

Section A: Q.1 – Q.10 Carry ONE mark each.

Q.1 Which one of the following is a simple tissue system in plants?

- (A) Epidermis
- (B) Parenchyma
- (C) Phloem
- (D) Xylem

Q.2 In DNA replication, the Okazaki fragments are joined by

- (A) DNA helicase
- (B) DNA ligase
- (C) DNA polymerase
- (D) DNA primase

Q.3 The most abundant type of RNA in a metabolically active mammalian cell is

- (A) mRNA
- (B) rRNA
- (C) snoRNA
- (D) tRNA

Q.4 Which organelle in a eukaryotic cell is the site of electron transport chain?

- (A) Endoplasmic reticulum
- (B) Golgi apparatus
- (C) Mitochondrion
- (D) Peroxisome

Q.5 RNA is a polymer of

- (A) glycosides
- (B) ribonucleosides
- (C) ribonucleotides
- (D) riboses

Q.6 Which one of the following is present in a bacterial cell?

- (A) 28S rRNA
- (B) 70S ribosome
- (C) Chitinous cell wall
- (D) Histones

Q.7 Which color of light excites a natural GFP to emit green fluorescence?

- (A) Blue
- (B) Green
- (C) Infrared
- (D) Red

Q.8 Which one of the following hormones promotes fruit ripening?

- (A) Absciscic acid
- (B) Auxin
- (C) Ethylene
- (D) Gibberellin

Q.9 Which one of the following has a catalytic RNA?

- (A) Ribonuclease H
- (B) Ribozyme
- (C) RNA polymerase I
- (D) RNA polymerase II

Q.10 The number of significant figures in a reported measurement of 0.00361 is

- (A) 3
- (B) 4
- (C) 5
- (D) 6

Section A: Q.11 – Q.30 Carry TWO marks each.

- Q.11 Match the terminology in **Group I** with the stimulus in **Group II** that generates growth response of plants

Group I	Group II
P. Gravitropism	1. Light
Q. Phototropism	2. Touch
R. Thigmotropism	3. Chemical
S. Chemotropism	4. Gravity

(A) P – 3, Q – 4, R – 2, S – 1

(B) P – 2, Q – 1, R – 3, S – 4

(C) P – 4, Q – 1, R – 2, S – 3

(D) P – 4, Q – 2, R – 1, S – 3

Q.12 The correct hierarchy of taxa in the Linnaean classification of eukaryotes is

- (A) kingdom, class, phylum, order, family, genus
- (B) kingdom, order, class, phylum, family, genus
- (C) kingdom, phylum, order, family, class, genus
- (D) kingdom, phylum, class, order, family, genus

Q.13 Which one of the following statements about polyploidy is correct?

- (A) Autopolyploids are derived from a single species
- (B) Autopolyploids are derived from two different species
- (C) Allopolyploids are derived from a single species
- (D) Allopolyploids are not fertile when mated with each other

Q.14 Which one of the following hormones is a tyrosine derivative?

- (A) Epinephrine
- (B) Estradiol
- (C) Progesterone
- (D) Testosterone

Q.15 Which one of the following immunoglobulins crosses the human placenta?

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

Q.16 Determine the correctness or otherwise of the following Assertion [a] and the Reason [r].

Assertion [a]: The resolving power of a transmission electron microscope is higher than that of the light microscope.

Reason [r]: The wavelength of electrons is shorter than that of visible light.

- (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.17 Match the morphology in **Group I** with the corresponding microorganism in **Group II**

Group I

P. Coccus

Q. Rod

R. Comma

S. Spiral

Group II

1. Treponema

2. Bacillus

3. Neisseria

4. Vibrio

(A) P – 3, Q – 2, R – 4, S – 1

(B) P – 4, Q – 1, R – 3, S – 2

(C) P – 2, Q – 4, R – 1, S – 3

(D) P – 1, Q – 2, R – 3, S – 4

Q.18 Which one of the following genetic crosses and their results indicates cytoplasmic inheritance?

- (A) Wild-type male $\times$ mutant female $\rightarrow$ 100% progeny are mutant
- (B) Wild-type male $\times$ mutant female $\rightarrow$ 25% progeny are wild-type
- (C) Mutant male $\times$ wild-type female $\rightarrow$ 50% progeny are mutant
- (D) Mutant male $\times$ wild-type female $\rightarrow$ 75% progeny are wild-type

Q.19 Which of the following is **NOT** a characteristic morphological feature of apoptotic cells?

- (A) Disassembly of nuclear envelope
- (B) DNA fragmentation
- (C) Increased cell size
- (D) Membrane blebbing

Q.20 Competition between two populations in an ecosystem is

- (A) beneficial (+) to both the populations
- (B) deleterious (-) to both the populations
- (C) beneficial (+) to one population, but deleterious (-) to the other population
- (D) beneficial (+) to one population, but no effect (0) on the other population

Q.21 Adenine constitutes 0.16 mole fraction in a given single-stranded DNA. What is the mole fraction of uracil in the resultant RNA, if this entire DNA fragment is transcribed?

- (A) 0.16
- (B) 0.32
- (C) 0.34
- (D) 0.68

Q.22 Which one of the following is **NOT** used as a component in subunit vaccines?

- (A) Capsular polysaccharide
- (B) Inactivated exotoxin
- (C) Inactivated virus
- (D) Viral glycoprotein

Q.23 Metabolic acidosis is associated with decreased plasma level of

- (A) bicarbonate
- (B) lactate
- (C) oxygen
- (D) urea

Q.24 Genes in two species that are derived from the same ancestral gene in their most recent common ancestor are called

- (A) analogs
- (B) heterologs
- (C) orthologs
- (D) paralog

Q.25 An object is placed 15 *cm* in front of a convex mirror, which has a radius of curvature 30 *cm*. Which one of the following is true of the image formed?

- (A) Real and inverted
- (B) Real and upright
- (C) Virtual and inverted
- (D) Virtual and upright

Q.26 If a variable Z shows a standard normal distribution, then the percent probability that

$$0 \leq z^2 \leq 1$$

is _____ (*rounded off to the nearest integer*).

- (A) 34
- (B) 68
- (C) 95
- (D) 99

Q.27 In chick embryo, the ectoderm generates

- (A) alveolar cells
- (B) germ cells
- (C) neurons
- (D) red blood cells

Q.28 The boiling points of Iodomethane, Dibromomethane, Bromomethane, Chloromethane follow the order

- (A) Bromomethane > Dibromomethane > Iodomethane > Chloromethane
- (B) Bromomethane > Iodomethane > Chloromethane > Dibromomethane
- (C) Dibromomethane > Iodomethane > Bromomethane > Chloromethane
- (D) Iodomethane > Bromomethane > Chloromethane > Dibromomethane

Q.29 Chromosome duplication during the cell cycle occurs in

- (A) G₁ phase
- (B) G₂ phase
- (C) M phase
- (D) S phase

Q.30 Ionic character of the covalent bonds in the compounds Cl_2 , HCl , NaCl , NaF follows the order

(A) $\text{Cl}_2 > \text{NaCl} > \text{HCl} > \text{NaF}$

(B) $\text{HCl} > \text{Cl}_2 > \text{NaF} > \text{NaCl}$

(C) $\text{HCl} > \text{NaCl} > \text{NaF} > \text{Cl}_2$

(D) $\text{NaF} > \text{NaCl} > \text{HCl} > \text{Cl}_2$

Section B: Q.31 – Q.40 Carry TWO marks each.

Q.31 Which of the following is/are lateral meristems?

- (A) Cork cambium
- (B) Procambium
- (C) Protoderm
- (D) Vascular cambium

Q.32 Which of the following statement(s) about Golden Rice is/are correct?

- (A) Consumption of it increases vitamin A levels
- (B) Consumption of it increases vitamin D levels
- (C) Consumption of it increases vitamin K levels
- (D) It is a transgenic crop containing β -carotene

Q.33 Which of the following statement(s) about eukaryotic DNA topoisomerase is/are correct?

- (A) Topoisomerase I creates transient single-strand breaks
- (B) Topoisomerase I creates transient double-strand breaks
- (C) Topoisomerase II creates transient single-strand breaks
- (D) Topoisomerase II creates transient double-strand breaks

Q.34 Which of the following method(s) is/are used to estimate protein concentration?

- (A) Anthrone
- (B) Biuret
- (C) Bradford
- (D) Lowry

Q.35 Which of the following is/are example(s) of a lotic ecosystem?

- (A) Lake
- (B) Pond
- (C) River
- (D) Stream

Q.36 Which of the following statement(s) about the effect of genetic drift is/are correct?

- (A) It can cause changes in the frequency of alleles at random
- (B) It is a mechanism of evolution
- (C) It can lead to loss of genetic variation within small populations
- (D) It is significant in large populations

Q.37 Which of the following technique(s) can be used to determine the three-dimensional structure of an organic compound?

- (A) Mass spectrometry
- (B) NMR spectroscopy
- (C) UV-visible spectroscopy
- (D) X-ray crystallography

Q.38 Which of the following entity(ies) is/are found inside the intact nucleus of eukaryotic cells?

- (A) Centrosome
- (B) Lysosome
- (C) Nucleolus
- (D) Nucleosome

Q.39 Which of the following is/are trace element(s)?

- (A) Mn
- (B) P
- (C) S
- (D) Zn

Q.40 Which of the following is/are true about Retrovirus?

- (A) It contains double-stranded RNA genome
- (B) It can cause cancer
- (C) It contains reverse transcriptase
- (D) It contains double-stranded DNA genome

Section C: Q.41 – Q.50 Carry ONE mark each.

- Q.41 A wooden plant accumulates 10 mg kg^{-1} of ^{14}C during its life span. A fossil of this plant was discovered and contains 2.5 mg kg^{-1} of ^{14}C . The age of this fossil at the time of discovery is _____ years (*rounded off to the nearest integer*).

(Use 5730 years as half-life of ^{14}C)

- Q.42 A cylinder contains 50 L of an ideal gas at a pressure of 50 atm. Assuming that the temperature remains unchanged, the volume of the gas at 1 atm is _____ L (*rounded off to the nearest integer*).

- Q.43 One molecule of the protein myoglobin contains one atom of iron. A myoglobin sample was found to contain 0.34% iron. The molecular weight of myoglobin is _____ g mol^{-1} (*rounded off to the nearest integer*).

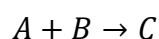
(Use 55.9 g mol^{-1} as atomic mass of iron)

- Q.44 The wavelength of visible light for the green color is 600 nm . The energy of photons of this color is _____ eV (*rounded off to one decimal place*).
(Planck's constant = $6.63 \times 10^{-34}\text{ Js}$, $1\text{ eV} = 1.6 \times 10^{-19}\text{ J}$,
speed of light = $3 \times 10^8\text{ ms}^{-1}$)
- Q.45 A ball dropped from a bridge hits the surface of the water in 3 s . The height of the bridge, ignoring air resistance, is _____ m (*rounded off to one decimal place*).
(Use $g = 9.8\text{ ms}^{-2}$)
- Q.46 For a given square, if the area of its incircle is 100 cm^2 , then the area of its circumcircle is _____ cm^2 (*rounded off to the nearest integer*).

- Q.47 The number of peaks in the ^1H NMR spectrum of methoxymethane (CH_3OCH_3) is _____.
- Q.48 The amount of agarose required to prepare 250 mL of 0.8% agarose gel is _____ grams (*rounded off to the nearest integer*).
- Q.49 Three genes x , y , and z are located on a chromosome in a linear order. If the recombination frequencies between x and y is 0.15, and between y and z is 0.10, then the expected frequency of double crossovers is _____ (*rounded off to three decimal places*).
- Q.50 A bacterial cell suspension contains 2×10^5 cells mL^{-1} . The volume of this suspension required to obtain 1.4×10^6 cells is _____ mL (*rounded off to the nearest integer*).

Section C: Q.51 – Q.60 Carry TWO marks each.

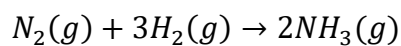
- Q.51 The data provided in the table were obtained from the following reaction, carried out at 273 K.



Initial concentration of [A] mol L^{-1}	Initial concentration of [B] mol L^{-1}	Initial rate of formation of [C] $\text{mol L}^{-1}\text{s}^{-1}$
0.2	0.2	0.3
0.4	0.2	0.6
0.4	0.4	2.4

The order of the reaction with respect to A is _____.

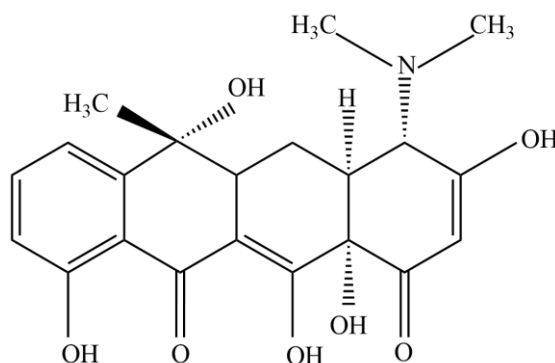
- Q.52 Ammonia is synthesized in the Haber process in the following reaction.



The temperature above which the reaction becomes spontaneous is _____ K (rounded off to one decimal place).

$$(\Delta H^0 = -92.2 \text{ kJ}, \quad \Delta S^0 = -199 \text{ JK}^{-1})$$

Q.53 In the given molecule,



the number of chiral centers is _____.

Q.54 Two resistors $2\ \Omega$ and $4\ \Omega$ are combined in parallel. If this combination is connected to a battery of $16\ V$, the maximum current that can be drawn from the battery is _____ A (rounded off to the nearest integer).

- Q.55 A box of mass 20 kg is pulled at constant speed across a floor by a rope. The rope makes an angle of 45° with the horizontal. Assuming that friction is negligible, the work done in pulling the box by a distance of 20 m is _____ J (rounded off to the nearest integer).
(Use $g = 9.8\text{ ms}^{-2}$)

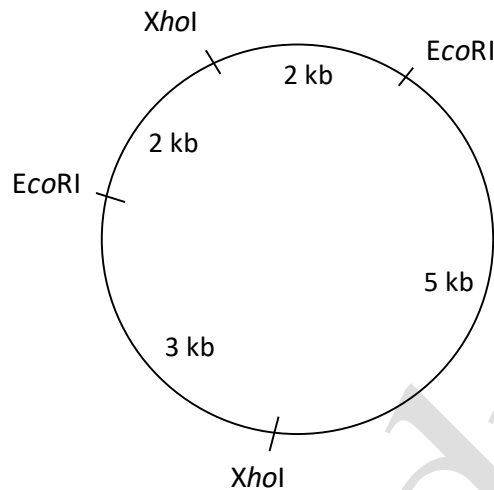
- Q.56 Consider an enzyme that follows simple Michaelis-Menten kinetics, and has a K_M of $5\text{ }\mu\text{M}$. The initial velocity of the reaction will be 10% of the maximum velocity at a substrate concentration of _____ μM (rounded off to two decimal places).

- Q.57 The value of $\lim_{x \rightarrow 3} \frac{x^2 - 9}{x^2 - 4x + 3}$ is _____ (rounded off to the nearest integer).

Q.58 A population of 1000 plants are in Hardy-Weinberg equilibrium. Two alleles R and r determine a particular trait in this population. If the number of plants with RR genotype is 640, Rr genotype is 320 and rr genotype is 40, the frequency of r allele (in percentage) in this population is _____ (*rounded off to the nearest integer*).

Q.59 If a fair coin is tossed two times, the probability that the first or the second toss will be heads is _____ (*rounded off to two decimal places*).

- Q.60 The restriction map of a circular plasmid is shown below, along with the indicated distances between the restriction sites.



The plasmid was completely digested with *EcoRI*, and *XhoI*. The products were analysed by agarose gel electrophoresis followed by ethidium bromide staining. The number of bands that will be visible in the gel when exposed to UV light is _____.