

GATE 2024

Life Sciences

Question Papers

General Aptitude (GA)

Q.1 – Q.5 Carry ONE mark Each

Q.1 If '→' denotes increasing order of intensity, then the meaning of the words [walk → jog → sprint] is analogous to [bothered → _____ → daunted]. Which one of the given options is appropriate to fill the blank?

- (A) phased
- (B) phrased
- (C) fazed
- (D) fused

Q.2 Two wizards try to create a spell using all the four elements, *water*, *air*, *fire*, and *earth*. For this, they decide to mix all these elements in all possible orders. They also decide to work independently. After trying all possible combination of elements, they conclude that the spell does not work. How many attempts does each wizard make before coming to this conclusion, independently?

- (A) 24
- (B) 48
- (C) 16
- (D) 12

- Q.3 In an engineering college of 10,000 students, 1,500 like neither their core branches nor other branches. The number of students who like their core branches is $\frac{1}{4}$ th of the number of students who like other branches. The number of students who like both their core and other branches is 500.

The number of students who like their core branches is

- (A) 1,800
(B) 3,500
(C) 1,600
(D) 1,500

- Q.4 For positive non-zero real variables x and y , if

$$\ln\left(\frac{x+y}{2}\right) = \frac{1}{2}[\ln(x) + \ln(y)]$$

then, the value of $\frac{x}{y} + \frac{y}{x}$ is

- (A) 1
(B) $\frac{1}{2}$
(C) 2
(D) 4

Q.5 In the sequence 6, 9, 14, x , 30, 41, a possible value of x is

(A) 25

(B) 21

(C) 18

(D) 20



Q.6 – Q.10 Carry TWO marks Each

Q.6 Sequence the following sentences in a coherent passage.

P: This fortuitous geological event generated a colossal amount of energy and heat that resulted in the rocks rising to an average height of 4 km across the contact zone.

Q: Thus, the geophysicists tend to think of the Himalayas as an active geological event rather than as a static geological feature.

R: The natural process of the cooling of this massive edifice absorbed large quantities of atmospheric carbon dioxide, altering the earth's atmosphere and making it better suited for life.

S: Many millennia ago, a breakaway chunk of bedrock from the Antarctic Plate collided with the massive Eurasian Plate.

(A) QPSR

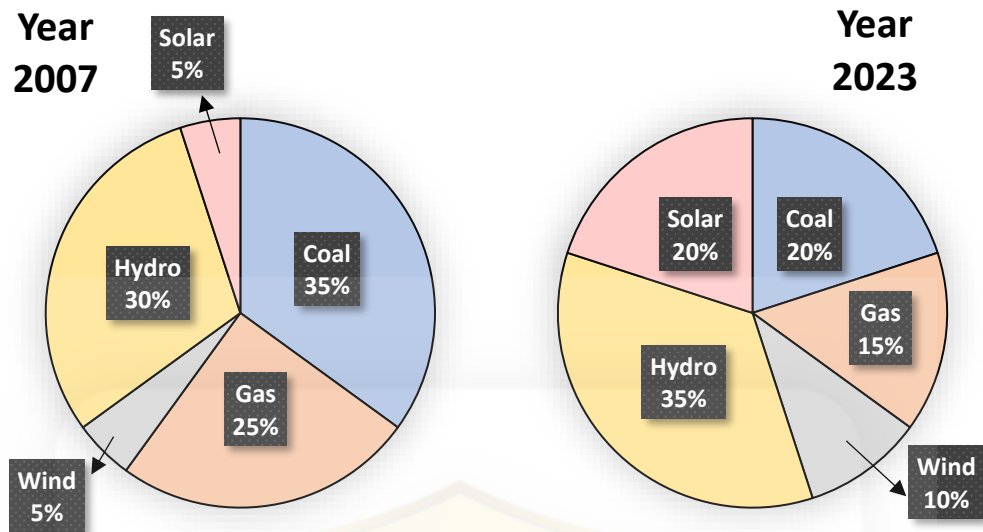
(B) QSPR

(C) SPRQ

(D) SRPQ

- Q.7 A person sold two different items at the same price. He made 10% profit in one item, and 10% loss in the other item. In selling these two items, the person made a total of
- (A) 1% profit
 - (B) 2% profit
 - (C) 1% loss
 - (D) 2% loss

Q.8 The pie charts depict the shares of various power generation technologies in the total electricity generation of a country for the years 2007 and 2023.



The renewable sources of electricity generation consist of Hydro, Solar and Wind. Assuming that the total electricity generated remains the same from 2007 to 2023, what is the percentage increase in the share of the renewable sources of electricity generation over this period?

- (A) 25%
- (B) 50%
- (C) 77.5%
- (D) 62.5%

Q.9 A cube is to be cut into 8 pieces of equal size and shape. Here, each cut should be straight and it should not stop till it reaches the other end of the cube.

The minimum number of such cuts required is

- (A) 3
- (B) 4
- (C) 7
- (D) 8

- Q.10 In the 4×4 array shown below, each cell of the first three rows has either a cross (X) or a number.

1	X	4	3
X	5	5	4
3	X	6	X

The number in a cell represents the count of the immediate neighboring cells (left, right, top, bottom, diagonals) NOT having a cross (X). Given that the last row has no crosses (X), the sum of the four numbers to be filled in the last row is

- (A) 11
(B) 10
(C) 12
(D) 9

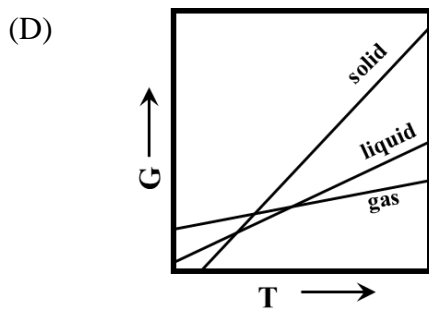
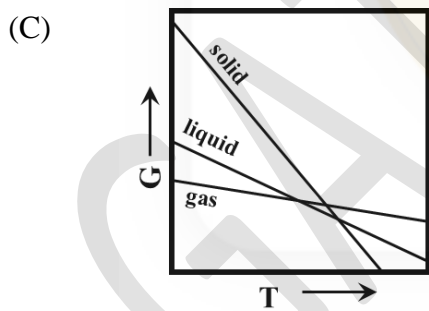
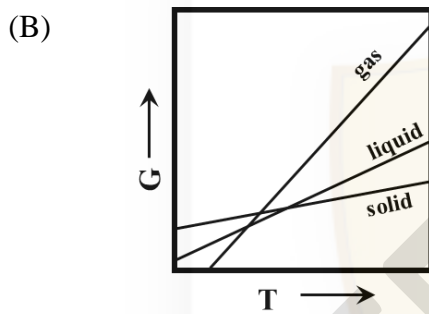
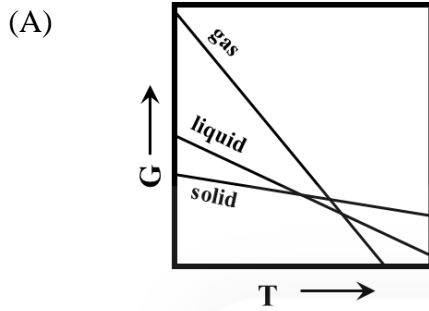
Chemistry (XL - P) - (Compulsory)

Q.11 – Q.19 Carry ONE mark Each

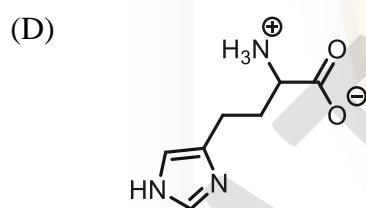
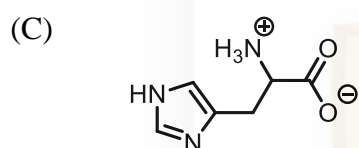
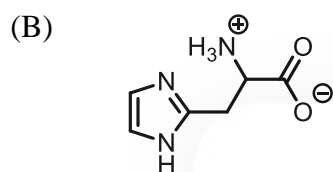
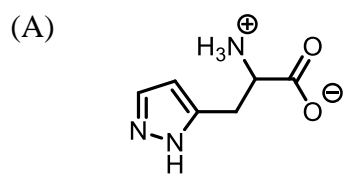
Q.11 The CORRECT order of electronegativity is

- (A) $\text{Al} > \text{Si} > \text{P} > \text{S}$
- (B) $\text{Al} > \text{S} > \text{Si} > \text{P}$
- (C) $\text{S} > \text{Si} > \text{Al} > \text{P}$
- (D) $\text{S} > \text{P} > \text{Si} > \text{Al}$

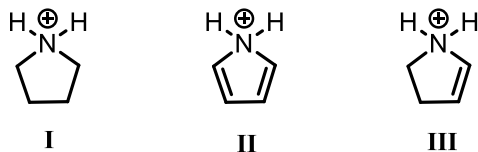
Q.12 Which one of the following is the CORRECT representation of the variation of the Gibbs free energy (G) of a substance with temperature (T) at constant pressure?



Q.13 Among the following, the structure representing histidine is

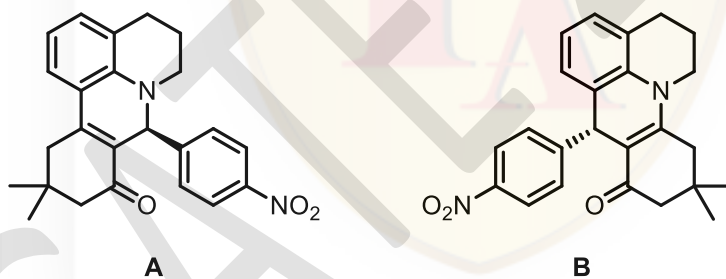


Q.14 The CORRECT order of acidity of the following compounds is



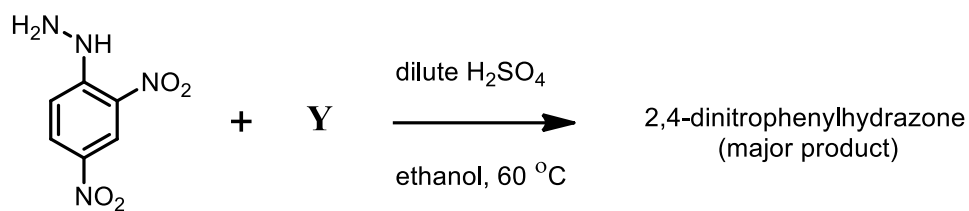
- (A) **I > II > III**
- (B) **II > III > I**
- (C) **I > III > II**
- (D) **III > II > I**

Q.15 The molecules **A** and **B** are a pair of _____.

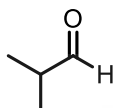


- (A) enantiomers
- (B) diastereomers
- (C) conformational isomers
- (D) constitutional isomers

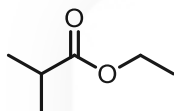
Q.16 The CORRECT option(s) of **Y** for the following reaction is/are



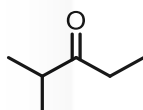
(A)



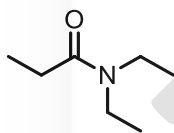
(B)



(C)



(D)



Q.17 The maximum number of electrons that can be accommodated in the shell with $n = 2$ is _____ (*in integer*).

(Given: n = principal quantum number)

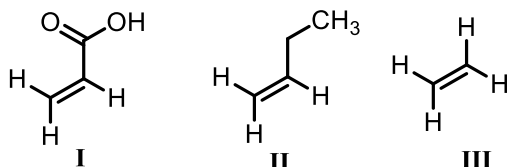
Q.18 One mole of an ideal gas expands isothermally and reversibly to double its volume. If the expansion work done by the system is 1728.85 J, the temperature of the system is _____ K (*rounded off to 2 decimal places*).

(Given: Gas constant, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$)

Q.19 The initial rate of a reaction triples when the concentration of a reactant, **A**, is doubled. The order of the reaction with respect to **A** is _____ (*rounded off to 2 decimal places*).

Q.20 – Q.27 Carry TWO marks Each

Q.20 Each of the following alkenes undergoes addition reaction with bromine. Under the same reaction conditions, the CORRECT trend in the reaction rates is



(A) I > II > III

(B) II > III > I

(C) I > III > II

(D) III > II > I

Q.21 An enzyme-catalyzed conversion of a substrate at 298 K proceeds by a Michaelis-Menten mechanism. The Lineweaver-Burk plot for the analysis of the experimental data has an intercept along the y-axis of $0.357 \text{ mmol}^{-1} \text{ dm}^3 \text{ s}$ and a slope of 2.10 s . The CORRECT Michaelis constant for the reaction is _____ (rounded off to 2 decimal places).

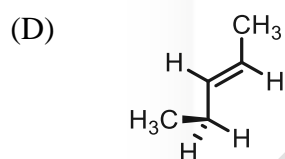
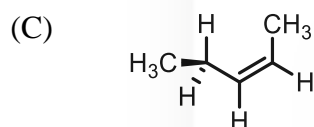
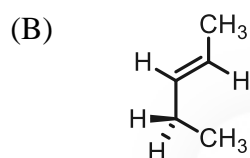
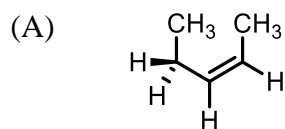
(A) $5.88 \text{ mmol dm}^{-3}$

(B) $5.88 \text{ mmol dm}^{-3} \text{ s}^{-1}$

(C) $2.80 \text{ mmol dm}^{-3}$

(D) $2.80 \text{ mmol dm}^{-3} \text{ s}^{-1}$

Q.22 Which one among the following structures is the most stable conformer of (Z)-pent-2-ene?



Q.23 Upon addition of compound **X** to an aqueous AgNO_3 solution, a white precipitate appears instantly. Also, **X** does not exhibit geometrical isomerism.

The CORRECT option(s) for **X** is/are

- (A) $[\text{Cr}(\text{OH}_2)_4\text{Cl}_2]\text{Cl}$
- (B) $[\text{Cr}(\text{OH}_2)_5\text{Cl}]\text{Cl}_2$
- (C) $[\text{Cr}(\text{OH}_2)_6]\text{Cl}_3$
- (D) $[\text{Cr}(\text{OH}_2)_3\text{Cl}_3]$

Q.24 The paramagnetic species among the following is/are
(Given: Atomic numbers of Cr = 24; Fe = 26; Ni = 28)

- (A) $[\text{Fe}(\text{CN})_6]^{3-}$
- (B) $[\text{Ni}(\text{OH}_2)_6]^{2+}$
- (C) $[\text{Ni}(\text{CN})_4]^{2-}$
- (D) $[\text{Cr}(\text{CN})_6]^{3-}$

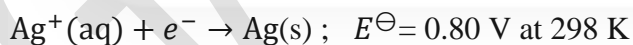
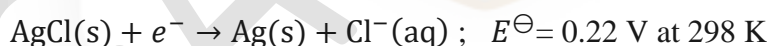
Q.25 The molecule(s) with non-zero dipole moment is/are

- (A) N₂
- (B) CO₂
- (C) NO
- (D) SO₂

Q.26 The ionic product of water at 40 °C is $2.92 \times 10^{-14} \text{ M}^2$. The pH of water at 40 °C is _____ (rounded off to 2 decimal places).

Q.27 Given the standard reduction potentials (E^\ominus) for the half-cell reactions below, the standard Gibbs free energy of the dissolution of silver chloride in water, at 298 K, is _____ J mol⁻¹ (rounded off to nearest integer).

(Given: Faraday constant, $F = 96500 \text{ C mol}^{-1}$; $J = C \times V$)



Biochemistry (XL-Q)

Q.28 – Q.35 Carry ONE mark Each

- Q.28 Which one of the following pairs of amino acids is NOT incorporated in a polypeptide chain?
- (A) 4-Hydroxyproline and γ -carboxyglutamate
 - (B) γ -Carboxyglutamate and desmosine
 - (C) Ornithine and citrulline
 - (D) 4-Hydroxyproline and 5-hydroxylysine
- Q.29 Mammalian cells cultured at low temperature (25 to 30 °C) leads to an increased sterol content in the membrane. Elevated sterols in the membrane results in
- (A) an enhancement in membrane fluidity.
 - (B) stabilization of membrane proteins.
 - (C) an increase in membrane permeability to water.
 - (D) a decrease in membrane fluidity.

Q.30 Which one of the following metabolic intermediates is common to glycolysis, nucleotide synthesis and glycogen synthesis?

- (A) Citrate
- (B) Oxaloacetate
- (C) Glucose 6-phosphate
- (D) Glycerol 3-phosphate

Q.31 In mammals, hematopoietic stem cells that give rise to different types of blood cells are known as

- (A) totipotent stem cells.
- (B) pluripotent stem cells.
- (C) myeloid progenitor cells.
- (D) lymphoid progenitor cells.

Q.32 Which one or more of the following statements correctly describe(s) the addition of N-nucleotides during the rearrangement of the immunoglobulin heavy chain-encoding gene?

- (A) Addition of N-nucleotides is template encoded.
- (B) N-nucleotides are added by terminal deoxynucleotidyl transferase.
- (C) The added N-nucleotides are common in V-D and D-J junction.
- (D) N-nucleotides are added by the DNA polymerase II.

Q.33 A newly identified viral protein contains one long α -helix spanning 60 amino acid residues. The number of main chain H-bonds formed in this helix is _____.
(Answer in integer)

Q.34 In a lactic acid solution at pH 4.8, the concentrations of lactic acid and lactate are 0.01 M and 0.087 M, respectively. The calculated pKa of lactic acid is _____.
(Round off to one decimal place)

Q.35 If a 10 mM solution of a biomolecule in a cuvette of path length 10 mm absorbs 90% of the incident light at 280 nm, the molar extinction coefficient of the biomolecule at this wavelength is _____ $M^{-1}cm^{-1}$.
(Round off to two decimal places)

Q.36 – Q.46 Carry TWO marks Each

- Q.36 Metabolic intermediates provide the backbone for the synthesis of amino acids. Match the metabolic intermediates listed in **Column I** with their corresponding amino acids given in **Column II**.

Column I	Column II
P. α -Ketoglutarate	i. Histidine
Q. Ribose 5-phosphate	ii. Glutamate
R. 3-Phosphoglycerate	iii. Aspartate
S. Phosphoenolpyruvate	iv. Phenylalanine
	v. Serine

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

Q.37 Which one of the following is the correct match between the molecular properties listed in **Column I** and the corresponding biochemical separation methods in **Column II**?

Column I	Column II
P. Solubility	i. Reverse phase chromatography
Q. Ionic charge	ii. Ultracentrifugation
R. Polarity	iii. Salting out
S. Molecular size	iv. Isoelectric focusing
	v. Gel electrophoresis

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

Q.38 Which one or more of the following statements is/are correct regarding the electromotive force generated by electron transfer chain?

- (A) It is used for the synthesis of ATP.
- (B) It is not used for active transport process.
- (C) It includes a pH gradient component.
- (D) It does not include an electrical potential gradient component.

Q.39 Which one or more of the following statements is/are correct regarding the transport and retention of proteins in different cell organelles?

- (A) Mannose 6-phosphate residues are involved in targeting proteins to lysosomes.
- (B) Transport of proteins into the mitochondrial compartment is aided by positively charged amino acid residues at the N-terminus and internal hydrophobic segments.
- (C) The retention of protein in the ER lumen requires the KDEL sequence motif at the C-terminus.
- (D) Nuclear proteins are transported in an unfolded conformation and the nuclear localization signal sequence is subsequently cleaved by peptidases in the nucleoplasm.

Q.40 Which one or more of the following statements correctly describe(s) fluorescence spectroscopy?

- (A) The emission maxima (λ_{\max}) is independent of the excitation wavelength.
- (B) The emission maxima (λ_{\max}) depends on the concentration of a quencher.
- (C) The emission maxima (λ_{\max}) varies with solvent polarity.
- (D) The emission maxima (λ_{\max}) varies with temperature.

Q.41 Which one or more of the following statements is/are correct in the processing of pre-mRNA in eukaryotes?

- (A) 3' → 5' exonuclease activity is involved in the conversion of pre-mRNA to mRNA.
- (B) 5'–capping and addition of 3'– poly A tail precedes splicing.
- (C) Splicing of pre-mRNA occurs via transesterification reaction.
- (D) Alternative splicing can yield different mRNA products from the same pre-mRNA.

Q.42 Which one or more of the following statements correctly describe(s) the changes upon the addition of puromycin during eukaryotic translation?

- (A) Puromycin resembles aminoacyl end of the charged tRNA.
- (B) Puromycin occupies the **A** site of the translating ribosomes.
- (C) Puromycin occupies the **P** site of the translating ribosomes.
- (D) Puromycin occupies the **E** site of the translating ribosomes.

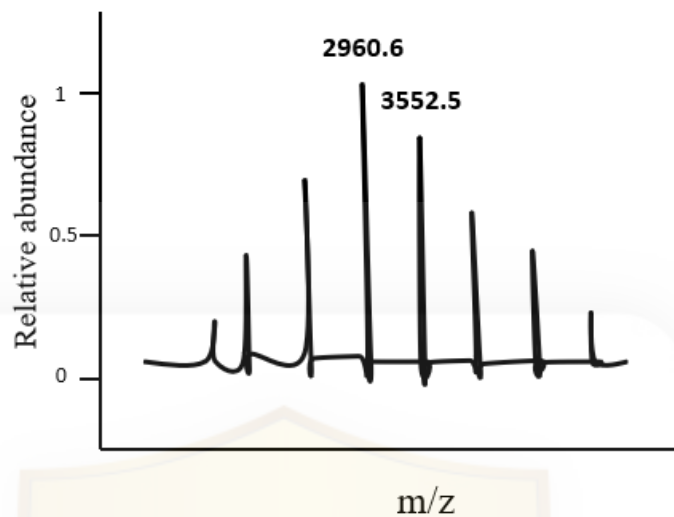
Q.43 Factor H, a complement regulatory protein in plasma, binds C3b and

- (A) competes with factor B to displace Bb from convertase.
- (B) initiates the catabolism of C3b into inactivate products.
- (C) then binds to C3bBb convertase.
- (D) acts as a cofactor for factor I.

Q.44 In Michaelis-Menten's equation, if $[S] = 15 K_m$, then the ratio $\frac{v_0}{V_{\max}}$ is _____.
(Round off to three decimal places)

Q.45 A 5250 base-pair long plasmid with 10 negative supercoils would have a linking number of _____, considering 10.5 base pairs per turn for B DNA.
(Answer in integer)

- Q.46 The spectrum of a protein obtained using electrospray ionization mass spectrometry (ESI-MS) is shown below. Two peaks, one at $m/z = 2960.6$ and the other at $m/z = 3552.5$, are marked. The mass of the protein associated with the $m/z = 2960.6$ peak is _____ Da. (Round off to two decimal places)



Botany (XL-R)

Q.47 – Q.54 Carry ONE mark Each

Q.47 Which one of the following plant families does apple (*Malus domestica*) belong to?

- (A) Rosaceae
- (B) Rutaceae
- (C) Rubiaceae
- (D) Ranunculaceae

Q.48 The collateral and open type of vascular bundle with endarch xylem strand is usually found in

- (A) monocot stem
- (B) dicot stem
- (C) monocot root
- (D) dicot root

Q.49 Which of the following tissue types is/are established during embryogenesis in wild-type *Arabidopsis thaliana*?

- (A) Shoot apical meristem
- (B) Rosette leaf primordium
- (C) Procambium
- (D) Lateral root primordium

Q.50 Which of the following plant natural products is/are cyanogenic glycoside(s)?

- (A) Linustatin
- (B) Limonene
- (C) Luteolin
- (D) Linamarin

Q.51 Which of the following plant diseases is/are caused by nematode?

- (A) Cereal cyst of barley
- (B) Ergot of rye
- (C) Wart of potato
- (D) Ear-cockle of wheat

Q.52 Which of the following selectable marker genes is/are used for herbicide tolerance during genetic transformation of plants?

- (A) *hpt*
- (B) *bar*
- (C) *nptII*
- (D) *pmi*

Q.53 Which of the following statements is/are **CORRECT** with reference to rubber production from plants?

- (A) Para rubber is produced from *Hevea brasiliensis*
- (B) India rubber is produced from *Ficus elastica*
- (C) Panama rubber is produced from *Manihot glaziovii*
- (D) Ceara rubber is produced from *Castilla elastica*

Q.54 In Calvin-Benson cycle, to produce 1 molecule of glyceraldehyde 3-phosphate by fixing 3 molecules of carbon dioxide, 9 molecules of ATP and _____ molecules (*in integer*) of NADPH are typically utilized.

Q.55– Q.65 Carry TWO marks Each

Q.55 In wild-type *Arabidopsis thaliana*, the four types of floral organs (sepal, petal, stamen, carpel) are arranged in concentric whorls from outside to inside. With reference to the *ABC* model of floral organ patterning, match the homeotic mutants in **Group 1** with their respective arrangements of organs in the four whorls given in **Group 2**.

Group 1		Group 2	
(P)	A class mutants	(i)	sepal, sepal, carpel, carpel
(Q)	B class mutants	(ii)	sepal, petal, petal, sepal
(R)	C class mutants	(iii)	carpel, stamen, stamen, carpel
		(iv)	sepal, sepal, petal, petal

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

Q.56 Match the inhibitors in **Group 1** with their respective targets in **Group 2**.

	Group 1		Group 2
(P)	Oligomycin	(i)	Cytochrome bc ₁ complex
(Q)	Antimycin A	(ii)	Photosystem II
(R)	3-(3,4-dichlorophenyl)-1,1-dimethylurea (DCMU)	(iii)	K ⁺ ionophore
(S)	Valinomycin	(iv)	F ₀ ATP synthase

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

Q.57 With reference to *Agrobacterium tumefaciens* mediated plant transformation, match the virulence factors in **Group 1** with their protein types in **Group 2**.

Group 1		Group 2	
(P)	VirG	(i)	Kinase
(Q)	VirA	(ii)	Helicase
(R)	VirE	(iii)	Transcriptional activator
(S)	VirC	(iv)	Single strand binding protein

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

Q.58 Match the plant products in **Group 1** with the plant species in **Group 2** that produce them and the respective plant parts in **Group 3** where they accumulate the most.

Group 1		Group 2		Group 3	
(P)	Liquorice	(i)	<i>Cinchona calisaya</i>	(a)	Leaf
(Q)	Quinine	(ii)	<i>Lawsonia inermis</i>	(b)	Root
(R)	Henna	(iii)	<i>Glycyrriza glabra</i>	(c)	Flower
(S)	Saffron	(iv)	<i>Papaver somniferum</i>	(d)	Bark
		(v)	<i>Crocus sativus</i>	(e)	Seed

- (A) P-iii-b, Q-i-d, R-ii-a, S-v-c
- (B) P-i-b, Q-iii-d, R-ii-a, S-iv-c
- (C) P-iii-b, Q-i-d, R-ii-e, S-v-c
- (D) P-iv-b, Q-i-d, R-iii-c, S-ii-a

Q.59 Match the types of ecological interactions in **Group 1** with their respective definitions in **Group 2**.

Group 1		Group 2	
(P)	Protocooperation	(i)	One species is harmed but the other is neither harmed nor benefitted
(Q)	Commensalism	(ii)	A type of mutualism where one species is benefitted more than the other
(R)	Amensalism	(iii)	Both the species are benefitted but the interaction between them is not obligatory
(S)	Helotism	(iv)	One species is benefitted without harming the other

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

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

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

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

Q.60 Match the types of ecological energy productivity in **Group 1** with their respective definitions in **Group 2**.

Group 1		Group 2	
(P)	Net primary productivity	(i)	Total amount of energy produced by autotrophs
(Q)	Gross primary productivity	(ii)	Amount of energy stored by autotrophs after respiration
(R)	Net productivity	(iii)	Net gain of energy by the consumers after energy loss
(S)	Secondary productivity	(iv)	Unused amount of energy after consumption by heterotrophs

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

Q.61 Which of the following combinations of plant diseases and the types of their causal organisms is/are **CORRECT**?

- (A) Late blight of potato – Bacteria
- (B) Black rot of crucifer – Bacteria
- (C) Tungro disease of rice – Mycoplasma
- (D) Root knot of tomato – Nematode

Q.62 Identify the **CORRECT** combination(s) of plant natural products and the categories they belong to.

- (A) Dhurrin – Phenolic compounds
- (B) Farnesene – Terpenoids
- (C) Naringenin – Cyanogenic glycosides
- (D) Vincristine – Alkaloids

Q.63 Identify the **CORRECT** combination(s) between the enzymes in **Group 1** and the reactions in **Group 2** they catalyze.

Group 1		Group 2	
(P)	Cinnamate-4-hydroxylase	(i)	L-phenylalanine → Cinnamic acid
(Q)	Glycerate kinase	(ii)	Glyceraldehyde 3-phosphate → dihydroxyacetone phosphate
(R)	PEP carboxylase	(iii)	Glycolate + O ₂ → Glyoxylate + H ₂ O ₂
(S)	Nitrate reductase	(iv)	NO ₃ ⁻ + NAD(P)H + H ⁺ → NO ₂ ⁻ + NAD(P) ⁺ + H ₂ O

(A) S-iv

(B) Q-ii

(C) P-i

(D) R-iii

- Q.64 In a genetic cross between two pure-line parents differing in the two independently segregating traits, plant height (tall vs dwarf) and flower color (purple vs white), all the F1 plants were tall with purple flowers. In a testcross population involving these F1 individuals, the expected percentage (%) of dwarf plants with purple flower would be _____ (*in integer*).
- Q.65 The mRNA of a hypothetical plant gene *HSDU* is 800-nucleotide long and encodes a protein of 160 amino acid residues. The calculated length of *HSDU CDS* would be _____ nucleotides (*in integer*).

Microbiology (XL-S)

Q.66 – Q.73 Carry ONE mark Each

Q.66 Which one of the following bacterial species can cause atypical pneumonia?

- (A) *Chlamydia pneumoniae*
- (B) *Streptococcus pneumoniae*
- (C) *Klebsiella pneumoniae*
- (D) *Haemophilus influenzae*

Q.67 Which one of the following organisms has axial filaments?

- (A) *Mycobacterium tuberculosis*
- (B) *Pasteurella multocida*
- (C) *Treponema pallidum*
- (D) *Shigella dysenteriae*

Q.68 Who among the following scientists was the pioneer in development of chemotherapy?

- (A) Elie Metchnikoff
- (B) Robert Koch
- (C) Paul Ehrlich
- (D) Ronald Ross

Q.69 In which of following processes, glutaraldehyde is used as a sterilizing agent?

- (A) Pasteurization
- (B) Incineration
- (C) Cold sterilization
- (D) Autoclaving

Q.70 The most abundant class of immunoglobulins in serum is _____.

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

Q.71 Which one of the following double-stranded sequences will **NOT** be recognized by a Type IIP restriction endonuclease?

- (A) 5'--GGTACC--3'
3'--CCTAGG--5'
- (B) 5'--GGATCC--3'
3'--CCTAGG--5'
- (C) 5'--CATATG--3'
3'--GTATAC--5'
- (D) 5'--GATTTC--3'
3'--CTAAAG--5'

Q.72 Which one of the following use inorganic compounds as an energy source?

- (A) Heterotrophs
- (B) Chemolithotrophs
- (C) Chemoorganotrophs
- (D) Photoheterotrophs

Q.73 Which one of the following represents the abundance of the organisms found in soil?

- (A) Fungi > Aerobic bacteria > Anaerobic bacteria
- (B) Aerobic bacteria > Fungi > Anaerobic bacteria
- (C) Aerobic bacteria > Anaerobic bacteria > Fungi
- (D) Anaerobic bacteria > Aerobic bacteria > Fungi

Q.74 – Q.84 Carry TWO marks Each

Q.74 Match the antibiotics in Group I with the microorganisms that produce them in Group II.

Group I

- (P) Streptomycin
- (Q) Bacitracin
- (R) Amphotericin B
- (S) Chloramphenicol

Group II

- (i) *Streptomyces griseus*
- (ii) *Bacillus licheniformis*
- (iii) *Streptomyces venezuelae*
- (iv) *Streptomyces nodosus*

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

Q.75 Which one of the following redox couples has the highest tendency to donate electrons?

- (A) Fumarate / succinate
- (B) NAD^+ / NADH
- (C) FAD / FADH
- (D) Pyruvate / lactate

Q.76 Which of the following is/are active transport mechanism(s) in prokaryotes where the substance is chemically altered during transport across the membrane?

- (A) Group translocation
- (B) Simple diffusion
- (C) Facilitated diffusion
- (D) Osmosis

Q.77 Which of the following cocci is/are examples of division in one plane?

- (A) Staphylococci
- (B) Streptococci
- (C) Micrococci
- (D) Diplococci

Q.78 Which of the following event(s) occur(s) during translation in prokaryotes?

- (A) tRNA binding to the start codon of mRNA on the 30s subunit of ribosome
- (B) Anticodon of tRNA binding to the start codon of mRNA on the 50s subunit of ribosome
- (C) The ribosome continues to move along the mRNA to add new amino acids to the polypeptide
- (D) The polypeptide is released when the ribosome reaches the stop codon

Q.79 Which of the following is/are consequence(s) of nitrous acid (HNO_2) mediated deamination?

- (A) Deamination of cytosine, adenine and guanine
- (B) GC-to-AT transitions
- (C) AT- to- GC transitions
- (D) Addition of alkyl group to the bases

Q.80 At root nodules, which of the following C₄ organic acid(s) is/are transported across the symbiosome membrane and into bacteroids?

- (A) Succinate
- (B) Pyruvate
- (C) Malate
- (D) Fumarate

Q.81 Which of the following is/are TRUE about the *Escherichia coli* chromosome?

- (A) It is typically bound by histones
- (B) It is circular in nature
- (C) It is found in the nucleoid
- (D) It contains multiple origins of replication

Q.82 At $t = 0$, the bacterial cell number is 10,000 cells/mL. At $t = 480$ minutes, the cell number increased to 320,000 cells/mL. The mean generation time during this exponential growth period, rounded off to the nearest integer is _____ minutes.

Q.83 A landfill sample was analyzed by dilution and plating techniques for viable bacterial count. When one gram of the landfill sample was diluted 1×10^{-4} (w/v) it yielded 400 CFU. The viable bacterial count (in million, rounded off to the nearest integer) in one gram landfill sample is _____.

Q.84 A fluorescence microscope with an objective lens of numerical aperture (NA) 1.5 is used with light of wavelength (λ) 600 nanometers. The lateral resolution limit of this microscope rounded off to the nearest integer, is _____ nanometers.

Zoology (XL-T)

Q.85 – Q.92 Carry ONE mark Each

Q.85 Which one of the following statements about gene expression is INCORRECT?

- (A) DNA is transcribed to mRNA.
- (B) mRNA can be reverse-transcribed to DNA.
- (C) mRNA can be translated to protein.
- (D) Protein can be reverse-translated to mRNA.

Q.86 Which one of the following tissues/organs is least likely to experience graft rejection when transplanted from a person to an unrelated person?

- (A) bone marrow
- (B) cornea
- (C) heart
- (D) kidney

Q.87 Codon bias is correlated with the relative frequencies of which one of the following types of RNA?

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

Q.88 CREB1 is a eukaryotic transcription factor. In which one of the following compartments of the cell is CREB1 predominantly localized?

- (A) lysosomes
- (B) mitochondria
- (C) nucleus
- (D) peroxisomes

Q.89 In certain species of salamanders, male-female pairs have multiple mating partners in a breeding season. Which one of the following terminologies accurately describes this mating system?

- (A) monogamy
- (B) polyandry
- (C) polygyny
- (D) polygynandry

Q.90 Which one of the following statements describes the key function of human sweat glands?

- (A) They serve as touch sensors.
- (B) They are responsible for skin color.
- (C) They regulate body temperature.
- (D) They store fat.

Q.91 Urease enzyme catalyzes the conversion of urea into ammonia and carbon dioxide. Which one of the following organisms expresses urease enzyme?

- (A) *Caenorhabditis elegans*
- (B) *Drosophila melanogaster*
- (C) *Helicobacter pylori*
- (D) *Homo sapiens*

Q.92 The human genetic code is triplet in nature with 64 codons made using four nucleotides. If the human genetic code was doublet in nature, the number of codons theoretically possible from four nucleotides is _____. (Answer in integer)

Q.93 – Q.103 Carry TWO marks Each

Q.93 Which one of the following statements is NOT TRUE of glycosaminoglycans?

- (A) Glycosaminoglycans are composed of repeating disaccharide units.
- (B) Glycosaminoglycans consist of amino sugars that are frequently sulfated.
- (C) Hyaluronic acid is an example of a glycosaminoglycan.
- (D) Methionine is the predominant amino acid to which glycosaminoglycan chains are conjugated to form proteoglycans.

Q.94 Which one of the options correctly matches the human tissues/organs with their embryonic germ layers of origin?

Tissues/organs	Embryonic germ layers
(P) liver	(I) ectoderm
(Q) cerebellum	(II) endoderm
(R) femur	(III) mesoderm

- (A) P-II, Q-I, R-III
(B) P-III, Q-I, R-II
(C) P-I, Q-II, R-III
(D) P-II, Q-III, R-I

- Q.95 Consider a large population of a finch species, where both small and big beak sizes are advantageous, and an intermediate beak size is maladaptive. Over a period of 10 years, which one of the following evolutionary processes is most likely to operate on the beak size of this finch population?
- (A) directional selection
 - (B) disruptive selection
 - (C) genetic drift
 - (D) stabilizing selection

Q.96 When the blood glucose level of a healthy person is 100 mg/dL, which one of the following options is most likely to represent the level of glucose in the urine of that person?

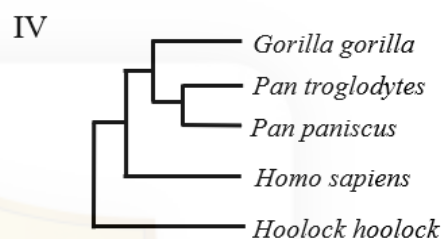
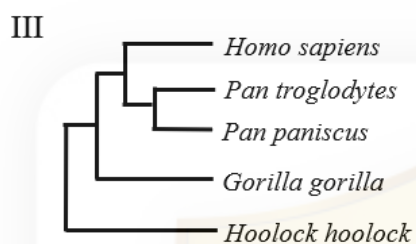
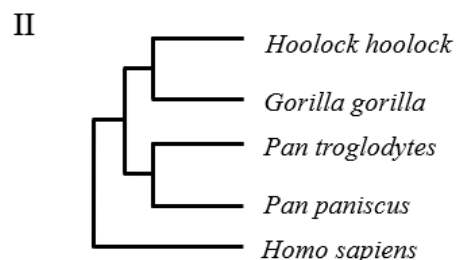
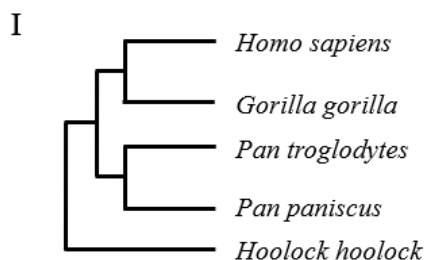
(A) < 1 mg/dL

(B) 10 mg/dL

(C) 50 mg/dL

(D) 100 mg/dL

Q.97 Which one of the following rooted tree topologies best describes the primate phylogeny?



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

Q.98 Consider a species of brightly colored beetle. Which one or more of the following observations suggest(s) that this species is aposematic?

- (A) Both male and female beetles are brightly colored.
- (B) Only male beetles are brightly colored.
- (C) Only female beetles are brightly colored.
- (D) The beetle species is toxic and distasteful.

Q.99 The embryos of which one or more of the following animals show meroblastic cleavage?

- (A) *Danio rerio* (zebrafish)
- (B) *Gallus gallus* (chicken)
- (C) *Synapta digita* (sea cucumber)
- (D) *Xenopus laevis* (frog)

Q.100 Which one or more of the following parasites is/are typically transmitted by mosquitoes as vector?

(A) *Leishmania donovani*

(B) *Plasmodium vivax*

(C) *Wuchereria bancrofti*

(D) *Trichuris trichiura*

Q.101 Consider the following nucleotide sequence:

5'-GCCGCCAUGGCGUCUGCUAGCUGGCUCGAUCGCGAGCGAUCGUAC
GUAUAGUAUGAA-3'

Assume canonical initiation, canonical termination, no post-translational modification, and the average molecular mass of an amino acid to be 110 daltons. The theoretical molecular mass of the polypeptide translated from the above nucleotide sequence is _____ daltons. (Answer in integer)

Q.102 The pKa of a buffer solution with pH of 5, consisting of 0.4 M sodium acetate and 0.04 M acetic acid, is _____. (Answer in integer)

Q.103 Consider a healthy person with the following lung volumes:

Residual volume = 900 mL

Expiratory reserve volume = 800 mL

Tidal volume = 200 mL

If the Total lung capacity is 5500 mL, then the Inspiratory reserve volume of the person is _____ mL. (Answer in integer)



Food Technology (XL-U)

Q.104 – Q.111 Carry ONE mark Each

Q.104 Which one of the following fungi produces aflatoxins?

- (A) *Aspergillus niger*
- (B) *Fusarium verticillioides*
- (C) *Aspergillus flavus*
- (D) *Rhizopus oligosporus*

Q.105 Under standard conditions in animal feeding studies, the weight gained (in grams) per gram of protein consumed by an animal is termed as

- (A) Net Protein Ratio
- (B) Net Protein Utilization
- (C) Coefficient of Protein Digestibility
- (D) Protein Efficiency Ratio

Q.106 Xerophthalmia is caused due to the deficiency of

- (A) Thiamin
- (B) Pantothenic acid
- (C) Vitamin A
- (D) Vitamin C

Q.107 Which one of the following steps is used to remove phosphatides from crude oil in the refining process?

- (A) Neutralization
- (B) Bleaching
- (C) Degumming
- (D) Deodorization

Q.108 The unique flavor of chocolate and cocoa is due to the formation of

- (A) 5-methyl-2-phenyl-2-hexenal
- (B) Cyclotene
- (C) Furaneol
- (D) Maltol

Q.109 Which one of the following statements regarding Hazard Analysis Critical Control Point (HACCP) plan is **NOT** correct?

- (A) HACCP is a management tool for ensuring food safety.
- (B) HACCP involves five preliminary steps and seven principles.
- (C) HACCP is not effective without prior implementation of prerequisite programs.
- (D) HACCP plan involves establishment of corrective actions as second principle.

Q.110 The product of cabbage fermentation by *Leuconostoc mesenteroides* is

- (A) Tempeh
- (B) Natto
- (C) Sauerkraut
- (D) Miso

Q.111 Which one of the following absorbents is **NOT** used as an ethylene absorber in active packaging of fruits and vegetables?

- (A) Potassium permanganate
- (B) Activated carbon
- (C) Calcium hydroxide
- (D) Silica gel

Q.112 – Q.122 Carry TWO marks Each

Q.112 Which one of the following statements regarding moisture sorption isotherms of a dried food is **NOT** correct?

- (A) At a given temperature, the difference between adsorption and desorption moisture isotherms is known as hysteresis.
- (B) At a given temperature and water activity, an adsorption isotherm exhibits higher equilibrium moisture content than a desorption isotherm in hysteresis.
- (C) At a given moisture content, effect of temperature on a moisture sorption isotherm follows the Clausius- Clapeyron equation.
- (D) The Guggenheim-Anderson-de Boer (GAB) equation is a multilayer moisture sorption model.

Q.113 Processing of fluid milk at 72 °C for 15 seconds is termed as

- (A) High-temperature, short-time (HTST) pasteurization
- (B) Low-temperature, long-time (LTLT) pasteurization
- (C) Ultra high-temperature (UHT) pasteurization
- (D) Homogenization process

Q.114 Match the anti-nutritional factor in **Column I** with their corresponding activity given in **Column II**.

Column I

Column II

P. Lectin

1. Flatulence

Q. Stachyose

2. Chelates with divalent cations and reduces their bio-availability

R. Phytate

3. Inhibits trypsin and chymotrypsin

S. Knuitz type inhibitor

4. Hemagglutination

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

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

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

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

Q.115 Which of the following fatty acids is/are known to increase the low density lipoprotein (LDL)-cholesterol?

(A) Omega-3 Fatty acids

(B) Trans Fatty acids

(C) Conjugated Linoleic acids

(D) Saturated Fatty acids

Q.116 The addition of which of the following to high-methoxyl pectin will result in gel formation?

- (A) Calcium ions
- (B) Hydrogen ions
- (C) Sodium ions
- (D) Sugar

Q.117 Which of the following steps in food processing is/are used to reduce the acrylamide formation in food products?

- (A) Pretreatment using asparaginase
- (B) Lowering the pH
- (C) Increasing the temperature.
- (D) Adding glucose.

Q.118 Which of the following enzymes is/are used for the production of high fructose syrup (HFS) from corn starch?

- (A) α -Amylase
- (B) β -Amylase
- (C) Xylose isomerase
- (D) Glucoamylase

Q.119 Which of the following is/are typical characteristic(s) of a fungal cell?

- (A) Presence of histone proteins
- (B) Presence of peptidoglycans in the cell wall
- (C) Presence of chitin in the cell wall
- (D) Presence of pseudomurein in the cell wall

Q.120 Which of the following statements is/ are correct regarding food and water borne disease and the class of causative microorganisms?

- (A) Legionellosis is a bacterial disease.
- (B) Giardiasis is caused by the protists.
- (C) Typhoid fever is caused by the virus.
- (D) Listeriosis is a fungal disease.

Q.121 Which of the following statements is/ are true?

- (A) Hagen-Poiseuille's law is used for calculation of molecular diffusion.
- (B) Fick's law is used for calculation of energy requirement in size reduction.
- (C) Ritinger's law is used for calculation of energy requirement in size reduction.
- (D) Stokes law is used for derivation of terminal velocity.

Q.122 A 10 kg tomato pulp is concentrated from an initial moisture content of 90% (wet weight basis) to 35% (wet weight basis). The weight of the concentrate in kg is _____ (*round off to 2 decimal places*).

**Life Sciences (XL)****Master Answer Key**

Q. No.	Session	Question Type	Section	Key/Range	Mark
1	6	MCQ	GA	C	1
2	6	MCQ	GA	A	1
3	6	MCQ	GA	A	1
4	6	MCQ	GA	C	1
5	6	MCQ	GA	B	1
6	6	MCQ	GA	C	2
7	6	MCQ	GA	C	2
8	6	MCQ	GA	D	2
9	6	MCQ	GA	A	2
10	6	MCQ	GA	A	2
11	6	MCQ	XL-P	D	1
12	6	MCQ	XL-P	A	1
13	6	MCQ	XL-P	C	1
14	6	MCQ	XL-P	B	1
15	6	MCQ	XL-P	D	1
16	6	MSQ	XL-P	A; C	1
17	6	NAT	XL-P	8 to 8	1
18	6	NAT	XL-P	299.90 to 301.90	1
19	6	NAT	XL-P	1.55 to 1.60	1
20	6	MCQ	XL-P	B	2
21	6	MCQ	XL-P	A	2
22	6	MCQ	XL-P	C	2
23	6	MSQ	XL-P	B; C	2
24	6	MSQ	XL-P	A; B; D	2
25	6	MSQ	XL-P	C; D	2
26	6	NAT	XL-P	6.76 to 6.78	2
27	6	NAT	XL-P	55960 to 55980	2
28	6	MCQ	XL-Q	C	1
29	6	MCQ	XL-Q	A	1
30	6	MCQ	XL-Q	C	1
31	6	MCQ	XL-Q	B	1
32	6	MSQ	XL-Q	B;C	1

33	6	NAT	XL-Q	56 to 56	1
34	6	NAT	XL-Q	3.8 to 3.9	1
35	6	NAT	XL-Q	98 to 102	1
36	6	MCQ	XL-Q	A	2
37	6	MCQ	XL-Q	C	2
38	6	MSQ	XL-Q	A;C	2
39	6	MSQ	XL-Q	A;B;C	2
40	6	MSQ	XL-Q	A;C;D	2
41	6	MSQ	XL-Q	C;D	2
42	6	MSQ	XL-Q	A;B	2
43	6	MSQ	XL-Q	A;D	2
44	6	NAT	XL-Q	0.93 to 0.95	2
45	6	NAT	XL-Q	490 to 490	2
46	6	NAT	XL-Q	17750 to 17770	2
47	6	MCQ	XL-R	A	1
48	6	MCQ	XL-R	B	1
49	6	MSQ	XL-R	A; C	1
50	6	MSQ	XL-R	A; D	1
51	6	MSQ	XL-R	A; D	1
52	6	MSQ	XL-R	B	1
53	6	MSQ	XL-R	A; B	1
54	6	NAT	XL-R	6 to 6	1
55	6	MCQ	XL-R	B	2
56	6	MCQ	XL-R	B	2
57	6	MCQ	XL-R	D	2
58	6	MCQ	XL-R	A	2
59	6	MCQ	XL-R	A	2
60	6	MCQ	XL-R	C	2
61	6	MSQ	XL-R	B; D	2
62	6	MSQ	XL-R	B; D	2
63	6	MSQ	XL-R	A	2
64	6	NAT	XL-R	25 to 25	2
65	6	NAT	XL-R	483 to 483	2
66	6	MCQ	XL-S	A	1
67	6	MCQ	XL-S	C	1
68	6	MCQ	XL-S	C	1
69	6	MCQ	XL-S	C	1
70	6	MCQ	XL-S	D	1
71	6	MCQ	XL-S	D	1
72	6	MCQ	XL-S	B	1

73	6	MCQ	XL-S	C	1
74	6	MCQ	XL-S	B	2
75	6	MCQ	XL-S	B	2
76	6	MSQ	XL-S	A	2
77	6	MSQ	XL-S	B;D	2
78	6	MSQ	XL-S	A;C;D	2
79	6	MSQ	XL-S	A;B;C	2
80	6	MSQ	XL-S	A;C;D	2
81	6	MSQ	XL-S	B;C	2
82	6	NAT	XL-S	95 to 97	2
83	6	NAT	XL-S	3 to 5	2
84	6	NAT	XL-S	200 to 250	2
85	6	MCQ	XL-T	D	1
86	6	MCQ	XL-T	B	1
87	6	MCQ	XL-T	D	1
88	6	MCQ	XL-T	C	1
89	6	MCQ	XL-T	D	1
90	6	MCQ	XL-T	C	1
91	6	MCQ	XL-T	C	1
92	6	NAT	XL-T	16 to 16	1
93	6	MCQ	XL-T	D	2
94	6	MCQ	XL-T	A	2
95	6	MCQ	XL-T	B	2
96	6	MCQ	XL-T	A	2
97	6	MCQ	XL-T	C	2
98	6	MSQ	XL-T	A;D	2
99	6	MSQ	XL-T	A;B	2
100	6	MSQ	XL-T	B;C	2
101	6	NAT	XL-T	1540 to 1540	2
102	6	NAT	XL-T	4 to 4	2
103	6	NAT	XL-T	3600 to 3600	2
104	6	MCQ	XL-U	C	1
105	6	MCQ	XL-U	D	1
106	6	MCQ	XL-U	C	1
107	6	MCQ	XL-U	C	1
108	6	MCQ	XL-U	A	1
109	6	MCQ	XL-U	D	1
110	6	MCQ	XL-U	C	1
111	6	MCQ	XL-U	C	1
112	6	MCQ	XL-U	B	2

113	6	MCQ	XL-U	A	2
114	6	MCQ	XL-U	A	2
115	6	MSQ	XL-U	B; D	2
116	6	MSQ	XL-U	B; D	2
117	6	MSQ	XL-U	A; B	2
118	6	MSQ	XL-U	A; C; D	2
119	6	MSQ	XL-U	A; C	2
120	6	MSQ	XL-U	A; B	2
121	6	MSQ	XL-U	C; D	2
122	6	NAT	XL-U	1.50 to 1.60	2