

Name: _____

Block: _____

Group: _____

Worksheet for IMAGINARY FLIGHTS (Seattle Sectional)

Instructions: You will be learning about addition of vectors in 2 dimensions by simulating real flight conditions on an obsolete Flight Navigation Chart. These charts are called “Sectional Charts” and are used by pilots to identify landmarks. Since you will be drawing displacements as well as velocity vectors on the chart, to keep confusion to a minimum, you should use two different units for your scales. It is suggested that you measure distances in *inches* and use *centimeters* for your velocity vectors.

1. Take a look at your sectional chart. Find the legend. Identify symbols used for airports, landmarks, etc. Identify the latitude and longitude lines across your chart.
2. For each flight, identify the “origin” and “destination” airports. Use the latitude and longitude numbers given. Mark them on the chart using different colors for each flight.
3. “Heading” refers to the direction you take off. You will not always be headed in the direction of the runway on the chart.
4. “Course” refers to the actual direction followed, as viewed from the ground.
5. “Air speed” is the velocity of the plane relative to the air. This is the speed at which the plane takes off. This is what the pilot sees on his or her speedometer.
6. “Wind speed” is the velocity of the wind relative to the ground.
7. “Ground speed” is the velocity of the plane relative to the ground.
8. When you want to find the direction of a course, or its heading, use the latitude and longitude lines as a compass rose. They represent the true cardinal points (North, South, East and West.)
9. Leave all your calculations on paper. Since all velocities are given in *km/h*, you will want to have all true distances in *kilometers*.
10. Your instructor will demonstrate the problems by solving the *Test Flight* for both parts. Flights on part A simulate flights in which the pilot *does nothing to compensate for the wind* (passive flying.) Those on part B simulate active corrections by the pilot, so the plane goes to the proper destination.
11. The maximum number of points for this activity is 40 points (20 points per part.)

Sectional Chart: *Seattle*

Scale (distances): _____ (from the chart)

Scale (velocities): _____

Scale (distances): _____ (true distances)

PART A: Passive Flying

Test Flight: *origin: Lewinston-Nez Pierce County Airport; 46° 22.5' N, 117° 0.5' W*
destination: Walla Walla Regional Airport; 46° 6' N, 118° 17' W
true speed: 200 km/h
wind speed: 38 km/h [S]

Flight 1: *origin: La Grande/Union County Airport; 45° 17.5' N, 118° 0.5' W*
destination: Walla Walla Regional Airport; 46° 6' N, 118° 17' W
true speed: 240 km/h
wind speed: 130 km/h [W]

Flight 2: *origin: Astoria Regional Airport; 46° 9.5' N, 123° 53' W*
destination: Portland International Airport; 45° 35' N, 122° 36' W
true speed: 200 km/h
wind speed: 98 km/h [N]

Flight 3: *origin: Salem Regional County Airport; 44° 54.5' N, 123° W*
destination: Portland International Airport; 45° 35' N, 122° 36' W
true speed: 190 km/h
wind speed: 66 km/h [W]

PART A: Passive Flying

Instructions: Fill out the columns on this table. Give all speeds in km/h, and all distances in km.

1. Use km/h as the units for velocity.
2. The HEADING and COURSE columns pertain to the direction only.
3. For the *ground speed*, list the magnitude as well as the direction of your vector.
4. For the locations on the column marked "Where will the plane be at...", give the landmark *and* its location on the chart (latitude and longitude.) Compute the time for the total flight.
5. List the names of three (3) *other* landmarks on the plane's course on the last column. You do not need to give their locations here.

Flight	Heading	Ground Speed	Course	Where will the plane be at...		Three (3) other landmarks
Test				t = 36.4 min?		#1
				t = 20.3 min?		#2
				Δt (flight)?		#3
#1				t = 17.7 min?		#1
				t = 20.2 min?		#2
				Δt (flight)?		#3
#2				t = 23.5 min?		#1
				t = 19.1 min?		#2
				Δt (flight)?		#3
#3				t = 24.4 min?		#1
				t = 35.6 min?		#2
				t = 35.6 min?		#3

PART B: Correcting the Flight (Active Flying)

Test Flight: *origin: Yakima International Airport; 46° 34' N, 120° 32.5' W*
destination: Hermiston Airport; 45° 50' N, 119° 15' W
true speed: 180 km/h
wind speed: 50 km/h [W]

Flight 1: *origin: Seattle Tacoma International Airport; 48° 19' N, 122° 18.5' W*
destination: Oak Harbor Regional County Airport; 48° 21.5' N, 122° 39.5' W
true speed: 250 km/h
wind speed: 36 km/h [E]

Flight 2: *origin: Grant County International Airport; 47° 12.5' N, 119° 19' W*
destination: Spokane International Airport; 47° 47.5' N, 117° 42' W
true speed: 230 km/h
wind speed: 54 km/h [N]

Flight 3: *origin: Snohomish County Airport; 47° 54' N, 122° 17' W*
destination: Abbotsford International Airport; 49° 1' N, 122° 23' W
true speed: 180 km/h
wind speed: 18 km/h [W]

PART B: Correcting the Flight (Active Flying)

1. **Instructions:** Fill out the columns on this table. Give all speeds in km/h, and all distances in km.
2. The HEADING and COURSE columns pertain to the direction only.
3. To find the heading angle (after correction):
 - a. Measure the angle between the wind speed and the true speed (before the correction); let's call this angle "α."
 - b. Calculate the **correction for the heading angle (β)** from this equation:

$$\beta = \arcsin^{-1} \left[\frac{\text{wind speed}}{\text{true speed}} \sin(180^\circ - \alpha) \right]$$

4. For the *ground speed*, list the magnitude as well as the direction of your vector.
5. For the locations on the column marked "Where will the plane be at...", give the landmark *and* its location on the chart (latitude and longitude.) Also, calculate the trip's total time Δt.
6. List the names of three (3) *other* landmarks on the plane's course on the last column (coordinates not needed.)

Flight	Heading	Ground Speed	Course	Where will the plane be at...		Three (3) other landmarks
Test				t = 18.1 min?		#1
				t = 45.1 min?		#2
				Δt (flight)?		#3
#1				t = 4.21 min?		#1
				t = 21.8 min?		#2
				Δt (flight)?		#3
#2				t = 12.2 min?		#1
				t = 24.0 min?		#2
				Δt (flight)?		#3
#3				t = 41.2 min?		#1
				t = 30.2 min?		#2
				Δt (flight)?		#3