EARTH SCIENCE

KEY

UNIT 2-H

YOUR PLANET

YOUR INHERITANCE

YOUR LEGACY

UPDATED AND ADAPTED FROM DAVID J. MILLS 2001

UNIT 2

MODELS & DIMENSIONS OF EARTH

I. **Model** = **ANYTHING THAT REPRESENTS THE PROPERTIES OF AN OBJECT OR SYSTEM**

A. **Types and examples of models:**

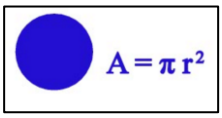
1. **PHYSICAL** – Provides us with information through our sense of sight. Physical models look like the "real" object.


2. **MECHANICAL** - a physical model with moving parts so that it can perform the functions or movements of the original object.

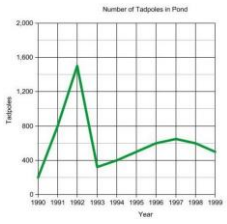


3. **MATHEMATICAL** - Mathematical relationships expressed by symbols, formulas, and equations.

$$density = \frac{mass}{volume}$$



4. **GRAPHIC** – A graph to provide a "picture" of a relationship.



5. **MENTAL** Models that can only exist in someone's mind.

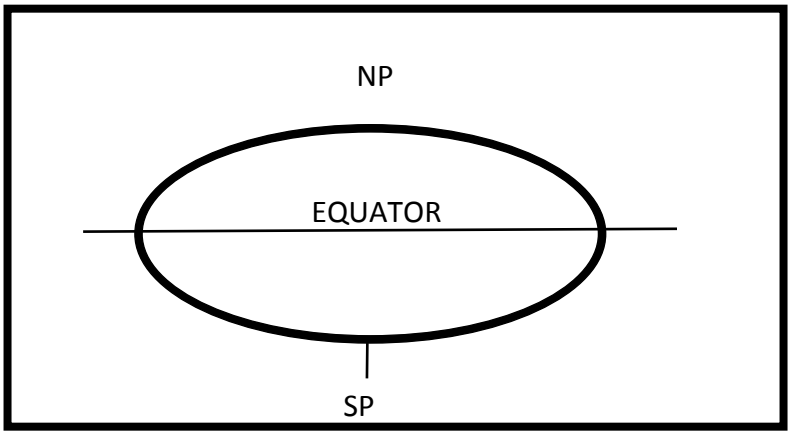
II. **Shape of Earth**: Earth LOOKS like a perfect sphere, but it is actually an: **OBLATE SPHERE**

A. **OBLATE SPHERE** – **Slightly flattened sphere**

1. . **Slightly flattened at the poles**

2**. Slightly bulging at the equator**

3. Diagram of an **oblate sphere**



NOT TO SCALE

How do we know?

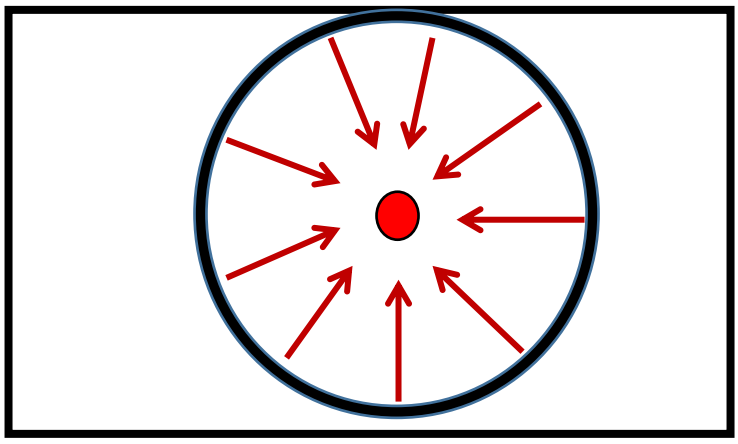
4. Earth's equatorial circumference is **GREATER** than its polar circumference

a. Equatorial Circumference = **24,900 mi**

b. Polar Circumference = **24,860 mi**

b. Causes of Earth's Shape

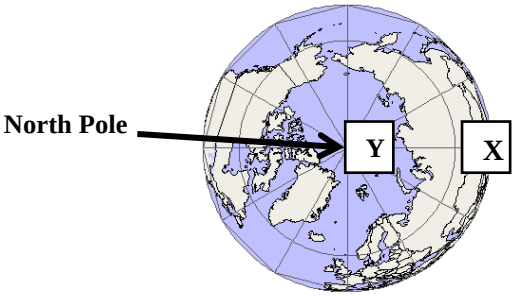
1. **GRAVITY** – an inward pulling force. This force pulls inward equally in all directions and causes the earth to be **SPHERICAL**



KEY:
↗ = Force of gravity

2. **CENTRIFUGAL FORCE** - An outward force caused by the spinning (or rotating) of the earth on its axis. This force causes the earth to **BULGE**

a. The faster the rotational speed, the **GREATER** the centrifugal force.



b. (1) How long does it take each location to make one complete rotation?

X – **24 Hours**

Y- **24 Hours**

(2) Which location, X or Y, travels a greater distance to make one complete rotation? **X**

(3) At which location, X or Y, is the rotational speed the greatest? **X**

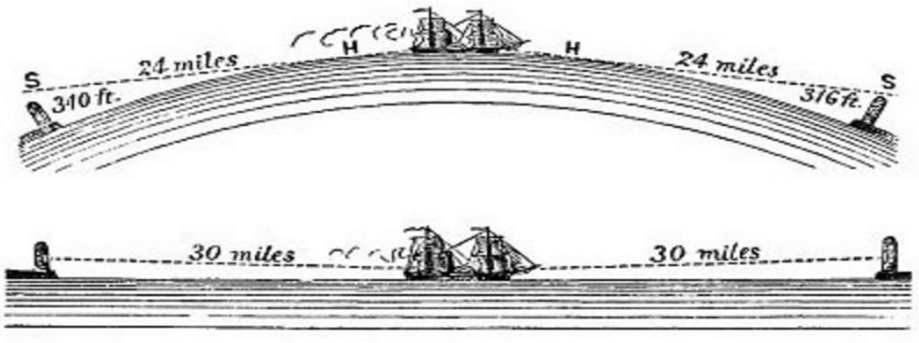
(4) At which location, X or Y, is centrifugal force the greatest? **X**

c. Therefore, the greater centrifugal force causes the earth to bulge at the **EQUATOR**

C. Evidence of Earth's Shape

1. **Photographs from space** revel that Earth is **ALMOST A PERFECT SPHERE / VERY SPHERICAL**.

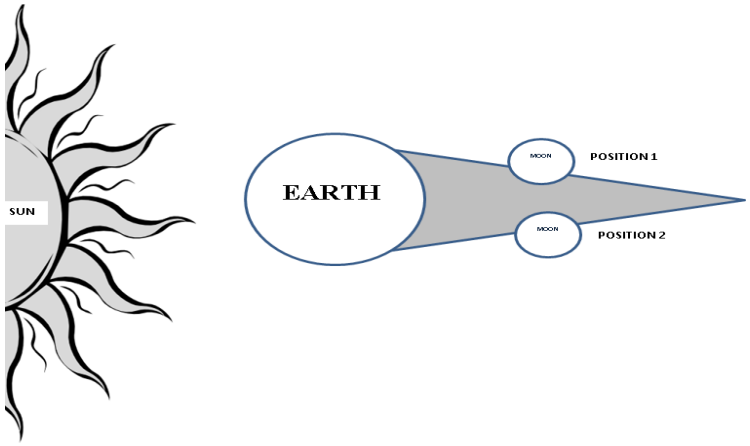
2. **Observations of ships on the horizon**



The gradual "appearance" or "disappearance" of a ship over the horizon is evidence that the earth's surface is **CURVED**

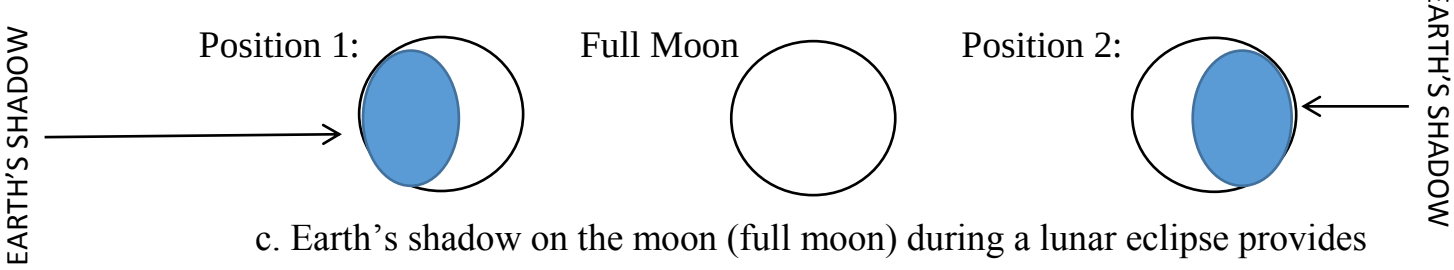
3. Observations of an Eclipse of the Moon (as viewed from earth)

a. As viewed from space:



As the moon orbits Earth and travels from position 1 to position 2, it passes through **EARTH'S SHADOW**

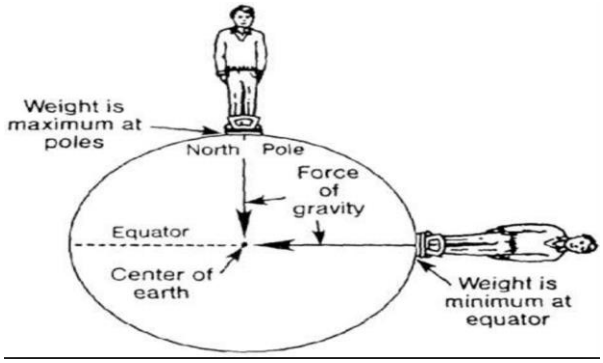
b. As viewed from earth:



c. Earth's shadow on the moon (full moon) during a lunar eclipse provides evidence that Earth is **SPHERICAL**

4. **Measurement of Gravity**

a. Diagram:



b. The shorter the distance between two objects, the greater the gravitational force. Therefore, a person or object that is closer to the center of the earth (the center of gravity) would weigh more than when the person or object is farther from the center of gravity.

c. (1) If the earth is an "Oblate Spheroid", where on the surface of Earth would a person be closer to the center of the earth? **POLES**

(2) Where on the surface of the earth would the person or object weigh the most? **POLES**

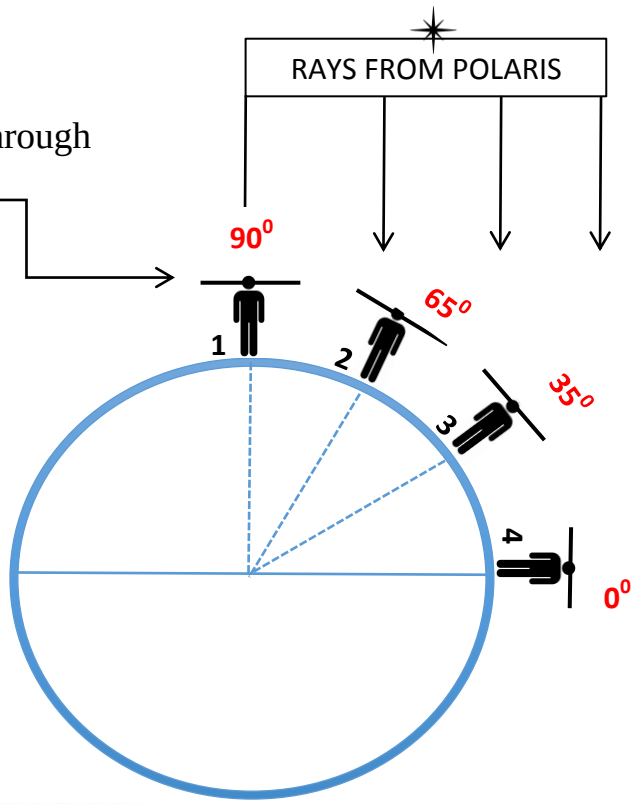
d. Under what circumstances would a person weigh the same everywhere on Earth? **IF THE EARTH WAS A PERFECT SPHERE**

5. **Observations of the North Star, Polaris**

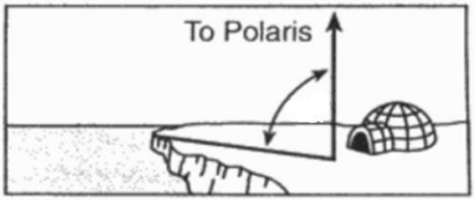
a. The altitude of Polaris changes as an observer moves north or south (in the Northern Hemisphere); this is because Earth is **SPHERICAL** and its surface is **CURVED**

(Altitude is the height, measured in degrees that a celestial body is above the horizon of the observer.)

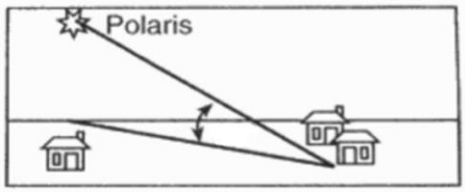
b. The horizon is shown by the line through the observer's line of vision.



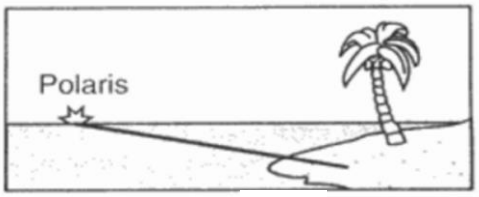
OBSERVER	LATITUDE	ALTITUDE OF POLARIS
1	90⁰	90⁰
2	65⁰	65⁰
3	35⁰	35⁰
4	0⁰	0⁰



Location 1 = 90⁰ Latitude



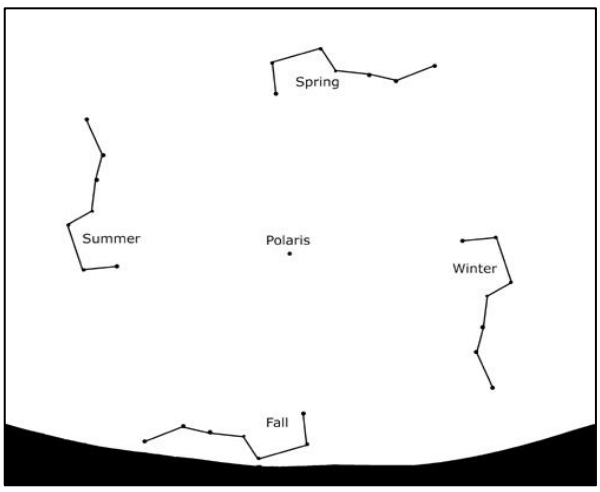
Location 2 = 35⁰ Latitude



Location 1 = 0⁰ Latitude

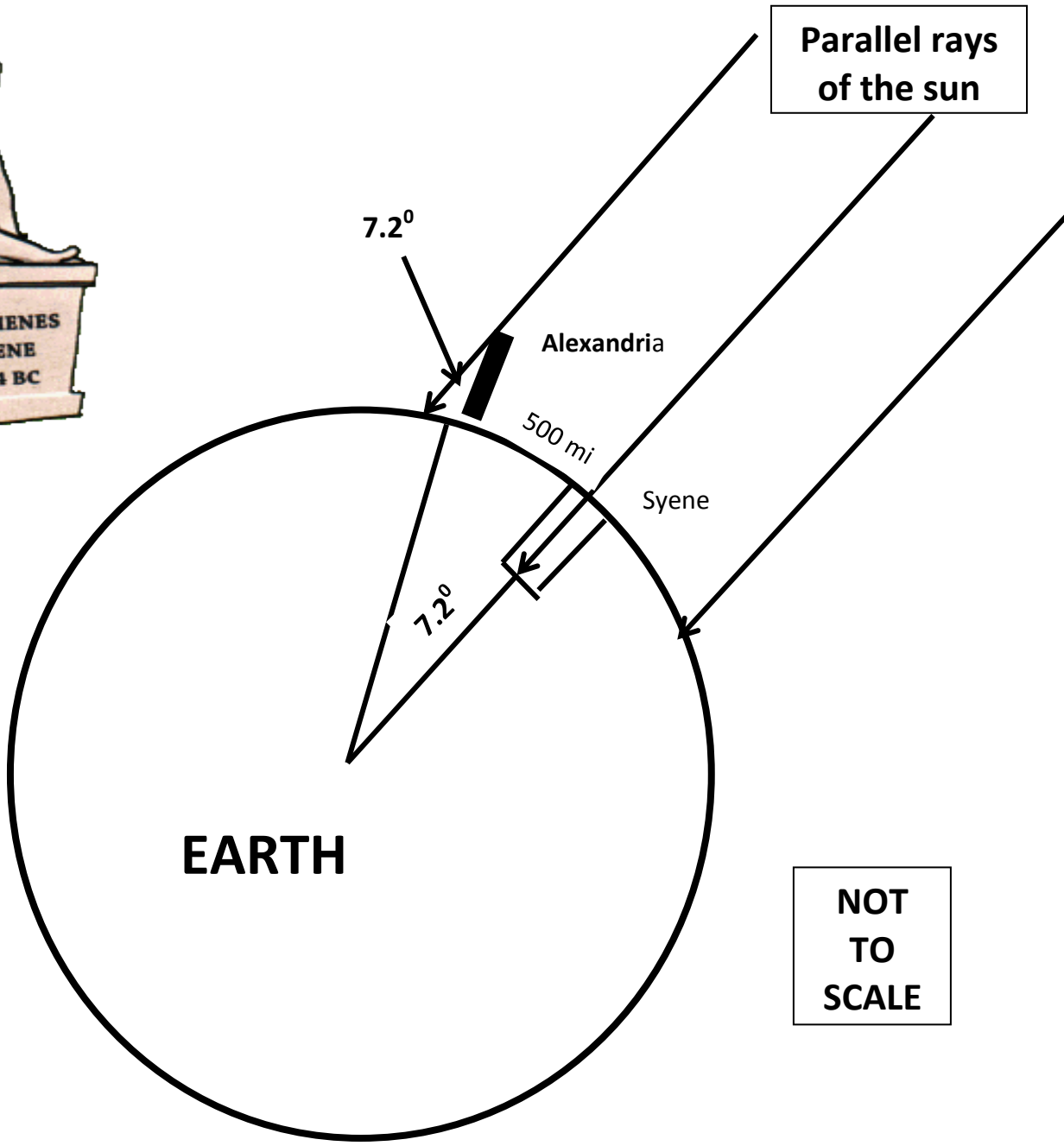
d. **Summary:** **THE ALTITUDE OF POLARIS ABOVE THE HORIZON IS EQUAL TO THE LATITUDE OF THE OBSERVER!**

e. **Locating Polaris / the North Star**



III. SIZE OF EARTH

A. The Greek mathematician, Eratosthenes, is credited as being the first man to make a scientific determination of Earth's circumference. The time was about 200 BC – over 2000 years ago!



2. Eratosthenes' method for determining Earth's Circumference:

	Angle		*Distance*
Part / Whole	**7.2° / 360°**	=	**500 / C**
7.2C = 180,000			
	7.2C / 7.2C	=	**180,000 / 7.2**
C = 25,000 miles			

B. Earth's other measurements:

Once earth's circumference is known, its other dimensions: diameter, radius, volume, and surface area can be calculated.

1. **Calculating Earth's diameter:**
   a. **C = π d**
   b. **25,000 = 3.14 d**
   c. **25,000 / 3.14**

7961.7 = d

2. Based on Earth's diameter, its radius would be: ~ 4000

3 Using the formula for the volume of a sphere, V = 4/3 πr², Earth's volume is:

1. **V = 4/3 π r²**
2. **V = 4/3 x 3.14 x (4000)³**
3. **V = 1.3 x 3.14 x 64,000,000,000**
4. **V = 4.18 x 64,000,000,000**
5. **V = 267,520,000,000 miles**

4. Using the formula for area of a sphere, A = π r² , Earth's area is:

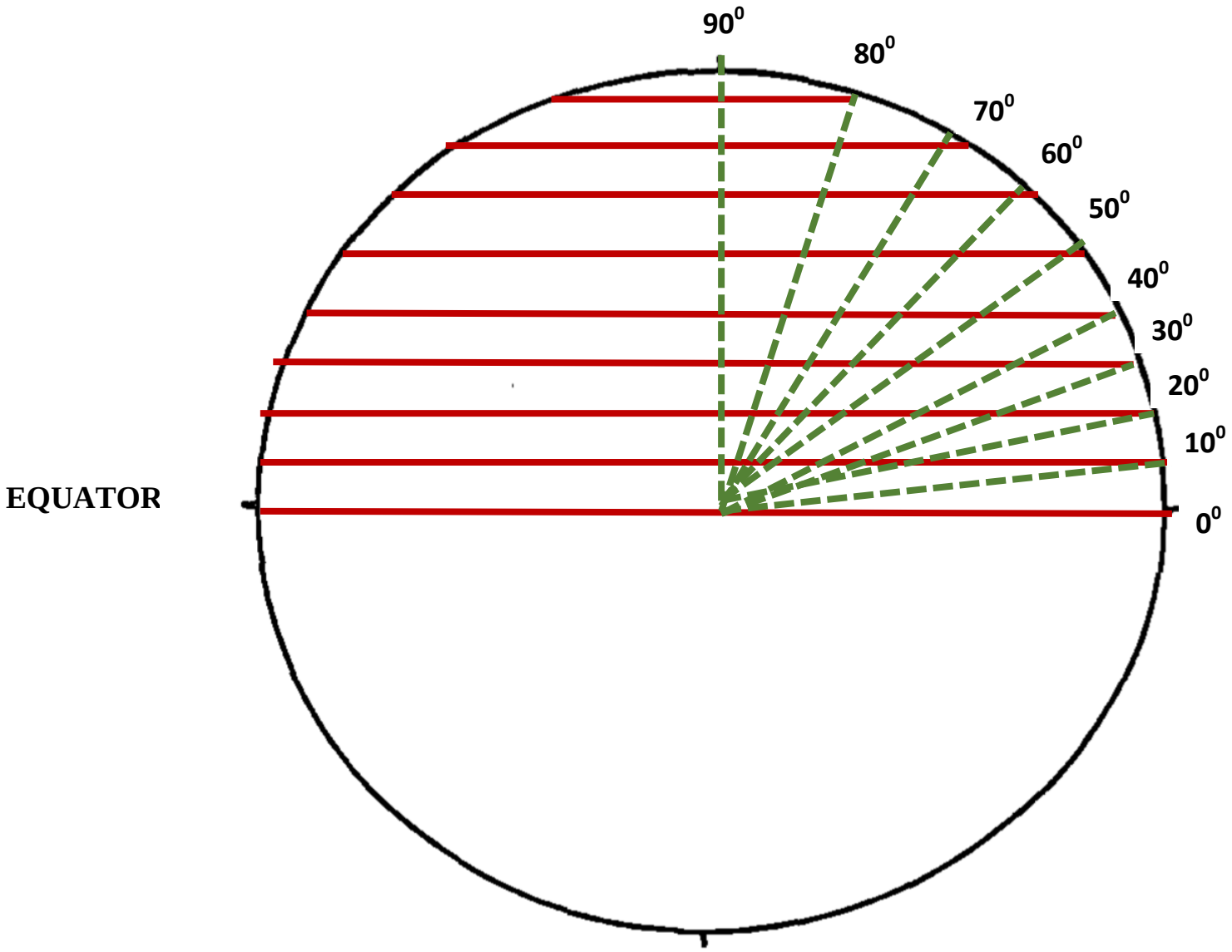
1. **A = 4 π r²**
2. **A = 4 x 3.14 x (4000)²**
3. **A = 12.56 x 16,000,000**
4. **A = 200,960,000 mi²**

A. **Latitude:** **ANGULAR DISTANCE NORTH OR SOUTH OF THE EQUATOR**

B. **PARALLELS: LINES USED FOR MEASURING LATITUDE; RUN EAST – WEST "PARALLEL" TO THE EQUATOR**

C. **EQUATOR: 0^0 LATITUDE; STARTING PLACE FOR MEASURING LATITUDE**

D. **latNORTH / SOUTH POLES; 90^O LATITUDE – MAXIMUM LATITUDE**



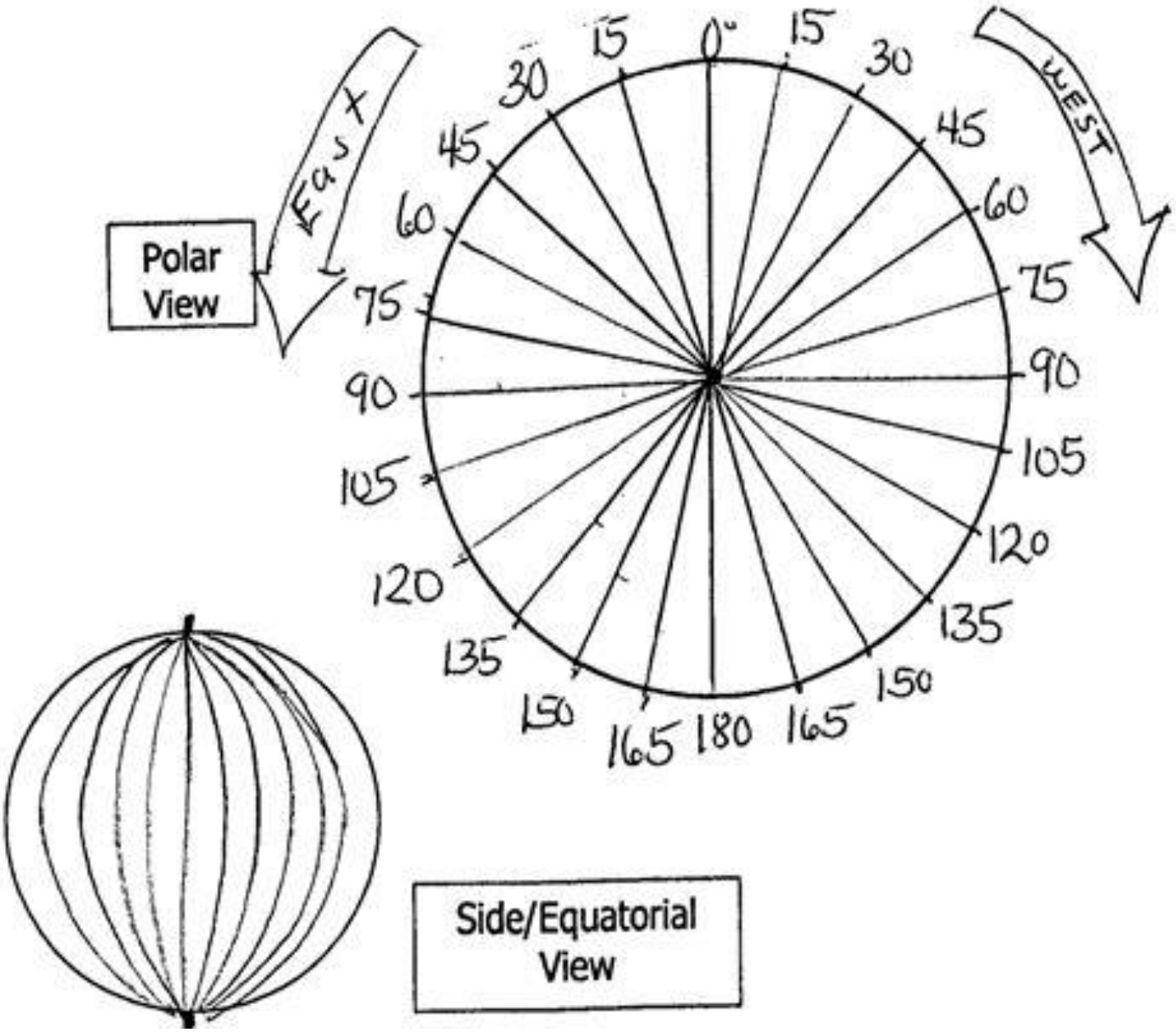
E. **LONGITUDE – ANGULAR DISTANCE EAST OR WEST OF THE PRIME**

MERIDIAN

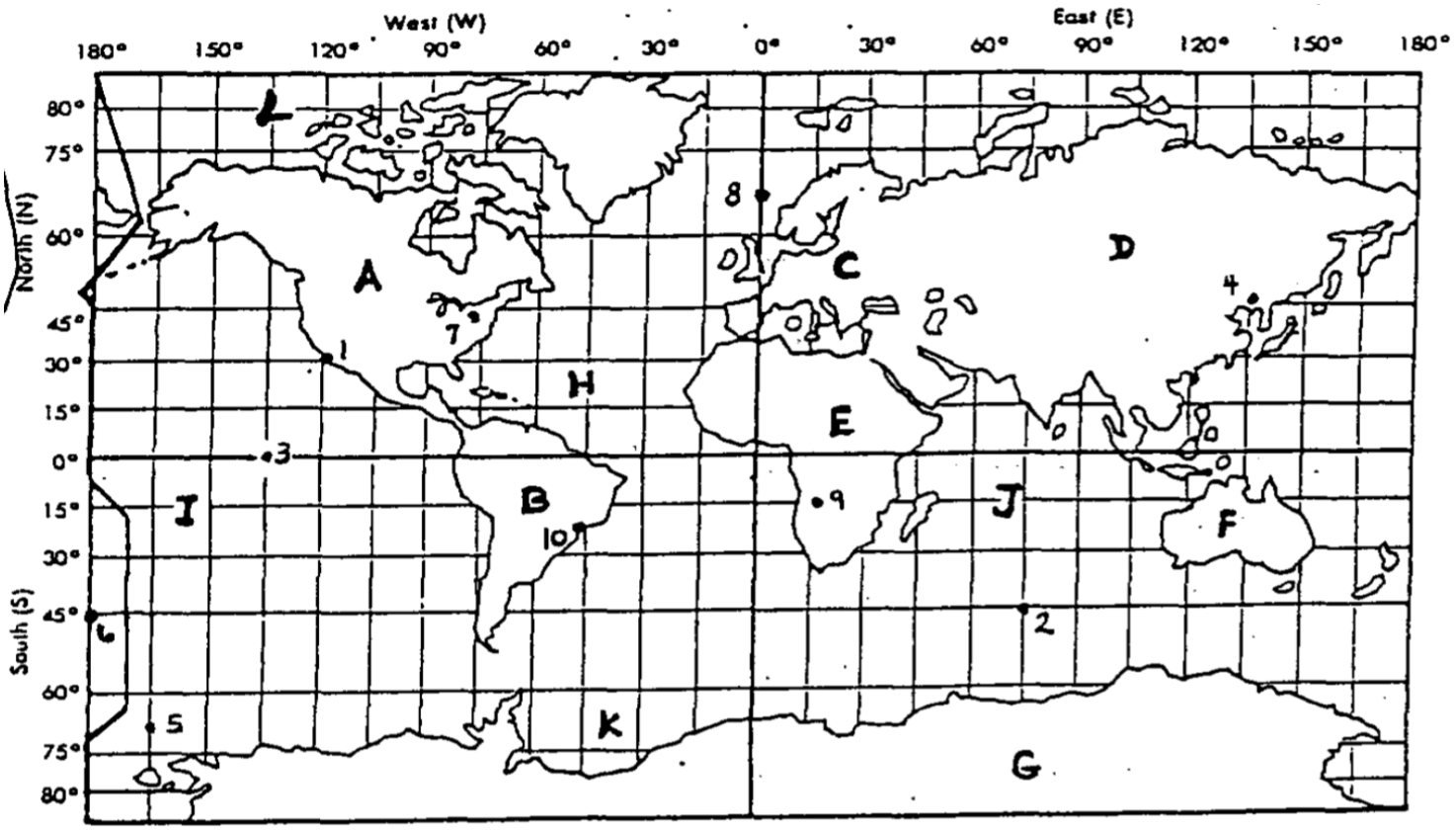
F. **MERIDIANS**: **LINES USED FOR MEASURING LONGITUDE; RUN NORTH / SOUTH FROM POLE TO POLE**

G. **PRIME MERIDIAN: 0^0 LONGITUDE; STARTING PLACE FOR MEASURING LONGITUDE**

H. **INTERNATIONAL DATE LINE: 180^0 LONGITUDE. MAXIMUM LONGITUDE**



C. DETERMININ LATITUDE AND LONGITUDE (CONTINENTS AND OCEANS)



1. Use the map above to determine the latitude and longitude of these numbered and lettered locations. Name the continents and Oceans indicated by the letters.

Location	Latitude	Longitude
1	30^0 N	120^0 W
2	45^0 S	75^0 E
3	0^0	135^0 W
4	45^0	135^0 E
5	$65\text{-}70^0$ S	165^0 W

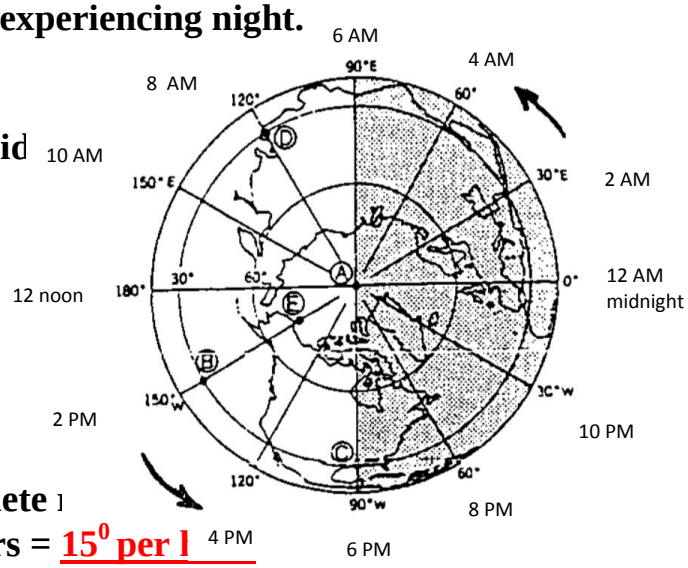
Location	Latitude	Longitude
6	45^0 S	180^0
7	$40\text{-}45^0$ N	$75\text{-}80^0$ W
8	$65\text{-}70^0$ N	0^0
9	15^0 S	15^0 E
10	$20\text{-}25^0$ S	$45\text{-}49^0$ S

Location	Continent
A	NORTH AMERICA
B	SOUTH AMERICA
C	EUROPE
D	ASIA
E	AFRICA
F	AUSTRALIA
G	ANTARCTICA

Location	Ocean
H	ATLANTIC
I	PACIFIC
J	INDIAN
K	ANTARCTIC
L	ARTIC

D. Earth's Time Zones

1. **As Earth rotates on its axis, half of Earth is facing the sun and is experiencing daylight; the other half is in darkness an is experiencing night.**



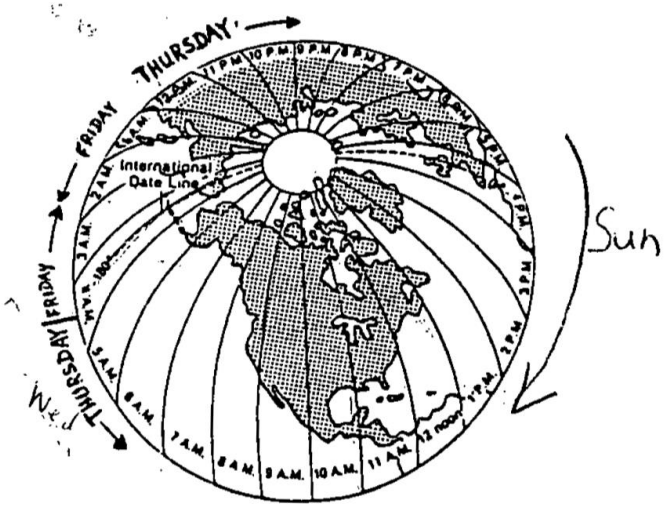
2. **When the sun is directly over a certain merid**
   or near that meridian
3. **Earth's rotational speed**

   Think:

   - **Earth is a sphere**
   - **There are 360^0 in a circle**
   - **Earth takes 24 hours to make one complete**
   - **Earth's rotational speed = 360^0 / 24 hours = 15^0 per l**

4. **A. Number of time zones on earth = 24**

   B. Approximate width of each time zone = 15^0



5. a. If it is Wednesday and you cross the International Date Line going WEST, it would then be **THURSDAY**

   b. If it is Tuesday and you cross the International Date Line going EAST, it would then be **MONDAY**

6. a. How many time zones were are there in the continental US? **4**

   b. Is it earlier or later in California than New York? **EARLIER**

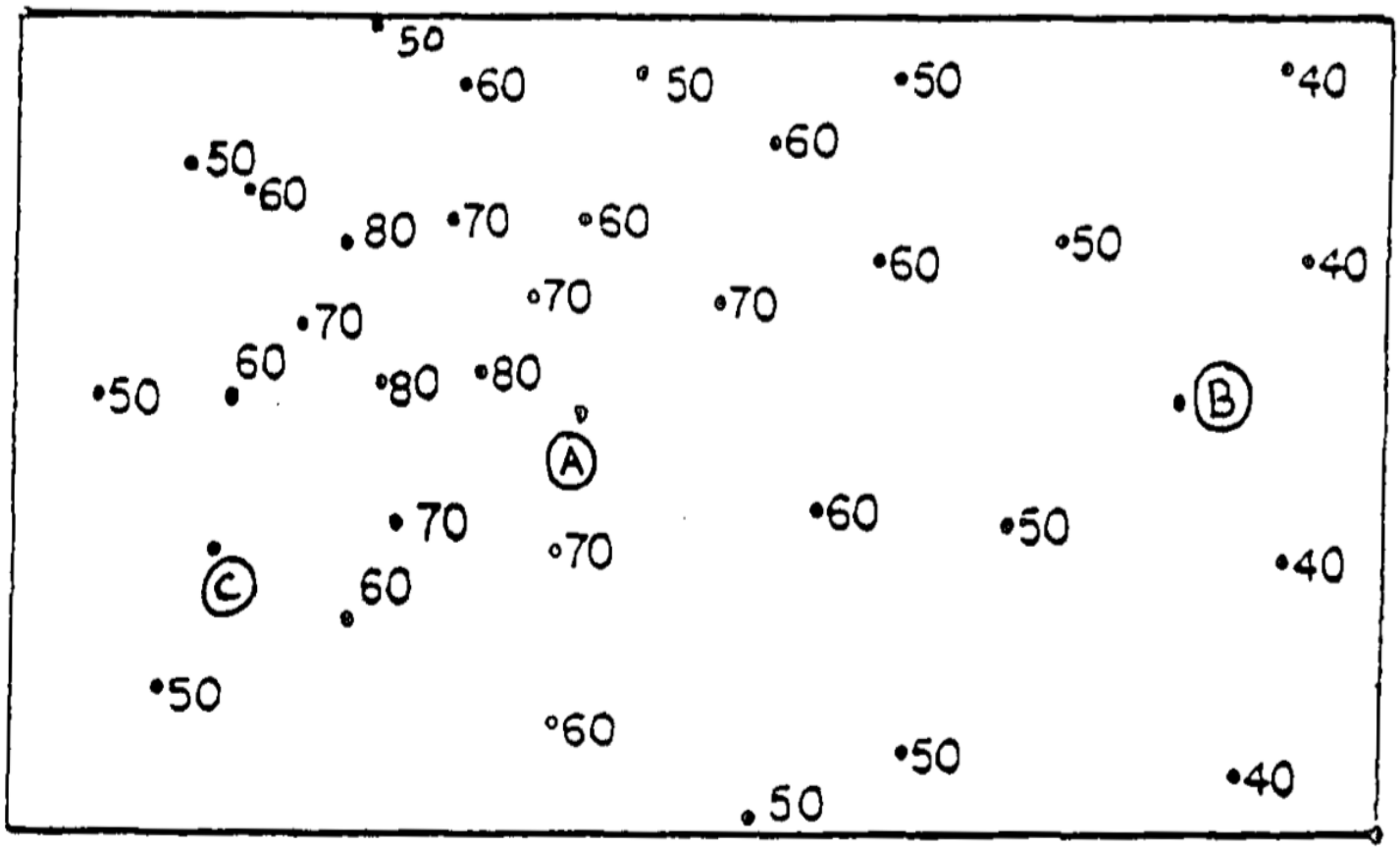
   c. If it is 8:00 EST, what time is it in PST? **5:00**

   d. If it is 6:00 MST, what time is it in EST? **8:00**

V. FIELDS – A FIELD IS A REGION OF SPACE / AREA THAT HAS A MEASURABLE VALUE OF A GIVEN PROPERTY AT EVERY POINT.

ISOLINES: CONNECT POINTS OF EQUAL VALUE.

A. The diagram below shows an elevation field map of a geographical region. The elevation is measured in feet (above sea level). Complete this field map by drawing elevation lines for 40, 50, 60, 70, & 80 feet.



1. What is the approximate elevation of point

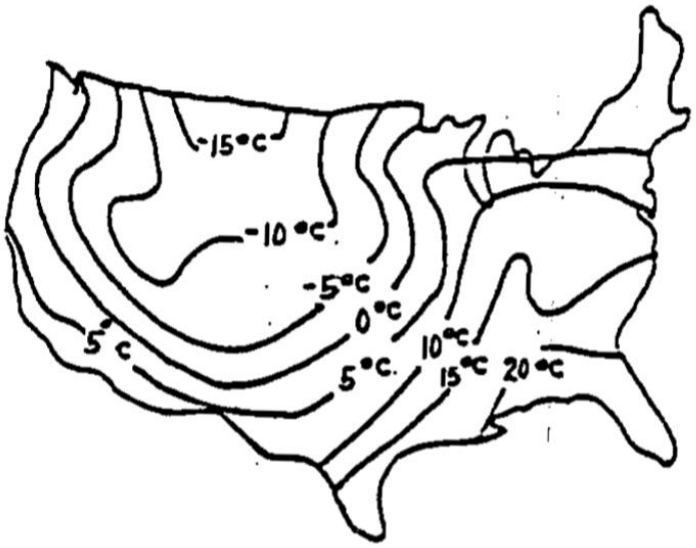
A 71-79 ft

B. 41 – 49 ft

C. 51 – 59 ft

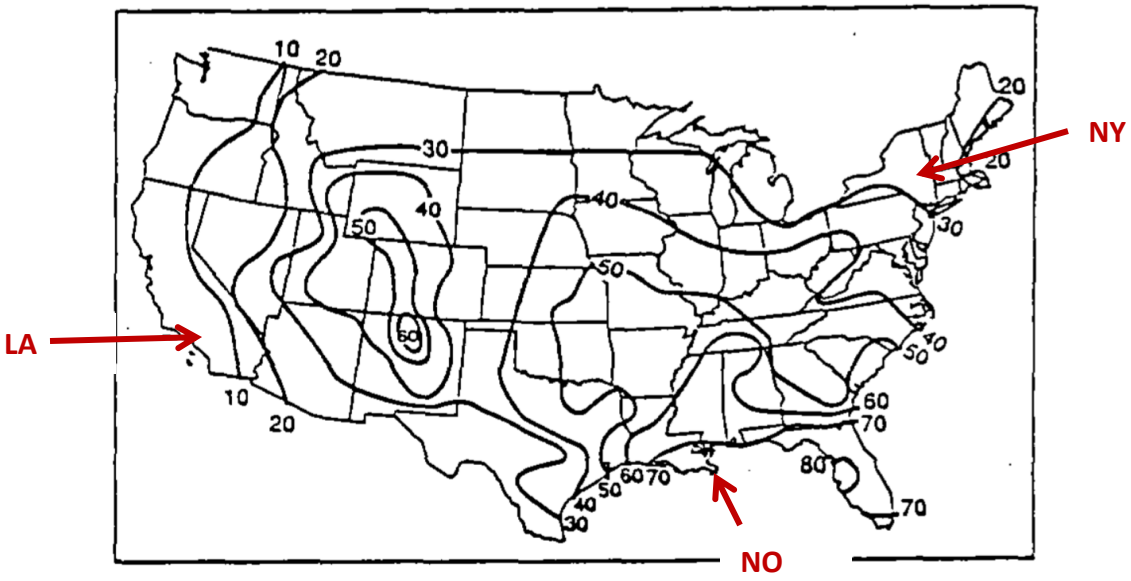
2. Isolines that show elevation are called CONTOUR LINES

C. The field map below shows weather data plotted for a January morning.



1. **What measurable property is shown on this map? TEMPERATURE**
2. **Based on this property, the Isolines on this map are called ISOTHERMS**
3. **What is the approximate measurement of this property for New York State? 5^0 C**

D. The field map below shows the average yearly number of thunderstorms in the United States.



1. **Approximately how many thunderstorms occur each year in:**
   a. **Albany, New York – 20 - 30**
   b. **Los Angeles, California - > 10**
   c. **New Orleans, Louisiana - < 70**

VI. TOPOGRAPHIC MAPS - are maps of elevation fields

A. Topographic Maps show the elevation of the land by using contour lines, and show other natural and man-made features by using symbols.

B. Contour Lines: ISOLINES ON A MAP THAT CONECT POINTS OF EQUAL ELEVATION

C. Elevation: DISTANCE (FEET) ABOVE SEA LEVEL

D. Contour Interval: DIFFERENCE IN ELEVATION BETWEEN TWO CONSECUTIVE CONTOUR LINES.

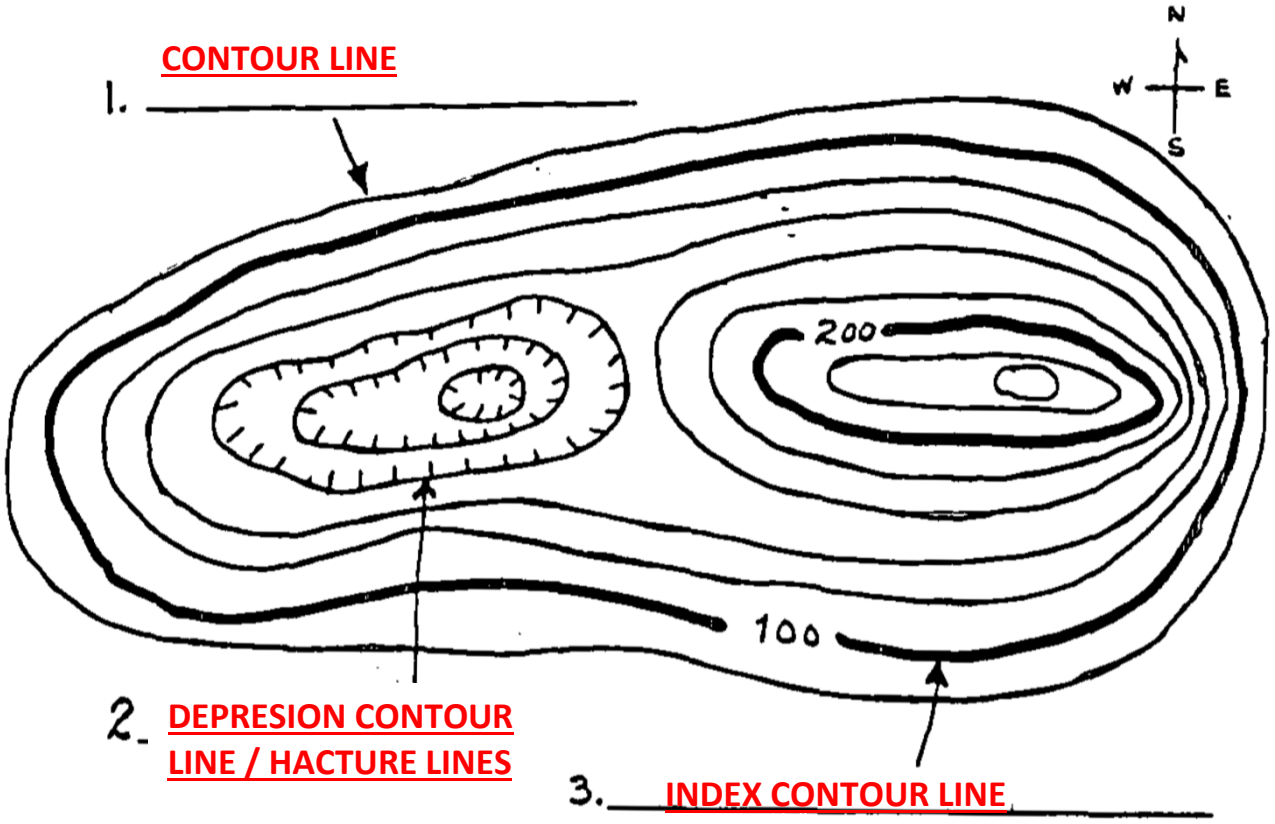
E. Index Contour Line: HEAVY, DARK CONTOUR LINE, USUALLY WITH NUMERICAL VALUE FOR ELEVATION MARKED (by 100 foot intervals)

F. Depression Contour Line: Special contour lines used to show a HOLE OR CRATER on Earth's surface. These lines are drawn like contour lines but are marked on the inside.

G. Benchmark (BM): MARKER IN THE GROUND INDICATING THE "EXACT" ELEVATION ABOVE SEA LEVEL ON A PARTICULAR DATE.

H. Spot Elevations: are the elevations of such places as road intersections, hilltops, lake surfaces, and other points of special interest. These points are located on a map by a small cross (+), unless the location is obvious, such as certain road intersections or hilltops.

I. **A simple contour map (or topographical map)4.**



4. Contour Interval: 20 FEET

5. Highest Possible Elevation (Of The Hilltop): 259 FEET

6. Which Is The Steepest Side Of The Hill: North, South, EAST, Or West?

7. How Do Contour Lines Show A Steeper Slope? LINES ARE CLOSER TOGETHER

8. What Three (3) Basic Features Of A Landform Do Contour Lines Show?

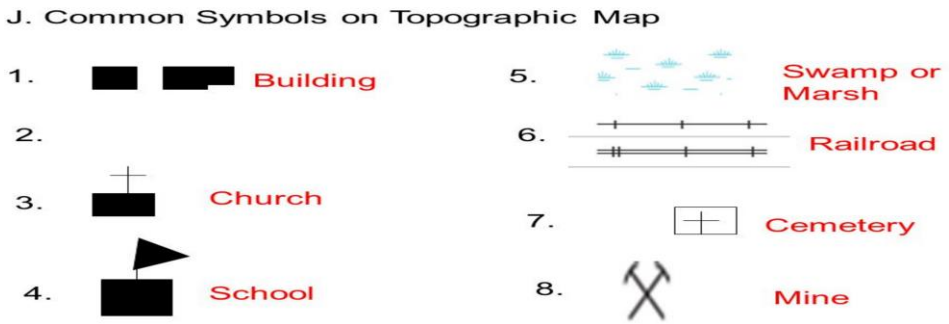
1. ELEVATION

2. STEEPNESS / GRADIENT

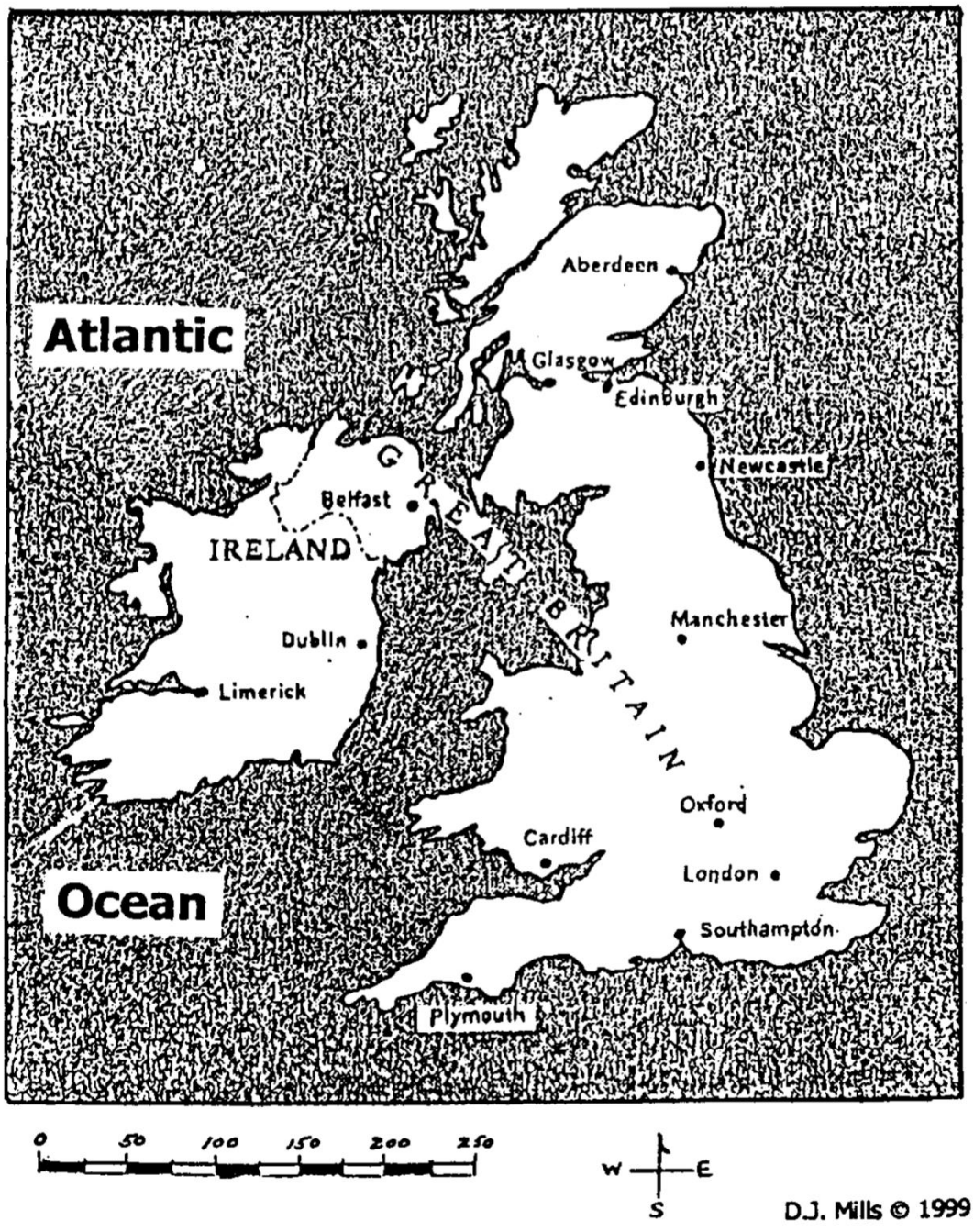
3. SHAPE (SIZE)

I. RIVER VALLEYS (THE LAW OF V's) – Contour lines bend upstream where they cross a river. This can be used to determine the direction in which a river is flowing

3. Common Symbols on Topographic Maps

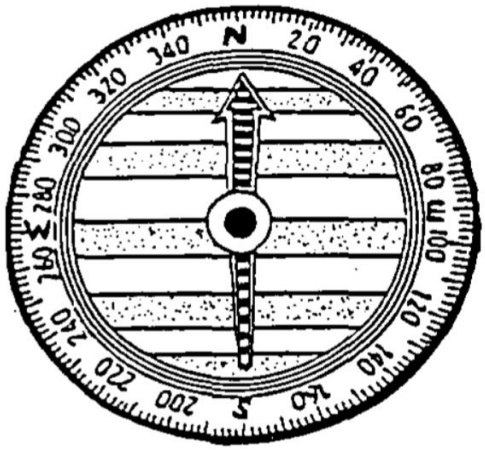


VII. Map Reading Skills



A. Directions on a map

Complete the statements below to give the correct direction between the cities on the map of Great Britain from the previous page. Use the terms: north, northeast, east, southeast, south, southwest, west or northwest.



1. Dublin is WEST of Manchester.
2. Manchester is EAST of Dublin.
3. Southampton is SOUTHEAST of Dublin.
4. Belfast is NORTHWEST of London.
5. Glasgow is NORTH of Cardiff.
6. Limerick is SOUTHWEST of Aberdeen.
7. Aberdeen is NORTHEAST of Limerick.
8. Manchester is SOUTH of Newcastle.

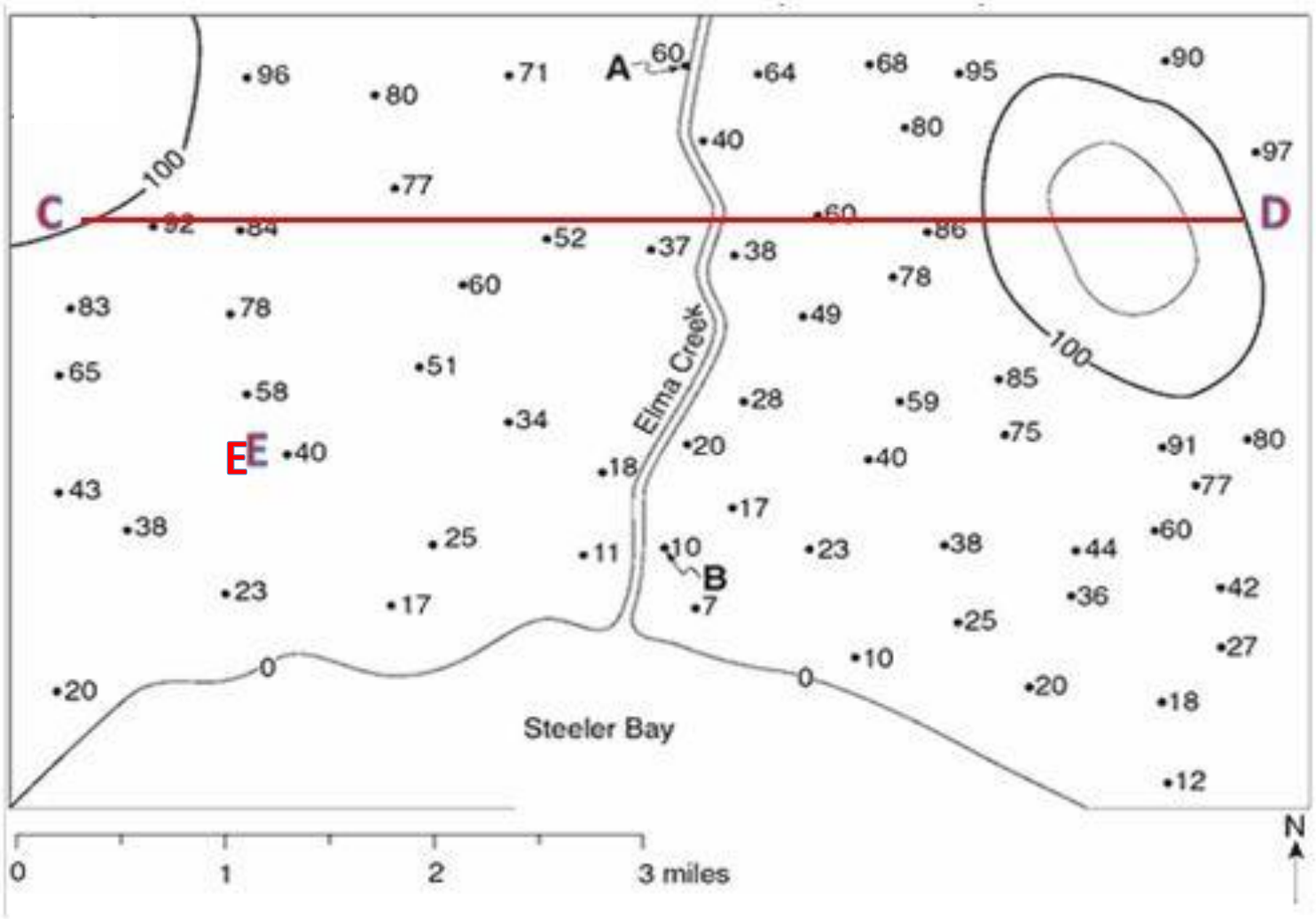
B. Distance on a map.

Use the given scale of miles on the map to determine the distance between the cities listed below.

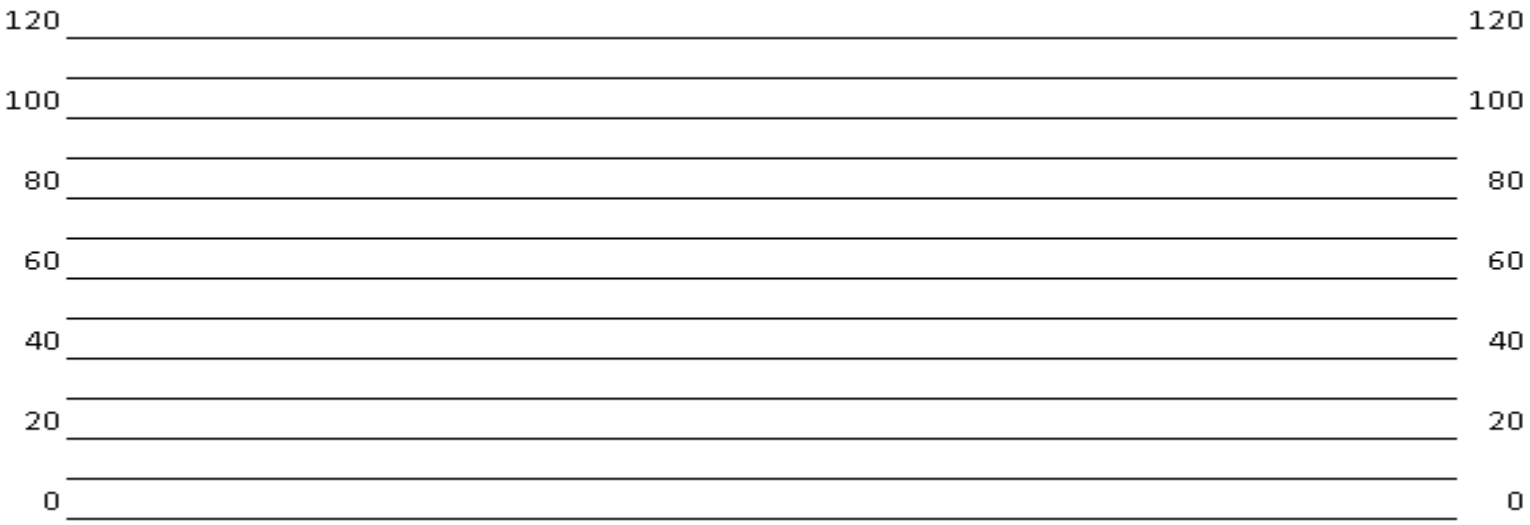
1. Cardiff to Oxford = 95 - 105 miles
2. Manchester to Dublin = 180 miles
3. Oxford to London = 45 miles
4. Plymouth to Limerick = 220 - 225 miles
5. London to Manchester = 150 miles
6. Aberdeen to Southampton = 350 miles
7. Which is the greater distance,
   a. from Aberdeen to Belfast
   or
   b. from Dublin to Oxford

VIII. TOPOGRAPHIC MAP SKILLS:

Drawing Contour Lines on a Field Map: draw contour lines for 20, 40, 60, and 80 ft



B. Drawing a Profile from a Contour Map



C. Gradient: RATE AT WHICH ELEVATION CHANGES FROM PLACE TO PLACE

1. Formula: $\text{GRADIENT} = \frac{\text{CHANGE IN FIELD VALUE}}{\text{CHANGE IN DISTANCE}}$

2. Calculating Gradient:

Use the elevation field map that that you drew contour lines on (which is on the previous page) to calculate the gradient between:

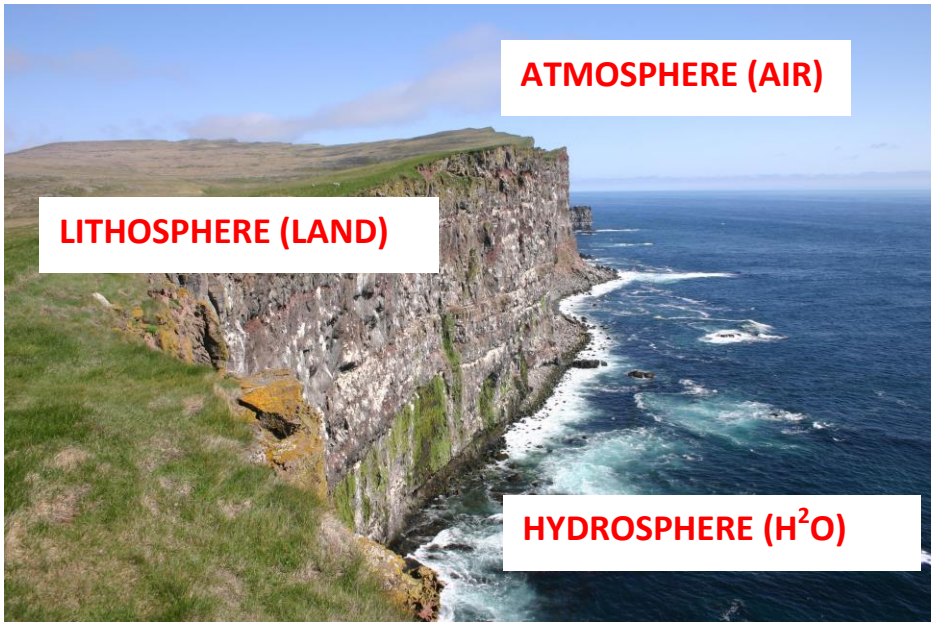
a. Point A and Point C

b. Point B and Point D

c. Point B and Point E

IX. Parts of Earth

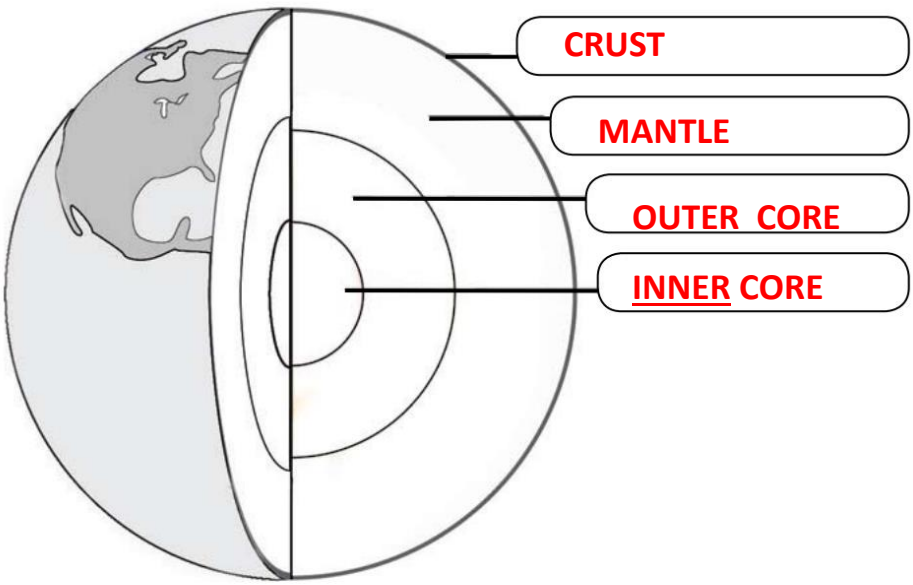
A. The three ‘ Spheres” of outer Earth are

1. **ATMOSPHERE** The shell of gases that surround earth
2. **HYDROSPHERE** The waters of Earth; its oceans, seas, lakes, and rivers.
3. **LITHOSPHERE** The dense, solid outer shell of Earth composed of rock.
4. 

5. (a) Which sphere of Earth is most dense? **LITHOSPHERE**

   (b) Which sphere of Earth is least dense? **ATMOSPHERE**

B. Earth’s Interior



UNIT 2 VOCABULARY

1. **Atmosphere:**
2. **Contour Line:**
3. **Contour Interval:**
4. **Coordinate System:**
5. **Crust:**
6. **Elevation:**
7. **Equator:**
8. **Gradient:**
9. **Hydrosphere:**
10. **Isoline:**
11. **Latitude:**
12. **Lithosphere:**
13. **longitude:**
14. **Pauses (of atmosphere):**
15. **Polaris**
16. **Prime Meridian:**
17. **Profile:**
18. **Slope:**
19. **Topographic map:**

Unit 2 Topics for Review and Study:

Latitude and Longitude

- **Lines**
- **Lat. Is N or S**
- **Long. Is E or W**

Rate of Rotation

Polaris

Graphic Relationships

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Topographic maps

- **elevation**
- **stream Flow**
- **gradient**
- **profile**
- **steep vs. gentle slope**
- **distance**
- **contour interval**
- **drawing isolines**

UNIT 1 HINTS & FACTS

(Here are some facts to help you study. You can also use this page to fill in your own)

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