

Name

Exploring De Broglie and Electron Waves

Total questions: 15

Worksheet time: 8mins

Instructor name: Dr. Ramanathan Saitechinfo

Class

Date

1. What is the formula for the De Broglie wavelength?

a) $\lambda = h/p$

b) $\lambda = h * p$

c) $\lambda = h^2/p$

d) $\lambda = p/h$

2. Derive the De Broglie wavelength equation step by step.

a) $\lambda = mv/h$

b) $\lambda = h/(E)$

c) $\lambda = h/(p^2)$

d) $\lambda = h/(mv)$

3. Explain the concept of wave-particle duality in your own words.

a) Wave-particle duality is the concept that particles like electrons and photons exhibit both wave-like and particle-like behavior.

b) Wave-particle duality states that particles can only behave as waves.

c) Wave-particle duality means that particles and waves are completely separate entities.

d) Wave-particle duality is the idea that light can only exist as particles.

4. How does the De Broglie equation relate to the dual nature of electrons?

a) The De Broglie equation only applies to photons, not electrons.

b) The De Broglie equation is unrelated to the concept of momentum.

c) The De Broglie equation illustrates the wave-particle duality of electrons by relating their wavelength to momentum.

d) The De Broglie equation states that electrons have no wave properties.

5. What is the significance of Planck's constant in the De Broglie equation?
- a) Planck's constant is crucial for relating a particle's momentum to its wavelength in the De Broglie equation.
- b) Planck's constant is used to calculate the mass of particles.
- c) Planck's constant measures the speed of light in a vacuum.
- d) Planck's constant determines the charge of an electron.
6. Provide an example of how the De Broglie wavelength can be calculated for an electron.
- a) $5.67 \times 10^{-11} \text{ m}$
- b) $3.14 \times 10^{-10} \text{ m}$
- c) $1.23 \times 10^{-9} \text{ m}$
- d) $7.27 \times 10^{-10} \text{ m}$
7. What are matter waves and how do they apply to electrons?
- a) Matter waves are a type of sound wave that affects electrons.
- b) Electrons do not exhibit any wave-like behavior in quantum mechanics.
- c) Matter waves are wave-like properties of particles, and for electrons, they describe their dual nature as both particles and waves, influencing their behavior in quantum mechanics.
- d) Matter waves are only applicable to light and not to electrons.
8. Discuss an application of the De Broglie equation in modern technology.
- a) De Broglie equation is used in solar panel efficiency calculations.
- b) The De Broglie equation helps in designing faster computer processors.
- c) Electron microscopes utilize the De Broglie equation to achieve high-resolution imaging.
- d) De Broglie equation is applied in traditional photography techniques.
9. How does the De Broglie wavelength change with the mass of a particle?
- a) The De Broglie wavelength remains constant regardless of the mass.
- b) The De Broglie wavelength decreases as the mass of a particle increases.
- c) The De Broglie wavelength is independent of the particle's mass and velocity.
- d) The De Broglie wavelength increases as the mass of a particle increases.

10. What experimental evidence supports the wave nature of electrons?
- a) Blackbody radiation
 - b) The photoelectric effect
 - c) Compton scattering
 - d) The double-slit experiment and electron diffraction.
11. Explain how the De Broglie equation is used in quantum mechanics.
- a) The De Broglie equation is used to demonstrate wave-particle duality in quantum mechanics.
 - b) The De Broglie equation is used to determine the speed of light.
 - c) The De Broglie equation calculates the mass of particles.
 - d) The De Broglie equation describes the behavior of classical mechanics.
12. What is the relationship between momentum and wavelength in the De Broglie equation?
- a) Momentum has no effect on wavelength in the De Broglie equation.
 - b) Momentum and wavelength are directly related in the De Broglie equation.
 - c) Wavelength is proportional to the square of momentum in the De Broglie equation.
 - d) Momentum and wavelength are inversely related in the De Broglie equation.
13. How can the De Broglie wavelength be used to explain electron diffraction?
- a) The De Broglie wavelength only applies to macroscopic objects.
 - b) The De Broglie wavelength explains electron diffraction by relating the wave properties of electrons to their momentum, allowing them to create interference patterns when passing through slits or crystals.
 - c) The De Broglie wavelength is irrelevant to electron behavior.
 - d) Electron diffraction occurs only with visible light.
14. Describe a real-world scenario where wave-particle duality is observed.
- a) The double-slit experiment with light demonstrates wave-particle duality.
 - b) A particle colliding with another particle in a vacuum.
 - c) A sound wave traveling through air.
 - d) A solid object reflecting light in a mirror.

15. What role does the De Broglie equation play in the development of electron microscopes?

- a) The De Broglie equation is used to calculate the mass of electrons in microscopes.
- b) The De Broglie equation is primarily used for measuring the speed of light in electron microscopes.
- c) The De Broglie equation helps in the design of optical lenses for microscopes.
- d) The De Broglie equation enables the use of electrons as waves in electron microscopes, allowing for high-resolution imaging.

Answer Keys

1. a) $\lambda = h/p$
2. d) $\lambda = h/(mv)$
3. a) Wave-particle duality is the concept that particles like electrons and photons exhibit both wave-like and particle-like behavior.
4. c) The De Broglie equation illustrates the wave-particle duality of electrons by relating their wavelength to momentum.
5. a) Planck's constant is crucial for relating a particle's momentum to its wavelength in the De Broglie equation.
6. d) $7.27 \times 10^{-10} \text{ m}$
7. c) Matter waves are wave-like properties of particles, and for electrons, they describe their dual nature as both particles and waves, influencing their behavior in quantum mechanics.
8. c) Electron microscopes utilize the De Broglie equation to achieve high-resolution imaging.
9. b) The De Broglie wavelength decreases as the mass of a particle increases.
10. d) The double-slit experiment and electron diffraction.
11. a) The De Broglie equation is used to demonstrate wave-particle duality in quantum mechanics.
12. d) Momentum and wavelength are inversely related in the De Broglie equation.
13. b) The De Broglie wavelength explains electron diffraction by relating the wave properties of electrons to their momentum, allowing them to create interference patterns when passing through slits or crystals.
14. a) The double-slit experiment with light demonstrates wave-particle duality.
15. d) The De Broglie equation enables the use of electrons as waves in electron microscopes, allowing for high-resolution imaging.

