XL : LIFE SCIENCES

Duration: Three Hours *Maximum Marks*: 100

Read the following instructions carefully.

1. Write your name and registration number in the space provided at the bottom of this page.
2. Take out the **O**ptical **R**esponse **S**heet (**ORS**) from this Question Booklet **without breaking the seal**.
3. Do not open the seal of the Question Booklet until you are asked to do so by the invigilator.
4. Write your registration number, your name and name of the examination centre at the specified locations on the right half of the **ORS**. Also, using HB pencil, darken the appropriate bubble under each digit of your registration number and the letters corresponding to your test paper code (XL).
5. This Question Booklet contains **28** pages including blank pages for rough work. After opening the seal at the specified time, please check all pages and report discrepancy, if any.
6. You can answer a maximum of 65 questions carrying 100 marks. Questions must be answered on the left hand side of the **ORS** by darkening the appropriate bubble (marked A, B, C, D) using HB pencil against the question number. **For each question darken the bubble of the correct answer**. In case you wish to change an answer, erase the old answer completely. More than one answer bubbled against a question will be treated as an incorrect response
7. This Question Booklet contains **Seven** sections as listed below.

Section	Page No.	Section	Page No.
GA: *General Aptitude*	02	K. Microbiology	15
H. *Chemistry*	04	L. Zoology	18
I. Biochemistry	07	M. Food Technology	21
J. Botany	11		

8. Section **GA** (General Aptitude) and Section **H** (Chemistry) are compulsory. Choose **two** more sections from the remaining sections with codes **I** through **M**. Using HB pencil, mark the codes of the sections you have chosen by darkening the appropriate bubbles on the left hand side of the **ORS** provided. **Make sure you have correctly bubbled the codes of the sections you have chosen. ORS will not be evaluated if this information is NOT marked.**
9. There are 10 questions carrying 15 marks in General Aptitude (GA) section, which is compulsory. Questions Q.1–Q.5 carry 1-mark each, and questions Q.6–Q.10 carry 2-marks each.
10. There are 15 questions carrying 25 marks in Section H (Chemistry), which is compulsory. Questions Q.1–Q.5 carry 1-mark each and questions Q.6–Q.15 carry 2-marks each. Questions Q.12 and Q.13 (1 pair) are common data questions. Questions Q.14 and Q.15 (1 pair) are linked answer questions. The answer to the second question of the pair of linked answer questions depends on the answer to the first question of the pair. If the first question in the linked pair is wrongly answered or is unattempted, then the answer to the second question in the pair will not be evaluated.
11. Each of the other sections (Sections I through M) contains 20 questions carrying 30 marks. Questions Q.1–Q.10 carry 1-mark each and questions Q.11–Q.20 carry 2-marks each.
12. Unattempted questions will result in zero marks. Wrong answers will result in **NEGATIVE** marks. In GA, for Q.1–Q.5, ⅓ mark will be deducted for each wrong answer and for Q.6–Q.10, ⅔ mark will be deducted for each wrong answer. In Section H, for Q.1–Q.5, ⅓ mark will be deducted for each wrong answer and for Q.6–Q.13, ⅔ mark will be deducted for each wrong answer. The question pair (Q.14, Q.15) is questions with linked answers. There will be negative marks only for wrong answer to the first question of the linked answer question pair i.e., for Q.14, ⅔mark will be deducted for wrong answer. There is no negative marking for Q.15. In all other section papers (Sections I through M), for Q.1–Q.10, ⅓ mark will be deducted for each wrong answer and for Q.11–Q.20, ⅔ mark will be deducted for each wrong answer.
13. Calculator is allowed whereas charts, graph sheets or tables are **NOT** allowed in the examination hall.

Name								
Registration Number	**XL**							

GA : General Aptitude (*Compulsory*)

Q. 1 – Q. 5 carry one mark each.

Q.1 The question below consists of a pair of related words followed by four pairs of words. Select the pair that best expresses the relation in the original pair:
Gladiator : Arena

(A) dancer : stage
(B) commuter : train
(C) teacher : classroom
(D) lawyer : courtroom

Q.2 Choose the most appropriate word from the options given below to complete the following sentence:
Under ethical guidelines recently adopted by the Indian Medical Association, human genes are to be manipulated only to correct diseases for which ———— treatments are unsatisfactory.

(A) similar
(B) most
(C) uncommon
(D) available

Q.3 Choose the word from the options given below that is most nearly opposite in meaning to the given word:
Frequency

(A) periodicity
(B) rarity
(C) gradualness
(D) persistency

Q.4 Choose the most appropriate word from the options given below to complete the following sentence:
It was her view that the country's problems had been ———— by foreign technocrats, so that to invite them to come back would be counter-productive.

(A) identified
(B) ascertained
(C) exacerbated
(D) analysed

Q.5 There are two candidates P and Q in an election. During the campaign, 40% of the voters promised to vote for P, and rest for Q. However, on the day of election 15% of the voters went back on their promise to vote for P and instead voted for Q. 25% of the voters went back on their promise to vote for Q and instead voted for P. Suppose, P lost by 2 votes, then what was the total number of voters?

(A) 100 (B) 110 (C) 90 (D) 95

Q. 6 to Q. 10 carry two marks each.

Q.6 **The horse has played a little known but very important role in the field of medicine. Horses were injected with toxins of diseases until their blood built up immunities. Then a serum was made from their blood. Serums to fight with diphtheria and tetanus were developed this way.**

It can be inferred from the passage, that horses were

(A) given immunity to diseases
(B) generally quite immune to diseases
(C) given medicines to fight toxins
(D) given diphtheria and tetanus serums

Q.7 The sum of n terms of the series 4+44+444+.... is

(A) (4/81) [10^{n+1} – 9n – 1]
(B) (4/81) [10^{n-1} – 9n – 1]
(C) (4/81) [10^{n+1} – 9n – 10]
(D) (4/81) [10^{n} – 9n – 10]

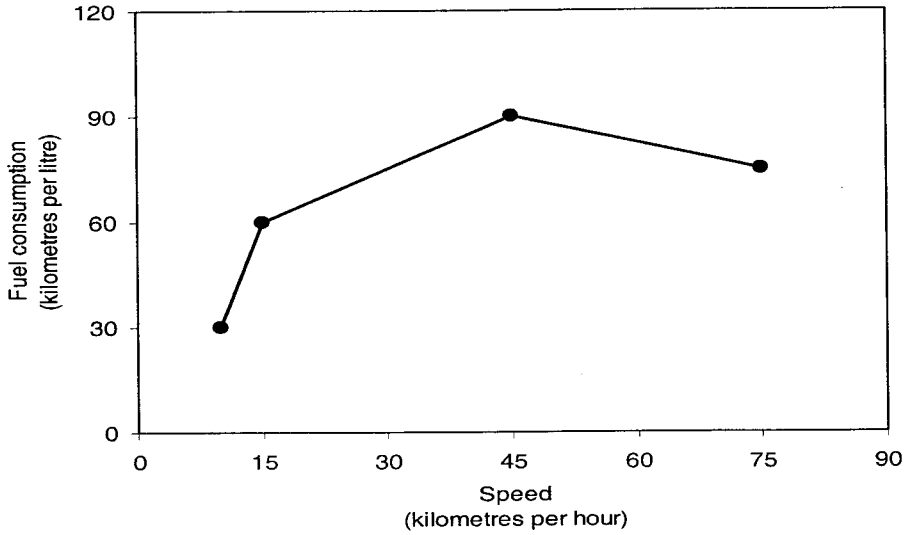
Q.8 Given that f(y) = | y | / y, and q is any non-zero real number, the value of | f(q) – f(–q) | is

(A) 0 (B) –1 (C) 1 (D) 2

Q.9 Three friends, R, S and T shared toffee from a bowl. R took 1/3rd of the toffees, but returned four to the bowl. S took 1/4th of what was left but returned three toffees to the bowl. T took half of the remainder but returned two back into the bowl. If the bowl had 17 toffees left, how many toffees were originally there in the bowl?

(A) 38 (B) 31 (C) 48 (D) 41

Q.10 The fuel consumed by a motorcycle during a journey while traveling at various speeds is indicated in the graph below.



The distances covered during four laps of the journey are listed in the table below

Lap	Distance (kilometres)	Average speed (kilometres per hour)
P	15	15
Q	75	45
R	40	75
S	10	10

From the given data, we can conclude that the fuel consumed per kilometre was least during the lap

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

END OF SECTION – GA

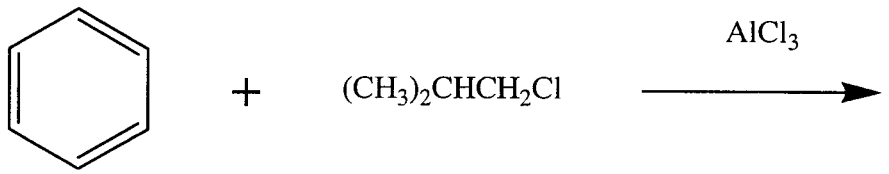
H : CHEMISTRY (*Compulsory*)

Q. 1 – Q. 5 carry one mark each.

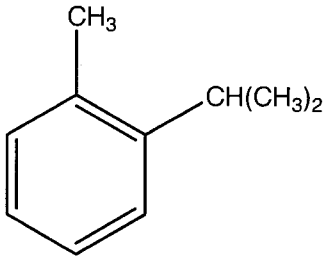
Q.1 Electrophile among the following is

(A) NH_3 (B) SO_3 (C) NO_2 (D) $CH{\equiv}C^-$

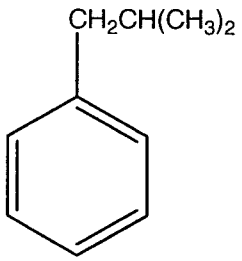
Q.2 The major product for the following reaction is



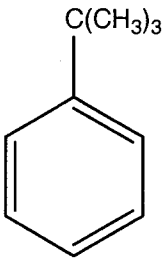
(A)



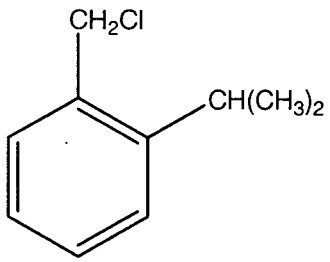
(B)



(C)



(D)



Q.3 Trouton's rule is obeyed by

(A) hydrogen (B) methanol (C) benzene (D) acetic acid

Q.4 Which one of the following compounds is known as silanes?

(A) Silicon hydrides
(B) Silicon halides
(C) Silicon hydroxides
(D) Silicon oxides

Q.5 The shape of PCl_5 is

(A) tetrahedral (B) square planar
(C) trigonal bipyramidal (D) square pyramidal

Q. 6 - Q. 15 carry two marks each.

Q.6 The correct order of acidity is

(A) $C_6H_5COOH < CH_3COOH < C_6H_5OH < C_2H_5OH$
(B) $CH_3COOH < C_6H_5COOH < C_2H_5OH < C_6H_5OH$
(C) $C_2H_5OH < C_6H_5OH < C_6H_5COOH < CH_3COOH$
(D) $C_2H_5OH < C_6H_5OH < CH_3COOH < C_6H_5COOH$

Q.7 Consider the following equilibrium

$$SO_2\,(g) + \tfrac{1}{2}\,O_2\,(g) \rightleftharpoons SO_3\,(g),\ \Delta H = -23.5\ \text{kCal mol}^{-1}$$

The formation of SO_3 is favoured by

(A) compression and decreasing the temperature
(B) compression and increasing the temperature
(C) expansion and increasing the temperature
(D) expansion and decreasing the temperature

Q.8 A molecular electronic excited state has a life time of 10^{-9} s, the uncertainty in measuring the frequency (Hz) of the electronic transition is approximately

(A) $\frac{h}{4\pi} \times 10^{9}$ (B) $\frac{h}{4\pi} \times 10^{-9}$ (C) $\frac{1}{4\pi} \times 10^{-9}$ (D) $\frac{1}{4\pi} \times 10^{9}$

Q.9 According to the molecular orbital theory, bond order for H_2^+ species is

(A) 0.5 (B) 1.0 (C) 1.5 (D) 2.0

Q.10 According to crystal field theory, the electronic configuration of $[Ti(H_2O)_6]^{3+}$ in the ground state is

(A) $e^1t_2^0$ (B) $t_{2g}^0e_g^1$ (C) $e^0t_2^1$ (D) $t_{2g}^1e_g^0$

Q.11 The ions with lowest and highest radii among O^{2-}, F^-, Na^+ and Mg^{2+} are respectively,

(A) Mg^{2+} and O^{2-} (B) O^{2-} and F^-
(C) O^{2-} and Mg^{2+} (D) Na^+ and Mg^{2+}

Common Data Questions

Common Data for Questions 12 and 13:

The solubility products of FeS, ZnS, CuS and HgS are 1.0×10^{-19}, 4.5×10^{-24}, 4.0×10^{-38} and 3.0×10^{-53} respectively.

Q.12 H_2S is passed through an aqueous solution containing all the four metal ions. The metal ion that precipitates first is

(A) Fe^{2+} (B) Zn^{2+} (C) Cu^{2+} (D) Hg^{2+}

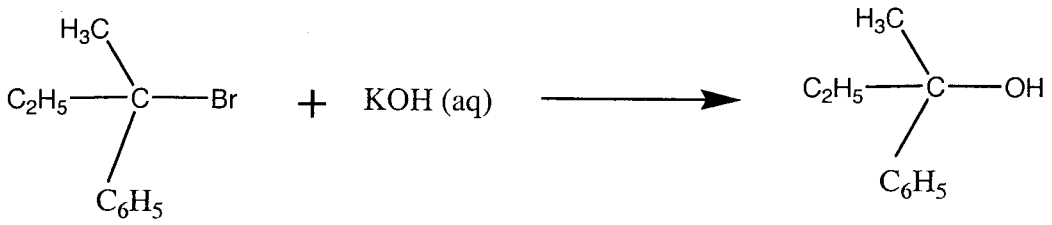
Q.13 The concentration of S^{2-}, at which FeS begins to precipitate from the mixture having 0.1 M Fe^{2+} is

(A) 1.0×10^{-17} M (B) 1.0×10^{-18} M (C) 1.0×10^{-19} M (D) 1.0×10^{-20} M

Linked Answer Questions

Statement for Linked Answer Questions 14 and 15:

Consider the reaction



Q.14 The above reaction is an example of

(A) addition reaction
(B) bimolecular elimination reaction (E_2)
(C) unimolecular substitution reaction (SN_1)
(D) bimolecular substitution reaction (SN_2)

Q.15 If the concentration of KOH in the reaction mixture is doubled, the rate of the reaction will be

(A) decreased to one-half
(B) the same
(C) increased by two-times
(D) increased by four-times

END OF SECTION - H

I : BIOCHEMISTRY

Q. 1 – Q. 10 carry one mark each.

Q.1 Which one of the following **DOES NOT** inhibit protein biosynthesis?

(A) Puromycin (B) Chloramphenicol (C) Cycloheximide (D) Oligomycin

Q.2 The activation of the complement components occurs via three distinct pathways. Which of the following component(s) is specific to the 'Alternate Pathway'?

(A) Factor B and D (B) Mannose binding protein (C) C1qr2s2 (D) C2

Q.3 Which one of the following enzymes fixes CO_2 into organic form?

(A) Ribulose 5-phosphate kinase
(B) Ribulose 1,5-bisphosphate carboxylase
(C) Pyruvate dehydrogenase
(D) Carbonic anhydrase

Q.4 Cytochrome C is normally found in the inner mitochondrial membrane. It is released into the cytoplasm during

(A) Apoptosis (B) Necrosis (C) Cell differentiation (D) Cell proliferation

Q.5 Horseradish peroxidase and alkaline phosphatase are the two enzymes commonly utilized as reagents in ELISA, because these enzymes

(A) are colored proteins
(B) are very small
(C) have high turnover number
(D) bind to ELISA plates

Q.6 The polarity of water molecule is due to

(A) its tetrahedral structure
(B) bonding electrons being attracted more to oxygen
(C) bonding electrons being attracted more to hydrogen
(D) its weak electrolytic property

Q.7 Cyanide poisoning is due to its direct inhibition of

(A) Electron transport chain
(B) Fatty acid biosynthesis
(C) Fatty acid oxidation
(D) Nucleic acid biosynthesis

Q.8 In humans, the largest energy reserve is

(A) liver glycogen
(B) muscle glycogen
(C) blood glucose
(D) adipose tissue triacylglycerol

Q.9 A mixture of four proteins of pIs 11, 7, 5 and 3 are loaded on DEAE anion-exchange column equilibrated with low ionic strength buffer of pH 8. Which of the four proteins would be expected to be retained on the column?

(A) Protein with pI 11 but not the others
(B) Proteins with pIs 11 and 7 but not 5 and 3
(C) Proteins with pIs 7, 5 and 3
(D) Protein with pI 7 but not the others

Q.10 Valinomycin, a cyclic peptide antibiotic, facilitates the transport of which one of the following ions?

(A) K^+ (B) Ca^{2+} (C) Na^+ (D) H^+

Q. 11 - Q. 20 carry two marks each.

Q.11 Match P, Q, R and S with the appropriate numbers 1 to 6 on the right

P) Basophils	1) Perforin
Q) T cells	2) Phagocytosis
R) B cells	3) Albumin
S) Neutrophils	4) Macroglobulin
	5) Fc receptors for IgE
	6) Plasma cells

(A) P -5, Q-1, R-6, S-2
(B) P-1, Q-2, R-3, S-4
(C) P-3, Q-4, R-5, S-1
(D) P-2, Q-6, R-1, S-3

Q.12 Two purified DNA samples A and B contain equal number of basepairs. Each of these DNA samples has one site each for *Eco*RI and *Bam*HI restriction enzymes. Complete digestion with both the enzymes yielded 3 DNA bands and 2 DNA bands respectively for A and B upon electrophoresis of the digestion products. Which one of the following explains the observation?

(A) A is circular DNA and B is linear
(B) B is circular DNA and A is linear
(C) A is circular DNA and B could be linear or circular
(D) B is circular DNA and A could be linear or circular

Q.13 In the following enzyme catalyzed reaction which follows Michaelis-Menten kinetics

$$E + S \underset{k_{-1}}{\overset{k_1}{\rightleftharpoons}} ES \xrightarrow{k_2} E + P$$

K_m is equal to

(A) $k_{-1}/(k_1.k_2)$ (B) $(k_1.\ k_2)/k_{-1}$ (C) $k_1/(k_2 + k_{-1})$ (D) $(k_2 + k_{-1})/k_1$

Q.14 Match the items in **Group I** with those in **Group II**

Group I	**Group II**
P) Progesterone	1) Peptide
Q) Dopamine	2) Fatty acid
R) Vasopressin	3) Carbohydrate
S) Prostaglandin	4) Catecholamine
	5) Eicosanoid
	6) Steroid

(A) P-3, Q-4, R-1, S-2
(B) P-6, Q-4, R-1, S-5
(C) P-3, Q-5, R-4, S-1
(D) P-6, Q-5, R-1, S-4

Q.15 Three samples of antibodies were electrophoresed under denaturing and reducing conditions on a 15 % acrylamide gel, followed by staining with Coomassie blue dye. Samples 1, 2 and 3 showed two, three and four stainable bands respectively. Which one of the following conclusions can be made from these observations?

(A) Sample 1 is IgG, 2 is IgA and 3 is IgM
(B) Sample 1 is IgA, 2 is IgM and 3 is IgG
(C) Sample 1 is IgG, 2 is IgM and 3 is IgA
(D) Sample 1 is IgA, 2 is IgG and 3 is IgM

Q.16 Four identical PCR reactions were carried out in tubes named I, II, III and IV. Besides the usual mix of dNTPs, each of the tubes respectively contained γ-^{32}P dATP, β-^{32}P dATP, α-^{32}P dATP and α-^{32}P rNTP. Which one of the tubes will have radiolabeled PCR product?

(A) Tube I (B) Tube II (C) Tube III (D) Tube IV

Q.17 Match the following:

Group I	Group II
P) Polynucleotide kinase	1) ATPase
Q) Fluoride	2) GTPase
R) Ras	3) Transketolase
S) *lac* operon	4) Enolase
	5) 5' end of DNA
	6) 3' end of DNA
	7) Only positive regulation
	8) Positive and negative regulation

(A) P-5, Q-4, R-2, S-8
(B) P-6, Q-3, R-1, S-7
(C) P-4, Q-2, R-1, S-6
(D) P-1, Q-7, R-5, S-3

Q.18 Collagen, α-keratin and tropomyosin have common structural features. They are

P) disulfide bridges to neighboring proteins.
Q) repeating sequences of amino acids
R) a high β-sheet content
S) superhelical coiling

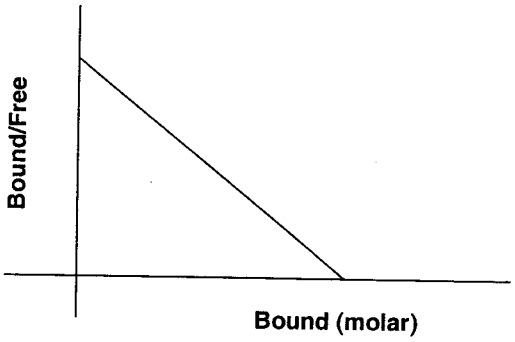
(A) P,Q (B) Q,R (C) Q,S (D) P,R

Q.19 Match the following

	Group I	Group II
P)	Tyrosine hydroxylation	1) Thyroxine
Q)	Tyrosine iodination	2) T cell Receptor
R)	Tyrosine phosphorylation	3) DOPA
S)	Tyrosine oxidation	4) Estradiol receptor
		5) Epinephrine
		6) Melanin
		7) Endorphin
		8) Serotonin

(A) P-1, Q-6, R-5, S-4
(B) P-5, Q-7, R-4, S-8
(C) P-2, Q-5, R-3, S-4
(D) P-3, Q-1, R-2, S-6

Q.20 Scatchard analysis of ligand-receptor interaction yielded the graph shown below. The affinity of the ligand-receptor interaction can be obtained from



(A) Y intercept
(B) X intercept
(C) Slope of the line
(D) Product of X intercept and Y intercept

END OF SECTION - I

J : BOTANY

Q. 1 – Q. 10 carry one mark each.

Q.1 The stalk with which the ovule remains attached to the placenta is called

(A) Micropyle (B) Chalaza (C) Funiculus (D) Hilum

Q.2 The diploid chromosome number of an organism is 2n = 14. What would be the expected chromosome numbers in a nullisomic?

(A) 12 (B) 13 (C) 15 (D) 16

Q.3 The mutagen ethidium bromide acts as a

(A) Deaminating agent
(B) Alkylating agent
(C) Intercalating agent
(D) Base analogue

Q.4 During photorespiration the reactive oxygen species, H_2O_2 is produced in

(A) Glyoxysome (B) Lysosome (C) Peroxisome (D) Dictyosome

Q.5 One of the defense mechanisms adopted by plants for detoxification of heavy metals is the synthesis of

(A) Phytochelatin (B) Calmodulin (C) Tubulin (D) Systemin

Q.6 In which one of the following phases of cell cycle the drug colchicine exerts its effect?

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

Q.7 The transition of water molecule from liquid to glassy state during cryopreservation is termed as

(A) Vitrification (B) Hyperhydricity (C) Cryoprotectant (D) Habituation

Q.8 The DNA content of a nucleus can be measured by

(A) ESR Spectroscopy
(B) FTIR Spectroscopy
(C) Flow Cytometry
(D) X-Ray Crystallography

Q.9 Retrograde signaling involves communication of

(A) nucleus to the chloroplast
(B) endoplasmic reticulum to the nucleus
(C) nucleus to the mitochondria
(D) chloroplast to the nucleus

Q.10 A photoautotrophic micropropagation system can be established by increasing the

(A) sucrose concentration in the culture medium
(B) CO_2 concentration in the culture medium
(C) agar concentration in the culture medium
(D) NH_4^+ concentration in the culture medium

Q. 11 - Q. 20 carry two marks each.

Q.11 Which of the following statements in photosynthesis are **CORRECT**?

P. The absorption maxima for photosystem I (PS I) and PS II are 680 nm and 700 nm, respectively

Q. Photosynthetic reaction centre contains 300 chlorophyll molecules and the release of one molecule of oxygen requires a minimum of 8 photons

R. The non-photochemical quenching of excitation energy is enhanced by the presence of zeaxanthin

S. The photochemical splitting of water occurs in PS I

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

Q.12 Which of the following statements are **TRUE** on DNA delivery methods during plant transformation?

P. Single stranded nicks are made in T-DNA border repeat by the VirD1, VirD2 and VirD3 protein complex

Q. *vir*A gene products form the export apparatus on the membrane for the transfer of T-DNA

R. Gold/Tungsten particles are used as microprojectiles in biolistic method

S. Acceleration of DNA-coated microprojectiles is carried out with compressed CO_2

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

Q.13 Match the following plant secondary compounds with their uses and source plants

Compounds	**Uses**	**Plant species**
P. Guggulusterol	1. Anti-hypertensive	i. *Lithospermum erythrorhizon*
Q. Shikonin	2. Anti-rheumatic	ii. *Catharanthus roseus*
R. Ajmalicine	3. Dye	iii. *Glycyrrhiza glabra*
S. Glycyrrhizin	4. Sweetner	iv. *Commiphora wightii*
	5. Anti-tumor	v. *Swertia chirata*
	6. Anti-plaque	vi. *Coptis japonica*

(A)	(B)	(C)	(D)
P-2-iv	P-3-iv	P-4-iv	P-4-iii
Q-3-i	Q-1-i	Q-3-i	Q-2-ii
R-1-ii	R-5-ii	R-1-v	R-5-i
S-4-iii	S-6-iii	S-2-vi	S-6-iv

Q.14 Match the gene of interest for various aspects of crop improvement

Gene insert	**Aspects of crop improvement**
P. *bar*	1. Tolerance to heavy metals
Q. *vip3A*	2. Nutritional improvement with increased vitamin A
R. *β-lcy*	3. Insect resistance
S. *gsh-II*	4. Herbicide resistance
	5. Delayed ripening
	6. Resistance to fungal infection

(A)	(B)	(C)	(D)
P-4	P-4	P-2	P-4
Q-3	Q-3	Q-4	Q-2
R-5	R-2	R-5	R-6
S-6	S-1	S-3	S-1

Q.15 Match the plants with their seed storage proteins

Plant	**Protein**
P. Rape seed	1. Kafirin
Q. Pea	2. Vicillin
R. Sorghum	3. Gliadin
S. Wheat	4. Napin
	5. Zein
	6. Patatin

(A)	(B)	(C)	(D)
P-4	P-2	P-4	P-3
Q-3	Q-3	Q-2	Q-2
R-5	R-6	R-1	R-4
S-2	S-1	S-3	S-5

Q.16 Match the name of the disease with the causal organism

Disease	**Causal organism**
P. False smut of rice	1. *Plasmopara viticola*
Q. Ring rot of potato	2. *Colletotrichum falcatum*
R. Red rot of sugarcane	3. *Corynebacterium sepidonicum*
S. Downy mildew of grape	4. *Ustilaginoidea virens*
	5. *Erwinia amylovora*
	6. *Synchytrium endobioticum*

(A)	(B)	(C)	(D)
P-1	P-4	P-6	P-5
Q-5	Q-3	Q-2	Q-3
R-2	R-2	R-4	R-2
S-4	S-1	S-1	S-4

Q.17 Identify the **CORRECT** statements for phylogenetic systems of classification

P. The most popular phylogenetic systems of classification is that of George Bentham and Joseph Dalton Hooker and was published in 'Genera Plantarum'

Q. A true phylogenetic system of classification was proposed by Adlof Engler and was published in 'Die Naturlichen Pflanzenfamilien'

R. The phylogenetic system of classification proposed by John Hutchinson was appeared in 'The Families of Flowering Plants'

S. The origin of dicot from primitive monocot was proposed by Arthur Cronquist in his book 'Systema Naturae'

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

Q.18 Which of the following statements are **TRUE** for the plastid genomes?

P. Plastid genome is circular in nature with genome size of 120-160 kb

Q. The plastid ribosomes are with sedimentation coefficient of 80S

R. The gene for the small subunit of ribulose bisphospate carboxylase (RubisCO) is located in the plastid

S. rRNAs in the plastid genome are arranged in one transcription unit

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

Q.19 Identify the **CORRECT** statements.

P. Specialized parenchymatous cells with tannins and crystals of calcium oxalate are termed as sclereids

Q. The sieve elements of angiosperms are surrounded by companion cells and are essential component of phloem loading

R. The exudation of water by guttation occurs through trichomes

S. The bulliform cells control the unrolling and hygroscopic movement of grass leaves

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

Q.20 Which of the following statements are **INCORRECT** on ecological point of view?

P. Primary succession involving xerosere is initiated in a wet habitat

Q. Halones commonly found in electronic equipment are one of the active force destroying the protective ozone layer in the stratosphere

R. Sympatric speciation occurs when the new species evolves in geographic isolation from the parent species

S. α-Diversity is the diversity of species within a habitat or community

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

END OF SECTION - J

K : MICROBIOLOGY

Q. 1 – Q. 10 carry one mark each.

Q.1 Quinolones inhibit bacterial growth by targeting

(A) DNA replication
(B) mRNA translation
(C) RNA polymerase
(D) active transport of nutrients into the cell

Q.2 To select for spontaneously arising histidine auxotrophs in a population, you would use a medium containing

(A) Histidine and penicillin
(B) Penicillin but no histidine
(C) Histidine and lysozyme
(D) Lysozyme but no histidine

Q.3 Which one of the following statements is **NOT** associated with contributions of Louis Pasteur?

(A) Anthrax is caused by anthrax bacillus
(B) Bacteria causing food spoilage come from air
(C) The disease causing organism must be isolated in pure culture
(D) Bacteria cause the wine disease

Q.4 The active transport of solute in the cell is characterized by

(A) its uptake along the concentration gradient utilizing energy
(B) requirement of a carrier to support transport along the concentration gradient
(C) chemical modification of the solute during its uptake
(D) its uptake against the concentration gradient

Q.5 Catabolite repression allows cells to save energy by

(A) inactivating catabolic enzymes
(B) inhibiting synthesis of total RNA
(C) regulating expression of genes required for utilization of less-efficient metabolites
(D) inhibiting translation of mRNAs encoding catabolic enzymes

Q.6 A newly emerged variant of Influenza virus can be selectively propagated from the mixed population by addition of

(A) Gangcyclovir
(B) Tamiflu
(C) Interferon gamma
(D) Neutralizing antibody

Q.7 The synthesis of an immunoglobulin in either a secretory or membrane bound form is governed by

(A) allelic exclusion
(B) class switching
(C) differential RNA processing
(D) affinity maturation

Q.8 The *cis-trans* test can determine whether a gene codes for

(A) an activator or a repressor
(B) an RNA or a protein
(C) a protein with the same or different amino acids
(D) a diffusible or non-diffusible product

Q.9 Which of the following are expected to be the abundant inhabitants of a nitrate and sulfate rich soil naturally depleted for oxygen?

(A) *Pseudomonas* and *Azotobacter*
(B) *Pseudomonas* and *Desulfovibrio*
(C) *Azotobacter* and *Thiobacillus*
(D) *Nitrosomonas* and *Nitrobacter*

Q.10 Which one of the following immersion oils would you use to get the best resolution in a light microscope (with 100X objective)?

(A) an oil with refractive index of 1.6
(B) an oil with refractive index of 1.5
(C) an oil with refractive index of 1.4
(D) an oil with refractive index of 1.3

Q. 11 - Q. 20 carry two marks each.

Q.11 Four Hfr strains of *E. coli* were generated from the same F^+ strain. The Hfr strains donated markers in the following order

Strain1: DQWMT; Strain 2: AXPTM; Strain 3: BNCAX; Strain 4: BDQWM

The order of the markers in the original F^+ strain is

(A) DQWMTPXACNB
(B) AXPTMDQWBNC
(C) BNCAXPTMDQW
(D) BDQWMNCAXPT

Q.12 Which one of the following forms of the same DNA molecule would bind maximum ethidium bromide?

(A) Negatively supercoiled
(B) Covalently closed relaxed circle
(C) Linear
(D) Positively supercoiled

Q.13 An actively growing culture of *E. coli* divides in about 20 min. Under laboratory conditions, time taken to replicate the entire genome of this bacterium would be about

(A) 20 min (B) 40 min (C) 10 min (D) 18 min

Q.14 Which of the statements about *Corynebacterium diphtheriae* biology is **NOT CORRECT**?

(A) All strains of *C. diphtheriae* are producers of diphtheria toxin
(B) Diphtheria toxin production can be minimized by high concentration of iron in the medium
(C) Diphtheria toxin inhibits protein synthesis
(D) Diphtheria toxin is an A-B toxin secreted as a polypeptide of 62 kDa

Q.15 Match the names of investigators in **Group 1** with their contributions in **Group 2**

Group 1	**Group 2**
P. Joseph Lister	1. Role of phagocytosis in infection
Q. John Needham	2. Disproved spontaneous generation
R. Elie Metchnikoff	3. Proved Spontaneous generation
S. Lazaro Spallanzani	4. Use of agar as solidifying agent
	5. Use of carbolic acid as disinfectant

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

Q.16 During replication of the *E. coli* chromosome, Okazaki fragments are produced from

(A) only one of the strands of the circular genome
(B) both the strands of the circular genome
(C) one of the strands in one generation and the other strand in the next generation
(D) both the strands of the circular genome provided that the heavy nitrogen (^{15}N) is present in the medium

Q.17 A new isolate of a facultative anaerobe utilizes either oxygen or pyruvate as terminal electron acceptor. This bacterium was grown either anaerobically with glucose as sole carbon source; or aerobically with lactose as the sole carbon source. Net increase in ATP production (per mole of the carbon source) during the aerobic growth would be

(A) 2-fold (B) 4-fold (C) 19-fold (D) 38-fold

Q.18 Based on their properties, match the "Genera" in **Group 1** with those in **Group 2**

Group 1	**Group 2**
P. *Bacillus*	1. *Sarcina*
Q. *Neisseria*	2. *Azotobacter*
R. *Rhizobium*	3. *Hyphomicrobium*
S. *Caulobacter*	4. *Clostridium*

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

Q.19 An actively growing culture (20 ml) of *E. coli* (1×10^5 per ml) was mixed with a total of 100 T4 phage particles, grown further for 40 min and mixed with a few drops of chloroform. Under the conditions used, the generation time of *E. coli* is 30 min, the infection cycle of phage T4 is 20 min, and the burst size is 100. Assuming that each infection was a successful one, how many plaque forming units would you expect at the end of the experiment?

(A) 10^4 (B) 10^3 (C) 10^5 (D) 10^6

Q. 20 Match the pair of organisms in **Group 1** with their characteristic interactions in **Group 2**

Group 1	**Group 2**
P. *Photoblepharon palpebratus* and *Vibrio fischeri*	1. Mutualism
Q. *Pseudomonas* and *Bdellovibrio*	2. Symbiosis
R. *Aspergillus* and *Pseudomonas*	3. Antagonism
S. *Thiobacillus ferrooxidans* and *Beijerinckia lacticogenes*	4. Parasitism

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

END OF SECTION - K

L : Zoology

Q. 1 – Q. 10 carry one mark each.

Q.1 Which one of the following is an example of eumetazoans?

(A) Dictyostelium (B) Hydra (C) Sponges (D) Volvox

Q.2 Which one of the following is characteristic of deuterostomes?

(A) Radially symmetric body
(B) Bilaterally symmetric body
(C) Presence of well-defined digestive system
(D) Formation of anus from blastopore

Q.3 Extraembryonic tissues are derived from which one of the following?

(A) Ectoderm (B) Endoderm (C) Trophoectoderm (D) Mesoderm

Q.4 Which one of the following type of immune cells is responsible for graft rejection?

(A) B cells (B) T cells (C) Macrophages (D) Eosinophils

Q.5 Which of the following is a main symptom of infection by *Wuchereria bancrofti*?

(A) Swelling of limbs (B) Skin rashes (C) Blindness (D) Brain cyst

Q.6 In insect's tracheal system, the transport of oxygen to the target tissue is done by

(A) fine branches of air tubes extending to almost every cell
(B) a liquid that fills the tracheal tube
(C) a specialized set of cells that produce myoglobin
(D) a specialized pigment

Q.7 Which one of the following examples represents an adaptation or a physiological activity that **DOES NOT** minimize the loss of body temperature of animals?

(A) Feathers or fur (B) Fat layers in the adipose tissue
(C) Shivering (D) Vasodilation

Q.8 Which one of the following hormones is **INCORRECTLY** paired with its function?

(A) Melatonin – biological rhythm (B) Glucagon – increases blood glucose levels
(C) Prolactin – stimulates milk secretion (D) Calcitonin – increases blood calcium level

Q.9 The term *innate behavior* refers to an animal behavior

(A) that is triggered by an environmental change
(B) that is taught by the parent
(C) that is developmentally fixed
(D) that an organism learns on its own by "a hit-and trial" approach

Q.10 Which of the following is **TRUE** about Kreb's cycle?

(A) Kreb's cycle generates NADPH
(B) The enzymes of Kreb's cycle reside in the inter-membrane space of a mitochondria
(C) It produces ATP, the energy currency of a cell
(D) None of the above

Q. 11 - Q. 20 carry two marks each.

Q.11 A genetic experiment was performed to map the gene(s) for eye colour in a newly-discovered moth species. Sex determination in this moth species: XY – male and XX – female. When blue-eyed males were mated to green-eyed females, all of both male and female progeny had green eyes. When these progeny were mated among themselves, about half of the males of the resulting second generation had blue eyes; however, all females were green-eyed. Which one of the following is consistent with the above data?

(A) Multiple genes control eye colour in this moth species
(B) Gene(s) for eye colour is located on the X chromosome
(C) Gene(s) for eye colour is located on the Y chromosome
(D) Gene(s) for eye colour may not be sex-linked

Q.12 In a newly discovered organism, normal development was unaffected when a few blastomeres were removed from 100-cell stage embryo. However, removal of five cells at the 1000-cell stage abolished the formation of kidney. Which one of the following options most accurately describes the type(s) of specification operating in the development of this organism?

(A) Conditional specification only
(B) Autonomous specification only
(C) Conditional and autonomous specifications
(D) Specification does not occur in this organism

Q.13 In which one of the following organisms, it is easiest to distinguish mutations on adjacent base pairs of DNA through genetic recombination experiments?

(A) Bacteriophages (B) Yeast (C) *Escherichia coli* (D) *Bacillus subtilis*

Q.14 RNA is considered as the first genetic material to have evolved on the earth. Which one of the following properties of RNA is critical for its functioning as the genetic material in the absence of DNA and protein?

(A) The presence of uracil as a base in place of thymine
(B) The RNA is less stable than DNA; therefore RNA has higher probability to evolve as genetic material as compared to DNA
(C) The single stranded RNA has a genotype as well as phenotype
(D) RNA exists in 3 forms while DNA has only one form

Q.15 The birth control pills contain hormonal formulations that may either arrest the ovulation or prevent the fertilization of egg. Some of the formulations do both. Which one of the following combinations represents a formulation that is likely to affect the process of ovulation and fertilization?

(A) Progesterone and estrogen
(B) Prostaglandin and estrogen
(C) Gonadotrophin and estradiol
(D) Prolactin and estradiol

Q.16 Behavioral studies on animals have shown that there is relationship between mechanism of reproduction and male parental care (protecting eggs or the young ones). In aquatic invertebrates, fishes and amphibians for example, the species that practice internal fertilization rarely show male parental care while a majority of species that practice external fertilization tend to exhibit male parental care. This is likely due to

(A) the male sex in species that practice internal fertilization are unable to defend against the predators
(B) the male sex in species that practice internal fertilization live on female as parasite
(C) the fact that the females of species that practice external fertilization die soon after laying the eggs
(D) the certainty of paternity in species that practice external fertilization and this behavior is reinforced over generation by natural selection

Q.17 The term *biological magnification* refers to the increased levels of a toxin seen in successive trophic levels in a food web. Which one of the following options correctly states the reason(s) for the increment of a toxin in the ecosystem?

(A) The toxin is highly toxic to primary producers, relatively less toxic to primary consumers, and non-toxic to secondary consumers. Thus, a higher level of toxin is seen in species representing higher trophic levels
(B) The toxin cannot be degraded by microorganism and consequently persist in the environment for years
(C) The toxin to begin with was not toxic or less toxic, but became more toxic by metabolism in the primary producers
(D) Both (B) and (C)

Q.18 From the point of view of the enzymatic reactions, which of the following **DOES NOT** belong here?

(A) Telomerase (B) Reverse transcriptase (C) Taq polymerase (D) Primase

Q.19 Which of the following statements is/are **TRUE** about JUXTACRINE signaling?

I. The ligand and the receptor engage in reciprocal signaling
II. Both the ligand and the receptor are membrane associated proteins
III. The ligand gets proteolytically cleaved after binding to the receptor

(A) I only (B) II only (C) III only (D) I, II and III

Q.20 Which of the following amino acid change (mutation) would **MOST** adversely affect the structure of an α-helix?

(A) A valine residue changed to an isoleucine residue
(B) A methionine residue changed to a proline residue
(C) An aspartic acid residue changed to a glutamic acid residue
(D) A histidine residue changed to an arganine residue

END OF SECTION - L

M : FOOD TECHNOLOGY

Q. 1 – Q. 10 carry one mark each.

Q.1 The protein responsible for spongy structure in bread is

(A) Albumin (B) Zein (C) Gluten (D) Gliadin

Q.2 The factor most responsible for making a good ice cream is

(A) Water content
(B) Homogenization
(C) Emulsifying agent
(D) Mixing index

Q.3 Listed below are some of the functions of fats in the human nutrition. Identify the **INCORRECT** function

(A) Concentrated source of energy
(B) Transport of oxygen to various organs
(C) Absorption of fat soluble vitamins
(D) Synthesis of cell membrane and hormones

Q.4 During ripening of cheese by *Penicillium roqueforti* the characteristic aroma is because of

(A) Methyl ketones
(B) Aceto acetic acid
(C) Diacetyl
(D) Acetoin

Q.5 Which of the following statements is **NOT TRUE** in case of oxidative rancidity of fatty foods?

(A) Peroxides and hydroperoxides are formed during auto-oxidation
(B) Auto-oxidation is a complex chain reaction
(C) The final breakdown products of auto-oxidation are aldehydes, ketones and alcohols
(D) The reaction is brought about by an enzyme, called lipase

Q.6 Which of the following group of characteristics is **CORRECT** in respect of *Shigella* species found as food pathogen?

(A) Gram positive, motile by gliding, spore forming cocci and transmitted by contaminated food
(B) Gram negative, motile by flagella, spore forming bacilli and transmitted by contaminated water
(C) Gram positive, non-motile, non-spore forming cocci and transmitted by contaminated air and water both
(D) Gram negative, non-motile, non-spore forming and transmitted by fecal-oral route

Q.7 Relate the vitamins listed below (left hand side) with the associated diseases (right hand side)

P. Thiamin	1. Pellagra
Q. Nicotinic acid	2. Beriberi
R. Folic acid	3. Scurvy
S. Ascorbic acid	4. Anemia

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

Q.8 Which of the following conditions for the heat resistance of microorganisms is **CORRECT**?

(A) Psychrophiles < Mesophiles < Thermophiles
(B) Psychrophiles > Mesophiles > Thermophiles
(C) Thermophiles > Psychrophiles > Mesophiles
(D) Mesophiles < Thermophiles < Psychrophiles

Q.9 The solubility of sodium bicarbonate in water is 9.6 g/100 g at 20 °C and 16.4 g/100 g at 60 °C. If a saturated solution of sodium bicarbonate at 60 °C is cooled to 20 °C, the percentage of the dissolved salt crystallized out will be

(A) 20.5 (B) 25.4 (C) 41.5 (D) 45.2

Q.10 Which one of the following statements is **NOT TRUE** in terms of nutritive evaluation of proteins?

(A) PER is defined as the live weight gain per unit weight of protein intake
(B) 'Metabolic nitrogen' is the amount of nitrogen present in the feces when a nitrogen free diet is fed to an animal
(C) Net protein utilization is a product of biological value and digestibility
(D) 'Chemical score' of a mixed protein diet can be calculated from the total amino acids present in the mixture

Q. 11 - Q. 20 carry two marks each.

Q.11 A sugar syrup (density = 1040 kg/m^3 and viscosity = 1600×10^{-6} Pa.s) is required to be pumped into a tank (1.5 m diameter and 3 m height) by a 3 cm inside diameter pipe. If the liquid is required to flow under laminar conditions the minimum time to fill the tank with the syrup will be

(A) 192.9 h (B) 19.3 h (C) 38.6 h (D) 57.9 h

Q.12 Match the following sauerkraut defects for their causative agents

P. Soft kraut	1. Due to growth of bacteria, mold and/or yeast
Q. Slimy kraut	2. Due to surface growth of *Torula* yeast
R. Rotted kraut	3. Bacterial growth does not initiate till last stage
S. Pink kraut	4. Rapid growth of *Lactobacillus cucumens* and *L. plantarum* specially at elevated temperature

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

Q.13 Match the following carbohydrates with their use in the food processing

P. High amylose starch	1. White sauces in cook freeze operations
Q. Pectin	2. Edible film for wrapping candies
R. Starch phosphates	3. As humectant in confectionary
S. Glucose	4. Setting agent in jams and jellies

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

Q.14 Match the food items and their principal flavouring agents given in the two columns below

P. Butter	1. Menthol
Q. Orange	2. Limonene
R. Cloves	3. Eugenol
S. Mint	4. Diacetal

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

Q.15 Match the food items on left hand side with their colloidal nature on right hand side

P. Curd	1. Foam
Q. Butter	2. Emulsion
R. Vegetable soup	3. Sol
S. Whipped egg white	4. Gel

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

Q.16 In an actively growing (exponential phase) yeast culture, the cell concentration increased from 10^3 cells per ml to 10^7 cells per ml in 4 h. The doubling time of the yeast is

(A) 120 minutes (B) 30 minutes (C) 18 minutes (D) 60 minutes

Q.17 The steps followed in Gram's staining of microorganisms are
P. Washing with neutral organic solvent
Q. Counter staining with a contrast dye
R. Staining with basic dye
S. Fixing the colour with a suitable mordant

Identify the **CORRECT** sequence.

(A) Q → S → R → P
(B) P → Q → R → S
(C) Q → P → S → R
(D) R → S → P → Q

Q.18 A continuous dryer was used to dry 12 kg/min of a blanched vegetable containing 50% moisture (wet weight basis) to give a product containing 10% moisture. As the dryer could handle feed material with moisture content not more than 25%, a part of dried material was recycled and mixed with the fresh feed. The evaporation rate in the dryer will be

(A) 2.08 kg/min (B) 5.33 kg/min (C) 3.33 kg/min (D) 2.93 kg/min

Q.19 An enzyme has a K_m of 4.7×10^{-5} M and V_m is 22 micro moles per litre per min. The enzyme reaction is carried out at a substrate concentration of 2×10^{-4} M. The initial reaction velocity for this enzyme catalyzed reaction will be

(A) 6.5 micro moles per litre per min
(B) 17.8 micro moles per litre per min
(C) 13.0 micro moles per litre per min
(D) 8.9 micro moles per litre per min

Q.20 The F – value at 121.1 °C, equivalent to 99.9999 percent destruction of a strain of *Clostridium botulinum,* is 1.8 min. The D_o value (decimal reduction time at reference temperature) of the organism will be

(A) 10.8 min (B) 0.3 min (C) 6.0 min (D) 0.2 min

END OF THE QUESTION PAPER