

What Is Special Relativity?

Worksheet

Special relativity states that mass and energy are equivalent: $E = mc$. As objects approach the speed of light, time slows down (time dilation) and lengths contract in the direction of motion.

$$E = mc^2$$

Questions

1. What does the formula $E = mc$ describe?

- A) The force on a moving object
- B) The equivalence of mass and energy
- C) The speed of an accelerating object
- D) The gravitational pull of a planet

2. According to special relativity, what happens to a clock moving at high speed?

- A) It runs faster
- B) It runs slower
- C) It stops completely
- D) It is unaffected

3. What is the speed of light in vacuum used in $E = mc$?

- A) 310 m/s
- B) 310 m/s
- C) 310 m/s
- D) 310 m/s

4. Which of these is a postulate of special relativity?

- A) Gravity acts instantly across space
- B) The speed of light is the same for all inertial observers
- C) Mass is always conserved separately from energy
- D) Time is absolute for all observers

5. Find the rest energy of a 1 kg object.

6. A nuclear reaction converts 0.001 kg (1 gram) of mass into energy. How much energy is released?

7. How much mass would need to be converted to produce 910 J of energy?

8. Define: What does $E = mc$ state?

9. Define: What are Einstein's two postulates of special relativity?

10. Define: What is time dilation?

Answer Key

1. B) The equivalence of mass and energy - $E = mc$ shows mass and energy are two forms of the same physical quantity.
2. B) It runs slower - Time dilation means a fast-moving clock ticks slower relative to a stationary observer.
3. C) 310 m/s - The speed of light in vacuum is approximately 310 m/s.
4. B) The speed of light is the same for all inertial observers - Einstein's second postulate: the speed of light in vacuum is constant regardless of the observer's motion.
5. $E = mc$ $E = 1$ (310) $E = 910$ J
6. $m = 0.001$ kg $E = mc = 0.001$ (310) $E = 910$ J
7. $E = mc$ $m = E/c$ $m = 910 / (310)$ $m = 1$ kg
8. Mass and energy are equivalent - a small amount of mass corresponds to an enormous amount of energy.
9. 1) Physics laws are the same in all inertial frames. 2) The speed of light in vacuum is constant for all observers.
10. Moving clocks run slower relative to a stationary observer, a direct consequence of special relativity.

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