TAP 311- 2: Using the wave equation

This question gives you practice in using the wave equation $c = f\lambda$.

Copy or print out the table below.

Wave calculations

1. Use the wave equation to calculate the missing quantities in the table. Where appropriate the speed of light in a vacuum is 3.0×10^8 m s^{-1}. Notice that waves of several types have been included.

Wave	Frequency	Wavelength	Speed	Medium
Sound	2000 Hz		340 m s^{-1}	In air
Yellow light	3.6×10^{14} Hz	0.61 μm		In water
X-rays		0.1 nm		In air
Microwave	6 GHz band			In a vacuum
Water ripples	8 Hz		400 mm s^{-1}	
Sonar	30 kHz	45 mm		In water
Radio waves from space		0.8 m		
Ultrasound	3.5 MHz		1600 m s^{-1}	In body tissue

Practical advice

Students need to substitute into the wave equation and change the subject of the formula. A mixture of powers of ten and prefixes have been used in the grid to give the student practice in interpreting these and in successfully keying the information into a calculator.

Alternative approaches

Extra rows can be added into the table with information on other parts of the electromagnetic spectrum, seismic waves, ocean waves etc.

Social and human context

Waves of a great variety are important in different areas of life, from ocean waves including rollers on which to surf to microwaves for cooking.

Answer and worked solutions

Wave	Frequency	Wavelength	Speed and media
Sound	2000 Hz	0.17 m	340 m s^{-1} in air
Yellow light	3.6×10^{14} Hz	0.61×10^{-6} m	2.2×10^{8} m s^{-1} in water
X-rays	3×10^{-18} Hz	0.1 nm	3.0×10^{8} m s^{-1} in air
Microwave	6 GHz	0.05 m	3.0×10^{8} m s^{-1} in space
Water waves	8 Hz	50 mm	400 mm s^{-1} on water
Sonar	30 kHz	45 mm	1350 m s^{-1} in water
Radio waves from space	375 kHz (2)	0.8 m	3.0×10^{8} m s^{-1} in space
Ultrasound	3.5 MHz	0.46 mm	1600 m s^{-1} in body tissue

External reference

This activity is taken from Advancing Physics chapter 3, 90S