

Sample Exam Questions

PS303 Modern Physics

1. A container holds gas molecules of mass m at a temperature T . A small probe inserted into the container measures the value of the x component of the velocity of the molecules. What is the average value of $\frac{1}{2} m v_x^2$ for these molecules?

(a) $\frac{3}{2} kT$ (b) $\frac{1}{2} kT$ (c) kT (d) $\sqrt{3}kT$

2. A star (assumed to be at rest relative to the Earth) is 100 light-years from Earth. (A light-year is the distance light travels in one year.) An astronaut sets out from Earth on a journey to the star at a constant speed of $0.98c$. (Note: At $v = 0.98c$, $\gamma = ?$)

(a) How long does it take for a light signal from Earth to reach the star, according to an observer on Earth?

(1) 100y (2) 98y (3) 102y (4) 20y

(b) How long does it take for the astronaut to travel from Earth to the star, according to an observer on Earth?

(1) 100y (2) 98y (3) 102y (4) 20y

(c) According to the astronaut, what is the distance from Earth to the star?

(1) 100 l.y. (2) 102 l.y. (3) 20 l.y. (4) 98 l.y.

(d) According to the astronaut, how long does it take for the astronaut to travel from Earth to the star?

(1) 100y (2) 102y (3) 20y (4) 20.4y

(e) Light takes 100 years to travel from Earth to the star, but the astronaut makes the trip in 20.4 y. Does that mean that the astronaut travels faster than light?

(1) Yes (2) No (3) Maybe

3. A certain particle has a proper lifetime of 1.00×10^{-8} s. It is moving through the laboratory at a speed of $0.85c$. What distance does the particle travel in the laboratory?
- (a) 2.55 m (b) 4.84 m (c) 1.34 m (d) 9.19 m
4. A π^0 meson (rest energy = 135 MeV) is moving through the laboratory with a kinetic energy of 405 MeV.
- (a) Expressed as a fraction of the speed of light, what is the speed of the pi meson?
- (b) At this speed, how long a track will the pi meson leave in the laboratory during its lifetime? The lifetime of a pi meson at rest in the laboratory 1.0×10^{-16} s
5. The most intense radiation emitted from a hot sample of metal has a wavelength of 60 μm . When the temperature of the sample is doubled, what will be the wavelength of the most intense radiation?
- (a) 30 μm (b) 120 μm (c) 960 μm (d) 15 μm
6. Light of wavelength 477 nm is incident on the surfaces of several different metals. For which value of the work function will electrons be emitted from the surface?
- (a) 4.2 eV (b) 3.7 eV (c) 3.2 eV (d) 2.3 eV
7. Which one of these processes involves a decrease in the kinetic energy of an electron?
- (a) bremsstrahlung (b) photoelectric effect (c) Compton scattering
- (d) pair production

Obviously there's more than this!