Chapter 7

The New Pilot: VECTORS AND MORE TRIGONOMETRY

NP-1. a) $\boxed{K = \frac{1}{2}ah}$ b) $h = b\sin C$ c) $\boxed{K = \frac{1}{2}ab\sin C}$

NP-2. 11.644 cm^2

NP-3. $K = \frac{1}{2}bc\sin A$ and $K = \frac{1}{2}ac\sin B$

NP-4. 128.558 sq. ft.

NP-5. a) $\boxed{\frac{}{3}, \frac{}{2}, \frac{2}{3}, \frac{3}{2}}$ b) $\boxed{0, \;, 2 \;, \frac{7}{6}, \frac{11}{6}, \frac{3}{2}}$

c) $\boxed{\frac{2}{3}, \frac{4}{3}, \;, \text{all} + 2\ \ n}$ d) $\boxed{\frac{}{6}, \frac{5}{6}, \frac{3}{2}, \text{all} + 2\ \ n}$

NP-6. $\boxed{\frac{}{6} + \frac{2}{3}n}$

NP-7. 0.122 inch

NP-8. a) sin 10 b) sin (x + y) c) cos x cos h – sin x sin hd) cos 6

NP-9. 3 + 4i, -3 + 4i

NP-10 $y = 16.98(3.404)^x$

NP-11 a) -1 x 2, 0 y 1 b) shift 3 units left c) stretch vertically

NP-12. $\boxed{\sqrt{138}}$ 11.747 feet

NP-13. a) $\frac{a}{c}$ b) $\frac{c}{b}$ c) $\boxed{\frac{b}{a}}$

NP-14. a) 5 b) 16 - 8 cos C + $\cos^2$ C

NP-15. a) h = b sin A b) h = a sin B d)

NP-16. b) Solve $\sin A = \frac{h}{b}$ for h. c) yes

d) The same two equations are true as in the acute case, so the algebra proceeds as before. d) yes

NP-17. a) 5 sin R b) 5 cos R c) 7 – 5 cos R

d) $(5\sin R)^2 + (7 - 5\cos R)^2 = 6^2$ e) $\cos R = \frac{19}{35}$, $R = 57.1^\circ$

f) $P = 44.4^\circ$, $Q = 78.5^\circ$

NP-19. a) 184.018 ft b) 294.354 ft

NP-20. Can't in (a) and (b) because you'll get two unknowns in any form of the equation. Can't in (d) for the same reason, and also because the triangle is not determined. Note that (c) is the only diagram in which you're given exactly one side

NP-21. a) G = 78°, OG = 7.351 in, DG = 5.035 in b) 18.102 sq. in

NP-22. a) $x^5 - 1$ b) $x^2 + x + 1$ NP-23. a) 70° b) 95°

NP-24. a) $x = \sqrt[6]{200}$ b) $x = \log_6 200$ c) 2.418, 2.957
d) 0.243, 18.361, 6^6

NP-25. a) $\boxed{\frac{}{6}, \frac{5}{6}, \frac{}{2}, \frac{3}{2}, \text{all} + 2\ \ n}$ b) 0.644, 5.640, , all + 2 n

NP-26. $-\frac{1}{x}$ NP-27. $16218\, x^{-1.5}$ NP-29. $a^2 + b^2 - 2ab \cos$

NP-30. a) a cos C b) a sin C c) b – a cos C
d) $c^2 = (a \sin C)^2 + (b - a \cos C)^2$

NP-31. 36.3°

NP-32. a) Yes, the third side is 142.6 ft b) 47.9° and 58.1°
c) Yes, because the lot area is approximately 6661 square feet

NP-33. Can't in (c) or (d) because you'll get two unknowns in any form of the equation. Also, the triangle is not determined in (d).

NP-35. $x = 4$, $y = \pm 2\sqrt{2}$ NP-36. $\frac{x\ \ 1}{(x+2)(x+1)}$

NP-37. a) Teacher Solution: This can be done using a combination of the Law of Cosines and the Law of Sines or else by observing that Ali is at (200 cos 15∞, 200 sin 15∞) and so the angle is 15∞more than
$$\tan\ ^{1}\left(\frac{100\ \ 200\sin 15}{200\cos 15}\right) = 14.109$$
b) $\boxed{\tan\ ^{1}\left(\frac{100\ \ x\sin 15}{x\cos 15}\right)}$

NP-39. center at (-3, 2), radius = 5 NP-40. $\boxed{y = \frac{19.2}{x^2}, g(6) = \frac{8}{15}, g(\ \ 3) = 2\frac{2}{15}}$

NP-41. $f^{-1}(x) = \frac{2x\ \ 2}{2\ \ x}$ NP-42. 12.393 cm NP-43 14 < x < 70 inches

NP-44. The Law of Sines calculation results in the sine of the angle at Icy's being greater than 1. The Law of Cosines calculation yields a quadratic equation with no real solutions.

NP-45. a) $I = 44.8^\circ$ (or $I = 135.2^\circ$, but don't point this out yet)

b) The answer students will get is d 40.69 m (and D 107.2°).

c) Katya missed the possibility that I could be obtuse. In fact,

$I = 135.2^\circ$, $D = 16.8^\circ$ and d 12.29 m.

NP-46. a) $a = 5$ b) $C = 90^\circ$ d) $C = 45.6^\circ$ or $C = 134.4^\circ$

e) $ACB = 180^\circ -$ $BCC' = 180^\circ -$ $BC'C$ since BCC' is isosceles.

f) Supplementary angles have the same sine. g) one

Challenge) 0 triangles if $a < c \sin A$; 1 triangle if $a = c \sin A$ or $a \geq c$) 2 triangles if $c \sin A < a < c$.

NP-48. a) $-1 < x < \frac{2}{3}$ b) x -2 or $x \geq \frac{1}{3}$

NP-49. b) 1.428 c) 2.059 d) 32 micrograms

NP-50. $b = 5\sqrt{3} \pm 2\sqrt{6}$ NP-51. h 3779.11 feet

NP-52. a) 92.87°, 48.52°, 38.62° b) 14.984 square meters

NP-53. $x = 0, -\frac{5}{2}$ NP-54. a) $-2x + h$ b) $-4y^2(x^2 + y^2)^{1/2}$

NP-55. a) $x \pi -1$ b) It approaches • . c) It approaches -•
d) It approaches 3. e) It approaches 3.

NP-56. $\cos C = 0$; $c^2 = a^2 + b^2 - 2ab(0)$; $c^2 = a^2 + b^2$ NP-57. $c = 12.490$

NP-58. a) 90° b) 225° c) 170°

NP-61. a) yes b) no d) e e) g
f) c g) d and e h) i and j
i) i and d; i and e; g and c; h and f
j) Order is not important. Vector addition is commutative

NP-63. b) 247∞ c) 345∞

NP-64. a) vectors s and r, vectors l and k b) yes

NP-66. c) Go 8 steps at a bearing of 300∞ NP-67. d) parallelogram

NP-68. a) 2^{21} b) x^3 c) x^{12} d) m^{-10}

NP-69. $x^4 + 4x^2 + 6 + \frac{4}{x^2} + \frac{1}{x^4}$ NP-70. a) 0.412, 2.73 b) $\frac{}{3}, \frac{2}{3}, \frac{4}{3}, \frac{5}{3}$

NP-71. $y = 56.234(6606.934)^x$ NP-72. c NP-73. $22\sqrt{2}$ at 135∞

NP-74. 8.66 due east, 5 due north. NP-76. b) (-4, 3)

NP-77. a) 6i – 2j b) (-1, 3) c) 2i

NP-78. b) $-25\sqrt{2}\ i - 25\sqrt{2}\ j$ c) the horizontal component
d) EMBED "Equation" * mergeformat $25\sqrt{2}$ 35.355 lbs

NP-79. a) 5 b) Because the resultant is 1 unit long. c) $\frac{3}{5}\ i + \frac{4}{5}\ j$

NP-80. a) 2a b) 0a is equivalent to 0; -1a is equivalent to -a.
c) opposite direction

NP-81. a) a – b = a + (-b)

NP-82. b) Use a vector equivalent to b which begins at the end point of a. a + b is then the vector from the initial point of a to the end point of b.
c) 3i + 2j d) b + c = -2i + j, c – a = -5i – j

NP-84. a) (5, 0). There are many other answers.
b) (6, 8). There are many other answers.

NP-85. r = (0, -7) = -7j, s = (0, 3) = 3j, u = (-3, 5) = -3i + 5j,
v = (8, -4) = 8i - 4j, z = (-3, 5) = -3i - 5j
a) 8i - 4j b) -6i c) 4i - 2j d) -11i + 9j

NP-86. b) $\frac{5}{13}i + \frac{12}{13}j$
c) Divide the coefficients of i and j by the magnitude of the vector.

NP-87. a) a force, weight, wind c) 35 mph (no direction mentioned)d) straight down
the vector points straight down. The picture is clearest
if the vector begins at the book.

NP-88. a) 15 b) 1 c) 222 d) 7
e) $a^2 + 6a + 6$ f) $-a^2 + 2a + 8$ g) They are not equal.

NP-89. Magnitude = $\sqrt{34}$ 5.831. Bearing = 211.0∞

NP-90. -21.213i + 21.213j

NP-91. PROBLEM SET A

1. 5
2. -1
3. 0; orthogonal
4. 0; orthogonal
5. 8
6. 7
7. 2x + 6; orthogonal if x = -3
8. -7x + 6y; orthogonal if $y = \frac{7}{6}x$
9. 7x; orthogonal if x = 0
10. $x^2 + y^2 - 4$; orthogonal if $x^2 + y^2 = 4$
11. 19.654∞ or 0.343 radians
12. 107.1∞ or 1.869 radians
13. 42.397∞ or 0.740 radians
14. 81.870∞ or 1.429 radians
15. 69.124∞ or 1.206 radians
16. 90∞ or 1.571 radians
17. 4
18. -10
19. $\boxed{\frac{3}{5}}$
20. 1.5
21. -2
22. 1.5
23. -0.5
24. $\frac{26}{7}$

PROBLEM SET B

25. (0.6, 0.8)
26. $\boxed{\frac{14}{3}}$
27. $\pm 2\sqrt{3}$
28. $z = \pm\sqrt{6}$
29. $\boxed{u = \frac{v}{\sqrt{v ◊ v}}}$

PROBLEM SET C

31. x = -1, y = -6.5
32. $\boxed{\|p + q\| = \|p \quad q\|}$.

NP-92. a) 105∞ b) 137∞ c) 783.23 m
d) 68.0∞ (BAC = 7.0∞)

NP-93. a) 783.23 mph b) 68.0∞
c) Virtually the same as the last one. d) 68.0∞, 1566.46 miles

NP-94. a) 45∞ b) 70.848 mph, angle opposite the "64" side = 15.4∞, so the bearing is 254.6∞ c) 1

NP-95. a) 96 miles SE of Houston b) Fly with a bearing of 347.6∞; The entire trip takes about 2 hours, 27 minutes.
c) 282.4∞; 1.971 hours or 1 hour, 58.3 minutes

NP-96. a) Mag. = $3\sqrt{2}$ 4.24, = $\frac{7}{4}$
b) Mag. = $\sqrt{145}$ 12.04, = $\tan^{-1}$ (-12) + = 1.654

NP-97. 15 sin 20∞= 5.13 km/hr

NP-98. a) 85∞ b) 129.81 mph
c) 127.6∞(Angle opposite 110 side = 27.4∞)

NP-99. $h = \frac{36}{20\ \ d}$

NP-100. a) $(2.5\sqrt{3}, 2.5)$ b) $(-5\sqrt{2}, -5\sqrt{2})$ c) $(-7.5, 7.5\sqrt{3})$

NP-101. a) (-2, 4) b) -10i – j c) (0, 0)

NP-102. a) $\frac{}{4}, \frac{3}{4}, \frac{5}{4}, \frac{7}{4}$ b) 0.723, 5.56, $\frac{2}{3}, \frac{4}{3}$

NP-104. a) (-32.14, 38.30) b) (121.24, -70) c) (-24.75, 24.75)

NP-105. (89.1, -31.7): Magnitude 94.57 at bearing 109.6∞

NP-106. a) -2i + 12j + 14k b) -5i – 4j

NP-107. b) AB = 6i – 3j, C = (2, 2.5) c) D = (3, 2)
d) E = (5, 1), F = (8, -.5), G = (-7, 7)

NP-109. a) P = A b) P = B c) between A and B d) beyond B
e) beyond A

NP-110. a) (-5, -7) b) (-2, 3) + t (-5, -7)

NP-111. b) (1, 2, 4) + t ((-2, 1, 2)

NP-112. a) 152∞
b) 302.97 mph, angle opposite the "80" side = 7.1∞; 103.9∞

NP-113. 13i – 8j – 20k

NP-114. 179.6 mph at a bearing of 99.2∞

NP-115. 2i + t (2i – j) NP-116. c) no .

Challenge. You must pull with 40 sin 22∞sec 16∞ 15.588 pounds of force.

NP-118. a) Not enough information for a specific time. All we know is the average rate at that time. b) 55.8 mph

NP-119. a) 1 b) 1 c) -$\sin^2(2x + 3)$ d) sin 2

NP-120. fx) = 1 if x > 0, -1 if x < 0

NP-121 a) (-8, 12) b) -7i + 5j c) -5i + 6j NP-122. 11.619 sq. ft

NP-124. a) (0, -15), (34.64, 20), (-21.21, 21.21) b) (13.43, 26.21)
c) 29.45 mph, 62.9∞upstream d) 1 hour, 29.4 minutes
e) 39.1 miles

NP-125. a) 52.3∞, 56.1∞, 71.6∞ b) 49.818 sq. km

NP-126. 81.2∞, 223.35 mph

NP-127. a) -37 b) 134.2∞ c) (-6, -4)
d) (-2, 5) + t (-2, -14)

NP-128. a) 72.6∞downstream at 9.25 ft/s b) 36.2 s c) 319.5 ft.

NP-129. 2i + j + 3k + t (2i -3j + 2k)

NP-130. a) v and vi b) i and iii c) v

NP-131. a) $\frac{20}{3}$ b) $4 + 2 \Diamond \frac{1}{2} \Diamond 2.5 + 2 \Diamond \frac{1}{2} \Diamond 2 \Diamond \sqrt{29} \quad 17.27$
c) $= \cos \ 1 \frac{[(2,0,\ 5)\Diamond(2,2,\ 5)]}{\sqrt{29}\Diamond\sqrt{33}} = \cos \ 1 \frac{\sqrt{29}}{\sqrt{33}} \quad 20.4\infty$

NP-132. a) $5\sqrt{2}$ b) EF = 5 cm; DF = $5\sqrt{3}$ cm NP-133. 200 ft

NP-134. a) cos b) sec 2x

NP-135. a) even b) f(x) gets bigger. c) f(x) gets bigger. d) x = ± $\sqrt{3}$

NP-136. $g(x)$ increases to • ; $g(x)$ decreases to -•