

ENTRANCE EXAMINATION FOR ADMISSION, MAY 2013.

Ph.D. (EARTH SCIENCE)

COURSE CODE : 110

Register Number :

Signature of the Invigilator
(with date)

COURSE CODE : 110

Time : 2 Hours

Max : 400 Marks

Instructions to Candidates :

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you -1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

1. The rock-deformation is said to be Newtonian (viscous) when
 - (A) strain is linearly proportional to stress
 - (B) rate of strain is linearly proportional to stress
 - (C) strain is not proportional to stress
 - (D) strain is independent of stress

2. The dip isogons in Similar folds are
 - (A) parallel
 - (B) convergent
 - (C) divergent
 - (D) perpendicular to the fold surface

3. Hawaiiin-Emperor chain of oceanic islands is a result of
 - (A) movement of Atlantic oceanic plate over a hot-spot
 - (B) movement of Pacific oceanic plate over a hot-spot
 - (C) subduction of Atlantic oceanic plate
 - (D) subduction of pacific plate

4. Igneous rocks usually associated with a mature Island-arc are

(A) tholeiitic	(B) calc-alkline
(C) Peralkaline	(D) Carbonatites

5. Suture Zone present in an orogenic belt is characterized by
 - (A) Oceanic crustal rocks and arc-trench sediments
 - (B) Molasse sedeiments
 - (C) Normal faults
 - (D) Horst and graben strucutres

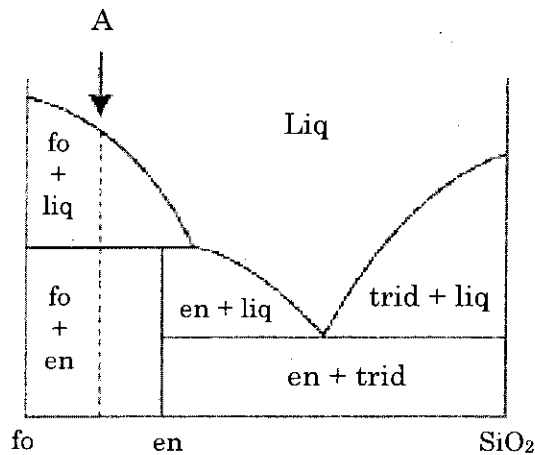
6. Aulacogen type of sedimentary basins form due to
 - (A) Failing of one of the rifts of triple-rift junction
 - (B) Thrusting in a collision related mountain building process
 - (C) Strike slip faulting along the margin of continent
 - (D) Normal faulting due to sedimentary loading

7. Which of the following is an example of continent-rifting
- (A) Basin and Range Province of USA
 - (B) Eastern Ghats of India
 - (C) Emperor-Hawaiin chain of islands
 - (D) Isua province of Greenland
8. The condition for the commencement of thermal convection is controlled by
- (A) Rayleigh number
 - (B) Reynolds number
 - (C) Stokes number
 - (D) Greens number
9. Submarine fans are actually composed of:
- (A) pelagic sediment from the water column
 - (B) sediments derived from abyssal plains
 - (C) land-derived sediments
 - (D) remains of marine organisms and volcanic ash
10. In which of the following situations will infiltration be the least?
- (A) steep slope with little vegetation
 - (B) gentle slope with dense vegetation
 - (C) gentle slope with little vegetation
 - (D) steep slope with dense vegetation
11. Which one of the following forms does NOT belong to the isometric system?
- (A) pyramid
 - (B) diploid
 - (C) octahedron
 - (D) tetrahedron
12. The number of space lattices and point groups present in all types of crystals are _____ and _____ respectively.
- (A) 32 & 230
 - (B) 30 & 232
 - (C) 14 & 32
 - (D) 16 & 30
13. A mineral gives X-ray diffraction peak at $2\theta=60^\circ$. Assuming that the X-ray wavelength is 1.5 \AA calculate the d-spacing.
- (A) 0.5 \AA
 - (B) 0.75 \AA
 - (C) 1.5 \AA
 - (D) 3.0 \AA
14. Which one of the following mineral is optically biaxial?
- (A) Calcite
 - (B) Aragonite
 - (C) Siderite
 - (D) Dolomite

15. Which one of the following mineral is uniaxial negative in optical properties?
 (A) Zircon (B) Quartz (C) Nepheline (D) Rutile
16. Refractive indices of olivine increase
 (A) with increase in Fayalite content
 (B) with decrease in Fayalite content
 (C) with increase in zoning
 (D) with increase in size.
17. Out of the three polymorphs of aluminum silicates,
 (A) Sillimanite is the high temperature polymorph, while Kyanite is high pressure.
 (B) Andalusite is the high temperature polymorph while sillimanite is high pressure
 (C) Kyanite is the high temperature polymorph while sillimanite is high pressure
 (D) Sillimanite is the high temperature polymorph while andalusite is high pressure
18. An example of a Pyroxene in which more than two thirds of the M2 sites are occupied by Ca cations
 (A) Enstatite (B) Diopside (C) Jadeite (D) Aegirine
19. Orthorhombic pyroxenes are similar to monoclinic pyroxenes in cell parameters except in the length of
 (A) a - axis which is higher in orthorhombic than in monoclinic
 (B) b - axis which is higher in orthorhombic than in monoclinic
 (C) c - axis which is higher in orthorhombic than in monoclinic
 (D) a - axis which is less in orthorhombic than in monoclinic
20. The group of clay minerals having 1:1 ratio of tetrahedral and octahedral components is
 (A) Kaolinite (B) Illite (C) Smectite (D) Vermiculite
21. Glaucophane is
 (A) a calcic amphibole (B) a white mica
 (C) a magnesium amphibole (D) an alkali amphibole
22. What are the major minerals present in peridotite?
 (A) pyroxene, biotite and quartz (B) olivine, pyroxene and spinel
 (C) amphibole, biotite and plagioclase (D) pyroxene, plagioclase and garnet

23. Identify the sequence of rocks arranged in the increasing order of density.
 (A) Andesite, basalt, gabbro (B) basalt, andesite, diorite
 (C) andesite, gabbro, basalt (D) gabbro, andesite, diorite
24. What is the temperature of crystallization of tholeiite basalt at 1 atm. P.?
 (A) 700°C (B) 900°C (C) 1200°C (D) 1700°C
25. When enstatite is heated to its melting point it gives rise to:
 (A) melt of its composition
 (B) melt of different composition and quartz
 (C) melt of different composition and forsterite
 (D) melt of different composition and periclase

Consider the Figure below and answer the following three questions.



26. Cooling of magma of composition 'A' will result in crystallization of _____ as the liquidus phase.
 (A) Anorthite (B) Cristobalite
 (C) Enstatite (D) Forsterite
27. On reaching the peritectic point the magma will _____.
 (A) react with forsterite to form enstatite.
 (B) crystallize enstatite and forsterite.
 (C) crystallize enstatite only.
 (D) crystallize enstatite and cristobalite.
28. What is the final mineral assemblage that will result on equilibrium crystallization of the magma?
 (A) Enstatite + Forsterite (B) Enstatite + Tridymite
 (C) Tridymite + Enstatite + Forsterite (D) Enstatite + Anorthite + Tridymite

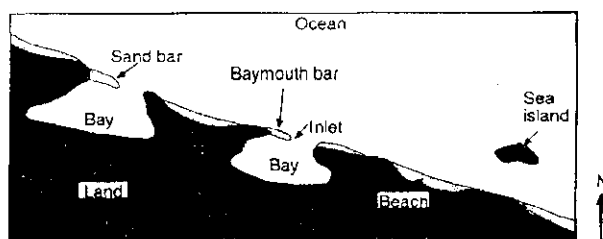
29. Which of the following is an example of chemical weathering?
 (A) burrowing (B) frost wedging (C) hydrolysis (D) Gauge
30. Which of the following minerals is least susceptible to weathering?
 (A) biotite (B) olivine (C) pyroxene (D) quartz
31. Which of the following is an example of a clastic sedimentary rock?
 (A) Chert (B) Limestone (C) Rock salt (D) Shale
32. In what environment do symmetrical ripples most likely form?
 (A) beach (waves) (B) desert (wind)
 (C) alluvial (stream) (D) glacial
33. Which of the following contains the coarsest-grained sediments?
 (A) topset beds (B) foreset beds
 (C) bottomset beds (D) Coset
34. A rectangular stream channel has a width of 33 ft. For a discharge of 3000 ft/s, what must the flow velocity be in order to keep the water from just rising above the top of the channel?
 (A) ~3 ft/s (B) ~6 ft/s (C) ~9 ft/s (D) ~10 ft/s
35. Which of the following statements concerning influences on porosity is least correct?
 (A) As the degree of cementation decreases, the porosity increases.
 (B) As the number of fractures increases, the porosity increases.
 (C) As sorting increases, the porosity decreases.
 (D) As the packing of particles increases, the porosity decreases.
36. Which hydrogeologic quantities are represented by the Win the governing equation $W = K(h_1 - h_2)A/L$
 (A) Leakage (B) Water released from storage
 (C) Recharge (D) Discharge

37. Textures in which the fragmental characteristics are NOT clearly visible are described as
(A) Epiclastic (B) Clastic (C) Non-clastic (D) Pyroclastic
38. Aeolian ripples are characterized by the presence of
(A) Coarser grains on the crests
(B) Finer grains on the crests
(C) Uniformly even grains on the crests and the troughs
(D) None of the above
39. What causes ice ages?
(A) variations in the earth's orbit
(B) variations in sun's heat output
(C) variations in sunlight reflected by the earth
(D) no definite cause has been conclusively proven
40. Glacial striations on an outcrop trend NE-SW. The direction of ice movement was:
(A) NE to SW (B) NW to SE
(C) SW to NE (D) could be either NE or SW
41. Water from a certain source is shown to contain 10,000 ppm dissolved solids. This indicates that percentage of the *particles* in this water are represented by the dissolved solids.
(A) 1% (B) 10% (C) 0.1% (D) 0.001%
42. Lithification is the *primary* process in the formation of one of the following rocks.
(A) gneiss (B) schist (C) conglomerate (D) marble
43. Which of these would indicate the former presence of a glacial lake?
(A) Varved clay (B) Out wash sands (C) Till (D) Loess
44. A medial moraine is developed:
(A) on the side of a glacier
(B) in the bergschrund
(C) at the end of the glacier
(D) in the middle of two coalesced glaciers

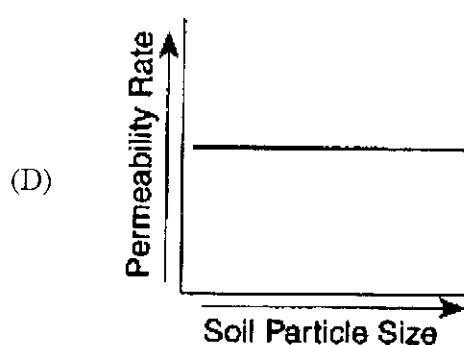
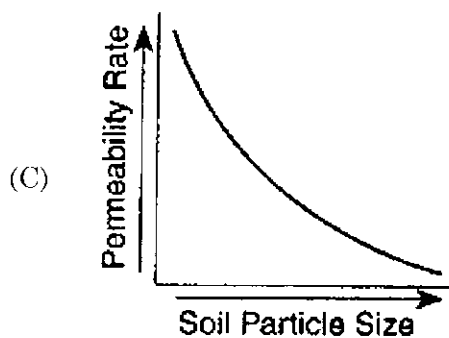
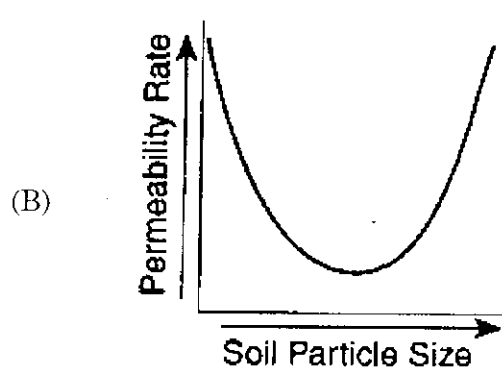
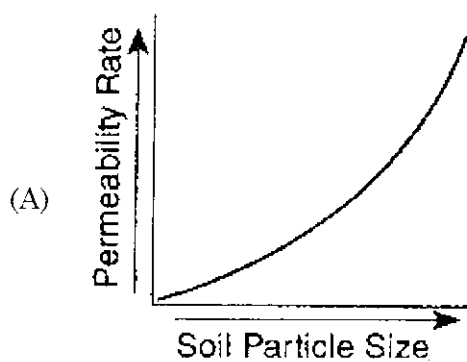
45. Most limestones have a large component of calcite that was originally extracted from seawater by:
- (A) inorganic chemical reactions (B) chemical weathering
(C) lithification (D) evaporation
46. The superposition of offshore facies over nearshore facies occurs when there is a marine:
- (A) superposition (B) invasion (C) regression (D) transgression
47. Well-sorted sediments contain
- (A) a limited size range of particles (B) a wide size range of particles
(C) only pebbles (D) abundant clay minerals
48. A mature sedimentary rock would exhibit which of these features?
- (A) Unstable mineral fragments (B) Angular mineral fragments
(C) A wide variety of particle sizes (D) Stable mineral fragments
49. Kimbelite pipes are associated with one of the following tectonic settings.
- (A) Aulacogen (B) MOR
(C) Obduction zone (D) Intra-continental rift
50. One of the following is the least important mechanism in ore deposition from a fluid.
- (A) reaction with wallrock (B) mixing of contrasting fluids
(C) decrease in temperature (D) decrease in pressure
51. One of the following is not produced by fluid-rock reaction.
- (A) skarn (B) greisen (C) hornfels (D) kaolinisation
52. One of the following is not a hydrothermal deposit.
- (A) Hutti gold deposit (B) Malanjkhand copper deposit
(C) Degana tungsten deposit (D) Bastar-Koraput tin deposit
53. One of the following is not a uranium prospect.
- (A) Basantgarh (B) Gogi
(C) Domiasiat (D) Tummalapalli

54. In a cliff, you see coal near the base, then sandstone above it, then limestone, then sandstone again, and finally coal near the top. This pattern most likely means
- (A) The sea retreated and then advanced again
 - (B) The sea advanced and then retreated again
 - (C) The climate changed from warm to cold and back
 - (D) Rainfall decreased and then increased again
55. Which is most likely to represent a deposit formed on dry land?
- (A) Black shale
 - (B) Red sandstone
 - (C) Mudrocks
 - (D) Dolomite
56. Trellis drainage is most likely to develop on
- (A) natural levees
 - (B) tilted sedimentary rock layers
 - (C) granite
 - (D) horizontal layers of volcanic rocks
57. Which of the following controls flow velocity in streams?
- (A) channel shape
 - (B) gradient
 - (C) depth
 - (D) all of these
58. Which of the following is a local base level?
- (A) lake
 - (B) point bar
 - (C) ocean
 - (D) floodplain
59. A stream can lengthen its channel by:
- (A) runoff
 - (B) hydraulic action
 - (C) headward erosion
 - (D) downcutting
60. Which factor does not directly influence the shape of a delta?
- (A) intensity of wave action on the shore
 - (B) strength and height of tides
 - (C) volume of sediment carried by the river
 - (D) none of the above
61. A stream that has more sediment to move than it can carry at one time is likely to be
- (A) mature
 - (B) meandering
 - (C) braided
 - (D) youthful
62. Most ore forming processes taking place in the earth crust involve the transport of metals by
- (A) aqueous fluid and CO₂ rich fluid
 - (B) aqueous fluid and magma
 - (C) magma and CO₂ rich fluid
 - (D) aqueous fluid

63. The map below shows some features along an ocean shoreline. In which general direction is the sand being moved along this shoreline by ocean (long shore) currents?



- (A) Northeast (B) Southeast (C) Northwest (D) Southwest
64. Which graph best represents the general relationship between soil particle size and the permeability rate of infiltrating rainwater?



65. According to Darcy's Law:
- (A) The velocity of flow in clay is higher than in sand.
- (B) The higher the gradient, the lower the velocity.
- (C) The water table is generally flatter in an area of high transmissivity.
- (D) Spring flow is independent of the hydraulic characteristics of the aquifer.

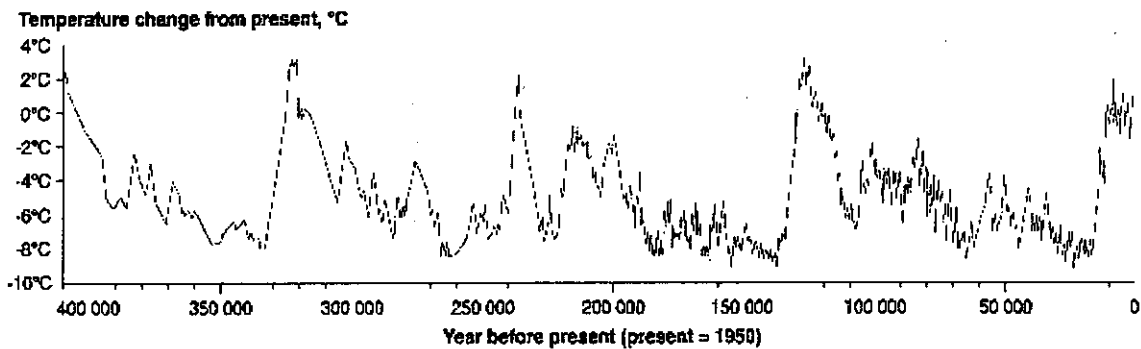
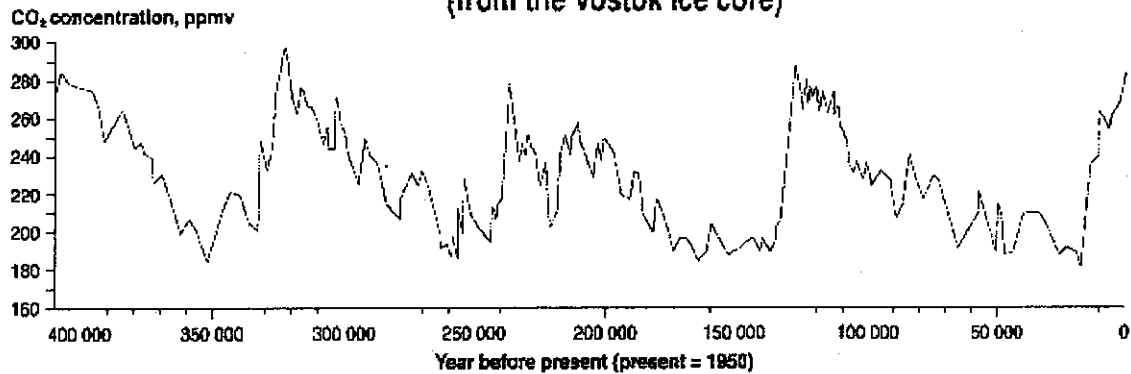
66. Rocks that show evidence of high ductile strain, are well-foliated, and contain porphyroclasts are referred to as:
- (A) breccias (B) mylonites (C) cataclasites (D) gouges
67. A site location map must include scale, orientation, title, and:
- (A) topographic contours (B) geologic units
(C) geographic reference (D) dip and strike symbol
68. Black and white vertical stereo aerial photographs are taken of an area which has a variety of mass movement phenomena present. For purposes of practical geologic and geomorphic interpretation of the photographs, one of the principal DISADVANTAGES of a flight time close to noon (sun time) is:
- (A) the film's spectral sensitivity to blue light is affected
(B) the resolving power of the camera lens is minimized
(C) thermal diffraction in the air distorts the image
(D) the high sun angle minimizes shadows and modelling of the terrain
69. An aerial photograph taken with a camera having a focal length of 6 inches flying 10,000 feet above the datum has a scale of:
- (A) 1:10,000
(B) 1:50,000
(C) 1 inch = 10,000 feet
(D) Scale cannot be determined from the data given.
70. Wollastonite deposits occur in one of the following.
- (A) granite (B) skarn (C) meta-pelite (D) limestone
71. Rare metal deposits are commonly associated with
- (A) carbonatite (B) syenite
(C) granite pegmatite (D) gabbro

72. The following element associations are common in ore deposits. But in only one of these groups, the elements do not occur together in periodic table.
- (A) PGE (B) Au-Ag (C) Cu-Ni (D) Pb-Zn
73. One of the following pairs does not form exsolution intergrowth in ore mineral assemblages.
- (A) chalcopyrite-sphalerite (B) magnetite-ilmenite
(C) pyrite-pyrrhotite (D) chalcopyrite-cubanite
74. One of the following ore minerals is commonly not idioblastic.
- (A) pyrite (B) galena (C) magnetite (D) sphalerite
75. One of the following metals is not known to form any mineral in which it is a constituent element.
- (A) Niobium (B) Cerium (C) Platinum (D) Rhenium
76. Solubility of water in silicate magma is controlled by
- (A) Pressure and temperature of magma
(B) Pressure and composition of magma
(C) Temperature and composition of magma
(D) Availability of water
77. High grade manganese ore mined from Sausar schist belt represent
- (A) syn-sedimentary deposit
(B) metamorphosed sedimentary deposit
(C) supergene enrichment of (A)
(D) supergene enrichment of (B)
78. Magmatic ore deposits are commonly associated with
- (A) granite (B) syenite (C) gabbro (D) peridotite
79. Refer to previous question. The reason for such association is
- (A) low viscosity of parent magma (B) high viscosity of parent magma
(C) low temperature of parent magma (D) high temperature of parent magma

80. Find the odd one out.
 (A) Fusus (B) Conus (C) Oliva (D) Cardita
81. Which type of coiling is rare in gastropoda?
 (A) dextral (B) sinistral (C) armestral (D) trochospiral
82. The Ordovician period is known as the age of
 (A) crinoids (B) graptolites (C) brachiopoda (D) corals
83. When did the Trilobite disappear from the Earth?
 (A) Devonian (B) Carboniferous
 (C) end of Permian (D) end of Cretaceous
84. Flat topped sea mounts are termed as
 (A) guyots (B) mesa (C) inselberg (D) monodnock
85. Dinosaurs are reported from the rocks of
 (A) Silurian (B) Devonian
 (C) Triassic (D) End of Permian
86. The most common mode of origin for cross-bedding is
 (A) Migration of small and mega-ripples
 (B) Deposition on the point bars of small meanders
 (C) Deposition on the inclined surfaces of beaches
 (D) Lee-side deposition of sand dunes
87. The most ancient ancestor of man seems to have appeared during
 (A) Paleocene (B) Eocene (C) Pliocene (D) Pleistocene
88. The main boundary thrust separates
 (A) Archaean and Cuddapah basin
 (B) Higher Himalaya from Lesser Himalaya
 (C) Siwalic from Higher Himalaya
 (D) Siwalik and Lesser Himalaya

Answer the following five questions using the figure given below.

**Temperature and CO₂ concentration in the atmosphere over the past 400 000 years
(from the Vostok ice core)**



Source: J.R. Petit, J. Jouzel, et al. Climate and atmospheric history of the past 420 000 years from the Vostok ice core in Antarctica, *Nature* 399 (3JUra), pp 429-436, 1999.

89. The CO₂ concentration in the Earth's atmosphere has _____ during the past 400 thousand years.
- (A) remained more or less same (B) increased
(C) decreased (D) changed cyclically
90. What is the kind of relationship that could be observed between CO₂ concentration in the atmosphere and its temperature?
- (A) Positive correlation
(B) Negative correlation
(C) No correlation
(D) Correlated positively for the past 50 k years only.
91. When did the atmospheric CO₂ concentration reached lowest during the past 100 k years?
- (A) At the beginning of human evolution (B) Early Paleolithic period
(C) Last glacial maximum (D) At the beginning of Holocene

92. During what period the maximum change in temperature was observed prior to 1950?
- (A) during last 20 thousand years
 (B) between 160 to 120 thousand years ago
 (C) between 400 to 390 thousand years ago
 (D) between 50 to 20 thousand years ago
93. Periods of lowest concentrations of atmospheric CO₂ coincided with
- (A) Interglacial periods (B) glacial periods
 (C) increased volcanic activity (D) mass-extinctions

Answer the following seven questions using the table given below.

Chemical composition of igneous rocks

	R1(wt. %)	R2 (wt. %)	R3 (wt. %)
SiO ₂	46.18	60.93	71.3
TiO ₂	1.61	0.82	0.31
Al ₂ O ₃	15.60	15.82	14.32
Fe ₂ O ₃	1.18	2.15	1.21
FeO	9.59	4.53	1.64
MnO	0.21	0.07	0.05
MgO	10.03	3.92	0.71
CaO	12.12	5.27	1.84
Na ₂ O	2.39	3.37	3.68
K ₂ O	0.71	3.11	4.07

94. Which of the major element oxides of above igneous rocks increase from R1 to R2 to R3?
- (A) Only SiO₂ (B) SiO₂, Al₂O₃ and FeO
 (C) SiO₂, Na₂O and K₂O (D) Al₂O₃, MgO, and CaO

95. Above rocks arranged in the increasing order of Normative quartz content is:
(A) R1, R2, R3 (B) R2, R1, R3 (C) R3, R1, R2 (D) R3, R2, R1
96. Higher abundance of CaO in R1 is due to:
(A) higher calcite content (B) higher clinopyroxene content
(C) higher albite content (D) higher orthopyroxene content
97. From the above table one can infer that
(A) alkali and mafic elements are positively correlated
(B) alkali and alumina are positively correlated
(C) alkali and mafic elements are negatively correlated
(D) alkali and silica elements are negatively correlated
98. The olivine will appear in the normative composition of:
(A) R1 only (B) R1 and R2
(C) R2 and R3 (D) R1, R2 and R3
99. The Al_2O_3 will be found essentially in _____ mineral in the above rocks.
(A) olivine (B) clinopyroxene (C) hornblende (D) feldspar
100. The major elements are arranged in the above table from top to bottom:
(A) increasing abundance (B) increasing ionic radii
(C) decreasing valency (D) increasing atomic number
-