

**2020-2024 Amateur Extra Class
FCC Element 4 Question Pool
Effective 7/01/2020 – 6/30/2024**

SUBELEMENT E3 - RADIO WAVE PROPAGATION [3 Exam Questions - 3 Groups]

E3A Electromagnetic waves; Earth-Moon-Earth communications; meteor scatter; microwave tropospheric and scatter propagation; aurora propagation; ionospheric propagation changes over the day; circular polarization

E3A01

What is the approximate maximum separation measured along the surface of the Earth between two stations communicating by EME?

- A. 500 miles, if the moon is at perigee
- B. 2000 miles, if the moon is at apogee
- C. 5000 miles, if the moon is at perigee
- D. 12,000 miles, if the moon is visible by both stations

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E3A02

What characterizes libration fading of an EME signal?

- A. A slow change in the pitch of the CW signal
- B. A fluttery irregular fading
- C. A gradual loss of signal as the sun rises
- D. The returning echo is several hertz lower in frequency than the transmitted signal

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E3A03

When scheduling EME contacts, which of these conditions will generally result in the least path loss?

- A. When the moon is at perigee
- B. When the moon is full
- C. When the moon is at apogee
- D. When the MUF is above 30 MHz

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E3A04

What do Hepburn maps predict?

- A. Sporadic E propagation
- B. Locations of auroral reflecting zones
- C. Likelihood of rain scatter along cold or warm fronts
- D. Probability of tropospheric propagation

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E3A05

Tropospheric propagation of microwave signals often occurs in association with what phenomenon?

- A. Grayline
- B. Lightning discharges
- C. Warm and cold fronts
- D. Sprites and jets

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E3A06

What might help to restore contact when DX signals become too weak to copy across an entire HF band a few hours after sunset?

- A. Switch to a higher frequency HF band
- B. Switch to a lower frequency HF band
- C. Wait 90 minutes or so for the signal degradation to pass
- D. Wait 24 hours before attempting another communication on the band

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E3A07

Atmospheric ducts capable of propagating microwave signals often form over what geographic feature?

- A. Mountain ranges
- B. Forests
- C. Bodies of water
- D. Urban areas

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E3A08

When a meteor strikes the Earth's atmosphere, a cylindrical region of free electrons is formed at what layer of the ionosphere?

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

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E3A09

Which of the following frequency ranges is most suited for meteor scatter communications?

- A. 1.8 MHz - 1.9 MHz
- B. 10 MHz - 14 MHz
- C. 28 MHz - 148 MHz
- D. 220 MHz - 450 MHz

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E3A10

Which type of atmospheric structure can create a path for microwave propagation?

- A. The jet stream
- B. Temperature inversion
- C. Wind shear
- D. Dust devil

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E3A11

What is a typical range for tropospheric propagation of microwave signals?

- A. 10 miles to 50 miles
- B. 100 miles to 300 miles
- C. 1200 miles
- D. 2500 miles

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E3A12

What is the cause of auroral activity?

- A. The interaction in the F2 layer between the solar wind and the Van Allen belt
- B. An extreme low-pressure area in the polar regions
- C. The interaction in the E layer of charged particles from the Sun with the Earth's magnetic field
- D. Meteor showers concentrated in the extreme northern and southern latitudes

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E3A13

Which of these emission modes is best for auroral propagation?

- A. CW
- B. SSB
- C. FM
- D. RTTY

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E3A14

What is meant by circularly polarized electromagnetic waves?

- A. Waves with an electric field bent into a circular shape
- B. Waves with a rotating electric field
- C. Waves that circle the Earth
- D. Waves produced by a loop antenna

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E3B Transequatorial propagation; long-path; grayline; ordinary and extraordinary waves; chordal hop; sporadic E mechanisms

E3B01

What is transequatorial propagation?

- A. Propagation between two mid-latitude points at approximately the same distance north and south of the magnetic equator
- B. Propagation between points located on the magnetic equator
- C. Propagation between a point on the equator and its antipodal point
- D. Propagation between points at the same latitude

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E3B02

What is the approximate maximum range for signals using transequatorial propagation?

- A. 1000 miles
- B. 2500 miles
- C. 5000 miles
- D. 7500 miles

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E3B03

What is the best time of day for transequatorial propagation?

- A. Morning
- B. Noon
- C. Afternoon or early evening
- D. Late at night

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E3B04

What is meant by the terms "extraordinary" and "ordinary" waves?

- A. Extraordinary waves describe rare long-skip propagation compared to ordinary waves, which travel shorter distances
- B. Independent waves created in the ionosphere that are elliptically polarized
- C. Long-path and short-path waves
- D. Refracted rays and reflected waves

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E3B05

Which amateur bands typically support long-path propagation?

- A. Only 160 meters to 40 meters
- B. Only 30 meters to 10 meters
- C. 160 meters to 10 meters
- D. 6 meters to 2 meters

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E3B06

Which of the following amateur bands most frequently provides long-path propagation?

- A. 80 meters
- B. 20 meters
- C. 10 meters
- D. 6 meters

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E3B07

What happens to linearly polarized radio waves that split into ordinary and extraordinary waves in the ionosphere?

- A. They are bent toward the magnetic poles
- B. They become depolarized
- C. They become elliptically polarized
- D. They become phase locked

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E3B08

What is the term for the long path opening that exists between two points on the Earth which are simultaneously near sunrise and sunset?

- A. Transequatorial
- B. Sporadic E
- C. Long-path
- D. Grayline

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E3B09

At what time of year is sporadic E propagation most likely to occur?

- A. Around the solstices, especially the summer solstice
- B. Around the solstices, especially the winter solstice
- C. Around the equinoxes, especially the spring equinox
- D. Around the equinoxes, especially the fall equinox

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E3B10

Why is chordal hop propagation desirable?

- A. The signal experiences less loss compared to multi-hop using Earth as a reflector
- B. The MUF for chordal hop propagation is much lower than for normal skip propagation
- C. Atmospheric noise is lower in the direction of chordal hop propagation
- D. Signals travel faster along ionospheric chords

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E3B11

At what time of day can sporadic E propagation occur?

- A. Only around sunset
- B. Only around sunset and sunrise
- C. Only in hours of darkness
- D. Any time

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E3B12

What is the primary characteristic of chordal hop propagation?

- A. Propagation away from the great circle bearing between stations
- B. Successive ionospheric refractions without an intermediate reflection from the ground
- C. Propagation across the geomagnetic equator
- D. Signals reflected back toward the transmitting station

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E3C Radio horizon; ground wave; propagation prediction techniques and modeling; effects of space weather parameters on propagation

E3C01

What does the radio communication term "ray tracing" describe?

- A. The process in which an electronic display presents a pattern
- B. Modeling a radio wave's path through the ionosphere
- C. Determining the radiation pattern from an array of antennas
- D. Evaluating high voltage sources for x-rays

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E3C02

What is indicated by a rising A or K index?

- A. Increasing disruption of the geomagnetic field
- B. Decreasing disruption of the geomagnetic field
- C. Higher levels of solar UV radiation
- D. An increase in the critical frequency

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E3C03

Which of the following signal paths is most likely to experience high levels of absorption when the A index or K index is elevated?

- A. Transequatorial
- B. Polar
- C. Sporadic E
- D. NVIS

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E3C04

What does the value of Bz (B sub Z) represent?

- A. Geomagnetic field stability
- B. Critical frequency for vertical transmissions
- C. Direction and strength of the interplanetary magnetic field
- D. Duration of long-delayed echoes

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E3C05

What orientation of Bz (B sub z) increases the likelihood that incoming particles from the sun will cause disturbed conditions?

- A. Southward
- B. Northward
- C. Eastward
- D. Westward

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E3C06

By how much does the VHF/UHF radio horizon distance exceed the geometric horizon?

- A. By approximately 15 percent of the distance
- B. By approximately twice the distance
- C. By approximately 50 percent of the distance
- D. By approximately four times the distance

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E3C07

Which of the following descriptors indicates the greatest solar flare intensity?

- A. Class A
- B. Class B
- C. Class M
- D. Class X

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E3C08

What does the space weather term "G5" mean?

- A. An extreme geomagnetic storm
- B. Very low solar activity
- C. Moderate solar wind
- D. Waning sunspot numbers

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E3C09

How does the intensity of an X3 flare compare to that of an X2 flare?

- A. 10 percent greater
- B. 50 percent greater
- C. Twice as great
- D. Four times as great

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E3C10

What does the 304A solar parameter measure?

- A. The ratio of x-ray flux to radio flux, correlated to sunspot number
- B. UV emissions at 304 angstroms, correlated to the solar flux index
- C. The solar wind velocity at 304 degrees from the solar equator, correlated to solar activity
- D. The solar emission at 304 GHz, correlated to x-ray flare levels

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E3C11

What does VOACAP software model?

- A. AC voltage and impedance
- B. VHF radio propagation
- C. HF propagation
- D. AC current and impedance

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E3C12

How does the maximum range of ground-wave propagation change when the signal frequency is increased?

- A. It stays the same
- B. It increases
- C. It decreases
- D. It peaks at roughly 14 MHz

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E3C13

What type of polarization is best for ground-wave propagation?

- A. Vertical
- B. Horizontal
- C. Circular
- D. Elliptical

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E3C14

Why does the radio-path horizon distance exceed the geometric horizon?

- A. E-region skip
- B. D-region skip
- C. Due to the Doppler effect
- D. Downward bending due to density variations in the atmosphere

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E3C15

What might be indicated by a sudden rise in radio background noise across a large portion of the HF spectrum?

- A. A temperature inversion has occurred
- B. A solar flare has occurred
- C. Increased transequatorial propagation is likely
- D. Long-path propagation is likely

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