W9AY STUDY GUIDE · ELEMENT 3 · FREE SAMPLE

General Class

NCVEC 2023–2027 question pool, 6th errata of February 4, 2026

35	423	35	2.5 h
EXAM QUESTIONS	IN THE POOL	QUESTION GROUPS	TO READ ONCE

This is one section, free. G3, Radio Wave Propagation: all 37 of its pool questions, each with its answer. Read the notes, then cover the answers and work through the questions, and watch how quickly the answers start to stick. The rest of the guide works the same way.

Get the full guide: w9ay.com/study/general. It adds a Start Here chapter, all 10 sections and every one of the 423 pool questions. Pay through Stripe; your download link appears as soon as you pay and is emailed to you.

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35 questions on the exam, drawn from 423 in the pool.

SECTION	TOPIC	ON THE EXAM	IN THE POOL	READING
G3	Radio Wave Propagation	3	37	~13 min

G3 — Radio Wave Propagation

3 of your 35 exam questions · 3 groups (G3A–G3C) · 37 questions in the pool

The most genuinely interesting subelement, and the one where understanding beats memorizing by the widest margin. Build the mental model of the ionosphere once and most answers fall out of it.

The core model. The Sun ionizes the upper atmosphere. Ionized gas refracts radio waves back toward Earth — that is skip. Four regions, stacked bottom to top: **D** (absorbs below ~10 MHz, daytime only), **E** (~1,200 miles per hop), **F1**, and **F2** (highest, ~2,500 miles per hop, the workhorse of HF (high frequency) DX (long-distance communication)). More solar activity means more ionization, which means the higher bands open.

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G3A — Sunspots and solar radiation; geomagnetic field and stability indices

One exam question comes from this group. 14 questions in the pool.

The indices. Two pairs that get confused:

INDEX	MEASURES
Sunspot number	Higher means better propagation at **higher** frequencies
Solar flux index	Solar radiation at a wavelength of **10.7 cm**
K-index	**Short-term** stability of **Earth's** geomagnetic field
A-index	**Long-term** stability of **Earth's** geomagnetic field

Both K and A measure *Earth's* field, not the Sun's. The only difference is the time scale — **K is Kwick**.

Three different delays, and this is the most-missed set in G3:

EVENT	TIME TO REACH US
Solar flare (UV and X-rays, at light speed)	**8 minutes**
Coronal mass ejection (particles, much slower)	**15 hours to several days**
Solar rotation cycle	**26–28 days**

The 26–28 day cycle happens because **the Sun's surface layers rotate**, bringing the same active regions back around.

Disturbances. A sudden ionospheric disturbance **hurts lower frequencies more**. A geomagnetic storm is a **temporary disturbance in Earth's geomagnetic field** and it **degrades high-latitude HF paths** — but its upside is **auroras that reflect VHF signals** (VHF = very high frequency). Coronal hole particles **disturb** HF (high frequency). At solar minimum, **15, 12, and 10 meters** are least reliable, while **20 meters works worldwide in daylight at any point in the cycle**.

All 14 pool questions for G3A

G3A01

How does a higher sunspot number affect HF propagation?

- A. Higher sunspot numbers generally indicate a greater probability of good propagation at higher frequencies
- B. Lower sunspot numbers generally indicate greater probability of sporadic E propagation
- C. A zero sunspot number indicates that radio propagation is not possible on any band
- D. A zero sunspot number indicates undisturbed conditions

Answer: A

G3A02

What effect does a sudden ionospheric disturbance have on the daytime ionospheric propagation?

- A. It enhances propagation on all HF frequencies
- B. It disrupts signals on lower frequencies more than those on higher frequencies
- C. It disrupts communications via satellite more than direct communications
- D. None, because only areas on the night side of the Earth are affected

Answer: B

G3A03

Approximately how long does it take the increased ultraviolet and X-ray radiation from a solar flare to affect radio

propagation on Earth?

- A. 28 days
- B. 1 to 2 hours
- C. 8 minutes
- D. 20 to 40 hours

Answer: C

G3A04

Which of the following are the least reliable bands for long-distance communications during periods of low solar activity?

- A. 80 meters and 160 meters
- B. 60 meters and 40 meters
- C. 30 meters and 20 meters
- D. 15 meters, 12 meters, and 10 meters

Answer: D

G3A05

What is the solar flux index?

- A. A measure of the highest frequency that is useful for ionospheric propagation between two points on Earth
- B. A count of sunspots that is adjusted for solar emissions
- C. Another name for the American sunspot number
- D. A measure of solar radiation with a wavelength of 10.7 centimeters

Answer: D

G3A06

What is a geomagnetic storm?

- A. A sudden drop in the solar flux index
- B. A thunderstorm that affects radio propagation
- C. Ripples in the geomagnetic force
- D. A temporary disturbance in Earth's geomagnetic field

Answer: D

G3A07

At what point in the solar cycle does the 20-meter band usually support worldwide propagation during daylight

hours?

- A. At the summer solstice
- B. Only at the maximum point
- C. Only at the minimum point
- D. At any point

Answer: D

G3A08

How can a geomagnetic storm affect HF propagation?

- A. Improve high-latitude HF propagation
- B. Degrade ground wave propagation
- C. Improve ground wave propagation
- D. Degrade high-latitude HF propagation

Answer: D

G3A09

How can high geomagnetic activity benefit radio communications?

- A. Creates auroras that can reflect VHF signals
- B. Increases signal strength for HF signals passing through the polar regions
- C. Improve HF long path propagation
- D. Reduce long delayed echoes

Answer: A

G3A10

What causes HF propagation conditions to vary periodically in a 26- to 28-day cycle?

- A. Long term oscillations in the upper atmosphere
- B. Cyclic variation in Earth’s radiation belts
- C. Rotation of the Sun’s surface layers around its axis
- D. The position of the Moon in its orbit

Answer: C

G3A11

How long does it take a coronal mass ejection to affect radio propagation on Earth?

- A. 28 days
- B. 14 days
- C. 4 to 8 minutes
- D. 15 hours to several days

Answer: D

G3A12

What does the K-index measure?

- A. The relative position of sunspots on the surface of the Sun
- B. The short-term stability of Earth's geomagnetic field
- C. The short-term stability of the Sun's magnetic field
- D. The solar radio flux at Boulder, Colorado

Answer: B

G3A13

What does the A-index measure?

- A. The relative position of sunspots on the surface of the Sun
- B. The amount of polarization of the Sun's electric field
- C. The long-term stability of Earth's geomagnetic field
- D. The solar radio flux at Boulder, Colorado

Answer: C

G3A14

How is long distance radio communication usually affected by the charged particles that reach Earth from solar coronal holes?

- A. HF communication is improved
- B. HF communication is disturbed
- C. VHF/UHF ducting is improved
- D. VHF/UHF ducting is disturbed

Answer: B

G3B — Maximum and Lowest Usable Frequency; short and long path; ionospheric refraction

One exam question comes from this group. 12 questions in the pool.

The window. Two frequencies bracket what works on a path right now. The **MUF** is the maximum usable frequency **between two specific points**; the **LUF** (lowest usable frequency) is the lowest. Both definitions are point-to-point — "during a 24-hour period" is the distractor on both questions.

FREQUENCY	RESULT
Between LUF and MUF	**Refracted back to Earth** — it works
Above the MUF	Passes through into space
Below the LUF	**Attenuated** before arriving
LUF above MUF	**No skywave propagation possible on that path**

The best frequency to use is just below the MUF, because that path takes the shallowest trip through the absorbing lower layers.

Determining conditions practically: use a **network of automated receiving stations on the internet** to see where your own transmissions land. Reverse beacon networks and PSK (phase-shift keying) Reporter, not the A-index and not listening for your own echoes.

Hop distances: E region 1,200 miles, F2 region 2,500 miles. Signals arriving by both short and long path produce **a slightly delayed echo**. And the low bands in summer suffer from **high atmospheric noise and static**.

All 12 pool questions for G3B

G3B01

What is a characteristic of skywave signals arriving at your location by both short-path and long-path propagation?

- A. Periodic fading approximately every 10 seconds
- B. Signal strength increased by 3 dB
- C. The signal might be cancelled causing severe attenuation
- D. A slightly delayed echo might be heard

Answer: D

G3B02

What factors affect the MUF?

- A. Path distance and location
- B. Time of day and season
- C. Solar radiation and ionospheric disturbances
- D. All these choices are correct

Answer: D

G3B03

Which frequency will have the least attenuation for long-distance skip propagation?

- A. Just below the MUF
- B. Just above the LUF
- C. Just below the critical frequency
- D. Just above the critical frequency

Answer: A

G3B04

Which of the following is a way to determine current propagation on a desired band from your station?

- A. Use a network of automated receiving stations on the internet to see where your transmissions are

being received
- B. Check the A-index
- C. Send a series of dots and listen for echoes
- D. All these choices are correct

Answer: A

G3B05

How does the ionosphere affect radio waves with frequencies below the MUF and above the LUF?

- A. They are refracted back to Earth
- B. They pass through the ionosphere
- C. They are amplified by interaction with the ionosphere
- D. They are refracted and trapped in the ionosphere to circle Earth

Answer: A

G3B06

What usually happens to radio waves with frequencies below the LUF?

- A. They are refracted back to Earth
- B. They pass through the ionosphere
- C. They are attenuated before reaching the destination
- D. They are refracted and trapped in the ionosphere to circle Earth

Answer: C

G3B07

What does LUF stand for?

- A. The Lowest Usable Frequency for communications between two specific points
- B. The Lowest Usable Frequency for communications to any point outside a 100-mile radius
- C. The Lowest Usable Frequency during a 24-hour period
- D. The Lowest Usable Frequency during the past 60 minutes

Answer: A

G3B08

What does MUF stand for?

- A. The Minimum Usable Frequency for communications between two points
- B. The Maximum Usable Frequency for communications between two points
- C. The Minimum Usable Frequency during a 24-hour period
- D. The Maximum Usable Frequency during a 24-hour period

Answer: B

G3B09

What is the approximate maximum distance along the Earth’s surface normally covered in one hop using the F2

region?

- A. 180 miles
- B. 1,200 miles
- C. 2,500 miles
- D. 12,000 miles

Answer: C

G3B10

What is the approximate maximum distance along the Earth's surface normally covered in one hop using the E region?

- A. 180 miles
- B. 1,200 miles
- C. 2,500 miles
- D. 12,000 miles

Answer: B

G3B11

What happens to HF propagation when the LUF exceeds the MUF?

- A. Propagation via ordinary skywave communications is not possible over that path
- B. HF communications over the path are enhanced
- C. Double-hop propagation along the path is more common
- D. Propagation over the path on all HF frequencies is enhanced

Answer: A

G3B12

Which of the following is typical of the lower HF frequencies during the summer?

- A. Poor propagation at any time of day
- B. World-wide propagation during daylight hours
- C. Heavy distortion on signals due to photon absorption
- D. High levels of atmospheric noise or static

Answer: D

G3C — Ionospheric regions; critical angle and frequency; HF scatter; NVIS

One exam question comes from this group. 11 questions in the pool.

Two "critical" terms, both meaning highest. The **critical frequency** is the *highest* frequency refracted back to Earth at a given angle. The **critical angle** is the *highest* takeoff angle that returns a wave to Earth. If you remember that both are "highest," you get both questions even if you mix up which is which.

The D region explains the low bands. It is the **closest region to Earth**, it is the **most absorbent below 10 MHz during daylight**, and it is why **40, 60, 80, and 160 meters are hard in the daytime**. It vanishes after dark, which is when those bands come alive.

F2 gives the longest skip because it is the highest — shallower geometry, longer hop. Not density, not Doppler.

Scatter fills the skip zone, and every scatter question follows from it being multipath: signals **flutter**, they sound **distorted because energy arrives by several different paths**, and they are **weak because only a small part of the energy is scattered** in there.

NVIS (near vertical incidence skywave) is **short-distance MF or HF propagation at high elevation angles** (MF = medium frequency; HF = high frequency) — fire nearly straight up, drop signals back down in a circle around you, fill in the skip zone. The matching antenna is in G9D01.

All 11 pool questions for G3C

G3C01

Which ionospheric region is closest to the surface of Earth?

- A. The D region
- B. The E region
- C. The F1 region
- D. The F2 region

Answer: A

G3C02

What is meant by the term “critical frequency” at a given incidence angle?

- A. The highest frequency which is refracted back to Earth
- B. The lowest frequency which is refracted back to Earth
- C. The frequency at which the signal-to-noise ratio approaches unity
- D. The frequency at which the signal-to-noise ratio is 6 dB

Answer: A

G3C03

Why is skip propagation via the F2 region longer than that via the other ionospheric regions?

- A. Because it is the densest
- B. Because of the Doppler effect
- C. Because it is the highest
- D. Because of temperature inversions

Answer: C

G3C04

What does the term “critical angle” mean, as applied to radio wave propagation?

- A. The long path azimuth of a distant station
- B. The short path azimuth of a distant station
- C. The lowest takeoff angle that will return a radio wave to Earth under specific ionospheric conditions
- D. The highest takeoff angle that will return a radio wave to Earth under specific ionospheric conditions

Answer: D

G3C05

Why is long-distance communication on the 40-, 60-, 80-, and 160-meter bands more difficult during the day?

- A. The F region absorbs signals at these frequencies during daylight hours
- B. The F region is unstable during daylight hours
- C. The D region absorbs signals at these frequencies during daylight hours
- D. The E region is unstable during daylight hours

Answer: C

G3C06

What is a characteristic of HF scatter?

- A. Phone signals have high intelligibility
- B. Signals have a fluttering sound
- C. There are very large, sudden swings in signal strength
- D. Scatter propagation occurs only at night

Answer: B

G3C07

What makes HF scatter signals often sound distorted?

- A. The ionospheric region involved is unstable
- B. Ground waves are absorbing much of the signal
- C. The E region is not present
- D. Energy is scattered into the skip zone through several different paths

Answer: D

G3C08

Why are HF scatter signals in the skip zone usually weak?

- A. Only a small part of the signal energy is scattered into the skip zone
- B. Signals are scattered from the magnetosphere, which is not a good reflector
- C. Propagation is via ground waves, which absorb most of the signal energy

- D. Propagation is via ducts in the F region, which absorb most of the energy

Answer: A

G3C09

What type of propagation allows signals to be heard in the transmitting station’s skip zone?

- A. Faraday rotation
- B. Scatter
- C. Chordal hop
- D. Short-path

Answer: B

G3C10

What is near vertical incidence skywave (NVIS) propagation?

- A. Propagation near the MUF
- B. Short distance MF or HF propagation at high elevation angles
- C. Long path HF propagation at sunrise and sunset
- D. Double hop propagation near the LUF

Answer: B

G3C11

Which ionospheric region is the most absorbent of signals below 10 MHz during daylight hours?

- A. The F2 region
- B. The F1 region
- C. The E region
- D. The D region

Answer: D

Bottom line for G3

D absorbs, E hops 1,200 miles, F2 hops 2,500 miles and is highest. K is Kwick (short-term), A is long-term, both measure **Earth's** field. Solar flux is measured at **10.7 cm**. Flare **8 minutes**, CME (coronal mass ejection) **15 hours to days**, solar rotation **26-28 days**. Work **just below the MUF** (MUF = maximum usable frequency). **LUF above MUF means no path.** (LUF = lowest usable frequency) Both "critical" terms mean **highest**. **Scatter** fills the skip zone, weak and fluttery. **NVIS** (near vertical incidence skywave) is high-angle short-range HF (high frequency).

Want the rest?

Get the full guide

The complete General Class guide is one PDF: a Start Here chapter (where the exam's 35 questions come from and what to learn first), all 10 sections and every one of the 423 pool questions, each with its answer.

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What the full guide covers

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