General Aptitude (GA)

Q.1 – Q.5 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**Gauri said that she can play the keyboard _____ her sister.**
(A)	as well as
(B)	as better as
(C)	as nicest as
(D)	as worse as

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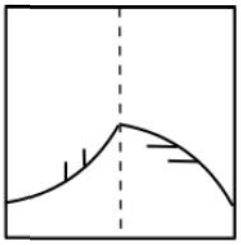
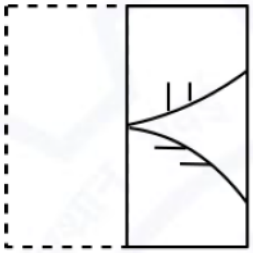
Q.2



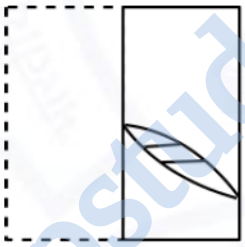
A transparent square sheet shown above is folded along the dotted line. The folded sheet will look like _____.

(A)



(B)

(C)



(D)

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Q.3	If θ is the angle, in degrees, between the longest diagonal of the cube and any one of the edges of the cube, then, cos θ =
(A)	$\frac{1}{2}$
(B)	$\frac{1}{\sqrt{3}}$
(C)	$\frac{1}{\sqrt{2}}$
(D)	$\frac{\sqrt{3}}{2}$

Q.4	If $\left(x-\frac{1}{2}\right)^2-\left(x-\frac{3}{2}\right)^2=x+2$, then the value of x is:
(A)	2
(B)	4
(C)	6
(D)	8

Q.5	Pen : Write :: Knife : _____ Which one of the following options maintains a similar logical relation in the above?
(A)	Vegetables
(B)	Sharp
(C)	Cut
(D)	Blunt

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Q. 6 – Q. 10 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

Q.6	**Listening to music during exercise improves exercise performance and reduces discomfort. Scientists researched whether listening to music while studying can help students learn better and the results were inconclusive. Students who needed external stimulation for studying fared worse while students who did not need any external stimulation benefited from music.** **Which one of the following statements is the CORRECT inference of the above passage?**
(A)	Listening to music has no effect on learning and a positive effect on physical exercise.
(B)	Listening to music has a clear positive effect both on physical exercise and on learning.
(C)	Listening to music has a clear positive effect on physical exercise. Music has a positive effect on learning only in some students.
(D)	Listening to music has a clear positive effect on learning in all students. Music has a positive effect only in some students who exercise.

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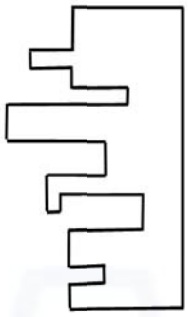
Q.7	 **A jigsaw puzzle has 2 pieces. One of the pieces is shown above. Which one of the given options for the missing piece when assembled will form a rectangle? The piece can be moved, rotated or flipped to assemble with the above piece.**
(A)	
(B)	
(C)	
(D)	

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Q.8	**The number of students in three classes is in the ratio 3:13:6. If 18 students are added to each class, the ratio changes to 15:35:21.** **The total number of students in all the three classes in the beginning was:**
(A)	22
(B)	66
(C)	88
(D)	110

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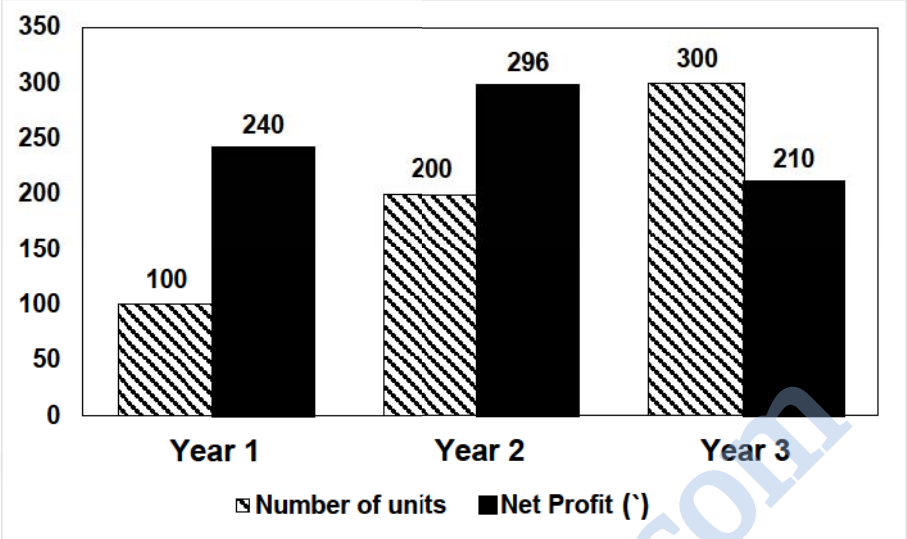
Q.9



The number of units of a product sold in three different years and the respective net profits are presented in the figure above. The cost/unit in Year 3 was ` 1, which was half the cost/unit in Year 2. The cost/unit in Year 3 was one-third of the cost/unit in Year 1. Taxes were paid on the selling price at 10%, 13% and 15% respectively for the three years. Net profit is calculated as the difference between the selling price and the sum of cost and taxes paid in that year.

The ratio of the selling price in Year 2 to the selling price in Year 3 is _____.

A)	4:3
(B)	1:1
(C)	3:4
(D)	1:2

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Q.10	**Six students P, Q, R, S, T and U, with distinct heights, compare their heights and make the following observations.** **Observation I: S is taller than R.** **Observation II: Q is the shortest of all.** **Observation III: U is taller than only one student.** **Observation IV: T is taller than S but is not the tallest.** **The number of students that are taller than R is the same as the number of students shorter than _____.**
(A)	T
(B)	R
(C)	S
(D)	P

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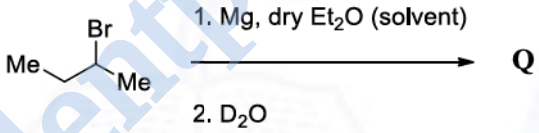
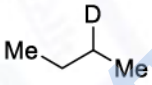
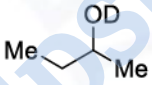
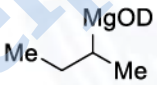
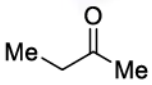
Chemistry (XL-P)

Q.1 – Q.2 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**The geometry of $Fe(CO)_5$ is** **(Given: Atomic number of Fe = 26)**
(A)	pentagonal planar
(B)	square pyramidal
(C)	trigonal bipyramidal
(D)	trigonal pyramidal

Q.2	**The structure of the major product Q of the following reaction is** 
(A)	
(B)	
(C)	
(D)	

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Q.3 – Q.5 Numerical Answer Type (NAT), carry ONE mark each (no negative marks).

Q. 3	**The time taken by a first order reaction to reach 90% completion is 20 s. The time taken for the reaction to reach 50% completion is _____ s (rounded off to the closest integer).**

Q. 4	**The ground state energy of an electron in a hydrogen atom is –13.60 eV. The energy of the electron in the third excited state is _____eV (rounded off to two decimal places).**

Q.5	**A solution of a compound shows an absorbance of 0.42 at 275 nm in a cuvette with 0.1 dm light path. The molar absorptivity of the compound is $\varepsilon_{275} = 8.4 \times 10^3\ M^{-1}\ cm^{-1}$. The concentration of the compound is _____ × 10^{-5} M (rounded off to the closest integer).**

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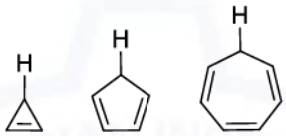
Q.6 – Q.9 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: – 2/3).

Q. 6	The CORRECT order of acidity of the following compounds is  I II III
(A)	**II > I > III**
(B)	**II > III > I**
(C)	**III > II > I**
(D)	**III > I > II**

Q. 7	The O–O bond order in O_2^{2-} species is
(A)	0.5
(B)	1.0
(C)	1.5
(D)	2.0

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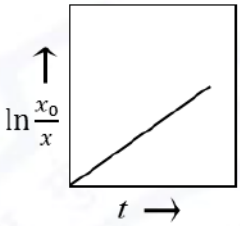
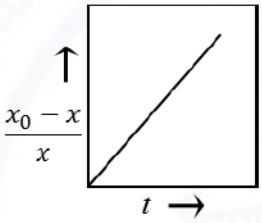
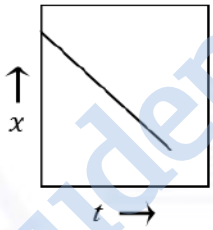
Q. 8 **For a reaction, X → Products**

Group I contains three plots of reactant concentrations as functions of time, where x = concentration of reactant X at time t; x_0 = concentration of reactant X at initial time, t = 0. Group II gives a list of different orders of reaction. Match the plots with the order of the reaction.

Group I	Group II
(P) 	(1) Zero order
(Q) 	(2) First order
(R) 	(3) Second order

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

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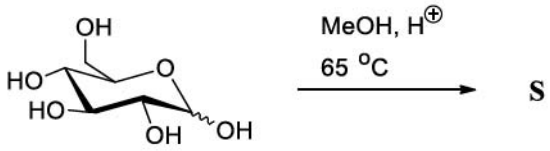
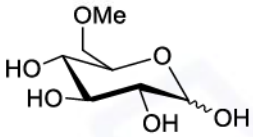
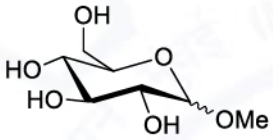
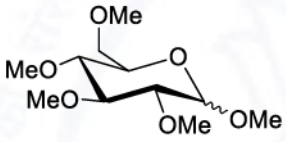
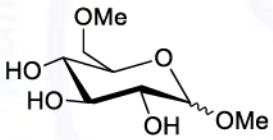
Q. 9	**The structure of the major product S of the following reaction is** 
(A)	
(B)	
(C)	
(D)	

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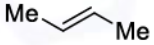
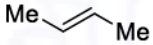
Q.10 – Q.11 Multiple Select Question (MSQ), carry TWO mark each (no negative marks).

Q. 10	**The CORRECT combination(s) of Y and T for the following elimination reaction is(are)** **T** (major)
(A)	Y = $\overset{\oplus}{N}Me_3$ and **T** = 
(B)	Y = $\overset{\oplus}{N}Me_3$ and **T** =
(C)	Y = Br and **T** =
(D)	Y = Br and **T** = 

Q. 11	**Among the following, the diamagnetic species is(are)** **(Given: Atomic numbers of Fe = 26, Co = 27, and Ni = 28)**
(A)	$[CoF_6]^{3-}$
(B)	$[Ni(H_2O)_6]^{2+}$
(C)	$[Fe(CN)_6]^{4-}$
(D)	$[Co(NH_3)_6]^{3+}$

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Q.12 – Q.15 Numerical Answer Type (NAT), carry TWO mark each (no negative marks).

Q. 12	**Given the following standard heats of formation, $\Delta_f H^{\ominus}(P, g) = 314.6$ kJ mol^{-1}, $\Delta_f H^{\ominus}(PH_3, g) = 5.4$ kJ mol^{-1}, and $\Delta_f H^{\ominus}(H, g) = 218.0$ kJ mol^{-1}, the average bond enthalpy of a P–H bond in PH_3(g) is _____ kJ mol^{-1} (rounded off to one decimal place).**

Q. 13	**The total number of possible geometrical isomer(s) for $[PtBrCl(NH_3)(py)]^0$ is _____.** **(Given: py = Pyridine and atomic number of Pt = 78)**

Q. 14	**Given the standard reduction potentials, $E^{\ominus}_{Mg^{2+}/Mg} = -2.37$ V and $E^{\ominus}_{Ag^{+}/Ag} = 0.80$ V, the potential of the following cell** $$Ag^{+}(aq., 1\ mM) + Mg(s) \rightleftharpoons Ag(s) + Mg^{2+}(aq., 0.2\ M)$$ **at 25 °C is_____ V (rounded off to two decimal places).** **(Given: Faraday constant = 96500 C mol^{-1}, Gas constant R = 8.314 J K^{-1}mol^{-1})**

Q. 15	**The freezing point of 80 g of acetic acid (freezing point constant 3.9 K kg mol^{-1}) was lowered by 7.8 K due to the addition of 20 g of a compound. The molar mass of the compound is _____ g mol^{-1} (rounded off to closest integer).**

END OF THE QUESTION PAPER

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Graduate Aptitude Test in Engineering (GATE 2021)

Paper / Section : Life Sciences (XL) / Chemistry (XL-P)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
1	6	MCQ	GA	A	1	1/3
2	6	MCQ	GA	B	1	1/3
3	6	MCQ	GA	B	1	1/3
4	6	MCQ	GA	B	1	1/3
5	6	MCQ	GA	C	1	1/3
6	6	MCQ	GA	C	2	2/3
7	6	MCQ	GA	A	2	2/3
8	6	MCQ	GA	C	2	2/3
9	6	MCQ	GA	A	2	2/3
10	6	MCQ	GA	C	2	2/3
1	6	MCQ	XL-P	C	1	1/3
2	6	MCQ	XL-P	A	1	1/3
3	6	NAT	XL-P	6 to 6	1	0
4	6	NAT	XL-P	-0.86 to -0.84	1	0
5	6	NAT	XL-P	5 to 5	1	0
6	6	MCQ	XL-P	B	2	2/3
7	6	MCQ	XL-P	B	2	2/3
8	6	MCQ	XL-P	C	2	2/3
9	6	MCQ	XL-P	B	2	2/3
10	6	MSQ	XL-P	B; D	2	0

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GATE 2021 Answer Key for Life Sciences (XL)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
11	6	MSQ	XL-P	C; D	2	0
12	6	NAT	XL-P	321.0 to 321.2	2	0
13	6	NAT	XL-P	3 to 3	2	0
14	6	NAT	XL-P	3.00 to 3.02	2	0
15	6	NAT	XL-P	125 to 125	2	0

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Biochemistry (XL-Q)

Q.1 – Q.10 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**Which one of the following molecules (~ 1mg/mL) do NOT absorb at 280 nm in an aqueous solution of pH 7.00 at room temperature?**
(A)	Poly deoxy-Guanylate (poly dG)
(B)	Adenosine triphosphate
(C)	Phenylalanine
(D)	Tyrosine

Q.2	**A molecule that forms a donor-acceptor energy transfer pair with the *dansyl* group is _____**
(A)	Aspartate
(B)	Histidine
(C)	Lysine
(D)	Tryptophan

Q.3	**The stationary phase used in gel filtration chromatography is composed of ____**
(A)	Blue dextran
(B)	Carboxymethyl (CM) cellulose
(C)	Diethylaminoethyl (DEAE) cellulose
(D)	Sepharose

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Q.4	**According to the "*wobble hypothesis*" inosine at the third position of the anticodon cannot form hydrogen bonds with _____**
(A)	Adenine
(B)	Cytidine
(C)	Guanine
(D)	Uracil

Q.5	**pKa value of the guanidinium group of Arginine is _____**
(A)	4.30
(B)	7.40
(C)	9.20
(D)	12.50

Q.6	**The non-coenzyme vitamin is _____**
(A)	Ascorbic acid
(B)	Folic acid
(C)	Nicotinic acid
(D)	Thiamine

Q.7	**Telomerase has a function similar to _____**
(A)	DNA dependent DNA polymerase
(B)	RNA polymerase
(C)	DNA gyrase
(D)	Reverse transcriptase

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Q. 8	**Which one of the following enzymes is used in Polymerase Chain Reaction ?**
(A)	*Klenow* fragment
(B)	*Taq* polymerase
(C)	*T7* polymerase
(D)	Primase

Q. 9	**In hepatocytes, the detoxification of drugs occurs in _____**
(A)	Golgi apparatus
(B)	Nucleolus
(C)	Rough endoplasmic reticulum
(D)	Smooth endoplasmic reticulum

Q.10	**Which one of the following antibiotics can form an ion channel in the bacterial membrane?**
(A)	Ampicillin
(B)	Gramicidin A
(C)	Gentamicin
(D)	Rifampicin

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Q.11 – Q.12 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: – 2/3).

Q.11	**Which one of the following cells lack hypoxanthine-guanine phosphoribosyltransferase (HGPRT)?**
(A)	B Cell
(B)	T Cell
(C)	Macrophage
(D)	Myeloma Cell

Q.12	**Which of the following lipids is non-ionic?**
(A)	Sphingomyelin
(B)	Galactocerebroside
(C)	Lecithin
(D)	Phosphatidyl inositol

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Q.13 – Q.20 Multiple Select Question (MSQ), carry TWO mark each (no negative marks).

Q.13	**Anti-B antibodies are present in the serum of _____**
(A)	Blood group A
(B)	Blood group B
(C)	Blood group AB
(D)	Blood group O

Q.14	**Which of the following are energy requiring processes?**
(A)	Facilitated diffusion
(B)	Active transport
(C)	Nonmediated transport
(D)	Na^+/K^+ transport

Q.15	**Which of the following are correctly paired?**
(A)	Replication: DnaA
(B)	Recombination: RecA
(C)	DNA repair: Rho factor
(D)	Transcription: Sigma factor

Q.16	**The high energy compound(s) is/are:**
(A)	Phosphoenol pyruvate
(B)	Adenosine monophosphate
(C)	1,3-Bisphosphoglycerate
(D)	Vitamin K

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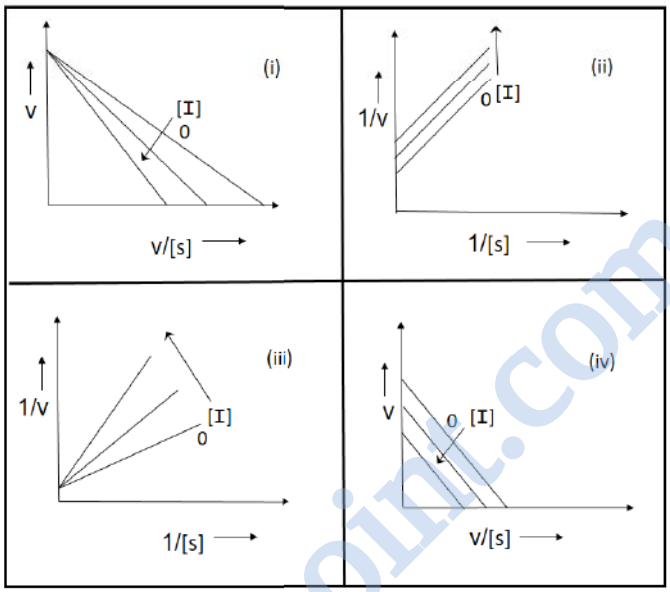
Q.17	**Given below are four plots obtained from separate experiments on enzyme inhibition kinetics. The velocity (v) of the reaction is plotted at varying concentrations of substrate (s) and inhibitor (I). The plot(s) corresponding to competitive inhibition is/are**



(A)	(i)
(B)	(ii)
(C)	(iii)
(D)	(iv)

Q.18	**With respect to sodium dodecyl sulphate - polyacrylamide gel electrophoresis (SDS-PAGE), which of these statement(s) is/are true?**
(A)	Ethidium bromide is used to track the progress of electrophoretic mobility
(B)	β-mercaptoethanol is used to reduce disulphide bonds
(C)	The protein migrates towards the anode
(D)	The lower molecular weight protein migrates slower than the larger molecular weight protein

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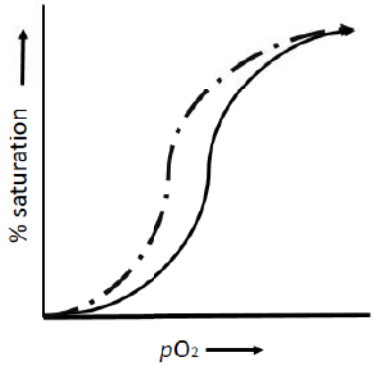
Q.19	**In the plot given below, the solid line represents oxygen binding to hemoglobin under physiological conditions. The broken line represents the condition(s) of** 
(A)	High CO_2 concentration
(B)	Increase in 2,3- Bisphosphoglycerate concentration
(C)	High pH
(D)	Loss of cooperativity

Q.20	**Considering the open chain forms, which of the following pair(s) represent/s an epimer?**
(A)	D-mannose and D-fructose
(B)	D-glucose and D-mannose
(C)	D-glucose and D-fructose
(D)	D-galactose and D-glucose

END OF THE QUESTION PAPER

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Graduate Aptitude Test in Engineering (GATE 2021)

Paper / Section : Life Sciences (XL) / Biochemistry (XL-Q)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
1	6	MCQ	XL-Q	C	1	1/3
2	6	MCQ	XL-Q	D	1	1/3
3	6	MCQ	XL-Q	D	1	1/3
4	6	MCQ	XL-Q	C	1	1/3
5	6	MCQ	XL-Q	D	1	1/3
6	6	MCQ	XL-Q	MTA	1	1/3
7	6	MCQ	XL-Q	D	1	1/3
8	6	MCQ	XL-Q	B	1	1/3
9	6	MCQ	XL-Q	D	1	1/3
10	6	MCQ	XL-Q	B	1	1/3
11	6	MCQ	XL-Q	D	2	2/3
12	6	MCQ	XL-Q	B	2	2/3
13	6	MSQ	XL-Q	A; D	2	0
14	6	MSQ	XL-Q	B; D	2	0
15	6	MSQ	XL-Q	A; B; D	2	0
16	6	MSQ	XL-Q	A; C	2	0
17	6	MSQ	XL-Q	A; C	2	0
18	6	MSQ	XL-Q	B; C	2	0
19	6	MSQ	XL-Q	C	2	0
20	6	MSQ	XL-Q	B; D	2	0

MTA means Marks to All

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Botany (XL-R)

Q.1 – Q.7 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**Wheat plants treated with prolonged cold temperature at the seedling stage flower earlier than the untreated control. Seeds collected from these treated individuals, however, give rise to plants that do not flower early. This phenomenon is called**
(A)	vernalization.
(B)	temperature acclimation.
(C)	photoperiodism.
(D)	adaptation.

Q.2	**Which ONE of the following plant taxa contains vascular tissue (xylem and phloem) but not woody tissue?**
(A)	Oak
(B)	Moss
(C)	Pine
(D)	Fern

Q.3	**Which ONE of the following statements regarding spores and gametes is CORRECT?**
(A)	Spores can directly undergo mitosis whereas gametes cannot.
(B)	Gametes can directly undergo mitosis whereas spores cannot.
(C)	Neither spores nor gametes can directly undergo mitosis.
(D)	Both spores and gametes can directly undergo mitosis.

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Q.4	Which ONE of the following organelles controls gravitropism in the roots of higher plants?
(A)	Chromoplast
(B)	Amyloplast
(C)	Chloroplast
(D)	Etioplast

Q.5	Phytoalexins play important role in plant defense against pathogens. Choose the INCORRECT option related to phytoalexins.
(A)	Phytoalexins belong to secondary metabolites.
(B)	Phytoalexins have antifungal activity.
(C)	Phytoalexins are abundant in plants under normal condition.
(D)	Different hosts produce phyallexins of varying chemical nature.

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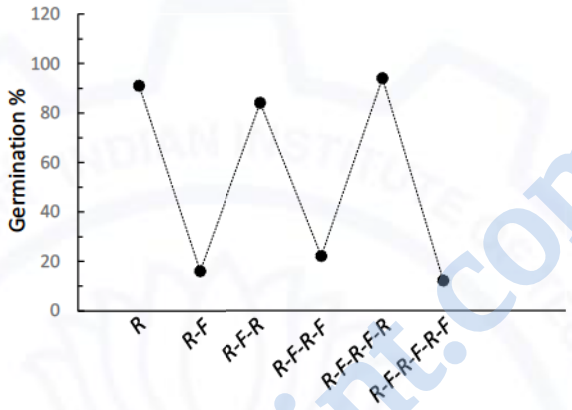
Q.6	**The figure shows the germination percentage of imbibed seeds treated with the given sequence of red (R) and far-red (F) light (each exposure lasting 5 min). The percentage of germination was scored after 72 hours in darkness at 25 °C. Based on this, which ONE of the following options is CORRECT?** 
(A)	Red light induces seed germination whereas far-red light inhibits it.
(B)	Red light inhibits seed germination whereas far-red light induces it.
(C)	Both red and far-red light inhibit seed germination.
(D)	Both red and far-red light induce seed germination.

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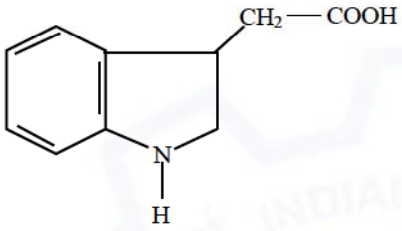
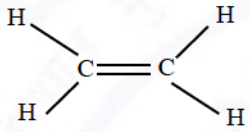
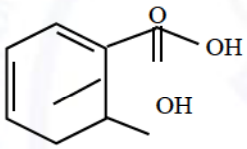
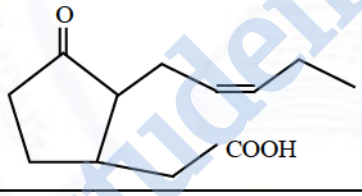
Q.7	**The structures of four plant hormones are shown. Identify the CORRECT hormone that is responsible for bending of coleoptile of canary grass in response to unidirectional white light.**
(A)	
(B)	
(C)	
(D)	

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Q.8 – Q.9 Multiple Select Question (MSQ), carry ONE mark each (no negative marks).

Q.8	**Which of the following cellular component(s) is/are NOT part(s) of cytoskeleton in Angiosperms?**
(A)	Microtubules
(B)	Microfilaments
(C)	Intermediate filaments
(D)	Centrioles

Q.9	**Which of the following enzyme(s), when overexpressed, would result in rice grains with increased β-carotene content?**
(A)	Phytoene synthase
(B)	Carotene desaturase
(C)	β-glucoronidase
(D)	Enolpyruvalshikimate-3-phosphate synthase (EPSPS)

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Q.10 Numerical Answer Type (NAT), carry ONE mark (no negative marks).

Q.10	**In spiral phyllotaxis, leaves are initiated sequentially on the meristem with two successive primordia being separated by golden angle. If a plant follows right-handed spiral phyllotaxis when looked down the meristem, then the angle between two successive leaves would be _____degrees (with correct sign, round off to one decimal place).**

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Q.11 – Q. 15 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

Q. 11	**Match the cell/tissue types in GROUP I with their corresponding total DNA content in GROUP II of a typical diploid Angiosperm species and choose the CORRECT option (C denotes DNA content in haploid genome).** GROUP I — GROUP II (P) Pollen tube — (1) 1C (Q) Megaspore mother cell — (2) 2C (R) Synergid — (3) 3C (S) Embryo sac prior to fertilization — (4) 4C (5) 8C
(A)	P-1, Q-2, R-3, S-5
(B)	P-2, Q-2, R-1, S-5
(C)	P-1, Q-2, R-1, S-5
(D)	P-2, Q-1, R-2, S-4

Q. 12	**Match the modified organs in GROUP I with their corresponding prototypic forms in GROUP II and choose the CORRECT option.** GROUP I — GROUP II P. Tendrils in grape vine — 1. Modified stem Q. Tendrils in garden pea — 2. Modified leaf R. Spines S. Thorns
(A)	P-1, Q-2, R-2, S-1
(B)	P-2, Q-1, R-1, S-2
(C)	P-1, Q-2, R-1, S-2
(D)	P-1, Q-1, R-2, S-1

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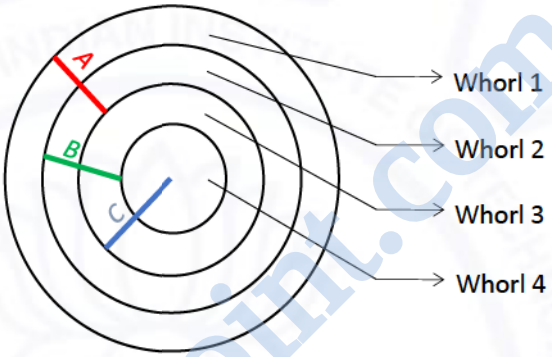
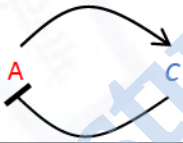
Q. 13 **The diagram describes the *ABC* model of flower patterning in Arabidopsis where the *A*, *B* and *C* functions are operational in the whorls (1+2), (2+3) and (3+4), respectively, in the wild-type flower. Removal of *A* or *C* function results in the floral organ arrangements as (carpel; stamen; stamen; carpel) or (sepal; petal; petal; sepal), respectively. Based on these observations, which ONE of the following molecular pathways is CORRECT for floral organ pattern generation? Arrow indicates activation and bar indicates inhibition.**



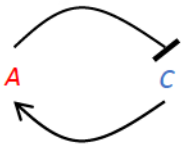
(A)

(B)



(C)

(D)



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Q. 14	**Find the CORRECT match among the plant species in GROUP I, the predominant phytochemical in GROUP II and the economic/medical use in GROUP III.**

GROUP I	GROUP II	GROUP III
P. *Syzygium aromaticum*	i. Vincristine	1. Toothache relief
Q. *Gracillaria sp.*	ii. Eugenol	2. Dessert jelly
R. *Catharanthus roseus*	iii. Agar	3. Leukaemia treatment
S. *Theobroma cacao*	iv. Morphine	4. Analgesic
T. *Papaver somniferum*	v. Flavonols	5. Beverage

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

Q. 15	**Match the genetically modified crop in GROUP I with the corresponding genetic element in GROUP II.**

GROUP I	GROUP II
P. Tomato with delayed fruit ripening	1. EPSP synthase
Q. Herbicide-resistant soybean	2. Δ12-Desaturase
R. Insect-resistant cotton	3. Polygalacturonase
S. Soybean with modified oil content	4. Bt-Cry protein

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

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Q.16 – Q.18 Multiple Select Question (MSQ), carry TWO mark each (no negative marks)

Q.16	**To understand the mechanism of systemic acquired resistance (SAR), a team of researchers isolated a mutant with reduced SAR response. Sequencing of this mutant revealed homozygous mutations in two genes, *X* and *Y*. Which of the following experiment(s) would test whether the mutant phenotype is caused by mutation in either or both the genes?**
(A)	Complement the mutant with *X* or *Y* and analyze the phenotype in each case.
(B)	Complement the mutant with both *X* and *Y* and analyze the phenotype.
(C)	Cross the mutant with wild-type and analyze the segregation pattern of the phenotype.
(D)	Compare the expression of *X* and *Y* in mutant and wild-type plants.

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Q.17 **The observations of an experiment on seed germination in various genotypes under different light conditions are given, where √ and X indicate germination and the lack of it, respectively.**

Genotype	Blue	Red	Far-red	White	Dark
Wild-type	√	√	√	√	X
cry1 mutant	X	√	√	√	X
phyA mutant	√	√	X	√	X
phyB mutant	√	X	√	√	X
vp1 mutant	√	√	√	√	√

Based on these observations, which of the following option(s) is/are CORRECT?

(A) All the three light qualities– blue, red and far-red – are required for seed germination.

(B) Any one of the three light qualities - blue, red and far-red – is sufficient to induce seed germination.

(C) The CRY1, phyA and phyB proteins are required for blue, red and far-red light perception, respectively.

(D) The VP1 protein is unlikely to be involved in light perception.

Q.18 **Which of the following option(s) is/are CORRECT in the context of hybrid plant generation using Barnase/Barstar-based male sterile lines?**

(A) Barnase inhibits Barstar.

(B) Barstar inhibits Barnase.

(C) Barnase and Barstar are used to generate the male sterile line and the restorer line, respectively.

(D) Barnase and Barstar are used to generate the restorer line and the male sterile line, respectively.

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Q.19 – Q.20 Numerical Answer Type (NAT), carry TWO mark each (no negative marks)

Q.19	**In a diploid plant species, the *T* allele produces tall individuals and is completely dominant over the *t* allele that produces short individuals. Similarly, the *W* allele produces round seeds and is completely dominant over the *w* allele that produces wrinkled seeds (assume *T* and *W* loci not linked). If a parent with *TTWW* genotype is crossed to another parent with *ttww* genotype, the fraction of the F_2 population produced by the fusion of both recombinant gametes would be _____. (Round-off to two decimal places.)**

Q.20	**In a population of a diploid plant species obeying Hardy-Weinberg equilibrium, a locus regulating flower color has two alleles *R* and *r*. Individuals with *RR*, *Rr* and *rr* genotypes produce red, pink and white flowers, respectively. If the ratio of red, pink and white flower-producing individuals in the population is 6:3:1, then the frequency of *r* allele in the population would be _____%.** **(Round-off to two decimal places.)**

END OF THE QUESTION PAPER

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Graduate Aptitude Test in Engineering (GATE 2021)

Paper / Section : Life Sciences (XL) / Botany (XL-R)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
1	6	MCQ	XL-R	A	1	1/3
2	6	MCQ	XL-R	D	1	1/3
3	6	MCQ	XL-R	A	1	1/3
4	6	MCQ	XL-R	B	1	1/3
5	6	MCQ	XL-R	C	1	1/3
6	6	MCQ	XL-R	A	1	1/3
7	6	MCQ	XL-R	A	1	1/3
8	6	MSQ	XL-R	C; D	1	0
9	6	MSQ	XL-R	A; B	1	0
10	6	NAT	XL-R	137.4 to 137.6 OR -137.6 to -137.4	1	0
11	6	MCQ	XL-R	B	2	2/3
12	6	MCQ	XL-R	A	2	2/3
13	6	MCQ	XL-R	C	2	2/3
14	6	MCQ	XL-R	B	2	2/3
15	6	MCQ	XL-R	A	2	2/3
16	6	MSQ	XL-R	A; B; C	2	0
17	6	MSQ	XL-R	B; D	2	0
18	6	MSQ	XL-R	B; C	2	0
19	6	NAT	XL-R	0.25 to 0.25	2	0

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GATE 2021 Answer Key for Life Sciences (XL)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
20	6	NAT	XL-R	25 to 25	2	0

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Microbiology (XL-S)

Q.1 – Q.5 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**Antonie van Leeuwenhoek observed several microscopic organisms under his hand-made microscope. He described them as**
(A)	Bacteria.
(B)	Fungi.
(C)	Animalcules.
(D)	Bacteriophages.

Q.2	**Which ONE of the following pathways oxidizes 1 mole of glucose to 2 moles of pyruvic acid along with one mole each of ATP, NADH and NADPH, in *Pseudomonas* spp., but not in *Bacillus* spp.?**
(A)	Gluconeogenesis
(B)	Embden-Meyerhoff Pathway (EMP)
(C)	Entner-Doudoroff (ED) Pathway
(D)	Pentose Phosphate Pathway (PPP)

Q.3	**Water balance in extreme halophiles such as *Halobacterium* is maintained by cell surface glycoproteins consisting of**
(A)	glycine and lysine.
(B)	lysine and histidine.
(C)	glycine.
(D)	aspartate and glutamate.

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Q.4	***Nocardia* spp. are not amenable to the classical method of Gram staining due to the presence of**
(A)	N-acetyltalosaminuronic acid in the cell wall.
(B)	thick peptidoglycan.
(C)	mycolic acid.
(D)	keto-deoxy-octulosonic acid.

Q.5	**Protists belonging to the genus *Trichonympha* thrive in the gut of termites. They help the termites use wood as a food source. This relationship is an example of**
(A)	parasitism.
(B)	competition.
(C)	commensalism.
(D)	mutualism.

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Q.6 – Q.9 Multiple Select Question (MSQ), carry ONE mark each (no negative marks).

Q.6	**Which of the following is/are used as electron donor/s for CO_2 reduction during photosynthesis in purple sulfur bacteria?**
(A)	Hydrogen sulfide
(B)	Thiosulfates
(C)	Methane
(D)	Sulfates

Q.7	**Which of the following catalyze(s) substrate-level phosphorylation?**
(A)	ATP synthase
(B)	Succinate thiokinase
(C)	Phosphofructokinase
(D)	Pyruvate kinase

Q.8	**Which of the following method(s) can be applied to identify a bacterial species?**
(A)	Fluorescent in situ hybridization (FISH)
(B)	Polymerase chain reaction (PCR) followed by sequencing of the amplicon
(C)	Gram staining
(D)	Acid-fast staining

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Q.9	**Which of the following event(s) would contribute to the induction of *lac* operon in a wild-type strain of *E. coli*?**
(A)	Accumulation of allolactose in the cell
(B)	Direct binding of cAMP to the promoter DNA
(C)	Binding of cAMP to a specific protein leading to its interaction with the promoter
(D)	Elimination of cAMP from the cell

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Q.10 Numerical Answer Type (NAT), carry ONE mark each (no negative marks).

Q.10	**One mole of a circular bacterial plasmid was digested with a high-fidelity restriction enzyme. The plasmid has five restriction sites for the enzyme used. The number of moles of fragments released upon cleavage at all sites is_____.**

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Q.11 – Q.16 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: – 2/3).

Q. 11	**Under anaerobic fermentative growth conditions, one mole of glucose yields 22 grams of *Streptococcus faecalis* or 8.6 grams of *Zymomonas mobilis.* The molar growth yield (Y_{ATP}) for (i) *S. faecalis* and (ii) *Z. mobilis* will be**
(A)	(i) 11 and (ii) 4.3
(B)	(i) 22 and (ii) 4.3
(C)	(i) 22 and (ii) 8.6
(D)	(i) 11 and (ii) 8.6

Q. 12	**The order of abundance of quinones (ubiquinone [UQ], menaquinone [MQ] and demethylmenaquinone [DMQ]) in *E. coli* growing anaerobically on fumarate is**
(A)	UQ > DMQ > MQ
(B)	MQ > DMQ >UQ
(C)	MQ = DMQ > UQ
(D)	MQ > UQ > DMQ

Q. 13	**What is the number of ATPs generated per molecule of NADH during oxidative phosphorylation in *E. coli* via (i) NDH-1 and cytochrome bo complex or (ii) the NDH-2 and cytochrome bd complex? (Assume H^+/ATP = 3)**
(A)	(i) 2.00 and (ii) 3.67
(B)	(i) 3.00 and (ii) 2.67
(C)	(i) 2.70 and (ii) 0.67
(D)	(i) 2.50 and (ii) 0.50

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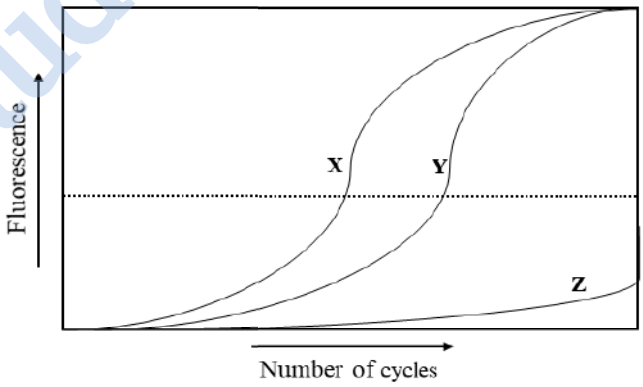
Q. 14	**Match the Immunoglobulin classes with their function** Immunoglobulin — Function (i) IgE — (p) protects the fetus (ii) IgG — (q) first antibody to be produced in response to infection (iii) IgM — (r) provides localized protection of mucosal surfaces (iv) IgA — (s) mediates allergic reaction (t) directly lyses the target cells
(A)	(i)- (s), (ii)-(p), (iii)-(q), (iv)-(r)
(B)	(i)- (p), (ii)-(t), (iii)-(q), (iv)-(r)
(C)	(i)- (q), (ii)-(p), (iii)-(t), (iv)-(r)
(D)	(i)- (r), (ii)-(p), (iii)-(t), (iv)-(s)

Q. 15	**The figure shows the profiles of quantitative real-time PCR (qRT-PCR) tests for SARS-CoV-2 conducted on the throat swab samples of three individuals (X, Y and Z). Tests were carried out under identical conditions. Dotted line represents the threshold fluorescent value. Identify the correct statement on the status of the COVID-19 tests of the individuals based on their qRT-PCR profiles.** 
(A)	X and Y are negative; Z is positive
(B)	X and Y are positive; There is no apparent difference in their viral load
(C)	X and Y are positive; X has the highest viral load
(D)	X and Y are positive; Y has the highest viral load

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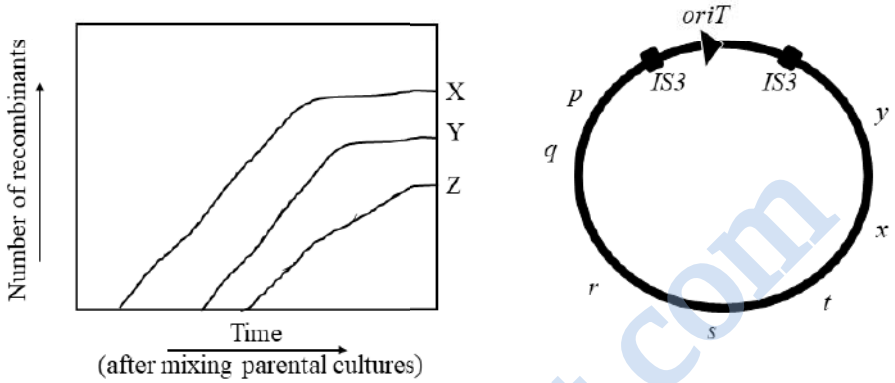
Q.16	**The rate of appearance of recombinant *E. coli* strains containing different genes after a mating between Hfr and F⁻ strains is shown in the graph (left). The approximate location of different genes (*p, q, r, s, t, x,* and *y*) along the Hfr chromosome is also shown (right). Based on this information, identify the recombinants X, Y and Z.** 
(A)	X is x^+, Y is r^+ and Z is p^+
(B)	X is p^+, Y is r^+ and Z is x^+
(C)	X is x^+, Y is p^+ and Z is r^+
(D)	X is p^+, Y is x^+ and Z is r^+

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Q.17 – Q.20 Numerical Answer Type (NAT), carry TWO mark each (no negative marks).

Q.17	**The genome of a bacterium encodes for 10 different surface antigens, whose expression can be turned 'ON' or 'OFF' randomly and independently. The number of possible antigenic combinations is_____.**

Q.18	**Suppose the mRNAs in a newly discovered bacteria are composed of only two distinct nucleotides (as opposed to four found in all known organisms). Considering that the organism has no nucleotide modification systems, the number of nucleotides required per codon to encode at least 20 distinct amino acids will be_____.**

Q. 19	**The decimal reduction time (*D*) for reducing 10^{12} spores of *Clostridium botulinum* to 1 spore at 111°C will be_____ min (in integer). The D value is 0.2 min at 121°C. The increase in temperature required to change *D* to $1/10^{th}$ of its initial value (*Z* value) is 10°C.**

Q. 20	**The generation time of *E. coli* is 30 minutes. For an exponentially growing culture, the initial number of bacteria required to reach a number of 10^9 in 2 hours is_____$\times 10^7$ (round off to two decimal places).**

END OF THE QUESTION PAPER

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Graduate Aptitude Test in Engineering (GATE 2021)

Paper / Section : Life Sciences (XL) / Microbiology (XL-S)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
1	6	MCQ	XL-S	C	1	1/3
2	6	MCQ	XL-S	C	1	1/3
3	6	MCQ	XL-S	D	1	1/3
4	6	MCQ	XL-S	C	1	1/3
5	6	MCQ	XL-S	D	1	1/3
6	6	MSQ	XL-S	A; B	1	0
7	6	MSQ	XL-S	B; D	1	0
8	6	MSQ	XL-S	A; B	1	0
9	6	MSQ	XL-S	A; C	1	0
10	6	NAT	XL-S	5 to 5	1	0
11	6	MCQ	XL-S	D	2	2/3
12	6	MCQ	XL-S	B	2	2/3
13	6	MCQ	XL-S	C	2	2/3
14	6	MCQ	XL-S	A	2	2/3
15	6	MCQ	XL-S	C	2	2/3
16	6	MCQ	XL-S	B	2	2/3
17	6	NAT	XL-S	1024 to 1024	2	0
18	6	NAT	XL-S	5 to 5	2	0
19	6	NAT	XL-S	24 to 24	2	0
20	6	NAT	XL-S	6.20 to 6.30	2	0

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Zoology (XL-T)

Q.1 – Q.7 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**Ichthyophis belongs to which of the following Class?**
(A)	Mammalia
(B)	Reptilia
(C)	Amphibia
(D)	Aves

Q.2	**The two homologous genes occurring in different species are called**
(A)	paralogous
(B)	orthologous
(C)	pseudologous
(D)	prologous

Q. 3	**The expression of holandric genes causes which of the following genetic trait in humans?**
(A)	Haemophilia
(B)	Sickle cell anaemia
(C)	Down's Syndrome
(D)	Hypertrichosis

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Q.4	Assume that the anticodon for an unknown amino acid is 3′ AUG 5′. The corresponding code on DNA sequence would be
(A)	3′ TAC 5′
(B)	5′ TAG 3′
(C)	3′ ATG 5′
(D)	5′ ATG 3′

Q. 5	The Organ of Corti is found in which of the following parts of human body?
(A)	Heart
(B)	Inner ear
(C)	Kidney
(D)	Nasal cavity

Q. 6	In adult athletes, muscles grow larger when exercised and are capable of regeneration after injury. This is due to proliferation and differentiation of
(A)	satellite cells
(B)	myelin sheath
(C)	oxyntic cells
(D)	choanocytes

Q. 7	The term innate behavior is a sort of animal behavior that is
(A)	triggered by an environmental change
(B)	learnt by hit-and-trial approach
(C)	trained and taught by the parent
(D)	fixed developmentally at the genetic level

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Q.8 – Q.10 Numerical Answer Type (NAT), carry ONE mark each (no negative marks).

Q.8	**A man, whose mother and father had blood groups A and O respectively, marries a woman with blood group AB. If the man has blood group A, then the number of different blood groups possible among their children will be _____ (*in integer*).**

Q. 9	**A population of snakes in an isolated island is in Hardy–Weinberg equilibrium for a gene with only two alleles (*A* and *a*). If the allelic frequency of *A* is 0.6, then the genetic frequency of *Aa* is _____ (*round off to 2 decimal places*).**

Q.10	**In the structure of a polypeptide, one α-helix (3.6_{13} helix) contains 32 intra-chain hydrogen bonds. The number of turns in the helix will be _____ (*in integer*).**

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Q.11 – Q. 16 Multiple Choice Question (MCQ), carry TWO marks each (for each wrong answer: – 2/3).

Q.11	**Match the terms in Column I with the specific descriptions in Column II** **Column I** — **Column II** P. Zygote — (i) A hollow sphere of cells Q. Morula — (ii) A newly born offspring R. Blastocyst — (iii) A cell that results from fertilization S. Ovum — (iv) An embryo T. Neonate — (v) An unfertilized egg U. Fetus — (vi) A compact mass of cells
(A)	P-(iii), Q-(vi), R-(i), S-(v), T-(ii), U-(iv)
(B)	P-(v), Q-(ii), R-(iii), S-(vi), T-(i), U-(iv)
(C)	P-(ii), Q-(iv), R-(vi), S-(v), T-(i), U-(iii)
(D)	P-(iii), Q-(vi), R-(ii), S-(v), T-(iv), U-(i)

Q. 12	**Match the autoimmune diseases in Column I for the self-antigens in Column II** **Column I** — **Column II** P. Rheumatoid arthritis — (i) Myelin Q. Systemic lupus erythematosus — (ii) Connective tissue R. Myasthenia gravis — (iii) DNA S. Multiple sclerosis — (iv) Acetylcholine receptors
(A)	P-(i), Q-(ii), R-(iii), S-(iv)
(B)	P-(ii), Q-(iii), R-(iv), S-(i)
(C)	P-(iii), Q-(i), R-(iv), S-(ii)
(D)	P-(iv), Q-(i), R-(ii), S-(iii)

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Q. 13 **Match the types of cell movements during gastrulation in Column I with the descriptions in Column II**

Column I	Column II
P. Invagination	(i) Migration of individual cells from the surface into the embryo's interior
Q. Involution	(ii) Infolding of a sheet (epithelium) of cells during the formation of endoderm in sea urchin
R. Ingression	(iii) Splitting of one cellular sheet into two nearly parallel sheets
S. Delamination	(iv) Inward movement of an expanding outer layer of cells so that it spreads over the internal surface of the remaining external cells

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

Q. 14 **Match the therapeutic factors in Column I with the applications in Column II**

Column I	Column II
P. Humulin	(i) Cancer therapy
Q. Erythropoietin	(ii) Diabetes
R. Plasminogen activator	(iii) Osteoporosis
S. Cathepsin K inhibitor	(iv) Anaemia
T. Leptin	(v) Myocardial infraction
	(vi) Obesity

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

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Q. 15	**Match the cell organelles in Column I with the appropriate functions in Column II**

Column I	**Column II**
P. Peroxisome	(i) Conversion of lipid to carbohydrate
Q. Endoplasmic reticulum	(ii) Oxidation of fatty acids
R. Glyoxysome	(iii) *N*-linked glycosylation
S. Golgi complex	(iv) Microtubule organization center
T. Centrioles	(v) *O*-linked glycosylation

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

Q. 16	**Cohesin and Condensin proteins of eukaryotes belong to which one of the following groups?**
(A)	Structural maintenance of chromosomes (SMC) proteins
(B)	Histones
(C)	DNA polymerases
(D)	Topoisomerases

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Q.17 – Q.18 Multiple Select Question (MSQ), carry TWO mark each (no negative marks).

Q. 17	**Which of the following options represent the animals as Endemic to India?**
(A)	Pygmy Hog
(B)	Mountain Bongo
(C)	Hirola
(D)	Purple Frog

Q. 18	**Which of the following amino acids contain more than one chiral center?**
(A)	Leucine
(B)	Isoleucine
(C)	Serine
(D)	Threonine

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Q.19 – Q.20 Numerical Answer Type (NAT), carry TWO mark each (no negative marks).

Q. 19	**An enzyme catalyzes the conversion of 30 µM of a substrate to product at reaction velocity of 9.0 µM s^{-1}. When $[E_t]$ = 30 nM and K_m = 10 µM, K_{cat} / K_m of enzyme will be $n \times 10^7$ M^{-1} s^{-1}. The value of n is _____ (*in integer*).**

Q. 20	**A cross is made between two animals of genotypes *AaBb* x *AaBb*, where loci *A* and loci *B* assort independently. The progeny of this dihybrid cross was then allowed to self-cross. The proportion of the progeny that showed segregation for loci *A* (i.e., produce *A-* and *aa* progeny) in % will be _____ (*in integer*).**

END OF THE QUESTION PAPER

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Graduate Aptitude Test in Engineering (GATE 2021)

Paper / Section : Life Sciences (XL) / Zoology (XL-T)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
1	6	MCQ	XL-T	C	1	1/3
2	6	MCQ	XL-T	B	1	1/3
3	6	MCQ	XL-T	D	1	1/3
4	6	MCQ	XL-T	C	1	1/3
5	6	MCQ	XL-T	B	1	1/3
6	6	MCQ	XL-T	A	1	1/3
7	6	MCQ	XL-T	D	1	1/3
8	6	NAT	XL-T	3 to 3	1	0
9	6	NAT	XL-T	0.48 to 0.48	1	0
10	6	NAT	XL-T	10 to 10	1	0
11	6	MCQ	XL-T	A	2	2/3
12	6	MCQ	XL-T	B	2	2/3
13	6	MCQ	XL-T	C	2	2/3
14	6	MCQ	XL-T	A	2	2/3
15	6	MCQ	XL-T	D	2	2/3
16	6	MCQ	XL-T	A	2	2/3
17	6	MSQ	XL-T	A; D	2	0
18	6	MSQ	XL-T	B; D	2	0
19	6	NAT	XL-T	4 to 4	2	0
20	6	NAT	XL-T	50 to 50	2	0

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Food Technology XL (U)

Q.1 – Q.10 Multiple Choice Question (MCQ), carry ONE mark each (for each wrong answer: – 1/3).

Q.1	**In a typical bacterial growth curve, the first order kinetics for growth rate is observed in**
(A)	Lag phase
(B)	Log phase
(C)	Stationary phase
(D)	Decline phase

Q.2	**Which of the following microorganisms is NOT a causative agent for food borne diseases?**
(A)	*Campylobacter jejuni*
(B)	*Clostridium perfingens*
(C)	Norovirus
(D)	*Borrelia burgdorferi*

Q.3	**Which one of the followings is NOT a fermented food product?**
(A)	Tofu
(B)	Vinegar
(C)	Sauerkraut
(D)	Tempeh

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Q.4	The Protein Efficiency Ratio (PER) is defined as
(A)	Percentage of absorbed nitrogen retained in the body
(B)	Weight gain in body mass (in gram) per gram protein intake
(C)	Ratio of essential and non-essential amino acids in a protein
(D)	Percent *in vitro* digestibility of a protein

Q.5	Which one of the following enzymes sequentially releases maltose from starch?
(A)	α–Amylase
(B)	β– Amylase
(C)	Glucoamylase
(D)	Pullulanase

Q.6	Highest mole % of amino acid mixture present in glutenin of wheat gluten are
(A)	Glutamine and glutamic acid
(B)	Serine and lysine
(C)	Alanine and tryptophan
(D)	Proline and glycine

Q.7	Which one of the following compounds is present in soybean and acts as phytoesterogen?
(A)	Tangeretin
(B)	Lutin
(C)	Quercetin
(D)	Genistein

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Q.8	Which one of the followings is an oligosaccharide?
(A)	Xanthan
(B)	Alginate
(C)	Raffinose
(D)	Gellan

Q.9	Bittering agent in grape fruit formed after juice extraction under acidic conditions is
(A)	Quinine
(B)	Theobromine
(C)	Isohumulone
(D)	Limonin

Q.10	Difference between adsorption and desorption isotherms is known as
(A)	Hysteresis
(B)	Dryness
(C)	Evaporation
(D)	Dehydration

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Q.11 – Q.13 Multiple Choice Question (MCQ), carry TWO mark each (for each wrong answer: – 2/3).

Q.11	**The conversion of pyruvate to lactic acid in homolactic fermentation is catalyzed by**
(A)	Lactate dehydrogenase
(B)	Pyruvate dehydrogenase
(C)	Lactase
(D)	Pyruvate decarboxylase

Q.12	**Which one of the following statements is <u>INCORRECT</u> with respect to Controlled Atmosphere Package (CAP) and Modified Atmosphere Package (MAP) of agro- produce?**
(A)	CAP and MAP limit microbial as well as biochemical activities.
(B)	Gas composition inside a MAP during the storage is continuously monitored and regulated.
(C)	CAP implies a greater degree of precision than MAP in maintaining specific levels of the gas composition.
(D)	Modification of the atmosphere inside a MAP is achieved by natural interplay between respiration of products and permeation of gases through the packaging film.

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Q.13	**Match unit operation in Column I with its application in food processing in Column II.**	
	Column I	**Column II**
	P. Hydrogenation	1. Removal of soft wax
	Q. Blanching	2. Shortening of fat
	R. Leaching	3. Inactivation of enzyme
	S. Winterization	4. Separation of dye
(A)	P-2, Q-4, R-2, S-I	
(B)	P-2, Q-3, R-4, S-1	
(C)	P-4, Q-1, R-2, S-3	
(D)	P-4, Q-2, R-1, S-3	

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Q.14 – Q.19 Multiple Select Question (MSQ), carry TWO mark each (no negative marks).

Q.14	**Which of the followings are correct pair of GRAS chemical food preservative, affected organism and given food matrix?**
(A)	Sodium lactate-Bacteria-Pre-cooked meat
(B)	Caprylic acid-Insects-Cheese wraps
(C)	Dehydroacetic acid-Molds-Squash
(D)	Sodium nitrite-Clostridia-Meat curing preparations

Q.15	**Choose the correct pair of pigment and their corresponding color in plant products**
(A)	Carotene-Yellow-orange-Peppers
(B)	Betanin-Purple/red-Cactus pear
(C)	Lycopene-Red-Red beets
(D)	Flavanols-Orange-red-Cauliflowers

Q.16	**Which of the following compounds act as anti-nutritional factors?**
(A)	Phytate
(B)	Isoflavones
(C)	Trypsin Inhibitor
(D)	Resveratrol

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Q.17	**Which of the followings is/are commonly used medium/media in the supercritical fluid extraction of spices and tea?**
(A)	Water
(B)	Carbon dioxide
(C)	Dichloromethane
(D)	Carbon dioxide with Ethanol

Q.18	**Which of the following expressions represent the Reynolds number of a fluid flowing through a uniform circular cross section pipe?**
(A)	$\frac{\text{(density of the fluid)} \times \text{(average velocity of the fluid)} \times \text{(internal diamater of the pipe)}}{\text{(dynamic viscosity of the fluid)}}$
(B)	$\frac{\text{(average velocity of the fluid)} \times \text{(internal diamater of the pipe)}}{\text{(kinematic viscosity of the fluid)}}$
(C)	$\frac{\text{(dynamic viscosity of the fluid)}}{\text{(average velocity of the fluid)} \times \text{(density of the fluid)} \times \text{(internal diamater of the pipe)}}$
(D)	$\frac{\text{(kinematic viscosity of the fluid)}}{\text{(average velocity of the fluid)} \times \text{(internal diamater of the pipe)}}$

Q. 19	**Which of the following combinations of analytical equipment, property measured and food property are correct?**
(A)	Particle size analyzer - particle size distribution - span value
(B)	Texture profile analyzer - morphology - chewiness
(C)	Differential scanning calorimeter - glass transition temperature - degree of caking
(D)	Capillary viscometer - viscosity - sensory

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Q.20 Numerical Answer Type (NAT), carry TWO mark (no negative marks).

Q.20	**Dry air is fed into a tray dryer. The percentage relative humidity of the air leaving the dryer is 60% at 70°C and 101.35 kPa. If, saturated vapour pressure of water at 70°C is 31.2 kPa, the humidity of the air leaving the dryer in kg water per kg dry air (*round off to 3 decimal places*) will be _____.** **(Given : Molecular weight of water and air are 18.02 g mol^{-1} and 28.97 g mol^{-1} respectively)**

END OF THE QUESTION PAPER

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Graduate Aptitude Test in Engineering (GATE 2021)

Paper / Section : Life Sciences (XL) / Food Technology (XL-U)

Q. No.	Session	Question Type MCQ/MSQ/NAT	Section Name	Answer Key/Range	Marks	Negative Marks
1	6	MCQ	XL-U	B	1	1/3
2	6	MCQ	XL-U	D	1	1/3
3	6	MCQ	XL-U	A	1	1/3
4	6	MCQ	XL-U	B	1	1/3
5	6	MCQ	XL-U	B	1	1/3
6	6	MCQ	XL-U	A	1	1/3
7	6	MCQ	XL-U	D	1	1/3
8	6	MCQ	XL-U	C	1	1/3
9	6	MCQ	XL-U	D	1	1/3
10	6	MCQ	XL-U	A	1	1/3
11	6	MCQ	XL-U	A	2	2/3
12	6	MCQ	XL-U	B	2	2/3
13	6	MCQ	XL-U	B	2	2/3
14	6	MSQ	XL-U	A; D	2	0
15	6	MSQ	XL-U	A; B	2	0
16	6	MSQ	XL-U	A; C	2	0
17	6	MSQ	XL-U	A; B; D	2	0
18	6	MSQ	XL-U	A; B	2	0
19	6	MSQ	XL-U	A; C	2	0
20	6	NAT	XL-U	0.135 to 0.150	2	0

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