Code No: M-87 Hall Ticket No:

ENTRANCE EXAMINATION 2016
Ph. D in Earth & Space Sciences

Date:
Time: **Marks: 75**

Instructions for the candidates:

1. All questions carry equal marks.
2. Write your Hall Ticket Number on the OMR Answer Sheet given to you. Also write the Hall Ticket Number in the space provided on the question paper booklet.
3. The question paper consists of Objective Type questions of one mark each.
4. The question paper consists of Part 'A' and Part 'B'.
5. **There is negative marking. Each wrong answer carries - 0.33 mark.**
6. Answers are to be marked on the OMR answer sheet following the instructions provided there upon.
7. Hand over the OMR answer sheet at the end of the examination to the Invigilator.
8. No additional sheets will be provided. Rough work can be done in the question paper itself/space provided at the end of the booklet.
9. Non-programmable calculators are allowed.

PART-A

1. The most abundant mineral in the planet earth
   a. Perovskite
   b. Olivine
   c. Garnet
   d. Plagioclase
2. A ^{4}He nucleus that escapes from a decaying heavy radiogenic isotope is called
   a. Alpha particle
   b. Gamma ray photon
   c. X- ray
   d. Beta particle
3. Coesite is a high pressure polymorph of
   a. Diopside
   b. Hypersthene
   c. Olivine
   d. Quartz
4. The mineral daubreelite is characteristic of
   a. Komatiite
   b. Boninite
   c. Iron meteorite
   d. Lherzolite
5. Pyrope garnet and chrome diopside characteristic minerals of
   a. Kimberlite
   b. Lamprophyre
   c. Lamproite
   d. Carbonitite

6. Mantle covers _____ percent of total mass of the planet earth
    a. 72 percent
    b. 35 percent
    c. 84 percent
    d. 20 percent
7. The crust-mantle boundary is known as
    a. Mohorivicic discontinuity
    b. Guternberg discontinivity
    c. Keller discontinuity
    d. Eskola discontinuity
8. The composition of sapphire is
    a. Al_2O_3
    b. $CaTiO_3$
    c. $Al_2(OH)_2$
    d. $AlSi_2O_5$
9. The characteristic rock type of continental rift setting
    a. Alkaline basalt
    b. Boninite
    c. Tholeiite
    d. Lherzolite
10. The characteristic assemblage of eclogite facies
    a. Lawsonite – glucophane-chloritoid
    b. Garnet – diopside-ilmanite
    c. Garnet – pigeonite-epidote
    d. Garnet – omphacite-rutile
11. Ophiolites corresponds to
    a. Abducted slices oceanic crust and mantle in orogenic belts
    b. Basaltic eruptions in island arc
    c. Ultramafic intrusions in continental rift
    d. Basaltic eruptions in Ocean islands
12. As per the IPCC report, over the period 1901 to 2010, global mean sea level rose by about
    a. 0.19 m
    b. 1.5 mm
    c. 10 m
    d. 0.33 m
13. The adiabatic lapse rate (per km)for moist unsaturated parcel will be approximately
    a. 6.3°C
    b. 9.8°C
    c. 6.3°F
    d. 0°C
14. Which of the following can is a common real world example of gradient wind balance?
    a. Anomalous anticyclonic flow around a high.
    b. Anticyclonic flow around a high.
    c. Anomalous anticyclonic flow around a low
    d. None of the above.
15. Among the following, identify the statement that does not apply to a barotropic atmosphere.
    a. Density at each point is determined solely by the pressure at that point.

b. No increase of geostrophic wind with height.
c. Vertical shear depends mainly upon horizontal gradient of temperature.
d. Large scale motion does not depend on height.

16. Among the following, which phenomenon primarily varies on intraseasonal time scales?
    a. ENSO.
    b. Madden-Julian oscillation.
    c. Southern Annular Mode.
    d. North Atlantic Oscillation.
17. The temperature to which a sample of air is cooled by evaporating water into it to make saturated, at constant pressure is called
    a. dry bulb temperature
    b. dew point temperature
    c. absolute temperature
    d. Wet bulb temperature.
18. One of the following condition results in anomalously reduced summer monsoon rainfall spells in India. Identify.
    a. La Niña
    b. Monsoon depressions.
    c. A strengthened Mascarene high
    d. Eastward shift in the Tibetan anticyclone.
19. The ratio indicating the relative importance of the horizontal and vertical friction is called
    a. Ekman number
    b. Froude number
    c. Rossby number
    d. Reynolds number
20. The layer in a water body where the rate of change of salt in the vertical is maximum is called
    a. Pycnocline
    b. Thermocline
    c. Halocline
    d. Oxycline
21. Thunderstorms are associated with the following type of clouds
    a. Nimbostratus
    b. Altocumulus
    c. Cumulonimbus
    d. None of the above
22. Deep mixed layers in winter are notably absent in
    a. North Pacific
    b. Labrador Sea
    c. Greenland Sea
    d. Polar southern oceans
23. If the radius of the earth were to shrink by 1%, its mass remaining the same, the acceleration due to gravity on the earth's surface would
    a. decrease by 2%
    b. remain unchanged
    c. increase by 2%
    d. will increase by 9.8%
24. A scatter plot shows
    a. The direction and strength of a relationship between two variables.

b. The linear relationship between two variables.
c. The prediction of value one variable knowing the value of the other variable.
d. None of the above

25. During which era did the initial opening of the present-day Atlantic Ocean most likely occur?
    a. Cenozoic
    b. Mesozoic
    c. Paleozoic
    d. Late Proterozoic

PART-B

26. Evaporation exceeds precipitation in
    a. Subtropics.
    b. high latitudes.
    c. equator.
    d. all of the above.
27. Without greenhouse effect, the global average mean would have been, approximately,
    a. 288 K
    b. 255 K
    c. 273 K
    d. 230 K
28. The average depth of the ocean is
    a. 37000 m
    b. 3700 m
    c. 10000 m
    d. 1000 m
29. Which of the following currents is a southward flowing current?
    a. Kuroshio current
    b. Gulf Stream current
    c. Oyashio current
    d. Pacific North equatorial current
30. Which of the following statements is false?
    a. Density of pure water is 0.999×10^3 $kg.m^{-3}$.
    b. Albedo of the ice can even reach as high as 7%.
    c. About 2% of the water on the earth is frozen.
    d. Overall salinity of sea water is 34.48 $g.kg^{-1}$.
31. The positive Indian Ocean Dipole typically peaks during the following season.
    a. March-May
    b. June-August
    c. December to February
    d. September-November
32. A thrust is a
    a. Normal fault
    b. Low angle reverse fault
    c. Decollement
    d. Wrench fault
33. Crenulation cleavage develops during
    a. Thrusting
    b. Rifting

c. Superimposed deformation
d. Extension

34. Transform faults are characterized by
a. Lateral slip of plates
b. Oblique slip of plates
c. Vertical slip of plates
d. Normal slip of plates

35. 'D' layer in mantle is located at the depth of
a. 660 km
b. 2900 km
c. 250 km
d. 400 km

36. Positive Ce anomalies in sediments indicate
a. Reducing environments
b. Oxidizing environments
c. Low PH-conditions
d. High PH environment

37. The elements which prefer to remain in residue of mantle melting are known as
a. Incompatible elements
b. Hygromagmatophile elements
c. Compatible elements
d. High Field Strength Elements

38. The transition crystal structure of aragonite to calcite takes place at the depth....in the sedimentary basin
a. 2000 m
b. 1200 m
c. 4500 m
d. 150 m

39. Loess corresponds to
a. Eolian deposits
b. Braided river flood plain
c. Alluvial fan
d. Lake deposits

40. Which of the following rock characterize deep water environments?
a. Marl
b. Sand stone
c. Loess
d. Carbonaceous shale

41. If CO_2 in sea water is increased by the addition of carbonate and bicarbonate ions from rivers, the ocean will become
a. More acidic (pH 6.5)
b. neutral in pH (pH7)
c. less acidic (pH 8.5)
d. more alkaline (pH 8.4)

42. Eustatic changes in sea level are visibly marked in the
a. Pliestocene
b. Paleocene
c. Paleozoic
d. Cretaceous

43. The depth of thermocline in the oceans

a. increases from equator to poleward
b. decreases from west to east
c. increases from west to east
d. decreases from equatorial to polar regions

44. A geostationary satellite orbiting at an altitude of 36,000 kms has a period of 24 hours. What is the orbital period of a satellite orbiting at an altitude of 1000 km (take the radius of the earth ~ 6000 km)
    a. $4/\sqrt{6}$ hr
    b. 2/3 hr
    c. 3/2 hr
    d. 1/9 hr
45. During storms, thatched roofs of huts are lifted and are carried away by wind. The basic principle that governs the process is
    a. Bernoulli's principle
    b. Coriolis force
    c. Pascal's law
    d. Archimedes principle
46. When moisture-laden winds are blocked by a mountain chain, intense rainfall happens as in Western Ghats regions. In such cases which one of the following factors is dominantly responsible for intense precipitation?
    a. Mountain heights
    b. Mountain orientation with respect to wind direction
    c. Ascent induced by latent heat of condensation of water vapor
    d. Vegetation on the mountain slopes
47. The radii of the earth and the moon are in the ratio 10:1 while acceleration due to gravity on the earth's surface and moon's surface are in the ratio 6:1. The ratio of escape velocities from earth's surface to that of moon surface is
    a. 10: 1
    b. 6 : 1
    c. 1.66 : 1
    d. 7.74 : 1
48. The principle of continents being in buoyant equilibrium is known as
    a. Isostasy
    b. the principle of buoyant equilibrium
    c. the elastic rebound theory
    d. none of these
49. What is the rest mass of a photon?
    a. 0.5
    b. 0
    c. 1
    d. 1.1
50. If the radius of the earth were to shrink by 1%, its mass remaining the same, the acceleration due to gravity on the earth's surface would
    a. decrease by 2%
    b. remain unchanged
    c. increase by 2%
    d. will increase by 9.8%
51. Melange deposits are associated with which plate margin?
    a. passive
    b. shear

c. tensional margin
d. compressional margin

52. The presence of "magnetic stripes" recorded in the oceanic crust reflects
a. reversals in polarity of the Earth's magnetic field
b. the rate of sea floor spreading
c. variation in composition of the oceanic crust
d. all of these

53. Ophiolites are
a. an ancient piece of sea floor
b. emplaced in a compressional setting
c. primarily igneous rocks with a thin sedimentary covering
d. all the above

54. Greenhouse effect is used to describe the
a. heating of the atmosphere by direct solar radiation
b. heating of the atmosphere by infrared radiation from the earth
c. conversion of carbon dioxide to oxygen by green plants
d. condensation of moisture to form dew

55. The number of neutrons in an atom of $_6C^{12}$ are
a. 6
b. 12
c. 18
d. 21

56. The most common structural element of the silicate mineral group is
a. a silicon-oxygen octahedron
b. a silicon-oxygen tetrahedron
c. a silicon-aluminum tetrahedron
d. a silicon-nitrogen tetrahedron

57. The atomic mass number of an element is the
a. number of protons
b. number of neutrons
c. number of protons plus neutrons
d. number of electrons

58. Which is the most abundant cation in the continental crust
a. silicon
b. iron
c. aluminum
d. oxygen

59. What can be said about a data set when its standard deviation is small?
a. The data are far apart
b. All of the data have the same value
c. The mean of the data can never be zero
d. The data are close together

60. Which of the following methods better explore the disseminated sulphides
a. Gravity method
b. Seismic method
c. Resistivity method
d. Induced polarization method

61. Two atoms with the same atomic number but different mass numbers are known as
a. solid solution
b. polymorphism

c. isotopes
d. None of the above

62. Relative frequency is a measure of
a. skewness
b. Probability
c. Kurtosis
d. Variance

63. Two minerals have same chemical composition but which mineral is more likely to form at higher pressures
a. the mineral with the greatest density
b. the mineral with the lowest density
c. the mineral with the lowest hardness
d. the mineral with the highest hardness

64. Acoustic impedance is defined as
a. Velocity X density
b. Velocity/density
c. Resistivity X density
d. Density X susceptibility

65. Compared to the mass and charge of a proton an antiproton has
a. the same mass and the same charge
b. greater mass and the same charge
c. the same mass and the opposite charge
d. greater mass and the opposite charge

66. Diamond is an example of
a. covalent bonding
b. ionic bonding
c. metallic bonding
d. all the above

67. The coarse grained equivalent of a basalt is a
a. Rhyolite
b. Gabbro
c. Andesite
d. Basalt

68. The rate of chemical weathering is increased by acids. The most common natural acid on the Earth's surface is
a. nitric
b. hydrochloric
c. carbonic
d. sulphuric

69. Which of the following minerals is most stable at the Earth's surface?
a. hematite
b. mica
c. olivine
d. feldspar

70. Negative skewness of the data indicates
a. Higher values are more
b. Lower values are more
c. Normal distribution of the data
d. Zero variance

71. Which form(s) of energy can be transmitted through a vacuum?

a. light, only
b. sound, only
c. both light and sound
d. neither light nor sound

72. Success of magnetic method depends exclusively on
    a. The contrast in magnetic susceptibility
    b. The contrast in both direction and magnitude of magnetization
    c. The contrast in resistivity
    d. The contrast in density
73. Clouds occur when moist air is cooled by
    a. expansion when it falls
    b. expansion when it rises
    c. compression when it falls
    d. compression when it rises
74. If the data follows Normal distribution
    a. Mean is greater than median
    b. Mode greater than median
    c. Mean greater than mode
    d. Mean, Median and Mode are equal
75. The sum of the cubes of first 9 natural numbers is
    a. 45
    b. 2025
    c. 91125
    d. 13125