SECTION – A

MULTIPLE CHOICE QUESTIONS (MCQ)

Q. 1 – Q.10 carry one mark each.

Q.1 Which one of the following minerals exhibits luminescence when exposed to ultraviolet light?

(A) Cassiterite (B) Wolframite (C) Tantalite (D) Scheelite

Q.2 In which one of the following mass extinction periods trilobites became extinct?

(A) Devonian (B) Permian (C) Triassic (D) Cretaceous

Q.3 En-echelon sigmoidal 'gash' veins indicate

(A) ductile shear zone
(B) brittle-ductile shear zone
(C) brittle shear zone
(D) saddle reef structure

Q.4 Which one of the following primary sedimentary structures is NOT used for palaeocurrent analysis?

(A) Current crescent
(B) Flute marks
(C) Symmetrical wave ripples
(D) Imbrication of pebbles

Q.5 The age of the Patcham Formation is

(A) Permian (B) Triassic (C) Jurassic (D) Cretaceous

Q.6 Rivers that receive water from groundwater seepage are termed as

(A) effluent rivers
(B) consequent rivers
(C) influent rivers
(D) braided rivers

Q.7 Conservative plate boundary is represented by

(A) normal fault
(B) growth fault
(C) transform fault
(D) reverse fault

Q.8 Which one of the following prismatic crystal forms belongs to the hexagonal crystal system?

(A) $\{11\bar{2}0\}$ (B) $\{h0\bar{h}l\}$ (C) $\{0001\}$ (D) $\{hk0\}$

Q.9 The characteristic rock of contact metamorphism is

(A) hornfels (B) blueschist (C) eclogite (D) granulite

Q.10 The volcanic equivalent of nepheline syenite is

(A) rhyolite (B) basanite (C) phonolite (D) andesite

Q. 11 – Q. 30 carry two marks each.

Q.11 Identify the correct match between mineral/ore and its physical property.

(A) Hematite - Yellow streak
(B) Barite - High specific gravity
(C) Psilomelane - Comb structure
(D) Azurite - Distinctive green colour

Q.12 Match the mineral deposits in Group I with their Indian occurrences in Group II.

Group I	Group II
P. Chromite	1. Jhamarkotra, Rajasthan
Q. Magnesite	2. Gudur, Andhra Pradesh
R. Mica	3. Byrapur, Karnataka
S. Phosphorite	4. Chalk Hills, Tamil Nadu

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

Q.13 A helically coiled ammonite *Turrilites* is differentiated from externally resembling Gastropoda *Turritella* by

(A) apical angle
(B) number of whorls
(C) direction of coiling
(D) chambered shell

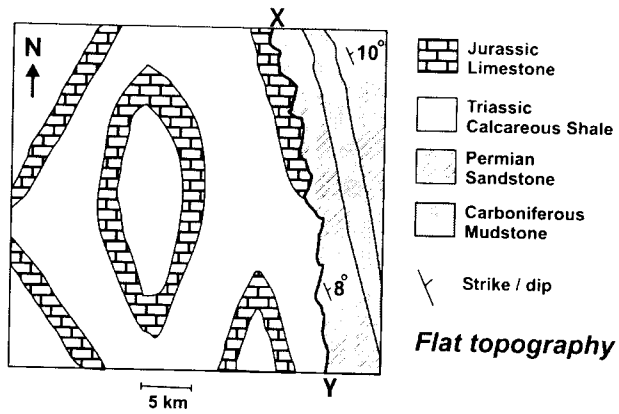
Q.14 The facial suture of trilobites running through the genal angle is known as

(A) proparian (B) marginal (C) gonatoparian (D) opisthoparian

Q.15 Which one of the following statements is correct for Class 1B (Parallel) folds?

(A) Orthogonal thickness at hinge > that at limb
(B) Axial planar thickness at hinge = that at limb
(C) Dip isogons are parallel
(D) Dip isogons are convergent

Q.16 In the given map, the **X-Y** surface has the same orientation as in the Palaeozoic sequence. **X-Y** represents



(A) angular unconformity
(B) non-conformity
(C) normal fault
(D) thrust

Q.17 Match the sedimentary features in Group I with the corresponding sedimentary environments of their formation in Group II.

Group I	Group II
P. Point Bar	1. Tidal
Q. Barchan	2. Meandering fluvial channel
R. Dropstone	3. Aeolian
S. Herring-bone cross stratification	4. Glacial

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

Q.18 Which one of the following lithostratigraphic units is of Phanerozoic Eon?

(A) Sargur Group
(B) Semri Group
(C) Uttatur Group
(D) Papaghni Group

Q.19 Match the geological processes (Group I) with their examples in Indian stratigraphy (Group II).

Group I	Group II
P. Permo-Carboniferous glaciation	1. Ariyalur Group
Q. Cretaceous marine transgression	2. Siwalik Group
R. Neogene fluvial sedimentation	3. Talchir Formation
S. Cretaceous inter-trappean sedimentation	4. Lameta Formation

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

Q.20 Check dams are constructed in association with main dam in the

(A) upstream of the main dam to check the siltation of the reservoir
(B) downstream of the main dam to check the siltation of the reservoir
(C) upstream of the main dam to check the seepage from the reservoir
(D) downstream of the main dam to check the seepage from the reservoir

Q.21 A geological formation neither containing nor transmitting water is termed as

(A) aquiclude
(B) aquitard
(C) aquifer
(D) aquifuge

Q.22 Which one of the following sequences of silicate structures indicates an increasing degree of sharing of corners of $(SiO_4)^{4-}$ tetrahedra?

(A) Nesosilicate → Single-chain inosilicate → Phyllosilicate → Tectosilicate
(B) Tectosilicate → Phyllosilicate → Single-chain inosilicate → Nesosilicate
(C) Nesosilicate → Phyllosilicate → Single-chain inosilicate → Tectosilicate
(D) Single-chain inosilicate → Nesosilicate → Phyllosilicate → Tectosilicate

Q.23 Match the igneous bodies in Group I with their ages in Group II.

Group I	Group II
P. Singhbhum granite	1. Neoproterozoic
Q. Malani rhyolite	2. Cretaceous
R. Deccan volcanics	3. Permian
S. Panjal Traps	4. Archaean

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

Q.24 The tubefeet in echinoids emerge through

(A) interambulacral plates
(B) ambulacral plates
(C) bourrelets
(D) plastron

Q.25 A mineral with a point group symmetry 2/m

(A) has two optic axes
(B) shows inclined extinction in (100) section
(C) shows straight extinction in (010) section
(D) is uniaxial

Q.26 The progressive metamorphic isograd sequence that explains Barrovian metamorphism in pelite is

(A) chlorite → staurolite → biotite → kyanite → sillimanite
(B) chlorite → andalusite → cordierite → sillimanite
(C) chlorite → biotite → garnet → staurolite → kyanite → sillimanite
(D) sillimanite → kyanite → staurolite → garnet → biotite → chlorite

Q.27 In metabasic rocks, plagioclase is not stable in

(A) granulite facies
(B) epidote amphibolite facies
(C) amphibolite facies
(D) eclogite facies

Q.28 A sandstone has < 5% matrix. The recalculated modal compositions of feldspar, quartz and rock fragments are 45%, 35%, 20%, respectively. The sandstone is classified as

(A) feldspathic wacke
(B) quartz wacke
(C) lithic arkose
(D) subfeldsarenite

Q.29 Match the earth layers (Group I) with corresponding approximate thicknesses (Group II).

Group I	Group II
P. Lithosphere	1. 2900 km
Q. Mantle	2. 2250 km
R. Outer Core	3. 1200 km
S. Inner Core	4. 100 km

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

Q.30 Pressure (1GPa = 10 kbar) and temperature at the centre of the Earth are estimated to be

(A) 360 GPa, 2600 K
(B) 450 GPa, 6000 K
(C) 360 GPa, 6000 K
(D) 450 GPa, 2600 K

SECTION - B

MULTIPLE SELECT QUESTIONS (MSQ)

Q. 31 – Q. 40 carry two marks each.

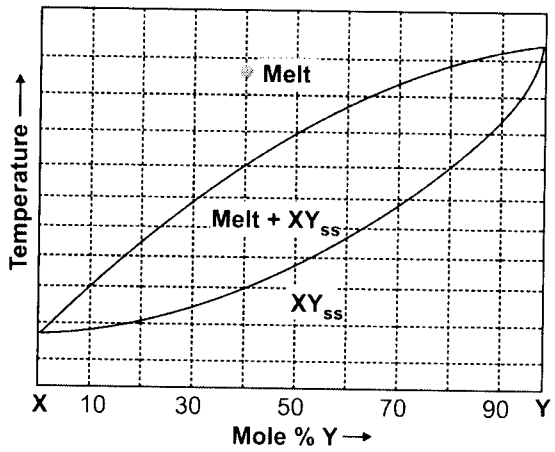
Q.31 Choose the landform(s) resulting from glacial erosion.

(A) Fjords (B) Moraines (C) Drumlins (D) Cirques

Q.32 Choose the correct combination(s) of type of dentition of Bivalvia and the corresponding representative genus.

(A) Taxodont - *Nucula*
(B) Isodont - *Spondylus*
(C) Pachydont - *Hippurites*
(D) Desmodont - *Mya*

Q.33 Shown below is an isobaric binary temperature-composition phase diagram in the system X-Y with complete miscibility between X and Y.



Which of the following statements is/are correct for crystallization of a starting melt of composition $X_{60}Y_{40}$ (the dot in the diagram)?

(A) The first formed crystal has a composition of $X_{20}Y_{80}$.
(B) The final melt composition during equilibrium crystallization is $X_{90}Y_{10}$.
(C) In case of fractional crystallization, the final melt is enriched in X than $X_{90}Y_{10}$.
(D) For fractional crystallization, the final crystal composition is $X_{60}Y_{40}$.

Q.34 Choose the correct combination(s) of textural features of magmatic rocks with corresponding petrological processes from the following.

(A) ophitic texture in dolerite - *peritectic crystallization*
(B) perthite in granite - *slow subsolidus cooling*
(C) spinifex texture in komatiite - *eruption of ultramafic lava*
(D) orthopyroxene rim around olivine in peridotite - *eutectic crystallization*

Q.35 Which of the following statements is/are NOT correct?

(A) (110) lies in zone [001]
(B) (021) lies in zone [100]
(C) (101) lies in zone [010]
(D) (111) lies in zone $[1\bar{1}1]$

Q.36 In an outcrop we find that the bedding planes are vertical and cleavage surfaces are horizontal. Which of the following fold types is/are inferred from this observation?

(A) Upright fold
(B) Recumbent fold
(C) Vertical fold
(D) Neutral fold

Q.37 Which of the following stratigraphic unit(s) is/are coal/lignite bearing?

(A) Barakar Formation
(B) Barail Group
(C) Cuddalore Formation
(D) Ariyalur Formation

Q.38 The Toposheet No(s). immediately adjacent to Toposheet No. 55J/8 is/are

(A) 55K/2 (B) 55J/12 (C) 55J/6 (D) 55K/5

Q.39 Which of the following is/are NOT true for texturally immature sandstone?

(A) Clay content is high
(B) Little or no clay present
(C) Grains are well sorted
(D) Grains are rounded

Q.40 P and S waves originate at earthquake focus and travel through the earth. Which of the following statements for these waves is/are correct?

(A) S-wave shadow zone is 154° wide
(B) P-wave shadow zones are 49° wide
(C) P-wave velocity abruptly increases downward at mantle-core boundary
(D) P-wave velocity abruptly drops downward at mantle-core boundary

SECTION – C

NUMERICAL ANSWER TYPE (NAT)

Q. 41 – Q. 50 carry one mark each.

Q.41 An object is spotted at S60°E front bearing from the observer. If the position is interchanged, the front bearing value in degree from North (measured clockwise) is ____.

Q.42 The mole% of forsterite component in olivine with chemical formula $Mg_{1.8}Fe_{0.2}SiO_4$ is ____.

Q.43 The Weiss symbol of a crystal face is 4a: 2b: c. The value of h in the corresponding Miller Index (hkl) is ____.

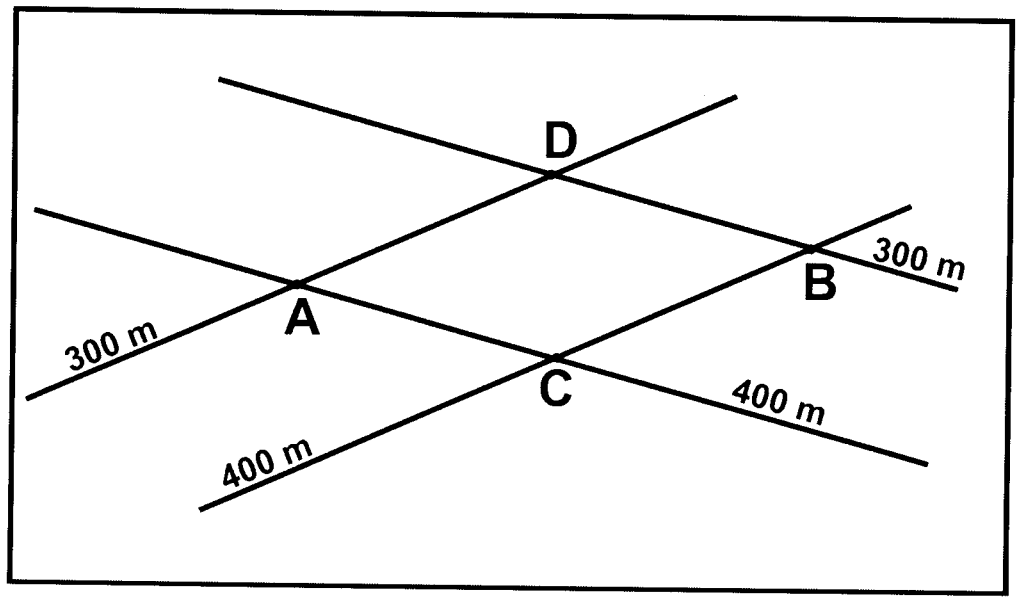
Q.44 In a mineral with chemical formula AT_4O_8, the ionic radii of A and O are 1.12 Å and 1.40 Å, respectively. The co-ordination number of cation A is _____.

Q.45 Aluminium (Al) can occur in both tetrahedral and octahedral co-ordinations in silicates. The amount of octahedral Al in a pyroxene crystal of composition $Mg_{1.4}Fe_{0.4}Al_{0.4}Si_{1.8}O_6$ is ____ (give answer in one decimal place).

Q.46 The birefringence of a mineral of thickness 30 μm and retardation 0.27 μm is ____ (give answer in three decimal places).

Q.47 Two limbs of a vertical chevron fold strike S70°E and N55°E. The value of the interlimb angle of the fold is ____ (degree).

Q.48 The schematic map given below shows intersecting strike lines of the same lithological contact. In the map, AB and CD are 5 cm and 3.5 cm, respectively. The scale of the map is 1 cm = 100 m. The plunge of the fold axis is ____ degrees (give answer in one decimal place).

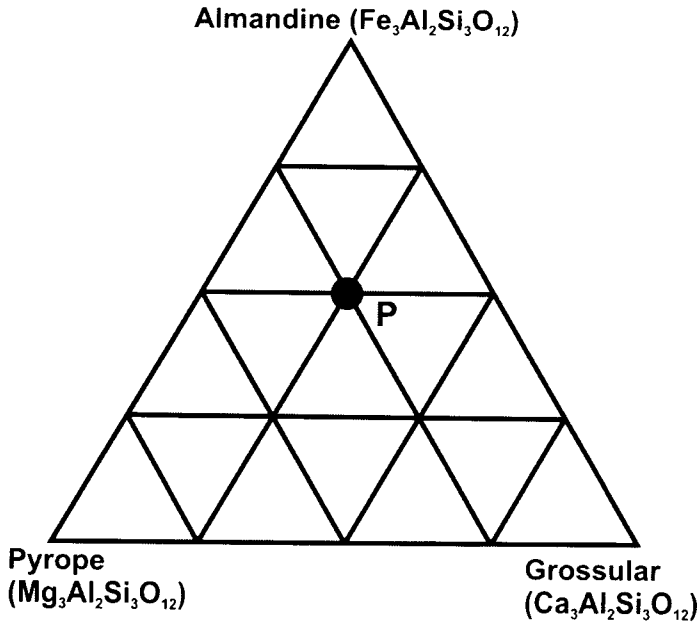


Q.49 The core-rim compositions of a normally zoned plagioclase crystal are as follows:

Core: $Ca_{0.6}\ Na_x\ Al_{1.6}\ Si_{2.4}\ O_8$ Rim: $Ca_{0.4}\ Na_y\ Al_{1.4}\ Si_{2.6}\ O_8$

The amount of increase of Na atom from core to rim per formula unit of plagioclase is _____ (give answer in one decimal place).

Q.50 Considering garnet chemical formula in 12 oxygen basis, the number of Mg cations in a garnet of chemical composition P (as shown in the figure) is ____ (give answer in two decimal places).



Q. 51 – Q. 60 carry two marks each.

Q.51 A fault surface in an outcrop has slickenside lineation whose pitch is 30°. The horizontal slip on the fault is 1.25 m, as determined from displaced vein. The net slip on the fault is ____ meter (give answer in two decimal places).

Q.52 In an outcrop, we find a Belemnite fossil broken into five rectangular pieces (boudins) of equal size. Long dimension of each boudin is 1.35 cm. Gap between adjacent boudins in all cases is 0.25 cm. Note that the long dimensions of boudins are perfectly aligned. The % elongation is ____ (give answer in one decimal place).

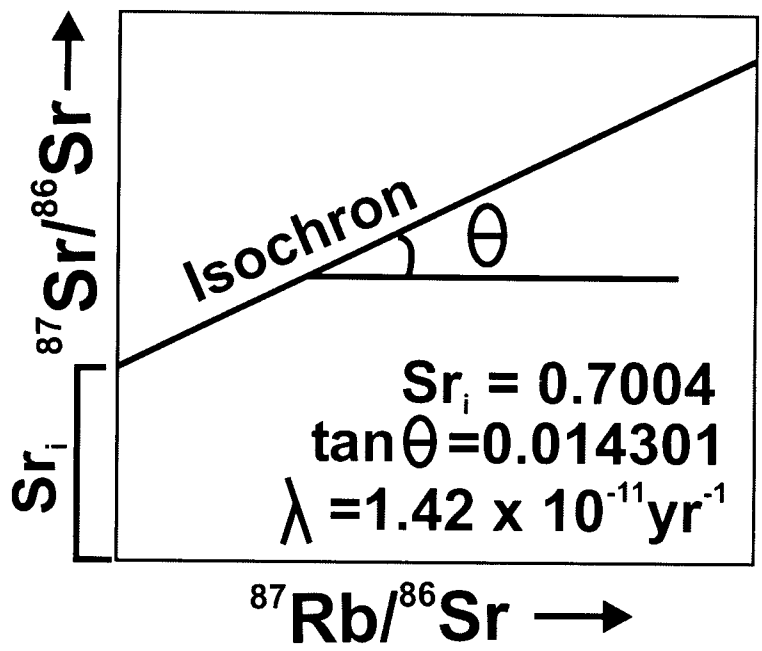
Q.53 A horizontal cylindrical ore body (diameter = 20 m, length = 200 m) has 5% metal content and density of 3500 kg/m^3. The reserve of the ore body is ____ million ton(s) (give answer in two decimal places).

Q.54 A drainage basin of fourth order covers an area of 40 sq. km. Within the basin, total length of 1st order drainage is 12.5 km, 2nd order drainage is 8.8 km, 3rd order drainage is 4.7 km and 4th order drainage is 4.0 km. The drainage density of the basin is ____ km^{-1} (give answer in two decimal places).

Q.55 Age of granitic rocks can be determined using Rb-Sr whole rock radioactive dating method and the following age equation,

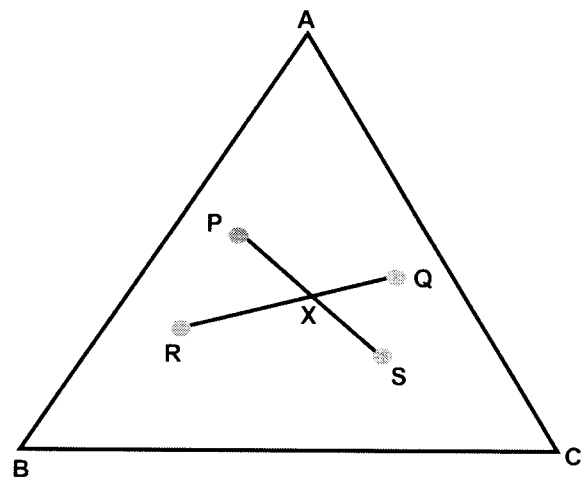
$$(^{87}Sr/^{86}Sr) = (^{87}Sr/^{86}Sr)_i + (^{87}Rb/^{86}Sr)(e^{\lambda t} - 1)$$

For a suite of representative co-magmatic granitic rocks, the Rb-Sr whole rock isochron plot and relevant data are shown in the diagram. The age of granite is calculated at ____Ga (1Ga = 10^9 yrs, give answer in one decimal place).



Q.56 Consider a granulite facies metamorphic rock with peak metamorphic condition at 9 kbar, 850°C. Assume a single layer crust of $\rho = 3000$ kg/m^3 and $g = 10$ m/sec^2 during metamorphism. The depth of burial during peak metamorphism is _____km. 1 Pascal = 1 kg/m/sec^2 and 1 bar = 10^5 Pascals.

Q.57 Consider four minerals P, Q, R and S in a three component chemical system (A-B-C) as shown in the figure. For a crossing tie-line relationship, the variance (degrees of freedom) of the equilibrium mineral assemblage at X is ____.

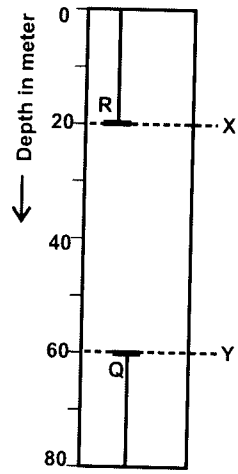


Q.58 The refractive indices of four minerals (P, Q, R, S) are as follows:

P ($\alpha = 1.712$, $\beta = 1.721$, $\gamma = 1.727$),
Q ($\varepsilon = 1.553$, $\omega = 1.544$),
R ($\alpha = 1.664$, $\beta = 1.672$, $\gamma = 1.694$) and
S ($\omega = 1.658$, $\varepsilon = 1.486$)

The value of maximum birefringence among all the minerals is ____ (give answer in three decimal places).

Q.59 In a sedimentary succession shown in the figure, the last occurrence of the fossil species Q (dated 50 Ma) and the first occurrence of the fossil species R (dated 30 Ma) are recorded at Y and X, respectively. The estimated rate of sedimentation is ___ m/million yrs (assume constant rate of sedimentation).



Q.60 The top surface of a coal seam is exposed at 150 m contour level on a hill top at location **A**. The same surface of the seam is also exposed on a river bed at location **B** at the 50 m contour level. The aerial distance **A-B** is 1 km. The amount of dip of the coal seam along **A-B** is ____ (degree). Give answer in one decimal place.

END OF THE QUESTION PAPER

JAM 2017 ANSWER KEY

Model Answer Key for GG Paper

Paper:**GEOLOGY**	Code:**GG**

SECTION – A (MCQ)				SECTION – B (MSQ)		SECTION – C (NAT Type)			
Q. No.	**KEY**	**Q. No.**	**KEY**	**Q. No.**	**KEYS**	**Q. No.**	**KEY RANGE**	**Q. No.**	**KEY RANGE**
01	D	**16**	D	**31**	A, D	**41**	300 – 300	**56**	30 – 30
02	B	**17**	B	**32**	A, B, C, D	**42**	90 – 90	**57**	1 – 1
03	B	**18**	C	**33**	A, B, C	**43**	1 – 1	**58**	0.172 – 0.172
04	C	**19**	A	**34**	B, C	**44**	8 – 8	**59**	2 – 2
05	C	**20**	A	**35**	D	**45**	0.2 – 0.2	**60**	5.0 – 6.0
06	A	**21**	D	**36**	B, D	**46**	0.009 - 0.009		
07	C	**22**	A	**37**	A, B, C	**47**	55 – 55		
08	A	**23**	B	**38**	B, D	**48**	15.8 – 16.0		
09	A	**24**	B	**39**	B, C, D	**49**	0.2 – 0.2		
10	C	**25**	A	**40**	A, D	**50**	0.75 – 0.75		
11	B	**26**	C			**51**	1.42 – 1.46		
12	C	**27**	D			**52**	14.7 – 14.9		
13	D	**28**	C			**53**	0.21 – 0.23		
14	C	**29**	A			**54**	0.75 – 0.75		
15	D	**30**	C			**55**	0.9 – 1.1		