Find $\theta$

**Law of Reflection:** $\theta_i = \theta_r$

\[90° - 35° = 65°\]

\[25° = 180° - 135° - 20°\]

\[180° - 45° = 135°\]

\[90° - 70° = 20°\]

- a) 70°
- b) 20°
- c) 50°
- d) 35°
- e) 65°
3. The wave front shown at the left for light which is initially in a medium with index of refraction $n=1.5$ and then reaches the plane surface (shown by a slanted line) that bounds a medium with index of refraction $n = 1$.

Which diagram below correctly shows the wave front while entering the medium at the right?

![Diagrams](image)

A. $i$
B. $ii$
C. $iii$
D. $iv$
E. $v$
7. Light in air \((n_{\text{air}} = 1)\) is initially traveling parallel to the face AC of an equilateral triangular prism, as shown in the figure. The prism is made of glass with an index of refraction of \(n_{\text{glass}} = 1.52\). If the light does not strike the face AC, what is the angle (in degrees) between the ray as it leaves the prism at face BC and the surface normal?

A. 83
B. 55
C. 19
D. 27
E. 59
10. A spaceship is moving at a speed of 0.95 c away from the Earth relative to an Earth’s observer. It shoots a plasma torpedo toward the Earth at a speed of 0.90 c relative to an observer on the ship. What is the velocity of the torpedo relative to the Earth’s observer?

A. 0.05 c  
B. 0.12 c  
C. 0.34 c  
D. 0.64 c  
E. 0.99 c
16. In the Compton effect, a photon of wavelength $\lambda$ and frequency $f$ hits an electron that is initially at rest. Which one of the following occurs as a result of the collision?

A. The photon is absorbed completely.
B. The photon gains energy, so the final photon has a frequency greater than $f$.
C. The photon gains energy, so the final photon has a wavelength greater than $\lambda$.
D. The photon loses energy, so the final photon has a frequency less than $f$.
E. The photon loses energy, so the final photon has a wavelength less than $\lambda$. 
An electron is given 0.75 MeV of kinetic energy, what is its velocity, as a fraction of the speed of light? You will have to assume the electron is moving relativistically.

\[
\gamma m_0 = (0.75 + 0.511)\text{MeV}/c^2
\]

\[
\frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} = \frac{(0.75 + 0.511)\text{MeV}/c^2}{0.511 \text{MeV}/c^2}
\]
Find the Brewster angle.

\[ \tan \theta_B = \frac{n_2}{n_1} \]
A spaceship is moving in a straight line from one star to another at a speed of 0.932c. To someone in the ship, the distance between the two stars appears to be 26.9 light-years (ly). What is the distance between the stars in the rest frame of the stars?

\[
\Delta \ell = \frac{\ell_0}{\gamma}
\]

\[
\gamma = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}}
\]

\[
\gamma = 2.76
\]

- a) 96.0 ly
- b) 74.2 ly
- c) 9.75 ly
- d) 21.5 ly
- e) 56.5 ly
As measured in Earth’s rest frame, a spaceship traveling at 0.964c takes 11.2 y to travel between two planets. How long does the trip take as measured by someone on the spaceship?

\[ \Delta t = t_0 \gamma \]

\[ \gamma = \frac{1}{\sqrt{1 - 0.964^2}} = 3.76 \]

- a) 2.98 y
- b) 30.7 y
- c) None of the other answers.
- d) 42.1 y
- e) 7.28 y
In a living organism, a fixed fraction $1.30 \times 10^{-12}$ of $^{12}\text{C}$ is the radioactive isotope $^{14}\text{C}$, which has a half life of 5730 y. What is the activity of the $^{14}\text{C}$ in 2.8g of $^{12}\text{C}$ found in living tissue in Bq (1/s)?

$$Activity \ R = \lambda N = \ln2 \frac{N}{t_{1/2}}$$

$$N = Fraction \times \text{Avogadro's } # \left(\frac{2.8g}{\text{Molar Mass }^{12}\text{C}}\right)$$

$$N = 1.3 \times 10^{-12} \times 6.022 \times 10^{23} \left(\frac{2.8g}{12g}\right) = 1.83 \times 10^{11}$$