



# THE OHM TOWN NEWS

*Voice of the Bridgerland Amateur Radio Club*

>>>>>>> <http://www.barconline.org> <<<<<<<

## December 2013

**Merry Christmas**

**Happy New Year**

### *Some Contents...*



President's Message .....2

Upcoming Activities .....3

Election Results for 2014 Officers .....3

Activity Support Prized Awarded .....3

ARRL News and Information .....4-10

Test Questions for Technician Class License .. 11

2013 Club Officers..... 12



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## PRESIDENT'S MESSAGE

The year is in its final month. We had a year filled with successful events and activities, including many interesting and informative programs presented at the club meetings. I want to thank all of you for your help and participation throughout the past year; we couldn't have done it without you. It has been a fun and exciting time, and all in all I have enjoyed every minute. Remember - the Bridgerland Amateur Radio Club is only as good as you, our members, make it.



Please remember that this club is for you. Let any of the officers or board members know of topics, activities, or anything that would be of interest to you and others. Amateur radio offers many activities that an individual can pursue, learn, and have fun with. There is: talking with friends within the local area on a hand-held (HT) or a mobile in your vehicle, DXing worldwide on the HF bands to a distant country, assisting with emergency and disaster communications, technical experimenting from a simple antenna to something complex as a transmitter or an interface between their radio and a computer, contesting to see who can make the most contacts in a limited period of time, talking to the space station with your HT and a hand held beam antenna, using Orbiting Satellites Carrying Amateur Radio (OCSAR) to experience satellite tracking and participate in radio propagation experiments, experimental work such as meteor scatter and earth-moon-earth communications, and digital communications from pactor, Winlink, PSK-31, to D-Star. And there is still more that I have not listed. There is something for everyone. Ham radio provides the broadest and most powerful wireless communication capability available to any private citizen anywhere in the world.

And for me, it is fascinating to explore the different aspects of amateur radio and I enjoy my time with the hobby.

At our November club meeting elections for 2014 BARC officers and board members, many of the existing officers and board members will be returning next year. The returning officers and board members for 2014 are: Cordell Smart KE7IK President, Ted McArthur AC7II Vice President, Tammy Stevens N7YTO Secretary, Kevin Reeve N7RXE Treasurer, and Tyler Griffiths N7UWX Board Member, and Theo Thomson N7TWT Board Member. Welcome onboard our new board member, Kelly Hansen KF7TDP. A hardy thanks goes to our outgoing board member Jared Smith N7SMI for the time and dedicated service he has provided.

Thanks again to everyone for your support. Our club has the most outstanding members and participation in amateur radio in the area.

Have a safe December and Happy Holidays.

73,  
Cordell  
KE7IK



# UPCOMING 2013 ACTIVITIES

19 Dec, 8:00 PM - RACES VHF Net 147.18 Snowbird 147.20 IRLP 146.72 Mt. Logan

## Starting in 2014

8 January, 7:30 PM — ARRL Rocky Mountain Division Net IRLP Node: 9871

11 January, 10:00 AM — Club Meeting

18 January 8:00 AM — RACES HF Net 3920 KHz

8 February, 10:00 AM — Club Meeting

12 February, 7:30 PM - ARRL Rocky Mountain Division Net IRLP Node: 9871

20 Feb, 8:00 PM - RACES VHF Net 147.18 Snowbird 147.20 IRLP 146.72 Mt. Logan

8 March, 10:00 AM — BARC Club

12 March, 7:30 PM - ARRL Rocky Mountain Division Net IRLP Node: 9871

15 March 8:00 AM — RACES HF Net 3920 KHz



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### Results of the Elections for the BARC Club Officers for 2014

**President:** Cordell Smart KE7IK

**Vice President:** Ted McArthur AC7II

**Secretary:** Tammy Stevens N7YTO

**Treasurer:** Kevin Reeve N7RXE

**Board:** Tyler Griffiths N7UWX Theo Thomson K7TWT Kelly Hansen KF7TDP

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### Awards Given Out at the December Club Meeting/**Christmas Party**

President's Leadership Award: Jared Smith N7SMI – Presented by Cordell

Spirit of Amateur Radio Award: Spencer Dattage KE7TAS – Presented by Tyler

President's Service Award: Kelly Hansen KF7TDP – Presented by Ted



### The Yearly Activity Support Prizes Went To:

**Jared Smith** N7SMI, a Kenwood TH-D72A Data Communicator which is a Dual Band 2M 70CM handheld transceiver with a built in TNC (1200/9600) and integrated GPS/ APRS

**Colleen Blanke** KF7PBP, a Kenwood TM-D710G Dual Band 2M/440 mobile transceiver with built-in GPS/APRS/TNC and ECHOLINK ready.

## The ARRL Letter for November 21, 2013 *Public Service: MARS 48 Hour Test Deemed "Unequivocal Success"*

Military Auxiliary Radio System ([MARS](#)) Army MARS Chief Stephen Klinefelter has declared the multi-faceted national communication exercise early this month "an unequivocal success," and he thanked all three MARS branches and the other participating military units and civilian entities for their "hard work, long hours, and dedication to the mission."

The MARS station at ARRL's Maxim Memorial Station, AAN1ARL, took part in the November 3-5 exercise, which Klinefelter said was "designed to test and stress our networks and our members' ability to process and respond to a variety of message traffic."

In the drill scenario, a catastrophe had wiped out normal telephone and Internet links. Communication was by voice and digital HF radio, the bulk encrypted as it would be in a hostile contingency. From start to finish, nets throughout 48 states operated without a break, with military MARS stations overseas also connected -- more than 5500 hours of operation by Army MARS participants alone.

Eastern Massachusetts Amateur Radio Emergency Service (ARES) handled exercise traffic as well. US Army MARS representatives met with ARRL staff at League Headquarters in early October to discuss ways the two organizations might collaborate in emergency response activities.



## *Ham Radio in Space: AMSAT-UK FUNcube-1 Satellite in Orbit*

A Russian Dnepr rocket carried AMSAT-UK's [FUNcube-1](#) -- now known officially as AMSAT-OSCAR 73 -- and 18 other satellites carrying Amateur Radio payloads to orbit at 0710 UTC on Thursday, November 21. Ground stations began receiving telemetry from FUNcube-1 soon after deployment and the satellite appears to be functioning normally.

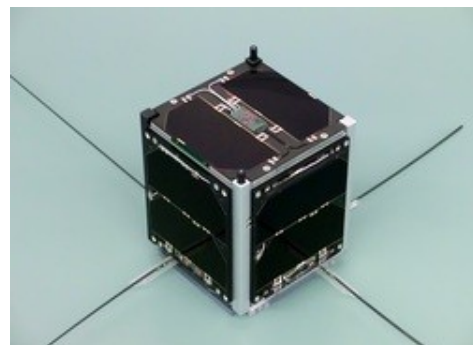
One of the satellites on the launch, [UniSat-5](#), will deploy a number of additional satellites. Among them should be the CubeSats PUCP-SAT-1, HumSat-D, estar-2, [lcube-1](#) and the PocketQubes [Wren](#), Eagle-1 (BeakerSat), [Eagle-2 \(\\$50Sat\)](#), QB-Scout1. PUCP-SAT-1 intends to subsequently release a further satellite Pocket-PUCP.

As well as UniSat-5 and its associated CubeSats and PocketQubes these Amateur Radio satellites were also on the launch:

<a href="#">HinCube</a>	<a href="#">FUNcube-1</a>	<a href="#">ZAcube-1</a>	<a href="#">First-MOVE</a>	UWE-3
Velox-P11	CubeBug-2	Triton-1	<a href="#">Delfi-n3Xt</a>	GOMX-1

For a frequency list, see <http://amsat-uk.org/2013/11/13/three-amateur-radio-satellite-deployments-in-november/>.

The latest orbital elements for FUNcube-1 are available at <http://funcube.org.uk/working-documents/latest-two-line-elements/>.



## ***Your League: ARRL Helps Manufacturer to Resolve Arc Fault Circuit Interrupter RFI Problems***

The ARRL Lab has worked with a manufacturer of arc fault circuit interrupter (AFCI) breakers to resolve complaints that Amateur Radio RF was causing certain breaker models to trip unnecessarily. Like the more common ground fault circuit interrupter (GFCI), the AFCI is a safety device. Primarily designed to detect problems that could result in a fire, AFCIs detect potentially hazardous arc faults that result from often unseen damage or poor connections in wiring and in extension cords and cord sets.

"Several months ago we started receiving reports from amateurs that when they transmitted, their AFCI breakers were tripping," said Mike Gruber, W1MG, the ARRL Lab's EMC specialist. He noted that the issue has been a topic of online ham radio discussions as well as on homeowner sites; it seems that stray RF is not the only thing that can cause a "nuisance trip" of an AFCI. Gruber pointed out that the National Electrical Code (NEC) already requires AFCIs in some household circuits, but not all US jurisdictions have adopted the requirement.

Gruber said that as AFCIs became more common in new construction in the US, reports started coming in that AFCIs in the vicinity -- not just in the radio amateur's home -- would trip in the presence of RF from an Amateur Radio transmitter. While each manufacturer's design is proprietary, most AFCIs detect arcs by monitoring the shape of the alternating current waveform, changes in current levels, voltage irregularities, and the presence of high frequency emissions or "noise." The ARRL Lab dug into the problem.

"Last summer we built a test fixture in which we could test any type of circuit breaker," Gruber said. It involved using W1AW as an RF source. Gruber said he bought one of "every AFCI that I could get my hands on," but when the Lab began testing them during W1AW transmissions, none of the devices tripped.



W1AW Station Manager Joe Carcia, NJ1Q, with the AFCI test stand. [Mike Gruber, W1MG, photo]

A ham in New Mexico who had reported AFCI problems sent some of his breakers to the ARRL Lab, "and those tripped when we tested them," Gruber said. The problematic breakers were certain models made by Eaton Corporation. "We already had an Eaton breaker, an older model, but it did not trip," he noted, adding that the breaker had a yellow button. The newer model, which had a white button, did trip in the presence of RF, however, even at power levels down to about 50 W on 17 meters.

Gruber contacted Eaton, and two of the manufacturer's engineers visited ARRL Headquarters in August. "Eaton was extremely cooperative and eager to resolve this," Gruber recounted. "They spent the day with us, going over our test methods and took some of the problematic breakers back with them, eventually developing a modified version.

"We have just finished testing the new version of the breaker, and it did not trip during W1AW transmissions and in other tests," Gruber reported. He said the new breaker is still in the queue for UL approval.

Eaton Engineering Director Andy Foerster said arc fault detection is challenging, in part because so many common household devices -- such as vacuum cleaners and power tools that use motors with brushes -- create arcing. In information provided to ARRL Eaton engineer Lanson Relyea said that because AFCIs rely on HF emission detection to verify arcing, "any signal that conducts or radiates a signal within the detection band of the AFCI can cause interference and cause the device to trip without the presence of a true arcing condition."

Eaton and ARRL agreed that when the manufacturer comes out with any new models of breakers, it

will ask the League to test them at W1AW. "It's a win-win situation," Gruber said. Eaton also has agreed to work with anyone having a problem with RF tripping its AFCIs.

Hams experiencing unwanted tripping problems with their or their neighbors' AFCIs should first contact the manufacturer. In the case of Eaton breakers, contact [Bob Handick](#) (412-893-3746) or [Joe Fello](#) (412-893-3745). Read [more](#).

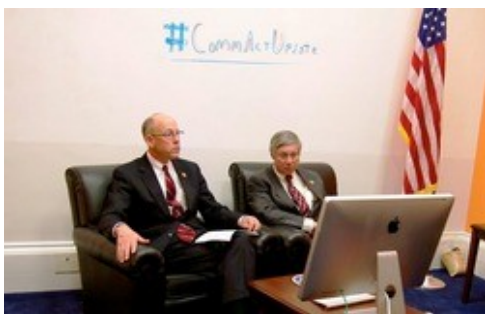


## **The ARRL Letter for December 5, 2013 Regulatory: Plans Announced to Update the Communications Act of 1934**

The US House Communications and Technology Subcommittee has [announced](#) plans for a multi-year effort to examine and update the Communications Act of 1934, the overarching law under which the FCC functions. The subcommittee, part of the US House Energy and Commerce Committee, is chaired by Oregon Republican Greg Walden, W7EQI. Walden and Energy and Commerce Committee Chair Fred Upton of Michigan made the announcement December 3.

"Today we are launching a multi-year effort to examine our nation's communications laws and update them for the Internet era," Upton said. "The United States has been the global leader in innovation and growth of the Internet, but unfortunately, our communications laws have failed to keep pace."

ARRL CEO David Sumner, K1ZZ, noted that the most recent significant update of the Communications Act was in 1996. "Under the leadership of Greg Walden, the subcommittee and its staff are well equipped to take up the challenge," Sumner said. "The ARRL will be monitoring the work closely as it goes forward next year and beyond."



US Representatives Greg Walden, W7EQI (left), and Fred Upton announce plans via Google Hangout to update the Communications Act.

The plan was made public via [Google Hangout](#), where the committee leaders were joined by former FCC Commissioner Robert McDowell, who said he was "delighted" to learn of the update plans. Upton explained that the process, to start in 2014, will involve a series of white papers and hearings focusing on what might be done "to improve the laws surrounding the communications marketplace as well as a robust conversation utilizing all platforms of digital media." He suggested a bill would be ready by 2015.

Walden said, "A lot has happened since the last update" and that the Communications Act is "now painfully out of date." He said he wants to open the discussion to input from everyone, and that interested parties may follow the plan's progress via [Twitter](#). "It's important for people to have an opportunity to weigh in," he said. "This is really a public process to get better public policy."

## ***Ham Radio in Space: Happy Birthday to AO-7!***

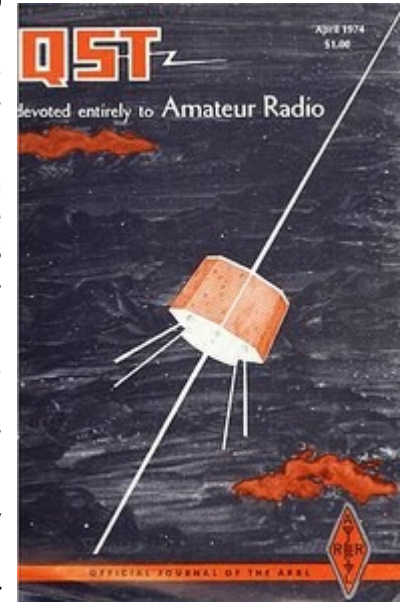
The [AO-7](#) Amateur Radio satellite turned 39 years old on November 15. Launched in 1974 from Vandenberg Air Force Base in California as the second AMSAT Phase 2 ham satellite, AO-7 continues to amaze.

After its batteries succumbed to old age, AO-7 went silent in 1981, only to spring back to life in 2002, although some believe it may have resurrected itself as much as a year earlier. AMSAT describes the Mode A/B bird as "semi-operational" and "almost certainly" running solely from its solar panels.

The ham satellite organization theorizes that AO-7's batteries shorted when they failed, but the short circuit subsequently opened, allowing the satellite to regain some functionality. This means AO-7 only works when it receives direct sunlight, and it shuts down when in eclipse. Since the satellite returned, terrestrial users have enjoyed numerous contacts via AO-7.

AMSAT-NA this week offered its congratulations to all involved in the designing, building, launching, and operating the satellite, adding, "It's an amazing achievement that, other than the batteries, most of the circuitry continues to function normally 39 years after launch."

AMSAT [newsletters](#) from the 1970s and early 1980s are available, courtesy of KA9Q. N4HY offers a [photo gallery](#) depicting AO-7's construction and launch of AO-7. -- Thanks to Paul Stoetzer, N8HM, via AMSAT News Service



AO-7 made the cover of the

## ***The ARRL Letter for December 12, 2013 Ham Radio in Space: NASA's Juno Spacecraft Hears Hams Say "HI"***



In a first-of-a kind for an interplanetary spacecraft, NASA's Juno spacecraft in October [was able to detect](#) Amateur Radio signals transmitting "HI" in coordinated, very slow-speed CW. More than a thousand radio amateurs around the globe greeted Juno October 9 as it looped past Earth for a gravity-assisted boost on its way to Jupiter. Participants were invited to spread out across 10 meters to transmit "HI" in very slow speed CW (1/25 WPM), sending 30 second dits punctuated by 30 second spaces and 90 seconds between the two characters.

"The second 'HI' was detected clearly," University of Iowa researcher and Waves Principal Engineer Don Kirchner, KD0L, told ARRL, noting that the distance to the spacecraft was about 37,500 kilometers (23,250 miles). "The signals were usually just at or above the noise

level, although at closest approach the first three dits of the 'H' had significantly higher signal levels," Kirchner continued. "A possible explanation is that for a short time we were inside the ionospheric waveguide and, as we increased in altitude, went back above it for the last dit." Shortly after that, Kirchner said, the spacecraft went into safe mode, so outbound data were lost.



The experiment involved 16 identical transmission rounds or cycles and ran a bit longer than 2-1/2 hours all told (1800 to 2040 UTC). The object of the experiment was to see if Juno's onboard "Waves" experiment would be able to detect the collaborative RF. Spreading out participants on a wide range of 10 meter frequencies was intended to improve the chance of the Waves instrument's hearing the ham signals. The detector has a bandwidth of 1 MHz.

According to the University of Iowa, after the flyby the Juno team evaluated the Waves instrument data containing the messages. Kirchner notes that while previous space missions -- Galileo on its way to Jupiter, and Cassini headed for Saturn -- were able to detect shortwave radio transmissions during their Earth encounters, it was not possible to decode intelligent information using the data from those spacecraft.

"We believe this was the first intelligent information to be transmitted to a passing interplanetary space instrument, as simple as the message may seem," said Bill Kurth, a University of Iowa Researcher and Lead Investigator for the Waves instrument. "This was a way to involve a large number of people - those not usually associated with Juno -- in a small portion of the mission."

Among stations participating were operators at the Virginia Tech Amateur Radio Club's K4KDJ, who posted [video](#) of their activity on YouTube.

Kurth said the activity raised awareness of the mission, adding that the University of Iowa already has heard from some who plan to follow Juno through its science mission at Jupiter. On December 10 during the fall meeting of the American Geophysical Union in San Francisco, Kurth and Juno Principal Investigator Scott Bolton of the Southwest Research Institute of San Antonio took part in a news conference to discuss the science gathered during the Juno flyby as well as the success of the "Say HI to Juno" project.

Kirchner said the project originated when public outreach staff at NASA's Jet Propulsion Laboratory in Pasadena, California, wanted to know if the UI receiver was able to pick up a voice message. Kurth and Kirchner came up with the idea that a slow Morse code message might work, and Kirchner enlisted the University of Iowa Amateur Radio Club to get involved, spreading the word via ham radio to raise awareness of the project.

Plans call for Juno to orbit Jupiter 33 times. Among a variety of investigations, Juno will explore Jupiter's northern and southern lights by flying directly through the electrical current systems that generate them. NASA's Jet Propulsion Laboratory, which manages the Juno mission for the principal investigator, posted a [mini-documentary](#) about the "Say HI to Juno" event on YouTube.

"We would again like to thank all amateurs who participated," Kirchner told ARRL. "At last report about 1400 had sent in a request for a Juno QSL." Anyone who took part can [request](#) a QSL card that acknowledges their help.



University of Iowa Amateur Radio Club President Tony Rogers, AD0EN, sits in the operator's chair of club station W0IO, which was among the stations greeting the Juno spacecraft in October. [Tim Schoon/University of Iowa, photo].





## Regulatory: Deadline Looms to Comment on ARRL's "Symbol Rate" Petition

The deadline is December 21 to file comments on the ARRL's "Symbol Rate" *Petition for Rule Making* ([PRM](#)). The ARRL filed the *Petition* last month, and the FCC has put it on public notice for comment as [RM-11708](#). The League subsequently filed an [Erratum](#) to correct an incorrect appendix included within the *Petition*. The *Petition* already has attracted more than 70 comments.



The ARRL has asked the FCC to delete the symbol rate limit in §97.307(f) of its Amateur Service rules and to replace it with a maximum data emission bandwidth of 2.8 kHz on frequencies below 29.7 MHz. The ARRL contends that the changes it proposes would "relieve the Amateur Service of outdated, 1980s-era restrictions that presently hamper or preclude Amateur Radio experimentation with modern high frequency (HF) and other data transmission protocols" and "permit greater flexibility in the choice of data emissions." Symbol

rate represents the number of times per second that a change of state occurs, not to be confused with data (or bit) rate.

Current FCC rules limit digital data emissions below 28 MHz to 300 baud, and between 28.0 and 28.3 MHz to 1200 baud. The League's petition points out that other radio services use transmission protocols in which the symbol rate exceeds the present limitations set forth in §97.307(f), while staying within the bandwidth of a typical HF single sideband channel (3 kHz).

"The symbol rate restrictions were created to suit digital modes that are no longer in favor," the ARRL noted in its petition. "If the symbol rate is allowed to increase as technology develops and the Amateur Service utilizes new data emission types, the efficiency of amateur data communications will increase."

## Events: Amateur Radio Direction Finding Enthusiasts Enjoy National, Regional Competition



ly 50 radio direction finding enthusiasts took part in the 13th USA Amateur Radio Direction Finding (ARDF) national championships, held in Jwharrie National Forest near Asheboro, North Carolina, in October. year's weeklong US competition was combined with the Seventh IF Championships of [IARU Region 2](#) (the Americas). ARDF [competi- rules](#) are established by the [IARU](#).

object is always to find as many of the required transmitters as possi- on the shortest time and then navigate to the finish line, using only one's direction-finding equipment plus a compass and the provided map," ained ARRL ARDF Coordinator Joe Moell, [KØOV](#). "There are classic petitions on separate days on the 2 meter and 80 meter bands, with up re transmitters in an area of about 1000 acres."



Moell said the competition included [two new events](#), both on 80 meters. "The *sprint* is a shortened course with 10 transmitters and a faster transmitter cycle," he explained. "*Foxoring* is a combination of orienteering and foxhunting, in which competitors receive maps marked with the approximate locations of a dozen very low-power transmitters that they are to find. Competitors are divided into six age categories for males and five for females, with medals awarded to winners in each category."

As in many European countries, the US national championships are open, meaning that visitors from other countries are welcome. Visitors compete for individual medals in an overall division that includes everyone. This year, visiting competitors came from China, Germany, Russia, Sweden, Ukraine and United Kingdom. Stateside radio-orienteers enjoyed comparing notes with them on ARDF equipment and techniques.

[Complete results](#) of all events are available on the Backwoods Orienteering Klub (BOK) website. More than 90 photos have been posted on Moell's [Homing In](#) website, which includes much more information about the growing sport of ARDF.

Plans are already underway for next year's national championships. These are expected to take place in early June, in time for selection of ARDF Team USA, which will travel to Kazakhstan for the 17th ARDF World Championships in September 2014. "A maximum of three competitors in each age-gender category may be on a nation's team," Moell pointed out. "They will be selected from the best performers at the 2013 and 2014 USA Championships." Read [more](#).



Nearing the finish line is Jay Hennigan, WB6RDV, who was the top USA competitor in the category for men over age 60 in the 2 meter, 80 meter, and sprint events. [Joe Moell, KØOV, photo]

## ***Milestones: RAYNET Marks 60 Years***

When England's east coast was struck by a devastating flood in 1953 that claimed more than 300 lives, evacuations were hindered by a lack of effective communication. Amateur Radio volunteers filled the gap, but at the time the UK had no volunteer emergency communication corps, such as ARES in the US. Previous attempts to establish such an organization ran into governmental roadblocks, but after the East Coast Flood, [RAYNET](#) -- the Radio Amateurs' Emergency Network was inaugurated in November 1953.



Today RAYNET's 2000 Amateur Radio members serve as the UK's premier volunteer communication group. To advance emergency communication as well as Amateur Radio, RAYNET and the Radio Society of Great Britain ([RSGB](#)) have a formal agreement to work together.

In a *Yorkshire Post* article, RAYNET Chairman Cathy Clark, G1GQJ, was quoted as saying, "With our current unpredictable climate and the high risk of failure of modern communications networks, RAYNET volunteers can make a crucial difference." -- *Thanks to John Bigley, N7UR, Nevada Amateur Radio Newswire*

Here is a link to a very well put together set of videos on how to set up and install Winlink 2000 email system on your windows computer.

[http://www.winlink.org/K4REF\\_Videos](http://www.winlink.org/K4REF_Videos)

Tyler Griffiths N7UWX

## Questions for Technician Class License

1. (T1D06) Which of the following types of transmissions are prohibited?
  - A. Transmissions that contain obscene or indecent words or language
  - B. Transmissions to establish one-way communications
  - C. Transmissions to establish model aircraft control
  - D. Transmissions for third party communications
  
2. (T2A11) What are the FCC rules regarding power levels used in the amateur bands?
  - A. Always use the maximum power allowed to ensure that you complete the contact
  - B. An amateur may use no more than 200 watts PEP to make an amateur contact
  - C. An amateur may use up to 1500 watts PEP on any amateur frequency
  - D. An amateur must use the minimum transmitter power necessary to carry out the desired communication
  
3. (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
  
4. (T4B02) Which of the following can be used to enter the operating frequency on a modern transceiver?
  - A. The keypad or VFO knob
  - B. The CTCSS or DTMF encoder
  - C. The Automatic Frequency Control
  - D. All of these choices are correct
  
5. (T5B09) What is the approximate amount of change, measured in decibels (dB), of a power increase from 5 watts to 10 watts?
  - A. 2 dB
  - B. 3 dB
  - C. 5 dB
  - D. 10 dB
  
6. (T6B05) Which of the following electronic components can amplify signals?
  - A. Transistor
  - B. Variable resistor
  - C. Electrolytic capacitor
  - D. Multi-cell battery
  
7. (T7B04) What is the most likely cause of interference to a non-cordless telephone from a nearby transmitter?
  - A. Harmonics from the transmitter
  - B. The telephone is inadvertently acting as a radio receiver
  - C. Poor station grounding
  - D. Improper transmitter adjustment
  
8. (T8B07) With regard to satellite communications, what is Doppler shift?
  - A. A change in the satellite orbit
  - B. A mode where the satellite receives signals on one band and transmits on another
  - C. An observed change in signal frequency caused by relative motion between the satellite and the earth station
  - D. A special digital communications mode for some satellites
  
9. (T9B08) Why should coax connectors exposed to the weather be sealed against water intrusion?
  - A. To prevent an increase in feedline loss
  - B. To prevent interference to telephones
  - C. To keep the jacket from becoming loose
  - D. All of these choices are correct
  
10. (T0A02) How does current flowing through the body cause a health hazard?
  - A. By heating tissue
  - B. It disrupts the electrical functions of cells
  - C. It causes involuntary muscle contractions
  - D. All of these choices are correct



(For answers to test questions see page 12)

# BARC Club Officers

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Merry Christmas and Happy New Year



Answers to questions on page 11: 1-A, 2-D, 3-C, 4-A, 5-B, 6-A, 7-B, 8-C, 9-A, 10-D