Revision notes for Foundation Licence Exam Revision V04 AMC era.odt
Notes may help for a last minute revision before sitting for the Foundation Licence Assessment.

Module 1 Electricity, Frequency & Wavelength

The basic Units of electricity are:
E = EMF (Electro Motive Force) measured in Volts (V)
I = Current measured in Amps (A)
R = Resistance measured in Ohms (Ω)
P = Power measured in Watts (W)

$P=E\times I$	$P=I^2\times R$	$P=\frac{E^2}{R}$
$I=\frac{E}{R}$	$I=\frac{P}{E}$	$I=\sqrt{\frac{P}{R}}$
$R=\frac{E}{I}$	$R=\frac{E^2}{P}$	$R=\frac{P}{I^2}$
$E=I\times R$	$E=\frac{P}{I}$	$E=\sqrt{P\times R}$

Formulas similar to the one above will be supplied with each question. Find the parameter you want and the parameters you've been given. Then find the formula that has the required parameter on the left and the two given parameters on the right. Simply plug in the known information and do the mathematics.

Remember to work in base units. Your answer will also be in base units. Look out for the correct multiple choice option that's disguised because it's expressed in multiple or sub-multiple units.

Multiples and sub-multiples of base units

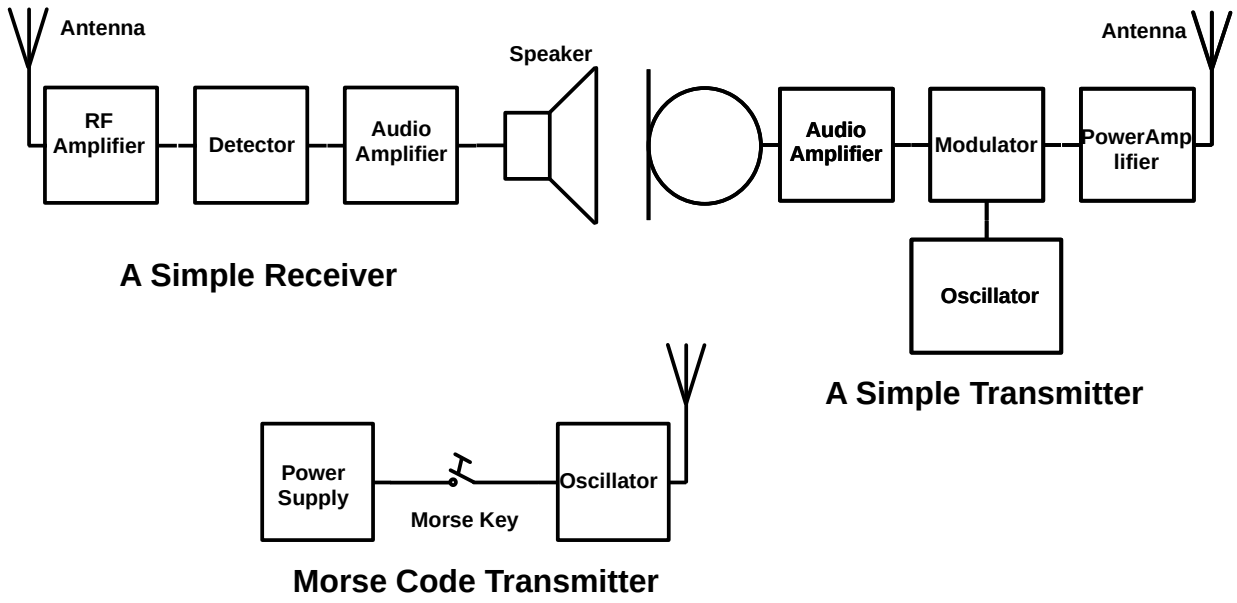
Symbol	Unit name	Multiply / Divide by	Engineering Notation
M	mega	x 1,000,000	10^6
k	kilo	x 1,000	10^3
m	milli	/ 1,000	10^{-3}

Read the question carefully to look for words from … to … Get the direction of conversion correct. If working in Volts, Amps or Ohms makes you nervous, then substitute something that you're comfortable with such as litres of metres.

When performing frequency (f) to wavelength (λ) conversions recall that
the speed of light (C) is = 300 Million m/s which gives the formula C=f*λ.
In radio this is sometimes expressed as **300=f(in Megahertz) * λ(metres).** It's one occasion when careful selection of multipliers and simplify the calculations. Look out for words in the question like "**half** wavelength dipole or **quarter** wave vertical"

Module 2 Transmitters and Receivers

Receiver (RX) and Transmitter (TX) block diagrams.



Your exam questions may include diagrams similar to those shown above with the name of one or more of the blocks omitted. You will be asked to name a particular block. If your memory or understanding of block diagrams is letting you down then use these clue to work out the answer. The question will tell you that it's a transmitter or a receiver. Then:
Look for the antenna symbol. That's the RF end. Think power amplifier for TX and RF amp for RX. Look for the microphone or speaker symbol. That's the audio end. Think audio amplifier for RX & TX. You'll have to work out the middle blocks yourself. Think of Modulator, Oscillator, Detector, etc.

Know that **AM** means Amplitude Modulation
Know that **FM** means Frequency Modulation
Know that **SSB** (single sideband) is a form of amplitude modulation.

Receiver have three 'S' characteristics:
Sensitivity = Ability to pick up weak signals
Selectivity = Ability to select (or pick) one signal from another when frequencies are close
Stability = Ability of RX to remain on the required frequency even if the temperature changes
Foundation Licence power level is 10Watts pX and 10Watts pY.
pX (PEP or Peak Envelope Power)is used to express the power in a variable signal such as SSB.
pY (Mean Power) is used to express the power in a constant signal such as FM.

Modulation	The way voice frequencies are converted to radio frequencies. Excessive modulation causes distortion and interference to others on adjacent frequencies.
Bandwidth	The amount of frequency spectrum (space) the signal occupies. (CW narrow band width; SSB more bandwidth: FM even more bandwidth)
Deviation	A term used with FM signals describing the amount by which the voice frequency changes (deviates) the carrier frequency.

Module 3 Antennas & Transmission Lines

Transmission lines:
Balanced = parallel line – symmetrical – flat TV ribbon or ladder line
Unbalanced = Coaxial cable – round with an outer shield and an inner conductor.

Antennas convert electrical signals to radio waves & vice versa
Antenna **gain** is measured in **decibels** (dB also dBi and dBd)
Know that decibels exist but knowledge of how to use them is not required.
The exam may ask a question in which gain is expressed as a simple multiplier of input power.
An antenna is **resonant** when its length is related to the wavelength of operation.
An antenna that radiates (or receives) better in some directions than others has **directivity**.
ERP = Effective Radiated Power. = Transmitter power times antenna gain (less losses)

SWR = Standing wave ratio = ratio of power out to power reflected back.

Less than 1.5:1	Considered acceptable
1.5:1 to 3:1	Needs adjustment of antenna - (probably length) or compensate using an Antenna Tuning Unit (ATU)
Greater than 3:1	Major problems. Look for short circuits, open circuits, wrong antenna etc.

A **Balun** (Balanced to Unbalanced) is used to match coax (un-balanced feeder) to a dipole (balanced antenna) to prevent currents flowing down the outside of the coax. These currents can cause unwanted radiation (eg interference).

Antenna types include: Vertical, ground plane, dipole, folded dipole, Yagi, and end fed.
Some antenna name also describe their length. Quarter wave vertical. Half wave dipole.

An RF or signal ground will improve the performance of unbalanced antennas. It will also help minimise interference and reduce shocks from reflected RF energy.

Module 4 Propagation

Isotropic antenna = theoretical point source radiator that radiates equally in all directions.
Radio waves travel in free space in straight lines.
The power of a radio wave reduces in proportion to the square of the distance from the source.
Inverse square law reduction. Think of the heat from a camp fire – twice the distance back means a quarter of the heat.

I**onosphere** = Upper layer of the atmosphere ionised by the sun.
VHF/UHF signals pass through the ionosphere but HF signals are refracted back down to earth.

Troposphere = Lower layer of the atmosphere where we live.
VHF/UHF signals can be trapped between different layers in the troposphere and ducted an abnormally long way. Think of thermal inversions and mirages.

Reflection – Signal bounced off solid material – The Ground, water, Metal objects
Refraction – Signal bent slowly & gradually – Ionosphere – HF radio propagation
Diffraction – Knife edge VHF/UHF signals fill in shadow beyond line of sight.
Sun Spot cycle – More sun spots = stronger ionosphere = better HF propagation

Module 5 Safety

Electrical
Electrical Safety Earth. Part of the AC mains power protection. Never remove a safety earth connection. Do not remove the covers of any mains powered equipment.
Australian mains voltage was nominally 240V until 2000. Now 230V (AS 30068:2000)
High voltages = Electrocution risk
High Currents = Fire risk

First Aid. Do not touch the person without isolating the power off first.
Always replace **fuses** with one of the **same type and current rating**.
Electrical Safety Switch – Residual Current Detectors – Earth Leakage Circuit Breakers
Approved Appliances – Mains powered equipment must have a compliance sticker with **standards tick** and compliance number.
Only suitably qualified persons are legally permitted to work on mains powered equipment.

Battery Safety
Batteries usually contain hazardous chemicals – corrosive chemicals.
Keep away from children – Don't short circuit or burn – dispose of properly.
Some batteries need to be used in a well ventilated location.

Radiation Safety
High levels of electromagnetic radiation (EMR) can be very dangerous.
The **higher** the **frequency** and the **higher** the **power,** the **higher** the **danger.**
EMR levels **increase** as you get **closer** to the source. Note the previous section on propagation.
Also note the previous section on ERP. Radiation levels are much higher in front of high gain antennas. Foundation Licence power levels and frequencies are normally considered low risk.
The best position for antennas is as high as possible out of reach of people & animals.

Cables & Leads
Keep things neat, tidy & out of the way so there are no trip hazards.

Erecting Antennas
Keep away from power lines.
Consider what may happen if the antenna falls during erection and later in use.
Working at heights has safety (fall risk) and legal issues (OH&S – insurance)

Lightning
Disconnect antennas before lightning arrives. Don't operate in an electrical storm.
Provide a lightning earth for towers, antennas etc. This earth may also double as a signal earth for better antenna performance. Don't use gas pipes for an earth.

Headphones
Loud noises – both wanted signals and unwanted 'noise' in headphones can damage your hearing.
Headphones can also electrically couple you to faulty equipment

Module 6 Electromagnetic Compatibility, Immunity & Interference

EMC = Electromagnetic Compatibility = Ability of sensitive electronic equipment to operate in close proximity to other sensitive electronic equipment.
EMI = Electromagnetic Immunity = Ability of electronic equipment to operate in strong electromagnetic fields.
Interference = Reception of unwanted signals.
Radiated interference Usually from your antenna into the other equipment (Is your antenna near or in the path of the TV antenna?) Move the antenna.
Conducted interference Conducted through mains wiring, speaker wires etc.
Cures for interference.

Reduce power
Move Antenna
Avoid problem frequencies
Fit RF filters to antenna feed line
Fit a balun to your antenna
Fit (build) a filter on the stereo speaker leads
Install a mains filter
A good signal earth helps reduce interference.
Ensure you are operating correctly (especially avoid over modulating)
and your equipment is not producing spurious signals or harmonics.

You **must not transmit** if you are causing **harmful interference**
The ACMA can impose restrictions on your licence and even tell you to shut down.

Module 7 Regulations

Amateur radio is a **hobby**, for **self-training** – **no commercial purpose or entertainment**.
Used for experiments and to talk to other amateurs – nobody else (except in an emergency)
The use of secret codes (Morse code & Q codes aren't secret) is not permitted except in an emergency or emergency training.
Amateur radio licences are issued in Australia to holders of appropriate certificates of proficiency.
An amateur radio licence is subject to:

Radiocommunications Act
Radiocommunications Regulations
Radiocommunications Licence conditions (Amateur Licence) Determination No1.
(known as the **LCD**)
Radiocommunications Licence Conditions (Apparatus Licence Determinations)

Bands Set by the ACMA as part of an international agreement.

Frequency
3.5 – 3.7 MHz
7.0 – 7.3 MHz
21.0 – 21.45 MHz
28.0 – 29.7 MHz
144 – 148 MHz
430.0 – 450.0 MHz

Allowable modulation depends on the band being used.

Band plans are guidelines that have no legal status but help coordinate orderly operation.
Foundation licensees can now use digital modes including D-Star.
Foundation licensees can now establish an IRLP or Echolink node as well as use IRLP and Echolink via a repeater or computer terminal.
Foundation Licensee stations can now operate in automatic or computer controlled mode.
Foundation (and all other) licensees must not permit an unqualified person to operate their station.
Foundation Licensee stations can now operate when directly connected to the public telecommunications network – this includes the internet.
Foundation licensees can now build their own equipment including transmitters.
Making your own antennas is also permitted.

Third Party Traffic Australian amateur stations can pass third party traffic provided:

No financial gain.
The third party message does not relate to the business or otherwise commercial traffic and is not an advertisement or entertainment.
Overseas third party traffic can only be conducted with countries that have an agreement with Australia.

Emergency signals made up of **Mayday (distress)** and **Pan Pan (urgency)**

If you hear an Emergency call: First listen to see if some authority responds. Then respond if nobody else does. Convey the message to the appropriate authority. Continue listening and assist as required.

Station Identification
You must **identify your station by using your call sign at the beginning and end of a transmission or a series of transmissions and at least every 10 minutes during a series of transmissions**. That's it!

Australian Amateur Radio Call Signs Be able to identify them.
The regulations surrounding Australian amateur radio callsigns has been relaxed considerably. The normal prefix is VK with AX being available for special national occasions such as Australia Day (26 January), Anzac Day (25 April) and World Telecommunications Day (17 May). The prefix VI can be made available for State or local events of significance.

The numeric value identifies the State where the licence was first allocated. The digit allocated to each state follows similar rules to those for postcodes. The suffix is generally three letters with some individual callsigns and groups reserved. The three letter suffixes starting with the letter "R" are generally reserved for repeaters and beacons. Two letter suffixes are only allocated to advanced stations. Four letter suffixes beginning with the letter "F" belong to foundation stations and were issued under a discontinued process.

An ACMA inspector is the only person authorised under the act to ask to see your licence.
The ACMA can impose restrictions on the operation of your station. Including the need to keep a log book of your transmissions.

Station security
You amateur radio station must be kept secure to prevent unlawful and unlicenced operation.
Note: the method of securing your station is not specified.
You must inform the ACMA of changes to your address.

Module 8 Practical

The phonetic alphabet is used to improve clarity and understanding.
The 'Q' codes are used to improve clarity and understanding.
Listen before you transmit
See the regulations section (Module 7)

Transceiver Controls

Usual only part of practical exam.

Control	**Function**
Power On/Off	Master control for the whole T/R.
AF Volume	How loud the audio comes from the speaker.
Squelch or Mute	No noise from the speaker if there's no signal stronger than the level set.
RF Gain	Controls the sensitivity of the receiver. Used to cut reduce strong signals.
Band Switch	Select desired band on a multi band set ie. 80M or 40M / 2M or 70CM.
Frequency control (VFO)	Move to desired frequency in the selected band.
Mode switch	Select desired modulation SSB? LSB? FM? AM? CW?
RIT – (Receiver Incremental Tuning)	Change the RX frequency slightly without moving the TX frequency.
Selectivity (Wide / narrow)	Adjustable selectivity to cut out unwanted adjacent signals or increase the receiver bandwidth to hear more of the signal (eg when listening to an AM signal).
Power Output	Ability to set the output power level of the transmitter.
Carrier	Can be used to set CW or AM power level.
Microphone Gain	Matches the loudness of your voice through the microphone to the modulation stage of the transmitter. Used to prevent over modulation which causes distortion and interference.
Tune / Load	Sometimes present to allow the output stage to be tuned (adjusted) to match the transmitting frequency. Normally found in valve transmitters but not in modern solid state equipment.

The danger of high voltages is electrocution.
The danger of high currents is fire.