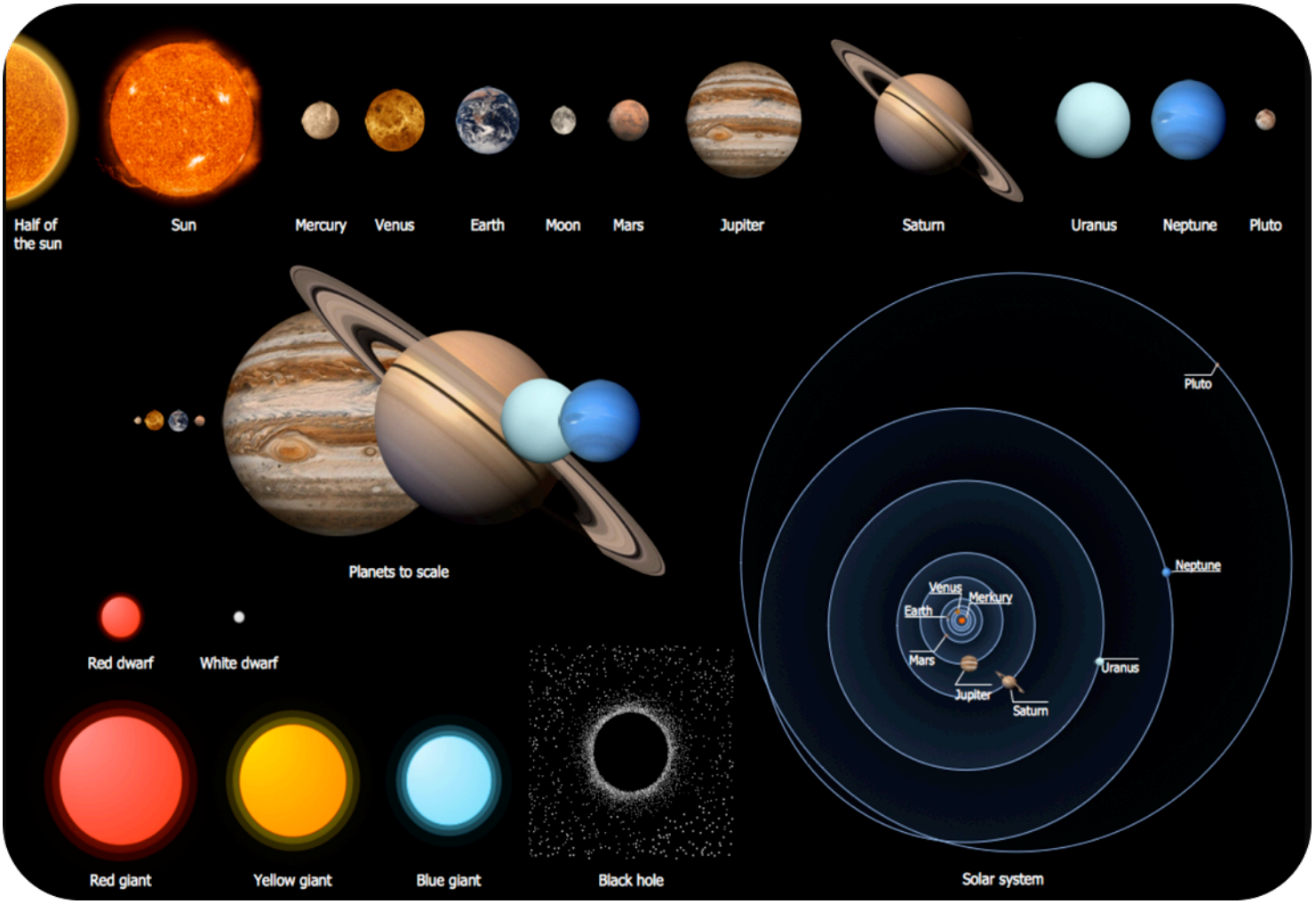
EARTH SCIENCE

UNIT 9 -NOTES

ASTRONOMY



YOUR PLANET

YOUR INHERITANCE

YOUR LEGACY

UPDATED AND ADAPTED FROM DAVID J. MILLS 2001

THE SOLAR SYSTEM

I. **The Solar System**: _____
_____.

a. **Celestial Body**: _____
_____.

i. **Examples**: _____.

b. **MAIN COMPONENTS/MEMBERS OF THE SOLAR SYSTEM**:

i. _____

1. Planets are objects that orbit the sun, have enough mass to be nearly round, are not satellites, & have removed debris and other objects from around its orbit.

ii. _____

1. Satellites are celestial bodies that orbit earth or another planet.

iii. _____

1. Small rocky bodies orbiting the sun.

iv. _____

1. Balls of frozen gases, rock and dust that orbit the sun. Jets of gas and dust form long "tails" that can be seen from earth.

v. _____

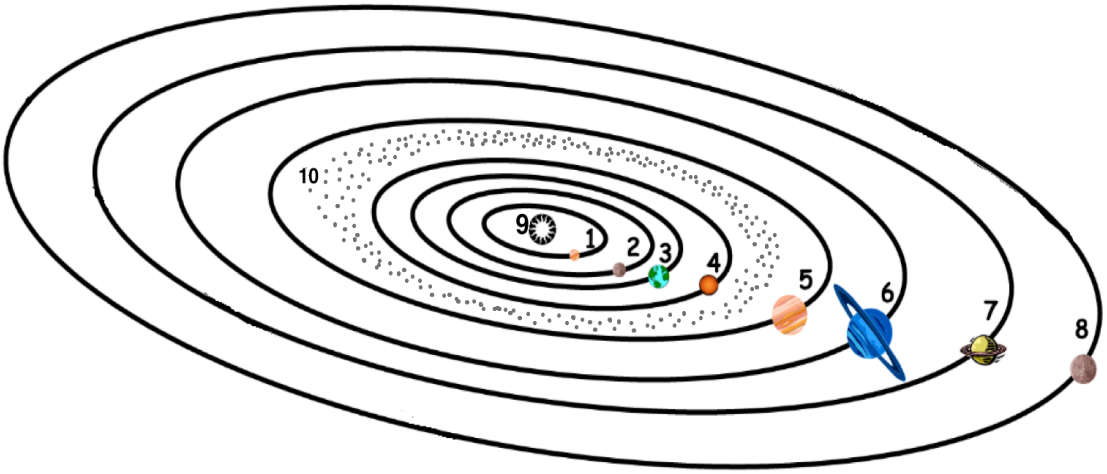
1. Small space rocks moving through the solar system.

vi. _____:

1. A meteoroid that enters Earth's atmosphere.

c. Solar System Diagram

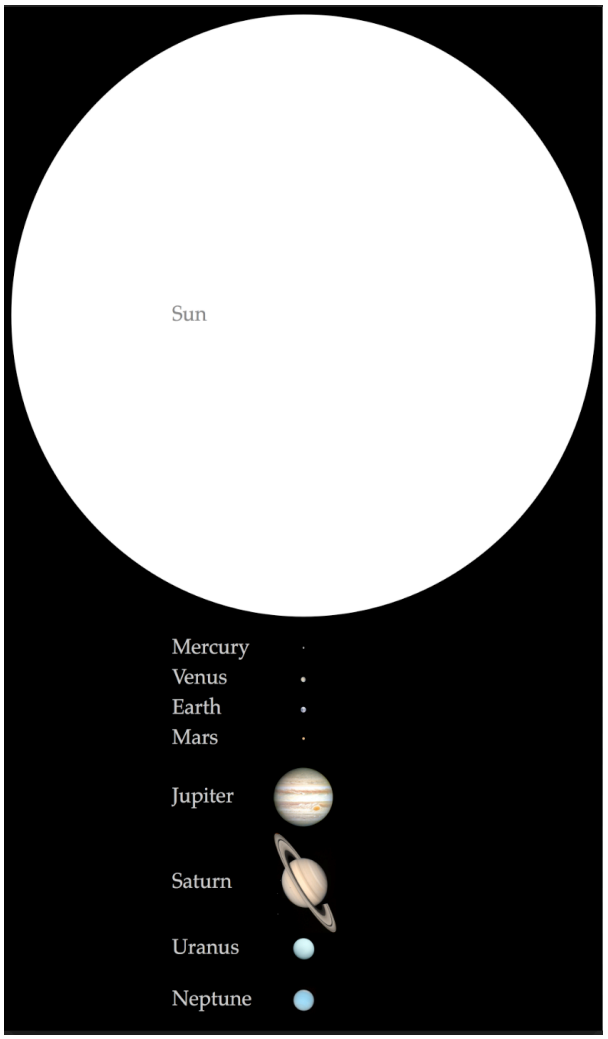
Orbits of the planets
The orbits are not drawn to scale.



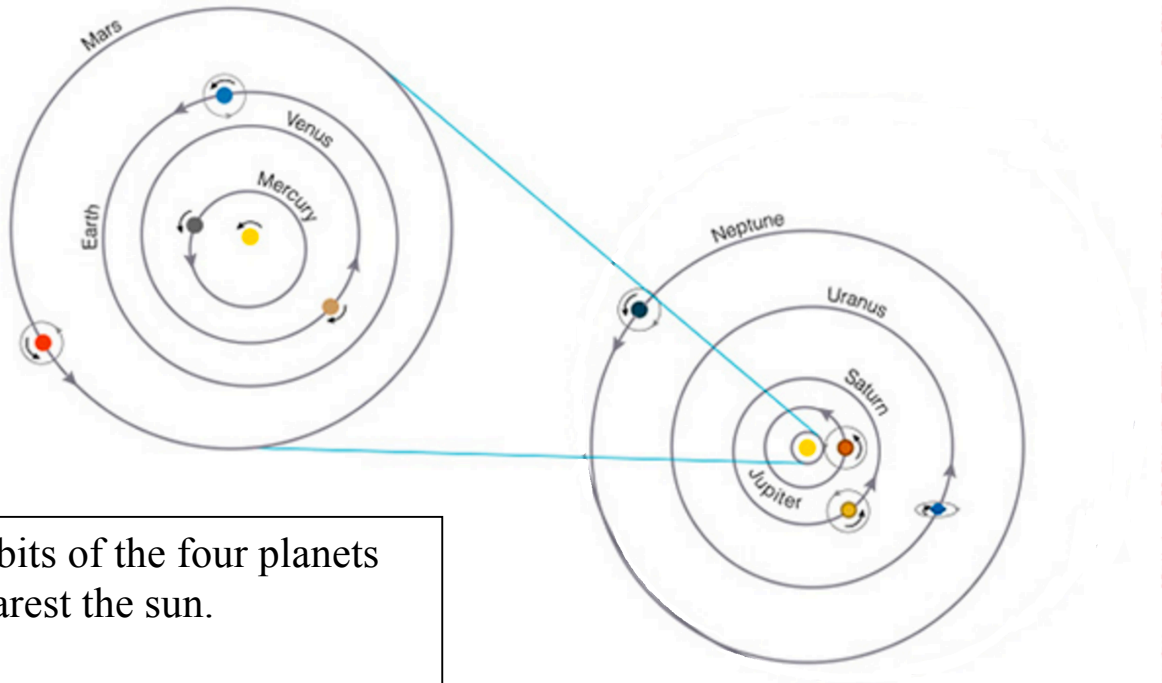
	NAME OF PLANET	SYMBOL	PLANET TYPE
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

d. The Planets:

i. Relative size of the sun and planets:



ii. Orbits of the planets and their relative distance:



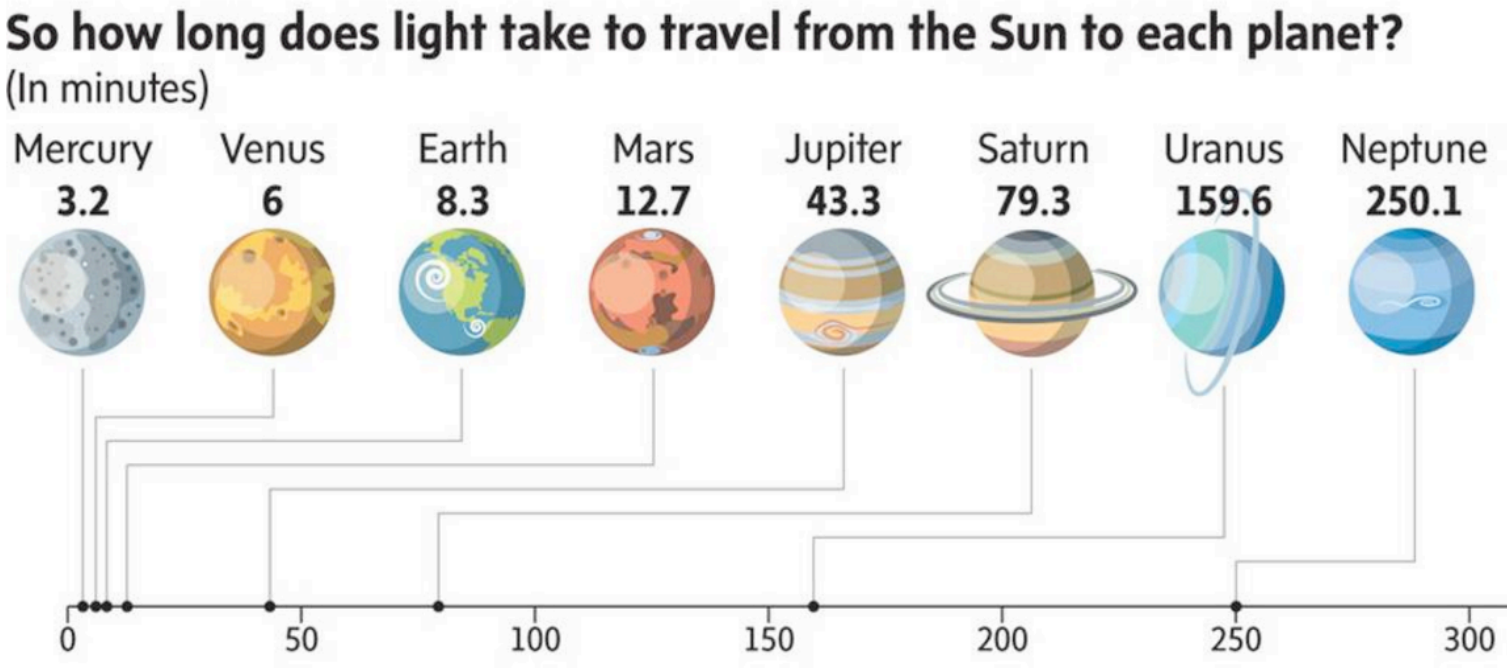
Orbits of the four planets nearest the sun.

Orbits of the outer planets. The innermost circle represents Mars' orbit.

II. EARTH'S PLACE IN THE UNIVERSE

a. Light year:
   i. _____
   ii. _____
   iii. The speed of light is _____miles/second.

1. The time it takes sunlight to reach each planet:



2. The time it takes sunlight to reach:

   a. The nearest star _____ = _____
   b. The brightest star _____ = _____
   c. The nearby Andromeda Galaxy = _____

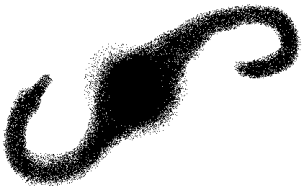
3. **Starlight**:
   a. We see all night stars as they _____ when the light _____.

   b. When we look at distant stars and galaxies, we look back in TIME.

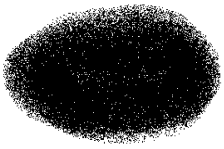
4. **Galaxies**:
   a. Billions of stars held together by _____

b. **Shape of galaxies**:

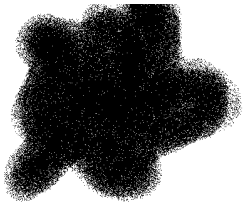
i. _____



ii. _____



iii. _____

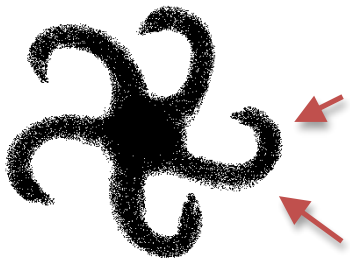


c. The Milky Way Galaxy:

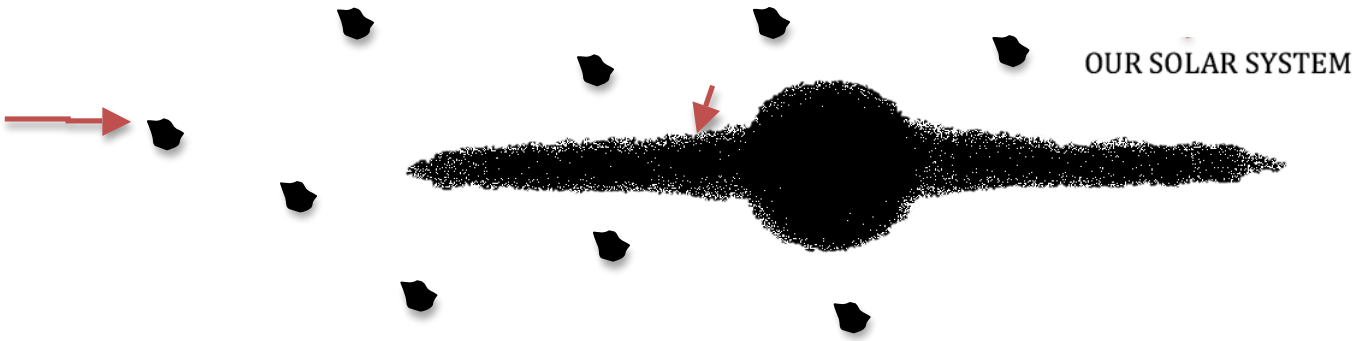
i. Our sun is only one of the estimated _____ _____ stars that make up the Milky Way Galaxy.

ii. The Milky Way Galaxy is a _____ galaxy.

1. Top View:



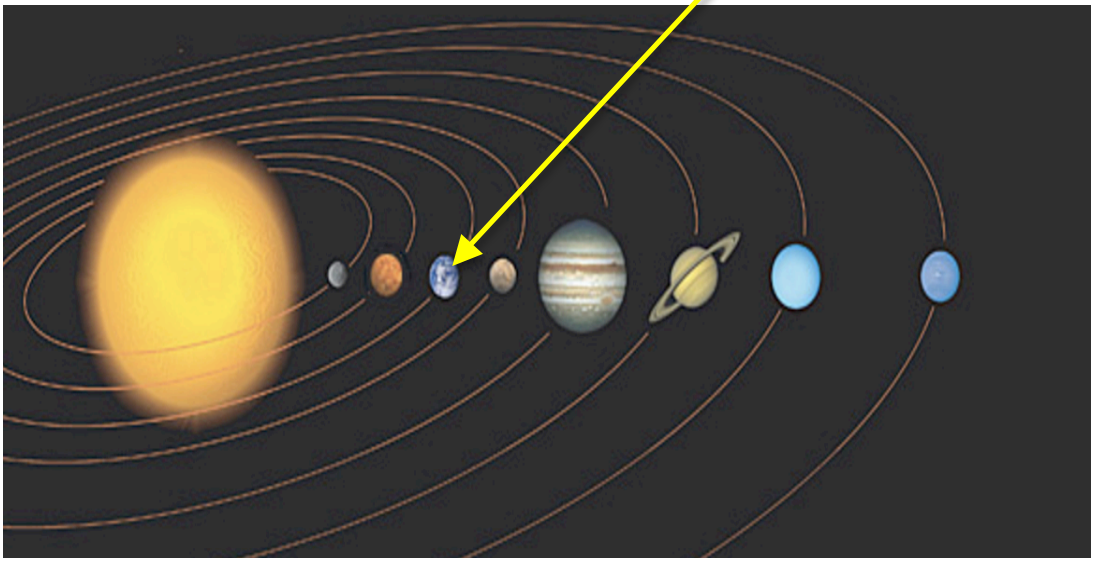
2. SIDE VIEW:



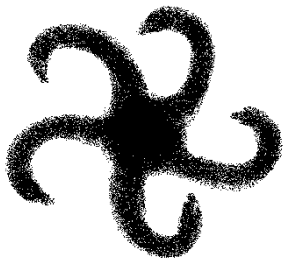
5. Levels and structure of the universe (earths place in the universe)

   a. **PLANET EARTH**: _____
   _____

   b. **OUR SOLAR SYSTEM**



   c. **MILKY WAY GALAXY**: _____
   _____
   _____
   _____
   _____.

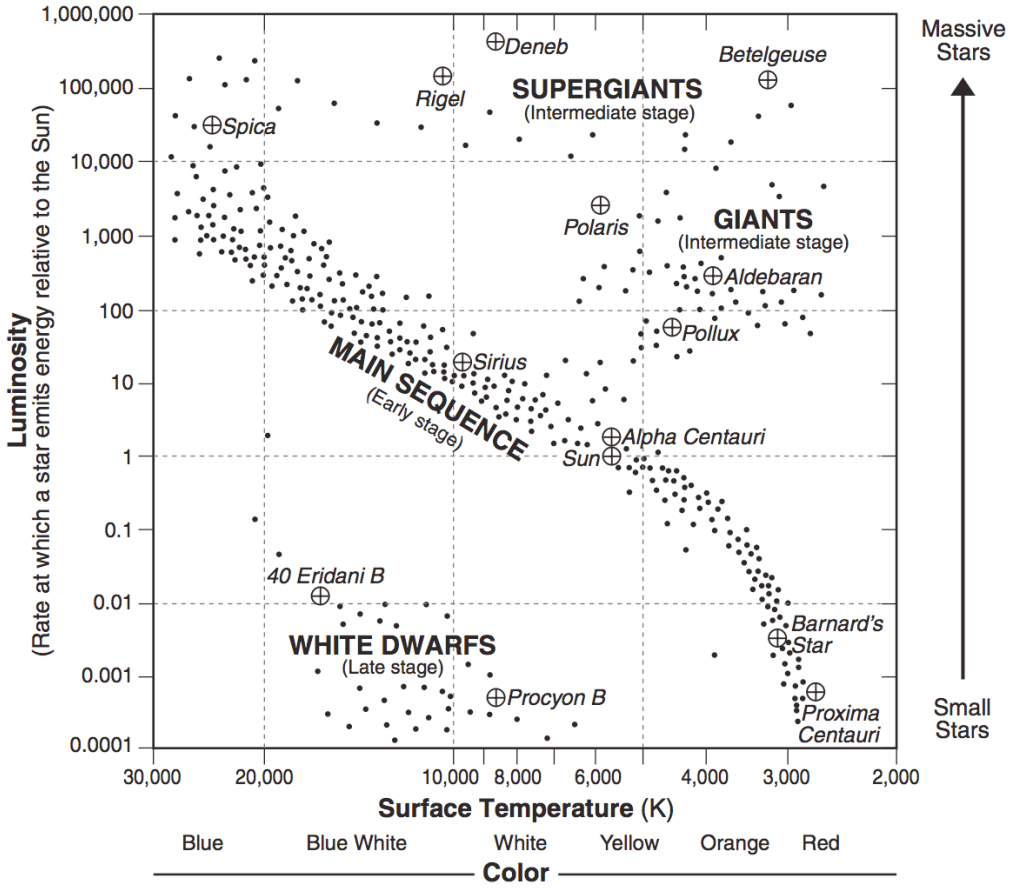


   d. **UNIVERSE**: _____
   _____
   _____.

6. ESRT Page _____: _____

Characteristics of Stars

(Name in italics refers to star represented by a ⊕.)
(Stages indicate the general sequence of star development.)



Solar System Data

Celestial Object	Mean Distance from Sun (million km)	Period of Revolution (d=days) (y=years)	Period of Rotation at Equator	Eccentricity of Orbit	Equatorial Diameter (km)	Mass (Earth = 1)	Density (g/cm^3)
SUN	—	—	27 d	—	1,392,000	333,000.00	1.4
MERCURY	57.9	88 d	59 d	0.206	4,879	0.06	5.4
VENUS	108.2	224.7 d	243 d	0.007	12,104	0.82	5.2
EARTH	149.6	365.26 d	23 h 56 min 4 s	0.017	12,756	1.00	5.5
MARS	227.9	687 d	24 h 37 min 23 s	0.093	6,794	0.11	3.9
JUPITER	778.4	11.9 y	9 h 50 min 30 s	0.048	142,984	317.83	1.3
SATURN	1,426.7	29.5 y	10 h 14 min	0.054	120,536	95.16	0.7
URANUS	2,871.0	84.0 y	17 h 14 min	0.047	51,118	14.54	1.3
NEPTUNE	4,498.3	164.8 y	16 h	0.009	49,528	17.15	1.8
EARTH'S MOON	149.6 (0.386 from Earth)	27.3 d	27.3 d	0.055	3,476	0.01	3.3

7. ESRT Page 15 Practice

1. Compared to terrestrial planets, Jovian planets have

   A) smaller equatorial diameters and shorter periods of revolution
   B) smaller equatorial diameters and longer periods of revolution
   C) larger equatorial diameters and shorter periods of revolution
   D) larger equatorial diameters and longer periods of revolution

2. Which planet has a density that is *less* than the density of liquid water?

   A) Mercury B) Earth
   C) Mars D) Saturn

3. Which characteristic of the planets in our solar system increases as the distance from the Sun increases?

   A) equatorial diameter
   B) eccentricity of orbit
   C) period of rotation
   D) period of revolution

4. Compared to the size and density of Earth, the Moon has a

   A) smaller diameter and lower density
   B) smaller diameter and higher density
   C) larger diameter and lower density
   D) larger diameter and higher density

5. Which planet has completed less than one orbit of the Sun in the last 100 years?

   A) Mars B) Mercury
   C) Neptune D) Uranus

6. Which two characteristics do all Jovian planets have in common?

   A) small diameters and low densities
   B) small diameters and high densities
   C) large diameters and low densities
   D) large diameters and high densities

7. Compared to Jovian planets, terrestrial planets have

   A) larger masses
   B) larger equatorial diameters
   C) shorter periods of revolution
   D) shorter periods of rotation

8. Which planet is located approximately ten times farther from the Sun than Earth is from the Sun?

   A) Mars B) Jupiter
   C) Saturn D) Uranus

9. Which object in our solar system has the greatest density?

   A) Jupiter B) Earth
   C) the Moon D) the Sun

10. Which planet would float if it could be placed in water?

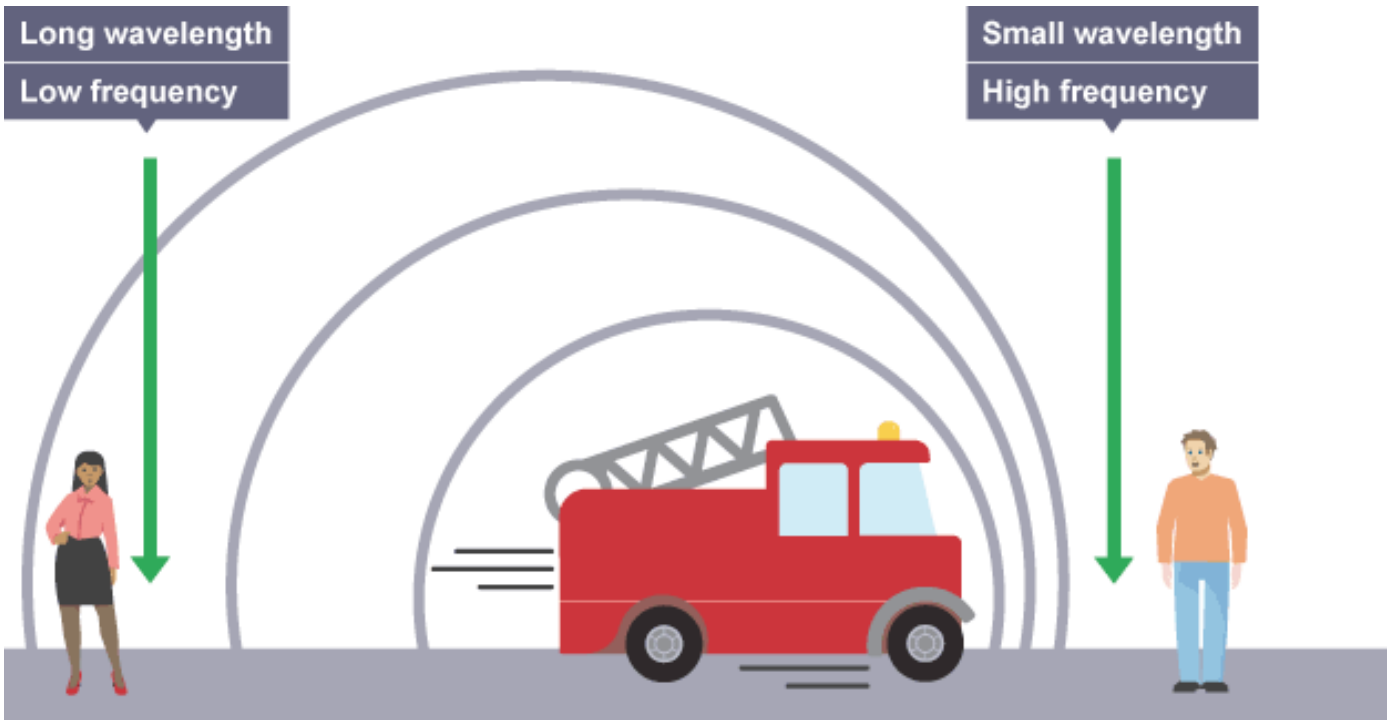
    A) Mercury B) Earth
    C) Saturn D) Pluto

b. **The Doppler Effect:** _____

_____

_____.

i.



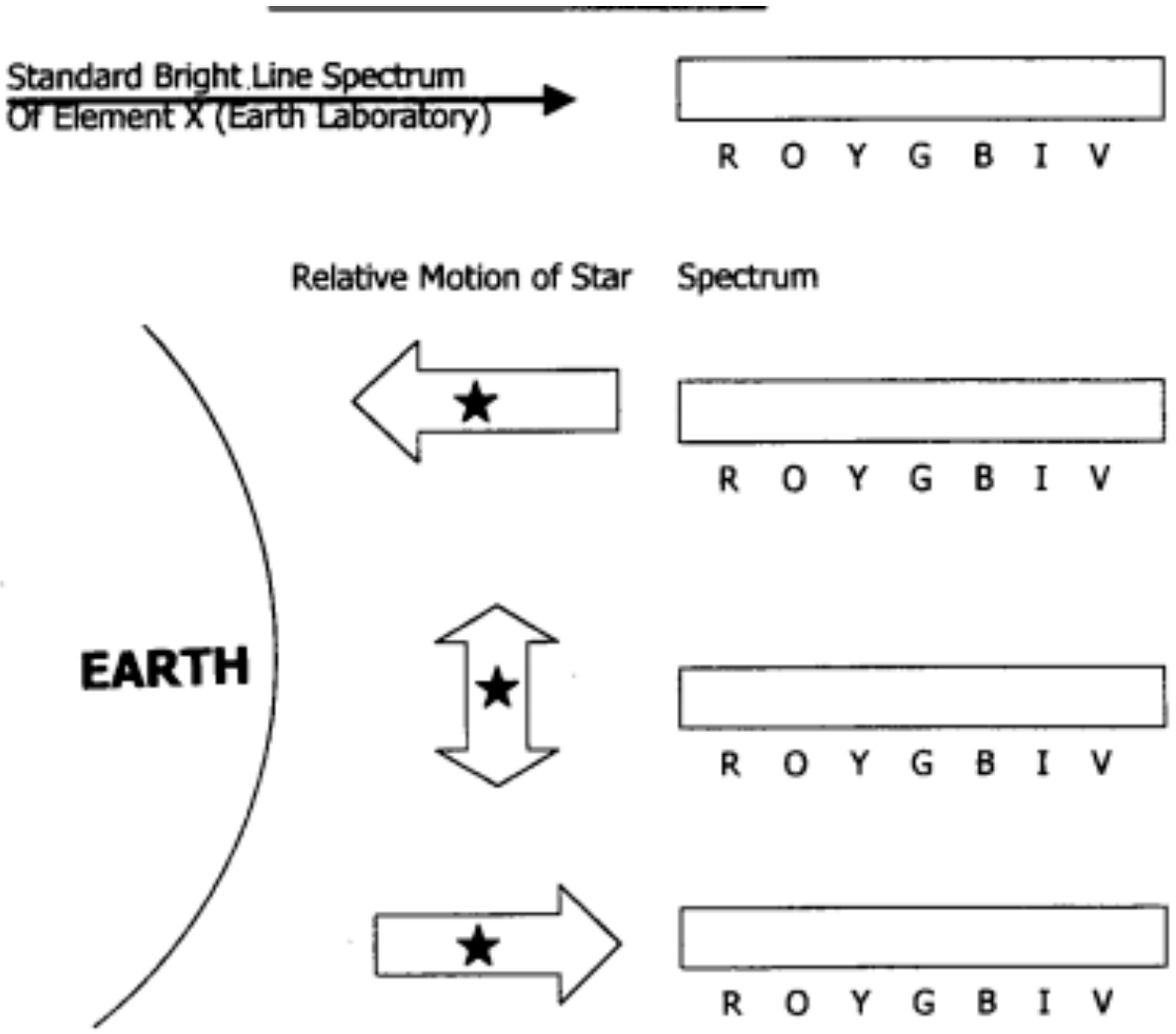
ii. **RED SHIFT – BLUE SHIFT**

1. **Red Shift and Blue Shift describe how light changes as objects in space (such as stars or galaxies) move closer or farther away from us.**

2. **Visible light is a spectrum of colors (like a rainbow).**

   a. When an object moves _____ from us, the light is shifted to the _____ end of the spectrum and its wavelength gets _____.

   b. When an object is moving _____ to us, the light is shifted to the _____ end of the spectrum and the wavelength gets _____.



3. The Big Bang Theory
   a. In the late 1920'S, Edwin Hubble discovered that ALL galaxies were "red shifted" when viewed from earth.

      This meant that all galaxies were _____ _____, and thus, the universe must be _____.

   b. This led to the theory that the universe began as a cosmic explosion that ocured15-20 billion years ago. The universe we live in today has evolved from this explosion of matter and energy.

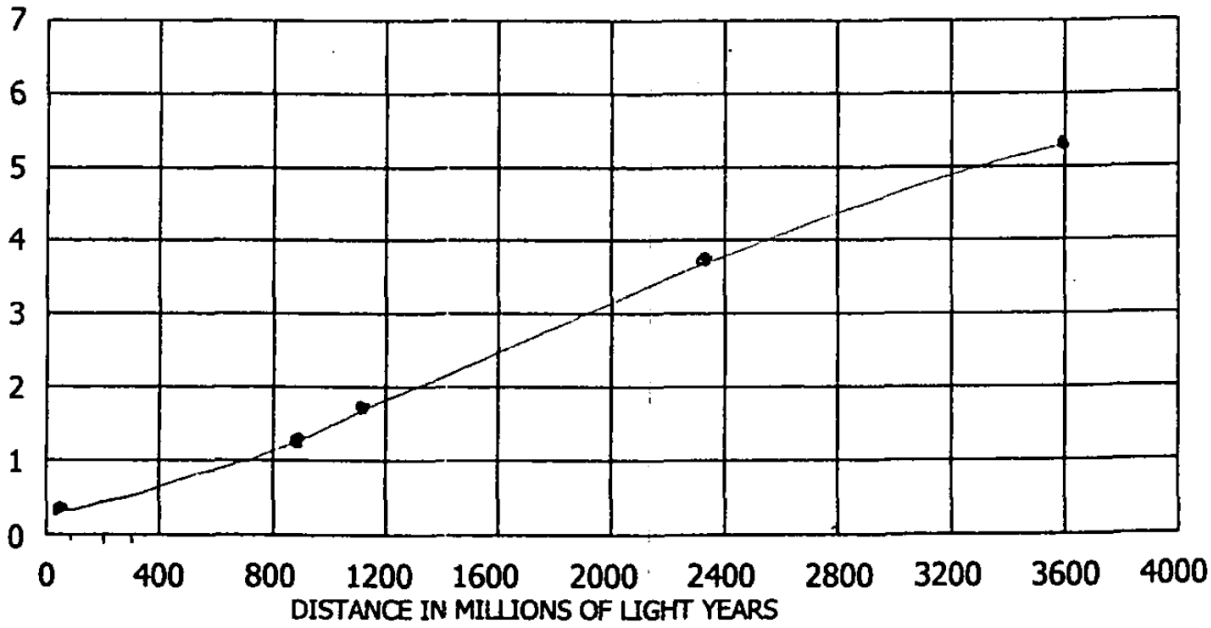
   c. An echo of background radiation can still be detected by radio telescope.

d. The data table below shows the distances of some galaxies from Earth. It also shows the "red shift" of each galaxy and how many units of red shift are exhibited by each galaxy.

1.

GALAXY	DISTANCE (light years)	RED SHIFT (arbitrary units) VIOLET → RED 0 1 2 3 4 5 6
VIRGO	70 000 000	
URSA MAJOR 1	900 000 000	
LEO	1 100 000 000	
BOOTES	2 300 000 000	
HYDRA	3 600 000 000	

2.

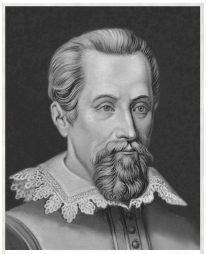


3. The amount of "red shift" is a result of the _____ at which the galaxy is moving.

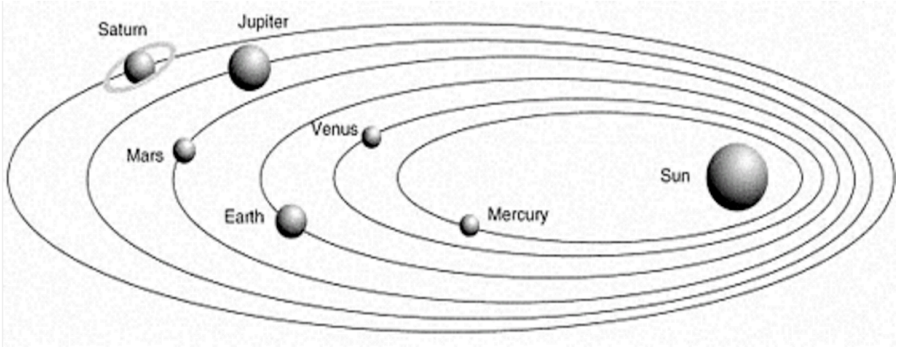
4. CONCLUSION: As the distance from earth _____, the amount (or degree) of red shift of a galaxy _____. This indicates that _____.

5.

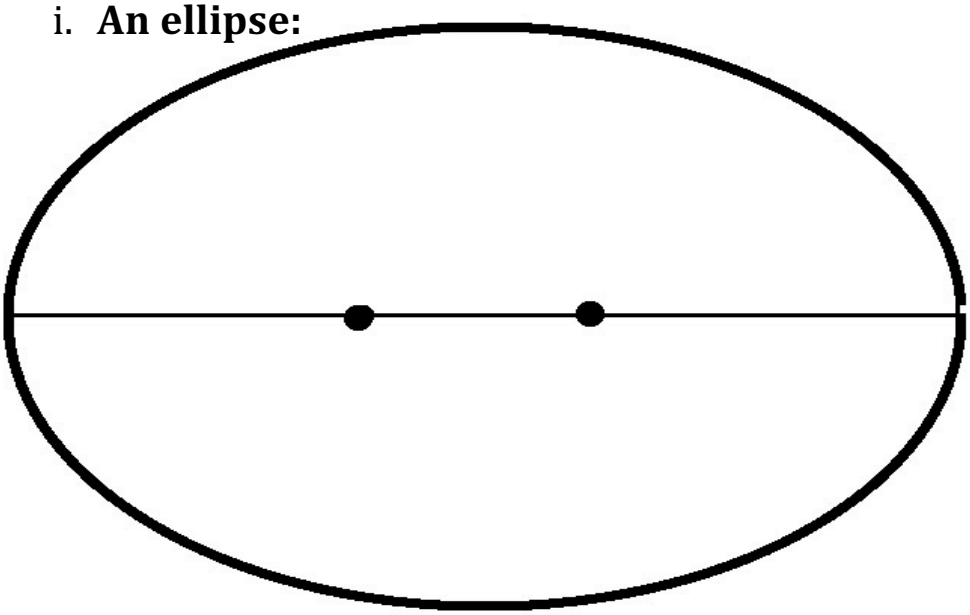
III. KEPLER'S LAWS OF PLANETARY MOTION:

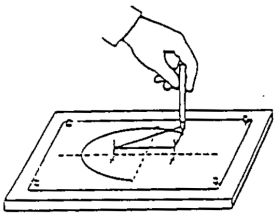

Johannes Kepler

a. LAW 1: _____
_____
_____.



i. **An ellipse:**





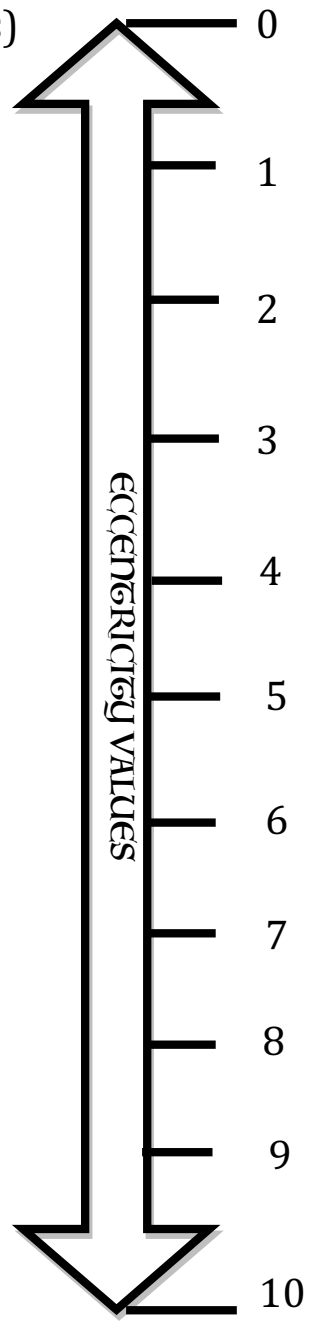
ii. **ECCENTRICITY:** a measure of the "shape" of an ellipse. The _____ circular it is, the _____ eccentric it is.

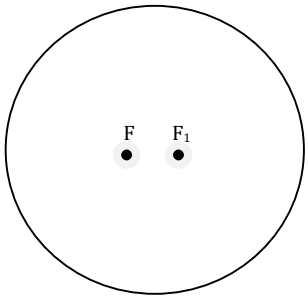
iii. **Formula**:

ESRT Page __

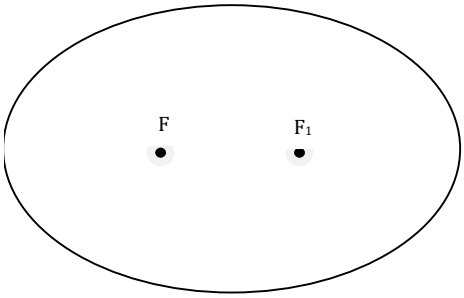
iv. **Sample Problem** – Based on the ellipse above:

v. **Eccentricity Sample Problems** (Range of values)

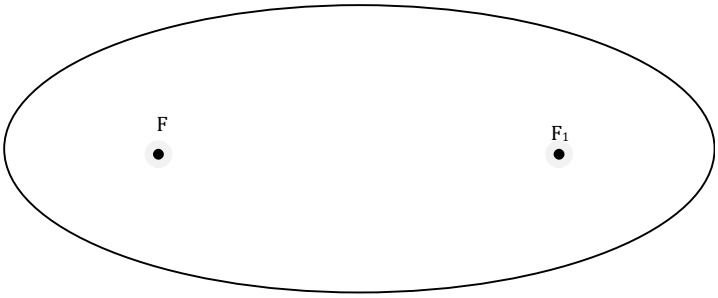


A 

B E=

C 

D E=

X 

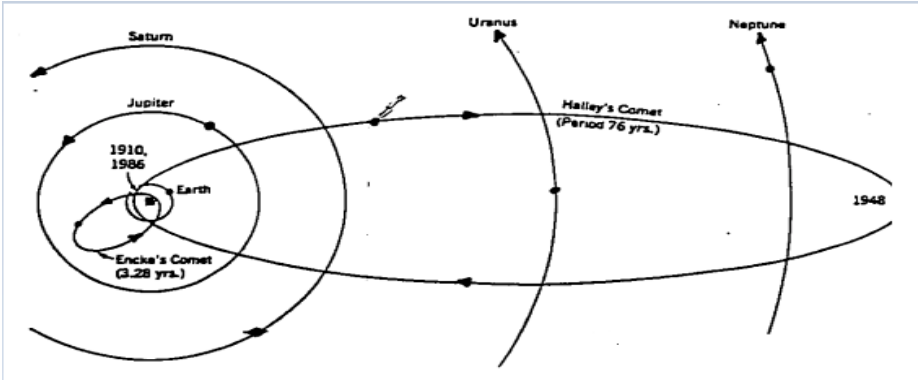
Y

E=

vi. **Relationship**: _____,

_____

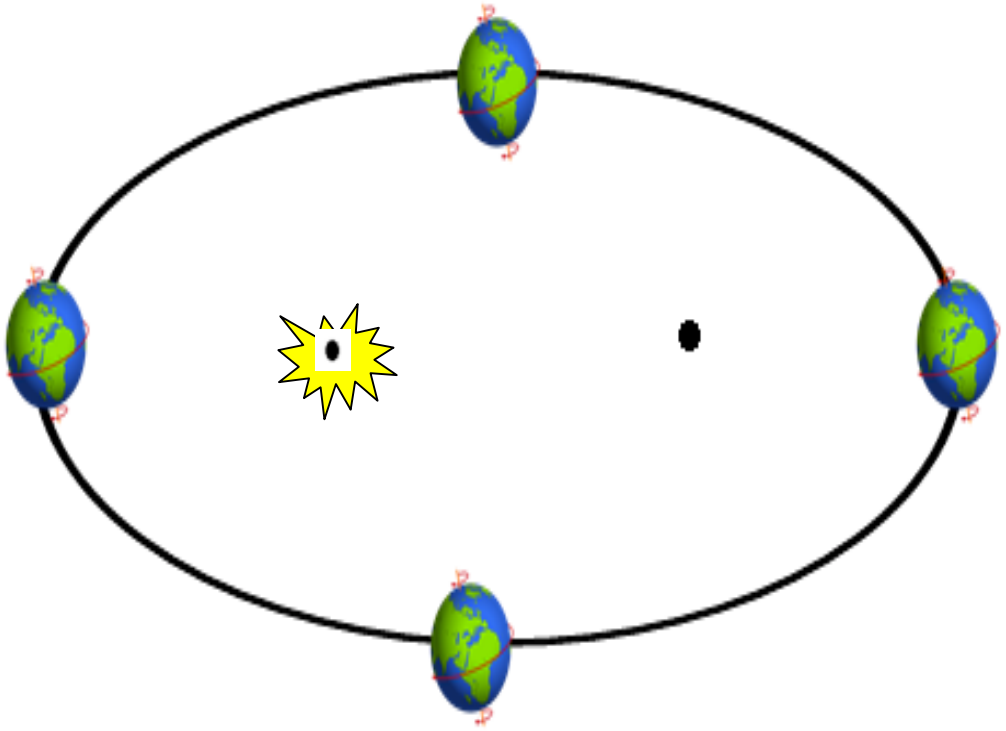
_____

vii. 

b. **LAW 2 –** _____

_____

_____



NOT TO SCALE

i. PERIHELION: _____
ii. APHELION: _____

c. LAW 3: _____

_____.

i. Farther planets have _____ orbital paths and _____ orbital speeds
ii. Closer planets have _____ orbital paths and _____ orbital speeds.

IV. GRAVITY:

a. Newton's Law of Gravity

i. _____
and will pull all other objects with a certain gravitational force.

ii. _____
_____
_____.

iii. _____
_____,
_____.

b. Gravity and Inertia:

i. **Newton's law of Inertia states that** _____
_____
_____.

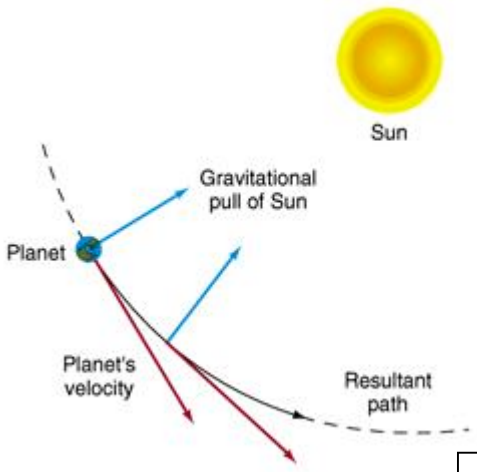
INERTIA

\+

GRAVITY

=

STABLE ORBIT



NOT TO SCALE

1. _____: _____
_____

2. _____: _____
_____

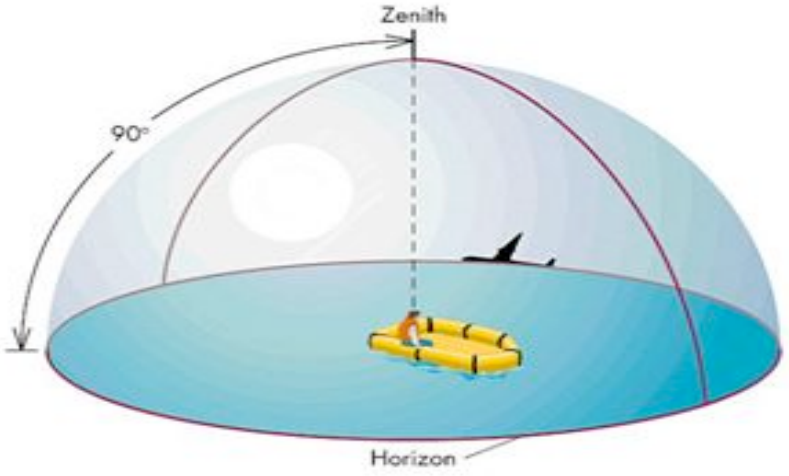
V. CELESTIAL OBSERVATIONS

a. **CELESTIAL OBJECT**: _____

_____

i. Examples: _____.

b. **CELESTIAL SPHERE** = _____



i. **Zenith**:

_____

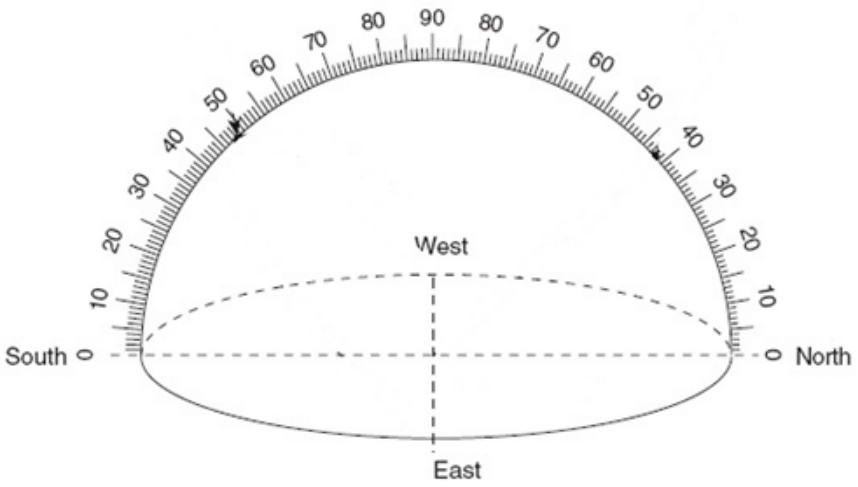
_____.

ii. **HORIZON**: _____

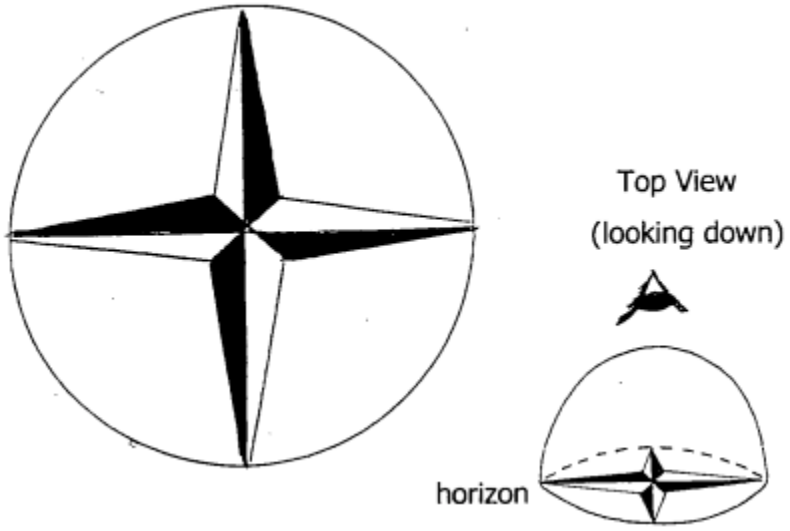
_____.

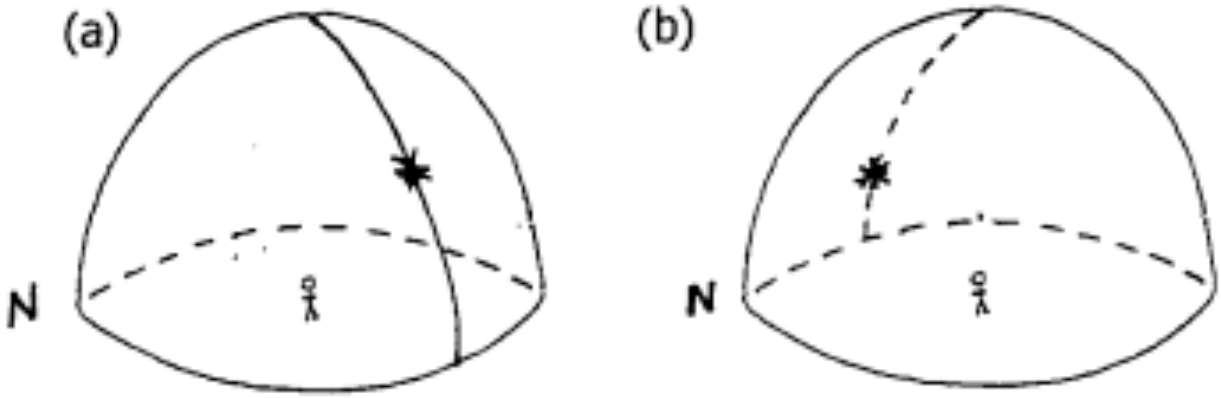
c. Location on the celestial sphere: **THE HORIZON SYSTEM**

i. **Altitude**: _____.

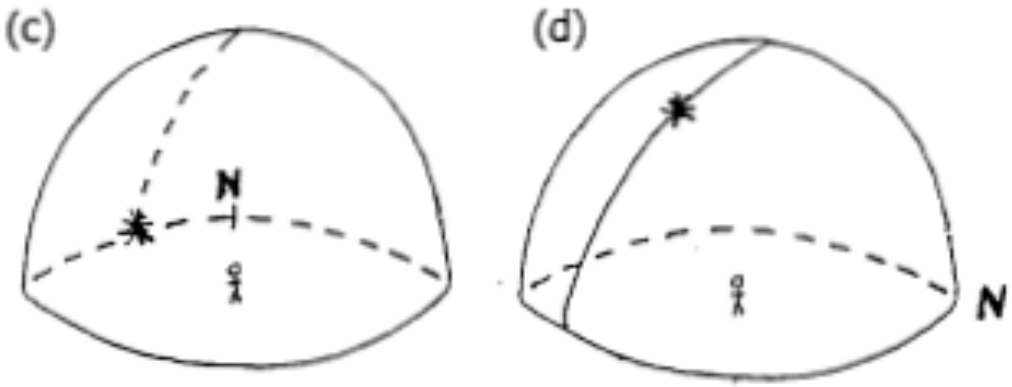


d. **AZIMUTH** = _____
_____.





	Az	h	Az	h
Common Terms	_____	_____	_____	_____
Degrees	_____	_____	_____	_____



	Az	h	Az	h
Common Terms	____	____	____	____
Degrees	____	____	____	____

e. **ROTATION**: _____
_____.

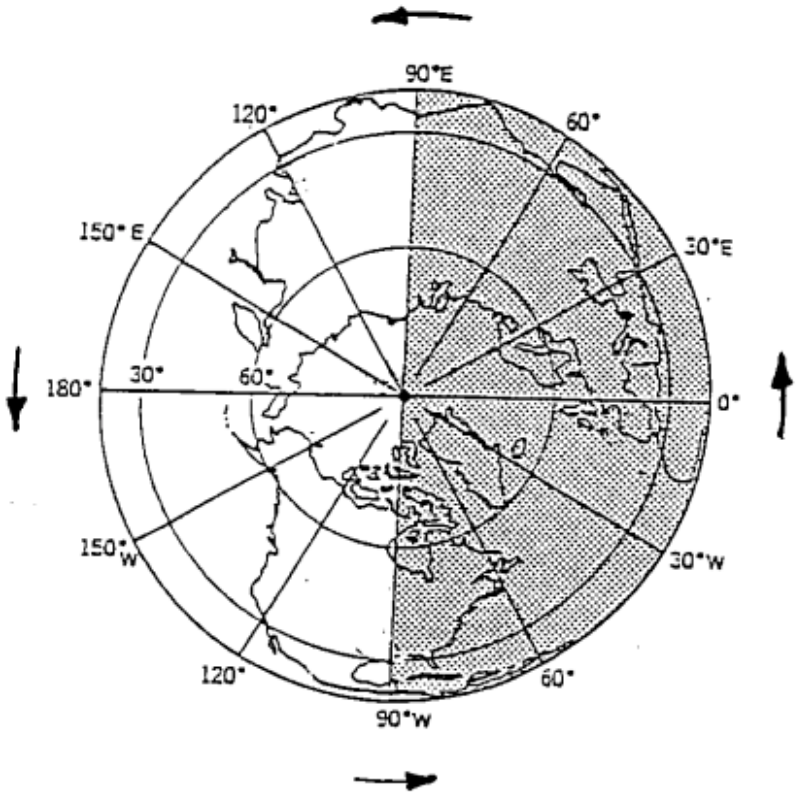
i. Earth's:

1. Direction of rotation: _____ to _____

2. Angular rate of Rotation: THINK – One complete rotation
   a. _____ degrees
   b. _____ hours
   c. **Rate** = _____

f. **Effects of earth's rotation**:

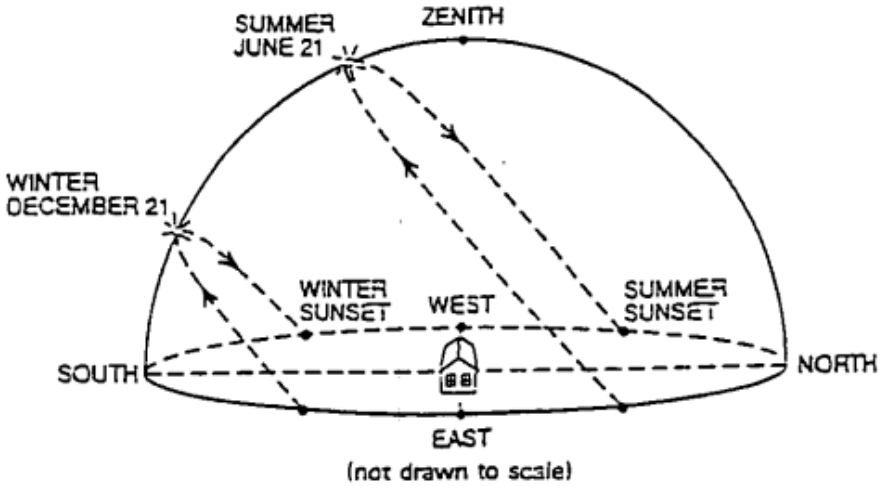
i. Day and Night



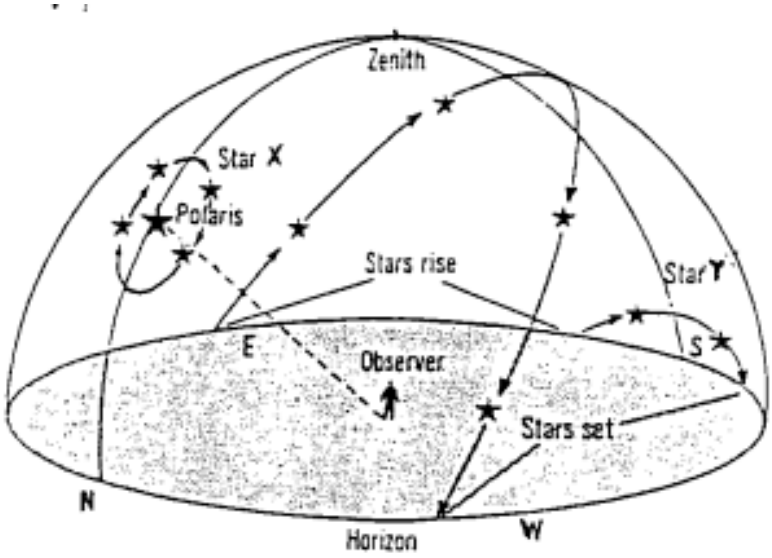
g. _____:

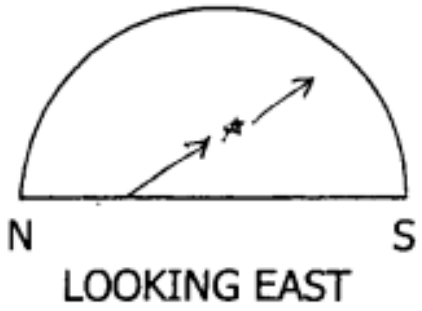
i. Earth rotates from _____ to _____ (note diagram above)

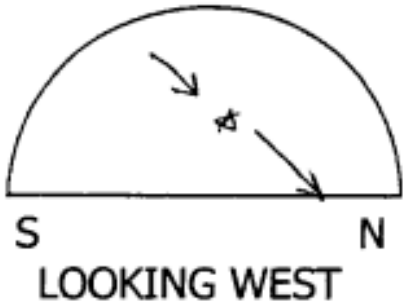
ii. Sun "appears" to move in an arc from _____ to _____ (Note diagram above)

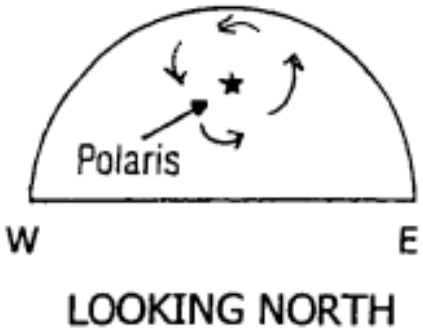


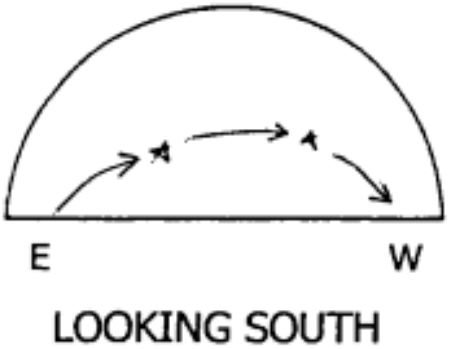
h. APPARENT DAILY MOTION OF THE STARS:





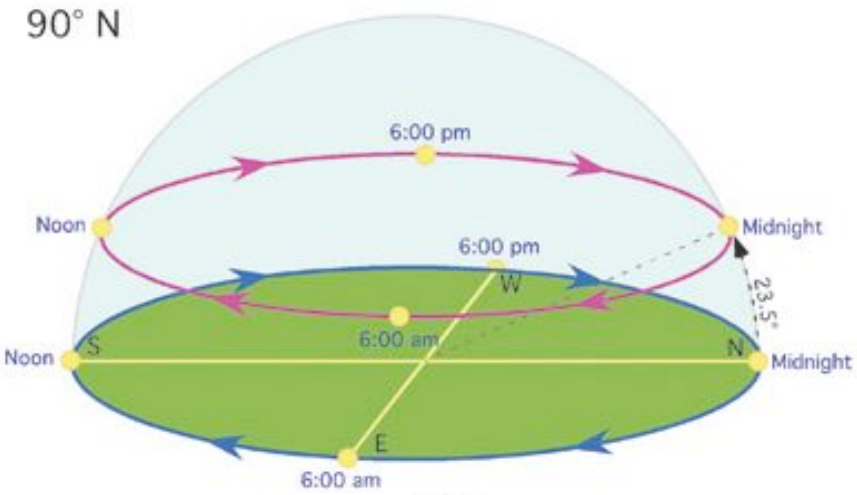


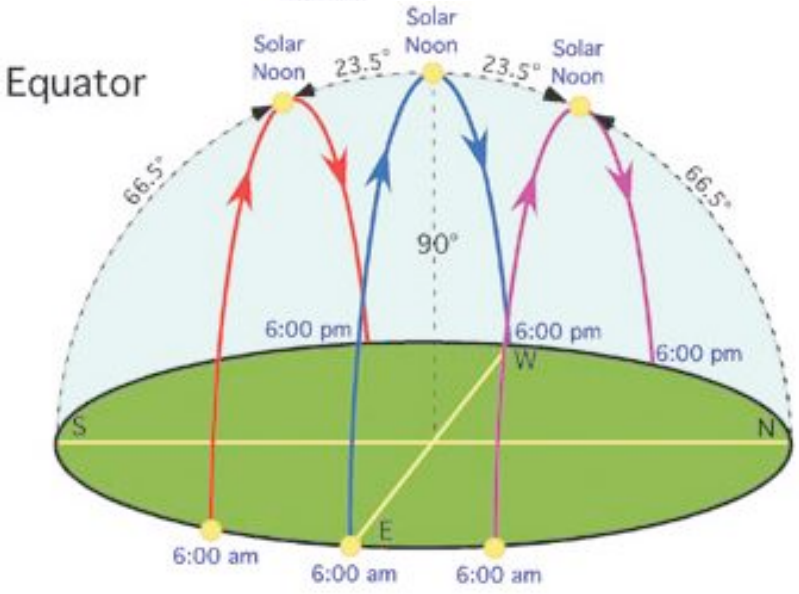


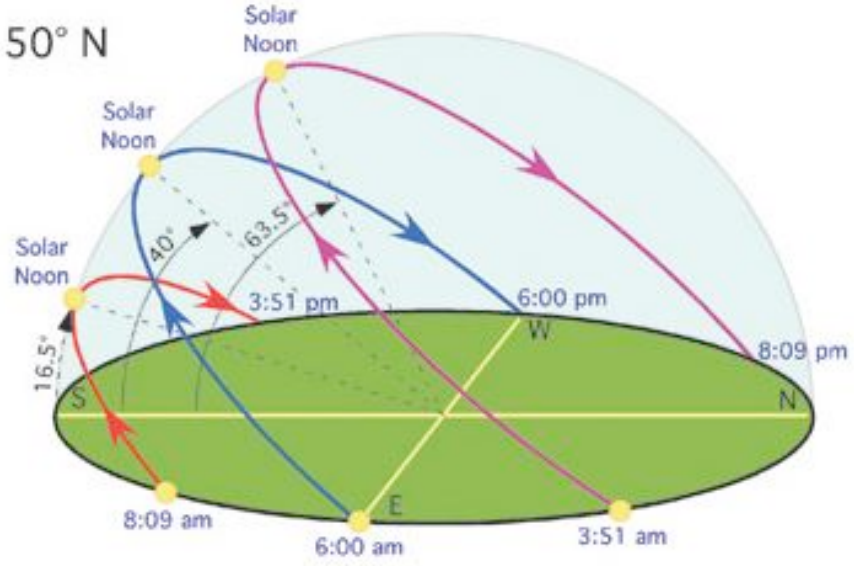


i. The apparent daily motion of celestial objects (like stars) changes when the observer's _____ on Earth changes.

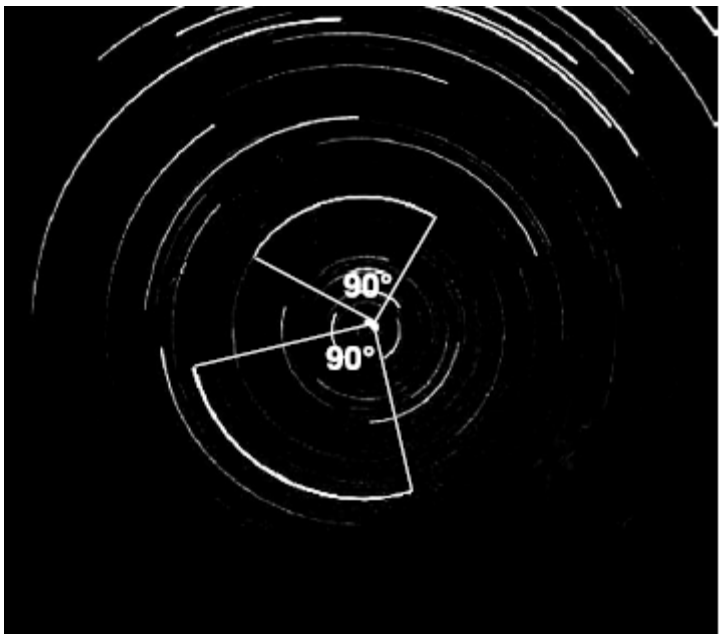
NO STARS RISE OR SET!







j. _____ – time- exposed photographic images that shows the apparent motion of stars; they appears as blurry lines across the film.



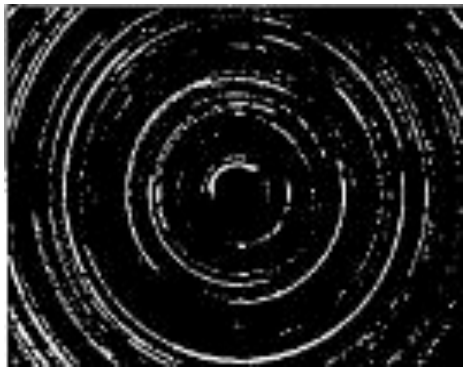
:

Time Exposure
_____ hours

Angular distance of star trails

_____ 0

STAR TRAIL PHOTOGRAPHS LOOKING NORTH, SOUTH, EAST, AND WEST.



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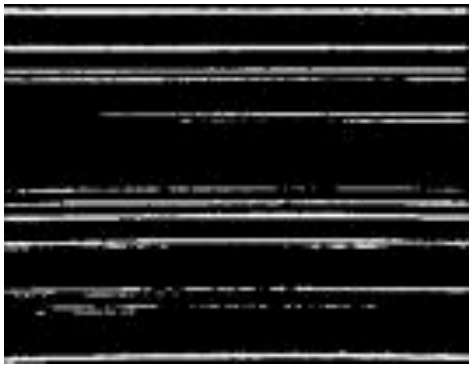
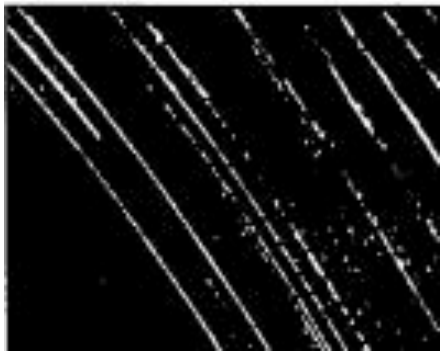


A: _____

B. _____



C: _____

D. _____

VI. MODELS OF THE UNIVERSE

a. _____

i. About 2000 years ago, the Greek astronomer, Claudius Ptolemy developed a detailed model of the universe based on the idea of revolving spheres.

ii. In this model of the universe, the _____ was at the center and all heavenly bodies moved around _____ in _____ _____.

iii. In Ptolemy's geocentric model:

1. _____ is in the _____ and doesn't move.

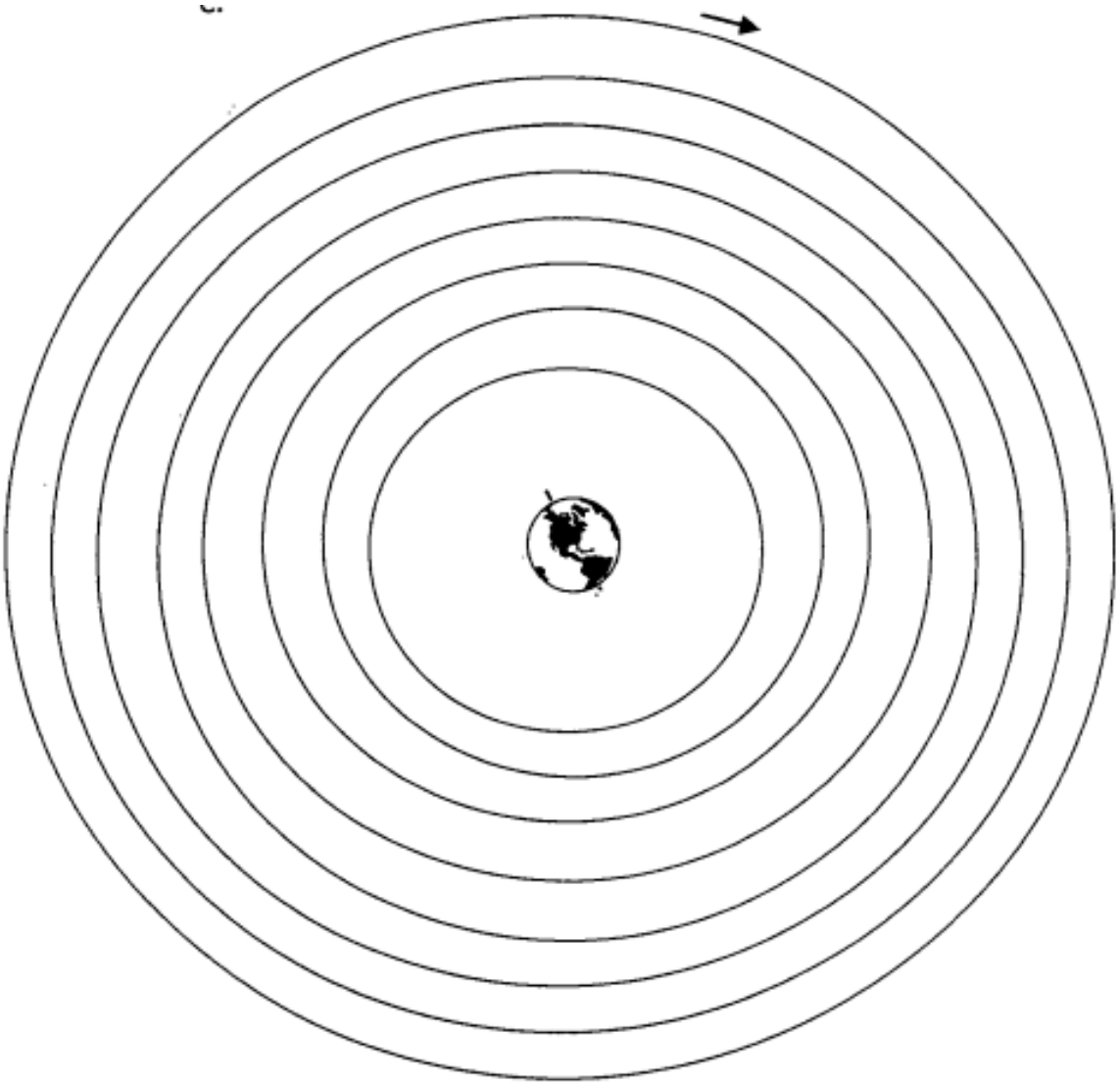
2. The _____ are located on a transparent sphere that rotates once each day from east to west around Earth.

3. The _____, the _____, and each _____ are carried by separate spheres of different sizes. These spheres also rotate east to west around earth (However, they rotate at slightly slower speeds than the sphere of stars and therefore have a general eastward drift relative to the stars. This explained the yearly cycle of nighttime stars.)

4. Each planet is located on an "epicycle" (or "epicircle" that also rotates. So as each planet moves around Earth on its sphere, it is also moving or rotating on its epicycle. This explained the strange "retrograde motion" of the planets relative to background stars. That is, the planets seemed to move backwards compared to the stars when you observed them for several weeks.)

iv. This model was accepted for almost 1400 years because it explained celestial observations made from Earth _____ _____.

v. **Ptolemy's GEOCENTRIC MODEL OF THE UNIVERSE**:



vi. The geocentric model does NOT explain terrestrial (Earth) observations such as:

1. _____
   _____
2. _____,
   _____

b. _____:

i. In the 1500's a new model of the universe was proposed in a book by the Polish astronomer Nicholas Copernicus.
ii. In this model of the universe, the _____ was at the center.
iii. Copernicus' heliocentric model can be summarized as follows:

1. The _____ is located in the _____ of the system and does NOT move.

2. The _____ are located on a stationary / unmoving, transparent sphere. The sphere is a great distance from the sun.

3. The _____, including _____, move in _____ around the sun.

4. The _____ moves in a circle around Earth.

5. Earth rotates on its axis from _____ to _____ each day.

iv. Copernicus' heliocentric model does NOT explain the apparent cyclic variations in the size of the Sun and the cyclic variation in the orbital speeds of the planets. This is because in Copernicus' heliocentric model, _____ _____.

c. Heliocentric Model (2nd Version)

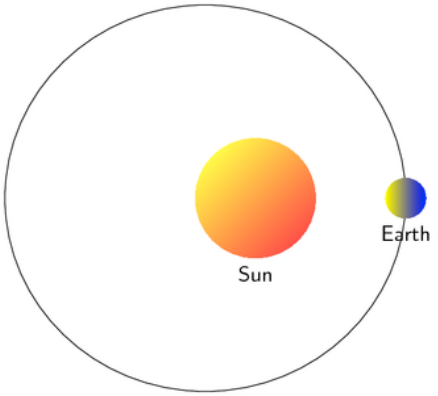
i. In 1609, Johannes Kepler published a book which included his first two "laws" of planetary motion". These laws explain why the apparent size of the sun changed and why the speed of a planet changes as it orbits the sun.

ii. This is because _____ _____.

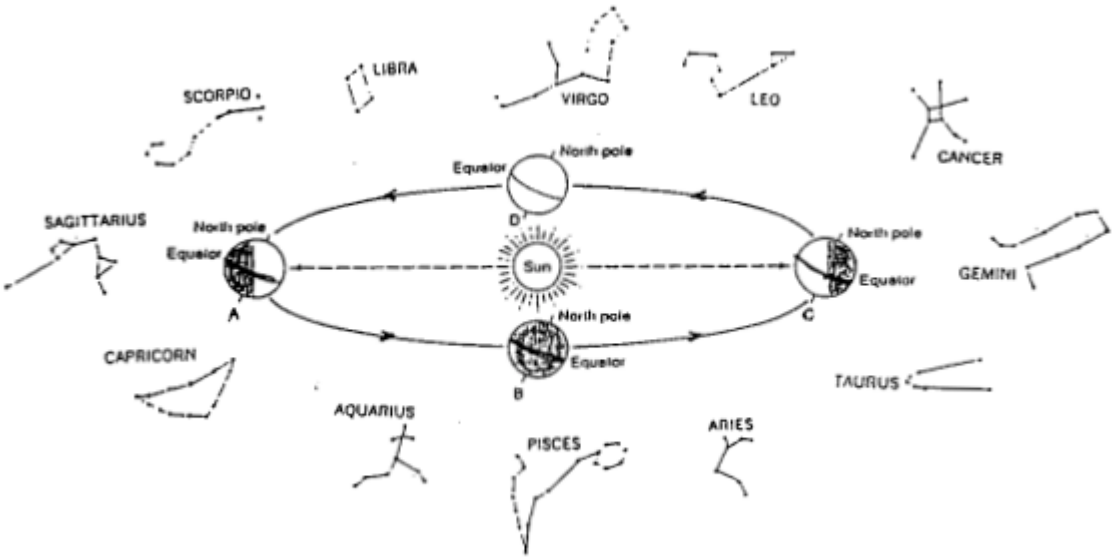
VII. **REVOLUTION**: _____
_____.

a. Earth's angular rate of revolution
THINK – One complete revolution:
1. _____ degrees
2. _____ days

3. Rate: _____



b. Effects of earth's Revolution:
i. Nighttime constellations change in a yearly cycle.



ii. _____: groups of stars that form patterns of imaginary things such as animals, legendary heroes, and mythological Gods.
iii. _____: a band of 12 constellations that forms a background for the sun as seen from the revolving earth.
iv. **Complete the data table below based on the diagram above**.

POSITION OF EARTH	SEASON	CONSTELLATIONS VISABLE AT NIGHT
A		
B		
C		
D		

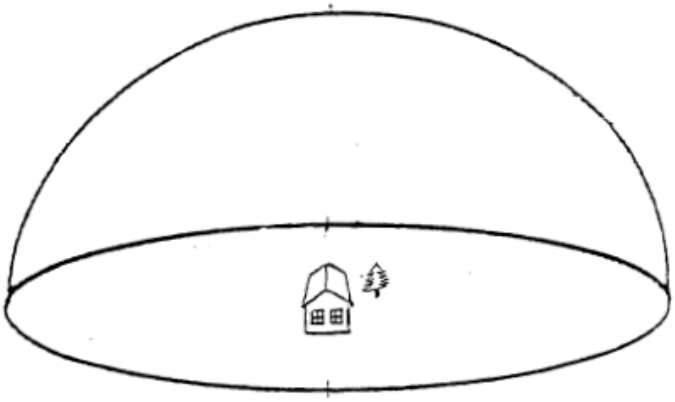
VIII. **SEASONS OF THE YEAR -**

a. Causes:

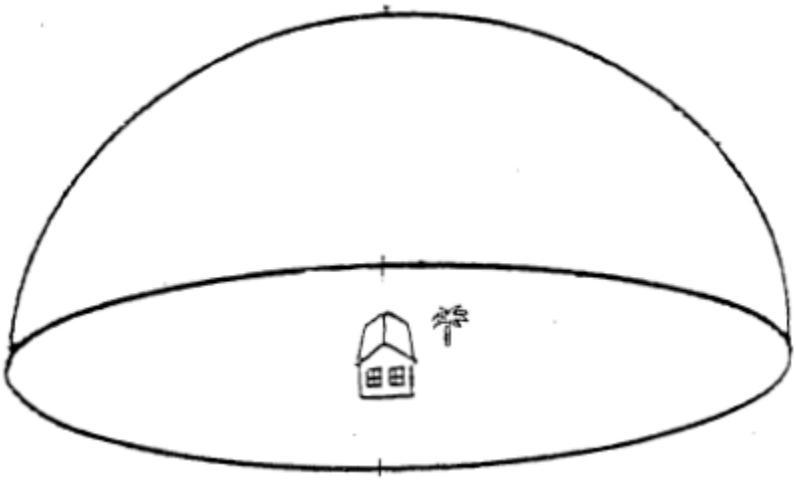
i. Earth _____ around the sun
ii. Earth is _____ / inclined on its axis _____.
iii. Earth's axis is always pointed in the _____ direction
iv. The apparent path of the sun _____ with the seasons.
v. The intensity (strength) of insolation is _____ when sunlight (insolation) is perpendicular to the surface – striking at _____ because the sunlight is concentrated in the smallest possible space.
vi. As the angle of insolation _____, the intensity of insolation _____.

b. The apparent path of the sun changes with the _____ and with _____.

i. NYS: _____ Latitude



ii. Equator _____ Latitude



IX. The Moon

a. The moon is a _____.

1. _____ = Latin word for the moon
2. _____ = Roman Goddess of the moon.

b. **PHYSICAL PROPERTIES OF THE MOON**

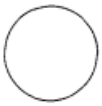
i. Size:

1. Diameter: _____ miles

2. Compared to Earth

$$\frac{\text{Diameter of Moon} = \_\_\_\_ \text{ miles}}{\text{Diameter of Earth} = 8000 \text{ miles}} = \_\_$$

3. Scale of size:



4. Gravity
   a. _____ the gravity of Earth
   b. _____

5. ATMOSPHERE:
   a. _____
   b. _____
   _____.

6. TEMPERATURES:
   a. _____ on the lighted side
   b. _____ on the dark side.
   These large temperature extremes exist because ____
   _____.
   _____.

c. LUNAR TOPOGRAPHY – Surface features of the moon.

i. _____: Bowl-shaped depressions formed primarily as a result of the impact of meteors.

1. There are many more craters on the moon than on earth because _____ _____ _____.

2. _____ – Appear as the "dark areas" on the moon's surface. Once thought to be _____.

3. _____ – appear as "bright streaks" that radiate from certain craters. Consist of shattered debris that was splashed out by the impact of meteors that formed the craters.

4. _____ – appear as the "light areas" on moon's surface. Consist of _____ and _____.

d. **THE MOON'S REVOLUTION**:

i. Period of revolution vs Cycle of phases

1. **PERIOD OF REVOLUTION**- _____
_____
_____.

a. _____

OR

b. _____ (ESRT Page ____)

2. **CYCLE OF MOON'S PHASES** – _____
_____
_____.
_____

ii. The moon revolves around Earth in an _____ orbit, and Earth is at one _____.

iii. This causes the moon's apparent _____ to change in a _____ manner.

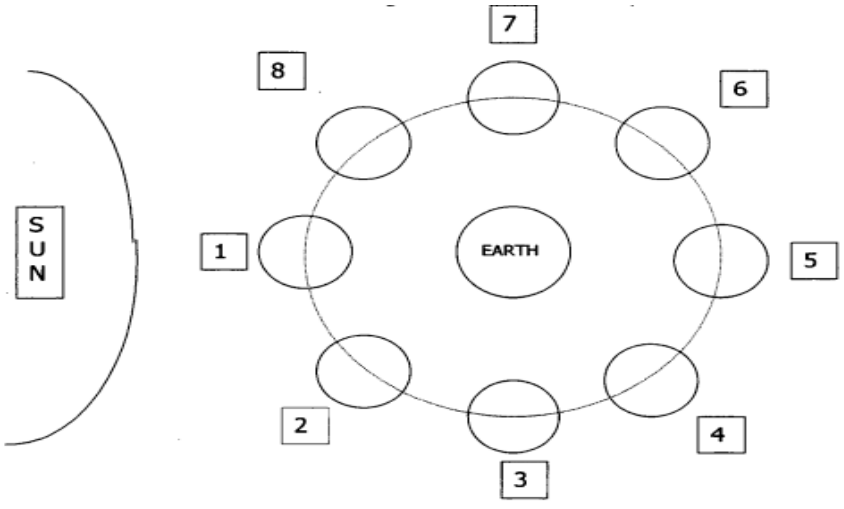
e. **PHASES OF THE MOON**:

i. Caused by _____.

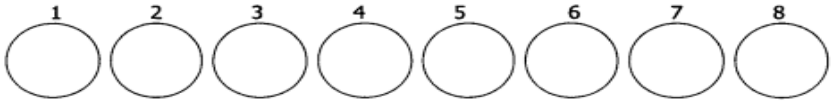
ii. Our earth view of _____
_____.

iii.

1. The Moon orbiting Earth as seen from space:



b. Phases of the moon as viewed from Earth



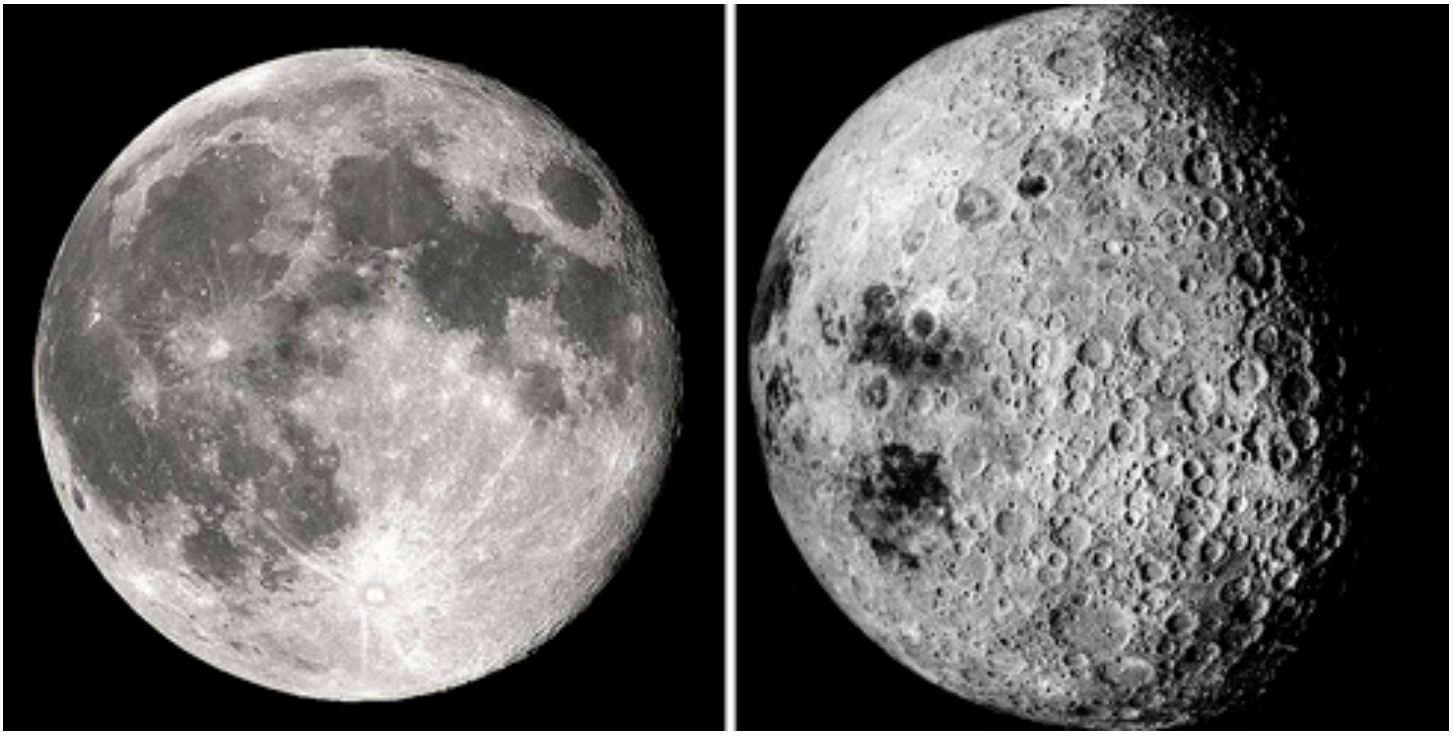
2. _____- The _____ of the moon's visible, illuminated surface from _____ moon to _____ moon.
3. _____- The _____ of the moon's visible illuminated surface, from _____ moon to _____ moon.

f. **THE NEAR AND FAR SIDE OF THE MOON**

i. _____ – the bright side of the moon that always faces earth. It is nearly half highlands and half maria.

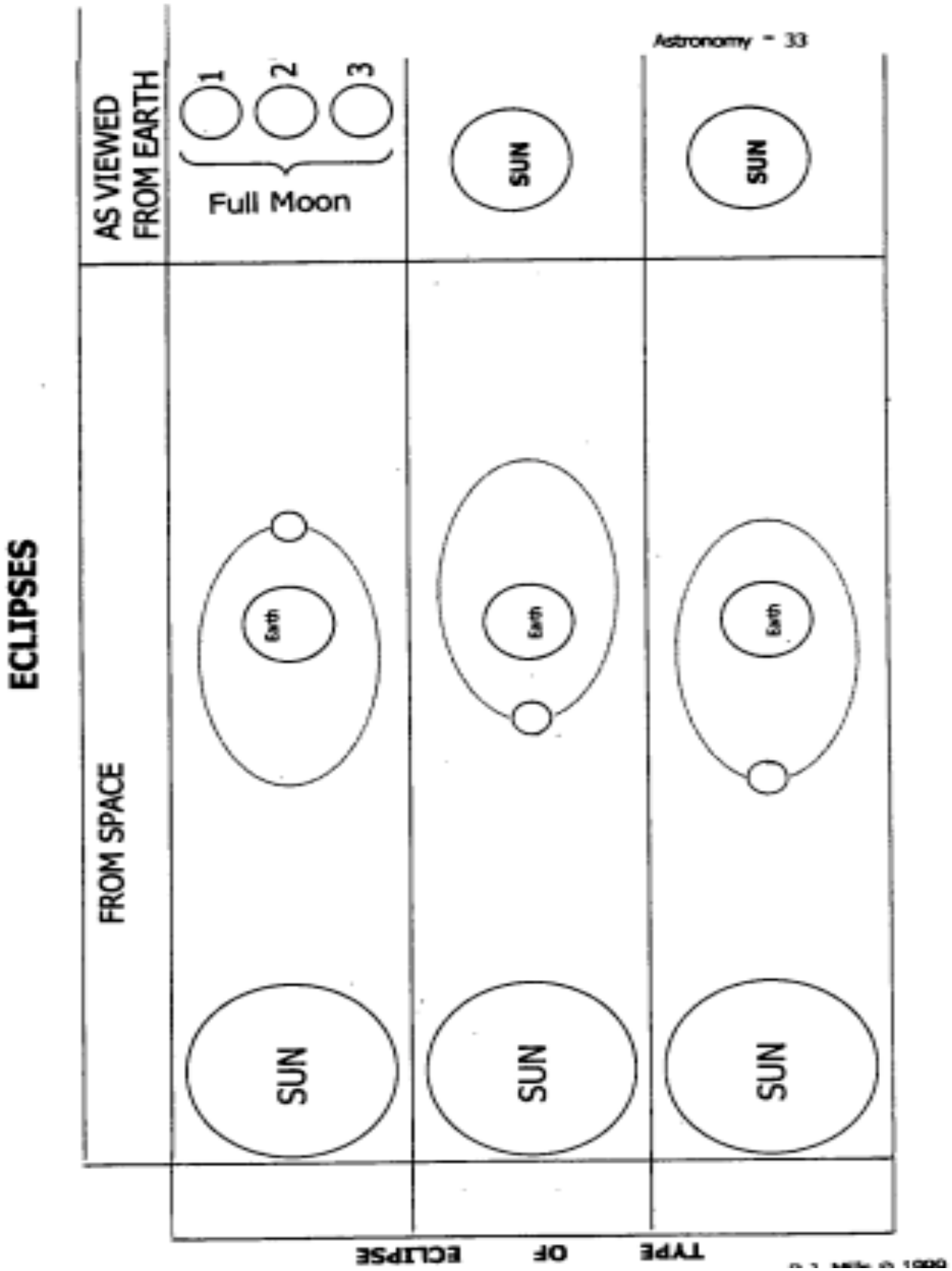
ii. _____- the side of the moon that _____ faces Earth. It is mostly highlands and craters.

iii. The same side of the moon (the near side) always faces Earth _____ _____.



NEAR SIDE **FAR SIDE**

g. ECLIPSES

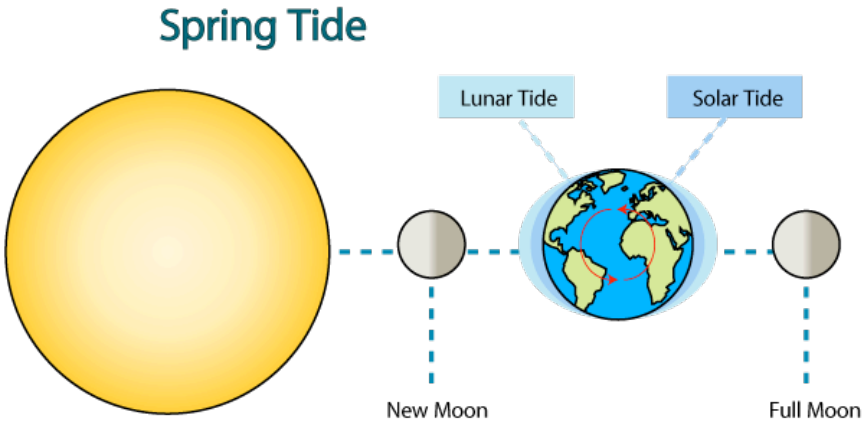

ECLIPSES
FROM SPACE
AS VIEWED FROM EARTH
1
2
3
Full Moon
SUN
Earth
TYPE OF ECLIPSE
Astronomy - 33

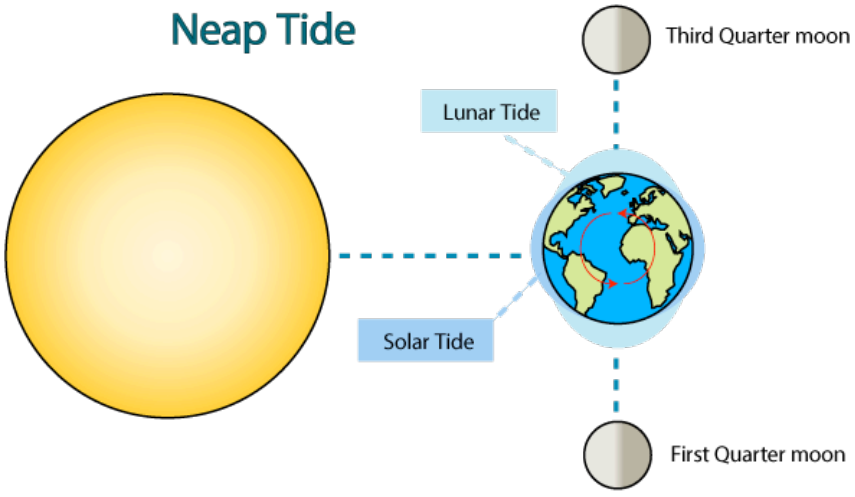
X. TIDES

a. Tides are the _____
   i. Caused by the moon's _____
   ii. Affected by Earth's _____.

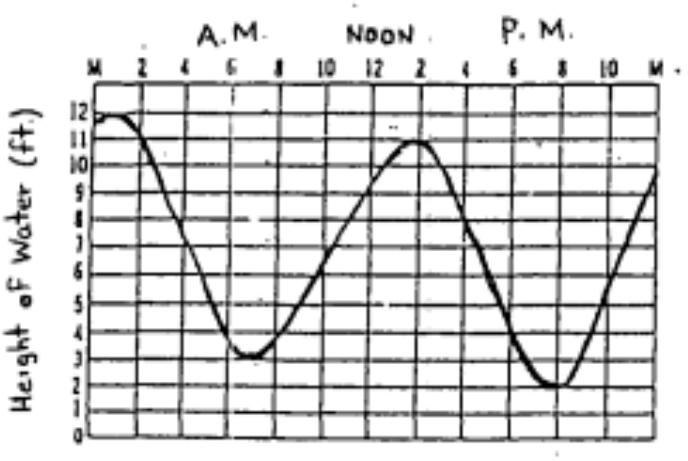
b. _____: _____ tides occur during the _____ _____ and the _____ phases when the _____, _____, and _____ are in line.

c. _____: _____ tides occur during the moon's _____ phases and the moon is _____ in line with the Earth and sun.





d. The period from high tide to high tide is normally about _____ _____. It is a _____ change.



e. The next high tide will occur at _____
f. The next low tide will occur at _____

UNIT 9 EXAM TOPICS

UNIVERSE

-Structure
-Doppler Effect

STARS

-ESRT Page 15
-Nuclear Fusion

PLANETS

-ESRT Page 15
-Terrestrial & Jovian
-Geocentric & Heliocentric

ECCENTRICITY

-ESRT Page 1
-Velocity
-Kinetic Energy
-Gravitational Force
-Foci
-Major Axis

THE MOON

-Phases
--Draw
--Read
-Time required – revolution vs Cycle of
-Phases
-Eclipses
-Solar
-Lunar
-Position of celestial objects
-Rotation and revolution

CELESTIAL SPHERES

-Draw paths
-Read paths
-4 specific dates

ROTATION

-15 degrees per hour
-Evidence
-Foucault Pendulum
-Coriolis effect
-Time zones
-Polar view diagrams
-Daily patterns

REVOLUTION

-1 degree per day
-Evidence
-Seasons
-Dates
-Position
-Latitude of direct rays
-Duration of insolation

TIDES

-Spring and neap
-Position of moon, sun, earth

UNIT 8 EXAM VOCABULARY

Asteroid

Axis of Rotation

Big Bang Theory

Celestial Object

Comet

Constellation

Coriolis Effect

Doppler Effect

Eccentricity

Eclipse

Ellipse

Focus

Foucault pendulum

Galaxy

Geocentric Model

Gravitation

Heliocentric Model

Impact Crater

Jovian Planet

Luminosity

Meteor

Milky Way Galaxy

Moon

Nuclear Fusion

Phases of the Moon

Red Shift

Revolution

Rotation

Solar System

Star

Terrestrial Planet

Tides

Time Zones

Universe