

Section 10.6: Vibrations in Aircraft

Section 10.6 Questions, page 471

1. Three normal types of vibration in aircraft are buffet, aircraft noise, and aeroelastic flutter. An example of buffet is the vibrations when flying through turbulence. An example of aircraft noise is the vibration during takeoff or landing. An example of aeroelastic flutter is the rapid vibration of the wings due to energy added by airflow to a small vibration.

2. Answers may vary. Sample answer: Aircraft travel much faster than cars so the vibrations in aircraft gather energy more rapidly and must be dealt with quickly, before they cause the aircraft to lose altitude.

3. Answers may vary. Sample answer: The cause of flutter is similar for a bridge and an aircraft. The vibrations produced gather energy from an external source (wind or airflow over a wing) and the energy of the vibrations gained is greater than the energy that is normally lost to natural damping.

The effect is different. A bridge could start to vibrate heavily and go beyond the resistance point, causing it to break. In the case of an aircraft, the wings will start to flutter rapidly and the aircraft could fall.

4. Answers may vary. Sample answer: The flight crew of an aircraft has experience with both natural and abnormal vibrations, so they are able to tell the difference. The average passenger does not have the same familiarity with aircraft vibrations.

5. Answers may vary. Sample answer: Three ways pilots and engineers can prevent or stop flutter are decreasing speed, levelling out the aircraft, and redesigning the structure of the wings to make them more rigid.

6. (a) The pogo effect is caused by the frequency of thrust vibrations (influenced by variable propellant flow rate) matching the natural frequency.

(b) The pogo effect is named that because the back and forth movement of the rocket resembles that of a pogo stick.

(c) Changing the length of the propellant pipes and adding dampers to the propellant pipes can prevent the pogo effect in rockets.

(d) Answers may vary. Sample answer: The pogo effect is similar to rapidly starting and stopping in a run, or rocking back and forth while moving forward.

7. Answers may vary. Sample answer: The compressor and/or the turbine rotate to force air through the jet engine. If the engine were unbalanced then the rotation will cause a periodic vibration in the jet engine which could transfer into the plane. If this periodic vibration is at the right frequency, it could cause resistance or flutter in a part of the aircraft. If the vibration from the engine continues at the same frequency for enough time, the amplitude of the induced vibration in the aircraft could continue to increase and might cause a serious problem.

8. Answers may vary. Students may include various jet engine types such as turboprop, turbofan, turbojet, and ramjet engines. They should include information on noise levels and uses of the engines.