

Worksheet: Matter Waves



Q1: If an electron and a muon have the same speed, which particle has the greater de Broglie wavelength?

A The muon

B The electron

Q2: Which of the following formulas shows the relation between the de Broglie wavelength of a particle, λ , its momentum p , and the Planck constant h ?

A $\lambda = h^2 p^2$

B $\lambda = \frac{p}{h}$

C $\lambda = \frac{h}{p^2}$

D $\lambda = h p^2$

E $\lambda = \frac{h}{p}$

Q3: A muon has a rest mass of 1.89×10^{-28} kg. If the muon is moving at a speed of 20 m/s, what is its de Broglie wavelength? Use a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

A 8.60×10^{39} m

B 1.75×10^{-7} m

C 4.64×10^{19} m

D 2.51×10^{-60} m

E 5.70×10^6 m

Q4: An electron has a rest mass of 9.11×10^{-31} kg. If the electron has a kinetic energy of 1.14×10^{-27} J, what is its de Broglie wavelength? Use a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

A 2.06×10^{-5} m

B 1.03×10^{-5} m

C 2.90×10^{-5} m

D 1.45×10^{-5} m

E 4.11×10^{-5} m

Q5: A proton has a rest mass of 1.67×10^{-27} kg. At what speed would a proton have to move in order to have a de Broglie wavelength of 8.82×10^{-9} m? Use a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

A 2,030 m/s

B 45.0 m/s

C 0.0222 m/s

D 6.71 m/s

E 9.49 m/s

Q6: What is the kinetic energy of a muon that has a de Broglie wavelength of 4.10×10^{-9} m? Use a value of 1.89×10^{-28} kg for the rest mass of a muon and a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

A 1.38×10^{-22} J

B 856 J

C 428 J

D 9.78×10^{-23} J

E 6.92×10^{-23} J

Q7: A particle has a de Broglie wavelength of 0.200 nm. What is its momentum? Use a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

A 1.33×10^{-43} kg·m/s

B 4.55×10^{56} kg·m/s

C 3.02×10^{23} kg·m/s

D 3.32×10^{-24} kg·m/s

E 1.66×10^{-14} kg·m/s

Q8: What is the de Broglie wavelength of an electron that has a momentum of 4.56×10^{-27} kg·m/s? Use a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

A 3.02×10^{-60} m

B 1.04×10^{40} m

C 2.11×10^{-14} m

D 6.88×10^6 m

E 1.45×10^{-7} m

Q9: If a muon and a proton have the same de Broglie wavelength, which particle has the greater speed?

- A The proton
- B The muon
- C Both have equal speeds.

Q10: In a nuclear fission reactor, the moderator is a material used to slow down the free neutrons in the reactor core, which increases the probability that they will cause a uranium nucleus to undergo fission. The neutrons must have kinetic energies of about 0.0400 eV. What is the de Broglie wavelength of a neutron with this kinetic energy? Use a value of 1.67×10^{-27} kg for the rest mass of a neutron and a value of 6.63×10^{-34} J·s for the Planck constant. Give your answer to 3 significant figures.

- A 2.03×10^{-10} m
- B 2.86×10^{-10} m
- C 1.43×10^{-10} m
- D 7.17×10^{-11} m
- E 1.01×10^{-10} m