13.1

1. For $z_1 = -1 + 2i$ and $z_2 = 3 + i$, find $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $\dfrac{z_1}{z_2}$, and $\dfrac{1}{z_2}$.

2. For $z_1 = -2 - 3i$ and $z_2 = -2 + 5i$, find $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $\dfrac{z_1}{z_2}$, and $\dfrac{1}{z_2}$.

3. For $z_1 = -3 + 3i$ and $z_2 = 3 + 6i$, find $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $\dfrac{z_1}{z_2}$, and $\dfrac{1}{z_2}$.

4. For $z_1 = +4i$ and $z_2 = -3 + 2i$, find $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $\dfrac{z_1}{z_2}$, and $\dfrac{1}{z_2}$.

5. For $z_1 = -4 - i$ and $z_2 = 2 + 3i$, find $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $\dfrac{z_1}{z_2}$, and $\dfrac{1}{z_2}$.

6. For $z_1 = 5 + 2i$ and $z_2 = +i$, find $z_1 + z_2$, $z_1 - z_2$, $z_1 z_2$, $\dfrac{z_1}{z_2}$, and $\dfrac{1}{z_2}$.

7. For a given complex number $z = x + iy$, find the real and imaginary parts of z^2 and $1/z$.

8. Find the modulus of the complex number $z = 1 + i$.

9. Find the modulus of the complex number $z = -2 + 3i$.

10. Find the modulus of the complex number $z = -9 + i$.

11. Find the modulus of the complex number $z = -5 + 4i$.

12. Find the modulus of the complex number $z = -5 - 3i$.

13.2

1. Convert the complex number $z = -2 + 2i$ to polar form.

2. Convert the complex number $z = -4 - 4i$ to polar form.

3. Convert the complex number $z = 2\sqrt{3} - 2i$ to polar form.

4. Convert the complex number $z = -1 - i$ to polar form.

5. Convert the complex number $z = 4i$ to polar form.

6. Convert the complex number $z = -3i$ to polar form.

7. Convert the complex number $z = -2i$ to polar form.

8. Convert the complex number $z = 2 - 3i$ to polar form.

9. Convert the complex number $z = 1 - i$ to polar form.

10. Convert the complex number $z = 1 + i$ to polar form.

11. Convert the complex number $z = 5\sqrt{3} + 5i$ to polar form.

12. Convert the complex number $z = -\sqrt{3} + i$ to polar form.

13. Convert the complex number $z = -1 + i$ to polar form.

14. Convert the complex number $z = 2 + 0i$ to polar form.

15. Convert the complex number $z = 2 + 3i$ to polar form.

16. Convert the complex number $z = 4 + 0i$ to polar form.

17. Convert the complex number $z = 2i$ to polar form.

18. Convert the complex number $z = -5\sqrt{3} + 5i$ to polar form.

19. Convert the complex number $z = \sqrt{3} - i$ to polar form.

20. Convert the complex number $z = -2 + 0i$ to polar form.

21. Convert the complex number $z = -2\sqrt{3} - 2i$ to polar form.

22. Convert the complex number $z = -4 + 4i$ to polar form.

23. Convert the complex number $z = 3 + 3i$ to polar form.

24. Convert the complex number $z = -2 - 2\sqrt{3}i$ to polar form.

25. Convert the complex number $z = -3\sqrt{3} - 3i$ to polar form.

26. Convert the complex number $z = 3\sqrt{3} - 3i$ to polar form.

27. Convert the complex number $z = 2 - 2\sqrt{3}i$ to polar form.

28. Convert the complex number $z = 2 + 2\sqrt{3}i$ to polar form.

29. Convert the complex number $z = -2 - 3i$ to polar form.

30. Convert the complex number $z = -4\sqrt{3} + 4i$ to polar form.

31. Convert the complex number $z = 4\sqrt{3} - 4i$ to polar form.

32. Convert the complex number $z = \sqrt{3} + i$ to polar form.

33. Convert the complex number $z = 5 + 5i$ to polar form.

34. Convert the complex number $z = -2 + 2\sqrt{3}i$ to polar form.

35. Convert the complex number $z = -\sqrt{3} - i$ to polar form.

36. Convert the complex number $z = -2 + 3i$ to polar form.

37. Convert the complex number $z = -3 + 0i$ to polar form.

38. Convert the complex number $z = 2\sqrt{3} + 2i$ to polar form.

39. Convert the complex number $z = 2 - 2i$ to polar form.

40. Convert the complex number $z = 5 - 5i$ to polar form.

41. For the complex numbers $z_1 = 2\left(\cos\left(\frac{1}{7}\pi\right) + i\sin\left(\frac{1}{7}\pi\right)\right)$ and $z_2 = 3\left(\cos\left(\frac{2}{5}\pi\right) + i\sin\left(\frac{2}{5}\pi\right)\right)$, compute $z_1 z_2$, $\dfrac{z_1}{z_2}$, z_1^2, and z_2^3.

42. For the complex numbers $z_1 = 2\left(\cos\left(\frac{-2}{7}\pi\right) + i\sin\left(\frac{-2}{7}\pi\right)\right)$ and $z_2 = 2\left(\cos\left(\frac{2}{11}\pi\right) + i\sin\left(\frac{2}{11}\pi\right)\right)$, compute $z_1 z_2$, $\dfrac{z_1}{z_2}$, z_1^5, and z_2^4.

43. For the complex numbers $z_1 = 3\left(\cos\left(\frac{-1}{11}\pi\right) + i\sin\left(\frac{-1}{11}\pi\right)\right)$ and $z_2 = 2\left(\cos\left(\frac{5}{13}\pi\right) + i\sin\left(\frac{5}{13}\pi\right)\right)$, compute $z_1 z_2$, $\dfrac{z_1}{z_2}$, z_1^2, and z_2^4.

44. For the complex numbers $z_1 = 2\left(\cos\left(\frac{4}{5}\pi\right) + i\sin\left(\frac{4}{5}\pi\right)\right)$ and $z_2 = \left(\cos\left(\frac{3}{7}\pi\right) + i\sin\left(\frac{3}{7}\pi\right)\right)$, compute $z_1 z_2$, $\dfrac{z_1}{z_2}$, z_1^4, and z_2^3.

45. For the complex numbers $z_1 = \left(\cos\left(\frac{-3}{11}\pi\right) + i\sin\left(\frac{-3}{11}\pi\right)\right)$ and $z_2 = \left(\cos\left(\frac{-3}{7}\pi\right) + i\sin\left(\frac{-3}{7}\pi\right)\right)$, compute $z_1 z_2$, $\dfrac{z_1}{z_2}$, z_1^2, and z_2^4.

46. Find all cube roots of $z = 2\left(\cos\left(\dfrac{3}{10}\pi\right) + i\sin\left(\dfrac{3}{10}\pi\right)\right)$. You may leave your answer in polar form.

47. Find all cube roots of $z = 2\left(\cos\left(\dfrac{3}{11}\pi\right) + i\sin\left(\dfrac{3}{11}\pi\right)\right)$. You may leave your answer in polar form.

48. Find all cube roots of $z = 2\left(\cos\left(\dfrac{2}{7}\pi\right) + i\sin\left(\dfrac{2}{7}\pi\right)\right)$. You may leave your answer in polar form.

49. Find all cube roots of $z = 3\left(\cos\left(\dfrac{3}{5}\pi\right) + i\sin\left(\dfrac{3}{5}\pi\right)\right)$. You may leave your answer in polar form.

50. Find all cube roots of $z = 2\left(\cos\left(\dfrac{3}{7}\pi\right) + i\sin\left(\dfrac{3}{7}\pi\right)\right)$. You may leave your answer in polar form.

51. Find all square roots of $z = -1 - 4i$.

52. Find all square roots of $z = 3 - i$.

53. Find all square roots of $z = 1 + 5i$.

54. Find all square roots of $z = 4 + i$.

55. Find all square roots of $z = -5 - i$.

56. Find all square roots of $z = 2 - 5i$.

57. Find all square roots of $z = -2 + 3i$.

58. Find all square roots of $z = -3 + i$.

59. Find all square roots of $z = 2 + 7i$.

60. Find all square roots of $z = 2 + 3i$.

61. Find all square roots of $z = -1 + 5i$.

62. Find all square roots of $z = 2 - 7i$.

63. Find all square roots of $z = 1 - 6i$.

64. Find all square roots of $z = -2 + 7i$.

65. Find all square roots of $z = -2 - 7i$.

66. Find all complex square roots of $z = 1 + \sqrt{3}i$.

67. Find all complex square roots of $z = 4 + 4i$.

68. Find all complex square roots of $z = 2 + 2i$.

69. Find all complex cube roots of $z = 3 + 3\sqrt{3}i$.

70. Find all complex cube roots of $z = 1 + \sqrt{3}i$.

71. Find all complex square roots of $z = 3\sqrt{3} + 3i$.

72. Find all complex cube roots of $z = \sqrt{3} + i$.

73. Find all complex cube roots of $z = 3 + 3i$.

74. Find all complex cube roots of $z = 3\sqrt{3} + 3i$.

75. Find all complex cube roots of $z = 4 + 4i$.

76. Find all complex square roots of $z = \sqrt{3} + i$.

77. Find all complex square roots of $z = 4\sqrt{3} + 4i$.

78. Find all complex square roots of $z = 3 + 3i$.

79. Find all complex square roots of $z = 3 + 3\sqrt{3}i$.

80. Find the cube roots of unity.

81. Find the fourth roots of unity.

82. Find the fifth roots of unity.

13.5

1. Compute the complex exponential $\exp(z)$ for $z = 6 - 3i$.

2. Compute the complex exponential $\exp(z)$ for $z = -1 + 2i$.

3. Compute the complex exponential $\exp(z)$ for $z = 5 + 11i$.

4. For the complex number $z = x + iy$, find the real and imaginary parts of the quantity $\exp(z^2)$ in terms of x and y.

5. Find all solutions to the equation

$$\exp(z) = -3 + i.$$

6. Find all solutions to the equation

$$\exp(z) = 3 + i.$$

7. Find all solutions to the equation

$$\exp(z) = 1 + 2i.$$

8. Find all solutions to the equation

$$\exp(z) = 2 + 3i.$$

9. Find all solutions to the equation

$$\exp(z) = -1 + 3i.$$

10. Find all solutions to the equation

$$\exp(z) = -1 + 2i.$$

13.7

1. Compute all values of $\ln{(1 + 2i)}$.

2. Compute all values of $\ln{(-3 + i)}$.

3. Compute all values of $\ln{(-2 + i)}$.

4. Compute all values of $\ln{(2 + 3i)}$.

5. Compute all values of $\ln{(3 + i)}$.

6. Compute all values of $\ln{(-3 + 2i)}$.

7. Find all values of $(-3 + 3i)^{4i}$ (that's the $4i$ power of $-3 + 3i$, not multiplication).

8. Find all values of $(-4 + 4i)^{2i}$ (that's the $2i$ power of $-4 + 4i$, not multiplication).

9. Find all values of $(-3 + 3i)^{2i}$ (that's the $2i$ power of $-3 + 3i$, not multiplication).

10. Find all values of $(-4 + 4i)^{3i}$ (that's the $3i$ power of $-4 + 4i$, not multiplication).

11. Find all values of $(-5 + 5i)^{2i}$ (that's the $2i$ power of $-5 + 5i$, not multiplication).