39.

$$2\cos x - \sec x + \tan x = 0$$
$$2\cos x - \frac{1}{\cos x} + \frac{\sin x}{\cos x} = 0$$
$$2\cos^2 x - 1 + \sin x = 0, \quad \cos x \neq 0$$
$$2(1-\sin^2 x) - 1 + \sin x = 0$$
$$2 - 2\sin^2 x - 1 + \sin x = 0$$
$$2\sin^2 x - \sin x - 1 = 0$$
$$(2\sin x + 1)(\sin x - 1) = 0$$
$$\sin x - 1 = 0 \quad \text{or} \quad 2\sin x + 1 = 0$$
$$\sin x = 1 \qquad \sin x = -\frac{1}{2}$$
$$x = \frac{\pi}{2} + 2k\pi \qquad x = \frac{7\pi}{6} + 2k\pi \text{ or } \frac{11\pi}{6} + 2k\pi$$

This answer doesn't check.

41.

$$\sin x + \cos x = 0$$
$$\sin x = -\cos x$$
$$\frac{\sin x}{\cos x} = -1, \quad \cos x \neq 0$$
$$\tan x = -1$$
$$\hat{x} = \frac{\pi}{4} \text{ and } x \text{ is in QII or QIV}$$
$$x = \frac{3\pi}{4} + 2k\pi \text{ or } x = \frac{7\pi}{4} + 2k\pi$$

Problem Set 7.3

1.

$$c^2 = a^2 + b^2 - 2ab\cos C$$
$$= (120)^2 + (66)^2 - 2(120)(66)\cos 60^\circ$$
$$= 10{,}836$$

$c = 100$ inches (rounded to 2 significant digits)

3.

$$\cos C = \frac{c^2 - a^2 - b^2}{-2ab}$$
$$= \frac{26^2 - 22^2 - 24^2}{-2(22)(24)}$$
$$= 0.3636$$

$C = 69^\circ$ (The largest angle is opposite the longest side)

5.

$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$= (4.2)^2 + (6.8)^2 - 2(4.2)(6.8)\cos 116^\circ$$
$$= 88.92$$

$a = 9.4$ meters

7.

$$\cos A = \frac{a^2 - b^2 - c^2}{-2bc}$$
$$= \frac{38^2 - 10^2 - 31^2}{-2(10)(31)}$$
$$= -0.6177$$

$A = 128^\circ$

9.

$$b^2 = a^2 + c^2 - 2ac\cos B$$
$$= (410)^2 + (340)^2 - 2(410)(340)\cos 151.5^\circ$$
$$= 528{,}714.211$$
$$b = 727 \text{ meters}$$

$$\sin A = \frac{a\sin B}{b} = \frac{410\sin 151.5^\circ}{727} = 0.2691$$
$$A = 15.6^\circ$$
$$C = 180^\circ - (15.6^\circ + 151.5^\circ) = 12.9^\circ$$

11.

$$\cos C = \frac{c^2 - a^2 - b^2}{-2ab} = \frac{0.75^2 - 0.48^2 - 0.63^2}{-2(0.48)(0.63)} = 0.1071$$
$$C = 84^\circ$$

$$\sin B = \frac{b\sin C}{c} = \frac{0.63\sin 84^\circ}{0.75} = 0.8354$$
$$B = 57^\circ$$
$$A = 180^\circ - (57^\circ + 84^\circ) = 39^\circ$$

13.

$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$= (0.923)^2 + (0.387)^2 - 2(0.923)(0.387)\cos 43^\circ 20'$$
$$= 0.4821$$
$$a = 0.694 \text{ kilometers}$$

$$\sin C = \frac{c\sin A}{a} = \frac{0.387\sin 43^\circ 20'}{0.694} = 0.3827$$
$$C = 22^\circ 30'$$
$$B = 180^\circ - (22^\circ 30' + 43^\circ 20') = 114^\circ 10'$$

Note: *Answers may differ depending on which angle you solve for first.*

15.

$$\cos C = \frac{c^2 - a^2 - b^2}{-2ab} = \frac{5.22^2 - 4.38^2 - 3.79^2}{-2(4.38)(3.79)} = 0.1898$$
$$C = 79.1^\circ$$

$$\sin B = \frac{b\sin C}{c} = \frac{3.79\sin 79.1^\circ}{5.22} = 0.7130$$
$$B = 45.5^\circ$$
$$A = 180^\circ - (79.1^\circ + 45.5^\circ) = 55.4^\circ$$

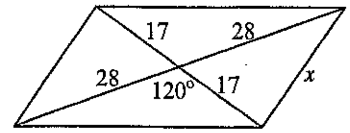
Note: *Answers may differ depending on which angle you solve for first.*

17.

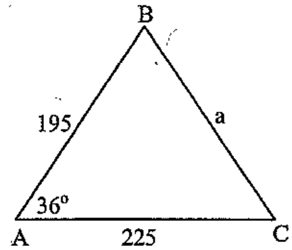
$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$a^2 = b^2 + c^2 - 2bc\cos 90^\circ$$
$$a^2 = b^2 + c^2 - 2bc(0)$$
$$a^2 = b^2 + c^2$$

19. The diagonals of a parallelogram bisect each other.
The angle opposite side x is $180^\circ - 120^\circ = 60^\circ$.

$$x^2 = 17^2 + 28^2 - 2(17)(28)\cos 60^\circ$$
$$= 597$$
$$x = 24 \text{ inches}$$



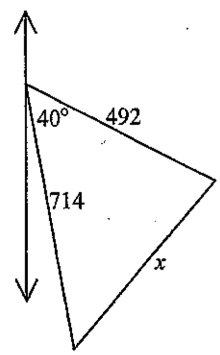
21. $d_1 = r_1 t_1 = 130(1.5) = 195 \text{ miles}$ $\quad$ $d_2 = r_2 t_2 = 150(1.5) = 225 \text{ miles}$



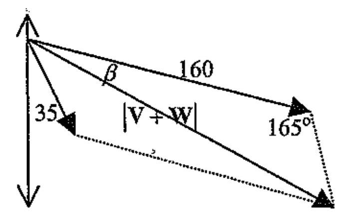
$$a^2 = b^2 + c^2 - 2bc\cos A$$
$$= (225)^2 + (195)^2 - 2(225)(195)\cos 36^\circ$$
$$= 17658.76$$
$a = 130$ miles (rounded to 2 significant digits)

23. Distance of first plane is 246 (2) or 492 miles.
Distance of second plane is 357 (2) or 714 miles.
Angle between the two planes is $175^\circ - 135^\circ$ or 40°.
We will use the Law of Cosines to find x:

$$x^2 = (492)^2 + (714)^2 - 2(492)(714)\cos 40^\circ$$
$$= 213655.56$$
$x = 462$ miles (rounded to 3 significant digits)



25. $$|\mathbf{V} + \mathbf{W}|^2 = |\mathbf{V}|^2 + |\mathbf{W}|^2 - 2|\mathbf{V}||\mathbf{W}|\cos\theta$$
$$= (35)^2 + (160)^2 - 2(35)(160)\cos 165^\circ$$
$$= 37,643$$
$|\mathbf{V} + \mathbf{W}| = 190$ mph (to 2 significant digits)

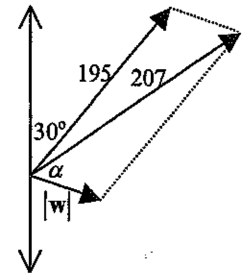


$$\sin\beta = \frac{35\sin 165^\circ}{190}$$
$$= 0.0477$$
$\beta = 3^\circ$ (to the nearest degree)

The true course is $150^\circ + 3^\circ = 153^\circ$. The ground speed of the plane is 190 mph.

27. The angle between the plane vector and its airspeed is 34.0° – 30.0° or 4.0°.
We will use the Law of Cosines to find the speed of the wind:

$$|\mathbf{w}|^2 = (195)^2 + (207)^2 - 2(195)(207)\cos 4.0^\circ$$
$$= 340.65$$
$$|\mathbf{w}| = 18.5 \text{ mph}$$



Next, we will use the Law of Sines to find α:

$$\sin\alpha = \frac{195\sin 4.0^\circ}{18.5}$$
$$= 0.7353$$
$$\alpha = 47.3^\circ$$

The wind is 18.5 mph at 34.0° + 47.3° or 81.3° from due north.

29. $$x^2 = (47.0)^2 + (47.5)^2 - 2(47.0)(47.5)\cos 78.0^\circ$$
$$= 3537$$
$$x = 59.5 \text{ cm}$$

The length of the down tube is 59.5 cm.

31. $$x^2 = (52.3)^2 + (48.0)^2 - 2(52.3)(48.0)\cos 75.0^\circ$$
$$= 3740$$
$$x = 61.2 \text{ cm}$$

$$\sin\theta = \frac{52.3\sin 75.0^\circ}{61.2}$$
$$= 0.8281$$
$$\theta = 55.6^\circ$$

The length of the down tube is 61.2 cm and the angle between the seat tube and the down tube is 55.6°.

33. $$\sin 3x = \frac{1}{2}$$

$$3x = \frac{\pi}{6} + 2k\pi \quad \text{or} \quad 3x = \frac{5\pi}{6} + 2k\pi$$
$$x = \frac{\pi}{18} + \frac{2k\pi}{3} \qquad x = \frac{5\pi}{18} + \frac{2k\pi}{3}$$

35. $$\tan^2 3x = 1$$

$$\tan 3x = 1 \quad \text{or} \quad \tan 3x = -1$$

$$3x = \frac{\pi}{4} + k\pi \qquad 3x = \frac{3\pi}{4} + k\pi$$
$$x = \frac{\pi}{12} + \frac{k\pi}{3} \qquad x = \frac{\pi}{4} + \frac{k\pi}{3}$$

37. $2\cos^2 3\theta - 9\cos 3\theta + 4 = 0$

$(2\cos 3\theta - 1)(\cos 3\theta - 4) = 0$

$\cos 3\theta - 4 = 0$ or $2\cos 3\theta - 1 = 0$

$\cos 3\theta = 4$ $\qquad$ $\cos 3\theta = \frac{1}{2}$

No Solution $\qquad$ $3\theta = 60^\circ + 360^\circ k$ or $3\theta = 300^\circ + 360^\circ k$

$\theta = 20^\circ + 120^\circ k$ $\qquad$ $\theta = 100^\circ + 120^\circ k$

39.

$$\sin 4\theta \cos 2\theta + \cos 4\theta \sin 2\theta = -1$$
$$\sin(4\theta + 2\theta) = -1$$
$$\sin 6\theta = -1$$
$$6\theta = 270^\circ + 360^\circ k$$
$$\theta = 45^\circ + 60^\circ k$$

41.

$$\sin\theta + \cos\theta = 1$$
$$(\sin\theta + \cos\theta)^2 = 1^2$$
$$\sin^2\theta + 2\sin\theta\cos\theta + \cos^2\theta = 1$$
$$1 + \sin 2\theta = 1$$
$$\sin 2\theta = 0$$
$$2\theta = 0^\circ \text{ or } 180^\circ$$
$$\theta = 0^\circ \text{ or } 90^\circ$$

Both answers check.

43. We can use the Pythagorean Theorem to find the ground speed:

$$|\mathbf{g}| = \sqrt{176^2 + 45.5^2}$$
$$= \sqrt{33{,}046.25}$$
$$= 182 \text{ mph}$$

We can use the tangent ratio to find the course of the plane:

$$\tan\theta = \frac{45.5}{176}$$
$$\theta = \tan^{-1}(0.2585)$$
$$= 14.5^\circ$$

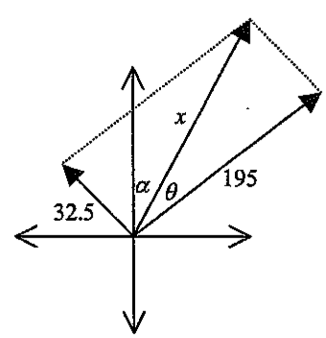
The true course of the plane is 40.0° + 14.4° or 54.5° from due north and the ground speed is 182 mph.

45. We can use the Pythagorean Theorem to find the ground speed:

$$x = \sqrt{195^2 + 32.5^2}$$
$$= \sqrt{39{,}081.25}$$
$$= 198 \text{ mph}$$

We can use the tangent ratio to find the course of the plane:

$$\tan\theta = \frac{32.5}{195}$$
$$\theta = \tan^{-1}(0.1667)$$
$$= 9.5^\circ \qquad \alpha = 30.0^\circ - 9.5^\circ \text{ or } 20.5^\circ$$



The true course of the plane is N 20.5° E and the ground speed is 198 mph..