

Directions:

Read the following text and decide whether each of the statements is true or false. Choose T if the statement is true or F if the statement is not true. Mark your answers on **ANSWER SHEET 1**. (10 points)

Copying Birds May Save Aircraft Fuel

Both Boeing and Airbus have trumpeted the efficiency of their newest aircraft, the 787 and A350 respectively. Their clever designs and lightweight composites certainly make a difference. But a group of researchers at Stanford University, led by Ilan Kroo, has suggested that airlines could take a more naturalistic approach to cutting jet-fuel use and it would not require them to buy new aircraft.

The answer, says Dr. Kroo, lies with birds. Since 1914, scientists have known that birds flying in formation – a V-shape – expend less energy. The air flowing over a bird's wings curls upwards behind the wingtips, a phenomenon known as upwash. Other birds flying in the upwash experience reduced drag, and spend less energy propelling themselves. Peter Lissaman, an aeronautics expert who was formerly at Caltech and the University of Southern California, has suggested that a formation of 25 birds might enjoy a range increase of 71%.

When applied to aircraft, the principles are not substantially different. Dr. Kroo and his team modeled what would happen if three passenger jets departing from Los Angeles, San Francisco and Las Vegas were to assemble over Utah, assume an inverted V-formation, occasionally change places so all could have a turn in the most favourable positions, and proceed to London. They found that the aircraft consumed as much as 15% less fuel (coupled with a reduction in carbon-dioxide output). Nitrogen-oxide emissions during the cruising portions of the flight fell by around a quarter.

There are, of course, knots to be worked out. One consideration is safety, or at least the perception of it. Would passengers feel comfortable travelling in company? Dr. Kroo points out that the aircraft could be separated by several nautical miles, and would not be in the intimate groupings favoured by display teams like the Red Arrows. A passenger peering out of the window might not even see the other planes. Whether the separation distances involved would satisfy air-traffic-control regulations is another matter, although a working group at the International Civil Aviation Organisation has included the possibility of formation flying in a blueprint for new operational guidelines.

It remains to be seen how weather conditions affect the air flows that make formation flight more efficient. In zones of increased turbulence, the planes' wakes will decay more quickly and the effect will diminish. Dr. Kroo says this is one of the areas his team will investigate further. It might also be hard for airlines to co-ordinate the departure times and destinations of passenger aircraft in a way that would allow them to gain from formation flight. Cargo aircraft, in contrast, might be easier to reschedule, as might routine military flights.

As it happens, America's armed forces are on the case already. Earlier this year the country's Defence Advanced Research Projects Agency announced plans to pay Boeing to investigate formation flight, though the programme has yet to begin. There are reports that some military aircraft flew in formation when they were low on fuel during the Second World War, but Dr. Lissaman says they are unsubstantiated. "My father was an RAF pilot and my cousin the skipper of a Lancaster lost over Berlin," he adds. So he should know.

41. Findings of the Stanford University researchers will promote the sales of new Boeing and Airbus aircraft.
- ☐ T] True
- ☐ F] False
42. The upwash experience may save propelling energy as well as reducing resistance.
- ☐ T] True
- ☐ F] False
43. Formation flight is more comfortable because passengers can not see the other planes.
- ☐ T] True
- ☐ F] False
44. The role that weather plays in formation flight has not yet been clearly defined.
- ☐ T] True
- ☐ F] False
45. It has been documented that during World War II, America's armed forces once tried formation flight to save fuel.
- ☐ T] True
- ☐ F] False