Earth's Shape

I. **_Evidence of Earth's Spherical Shape_**

A. Two millennia ago Greek mathematicians determined Earth's shape was _____.
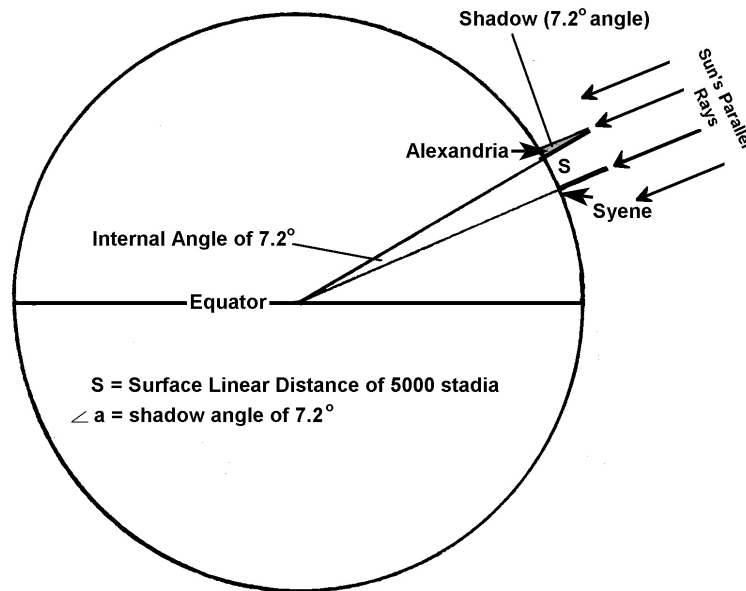
1. <u>Aristarchus</u> (310 B.C. to 210 B.C.)
   a. Believed in _____ universe.
   b. Attempted to determine the size of the Sun and Moon and distances to them.

2. <u>Eratosthenes</u> (274 B.C. to 195 B.C)
   a. Calculated Earth's _____ .
   b. Evidence of _____ shape
      (1) On the summer solstice at noon, the Sun's altitude is _____ at two locations on the same meridian of longitude.
      (2) Can be explained by a _____ Earth.
   c. Measurements of _____ allowed for a mathematical calculation of circumference using geometric relationships.
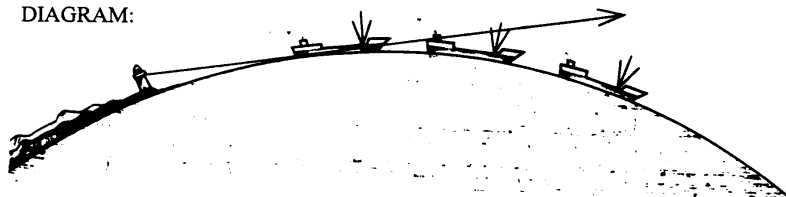
$$\frac{\angle a}{360^\circ} = \frac{S}{C} \qquad \text{Where:} \quad \begin{array}{ll} \angle a & = \text{shadow angle} \\ S & = \text{surface distance} \\ C & = \text{circumference} \end{array} \qquad \Longrightarrow \qquad \frac{7.2^\circ}{360^\circ} = \frac{5000 \text{ stadia}}{C}$$

Shadow (7.2° angle)

Sun's Parallel Rays

Alexandria → S

Syene

Internal Angle of 7.2°

Equator

S = Surface Linear Distance of 5000 stadia
∠ a = shadow angle of 7.2°

B. <u>Ships Sailing out to Sea</u>
   1. Masts of ships are the _____ to disappear below the horizon.
   2. Caused by Earth's _____ .

   DIAGRAM:

C.   Sunlight at Sunset
    1. As the Sun sets, the last sunlight is seen on_____ objects.
    2. Examples:
        a. Airplanes
        b. Tops of mountains
        c. Tall buildings

D.   Lunar Eclipses:
    ⇨ Earth's shadow is _____ .

Partial Lunar Eclipse

E.   Ferdinand Magellan's ships _____ Earth in 1522.

F.   Photographs of Earth from Space
    1. The_____ evidence for Earth's shape.
    2. Clearly shown as being_____ .

II.   ***Earth's Shape is not a Perfect Sphere***
 A.   Earth's true shape is an _____ .
    1. A perfect sphere's circumference is _____ through the poles and equator.
    2. Earth's Polar diameter (and circumference) is _____ than at the equator.
    3. As a result, Earth has a _____ at the equator which can't be seen by the naked eye.
    4. This is caused by Earth's _____ .

  B.   Evidence of Earth's True Shape
    1. Gravity Measurements
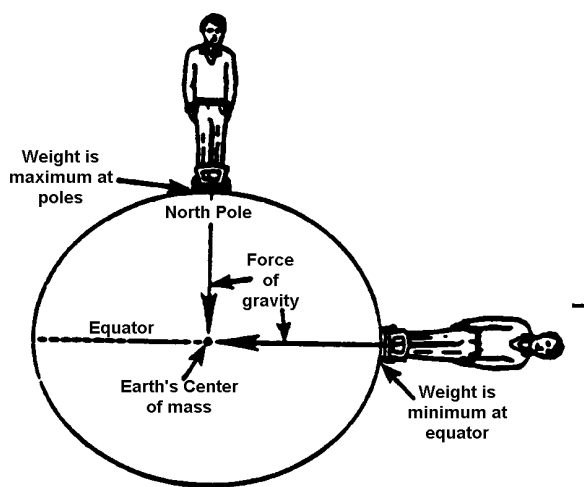   a. Directional Component of Earth's Gravity
            (1)   Objects are attracted towards Earth's center of _____ .
            (2)   The direction of this force would always be _____ at every location on a perfectly spherical Earth.
            (3)   Actual measurements show that the direction of the force of gravity is _____ _____ at every point.
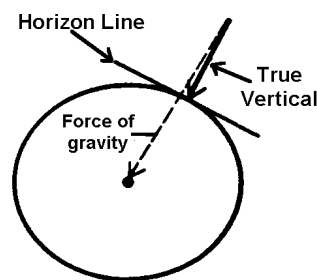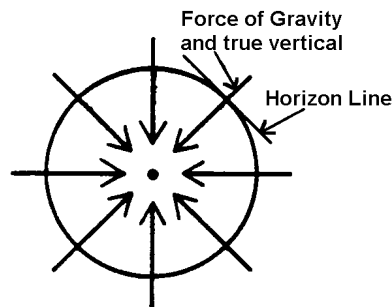
        b. Magnitude of Gravity Measurements.
            (1)   The force of gravity should be _____ at every location on a perfectly spherical Earth.
            (2)   Actual measurements show that the force of gravity is _____ at the poles than at the equator (factoring out the effect of elevation).
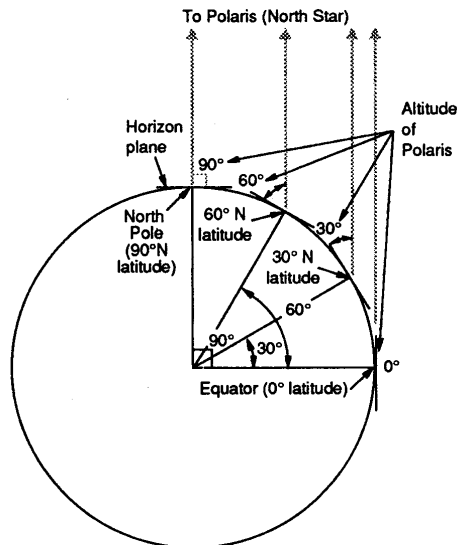
(a) According to Newton's Universal Law of Gravitation, the factor affecting force must be a change in _____.

(b) As distance decreases, force _____.

(c) As a result, the greater force at the poles is the result of a _____ distance to Earth's center of mass, indicating a smaller polar diameter.

Weight is maximum at poles

North Pole

Force of gravity

Equator

Earth's Center of mass

Weight is minimum at equator

(3) Since weight is the effect of gravity on a mass, a person's weight is slightly _____ at the equator than at the poles.

2. The Altitude of Polaris

   a. The altitude to Polaris is equal to the observer's _____.

To Polaris (North Star)

Horizon plane

Altitude of Polaris

North Pole (90°N latitude)

60° N latitude

30° N latitude

Equator (0° latitude)

The altitude of Polaris

LOCATION	LATITUDE (degrees)	ALTITUDE (degrees)
North Pole	90N	90
Yukon	60N	60
Montreal	45N	45
Equator	0	0

(an obvious and simple navigational tool)

   b. Precise measurements show that the altitude is _____ than the latitude because Earth isn't perfectly spherical.