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so many fake sites. this is the first one which worked! Many thanks

12P/218/29

11. The length of a spaceship is measured to be exactly half of its proper length by an observer. The relative velocity of the observer is

- (1)  $\frac{1}{2}c$  (2)  $\frac{\sqrt{3}}{2}c$  (3)  $\frac{\sqrt{2}}{2}c$  (4)  $\frac{1}{\sqrt{2}}c$

12. If the total energy of a particle of mass  $m$  is equal to twice its rest energy, then the magnitude of the particle's relativistic momentum is

- (1)  $\frac{mc}{2}$  (2)  $\frac{mc}{\sqrt{2}}$  (3)  $mc$  (4)  $\sqrt{3}mc$

13. If a charged pion that decays in  $10^{-8}$  second in its own rest frame is to travel 30 metres in the laboratory before decaying, the pion's speed must be most nearly

- (1)  $0.43 \cdot 10^8$  m/s (2)  $2.84 \cdot 10^8$  m/s  
(3)  $2.90 \cdot 10^8$  m/s (4)  $2.98 \cdot 10^8$  m/s

14. A particle leaving a cyclotron has a total relativistic energy of 10 GeV and a relativistic momentum of 9 GeV/c. What is the rest mass of this particle?

- (1) 0.25 GeV/c<sup>2</sup> (2) 1.20 GeV/c<sup>2</sup> (3) 2.00 GeV/c<sup>2</sup> (4) 6.00 GeV/c<sup>2</sup>

15. A tube of water is travelling at  $\frac{1}{2c}$  relative to the lab frame when a beam of light travelling in the same direction as the tube enters it. What is the speed of light in the water relative to the lab frame? (The index of refraction of water is  $\frac{3}{2}$ .)

- (1)  $\frac{1}{2c}$  (2)  $\frac{2}{3c}$  (3)  $\frac{5}{6c}$  (4)  $\frac{10}{3c}$

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