PART - A (1-20)

1. Which of the following is a fresh - water lake ?

(A) Chilka

(B) Dal

(C) Sambar

(D) None of the above

2. The most violent type of volcanic eruption are

(A) Strombolian type

(B) Plinian type

(C) Vulcanian type

(D) Pelean type

3. The velocity of propagation of Tsunami in deep water is given by the relation.

(A) V = gd

(B) V^2 = gd

(C) V = mgd

(D) $V^2 = \frac{Mg}{d}$

4. Our sun is believed to be a

(A) Primary star

(B) Secondary star

(C) Atmosphere of proton

(D) Super Nova

5. Which of the following symmetry class is characterized by ehantiomorphic forms

(A) $\bar{4}_m$

(B) 422

(C) 4mm

(D) $\frac{2}{m}\frac{2}{m}\frac{2}{m}$

6. Indicatrix of a Tetragonal crystal is a

(A) Sphere

(B) Cube

(C) Symmetrical ellipsoid

(D) Asymmetrical ellipsoid.

7. Structure of olivine consists of layers, which are parallel to

(A) (100)

(B) (001)

(C) (101)

(D) (111)

8. The hardness of streak plate is about

(A) 7

(B) 5

(C) 8

(D) 5.5

9 In case of wind erosion, the base level is

(A) Mean sea level

(B) Sea level

(C) Water table

(D) Perched water table

10. The age of cuddapah is approximately

(A) 2000 MY

(B) 1600 MY

(C) 1200MY

(D) None of the above

11. Most characteristic drainage pattern of a trap area is

(A) Dendritic

(B) Barbed

(C) Rectangular

(D) Parallel

12. Champaner series of Gujrat is equivalent to

(A) Bundelkhand Gneiss

(B) Aravallis

(C) Sausar series

(D) None of these

13. Which group provides fastest moving invertebrates ?

(A) Brachiopoda

(B) Echinodermata

(C) Cephalopod

(D) Gastropoda

14. The Ammonoids became extinct at the close of

(A) Triassic

(B) Cretaceous

(C) Jurassic

(D) Eocene

15. The size particle in case of suspension is

(A) 10^{-5} cm

(B) 10^{-7}cm

(C) 10^{-6} cm

(D) 10^{-4} cm

16. In the Baveno twins (021) is the

(A) Twin plane

(B) Equilateral

(C) Composition plane

(D) Both (A) and (C) are correct

17. The book " origin of species " is written by

(A) Charles Dickens

(B) Charles Darwin

(C) Count Leo tolstoy

(D) Ernest Hemingway

18. A reverse fault dipping at an angle of less than 45° is known as

(A) Over thrust

(B) Thrust

(C) Under thrust

(D) High angle fault.

19. Graphic texture shows crystallization at

(A) Tripple point

(B) Eutectic point

(C) Incongruent point

(D) There is no such fixed point.

20. 'Petrifaction' is a type of fossilization where:

(A) Original form is preserved

(B) Original form and structure are preserved

(C) Entire organism is preserved

(D) Only the hard parts are preserved

PART - B (21- 40)

21. According to the Unified Soil Classification, a soil described as a GW is

(A) well-graded gravel or gravel-sand mixture, with no or few fines

(B) poorly graded gravel or gravel-sand mixture, with no or few fines

(C) coarse clayey gravel

(D) organic silt of low plasticity

22. The **picture below** is described by which of the following terms?

(A) Subangular

(B) Arkose

(C) Poorly sorted

(D) Mature

23. Which of the following exhibits a spherical symmetry of fabric?

(A) Spherulites

(B) Geodes

(C) Oolites

(D) All of the above.

24. Fossil fecal pellets of antient animals are described as

(A) Gastroliths

(B) Coproliths

(C) Beekite rings

(D) Pseudo fossils

25. The most favourable environment for the presservation of fossils is

(A) Terrestrial

(B) Lacustrine

(C) Fluvial

(D) Marine.

26. Which of the following is not a living fossils?

(A) Lingula

(B) Nucula

(C) Nautilus

(D) Nummulites.

27. Man's hand, bat's wing and seal's flipper are all examples of:

(A) Analogous organs

(B) Homologous organs

(C) Vestigial organs

(D) Homeomorphs

28. Geologic processes like deposition are extremely slow. About how long did it take to deposit all the sedimentary rocks that are found along the sides of the Grand Canyon?

(A) 3000 years

(B) 3 million years

(C) 300 million years

(D) 3 billion years

29. What is meant by the term chronological sequence?

(A) it is one of the principles of stratigraphy used to determine relative ages

(B) it refers to the absolute ages of rocks

(C) it is the geologic time scale that we use to characterize the ages of all rocks

(D) it is the order that things happened in geologic history

30. In stratigraphy, the principle of stratigraphic superposition states that:

(A) all sedimentary beds start off being horizontal

(B) all sedimentary beds are separated by bedding planes

(C) a sedimentary bed is younger than the bed above it and older than the bed below it

(D) a sedimentary bed is older than the bed above it and younger than the bed below it

31. The first vertebrates appeared during

(A) Cambrian

(B) Ordovician

(C) Silurian

(D) Devonian

32. The foraminifera belongs to the class,

(A) Sarcodina

(B) Sporozoa

(C) Flagelleta

(D) Mastigophora

33. In graptolites, the hard parts are made up of

(A) Silica

(B) Calcium carbonate

(C) Chitin

(D) Calc-arenite

34. The bravis lattice of Nacl structure is

(A) P-cell

(B) Body centred

(C) Face centred

(D) Base centred

35. Gastropods exhibit:

(A) Bilateral symmetry

(B) Bi-radial symmetry

(C) Radial symmetry

(D) Asymmetry

36. Squids are present day representatives of:

(A) Brachiopods

(B) Cephalopods

(C) Gastropods

(D) Pelecypods

37. Consider the following characteristics:

1. High relief
2. Pale Yellow to brown Pleochroism
3. Parallel Extinction
4. Week Birefringence

Which one of the following mineral has the above mentioned characteristic?

(A) Biotite

(B) Hornblende

(C) Olivine

(D) Staurolite

38. A rhombohedron has-

(A) Vertical symmetry planes,

(B) Horizontal symmetry planes,

(C) Diagonal symmetry planes,

(D) No symmetry plane.

39. The R.I of Canada balsam is-

(A) 1.5

(B) 1.54

(C) 1.8

(D) 1.65.

40. The wavelength of red light is-

(A) 560 nm

(B) 470 nm

(C) 730 nm

(D) 650 nm.

PART - C (41- 50)

41. Discuss about Mantle of the Interior of the Earth.

42. Describe about various types of Drainage Pattern.

43. Discuss the Neo Proterozoic Malani Magmatism of northwestern Indian shield.

44. Discuss about Mechanism and supporting evidences of Continental drifting.

45. Write short note on the Mangalwar complex.

46. Describe briefly various terminology used for recognition of colors in minerals.

47. Write down the purposes of monitoring wells.

48. Describe the important coal mining technology?

49. How do you determine the sense of shear for a ductile shear zone?

50. Differentiate the followings:

A. Strike and Dip

B. Apparent Dip and True Dip

ANSWER KEY

QUE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
ANS	B	D	B	B	B	C	A	A	C	B	D	B	C	B	D	D	B	D	B	C
QUE	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
ANS	A	B	D	A	D	D	B	C	D	D	B	A	C	C	D	B	D	A	B	D

HINTS & SOLUTIONS

1.(B) India has a large number of lakes spread all over the country, from Kashmir to Kerala and from Rajasthan to Assam. Among the better-known fresh water lakes in India are the Dal lake in Srinagar and the Nainital lake. Dal Lake is one of the most beautiful lakes of India and is the second largest in the J&K state. Being located in the heart of the Srinagar City (latitude 34°18'N, longitude 74°91'E, average altitude of 1,583 m), Dal can be considered to be an urban lake.

2.(D) Pelean eruptions result from the collapse of an andesitic or rhyolitic lava dome, with or without a directed blast, to produce glowing avalanches or nuée ardentes, as a type of pyroclastic flow known as a block-and-ash flow. Pelean eruptions are considered violently explosive.

3.(B) The dynamics of tsunamis are essentially governed by the shallow water equations. The speed of propagation {v} of a tsunami can be approximated by the formula

$$V^2 = gd$$

4.(B) The Sun is a secondary star, created from such debris of an earlier star.

5.(B) The ehantiomorphic forms of symmetry class do not have a plane of symmetry, an inversion axis, or a centre of symmetry. The crystal classes in which such enantiomorphic forms are found are 1, 2, 3, 4, 6, 23, 222, 32, 422, 622 and 432.

6.(C) In hexagonal, trigonal and tetragonal crystals, the optical indicatrix is an ellipsoid of revolution (symmetry ∞/mm).

7.(A) The structures of the humite group minerals are closely related to that of forsterite but the original interpretation that the structures consist essentially of layers parallel to (100), having the atomic arrangment of olivine, which alternate with layers of brucite-sellaite, $Mg(OH, F)_2$, has been shown to be inaccurate.

8.(A) A streak plate has hardness of 7 on the Mohs scale, so harder minerals will not leave a streak. Diamond has a hardness of 10 and corundum is 9 - so neither will leave a streak.

9.(C) The base level of wind erosion is the water table, which may be far below the sea level.

10.(B) Based on the stromatolite assemblage, the age of the Cuddapahs is dated early to Late Riphean (1600 to 900 m.y.).

11.(D) During the Pliocene and Early Pleistocene period drainage was characterized by axial drainage parallel to this trap, and sediments were transported from the northeast, shown by micro-mineralogical data of detrital heavy minerals.

12.(B) The Proterozoic Champaner Basin of eastern Gujarat is considered equivalent to the upper part of the Aravalli Supergroup.

13.(C) The cephalopod nervous syhstem is the most complex of any invertebrate nervous system. Although species-specific differences exist, its high level of complexity almost certainly is due to the cephalopods' very active, fast-moving. predatory life style, and their complex behavior and extreme flexibility of response to different envirionmental situations.

14.(B) The ammonites lived during the Jurassic and Cretaceous periods, flourishing in the ancient seas at the same time as the dinosaurs lived on land, and became suddenly and inexplicably extinct at the end of the Cretaceous period.

15.(D) Sedimentation analysis in a gravitational field is used for dispersed media with relatively massive particles, such as suspensions, emulsions, and dusts, with particle sizes of 10^{-2} to 10^{-4}cm.

16.(D) Baveno twin law is an uncommon twin law applicable in feldspar, in which the twin plane and composition surface are (021); a Baveno twin usually consists of two individuals.

17.(B) "Origin of Species", published on 24 November 1859, is a work of scientific literature by Charles Darwin which is considered to be the foundation of evolutionary biology. Its full title was On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.

18.(D) According to the magnitude of dip of the reverse fault plane is -

- high angle when the fault plane dips less than 45 degrees
- low angle when the fault plane dips more than 45 degrees

19.(B) Graphic and micrographic textures are intergrowths of quartz in K-feldspar host (mostly orthoclase or microcline), which can be form

(a) by replacement,

(b) simultaneous crystallization at the eutectic point, or

(c) crystallization from supercooled liquids.

20.(C) A fossil is the evidence of preexisting life which has been preserved in the entire organism. Five of the most common fossil types are: molds and casts, impressions, compressions, unaltered material, and petrifactions.

PART - B (21- 40)

21.(A) According to the Unified Soil Classification, a soil described as a GW is well graded gravels and gravel-sand mixtures with little or no fines. The presence of the fines must not notably change the strength characteristics of the coarse-grained fraction and must not interfere with its free draining characteristics.

22.(B) Arkose, coarse sandstone (sedimentary rock composed of cemented grains 0.06–2 millimetres [0.0024–0.08 inch] in diameter) primarily made up of quartz and feldspar grains together with small amounts of mica, all moderately well sorted, slightly worn, and loosely cemented with calcite or, less commonly, iron oxides or silica.

23.(D) Spherulite, spherical body generally occurring in glassy rocks, especially silica-rich rhyolites. Geodes are spherical or oblong rocks filled or partially filled with minerals. Oolite any sedimentary rock, esp limestone, consisting of tiny spherical concentric grains within a fine matrix. So all of the above exhibits a spherical symmetry.

24.(A) Fossil fecal pellets of antient animals are described as gastroliths. Gastroliths are the highly polished stones from the gizzards of birds, or the stomachs of reptiles (including dinosaurs). Gastroliths or gizzard stones were probably used to grind food in the stomach of the animal.

25.(D) In general, marine and transitional (shoreline) environments are more favorable for fossil preservation than are continental environments, because the rate of sediment deposition tends to be higher.

26.(D) Nummulites are protists from the phylum granuloreticulosa, and the class foraminifera, also called foraminiferida. It is not a living fossil.

27.(B) Homologous structures are parts of the body that are similar in structure to other species' comparative parts. These similarities are evidence that life on Earth has a common ancient ancestor that the diverse species have evolved from over time. For example: the flipper of a whale, the wing of a bat, and the human arm.

28.(C) Geologic processes like deposition are extremely slow. The layered series of sedimentary rocks exposed in the Grand Canyon, Arizona,is almost 2000 m thick and was deposited over a period of 300 million years.

29.(D) Chronological Sequence is the science of arranging time in periods and ascertaining the dates and historical order of past events.

30.(D) One of the major principles of stratigraphy is that within a sequence of layers of sedimentary rock, the oldest layer is at the base and that the layers are progressively younger with ascending order in the sequence. This is termed the law of superposition and is one of the great general principles of geology.

31.(B) The Ordovician Period lasted almost 45 million years, beginning 488.3 million years ago and ending 443.7 million years ago. The Ordovician is best known for its diverse marine invertebrates, including graptolites, trilobites, brachiopods, and the conodonts (early vertebrates).

32.(A) Foraminiferan, common name for members of the class Foraminifera, large, shelled ameboid protozoans belonging to the phylum Sarcodina. Most foraminiferan shells are calcareous, but some are siliceous, and others are built of sand grains.

33.(C) Most plants and animals have hard parts capable of becoming fossilized. These include shells, teeth, bones and woody tissue of plants. These hard parts are composed of substances such as calcite, calcium phosphate, silica and chitin which are capable of resisting weathering and chemical action.

34.(C) Many materials exist in the sodium chloride (NaCl) or rocksalt crystal structure. In addition to many of the halides, including AgCl, KBr, LiF, NaI, many ceramics, including MgO, Cao, NiO, TiN, ZrN, TiC, ZrC and ZrB, have the NaCl structure. The NaCl structure is based on the face-centered cubic Bravais lattice with a basis of two atoms at 0,0,0 and 1/2,0,0.

Face-centered cubic (cubic F) lattice + two atoms $\rightarrow$ NaCl structure

35.(D) The Gastropoda or gastropods, more commonly known as snails and slugs, are a large taxonomic class within the phylum Mollusca. All gastropods are asymmetrical and have helical shells.

36.(B) The Vampire Squid (Vampyroteuthis infernalis) is the single living representative of the cephalopod group known as the Vampyromorpha. It is a small (mantle length to 13 cm), gelatinous species that occurs in mesopelagic to bathypelagic depths (typically between 600 and 1200 m) in temperate and tropical waters of the Pacific, Atlantic, and Indian Oceans.

37.(D) Staurolite is a metamorphic mineral common in medium grade micaceous schists and gneisses. It has composition $Fe_2Al_9Si_4O_{23}(OH)$. Staurolite has diagnostic pleochroic yellow color, parallel extinction in longitudinal sections, symmetrical in basal sections, birefringence Interference is not obvious in thin section and has high relief.

38.(A) Rhombohedron is the typical form of trigonal system. It has three planes of symmetry. It is a parallelepiped bounded by six rhombi such that opposite faces are congruent.

39.(B) Canada balsam, also called Canada turpentine or balsam of fir, is a turpentine which is made from the resin of the balsam fir tree (Abies balsamea) of boreal North America. Due to its high optical quality and the similarity of its refractive index to that of crown glass (n = 1.55), purified and filtered Canada balsam was traditionally used in optics as an invisible-when-dry glue for glass, such as lens elements.

40.(D) The wavelength of a visible red light is about 650 nm and this red light has the longest wavelength of all the other colours in the colour spectrum.

PART - C (41- 50)

41. The Mantle

The next layer that is detected by seismic waves is a **low-velocity zone** in the upper mantle from a depth of about 100 km to a depth of about 250 km. Both P and S-waves slow down, showing that the zone is partially melted (about 10%). This zone is also called the **asthenosphere** ("weak layer") and is considered to be plastic compared to the rigid zone above which is called the **lithosphere**. The lithosphere contains the crust and the upper mantle down to the low velocity zone. We will see that this partially melted zone is thought to be the base of the plates which move on the surface of the earth.

This layer makes up about 80% of the earth by volume. **Solid Samples** ripped out of the mantle by volcanic action as well as some exposed mantle rocks show us that the mantle is much more homogeneous than the crust. It is made primarily of olivine ($Mg_2\ SiO_4$) with some pyroxene ($MgSiO_3$) and garnet. It's named for the gem quality olivine (peridot) as peridotite.

Temperature in the earth increases with depth (30 degree C/ km near the surface) to about 3000 degrees at the mantle-core boundary, but the rate of increase in the mantle is so small that mantle must be a good transporter of heat from deep to shallower areas. It does this by flowing plastically in a process called convection. Due to the decay of radioactive elements like uranium, thorium and potassium about half the heat flow comes out of the earth.

Because the mantle is plastic, it is not rigid enough to support the continental and oceanic crusts, so they have to "float" on the mantle. So mountains have crust thicknesses of up to 60 km. While average thickness may be 35 km. Oceanic crust is thin and dense so it floats

much lower than continental material would. Glaciers on Greenland have depressed the central part of the "continent" to below sea level.

42. **Drainage Patterns.** Refers to the particular plan or design which the individual stream courses collectively form. (A) Dendritic–characteristic of homogenous rock surfaces of uniform resistance implying a notable lack of structural control ; pinnate pattern is a variation. (B) Trellis–sub parallel streams aligned along the strike of rock formations ; characteristic of uniformly dipping beds of varying rock hardness; reflects marked structural control of most stream courses. (C) Radial–typical of domal uplifts, slopes of volcanoes, large basins and gulf depressions. (D) Rectangular–both the mainstream and its tributaries display right-angled bends. They reflect control exerted by joint or fault systems. Angulate pattern is a variant.

43. The Neo Proterozoic (~750 Ma) Malani magmatic province occupies a large area (~50,000 km^2) of the northwestern Indian shield. It is dominantly made up of felsic (rhyolitic) lava flows and granitic plutons, with subordinate mafic lavas, and felsic and mafic dykes. The Malani province represents a large, intraplate, an orogenic felsic event, which is why some workers have ascribed it to a mantle plume. Geological observations indicate, however, that Malani volcanism occurred along parallel crustal fractures that developed as a result of extensional tectonics.

44. **Mechanism of Drift.** Tidal forces of the Sun and Moon and precision effect (pohlfluct forces) caused the general drift of the continents towards West

Supporting Evidences. (1) Matching of the coastlines of South America and Africa (at 2000 m contour) , (2) Presence of Permo–Carboniferous tillites in widely separated regions of the present day e.g. Talcbir tillites (India), Pagoda tillites (Antarctica), Dywka tillites (S. Africa), Tubaro Tillites (Brazil) etc., (3) Paleontological evidences : (a) Presence of Mesosaurus (Permian) in S.America and Africa, (b) Occurrence of marsupial opossums in Australia and S.America (c) Distribution of lumbricoid and megascolecid earthworms in different continents, (d) Distribution of Gondwana plant fossils in all the southern continents. (4) Similarity of stratigraphic sequence of rock units in Africa, India S. America, Australia and

even Antarctica, (5) The continuity of geosynclinal mountain belts which encircle the continents; (6) Paleomagnetic reconstruction based on Polar wandering curves.

45. The **Mangalwar Complex (MC)** of the Bhilwara Supergroup terrain contains varied lithologic assemblages and tectonic units of a 'greenstone like' sequence, and comprises ultramafic bodies and mafic igneous bodies of volcanic and plutonic precursors, now represented by amphibolites, highly diverse metasediments such as metapelitic and aluminous paragneiss, fuchsite bearing quartzite and low Mg marble and calc silicate gneiss, coarse clastics such as graywacke and tuffaceous sediments represented by graphitic schist. Granodioritic and tonalitic gneisses (Untala, Gingla) represent the consolidation of the early crust at ca. 2.9 Ga and the end Archaean cratonisation is indicated by the Berach Granite (ca 2.6 Ga). Although Archaean cratonisation event is well documented in the BSG rocks of Rajasthan, some authors put controvertible arguments against this end Archaean event and believe that the HG is not a part of the Archaean basement on the equivocal premise that the Berach Granite (2.6 Ga) forms the basement for the Hindoli Group (HG) in South-Eastern Rajasthan. Nevertheless, the Archaean Proterozoic boundary can be constrained to a slot of 2.5 to 2.6 Ga in Rajasthan from the available field geochronologic and thematic data base. It may, however, mentioned that the stratigraphic relationships of the different lithologic assemblages of the BSG are not clear as the different rock units are usually demarcated by prominent ductile shear zones (DSZ) running for kilometers. Thus, during the Proterozoic period, the Archaean crust (BSG) was extensively reworked through the development of DSZs and granitic activity. The MC presumed to represent an Archaean primary granite greenstone belt whereas the HG is suggested to represent a secondary granite greenstone belt in NW Indian shield.

46. • **Idiochromatic** minerals are "self colored" due to their composition. The color is a constant and predictable component of the mineral. Examples are blue Azurite, red Cinnabar, and green Malachite.

• **Allochromatic** minerals are "other colored" due to trace impurities in their composition or defects in their structure. In this case, the color is a variable and unpredictable property of

the mineral. Examples are the blue in Amazonite (orthoclase), yellow in Heliodor (spodumene) and the rose in rose quartz.

• **Pseudochromatic** minerals are "false colored" due to tricks in light diffraction. In these cases, color is variable but a unique property of the mineral. Examples are the colors produced by precious opal and the shiller reflections of labradorite.

47. Various purposes of monitoring wells

Groundwater level monitoring

- water level fluctuations,
- water quantity
- ground water flow direction

Pumping tests/slug tests

- aquifer properties

Water quality monitoring

- sampling

In-situ measurement

48. Coal Mining Technology

- Most of coal production comes from open-pit mines, contributing over 84%.
- **Technology in-place in Open-pit mining**: shovel shovel-dumper, dragline, in in-pit crushing & conveying, surface miners. Bucket Bucket-wheel excavators in Lignite mining.
- **Technology in-place in Underground mining** : Conventional & Mechanized Board & Pillar; Powered support Longwall, Continuous miner.

49. Indicators of shear sense in ductile shear zone are as follows-

- Drag of mark layers and earlier foliations
- Asymmetric folds
- Sheath folds
- S-C fabrics
- Mica fishes
- Asymmetric Tails (Sigma type)
- Asymmetric Tails (Delta type)
- Asymmetric pressure shadow
- Domino structures

- Retort structures

50. STRIKE

It is the direction of a line formed by the direction of the plane of a bed with a horizontal plane. The strike is always at right angles to the true dip.

The instrument used to measure dip and strike is called compass clinometer.

Dip

It is the angle of Inclination of a rock bed with the horizontal plane. The dip includes both the direction and the angle.

Apparent Dip and True Dip

The true dip is the maximum angle, which an inclined bed makes with the horizontal. It is measured at right angles to the strike in a vertical plane.

It the angle measured in any other direction, as along Cd1 or Cd2 it will have a value less than the true dip. Such partial dip angles are called 'apparent dip' . So the apparent dip may be defined as "the inclination of bed to the horizontal in any other direction than the direction of true dip".

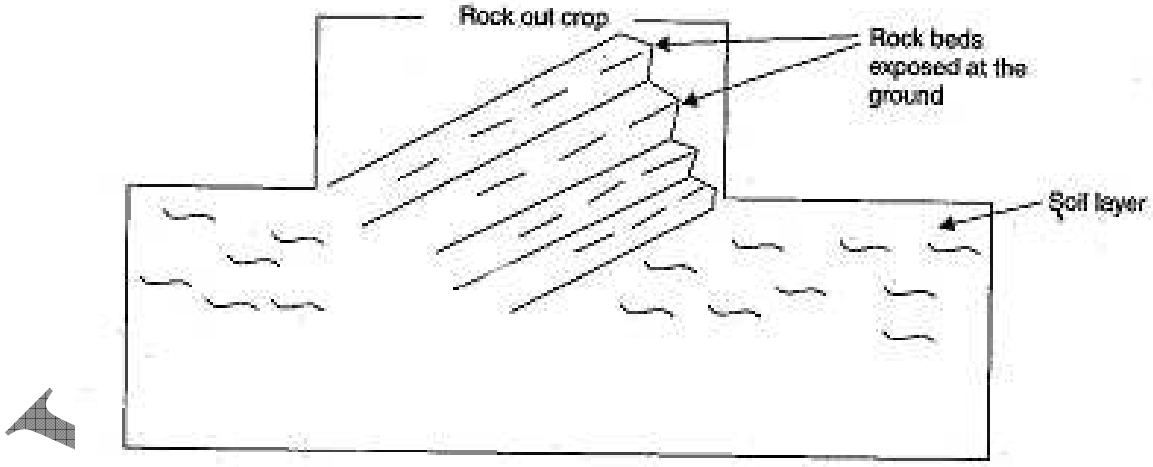
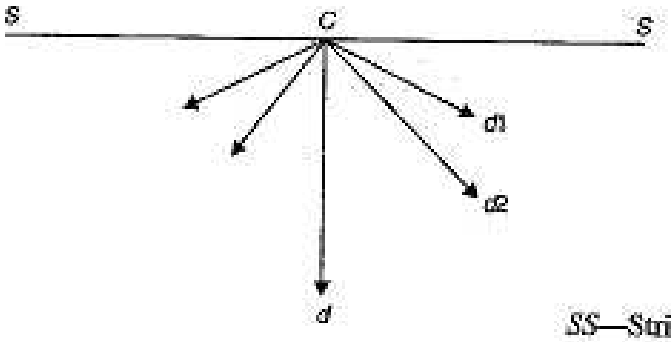


Fig. *Dip and Strike of beds*



SS—Strike
Cd—True dip
*Cd*1 and *Cd*2—Apparent dip

Fig. *True dip and apparent dip*