Note: Draw neat diagrams where necessary.

Max. Marks 100
Duration 3 Hrs

1 a **Fill in the blanks** 10

i) Earth's crust can be divided into continental crust and oceanic crust based on the presence of **CONRAD** discontinuity.
ii) Toposheet immediately east of toposheet no. 48E/09 is **48E/13**
iii) A long, irregular and rough surface opening in the rock is called as **FRACTURE.**
iv) Shape of the Earth with flattened poles and bulging at equator, is called as **GEOID / OBLATE SPHEROID.**
v) A fault striking perpendicular to the strike of the bed is called **DIP** fault.
vi) The inner part of the core of the Earth is called as **INNER CORE.**
vii) The toposheets we use in fieldwork are a result of **POLYCONIC** projection.
viii) On the map of 1:50,000 scale, an object of 6 km length will be **12** cm.
ix) Dip direction of a bed striking $N60^0E$ is **$N150^0$ OR $S30^0E$**
x) A fold with limbs dipping away from each other is called as **ANTICLINE.**

b **Define the following** 10

i) Troposphere and stratosphere
-The troposphere is the lowest layer of Earth's atmosphere. Most of the mass (about 75-80%) of the atmosphere is in the troposphere.
-The stratosphere is a layer of Earth's atmosphere above the stratosphere.

ii) Conrad and Mohorovicic discontinuity
-A boundary within the Earth's continental crust that can be detected seismically at about 10–12 km depth.
-The Mohorovicic Discontinuity, or "Moho," is the boundary between the crust and the mantle

iii) Strike and dip
-Direction formed by the intersection of a imaginary horizontal plane and dipping bed.

iv) Isoclinal and overturned fold
-A fold with an equal angle of dip on both limbs.
-An overturned fold, or overfold, has the axial plane inclined to such an extent that the strata on one limb are overturned.

v) Anticline and syncline
-an anticline is a fold that is convex up and has its oldest beds at its core.
-A syncline is a fold that is concave upwards and has youngest beds at its core.

2 **Attempt any two of the following-**

a 10

Explain the 'Herndon's Georeactor' theory for the sustained magnetic field observed on Earth. Why does this theory appear logical than the theory by Bullard and Elsasser?

Beginning in 1969, astronomers discovered that three of the giant planets, Jupiter,

Saturn, and Neptune, each radiate about twice as much energy as they receive from the Sun. Those planets each contain a powerful energy source which was inexplicable until J. Marvin Herndon, demonstrated in 1992 the feasibility of natural, nuclear fission reactors as the energy source for those planets. Herndon initially considered thermal neutron reactors moderated by hydrogen, but soon realized that without hydrogen, the reactors would function quite well as fast neutron breeder reactors.

Aware that the uranium resides almost exclusively in the alloy portion of the chondrite, his publications have resulted in a fundamentally new understanding of georeactor structure, georeactor dynamics and georeactor generation of Earth's magnetic field.

The numerical simulation calculations, published in 2001, demonstrated that that Earth's georeactor is capable of functioning over the entire period which the Earth has existed, 4.5 billion years, and is capable of producing power at the same levels estimated to be necessary for powering the geomagnetic field. The calculations also showed that the georeactor would operate as a fast neutron breeder reactor and that it must have some inherent mechanism for regulating operating power and for removing fission products. Moreover, the helium fission products from the georeactor turned out to occur in the same range of compositions as the deep-Earth helium found in oceanic basalt.

Bullard and Elasser Theory: Dynamo theory, geophysical theory that explains the origin of Earth’s main magnetic field in terms of a self-exciting (or self-sustaining) dynamo. In this dynamo mechanism, fluid motion in Earth’s outer core moves conducting material (liquid iron) across an already existing weak magnetic field and generates an electric current. (Heat from radioactive decay in the core is thought to induce the convective motion.) The electric current, in turn, produces a magnetic field that also interacts with the fluid motion to create a secondary magnetic field. Together, the two fields are stronger than the original and lie essentially along the axis of Earth’s rotation.

b Explain the generation of earth’s magnetic field. What is the difference between true north and magnetic north? 10

Right at the heart of the Earth is a solid inner core, two thirds of the size of the Moon and composed primarily of iron. At a hellish 5,700°C, this iron is as hot as the Sun’s surface, but the crushing pressure caused by gravity prevents it from becoming liquid.

Surrounding this is the outer core, a 2,000 km thick layer of iron, nickel, and small quantities of other metals. Lower pressure than the inner core means the metal here is fluid.

Differences in temperature, pressure and composition within the outer core cause convection currents in the molten metal as cool, dense matter sinks whilst warm, less dense matter rises. The Coriolis force, resulting from the Earth’s spin, also causes swirling whirlpools.

This flow of liquid iron generates electric currents, which in turn produce magnetic fields. Charged metals passing through these fields go on to create electric currents of their own, and so the cycle continues. This self-sustaining loop is known as the geodynamo.

The spiralling caused by the Coriolis force means that separate magnetic fields created are roughly aligned in the same direction, their combined effect adding up to produce one vast magnetic field engulfing the planet.

The Earth rotates on the geographic north and south poles. The geographic north and south poles are where lines of longitude (meridians) converge in the north. The south and north pole are directly opposite to one another.

The North Pole is located in the middle of the Arctic Ocean. Scientists have tried marking the North pole. Because the water here is permanently covered with moving sea ice, it's practically impossible to construct any type of permanent station at the true North Pole.

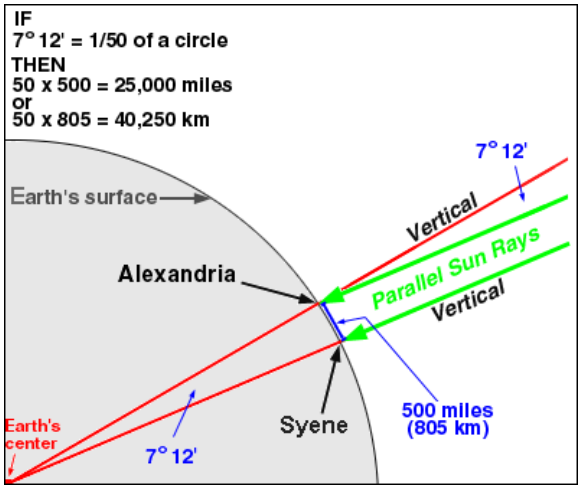
On the other side of the Earth, the South Pole lies on a continental land mass known as Antarctica. Because the ice on top of Antarctica moves only a few meters a year, the United States Antarctica program has installed a marker here to delineate the true South Pole.

The Magnetic North Pole (also known as the North Dip Pole) is a point on Ellesmere Island in Northern Canada where the northern lines of attraction enter the Earth.

A compass needle rests freely in its casing so it can maneuver itself. When you pull out a compass, it aligns itself with the Earth's magnetic field. The small magnetic pin is how a compass responds to Earth's magnetism.

This means that a compass needle will point to the Magnetic North Pole – which is different from the geographic north.

c Who was the first person to successfully measure the circumference of the Earth? Describe his method of measurement of the Earth's circumference. 10



While in Syene, Egypt (known today as Aswan), he noticed that the sun's rays shone directly down a well, casting no shadow at all. From this, he concluded that the sun was directly overhead at Syene. On the same date in Alexandria, a rod perpendicular to the ground cast a shadow that was 7° 12' from perpendicular.
Eratosthenes then divided 360° by 7° 12' and determined that 7° 12' was 1/50th of a circle. Now all he had to do was find the distance from Syene to Alexandria and multiply it by 50 to get the earth's circumference.
Many scholars believe Eratosthenes measured the distance by measuring a single pace and then counting the number of paces from Syene to Alexandria. While this

is possible, it is just as likely that he counted the revolutions of a wheel with a known circumference, since this was a common method of measurement in both Egypt and Greece. Either way, he probably hired someone or enlisted a slave to accomplish the task. The distance figure he used was 805 kilometers or 500 miles.
Next, he multiplied this distance by 50 to get 40,250 kilometers (25,000 miles). Today, most scientists set the earth's circumference at 40,096 kilometers (24,901 miles). This gives Eratosthenes' estimate less than a one percent error—an excellent approximation of the earth's circumference

d How old is the Earth and how was its age determined? Why are meteorites used in calculating the age of the Earth? 10

4.56 Billion years.

The oldest rocks on Earth found to date are the Acasta Gneiss in northwestern Canada near the Great Slave Lake, which are 4.03 billion years old. But rocks older than 3.5 billion years can be found on all continents. Greenland boasts the Isua supracrustal rocks (3.7 to 3.8 billion years old), while rocks in Swaziland are 3.4 billion to 3.5 billion years. Samples in Western Australia run 3.4 billion to 3.6 billion years old.

Research groups in Australia found the oldest mineral grains on Earth. These tiny zirconium silicate crystals have ages that reach 4.3 billion years, making them the oldest materials found on Earth so far. Their source rocks have not yet been found.

The rocks and zircons set a lower limit on the age of Earth of 4.3 billion years, because the planet itself must be older than anything that lies on its surface.

In 1953, Clair Cameron Patterson, a renowned geochemist at the California Institute of Technology, measured ratios of lead isotopes in samples of the meteorite that put tight constraints on Earth's age. Samples of the meteorite show a spread from 4.53 billion to 4.58 billion years. Scientists interpret this range as the time it took for the solar system to evolve, a gradual event that took place over approximately 50 million years.

By using not only the rocks on Earth but also information gathered about the system that surrounds it, scientists have been able to place Earth's age at approximately 4.54 billion years.

3 **Attempt <u>any two</u> of the following-**

a With the help of suitable example explain the toposheet catalogue system used by Survey of India at the scale of 1:50000. 10

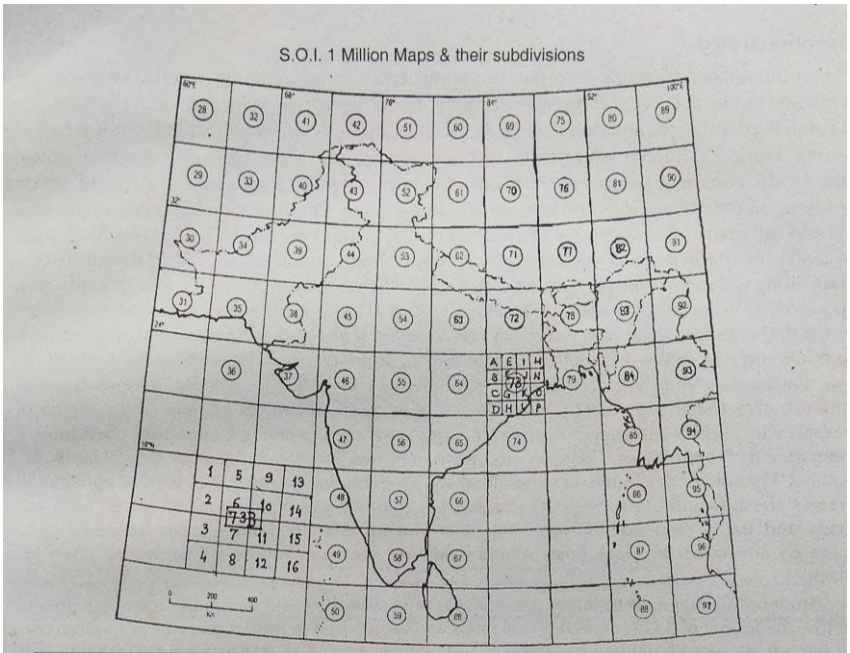


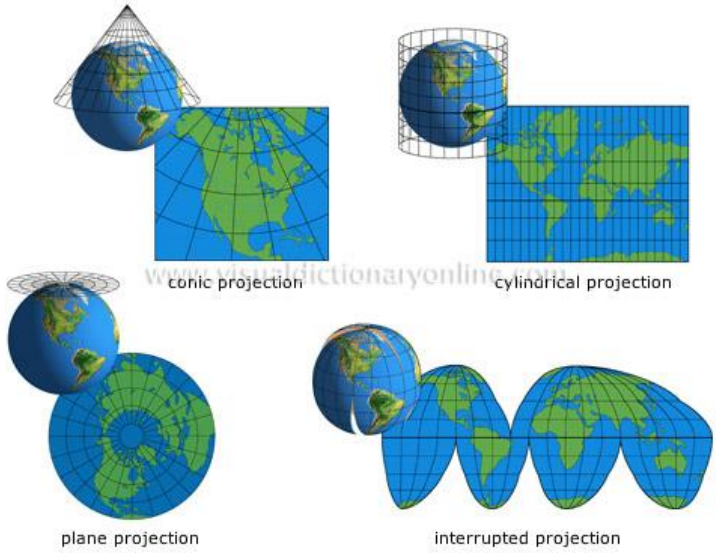
Fig. 3.11 Index Map for S.O.I. Toposheets

into 16 sheets of 1° × 1° rectangles, each of which is further subdivided into 16 rectangular sheets. All of these sheets have been designated by a letter and a number. The table below shows the system of topographical sheet hierarchy. The reference number allotted to various categories of sheets is itself an indicator of the scale and surface-extent of the sheets. In table 3.4 below the map hierarchy has been shown according to the system adopted (fig. 3.11).

TABLE 3.4

Name of sheet	Extent covered	FPs scale	Metric scale	Reference No. Example
Million sheet	4° × 4°	1 inch to 16 miles	1 cm to 10 km.	65
Quarter-inch or degree sheet	1° × 1°	1 inch to 4 miles	1 cm. to 2.5 km.	65 G (one of A to P)
Half-inch sheet	30′ × 30′	1 inch to 2 miles	1 cm. to 1 km.	65 G/SE (one of 4 quadrant sheets)
Inch sheet	15′ × 15′	1 inch to 1 mile	2 cm. to 1 km.	65G/15 (one of 1 to 16)
Special	5′ × 7′ 30″	—	4 cm. to 10 km.	65G/15/3 (one of 6 sheets)

b What are the various ways in which a spherical earth surface can be projected on plain paper? What are various errors which can result from the various types of map projections. 10



c List the various factors that modify ocean currents and explain with examples each 10

of them. Would the pattern of ocean currents that we see today be modified with the shifting of continents?

There are a variety of factors that affect how ocean currents (water in motion) are created, including a combination of two or more factors. The different types of currents (referred to as surface or thermohaline, depending on their depth) are created by, among other things, wind, water density, the topography of the ocean floor and the coriolis effect.

Wind

Wind is the single biggest factor in the creation of surface currents. Strong winds moving across an expanse of water move the surface of the water. These strong winds are not random breezes; the major winds that most often effect the creation of ocean currents are the Westerlies, which blow west to east, and the Trade Winds, which blow east to west.

Water Density

Another major factor in the creation of currents is water density, caused by the amount of salt in a body of water, and its temperature. Water with a higher salinity, or colder water, is more dense and likely to sink. Sinking water pushes the water below it up. The combination of sinking and rising in the same area causes a current.

Ocean Bottom Topography
Water contours to the topography of the ocean floor or bed. If the ocean bottom "drops out," like in a valley or trench, the moving water will move downward. If there is a rise in the ocean bottom, like a ridge or mountain, the water moving along it will be forced upward. The sudden upward or downward change of direction causes water displacement, creating a current.

Coriolis Effect
When a rotating object collides with another moving or stationery force, it creates a new motion. The Earth's rotation creates two currents: one, a clockwise movement of water in the Northern Hemisphere; the other, a counter-clockwise movement of water in the Southern hemisphere. When these currents are deflected by land masses, they create huge ocean currents called gyres

d Explain the impact of the Coriolis deflection on coastal upwelling of sea water. 10

4 **Attempt <u>any two</u> of the following**

a What are columnar joints? Write a note on formation of the columnar joint in rocks and cite a few examples. 10

b With the help of suitable diagrams explain outcrop patterns of beds as seen in a valley. Will you be able to determine the attitude on absolutely horizontal terrain? Justify your answer 10

c Draw a neat diagram of a Brunton compass and annotate its various parts. Explain the significance of the thin copper wire on the southern end of the magnetic needle within the compass. Also add a note on the special feature which damps the 10

movement of the needle.

d Describe the classification of faults based on axial plane and hinge. 10

-Classification along with well labelled diagrams.

5 **Write notes on <u>any four</u> of the following** 20

i) Magnetic declination and Magnetic inclination
Definition and description-

ii) Earth's heat budget
Description and diagram

iii) Domes and Basins
Structure diagram and description

iv) Global Wind Circulation

v) Morphological classification of folds
Diagrams and descriptions

vi) Ocean conveyer belt
Diagrams and descriptions

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