WIND, MAGNETIC FIELDS, AND FLIGHT ROUTES

OBJECTIVE

Demonstrate an understanding of the effect of wind and magnetism on navigation by determining headings, times, and fuel requirements for the scenarios in the questions.

TC +/- WCA= TH TH +/- MV=MH MH +/- DEV = CH

TC +/– MV = MC MC +/– DEV = CH

Sample Compass Deviation Card:

For (Magnetic)	N	30	60	E	120	150
Steer (Compass)	0	28	57	86	117	148
For (Magnetic	S	210	240	W	300	330
Steer (Compass)	180	212	243	274	303	332

Editorial credit: Pilot's Handbook of Aeronautical Knowledge

You are taking off out of Topeka Regional Airport (KFOE) in Topeka, Kansas, to visit some friends in Salina, Kansas, about 100 NM to the west. You've also planned to stop for lunch between Topeka and Salina at Emporia Airport (KEMP). The two legs of this flight are plotted on the sectional chart excerpts below.

KFOE to KEMP:

- TC: 209 degrees
- Distance: 45 NM

Editorial credit: SkyVector

KEMP to KSLN:

- TC: 287 degrees
- Distance: 74 NM

Editorial credit: SkyVector

You plan to fly the entire trip at **110 knots true airspeed.** Your performance charts tell you the fuel burn rate under those conditions will be **10 GPH.** You'll start the trip with **15 gallons of fuel** on board.

As you consider your planned altitude, you decide to choose the altitude that gives you the most favorable winds. When you pull up the winds aloft forecast, you see data for three airports: Wichita (KICT), Salina (KSLN), and Kansas City (KMKC). KICT is southwest of Salina and KMKC is just a few miles east of Topeka.

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FT   3000   6000     9000
ICT  1823   1129+04  3524+06
SLN  1923   1124+07  3317+04
MKC  1824   1029+05  3523+02
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QUESTIONS

1. Which altitude gives you a tailwind on the leg to Salina?

   6,000 feet shows a wind from 110 degrees, which is a direct tailwind to the planned true course of 290 to Salina. The winds at the other altitudes are not as favorable.

2. What wind values would you plan to use in your calculations on the first leg? What wind values would you use on your second leg? Why?

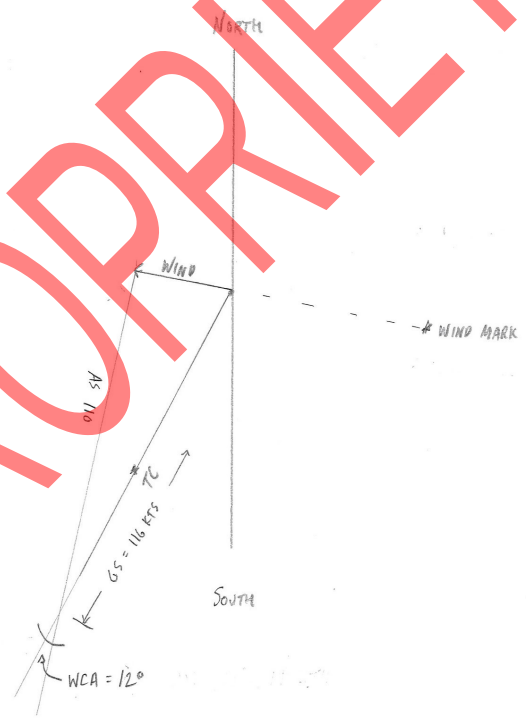
   The best response for the winds on the first leg is to use the winds at KMKC, as those are the nearest to the flight path.

   For the leg to KSLN, the winds at 3,000 feet and 6,000 feet for both KMKC and KSLN are within 10 degrees of each other, and the winds at 6,000 feet provide a tailwind on this leg. Since the pilot begins this leg closer to KSLN than KMKC and is traveling toward KSLN, selecting the KSLN winds is a good choice.

NOTE: For the calculations in questions 3, 4, and 5, use a wind value of 110 degrees / 25 knots.

3. Draw a wind triangle to determine the compass heading and groundspeed for the leg from Topeka to Emporia.

   *The following triangle is created using the steps from the lesson and **Which Way to Steer? Teacher Notes 4:***



   *Based on the wind triangle above, the **groundspeed would be 116 knots.***

   *The **compass heading is 195 degrees or 196 degrees.** The true heading is 197 degrees. Due to a magnetic variation of 3 degrees east, as seen on the sectional near Topeka, the magnetic heading would be 194 degrees. The compass deviation card indicates a +1 or +2 degree change to the heading resulting in a compass heading of 195 degrees or 196 degrees.*

4. How long would this leg take? How much fuel would be consumed on the flight to Emporia?

   With a groundspeed of 116 knots and a distance of 45NM, the flight time = 45 / 116 = ***0.39 hours = 23 minutes.*** *At a burn rate of 10 GPH, Fuel used = .39 x 10 =* ***3.9 gallons.***

5. How have wind and magnetism affected the planning for this leg?

   There is a slight tailwind and a need to offset the heading to the east to avoid drifting too far west. With a -3 variation and +1 compass deviation, the 2-degree magnetic heading error was slight.

6. The leg from Emporia to Salina is a true course of 287 degrees. If airspeed is 110 knots, and the wind is from 107 degrees at 25 knots, determine the compass heading and ground speed from KEMP to KSLN.

   No wind correction angle is needed (the wind direction is the reciprocal of the true course), so MC = TC - MV. Students may choose to use a MV of 3, 4, or even 3.5 degrees. The MC = 287 – 4 = 283 degrees. The compass deviation at this heading is approximately +4 degrees. CH = 283 + 4, so the ***CH = 287 degrees.*** *With no crosswind component, wind velocity is pure tailwind. Thus, the groundspeed = airspeed + windspeed = 110 + 25 =* ***GS = 135 knots.***

7. Using the groundspeed from number 6 above, how long would this leg take? How much fuel would be consumed on the leg to Salina?

   Flight time = 74 / 135 = ***0.55 hours = 33 minutes.*** *At 10 GPH, Fuel used = 10 Ð 0.55 =* ***5.5 gallons.***

8. How much fuel will the entire flight use? Will the aircraft have enough fuel on board to make the trip without refueling?

   Total fuel used = 3.9 + 5.5 = ***9.4 gallons.*** *A 30-minute fuel reserve at 10 GPH would be an additional 5 gallons, meaning the flight would require* ***14.4 gallons.*** *Since the initial fuel on board is* ***15 gallons****, the aircraft has enough fuel to complete the flight without refueling. (However, few pilots would likely "cut it that close," and they'd probably either add fuel before leaving KFOE or would add fuel at KEMP.)*

9. Assuming you spend an hour at lunch at Emporia, about how long would the total trip to KSLN take?

   Total time = 0.39 + 0.55 + 1.0 = 1.94 hours, essentially a two-hour trip, though this does not account for time to preflight, conduct ground operations, or experience any other delays.

10. How have wind and magnetism affected the planning for this leg?

    A substantial tailwind increased the groundspeed to shorten the flight time for this leg. This resulted in low fuel consumption. Note how close the fuel used on this leg is to the fuel on board at KEMP. Without the tailwind, the pilot would not have had enough fuel to make this one-leg flight.

    There were magnetic variations of 3 to 4 degrees which, while not large, could make a difference over the length of a 75 NM leg. Compass deviation values were also present, but small (one to two degrees).