Notice to the Reader

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Cover Photo: At the time the photo was taken, all equipment was de-energized.
# Table of Contents

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People study for a variety of reasons. Some study to improve their understanding and grasp of their chosen field, but the vast majority study because they will be required to show their competence in a given subject. Competence is generally measured by test scores. Unfamiliarity with the specific subject is one of the main reasons for low scores. Another reason is, a person’s performance is only a sample of his or her behavior at that point in time. In other words, test scores are not set in concrete and you can improve your score by preparing better, improving your attitude, and understanding the best methods to use in test taking.

The easiest way to improve your test performance is to reduce your anxiety level. The study guides sponsored by the International Association of Electrical Inspectors are designed to improve your understanding of how to find information in the National Electrical Code®. The questions are designed to be similar to test formats you are likely to find in electrical inspector certification examinations. It should be understood that no effort is made to duplicate those questions exactly. To do so, would be nonproductive as questions are changed from time to time. Rather, the approach used in these study guides is to help you master locating information quickly and accurately. You can then master any test question. The refresher courses are available in three modules: Electrical General Study Guide, One- and Two-Family Dwellings Study Guide, and Plan Review Study Guide.

The goal of these courses is to ensure your best possible performance by understanding how to use the National Electrical Code® and thus reduce your anxiety level. The courses may be used for individual home study and are also ideally suited for an instructor/pupil classroom approach.

Examination for Certification
Methods to Improve Your Test Scores

1. Prepare by studying. The questions in this refresher course are designed to teach you how to find the rules quickly and efficiently. If you learn how to use the table of contents and index properly, you will find the material in a reasonably short period. This knowl-
Knowledge and confidence will help reduce your anxiety and raise your scores. Consistent study leads to a higher retention level than cramming just prior to the examination date. The ultimate goal is to become familiar with the use of the NEC and testing format.

2. **Arrive on time.** Make sure you allow plenty of time to arrive promptly, but not too early. Since nervousness is contagious, don’t associate too closely with the other examinees as you may pick up their anxiety level.

3. **Eliminate wrong answers.** If the test is multiple choice and you have four alternatives, the odds are 4 to 1 that you can guess the right answer. If you eliminate any two alternatives, your chances are increased to 50-50.

4. **Read directions carefully.** Many mistakes are made merely because the directions have been misunderstood. If, after reading carefully, you still are not sure, ask the proctor for clarification.

5. **Allow yourself enough time.** Based on the number of questions you have to answer, allot a specific amount of time for each question.

6. **Answer question first.** If the question has several alternatives, attempt to answer the question before you check the alternatives. In this way you can evaluate your answer against the alternatives.

7. **Skip difficult questions.** If you are unsure of the answer or know that you are familiar with the material but don’t have a ready answer, skip the question and go on to other material. Complete known questions then return to those you don’t know. Chances are, your mind will subconsciously work out the answer so that it will be easier when you return to it.

8. **First choice is usually best.** If you pick an answer to a multiple choice question and have later reservations about the right answer, remember that your first choice is usually best. If on later evaluation you know you have made a mistake, by all means change your answer.

9. **Read questions carefully.** Make sure you note key words that might change the meaning of the questions. Note negative disclaimers such as, “which of the following are not...”. A handy way to increase understanding is to underline key words. This has a tendency to channel your thinking along the right path.

10. **Make sure you are comfortable.** If you have on too many clothes, remove some. Being too warm has a tendency to make you drowsy, which leads to a loss of concentration.

11. **Re-check your work.** The last thing you should do before handing in your paper is to recheck and make sure you have not made any clerical mistakes. Many times you will know the right answer, but lose points on your score because of a clerical error.

**Study Plan**

Familiarize yourself completely with the codebook. Until one is familiar with the Code to the extent that location of specific requirements is committed to memory, use of the index is the best way to find information. The index contains in alphabetical order a list of what is in the Code, telling where to find topics covered.

Even though you may know the answer to a question, follow this sequence to establish the answer:

1. Check the table of contents to find the proper code article.

2. Select key words from the question **and** that will identify the code article and subject matter that will be used to find the requirements in the index.

Select key words from the question **that** will identify the code article and subject matter that will be used to find the requirements in the index.

For example, you have been asked to verify the size of a grounding electrode conductor for a 200 ampere AC service supplying a dwelling. The dwelling unit has a metal water pipe and the service-entrance conductors are 3/0, THWN, copper.
From the question, you can identify the subject of the question is a grounding electrode conductor. Specifically, you are being asked to determine the size. Additional key words or subject matter are the size of the service-entrance conductors and the fact the dwelling is supplied by a metal water pipe.

Looking in the index, you find “Grounding electrode conductors” under which you will find “Sizing 250.30(A)(6)(a), 250.66 and 250.166.” Scanning 250.30(A)(6) you quickly realize this is related to separately derived systems; so the next choice was 250.66 from the index. Section 250.66 is titled “Size of Alternating-Current Grounding Electrode Conductors.”

The opening paragraph of 250.66 states the grounding electrode conductor cannot be less than given in Table 250.66 except as permitted in (A)–(C). Scanning 250.66(A)–(C), you find they are not applicable to the question; so Table 250.66 must be used.

Table 250.66 is based on the size of the service-entrance conductors; so in our case, we determine a 4 AWG copper grounding electrode conductor is required for an AC service supplied by 3/0 copper conductors.

3. If, in the index, you do not readily find the location of the requirements related to the question, scan the bold face titles of the appropriate sections in the body of the code to locate quickly the subject material.

The Table of Contents lists in numerical sequence the subjects covered by each chapter and each article. So it provides the article number, part number if applicable, and a page number that can be used to find a location to start scanning section and subsection titles. Experienced users of the NEC are generally familiar with the content of NEC articles and, therefore, often use the Table of Contents of to find a page number as a starting point.

Using the above question, an experienced user of the NEC would know that grounding and bonding requirements are found in Article 250. Scanning the information in the Table of Contents, we find the requirements for the “Grounding Electrode System and Grounding Electrode Conductor” are in Part III of Article 250 and they start on Page 117. Scanning the boldfaced section and subsection titles starting on page 117, we find 250.66 “Size of Alternating-Current Grounding Electrode Conductors on page 121.”

This study guide is divided into subject categories and each category has several questions. Each question is followed by the procedure for finding the correct answer. Follow the procedures step by step to learn good work habits. The answers are listed in the back of the book. Do not look up the answers until you have completed work in the entire category.

Remember, you are only shortchanging yourself by not following the step-by-step method of problem solving. The goal is to learn how to find code information in the most efficient manner.

This study guide is based on the National Electrical Code, 2014 edition.
The National Electrical Code, sponsored by the National Fire Protection Association, is the most widely adopted code in the world. It is also, in all probability, the most widely misinterpreted code in the world. The NEC is adopted by federal, state and local governments as well as by private industry. As far as NFPA is concerned, the NEC is purely advisory. It becomes enforceable as law only upon adoption by an agency having authority to enforce its rules. Requirements for electrical inspection of installations, licensing of electrical contractors and electricians, as well as qualifications of electrical inspectors usually are contained in laws or ordinances that are associated with adoption and enforcement of electrical codes.

Scope of the Code
Article 90 serves as an introduction to the NEC and provides a scope to specify the electrical installations that are covered and those that are not covered. The Code covers installations of electric conductors and equipment within or on public and private buildings or other structures, including mobile homes, recreational vehicles, and floating buildings; and other premise wiring such as yards, carnival, parking, and other lots, and industrial substations. The Code also covers installations of conductors and equipment that connect to the supply of electricity, installations of other outside conductors and equipment on the premises, as well as installations of signaling and communications conductors and equipment and optical fiber cable.

In addition, the Code covers installations in buildings used by the electric utility, such as office buildings, warehouses, garages, machine shops and recreational buildings that are not an integral part of a generating plant, substation or control center.

The Code does not cover installations in ships, watercraft other than floating buildings, railway rolling stock, aircraft, or automotive vehicles other than mobile homes and recreational vehicles.

It also does not cover underground mines, railway conductors, or installations of communications equipment under the exclusive control of the communications utility. This latter requirement generally applies to overhead and underground communications conductors up to their termination in a locked room under the exclusive control of the communications utility. Installations, such as
telephone distribution conductors, in hung ceilings or other accessible locations, are not normally under the exclusive control of the telephone company and are, therefore, covered by Article 800. Electric utility generation, transmission, transformation and distribution conductors including associated lighting are not normally covered by the NEC.

**Enforcement**

It is intended that the authority having jurisdiction interpret the rules in the Code and approve all devices, materials, equipment and conductors.

**90.4 Enforcement.** This Code is intended to be suitable for mandatory application by governmental bodies that exercise legal jurisdiction over electrical installations, including signaling and communications systems, and for use by insurance inspectors. The authority having jurisdiction for enforcement of the Code has the responsibility for making interpretations of the rules, for deciding on the approval of equipment and materials, and for granting the special permission contemplated in a number of the rules.

While the code is primarily intended to apply to new construction, the second paragraph of 90.4 permits the authority having jurisdiction to use his or her judgment in applying the code to rewiring in old installations.

By special permission, the authority having jurisdiction may waive specific requirements in this code or permit alternative methods where it is assured that equivalent objectives can be achieved by establishing and maintaining effective safety.

In discharging the responsibilities granted in 90.4, authorities having jurisdiction should enforce the requirements of 110.3(B) to assure that equipment is used as intended by the manufacturer and electrical products testing laboratory.

All mandatory rules are characterized by the use of the word “shall.” Where the word “may” is used it means that the authority having jurisdiction has the prerogative of granting permission.

This should not be confused with the permissive term “may,” which has largely been replaced in current editions of the code by the term “shall be permitted.”

**90.5 Mandatory Rules, Permissive Rules, and Explanatory Material.**

(A) **Mandatory Rules.** Mandatory rules of this Code are those that identify actions that are specifically required or prohibited and are characterized by the use of the terms shall or shall not.

(B) **Permissive Rules.** Permissive rules of this Code are those that identify actions that are allowed but not required, are normally used to describe options or alternative methods, and are characterized by the use of the terms shall be permitted or shall not be required.

(C) **Explanatory Material.** Explanatory material, such as references to other standards, references to related sections of this Code, or information related to a Code rule, is included in this Code in the form of informational notes. Informational notes are informational only and are not enforceable as requirements of this Code. Brackets containing section references to another NFPA document are for informational purposes only and are provided as a guide to indicate the source of the extracted text. These bracketed references immediately follow the extracted text.

Informational Note: The format and language used in this Code follows guidelines established by NFPA and published in the NEC Style Manual. Copies of this manual may be obtained from NFPA.

(D) **Informative Annexes.** Nonmandatory information relative to the use of the NEC is provided in informative annexes. Informative annexes are not part of the NEC, but are included for informative purposes only.

Informational notes are sometimes mistakenly enforced as mandatory requirements. They are intended to provide information or explanatory material and are not intended to be enforced as a part of the requirements. Where more than one Informational Note follows a section, they are numbered consecutively such as Informational Note No. 1, Informational Note No. 2, etc.
Use the Table of Contents and Index
To save time, one should use the table of contents to his or her best advantage. The table of contents lists in numerical sequence the subjects covered by each chapter and each article. Review of the table of contents gives an excellent overview of where the Code covers specific subjects or equipment.

Until one is familiar with the Code to the extent that location of specific requirements is committed to memory, use of the index is the best way to find information. The index contains in alphabetical order a list of what is in the Code, telling where to find topics covered. In some cases, the location of topics can be found in more than one way. For instance, the ampacities for conductors can be found under the heading “Ampacities” and also under the heading “Conductors.”

Seemingly vague requirements can often become crystal clear by making use of the definitions in Article 100. For instance, the definition of overload says that a fault, such as a short circuit or ground fault, is not an overload.

Code Arrangement
The arrangement of the Code is explained in 90.3. One should become thoroughly familiar with this concept for proper application of code rules. General rules in early chapters are sometimes supplemented or modified by later chapters.

90.3 Code Arrangement. The Code is divided into the introduction and nine chapters, as shown in Figure 90.3. Chapters 1, 2, 3, and 4 apply generally; Chapters 5, 6, and 7 apply to special occupancies, special equipment, or other special conditions. These latter chapters supplement or modify the general rules. Chapters 1 through 4 apply except as amended by Chapters 5, 6, and 7 for the particular conditions.

Chapter 8 covers communication systems and is not subject to the requirements of Chapters 1 through 7, except where the requirements are specifically referenced therein. For example, refer to 800.44(A)(3), Climbing Space. “The climbing space through communications wires and cables shall comply with the requirements of 225.14(D).” Without a reference like this, there would not be any requirements for climbing space relative to communications conductors unless specifically included in Article 800.

Chapter Arrangement
Many articles have a scope that explains what is covered by that article. Mistakes in understanding and application of Code requirements are often avoided by reviewing the article scope before assuming general coverage of a requirement. Let’s look at the scope of Article 555.

555.1 Scope. This article covers the installation of wiring and equipment in the areas comprising fixed or floating piers, wharves, docks, and other areas in marinas, boatyards, boat basins, boathouses, yacht clubs, boat condominiums, docking facilities associated with residential condominiums, any multiple docking facility, or similar occupancies, and facilities that are used, or intended for use, for the purpose of repair, berthing, launching, storage, or fueling of small craft and the moorage of floating buildings. Private, noncommercial docking facilities constructed or occupied for the use of the owner or residents of the associated single-family dwelling are not covered by this article.

Numbering System
Essential to the understanding of any standard is familiarizing oneself with the arrangement and numbering system employed. The numbering system utilized for the NEC consists of the introduction Article 90, along with chapters numbered from 1 through 9. Chapters are further divided into several articles consisting of numbers in hundreds such as Article 100, Article 200, Article 300, etc. All articles in Chapter 1 begin with 100, Chapter 2 with 200, etc.

Some articles have several parts which are in roman numerical sequence such as I, II, III,
Common requirements are grouped in parts of articles. Part I, General, usually contains provisions that apply to all the other parts of the article. Other parts contain provisions that are independent of all other parts; except Part I General. For instance, Part II of Article 680 contains provisions for permanently installed pools, and Part III contains provisions for storable pools. Each part is separate and independent of the other, but all parts must comply with the applicable general requirements of Part I; unless specifically stated otherwise.

All articles are divided into sections such as 110.3, 110.5, 110.8, 110.26, etc. Subsections are further numbered with lower case alphabetical characters similar to 110.26(A), 110.26(B), 110.26(C). In some cases, paragraphs following subsections are numbered similar to 110.27(A)(1), 110.27(A)(2), 110.27(A)(3), etc.

Parallel Numbering
The NEC-2002 introduced a new parallel numbering system. Common types of rules or information are assigned the same numbered section in each article. As an example, article scopes are designed as “.1” and definitions for the specific article are assigned as “.2”. Uses permitted are “.10” in all articles. This will help users of the Code locate this type of common material without having to search for it in different locations on each article.

General Requirements
Users often miss important requirements by failing to review the general requirements before deciding that the subject is not covered in the Code. Article 110 contains general requirements for electrical installations that are applied throughout all the other articles, unless modified by other articles. Article 300 provides the general requirements for wiring methods and materials; and by its scope, it can be modified by other articles within Chapter 3. Remember that per 90.3 the general requirements of chapters one through three can be modified by other articles in chapters five, six or seven. Only those sections in Article 300 that are referenced in Articles 725, 760, 770, 800, 810, 820, 830, and 840, apply in the latter articles. The sections of Article 300 that apply to those later articles can be found under “Other Articles” which is typically in “.3” of the respective article. This is due to the unique nature of the requirements in the latter articles.

Table Notes
Tables utilize a smaller size type for the footnotes, which are mandatory to the application of the table. For example, see the footnotes that follow Table 300.5 that read as follows:

Notes:
1. Cover is defined as the shortest distance in millimeters (inches) measured between a point on the top surface of any direct-buried conductor, cable, conduit, or other raceway and the top surface of finished grade, concrete, or similar cover.
2. Raceways approved for burial only where concrete encased shall require concrete envelope not less than 50 mm (2 in.) thick.
3. Lesser depths shall be permitted where cables and conductors rise for terminations or splices or where access is otherwise required.
4. Where one of the wiring method types listed in Columns 1–3 is used for one of the circuit types in Columns 4 and 5, the shallowest depth of burial shall be permitted.
5. Where solid rock prevents compliance with the cover depths specified in this table, the wiring shall be installed in metal or nonmetallic raceway permitted for direct burial. The raceways shall be covered by a minimum of 50 mm (2 in.) of concrete extending down to rock.

Note also, in the case of Table 300.5, the definition of cover, which is located as note 1.

Exceptions
Basic rules are stated in standard (Roman) type and are followed by all the exceptions to the basic rule. Exceptions are set in italics. It is important to clearly read and understand the requirements of the basic rule before applying the exception. Exceptions apply only to the section or subsection they follow, unless stated differently in the rule. See the following example.
Several sections use a type of exception that can be considered “except as provided in ______ through ______.” Look at 240.21 for an example of this concept. The general rule for location of the overcurrent device applies “except as specified in 240.21(A) through (H).”

Installation and Use
“Listed or labeled equipment shall be installed and used in accordance with any instructions included in the listing or labeling” [110.3(B)].

Purpose
The Code is not intended as a design specification, and proper application dictates the use of nationally recognized product safety standards. Neither is the Code an instruction manual for untrained persons.

90.1(A) Purpose. The purpose of this Code is the practical safeguarding of persons and property from hazards arising from the use of electricity. This Code is not intended as a design specification or an instruction manual for untrained persons.

Definitions
Article 100, Definitions, generally contains definitions of terms only where used in two or more articles as stated in the Scope. When an article requires a definition of a term not used in other parts of the Code, that definition will be found within the article in which it is used at “.2” in the parallel numbering system. In most other cases, Webster’s Dictionary or the Institute of Electrical and Electronics Engineers Dictionary will suffice. The cultivation of an electrical technical vocabulary is a must to understand the more intricate requirements. The IEEE Standard Dictionary of Electrical Terms proves helpful even to the seasoned veteran.

Applying the subtle rules that are used in writing the Code will assist old hands as well as the beginner. Failure to follow the simple rules leads to controversy and non-uniformity.
QUESTION 1. A 2-horsepower, 230-volt, single-phase, alternating-current motor is located 105 m (350 ft) from the service. What is the minimum size uncoated stranded copper conductor that is required to limit the voltage drop to 3 percent or less?

Note: Assume an ambient temperature of 75°C (167°F) and a copper conductor K (constant) factor of 12.9.

A. 12 AWG  
B. 10 AWG  
C. 8 AWG  
D. 6 AWG

PROCEDURE TO ESTABLISH ANSWER

The question is about voltage drop for a motor circuit.

1. In Index, find “Motors” under which find “Current, full load. see Full-load current motors.”

2. Under “Full-load current motors,” find “Alternating current” under which find “Single-phase, Table 430.248.”

3. In Table 430.248 find a 2-horsepower, 230-volt motor rated 12 amperes.

4. Using the voltage drop formula:
   \[
   VD = 2 \times K \times I \times L \times \frac{1}{cm} (amperage) \times \text{cm (circular mils of wire)}
   \]

WHERE:

\( VD = \text{Volts Dropped} \)

You then take the volts dropped and divide it by the voltage of the circuit or system, and the result is the percentage (%) of voltage drop.
A 3% voltage drop, for example
   = 3% x 230 volts
   = 6.9 volts

\[ K = 12.9 \]
\[ \text{cm} = \text{Circular mil area of conductor} \]
   (Chapter 9, Table 8)

\[ V_D = 2 \text{ KLI/cm} \]

When transposed, the new formula shown below will give us the minimum size wire needed to permit a maximum of 3% voltage drop on the circuit.

\[ cm = 2 \text{ KLI/} V_D \]

\[ cm = 2 \times 12.9 \times 350 \times 12 \div 6.9 \]
   \[ = 108,360 \div 6.9 \]
   \[ = 15,704 \text{ cm} \]

► 5. In Index find “Conductors,” under which find “Copper, Properties, Chap. 9, Table 8.”

► 6. In Table 8, we find 10 AWG has 10,380 circular mils and 8 AWG has 16,510 circular mils. Therefore, based on the above formula, we select an 8 AWG copper conductor.

► 7. \[ V_D = 2 \text{ KLI/cm} \]
   \[ = 2 \times 12.9 \times 350 \times 12 \]
   \[ = 108,360 \div 16,510 \]
   \[ = 6.56 \text{ volts} \]

► 8. \[ 6.56 \text{ volts} \div 230 \text{ volts} \]
   \[ = .028 \]
   \[ = 2.8\% \text{ voltage drop} \]

The 8 AWG copper conductor will limit the voltage drop to 3% or less.

The correct answer is C.

For practice, better understanding and mastery of voltage drop calculations, the following exercises are suggested.

Another method of finding the voltage drop is:
Use steps 1 through 3 above, then:

► 9. In Index, find “Conductors,” under which find “Copper, Properties, Chap. 9, Table 8.”

► 10. In Table 8, we find the resistance of a 10 AWG uncoated stranded copper conductor to be 1.24 ohms per 1000 ft. The length of conductor to the load and back (2 x 350 feet) = 700 ft.

   \[ 700 \text{ ft./1000 ft} = 0.7 \]
   \[ 0.7 \times 1.24 = 0.868 \]

► 12. Use the Ohm’s Law Formula
   \[ V_D (\text{Volts Drop}) \]
   \[ E = I \times R \]
   \[ = 12 \text{ amps} \times 0.868 \text{ ohms} \]
   \[ = 10.416 \text{ voltage drop, which is greater than the allowed 6.9 volts (3 percent of 230 volts).} \]

► 13. Per Table 8, the resistance of an 8 AWG copper uncoated stranded copper conductor is 0.778 ohms per 1000 ft.
   \[ 700 \text{ ft} \times 1000 \text{ ft} = 0.7 \]
   \[ 0.7 \times 0.778 = 0.5446 \text{ ohms} \]

► 14. Again, use the Ohm’s Law Formula
   \[ V_D (\text{Volts Drop}) \]
   \[ E = I \times R \]
   \[ = 12 \text{ amps} \times 0.5446 \text{ ohms} \]
   \[ = 6.5352 \text{ volts, which is within the permitted 3 percent (6.9 volts drop) permitted in the question.} \]

► 15. The correct answer is C.
QUESTION 2. A 208Y/120-volt, 3-phase, 4-wire wye-connected circuit to a process machine is 100 feet to the machine from the circuit breaker and has 45 amperes per phase of balanced resistance load. What is approximate percentage of voltage drop?

Note: Assume an ambient temperature of 75°C (167°F) and a conductor K (constant) factor of 12.9.

A. 1.5 percent
B. 1.8 percent
C. 2.6 percent
D. 3.0 percent

ANSWER ______________

PROCEDURE TO ESTABLISH ANSWER

The question is about calculating voltage drop.

K = 12.9
L = Length of circuit in feet (one way)
VD = Volt Drop
I = Current
Cm = Circular mil area of 6 AWG (Chapter 9, Table 8) = 26,240 cm

(6 AWG would be the required conductor size for the 45-ampere load.)

By using voltage drop formulas, use either of the following methods:

Note: it is very important to know how and where we get the formulas used, and how to use them. In the past, some engineers have used 2 and .866 in formulas for 3-phase voltage drop formulas. Many have wondered, Where did the .866 come from? The answer is: 2 x .866 = 1.732. You can choose to use 2 x .866 or just use 1.732 for 3-phase voltage drop calculations. For these calculations, we will use 1.732.

Method 1.

VD = 1.732 x KLI/cm
= 1.732 x 12.9 x 100 ft. x 45 amps
= 100,542.6 / 26,240 cm
(circular mil area of 6 AWG)
= 3.83 volts

The percentage of voltage drop is:
= 3.83 volts ÷ 208 volts
= 1.8%

The correct answer is B.

Method 2. By using the resistance in NEC Chapter 9, Table 8: (Note: The resistance of 6 AWG uncoated copper wire is .491 ohms per 1,000 feet.)

VD = IR x 1.73
Where R = 0.491/1000 x 100 (feet)
= 0.0491 ohms

VD = 45 x 0.0491 x 1.73
= 3.8 volts drop

Percent volt drop
= 3.8 ÷ 208 volts
= 1.8%

Method 3. This method is not often used.

VD = 2 x R x L x I/1000
= 2 x 0.491 ohms x 100 ft. x 45 amp /1000
= 4.419 volts

Percent volt drop
= 4.419 volts x 8.66
= 38.26854

38.26854/208 volts
= 0.1839833
= .0184
= 1.8%
QUESTION 3. What is the calculated load for three pieces of commercial electric cooking equipment that may be operated at the same time? The loads are 5 kVA, 3.5 kVA and 9 kVA, all operating at 240 volts.

A. 45 amperes  
B. 54 amperes  
C. 60 amperes  
D. 66 amperes

ANSWER ______________

PROCEDURE TO ESTABLISH ANSWER
The question is about calculating branch-circuit loads for commercial cooking equipment.

► 1. In Index, find “Loads” under which find “Branch circuits” under which find “Calculations, Art 220, Annex D.”

► 2. Scan Article 220 and find Section 220.56 and Table 220.56, which for three units permits a 90 percent demand factor.

► 3. Proceed with the calculation.
   \[
   \begin{align*}
   &= 5,000 \text{ VA} + 3,500 \text{ VA} + 9,000 \text{ VA} \\
   &= 17,500 \text{ VA} \\
   &= 17,500 \text{ VA} \times 90\% \\
   &= 15,750 \text{ VA} \\
   &= 15,750 \text{ VA} \div 240 \text{ volts} \\
   &= 65.63 \text{ amperes (round up to 66 amps, per 220.5(B), Fractions of an Ampere).}
   \end{align*}
   \]

► 4. The correct answer is D.

QUESTION 4. What size Type THW copper conductors installed in rigid metal conduit is required for a load consisting of 64,750 VA at 120/240 volts, 3-wire?

A. 250 kcmil  
B. 300 kcmil  
C. 400 kcmil  
D. 500 kcmil

ANSWER ______________

PROCEDURE TO ESTABLISH ANSWER
The question is about sizing of conductors.

► 1. Using the Ohm’s Law formula
   \[
   I = \frac{P}{E}
   \]
   \[
   = \frac{64,750 \text{ VA (Watts power)}}{240 \text{ V}}
   = 269.79 \text{ amperes.}
   \]

► 2. In Index, find “Conductors” under which find “Copper” under which find “Ampacities, Tables 310.15(B)(16), etc.”

► 3. In Table 310.15(B)(16) in the 75°C column (Type THW), find an ampacity that is equal to or next greater than 270 amperes, which is a 300-kcmil copper (rated at 285 amperes).

► 4. The correct answer is B.

QUESTION 5. For the purpose of determining conductor fill in conduit, what is the total area in square inches of three 4/0 AWG Type THWN and three 2/0 AWG Type THWN conductors?

A. 0.7823  
B. 1.6380  
C. 2.0329  
D. 4.6298
QUESTION 6. What is the amperage of a 975-watt load operating at a 75 percent power factor on a 120-volt ac single-phase circuit?

A. 4.2  
B. 8.7  
C. 10.8  
D. 12.1
QUESTION 7. A 3-phase motor control center is fed with two sets of 500 kcmil Type THW copper conductors in parallel in a single raceway. What is the maximum allowable conductor ampacity if the conductors are installed in one metric designator 103 (4 in.) conduit?

A. 380 amperes  
B. 608 amperes  
C. 760 amperes  
D. 800 amperes

ANSWER ______________

PROCEDURE TO ESTABLISH ANSWER
The question is about the ampacity of conductors where paralleled in a single raceway.

► 1. In Index, find “Ampacities” under which find “Conductors, 310.15, Tables 310.15(B)(16) through 310.15(B)(21), etc.”

► 2. Section 310.15(B) requires that ampacities for conductors rated 0–2000 volts shall be as specified in Tables 310.15(B)(16) through 310.15(B)(19), and Ampacity Tables 310.15(B)(20) and 310.15(B)(21) as modified by (B)(1) through (B)(7).

► 3. In Table 310.15(B)(16) find that 500-kcmil Type THW copper conductors have an ampacity rating of 380 amperes.

► 4. Where six paralleled 500 kcmil conductors are contained in one conduit, Section 310.15(B)(3)(a) applies and requires that the ampacity ratings given in Table 310.16 through 310.19 be reduced to 80 percent per Table 310.15(B)(3)(a).

► 5. 380 amperes x (2 conductors per phase)  
= 760 amperes x .8  
(80% of the ampacity may be used because of 6 conductors installed in the raceway together — derate).  
= 608 amperes per phase.

► 6. The correct answer is B.

QUESTION 8. An 800-ampere service switch is supplied from a wye-connected 480Y/277-volt utility transformer with the neutral point grounded. Service-entrance conductors are two sets of parallel 500 kcmil Type THWN conductors. There are no line-to-neutral loads. The minimum size copper grounded conductor required to be brought from the transformer to the service is:

A. 6 AWG  
B. 4 AWG  
C. 2 AWG  
D. 2/0 AWG

ANSWER ______________
First line of electrical safety is the Plan Review.

Can you determine whether plans comply with the National Electrical Code and satisfy other applicable codes?

- This knowledge is essential for doing the work and for passing the certification exam.

How do you determine whether conductors and equipment are sized adequately and rated to the calculated load?

- Learn the math; do it accurately — every time.

True or False? Both new or altered electrical plans for installations in educational, institutional, health and other personal care facilities must be reviewed and approved before the electrical installation or alteration starts.

- Being sure is your chance to be a hero and save the owner, and yourself, some headaches.

Not only must you be able to make these choices, there are other questions to answer before you take the state or certification test to qualify as an electrical plan reviewer. If career advancement is your goal, you need this study guide and some dedicated study time.

Plan Review Study Guide is for busy people who are working and studying at the same time. It not only gives you basic answers, but it also teaches you the steps to solve the problems and to navigate the National Electrical Code to find the answers quickly and efficiently.

Take the first step in becoming an electrical plans reviewer. With study and focus, you are on your way to face the challenges and responsibility necessary to do the job. Invest in your future; it will pay dividends.