SESSION 9: WEATHER HAZARDS — TURBULENCE, WINDSHEAR, AND MOUNTAIN WAVE

1. Mechanical turbulence results from:

A. Surface heating creating rising thermal columns

B. Airflow disruption by terrain features and obstacles

C. Wind shear at the jet stream level

D. Frontal boundaries shearing against each other

2. Thermal (convective) turbulence is most pronounced:

A. At night over open water

B. On warm, sunny afternoons over continental land

C. During the early morning over mountainous terrain

D. In stable air masses near a warm front

3. Clear-air turbulence (CAT) at high altitude is predominantly a result of:

A. Surface mechanical effects

B. Thermal convection from the ground

C. Wind shear associated with the jet stream

D. Frontal lifting in the lower troposphere

4. The "moderate" turbulence intensity level is characterized by:

A. Slight, erratic changes with the aircraft remaining easily controlled

B. Aircraft momentarily out of control with violent tossing

C. Possible structural damage to the aircraft

D. Definite strain against seat belts, with walking difficult and loose objects tossed

5. When severe turbulence is encountered, the appropriate airspeed technique is to:

A. Establish turbulence penetration airspeed (maneuvering speed) and accept altitude variations

B. Increase to maximum cruise speed to power through the turbulence

C. Slow to just above stall speed and maintain altitude precisely

D. Maintain exact altitude with aggressive control inputs

6. Mountain wave turbulence forms when stable air flows over a ridge with winds that are:

A. Light and variable from any direction

B. Strong but parallel to the ridge line

C. Weak and perpendicular to the ridge

D. Relatively strong (≥25 knots) and roughly perpendicular to the ridge

7. Lenticular clouds associated with mountain wave are identified by their:

A. Towering vertical development and anvil tops

B. Ragged, churning, rapidly changing appearance

C. Lens shape and stationary, hovering appearance

D. Low, uniform gray overcast layer

8. The rotor zone beneath a mountain wave crest is significant because it contains:

A. Violent, unpredictable turbulence more severe than the primary wave

B. The smoothest air in the entire wave system

C. Only light chop suitable for routine penetration

D. No turbulence, serving as a safe transit corridor

9. Why is clear-air turbulence (CAT) particularly hazardous?

A. It always occurs within visible cloud layers

B. It is invisible and provides no visual warning

C. It is confined to altitudes below 5,000 feet

D. It only affects aircraft on the ground

10. Why must a turbulence PIREP always be interpreted with the reporting aircraft type in mind?

A. Different aircraft use entirely different turbulence scales

B. PIREPs from light aircraft are not valid for planning

C. Turbulence intensity is aircraft-dependent; the same air affects light and heavy aircraft differently

D. The aircraft type determines when the report expires

11. Low-level wind shear (LLWS) is particularly hazardous because it occurs:

A. Near the ground at low altitude during approach and departure, with minimal recovery margin

B. Only at cruise altitude where recovery is easy

C. Exclusively in clear, calm conditions

D. Only over open ocean far from terrain

12. Wake turbulence is most intense behind a preceding aircraft that is:

A. Light, fast, and in a clean configuration

B. Descending rapidly at high airspeed

C. Heavy, slow, and at high angle of attack

D. On the ground with engines at idle

13. Frontal turbulence is generally more abrupt and severe along a:

A. Warm front, due to its gradual slope

B. Cold front, due to its steeper slope and faster relative motion

C. Stationary front, due to its lack of movement

D. Dissipating occlusion only

14. Mountain wave standing waves can extend downwind of the triggering terrain for approximately:

A. 5 to 10 miles

B. 100 to 300 miles

C. Less than 1 mile

D. Over 1,000 miles

15. The "light" turbulence intensity level is described as:

A. Slight, erratic changes in altitude or attitude with the aircraft remaining in positive control

B. Aircraft violently tossed about and nearly impossible to control

C. Occupants forced violently against seat belts

D. Structural damage to the aircraft is possible

16. Updrafts on the windward side of a mountain wave can exceed:

A. 500 feet per minute

B. 1,000 feet per minute

C. 2,000 feet per minute

D. 100 feet per minute

17. A pilot cruising in clear air over a mountain range during strong jet stream winds in winter should anticipate:

A. Possible severe to extreme turbulence with no visual warning

B. Guaranteed smooth air above the ridge tops

C. Turbulence only when clouds are present

D. No turbulence concern above 10,000 feet

18. AIRMET Tango is issued for which turbulence-related condition?

A. Severe turbulence not associated with thunderstorms

B. Moderate turbulence and low-level wind shear

C. Extreme turbulence requiring an emergency declaration

D. Clear-air turbulence above FL450 only

19. Wind shear turbulence is produced when:

A. The surface is uniformly heated by the sun

B. Air flows smoothly over flat terrain

C. A single air mass moves at constant speed

D. Adjacent layers of air move at significantly different speeds or directions

20. When severe or extreme turbulence is forecast, the most appropriate strategic response is to:

A. Avoid the affected area or altitude, or delay the flight

B. Penetrate at maximum cruise airspeed

C. Descend immediately regardless of terrain

D. Maintain the planned altitude and accept the turbulence

21. The "severe" turbulence intensity level is characterized by:

A. Slight erratic changes with the aircraft easily controlled

B. Definite strain against seat belts with walking difficult

C. Light chop with no effect on occupants

D. Abrupt attitude changes and the aircraft momentarily out of control

22. A rotor cloud, when present beneath a mountain wave, can be identified as a:

A. Smooth, lens-shaped stationary cloud at the wave crest

B. High cirrus layer signaling an approaching front

C. Ragged, churning cloud mass beneath the lenticular cap

D. Uniform low stratus layer at the surface

23. The proper operational response when entering known mountain wave conditions is to:

A. Maintain precise altitude using aggressive elevator inputs

B. Increase airspeed to maximum to exit the wave quickly

C. Descend below the ridge line to find smoother air

D. Establish turbulence penetration airspeed and manage airspeed rather than chasing altitude

24. The Coriolis illusion, a turbulence-related disorientation hazard, is triggered by:

A. Head movement during a sustained coordinated turn

B. Rapid acceleration on takeoff

C. An abrupt updraft encountered in cruise

D. Flying toward a sloped cloud layer at night

25. Why is attempting to maintain exact altitude in severe turbulence with aggressive control inputs dangerous?

A. It causes the autopilot to disconnect unexpectedly

B. It triggers spatial disorientation in all cases

C. It increases fuel consumption significantly

D. It is more likely to cause structural damage than the turbulence itself

ANSWER KEY & EXPLANATIONS – SESSION 9

1. B. Terrain/obstacles — Mechanical turbulence results from airflow disruption by terrain features and obstacles.

2. B. Warm afternoons over land — Thermal turbulence is most pronounced on warm, sunny afternoons over continental land surfaces.

3. C. Jet stream shear — High-altitude CAT is predominantly a wind shear phenomenon associated with the jet stream.

4. D. Strain/walking difficult — Moderate turbulence produces definite strain against seat belts, difficulty walking, and tossed loose objects.

5. A. Penetration airspeed — In severe turbulence, establish maneuvering (penetration) airspeed and accept altitude variations.

6. D. Strong, perpendicular — Mountain wave forms with relatively strong winds (≥25 knots) roughly perpendicular to the ridge.

7. C. Lens-shaped, stationary — Lenticular clouds are identified by their lens shape and stationary, hovering appearance.

8. A. Violent turbulence — The rotor zone contains violent, unpredictable turbulence more severe than the primary wave.

9. B. Invisible/no warning — CAT is hazardous because it is invisible and provides no visual warning.

10. C. Aircraft-dependent — Turbulence intensity is aircraft-dependent; the same air affects light and heavy aircraft differently.

11. A. Near ground/low margin — LLWS is hazardous because it occurs near the ground during approach and departure with minimal recovery margin.

12. C. Heavy/slow/high AOA — Wake turbulence is most intense behind a heavy, slow aircraft at high angle of attack.

13. B. Cold front — Cold fronts produce more abrupt and severe frontal turbulence due to their steeper slope and faster motion.

14. B. 100–300 miles — Mountain wave standing waves can extend 100 to 300 miles downwind.

15. A. Slight erratic, controlled — Light turbulence produces slight, erratic changes with the aircraft remaining in positive control.

16. C. Over 2,000 fpm — Windward-side mountain wave updrafts can exceed 2,000 feet per minute.

17. A. Severe, no warning — Strong winter jet stream winds over a range can produce severe to extreme turbulence with no visual warning.

18. B. Moderate turbulence/LLWS — AIRMET Tango covers moderate turbulence and low-level wind shear.

19. D. Adjacent layers differ — Wind shear turbulence occurs when adjacent layers move at significantly different speeds or directions.

20. A. Avoid or delay — The strategic response to forecast severe/extreme turbulence is to avoid the area/altitude or delay the flight.

21. D. Momentarily out of control — Severe turbulence produces abrupt attitude changes with the aircraft momentarily out of control.

22. C. Ragged churning cloud — A rotor cloud appears as a ragged, churning mass beneath the smooth lenticular cap.

23. D. Manage airspeed — In mountain wave, establish turbulence penetration airspeed and manage airspeed rather than chasing altitude.

24. A. Head movement in turn — The Coriolis illusion is triggered by head movement during a sustained coordinated turn.

25. D. Structural damage — Aggressively chasing altitude in severe turbulence is more likely to cause structural damage than the turbulence itself.