1. List four advantages of three-phase over single-phase systems. Smaller machines, less copper, smoother more balanced power, and no starting system required for motors.

2. How far apart (degrees) are the individual sine waves in a three-phase system? 120°

3. What are the two main connection types? Delta and Wye

4. Which connection type has one end of all three windings connected together? Wye

5. What is phase sequence? Order in which the sine waves reach their peak.

6. What are two methods of changing phase sequence? Reverse direction of prime mover or interchange any two wires.

7. What is the color sequence for the phases of a three-phase system and who says so? Red, Black, Blue, and white or natural grey. CEC

8. Which vector is normally used as the reference in a parallel circuit? Voltage Series? Amperage

9. Where is the 0 degree reference point for drawing vectors? 0° at 3 o’clock

10. Is a lagging vector drawn clockwise from the reference point or counterclockwise? Counterclockwise

11. Which phase is typically used as the reference phasor? A

12. When is a voltage across a source considered positive? When it goes from positive to negative.
13. When is a voltage across a load considered positive? When it goes from negative to positive.

14. What is the relationship between line current and phase current in a Y connected three-phase system? Equal

15. What is the relationship between line voltage and phase voltage in a Y connected three-phase system? Phase voltage times 1.73 = line voltage.

16. What is the relationship between line current and phase current in a delta connected three-phase system? Phase current times 1.73 = line current.

17. What is the relationship between line voltage and phase voltage in a delta connected three-phase system? Equal

18. What is Kirchoff’s Law as it applies to each phase of a three-phase system? The phasor sum of currents leaving a junction in an ac circuit must equal the phasor sum of currents entering that junction.

19. Which version of Ohm’s law is used to find current in each phase of a three-phase circuit? $I_p = \frac{E_p}{Z_p}$

20. Why is the neutral wire grounded in a three-phase four-wire system? Reduce transient overvoltages, improve lightening protection, easier to locate ground faults, improved system and equipment fault protection, improved service cost and reliability, limits voltage-to-ground in a fault situation.

21. Which type of connection is typically an ungrounded system? Three-phase, three-wire, delta system.

22. What is required by the CEC to be installed on an ungrounded system? Ground detection device
23. What is the simplest form of ground fault indication? **Three indicating lights.**

24. Under normal conditions, (no fault) what is the status of the indicating lights? **Glow dim.**

25. What is the status of the indicating lights when a fault occurs? **2 Bright, 1 dark**

26. Where is the ground connection made on a four-wire delta three-phase system? **Center of coil BC**

27. Which phase of a four-wire delta system must have the highest voltage to ground? **(According to the CEC) A**

28. What does the term “high leg” mean in relation to three-phase systems? **The phase with the highest voltage to ground.**

29. What is the formula for VA in a three-phase circuit? **\( VA_T = \sqrt{3}E_L \times I_L \) or **\( VA_T = 3E_P \times I_P \)**

30. What is the formula for Power (true) in a three-phase circuit? **\( VA_T = \sqrt{3}E_L \times I_L \times PF \) or **\( VA_T = 3E_P \times I_P \times PF \)**

31. How would you quickly test for a balanced three-phase load using an ammeter? **Measure current on the neutral wire. Should be zero.**

32. What is the current through each phase of a Y connected load where \( E_{Line} = 208 \) V and \( Z_{Phase} = 8 \) ohms? **15A**

33. What is the current through each phase of a Y connected load where \( E_{Phase} = 600 \) V and \( Z_{Phase} = 100 \) ohms? **6 A**

34. What is the apparent power (VA) for the phase in question 32? **5404 VA**

35. What is the apparent power for the phase in question 33? **10,800 VA**
36. What is the total circuit power (true) for question 32 if the power factor is 85%?
   4587 W

37. What is the total circuit power (true) for question 33 if the power factor is 95%?
   10,260 W

38. What is the current through each phase of a delta connected load where $E_{\text{Line}} = 208$ V and $Z_{\text{Phase}} = 12$ ohms? 17.3 A

39. What is the current through each phase of a delta connected load where $E_{\text{Phase}} = 600$ V and $Z_{\text{Phase}} = 150$ ohms? 4 A

40. What is the apparent power (VA) for the phase in question 38? 10,795 VA

41. What is the apparent power (VA) for the phase in question 39? 7200 VA

42. What is the total circuit power (true) for question 38 if the power factor is 95%?
   10,255 W

43. What is the total circuit power (true) for question 39 if the power factor is 85%?
   6120 W

44. What is the result of an “open” in a delta connected load? Two phases continue as before but one phase drops off. 66.6% of power produced

45. What percentage of the power used in a three-phase, three-wire, wye connected load will remain if there is an “open” in one line? 50%

46. What percentage of the power used in a three-phase, four-wire wye connected load will remain if there is an “open” in one line? 50%

47. What is the resultant circuit when an “open” occurs in a three-phase, three-wire delta circuit? Parallel, single-phase with two branches.
48. What percentage of the power used in a three-phase, three-wire, delta connected load will remain if there is an “open” in a fuse? 50%

Unit 2

1. What is the formula for power in a three-phase circuit when phase values are known? \( P_T = 3E_P I_P \times PF \)

2. Where are the ends of the potential coils (that are not connected to the phases) terminated when using the three-wattmeter method of measuring power and there is no neutral? Join together to form a wye.

3. What is the formula for \( P_T \) when the two-wattmeter method is used? \( P_T = W_1 + W_2 \)

4. What is the formula for \( P_T \) when the one-wattmeter method is used? \( P_T = W_1 \times 3 \)


6. What is the most efficient place to connect a power factor correction capacitor? At the inductive load.

7. What precaution must be taken when selecting overload heaters for a motor where power factor correction capacitors are installed at the motor? Overload heaters must be downsized for the corrected amperage when the capacitors are added.