Materials Science (XE - C)

Question Number : 34 **Correct : 1 Wrong : -0.33**

Which of the following is a Frenkel defect?

(A) One Cl vacancy and one Na vacancy in NaCl
(B) One Zn vacancy and one Zn interstitial in ZnO
(C) K at the Na site in NaCl
(D) None of the above

Question Number : 35 **Correct : 1 Wrong : -0.33**

Which processing technique is best suited for manufacturing decorative PVC floor tiles?

(A) Blow molding
(B) Filament winding
(C) Rotational molding
(D) Calendering

Question Number : 36 **Correct : 1 Wrong : -0.33**

During deformation of a semi-crystalline polymer, with spherulitic morphology, stressed in tension, what happens to the amorphous and the crystalline regions at the later stages?

(A) Amorphous regions remain intact and only crystallites experience bending and stretching of chains
(B) Only amorphous regions elongate in the stress direction and crystallites remain intact
(C) Amorphous regions elongate in the stress direction and crystallites experience bending and stretching of chains
(D) None of the above

Question Number : 37 **Correct : 1 Wrong : -0.33**

Which of the following statement(s) is / are true regarding the structure-property correlation in polymers?

(i) Polymers that are less coiled are more crystalline than those that are more coiled
(ii) Branched polymers are more crystalline than the linear ones
(iii) Polymers with inter-chain interactions have higher glass transition temperature than those without inter-chain interactions
(iv) Polymers with inter-chain interactions are more crystalline than those without inter-chain interactions

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

Question Number : 38 **Correct : 1 Wrong : -0.33**

The contrast obtained in scanning electron microscope using back scattered electrons depends on

(A) Atomic number of the specimen material
(B) Accelerating voltage of the microscope
(C) Working distance in the microscope
(D) Type of the electron emitter in the microscope

Question Number : 39 **Correct : 1 Wrong : -0.33**

Ceramic materials fail at stresses much lower than their theoretical strength due to

(A) Presence of dislocations
(B) High elastic modulus
(C) Presence of voids
(D) Anisotropy in crystal structure

Question Number : 40 **Correct : 1 Wrong : -0.33**

The Miller indices of the first three Bragg peaks in the X-ray diffraction pattern obtained from a polycrystalline iron sample at room temperature are

(A) (111), (200), (220)
(B) (100), (110), (111)
(C) (100), (110), (200)
(D) (110), (200), (220)

Question Number : 41 **Correct : 1 Wrong : -0.33**

The number of close packed planes in the lattice of an FCC metal is

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

Question Number : 42 **Correct : 1 Wrong : -0.33**

Which of the following treatment(s) can increase the electrical conductivity of silicon

(i) Heating
(ii) Doping with arsenic
(iii) Doping with aluminium
(iv) Exposure to light

(A) Only (i)
(B) Only (i) and (ii)
(C) Only (i), (ii) and (iv)
(D) All (i), (ii), (iii) and (iv)

Question Number : 43 **Correct : 2 Wrong : 0**

The unit cell volume of polyethylene (PE) is 0.0933 nm^3. Assuming two ethylene repeat units are contained within each unit cell, the density of a totally crystalline PE will be ..... g/cm^3 (Take the atomic weights for carbon and hydrogen as 12.01 g/mol and 1.008 g/mol, respectively and the Avogadro's number as 6.023×10^{23} repeat units/mol)

Question Number : 44 **Correct : 2 Wrong : 0**

A continuous, aligned carbon fibre (CF) reinforced polymer composite with 30 vol% of CF and rest resin was designed for a specific application. The modulus of elasticity of CF is 170 GPa and that of the resin is 3.0 GPa. The modulus of elasticity for this composite in the direction of fibre alignment is .....GPa.

Question Number : 45 **Correct : 2 Wrong : -0.66**

Match the composites in Column I with the most suitable application in Column II

Column I	Column II
(P) Exfoliated silicates filled butyl rubber	(1) Automobile pistons
(Q) Fiber reinforced aluminium alloy	(2) Contact lenses
(R) Silicon carbide whiskers reinforced alumina	(3) Ski boards
(S) Carbon particles reinforced plastic composites	(4) Tennis balls
	(5) Cutting tool inserts for machining

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

Question Number : 46 **Correct : 2 Wrong : -0.66**

Match the processes in Column I with products in Column II

Column I	Column II
(P) Slip casting	(1) Metal powders
(Q) Zone refining	(2) Thin films
(R) Sputtering	(3) Ceramic parts
(S) Atomization	(4) Single crystal
	(5) Metal sheets

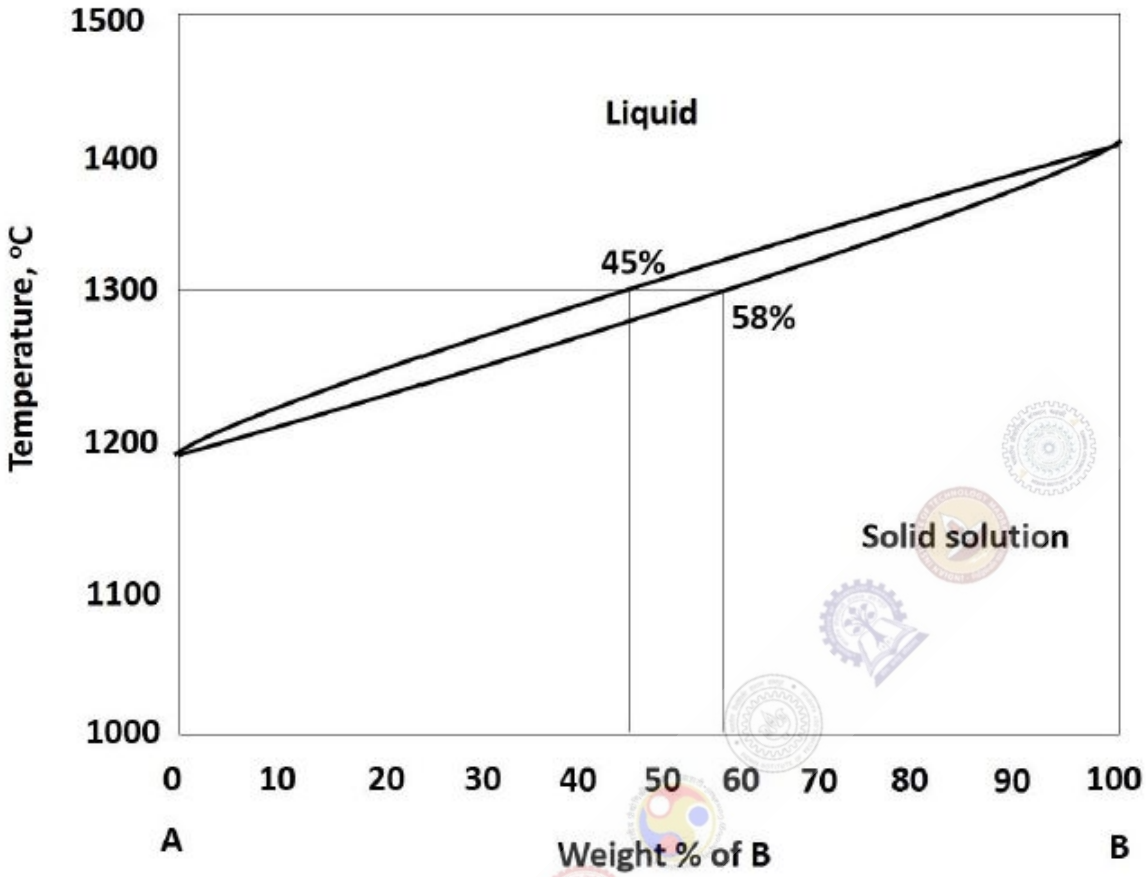
(A) P-3; Q-4; R-2; S-1
(B) P-2; Q-1; R-2; S-1
(C) P-3; Q-4; R-5; S-1
(D) P-3; Q-4; R-1; S-5

Question Number : 47 **Correct : 2 Wrong : 0**

The value of diffusivity (D) for the diffusion of carbon (C) in γ-iron at 727 °C is…….x10^{-13} m^2/s
(Given $D_o = 2x10^{-5}$ m^2/s; activation energy, Q = 142 kJ/mol; R = 8.314 J/mol. K)

Question Number : 48 **Correct : 2 Wrong : 0**

Refer to the figure below:



If the alloy contains 47 wt. % of A and 53 wt. % of B at 1300 °C, the wt. % of liquid present in the alloy at this temperature will be ……..

Question Number : 49 **Correct : 2 Wrong : -0.66**

Which of the following statement(s) is/are true

(i) All piezoelectric materials are necessarily ferroelectric
(ii) All ferroelectric materials are necessarily piezoelectric
(iii) All pyroelectric materials are necessarily piezoelectric
(iv) All pyroelectric materials are necessarily ferroelectric

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

Question Number : 50 **Correct : 2 Wrong : 0**

If the energy of formation of vacancies in pure copper is 0.9 eV, the fraction of vacancies in pure copper at 27 °C will be .....$x10^{-16}$ (Boltzmann's constant is $8.62x10^{-5}$ eV/K)

Question Number : 51 **Correct : 2 Wrong : 0**

A ceramic material with a critical flaw size of 30 μm has fracture stress of 300 MPa. For the same material the fracture stress for a critical flaw size of 90 μm will be .....MPa.

Question Number : 52 **Correct : 2 Wrong : -0.66**

An inorganic material that is transparent under solar light appears coloured when doped with transition metal ions. The possible reason(s) for the colour is/are

(i) The electronic energy levels of the host material changes significantly by doping
(ii) The doped element selectively absorbs certain wavelength of light other than the perceived colour
(iii) The doped element emits radiation of specific wavelength

Which of the above statement(s) is/are true?

(A) Only (i) (B) Both (i) and (ii) (C) Both (i) and (iii) (D) Both (ii) and (iii)

Question Number : 53 **Correct : 2 Wrong : 0**

Copper is an FCC metal with lattice parameter of 3.62 Å. Hall effect measurement shows electron mobility to be $3.2x10^{-3}$ $m^2V^{-1}s^{-1}$. Electrical resistivity of copper is $1.7 x10^{-8}$ Ωm. The average number of free electrons per atom in copper is .....(Charge of an electron: $1.6x10^{-19}$ C)

Question Number : 54 **Correct : 2 Wrong : -0.66**

In an ionic solid the cation and the anion have ionic radii as 0.8 Å and 1.6 Å respectively. The maximum coordination number of the cation in the structure will be

(A) 3 (B) 4 (C) 6 (D) 8

Question Number : 55 **Correct : 2 Wrong : -0.66**

Which of the following statement(s) is / are true regarding susceptibility of a material

(i) Magnetic susceptibility is positive for a diamagnetic material
(ii) Magnetic susceptibility is negative for a diamagnetic material
(iii) Magnetic susceptibility is negative for an antiferromagnetic material
(iv) Magnetic susceptibility is positive for a paramagnetic material

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

General Aptitude

Question Number : 166 **Correct : 1 Wrong : -0.33**

The event would have been successful if you _____able to come.

(A) are (B) had been (C) have been (D) would have been

Question Number : 167 **Correct : 1 Wrong : -0.33**

There was no doubt that their work was thorough.

Which of the words below is closest in meaning to the underlined word above?

(A) pretty (B) complete (C) sloppy (D) haphazard

Question Number : 168 Correct : 1 Wrong : -0.33

Four cards lie on a table. Each card has a number printed on one side and a colour on the other. The faces visible on the cards are 2, 3, red, and blue.

Proposition: If a card has an even value on one side, then its opposite face is red.

The cards which MUST be turned over to verify the above proposition are

(A) 2, red (B) 2, 3, red (C) 2, blue (D) 2, red, blue

Question Number : 169 Correct : 1 Wrong : -0.33

What is the value of x when $81 \times \left(\frac{16}{25}\right)^{x+2} \div \left(\frac{3}{5}\right)^{2x+4} = 144$?

(A) 1 (B) -1 (C) -2 (D) Cannot be determined

Question Number : 170 Correct : 1 Wrong : -0.33

Two dice are thrown simultaneously. The probability that the product of the numbers appearing on the top faces of the dice is a perfect square is

(A) 1/9 (B) 2/9 (C) 1/3 (D) 4/9

Question Number : 171 Correct : 2 Wrong : -0.66

Bhaichung was observing the pattern of people entering and leaving a car service centre. There was a single window where customers were being served. He saw that people inevitably came out of the centre in the order that they went in. However, the time they spent inside seemed to vary a lot: some people came out in a matter of minutes while for others it took much longer.

From this, what can one conclude?

(A) The centre operates on a first-come-first-served basis, but with variable service times, depending on specific customer needs.
(B) Customers were served in an arbitrary order, since they took varying amounts of time for service completion in the centre.
(C) Since some people came out within a few minutes of entering the centre, the system is likely to operate on a last-come-first-served basis.
(D) Entering the centre early ensured that one would have shorter service times and most people attempted to do this.

Question Number : 172 **Correct : 2 Wrong : -0.66**

A map shows the elevations of Darjeeling, Gangtok, Kalimpong, Pelling, and Siliguri. Kalimpong is at a lower elevation than Gangtok. Pelling is at a lower elevation than Gangtok. Pelling is at a higher elevation than Siliguri. Darjeeling is at a higher elevation than Gangtok.

Which of the following statements can be inferred from the paragraph above?

i. Pelling is at a higher elevation than Kalimpong
ii. Kalimpong is at a lower elevation than Darjeeling
iii. Kalimpong is at a higher elevation than Siliguri
iv. Siliguri is at a lower elevation than Gangtok

(A) Only ii (B) Only ii and iii (C) Only ii and iv (D) Only iii and iv

Question Number : 173 **Correct : 2 Wrong : -0.66**

P, Q, R, S, T and U are seated around a circular table. R is seated two places to the right of Q. P is seated three places to the left of R. S is seated opposite U. If P and U now switch seats, which of the following must necessarily be true?

(A) P is immediately to the right of R
(B) T is immediately to the left of P
(C) T is immediately to the left of P or P is immediately to the right of Q
(D) U is immediately to the right of R or P is immediately to the left of T

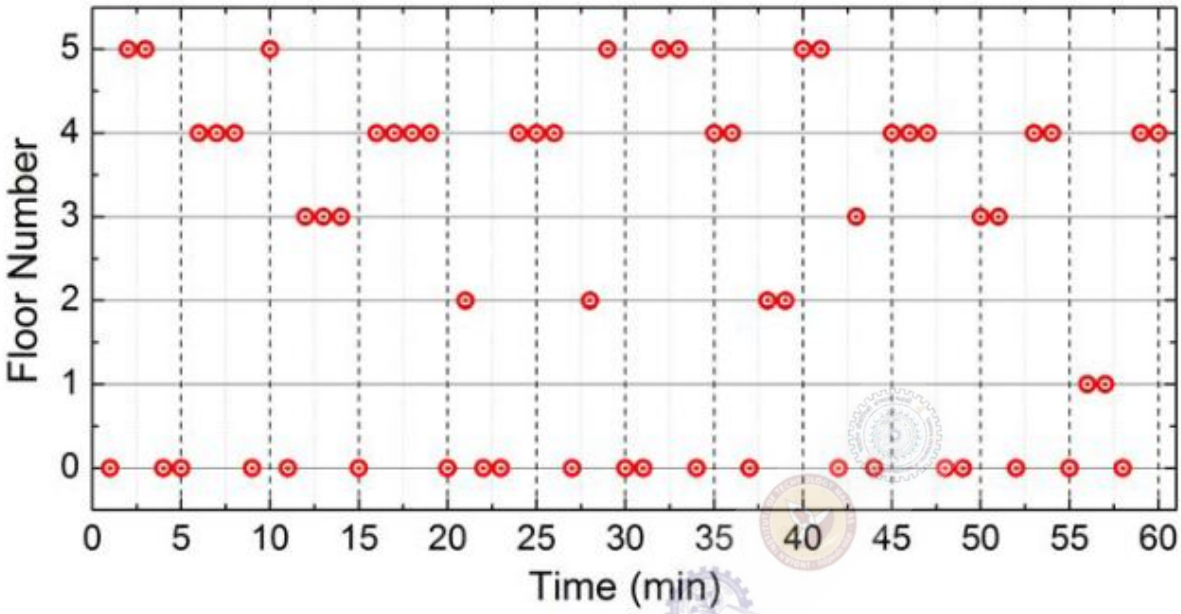
Question Number : 174 **Correct : 2 Wrong : -0.66**

Budhan covers a distance of 19 km in 2 hours by cycling one fourth of the time and walking the rest. The next day he cycles (at the same speed as before) for half the time and walks the rest (at the same speed as before) and covers 26 km in 2 hours. The speed in km/h at which Budhan walks is

(A) 1 (B) 4 (C) 5 (D) 6

Question Number : 175 **Correct : 2 Wrong : -0.66**

The points in the graph below represent the halts of a lift for durations of 1 minute, over a period of 1 hour.



Which of the following statements are correct?

i. The elevator never moves directly from any non-ground floor to another non-ground floor over the one hour period

ii. The elevator stays on the fourth floor for the longest duration over the one hour period

(A)) Only i (B) Only ii (C) Both i and ii (D) Neither i nor ii

Q. No.	Type	Section	Key	Marks
1	NAT	XE-A	2.98 to 3.02	1
2	MCQ	XE-A	D	1
3	NAT	XE-A	6.98 to 7.02	1
4	NAT	XE-A	2.98 to 3.02	1
5	MCQ	XE-A	C	1
6	NAT	XE-A	7.98 to 8.02	1
7	MCQ	XE-A	C	1
8	MCQ	XE-A	A	2
9	NAT	XE-A	0.98 to 1.02	2
10	NAT	XE-A	-0.02 to 0.02	2
11	MCQ	XE-A	C	2
12	MCQ	XE-B	B	1
13	MCQ	XE-B	B	1
14	MCQ	XE-B	C	1
15	MCQ	XE-B	A	1
16	MCQ	XE-B	D	1
17	MCQ	XE-B	D	1
18	MCQ	XE-B	A	1
19	NAT	XE-B	22.6 to 22.6	1
20	MCQ	XE-B	A	1
21	NAT	XE-B	72.5 to 75.0	2
22	NAT	XE-B	62 to 66	2
23	MCQ	XE-B	D	2
24	MCQ	XE-B	C	2
25	NAT	XE-B	0.66 to 0.67	2
26	NAT	XE-B	6005 to 6005	2
27	NAT	XE-B	0.05 to 0.06	2
28	MCQ	XE-B	D	2
29	NAT	XE-B	1.3 to 1.4	2
30	NAT	XE-B	28.9 to 31.4	2
31	NAT	XE-B	0.21 to 0.22	2
32	NAT	XE-B	7.0 to 7.2	2
33	MCQ	XE-B	B	2
34	MCQ	XE-C	B	1
35	MCQ	XE-C	D	1
36	MCQ	XE-C	C	1

37	MCQ	XE-C	B	1
38	MCQ	XE-C	A	1
39	MCQ	XE-C	C	1
40	MCQ	XE-C	D	1
41	MCQ	XE-C	B	1
42	MCQ	XE-C	D	1
43	NAT	XE-C	0.990 to 1.010	2
44	NAT	XE-C	53.0 to 53.2	2
45	MCQ	XE-C	A	2
46	MCQ	XE-C	A	2
47	NAT	XE-C	7.5 to 7.7	2
48	NAT	XE-C	37.5 to 38.5	2
49	MCQ	XE-C	B	2
50	NAT	XE-C	7.50 to 7.80	2
51	NAT	XE-C	172 to 174	2
52	MCQ	XE-C	D	2
53	NAT	XE-C	1.35 to 1.37	2
54	MCQ	XE-C	C	2
55	MCQ	XE-C	A	2
56	NAT	XE-D	69 to 73	1
57	MCQ	XE-D	B	1
58	MCQ	XE-D	C	1
59	MCQ	XE-D	C	1
60	MCQ	XE-D	A	1
61	MCQ	XE-D	B	1
62	MCQ	XE-D	A	1
63	NAT	XE-D	0.26 to 0.28	1
64	MCQ	XE-D	A	1
65	MCQ	XE-D	D	2
66	NAT	XE-D	134 to 136	2
67	NAT	XE-D	0.55 to 0.65	2
68	NAT	XE-D	1785 to 1792	2
69	NAT	XE-D	0.45 to 0.50	2
70	NAT	XE-D	32 to 35	2
71	NAT	XE-D	10 to 10	2
72	NAT	XE-D	02 to 02	2
73	MCQ	XE-D	A	2

74	NAT	XE-D	17 to 18	2
75	MCQ	XE-D	C	2
76	MCQ	XE-D	B	2
77	MCQ	XE-D	B	2
78	MCQ	XE-E	B	1
79	MCQ	XE-E	C	1
80	MCQ	XE-E	C	1
81	NAT	XE-E	0.17 to 0.18	1
82	MCQ	XE-E	B	1
83	MCQ	XE-E	D	1
84	MCQ	XE-E	A	1
85	MCQ	XE-E	B	1
86	NAT	XE-E	499 to 501	1
87	NAT	XE-E	53 to 55	2
88	MCQ	XE-E	D	2
89	NAT	XE-E	0.026 to 0.030	2
90	NAT	XE-E	73.5 to 73.8	2
91	NAT	XE-E	2.2 to 2.2	2
92	NAT	XE-E	0.140 to 0.150	2
93	MCQ	XE-E	C	2
94	MCQ	XE-E	A	2
95	MCQ	XE-E	A	2
96	NAT	XE-E	2225 to 2230	2
97	NAT	XE-E	0.76 to 0.82	2
98	NAT	XE-E	29.0 to 30.0	2
99	NAT	XE-E	60.5 to 61.5	2
100	MCQ	XE-F	D	1
101	MCQ	XE-F	B	1
102	MCQ	XE-F	A	1
103	MCQ	XE-F	C	1
104	MCQ	XE-F	A	1
105	MCQ	XE-F	D	1
106	MCQ	XE-F	C	1
107	MCQ	XE-F	D	1
108	MCQ	XE-F	A	1
109	MCQ	XE-F	B	2
110	MCQ	XE-F	C	2

111	NAT	XE-F	55.95 to 56.55	2
112	NAT	XE-F	1.14 to 1.24	2
113	MCQ	XE-F	C	2
114	NAT	XE-F	410 to 418	2
115	MCQ	XE-F	B	2
116	MCQ	XE-F	A	2
117	NAT	XE-F	98.5 to 99.5	2
118	NAT	XE-F	41.00 to 42.20	2
119	MCQ	XE-F	D	2
120	NAT	XE-F	-67.3 to -66.3	2
121	MCQ	XE-F	B	2
122	MCQ	XE-G	B	1
123	MCQ	XE-G	B	1
124	MCQ	XE-G	D	1
125	MCQ	XE-G	B	1
126	NAT	XE-G	1000 to 1000	1
127	MCQ	XE-G	A	1
128	NAT	XE-G	2078 to 2086	1
129	NAT	XE-G	0.80 to 0.90	1
130	MCQ	XE-G	A	1
131	MCQ	XE-G	C	2
132	MCQ	XE-G	B	2
133	MCQ	XE-G	D	2
134	NAT	XE-G	25550 to 25650	2
135	MCQ	XE-G	D	2
136	NAT	XE-G	53.30 to 55.25	2
137	NAT	XE-G	64.0 to 64.0	2
138	NAT	XE-G	0.14 to 0.18	2
139	MCQ	XE-G	D	2
140	NAT	XE-G	6.80 to 7.20	2
141	NAT	XE-G	10.80 to 11.20	2
142	NAT	XE-G	9000 to 9000	2
143	NAT	XE-G	0.30 to 0.40	2
144	MCQ	XE-H	B	1
145	MCQ	XE-H	C	1
146	NAT	XE-H	98.9 to 100.5	1
147	MCQ	XE-H	D	1

148	MCQ	XE-H	B	1
149	MCQ	XE-H	D	1
150	MCQ	XE-H	C	1
151	MCQ	XE-H	A	1
152	MCQ	XE-H	B	1
153	NAT	XE-H	22.05 to 22.15	2
154	NAT	XE-H	0.59 to 0.61	2
155	NAT	XE-H	286.55 to 287.55	2
156	MCQ	XE-H	C	2
157	NAT	XE-H	-4.10 to -3.90	2
158	NAT	XE-H	0.42 to 0.46	2
159	NAT	XE-H	51 to 52	2
160	MCQ	XE-H	B	2
161	MCQ	XE-H	A	2
162	NAT	XE-H	199 to 205	2
163	MCQ	XE-H	D	2
164	MCQ	XE-H	C	2
165	MCQ	XE-H	B	2
166	MCQ	GA	B	1
167	MCQ	GA	B	1
168	MCQ	GA	C	1
169	MCQ	GA	B	1
170	MCQ	GA	B	1
171	MCQ	GA	A	2
172	MCQ	GA	C	2
173	MCQ	GA	C	2
174	MCQ	GA	D	2
175	MCQ	GA	D	2