What is quantum tunnelling?

i. Quantum tunnelling is defined as a quantum mechanical process where wavefunctions can penetrate through a potential barrier.

ii. The transmission through the potential barrier can be finite and relies exponentially on the barrier width and barrier height.

iii. The wave functions have the genuine probability of disappearing on one side and reappearing on the remaining side.

iv. The first derivative of the wave functions is continuous. In the steady-state case, the probability flux in the forward trajectory is spatially uniform.

v. No wave or particle is eliminated. Tunnelling happens with barriers of thickness about 1–3 nm and smaller.

vi. Quantum tunnelling cannot be explained through the laws of classical mechanics, where a dense potential barrier needs potential energy.

vii. It has a crucial role in physical processes such as nuclear fusion. It's been used in quantum computing, tunnel diodes and scanning tunnelling microscopes.

viii. Tunnelling can be understood through the concepts of Heisenberg's uncertainty principle. In other words, the uncertainty in the precise location of electromagnetic particles permits these particles to break the laws of classical physics and propagate in space without going over the potential energy boundary.

ix. Both tunnelling and uncertainty principle are mutually compatible as they consider a quantum body as both wave and particle simultaneously.

x. Application of quantum tunnelling are in Scanning Tunnelling Microscope, Nuclear Fusion, quantum tunnelling, etc

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