Technician Study Sheet Instructions

The following pages contain information extracted from the question pool. Information is on this sheet because it simply requires memorization and addresses multiple questions in the pool. To prepare for the class, read through this information and memorize as much as possible in advance. There are also practice tests available online at **http://www.qrz.com/p/testing.pl**. These practice tests use the actual FCC question pool and provide a sample of the material covered in a real test.

Technician Class Frequency Privileges (1500 watt PEP max)

These are the frequencies allocated for us to Technician class operators after passing the written (element 2) exam. There is an inverse proportional relationship between frequency and wavelength. Longer wavelengths have lower frequencies. There are several frequency to wavelength conversion questions using the formula shown.

Identification

All operators must identify themselves with their FCC callsign every 10 minutes while talking and at the end of a transmission or it is an illegal "unidentified transmission". There is no requirement to ID at the beginning – it only helps the other operator. CW (morse code) at less than 20 words per minute is always an acceptable way to ID.

License Period

An amateur license is valid for 10 years. It can be renewed no earlier than 90 days in advance. There is a two year renewal grace period during which time the license is not valid but can be renewed with no loss of privileges (no retest). Transmitting during the grace period is not allowed.

Good Amateur Practices

The radio spectrum is a shared resource and the FCC rules are largely based on "play nicely with others". Good Amateur Practice is exactly that. They include "listen before transmitting" to insure the frequency isn't already being used. Use the minimum power necessary (use your inside voice). If you want to break into a conversation in progress, you simply give your callsign between exchanges, the word "break" is only used to indicate emergency traffic. Additionally, Amateur Radio also cannot compete with commercial services so there is no broadcasting, business or music allowed (music can only be transmitted as incidental to a Space Shuttle/ISS rebroadcast).

Filters

Appropriate filters should be built into transmitters and receivers. Transmitters may need an additional low pass filter to remove unwanted harmonics that would affect TVs. TVs and FM radios may need a high pass filter to remove large amounts of HF frequency radiation that can overload them. Hams are only responsible for clean transmissions, not poor receiver design.

Repeater Frequency Separation (Split)

Repeaters are often placed on hilltops to extend the range of mobile and portable stations (handhelds). They listen on one frequency and simultaneously retransmit on another. The difference between transmit and receive frequencies is called "split" and varies for each band. All new radios know the split for each band but older units may not.

Bandwidth

Bandwidth determines how much spectrum a signal occupies. Narrower signals tend to be more efficient and have longer range.

Unit Conversions

These are basic metric conversions. Notice they involve moving the decimal place some number of digits right or left. 1,000 Kilohertz = 1 Megahertz.

Frequencies

Radios and telephones are both designed to carry Voice Frequencies between 300-3000 Hertz. Radio Waves generally begin at a range above human hearing at 20,000 Hertz

Radio Modes

The simplest radio signal is just a single frequency. By turning that radio wave on and off, it's possible to send morse code (CW). Amplitude Modulation is the simplest voice modulation scheme but it's not very efficient because it has two identical (redundant) sidebands with the voice information and the radio carrier that doesn't contain any information. Amateur radios often use Single Sideband (SSB) transmissions that are spectrally (space) and power efficient by removing one of the AM sidebands and the carrier before transmission. This leaves either the upper or lower sideband (USB/LSB). Convention dictates that lower sideband (LSB) signals are used below 10MHz and upper sideband (USB) is used above 10MHz.

Q Signals

Q Signals are shorthand created for morse code operators. Many of these have found their way into voice operations as well. The bolded items are asked specifically.

SWR

SWR stands for Standing Wave Ratio and is a measure of how well the antenna is matched to the radio. A 1:1 SWR means all the radio output power is being transferred to the antenna and is ideal. A high SWR can overheat the radio so most radios have circuitry that lowers output levels as SWR increases.

Antenna Lengths

The dipole is the basic "T" shaped antenna, similar to what is supplied with FM stereos that tack to the wall. The top of the antenna is a half wavelength for the desired frequency and the feed line (coax) can be any length. There are a number of vertical antenna designs but the ¼ wave is the basic design. Use the wavelength formula to calculate wavelength for the desired frequency. A dipole will be half that length and the ¼ vertical will be 1/4th that wavelength. Multiply this by 39 to convert meters to inches.

There is also mention of yagis, quads and dish antennas. All of these designs are very directional. Yagis have multiple elements like TV antennas. Quads are big loops and can also be made into multi-element antennas. These multi-element designs are generally referred to as "beams".

Radio Functions

This section refers to actual knobs and buttons on an amateur radio (and many others). Tuning is accomplished via the tuning knob known as VFO (Variable Frequency Oscillator) knob, Up/Down buttons or a keypad on the radio. Receiver Incremental Tune (RIT) allows fine-tuning of the receiver without affecting the transmit frequency. The Squelch function is designed to keep the radio quiet when there is no signal present.

Technician Class Frequency Privileges (1500 watt PEP max)

6 meters	50-54 MHz
2 meters	144-148 MHz
1.25 meters	222-225 MHz - (219-220 MHz point-to-point digital links)
70 centimeters	420-450 MHz - (435-438 MHz satellite subband, 446.000 MHz FM calling)
23 centimeters	1240-1300 MHz

Bands are organized with narrow modes (CW) near the bottom.

$$\text{Wavelength(meters)} = \frac{300}{\text{Frequency(MHz)}}$$

Valid US callsigns start with A, K, N or W (WANK) and contain 1 digit (0-9).

The Federal Communications Commission (FCC) regulates radio use in the US, the International Telecommunication Union (ITU) organizes radio operations internationally.

Technician License Examination - Study Sheet

License Period – 10 years with 2 year grace and can renew 90 days before expiration.

Know Local, Remote and Automatic control of a transmitter.

A Club must have at least 4 members to be eligible for club license.

Identification - Must ID every 10 minutes and at the end of transmission – CW <20WPM OK

Good Amateur Practices
Listen before transmitting, just transmit callsign to break into a conversation, minimum power. Amateur Radio allows no broadcasting, no music transmissions, no codes/ciphers intended to obscure a message, no swearing, no ethnic/racial slurs and no business.

Filters
Spurious emissions/harmonics (your problem) require low-pass filter at transmitter.
RF/frontend/fundamental overload (their problem) requires high-pass filter at TV receiver.

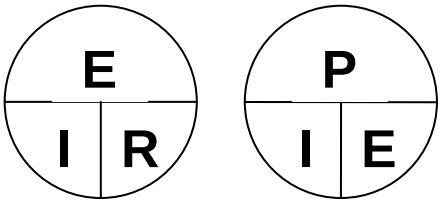
Repeater Frequency Separation (Split)	
2 meter band	600 kHz
70 centimeter band	5.0 MHz

Bandwidth	
CW signal	150 Hz
SSB signal	2-3 kHz
FM signal	5-15 kHz
TV (NTSC) signal	6 MHz

Ohm's Law and Power Formulas

The circles are designed as a memory tool to help you remember the formulas. The first circle is Ohm's law. To use them, simply cover the value you want and solve remaining equation. To solve for E (voltage or Electromotive force), cover it up and multiply current in amperes times resistance in ohms. To solve for resistance, cover R and divide voltage in volts by current in amperes. All the formulas are listed below. Blank paper is provided for the test and participants are allowed to write down whatever they need.

Ohm's Law and Power Formulas



E = Voltage in Volts
I = Current in Amperes
R = Resistance in Ohms
P = Power in Watts

Cover the value you need and divide or multiply the remaining values as appropriate.
Examples:

E = I x R	I = E / R	R = E / I
P = I x E	I = P / E	E = P / I

See this video: http://www.youtube.com/watch?v=QwNSa_8ro_Y.
The video uses V instead of E. For our purposes V and E are interchangeable terms.

Unit Conversions

Mega	10^{6}	1,000,000	Micro	10^{-6}	0.000001	Pico	10^{-12}	0.000000000001
Kilo	10^{3}	1,000	Milli	10^{-3}	0.001	Nano	10^{-9}	0.000000001

Voice Frequencies are 300-3000Hz and Radio Waves are >20,000Hz.

Measuring Units

Frequency	**Hertz**	Resistance	**Ohm**
Current	**Ampere**	Power	**Watt**
Electromotive Force	**Volts**		

Radio Modes

Amplitude Modulation (AM), Single Sideband (SSB) and Code (CW) are all related.
A product detector is used for SSB/CW reception, a discriminator is used for FM.
FM antenna polarization is vertical by convention (best for cars), SSB/CW is horizontal
Upper Sideband (USB) is used above about 10 MHz
Continuous Tone Coded Squelch System (CTCSS) uses subaudible tone to unmute receiver

Q Signals

QRM	Man-made noise	QRN	Atmospheric noise
QSY	Change frequency	QTH	Current/home location

CQ means calling any station. Respond with *station callsign* (this is) *your callsign.*

Emergency Communications

RACES only serves government agencies and ARES serves government and NGO groups.
Messages contain name of sender in the preamble, no more than 25 words and a check.

A 3dB change is double, 6db is quadruple and 10dB is a ten-fold increase.

Inductors store energy in a magnetic field. Capacitors store energy in an electric field.
A Bipolar Transistor has an emitter. A Field Effect Transistor has a gate.

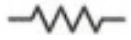
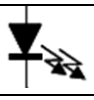
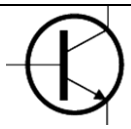
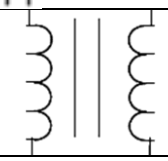
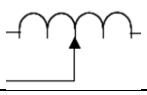
SWR of 1:1 is perfect and near 2:1 transmitters generally start reducing power output.

Antenna Types

Half Wave Dipole
Quarter Wave Vertical

$$\text{Wavelength(meters)} = \frac{300}{\text{Frequency(MHz)}}$$

Schematic Symbols

Resistor		Capacitor		SPST Switch	
Variable Resistor		Lamp		LED	
Transistor		Transformer		Antenna	
Battery		Variable Inductor			

Frequency Bands

HF	3 - 30 MHz	100m - 10m
VHF	30 - 300 MHz	10m – 1m
UHF	300 - 3000 MHz	1m – 10cm

Radio Functions

RIT – Receiver Incremental Tune
Squelch mutes receiver
VFO Knob changes operating frequency