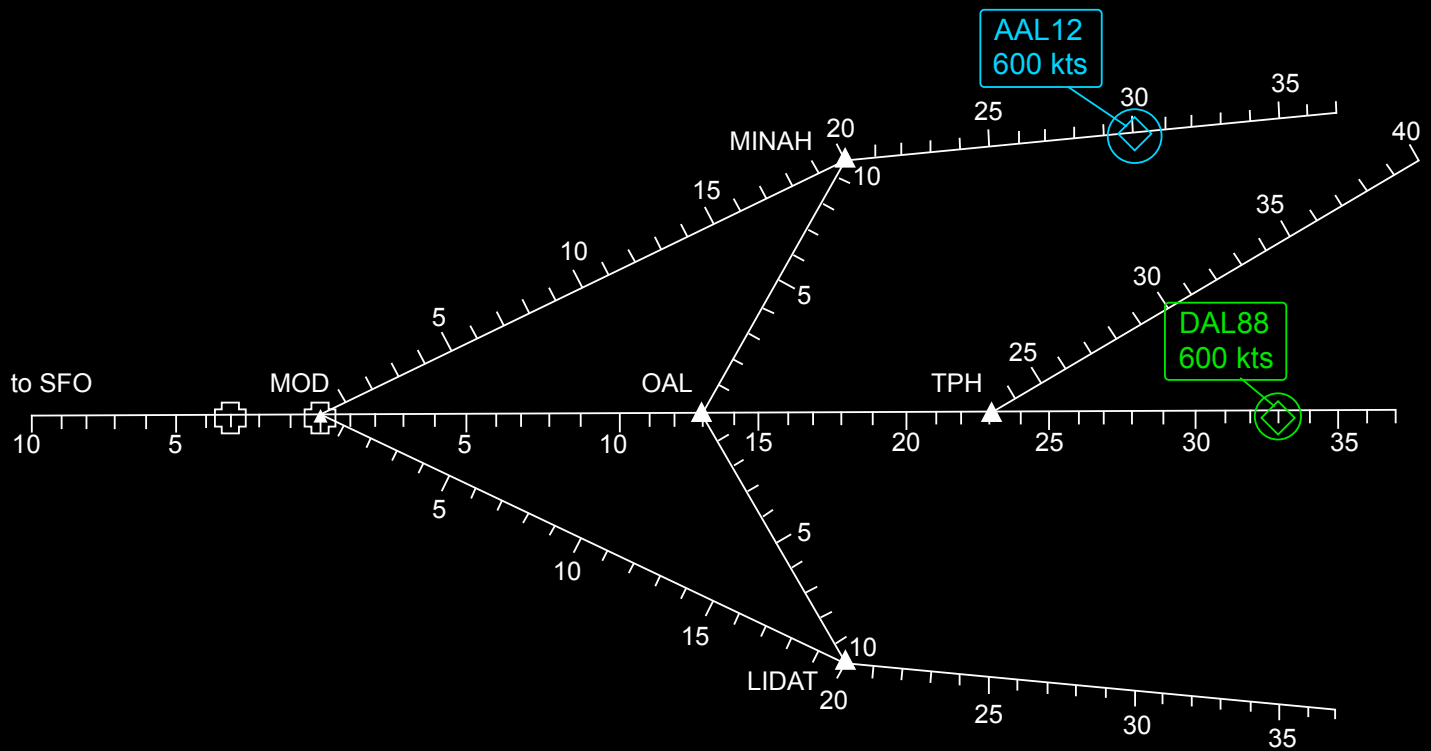




LineUp with Math

Math-Based Decisions in Air Traffic Control

STUDENT WORKBOOK E

Resolving Air Traffic Conflicts by Changing Speed

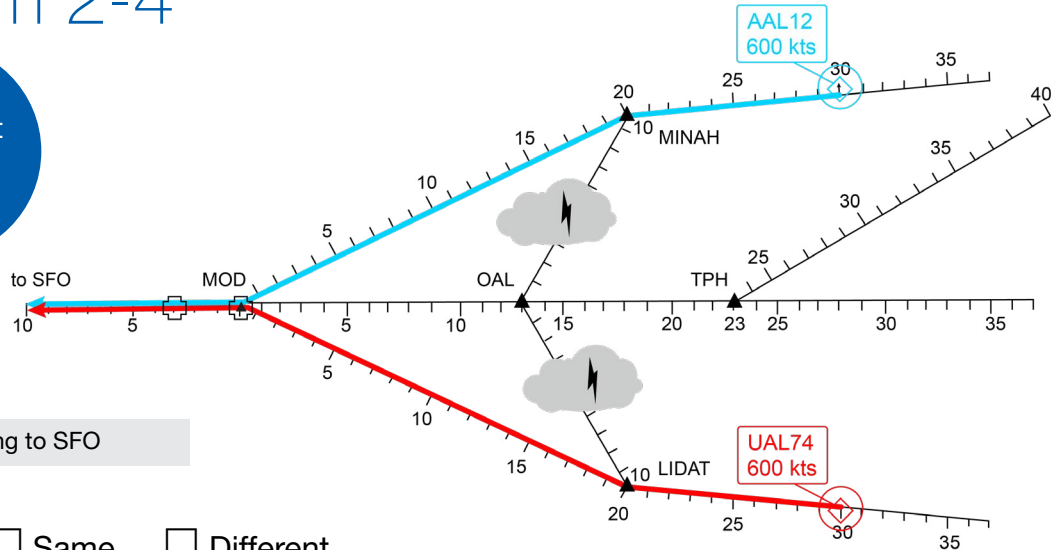
- * 2 planes, each at the same starting speed.
- * Simulator Problems 2-4, 2-5, 2-6, 2-7.

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

WORKSHEET #1

Problem 2-4

Ideal
Spacing at
MOD =
3 NM



Both planes are going to SFO

- Speeds: ☐ Same ☐ Different
- Headstart = _____ NM = separation at MOD
- Additional spacing needed for ideal spacing _____ NM

600 kts = 10 NM/Min

How Much Time Before You Need Ideal Spacing?

- At 600 knots, how many minutes will it take the planes to reach MOD? _____ mins

What Speed Change Will Solve the Problem?

The planes are traveling at the maximum speed of 600 knots.

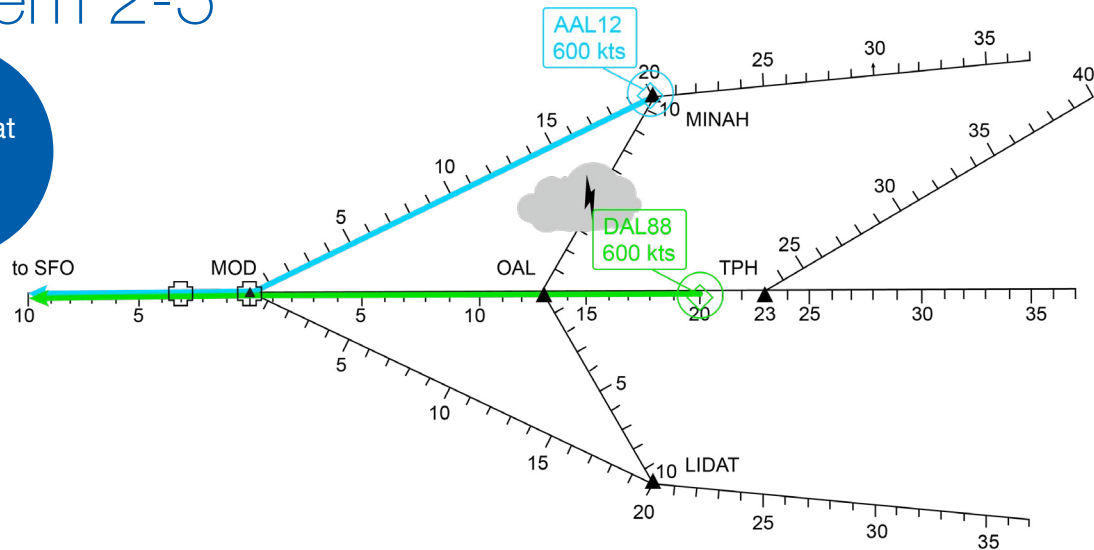
- Reduce the speed of one plane by 60 knots. Which plane will you choose to slow down to 540 knots? _____
- At 540 knots, how many nautical miles less will this plane travel **each minute**?
_____ nautical miles **per minute**
- In 3 minutes, how much additional spacing will be gained due to the speed reduction?
_____ nautical miles
- Does the 60-knot speed drop give ideal spacing at MOD? ☐ Yes ☐ No

Remember: A 60 knot difference in speed causes 1 nautical mile difference in distance each minute.

WORKSHEET #2

Problem 2-5

Ideal
Spacing at
MOD =
3 NM



1. Speeds: ☐ Same ☐ Different
2. Spacing at MOD = _____ NM
3. Additional spacing needed _____ NM
4. At 600 knots, how many minutes will it take the planes to reach MOD? _____ minutes

⚠ Air traffic controllers change speed in 60-knot increments. A 60-knot difference in speed causes a 1 nautical mile difference in distance each minute.

600 kts = 10 NM/Min

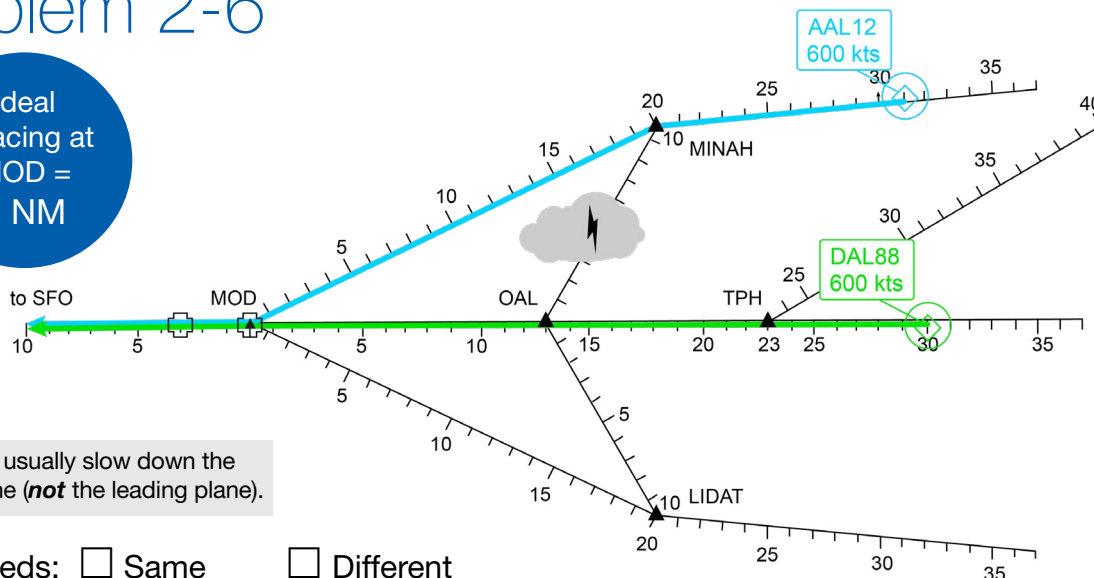
➔ First, slow AAL12 (or DAL88) by 60 knots, to 540 knots.

5. At MOD, how much spacing will be gained? _____ nautical miles
6. Did the 60-knot speed drop give ideal spacing at or before MOD? ☐ Yes ☐ No
Try a greater speed drop. Slow AAL12 by 60 more miles, totaling 120 knots. The new speed will be _____ knots.
7. Now how much spacing will be gained at MOD? _____ nautical miles
8. Did the 120-knot speed drop give Ideal Spacing at MOD? ☐ Yes ☐ No
9. What could the controller do to achieve at least ideal spacing?

WORKSHEET #3

Problem 2-6

Ideal
Spacing at
MOD =
3 NM



Controllers usually slow down the trailing plane (**not** the leading plane).

600 kts = 10 NM/Min

- Speeds: ☐ Same ☐ Different
- Spacing at MOD = _____ NM
- Additional spacing needed = _____ NM
- At 600 knots, how many minutes will it take the **lead** plane to reach MOD? _____ NM
- Which plane would a controller slow down to 540 knots? _____
- At this speed, how many nautical miles less will this plane travel **each minute**?
_____ nautical miles **per minute**
- At MOD, how much additional spacing will be gained due to the speed reduction?
_____ nautical miles
- What is the new spacing at MOD? _____ nautical miles
- Is the spacing ideal? ☐ Yes ☐ No
- If no, after how many minutes will the plane need to speed back up to 600 knots to make the spacing ideal at MOD? _____ minutes

* A 60 knot difference in speed causes a 1 nautical mile difference in distance each minute.

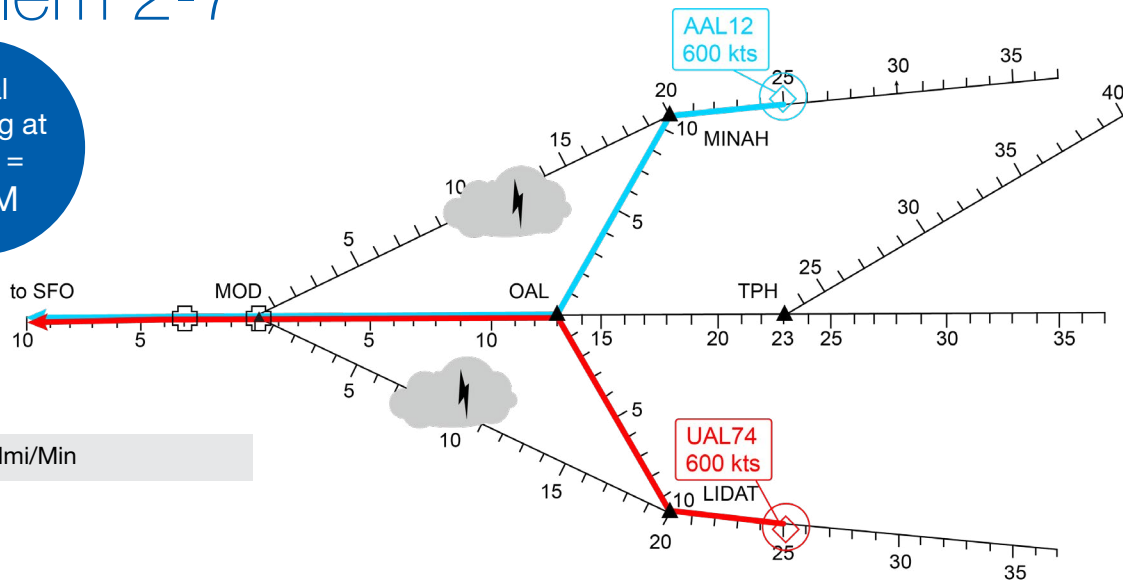
NAME _____

WORKBOOK E • LINE UP WITH MATH

WORKSHEET #4

Problem 2-7

Ideal
Spacing at
MOD =
3 NM



⚠ Air traffic controllers change speed in 60-knot increments. A 60-knot difference in speed causes a 1 nautical mile difference in distance each minute.

→ Analyze the problem at **OAL**. Does it meet or exceed **minimum separation**. ☐ Yes ☐ No

- Spacing at **OAL** = _____ NM
Additional spacing needed for minimum separation = _____ NM
- Solve the problem by slowing down one plane by 60 knots making the new speed _____ knots.
- Which plane will slow down? _____
- At OAL, how much additional spacing will be added due to the speed reduction?
_____ NM
- At 540 knots, will the planes have at least minimum separation?
☐ Yes ☐ No If no, what will be the new speed? _____ knots
- At the new speed, what will the separation be at **OAL**? _____ nautical miles
- At the final speed change, do the planes reach **minimum separation** at OAL? ☐ Yes ☐ No
- If yes, when must the planes speed back up to 600 knots to get **ideal spacing** at MOD?

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