Single-Phase Power Calculations: 100 Practice Problems

P (Real), Q (Reactive), S (Complex), |S| (Apparent), and pf (Power Factor)

100 Questions on Single-Phase Power

1. A load has V = 120 Vrms and I = 5 Arms with a phase difference of 0 degrees. Calculate Real Power P.
   Ans: 600 W

2. Calculate the Reactive Power Q for the load in Q1.
   Ans: 0 VAR

3. Calculate the Apparent Power |S| for the load in Q1.
   Ans: 600 VA

4. What is the Power Factor of a purely resistive load?
   Ans: 1.0 (Unity)

5. Define the unit for Complex Power S.
   Ans: Volt-Ampere (VA)

6. A load draws 1000 W and 500 VAR. Calculate the magnitude of Complex Power |S|.
   Ans: 1118.03 VA

7. Calculate the Power Factor for a load with P = 800 W and Q = 600 VAR.
   Ans: 0.8 lagging

8. If the current leads the voltage, is the reactive power positive or negative by convention?
   Ans: Negative

9. A 240Vrms source supplies a load with 10A rms at a 30 degree lagging phase angle. Find P.
   Ans: 2078.46 W

10. Find the Reactive Power Q for the load in Q9.
    Ans: 1200 VAR

11. Find the Apparent Power |S| for the load in Q9.
    Ans: 2400 VA

12. If P = 1500 W and |S| = 2000 VA, calculate the Power Factor.
    Ans: 0.75

13. Calculate the reactive power for a load with |S| = 500 VA and pf = 0.6 leading.
    Ans: -400 VAR

14. A circuit has an impedance Z = 10 + j5 Ohms. If I = 2A rms, find Real Power P.
    Ans: 40 W

15. Find the Reactive Power Q for the circuit in Q14.
    Ans: 20 VAR

16. Find the Complex Power S in rectangular form for Q14.
    Ans: 40 + j20 VA

17. If V = 100 < 0 deg and I = 2 < -45 deg, calculate P.
    Ans: 141.42 W

18. Calculate Q for the values in Q17.
    Ans: 141.42 VAR

19. Calculate Complex Power S in polar form for Q17.
    Ans: 200 < 45 deg VA

20. A load has pf = 0.9 lagging. Is it inductive or capacitive?

Ans: Inductive

21. A 100 Ohm resistor is connected to a 120V rms source. Find P.
   Ans: 144 W

22. Find the Apparent Power |S| for the resistor in Q21.
   Ans: 144 VA

23. An inductor with reactance Xl = 50 Ohms is connected to 100V rms. Find Q.
   Ans: 200 VAR

24. Find the Real Power P for the inductor in Q23.
   Ans: 0 W

25. A capacitor with reactance Xc = 40 Ohms is connected to 120V rms. Find Q.
   Ans: -360 VAR

26. Find the Power Factor of a purely capacitive load.
   Ans: 0 (leading)

27. If Z = 30 - j40 Ohms and V = 200V rms, find |S|.
   Ans: 800 VA

28. Find the Real Power P for Q27.
   Ans: 480 W

29. Find the Reactive Power Q for Q27.
   Ans: -640 VAR

30. Find the Power Factor for the load in Q27.
   Ans: 0.6 leading

31. If I = 5 < 30 deg and Z = 20 < -20 deg, find S.
   Ans: 500 < -20 deg VA

32. From Q31, extract P.
   Ans: 469.85 W

33. From Q31, extract Q.
   Ans: -171.01 VAR

34. A motor draws 5 kVA at 0.85 pf lagging. Find P.
   Ans: 4.25 kW

35. Find the Reactive Power Q for the motor in Q34.
   Ans: 2.63 kVAR

36. V(t) = 170 cos(wt) and i(t) = 10 cos(wt - 60). Find P.
   Ans: 425 W (using RMS: 120.2V * 7.07A * cos 60)

37. Find |S| for the signals in Q36.
   Ans: 850 VA

38. Find the pf for the signals in Q36.
   Ans: 0.5 lagging

39. A 120V source supplies a 1.2 kW heater. Find current I rms.
   Ans: 10 A

40. Find the impedance Z of the heater in Q39.
   Ans: 12 Ohms

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41. Calculate S if V = 120 < 0 and I = 10 < 30.
    Ans: 1200 < -30 deg VA

42. Is the load in Q41 leading or lagging?
    Ans: Leading

43. Find P for Q41.
    Ans: 1039.23 W

44. Find Q for Q41.
    Ans: -600 VAR

45. If S = 400 + j300 VA, find the pf.
    Ans: 0.8 lagging

46. Find the phase angle of the current relative to voltage for Q45.
    Ans: -36.87 degrees

47. If S = 200 - j150 VA, find |S|.
    Ans: 250 VA

48. Find the pf for Q47.
    Ans: 0.8 leading

49. Z = 4 + j3 Ohms. Source V = 10 < 0 Vrms. Find S.
    Ans: 16 + j12 VA

50. What is the apparent power for Q49?
    Ans: 20 VA

Single-Phase Power Calculations: 100 Practice Problems

P (Real), Q (Reactive), S (Complex), |S| (Apparent), and pf (Power Factor)

100 Questions on Single-Phase Power (Continued)

51. A load has P = 500W and pf = 0.707 lagging. Find Q.
    Ans: 500 VAR

52. Find |S| for Q51.
    Ans: 707.11 VA

53. A load has Q = -1000 VAR and pf = 0.8 leading. Find P.
    Ans: 1333.33 W

54. Find |S| for Q53.
    Ans: 1666.67 VA

55. An impedance Z = 15 < 45 deg Ohms is connected to 240V rms. Find S.
    Ans: 3840 < 45 deg VA

56. Calculate P for Q55.
    Ans: 2715.29 W

57. Calculate Q for Q55.
    Ans: 2715.29 VAR

58. If V = 230 < 10 and I = 2 < 40, find S.
    Ans: 460 < -30 deg VA

59. Find pf for Q58.
    Ans: 0.866 leading

60. Is Q58 inductive or capacitive?
    Ans: Capacitive

61. Two loads in parallel: L1=100W, L2=200W. Find total P.
    Ans: 300 W

62. L1=50 VAR, L2=50 VAR. Find total Q.
    Ans: 100 VAR

63. L1=100W, 50VAR; L2=200W, -20VAR. Find total S in rectangular form.
    Ans: 300 + j30 VA

64. Calculate the total magnitude |S| for Q63.
    Ans: 301.49 VA

65. Calculate the total pf for Q63.
    Ans: 0.995 lagging

66. Load A: 2kVA at 0.8 pf lag. Find P_a and Q_a.
    Ans: Pa=1.6kW, Qa=1.2kVAR

67. Load B: 1kVA at 0.9 pf lead. Find P_b and Q_b.
    Ans: Pb=0.9kW, Qb=-0.436kVAR

68. Find total P for Load A + Load B in parallel.
    Ans: 2.5 kW

69. Find total Q for Load A + Load B in parallel.
    Ans: 0.764 kVAR

70. Find total |S| for Load A + Load B in parallel.

Ans: 2.614 kVA

71. Find total pf for Load A + Load B in parallel.
Ans: 0.956 lagging

72. A 10 Ohm resistor and 10 Ohm inductive reactance are in parallel. V = 100V. Find total P.
Ans: 1000 W

73. Find total Q for Q72.
Ans: 1000 VAR

74. Find total |S| for Q72.
Ans: 1414.21 VA

75. Find the total pf for Q72.
Ans: 0.707 lagging

76. Three loads: P1=1kW, P2=2kW, P3=1.5kW. Total P?
Ans: 4.5 kW

77. Q1=1kVAR, Q2=0kVAR, Q3=-0.5kVAR. Total Q?
Ans: 0.5 kVAR

78. Find total |S| for Q76 & Q77.
Ans: 4.527 kVA

79. Find total pf for Q76 & Q77.
Ans: 0.994 lagging

80. Is the combined load in Q79 leading or lagging?
Ans: Lagging

81. A load at 120V draws 600W at 0.6 pf lag. Find current I rms.
Ans: 8.33 A

82. Find the complex impedance Z for Q81.
Ans: 8.64 + j11.52 Ohms

83. A device is rated 1200 VA, 120V. Find max current.
Ans: 10 A

84. If the device in Q83 operates at 0.8 pf, find P.
Ans: 960 W

85. Find Q for Q84.
Ans: 720 VAR

86. A transmission line has resistance 0.5 Ohms. A load draws 20A. Find line power loss.
Ans: 200 W

87. Does line loss depend on the load's pf?
Ans: Indirectly, as lower pf requires more current for same P

88. Define Reactive Power in terms of V, I, and theta.
Ans: Q = V * I * sin(theta)

89. S = 1000 < 0 deg VA. What is the pf?
Ans: 1.0

90. What is the reactive power for Q89?
Ans: 0 VAR

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91. A load has S = j500 VA. What is the pf?
    Ans: 0

92. Is the load in Q91 purely inductive or purely capacitive?
    Ans: Purely inductive

93. A load has S = -j200 VA. What is the pf?
    Ans: 0

94. Is the load in Q93 purely inductive or purely capacitive?
    Ans: Purely capacitive

95. Calculate S if V = 100 + j50 V and I = 2 - j1 A.
    Ans: 150 + j200 VA (S = VI*)

96. From Q95, find P.
    Ans: 150 W

97. From Q95, find Q.
    Ans: 200 VAR

98. From Q95, find |S|.
    Ans: 250 VA

99. From Q95, find pf.
    Ans: 0.6 lagging

100. A load draws 400W and has a phase angle of -30 degrees. Find |S|.
    Ans: 461.88 VA