# Answers to Lesson2 Questions: U2Ch4L2

## Essential Question

1. How does light reveal the energy levels within an atom?  
 - Light is emitted or absorbed when electrons transition between energy levels in an atom. The energy of the light corresponds to the difference between these levels, creating a spectral signature unique to each element.

## Curiosity Corner

2. What controls the distance at which electrons orbit the nucleus? How does energy influence these distances?  
 - The distance of an electron from the nucleus depends on its energy level. Higher energy levels allow electrons to orbit farther from the nucleus, while lower energy levels bring them closer.

## Progress Check 1

3. Explain how the energy from microwaves interacts with food molecules to heat them.  
 - Microwaves cause water molecules in food to vibrate rapidly, generating heat through friction. This energy transfer raises the temperature of the food.

## Progress Check 2

4. What are some uses of electromagnetic radiation that depend on the differences in energy between radio waves and X-rays?  
 - Radio waves, with lower energy, are used for communication (e.g., broadcasting and Wi-Fi), while X-rays, with higher energy, are used for medical imaging and material analysis.

## Progress Check 3

5. Explain why microwaves can heat food but radio waves cannot, even though both are forms of electromagnetic radiation.  
 - Microwaves have higher energy than radio waves, allowing them to interact with water molecules and cause vibration, which generates heat. Radio waves lack sufficient energy for such interactions.

6. Calculate the energy of a photon that has a frequency (ϑ) of 8.2 × 10¹³ Hz. Use Planck’s constant (h = 6.626 × 10⁻³⁴ Js).  
 - Energy (E) = h × ϑ = (6.626 × 10⁻³⁴ Js) × (8.2 × 10¹³ Hz) = 5.434 × 10⁻²⁰ J.

## Progress Check 4

7. A gas emits a bright blue light when it is energized. Explain why this occurs and what it tells about the energy levels of the electrons in the gas.  
 - The bright blue light is emitted as electrons in the gas transition from higher to lower energy levels, releasing energy as photons. The blue color indicates a specific energy gap unique to the gas.

## Progress Check 5

8. Explain how the differences in wavelength and energy make radio waves useful for broadcasting.  
 - Radio waves have long wavelengths and low energy, allowing them to travel long distances without significant attenuation. These properties make them ideal for transmitting signals in broadcasting.

## Lesson Check

9. Describe how different types of electromagnetic radiation vary in their energy and wavelength. Use examples from the spectrum, such as radio waves and gamma rays, to explain your answer.  
 - Electromagnetic radiation ranges from low-energy, long-wavelength radio waves to high-energy, short-wavelength gamma rays. For example, gamma rays penetrate dense materials, while radio waves are ideal for communication.

10. Explain why X-rays are suitable for medical imaging, while microwaves are used for heating food, even though both are forms of electromagnetic radiation. How does the energy and frequency of each type contribute to their specific uses?  
 - X-rays have high energy and short wavelengths, enabling them to penetrate soft tissues and highlight bone structures. Microwaves have lower energy and longer wavelengths, making them suitable for heating food by interacting with water molecules.

11. Electrons can shift between energy levels based on the energy they absorb or release, similar to how satellites adjust their orbits. How does this concept help explain why different types of electromagnetic radiation, like ultraviolet or infrared, interact differently with atoms?  
 - The energy of electromagnetic radiation determines the interaction. Ultraviolet radiation can excite electrons to higher levels, while infrared causes molecular vibrations without electron excitation.

12. A neon sign emits visible light when electricity passes through it. Based on the quantum mechanical model, explain why this happens and how it connects to the movement of electrons within the atom.  
 - Electricity energizes electrons, causing them to jump to higher energy levels. When they return to lower levels, they emit photons of specific wavelengths, producing neon's characteristic glow.

13. Different forms of electromagnetic radiation can interact with matter in specific ways. Explain how ultraviolet light can cause sunburns, while infrared light is felt as heat. What makes their interactions with matter different?  
 - Ultraviolet light has enough energy to damage DNA, causing sunburns. Infrared light, with lower energy, increases molecular vibrations, which we perceive as heat.

14. Relate the process of electrons absorbing and releasing energy to how salt helps melt ice on roads. How do these two different processes demonstrate the effects of energy interactions?  
 - Electrons absorbing/releasing energy involve discrete quantum jumps, while salt melting ice disrupts molecular interactions, lowering the freezing point through energy exchange.

15. Which of the following best explains why X-rays can pass through soft tissue but are absorbed by bones?  
 - Correct answer: B. X-rays have higher energy, which allows them to penetrate soft tissues.

16. Why do elements emit different colors of light when they are energized?  
 - Correct answer: C. Each element has a unique arrangement of electrons that causes them to emit different energy levels as light.

## Beyond the Lesson

17. How does understanding the electromagnetic spectrum enable scientists to design technologies for healthcare and communication?  
 - Knowledge of the spectrum allows the development of X-ray machines for medical imaging, MRI scanners using radio waves, and Wi-Fi technologies, demonstrating the diverse applications of electromagnetic radiation.