Q. 1 – Q. 5 carry one mark each.

Q.1 The chairman requested the aggrieved shareholders to _____ him.

(A) bare with (B) bore with (C) bear with (D) bare

Q.2 Identify the correct spelling out of the given options:

(A) Managable (B) Manageable (C) Mangaeble (D) Managible

Q.3 Pick the odd one out in the following:

13, 23, 33, 43, 53

(A) 23 (B) 33 (C) 43 (D) 53

Q.4 R2D2 is a robot. R2D2 can repair aeroplanes. No other robot can repair aeroplanes.

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

(A) R2D2 is a robot which can only repair aeroplanes.

(B) R2D2 is the only robot which can repair aeroplanes.

(C) R2D2 is a robot which can repair only aeroplanes.

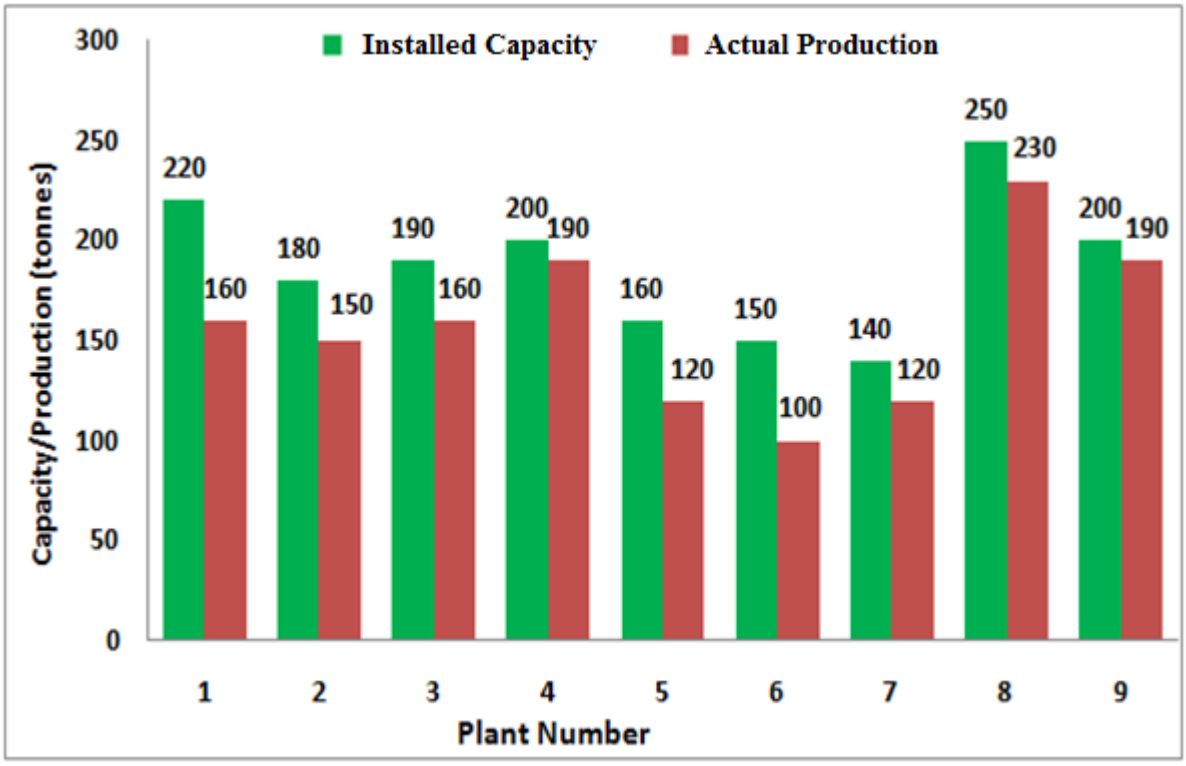
(D) Only R2D2 is a robot.

Q.5 If $|9y-6| = 3$, then $y^2 - 4y/3$ is _____.

(A) 0 (B) +1/3 (C) −1/3 (D) undefined

Q. 6 – Q. 10 carry two marks each.

Q.6 The following graph represents the installed capacity for cement production (in tonnes) and the actual production (in tonnes) of nine cement plants of a cement company. Capacity utilization of a plant is defined as ratio of actual production of cement to installed capacity. A plant with installed capacity of at least 200 tonnes is called a large plant and a plant with lesser capacity is called a small plant. The difference between total production of large plants and small plants, in tonnes is ____.



Q.7 A poll of students appearing for masters in engineering indicated that 60 % of the students believed that mechanical engineering is a profession unsuitable for women. A research study on women with masters or higher degrees in mechanical engineering found that 99 % of such women were successful in their professions.

Which of the following can be logically inferred from the above paragraph?

(A) Many students have misconceptions regarding various engineering disciplines.

(B) Men with advanced degrees in mechanical engineering believe women are well suited to be mechanical engineers.

(C) Mechanical engineering is a profession well suited for women with masters or higher degrees in mechanical engineering.

(D) The number of women pursuing higher degrees in mechanical engineering is small.

Q.8 Sourya committee had proposed the establishment of Sourya Institutes of Technology (SITs) in line with Indian Institutes of Technology (IITs) to cater to the technological and industrial needs of a developing country.

Which of the following can be logically inferred from the above sentence?

Based on the proposal,

(i) In the initial years, SIT students will get degrees from IIT.
(ii) SITs will have a distinct national objective.
(iii) SIT like institutions can only be established in consultation with IIT.
(iv) SITs will serve technological needs of a developing country.

(A) (iii) and (iv) only.
(B) (i) and (iv) only.
(C) (ii) and (iv) only.
(D) (ii) and (iii) only.

Q.9 Shaquille O' Neal is a 60% career free throw shooter, meaning that he successfully makes 60 free throws out of 100 attempts on average. What is the probability that he will successfully make exactly 6 free throws in 10 attempts?

(A) 0.2508 (B) 0.2816 (C) 0.2934 (D) 0.6000

Q.10 The numeral in the units position of $211^{870} + 146^{127} \times 3^{424}$ is _____.

END OF THE QUESTION PAPER

XL-I : BIOCHEMISTRY

Q. 1 – Q. 10 carry one mark each.

Q.1 Heterologous expression of green fluorescent protein is possible because the genetic code is

(A) universal (B) triplet (C) degenerate (D) non-overlapping

Q.2 Phosphoglucose isomerase was incubated with 0.2 M of glucose 6-phosphate. On reaching equilibrium, 55% of glucose 6-phosphate was converted to fructose 6-phosphate. The equilibrium constant for this reaction is _____.

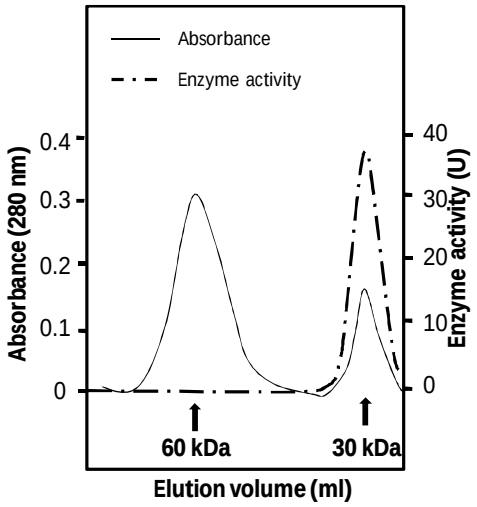
Q.3 Hydrolysis of a peptide involves cleavage of the bond between the atoms

(A) N and C_α (B) C and O (C) C_α and C (D) N and C

Q.4 Inter-conversion of UDP-glucose and UDP-galactose is catalyzed by

(A) an oxidase (B) a kinase (C) an epimerase (D) a mutase

Q.5 Gel filtration profile and corresponding activity data for a pure enzyme are shown in the figure below. The same enzyme sample on SDS-PAGE runs as a 30 kDa polypeptide.



Which one of the following is the correct interpretation of the data?

(A) Both monomer and dimer are active (B) Enzyme is active only as a monomer
(C) Protein does not form dimers (D) Enzyme is active only as a dimer

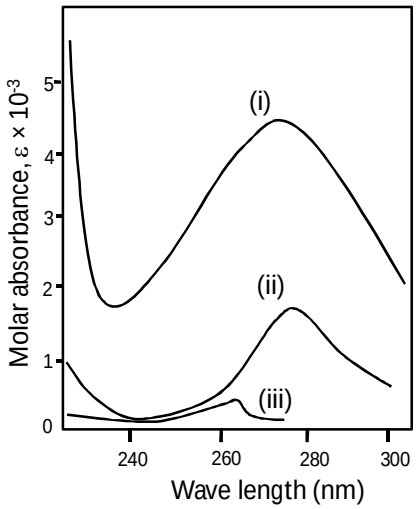
Q.6 Amino acid residues predominantly involved in protein-DNA interactions are

(A) alanines (B) negatively charged
(C) prolines (D) positively charged

Q.7 Cellulose serves as a structural polymer whereas starch does not. This is because cellulose contains

(A) $\beta 1 \rightarrow 4$ linked glucose monomers and inter-chain hydrogen bonds
(B) $\beta 1 \rightarrow 4$ linked glucose monomers and intra-chain hydrogen bonds
(C) $\alpha 1 \rightarrow 4$ linked glucose monomers and inter-chain hydrogen bonds
(D) $\alpha 1 \rightarrow 4$ linked glucose monomers and intra-chain hydrogen bonds

Q.8 Molar absorption spectra labeled (i), (ii) and (iii) for three different amino acids are shown below.



Which one of the following is the correct combination of spectral assignments?

(A) (i) - tryptophan, (ii) - tyrosine, (iii) - phenylalanine
(B) (i) - phenylalanine, (ii) - tryptophan, (iii) - tyrosine
(C) (i) - proline, (ii) - tyrosine, (iii) - tryptophan
(D) (i) - tryptophan, (ii) - proline, (iii) - phenylalanine

Q.9 The fluidity of a phospholipid membrane increases when the fatty acid

(A) chain length increases and degree of unsaturation decreases
(B) chain length decreases and degree of unsaturation increases
(C) chain length decreases and degree of unsaturation decreases
(D) chain length increases and degree of unsaturation increases

Q.10 Polypeptides are biosynthesized on the ribosomes inside the cell. Chemical synthesis of polypeptides is also possible through Merrifield's solid-phase peptide synthesis. In both the cases the polypeptide chain is extended one amino acid at a time. The direction of polypeptide synthesis is from

(A) C-terminus to N-terminus in both the cases
(B) N-terminus to C-terminus in both the cases
(C) C-terminus to N-terminus on the ribosomes and N-terminus to C-terminus in solid-phase synthesis
(D) N-terminus to C-terminus on the ribosomes and C-terminus to N-terminus in solid-phase synthesis

Q. 11 – Q. 20 carry two marks each.

Q.11 Four groups of metabolites are given below. Choose the group in which all the compounds contain at least one bond whose $\Delta G'^{o}$ of hydrolysis is ≤ -7.0 kcal/mole.

(A) Glucose 1-phosphate, Adenosine triphosphate, Fructose 1,6-bisphosphate
(B) Creatine phosphate, Acetyl phosphate, Succinyl CoA
(C) Glycerol 3-phosphate, Acetyl CoA, 1,3-Bisphosphoglycerate
(D) Glucose 6-phosphate, Phosphoenolpyruvate, Adenosine diphosphate

Q.12 The $\Delta G'^{o}$ for the malate dehydrogenase catalyzed step of Krebs cycle is $+7.1$ kcal/mole. Nevertheless, the conversion of malate to oxaloacetate *in vivo* proceeds spontaneously because the subsequent reaction that consumes oxaloacetate has a $\Delta G'^{o}$ of

(A) -3.0 kcal/mole
(B) $+3.0$ kcal/mole
(C) -7.7 kcal/mole
(D) $+7.7$ kcal/mole

Q.13 When freshly isolated intact mitochondria were incubated with ADP and inorganic phosphate neither the oxygen consumption nor the ATP synthesis could be detected. Addition of succinate resulted in increased oxygen consumption as well as ATP synthesis with time. Subsequent addition of cyanide to this system will result in which one of the following?

(A) Both oxygen consumption and ATP synthesis are inhibited
(B) Oxygen consumption continues but ATP synthesis is inhibited
(C) Oxygen consumption is inhibited but ATP synthesis continues
(D) Both oxygen consumption and ATP synthesis continue

Q.14 Three micrograms of a circular plasmid of 4200 bp was digested with a restriction enzyme and subjected to agarose gel electrophoresis. Five DNA fragments of different sizes were observed and their sizes summed up to 4200 bp. The number of picomoles of DNA ends generated after complete digestion with the enzyme is _____.

(Given: average molecular weight of each base pair is 660 Da)

Q.15 An enzyme was purified using ion-exchange chromatography and the results are shown in the table below.

Step	**Volume (ml)**	**Total protein (mg)**	**Total activity (U)**
Cell extract	8000	400	800
DEAE Sephacel	10	2	200

Which one of the following is the correct interpretation of these data?

(A) 50 fold purification was achieved with 25% yield of the enzyme
(B) 25 fold purification was achieved with 50% yield of the enzyme
(C) 50 fold purification was achieved with 4% yield of the enzyme
(D) 200 fold purification was achieved with 25% yield of the enzyme

Q.16 Aspartate residues are found in the active sites of many enzymes. The pK_a for the β-carboxylate of aspartate is 3.86. At physiological pH this group can function as

(A) a nucleophile and a conjugate acid
(B) an electrophile and a conjugate acid
(C) a nucleophile and a conjugate base
(D) an electrophile and a conjugate base

Q.17 Kinetic parameters for the enzyme fumarase with three different substrates are given below.

Substrate	**K_M (μM)**	**k_{cat} (sec^{-1})**
Fluorofumarate	27	2700
Fumarate	5	800
Chlorofumarate	111	20

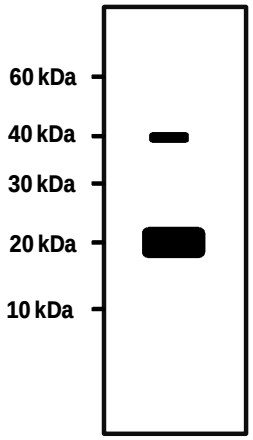
The specificity of fumarase for the substrates decreases in the order

(A) Fluorofumarate > Fumarate > Chlorofumarate
(B) Chlorofumarate > Fluorofumarate > Fumarate
(C) Fumarate > Fluorofumarate > Chlorofumarate
(D) Fumarate > Chlorofumarate > Fluorofumarate

Q.18 A polypeptide with the amino acid sequence 'AGKPDHEKAHL' was dissolved in a buffer of pH 1.8. The predominant form of the polypeptide will have a net charge of

(A) +4 (B) +5 (C) +7 (D) +11

Q.19 An N-terminal His-tagged protein of molecular weight 40 kDa was purified using Ni-NTA column. This protein sample was subjected to SDS-PAGE. A western blot of the same using anti-His antibodies is shown below.



Which one of the following interpretations is correct?

(A) Only the His-tag of the protein got removed
(B) The protein forms oligomers
(C) The purified protein sample is homogeneous
(D) The protein has a stable N-terminal 20 kDa domain

Q.20 The sequence of a polypeptide that forms a transmembrane helix is shown below.

```
1           11          21          31          41
|           |           |           |           |
TGERVQLAHH FSEPEITLII FGVMAGVIGT ILLASYGIRR LIKKSP
```

Which one of the following segments of the peptide is most likely to span the membrane?

(A) E3-G22 (B) V5-A25 (C) E15-A34 (D) F21-R40

END OF THE QUESTION PAPER

Space for Rough Work

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