DATE:

PHYSICAL SCIENCES.

DATE: _____

i- Constituents & structure:

Past Paper Question

1- Describe different methods to estimate the age of Universe. (2018)

2. What is black hole? How black holes are formed & discovered? (2023)

3. Differentiate b/w a star & a planet. What is the magnitude of a star & how the color of star is correlated with their temp? (2021)

4. Briefly describe the most popular & accepted theory about the origin of Universe? (2021)

5. Explain the terms Dark Energy & Dark Matter? (2018)

6. Define the term Black Hole. What's expected inside it? (2018) (2007)

7. Briefly describe what is big bang theory? (2011)

8. What is galaxy? The earth belongs to which galaxy? (2011)

9. Imp features of Sun & structure of Sun. (2008-2009)

DATE: _____ DAY: _____

1- The Universe

Big Bang Theory:

According to Big Bang Theory, the Universe came into existance about 15 to 20 billion years ago when a catacylsmic explosion took place. The Echo of this big bang can still be heard in the form of microwave radio signal from space. This is also called as the 3K microwave background radiation first detected by Arno Penzias & Rober Wilson for which they awarded the Nobel Prize. Before the birth of our Universe, there was no time, no matter & Space. All the energy & matter of the future cosmos were concentrated in a single point of energy. All the forces were unified in this single point & were in perfect harmony. By somecway this harmony was ~~distributed~~ disturbed and this

DATE: / /

triggered a catastrophic explosion, filling our space with every particle of matter hurled away from every other particle. Thus, this is how our Universe exploded into life; and matter, space & time came into being. (Book : Dr. M. Akram Kashmi

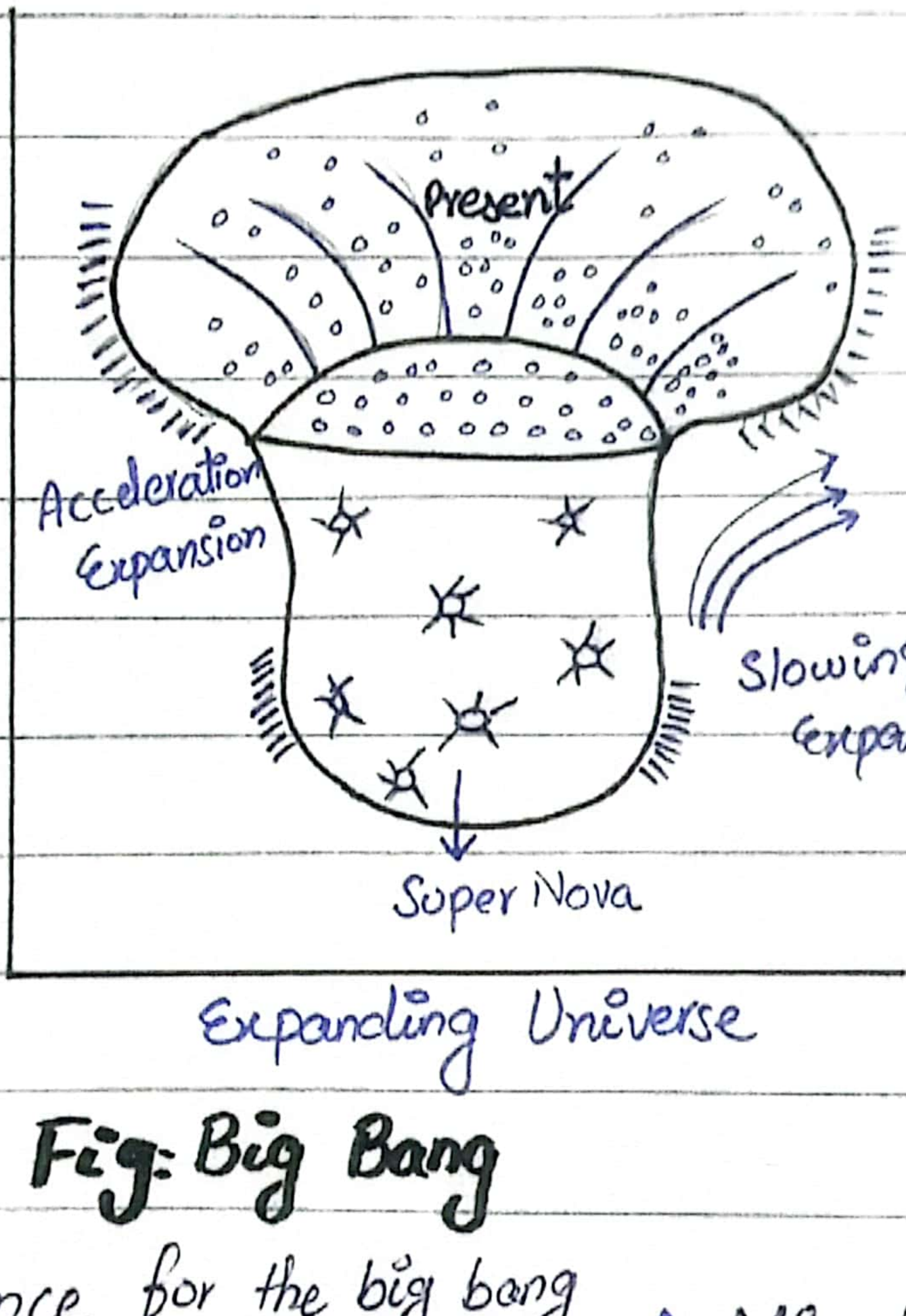


Fig: Big Bang

Evidence for the big bang → Mian Shafiq (Book)

The ultimate fate of Universe.

Methods to estimate the age of Universe.

Astronomers estimate the age of universe in two ways:

DATE: DAY:

1- Calculating the expansion rate of the universe:

According to the scientist, the universe is approximately 14 billion years old. It is the age of universe that is estimated from big bang. According to this method, we assume that universe is expanding at a constant rate by using Hubble's constant (H_0).

Hubble noted that the distance of a galaxy is directly proportional to its speed, and means. The futher the galaxy was, it was moving away.

$d = vt$

$t = d/v$

wher $v = H_0 d$

$t = d/H_0 d$

$t = 1/H$

$H_0 = 2.34 \times 10^{-18}\ s^{-1}$

$t = 1/2.34 \times 10^{-18}\ s^{-1}$

$t = 4.27 \times 10^{17}\ s$

$1\ year = 3.15 \times 10^{7}\ s$

$t = \frac{4.27 \times 10^{7}}{3.15 \times 10^{7}} = 1.35 \times 10^{10}$ years.

$= 1.35 \times 10^{9}$ years.

$= 13.5$ billion years

Hence, Scientist were able to use the Hubble constant to estimate the age of Universe by working backwards to Big Bang.

2- By determining the age of oldest stars

Scientist determine the age of the universe by following

Spectrum:

The star's spectrum helps determine the age of stars because blue stars tend to die faster than red stars.

Luminosity:

A brighter star will exhaust the its energy faster than a less big star. Therefore the star with less luminous intensity exists for a longer thime than with a more luminous intensity.

Mass:

The amount of a star's mass also helps in finding the life of a star. If a star is dense, it tends to die quickly as compared to a less dense star. Thus the density factor also helps calculate a star's life.

(CSSprepforum)

DATE: _____ DAY: _____

2. Galaxy

Defn:

A galaxy is a gravitationally bound system containing black hole, stars, stellar remnants, interstellar gas & dust (nebulae), planets, dwarf planets, small solar system bodies, satellites etc. are all contained with in a galaxy.

⇒ There are billions of galaxies within our universe.

Classification of galaxies.

According to the Hubble Tunning Fork diagram, the types of galaxies are as follow.

Types

Spiral galaxies	Elliptical galaxies	lenticular	Irregular galaxies
• They are flat, rotating, spiral structures • Examples include Milky way & Andromeda.	• They have an elliptical profile, giving them an ellipsoidal appearance regardless of the angle. • e.g. Galaxy M49 & Galaxy M59	• An intermediate form which has the properties of both, elliptical as well as spiral galaxies.	An irregular galaxy is the catchall name given to any galaxy that does not neatly fit into one of the categories of the Hubble classification scheme.

DATE:

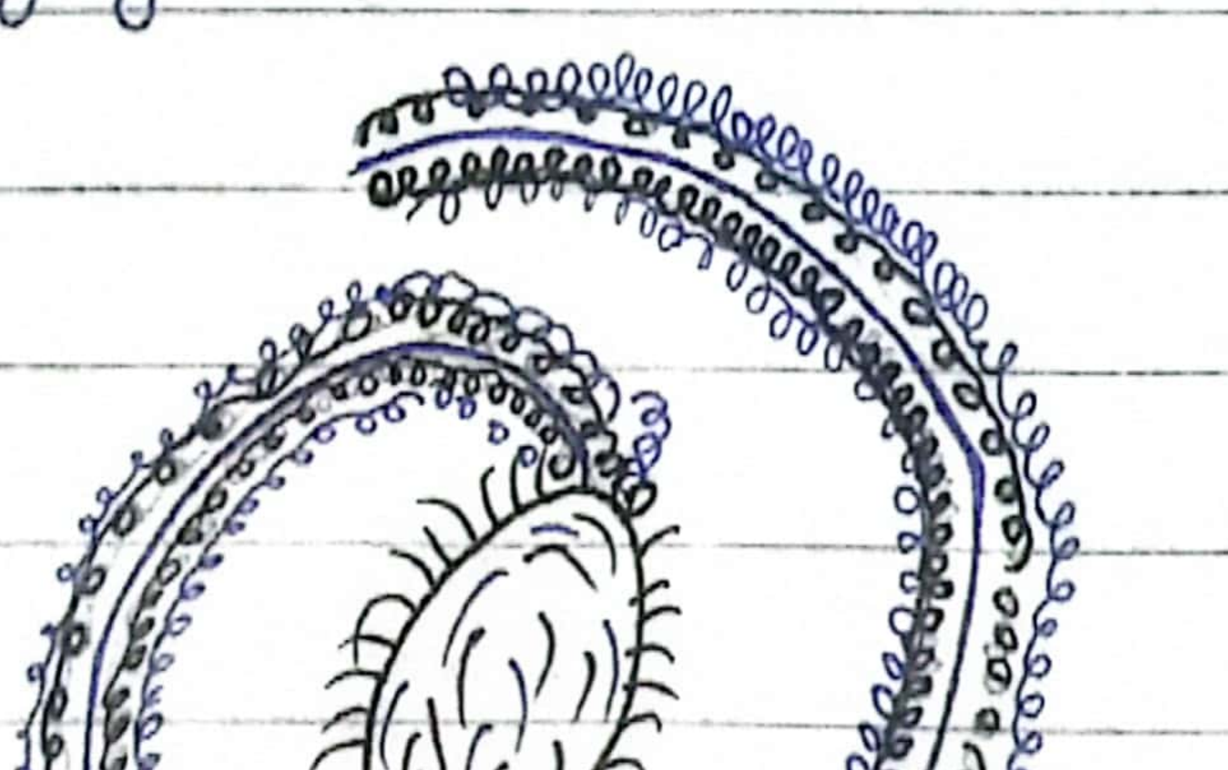
- Structures do not align neatly.
- Can not be readily classified as spiral, elliptical or lenticular.
- Examples include The Small Megallanic clouds & the Large Megallanic clouds.

Milky Way (JWT)

The future of Milky way:

➡ Studies suggest that Nearest Galaxy called Andromeda is approaching the Milky way galaxy at a speed of 100-140 KM/Sec.

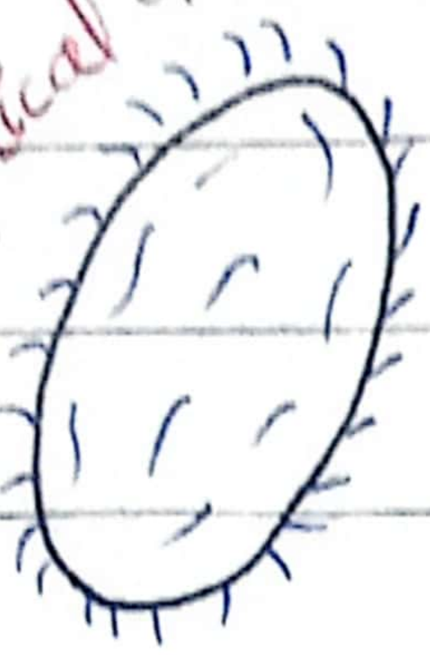
➡ At this speed, the two galaxies would collide in the coming 3-4 billion years, merging to form a new elliptical galaxy.



:: Fig: Milky Way.

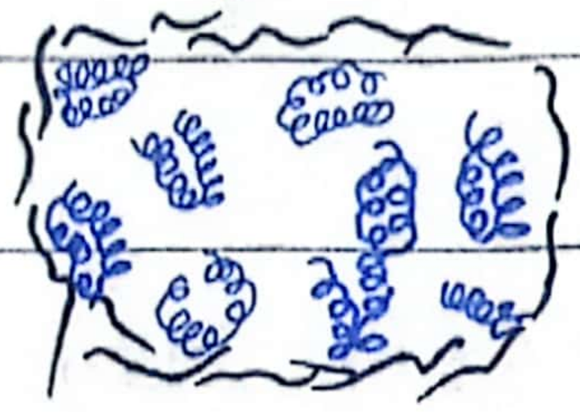
DATE: _____ DAY: _____

Elliptical Galaxy



Spiral Galaxy.

Irregular Galaxy.



3. Light Year:

The distance travelled by the light at the speed of 3×10^8 m/s in one year is called light year.

A light year is a unit of astronomical distance, representing the distance that light travels in one year.

The approximate value for a light year is about 9.461 trillion kilometers.

$$\text{Distance(Light year)} = \frac{\text{Speed of light} \times \text{Time (in second}}{\text{No. of seconds in a year.}}$$

DATE: _____ DAY: _____

4. Solar System

i- Planets. ⇒ JWT

ii- Dwarf planets.

iii- Satellites:

A satellite is an artificial body or a natural celestial body that orbits a planet, dwarf planet or a minor planet.

Types:

Satellites are of two types:

a) Natural Satellite b) Artificial Satellite

Natural Satellite:

A natural satellite or moon is a natural celestial body that orbits a planet or dwarf planet or minor planets.

Earth	One moon.	Mars	02 moons (Phobos, Deimos
Mercury + Venus	No moon.	Jupiter	79 moons.
Saturn	62 moons (Titan)	Uranus	27 moons
Neptune.	14 moons (Sao, Neso)		

Artificial Satellites:

- An artificial satellite is a semi-independent computer controlled system placed by humans in an orbit, for different purposes.
- They set in a certain speed where gravity &

DATE: _____ DAY: _____

centrifugal force balance each other & the satellite remains in the orbit, neither falling down nor ascending upwards.

- Satellite need an escape velocity to reach space.

The history of artifical satellites:

➡ First artificial satellite was sputnik 1. USSR Oct 1957

➡ Second artificial satellite was Spatnik 2. USSR Nov 1957

➡ First satellite Bus (HS-333) launched in 1972.

➡ The largest satellite to date is International Space station. (ISS)

International Space Station:

➡ The first piece of ISS was launched in November 1998.

➡ NASA & its partners from around the World completed construction of the space station in 2011.

➡ The international space station is a large spacecraft in orbit arand Earth.

➡ It serves as a home where Crews of astronauts & cosmonauts live.

➡ It orbits Earth at an average altitude of approximatdy 250 miles.

DATE: _____ DAY: _____

⇒ it travels at 17,500 mph. This means it orbits Earth every 90 minutes.

⇒ It's an important place to carry out tests & research that will help future space missions to places like Moon & Mars.

Always Remeber!!!

A spacecraft & satellite is same thing.

A space shuttle is however different.

Classificate of Satellite

On the basis of Orbit

- **Heliocentric Orbit** ⇒ An orbit around sun.
- **Aero-centric Orbit** ⇒ An orbit around the other planets, e.g Mars or Venus.
- **Geocentric Orbit** ⇒ An orbit around the Earth.

four types depending upon Altitude

- **LEO** ⇒ Low Earth Orbit
  Altitude: (180-2000KM)
- **MEO** ⇒ Medium Earth Orbit. (2000-35786 KM)
- **GEO** ⇒ Geo Synchronus Orbit (35,786KM)
- **HEO** ⇒ High Earth Orbit (Above 35,786 KM)

DATE: _____ DAY: _____

According to function

1. Astronomical Satellites (Observation of other planets)
2. Bio Satellites (Carry living Organism to space for experim
3. Earth Observation Satellites (Map making, meterology, environment monitoring)
4. Navigation Satellites (Radio time signals, Mobile Recievers enabler)
5. Space station satellites (Human beings live inside ISS)

iv- Asteroid
v- Meteroid
vi- Comet
vii- Constellation- → from JWT

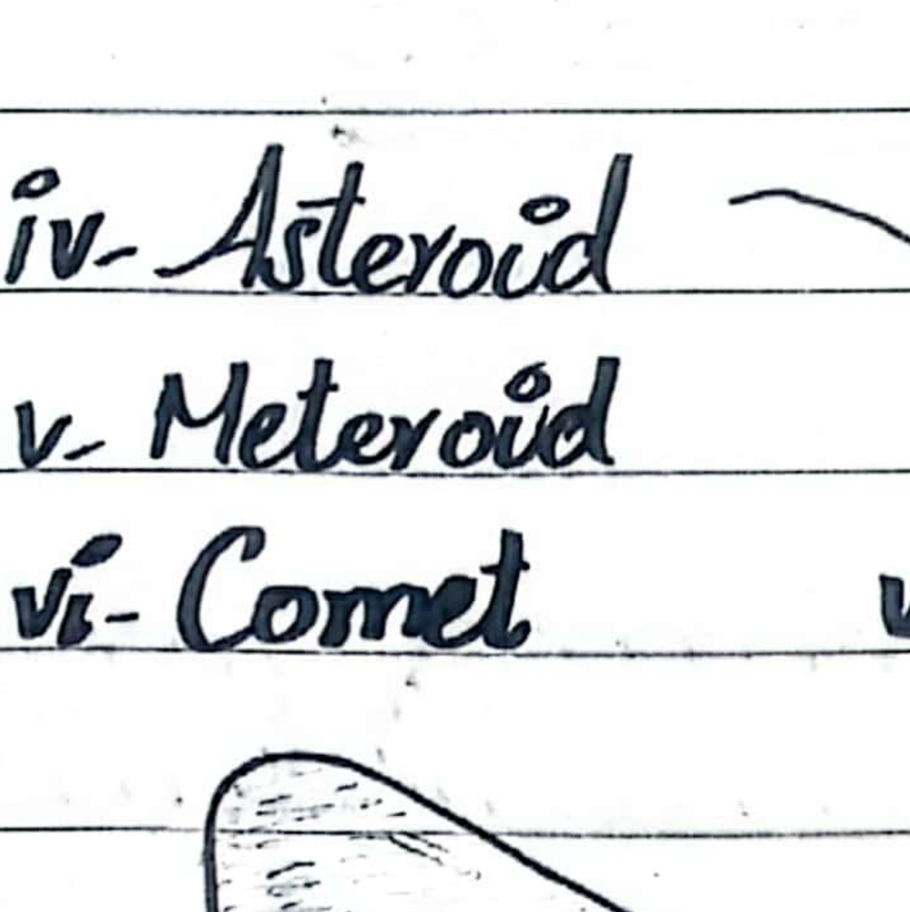


Fig: Asteroid

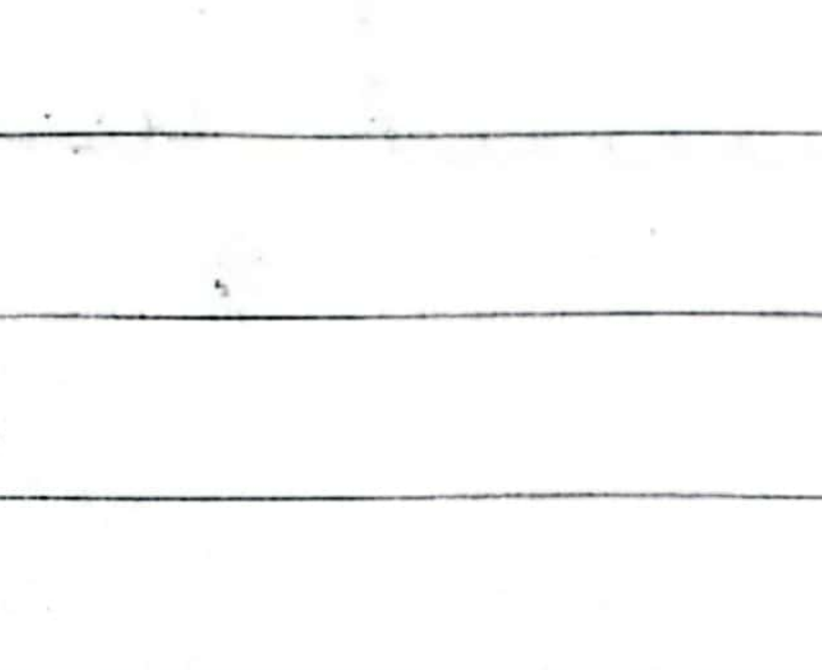


Fig: Meteroid

DAY:

DATE:

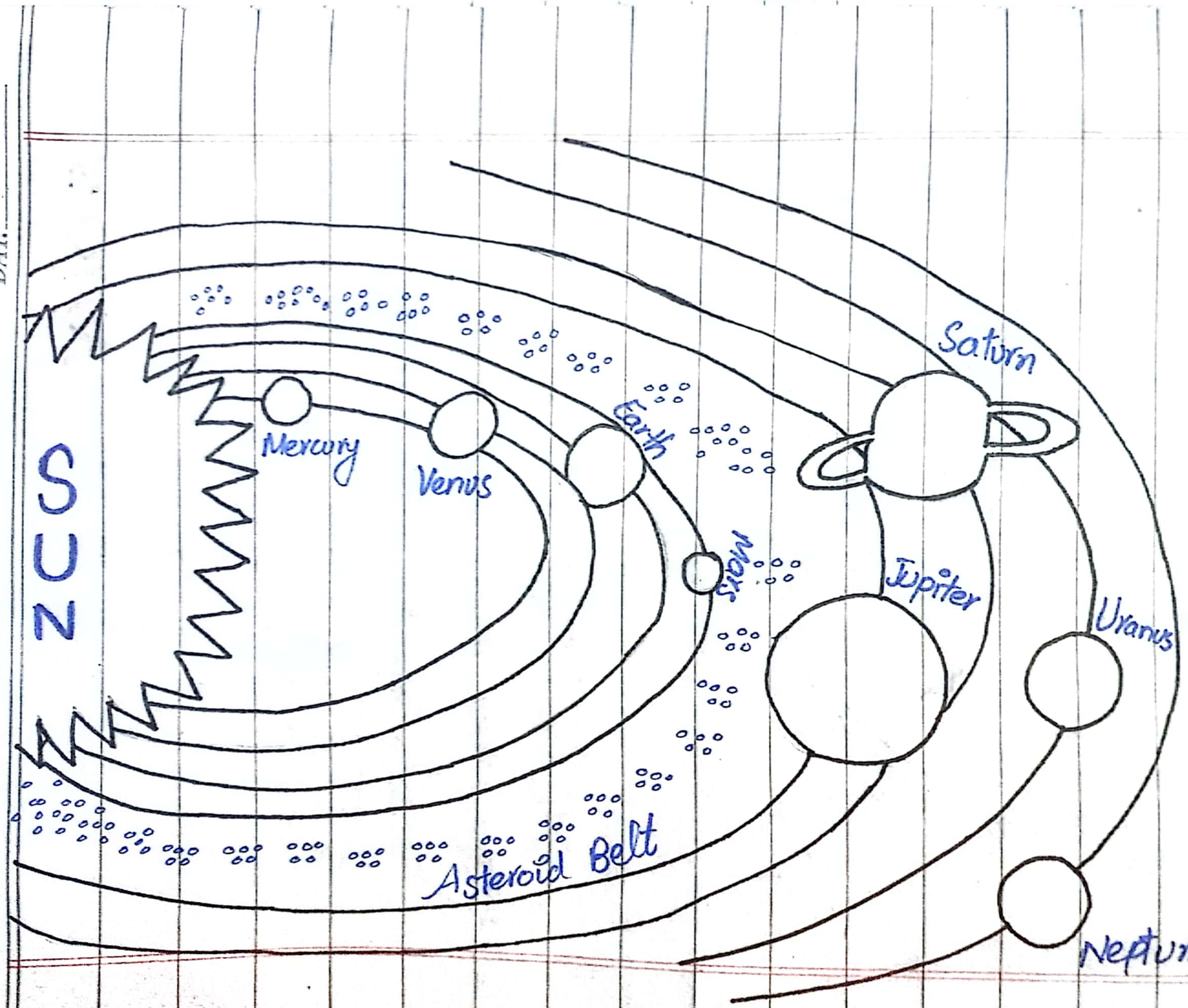


Fig: Planets Revolving around SUN.

DATE: _____ DAY: _____

5. SUN

- SUN
  - Composition
    - a. The Core
    - b. The Radiative Zone
    - c. The Connective Zon-
  - Atmosphere
    - a. Photosphere
    - b. Chromo-sphere
    - c- Corona.

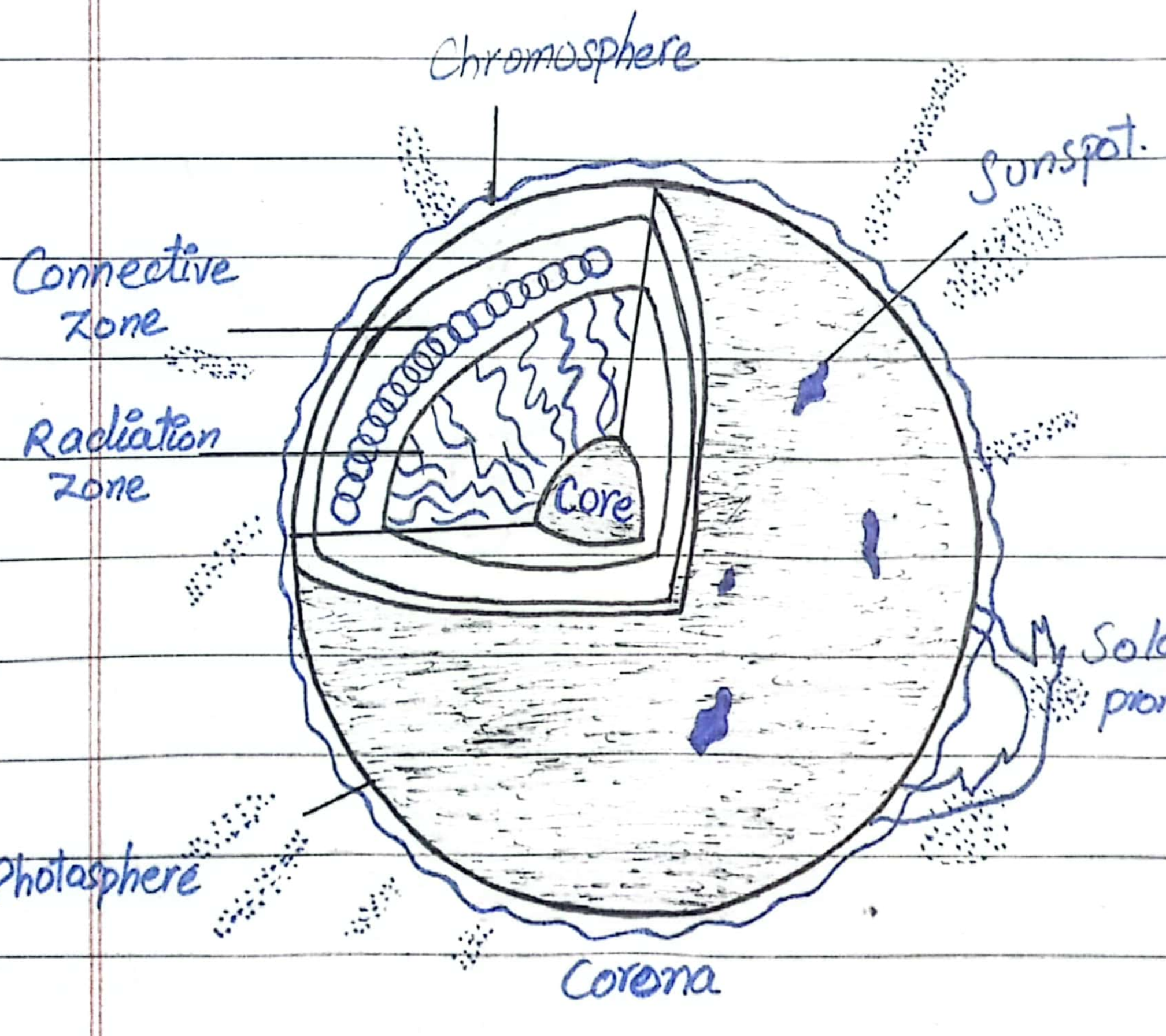


Fig: Structure of the SUN.

DATE: _____ DAY: _____

Atmosphere of the SUN:

Atmosphere of Sun consist of 3 layers.

1- Photosphere

2- Chromosphere

3- Corona.

1- Photasphere

- The surface of the sun is called photosphere.
- The surface of the sun is only part that can be seen from Earth on a typical day, without use of specialized equipment.
- The photosphere is thinner, cooler layer than its neighbouring layers. It is only about 500km wide.
- The temp of photosphere is 5500°c approx.

2- Chromosphere:

- Above the photosphere, another layer of atmosphere is present which is called chromosphere.
- The thickness of this layer is around 2000 km.
- Temp of this layer is about 20,000°C.
- The chromosphere is no longer white light like the photosphere but is mostly red in visible light.

DATE: _____ DAY: _____

3. Corona

The highest part of solar atmosphere is called Corona.

The Corona is the outermost part of sun's atmosphere which is usually hidden by the bright light of the Sun's surface. That makes it difficult to see without using special instruments.

Sunspots:

Sunspots are cool, dark patches on the Sun's surface. They are caused by disturbances in sun's magnetic field which make them cooler than the surrounding area.

Solar prominence:

- A solar prominence is a large, bright feature extending outward from the Sun's surface.

A prominence forms over timescales of about a day, and stable prominences may persist in the corona for several months, looping hundreds of thousands of miles into

DATE: _____ DAY: _____

Space. 6. The Earth.

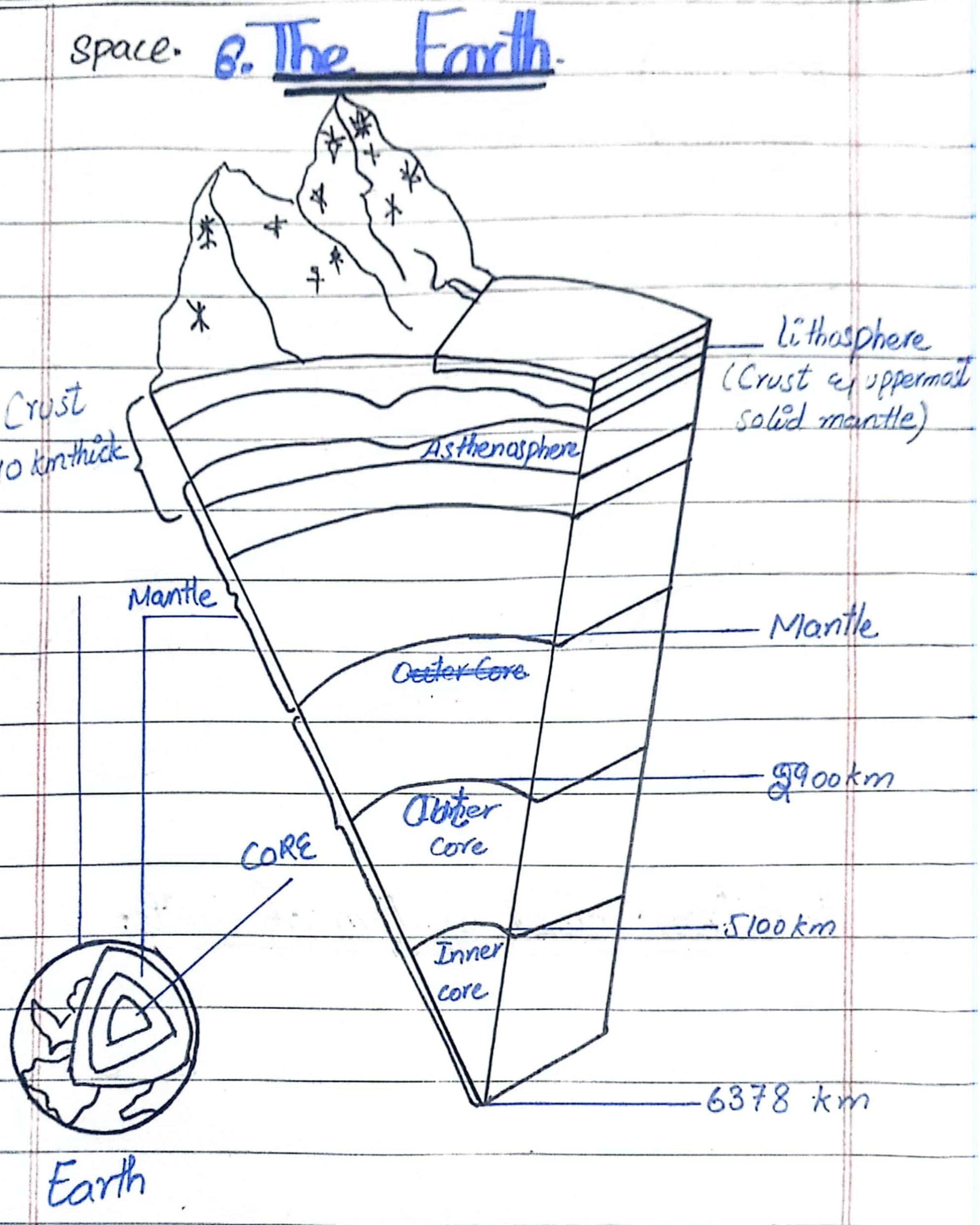
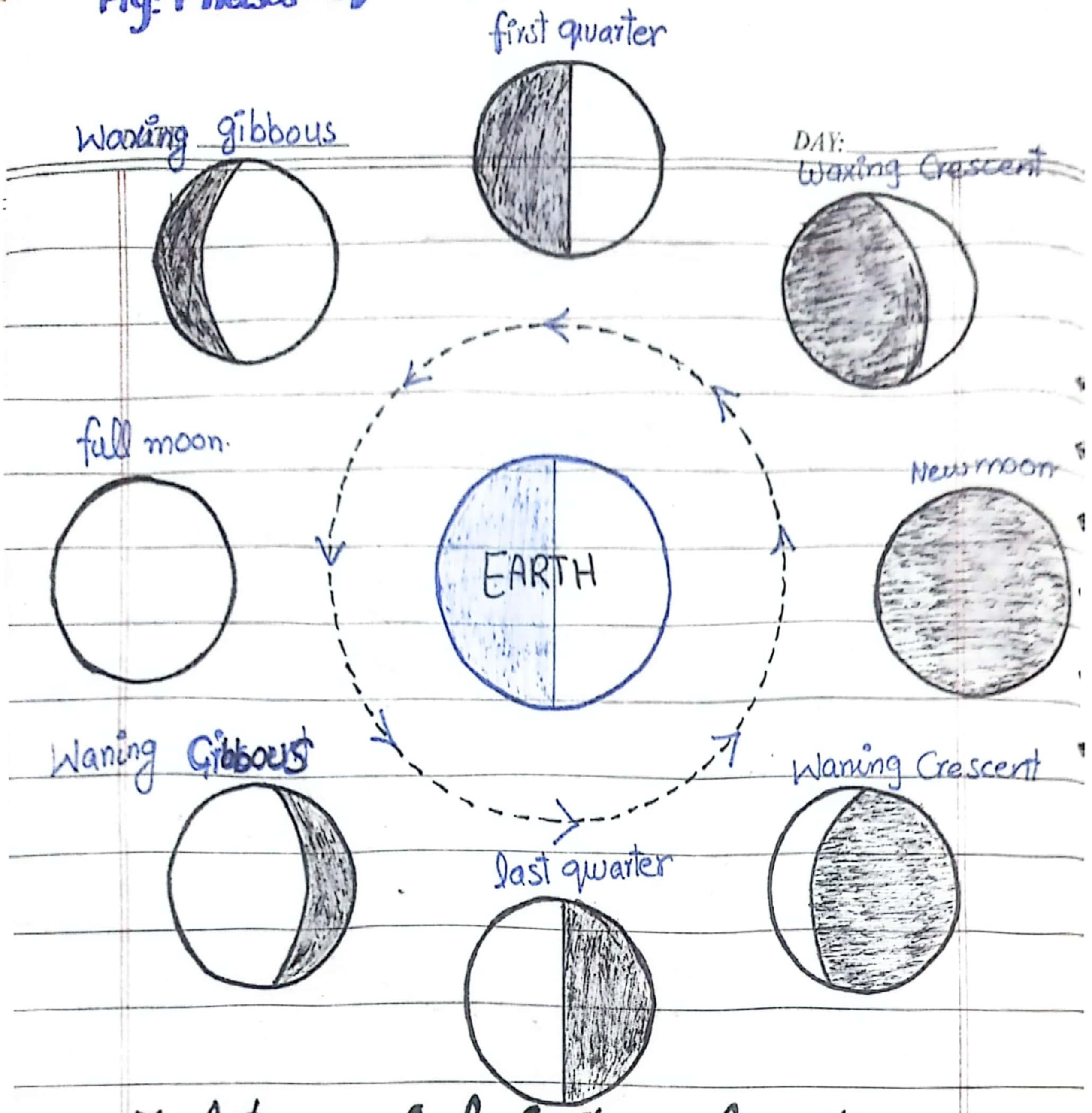


Fig: Earth Structure.

MOON: (From NOA Book)

Fig: Phases of Moon.



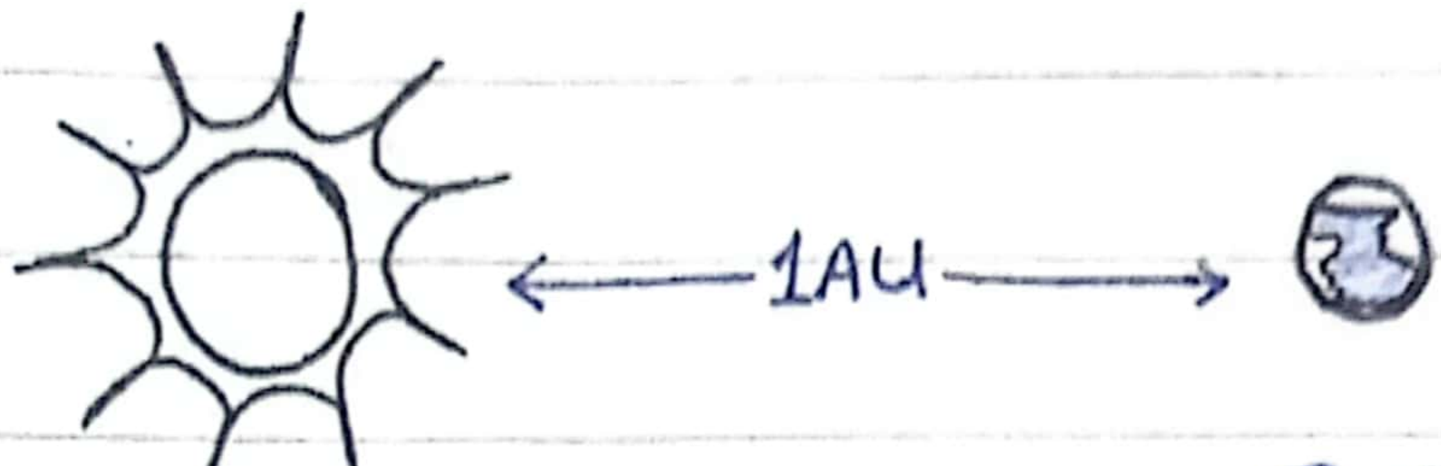
7. Astronomical System of Units:

One astronomical unit (AU) represents the mean distance b/w the Earth and our Sun. The AU is approximately 150 million kilometers or 93 million miles.

In 2012, the International Astronomical Union defined the distance to be 149,597,870,700m.

1 AU = 149,597,870.700 kilometers.

DATE: _____ DAY: _____



Dark Energy:

- In 1929, Edward Hubble examined how the wavelength of light emitted by the distant galaxies, shifts towards the red end of the electromagnetic spectrum. He found that fainter, more distant galaxies showed a larger degree of red shift; closer galaxies, not so much. Hubble determined that this was because the universe itself is expanding.
- Whatever there is empty spaces in the universe, more is forming every second. So, dark energy is some kind of energy intrinsic to empty spaces.

Features of Dark Energy:

- It makes up approximately 68% of the universe & appears to be associated with the vaccum in space.
- It is evenly distributed throughout the universe.

DATE: DAY

Even distribution means that dark energy does not have local gravitational effect, but rather a global effect on the universe. This leads to repulsive force, which tends to accelerate the expansion.

Ideas to Explain Dark Energy

- Empty spaces has its own energy.
- Idea of Einstein in 1917, idea of cosmological constant, a force that counteract force of gravity.
- Idea of virtual particles (form from nothing & then disappear into nothing again) in empty spaces. The energy from those particles could be dark energy.
- It is unknown kind of energy, fluid or field.

Example: Phantom Dark Energy.

Dark Matter:

- Galaxies are rotating with such speed that the gravity generated by this observable matter could not possible hold them together; they should have torn themselves long ago. This leads scientists to believe that something we cannot see at work.

DATE: _____ DAY: _____

- They think something we have yet to detect it directly giving these galaxies extra mass, generating the extra gravity they need to stay intact. This strange matter was called Dark Matter since it is not visible.

Features of Dark Matter:

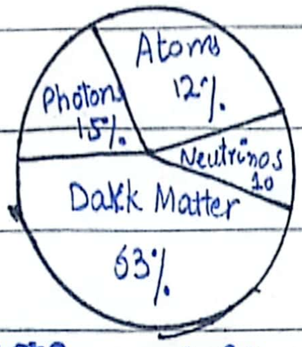
- Unlike normal matter, it does not interact with the electromagnetic force.
- It does not absorb, emit or reflect sunlight.
- Scientists are able to infer its existence only from the gravitation effect.
- Places with concentration of dark matter bend light passing near by. (interact with gravity.
- It seems to outweight visible matter roughly 6 to one making up about 27% of the universe.

Examples:

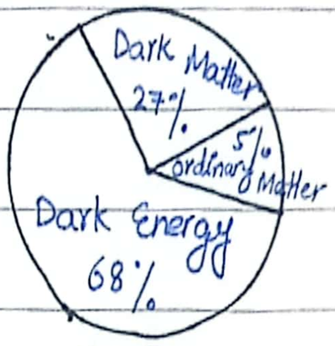
Neutron Stars.

Black holes.

DATE: _____ DAY: _____



13-8 billion year ago



Today

Black Hole:

(It is a place in space where gravity pulls)

A black hole is a massive object in space that is so dense that within a certain radius, its gravitational field does not let anything escape from it, not even light. The first image of a black hole would only be taken in 2019, the proof of its existence was already there in Einstein's eq.

Example:

Sagittarius A* is a supermassive black hole that exists at the centre of the milky way galaxy.

What is expected inside the Black Hole?

The black hole is called a black hole because the gravity & density inside the black hole are so strong that it attracts

DATE: _____ DAY: _____

everything coming toward it, even the electromagnetic radiation cannot escape. Hence, the black hole cannot be observed directly. However, it can be observed by its gravitational influence on nearby matter. The boundary of black holes is called the event horizon.

⇒ In 2019, the Event Horizon telescope imaged a supermassive black hole in the galaxy M87.

How black holes are discovered?

* Although the existing of black holes was first predicted by Albert Einstein in 1916 in his general theory of relativity, the first official black hole was discovered in 1964 by astronomers when a sounding rocket detected celestial sources of X-rays.

* The first black hole detected according to NASA, was Cygnus X-1, located within the Milky way in the constellation of Cygnus, the Swan.

* However, the term "black hole" was not coined until 1967, when American astronomer

DATE: _____ DAY: _____

John Wheeler named it so.

* Moreover, in 1971, astronomers determined the X-rays were coming from a bright blue star orbiting a strange dark object an all-consuming black hole.

How black holes are formed?

* Stars more than 6 times as massive as our Sun are called Massive stars. A massive star has short lifespan than the Sun or other low mass stars. Hydrogen in the core of a massive star is used up with much fast speed. After only 500 to 100 million years, no hydrogen is left in the core of a massive star. At this time, the core collapses and the star becomes 1000 times greater than its original size. it is now called a SURERGIAT.

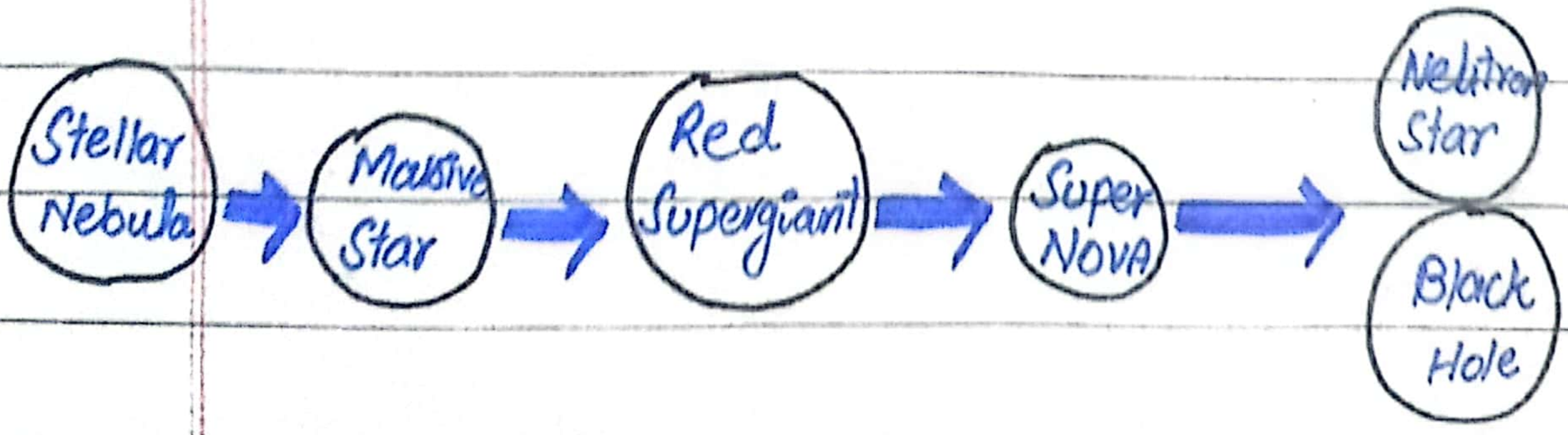
* With the passage of time, the supergiant becomes so dense that it cannot bear the pressure of outer layers. The outer layers crash inward with a tremendous explosion, called SUPERNOVA.

DATE: DAY:

* At the time of Supernova, the light of the star becomes much more than all other stars of the galaxy. Great shells of the gases fly ~~over~~ off the star. Only the tiny core of the star remains left. This core contains only neutrons, so it is called a NEUTRON STAR.

It is extremely dense.

* Sometimes after the supernova explosion the massive star becomes a Black Hole. A black hole is so dense that nothing can escape from it due to its very strong gravity. Even light cannot escape from a black hole & it is no more glowing. In fact, the black hole is the last stage of the life cycle of a massive star.



DATE: _____ DAY: _____

Difference blw Star & planet.

Star	Planet
Definition:	
A star is a celestial body that possesses light & reflects light on its own.	A planet is a celestial body that does not have an internal source of light. They recieve light from external sources, like Sun.
Numbers:	
There are billions & millions of stars present in the universe.	Our solar system that is a part of known universe has only 8 planets.
Size & temp:	
Stars are huge in size & have high temp.	Planets have relatively small size & low temp.
Movement:	
Stars move freely in the universe within	Every star, like Sun, has planets revolving

DATE: _____ DAY: _____

a twinkly effect. They do not revolve around any other star or planet.	around it in orbits.

Life Cycle:

Stars undergo a life cycle.	Planets do not have life cycle.

Examples:

Sun, Barnard's star (closest red dwarf star), Sirius star (brightest star in night sky).	Mercury, Earth, Jupiter, Saturn.

Magnitude of a Star:

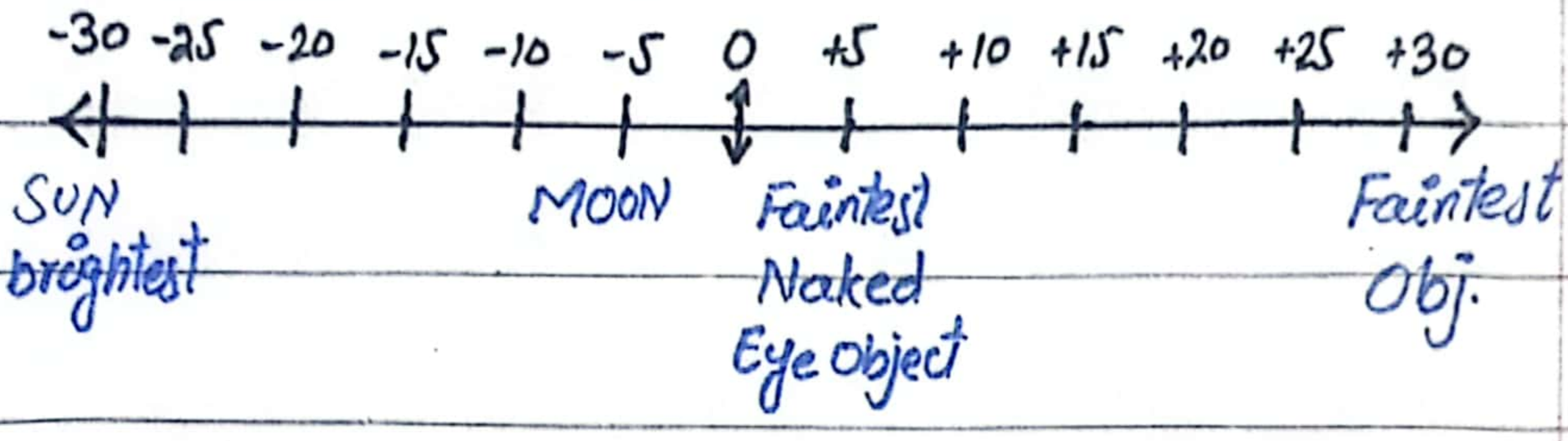
The measure of the brightness of a star is called magnitude of a star. It is measured with a stellar magnitude scale that ranges from +30 to -30.

On this scale, the brightest object has the smallest number & the faintest object has the largest no. For instance, the star of magnitude -1 is brighter than

DATE: _____ DAY: _____

the star of magnitude +10.

Sirius is the brightest star with a magnitude of -1.46.



Relation blw the Color & temp of star:

The surface temp of a star determines the color it emits. The color, in turns, depend upon wavelength, & λ depends on a given magnitude. Thus, According to Plank's Equ:

$$E \propto \frac{1}{\lambda}$$

where E = Energy & λ = wavelength emitted by light.

Hence, the blue stars with a low wavelength having high energy as well as high temp & thus are hot. Whereas the red stars with a high λ have low Energy & low temp, thus are cold.

DATE: _____ DAY: _____

For instance, Sirius is a hot star emitting blue light, & betelgeuse is a cold star that emits red light.