



*Exploring the World of Science*

University of Michigan Science Olympiad  
2021 Invitational Tournament

# WiFi Lab C

**Test length:** 50 Minutes

**Team name:** \_\_\_\_\_ **Team number:** \_\_\_\_\_

**Student names:** \_\_\_\_\_

## WiFi Lab C - WIFI test version 1.0 - University of Michigan Div C - 02-20-2021

### Instructions (shown before students start the test)

Welcome to the University of Michigan 2021 Invitational WiFi Lab test! Make sure you have a stable internet connection and are ready to compete!

For this test, you are allowed the following resources:

- A Google Meet/Zoom/Skype/Phone/Video call with your partner
- A cheat sheet/binder, printed or in pdf format on your computer
- Programmable/Non-programmable calculator
- Scratch paper

You MAY NOT take advantage of the following resources. Doing so will result in a disqualification plus 30 points added to your team's overall score.

- ANY internet resource
- Help from any person other than your partner
- A printed version of the test

### Introduction (shown after students start the test)

This test consists of 22 questions and you will have 50 minutes to complete it.

The Tiebreakers for this test will be: 19, 14, 4

If you experience technical difficulties during the test:

- Immediately contact the event supervisor through the classroom feature on Scilympiad, stating clearly what issue you are having.
- If your work is not saving/submitting, take screenshots of your answers on Scilympiad and submit them to this google form. Try to stay within your allotted 50 minutes.

- 1. (1.00 pts)** Rank the list of radio waves in order of increasing frequency.  
FM radio, TV channels 14-69, AM radio, citizens band

- 2. (1.00 pts)** Rank the types of electromagnetic waves in order of increasing wavelength.  
infrared, X rays, long waves, radio waves

- 3. (1.00 pts)**  
True or false. when using groundwave propagation, shortwave or medium wave band signals are sent through the ground to their destination. They can do this, as when diffracted the waves are vertically polarized, allowing them to follow the curvature of the earth.

☐ True ☐ False

- 4. (1.00 pts)** What method of radio wave propagation is used with FM radio and radar, and above what frequency does this method work best?

**5. (1.00 pts)** When trying to send a 73 MHz wave from Ann Arbor to Paris, France, which sky layer would the wave reflect off of?

- ☐ A) D
- ☐ B) E
- ☐ C) F1
- ☐ D) F2
- ☐ E) None of the above

**6. (1.00 pts)** If a radio wave is sent through space at a frequency of 570 MHz, what is its wavelength?

**7. (1.00 pts)** If a radio wave at a frequency of 1050 MHz is sent from Ann Arbor to Chicago, what method of transmission would be used?

**8. (1.00 pts)** A 1700 MHz AM radio frequency is sent during the day from Ann Arbor to Detroit. What method of transmission is used?

**9. (1.00 pts)** A wave is sent through a vacuum with a wavelength of 1.05 miles. What is its frequency, in Kilohertz?

**10. (1.00 pts)** Which type of antenna is the most commonly used?

- ☐ A) Wire
- ☐ B) Aperture
- ☐ C) Reflector

- ☐ D) Micro Strip
- ☐ E) Array

11. (1.00 pts) Which type of antenna is commonly used in smartphones?

- ☐ A) Wire
- ☐ B) Aperture
- ☐ C) Reflector
- ☐ D) Micro Strip
- ☐ E) Array

12. (1.00 pts) If a half-wave dipole antenna was transmitting at 600 MHz, how long would the dipole be?

13. (1.00 pts) True or false: A commonly used antenna that radiates equally in all directions is called an isotropic antenna

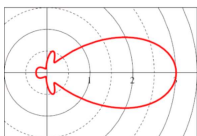
- ☐ True
- ☐ False

14. (2.00 pts)

You are tasked to construct an antenna that transmits at a frequency of 4.35 MHz. If the signal has to travel 38.745 km, what is the length of the antenna needed and how long would it take for the signal to travel to its destination?

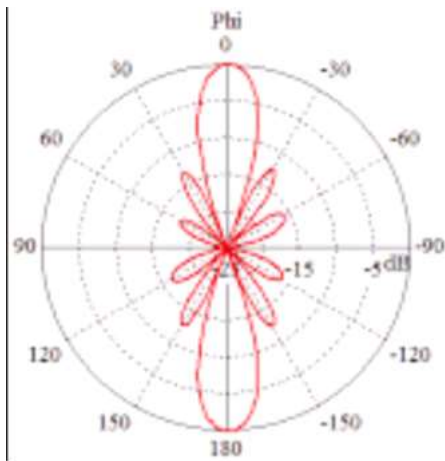
15. (1.00 pts) What kind of antenna is most likely to be used in a wearable electronic device?

16. (1.00 pts) This is a radiation pattern diagram for a certain type of antenna. What type is it?



17. (1.00 pts) What happens when the diameter of a loop antenna approaches the size of one wavelength?

18. (1.00 pts) What type of antenna exhibits this gain pattern?



19. (1.00 pts)

Given a radar with minimum detectable signal of 1 dBm, amount of power transmitted of 360 dBm, maximum power gain of 3 dBi, an effective aperture of 0.75, and cross section of 14 square meters, what is the maximum range?

20. (1.00 pts)

Given a radar with a maximum range of 14m, minimum detectable signal of 2 dBm, power transmitted of 120 dBm, power gain of 380 dBi, and cross section of 560 square meters, what is the effective aperture of the radar?

**21. (1.00 pts)** Given a pulse length of 1.56 nano seconds, what is the bandwidth required (in MHz)?

**22. (1.00 pts)** Given a radar with a noise figure of 1.4 and an effective noise bandwidth of 12 mHz, what is the noise power of the radar?

**23. (1.00 pts)** What kind of radiation pattern would a rhombic antenna produce?

Congratulations on completing the University of Michigan 2021 Invitational WiFi Lab test!

If you have any questions or concerns pertaining to this event, please email [tec.umichscioly@umich.edu](mailto:tec.umichscioly@umich.edu), and we will try to get back to you as soon as we can.