



XL: Life Sciences

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?

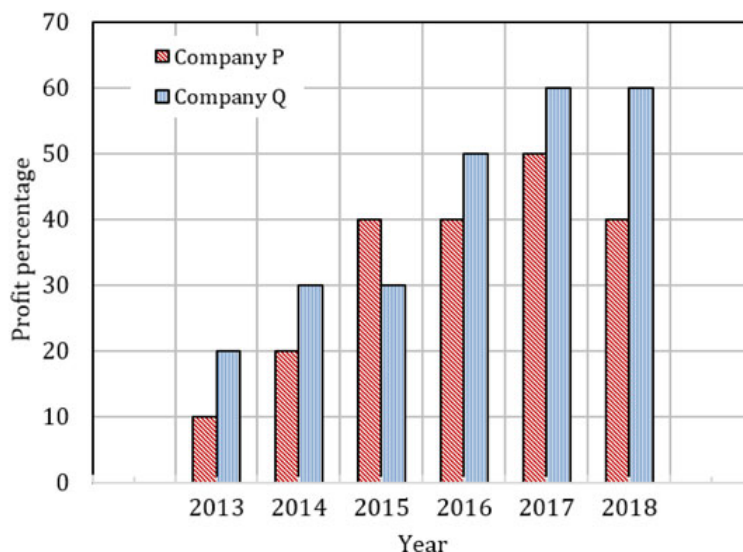
- (A) 66.6
- (B) 75.2
- (C) 88.2
- (D) 116.5

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

XL: Life Sciences - P: Chemistry (Compulsory)

Q1 - Q5 carry one mark each.

Q.No. 1 An aqueous solution contains a mixture of 10^{-8} M NaCl and 10^{-8} M HCl.

Choose the correct statement about this solution.

- (A) The solution is a buffer with pH less than 7.00
 (B) The solution is a buffer with pH greater than 7.00
 (C) The solution is not a buffer but has its pH less than 7.00
 (D) The solution is not a buffer but has its pH greater than 7.00

Q.No. 2 The coordination complex which has a distorted octahedral structure is

(Given: Atomic numbers of **V**: 23; **Mn**: 25; **Ni**: 28; **Cu**: 29)

- (A) $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$
 (B) $[\text{Mn}(\text{H}_2\text{O})_6]^{2+}$
 (C) $[\text{V}(\text{H}_2\text{O})_6]^{2+}$
 (D) $[\text{Cu}(\text{H}_2\text{O})_6]^{2+}$

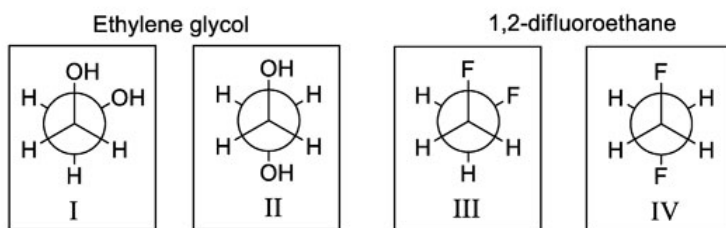
Q.No. 3 In naphthalene, the value of the integer “*n*” according to Hückel’s rule of aromaticity is _____.

Q.No. 4 The azimuthal quantum number (*l*) of an electron in the d_{z^2} orbital of a copper atom (atomic number: 29) is _____.

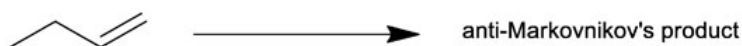
Q.No. 5 The standard enthalpy of reaction (in kJ mol^{-1}) for obtaining three moles of H_2 (g) from atomic hydrogen in gas phase is _____. (Given: Standard enthalpy of formation of atomic hydrogen in gas phase is 218 kJ mol^{-1})

Q6 - Q15 carry two marks each.

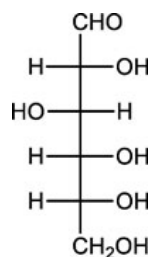
- Q.No. 6 The **correct** order of the first ionization energies of He, B, N and O in their corresponding ground state is
- (A) He > N > O > B
 (B) O > N > B > He
 (C) He > B > N > O
 (D) N > O > B > He
- Q.No. 7 Based on the molecular orbital theory, which one of the following statements with respect to N_2 , N_2^+ , O_2 and O_2^+ is **correct**?
- (A) Bond orders of N_2 and O_2 are higher than their corresponding cations.
 (B) Bond energy of N_2^+ is higher than that of N_2 , whereas bond energy of O_2^+ is lower than that of O_2 .
 (C) The unpaired electrons in N_2^+ and O_2^+ are present in σ and π^* orbitals, respectively.
 (D) The bond in N_2^+ is shorter than that in N_2 , whereas bond in O_2 is shorter than that in O_2^+ .
- Q.No. 8 Which one of the following statements is **incorrect** about the diborane molecule?
- (A) B-H^t bond is a 2-centre-2-electron bond (H^t: terminal hydrogen).
 (B) BH^bB bond is a 3-centre-2-electron bond (H^b: bridged hydrogen).
 (C) The bond angle H^tBH^t is 122° (H^t: terminal hydrogen).
 (D) The B-H^t bond distance is longer than B-H^b bond distance (H^t: terminal hydrogen, H^b: bridged hydrogen).
- Q.No. 9 Given below are Newman projections of ethylene glycol and 1,2-difluoroethane about their respective C-C bonds. The most stable conformations (lowest energy) of ethylene glycol and 1,2-difluoroethane are



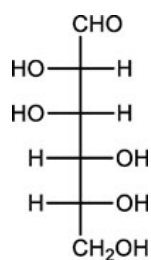
- (A) I and III respectively.
 (B) I and IV respectively.
 (C) II and III respectively.
 (D) II and IV respectively.
- Q.No. 10 In the reaction given below, choose the condition that gives an anti-Markovnikov's product.



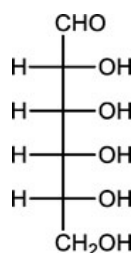
- (A) Peroxide / HCl
 (B) Aqueous mercuric acetate treatment
 (C) Diborane addition
 (D) Sulfuric acid addition
- Q.No. 11 Which one of the following hexoses will give an osazone that has a different melting point from that of the osazone obtained from D (+) glucose?
- (A)



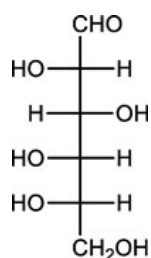
(B)



(C)



(D)



Q.No. 12 A molecule in solution crystallizes into two different crystal forms with rate constants of 0.02 s^{-1} and 0.13 s^{-1} . If the crystallization is assumed to be under kinetic control, then the half-life (in seconds, rounded off to one decimal place) of the molecule is _____.

Q.No. 13 The standard potential (E_{cell}°) for a cell reaction given below is $+0.7 \text{ V}$. The standard reaction free energy ($\Delta_r G^{\circ}$) for this cell is _____ kJ mol^{-1} (correct up to two decimal places). (Given: Faraday constant, $F = 96500 \text{ C mol}^{-1}$)



Q.No. 14 The activation energy (E_a) estimated for a reaction from the Arrhenius equation is 21 kJ mol^{-1} . If the frequency factor is assumed to be independent of temperature, then the ratio of the rate constants determined at 298 K and 260 K is _____ (rounded off to two decimal places). (Given: Gas constant, $R = 8.315 \text{ J K}^{-1} \text{ mol}^{-1}$)

Q.No. 15 At a given pressure, a substance is heated from 2000 K to 2600 K . If the entropy of the substance is $60 \text{ J K}^{-1} \text{ mol}^{-1}$, and is assumed to be constant over the given temperature range, then the change in the chemical potential (in kJ mol^{-1}) of the substance is _____.

Q1 - Q10 carry one mark each.

- Q.No. 1 Which one of the following hormones initiates a signaling cascade by directly binding to an intra-cellular receptor?
- (A) Insulin
 - (B) Gonadotropin
 - (C) Progesterone
 - (D) Epinephrine
- Q.No. 2 Which one of the following bonds is NOT present in ATP?
- (A) Phosphoester
 - (B) Phosphoanhydride
 - (C) N-Glycosidic
 - (D) α -Glycosidic
- Q.No. 3 The reaction involved in the direct conversion of L-phenylalanine to L-tyrosine is
- (A) Hydroxylation
 - (B) Decarboxylation
 - (C) Transamination
 - (D) Reduction
- Q.No. 4 The human major histocompatibility complex (MHC) is
- (A) Polygenic and monomorphic
 - (B) Polygenic and polymorphic
 - (C) Monogenic and polymorphic
 - (D) Monogenic and monomorphic
- Q.No. 5 Har Gobind Khorana and Marshall Nirenberg elucidated the genetic code by using a cell-free protein synthesizing system. It was found that poly(U) and poly(C) result in the synthesis of poly(L-Phe) and poly(L-Pro), respectively. Based on these observations, which one of the following conclusions is correct?
- (A) Codon GGG specifies L-Phe and codon AAA specifies L-Pro
 - (B) Codon CCC specifies L-Phe and codon UUU specifies L-Pro
 - (C) Codon AAA specifies L-Phe and codon GGG specifies L-Pro
 - (D) Codon UUU specifies L-Phe and codon CCC specifies L-Pro
- Q.No. 6 Binding of an antibody to its cognate antigen does NOT involve
- (A) Covalent bonds
 - (B) Electrostatic forces
 - (C) Van der Waals forces
 - (D) Hydrogen bonds
- Q.No. 7 A globular protein of molecular weight 50 kDa exists as a mixture of monomers and dimers in solution. The most appropriate technique for the separation of these two forms of the protein is
- (A) Thin layer chromatography
 - (B) Ion exchange chromatography
 - (C) Gel filtration chromatography
 - (D) Paper chromatography
- Q.No. 8

Choose the correct order of molecules according to their ability to diffuse across a lipid bilayer.

- (A) $\text{CO}_2 > \text{H}_2\text{O} > \text{Glucose} > \text{RNA}$
- (B) $\text{CO}_2 > \text{Glucose} > \text{H}_2\text{O} > \text{RNA}$
- (C) $\text{RNA} > \text{Glucose} > \text{CO}_2 > \text{H}_2\text{O}$
- (D) $\text{H}_2\text{O} > \text{CO}_2 > \text{RNA} > \text{Glucose}$

Q.No. 9 When one glucose unit from glycogen gets converted to lactate in the muscle, the net number of ATP molecules produced is _____.

Q.No. 10 Considering that the three pK_{a} s of histidine are $\text{pK}_1=1.8$, $\text{pK}_2=9.2$ and $\text{pK}_{\text{R}}=6.0$, its isoelectric point will be _____ (rounded off to one decimal place).

Q11 - Q20 carry two marks each.

Q.No. 11 One mole of a native protein upon N-terminal analysis yielded one mole each of Asp and Val. Therefore, the protein in its native state exists as a

- (A) Monomer
- (B) Homo-dimer
- (C) Hetero-dimer
- (D) Tetramer

Q.No. 12 The prosthetic groups/cofactors involved in both 1e^- and 2e^- transfer in the mitochondrial electron transport chain are

- (A) NAD and NADP
- (B) NAD and FAD
- (C) Heme and FMN
- (D) Coenzyme Q and FMN

Q.No. 13 Match the items in **Group I** with the most appropriate items in **Group II** and choose the correct option.

Group I	Group II
P. Integrin	1. Phagocytosis in the neural tissue
Q. Microglial cell	2. Antigen processing by cross-presentation
R. TLR-7	3. Single stranded RNA recognition
S. Dendritic cell	4. Binding of cells to endothelium

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

Q.No. 14 The correct combination of glycosidic linkages present in glycogen is

- (A) $\alpha 1 \rightarrow 4$ and $\alpha 1 \rightarrow 6$

- (B) α 1 \rightarrow 4 and β 1 \rightarrow 6
- (C) α 1 \rightarrow 6 and β 1 \rightarrow 4
- (D) α 1 \rightarrow 6 and β 1 \rightarrow 6

Q.No. 15 Polypeptides are either biosynthesized on the ribosomes using an mRNA template or chemically synthesized by the Merrifield's solid phase method. The correct directions of peptide synthesis are

- (A) C \rightarrow N direction on the ribosomes and N \rightarrow C direction on the solid phase
- (B) N \rightarrow C direction on the ribosomes and C \rightarrow N direction on the solid phase
- (C) N \rightarrow C direction in both cases
- (D) C \rightarrow N direction in both cases

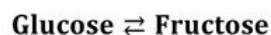
Q.No. 16 A solution absorbs 20% of the incident light in a cuvette of path length 1.0 cm. The amount of light transmitted by the same solution in a cuvette of 3.0 cm path length is _____% (rounded off to one decimal place).

Q.No. 17 The second pKa of phosphoric acid is 6.8. The ratio of Na₂HPO₄ to NaH₂PO₄ required to obtain a buffer of pH 7.0 is _____ (rounded off to two decimal places).

Q.No. 18 A PCR in a 100 μ L reaction volume, containing two primers at a concentration of 0.2 μ M each, is set up to amplify a 250 base pair DNA fragment. Consider the average molecular weight of one base pair as 660 Da. If the primers are fully consumed by the end of the reaction, the amount of the final PCR product formed is _____ μ g (rounded off to one decimal place).

Q.No. 19 An enzyme obeying Michaelis-Menten kinetics shows a reaction velocity (v) of 10 μ mol/min when the substrate concentration [S] equals its K_M . The maximal velocity V_{max} for this enzyme is _____ μ mol/min (correct to integer number). (K_M is Michaelis-Menten constant)

Q.No. 20 The enzyme glucose isomerase catalyzes the inter-conversion of glucose and fructose as shown.



The $\Delta G_0'$ for this reaction is zero kcal/mol. After adding glucose isomerase to a 0.12 M glucose solution and allowing the reaction to attain equilibrium, the final concentration of fructose in the reaction mixture will be _____ mM.

XL: Life Sciences - R: Botany

Q1 - Q10 carry one mark each.

- Q.No. 1 Indefinite stamen is a characteristic feature of which of the following plant families?
- (A) Malvaceae
 - (B) Apocynaceae
 - (C) Poaceae
 - (D) Brassicaceae

- Q.No. 2 In natural condition, which of the following plants **DOES NOT** exhibit anomalous secondary growth?
- (A) Rice
 - (B) Aloe
 - (C) Yucca
 - (D) Dracaena
- Q.No. 3 In a typical angiosperm under natural condition, primary meristems are usually established during
- (A) Gametogenesis
 - (B) Embryogenesis
 - (C) Vegetative phase development
 - (D) Secondary growth
- Q.No. 4 2-Methoxy-3, 6-dichlorobenzoic acid belongs to which class of plant growth regulators?
- (A) Synthetic auxin
 - (B) Synthetic cytokinin
 - (C) Strigolactone
 - (D) Brassinosteroid
- Q.No. 5 In a typical green plant, the first stable product of Calvin cycle is
- (A) Oxaloacetic acid
 - (B) Succinic acid
 - (C) Maleic acid
 - (D) 3-Phosphoglyceric acid
- Q.No. 6 Among the following, which best describes an organism that lives at the expense of other organisms, harmful but usually not killing?
- (A) Predator
 - (B) Symbiotic
 - (C) Prey
 - (D) Parasite
- Q.No. 7 The oleo-gum resin asafoetida (hing) is obtained from the cut surface of
- (A) Stem
 - (B) Root
 - (C) Leaf
 - (D) Fruit
- Q.No. 8 'Bakanae' disease or 'foolish seedling' disease is caused by
- (A) Fungus
 - (B) Bacterium
 - (C) Virus
 - (D) Mycoplasma
- Q.No. 9 Which of the following chemicals is used for doubling of chromosome numbers during production of 'doubled haploids' in crop plants?
- (A) Hygromycin
 - (B) Kanamycin
 - (C) Colchicine
 - (D) Glufosinate

Q.No. 10 An mRNA of a nuclear encoded plant gene, *DSH20* has an ORF of 1353 nucleotides. Provided that average molecular weight of amino acid is 110 Dalton (Da), calculated molecular weight of DSH20 protein in kDa (*round off to 1 decimal place*) is _____

Q11 - Q20 carry two marks each.

Q.No. 11

- (A) P-ii-1, Q-iv-3, R-v-2, S-iii-4
- (B) P-ii-1, Q-i-3, R-v-4, S-iii-2
- (C)
- (D)

Q.No. 12

- (A)
- (B)
- (C)
- (D)

Q.No. 13

- (A)
- (B)
- (C)
- (D)

Q.No. 14

- (A)
- (B)
- (C)
- (D)

Q.No. 15

- (A)
- (B)
- (C)
- (D)

Q.No. 16

- (A)
- (B)
- (C)
- (D)

Q.No. 17

- (A)
- (B)
- (C)
- (D)

Q.No. 18

- (A)
- (B)
- (C)
- (D)

Q.No. 19

- (A)

- (B)
- (C)
- (D)

Q.No. 20

XL: Life Sciences - S: Microbiology

Q1 - Q10 carry one mark each.

Q.No. 1

- (A)
- (B)
- (C)
- (D)

Q.No. 2

- (A)
- (B)
- (C)
- (D)

Q.No. 3

- (A)
- (B)
- (C)
- (D)

Q.No. 4

- (A)
- (B)
- (C)
- (D)

Q.No. 5

- (A)
- (B)
- (C)
- (D)

Q.No. 6

- (A)
- (B)
- (C)
- (D)

Q.No. 7

- (A)
- (B)
- (C)
- (D)

Q.No. 8

- (A)
- (B)
- (C)
- (D)

Q.No. 9

- (A)
- (B)
- (C)
- (D)

Q.No. 10

Q11 - Q20 carry two marks each.

Q.No. 11

- (A)
- (B)
- (C)
- (D)

Q.No. 12

- (A)
- (B)
- (C)
- (D)

Q.No. 13

- (A)
- (B)
- (C)
- (D)

Q.No. 14

- (A)
- (B)
- (C)
- (D)

Q.No. 15

- (A)
- (B)
- (C)
- (D)

Q.No. 16

- (A)
- (B)
- (C)
- (D)

Q.No. 17

Q.No. 18

Q.No. 19

Q.No. 20

XL: Life Sciences - T: Zoology

Q1 - Q10 carry one mark each.

Q.No. 1

- (A)

- (B)
- (C)
- (D)

Q.No. 2

- (A)
- (B)
- (C)
- (D)

Q.No. 3

- (A)
- (B)
- (C)
- (D)

Q.No. 4

- (A)
- (B)
- (C)
- (D)

Q.No. 5

- (A)
- (B)
- (C)
- (D)

Q.No. 6

- (A)
- (B)
- (C)
- (D)

Q.No. 7

- (A)
- (B)
- (C)
- (D)

Q.No. 8

- (A)
- (B)
- (C)
- (D)

Q.No. 9

- (A)
- (B)
- (C)
- (D)

Q.No. 10

- (A)
- (B)
- (C)
- (D)

Q11 - Q20 carry two marks each.

Q.No. 11

- (A)
- (B)
- (C)
- (D)

Q.No. 12

- (A)
- (B)
- (C)
- (D)

Q.No. 13

- (A)
- (B)
- (C)
- (D)

Q.No. 14

- (A)
- (B)
- (C)
- (D)

Q.No. 15

- (A)
- (B)
- (C)
- (D)

Q.No. 16

- (A)
- (B)
- (C)
- (D)

Q.No. 17

- (A)
- (B)
- (C)
- (D)

Q.No. 18

- (A)
- (B)
- (C)
- (D)

Q.No. 19

- (A)
- (B)
- (C)
- (D)

Q.No. 20

XL: Life Sciences - U: Food Technology

Q1 - Q10 carry one mark each.

Q.No. 1

- (A)
- (B)
- (C)
- (D)

Q.No. 2

- (A)
- (B)
- (C)
- (D)

Q.No. 3

- (A)
- (B)
- (C)
- (D)

Q.No. 4

- (A)
- (B)
- (C)
- (D)

Q.No. 5

- (A)
- (B)
- (C)
- (D)

Q.No. 6

- (A)
- (B)
- (C)
- (D)

Q.No. 7

- (A)
- (B)
- (C)
- (D)

Q.No. 8

- (A)
- (B)
- (C)
- (D)

Q.No. 9

Q.No. 10

Q11 - Q20 carry two marks each.

Q.No. 11

- (A)
- (B)
- (C)
- (D)

Q.No. 12

- (A)
- (B)
- (C)
- (D)

Q.No. 13

- (A)
- (B)
- (C)
- (D)

Q.No. 14

- (A)
- (B)
- (C)
- (D)

Q.No. 15

- (A)
- (B)
- (C)
- (D)

Q.No. 16

- (A)
- (B)
- (C)
- (D)

Q.No. 17

- (A)
- (B)
- (C)
- (D)

Q.No. 18

- (A)
- (B)
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- (D)

Q.No. 19

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Q.No. 20