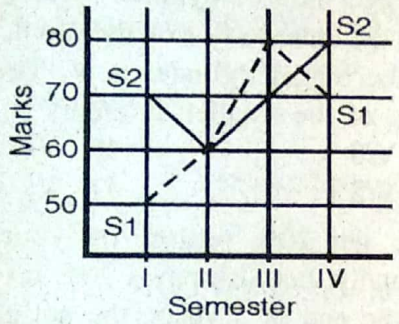
Previous Paper (Solved)

CSIR-UGC (NET) EARTH SCIENCES JUNE-2014

PART-A

1. Marks obtained by two students S1 and S2 in a four semester course are plotted in the following graph



Which of the following statements is true?

A. S2 got higher marks than S1 in all four semesters.

B. Over four semesters, S1 improved by a higher percentage compared to S2.

C. Total marks of S1 and S2 are equal.

D. S1 and S2 did not get the same marks in any semester.

2. The following table shows the price of diamond crystals of a particular quality.

Wt. of a diamond crystals (in carat)	*Price per carat (in lakh ₹)*
1	4
2	8
3	12
4	16

What will be the price (in lakh ₹) of a 2.5 carat diamond crystal?

A. 10 B. 20

C. 25 D. 50

3. How many digits are there in $2^{17} \times 3^2 \times 5^{14} \times 7$?

A. 14 B. 15

C. 16 D. 17

4. A man on the equator moves along 0° longitude up to 45°N. He then turns east and moves up to 90°E, and returns to the equator along 90°E. The distance covered in multiples of Earth's radius R is

A. $\left(\frac{3}{4}\pi\right)R$ B. $\left(\frac{\pi}{2}+\frac{\pi}{4\sqrt{2}}\right)R$

C. $\left(\frac{\pi}{2}+\frac{\pi}{2\sqrt{2}}\right)R$ D. $\left(\frac{\pi}{4}+\frac{\pi}{\sqrt{2}}\right)R$

5.

On a semi-circle of diameter 10 m drawn on a horizontal ground are standing 4 boys A, B, C and D with distances AB = BC = CD. The length of the line-segment joining A and B is

A. 5 m B. 6 m

C. 7 m D. $\frac{5\pi}{3}$ m

6. What is the next number in the following sequence?

2, 3, 5, 6, 3, 4, 7, 12, 4, 5, 9, ...,

A. 10

B. 20

C. 13

D. 6

7. The following sum is

$1 + 1 - 2 + 3 - 4 + 5 - 6 \ldots -20 = ?$

A. 10

B. −10

C. −11

D. −9

8. You are given 100 verbs using which you have to form sentences containing at least one verb, without repeating the verbs, under the condition that the number of verbs (from this set of 100) in any two sentences should not be equal. The maximum number of sentences you can form is

A. 10 C. 13
B. 14 D. 100

9. A 4 × 4 magic square is given below.

1	15	14	4
12	6	7	9
8	10	11	5
13	3	2	16

How many 2 × 2 squares are there in it whose elements add up to 34?

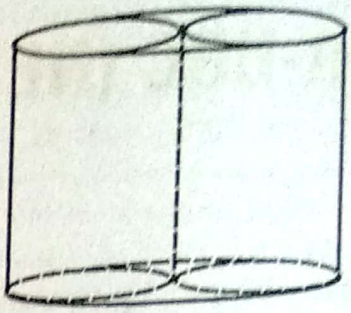
A. 6 B. 9
C. 4 D. 5

10. To go from the engine to the last coach of his train of length 200 m, a man jumped from his train to another train moving on a parallel track in the opposite direction, waited till the last coach of his original train appeared and then jumped back. In how much time did he reach the last coach if the speed of each train was 60 km/hr?

A. 5 s
B. 6 s
C. 10 s
D. 12 s

11. November 9, 1994 was a Wednesday. Then which of the following is true?

A. November 9, 1965 is a Wednesday and November 9, 1970 is a Wednesday.
B. November 9, 1965 is not a Wednesday and November 9, 1970 is a Wednesday.
C. November 9, 1965 is a Wednesday and November 9, 1970 is not a Wednesday.
D. November 9, 1965 is not a Wednesday and November 9, 1970 is not a Wednesday.

12. 

Two identical cylinders of the same height as a bigger hollow cylinder were put vertically into the latter to fit exactly into it. The volume of the bigger cylinder is V. The volume of each of the smaller cylinders is

A. V/8 B. V/4
C. V/2 D. V

13. You get 20% returns on your investment annually, but also pay a 20% tax on the gain. At the end of 5 years, the net gain made by you (as percentage of the capital) is approximately

A. 0 B. 16
C. 80 D. 100

14. Coordinates of a point in x, y, z space is (1, 2, 3). What would be the coordinates of its reflection in a mirror along the x, z, plane?

A. (–1, –2, –3) B. (1, –2, –3)
C. (1, –2, 3) D. (–1, 2, 3)

15. A cubic cavity of edge 20 μm is filled with a fluid with a cubic solid of edge 2 μm. What per cent of the cavity volume is occupied by the fluid?

A. 10.0
C. 90.0 B. 20.0
D. 99.9

16. Find the missing number in sequence

61, 52, 63, 94,—, 18, 001, 121

A. 46
C. 66 B. 70
D. 44

17. What is the length of the longest rod that can be put in a hemispherical bowl of radius 10 cm such that no end of the rod is outside the bowl? (Assume that the rod has negligible thickness.)

A. $10\sqrt{2}$ cm B. $10\sqrt{3}$ cm
C. $10\sqrt{4}$ cm D. $10\sqrt{5}$ cm

18. If a 4 digit year (e.g. 1927) is chosen randomly, what is the probability that it is NOT a leap year?

A. $\frac{3}{4}$ B. $\frac{1}{4}$

C. $< \frac{1}{4}$ D. $> \frac{3}{4}$

19. After giving 20% discount on the marked price to a customer, the seller's profit was 20%. Which of the following is true?

A. Sale price $= \frac{\text{Marked price + Cost price}}{2}$

B. Sale price $< \frac{\text{Marked price + Cost price}}{2}$

C. $\frac{2}{3}$ (Marked price + Cost price) > Sale price $> \frac{\text{Marked price + Cost price}}{2}$

D. Sale price $> \frac{2}{3}$ (Marked price + Cost price)

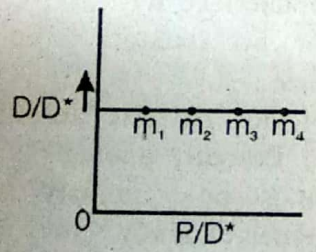
20. Three years ago, the difference in the ages of two brothers was 2 years. The sum of their present ages will double in 10 years. What is the present age of the elder brother?

A. 6
B. 11
C. 7
D. 9

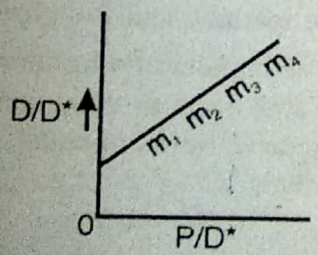
PART-B

21. The following graphs depict the ratio of parent (P) to daughter elements versus daughter isotope measured in four different minerals m_1, m_2, m_3, m_4 from a rock. Which of these graphs indicates that none of these minerals had daughter isotope (D) to start with? (D* is non radiogenic isotope)

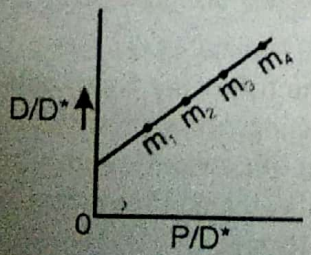
A.



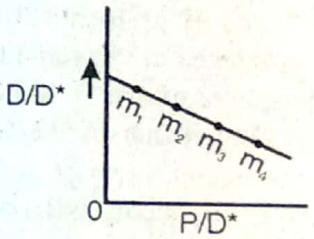
B.



C.



D.



22. Mass movement on hill slopes can be reduced by
A. removal of vegetation
B. construction of roads
C. overloading
D. lowering of water table

23. A drastic increase in the drainage basin area of a river is possible only by
A. headward erosion by the main river
B. river capture
C. avulsion
D. increase in surface runoff

24. **Statement I :** The gravity field inside a homogeneous and isotropic sphere decreases from surface to centre in direct proportion to the density of the sphere.
Statement II : The gravity field inside the Earth decreases gently in the lighter mantle and sharply in the denser core.

A. Statements I and II are true
B. Statement I is true; but II is false
C. Statement I is false; but II is true
D. Statement I and II are false

25. Change of normal olivine structure to spinel structure with increasing depth in the mantle represents a change in the coordination number of Si from
A. 4-fold to 6-fold
B. 6-fold to 4-fold
C. 6-fold to 8-fold
D. 8-fold to 6-fold

26. The most abundant cation/anion pairs in river and sea, respectively are
A. (Ca^{2+}/HCO_3^-) and (Na^+/Cl^-)
B. (Na^+/SO_4^{2-}) and (Na^+/Cl^-)
C. (Mg^{2+}/SO_4^{2-}) and (Mg^{2+}/HCO_3^-)
D. (Ca^{2+}/HCO_3^-) and (Na^+/SO_4^{2-})

27. Seamounts I and II of identical height and weight are emplaced at the same time on the oceanic lithosphere of age 10 Ma and 60 Ma, respectively. Which one of the following is true?
A. Depth of the ocean will be more at seamount I than at seamount II.
B. Depth of the ocean will be the same at seamounts I and II.
C. Depth of the ocean will be less at seamount I than at seamount II.
D. Depth of the ocean is unrelated to the age of oceanic lithosphere.

28. In their pure form quartz and calcite are
A. both paramagnetic
B. diamagnetic and paramagnetic respectively
C. paramagnetic and diamagnetic respectively
D. both diamagnetic

29. Powder X-ray diffractograms of halite (NaCl) and sylvite (KCl) have the same number of lines, however, their *d* spacings are different because
A. both are not isostructural
B. Sodium is a smaller ion than potassium
C. Potassium is a smaller ion than sodium
D. of differences in the X-ray scattering of sodium and potassium ions

30. **Statement I :** Intraplate seismicity is mostly confined to the upper 10-15 km.
Statement II : Temperature increases with depth inside the Earth.
A. Statement II is correct but I is false
B. Both statements are wrong
C. Both statements are correct
D. Statement I is correct but II is false

31. If the mass of organic carbon in sedimentary rocks in the Earth's crust is 21,000 kg m^{-3}, then the estimated oxygen liberated by photosynthesis is
A. ~ 10,000 kg m^{-3}
B. ~ 56,000 kg m^{-3}
C. ~ 30,000 kg m^{-3}
D. ~ 20,000 kg m^{-3}

32. Which one of the following is the correct pair of a pelagic deposit type and its origin?
A. Red clays – Biogenous
B. Manganese nodules – Lithogenous
C. Siliceous oozes – Biogenous
D. Calcareous oozes – only Hydrogenous

33. An isostatically compensated elevated land mass is characterized by
A. little or no isostatic and Bouguer anomalies
B. little or no isostatic anomaly, but a negative Bouguer anomaly
C. negative isostatic anomaly, but little or no Bouguer anomaly
D. negative isostatic and Bouguer anomalies

34. The magnetic latitude of a location where the horizontal and vertical components of the Earth's magnetic field are equal
A. is less than 30°
B. is 60°
C. lies between 30° and 45°
D. is 45°

35. Which of the following represents the regions with decreasing order of surface heat flow?
A. Western Dharwar Craton, Cambay basin, Deccan Volcanic Province, Central Indian Ocean Ridge.

B. Central Indian Ocean Ridge, Cambay basin, Deccan volcanic Province, Western Dharwar Craton.
C. Deccan Volcanic Province, Cambay Basin, Central Indian Ocean Ridge, Western Dharwar Craton.
D. Central Indian Ocean Ridge, Western Dharwar Craton, Deccan Volcanic Province, Cambay basin.

36. A mineral contains both compatible and incompatible elements. If 2% of this mineral gets melted, the melt will have, relative to the residual solid
A. a higher concentration of incompatible elements.
B. a lower concentration of incompatible elements.
C. 2% of incompatible elements originally present.
D. a higher concentration of compatible elements.

37. The bulk chemical compositions of two samples of a metamorphic rock are the same but their mineralogical compositions are different. Which of the following is true?
A. Mineralogical composition is completely independent of bulk chemical composition.
B. Some elements are removed as amorphous forms.
C. These two samples represent different pressure-temperature conditions of formation.
D. Fluids have been removed from these samples.

38. Relative to the lithosphere, in the asthenosphere, there is a velocity
A. decrease in shear waves
B. increase in Rayleigh waves
C. increase in shear waves
D. increase in longitudinal waves

39. Magma is generated in subduction zone because of the
A. lowering of melting point in mantle due to decrease of pressure.
B. lowering of melting point due to incorporation of fluids in mantle.
C. increase in temperature due to fast descending subducting plate
D. increase in temperature due to rise of mantle plume

40. During seismic wave propagation, rocks undergo deformation which is
A. elastic B. brittle
C. plastic D. ductile

41. Hydraulic conductivity is high in an aquifer composed of
A. mudstone B. sandstone
C. igneous rocks D. metamorphic rocks

42. At high pressure and temperature, rocks begin to develop permanent ductile strain under stress. It happens when the stress reaches the
A. ultimate strength B. shear strength
C. fracture strength D. yield strength

43. Which of the following properties of a rock with fluid filled cracks would best represent its rheology?
A. Elasticity B. Plasticity
C. Visco-elasticity D. Viscosity

44. Cross bedding in limestone implies
A. *in situ* precipitation of carbonate in fluvial environment.
B. *in situ* precipitation of carbonate in lake environment.
C. *in situ* precipitation of carbonate in marine environment.
D. reworking of carbonate in depositional environment.

45. Which of the following metals is known to occur as native element, oxide mineral and as sulphide mineral in different types of ores?
A. Copper B. Lead
C. Zinc D. Gold

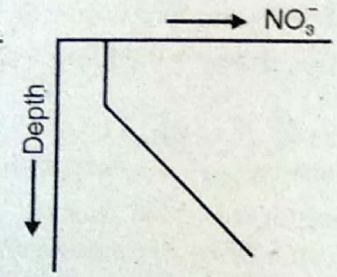
46. The Earth's magnetic field increases with latitude. At which latitude will the magnetic field be thrice of that at the equator?
A. Nowhere B. 30°
C. 60° D. 90°

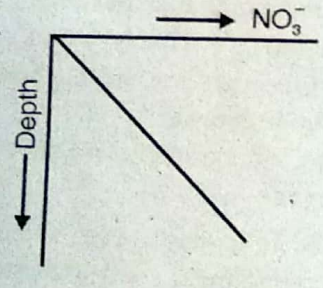
47. Lithification of a sedimentary rock does not include one of the following:
A. compaction
B. cementation
C. crystallization
D. denudation

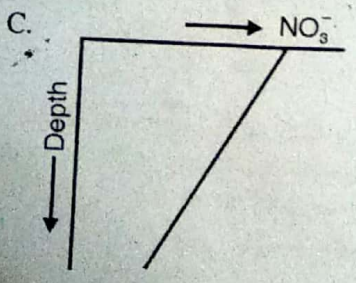
48. The major part of the hypsographic curve is occupied by the
A. abyssal plain
B. continental slope
C. highlands and mountains
D. depressions on the ocean floor

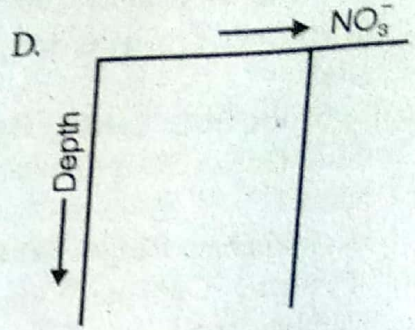
49. The supply of sodium to river waters is mainly from
A. aerosols
B. silicate weathering
C. weathering of evaporites
D. pollution

50. Which of these depth profiles depicts the correct variation of concentration of nitrate in the polar ocean?

A.


B.


C.


D.


51. Pressure and density change over an altitude of 2.3 times the scale height (2.3H) in the atmosphere of the Earth are as follows:
A. Pressure changes by a factor of 2 and density changes by a factor of 6
B. Pressure changes by a factor of 10 and density changes by a factor of 4
C. Pressure and density both change by a factor of 10
D. Pressure changes by a factor of 8 and density changes by a factor of 10

52. Relative to dry air, moist air is
A. heavier
B. lighter
C. heavier or lighter depending on the temperature of water vapour
D. heavier or lighter depending on the pressure

53. Identify the correct sequence of albedo (higher to lower).
A. Fresh snow > glacier ice > sea ice > old snow
B. Fresh snow > old snow > sea ice > glacier ice
C. Old snow > fresh snow > glacier ice > sea ice
D. Old snow > sea ice > glacier ice > fresh snow

54. Thunderstorms occur during late afternoons/ evenings because
A. there is insufficient water vapor build up in the morning
B. wind is very less in the morning
C. absence of weather systems such as lows
D. increased solar heating in the afternoon as the day progresses

55. Geostrophic winds cannot occur over
A. the Equator
B. the Tropic of Cancer
C. the Tropic of Capricorn
D. the Arctic Circle

56. Which one of the following is NOT a component of the global thermohaline circulation?
A. The Atlantic Conveyor
B. The Indonesian throughflow
C. The Pacific and Indian Ocean Anticonveyor
D. The Southern Oscillation

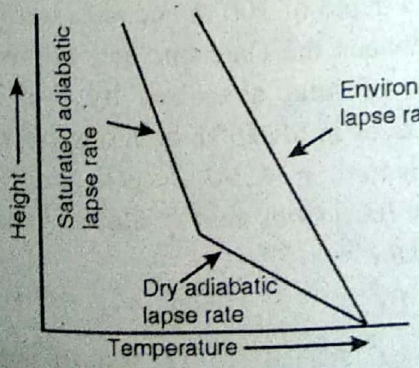
57. Among these, which form of nitrogen in the ocean water is the most preferred form for autotrophic processes?
A. N_2 gas
B. NH_4^+
C. NO_3^+
D. N_2O

58. Marine Snow is
A. snowfall near polar ocean
B. aggregate of particulate matter derived from living organisms in the ocean
C. submarine gas hydrates
D. sea ice

59. Evaporation is maximum during a
A. hot and windy day
B. cool and calm day
C. hot and calm day
D. cool and windy day

60. The relative efficiency with which light at 0.3 μm and light at 0.6 μm are scattered by air molecules is
A. 16
B. 3.45
C. 10
D. 8

61. What type of atmospheric stability/instability do the curves in the figure represent?



A. Absolute stability
B. Absolute instability
C. Conditional stability
D. Static instability

62. Cyclone formation over Indian Ocean is highly likely
A. during the pre and most monsoon seasons
B. during the active monsoon phase
C. during the period of strong vertical wind shear
D. in the presence of strong monsoon depression over land

63. Which of the following is formed by continuous flushing of water through a silicate rock?
A. Placer gold
B. Ferro-manganese nodule
C. Diamond-bearing conglomerate
D. Bauxite

64. A soil containing no sign of parent rock fabric is known as a
A. duricrust
B. regolith
C. solum
D. residual soil

65. Carbonate precipitation caused by ground water table fluctuation in a sedimentary horizon would be in
A. vein form
B. bedded form
C. nodular form
D. disseminated form

66. Which of the following types of clouds can commonly be observed above the elevation of Mt. Everest?
A. Cumulonimbus
B. Stratocumulus
C. Cirrostratus
D. Altostratus

67. Identify the correct statement :
A. The greenhouse effect is caused by a hole in the ozone layer, which allows in more sunlight
B. The melting of floating sea-ice would cause a catastrophic flooding of coastal areas
C. Throughout the geological history of the Earth, humans have been the main cause of climate change
D. Climate change is a natural process, and perhaps accelerated by humans recently

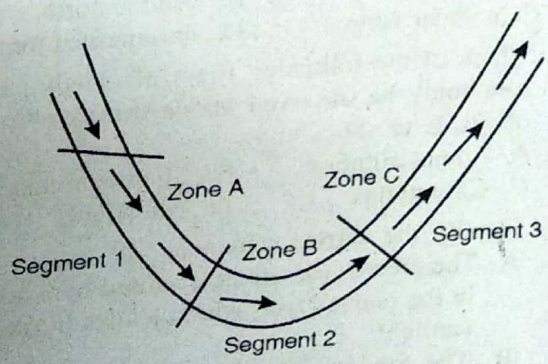
68. Due to Coriolis force, a moving object in the Earth's atmosphere in any direction will
A. not be deflected at all in both the hemispheres.
B. get deflected towards right in the northern and left in the southern hemisphere.
C. get deflected in the same direction in both the hemispheres.
D. get deflected to the left in the northern and right in the southern hemisphere.

69. Despite the relative sluggishness with which the ocean current moves *vis-a-vis* the atmosphere, the oceans are as effective as the atmosphere in transporting excess heat from lower to higher latitudes. This statement is
A. incorrect
B. partially correct; while ocean currents do move sluggishly, they are not as effective as the atmosphere in transporting excess heat.
C. correct; the reason for the effectiveness of the ocean transporting excess heat is due only to its higher specific heat.
D. completely correct; the reason for the effectiveness of the ocean transporting excess heat is due to its higher density and higher specific heat.

70. In a map of the global ocean showing dissolved oxygen at 200 m depth, the Arabian Sea, California coast and the Peru margins show minimum values because these regions experience
A. intense seasonal upwelling
B. intense seasonal downwelling
C. intense horizontal advection currents
D. excess precipitation over evaporation

PART-C

71. With reference to the air flow along a Rossby wave trough shown below, identify the zone where vorticity increases with time. Also, does the air converge or diverge in the identified zone?



A. Zone B, diverges
B. Zone A, converges
C. Zone C, converges
D. Zone B, converges

72. Many meteorological satellites have a channel between 10 μm and 11.5 μm because, in this band the atmosphere
A. is transparent to visible radiation
B. is transparent to infrared radiation
C. is highly absorbing
D. emits maximum energy

73. A trade wind inversion is best developed
A. near the eastern edges of the subtropical highs
B. over the western sectors of the subtropical highs
C. where the wind flow generates warm ocean currents
D. where the wind flow is towards regions of higher values of absolute vorticity

74. During an EI Nino, entire oceanic mixed layer having a depth of 100 m becomes warmer by 2 °C between the Date line and 120°W. The amount of heat absorbed by this ocean mixed layer in 5°S–5°N belt is (*specific heat of seawater = 4200 J/kg/K, density of water = 1000 kg/m^3 and 1° latitude/longitude = 100 km*)
A. 5×10^{21} J
B. 2×10^{15} J
C. 5×10^{10} J
D. 4×10^{16} J

75. From the first law of thermodynamics we have $C_v dT + p d\alpha = dQ$ the heat supplied, $p d\alpha$, the work done by air of pressure p and specific volume α, $C_v dT$, the increase in internal energy, C_v = specific heat at constant volume, T = absolute temperature. $\frac{D}{Dt}$ is the substantial derivative. The rate of change of entropy of the above system can be written as

A. $C_p \frac{D}{Dt}(ln T) - R \frac{D}{Dt}(ln p)$

B. $C_p \frac{D}{Dt}(ln T) + R \frac{D}{Dt}(ln p)$

C. $C_v \frac{D}{Dt}(T) - \alpha \frac{D}{Dt}(p)$

D. $C_v \frac{D}{Dt}(T) + \alpha \frac{D}{Dt}(p)$

76. The relative vorticity value at the centre of a tropical cyclone which forms over the southern tropical oceans is
A. maximum positive
B. maximum negative
C. minimum positive
D. minimum negative

77. An improvement of the parcel method of investigating static stability is to consider compensating subsidence motion. How will the stability characteristics of an adiabatic ascent of an unsaturated moist air parcel be modified due to incorporation of compensating subsidence motion?
A. Ascending parcel will become more unstable
B. Ascending parcel will become more stable
C. Ascending parcel will tend to neutral equilibrium
D. The stability of the ascending parcel will remain unchanged

78. Diatom production in the coastal and estuarine region is limited by the availability of dissolved
A. nitrate
B. phosphate
C. silicate
D. iron

79. Volcanogenic massive sulfide ore deposits are known for concentration of certain ore elements. What are the most common ore elements in the decreasing order of abundance?
A. Fe, Ni, Co, Cu
B. Zn, Cu, Pb, Ag
C. Zn, Cu, Ni, Au
D. Pb, Zn, Cu, Mo

80. A poorly sorted sedimentary rock is observed to contain abundant angular grains and rock fragments along with fresh feldspar grains. Which one is the most likely tectonic setting for the above?
A. Stable continental margin
B. Active continental margin
C. Intra-cratonic basin
D. Ocean trenches

81. Similar rock type is exposed in the line following geographic settings : (*a*) arid with high relief, (*b*) humid with high relief, (*c*) humid with low relief. The most probable sequence of clay mineral assemblage expected in the above settings is
A. (*a*) illite/chlorite (*b*) smectite (*c*) kaolinite /gibbsite
B. (*a*) smectite (*b*) kaolinite /gibbsite (*c*) illite/chlorite
C. (*a*) kaolinite /gibbsite (*b*) smectite (*c*) illite/chlorite
D. (*a*) smectite (*b*) illite/chlorite (*c*) kaolinite /gibbsite

82. On fractional crystallization of plagioclase that formed earlier, the residual magma will have
A. positive Eu anomaly and Nb depletion
B. negative Eu anomaly and enrichment of Sr
C. negative Eu anomaly and depletion of Sr
D. no Eu anomaly and depletion of Ni

83. Which one of the following sequences of plate tectonic events from the oldest to the youngest is correct?
A. Break-up of Gondwanaland – Break up of Pangea – Opening of Drake passage – losing of Central American seaway.

B. Break up of Pangea – Break-up of Gondwanaland – Opening of Drake passage – Closing of Central American seaway.

C. Break up of Pangea – Break-up of Gondwanaland – Closing of Central American seaway – Opening of Drake passage.

D. Break up of Pangea – Closing of Central American seaway – Break-up of Gondwanaland – Opening of Drake passage.

84. If a river has a braided pattern,

(*a*) the channel is likely to be relatively stable

(*b*) the stream has very easily erodible banks

(*c*) the stream carries a very heavy and coarse sediment load

(*d*) the channel bed has a relatively steep slope

(*e*) the stream carries most of its load in suspension

Taking T as true and F as false, pick the option which gives the true – false sequence in the correct order

A. TFFFT B. FFFFF

C. FTTTF D. TTTTT

85. Consider a coastal aquifer with possible seawater intrusion. If a pumping well is located at an elevation of 6 m above mean sea level and the depth to water table is 5 m, the total thickness of the fresh water column will be

A. 11 m B. 40 m

C. 41 m D. 30 m

86. For a meandering river with high sinuosity, the minimum velocity of water will be observed

A. in the concave bank

B. in the convex bank

C. in the middle of the river

D. at the bottom of the river

87. A function y satisfies the differential equation $\frac{d^2y}{dx^2} = y$, with $y(0) = 1$ and $y(2) = 5$.

Then $y(1)$

A. 2.0 B. 2.33

C. 2.50 D. 2.67

88. The amplitude A and phase ϕ spectra of the Fourier transform of the exponential decay function of decay constant a are

A. $A = \frac{1}{a^2 + w^2}$, $\phi = \frac{w}{a}$

B. $A = \frac{1}{a^2 + w^2}$, $\phi = \frac{-w}{a}$

C. $A = \frac{1}{\sqrt{a^2 + w^2}}$, $\phi = \frac{-w}{a}$

D. $A = \frac{1}{\sqrt{a^2 + w^2}}$, $\phi = \frac{w}{a}$

89. A coarse grained rock C and another fine grained rock F, of identical volume percentages of magnetic minerals, acquire thermoremanent magnetism (TRM) in the Earth's magnetic field at the same location and time. Then the TRM of C is

A. stronger than F, and it has a higher magnetic susceptibility.

B. stronger than F, but has a lower magnetic susceptibility.

C. weaker than F, but it has higher magnetic susceptibility.

D. weaker than F, and it has a lower magnetic susceptibility.

90. A vertical magnetic anomaly profile across a spherical ore body magnetized at an angle of 60° is given. The distance between the points of half the maximum anomaly values is 141 m. The depth to the centre of the spherical body is

A. 141 m B. 121 m

C. 100 m D. 71 m

91. A continental crust contains uniformly distributed radiogenic heat sources with the heat generation rate of $2\mu W/m^3$ in the upper 20 km crust. This crust is eroded at the rate of 0.5 km/Ma for 40 million years. Assuming a steady state thermal regime at the end of erosion episode, the final surface heat flux will be

A. less than the mantle heat flux.

B. equal to the mantle heat flux.
C. 1.5 times the mantle heat flux.
D. 2 times the mantle heat flux.

92. A seismic survey over a horizontal reflector brought out a two-way travel time of 1.0 sec at the shot point, while the refraction survey brought out the intercept time of 0.8 sec. A detector placed at 1.8 km distance from the shot point received the refracted and reflected waves simultaneously. The depth to the reflector is
A. 0.8 km. B. 1.2 km.
C. 1.6 km. D. 2.0 km.

93. The gravity profile across a steeply dipping dyke recorded a maximum anomaly g. The width of the anomaly, the distance between the positions of the anomaly values of 0.5 g, is w. If the dyke, located at the same depth, dips at a gentle angle, then its maximum anomaly g' and its width w' are
A. $g' > g,\ w' > w$ B. $g' > g,\ w' < w$
C. $g' < g,\ w' < w$ D. $g' < g,\ w' > w$

94. The formation resistivity factors of two sedimentary rocks of porosity 10% and 20% are in the ratio 4:1. If the porosities of these rocks are 12% and 24%, respectively, their formation resistivity factors are in the ratio of
A. 5 : 1 B. 4 : 1
C. 3.2 : 1 D. 2 : 1

95. A seismic observatory recorded the S wave 12 seconds later than the P wave. If the velocity of the P waves in the medium is around 6.5 km/s, the epicenter of the earthquake lies at a distance of
A. 30 – 50 km B. 60 – 80 km
C. 80 – 120 km D. 120 – 150 km

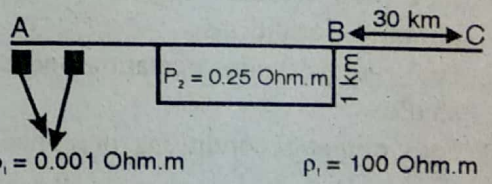
96. The velocity of the P-wave in an Earth model, of radius 6,370 km with a core of radius 2900 km, increases from 6.37 km/sec from the Earth's surface to 14.5 km/sec at the mantle-core boundary. The angle of emergence of the P-wave recorded at the epicentral distance of 103°, beyond which no direct P-wave was recorded, is
A. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$ B. $\sin^{-1}\left(\frac{1}{3}\right)$
C. $\sin^{-1}\left(\frac{1}{\sqrt{5}}\right)$ D. $\sin^{-1}\left(\frac{1}{5}\right)$

97. The mean temperature of London is higher than that of Toronto, though located at the same latitude. This is because of
A. higher greenhouse gas emission
B. presence of Gulf stream
C. ENSO phenomenon
D. North Atlantic Oscillation

98. Sediments accumulate in a rift-type basin undergoing syndepositional subsidence by:
A. normal faulting in extensional regimes
B. reverse faulting in collisional regimes
C. strike-slip faulting in extensional regimes
D. imbricate thrust faulting in collisional regimes

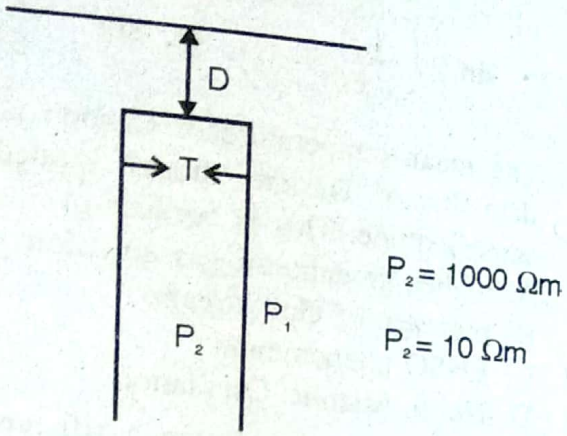
99. Tropical cyclones weaken after landfall due to
A. decreased friction over land
B. absence of moisture provided by the oceans
C. change in the vertical wind shears
D. difference in the temperature gradient

100. Long period magnetotelluric soundings were carried out over the following model at A, B and C:



The apparent resisitivity (ρ_a) and phase (ϕ_a) in xy and yx directions are ρ_{axy} and ρ_{ayx} and ϕ_{axy} and ϕ_{ayx}, respectively. Which of the following statements is true for C?
A. no splitting between ρ_{axy} and ρ_{ayx} and ϕ_{axy} and ϕ_{ayx}.
B. no splitting in (ρ_a) and (ϕ_a) up to 10 sec and both curves start spliting thereafter.
C. no splitting in ρ_a curves, but ϕ_a curves start splitting at 10 sec.
D. ρ_a curves start splitting at 10 sec, but ϕ_a curves show no splitting.

101. A horizontal loop EM survey is to be carried out over a conductive dyke of large strike length as shown below:



The dyke can be successfully mapped if the minimum skin depth and the transmitter-receiver distance are, respectively;

A. 0.2 D and 1.0 D
B. 0.5 D and 0.5 D
C. 0.1 D and 1.0 D
D. 2.0 D and 2.0 D

102. Examination of Precambrian sedimentary records prior to 2 Ga reveals fluvial deposits dominated by braided rivers and marine deposits dominated by limestones. This is because

A. land was of high gradient with humid climatic conditions
B. land was without vegetation with arid climatic conditions
C. land was without vegetation and sea was shallow
D. cool climatic conditions prevailed

103. x_{cr} and T_{cr} are the cross-over distance and cross over time, respectively, in a seismic travel time curve over a horizontal interface between two layers with velocities, V_1 and V_2. If the velocities in both the layers are doubled then

A. x_{cr} and T_{cr} are unchanged
B. both x_{cr} and T_{cr} will have twice their present values
C. x_{cr} is unchanged, while T_{cr} will have half its present value
D. x_{cr} will have half its present value, while T_{cr} is unchanged

104. Which one of the following is considered as the present day marine remnant of the Tethys?

A. Andaman Sea
B. Bering Sea
C. South China Sea
D. Mediterranean Sea

105. $\Delta g(x, y)$ are the gravity anomalies recorded on a horizontal plane underlain by a distribution of mass M with a density d surrounded by a material of constant density d_0. G is the Newton's gravitational constant. If

$$A = \int_s \Delta g(x, y)\, ds, \text{ then } M =$$

A. $A/4\pi G$
B. $A/2\pi G$
C. $(A/4\pi G) \times (d/d_0)$
D. $(A/2\pi G) \times d / (d - d_0)$

106. Total field magnetic anomalies along a profile are found to be everywhere half of the values of anomalies in the vertical component. What is your inference?

A. Such a situation does not occur anywhere
B. The anomalous body strikes E – W at the equator
C. The anomalous body strikes N – S and is located at the latitude 30°
D. The anomalous body strikes N – S and is located at the latitude $\tan^{-1}(1/2/\sqrt{3})$.

107. The densities of the Earth and Mars are in the ratio 14 : 10. The rate of decrease of the gravity field of Mars on its surface with elevation would be

A. 0.31 gal/km
B. 0.25 gal/km
C. 0.22 gal/km
D. 0.10 gal/km

108. Cyclostrophic wind velocity at a radius of 100 km for a pressure gradient of 0.025 kPa km^{-1} is

A. 25 ms^{-1}
B. 40 ms^{-1}
C. 50 ms^{-1}
D. 100 ms^{-1}

109. The convective available potential energy of the atmosphere over a station is 1800 J. Assuming no frictional drag, if all of this energy is converted to kinetic energy, then

the updraft velocity at the level of free convection is

A. 50 ms^{-1} B. 70 ms^{-1}
C. 60 ms^{-1} D. 40 ms^{-1}

110. Pressure gradient acceleration over two cities at a certain altitude (ρ_{air} at that altitude is 0.5 kgm^{-3}) that are 500 km apart due a pressure difference of 10 hPa is

A. 0.04 cm s^{-2} B. 0.4 m s^{-2}
C. 0.04 m s^{-2} D. 0.4 cm s^{-2}

111. The governing equations resulting from the Eulerien description of fluid motion are found to be more convenient and are more widely used as compared to the equations resulting from the Lagrangian description of fluid motion, since

A. there are no non-linear terms in the equation governing Eulerian description of fluid flow
B. the Eulerian description assumes the fluid to be a continuum
C. having a fixed coordinate system, the Eulerian description of fluid motion envisages fluid properties as fields (scalar and vector fields)
D. the Eulerian equations are a set of ordinary differential equations

112. During the southern hemispheric summer, the Intertropical Convergence Zone (ITCZ) typically lies:

A. south of the equator
B. on the Tropic of Cancer
C. on the 45th N parallel
D. on the Arctic circle

113. The vertical distribution of temperature in the atmosphere is obtained using several infrared channels centered around 15 μm using satellite radiometer because

A. CO_2 has strong absorption centered around this wavelength
B. CO_2 is a greenhouse gas
C. O_2 has strong absorption centered around this wavelength
D. water vapour has strong absorption centered around this wavelength

114. Which of the following statements is incorrect?

A. Westerlies blow over most of continental USA
B. Northern Canada will not be affected by atmospheric nuclear testing carried out over Greenland
C. Prevailing winds over most of India are trade winds
D. Major deserts of the world lie between 20-35° N/S latitudes

115. The climograph for a region indicates that rainfall is distributed nearly uniformly throughout the year with monthly averages of 12 cm and that average monthly temperatures vary by 2° C. Based on this information, under which climate zone would you classify the location?

A. Mild mid-latitude
B. Humid subtropical
C. Tropical wet
D. Marine west coast over mid-latitudes

116. If the column primary productivity is 795 mg C m^{-2} day^{-1}, approximately how much nitrogen is utilized?

A. 10 mg N m^{-2} day^{-1}
B. 20 mg N m^{-2} day^{-1}
C. 10 mM N m^{-2} day^{-1}
D. 20 mM N m^{-2} day^{-1}

117. Which of the following processes occur during EI Nino?

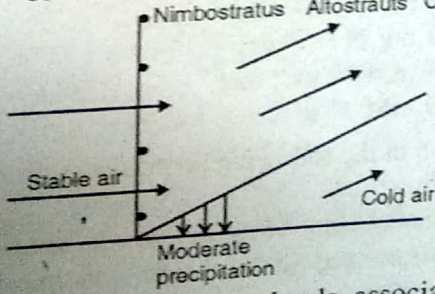
A. Weakening of trade winds leading to deeper and shallower thermocline in the western and eastern Pacific, respectively, compared to normal condition
B. Strengthening of trade winds leading to shallower and deeper thermocline in the western and eastern Pacific, respectively, compared to normal conditon.
C. Weakening of trade winds leading to shallower and deeper thermocline in the western and eastern Pacific, respectively, compared to normal Conditon.
D. Weakening of trade winds with no change in the depth of the thermocline

118. If a 10 m water column (specific heat of water = 4000 J kg^{-1} K^{-1}; density of water = 1000 kg m^{-3}) gains 50 W m^{-2} of heat for 10 hours, its temperature will increase by
A. 0.45 °C
B. 0.045 °C
C. 0.55 °C
D. 0.055 °C

119. At a pH of 8.1 in seawater, the predominant forms of dissolved inorganic carbon and phosphorous are
A. CO_3^{2-} and PO_4^{3-}
B. HCO_3^- and PO_4^{3-}
C. HCO_3^- and HPO_4^{2-}
D. CO_3^{2-} and $H_2PO_4^-$

120. Under oxygen deficient condition, the sequence in which the chemical species are formed is
A. Ammonium, nitrite, methane, hydrogen sulfide
B. Nitrite, methane, ammonium, hydrogen sulfide
C. Methane, hydrogen sulfide, ammonium, nitrite
D. Nitrite, ammonium, hydrogen sulfide, methane

121. The figure below is a representation of which of the following idealized conditions?



A. Weather and clouds associated with a warm front
B. Weather associated with a cold front
C. Weather and clouds associated with an occluded front
D. Weather associated with a stationary front

122. The alkalinity of a sample of surface seawater is 2.5 mol m^{-3} and its ΣCO_2 is 2.3 mol m^{-3}. What will be the concentration of CO_3^{2-} in this sample?
A. 6.8 mol m^{-3}
B. 0.2 mol m^{-3}
C. 1.08 mol m^{-3}
D. 0.05 mol m^{-3}

123. One of the approaches to combat global warming is by Iron fertilization of high nutrient low chlorophyll (HNLC) waters. What is the potential danger involved?
A. Excess organic particles will cause anoxic condition in surface water and consequent mass mortality
B. The sinking of organic particles will cause denitrification condition in the intermediate water and consequent diffusion of nitrous oxide into the atmosphere
C. Community shift in favour of nano-plankton and picoplankton
D. Dominance of diatoms and loss of biodiversity

124. When the air temperature is 30 °C, a hygrometer reads a relative humidity of 40%. If the saturated vapour pressure at 30 °C is 4.23 kPa, what is the vapour pressure?
A. 16.92 kPa
B. 10.58 kPa
C. 1.69 kPa
D. 1.06 kPa

125. The uptake of nutrient by marine phyto-plankton is described by the equation $r = r_0S/(S + S_0)$, where r is the uptake rate, S is substrate (nutrient) concentration and r_0 and S_0 refer to intitial values which are positive. When S approaches S_0, r approaches
A. half of its maximum value
B. its maximum value
C. zero
D. an indeterminate value

126. During the monsoon season in the Western Arabian Sea, due to Ekman pumping, the surface waters move
A. northwards, parallel to the monsoon current
B. southwards, against the monsoon current
C. eastwards, perpendicular to the monsoon current
D. westwards, perpendicular to the monsoon current

127. Runaway greenhouse effect could occur on Earth because
A. the negative feedbacks between the concentration of greenhouse gas and climate are strong
B. the positive feedbacks between the concentration of greenhouse gas and climate are weak
C. saturation vapour pressure of water is a decreasing function of temperature
D. saturation vapour pressure of water is an increasing function of temperature

128. Which of the following does not happen in the surface waters during oceanic upwelling?
A. Reduction of sea surface temperature and increase of dissolved CO_2
B. Reduction of sea surface temperature and decrease of dissolved CO_2
C. Increase of surface nutrient and primary production
D. Increase of pCO_2 and decrease of pH

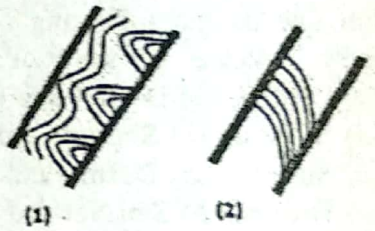
129. The relative abundance sequence of the given major cations / anions in seawater is
A. Ca^{2+}, K^+, Mg^{2+}, Sr^{2+} / F^-, Br^-, SO_4^{2-}
B. Mg^{2+}, Ca^{2+}, K^+, Sr^{2+} / SO_4^{2-}, Br^-, F^-
C. K^+, Mg^{2+}, Ca^{2+}, Sr^{2+} / SO_4^{2-}, Br^-, F^-
D. Mg^{2+}, Ca^{2+}, K^+, Sr^{2+} / F^-, Br^-, SO_4^{2-}

130. Five samples of a metamorphic rock yielded an Sm-Nd isochron age of 2.5 Ga and Rb-Sr isochron age of 0.5 Ga. Which of the following could explain these results?
A. Rb in the rock was incorporated after its formation
B. Rb-Sr system was reset at 0.5 Ga but Sm-Nd system remained closed since 2.5 Ga
C. This rock contains more Sm, Nd and less Rb, Sr
D. Bulk chemical composition of the rock got changed at 0.5 Ga

131. Maximum evaporation takes place between 30°N and 30°S latitudes because
A. maximum solar radiation is received between 30°N and 30°S
B. maximum solar radiation is received and also 50% of the Earth's area is located between 30°N and 30°S
C. this latitude belt is relatively cloud free
D. maximum precipitation takes place between 30°N and 30°S

132. Which one of the following sequences of minerals represents increasing aluminium content?
A. Augite, garnet, biotite, hornblende
B. Hornblende, augite, garnet, biotite
C. Biotite, augite, hornblende, garnet
D. Augite, hornblende, biotite, garnet

133. Vertical sections of a folded sandstonebed at locations I and II are as follows:



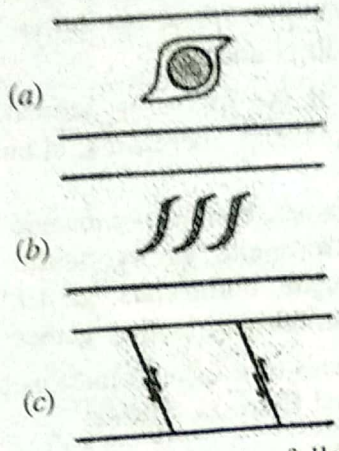
Which one of the following is the correct interpretation?
A. I-normal sequence, II-overturned sequence
B. I-overturned sequence, II-normal sequence
C. I-overturned sequence, II-overturned sequence
D. I-normal sequence, II-normal sequence

134. A stratigraphic succession of a Quaternary unit is characterized by the following lithounits from the bottom to the top.

Gravel bed → sand-mud alternation with palaeosols → well rounded and wellsorted silt or very fine sand

Probable depositional environments for the above sequence are
A. distal part of alluvial fan → braided river → aeolian
B. proximal part of alluvial fan → braided river → lake
C. proximal part of alluvial fan →flood plain → aeolian
D. proximal part of alluvial fan → lake → braided river

135. A field geologist observed (a) mantled porphyroclasts (b) en-echelon veins and (c) high-angle Riedel fractures from three shear zones as shown below.



Which one of the following combinations correctly indicates the sense of shear?

A. (*a*) Dextral, (*b*) Dextral and (*c*) Sinistral
B. (*a*) Sinistral, (*b*) Sinistral and (*c*) Dextral
C. (*a*) Sinistral, (*b*) Dextral and (*c*) Sinistral
D. (*a*) Dextral, (*b*) Sinistral and (*c*) Dextral

136. The differences in the processes of formation of coal and petroleum deposits are in the
(*a*) source of hydrocarbon
(*b*) geothermal gradient in which these formed
(*c*) time required for their maturation
(*d*) retention or migration of the final product

Which of the options below is correct?

A. only (*a*)
B. only (*b*)
C. only (*c*)
D. all (*a*), (*b*), (*c*) and (*d*)

137. If a crystal shows point group symmetry mm2, choose the crystal form that cannot develop in this class :

A. a-pinacoid
B. b-pinacoid
C. c-pinacoid
D. Rhombic pyramid

138. Choose the correct pair of shell morphology of benthic foraminifera and their micro-habitat preferences given below:

A. Flattened test-epifaunal, cylinderical test-infaunal
B. Plano-convex test-epifaunal, tapered test-infaunal
C. Tapered test-epifaunal, milioline test-infaunal
D. Plano-convex test-epifaunal, milioline test-infaunal

139. The mean surface elevation of a foreland basin increases while undergoing tectonic loading and erosional unloading in the hinterland. In such a scenario, how do the rivers and coarse facies behave?

A. Transverse rivers join a longitudinal river in proximal and medial parts and coarse facies are restricted to near the mountain front.
B. Transverse rivers flow across much of the foreland, coarse facies prograde far across the basin.
C. Longitudinal rivers are in distal position and coarse facies are restricted in the medial part.
D. Transverse rivers are very long and join the longitudinal river in distal part, coarse facies are restricted to distal part.

140. The correct sequence of magnetic polarity events in the marine Cenozoic sedimentary record from older to younger is

A. Gilbert Reversal, Gauss Normal, Matuyama Reversal, Brunhes Normal
B. Gilbert Reversal, Matuyama Reversal, Gauss Normal, Brunhes Normal
C. Gilbert Reversal, Brunhes Normal, Matuyama Reversal, Gauss Normal
D. Gilbert Reversal, Matuyama Reversal, Brunhes Normal, Gauss Normal

141. Choose the correct order of deep sea deposits in relation to increasing depth of ocean water column.

A. Red clays, pteropod ooze, foraminiferal ooze, radiolarian ooze
B. Red clays, radiolarian ooze, foraminiferal ooze, pteropod ooze
C. Pteropod ooze, foraminiferal ooze, radiolarian ooze, red clays
D. Foraminiferal ooze, pteropod ooze, radiolarian ooze, red clays

142. Paired metamorphic belts may form when:
A. a high-pressure metamorphic belt is accreted to a low pressure belt
B. an oceanic plate subducts beneath an island arc
C. two metamorphic belts of any age fuse with one another
D. a regional metamorphic belt undergoes contact metamorphism

143. Assume that a vertical photograph was taken at a flying height of 2500 m above sea level by a camera with a lens of focal lenth 152 mm. Determine the scale of photograph of the terrain whose average surface elevation is 980 m.
A. 1 : 50,000
B. 1 : 20,000
C. 1 : 10,000
D. 1 : 5,000

144. The major effect of Messinian Crisis event on the world ocean was the
A. rise of global sea level
B. lowering of global sea level
C. increase of global sea surface temperature
D. significant reduction in salt budget of the global ocean

145. Match the following and identify the correct answer.

Dominant wind direction	*Sand Dune Type*
(*a*) Uni-directional	(*d*) Barchan
(*b*) Bi-directional	(*e*) Seif
(*c*) Multi-directional	(*f*) Parabolic
	(*g*) Star

A. (*a*) – (*g*), (*b*) – (*d*), (*b*) – (*f*), (*c*) – (*e*)
B. (*a*) – (*d*), (*b*) – (*e*), (*a*) – (*f*), (*c*) – (*g*)
C. (*a*) – (*d*), (*a*) – (*g*), (*b*) – (*e*), (*c*) – (*g*)
D. (*a*) – (*f*), (*a*) – (*e*), (*b*) – (*d*), (*c*) – (*g*)

146. Nearly 90% of global organic production occurs on the continental margins despite that they cover only about 8% of the global surface area. What is its effect on the sediments deposited?
A. The sediments are more organic rich due to production of nano and pico plankton.
B. The sediments are more organic rich due to production of micro plankton that survive water column oxidation.
C. The sediments are organic poor as the particulate organic matter does not survive water column oxidation
D. No effect on sediment organic matter

147. Match the following and identify the correct answer.

(*a*) Pediments and inselbergs	(*e*) Sedimentary rocks
(*b*) Ventifacts	(*f*) Crystalline rocks
(*c*) Blow outs	(*g*) Deflation
(*g*) Mesas and Buttes	(*h*) Abrasion

A. (*a*) – (*f*), (*b*) – (*g*), (*c*) – (*h*), (*d*) – (*e*)
B. (*a*) – (*e*), (*b*) – (*h*), (*c*) – (*g*), (*d*) – (*f*)
C. (*a*) – (*f*), (*b*) – (*g*), (*c*) – (*h*), (*d*) – (*g*)
D. (*a*) – (*f*), (*b*) – (*h*), (*c*) – (*g*), (*d*) – (*e*)

148. Major reasons of frequent avulsion in the Kosi river of the Himalayan river system are
A. large scale deforestation in the Himalaya and high sediment supply by tectonic activity.
B. higher amount of suspended sediment load and high precipitation.
C. decrease in precipitation resulting in high sediment to water ratio.
D. change in the catchment area of the river by river capture

149. A concave coastline with protruding delta and spits indicates
A. an emerging coast
B. an embayed coast
C. a subsiding coast
D. an active coast

150. In a side-looking radar image of a mountain region, which of the following is true?
A. Lower the depression angle, shadow is the phenomenon
B. Higher the depression angle, layover is the phenomenon
C. Higher the depression angle, foreshortening is the phenomenon
D. Lower the depression angle, foreshortening is the phenomenon