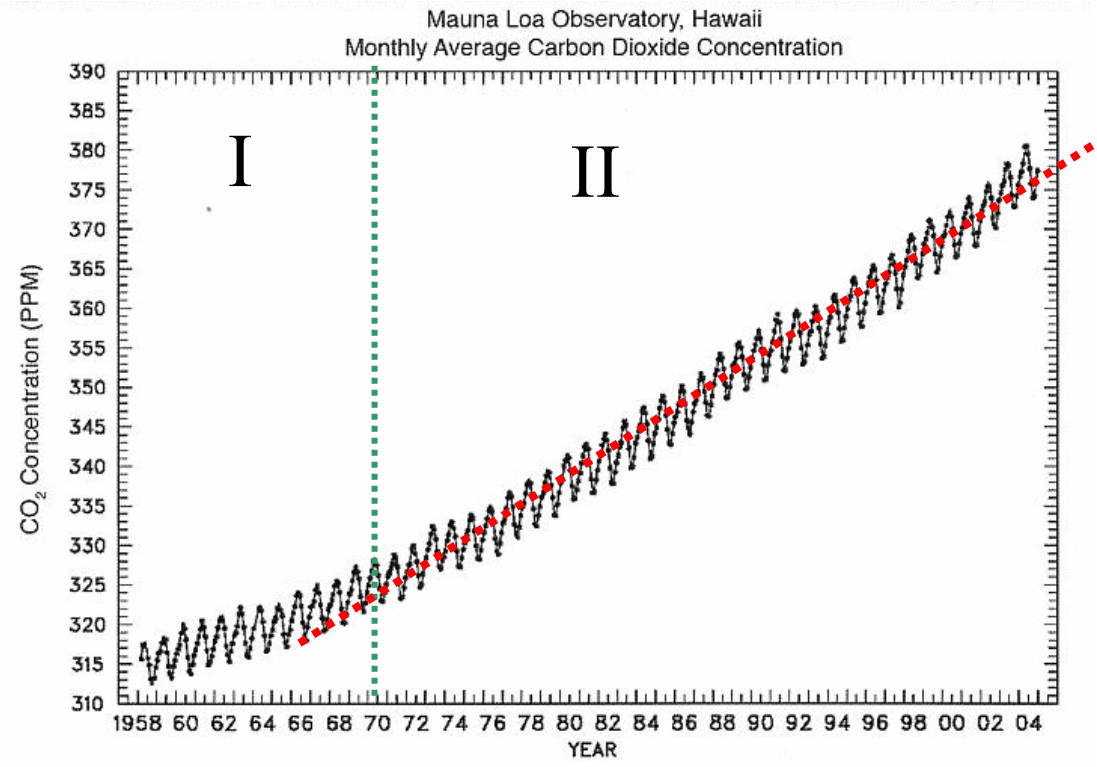
1. Use the following figure to answer the questions below (1.8 pts total, 0.6 pt each).



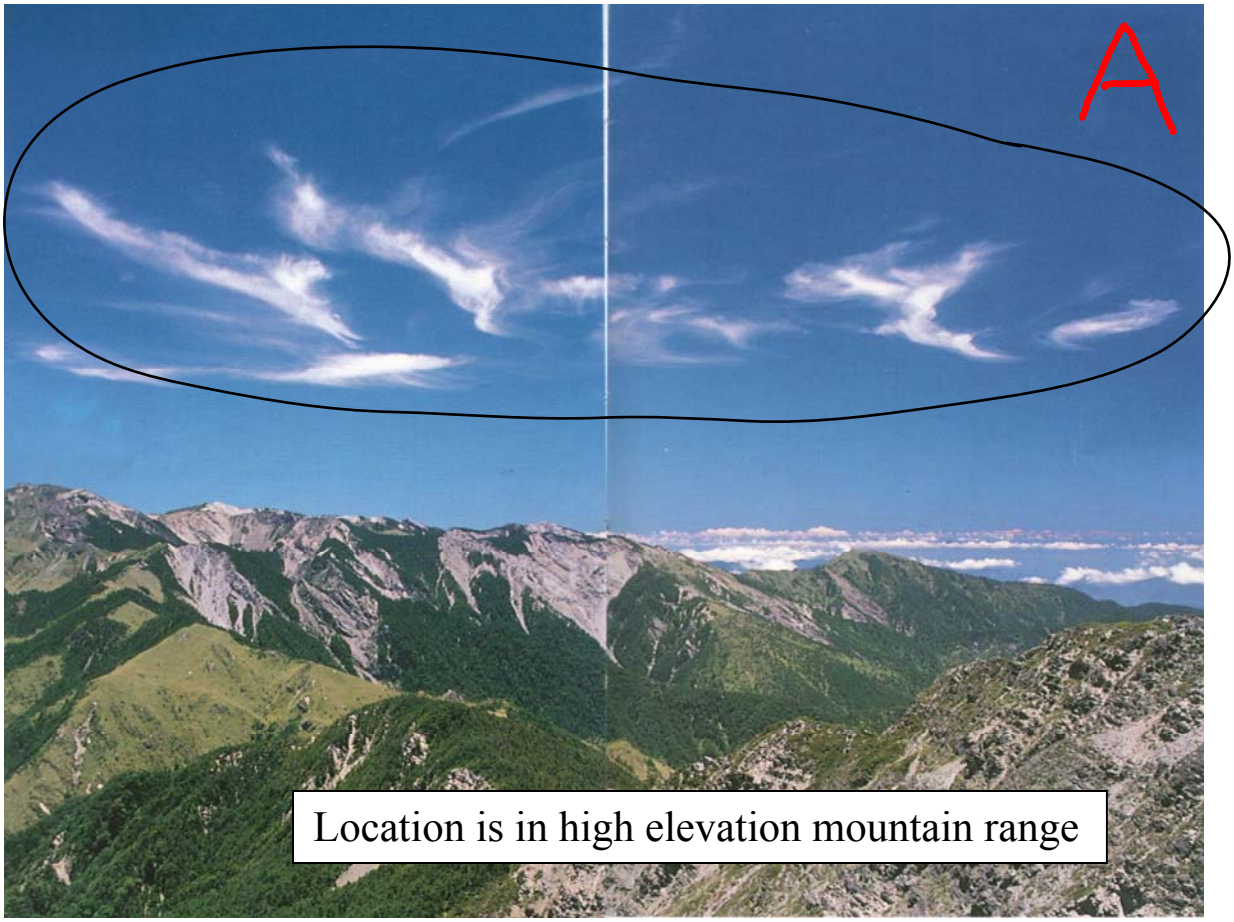
(a) Calculate the percent increase in CO_2 from 1970 to 2004. (0.6 pt)

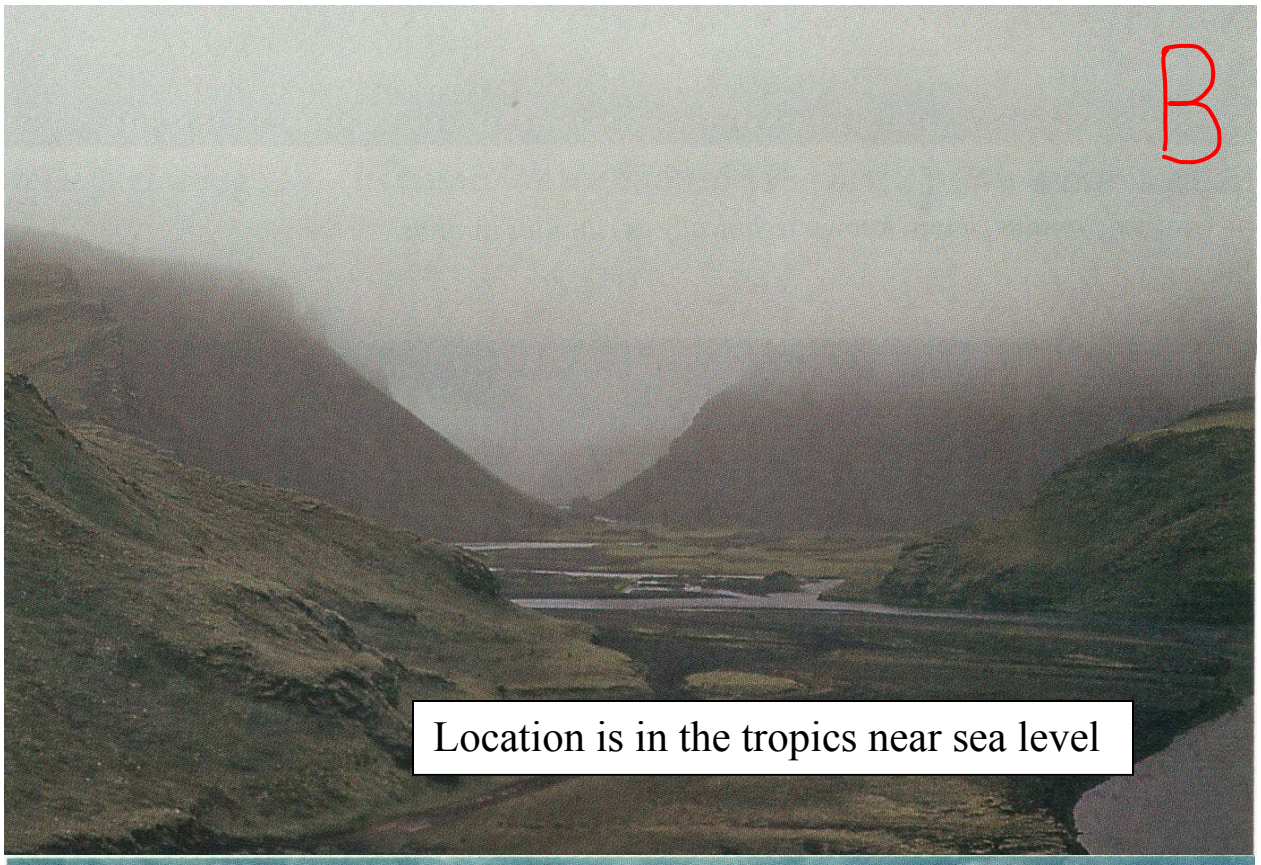
(b) Estimate in ppm the annual range of CO_2 variation. (0.6 pt)

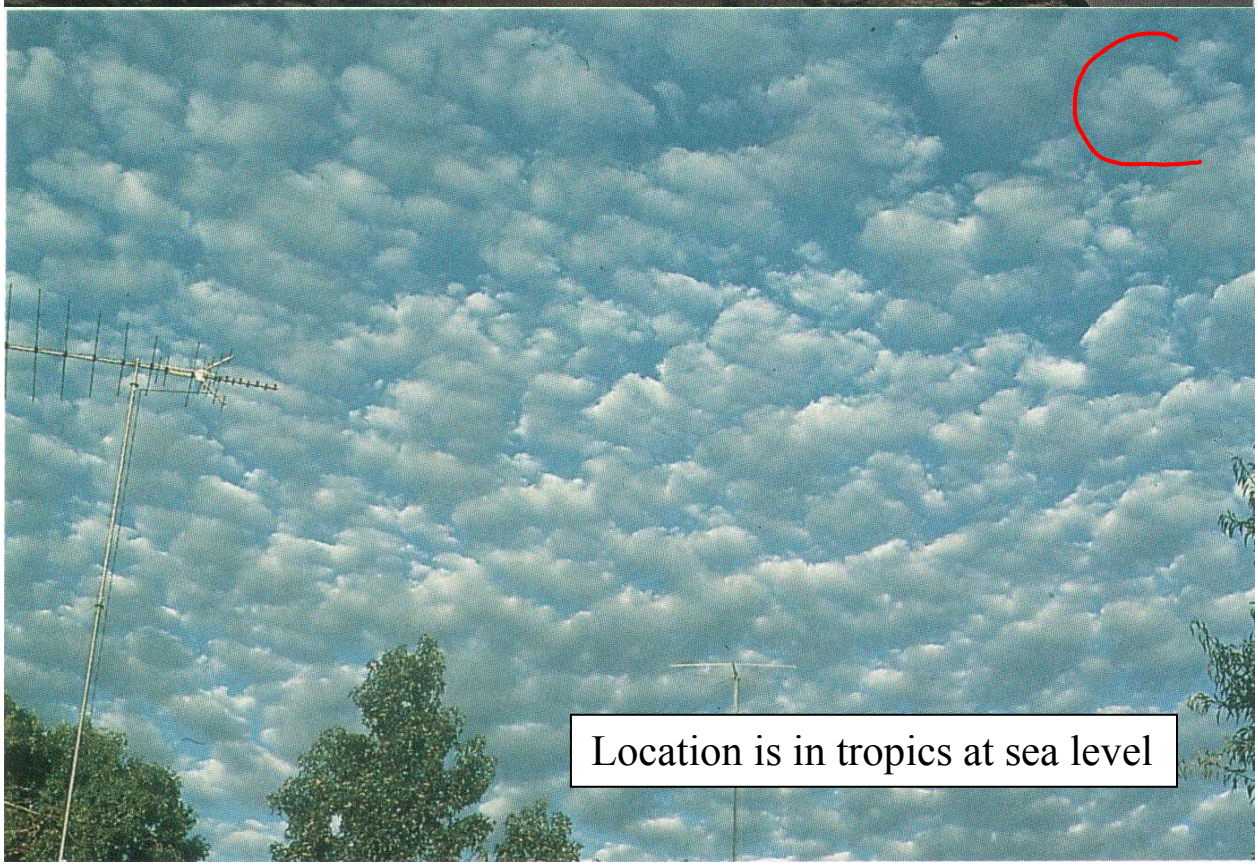
(c) In addition to CO_2, list two other greenhouse gases produced by human activities. (0.6 pt)

2. Use the three images of clouds to complete the chart below (2.7 pts total, 0.3 pt each).

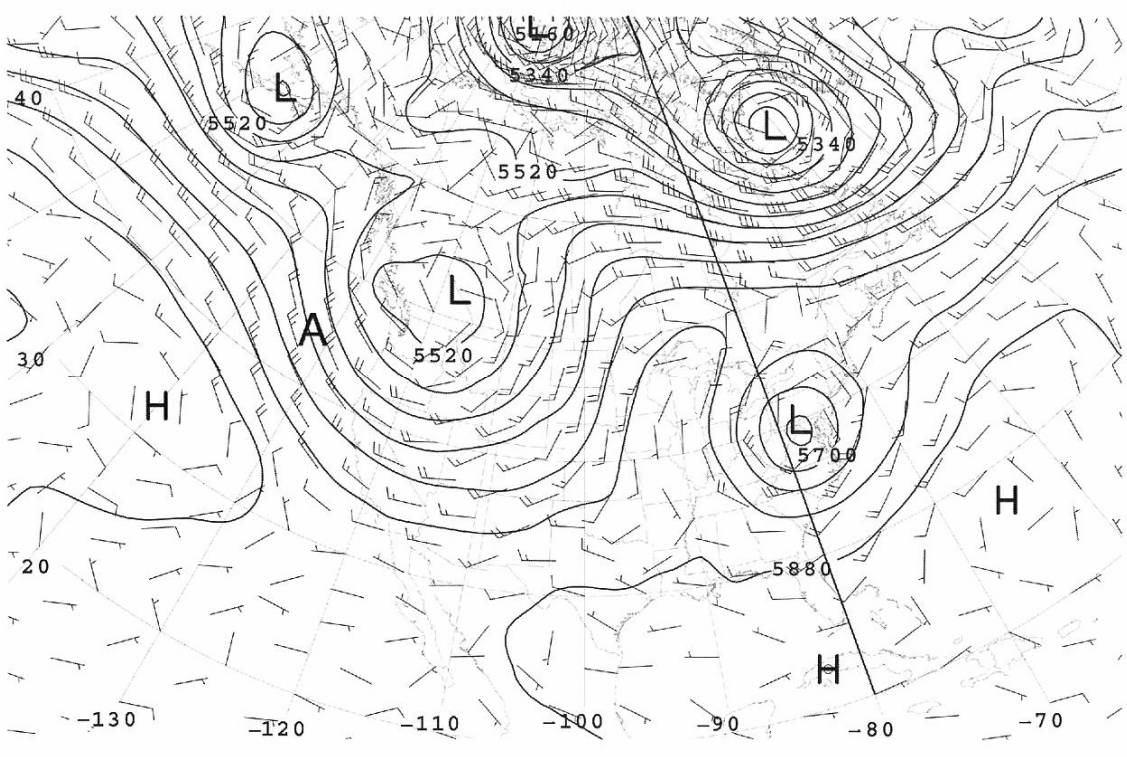
	A	B	C
Name of cloud type			
H_2O form (liquid, ice, vapor)			
Altitude of cloud (low, medium, high)			




B
Location is in the tropics near sea level


C
Location is in tropics at sea level

3. The position marked A is used in answering the following question (2.5 pts total):



The equation below describes the balanced flow at location **A** in this 500 hPa chart:

$$\frac{V^2}{R} + fV = -\frac{1}{\rho}\frac{\Delta P}{\Delta n}$$

(1.) (2.) (3.)

Where V is the wind speed, f is the Coriolis parameter, ΔP is the pressure difference in a distance Δn, n is normal to the horizontal velocity vector and pointing to left hand side of the wind direction, and R is the radius of curvature of trajectory.

a) Explain the physical meaning of each term in the equation.

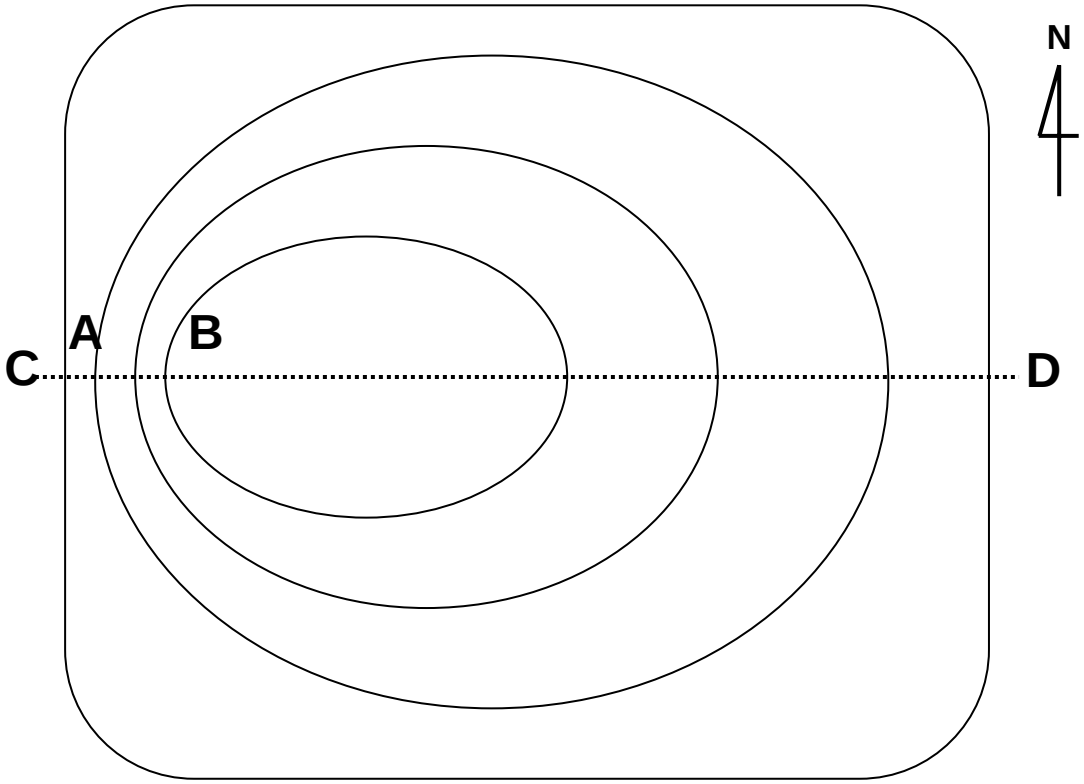
(1.)_____(0.5 pt)

(2.) _____(0.5 pt)

(3.) _____(0.5 pt)

b) On the figure above, show the direction of term(2) and term(3) at the position **A**. (1 pt)

4. The following figure shows a schematic diagram of sea surface height in the North Pacific Ocean. [9 pts/3 →3 pts total]



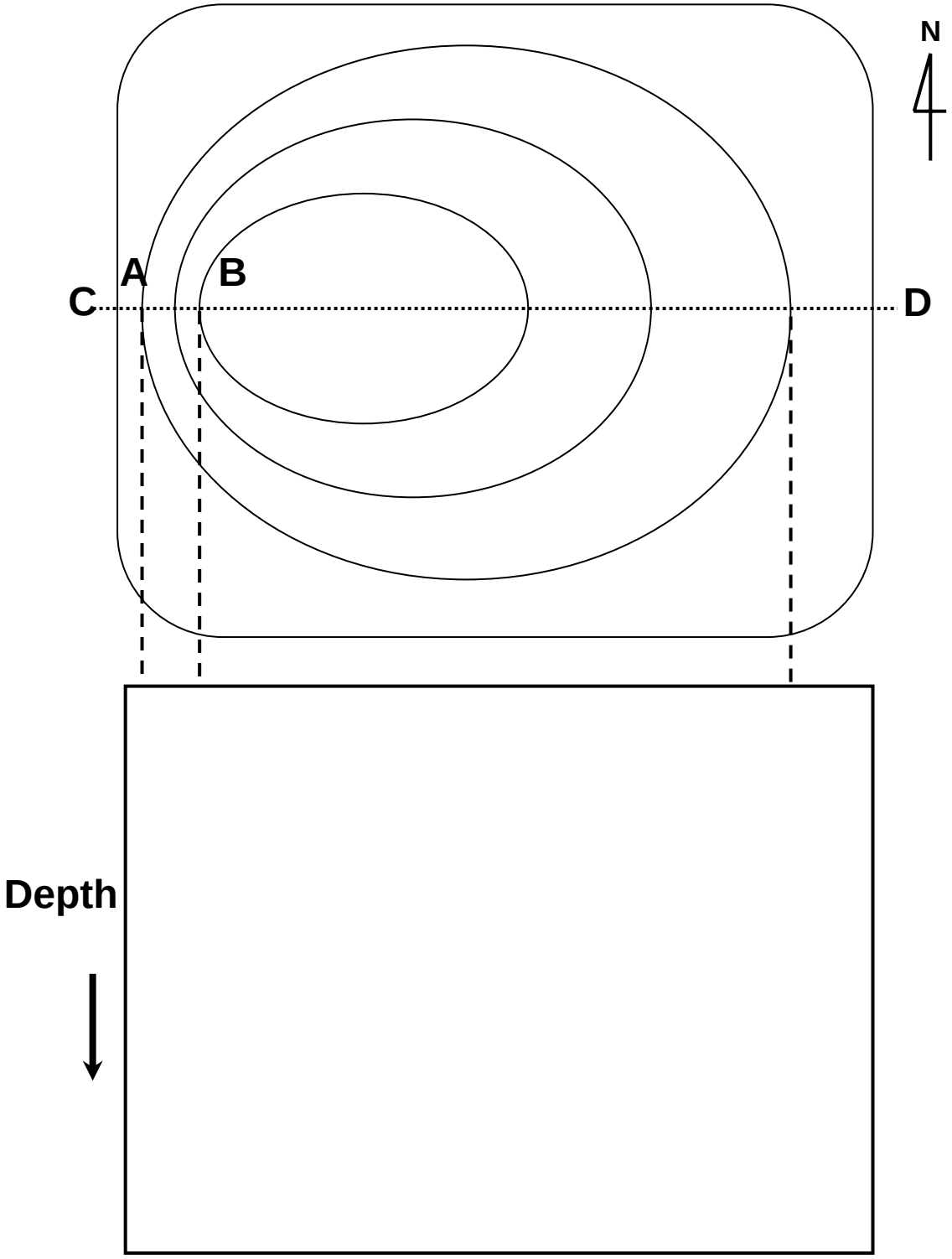
(a) Which station shows higher sea surface height between A and B? [1 pt]

(b) Show sea surface current vectors corresponding to the above sea surface height pattern. Draw the vectors on the figure above. [3 pts]

(c) Continued from question (b), what are the two dominant forces responsible for the currents? [1 pt]

(d) Also continued from question (b), explain the main cause of the asymmetrical circulation [2 pts]

(e) Draw temperature contours for the vertical section across the line CD in the blank figure below [2 pts]



5. This set of questions tries to show the Kepler's third law using the images of Uranus and its moons. Figure (1) shows the images of Uranus taken by Hubble Space Telescope in 1997, and the time interval between left and right images was 90 minutes. There are 8 moons revolving around Uranus as seen in the images.

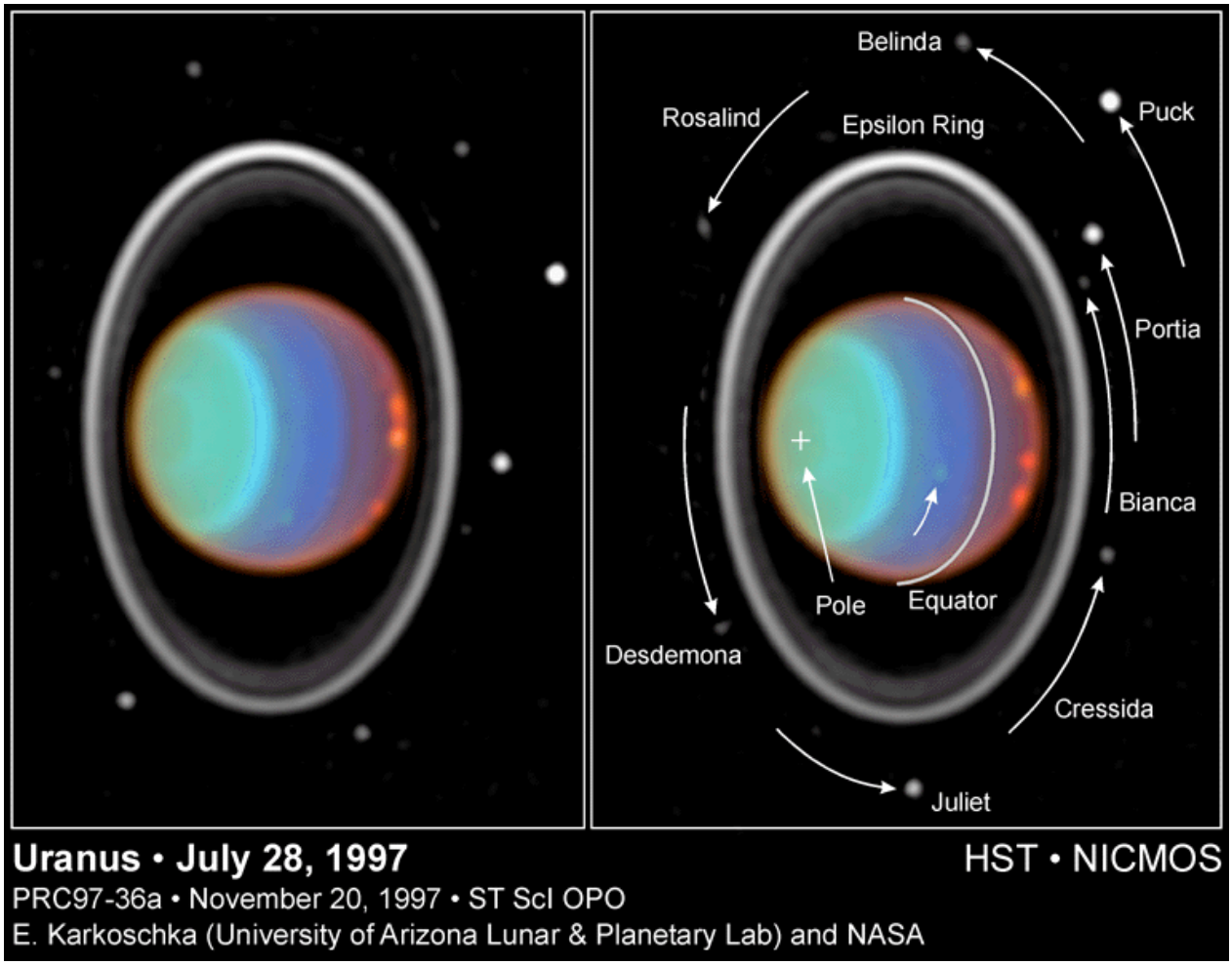


Figure (1) The images of Uranus

In order to figure out the motion of these 8 moons, the two images in Figure (1) were overlapped and combined to form a single image shown in Figure (2). Assume that the orbits of the 8 moons are circular and lying on the same plane with the same inclination angle. (Note: you are observing the plane of the circular orbits from an angle so that they appear as ellipses.) Using a ruler, a protractor and a compass, measure the radius of each orbit (R) in mm and estimate the period of revolution (T) of each orbit in hours. Note that the periods of all 8 moons are less than 24 hours. The procedure below described by steps a) to g) on the next page was used to find the information that is in Table 1. Use the same procedure to complete Table 1. (3 pts total)

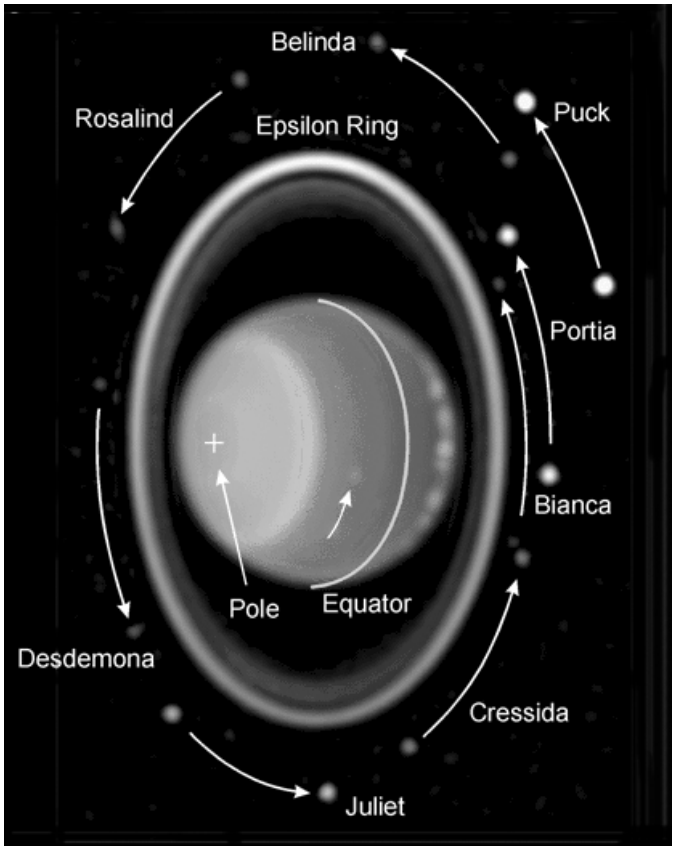


Figure (2) The motion of Uranus' moons

a) Find the center of Uranus and mark it as the origin of an x and y axis.
b) Find the observed elliptical orbit of Portia using its track in figure (2).
c) Draw the approximate elliptical orbit on figure (2).
   Note: Keep the center of ellipse at origin.
d) Draw the circular orbit from the observed ellipse orbit found in steps b) and c).
   Note: Keep the length of the semi major axis in the ellipse to be the same as the radius of the circular orbit.
e) Find the first and the second positions (90 minutes apart) of Portia at the circular orbit you drew.
   Note: Draw perpendicular lines from the y axis, passing through Portia's two images in figure (2). Find two points on the circular orbit by intersecting these two perpendicular lines with the circular orbits.
f) Find the angular difference between the two points in the circular orbit.
   Note: Draw two lines from the origin to the two points you found in step e).

g) Calculate the orbital period in hours.
Note: The two images were taken 90 minutes apart.

1) Complete the table below for both Portia and Puck (2 pts)

Table 1					
Moons	R(mm) radius of circular orbit	Angular difference(º) in 90 minutes	T(hour) Period of orbit	R^3	T^2
Belinda	54	34º	15.88	157464	252.2
Bianca	41				
Cressida	44.5	44.2	12.22	88121	149.3
Desdemona	45	43	12.56	91125	157.7
Juliet	46.5	41	13.17	100545	173.5
Portia					
Puck					
Rosalind	50	38	14.21	125000	201.9

2) Plot a graph to show Kepler's third law. On the graph paper, plot the data points on Table 1 showing the relationship of R^3 and T^2 of the 7 moons. Draw the best straight line that fits Kepler's third law in your graph. (0.5 pt)

3) Estimate the period of Bianca using graph made in question 2). [The radius of Bianca's circular orbit is 41 mm.] (0.5 pt)

6. Telescope Practical Section

1) Operation (3 pts)

Please go to the station where parts of telescopes can be found. Take one set of telescope parts and set it up as following steps.

** A proctor will evaluate how you set up the telescope.

a) Mount the telescope to the tripod firmly. (0.5 pt)

b) Adjust the tripod, set the equatorial mount oriented to the north. (0.5 pt)

[See the direction mark on the ground]

c) Adjust the tripod using the bubble level on it. (0.5 pt)

d) Adjust the angle of the equatorial mount based on the latitude of Manila, 14° 36′.(0.5 pt)

e) Balance the main telescope with the weight. (0.5 pt)

f) Balance the telescope parts which consist of the main telescope, the finder, and the eyepiece. (0.5 pt)

2) Find the the diameter and focal length of the main telescope and complete Table 2 (2 pts)

Diameter of main telescope = ( ) cm

Focal length of main telescope = ( ) mm

Table 2.

eyepiece	magnification
Or 6 mm	
Or 12 mm	
K 25 mm	

When you finish questions above, please raise your hand and the proctor will let you go back to your seat.

3) Usually, the pupil of human eye will enlarge to 8 mm in a dark place for about 15-20 minutes. If a person observes a faint star with magnitude 6.0, what magnitude of a heavenly object can he/she observe with this telescope? (1 pt)

4) In observing Saturn, which eyepiece in Table 2 would be the best choice if you want to see more detail? (1 pt)

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There are 8 stations for the geology practical section
Please spend only **5 minutes** for each station.

Station 1 [1.6 pts]

Identify the following rock specimens:

Rock Specimen Number	Answer
2	
19	
30	
32	

Station 2 [1.6 pts]

Identify the following rock minerals:

Rock Mineral Number	Answer
3	
23	
39	
40	

Station 3 [1.6 pts]

Identify the following rock specimens:

Rock Specimen Number	Answer
21	
27	
39	
82	

Station 4 [1.6 pts]

Identify the following rock specimens:

Rock Specimen Number	Answer
43	
46	
49	
60	

Station 5 [0.9 pt]

* Please do not touch the block model

Examine the given geologic cross-section and choose the correct event sequence from the oldest to the youngest.

1. faulting
2. uplift and erosion
3. deposition of sedimentary beds below the solid horizontal line (labelled 92)
4. subsidence
5. deposition of sedimentary beds above the solid horizontal line (labelled 92)
6. folding

Choose the correct answer

a. 3-2-5-1-4-6
b. 6-3-2-4-5-1
c. 3-4-6-2-5-1
d. 3-6-4-2-5-1
e. 3-6-2-4-5-1

Answer : _____

Station 6 [0.9 pt]

Write down the number of the rock specimen that matches the thin section.

Answer : _____

Station 7 [0.9 pt]

Write down the number of the rock specimen that matches the thin section.

Answer : _____

Station 8 [0.9 pt]

Write down the number of the rock specimen that matches the thin section.

Answer : _____