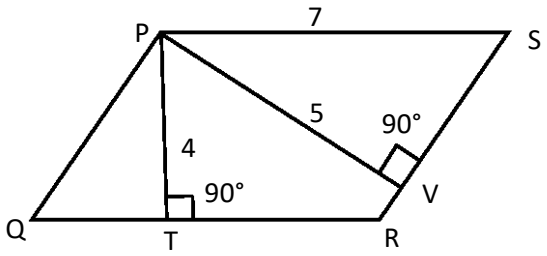
General Aptitude (GA)

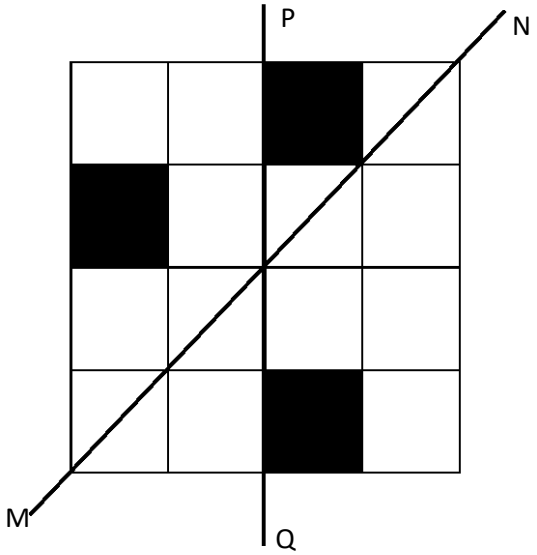
Q.1 – Q.5 Carry ONE mark Each

Q.1	"You are delaying the completion of the task. Send _____ contributions at the earliest."
(A)	you are
(B)	your
(C)	you're
(D)	yore

Q.2	References : _____ : : Guidelines : Implement (By word meaning)
(A)	Sight
(B)	Site
(C)	Cite
(D)	Plagiarise

Q.3	In the given figure, PQRS is a parallelogram with PS = 7 cm, PT = 4 cm and PV = 5 cm. What is the length of RS in cm? (The diagram is representative.)
	
(A)	$\frac{20}{7}$
(B)	$\frac{28}{5}$
(C)	$\frac{9}{2}$
(D)	$\frac{35}{4}$

Q.4	In 2022, June Huh was awarded the Fields medal, which is the highest prize in Mathematics. When he was younger, he was also a poet. He did not win any medals in the International Mathematics Olympiads. He dropped out of college. Based only on the above information, which one of the following statements can be logically inferred with *certainty*?
(A)	Every Fields medalist has won a medal in an International Mathematics Olympiad.
(B)	Everyone who has dropped out of college has won the Fields medal.
(C)	All Fields medalists are part-time poets.
(D)	Some Fields medalists have dropped out of college.

Q.5	A line of symmetry is defined as a line that divides a figure into two parts in a way such that each part is a mirror image of the other part about that line. The given figure consists of 16 unit squares arranged as shown. In addition to the three black squares, what is the minimum number of squares that must be coloured black, such that both PQ and MN form lines of symmetry? (The figure is representative)
	
(A)	3
(B)	4
(C)	5
(D)	6

Q.6 – Q.10 Carry TWO marks Each

Q.6	Human beings are one among many creatures that inhabit an imagined world. In this imagined world, some creatures are cruel. If in this imagined world, it is given that the statement "Some human beings are not cruel creatures" is FALSE, then which of the following set of statement(s) can be logically inferred with *certainty*? (i) All human beings are cruel creatures. (ii) Some human beings are cruel creatures. (iii) Some creatures that are cruel are human beings. (iv) No human beings are cruel creatures.
(A)	only (i)
(B)	only (iii) and (iv)
(C)	only (i) and (ii)
(D)	(i), (ii) and (iii)

Q.7	To construct a wall, sand and cement are mixed in the ratio of 3:1. The cost of sand and that of cement are in the ratio of 1:2. If the total cost of sand and cement to construct the wall is 1000 rupees, then what is the cost (in rupees) of cement used?
(A)	400
(B)	600
(C)	800
(D)	200

Q.8	The World Bank has declared that it does not plan to offer new financing to Sri Lanka, which is battling its worst economic crisis in decades, until the country has an adequate macroeconomic policy framework in place. In a statement, the World Bank said Sri Lanka needed to adopt structural reforms that focus on economic stabilisation and tackle the root causes of its crisis. The latter has starved it of foreign exchange and led to shortages of food, fuel, and medicines. The bank is repurposing resources under existing loans to help alleviate shortages of essential items such as medicine, cooking gas, fertiliser, meals for children, and cash for vulnerable households. Based only on the above passage, which one of the following statements can be inferred with *certainty*?
(A)	According to the World Bank, the root cause of Sri Lanka's economic crisis is that it does not have enough foreign exchange.
(B)	The World Bank has stated that it will advise the Sri Lankan government about how to tackle the root causes of its economic crisis.
(C)	According to the World Bank, Sri Lanka does not yet have an adequate macroeconomic policy framework.
(D)	The World Bank has stated that it will provide Sri Lanka with additional funds for essentials such as food, fuel, and medicines.

Q.9	The coefficient of x^4 in the polynomial $(x-1)^3(x-2)^3$ is equal to _____.
(A)	33
(B)	-3
(C)	30
(D)	21

Q.10	Which one of the following shapes can be used to tile (completely cover by repeating) a flat plane, extending to infinity in all directions, without leaving any empty spaces in between them? The copies of the shape used to tile are identical and are not allowed to overlap.
(A)	circle
(B)	regular octagon
(C)	regular pentagon
(D)	rhombus

Q.11 – Q.35 Carry ONE mark Each

Q.11	Eukaryotic transcription is carried out by
(A)	DNA-dependent RNA polymerase
(B)	DNA-dependent DNA polymerase
(C)	RNA-dependent DNA polymerase
(D)	RNA-dependent RNA polymerase
Q.12	Acetylcholine released by the parasympathetic nerves has which one of the following functions in the heart pacemaker cells?
(A)	It binds to GPCR and activates G protein to slow the heart rate
(B)	It stimulates GABA-activated ion-channel coupled receptor to increase the heart rate
(C)	It binds to GPCR and inhibits G protein to slow the heart rate
(D)	It inhibits GABA-activated ion-channel coupled receptor to increase the heart rate

Q.13	Determine the correctness or otherwise of the following Assertion [a] and the Reason [r]. Assertion [a]: In multicellular organisms, cells of different lineages have different gene expression profiles. Reason [r]: Alternative splicing is the only mechanism to generate protein diversity.
(A)	Both [a] and [r] are false
(B)	Both [a] and [r] are true and [r] is the correct reason for [a]
(C)	Both [a] and [r] are true but [r] is not the correct reason for [a]
(D)	[a] is true but [r] is false
Q.14	Determine the correctness or otherwise of the following Assertion [a] and the Reason [r]. Assertion [a]: Chromosome mutations can change the structure of chromosomes. Reason [r]: All chromosome mutations arise due to nondisjunction of chromosomes during mitosis or meiosis.
(A)	Both [a] and [r] are false
(B)	[a] is true but [r] is false
(C)	Both [a] and [r] are true and [r] is the correct reason for [a]
(D)	Both [a] and [r] are true but [r] is not the correct reason for [a]

Q.15	C-value paradox refers to
(A)	the lack of correlation between genome size and genetic complexity of an organism
(B)	the presence of genetic sequences that propagate themselves within a genome
(C)	the coexistence of multiple alleles at a genetic locus
(D)	the concept that two or more genes may have the same function
Q.16	Which one of the following drugs is NOT an immune checkpoint inhibitor?
(A)	Ipilimumab
(B)	Pembrolizumab
(C)	Nivolumab
(D)	Trastuzumab

Q.17	Dendritic cells are involved in cross-presentation of antigens. Which of the following protein(s) is(are) required for cross-presentation? P. Basic leucine zipper ATF-like transcription factor 3 (BATF3) Q. Membrane associated ring-CH-type finger 1 (MARCH-1) R. Solute carrier family 10 member 1 (SLC10A1) S. Class II-associated invariant chain peptide (CLIP)
(A)	P only
(B)	P and R only
(C)	P, Q and R only
(D)	S only
Q.18	Which one of the following is required for the development of B-cells in the bone marrow?
(A)	Stromal cells
(B)	Dendritic cells
(C)	Kupffer cells
(D)	NK cells

Q.19	Which one of the following statements is TRUE about leghemoglobin?
(A)	It binds oxygen to protect nitrogenase
(B)	It binds hemoglobin to protect oxygenase
(C)	It binds oxygen to protect hydrogenase
(D)	It binds oxygen to protect oxygenase
Q.20	The correct sequence of events during bacteriophage infection of a bacterial cell is
(A)	landing → attachment → tail contraction → penetration and unplugging → DNA ejection
(B)	attachment → landing → penetration and unplugging → tail contraction → DNA ejection
(C)	landing → tail contraction → attachment → DNA ejection → penetration and unplugging
(D)	attachment → tail contraction → landing → penetration and unplugging → DNA ejection

Q.21	Intracellular proteins are targeted for proteolytic degradation in proteasomes upon conjugation with
(A)	ubiquitin
(B)	integrin
(C)	peptidase
(D)	calreticulin
Q.22	In ELISA, which of the following enzymes are conjugated to antibodies for detection of the analyte?
	P. Alkaline phosphatase Q. Trypsinase R. Horseradish peroxidase S. Amylase
(A)	P and R
(B)	P and Q
(C)	Q and S
(D)	R and S

Q.23	In hybridoma technology, which one of the following enzymes is absent in the myeloma cells that are used for monoclonal antibody production?
(A)	Hypoxanthine-guanine phosphoribosyltransferase
(B)	Alanine aminotransferase
(C)	Triose phosphate isomerase
(D)	Glycosyltransferase
Q.24	Which of the following methods are used for detection of DNA and RNA, respectively?
(A)	Southern and Northern blotting
(B)	Southern and Western blotting
(C)	Northern and Southern blotting
(D)	Northern and Western blotting

Q.25 Match the types of RNA in Group I with their corresponding function in Group II.

Group I	**Group II**
P. mRNA	1. Serves as adaptors between mRNA and amino acids during protein synthesis
Q. rRNA	2. Regulates post-transcriptional gene expression
R. miRNA	3. Codes for proteins
S. tRNA	4. Forms the core of the ribosome structure and catalyzes protein synthesis

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

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

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

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

Q.26	Which one of the following programs is used for finding distantly related (or remote) protein homologs?
(A)	BLASTN
(B)	BLASTX
(C)	PSI-BLAST
(D)	TBLASTX
Q.27	Which one of the following is used for global alignment of two protein sequences?
(A)	Chou-Fasman method
(B)	Garnier-Osguthorpe-Robson (GOR) method
(C)	Needleman-Wunsch algorithm
(D)	Smith-Waterman algorithm

Q.28	Which one of the following methods CANNOT be used to determine the secondary structure content of a protein?
(A)	Circular dichroism spectroscopy
(B)	Fourier transform infrared spectroscopy
(C)	Mass spectrometry
(D)	X-ray crystallography
Q.29	Which one of the following plant growth regulators facilitate adventitious root formation?
(A)	Auxin
(B)	Zeatin
(C)	Dihydrozeatin
(D)	Kinetin
Q.20	Fabry disease in humans is a X-linked disease. The probability (in percentage) for a phenotypically normal father and a carrier mother to have a son with Fabry disease is _____.

Q.31	The value of $\lim_{x\to 0}\left[\frac{\cos 2x-\cos 4x}{x^2}\right]$ is _____.
Q.32	A series (S) is given as S = 1 + 3 + 5 + 7 + 9 + …… The sum of the first 50 terms of S is _____.
Q.33	Two fair six-sided dice are thrown. The probability of getting 12 as the product of the numbers on the dice (rounded off to two decimal places) is _____.
Q.34	If $7^{3x}=216$, the value of 7^{-x} (rounded off to three decimal places) is _____.
Q.35	The distance between the two points of intersection of $x^2+y=7$ and $x+y=7$ (rounded off to two decimal places) is _____.

Q.36 – Q.65 Carry TWO marks Each

Q.36 Match the immune tolerance mechanisms in Group I with their respective outcomes in Group II.

Group I	**Group II**
P. Anergy	1. Elimination of activated T-cells after antigen clearance
Q. Activation-induced cell death	2. Inhibition of auto-reactive T-cells at periphery
R. Receptor editing	3. Unresponsiveness to antigens due to lack of co-stimulatory molecules
S. Regulatory T-cells	4. Elimination of auto-reactive B-cells

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

Q.37 Match the type of bacteria in Group I with their respective growth properties in Group II.

Group I	**Group II**
P. Halophile	1. Grows optimally between 20 °C and 45 °C
Q. Piezophile	2. Grows best at low water activity
R. Mesophile	3. Grows at high level of salt
S. Xerophile	4. Grows optimally at high hydrostatic pressure

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

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

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

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

Q.38 Match the virus in Group I with the type of genome it contains in Group II.

Group I	**Group II**
P. T4 bacteriophage	1. dsRNA
Q. SARS-CoV-2	2. ssDNA
R. Pseudomonas phage ϕ6	3. dsDNA
S. ϕX174 bacteriophage	4. ssRNA

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

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

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

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

Q.39	The event(s) that lead(s) to inactivation of tumor suppressor genes in cancer cells is(are)
(A)	gene amplification
(B)	promoter methylation
(C)	loss of heterozygosity
(D)	histone acetylation
Q.40	Methylation of CpG islands near the promoter of a gene can inhibit transcription by
(A)	preventing RNA polymerase binding
(B)	facilitating repressor binding
(C)	facilitating heterochromatin formation
(D)	inducing euchromatin formation

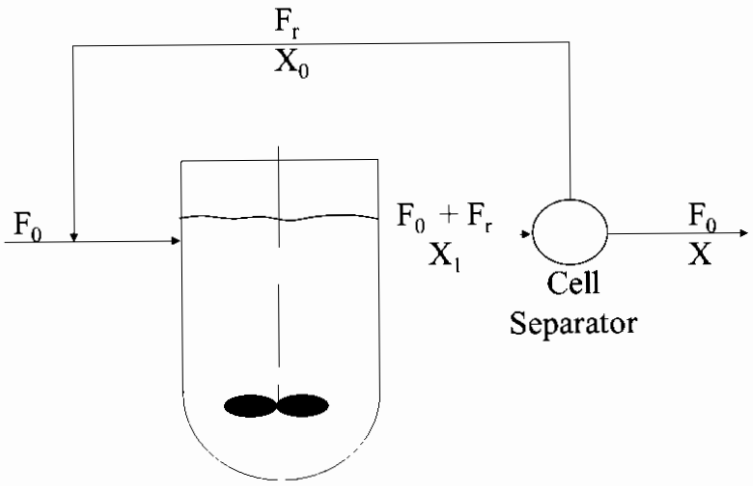
Q.41	Which of the following statement(s) is(are) TRUE about induced pluripotent stem cells?
(A)	They can self-renew
(B)	They require specific signals to maintain their stemness
(C)	They cannot be genetically manipulated
(D)	They can form organoids *in vitro*
Q.42	Which of the following statement(s) is(are) TRUE about fluoroquinolone drugs?
(A)	They contain quinolone ring(s)
(B)	They inhibit RNA polymerase
(C)	They bind to bacterial topoisomerase
(D)	They bind to 23S rRNA within the 50S ribosome subunit

Q.43	Which of the following is(are) plant protoplast fusogenic agent(s)?
(A)	Sodium nitrate
(B)	Polyvinyl alcohol
(C)	Polyethylene glycol
(D)	Bromoxynil
Q.44	Direct DNA transfer method(s) used for plant genetic engineering is(are)
(A)	microparticle bombardment
(B)	electroporation
(C)	polyethylene glycol treatment
(D)	Agrobacterium-mediated transformation

Q.45	Which of the following vector(s) is(are) used to clone a DNA fragment of size 220 kb?
(A)	Bacterial artificial chromosome
(B)	Yeast artificial chromosome
(C)	Cosmids
(D)	pUC19 plasmid
Q.46	The following reaction represents biomass synthesis from hexadecane $C_{16}H_{34} + 12.5O_2 + 2.13NH_3 \rightarrow 10.6CH_{1.66}O_{0.27}N_{0.27} + 5.37CO_2 + 11.4H_2O$ where $CH_{1.66}O_{0.27}N_{0.27}$ represents the biomass. The value of respiratory quotient (rounded off to two decimal places) is _____.
Q.47	Temperature of a reaction with an activation energy value of $15\,kcal.mol^{-1}$ is increased from 300 K to 310 K. If the value of the ideal gas constant (R) is 1.9872 $cal.mol^{-1}.K^{-1}$, the ratio of the reaction rate constants $\left(k_{310}/k_{300}\right)$ (rounded off to two decimal places) is _____.
Q.48	*E. coli* is cultivated in a chemostat operated at a dilution rate of $0.2\ h^{-1}$. The values of biomass yield due to oxygen consumption and the steady state biomass concentration are $0.2\,g.g^{-1}$ and $10\,g.L^{-1}$, respectively. The oxygen transfer rate (in $g.L^{-1}.h^{-1}$) is _____.

Q.49	Aqueous two-phase extraction is used to recover α-amylase from a solution. A polypropylene glycol-dextran mixture is added and the solution separates into upper and lower phases. The partition coefficient is 4.0 and the ratio of upper to lower phase volume is 5.0. The enzyme recovery or yield (in percentage, rounded off to the nearest integer) is _____.
Q.50	*E. coli* cultivated at 298 K uptakes an uncharged compound (A) by passive diffusion. The intracellular and extracellular concentrations of A are 0.001 M and 0.1 M, respectively. If the value of the ideal gas constant R is 1.9872 $cal.mol^{-1}.K^{-1}$, the free-energy change (in $kcal.mol^{-1}$) for this passive diffusion of A (rounded off to two decimal places) is _____.
Q.51	If there are three unrooted trees for four protein sequences, the number of rooted trees for the same number of sequences is _____.
Q.52	The number of different possible ways of forming five intramolecular disulfide bonds with ten cysteine residues of a protein is _____.

Q.53 The following schematic diagram shows a chemostat with cell recycle



where F_0 and F_r are the volumetric flow rates (in $L.h^{-1}$) of feed and recycle streams, respectively. X_1, X_0 and X are the cell concentrations (in $g.L^{-1}$) in the reactor, recycle-stream and product-stream, respectively. If $\frac{X_0}{X_1}=1.5, \frac{F_r}{F_0}=0.7$ and X_1 is $7.3\, g.L^{-1}$, the value of X (in $g.L^{-1}$, rounded off to one decimal place) is _____.

Q.54 An enzyme (E) catalyzes the biochemical reaction $A \rightarrow B$ with k_{cat} equal to $500\, s^{-1}$. If the initial reaction velocity (V_0) is $10\, \mu M.s^{-1}$ at the total enzyme concentration [E_t] of 30 nM and substrate concentration [A] of $40\, \mu M$, the value of K_m (in μM) is _____.

Q.55 DNA sample collected from an unidentified bacterial species (Y) contains 13% of adenine. The G+C content (in percentage) of Y is _____.

Q.56	If 1000 bp of a double-helical DNA weighs 1×10^{-18} gm and distance between two bp is $0.34\,nm$, the total amount of DNA (in mg, rounded off to one decimal place) required to stretch from Earth to Moon (assuming the distance between Earth and Moon to be 3,74,000 km) is _____.
Q.57	A protein has three identical sites arranged at the vertices of an equilateral triangle. If one site is filled with a dye (donor), the measured quantum yield (ϕ_D) is 0.5. Filling one site with a donor dye and a second site with an acceptor dye results in ϕ_D of 0.25. The measured ϕ_D of one site filled with donor and the other two sites filled with acceptor dye (rounded off to three decimal places) is _____.
Q.58	If $A=\begin{pmatrix}1 & 2\\ 3 & 5\end{pmatrix}$, the value of $\left\|A^4+3A^2-5A+6I\right\|$ is _____.
Q.59	If $f(x)=\dfrac{\sin x+\cos x}{\sin x-\cos x}$, the value of $f'(x)$ at $x=0$ is _____.
Q.60	If $f(2)=5$ and $(f(x))(f(x+1))=3$ for all real values of x, the value of $f(10)$ is _____.
Q.61	Ten playing cards numbered 1, 2, 3, …., 10 are placed face down on a table. One card is drawn at random, its number recorded, and then replaced face down. A card is drawn again at random. The probability that the number on the second draw is greater than the number on the first draw (rounded off to two decimal places) is _____.

Q.62	The values of the consistency index 'K' and the flow behavior index 'n' of a dilatant fluid are 0.415 (in CGS units) and 1.23, respectively. The value of the apparent viscosity (in $g.cm^{-1}.s^{-1}$) of this fluid at a shear rate of $60\,s^{-1}$ (rounded off to the nearest integer) is _____.
Q.63	An evaporator is insulated using glass wool material of 0.15 m thickness. The inner most surface and the outer surface of the insulation are at $700\ ^{\circ}C$ and $80\ ^{\circ}C$, respectively. The mean thermal conductivity of the glass wool under these conditions is $0.29\ W.m^{-1}.K^{-1}$. The rate of heat loss (in W) through $1.2\ m^2$ of the evaporator wall surface (rounded off to the nearest integer) is _____.
Q.64	A proportional controller is used to control the temperature of an autoclave from $60\,^{\circ}C$ to $130\,^{\circ}C$. If the proportional band setting of the controller is 25%, the proportional gain value is _____.
Q.65	A dNTP master-mix is prepared by combining $40\,\mu L$ of each $20\,mM$ dNTP stock (dATP, dCTP, dGTP and dTTP). $4\,\mu L$ of this dNTP master-mix is added to a PCR mix and the final volume is adjusted to $50\,\mu L$. The concentration (in μM) of total dNTPs in the PCR mix is _____.

END OF QUESTION PAPER

GATE 2023 Biotechnology (BT)

Q. No.	Session	Question Type (QT) MCQ/MSQ/NAT	Subject Name (SN)	Key/Range (KY)	Mark (MK)
1	6	MCQ	GA	B	1
2	6	MCQ	GA	C	1
3	6	MCQ	GA	B	1
4	6	MCQ	GA	D	1
5	6	MCQ	GA	C	1
6	6	MCQ	GA	D	2
7	6	MCQ	GA	A	2
8	6	MCQ	GA	C	2
9	6	MCQ	GA	A	2
10	6	MCQ	GA	D	2
11	6	MCQ	BT	A	1
12	6	MCQ	BT	A	1
13	6	MCQ	BT	D	1
14	6	MCQ	BT	B	1
15	6	MCQ	BT	A	1
16	6	MCQ	BT	D	1
17	6	MCQ	BT	A	1
18	6	MCQ	BT	A	1
19	6	MCQ	BT	A	1
20	6	MCQ	BT	A	1
21	6	MCQ	BT	A	1
22	6	MCQ	BT	A	1
23	6	MCQ	BT	A	1
24	6	MCQ	BT	A	1
25	6	MCQ	BT	A	1
26	6	MCQ	BT	C	1
27	6	MCQ	BT	C	1
28	6	MCQ	BT	C	1
29	6	MCQ	BT	A	1
30	6	NAT	BT	25 to 25	1
31	6	NAT	BT	6 to 6	1
32	6	NAT	BT	2500 to 2500	1
33	6	NAT	BT	0.10 to 0.12	1
34	6	NAT	BT	0.166 to 0.168	1
35	6	NAT	BT	1.40 to 1.42	1
36	6	MCQ	BT	A	2
37	6	MCQ	BT	A	2
38	6	MCQ	BT	A	2
39	6	MSQ	BT	B, C	2
40	6	MSQ	BT	A, B, C	2
41	6	MSQ	BT	A, B, D	2
42	6	MSQ	BT	A, C	2
43	6	MSQ	BT	A, B, C	2
44	6	MSQ	BT	A, B, C	2
45	6	MSQ	BT	A, B	2

46	6	NAT	BT	0.41 to 0.44	2
47	6	NAT	BT	2.24 to 2.26	2
48	6	NAT	BT	10 to 10	2
49	6	NAT	BT	94 to 96	2
50	6	NAT	BT	-2.74 to -2.71	2
51	6	NAT	BT	15 to 15	2
52	6	NAT	BT	945 to 945	2
53	6	NAT	BT	4.6 to 4.9	2
54	6	NAT	BT	20 to 20	2
55	6	NAT	BT	74 to 74	2
56	6	NAT	BT	1.0 to 1.2	2
57	6	NAT	BT	0.165 to 0.168	2
58	6	NAT	BT	10551 to 10551	2
59	6	NAT	BT	-2 to -2	2
60	6	NAT	BT	5 to 5	2
61	6	NAT	BT	0.45 to 0.45	2
62	6	NAT	BT	1 to 1	2
63	6	NAT	BT	1437 to 1439	2
64	6	NAT	BT	4 to 4	2
65	6	NAT	BT	1600 to 1600	2