Technician Licensing Class

Radio wave characteristics, radio and electromagnetic properties, propagation modes

T3A - T3C

Valid
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updated to 2018 Question Pool by NQ4K for Sterling Park Amateur Radio Club

T 3 A

- Radio wave characteristics:
  - how a radio signal travels;
  - fading;
  - multipath;
  - polarization;
  - wavelength vs absorption;
  - antenna orientation

T 3 A

- If another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted, try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion. T3A01

- The range of VHF and UHF signals is greater in the winter because there is less absorption by vegetation. T3A02

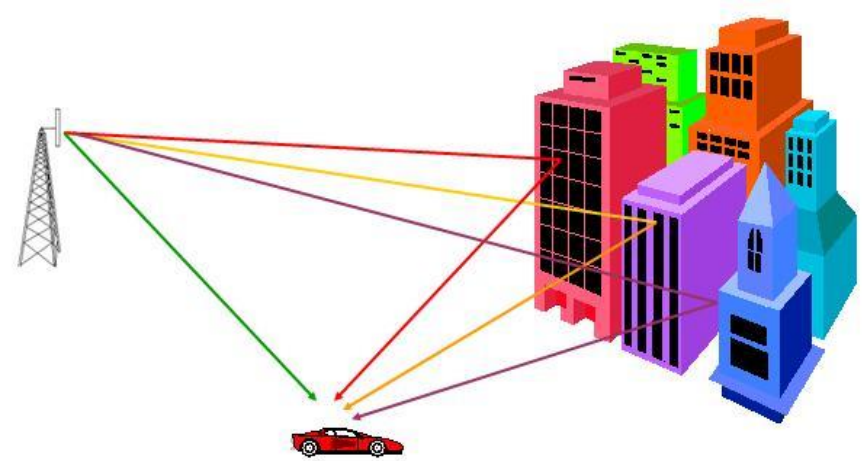
T 3 A

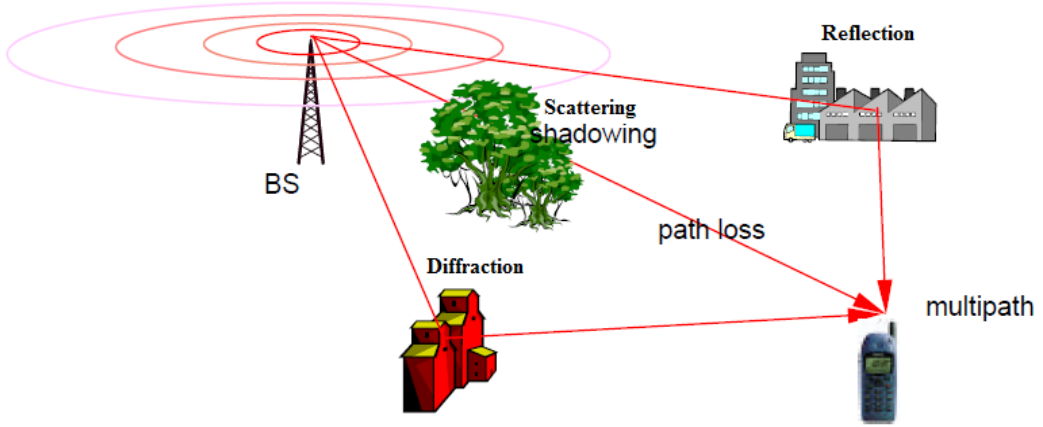
- Horizontal antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands. T3A03

- Signals could be significantly weaker if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization. T3A04

T 3 A

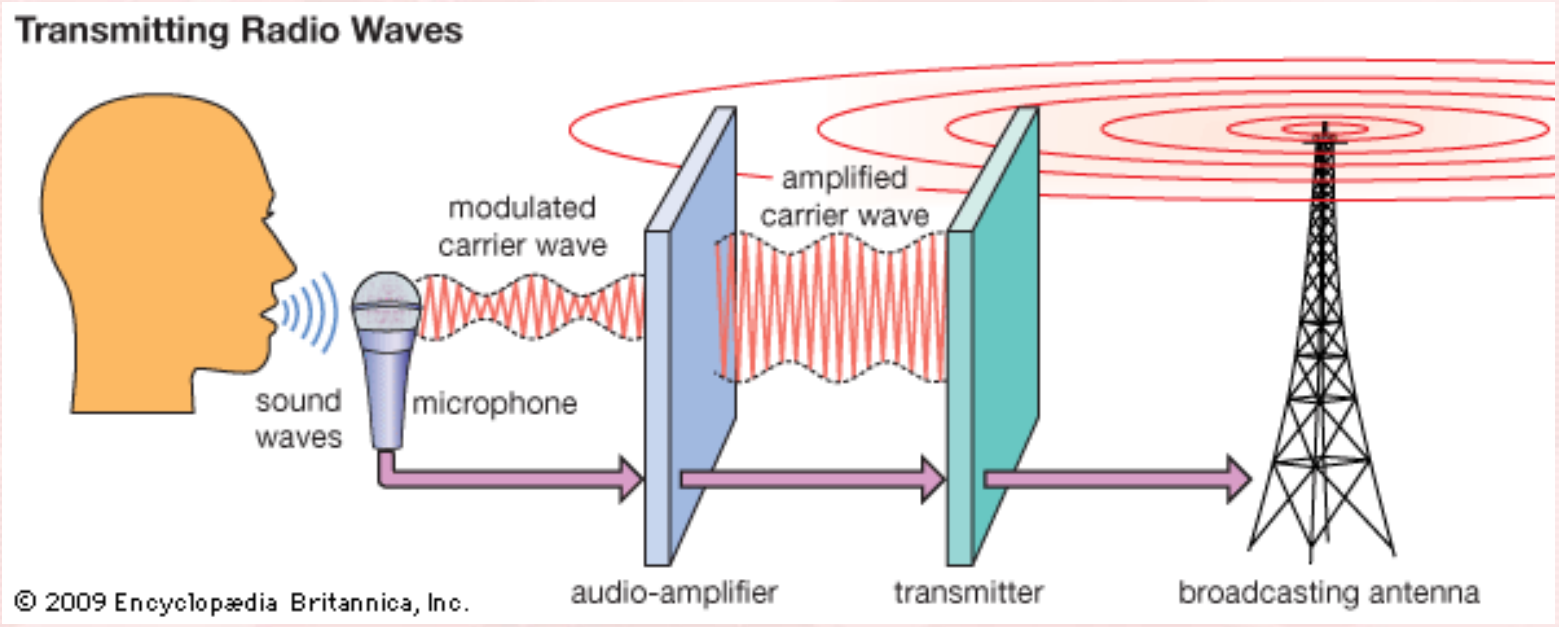
- When buildings or obstructions are blocking a direct line of sight path to a distant repeater using a directional antenna, try to find a path that reflects signals to the repeater. T3A05





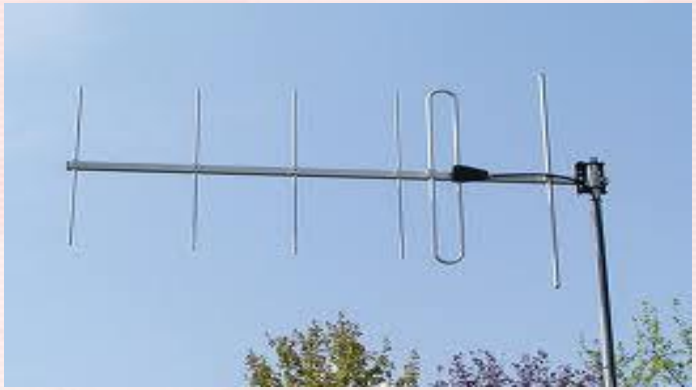
T 3 A

- The rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting is called picket fencing. T3A06
- An electromagnetic wave carries radio signals between transmitting and receiving stations. T3A07



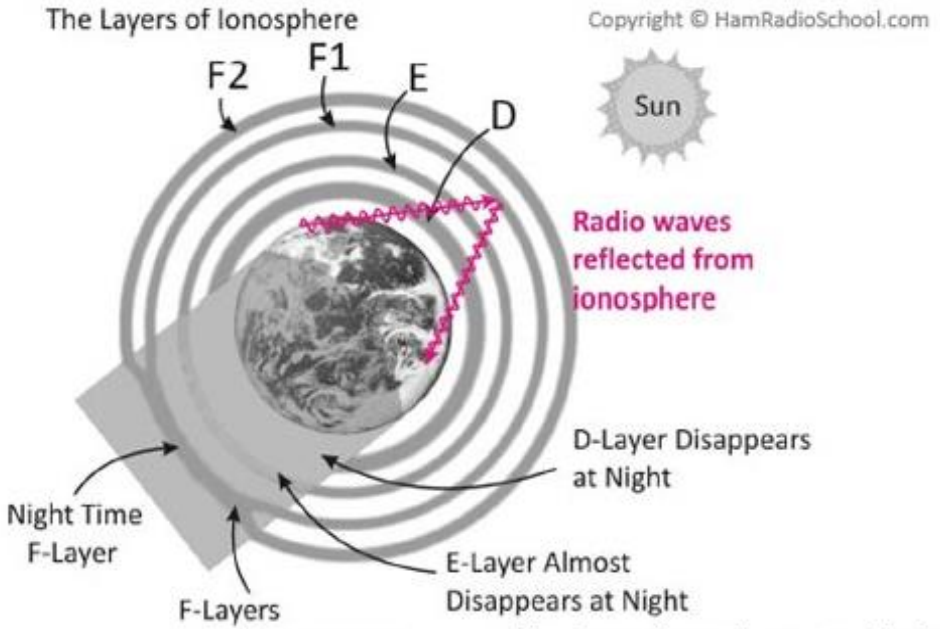
T 3 A

- Random combining of signals arriving via different paths is a likely cause of irregular fading of signals received by ionospheric reflection. T3A08
- Skip signals refracted from the ionosphere are elliptically polarized and can be received with either a vertically or horizontally polarized antenna. T3A09

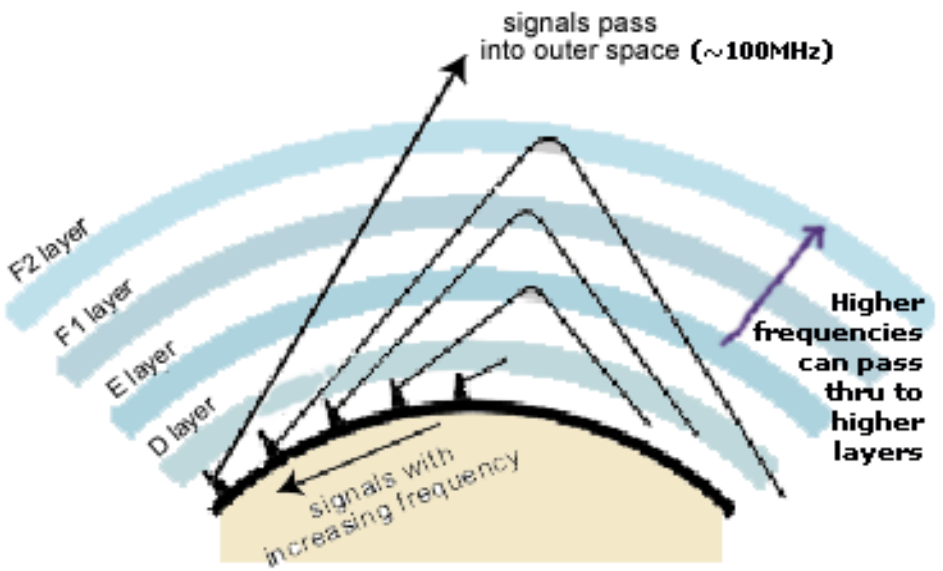


T 3 A

- Error rates are likely to increase if data signals propagate over multiple paths. T3A10
- The ionosphere is the part of the atmosphere that enables the propagation of radio signals around the world. T3A11



The ionosphere changes with the day-night cycle.



How the ionospheric layers refract different frequencies

T 3 A

- Fog and light rain will have little effect on radio range on the 10 meter and 6 meter bands. T3A12

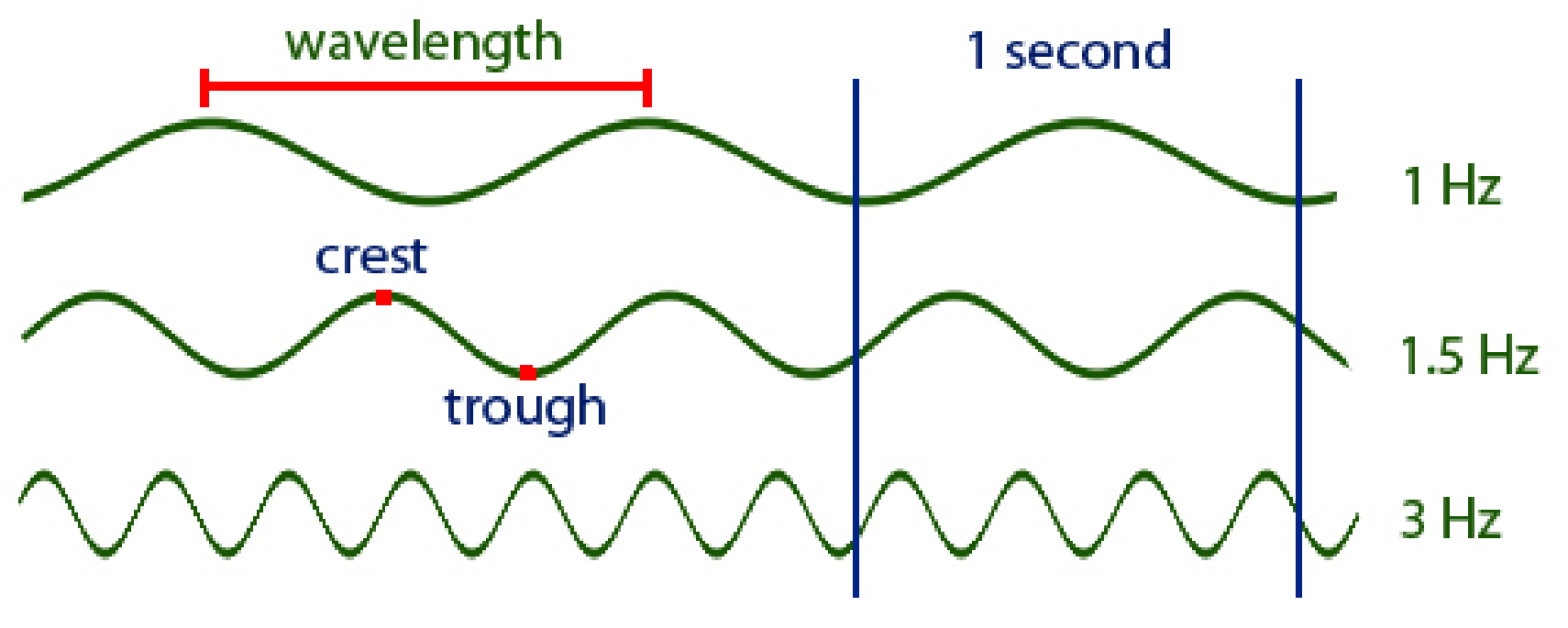
- Precipitation will decrease range at microwave frequencies, but not high winds, low barometric pressure or cold temperatures. T3A11

T 3 B

- Radio and electromagnetic wave properties:
  - the electromagnetic spectrum;
  - wavelength vs frequency;
  - nature and velocity of electromagnetic waves;
  - definition of UHF, VHF, HF bands;
  - calculating wavelength

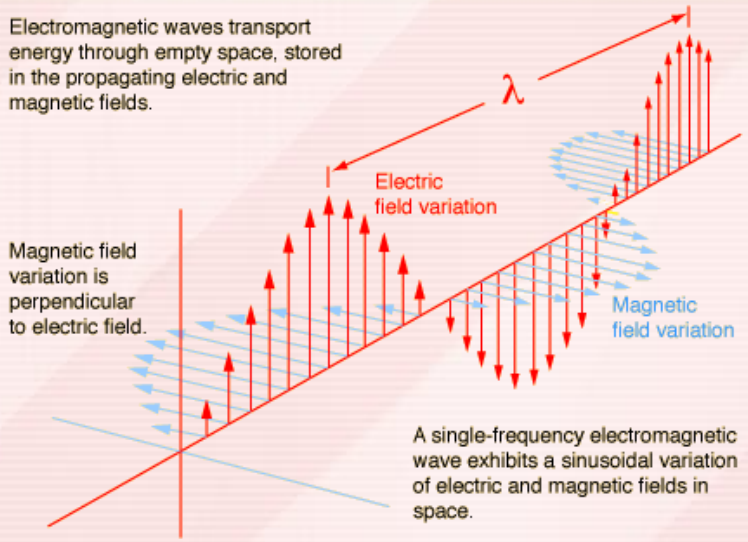
T 3 B

- The name for the distance that a radio wave travels over one complete cycle is its wavelength. T3B01

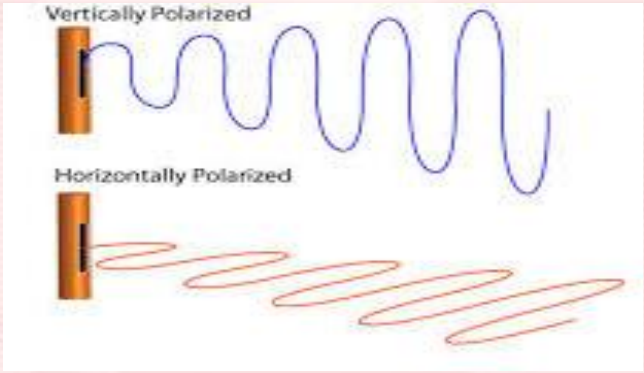


T 3 B

- The two components of a radio wave are electric and magnetic fields. T3B03



- The orientation of the electric field is the property of a radio wave used to describe its polarization. T3B02



T 3 B

- A radio wave travels through free space at the speed of light. T3B04

- The approximate velocity of a radio wave as it travels through free space is 300 million meters per second. T3B11

T 3 B

- The relationship of the wavelength of a radio wave to its frequency is that, as the wavelength gets shorter the frequency increases. T3B05

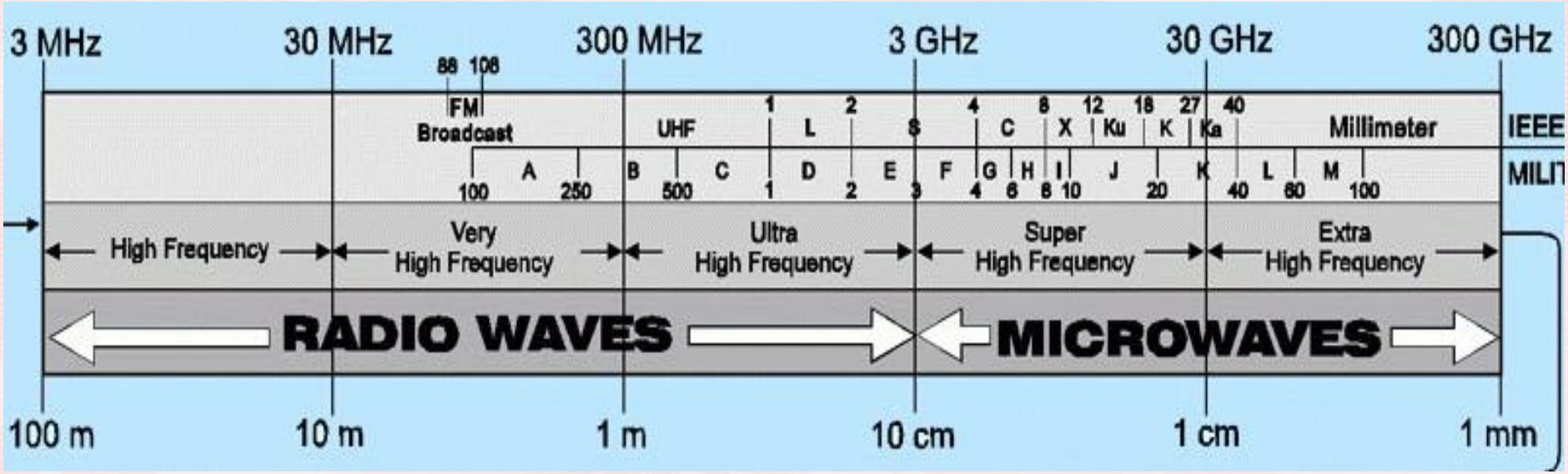
  The formula for converting frequency to approximate wavelength in meters is:

  Wavelength (in meters) = 300 ÷ F (MHz) T3B06

- The property of radio waves often used to identify the different frequency bands is its approximate wavelength. T3B07

T 3 B

- High frequency (HF) extends from 3 to 30 MHz. T3B10
- The VHF spectrum extends from 30 MHz to 300 MHz. T3B08
- The UHF spectrum extends from 300 MHz to 3000 MHz. T3B09



T 3 C

- Propagation modes:
  - line of sight;
  - sporadic E;
  - meteor and auroral scatter and reflections;
  - tropospheric ducting;
  - F layer skip;
  - radio horizon

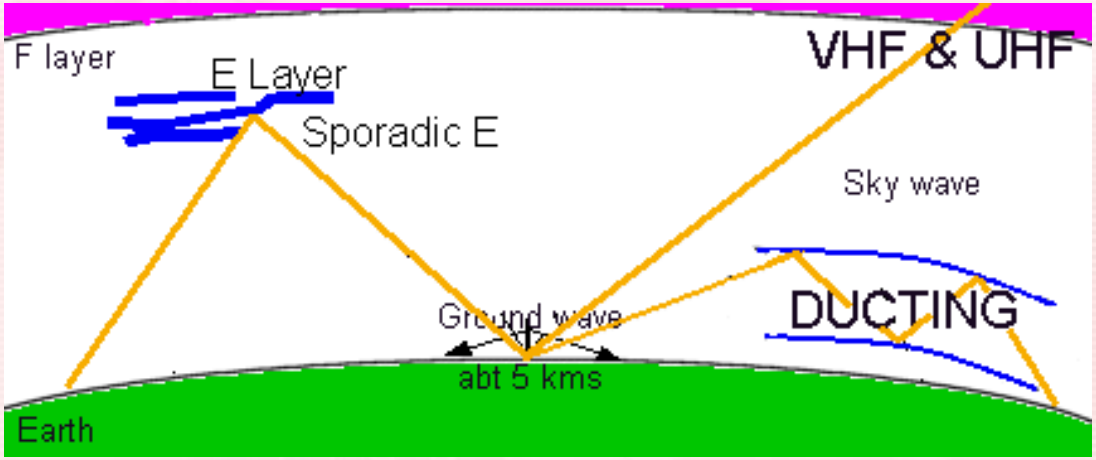
T 3 C

- Due to UHF frequencies signals not usually refracted by the ionosphere, direct UHF signals are rarely heard from stations outside your local coverage area. T3C01

- Long distance ionospheric propagation is far more common on HF and is an advantage of HF versus VHF and higher frequencies. T3C02

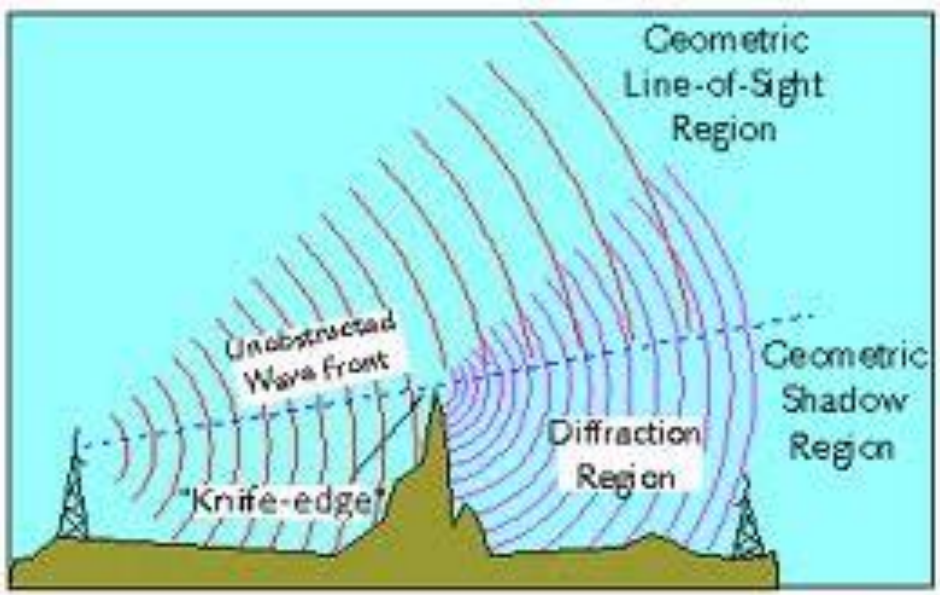
T 3 C

- A characteristic of VHF signals received via auroral reflection exhibits rapid fluctuations of strength and often sound distorted. T3C03
- Sporadic E skip is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands. T3C04



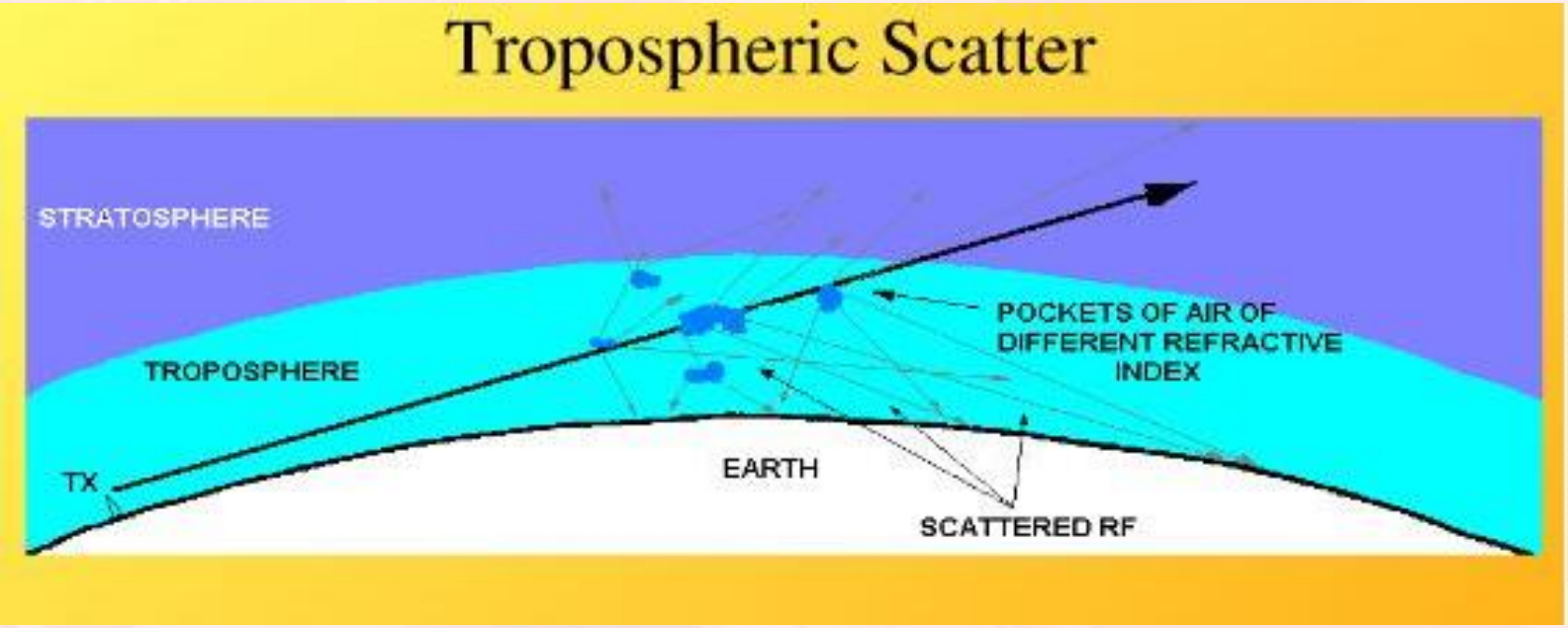
T 3 C

- Knife-edge diffraction effects might cause radio signals to be heard despite obstructions between transmitting and receiving stations. T3C05



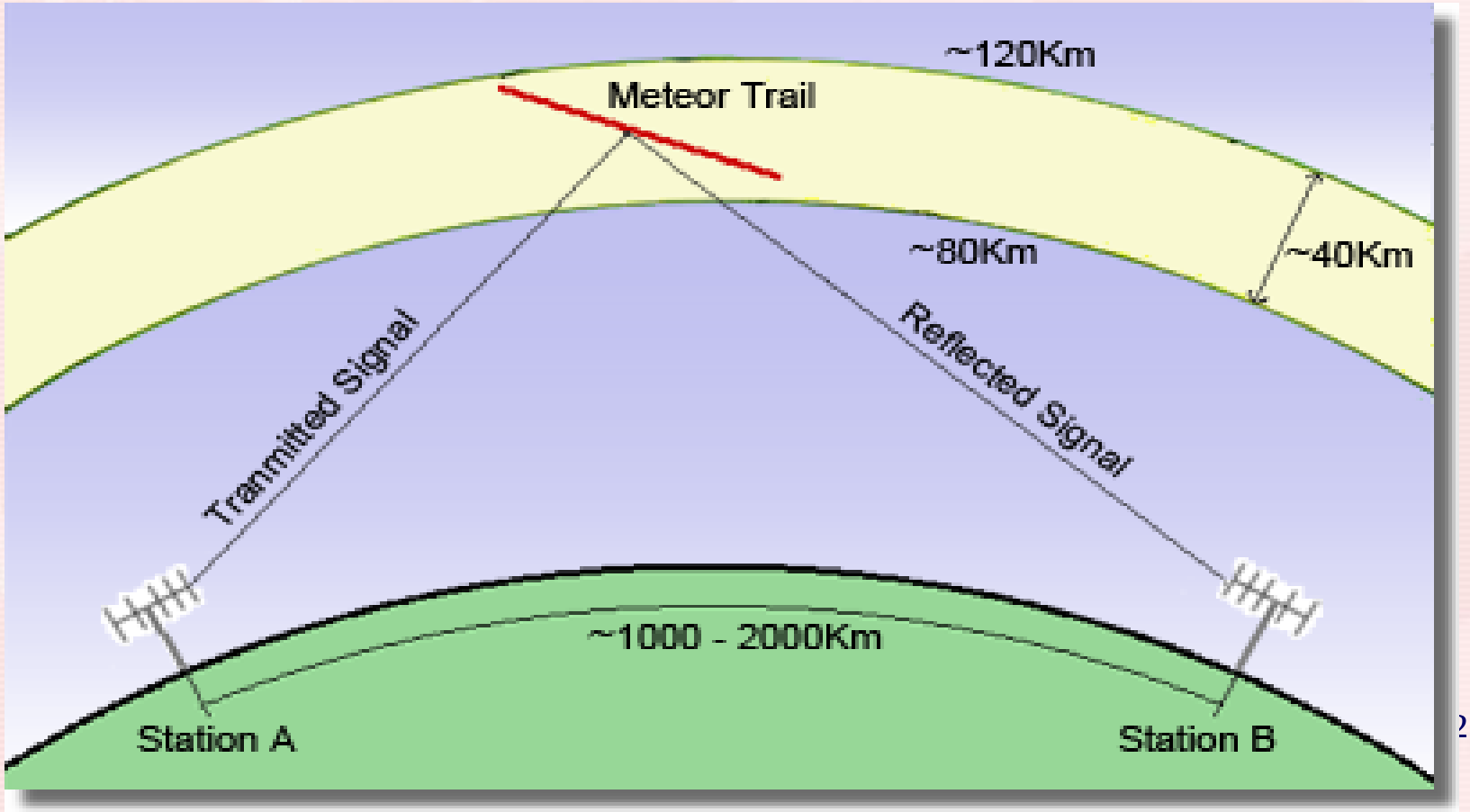
T 3 C

- Tropospheric scatter is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis. T3C06



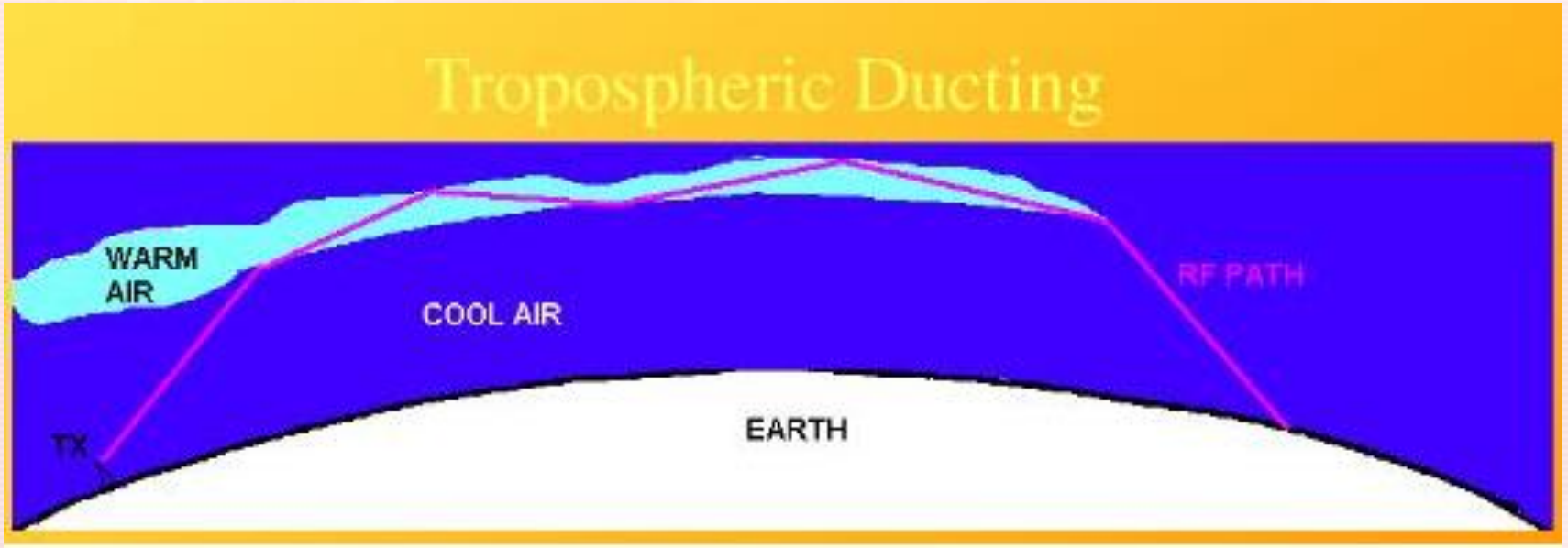
T 3 C

- The 6 meter band is best suited for communicating via meteor scatter. T3C07



T 3 C

- Temperature inversions in the atmosphere cause tropospheric ducting. T3C08



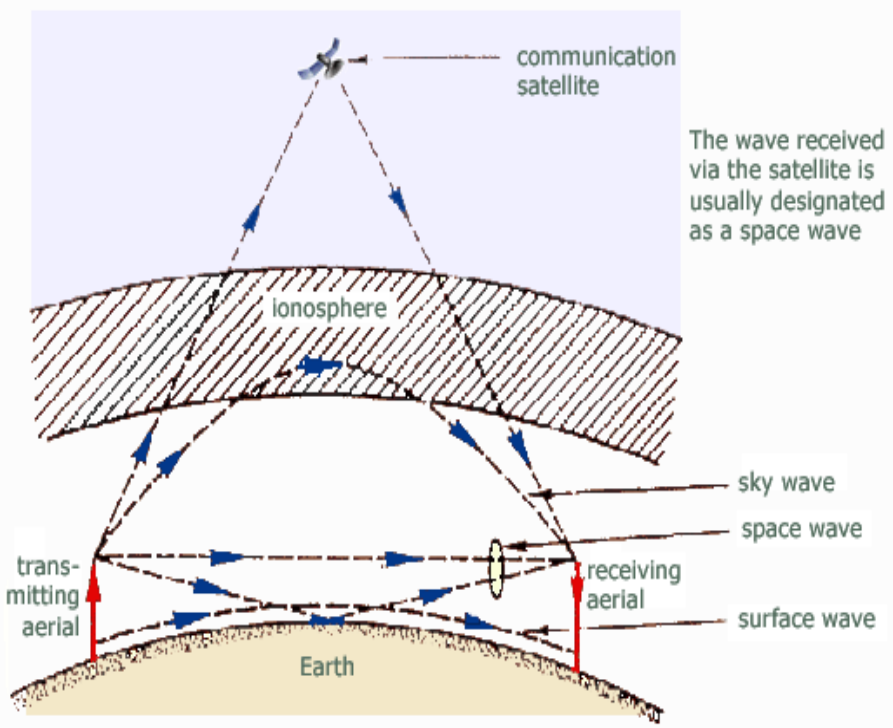
T 3 C

- From dawn to shortly after sunset during periods of high sunspot activity is generally the best time for long-distance 10 meter band propagation via the F layer. T3C09

- The 6 or 10 meter bands may provide long distance communications during the peak of the sunspot cycle. T3C10

T 3 C

- VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations due to the earth seems less curved to radio waves than to light. T3C11



The transmission paths for radio waves: surface waves, space waves and sky waves

Element 2 Technician Class Question Pool

T 3 A – T 3 C

T3A01 What should you do if another operator reports that your station's 2 meter signals were strong just a moment ago, but now they are weak or distorted?

A. Change the batteries in your radio to a different type
B. Turn on the CTCSS tone
C. Ask the other operator to adjust his squelch control
D. Try moving a few feet or changing the direction of your antenna if possible, as reflections may be causing multi-path distortion

T3A02 Why might the range of VHF and UHF signals be greater in the winter?

A. Less ionospheric absorption

B. Less absorption by vegetation

C. Less solar activity

D. Less tropospheric absorption

T3A03 What antenna polarization is normally used for long-distance weak-signal CW and SSB contacts using the VHF and UHF bands?

A. Right-hand circular
B. Left-hand circular
C. Horizontal
D. Vertical

T3A04 What can happen if the antennas at opposite ends of a VHF or UHF line of sight radio link are not using the same polarization?

A. The modulation sidebands might become inverted
B. Signals could be significantly weaker
C. Signals have an echo effect on voices
D. Nothing significant will happen

T3A05 When using a directional antenna, how might your station access a distant repeater if buildings or obstructions are blocking the direct line of sight path?

A. Change from vertical to horizontal polarization
B. Try to find a path that reflects signals to the repeater
C. Try the long path
D. Increase the antenna SWR

T3A06 What term is commonly used to describe the rapid fluttering sound sometimes heard from mobile stations that are moving while transmitting?

A. Flip-flopping

B. Picket fencing

C. Frequency shifting

D. Pulsing

T3A07 What type of wave carries radio signals between transmitting and receiving stations?

A. Electromagnetic

B. Electrostatic

C. Surface acoustic

D. Magnetostrictive

T3A08 Which of the following is a likely cause of irregular fading of signals received by ionospheric reflection?

A. Frequency shift due to Faraday rotation

B. Interference from thunderstorms

C. Random combining of signals arriving via different path lengths

D. Intermodulation distortion

T3A09 Which of the following results from the fact that skip signals refracted from the ionosphere are elliptically polarized?

A. Digital modes are unusable

B. Either vertically or horizontally polarized antennas may be used for transmission or reception

C. FM voice is unusable

D. Both the transmitting and receiving antennas must be of the same polarization

T3A10 What may occur if data signals arrive via multiple paths?

A. Transmission rates can be increased by a factor equal to the number of separate paths observed

B. Transmission rates must be decreased by a factor equal to the number of separate paths observed

C. No significant changes will occur if the signals are transmitting using FM

D. Error rates are likely to increase

T3A11 Which part of the atmosphere enables the propagation of radio signals around the world?

A. The stratosphere

B. The troposphere

C. The ionosphere

D. The magnetosphere

T3A12 How might fog and light rain affect radio range on the 10 meter and 6 meter bands?

A. Fog and rain absorb these wavelength bands

B. Fog and light rain will have little effect on these bands

C. Fog and rain will deflect these signals

D. Fog and rain will increase radio range

T3A13 What weather condition would decrease range at microwave frequencies?

A. High winds

B. Low barometric pressure

C. Precipitation

D. Colder temperatures

T3B01 What is the name for the distance a radio wave travels during one complete cycle?

A. Wave speed
B. Waveform
C. Wavelength
D. Wave spread

T3B02 What property of a radio wave is used to describe its polarization?

A. The orientation of the electric field
B. The orientation of the magnetic field
C. The ratio of the energy in the magnetic field to the energy in the electric field
D. The ratio of the velocity to the wavelength

T3B03 What are the two components of a radio wave?

A. AC and DC
B. Voltage and current
C. Electric and magnetic fields
D. Ionizing and non-ionizing radiation

T3B04 How fast does a radio wave travel through free space?

A. At the speed of light
B. At the speed of sound
C. Its speed is inversely proportional to its wavelength
D. Its speed increases as the frequency increases

T3B05 How does the wavelength of a radio wave relate to its frequency?

A. The wavelength gets longer as the frequency increases
B. The wavelength gets shorter as the frequency increases
C. There is no relationship between wavelength and frequency
D. The wavelength depends on the bandwidth of the signal

T3B06 What is the formula for converting frequency to approximate wavelength in meters?

A. Wavelength in meters equals frequency in hertz multiplied by 300

B. Wavelength in meters equals frequency in hertz divided by 300

C. Wavelength in meters equals frequency in megahertz divided by 300

D. Wavelength in meters equals 300 divided by frequency in megahertz

T3B07 What property of radio waves is often used to identify the different frequency bands?

A. The approximate wavelength
B. The magnetic intensity of waves
C. The time it takes for waves to travel one mile
D. The voltage standing wave ratio of waves

T3B08 What are the frequency limits of the VHF spectrum?

A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz

T3B09 What are the frequency limits of the UHF spectrum?

A. 30 to 300 kHz
B. 30 to 300 MHz
C. 300 to 3000 kHz
D. 300 to 3000 MHz

T3B10 What frequency range is referred to as HF?

A. 300 to 3000 MHz
B. 30 to 300 MHz
C. 3 to 30 MHz
D. 300 to 3000 kHz

T3B11 What is the approximate velocity of a radio wave as it travels through free space?

A. 3000 kilometers per second
B. 300,000,000 meters per second
C. 300,000 miles per hour
D. 186,000 miles per hour

T3C01 Why are direct (not via a repeater) UHF signals rarely heard from stations outside your local coverage area?

A. They are too weak to go very far

B. FCC regulations prohibit them from going more than 50 miles

C. UHF signals are usually not reflected by the ionosphere

D. UHF signals are absorbed by the ionospheric D layer

T3C02 Which of the following is an advantage of HF vs VHF and higher frequencies?

A. HF antennas are generally smaller

B. HF accommodates wider bandwidth signals

C. Long distance ionospheric propagation is far more common on HF

D. There is less atmospheric interference (static) on HF

T3C03 What is a characteristic of VHF signals received via auroral reflection?

A. Signals from distances of 10,000 or more miles are common

B. The signals exhibit rapid fluctuations of strength and often sound distorted

C. These types of signals occur only during winter nighttime hours

D. These types of signals are generally strongest when your antenna is aimed west

T3C04 Which of the following propagation types is most commonly associated with occasional strong over-the-horizon signals on the 10, 6, and 2 meter bands?

A. Backscatter

B. Sporadic E

C. D layer absorption

D. Gray-line propagation

T3C05 Which of the following effects might cause radio signals to be heard despite obstructions between the transmitting and receiving stations?

A. knife-edge diffraction

B. Faraday rotation

C. Quantum tunneling

D. Doppler shift

T3C06 What mode is responsible for allowing over-the-horizon VHF and UHF communications to ranges of approximately 300 miles on a regular basis?

A. Tropospheric scatter

B. D layer refraction

C. F2 layer refraction

D. Faraday rotation

T3C07 What band is best suited to communicating via meteor scatter?

A. 10 meters

B. 6 meters

C. 2 meters

D. 70 cm

T3C08 What causes tropospheric ducting?

A. Discharges of lightning during electrical storms

B. Sunspots and solar flares

C. Updrafts from hurricanes and tornadoes

D. Temperature inversions in the atmosphere

T3C09 What is generally the best time for long-distance 10 meter band propagation via the F layer?

A. From dawn to shortly after sunset during periods of high sunspot activity

B. From shortly after sunset to dawn during periods of high sunspot activity

C. From dawn to shortly after sunset during periods of low sunspot activity

D. From shortly after sunset to dawn during periods of low sunspot activity

T3C10 Which of the following bands may provide long distance communications during the peak of the sunspot cycle?

A. 6 or 10 meter bands

B. 23 centimeter band

C. 70 centimeter or 1.25 meter bands

D. All of these choices are correct

T3C11 Why do VHF and UHF radio signals usually travel somewhat farther than the visual line of sight distance between two stations?

A. Radio signals move somewhat faster than the speed of light

B. Radio waves are not blocked by dust particles

C. The Earth seems less curved to radio waves than to light

D. Radio waves are blocked by dust particles