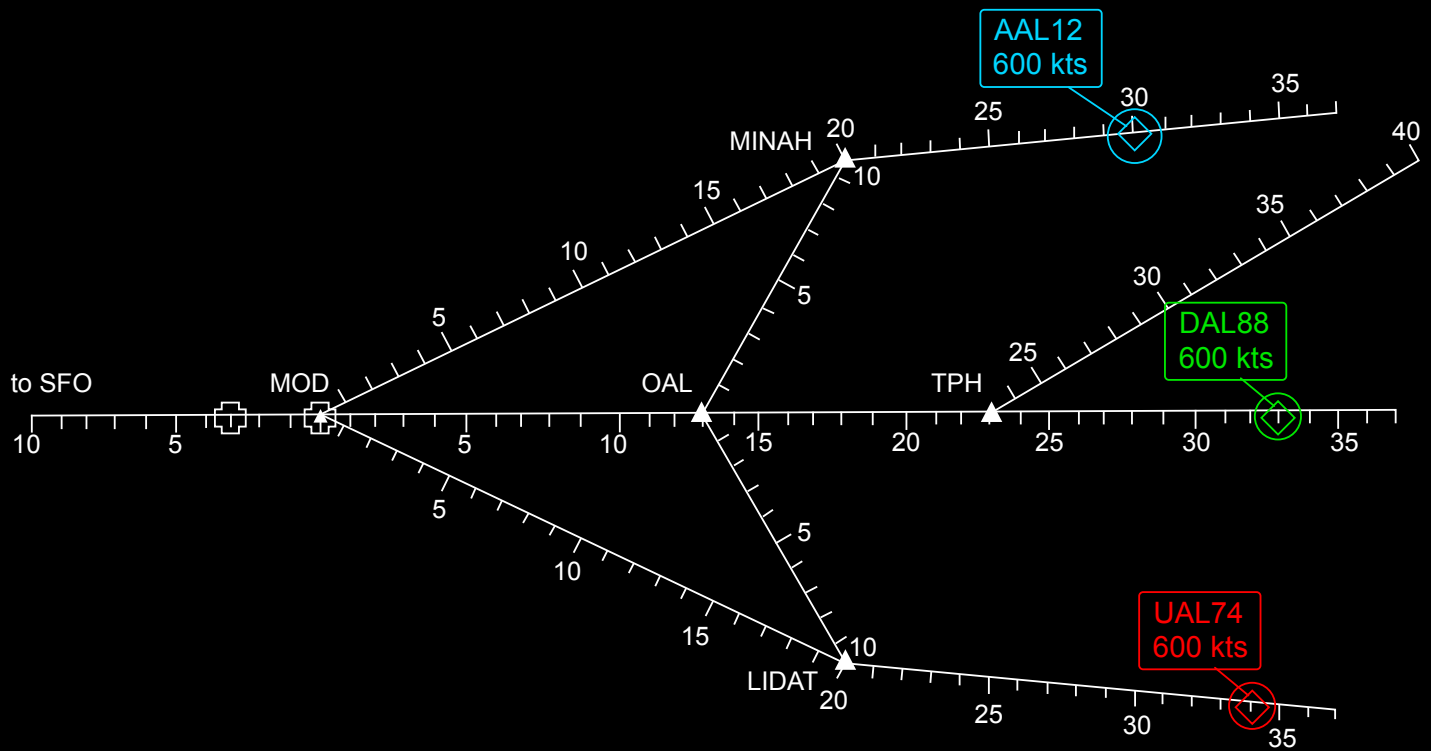




LineUp with Math

Math-Based Decisions in Air Traffic Control

STUDENT WORKBOOK F

Resolving Air Traffic Conflicts by Changing Speed

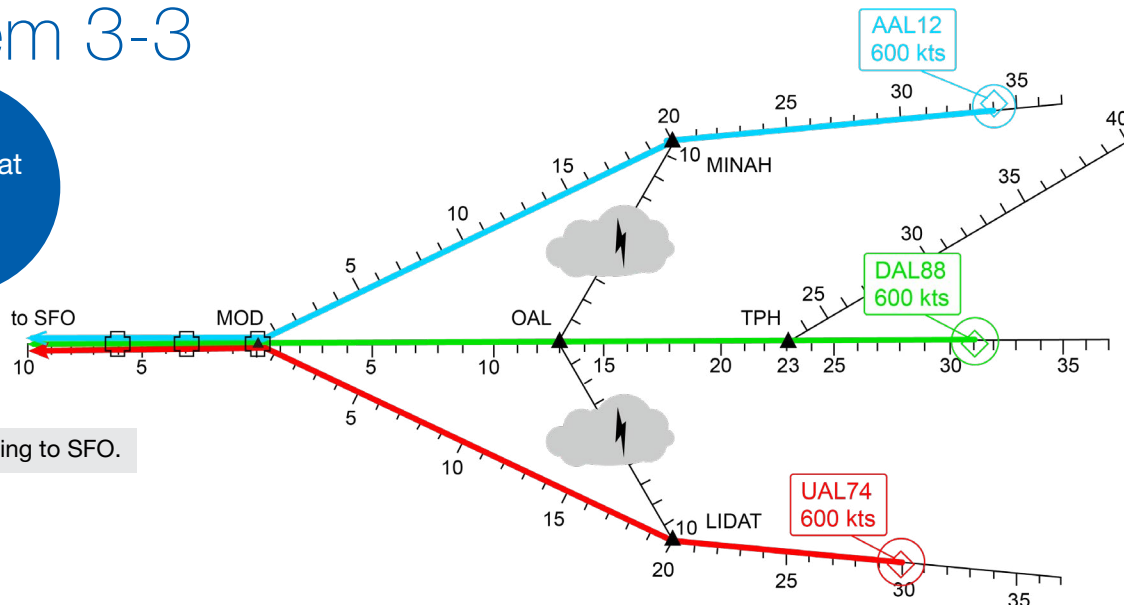
- * 3 planes, each at the same starting speed.
- * Simulator Problems 3-3, 3-4, 3-5, 3-6.

Simulator at: <https://atcsim.nasa.gov/simulator/sim2/sector33.html>

WORKSHEET #1

Problem 3-3

Ideal
Spacing at
MOD =
3 NM



All 3 planes are going to SFO.

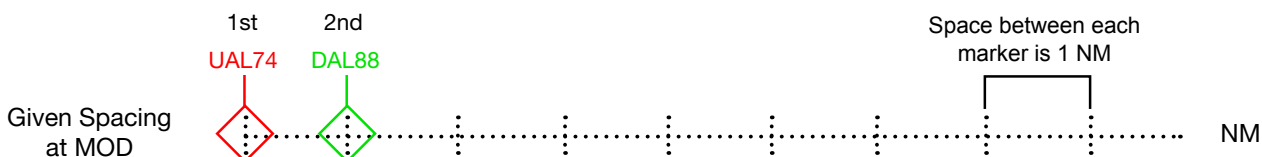
→ Analyze the diagram to determine any spacing needs and notice the alternate routes are closed.

1. To find the arrival order of the 3 planes at MOD, fill in the blanks.

Plane	AAL12	DAL88	UAL74
Distance to MOD, NM	_____	_____	_____
Arrival Order	_____	_____	_____

⚠ To picture arrival order and spacing of each plane, use a number line. Start with the first plane to arrive and work back to the last plane.

2. Use a $\diamond$ to show the order and spacing for the 3rd plane. Label the $\diamond$ with the plane's call sign.



It helps to picture the arrival order and spacing at MOD!

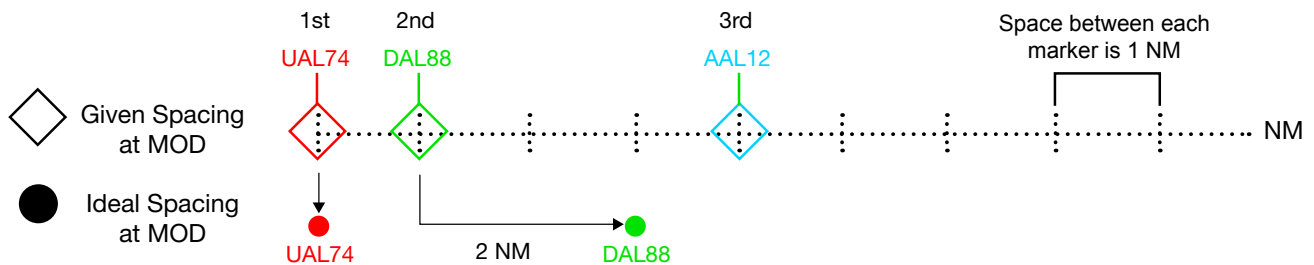
WORKSHEET #1 continued

Problem 3-3

→ Next, determine the additional spacing needed to get Ideal Spacing at MOD.

3. How much spacing is needed between the first and second plane? _____ nautical miles

→ An arrow is used to show the additional spacing needed for the 2nd plane with a (dot) at the end of the arrow labeled with the plane's call sign.



4. Based on the **NEW** position of the 2nd plane, how much additional spacing is needed between the second and third plane to get ideal spacing?
_____ nautical miles
5. Use an arrow to show the additional spacing for the third plane. Put a (dot) at the end of the arrow to show the new spacing and label it with the plane's call sign.

→ Analyze the speed changes that need to be made. Begin with the second plane.

6. How much will you slow its speed? _____ knots

What will the new speed be? _____ knots

7. How many minutes will it take to get the additional spacing?
_____ minutes

8. Will the planes get the additional spacing needed before MOD? ☐ Yes ☐ No

A 60-knot difference in speed will cause a 1 NMle difference in spacing **each minute**

WORKSHEET #1 continued

Problem 3-3

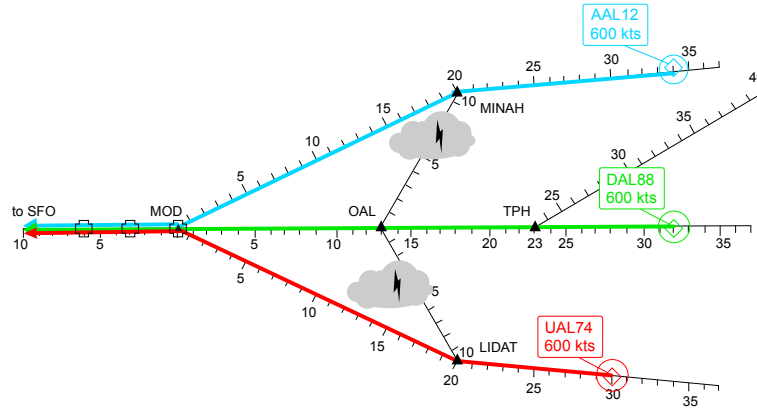
9. Now, what speed changes will be needed for the third plane? Fill in the blanks.

Plane Call Sign	Additional Spacing Needed	New Speed	Time Until Ideal Spacing	At or Before MOD?
_____	_____ NM	_____ Kts	_____ Mins	☐ Yes ☐ No

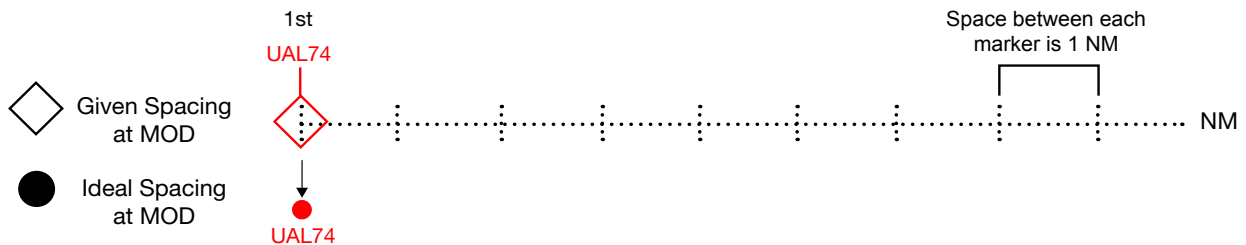
➔ If Yes, Congratulations! If no, try again!

WORKSHEET #2

Ideal
Spacing at
MOD =
3 NM



1. Plot each plane's given spacing at MOD with a $\diamond$. Use an arrow with a • (dot) at the end to show the additional spacing needed to get ideal spacing. Label each dot with the plane's call sign.



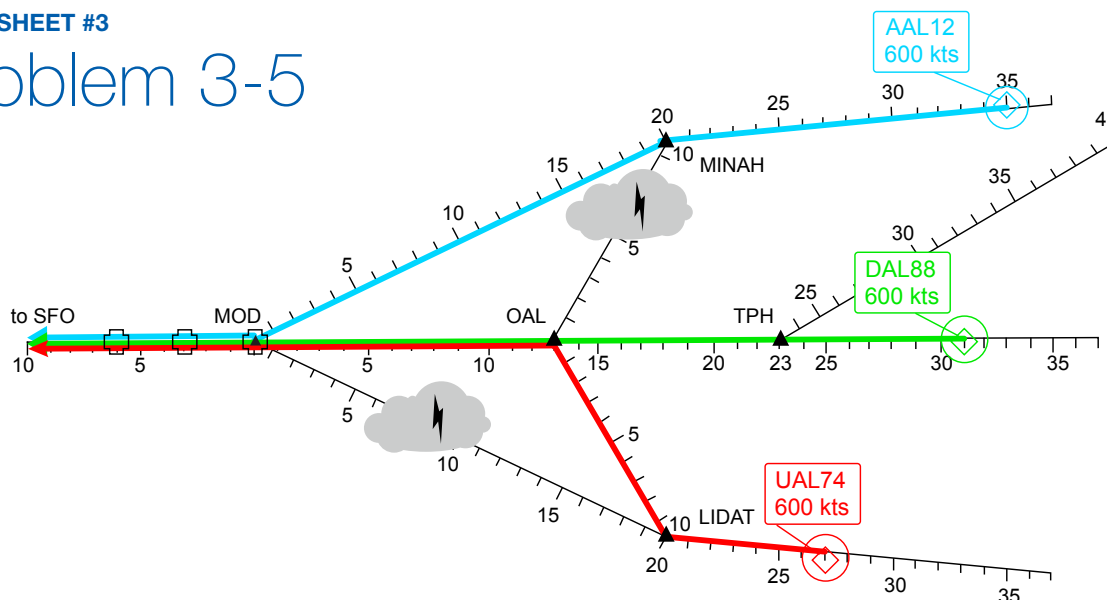
2. Fill in the table with the speed changes needed to get ideal spacing at MOD.

Order	Call Sign	Additional Spacing Needed	New Speed	Time Until Ideal Spacing	At or Before MOD?
2nd	_____	_____ NM	_____ Kts	_____ Mins	☐ Yes ☐ No
3rd	_____	_____ NM	_____ Kts	_____ Mins	☐ Yes ☐ No

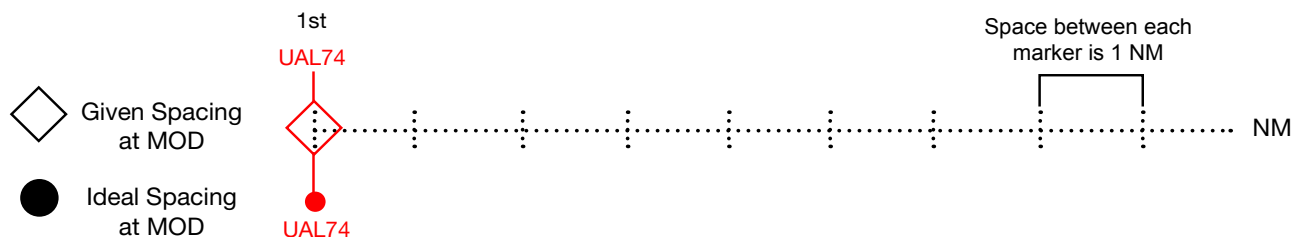
➔ If Yes, Congratulations! If no, try again!

WORKSHEET #3

Problem 3-5



- Plot each plane's given spacing at MOD with a . Use an arrow with a • (dot) at the end so show the additional spacing needed to get ideal spacing. Label each dot with the plane's call sign.



- What speed changes will need to be made to to get ideal spacing at MOD? Fill in the table.

Order	Call Sign	Additional Spacing Needed	New Speed	Time Until Ideal Spacing	At or Before MOD?
2nd	_____	_____ NM	_____ Kts	_____ Mins	☐ Yes ☐ No
3rd	_____	_____ NM	_____ Kts	_____ Mins	☐ Yes ☐ No

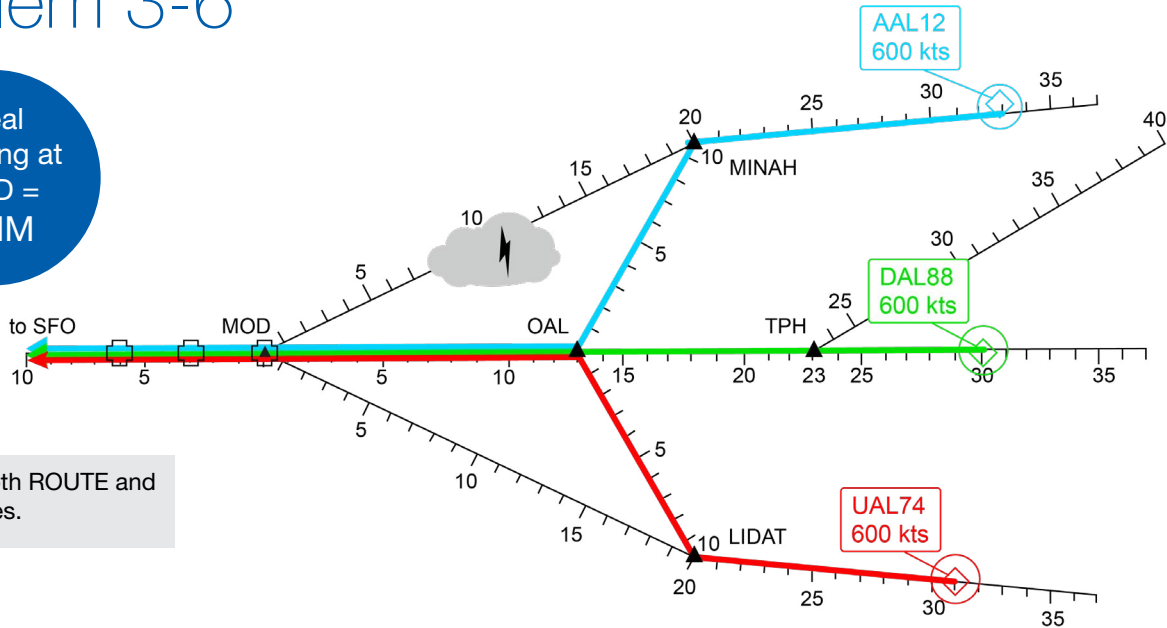
- At the new speeds, will UAL74 and DAL88 have at least minimum separation at **OAL**?

☐ Yes ☐ No

WORKSHEET #4

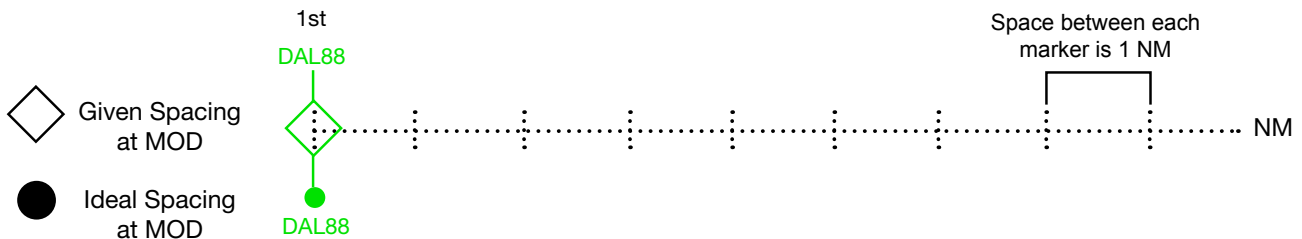
Problem 3-6

Ideal
Spacing at
MOD =
3 NM



You will use both ROUTE and
SPEED changes.

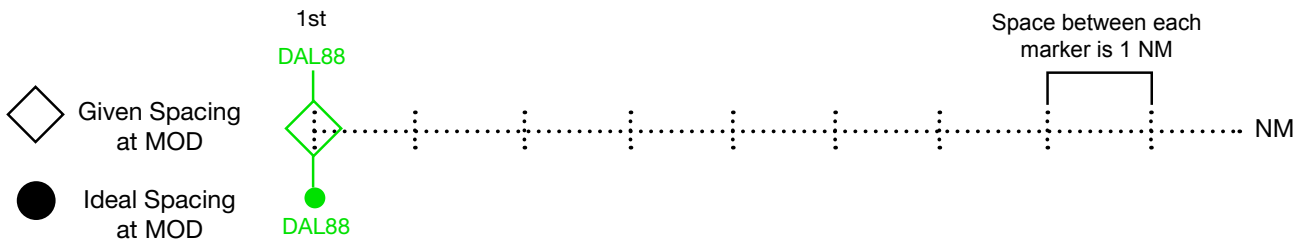
- Plot each plane's given spacing at MOD with a $\diamond$. Use an arrow with a • (dot) at the end to show the additional spacing needed to get ideal spacing. Label each dot with the plane's call sign.



- For the second plane, what route change and speed change will give ideal spacing at MOD?

Changes: Route _____ Speed: _____ knots

- With the new route and speed changes, plot the second and third plane's new position and any new spacing needed.

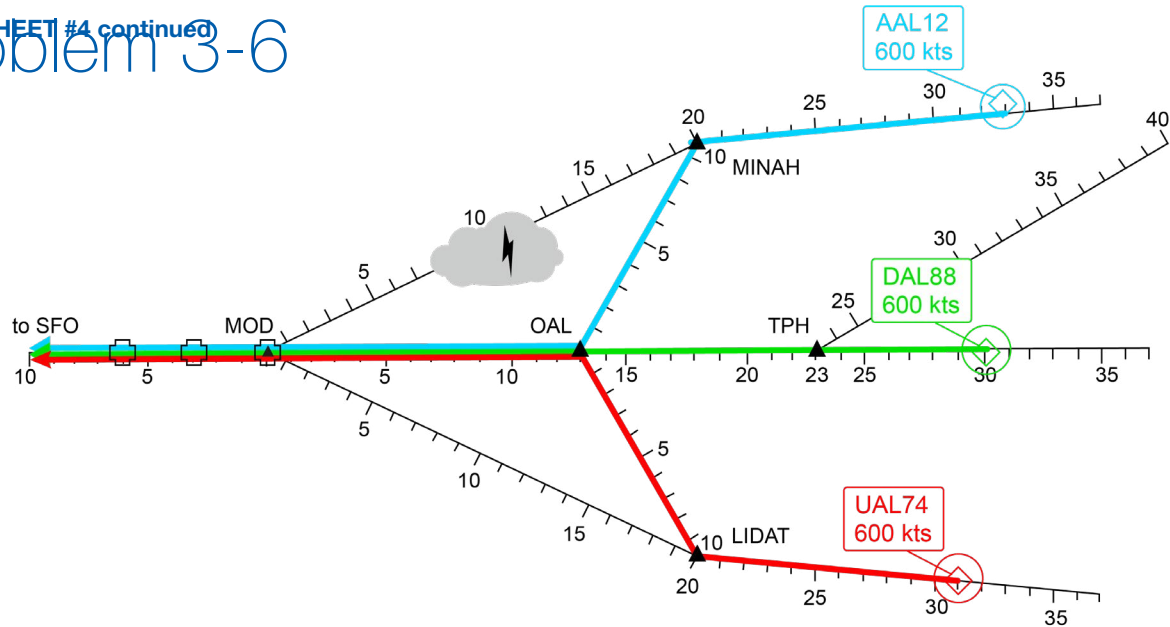


- How many minutes will the plane slow down until it needs to speed back up to 600 knots?

_____ minutes

WORKSHEET #4 continued

Problem 3-6



5. On the above diagrams, mark the new route and speed changes.
6. If the speed change, after how many minutes will the plane need to speed back up to 600 knots to maintain **ideal spacing** at MOD? _____ minutes
7. With the new speeds, will the other planes have **minimum separation** at OAL?

☐ No
 ☐ Yes

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