Q. 1 – Q. 5 carry one mark each.

Q.1 The volume of a sphere of diameter 1 unit is _____ than the volume of a cube of side 1 unit.

(A) least (B) less (C) lesser (D) low

Q.2 The unruly crowd demanded that the accused be _____ without trial.

(A) hanged (B) hanging (C) hankering (D) hung

Q.3 Choose the statement(s) where the underlined word is used correctly:

(i) A prone is a dried plum.
(ii) He was lying prone on the floor.
(iii) People who eat a lot of fat are prone to heart disease.

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

Q.4 **Fact:** If it rains, then the field is wet.

Read the following statements:
(i) It rains
(ii) The field is not wet
(iii) The field is wet
(iv) It did not rain

Which one of the options given below is **NOT** logically possible, based on the given fact?

(A) If (iii), then (iv). (B) If (i), then (iii).

(C) If (i), then (ii). (D) If (ii), then (iv).

Q.5 A window is made up of a square portion and an equilateral triangle portion above it. The base of the triangular portion coincides with the upper side of the square. If the perimeter of the window is 6 m, the area of the window in m^2 is _____.

(A) 1.43 (B) 2.06 (C) 2.68 (D) 2.88

Q. 6 – Q. 10 carry two marks each.

Q.6 Students taking an exam are divided into two groups, **P** and **Q** such that each group has the same number of students. The performance of each of the students in a test was evaluated out of 200 marks. It was observed that the mean of group **P** was 105, while that of group **Q** was 85. The standard deviation of group **P** was 25, while that of group **Q** was 5. Assuming that the marks were distributed on a normal distribution, which of the following statements will have the highest probability of being **TRUE**?

(A) No student in group **Q** scored less marks than any student in group **P**.

(B) No student in group **P** scored less marks than any student in group **Q**.

(C) Most students of group **Q** scored marks in a narrower range than students in group **P**.

(D) The median of the marks of group **P** is 100.

Q.7 A smart city integrates all modes of transport, uses clean energy and promotes sustainable use of resources. It also uses technology to ensure safety and security of the city, something which critics argue, will lead to a surveillance state.

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

(i) All smart cities encourage the formation of surveillance states.
(ii) Surveillance is an integral part of a smart city.
(iii) Sustainability and surveillance go hand in hand in a smart city.
(iv) There is a perception that smart cities promote surveillance.

(A) (i) and (iv) only (B) (ii) and (iii) only

(C) (iv) only (D) (i) only

Q.8 Find the missing sequence in the letter series.

B, FH, LNP, _ _ _ _.

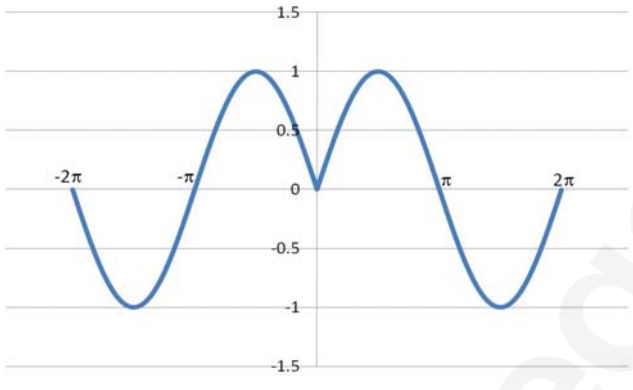
(A) SUWY (B) TUVW (C) TVXZ (D) TWXZ

Q.9 The binary operation □ is defined as $a \square b = ab+(a+b)$, where a and b are any two real numbers. The value of the identity element of this operation, defined as the number x such that $a \square x = a$, for any a, is _____.

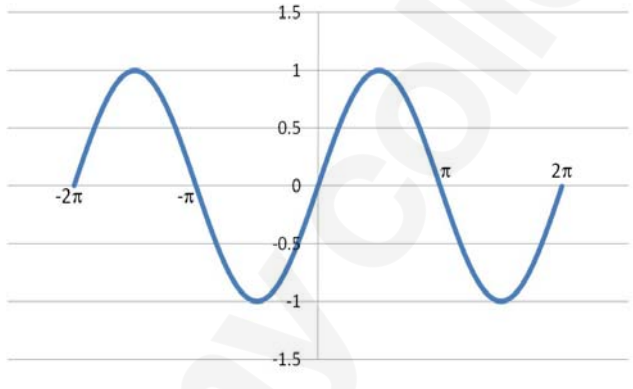
(A) 0 (B) 1 (C) 2 (D) 10

Q.10 Which of the following curves represents the function $y = \ln(|e^{[|\sin(|x|)|]}|)$ for $|x| < 2\pi$? Here, x represents the abscissa and y represents the ordinate.

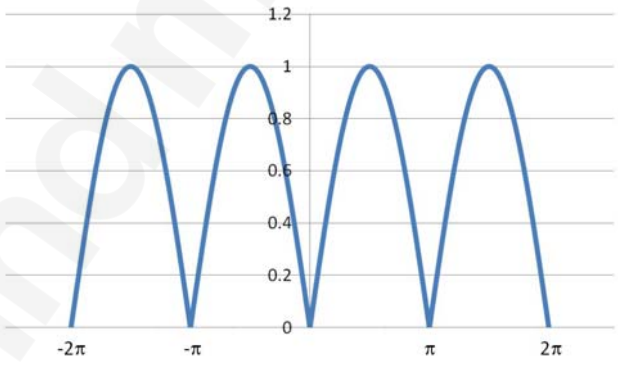
(A)



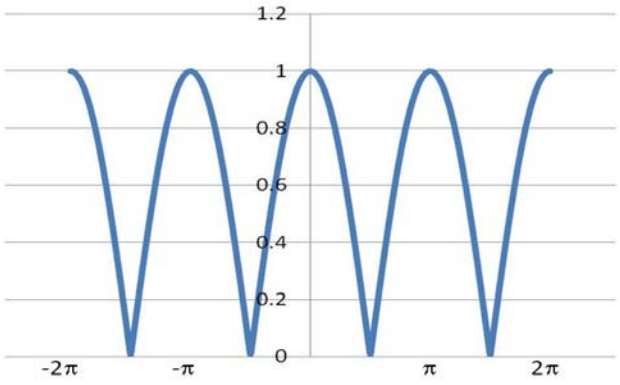
(B)



(C)



(D)



END OF THE QUESTION PAPER

Q. 1 – Q. 25 carry one mark each.

Q.1 Bacteria with two or more flagella at one or both ends are called

(A) amphitrichous (B) peritrichous (C) lophotrichous (D) atrichous

Q.2 Which family of viruses has single stranded DNA?

(A) Herpesviridae (B) Poxviridae (C) Retroviridae (D) Parvoviridae

Q.3 What will be the binding status of regulatory proteins in *lac* operon when concentrations of both lactose and glucose are very low in the culture medium?

(A) Only the repressor remains bound to the operator
(B) Only the cyclic AMP-Catabolic Activator Protein (cAMP-CAP) complex remains bound to the CAP binding site
(C) Neither the repressor nor cAMP-CAP complex remain bound to their respective binding sites
(D) Both the repressor and cAMP-CAP complex remain bound to their respective binding sites

Q.4 Which of the following are TRUE for *Treponema pallidum*?

P. It is the causative agent of syphilis
Q. It is a spirochete
R. It is a non-motile bacterium
S. It is generally susceptible to penicillin

Choose the correct combination.

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

Q.5 In a typical mitotic cell division cycle in eukaryotes, **M** phase occurs immediately after the

(A) $\mathbf{G_0}$ phase (B) **S** phase (C) $\mathbf{G_1}$ phase (D) $\mathbf{G_2}$ phase

Q.6 Which one of the following is **NOT** a therapeutic agent based on nucleic acid for the treatment of genetic disorders?

(A) Antisense oligonucleotide (B) Ribozyme
(C) Aptamer (D) Avidin

Q.7 ATP biosynthesis takes place utilizing the H^+ gradient in mitochondria and chloroplasts. Identify the correct sites of H^+ gradient formation.

(A) Across the outer membrane of mitochondria and across the inner membrane of chloroplast
(B) Across the inner membrane of mitochondria and across the thylakoid membrane of chloroplast
(C) Within the matrix of mitochondria and across the inner membrane of chloroplast
(D) Within the matrix of mitochondria and within the stroma of chloroplast

Q.8 Which one of the following is **NOT** an algorithm for building phylogenetic trees?

(A) Maximum parsimony (B) Neighbor joining
(C) Maximum likelihood (D) Bootstrap

Q.9 Cesium chloride density gradient centrifugation is commonly used for the separation of DNA molecules. The buoyant density, !, of a double stranded Cs^{+}DNA is given by the equation
! = 1.66 + 0.098X_{G+C}
where X_{G+C} denotes

(A) total number of G and C
(B) mole fraction of G+C
(C) number of GC repeats
(D) ratio of G+C to A+T content

Q.10 Disaccharide molecules that contain Ɛ 1 →4) glycosidic linkage are

(A) sucrose and maltose
(B) sucrose and isomaltose
(C) maltose and isomaltose
(D) lactose and cellobiose

Q.11 Junctional diversity of antibody molecules results from

(A) the addition of switch region nucleotides
(B) the addition of N and P nucleotides
(C) the joining of V, D and J segments
(D) mutations in complementarity-determining regions

Q.12 Which one of the following is **NOT** used for the measurement of cell viability in animal cell culture?

(A) Trypan blue dye exclusion
(B) Tetrazolium (MTT) assay
(C) LDH activity in the culture medium
(D) Coulter counter

Q.13 Which one of the following techniques relies on the spin angular momentum of a photon?

(A) CD spectroscopy
(B) Fluorescence spectroscopy
(C) IR spectroscopy
(D) Raman spectroscopy

Q.14 Which one of the following statements is **NOT** true?

(A) In competitive inhibition, substrate and inhibitor compete for the same active site of an enzyme
(B) Addition of a large amount of substrate to an enzyme cannot overcome uncompetitive inhibition
(C) A transition state analogue in enzyme catalyzed reaction increases the rate of product formation
(D) In non-competitive inhibition, K_m of an enzyme for its substrate remains constant as the concentration of the inhibitor increases

Q.15 Based on their function, find the **ODD** one out.

(A) miRNA (B) siRNA (C) shRNA (D) snRNA

Q.16 Prandtl number is the ratio of

(A) thermal diffusivity to momentum diffusivity
(B) mass diffusivity to momentum diffusivity
(C) momentum diffusivity to thermal diffusivity
(D) thermal diffusivity to mass diffusivity

Q.17 Fed batch cultivation is suitable for which of the following?

P. Processes with substrate inhibition
Q. Processes with product inhibition
R. High cell density cultivation

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

Q.18 A biological process is involved in the _____ treatment of industrial effluent.

(A) primary (B) secondary (C) tertiary (D) quaternary

Q.19 In dead-end filtration, rate of filtration is

(A) directly proportional to the square root of pressure drop across the filter medium
(B) inversely proportional to the pressure drop across the filter medium
(C) inversely proportional to the viscosity of the solution
(D) inversely proportional to the square of viscosity of the solution

Q.20 The power required for agitation of non-aerated medium in fermentation is _____ kW.

Operating conditions are as follows:
Fermentor diameter = 3 m
Number of impellers = 1
Mixing speed = 300 rpm
Diameter of the Rushton turbine = 1 m
Viscosity of the broth = 0.001 Pa.s
Density of the broth = 1000 $kg.m^{-3}$
Power number = 5

Q.21 Which one of the following is the most suitable type of impeller for mixing high viscosity (viscosity > 10^5 cP) fluids?

(A) Propeller (B) Helical ribbon (C) Paddle (D) Flat blade turbine

Q.22 Runs scored by a batsman in five one-day matches are 55, 75, 67, 88 and 15. The standard deviation is _____.

Q.23 The positive Eigen value of the following matrix is _____.

$$\begin{bmatrix} 2 & 1 \\ 5 & 2 \end{bmatrix}$$

Q.24 The Laplace transform F(s) of the function $f(t) = \cos(at)$, where a is constant, is _____.

(A) $\frac{s^2}{s^2 - a^2}$ (B) $\frac{a}{s^2 - a^2}$ (C) $\frac{s}{s^2 - a^2}$ (D) $\frac{s}{s^2 - a^2}$