1 a **Fill in the blanks** 10

i) **OCEANIC, CONTINENTAL**
ii) **JOINT**
iii) **4560 or 4600**
iv) **OBLATE SPHEROID.**
v) **DIVERGENT**
vi) **43H/11.**
vii) **12**
viii) **CLOCKWISE**.
ix) **NEBULAR HYPOTHESIS**
x) **DIP**

b **Define the following** 10

i) Contour and datum
-An imaginary line joining the points of equal elevation or depth.
- Define the shape of the earth including Ellipsoid (size and shape)

ii) Cylindrical and conical projection
-Earth intersects the cylinder on two small circles. All points along both circles have no scale distortion.

- Earth intersects the cone at two circles. all points along both circles have no scale distortion.

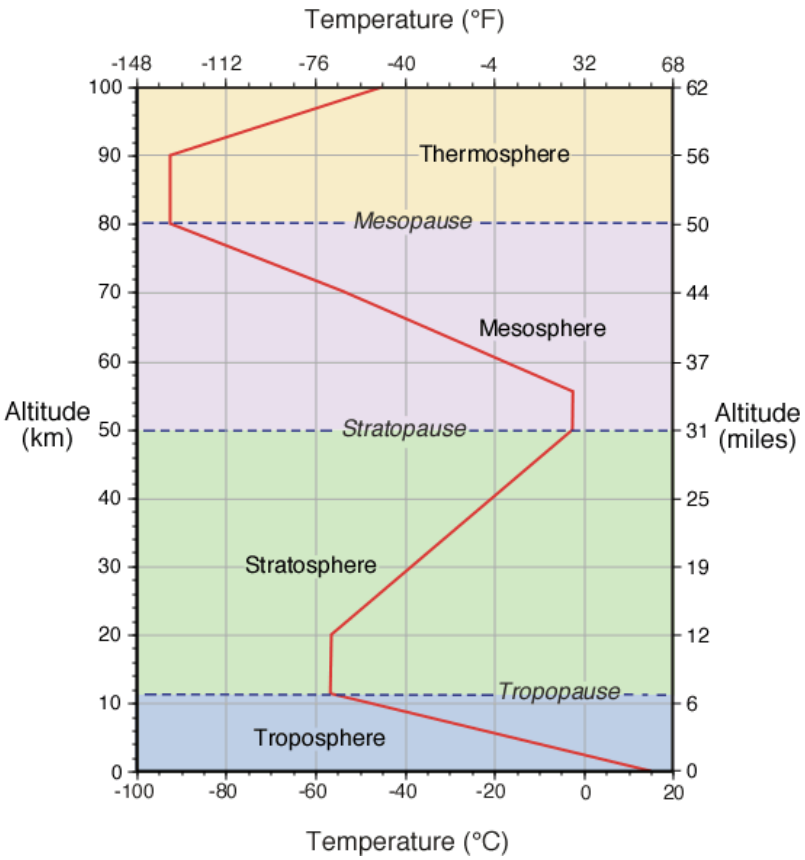
iii) Fractures and faults
-Fractures are irregular surface openings
-Faults are types of fractures in which as relative displacement of the block is seen.

iv) Asthenosphere and lithosphere
-The upper layer of the earth's mantle in which there is relatively low resistance to plastic flow and convection is thought to occur.
- The rigid outer part of the earth, consisting of the crust and upper mantle

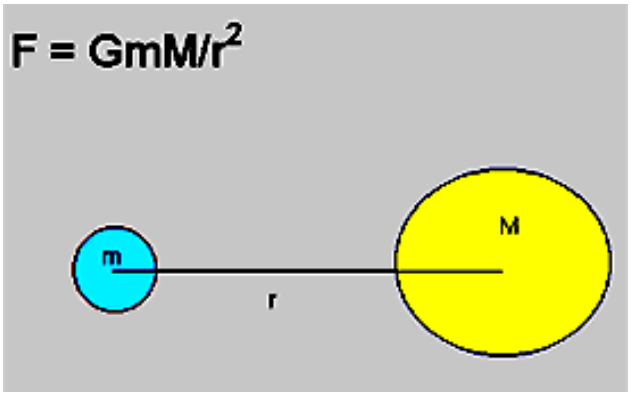
v) Disconformity and non-conformity
-A break in a sedimentary sequence which does not involve a difference of inclination between the strata on each side of the break.
- A nonconformity exists between sedimentary rocks and metamorphic or igneous rocks when the sedimentary rock lies above and was deposited on the pre-existing and eroded metamorphic or igneous rock.

2 **Answer <u>any two</u> of the following-**

a Starting from the sea level, explain the variation in earths atmospheric temperature. Explain the composition of the Earth's atmosphere and describe its various layers. 10



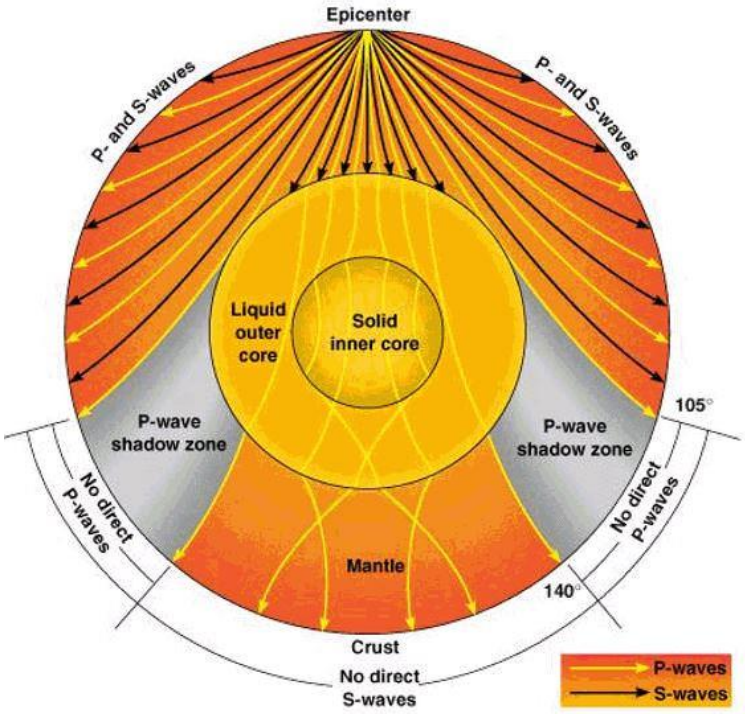
b How would you be able to determine the mass of our planet? Is the mass of the Earth a constant? Justify your answer. 10



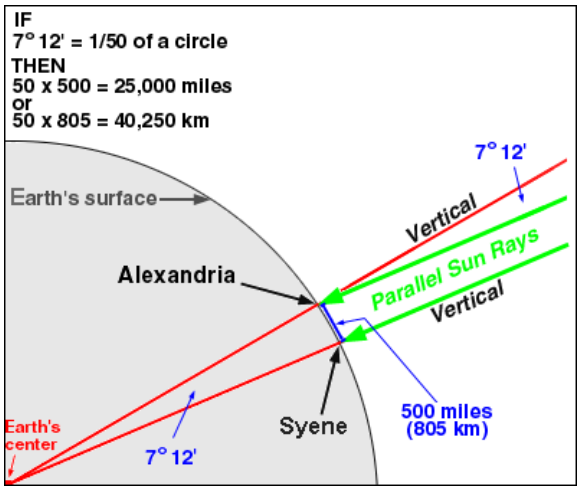
Issac Newton's Law of Universal Gravitation tells us that the force of attraction between two objects is proportional the product of their masses divided by the square of the distance between their centers of mass. To obtain a reasonable ap-

proximation, we assume their geographical centers are their centers of mass. Because we know the radius of the Earth, we can use the Law of Universal Gravitation to calculate the mass of the Earth in terms of the gravitational force on an object (its weight) at the Earth's surface, using the radius of the Earth as the distance. We also need the Constant of Proportionality in the Law of Universal Gravitation, *G*. This value was experimentally determined by Henry Cavendish in the 18th century to be the extemely small force of 6.67×10^{-11} Newtons between two objects weighing one kilogram each and separated by one meter. Cavendish determined this constant by accurately measuring the horizontal force between metal spheres in an experiment sometimes referred to as "weighing the earth."

c Describe the composition of the Earth's interior and how it is determined using seismic waves. 10



d Describe the method of determination of Earth's circumference used by the Eratosthenes. 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.

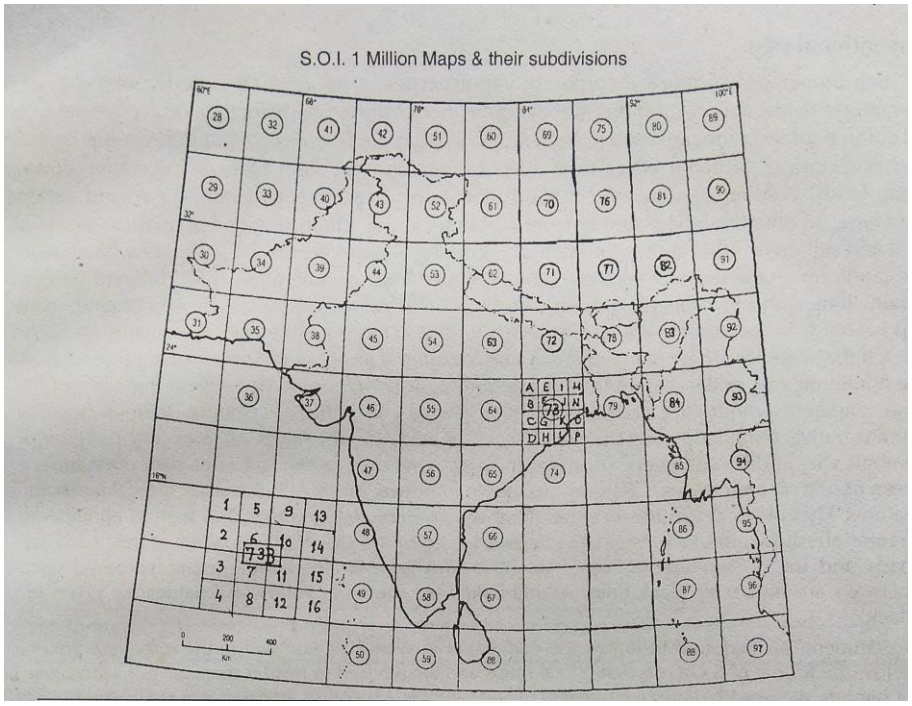
Eratosthenes then divided 360° by 7° 12' and determined that 7° 12' was 1/50th of a circle. Now all he had to do was find the distance from Syene to Alexandria and multiply it by 50 to get the earth's circumference.

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.

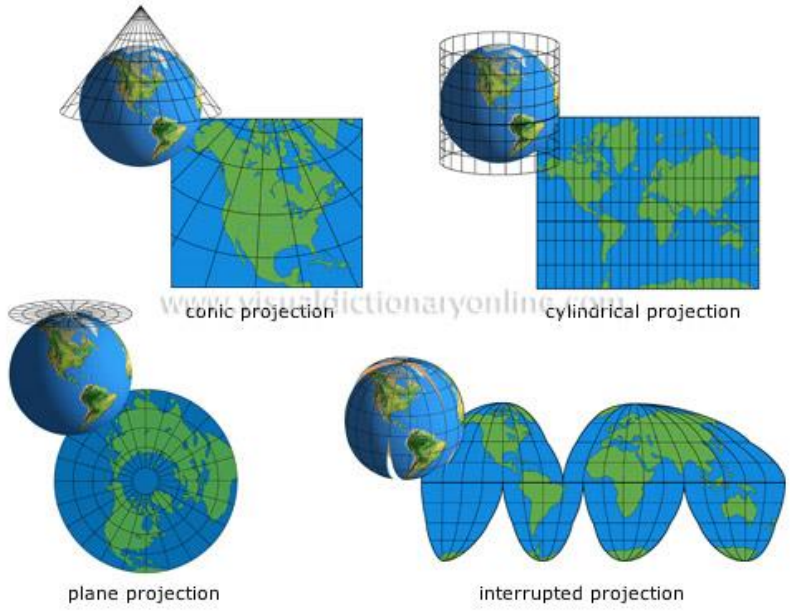
Next, he multiplied this distance by 50 to get 40,250 kilometers (25,000 miles). Today, most scientists set the earth's circumference at 40,096 kilometers (24,901 miles). This gives Eratosthenes' estimate less than a one percent error—an excellent approximation of the earth's circumference.

3 Answer <u>any two</u> of the following-

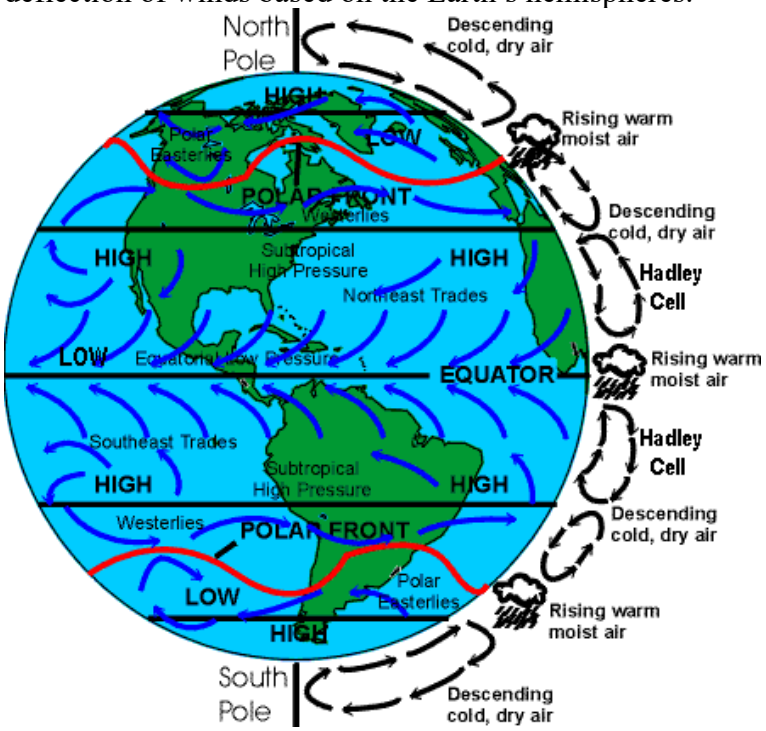
a Nawagaon city falls within sheet number 55J/12 at a scale of 1:50,000, Explain with a grid diagram the catalogue number of the sheet covering Nawagaon city at a scale of 1:1000000 (Given: Sheet 55J/12: North -West corner coordinates N 22° 15' E 78°30') 10



b Describe various types of map projection used in cartography. *10*



c Explain the 'Global Wind Circulation' pattern. Add a note on the cause of deflection of winds based on the Earth's hemispheres. 10



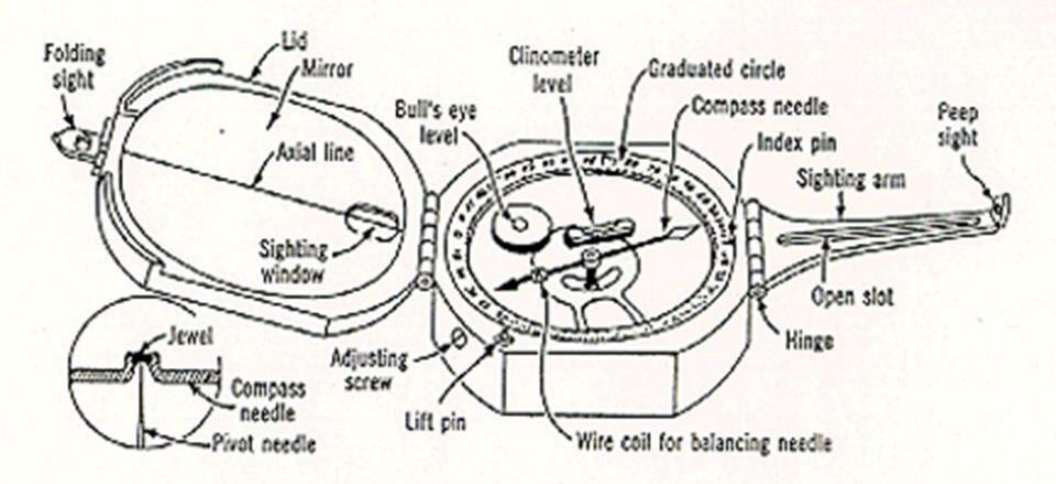
d Explain in detail various types of maps and map scales. Add a note on large and small-scale maps 10

Size of Scale	**Representative Franction (RF)**
Large Scale	**1:25,000** or larger
Medium Scale	**1:1,000,000** to **1:25,000**

Small Scale **1:1,000,000** or smaller

Description for each case should be given.

4 Answer <u>any two</u> of the following- 10

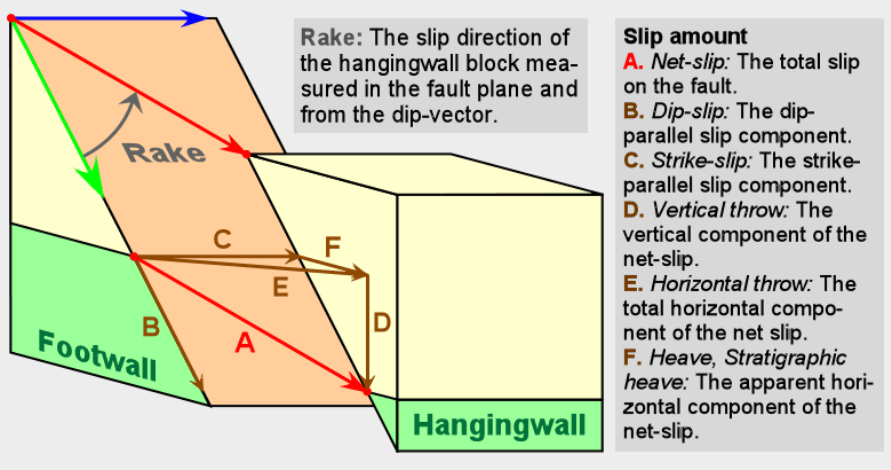
a 

How is a 'Brunton' compass different from a conventional magnetic compass? Draw a diagram and annotate the various essential parts of a 'Brunton' compass. What is the special 'magnetic needle damping' mechanism provided in a original version of the Brunton compass?

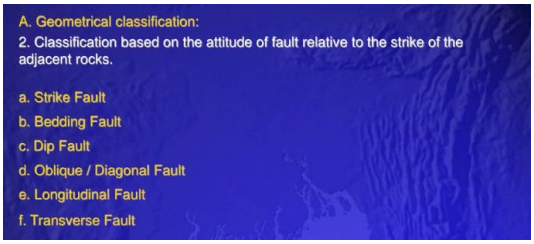
This compass differs from modern compasses, as it utilizes magnetic induction damping rather than fluid to dampen needle oscillation. It is widely used by geologists and surveyors to make accurate degree and angle measurements. The compass may be adjusted for declination angle according to one's location on the earth, in order used by geologists and surveyors to make accurate degree and angle measurements. Bruton compass, precision instrument for a variety of surveying functions such as preliminary surveys, mining works etc. 50 mm needle with 7ernier pivot, vertical graduation 0-90 in both directions with 7ernier reading direct to 10' contains a damper for magnetic needle movement, graduated 0 to 360. Complete in leather sling case

b Explain How faults are classified based on 10

1. Rake of net slip

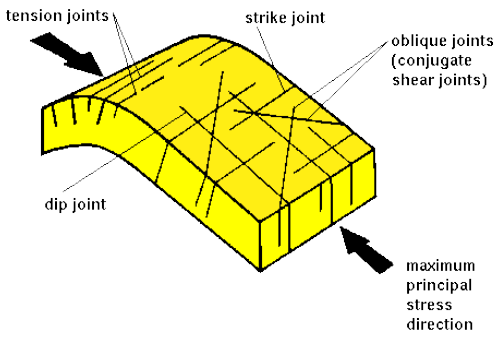


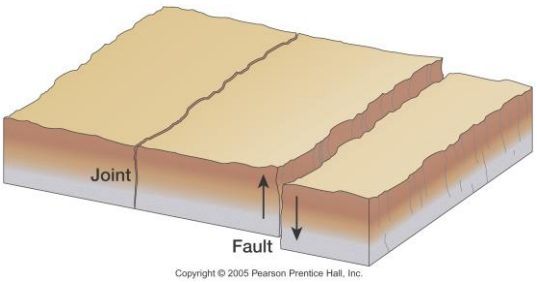
2. Orientation of fault with respect to bedding plane



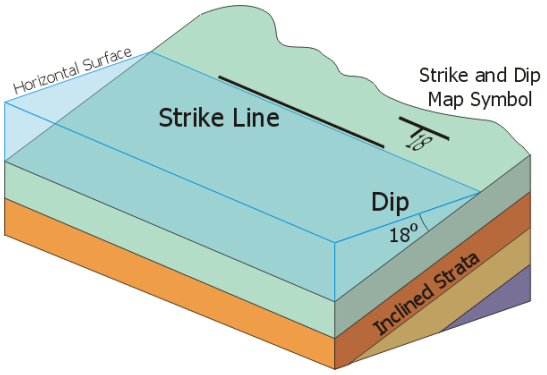
c What is the difference between joints, fractures and faults? Explain with the help of suitable diagrams. 10

Joints and **faults** are types **of fractures**. A **joint is** a **fracture** along which no movement has taken place, usually caused by tensional forces. A **fault is** a **fracture** or break **in the** rock along which movement has taken place.

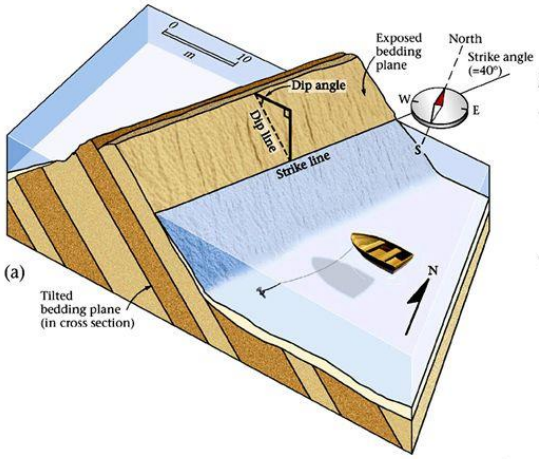


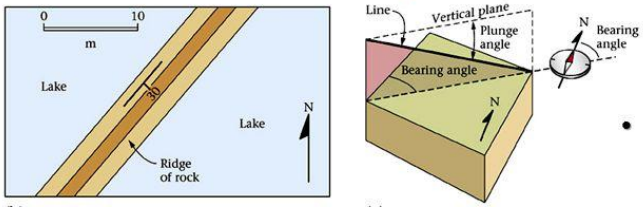


d Define strike and true dip of strata. With the help of suitable diagrams explain use of Brunton compass for the measurement of strike and dip of bedding plane. 10



Measuring Orientation: Strike and Dip





- In order to characterize geologic structures, one must be able to quantify the orientation of structures.

For Planar features we use:

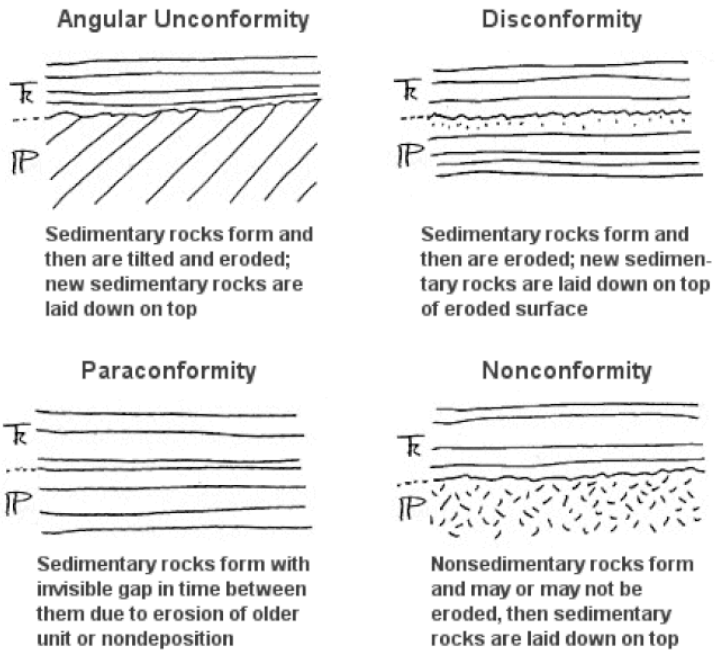
- ***Strike***: The orientation of the intersection line between a horizontal surface and the feature of interest. Measured with a compass.
  - E.g. north, N45W, 285, etc...
- ***Dip***: The acute angle between the feature of interest and a horizontal plane.
  - E.g. 0° = horizontal 90° = vertical

For linear features we use:

- Trend: the trend of the line if you were looking down on the feature from above
  - E.g. north, NW, 320, 090, etc...
- Plunge: Acute angle between the line and a horizontal
  - E.g. 46°, 75°, etc...

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

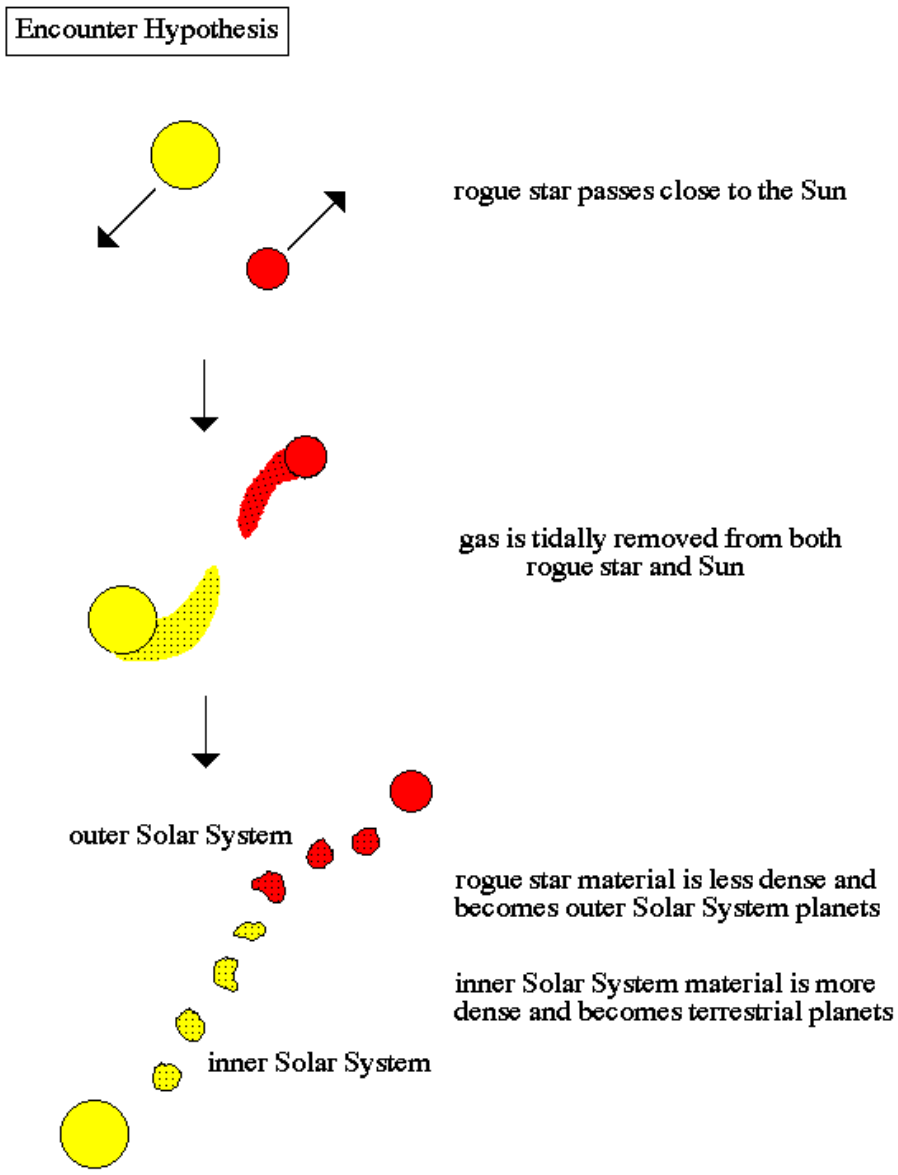
i) Types of unconformities



ii) Theories of origin of solar system

Encounter Hypothesis:

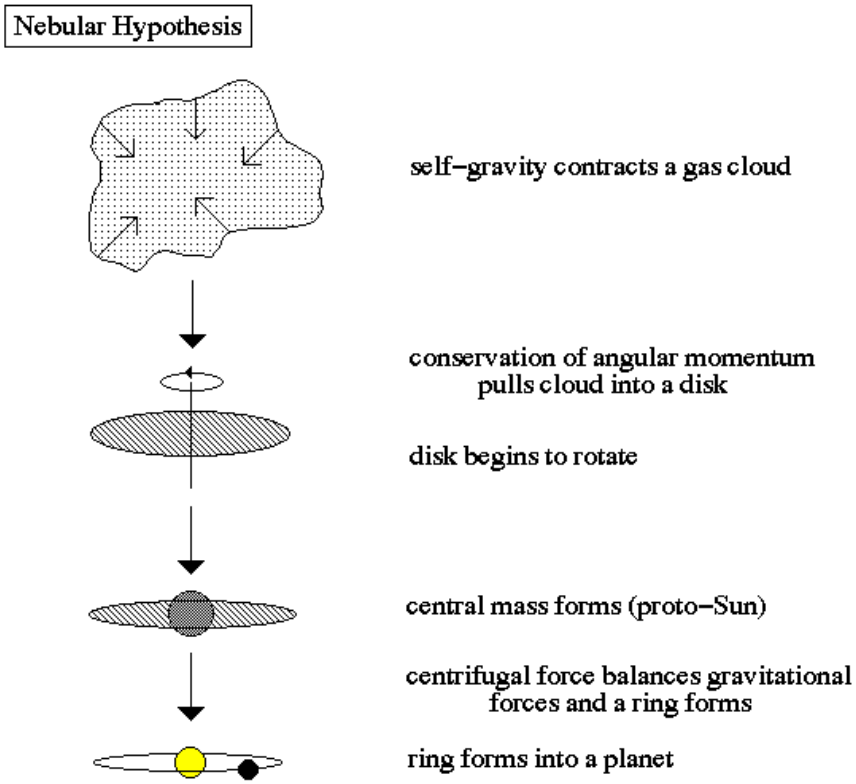
One of the earliest theories for the formation of the planets was called the encounter hypothesis. In this scenario, a rogue star passes close to the Sun about 5 billion years ago. Material, in the form of hot gas, is tidally stripped from the Sun and the rogue star. This material fragments into smaller lumps which form the planets. This hypothesis has the advantage of explaining why the planets all revolve in the same direction (from the encounter geometry) and also provides an explanation for why the inner worlds are denser than the outer worlds.



However, there are two major problems for a theory of this type. One is that hot gas expands, not contracts. So lumps of hot gas would not form planets. The second is that encounters between stars are extremely rare, so rare as to be improbable in the lifetime of the Universe (15 billion years).

Nebular Hypothesis:

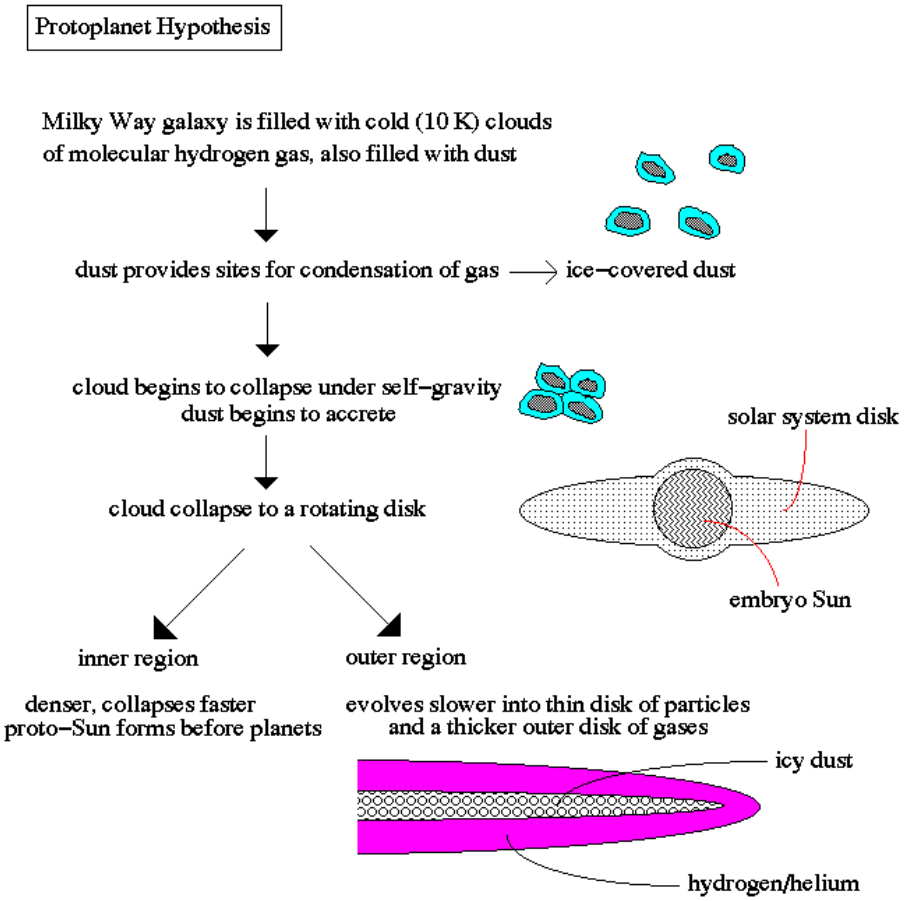
A second theory is called the nebular hypothesis. In this theory, the whole Solar System starts as a large cloud of gas that contracts under self-gravity. Conservation of angular momentum requires that a rotating disk form with a large concentration at the center (the proto-Sun). Within the disk, planets form.



While this theory incorporates more basic physics, there are several unsolved problems. For example, a majority of the angular momentum in the Solar System is held by the outer planets. For comparison, 99% of the Solar System's mass is in the Sun, but 99% of its angular momentum is in the planets. Another flaw is the mechanism from which the disk turns into individual planets.

Protoplanet Hypothesis:

The current working model for the formation of the Solar System is called the protoplanet hypothesis. It incorporates many of the components of the nebular hypothesis, but adds some new aspects from modern knowledge of fluids and states of matter.



i) Coriolis effect

Coriolis force, in classical mechanics, an inertial force described by the 19th-century French engineer-mathematician Gustave-Gaspard Coriolis in 1835. Coriolis showed that, if the ordinary Newtonian laws of motion of bodies are to be used in a rotating frame of reference, an inertial force—acting to the right of the direction of body motion for counterclockwise rotation of the reference frame or to the left for clockwise rotation—must be included in the equations of motion.

The Coriolis effect is most apparent in the path of an object moving longitudinally. On the Earth an object that moves along a north-south path, or longitudinal line, will undergo apparent deflection to the right in the Northern Hemisphere and to the left in the Southern Hemisphere. There are two reasons for this phenomenon: first, the Earth rotates eastward; and second, the tangential velocity of a point on the Earth is a function of latitude (the velocity is essentially zero at the poles and it attains a maximum value at the Equator). Thus, if a cannon were fired northward from a point on the Equator, the projectile would land to the east of its due north path. This variation would occur because the projectile was moving eastward faster at the Equator than was its target farther north. Similarly, if the weapon were

fired toward the Equator from the North Pole, the projectile would again land to the right of its true path. In this case, the target area would have moved eastward before the shell reached it because of its greater eastward velocity. An exactly similar displacement occurs if the projectile is fired in any direction.

ii) Lehman and Gutenberg discontinuity

Discontinuity at a depth of ~ 210 km is also called the Lehmann discontinuity Despite the detection of the L, the existence of a global discontinuity at this depth is still under discussion. Most of the regions where the L has been detected belong to continental or island arc regions. The fact that a reflection from this depth is missing in the global long-period stacks supports either the theory of the regional nature of the L, or indicates a strong depth variation of this reflector. Nevertheless, the L, with an increase of P and S-velocity of ~7 % at a sharp boundary, has been part of some global Earth models such as the Preliminary Reference Earth Model (PREM).
A major solid-solid phase transition within mantle material has not been found at pressure conditions (7 GPa - 8 GPa) and upper mantle temperatures relevant at depths of 210 km

Guttenberg: According to geophysicists, the Gutenberg discontinuity, also called D″ (D double prime or D prime prime), occurs within the Earth's interior at a depth of about 1,800 mi (2,900 km) below the surface. At that depth there is an abrupt change in the seismic waves (generated by earthquakes or explosions) that travel through Earth. In addition, at this depth, primary seismic waves (P waves) decrease in velocity while secondary seismic waves (S waves) disappear completely. S waves shear material, and cannot transmit through liquids, so it is conjectured that the unit above the discontinuity is solid, while the unit below is in a liquid, or molten, form. This distinct change marks the boundary between two sections of Earth's interior, known as the lower mantle (which is considered solid) and the underlying outer core (believed to be molten).

iii) Meteorites and age of Earth

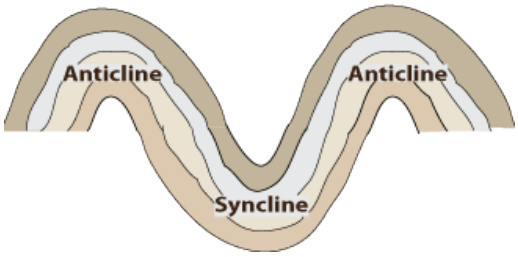
The best age for the Earth comes not from dating individual rocks but by considering the Earth and meteorites as part of the same evolving system in which the isotopic composition of lead, specifically the ratio of lead-207 to lead-206 changes over time owing to the decay of radioactive uranium-235 and uranium-238, respectively. Scientists have used this approach to determine the time required for the isotopes in the Earth's oldest lead ores, of which there are only a few, to evolve from its primordial composition, as measured in uranium-free phases of iron meteorites, to its compositions at the time these lead ores separated from their mantle reservoirs. These calculations result in an age for the Earth and meteorites, and hence the Solar System, of 4.54 billion years with an uncertainty of less than 1 percent. To be precise, this age represents the last time that lead

isotopes were homogeneous througout the inner Solar System and the time that lead and uranium was incorporated into the solid bodies of the Solar System. The age of 4.54 billion years found for the Solar System and Earth is consistent with current calculations of 11 to 13 billion years for the age of the Milky Way Galaxy (based on the stage of evolution of globular cluster stars) and the age of 10 to 15 billion years for the age of the Universe (based on the recession of distant galaxies).

iv) Anticlines and synclines

Syncline and anticline

Syncline and anticline are terms used to describe folds based on the relative ages of folded rock layers. A syncline is a fold in which the youngest rocks occur in the core of a fold (i.e., closest to the fold axis), whereas the oldest rocks occur in the core of an anticline.



It is important to note that syncline and anticline do not necessarily relate to the shape or orientation of folded layers, although the origin of the words implies this. The term originates from the Greek word sun (xun), meaning together, and the Greek word klei, meaning to lean, so syncline implies leaning together or leaning towards. Ant is the Greek prefix meaning opposite or opposing, so the word anticline implies oppositely leaning. Beds dip towards the fold axis in a syncline and away from the fold axis in an anticline only when the folded layers were upright before folding (i.e., where younger layers overlaid older layers). Before describing folds, it is therefore necessary to establish the primary order in which layers were deposited. To do this, facing, younging, or way-up criteria are used. These are synonymous terms for primary sedimentary structures (e.g., graded or cross-bedding) or igneous structures (e.g., vesicles, pillows) preserved in the folded layers. Where the relative ages of rocks are not known (as is often the case in metamorphic rocks), the term synform and not syncline should be used to describe folds where layers are bent downwards so that they dip towards the fold axis, and antiform and not anticline should be used where beds are arched upwards so that layers dip away from the fold axis.

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