

GATE 2014: General Instructions during Examination

1. Total duration of the GATE examination is **180** minutes.
2. The clock will be set at the server. The countdown timer at the top right corner of screen will display the remaining time available for you to complete the examination. When the timer reaches zero, the examination will end by itself. You need not terminate the examination or submit your paper.
3. Any useful data required for your paper can be viewed by clicking on the **Useful Common Data** button that appears on the screen.
4. Use the scribble pad provided to you for any rough work. Submit the scribble pad at the end of the examination.
5. You are allowed to use a non-programmable type calculator, however, sharing of calculators is not allowed.
6. The Question Palette displayed on the right side of screen will show the status of each question using one of the following symbols:

 You have not visited the question yet.

 You have not answered the question.

 You have answered the question.

 You have NOT answered the question, but have marked the question for review.

 You have answered the question, but marked it for review.

The **Marked for Review** status for a question simply indicates that you would like to look at that question again. *If a question is answered, but marked for review, then the answer will be considered for evaluation unless the status is modified by the candidate.*

Navigating to a Question :

7. To answer a question, do the following:
 - a. Click on the question number in the Question Palette to go to that question directly.
 - b. Select an answer for a multiple choice type question by clicking on the bubble placed before the 4 choices, namely A, B, C and D. Use the virtual numeric keypad to enter a number as answer for a numerical type question.
 - c. Click on **Save & Next** to save your answer for the current question and then go to the next question.
 - d. Click on **Mark for Review & Next** to save your answer for the current question and also mark it for review, and then go to the next question.

Caution: Note that your answer for the current question will not be saved, if you navigate to another question directly by clicking on a question number without saving the answer to the previous question.

You can view all the questions by clicking on the **Question Paper** button. This feature is provided, so that if you want you can just see the entire question paper at a glance.

Answering a Question :

8. Procedure for answering a multiple choice (MCQ) type question:
 - a. Choose one answer from the 4 options (A,B,C,D) given below the question, click on the bubble placed before the chosen option.
 - b. To deselect your chosen answer, click on the bubble of the chosen option again or click on the **Clear Response** button.
 - c. To change your chosen answer, click on the bubble of another option.
 - d. To save your answer, you MUST click on the **Save & Next** button.
9. Procedure for answering a numerical answer type question:
 - a. To enter a number as your answer, use the virtual numerical keypad.
 - b. A fraction (e.g. -0.3 or -.3) can be entered as an answer with or without '0' before the decimal point. As many as four decimal points, e.g. 12.5435 or 0.003 or -932.6711 or 12.82 can be entered.
 - c. To clear your answer, click on the **Clear Response** button.
 - d. To save your answer, you MUST click on the **Save & Next** button
10. To mark a question for review, click on the **Mark for Review & Next** button. *If an answer is selected (for MCQ) or entered (for numerical answer type) for a question that is **Marked for Review**, that answer will be considered in the evaluation unless the status is modified by the candidate.*
11. To change your answer to a question that has already been answered, first select that question for answering and then follow the procedure for answering that type of question.
12. Note that ONLY Questions for which answers are *saved* or *marked for review after answering* will be considered for evaluation.

Choosing a Section :

13. Sections in this question paper are displayed on the top bar of the screen. Questions in a Section can be viewed by clicking on the name of that Section. The Section you are currently viewing will be highlighted.
14. A checkbox is displayed for every optional Section, if any, in the Question Paper. To select the optional Section for answering, click on the checkbox for that Section.
15. If the checkbox for an optional Section is not selected, the **Save & Next** button and the **Mark for Review & Next** button will NOT be enabled for that Section. You will

only be able to see questions in this Section, but you will not be able to answer questions in the Section.

16. After clicking the **Save & Next** button for the last question in a Section, you will automatically be taken to the first question of the next Section in sequence.
17. You can move the mouse cursor over the name of a Section to view the answering status for that Section.

Changing the Optional Section :

18. After answering the chosen optional Section, partially or completely, you can change the optional Section by selecting the checkbox for a new Section that you want to attempt. A warning message will appear along with a table showing the number of questions answered in each of the previously chosen optional Sections and a checkbox against each of these Sections. Click on a checkbox against a Section that you want to reset and then click on the **RESET** button. Note that RESETTING a Section will DELETE all the answers for questions in that Section. Hence, if you think that you may want to select this Section again later, you will have to note down your answers for questions in that Section. If you do not want to reset the Section and want to continue answering the previously chosen optional Section, then click on the **BACK** button.
19. If you deselect the checkbox for an optional Section in the top bar, the following warning message will appear: "Deselecting the checkbox will DELETE all the answers for questions in this Section. Do you want to deselect this Section?" If you want to deselect, click on the **RESET** button. If you do not want to deselect, click on the **BACK** button.
20. You can shuffle between different Sections or change the optional Sections any number of times.

GATE 2014 Examination

XL: Life Sciences

Duration: 180 minutes

Maximum Marks: 100

Read the following instructions carefully.

1. To login, enter your Registration Number and password provided to you. Kindly go through the various symbols used in the test and understand their meaning before you start the examination.
2. Once you login and after the start of the examination, you can view all the questions in the question paper, by clicking on the **View All Questions** button in the screen.
3. This paper consists of 7 sections: **GA** (General Aptitude), **H** (Chemistry), **I** (Biochemistry), **J** (Botany), **K** (Microbiology), **L** (Zoology) and **M** (Food Technology).
Section **GA** (General Aptitude) and Section **H** (Chemistry) are compulsory.
Attempt any 2 sections out of the 5 optional Sections **I** through **M**.
There are 10 questions carrying 15 marks in the compulsory General Aptitude (**GA**) section.
Questions 1 to 5 of this section carry 1 mark each, and questions 6 to 10 carry 2 marks each.
There are 15 questions carrying 25 marks in Section **H** (Chemistry), which is compulsory. Questions 1 to 5 of this section carry 1 mark each and questions 6 to 15 carry 2 marks each.
Each of the optional sections (Sections **I** through **M**) contains 20 questions carrying 30 marks. In these sections, questions 1 to 10 are of 1 mark, while questions 11 to 20 are of 2 marks.
4. Depending upon the GATE paper, there may be useful common data that may be required for answering the questions. If the paper has such useful data, the same can be viewed by clicking on the **Useful Common Data** button that appears at the top, right hand side of the screen.
5. The computer allotted to you at the examination center runs specialized software that permits only one answer to be selected for multiple-choice questions using a mouse and to enter a suitable number for the numerical answer type questions using the virtual keyboard and mouse.
6. Your answers shall be updated and saved on a server periodically and also at the end of the examination. The examination will **stop automatically** at the end of **180 minutes**.
7. In each paper a candidate can answer a total of 65 questions carrying 100 marks.
8. The question paper may consist of questions of **multiple choice type (MCQ)** and **numerical answer type**.
9. Multiple choice type questions will have four choices against A, B, C, D, out of which only **ONE** is the correct answer. The candidate has to choose the correct answer by clicking on the bubble (○) placed before the choice.
10. For numerical answer type questions, each question will have a numerical answer and there will not be any choices. **For these questions, the answer should be entered** by using the virtual keyboard that appears on the monitor and the mouse.
11. All questions that are not attempted will result in zero marks. However, wrong answers for multiple choice type questions (MCQ) will result in **NEGATIVE** marks. For all MCQ questions a wrong answer will result in deduction of $\frac{1}{3}$ marks for a 1-mark question and $\frac{2}{3}$ marks for a 2-mark question.
12. There is **NO NEGATIVE MARKING** for questions of **NUMERICAL ANSWER TYPE**.
13. Non-programmable type Calculator is allowed. Charts, graph sheets, and mathematical tables are **NOT** allowed in the Examination Hall. You must use the Scribble pad provided to you at the examination centre for all your rough work. The Scribble Pad has to be returned at the end of the examination.

Declaration by the candidate:

“I have read and understood all the above instructions. I have also read and understood clearly the instructions given on the admit card and shall follow the same. I also understand that in case I am found to violate any of these instructions, my candidature is liable to be cancelled. I also find at the start of the examination that all the computer hardware allotted to me is in proper working condition”.

Q. 1 – Q. 5 carry one mark each.

- Q.1 Choose the most appropriate word from the options given below to complete the following sentence.

A person suffering from Alzheimer's disease _____ short-term memory loss.

- (A) experienced (B) has experienced
(C) is experiencing (D) experiences

- Q.2 Choose the most appropriate word from the options given below to complete the following sentence.

_____ is the key to their happiness; they are satisfied with what they have.

- (A) Contentment (B) Ambition (C) Perseverance (D) Hunger

- Q.3 Which of the following options is the closest in meaning to the sentence below?

“As a woman, I have no country.”

- (A) Women have no country.
(B) Women are not citizens of any country.
(C) Women's solidarity knows no national boundaries.
(D) Women of all countries have equal legal rights.

- Q.4 In any given year, the probability of an earthquake greater than Magnitude 6 occurring in the Garhwal Himalayas is 0.04. The average time between successive occurrences of such earthquakes is ____ years.

- Q.5 The population of a new city is 5 million and is growing at 20% annually. How many years would it take to double at this growth rate?

- (A) 3-4 years (B) 4-5 years (C) 5-6 years (D) 6-7 years

Q. 6 – Q. 10 carry two marks each.

- Q.6 In a group of four children, Som is younger to Riaz. Shiv is elder to Ansu. Ansu is youngest in the group. Which of the following statements is/are required to find the eldest child in the group?

Statements

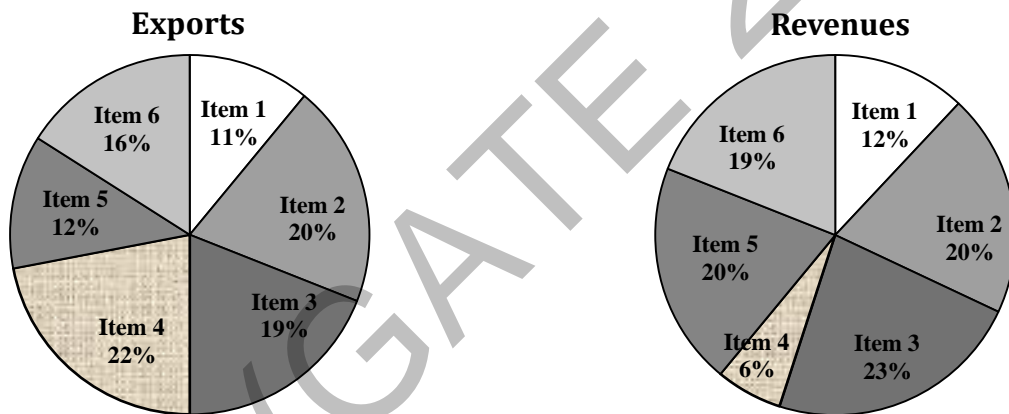
1. Shiv is younger to Riaz.
2. Shiv is elder to Som.

- (A) Statement 1 by itself determines the eldest child.
(B) Statement 2 by itself determines the eldest child.
(C) Statements 1 and 2 are both required to determine the eldest child.
(D) Statements 1 and 2 are not sufficient to determine the eldest child.

- Q.7 Moving into a world of big data will require us to change our thinking about the merits of exactitude. To apply the conventional mindset of measurement to the digital, connected world of the twenty-first century is to miss a crucial point. As mentioned earlier, the obsession with exactness is an artefact of the information-deprived analog era. When data was sparse, every data point was critical, and thus great care was taken to avoid letting any point bias the analysis.
From "BIG DATA" Viktor Mayer-Schonberger and Kenneth Cukier

The main point of the paragraph is:

- (A) The twenty-first century is a digital world
 (B) Big data is obsessed with exactness
 (C) Exactitude is not critical in dealing with big data
 (D) Sparse data leads to a bias in the analysis
- Q.8 The total exports and revenues from the exports of a country are given in the two pie charts below. The pie chart for exports shows the quantity of each item as a percentage of the total quantity of exports. The pie chart for the revenues shows the percentage of the total revenue generated through export of each item. The total quantity of exports of all the items is 5 lakh tonnes and the total revenues are 250 crore rupees. What is the ratio of the revenue generated through export of Item 1 per kilogram to the revenue generated through export of Item 4 per kilogram?



- (A) 1:2 (B) 2:1 (C) 1:4 (D) 4:1
- Q.9 X is 1 km northeast of Y. Y is 1 km southeast of Z. W is 1 km west of Z. P is 1 km south of W. Q is 1 km east of P. What is the distance between X and Q in km?
 (A) 1 (B) $\sqrt{2}$ (C) $\sqrt{3}$ (D) 2
- Q.10 10% of the population in a town is HIV⁺. A new diagnostic kit for HIV detection is available; this kit correctly identifies HIV⁺ individuals 95% of the time, and HIV⁻ individuals 89% of the time. A particular patient is tested using this kit and is found to be positive. The probability that the individual is actually positive is _____

END OF THE QUESTION PAPER

H : CHEMISTRY (COMPULSORY)**Q. 1 – Q. 5 carry one mark each.**

Q.1 Hybridizations of nitrogen in NO_2^+ , NO_3^- , NH_4^+ respectively are

- (A) sp , sp^2 and sp^3 (B) sp , sp^3 and sp^2
 (C) sp^2 , sp and sp^3 (D) sp^3 , sp^2 and sp

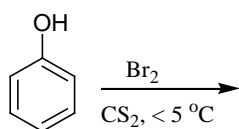
Q.2 Potassium metal crystallizes in the body-centered cubic structure. The number of atoms per unit cell is equal to

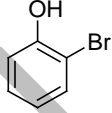
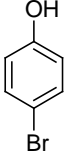
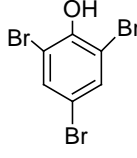
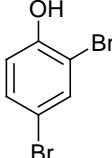
- (A) one (B) two (C) three (D) four

Q.3 Assuming ideal condition, the solution that has the highest freezing point is

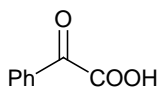
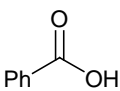
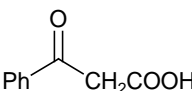
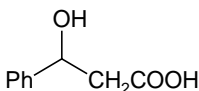
- (A) 0.002 M aqueous solution of copper nitrate
 (B) 0.001 M aqueous solution of potassium dichromate
 (C) 0.001 M aqueous solution of sodium chloride
 (D) 0.002 M aqueous solution of magnesium chloride

Q.4 The major product formed in the following reaction is



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

Q.5 The acid that undergoes decarboxylation most readily upon heating is

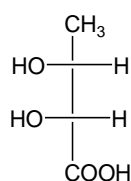
- (A)  (B)  (C)  (D) 

Q. 6 – Q. 15 carry two marks each.

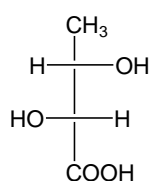
- Q.6 A ball of mass 330 g is moving with a constant speed, and its associated de Broglie wavelength is 1×10^{-33} m. The speed of the ball is _____ m s^{-1} . ($h = 6.6 \times 10^{-34}$ J s)
- Q.7 Diphosphonic acid ($\text{H}_4\text{P}_2\text{O}_5$) has no P–P bond. This acid is
(A) tetrabasic (B) tribasic (C) dibasic (D) monobasic
- Q.8 The magnetic moment of an octahedral Co(II) complex is approximately $4.0 \mu_B$ (atomic number of Co is 27). The CFSE for this complex, in Δ_o units, is _____ .
- Q.9 The complex ion $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$ (atomic number of Cr is 24) exhibits
(A) slightly distorted octahedral geometry
(B) tetragonally elongated octahedral geometry
(C) tetragonally compressed octahedral geometry
(D) perfect octahedral geometry
- Q.10 Assuming ideal behavior, the density of fluorine gas at 20°C and 0.3 atm is _____ g L^{-1} .
(Molecular weight of $\text{F}_2 = 38 \text{ g mol}^{-1}$, $R = 0.082 \text{ L atm mol}^{-1} \text{ K}^{-1}$)
- Q.11 For a first order reaction, the time required for 50% completion is 20 minutes. The time required for 99.9% completion of the reaction is _____ minutes.
- Q.12 At 298 K, the bond dissociation energies of C–H, C–C and C=C are 415, 344 and 615 kJ mol^{-1} , respectively. The enthalpy of atomization of carbon is 717 kJ mol^{-1} and that of hydrogen is 218 kJ mol^{-1} . The heat of formation of naphthalene at 298 K is _____ kJ mol^{-1} .

Q.13 The Fisher projection that represents (2R,3S)-2,3-dihydroxybutanoic acid is

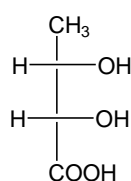
(A)



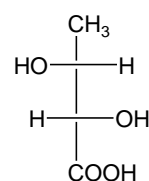
(B)



(C)

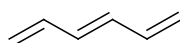


(D)

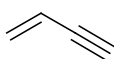


Q.14 A hydrocarbon that undergoes ozonolysis (reaction with ozone followed by reduction with Me_2S) to form formaldehyde and glyoxal is

(A)



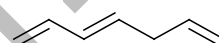
(B)



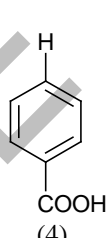
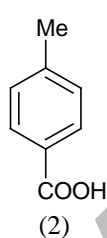
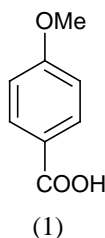
(C)



(D)



Q.15 The order of acidity of the following acids is

(A) $3 > 2 > 1 > 4$ (B) $1 > 4 > 3 > 2$ (C) $4 > 3 > 2 > 1$ (D) $3 > 4 > 2 > 1$

END OF THE QUESTION PAPER

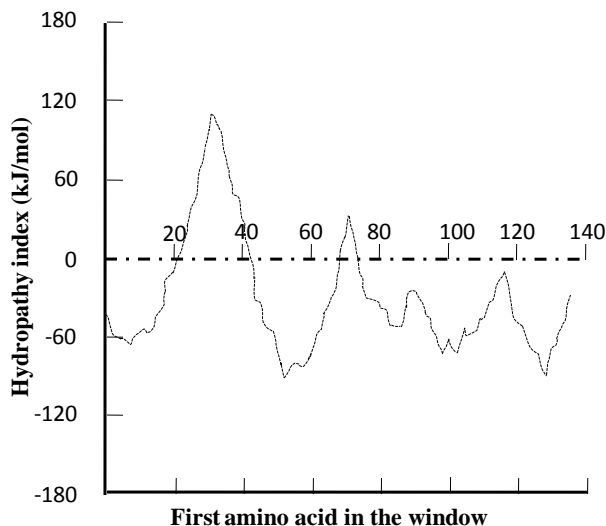
I : BIOCHEMISTRY**Q. 1 – Q. 10 carry one mark each.**

- Q.1 During an enzyme catalyzed reaction, the equilibrium constant
- (A) increases
(B) decreases
(C) remains unchanged
(D) can increase or decrease, depending on the enzyme
- Q.2 A mixture of Arginine, Phenylalanine and Histidine was fractionated using cation exchange chromatography at neutral pH. The amino acids were eluted with an increasing salt gradient. Identify the correct order of elution.
- (A) Arginine, Histidine, Phenylalanine
(B) Phenylalanine, Histidine, Arginine
(C) Histidine, Phenylalanine, Arginine
(D) Arginine, Phenylalanine, Histidine
- Q.3 Which one of the following proteases does **NOT** cleave on the carboxyl side of any Arginine residue in a protein?
- (A) Trypsin
(B) Proteinase K
(C) Thrombin
(D) Chymotrypsin
- Q.4 The receptor for epinephrine is a
- (A) Tyrosine kinase receptor
(B) Serine-threonine kinase receptor
(C) G-protein-coupled receptor
(D) Ligand activated transcription factor
- Q.5 Choose the option with two reducing sugars.
- (A) Lactose and Maltose
(B) Trehalose and Sucrose
(C) Maltose and Trehalose
(D) Lactose and Sucrose
- Q.6 The affinity of an antibody can be determined quantitatively by
- (A) MALDI-TOF MS
(B) isoelectric focusing
(C) SDS-PAGE
(D) equilibrium dialysis
- Q.7 Which one of the following molecules is an allosteric activator of phosphofructokinase-1?
- (A) Fructose 1,6-bisphosphate
(B) Fructose 2,6-bisphosphate
(C) Glucose 6-phosphate
(D) Citrate
- Q.8 For a single substrate enzyme, a reaction is carried out at a substrate concentration four times the value of K_m . The observed initial velocity will be _____ % of V_{max} .
- Q.9 Consider the following biochemical reaction:



The equilibrium constant under biochemical standard conditions (K'_{eq}) for the above reaction is 254. The standard free energy change ($\Delta G'^{\circ}$) for the conversion of fructose 6-phosphate is _____ kJ/mol.

Q.10 Given below is the hydropathy plot of a monomeric transmembrane protein.



How many transmembrane α -helices are present in the protein?

- (A) 1 (B) 2 (C) 4 (D) 5

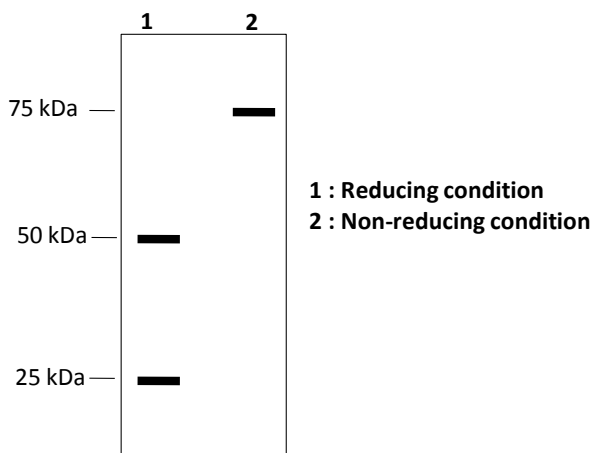
Q. 11 – Q. 20 carry two marks each.

Q.11 An aqueous solution contains two compounds X and Y. This solution gave absorbance values of 1.0 and 0.4 at 220 and 280 nm, respectively, in a 1 cm path length cell. Molar absorption coefficients (ϵ) of the compounds X and Y are as shown in the table below.

	ϵ_{220} ($M^{-1}cm^{-1}$)	ϵ_{280} ($M^{-1}cm^{-1}$)
Compound X	1000	200
Compound Y	800	400

The concentration of Y in the solution is _____ mM.

Q.12 A purified oligomeric protein was analyzed by SDS-PAGE under reducing and non-reducing conditions. A one litre solution of 1 mg/ml concentration has 4.01×10^{18} molecules of the oligomeric protein. Based on the data shown below, deduce the total number of polypeptide chains that constitute this protein.



- (A) 2 (B) 4 (C) 6 (D) 12

- Q.13 The concentration of Mg^{2+} ions outside a cell is twice the concentration inside. If the transmembrane potential of the cell is -60 mV (inside negative), the free energy change of transporting Mg^{2+} ions across the membrane against the concentration gradient at $37^\circ C$ is _____ kJ/mol.

Faraday constant: 96.5 kJ/V mol

- Q.14 Match the entries in Group I with those in Group II

Group I	Group II
P) J chain	1) VDJ recombinase complex
Q) Serpin	2) Component of MHC class I
R) $\beta 2$ -microglobulin	3) B cell co-receptor complex
S) Artemis	4) C1 complement inhibitor
	5) Component of MHC class II
	6) Multimerization of IgA and IgM

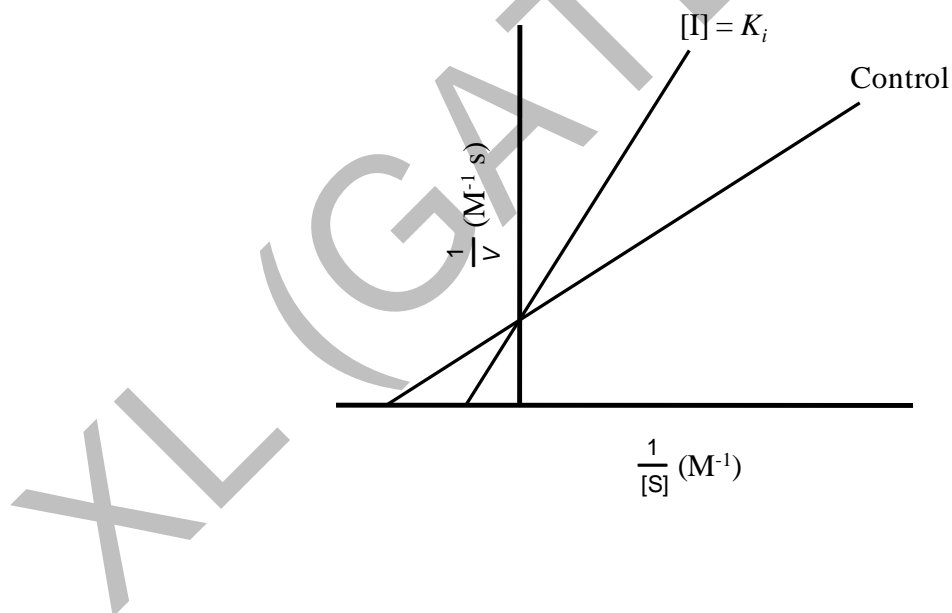
(A) P-3, Q-4, R-5, S-1

(B) P-6, Q-5, R-2, S-3

(C) P-6, Q-4, R-2, S-1

(D) P-3, Q-4, R-1, S-6

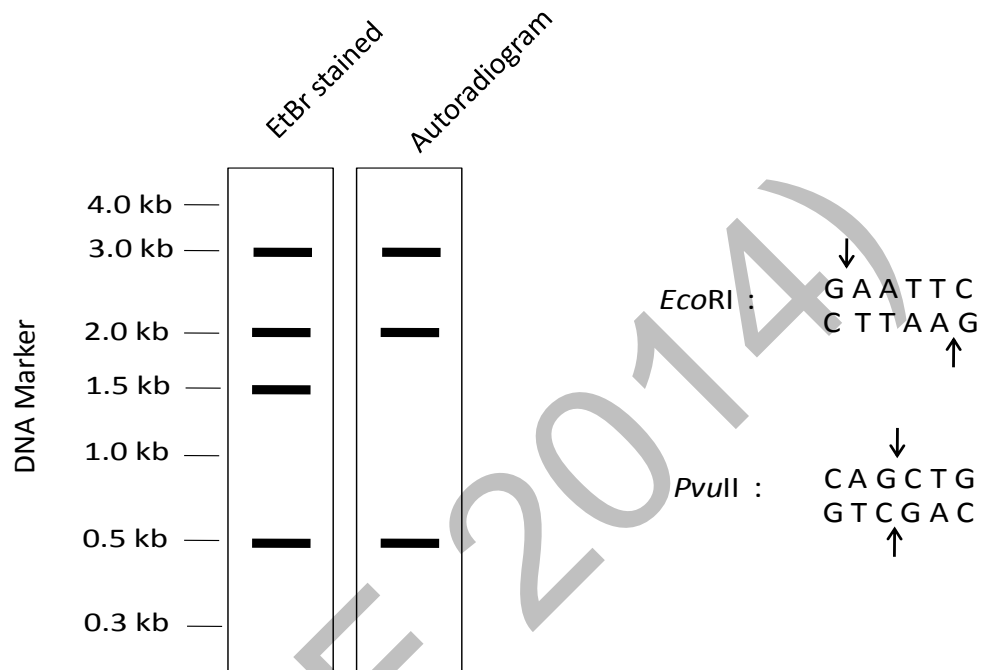
- Q.15 The kinetic data for a single substrate enzyme is shown below. The concentration of inhibitor $[I]$ used in the reaction was equal to the K_i of the inhibitor. The K_m value of an uninhibited reaction is 2×10^{-5} M. In the presence of the inhibitor, the observed K_m value is _____ $\times 10^{-5}$ M.



- Q.16 One litre of phosphate buffer was prepared by adding 208 grams of Na_2HPO_4 (Mol. wt. 142) and 71 grams of NaH_2PO_4 (Mol. wt. 120) in water. If the pK_a for the dissociation of $H_2PO_4^-$ into HPO_4^{2-} and H^+ is 6.86, the pH of the buffer will be _____.

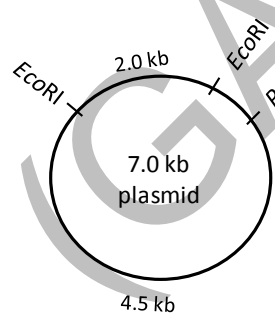
Q.20

A 7 kb DNA molecule of a specific sequence has two *EcoRI* and one *PvuII* restriction endonuclease sites. The restriction sites are shown below. The DNA was completely digested with both *EcoRI* and *PvuII*. The digestion product was purified and added to an appropriately buffered reaction mixture at 37 °C, which contained the Klenow fragment of DNA polymerase I and α -³²P dNTPs. After one hour, the DNA in the reaction product was purified and analyzed by electrophoresis. The bands were visualized by both ethidium bromide (EtBr) staining and autoradiography. The result is shown below.

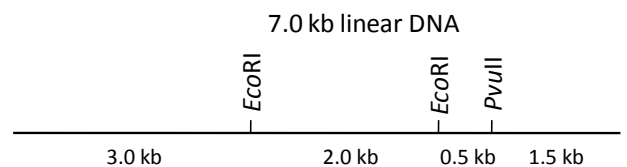


Which one of the following restriction maps is in agreement with the above result?

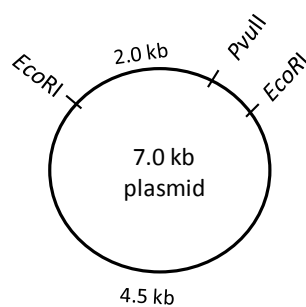
(A)



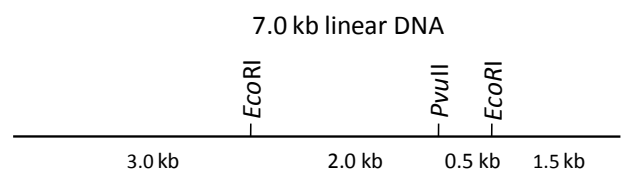
(B)



(C)



(D)



END OF SECTION I

J : BOTANY**Q. 1 – Q. 10 carry one mark each.**

- Q.1 Plant which grows attached to another plant species but is not a parasitic is known as
(A) Endophyte (B) Halophyte (C) Epiphyte (D) Lithophyte
- Q.2 An ideal cybrid should have
(A) both nuclear genome and cytoplasmic genome equally from both the parents
(B) nuclear genome from one of the parents and cytoplasmic genome from other parent
(C) nuclear genome predominantly/exclusively from one of the parents and cytoplasmic genome equally from both the parents
(D) nuclear genome equally from both the parents and cytoplasmic genome predominantly/exclusively from one of the parents
- Q.3 Transmission Electron Micrograph of fungal cell can usually be distinguished from plant cell due to lack of **P** and having less abundant **Q**. Find the correct combination of **P** and **Q**.
(A) P- Plastid; Q-Vacuoles
(B) P- Plastid; Q-Mitochondria
(C) P- Plastid; Q-Endoplasmic reticulum
(D) P- Mitochondria; Q-Plastid
- Q.4 Identify the **CORRECT** answer
RNA interference (RNAi)
P. is an event of post transcriptional gene silencing
Q. works through RNA induced silencing complex
(A) P only (B) Q only (C) Both P and Q (D) neither P nor Q
- Q.5 Find the odd one out
(A) Petal (B) Sepal (C) Petiole (D) Tepal
- Q.6 **Plantibody** is the
(A) **Antibody** expressed in transgenic plant
(B) **Transgenic plant** that expresses antibody
(C) **Antibody** against plant based antigen
(D) **Transgenic plant** that expresses antigen

Q.7 In a typical oil-seed crop, the matured seeds are enriched with
 (A) Phospholipid (B) Galactolipid (C) Neutral lipid (D) Sphingolipid

Q.8 Match the following products (Column I) with the corresponding plant species (Column II)

Column I	Column II
P. Saffron	1. <i>Garcinia sp.</i>
Q. Gamboge	2. <i>Rocella tinctoria</i>
R. Litmus	3. <i>Crocus sativus</i>
S. Turmeric	4. <i>Curcuma sp.</i>

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

Q.9 The semi-dwarf trait of corn, wheat and rice plants used in breeding program during 1960s resulted in green revolution. Later this 'green-revolution gene' has been identified to be involved in either signal transduction pathway or biosynthesis of

(A) Auxin (B) Gibberellin (C) Cytokinin (D) Ethylene

Q.10 In classical model to explain the plant-pathogen interaction, the host will not develop the disease upon the pathogen attack when

(A) The resistance gene (*R*) is non-functional (B) The avirulence gene (*Avr*) is non-functional
 (C) Both *R* and *Avr* are non-functional (D) Both *R* and *Avr* are functional

Q. 11 – Q. 20 carry two marks each.

Q.11 Select the **CORRECT** combination from the promoter (Column I), transcription machinery used (Column II) and target tissue type (Column III) to express a foreign gene in a plant system.

Column I	Column II	Column III
P. <i>Ubiquitin</i>	1. Chloroplast	i. Leaf
Q. <i>Napin</i>	2. Nucleus	ii. Seed
R. <i>RbcL</i>	3. Mitochondria	
S. <i>RbcS</i>		

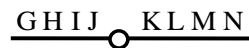
(A) P-1-i, Q-3-ii, R-2-i, S-3-ii (B) P-3-i, Q-1-i, R-2-ii, S-1-ii

(C) P-2-i, Q-2-ii, R-1-i, S-2-i (D) P-1-ii, Q-3-i, R-2-ii, S-3-ii

Q.12 In a plant species, flower colour purple is dominant over white. One such purple-flowered plant upon selfing produced 35 viable plants, of which 9 were white-flowered and the rest were purple-flowered. What fraction of these purple-flowered progeny is expected to be pure purple-flowered line?

- (A) 1/2 (B) 1/3 (C) 1/4 (D) 2/3

Q.13 Following diagram represents the sequence of genes in a normal chromosome of a plant species:



Match the **CORRECT** combination for chromosomal mutation using Column - I and Column - II.

Column-I

- P. G H I K L ○ J M N
- Q. G J ○ K L H I M N
- R. G H I J ○ K L K L M N
- S. G H J ○ K L M N

Column-II

1. Tandem duplication
2. Deletion
3. Pericentric inversion
4. Non-reciprocal translocation

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

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

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

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

Q.14 Match the nuclei status of mutant plant (Column-I) with the typical chromosome number (Column-II), when the wild type plant species is having $2N = 46$ chromosomes.

Column-I

- P. Trisomic
Q. Triploid
R. Monosomic
S. Monoploid

Column-II

1. 23
2. 45
3. 47
4. 69

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

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

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

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

Q.15 Match the following reporter genes used in plant transformation experiments with the source of gene and detection/assay system

Reporter gene

- P. β -glucuronidase
Q. Green fluorescence protein
R. Luciferase
S. Chloramphenicol acetyl transferase

Source of gene

1. *Aequorea victoria*
2. *Photinus pyralis*
3. *E. coli*

Detection/assay

- i. Radioactive assay
- ii. Fluorimetric
- iii. Fluorescence
- iv. Luminescence

(A) P-3-i, Q-1-ii, R-2-iii, S-3-iv

(B) P-3-ii, Q-1-iii, R-2-iv, S-3-i

(C) P-2-ii, Q-1-iii, R-3-iv, S-1-i

(D) P-1-ii, Q-2-iii, R-3-i, S-3-iv

Q.16 Find the **CORRECT** statements in the context of Global warming effect on plant photosynthesis.

P. Decreasing aqueous solubility of dissolved CO₂ compared to dissolved O₂

Q. Decreasing oxygenase activity of Rubisco relative to carboxylation

R. Enhancing the ratio of CO₂ to O₂ in air equilibrated solution

S. Increasing photorespiration relative to photosynthesis

(A) P & Q

(B) R & S

(C) P & R

(D) P & S

Q.17 Statements given below are either **TRUE** (T) or **FALSE** (F). Find the correct combination.

P. Regulation of cell cycle progression depends on cyclin dependent kinase (CDK) and protease activity.

Q. In photosynthesis, oxidation of water produces O₂ and releases electrons required by photosystem I (PSI).

R. Photorespiratory reaction occurring in oxidative photosynthetic carbon (C₂) pathway involves a cooperative interaction among three organelles: chloroplast, peroxisome and mitochondria.

S. Ethylene acts as a promoter of senescence and cytokinins act as a senescence antagonist.

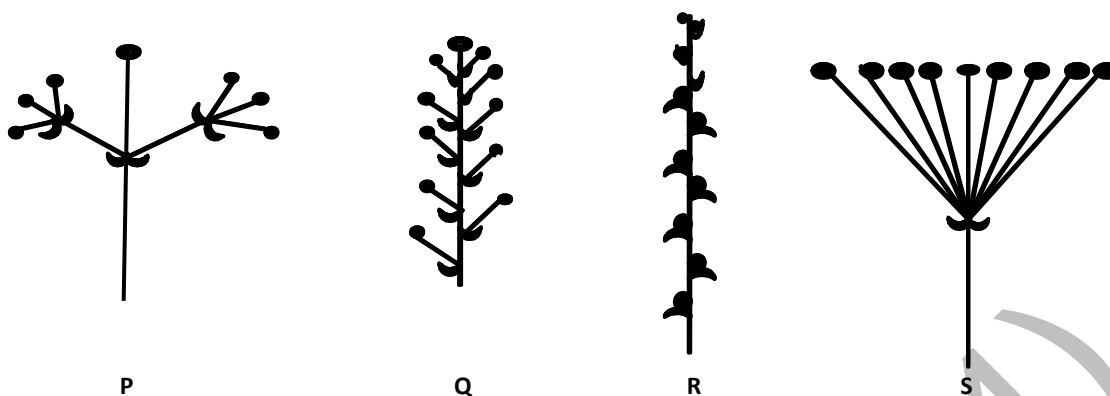
(A) P-T, Q-F, R-T, S-F

(B) P-T, Q-T, R-T, S-F

(C) P-T, Q-F, R-F, S-T

(D) P-T, Q-F, R-T, S-T

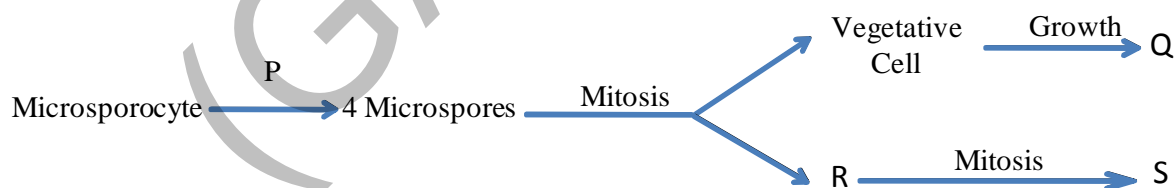
Q.18 Match the following diagrams P, Q, R, and S with the inflorescence type (Column I) and the corresponding plant species (Column II).



Column I	Column II
1. Umbel	i. <i>Pedicularis sp</i>
2. Raceme	ii. <i>Smilacina sp.</i>
3. Compound determinate	iii. <i>Epilobium sp.</i>
4. Spike	iv. <i>Pelargonium sp.</i>

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

Q.19 Find the right combination for P, Q, R and S with respect to gametophyte development in flowering plants.



- (A) P-Meiosis, Q -Generative cell , R- Pollen Tube, S- 2 Sperm Cells
- (B) P- Meiosis, Q- Pollen Tube, R- Generative Cell, S- 2 Sperm Cells
- (C) P-Mitosis, Q- Generative Cell, R- Pollen Tube, S- 2 sperm Cells
- (D) P- Growth, Q- 2 Sperm Cells, R- Pollen Tube, S- Generative Cell

Q.20 Match the definition (Column I) with the type of plant community (Column II)

Column I	Column II
P. The process of occupation of a particular area by different plant communities from their birth to maturity	1. Formation
Q. A major ecological unit of vegetation	2. Consociation
R. A smaller unit of plant association	3. Faciation
S. A subdivision of plant association which is related to minor differences in temperature and moisture relations	4. Plant succession

(A)

P-1
Q-3
R-4
S-2

(B)

P-3
Q-2
R-1
S-4

(C)

P-4
Q-1
R-2
S-3

(D)

P-2
Q-4
R-3
S-1

END OF THE QUESTION PAPER

K: MICROBIOLOGY**Q. 1 – Q. 10 carry one mark each.**

- Q.1 Most viral capsids have
(A) 08 faces (B) 12 faces (C) 16 faces (D) 20 faces
- Q.2 Intergenic suppression involves mutation in
(A) rRNA (B) mRNA (C) tRNA (D) cDNA
- Q.3 Which one of the following proteins does **NOT** bind to a gaseous ligand?
(A) Leghemoglobin (B) Carbonic anhydrase
(C) Nitrogenase (D) NADPH oxidase
- Q.4 A bacterial culture (5×10^8 cells/ml) is maintained in a chemostat of working volume 10 L. If the doubling time of the bacteria is 50 min, the required rate of flow of nutrients (in ml/min) is _____.
- Q.5 Rheumatic fever is an example of
(A) autoimmune disease (B) type IV hypersensitive reaction
(C) immunodeficiency disease (D) neurodegenerative disorder
- Q.6 Oxygenases that catalyse the initial step in the degradation of polycyclic aromatic hydrocarbons by using molecular oxygen belong to which enzyme class?
(A) Hydrolase (B) Transferase
(C) Lyase (D) Oxido-reductase
- Q.7 Which one of the following is **NOT** involved in horizontal gene transfer?
(A) Conjugation (B) Transformation
(C) Transduction (D) Mutation
- Q.8 The principle of immunization was first explained by
(A) Edward Jenner (B) Elie Metchnikoff
(C) Louis Pasteur (D) Robert Koch
- Q.9 Lysozyme catalyzes the breakdown of
(A) NAG-NAM (B) lipopolysaccharide (C) teichoic acid (D) lipoprotein A
- Q.10 Which one of the following microscopic techniques can be used to study the contour of proteins?
(A) SEM (B) TEM (C) AFM (D) Confocal microscopy

Q. 11 – Q. 20 carry two marks each.

Q.11 Match compounds in **Group I** with inhibitory activities in **Group II**.

Group I

- (P) Vancomycin
(Q) Rifampin
(R) Puromycin
(S) Ciprofloxacin

Group II

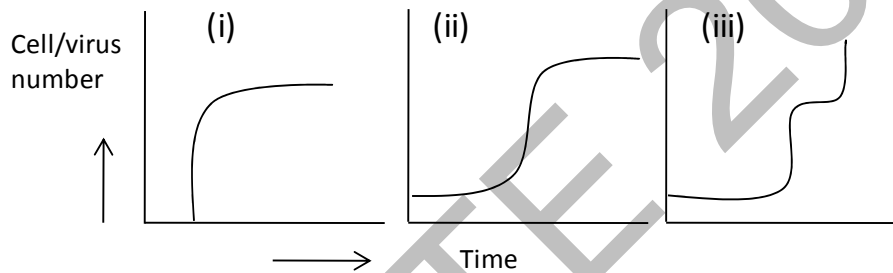
- (i) Folate metabolism
(ii) DNA synthesis
(iii) Protein synthesis
(iv) RNA synthesis
(v) Cell wall synthesis

- (A) P-v, Q-iv, R-iii, S-ii
(C) P-iv, Q-i, R-iii, S-ii

- (B) P-iv, Q-iii, R-i, S-ii
(D) P-v, Q-iii, R-ii, S-iv

Q.12 Match the organisms with the appropriate growth curves.

- (P) Bacteria
(Q) Extracellular virus
(R) Intracellular virus



- (A) P-iii, Q-i, R-ii
(C) P-ii, Q-iii, R-i

- (B) P-ii, Q-i, R-iii
(D) P-i, Q-ii, R-iii

Q.13 The length of a coding region in an mRNA is 897 bases. How many amino acids will be there in the polypeptide synthesized using this mRNA?

- (A) 297 (B) 298 (C) 299 (D) 897

Q.14 Match the media in **Group I** for screening microbial isolates in **Group II**.

Group I

- (P) Blood agar media
(Q) Minimal media
(R) Skimmed milk agar media
(S) Bile salt media

Group II

- (i) Coliforms
(ii) Protease producers
(iii) Hemolytic microbes
(iv) Lipase producers
(v) Autotrophs

- (A) P-iii, Q-v, R-ii, S-i
(C) P-i, Q-iii, R-ii, S-iv

- (B) P-iii, Q-ii, R-i, S-iv
(D) P-ii, Q-i, R-iv, S-v

Q.15 During a bacterial growth experiment, the total viable cell count at 2 h and 6 h was 1×10^4 cells/ml and 1×10^9 cells/ml, respectively. The specific growth rate (in h^{-1}) of the culture is _____.

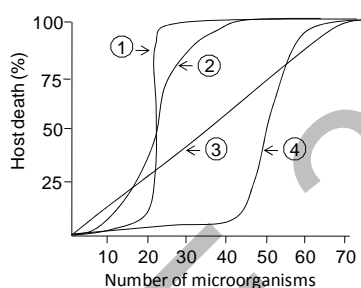
Q.16 The concentration of sodium chloride in the cytoplasm of a *Halobacterium* sp. was found to be 250 ng/nl. The molarity (in M) of sodium chloride is _____.

Q.17 Match organisms in **Group I** with shapes in **Group II** and flagellar arrangements in **Group III**.

Group I		Group II		Group III	
(P)	<i>Salmonella typhi</i>	(i)	helical	(1)	non-motile
(Q)	<i>Saccharomyces cerevisiae</i>	(ii)	rod	(2)	amphitrichous
(R)	<i>Aquaspirillum serpens</i>	(iii)	curved rod	(3)	peritrichous
(S)	<i>Vibrio cholerae</i>	(iv)	ovoid	(4)	polar

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

Q.18 Lethal dose curves of different microorganisms (1, 2, 3 and 4) are shown below. Which of these microorganisms are the most lethal?



- (A) 1 & 3 only (B) 1 & 2 only (C) 3 & 4 only (D) 2 & 3 only

Q.19 Match items in **Group I** with sterilization methods in **Group II**.

Group I		Group II	
(P)	Ampicillin	(i)	70 % alcohol treatment
(Q)	1% glucose in phosphate buffer	(ii)	Autoclaving at 15 psi for 15 min
(R)	Plastic syringe	(iii)	Autoclaving at 10 psi for 20 min
(S)	Luria broth	(iv)	Membrane filtration
		(v)	γ -ray irradiation

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

Q.20 Which of the following statements are **TRUE** regarding *recA* mutants of *E. coli*?

- (P) Exhibit much reduced recombination
 (Q) Do not survive UV irradiation
 (R) Show no effect on doubling time
 (S) Exhibit pleiotropy
- (A) P, Q & R only (B) P, Q & S only
 (C) P, R & S only (D) Q, R & S only

END OF SECTION-K

L : ZOOLOGY**Q. 1 – Q. 10 carry one mark each.**

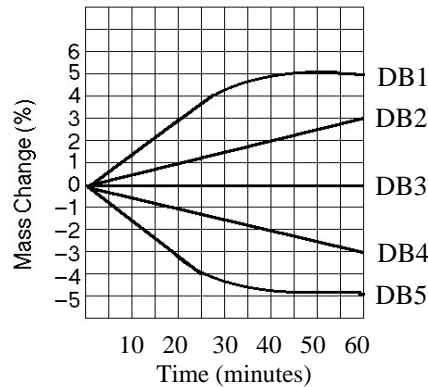
- Q.1 Small geographic areas with high concentrations of endemic species and a large number of endangered and threatened species are known as
- (A) endemic sinks (B) critical communities
(C) biodiversity hot spots (D) endemic metapopulations
- Q.2 Which ONE of the following animals has “Osculum” as an excretory structure?
- (A) Hydra (B) Sponge (C) Jelly Fish (D) Sea pen
- Q.3 During development of which ONE of the following organisms, bilateral meroblastic cleavage is found?
- (A) Mollusc (B) Fish (C) Bird (D) Amphibian
- Q.4 The mitochondrion is NOT considered a part of the endomembrane system on account of which ONE of the following reasons?
- (A) It does not undergo structural changes
(B) It is not derived from the ER or Golgi
(C) It does not synthesize proteins
(D) It is not attached to the outer nuclear envelope
- Q.5 The end products of glycolysis include ATP,
- (A) CO₂ and H₂O (B) H₂O and pyruvate
(C) NADH and pyruvate (D) CO₂ and NADH
- Q.6 The TATA box is found in the vicinity of the transcription start site. The role of this box is to
- (A) serve as a ribosome recruitment site
(B) serve as RNA polymerase binding site
(C) provide 3-D structural integrity to a DNA molecule
(D) act as a terminator sequence
- Q.7 Which ONE of the following processes does NOT occur in prokaryotic gene expression, but occurs in eukaryotic gene expression?
- (A) Transcription of mRNA, tRNA, and rRNA
(B) Binding of RNA polymerase to the promoter
(C) Addition of a poly-A tail to the 3' end and the 5' capping of an mRNA
(D) Translation begins as soon as transcription is initiated
- Q.8 In Graves' disease, the presence of auto antibodies against which ONE of the following molecules is the direct cause of hyperthyroidism?
- (A) Thyroperoxidase (B) Thyroxine
(C) Thyroid stimulating hormone (D) Thyroid stimulating hormone receptor
- Q.9 In mammals, the two important organs associated with the production and elimination of urea are
- (A) gastrointestinal tract and lungs (B) gastrointestinal tract and liver
(C) kidneys and lungs (D) liver and kidneys

- Q.10 Some endocrine glands produce hormones that stimulate functions of other endocrine glands. Which ONE of the following hormones specifically acts to increase secretion of other hormones?
- (A) Thyroxine (B) Prolactin (C) ACTH (D) ADH

Q. 11 – Q. 20 carry two marks each.

- Q.11 If the recombination frequency between X - Y loci is 12, X - Z loci is 4, and Y - Z loci is 8, then the order of the loci on the chromosome is
- (A) X-Y-Z (B) Y-X-Z (C) X-Z-Y (D) Z-Y-X
- Q.12 A cross is made between a white eyed-miniature winged female with a red eyed-normal winged male of *Drosophila melanogaster*. Further crossing of F1 female offspring from this cross with a white eyed-miniature winged male fly gave 95 white eyed-normal winged, 102 red eyed-miniature winged, 226 red eyed-normal winged and 202 white eyed-miniature winged offspring in F2 generation. What is the percent frequency of recombination between the two genes?
- (A) 20.11 (B) 31.52 (C) 49.10 (D) 34.12
- Q.13 A green fluorescent protein (GFP) encoding gene is fused to a gene encoding specific protein for expression in cells. What is the advantage of using GFP over staining cells with fluorescently labeled antibodies that bind to the target protein?
- (A) It bleaches less compared to fluorescent probes.
(B) It allows imaging at higher resolution than fluorescent probes.
(C) It provides more precise location of the protein than fluorescent probes.
(D) Its fusion allows tracking the location of the protein in living cells, while staining usually requires fixation of cells.
- Q.14 A newborn was accidentally given a drug that destroyed the thymus. Which ONE of the following would be the most likely outcome?
- (A) Lack of class I MHC molecules
(B) Inability to rearrange antigen receptors
(C) Inability to differentiate to mature T cells
(D) Reduction in T-independent number of B cells
- Q.15 One individual has a parasitic worm infection and another is responding to an allergen such as pollen. Which ONE of the following features is common to both of them?
- (A) Increase in cytotoxic T cell population
(B) Risk of developing an autoimmune disease
(C) Reduced innate immune response
(D) Increased levels of IgE

- Q.16 Five dialysis bags (DB1-DB5), impermeable to sucrose, were filled with various concentrations of sucrose. The bags were placed in separate beakers containing 0.6 M sucrose solution. Every 10 minutes, the bags were weighed and the percent change in mass of each bag was plotted as a function of time.



- Which plot in the graph (X-axis representing time in minutes and Y-axis representing mass change in percentage) represent(s) bags that contain a solution that is hypertonic at 50 minutes?
- (A) DB2 (B) DB4 (C) DB3 (D) DB4 and DB5
- Q.17 Which ONE of the following combinations of products will result, when 3 molecules of acetyl CoA is fed into TCA cycle?
- (A) 1 ATP, 2 CO₂, 3 NADH, and 1 FADH₂
 (B) 3 ATP, 6 CO₂, 9 NADH, and 3 FADH₂
 (C) 3 ATP, 3 CO₂, 3 NADH, and 3 FADH₂
 (D) 38 ATP, 6 CO₂, 3 NADH, and 12 FADH₂
- Q.18 A DNA fragment shown below has restriction sites I and II, which create fragments X, Y, and Z. Which ONE of the following agarose gel electrophoresis patterns represents the separation of these fragments?



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

- Q.19 Theoretically, it is possible to resurrect the extinct woolly mammoth by which ONE of the following methods?
- (A) Transferring cell nuclei from the frozen tissue into enucleated unfertilized eggs of a suitable mammal
 (B) Introducing sequenced mammoth genome into donor eggs of a suitable mammal
 (C) Transferring mammoth nuclear material into stem cells
 (D) Collection of oocytes from ovaries of the frozen mammoth for *in vitro* fertilization and transfer of fertilized eggs into animals such as elephants

- Q.20 Regions of higher abundance of cholesterol molecules on the plasma membrane will
- (A) be more fluid
 - (B) result in clogged arteries as it can detach from the plasma membrane
 - (C) be more rigid than the surrounding membrane
 - (D) have higher rates of lateral movement of proteins into and out of plasma membrane

END OF THE QUESTION PAPER

M : FOOD TECHNOLOGY**Q. 1 – Q. 10 carry one mark each.**

- Q.1 Which one of the following is NOT a source of caffeine?
(A) Coffee (B) Cocoa beans (C) Corn syrup (D) Tea leaves
- Q.2 Yoghurt is prepared using a pair of microorganisms. Choose the correct pair from the following:
(A) *Lactobacillus bulgaricus*, *Streptococcus thermophilus*
(B) *Lactobacillus lactis*, *Streptococcus thermophilus*
(C) *Lactobacillus bulgaricus*, *Streptococcus lactis*
(D) *Lactobacillus lactis*, *Streptococcus lactis*
- Q.3 Choose the target organism for milk pasteurization from the following:
(A) *Mycobacterium tuberculosis* (B) *Coxiella burnetii*
(C) *Clostridium botulinum* (D) *Bacillus cereus*
- Q.4 Hypobaric storage is also known as _____
(A) Modified atmospheric storage
(B) Controlled atmospheric storage
(C) Low pressure storage
(D) Modified aseptic package
- Q.5 In a solution of vegetable oil (molecular mass = 292 kg kmol⁻¹) and ethanol (molecular mass = 46 kg kmol⁻¹), the concentration of vegetable oil in the solution is measured to be 60% (total mass basis). Therefore, mole fraction of ethanol in the solution is _____.
- Q.6 An experiment started with 4 numbers of bacterial cells. After nth generation, number of cells becomes 128. Therefore, value of 'n' is _____.
- Q.7 One ton of refrigeration means one of the following options:
(A) Cooling provided by one kg of ice in one hour
(B) Cooling provided by one ton of ice in one hour
(C) Energy extracted to freeze one ton of water in one day
(D) Coefficient of performance is unity
- Q.8 Fruit juice is flowing in a circular pipe (inner diameter 2 cm) at a mass flow rate of 2 kg s⁻¹ and at a temperature of 25°C. The density and viscosity of the juice at 25°C are 1045 kg m⁻³ and 0.5 Pa s, respectively. Take $\pi = 22/7$. The Reynolds number for this flow will be _____.
- Q.9 Shear stress (τ , Pa) and shear rate ($\dot{\gamma}$, s⁻¹) relationship of a pseudoplastic fluid follows the Power law equation given by, $\tau = k\dot{\gamma}^n = 2.6 \dot{\gamma}^{0.45}$, where 'n' and 'k' are flow behavior index and consistency index respectively. The apparent viscosity (μ_a) of the fluid at a shear rate of 5 s⁻¹ is _____ Pa s.
- Q.10 In a sterilization process, D_{121.1} value of the target organism is 0.22 minute. Time required for 99.999% inactivation of the target organism at 121.1°C will be _____ minutes.

Q. 11 – Q. 20 carry two marks each.

Q.11 A centrifuge having diameter of 10 cm is rotating at 10000 rpm. Take $\pi = 22/7$ and $g = 9.81 \text{ m s}^{-2}$. The ratio of centrifugal force to gravitational force will be _____.

Q.12 Match the items under Group I with items under Group II

Group I

P. Threonine
Q. Pyridoxine phosphate
R. Xylose
S. Oleic acid

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

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

Group II

1. Fatty acid
2. Sugar
3. Amino acid
4. Co-enzyme

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

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

Q.13 Match the items under Group I with items under Group II

Group I

P. Iron
Q. Calcium
R. Zinc
S. Iodine

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

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

Group II

1. Osteoporosis
2. Anemia
3. Goiter
4. Dwarfism

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

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

Q.14 In a counter-current double pipe heat-exchanger, milk is cooled from 110 to 40°C using chilled water as coolant. Water enters at 5°C and leaves at 60°C. Heat flux for the system with overall heat transfer coefficient of $950 \text{ W m}^{-2} \text{ K}^{-1}$ will be _____ W m^{-2} .

Q.15 Saturated steam at 100°C is injected at 0.2 kg s^{-1} into air stream flowing at 3 kg s^{-1} and 25°C. Air contains 0.012 kg moisture per kg dry air. If the atmospheric pressure is 101.1 kPa, absolute humidity of air will be _____ kg kg^{-1} .

Q.16 In an evaporator, milk is concentrated from 9.8% TSS to 52% TSS. Assume the solutes in the milk are non-volatile. The amount of vapour produced for 100 kg feed will be _____ kg.

Q.17 Water enters a cylindrical tank at a steady uniform rate of $0.1 \text{ m}^3 \text{ s}^{-1}$; simultaneously water is discharged from the tank through an orifice (area 0.05 m^2) located at the bottom of the tank. Initial level of water in the tank from the bottom is 5 m. If the acceleration due to gravity = 9.81 m s^{-2} and coefficient of discharge = 0.30, the final value of the steady-state height of water level from the bottom of tank is _____ m.

Q.18 Match the following between Group I and Group II in relation to pretreatments.

Group I

- P. Ascorbic acid dip
- Q. Heat blanching
- R. Deaeration
- S. Rendering

Group II

- 1. Sogginess in fruits
- 2. Minimizes fruit oxidation
- 3. Melting of fat in meat
- 4. Removal of odours
- 5. Minimizes destruction of vitamin C

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

(B) P-2, Q-1, R-5, S-3

(C) P-1, Q-3, R-4, S-5

(D) P-3, Q-4, R-5, S-2

Q.19 A chocolate mix at 100°C is flowing through a 2 cm diameter and 4 m long stainless steel tube at 13.2 kg per minute. The density of the mix is 1750 kg m⁻³ and its viscosity at 100°C is 2 Pa s. Take $\pi = 22/7$. The pressure drop for this flow will be _____ Pa.

Q.20 In a tray dryer, 100 kg of a vegetable material in a suitably reduced form is dried to yield a final product of 75 kg. The dried sample of 5 g, when kept in an oven at 105°C for 24 hours results in 3.56 g of dry matter. The moisture content of the vegetable, before drying, in dry basis is _____%.

END OF THE QUESTION PAPER