\[
\frac{\sin \alpha}{a} = \frac{\sin \beta}{b} = \frac{\sin \gamma}{c}
\]
\[
a^2 = c^2 + b^2 - 2cb \cos \alpha
\]
\[
b^2 = a^2 + c^2 - 2ac \cos \beta
\]
\[
c^2 = a^2 + b^2 - 2ab \cos \gamma
\]
\[
x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}
\]
\[
\sin(2u) = 2 \sin u \cos u
\]
\[
\cos(2u) = \cos^2 u - \sin^2 u
\]
\[
\tan(2u) = \frac{2 \tan u}{1 - \tan^2 u}
\]
1. Find the exact value of \( \cos^{-1}\left(\frac{-\sqrt{3}}{2}\right) = \frac{5\pi}{6} \)
   A. \( \frac{-\pi}{6} \)
   B. \( \frac{5\pi}{6} \)
   C. \( \frac{-5\pi}{6} \)
   D. \( \frac{\pi}{6} \)
   E. None of the above

2. Find the exact value of \( \arcsin\left(\sin \frac{4\pi}{3}\right) \).
   A. \( \frac{\pi}{3} \)
   B. \( \frac{2\pi}{3} \)
   C. \( \frac{-\pi}{3} \)
   D. \( \frac{5\pi}{3} \)
   E. \( \frac{4\pi}{3} \) (Not the answer! Do not pick this.)

3. Find the solutions of the equation \( 5\tan^2 t + 3\tan t - 9 = 0 \) in the interval \( \left[-\frac{\pi}{2}, \frac{\pi}{2}\right] \).
   Round to nearest 0.0001 radians. **Check the mode on your calculator!**
   A. \(-1.0325, 0.8214\) \( \tan t = -\frac{3\pm\sqrt{9-4(5)(-9)}}{2(5)} = -\frac{3\pm\sqrt{189}}{10} \)
   B. \(-1.7266, 0.9266\)
   C. \(-1.0458, 0.7473\)
   D. \(-1.6748, 1.0748\)
   E. None of the above
4. Find the perimeter of $\triangle ABC$, given angle $\gamma = 82^\circ$, side $b = 36$, and side $c = 63$. Round to the nearest whole number. Check the mode on your calculator!

A. 136  
B. 129  
C. 161  
D. 156  
E. None of the above

\[ P = a + b + c \]
\[ P = 155.9535 \]

5. As shown in the figure below, a cable car carries passengers from a point $A$, which is 2.1 miles from a point $B$ at the base of a mountain, to a point $P$ at the top of the mountain. The angles of elevation of $P$ from $A$ and $B$ are $\alpha = 31^\circ$ and $\beta = 65^\circ$, respectively. Find the distance from Point $A$ to Point $P$ to the nearest tenth of a mile.

A. 3.2 miles  
B. 3.0 miles  
C. 3.6 miles  
D. 3.4 miles  
E. None of the above

\[ \sin 34^\circ = \frac{\sin 115^\circ}{x} \]
\[ x = \frac{2.1 \sin 115^\circ}{\sin 34^\circ} \]
\[ x \approx 3.404 \]

6. A triangular plot of land has sides of lengths 450 feet, 390 feet, and 280 feet. Approximate the smallest angle between the sides to one decimal place.

A. 27.9$^\circ$  
B. 38.1$^\circ$  
C. 23.4$^\circ$  
D. 32.7$^\circ$  
E. None of the above

\[ \frac{280^2 = 390^2 + 450^2 - 2(390)(450)\cos x}{-276200 = \cos x} \]
\[ \cos x = 0.7869 \]
\[ x = \cos^{-1}(0.7869) \]
\[ x = 38.1038^\circ \]
7. A ship leaves port at 1:00 pm and sails in the direction N40°E at a rate of 50 mph. At 2:00 pm a second ship leaves the same port and sails in the direction N35°W at a rate of 25 mph. To the nearest mile, how far apart are the two ships at 4:00 pm?

A. 163 miles
B. 170 miles
C. 145 miles
D. 158 miles
E. None of the above

\[ X^2 = 50^2 + 150^2 - 2(50)(150) \cos 75° \]
\[ X = 145.319° \]

8. Given \( a = \langle 5, -7 \rangle \) and \( b = \langle 6, 3 \rangle \), find \( 4a + 5b \).

A. \( \langle 50, -13 \rangle \)
B. \( \langle -10, -43 \rangle \)
C. \( \langle 10, -43 \rangle \)
D. \( \langle -50, 13 \rangle \)
E. None of the above

\[ 4\mathbf{a} = \langle 20, -28 \rangle \]
\[ 5\mathbf{b} = \langle 30, 15 \rangle \]
\[ \mathbf{b} = \langle 50, -13 \rangle \]

9. The vectors \( a \) and \( b \) represent two forces acting at the same point, and \( \theta \) is the smallest positive angle between \( a \) and \( b \). Approximate the magnitude of the resultant force to one decimal place.

\( \|a\| = 8.2 \text{ lb}, \quad \|b\| = 12.5 \text{ lb}, \quad \theta = 60° \)

A. \( \|\mathbf{r}\| = 11.0 \text{ lb} \)
B. \( \|\mathbf{r}\| = 18.1 \text{ lb} \)
C. \( \|\mathbf{r}\| = 14.7 \text{ lb} \)
D. \( \|\mathbf{r}\| = 17.3 \text{ lb} \)
E. None of the above

\[ X^2 = 8.2^2 + 12.5^2 - 2(8.2)(12.5) \cos 120° \]
\[ X = 180.55^2 \]
10. Find a vector that has the same direction as \(5i - 8j\) and 6 times the magnitude.

A. \(\frac{-30}{\sqrt{89}} i + \frac{48}{\sqrt{89}} j\)  
B. \(-30i + 48j\)  
C. \(\frac{30}{\sqrt{89}} i - \frac{48}{\sqrt{89}} j\)  
D. \(30i - 48j\)  
E. None of the above

11. Find side \(a\) of \(\triangle ABC\) given \(\alpha = 40^\circ\), \(b = 10\), and \(c = 20\).
Round to one decimal place.

\[a^2 = 10^2 + 20^2 - 2(10)(20) \cos 40^\circ\]

\[a = 13.9\]

A. 13.5  
B. 13.9  
C. 14.4  
D. 14.8  
E. None of the above

---

For Questions 12 and 13, use vector \(a = \langle 7, 13 \rangle\) and round to one decimal place.

12. What is the magnitude of vector \(a\)?

A. \(\|a\| = 14.8\)  
B. \(\|a\| = 14.5\)  
C. \(\|a\| = 15.1\)  
D. \(\|a\| = 15.4\)  
E. None of the above

\[\|a\| = \sqrt{7^2 + 13^2} = 14.76\

13. What is the smallest positive angle, \(\theta\), between the positive x-axis and vector \(a\)?

A. \(\theta = 28.3^\circ\)  
B. \(\theta = 36.4^\circ\)  
C. \(\theta = 61.7^\circ\)  
D. \(\theta = 72.5^\circ\)  
E. None of the above

\[\tan \theta = \frac{y}{x} = \frac{13}{7}\]

\[\theta = \tan^{-1} \left(\frac{13}{7}\right) = 61.6992^\circ\]
Questions 14 and 15: An airplane with an airspeed of 510 mph is flying in the direction 150° and a 63 mph wind is blowing in the direction of 80°.

14. What is the ground speed of the plane? Round to the nearest whole number.

A. 535 mph
B. 476 mph
C. 549 mph
D. 498 mph
E. None of the above

[Calculation]
\[ x = 510^2 + 63^2 - 2(510)(63)\cos 110° \]
\[ x = 534.8338 \text{ mph} \]

15. What is the true course of the plane? Round to the nearest whole degree.

A. 135°
B. 141°
C. 138°
D. 144°
E. None of the above

[Calculation]
\[ \tan \theta = \frac{317.0}{-430.7} \]
\[ \theta = \tan^{-1}(-0.7361) + 180° \]
\[ \theta = -36.4° + 180° \]
\[ \theta = 143.6° \]
<table>
<thead>
<tr>
<th>Questions</th>
<th>Answers</th>
<th>Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>( \frac{5\pi}{6} )</td>
<td>B</td>
</tr>
<tr>
<td>2.</td>
<td>( -\frac{\pi}{3} )</td>
<td>C</td>
</tr>
<tr>
<td>3.</td>
<td>-1.0325, 0.8214</td>
<td>A</td>
</tr>
<tr>
<td>4.</td>
<td>156</td>
<td>D</td>
</tr>
<tr>
<td>5.</td>
<td>3.4 miles</td>
<td>D</td>
</tr>
<tr>
<td>6.</td>
<td>38.1°</td>
<td>B</td>
</tr>
<tr>
<td>7.</td>
<td>145 miles</td>
<td>C</td>
</tr>
<tr>
<td>8.</td>
<td>( \langle 50, -13 \rangle )</td>
<td>A</td>
</tr>
<tr>
<td>9.</td>
<td>( |r| = 18.1\ lb )</td>
<td>B</td>
</tr>
<tr>
<td>10.</td>
<td>30i - 48j</td>
<td>D</td>
</tr>
<tr>
<td>11.</td>
<td>13.9</td>
<td>B</td>
</tr>
<tr>
<td>12.</td>
<td>( |a| = 14.8 )</td>
<td>A</td>
</tr>
<tr>
<td>13.</td>
<td>( \theta = 61.7^\circ )</td>
<td>C</td>
</tr>
<tr>
<td>14.</td>
<td>535 mph</td>
<td>A</td>
</tr>
<tr>
<td>15.</td>
<td>144°</td>
<td>D</td>
</tr>
</tbody>
</table>