

Name

**Exploring De Broglie Concepts**

Total questions: 15

Worksheet time: 8mins

Instructor name: Dr. Ramanathan Saitechinfo

Class

Date

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

a)  $\lambda = h / p$

b)  $\lambda = h * p$

c)  $\lambda = h + p$

d)  $\lambda = p / h$

2. Explain the concept of matter waves in your own words.

a) Matter waves are the same as sound waves.

b) Matter waves are the wave-like behavior of particles, as described by quantum mechanics.

c) Matter waves only exist in solid objects.

d) Matter waves are a type of electromagnetic radiation.

3. What does wave-particle duality imply about the nature of light?

a) Light is solely a particle.

b) Light has both wave-like and particle-like properties.

c) Light has no defined properties.

d) Light behaves only as a wave.

4. List two applications of De Broglie's hypothesis in modern physics.

a) 1. Electron microscopy, 2. Quantum mechanics.

b) Classical mechanics

c) Thermodynamics

d) Relativity



11. What is the relationship between the speed of a particle and its De Broglie wavelength?
- a) The speed of a particle is proportional to its De Broglie wavelength.      b) The speed of a particle has no effect on its De Broglie wavelength.
- c) The speed of a particle is directly related to its De Broglie wavelength.      d) The speed of a particle is inversely related to its De Broglie wavelength.
12. Calculate the De Broglie wavelength of a baseball (mass = 0.145 kg) moving at 40 m/s.
- a)  $1.142 \times 10^{-34}$  m      b)  $2.5 \times 10^{-34}$  m
- c)  $1.45 \times 10^{-34}$  m      d)  $3.0 \times 10^{-34}$  m
13. How does the concept of matter waves challenge classical physics?
- a) Matter waves challenge classical physics by introducing wave-particle duality, showing that particles can behave like waves.      b) Matter waves eliminate the need for quantum mechanics.
- c) Matter waves only apply to macroscopic objects.      d) Matter waves confirm classical physics principles.
14. What is the De Broglie wavelength of a photon with a frequency of  $5 \times 10^{14}$  Hz? ( $c = 3 \times 10^8$  m/s)
- a)  $6 \times 10^{-7}$  m      b)  $9 \times 10^{-8}$  m
- c)  $1 \times 10^{-6}$  m      d)  $3 \times 10^{-7}$  m
15. Explain how the De Broglie wavelength is relevant in electron microscopy.
- a) The De Broglie wavelength is crucial in electron microscopy as it determines the resolution; shorter wavelengths allow for higher resolution imaging of nanoscale structures.      b) Longer wavelengths improve the resolution in electron microscopy, allowing for better imaging.
- c) The De Broglie wavelength has no impact on the imaging of biological samples in electron microscopy.      d) The De Broglie wavelength is irrelevant in electron microscopy as it only applies to optical microscopes.

## Answer Keys

1. a)  $\lambda = h / p$
2. b) Matter waves are the wave-like behavior of particles, as described by quantum mechanics.
3. b) Light has both wave-like and particle-like properties.
4. a) 1. Electron microscopy,  
2. Quantum mechanics.
5. d)  $4.85 \times 10^{-10} \text{ m}$
6. a) The De Broglie hypothesis is significant because it establishes the wave-particle duality of matter, which is a cornerstone of quantum mechanics.
7. d) The De Broglie wavelength decreases with an increase in momentum.
8. b) Electron microscopy is a practical application of De Broglie waves in technology.
9. c)  $1.326 \times 10^{-24} \text{ kg}\cdot\text{m/s}$
10. a) Wave-particle duality leads to quantized energy levels and probabilistic electron distributions in atoms.
11. d) The speed of a particle is inversely related to its De Broglie wavelength.
12. a)  $1.142 \times 10^{-34} \text{ m}$
13. a) Matter waves challenge classical physics by introducing wave-particle duality, showing that particles can behave like waves.
14. a)  $6 \times 10^{-7} \text{ m}$
15. a) The De Broglie wavelength is crucial in electron microscopy as it determines the resolution; shorter wavelengths allow for higher resolution imaging of nanoscale structures.

