

Science Olympiad: Crave the Wave, Test sheet

Name(s):

School:

Town:

Circle the correct answer for problems 1-20.

Each correct answer yields 1 point.

1) Electromagnetic waves in vacuum travel with the speed of light $c = 300,000$ km/s. Estimate the time it takes for light to get from Earth to the Sun?

- A:** 0.013 s
- B:** 1.28 s
- C:** 500 s
- D:** 1 hour and 8 min
- E:** 24 hours

2) Which type of electromagnetic wave corresponds to the largest frequency?

- A:** infrared
- B:** x-ray
- C:** ultraviolet
- D:** radiowave
- E:** microwave

3) When light passes from air into glass it becomes refracted. Calculate the angle of refraction if the angle of incidence is 30 degrees.

- A:** 22 degrees
- B:** 32 degrees
- C:** 42 degrees
- D:** 52 degrees
- E:** 62 degrees

4) When you blow across the top of a cola bottle you can generate sound. As you drink more of the cola you lower the liquid level and the frequency of the sound becomes

- A:** initially smaller and then larger
- B:** larger
- C:** stays constant
- D:** smaller
- E:** initially larger and then smaller

5) The frequency of sound waves from a receding car

- A:** is shifted down
- B:** is shifted up
- C:** remains unchanged

D: is always doubled

E: is always reduced by a factor of 2

6) If you double the frequency of yellow light you get

- A:** still yellow light
- B:** red light
- C:** ultraviolet light
- D:** infrared light
- E:** green light

7) The shaking amplitude of an earthquake can be characterized by the Richter magnitude scale. This is a base-10 logarithmic scale. How many times larger is the shaking amplitude for an earthquake that measures 5.3 compared to one that measures 4.7?

- A:** 2
- B:** 4
- C:** 8
- D:** 16
- E:** 32

8) There are transversal and longitudinal waves. Which one is longitudinal?

- A:** radio wave
- B:** microwave
- C:** sound wave
- D:** infrared light
- E:** a wave on a string

9) The index of refraction gives you the factor by which the speed of light is reduced as compared to vacuum. Assume light travels in a medium with an index of refraction $n = 1.5$. What is its speed?

- A:** 100,000 km/s
- B:** 200,000 km/s
- C:** 300,000 km/s
- D:** 400,000 km/s
- E:** 500,000 km/s

10) Jane approaches the plane mirror in her room with a speed of 30 cm/s. How fast does she approach her image in the mirror?

- A:** 15 cm/s
- B:** 20 cm/s
- C:** 30 cm/s
- D:** 45 cm/s
- E:** 60 cm/s

11) Jane is 1.6 m tall. What is the minimal height of the plane mirror in her room so that she can see her head and feet at the same time?

- A: 0.2 m
- B: 0.4 m
- C: 0.8 m
- D: 1.2 m
- E: 1.6 m

12) Light of which color makes the resolution of an optical instrument largest?

- A: green
- B: yellow
- C: red
- D: blue
- E: orange

13) Earth is 150 million kilometers away from Sun. Saturn is roughly 1500 million kilometers away from Sun. Compared to Earth, the intensity of the Sun on Saturn is

- A: 10 times smaller
- B: 33.3 times smaller
- C: 66.6 times smaller
- D: 100 times smaller
- E: 333 times smaller

14) Which choice most closely represents the wavelength in a microwave oven.

- A: 12 micrometers
- B: 12 meters
- C: 12 centimeters
- D: 12 kilometers
- E: 12 nanometers

15) Two identical periodic waves that travel exactly in opposite direction cause

- A: destructive interference
- B: a standing wave
- C: refraction
- D: constructive interference
- E: diffraction

16) Two radio antennas transmit the same signal, both with wavelength 3 meters. A radio is 15.5 meters away from the first antenna and 20 meters away from the second antenna. The radio receives

- A: no signal because of destructive interference.

B: a maximal signal due to constructive interference.

C: a signal that increases with time.

D: a signal that decreases with time.

E: a slowly oscillating signal.

17) Electromagnetic waves are predicted by

A: Newton's laws

B: Einstein's field equations

C: Maxwell's equations

D: the Schrodinger equation

E: the Helmholtz equation

18) Visible light arriving at Earth from other galaxies and stars has

A: increased frequency

B: decreased frequency

C: no change in frequency

D: we do not know because the emitted frequency cannot be measured

E: in some cases increased frequency and in some cases decreased frequency

19) The wavelength of a water wave depends on the motion of the observer. However, the wavelength of an electromagnetic is always the same, irrespective of the motion of the observer. This observation forms the basis of a theory formulated in 1905 by

A: Max Planck

B: Niels Bohr

C: Werner Heisenberg

D: Pablo Picasso

E: Albert Einstein

20) What is largest:

A: the number of molecules in a cup of water

B: the number of wavelengths of blue light that fit into the distance between Earth and Sun.

C: the number of cells in a human body

D: the number of stars in our galaxy

E: the mass of the Himalaya mountain range, expressed in kilograms.

Tie-breaker: The following problem will only be used to resolve ties. Give a numerical answer as accurately as possible.

A fisherman sees a fish beneath him in a river at an apparent depth of 1.6 m. At what depth should he put his net?

Write your answer (in meters) here: