



- **Speed of light** is constant in all frames of reference. It is denoted by  $c$  and is approximately  $3 \times 10^8$  m/s.
- **Time dilation**: Time appears to pass slower for an object in motion as observed from a stationary frame. Formula:  $\Delta t = \gamma \Delta t_0$ , where  $\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}$ .
- **Length contraction**: The length of an object in motion is contracted along the direction of motion. Formula:  $L = L_0 \sqrt{1 - \frac{v^2}{c^2}}$ .
- **Relativity of simultaneity**: Events that are simultaneous in one frame are not simultaneous in another frame moving relative to the first.
- **Mass-energy equivalence**:  $E = mc^2$ . Energy and mass are interchangeable.
- **Spacetime**: A 4-dimensional continuum where space and time are intertwined.
- **Worldlines**: Paths of objects in spacetime. Light travels along 45-degree lines.
- **Event horizon**: A boundary in spacetime beyond which events cannot affect an observer.
- **Black holes**: Regions of spacetime where gravity is so strong that nothing, not even light, can escape.
- **Gravitational time dilation**: Time passes slower in a stronger gravitational field.
- **General Relativity**: Gravity is the curvature of spacetime caused by mass and energy.
- **Geodesics**: The straightest possible paths in curved spacetime.
- **Equivalence principle**: The effects of gravity are indistinguishable from the effects of acceleration.
- **Gravitational waves**: Ripples in spacetime caused by accelerating massive objects.
- **Dark matter**: Invisible matter that interacts gravitationally but not electromagnetically.
- **Dark energy**: A form of energy that causes the universe to expand at an accelerating rate.
- **Big Bang**: The beginning of the universe as a hot, dense state that expanded and cooled.
- **Cosmic Microwave Background (CMB)**: The afterglow of the Big Bang, a uniform radiation field.
- **Redshift**: The shift of light towards longer wavelengths due to the expansion of the universe.
- **Hubble's Law**: The distance between galaxies is proportional to their recession velocity.
- **Galaxies**: Large systems of stars, gas, and dust held together by gravity.
- **Star formation**: The process by which clouds of gas and dust collapse to form stars.
- **Stellar evolution**: The life cycle of a star from birth to death.
- **Supernovae**: Explosions that occur at the end of a star's life.
- **Black holes**: Regions of spacetime where gravity is so strong that nothing can escape.
- **White dwarfs**: Hot, dense remnants of stars that have exhausted their fuel.
- **Neutron stars**: Extremely dense remnants of stars, composed mostly of neutrons.
- **Pulsars**: Rapidly rotating neutron stars that emit beams of electromagnetic radiation.
- **Galaxies**: Large systems of stars, gas, and dust held together by gravity.
- **Galaxy clusters**: Groups of galaxies held together by gravity.
- **Superclusters**: Large-scale structures of galaxy clusters.
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## Questions for Oral Answers

1. **What is the speed of light?** It is a constant, approximately  $3 \times 10^8$  m/s, and is denoted by  $c$ .
2. **What is time dilation?** Time appears to pass slower for an object in motion as observed from a stationary frame.
3. **What is length contraction?** The length of an object in motion is contracted along the direction of motion.

