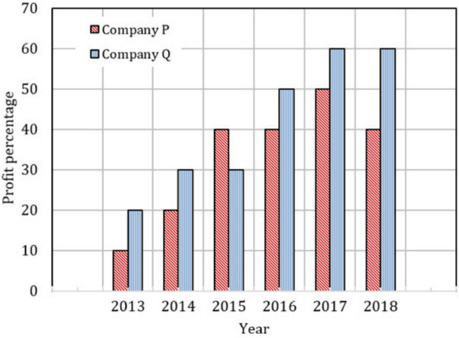
(A) 0

(B) 6

(C) 12

(D) 16

Q.No. 10 The profit shares of two companies P and Q are shown in the figure. If the two companies have invested a fixed and equal amount every year, then the ratio of the total revenue of company P to the total revenue of company Q, during 2013 - 2018 is_____.



(A) 15 : 17

(B) 16 : 17

(C) 17 : 15

(D) 17 : 16

BT: Biotechnology

Q1 - Q25 carry one mark each.

Q.No. 1 Protein P becomes functional upon phosphorylation of a serine residue. Replacing this serine with ________________ will result in a phosphomimic mutant of P.

(A) alanine

(B) aspartic acid

(C) phenylalanine

(D) lysine

Q.No. 2 Ras protein is a

(A) trimeric GTPase involved in relaying signal from cell surface to nucleus.

(B) monomeric GTPase involved in relaying signal from cell surface to nucleus.

(C) trimeric GTPase involved in regulation of cytoskeleton.

(D) monomeric GTPase involved in regulation of cytoskeleton.

Q.No. 3 Which of the following statements are **CORRECT**?

[P] Viruses can play a role in causing human cancer

[Q] A tumor suppressor gene can be turned off without any change in its DNA sequence

[R] Alteration in miRNA expression levels contributes to the development of cancer

(A) P and Q only

(B) Q and R only

(C) P and R only

(D) P, Q and R

Q.No. 4 Which class of antibody is first made by developing B cells inside bone marrow?

(A) IgG
(B) IgE
(C) IgA
(D) IgM

Q.No. 5 Determine the correctness or otherwise of the following Assertion [a] and the Reason [r] regarding mammalian cells.

Assertion [a]: Cells use Ca^{2+}, and not Na^{+}, for cell-to-cell signaling

Reason [r]: In the cytosol, concentration of Na^{+} is lower than that of Ca^{2+}

(A) Both [a] and [r] are true and [r] is the correct reason for [a].
(B) Both [a] and [r] are true but [r] is not the correct reason for [a].
(C) Both [a] and [r] are false.
(D) [a] is true but [r] is false.

Q.No. 6 Vincristine and vinblastine, two commercially important secondary metabolites from *Catharanthus roseus*, are examples of

(A) alkaloids.
(B) flavonoids.
(C) terpenoids.
(D) steroids.

Q.No. 7 DNA synthesized from an RNA template is called

(A) recombinant DNA.
(B) transcript.
(C) T-DNA.
(D) complementary DNA.

Q.No. 8 Two monomeric His-tagged proteins of identical molecular weight are present in a solution. pIs of these two proteins are 5.6 and 6.8. Which one of the following techniques can be used to separate them?

(A) Denaturing polyacrylamide gel electrophoresis
(B) Size-exclusion chromatography
(C) Ion-exchange chromatography
(D) Nickel affinity chromatography

Q.No. 9 During a positive-negative selection process, transformed animal cells expressing ____________________ are killed in presence of ganciclovir in the medium.

(A) pyruvate kinase
(B) viral thymidine kinase
(C) viral serine/threonine kinase
(D) viral tyrosine kinase

Q.No. 10 A vector derived from which one of the following viruses is used for high-frequency genomic integration of a transgene in animal cells?

(A) Adenovirus

(B) Adeno-associated virus

(C) Lentivirus

(D) Herpes simplex virus

Q.No. 11 Which one of the following statements about *Agrobacterium* Ti plasmid is **CORRECT**?

(A) *Vir* genes are located within the T-DNA segment

(B) Phytohormone biosynthesis genes are located outside the T-DNA segment

(C) Opine catabolism genes are located within the T-DNA segment

(D) Opine biosynthesis genes are located within the T-DNA segment

Q.No. 12 Which of the following types of molecules act as biological catalysts?

[P] Protein

[Q] RNA

[R] Phospholipid

(A) P and Q only

(B) P and R only

(C) Q and R only

(D) P, Q and R

Q.No. 13 Which one of the following media components is used to maintain pH in mammalian cell culture?

(A) $CaCl_2$

(B) $MgSO_4$

(C) NaCl

(D) $NaHCO_3$

Q.No. 14 Which of the following are energy transducing membranes?

[P] Plasma membrane of bacteria

[Q] Inner membrane of chloroplasts

[R] Inner membrane of mitochondria

(A) P and Q only

(B) P and R only

(C) Q and R only

(D) P, Q and R

Q.No. 15 Amino acid sequences of cytochrome c and ribulose 5-phosphate epimerase from 40 organisms were chosen and phylogenetic trees were obtained for each of these two protein families.

Determine the correctness or otherwise of the following Assertion [a] and the Reason [r].

Assertion [a]: The two trees will not be identical

Reason [r]: The nature and frequency of mutations in the two families are different

(A) Both [a] and [r] are true and [r] is the correct reason for [a].

(B) Both [a] and [r] are true but [r] is not the correct reason for [a].

(C) Both [a] and [r] are false.

(D) [a] is false but [r] is true.

Q.No. 16 A microorganism isolated from a salt-rich (salt concentration ~2 M) lake was found to possess diglycerol tetraethers, with polyisoprenoid alcohol side chains, as the major lipid component of its cell membrane. The isolated organism is

(A) a planctomycete.

(B) a cyanobacteria.

(C) a unicellular amoeba.

(D) an archaea.

Q.No. 17 A function *f* is as follows:

$$f(x) = \begin{cases} 15 & if\ x < 1 \\ cx & if\ \ x \geq 1 \end{cases}$$

The function *f* is a continuous function when *c* is equal to ______________ (answer is an integer).

Q.No. 18 Given that $Z = X^2 + Y^2$, the value of $\dfrac{\partial Z}{\partial X}$ for X = 1 and Y = 0 is ___________ (answer is an integer).

Q.No. 19 The elemental composition of dry biomass of a yeast species is $CH_{1.6}O_{0.4}N_{0.2}S_{0.0024}P_{0.017}$. The contribution of carbon to the dry biomass is ___________% (round off to 2 decimal places).

[Given: atomic weights of H, C, N, O, P and S are 1, 12, 14, 16, 31 and 32, respectively]

Q.No. 20 Solvents A and B are completely immiscible. Solute S is soluble in both these solvents. 100 g of S was added to a container which has 2 kg each of A and B. The solute is 1.5 times more soluble in solvent A than in solvent B. The mixture was agitated thoroughly and allowed to reach equilibrium. Assuming that the solute has completely dissolved, the amount of solute in solvent A phase is ______________ g.

Q.No. 21 The number of molecules of a nucleotide of molecular weight 300 g/mol present in 10 picomoles is ______________ x 10^{12} (round off to 2 decimal places).

Q.No. 22 To facilitate mass transfer from a gas to a liquid phase, a gas bubble of radius *r* is introduced into the liquid. The gas bubble then breaks into 8 bubbles of equal radius. Upon this change, the ratio of the interfacial surface area to the gas phase volume for the system changes from $3/r$ to $3n/r$. The value of n is ____________.

Q.No. 23 The largest eigenvalue of the matrix $\begin{bmatrix} 4 & 1 \\ -2 & 1 \end{bmatrix}$ is _________.

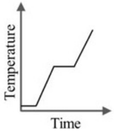
Q.No. 24 A normal random variable has mean equal to 0, and standard deviation equal to 3. The probability that on a random draw the value of this random variable is greater than 0 is ________________ (round off to 2 decimal places).

Q.No. 25 A variable Y is a function of t. Given that $Y(t = 0) = 1$ and $Y(t = 1) = 2$, $\dfrac{dY}{dt}$ in the interval $t = [0, 1]$ can be approximated as ________________.

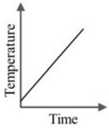
Q26 - Q55 carry two marks each.

Q.No. 26 A block of ice at 0 °C is supplied heat at a constant rate to convert ice to superheated steam. Which one of the following trajectories correctly represents the trend of the temperature of the system with time? Assume that the specific heat of H_2O is not a function of temperature.

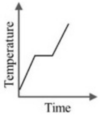
(A)



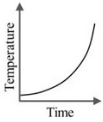
(B)



(C)



(D)



Q.No. 27 The DNA sequence shown below is to be amplified by PCR:

5′GCTAAGATCTGAATTTTCC......TTGGGCAATAATGTAGCGC3′
3′CGATTCTAGACTTAAAAGG......AACCCGTTATTACATCGCG5′

Which one of the following pair of primers can be used for this amplification?

(A) 5′GGAAATTCAGATCTTAGT3′ and 5′TGGGCAATAATGTAGCGC3′
(B) 5′GCTAAGATCTGAATTTC3′ and 5′GCGCTACATTATTGCCCA3′
(C) 5′CGGAAATTCAGATCTTAG3′ and 5′GCGCTACATTATTGCCCA3′
(D) 5′GCTAAGATCTGAATTTC3′ and 5′TGGGCAATAATGTAGCGC3′

Q.No. 28 Which of the following statements about immune response are **CORRECT**?

[P] T cells are activated by antigen-presenting cells

[Q] Foreign peptides are not presented to helper T cells by Class II MHC proteins

[R] Dendritic cells are referred to as professional antigen-presenting cells
(A) P and R only
(B) P and Q only
(C) Q and R only
(D) P, Q and R

Q.No. 29 Which of the following statements are **CORRECT** about eukaryotic cell cycle?

[P] CDKs can phosphorylate proteins in the absence of cyclins

[Q] CDKs can be inactivated by phosphorylation

[R] Degradation of cyclins is required for cell cycle progression

[S] CDKs are not involved in chromosome condensation
(A) P and R only
(B) P and S only
(C) P, Q and R only
(D) Q and R only

Q.No. 30 W, X and Y are the intermediates in a biochemical pathway as shown below:

$$S \cdots\cdots\rightarrow W \rightarrow X \rightarrow Y \rightarrow Z$$

Mutants auxotrophic for Z are found in four different complementation groups, namely Z1, Z2, Z3 and Z4. The growth of these mutants on media supplemented with W, X, Y or Z is shown below (Yes: growth observed; No: growth not observed):

Mutants	Media supplemented with			
	W	X	Y	Z
Z1	No	No	Yes	Yes
Z2	No	Yes	Yes	Yes
Z3	No	No	No	Yes
Z4	Yes	Yes	Yes	Yes

What is the order of the four complementation groups in terms of the step they block?

(A) $S \overset{Z1}{\dashrightarrow} W \xrightarrow{Z2} X \xrightarrow{Z3} Y \xrightarrow{Z4} Z$

(B) $S \overset{Z4}{\dashrightarrow} W \xrightarrow{Z2} X \xrightarrow{Z1} Y \xrightarrow{Z3} Z$

(C) $S \overset{Z3}{\dashrightarrow} W \xrightarrow{Z1} X \xrightarrow{Z2} Y \xrightarrow{Z4} Z$

(D) $S \overset{Z4}{\dashrightarrow} W \xrightarrow{Z1} X \xrightarrow{Z2} Y \xrightarrow{Z3} Z$

Q.No. 31 In tomato plant, red (*R*) is dominant over yellow (*r*) for fruit color and purple (*P*) is dominant over green (*p*) for stem color. Fruit color and stem color assort independently. The number of progeny plants of different fruit/stem colors obtained from a mating are as follows:

Red fruit, purple stem – 145

Red fruit, green stem – 184

Yellow fruit, purple stem – 66

Yellow fruit, green stem – 47

What are the genotypes of the parent plants in this mating?

(A) *RrPp* x *Rrpp*
(B) *RrPp* x *RrPp*
(C) *RRPP* x *rrpp*
(D) *RrPP* x *Rrpp*

Q.No. 32 Some of the cytokinins used in plant tissue culture media are given below:

[P] BAP

[Q] Zeatin

[R] Kinetin

[S] 2iP

Which of these are synthetic analogs?

(A) P and Q only
(B) Q and S only
(C) R and S only
(D) P and R only

Q.No. 33 Carl Woese used the gene sequence of which one of the following for phylogenetic taxonomy of prokaryotes?

(A) A ribosomal RNA of large ribosomal subunit
(B) A ribosomal RNA of small ribosomal subunit
(C) A ribosomal protein of large ribosomal subunit
(D) A ribosomal protein of small ribosomal subunit

Q.No. 34 A list of pathogens (Group I) and a list of anti-microbial agents (Group II) used to treat their infections are given below. Match the pathogens with the corresponding anti-microbial agents.

Group I	**Group II**
[P] Influenza A virus	1. Isoniazid
[Q] Fungus	2. Amantadine
[R] Plasmodium	3. Fluconazole
[S] Mycobacterium	4. Artemisinin
	5. Iodoquinol

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

Q.No. 35 Determine the correctness or otherwise of the following Assertion [a] and the Reason [r].

Assertion [a]: Dam methylase protects *E. coli* DNA from phage endonucleases

Reason [r]: *E. coli* Dam methylase methylates the adenosine residue in the sequence

"GATC"

(A) Both [a] and [r] are true and [r] is the correct reason for [a]

(B) Both [a] and [r] are true but [r] is not the correct reason for [a]

(C) Both [a] and [r] are false

(D) [a] is false but [r] is true

Q.No. 36 Determine the correctness or otherwise of the following Assertion [a] and the Reason [r].

Assertion [a]: Embryonic stem cells are suitable for developing knockout mice

Reason [r]: Homologous recombination is more frequent in embryonic stem cells than that in somatic cells

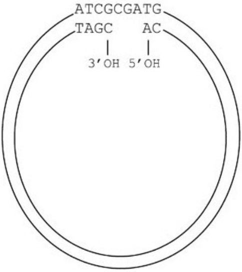
(A) Both [a] and [r] are false

(B) Both [a] and [r] are true, and [r] is the correct reason for [a]

(C) Both [a] and [r] are true, but [r] is not the correct reason for [a]

(D) [a] is true, but [r] is false

Q.No. 37 The schematic of a plasmid with a gap in one of the strands is shown below:



Which of the following enzyme(s) is/are required to fill the gap and generate a covalently closed circular plasmid?

[P] DNA ligase

[Q] Alkaline phosphatase

[R] DNA polymerase

[S] Polynucleotide kinase

(A) P only

(B) P, R and S only

(C) P and R only

(D) P, Q and R only

Q.No. 38 Match sub-cellular organelles listed in Group I with their features listed in Group II:

Group I	Group II
[P] Mitochondrion	1. Single-membrane enclosed
[Q] Chloroplast	2. Double-membrane enclosed
[R] Nucleus	3. Maternal inheritance
[S] Endoplasmic reticulum	4. Endosymbiotic origin

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

Q.No. 39 Which of the following strategies are used by cells for metabolic regulation?

[P] Phosphorylation - dephosphorylation

[Q] Allostery

[R] Feedback inhibition

(A) P and Q only
(B) P and R only
(C) Q and R only
(D) P, Q and R

Q.No. 40 Determine the correctness or otherwise of the following Assertion [a] and the Reason [r].

Assertion [a]: A zygote and its immediate descendant cells are unspecialized and are called totipotent

Reason [r]: Totipotent cells retain the capacity to differentiate into only a few cell types

(A) Both [a] and [r] are false
(B) Both [a] and [r] are true but [r] is not the correct reason for [a]
(C) Both [a] and [r] are true and [r] is the correct reason for [a]
(D) [a] is true but [r] is false

Q.No. 41 Which of the following statements about gene therapy are **CORRECT**?

[P] Affected individuals, but not their progeny, can be cured through germline gene therapy

[Q] Affected individuals, as well as their progeny, can be cured through germline gene therapy

[R] Affected individuals, but not their progeny, can be cured through somatic gene therapy

[S] Affected individuals, as well as their progeny, can be cured through somatic gene therapy

(A) P and R only
(B) P and S only
(C) Q and R only
(D) Q and S only

Q.No. 42 Determine the correctness or otherwise of the following Assertion [a] and the Reason [r].

Assertion [a]: A genetically engineered rice that produces beta-carotene in the rice grain is called Golden rice

Reason [r]: Enabling biosynthesis of provitamin A in the rice endosperm gives a characteristic yellow/orange color

(A) Both [a] and [r] are false
(B) Both [a] and [r] are true but [r] is not the correct reason for [a]
(C) Both [a] and [r] are true and [r] is the correct reason for [a]
(D) [a] is true but [r] is false

Q.No. 43 The sequence of a 1 Mb long DNA is random. This DNA has all four bases occurring in equal proportion. The number of nucleotides, on average, between two successive *Eco*RI recognition site GAATTC is ____________.

Q.No. 44 *E. coli* was grown in ^{15}N medium for several generations. Cells were then transferred to ^{14}N medium, allowed to grow for 4 generations and DNA was isolated immediately. The proportion of total DNA with intermediate density is __________ (round off to 2 decimal places).

Q.No. 45 A batch reactor is inoculated with 1 g/L biomass. Under these conditions, cells exhibit a lag phase of 30 min. If the specific growth rate in the log phase is 0.00417 min^{-1}, the time taken for the biomass to increase to 8 g/L is _______________ min (round off to 2 decimal places).

Q.No. 46 The system of linear equations

$$cx + y = 5$$

$$3x + 3y = 6$$

has no solution when c is equal to _____________________.

Q.No. 47 The amino acid sequence of a peptide is Phe-Leu-Ile-Met-Ser-Leu. The number of codons that encode the amino acids present in this peptide is given below:

Phe: 2 codons

Leu: 6 codons

Ile: 3 codons

Met: 1 codon

Ser: 4 codons

The number of unique DNA sequences that can encode this peptide is __________.

Q.No. 48 Assume that a cell culture was started with five human fibroblast cells. Two cells did not divide even once whereas the other three cells completed three rounds of cell division. At this stage, the total number of kinetochores in all the cells put together is

_______________ .

Q.No. 49 Growth of an organism on glucose in a chemostat is characterized by Monod model with specific growth rate = 0.45 h^{-1} and K_s = 0.5 g/L. Biomass from the substrate is generated as Y_{XS} = 0.4 g/g. The chemostat volume is 0.9 L and media is fed at 1 L/h and contains 20 g/L of glucose. At steady state, the concentration of biomass in the chemostat is _________________ g/L.

Q.No. 50 A function *f* is given as:

$$f(X) = 4X - X^2$$

The function *f* is maximized when X is equal to ____________ .

Q.No. 51 An infinite series *S* is given as:

$S = 1 + 2/3 + 3/9 + 4/27 + 5/81 + \ldots$ (to infinity)

The value of *S* is _______________ (round off to 2 decimal places).

Q.No. 52 Protein A and protein B form a covalent complex. Gel filtration chromatography of this complex showed a peak corresponding to 200 kDa. SDS-PAGE analysis of this complex, with and without beta-mercaptoethanol, showed a single band corresponding to molecular weight 50 and 25 kDa, respectively. Given that the molecular weight of protein A is 25 kDa, the molecular weight of protein B is

___________ kDa .

Q.No. 53 The concentrations of ATP, ADP and inorganic phosphate in a cell are 2.59, 0.73 and 2.72 mM, respectively. Under these conditions, free energy change for the synthesis of ATP at 37 °C is ____________ kJ/mol (round off to 2 decimal places).

Given: free energy change for ATP hydrolysis under standard conditions is -30.5 kJ/mol and R = 8.315 kJ/mol.K

Q.No. 54 An algorithm was designed to find globins in protein sequence databases. A database which has 78 globin sequences was searched using this algorithm. The algorithm retrieved 72 sequences of which only 65 were globins. The sensitivity of this algorithm is _______________ % (round off to 2 decimal places).

Q.No. 55 The mitochondrial electron transfer chain oxidizes NADH with oxygen being the terminal electron acceptor. The redox potentials for the two half-reactions are given below:

$$\mathrm{NAD^+ + H^+ + 2e^- \rightarrow NADH, E^{0\prime} = -0.32V}$$

$$\mathrm{\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O, E^{0\prime} = 0.816V}$$

The free energy change associated with the transfer of electrons from NADH to O_2 is _______________ kJ/mol (round off to 2 decimal places).

Given: F = 96500 C/mol.