MASTER EXAM WORKBOOK

By Tom Henry and Tim Henry

Based on the 2023 National Electrical Code®

This workbook is designed to help prepare the electrician for the Master electrical examination.

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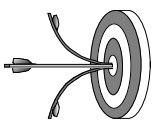
CODE ELECTRICAL
LEADER IN ELECTRICAL
EDUCATION WORLD WIDE



WE DIDN'T INVENT ELECTRICAL TRAINING .... WE PERFECTED IT.

ENRY PUBLICATIONS ™ SINCE 1985

CONTENT

PREPARING FOR AN OPEN BOOK EXAM

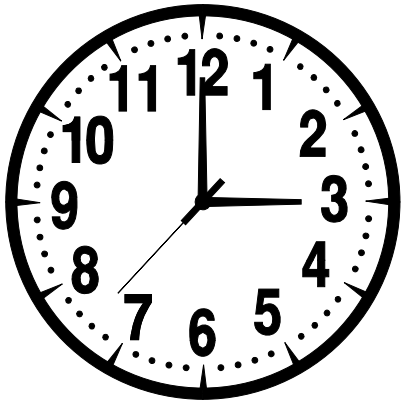
Open Book

Most applicants agree this is the most difficult part of an electrical exam. Time becomes such an important factor. 100 questions in four hours on the Master exam.

Open book is a test of your knowledge and use of the National Electrical Code. 86% of the open book Master questions are from the Code book.

Your score on the open book exam depends on how familiar you are with the Code book. Most exam applicants run out of time and are not able to find all the answers to the questions within the limited time.

Master Exam
100 Questions
4 Hour Time Limit



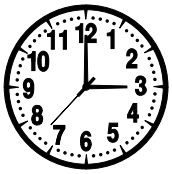
That averages to
2.4 minutes
per question

The key to an open book exam is not to spend too much time on one question. If the question does not contain a key word that you can find in the index, **skip this question**, and continue to the next question. If you spend 3 minutes, 5 minutes, 6 minutes on a question and never find the answer you are eating into the time that should be used for the answers you can find.

In general, there are usually 8 to 10 really difficult questions on an exam. The remaining questions after proper preparation, you will be able to find within the alotted time. Skip these 8 or 10 as you recognize them and move on finding the other answers. If you answer 40 questions correctly out of a total of 50 questions your score would be 80%! That's better than in some cases where the applicant hasn't even answered 20 questions and time has run out. You **can't** spend 5 or 6 minutes on a question. Never leave a question unanswered, unanswered is counted wrong. Always select a multiple choice answer before time runs out.

Proper preparation is so important in passing an open book exam. Don't be guilty of reading a question and feeling, "I know the answer so I won't bother looking in the Code book." The following pages will prove how this can be a big mistake. I teach by being properly prepared with how to find your way around in the Code book. You'll be able to look up all the answers within the time limit.

The difficulty occurs when you say Code book.



Your score on the open book exam depends on how familiar you are with the **Code book**. Most exam applicants **run out of time** and are not able to find all the questions and select a choice of answer within the limited time.

Test question writers hope the question is never copied.

Their score is instantaneous but they **never know what questions were wrong** or where their weaknesses are.

The elusive license, is still unattainable at this point. How would the applicant ever find out what the **correct answer** is? They are not permitted to ever knowing the **correct answer**. How are you to be educated if you **never** know the correct answer?

The only time you will ever know the "**correct answer**" is when you read *Tom Henry Books* where from all the years of studying the intent of the NEC from the TCD, TCR giving the substantiation for each of the new safety rules or deletions from the NEC each three years.

At my age 84, I've been through 21 code cycles and written over 100 electrical books which will give you the **correct answer** in full detail.

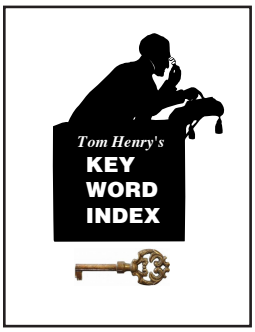
•The Code is Truly a "National" Code. - The men who freely contribute their time and study to the writing of the Code come from all over the United States and thus the final document represents a nationwide cross-section of opinion.

•The Code is an "American Standard." - The fact that the writers of the Code are organized under the procedure of the American Standards Association makes this possible. This simply means that the Code is officially recognized as representing standard American practice. It is a simple standard; there is no need for necessity for anyone to develop another code; the National Electrical Code is sufficient. Proof of this is the fact that cities and other governmental bodies all over the United States have adopted it as the *safety standard for electrical installations*, in spite of the fact that the Code itself, being written by a technical association, has no legal or mandatory status whatsoever.

The National Electrical Code is based on the fact that **to do less would be a hazard**. Many of the sections of the NEC are a result of known fire; incorporating corrections into the NEC each three years is an attempt to prevent similar occurrences.

Every rule in your safety manual is written in somebody's blood. The freedom and safety that you and I enjoy in our communities in large part is due to the sacrifice of others.

THE OPEN BOOK EXAM



The best reference book for locating words in the Code book is "The Key Word Index". This book contains every word in the Code book with section number and page number. **Now you can find what you're looking for in seconds!** Now you'll be able to show them out on the job where it says that in the Code book. Try it once and you'll never be without it.

The "***ULTIMATE***" Code package includes the ***2023*** NEC, *Tom Henry* 68 TABS (installed), KEY WORD INDEX, REMINDER BOOK, 14 pages of FORMULA INSERTS, plus over 3,600 ***KEY*** Code references **HI-LITED**!

Will Rogers once said, "You can't come back from someplace you've never been." This book will take you there.

•If you focus first on figuring out what the answer is, **before looking at the options given**, it will force you to think back to the text or the lecture where you first heard this information.

This process helps to improve your concentration, and will exercise your memory.

•If you are really stuck on a question, make your best guess and put a question mark next to it. If you finish the test with time to spare, go back and reconsider the ones you marked.

If you do not want to guess, skip the question and put a mark beside it, so you can return to it if you have time at the end of the test.

•Skip answers when you are stuck, but try to get back to them if you can – **it's best to answer every question you can**, within the allotted time frame.

•Forget about always sticking to your first choice. Many people say that your first guess on a test question is usually right, so you should never change your answer. However, recent studies have shown that isn't the case – you're just as likely, or even more likely, to get it right if you change an answer you aren't sure about. So don't stress over whether to change an answer because it wasn't your first choice. **If you change your mind, change your answer**.

•Data collected from takers shows that test-takers who changed some of their answers tended to score higher than those who always stuck with their first choice.

Test takers in the study most often changed answers from wrong to right, which resulted in a higher score.

To pass the exam is very simple, it takes work! Like with anything in life, you get out of it what you put into it. The more time you spend preparing for the exam, the easier it will become. As you work these exams and grade yourself, hi-lite the answers with a marking pen in your Code book, or better yet purchase the "Ultimate Code Book" which has the complete package for taking an electrical exam.

The key to the exam is that the student must first **understand** the question, which requires **careful reading of each word.**

Read this sentence:

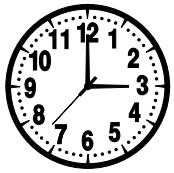
FINISHED FILES ARE THE RESULT OF YEARS OF SCIENTIFIC STUDY COMBINED WITH THE EXPERIENCE OF YEARS.

Now read it once more, and count the **F's** in the sentence. How many did you find?

(a) 3 (b) 4 (c) 5 (d) 6

If you are a careful reader, you will find all **6** F's.

Most applicants taking an exam are not familiar enough with the Code book and it's easy to understand why only 30 out of 100 pass an electrical exam. Many are ***unsuccessful*** because they failed to ***read*** the question correctly.



Your score on the open book exam depends on how familiar you are with the **Code book**. Most exam applicants run out of time and are not able to find all the answers to the questions within the limited time.

Number skills can be tested with math problems or interpreting plans, charts and graphs. You may wonder whether to concentrate on improving your strong areas or on building some background in your fields of ***weakness***. Working more practice exams, broader coverage, would be included for those subjects which are more important in your work. Now weigh your strengths and weaknesses against the job requirements and prepare accordingly.

This book contains 20 General Knowledge exams, 21 Code book exams with two 4 hour 100 question final exams. This will aid you in better understanding the time involved with answering correctly.

25 questions at 2.4 minutes per question = 60 minutes.

Spend an hour a day working a practice exam and see your scoring increase!

NEC Code consists of **9 chapters** each dividing into four groupings: General Requirements; Specific Requirements; Communications Systems and Tables

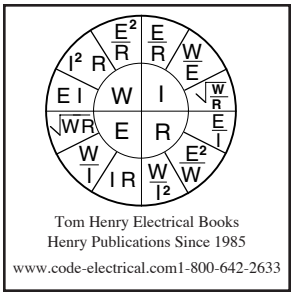
Chapter 1: General
Chapter 2: Wiring and Protection
Chapter 3: Wiring Methods and Materials
Chapter 4: Equipment for General Use
Chapter 5: Special Occupancies
Chapter 6: Special Equipment
Chapter 7: Special Conditions
Chapter 8: Communications Systems
Chapter 9: Tables – Conductor and Raceway Specifications

I agree with questions from theory-Ohm's law, voltage drop, ampacity, tools, plan reading.

But the difficulty for the applicant comes **from asking questions from all nine chapters** of the National Electrical Code.

The preparation for the exam should educate the dangers of the **behavior of electricity**, the overload, short circuit, the explosion, the fire, the injuries, the deaths.

For some electricians, it has been twenty years or more since they have used math formulas, theory, and calculations. For most, the last time was an apprenticeship class. Now, for the exam, we are required to be an expert in the reading of the Code and in applying all of the tables and demand factors to the calculations.



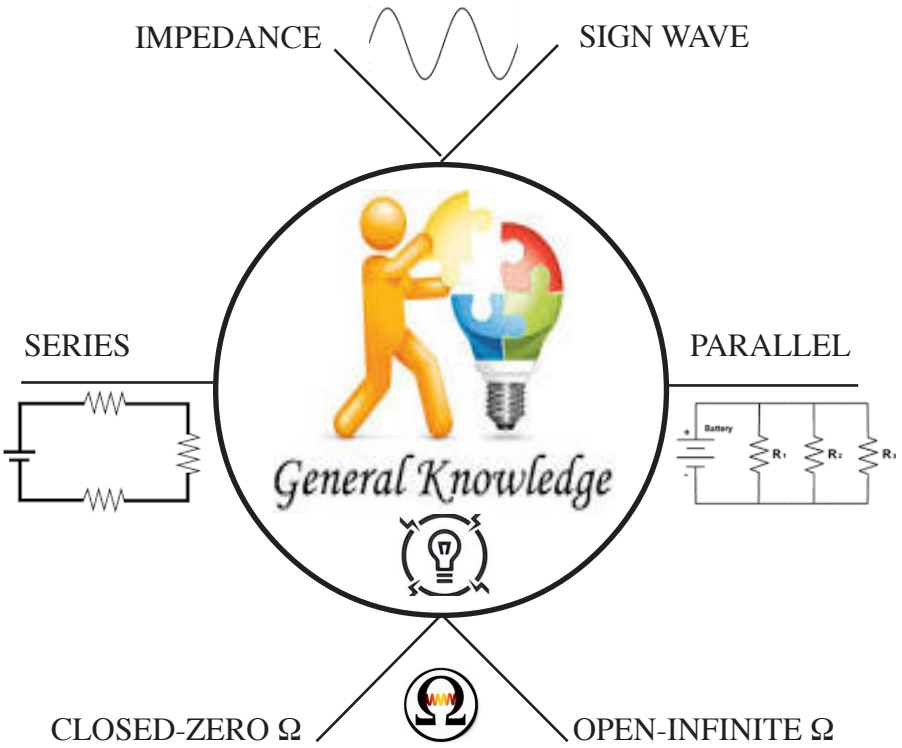
The most difficult task in preparing for the electrical exam is trying to "memorize" the formulas. You increase the strength of your memory by *overlearning the subject* and that's what our books are about. Our books will show an easier way to study. Study smarter, not harder.

Memorization is the process of committing something to memory. The act of memorization is often a deliberate mental process undertaken in order **to store in memory for later recall.** Memory is the "process of retaining information over time."

Memorization is a frontage road: It runs parallel to the best parts of learning, never intersecting. It's a detour around all the action, ***a way of knowing without learning***. Only through sustained effort of **rehearsing information are we able to memorize data for longer than a short period of time**.

We tend to remember things that interest us or are made memorable to us.

GENERAL KNOWLEDGE CATEGORIES



General knowledge is information that has been accumulated over time through various mediums, sources. It excludes specialized learning that can only be obtained with extensive training and information confined to a single medium.

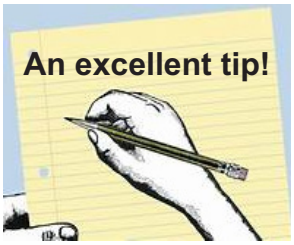
General Knowledge or General Awareness is an important and common section in all competitive and government recruitment examinations.

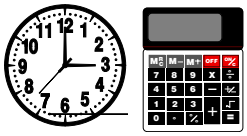
The questions can be answered easily in the time limit. It's very simple, either you know the answer or you don't. It doesn't help to sit and scratch your head pondering over the correct answer. It has been proven in test taking that the longer you hesitate in selecting the choice, the more likely you are to talk yourself out of the correct answer.

Read the question and the choice of answers **carefully** and select your choice and move to the next question.

Hand-writing is a powerful tool for memorization, and it is even more effective if you do it repeatedly. **Get out a pen and paper and start hand-writing what you need to memorize**.

The **General Knowledge** exam questions your knowledge on "Other than Code questions." Some questions may seem difficult for you, but they represent every conceivable type of question encountered on previous electrical exams.





Instead of marking your choice of answer in the book, write it on a separate paper, that way you can retake the exam over until you feel you understand the question and answer.

The exams are ***timed based***, so write down the time you start and finish the practice exam.

25 questions at 2.4 minutes per question = 60 minutes. **Spend an hour a day** working a practice exam and see your scoring increase!

Start now by *reading the question carefully* using your formula sheets and calculator.

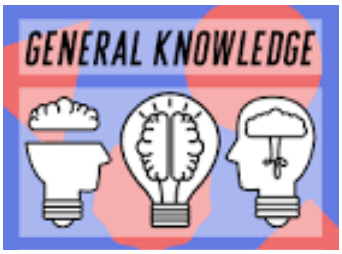
To grade your exam:
Count the number of correct answers
and divide by the number of questions 25.
Example: 19 correct answers ÷ 25 questions = 76%

General knowledge categories such as the behavior of electricity, theory, Ohm's Law, ac-dc power, voltage drop, power factor, efficiency, cost, tools, safety, plan reading, specifications, etc.

The **general knowledge** categories test your knowledge of what you have learned from the years spent in the electrical field to **qualify** to take the exam. How much can you remember from your training?

The NEC is updated every 3 years, **general knowledge** categories remain the same over the years in most cases.

There is no NEC section to locate for **general knowledge** questions, you must select the correct answer by **memory**. These are the questions where **formulas** come into play.



GENERAL KNOWLEDGE EXAM #17
25 Questions
30 minute Time Limit

1. ____ is the symbol used for the delta connection.

(a) Ω (b) ∑ (c) ø (d) Δ

2. A switch is a device for ____.

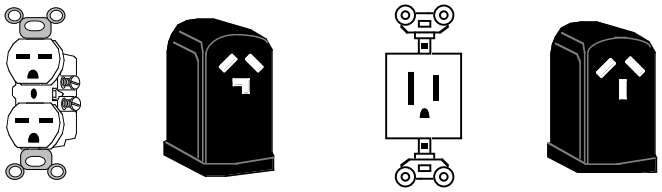
I. making or braking connections
II. changing connections
III. interruption of circuit under short-circuit conditions

(a) I only (b) I and II only (c) II and III only (d) I, II and III

3. One of the essential functions of any switch is to maintain a ____.

(a) good high-resistance contact in the closed position
(b) good low-resistance contact in the closed position
(c) good low-resistance contact in the open position
(d) good high-resistance contact in the open position

4. Which of the following is a 30 amp receptacle?



(a) **(b)** **(c)** **(d)**

5. When the ground resistance exceeds the allowable value of 25 ohms, the resistance can be reduced by ____.

I. paralleling ground rods
II. using a longer ground rod
III. using a larger diameter ground rod
IV. chemical teatment of the soil

(a) II and III only (b) I, II and III only (c) II, III and IV only (d) I, II, III and IV

6. Standard lengths of conduit are in 10 foot lengths. A required feeder raceway is 18 yards in length, how many lengths of 10 foot conduit would you need?

(a) 4 (b) 5 (c) 6 (d) none of these

7. The term "open circuit" means ____.

(a) the wiring is in an open area
(b) the wiring is exposed on a building
(c) all parts of the circuit are not in contact
(d) the circuit has one end exposed

8. Which of the items below is used to test specific gravity?


(a)


(b)


(c)


(d)

9. Conduit should be installed as to prevent the collection of water in it between outlets. The conduit should **not** have a _____.

(a) low point at an outlet
(b) high point at an outlet
(c) high point between successive outlets
(d) low point between successive outlets

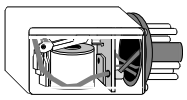
10. Brass is an alloy of ____.

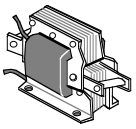
(a) zinc and copper (b) lead and copper (c) tin and lead (d) lead and iron

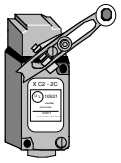
11. Enclosed knife switches that require the switch to be open before the housing door can be opened, are called ____ switches.

(a) release (b) air-break (c) safety (d) service

12. Which of the following is a solenoid?


(a)


(b)


(c)


(d)

13. A close nipple ____.

(a) is always 1/2" or less in length
(b) has no threads
(c) has only internal threads
(d) has threads over its entire length

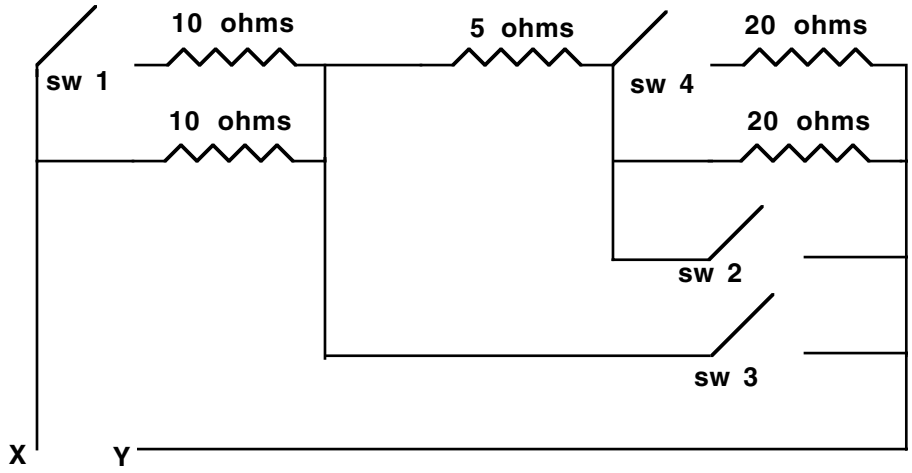
14. When applying rubber tape to an electrical splice, it would be necessary to ____.

(a) stretch the tape properly during the application
(b) apply an adhesive to the splice before applying the tape
(c) apply the rubber tape after any other tape
(d) apply heat to the tape when installing

15. A limit switch is used on a piece of machinery to open the circuit when the ____.

(a) current exceeds a preset limit **(b) travel reaches a preset limit**
(c) pressure exceeds a preset limit **(d) temperature reaches a preset limit**

16. With switches 1 and 2 closed, the combined resistance of the circuit is ____ ohms.



(a) 30 (b) 25 (c) 10 (d) 3

17. Which of the following is **not** considered part of a luminaire?

(a) ballast
(b) a lampholder
(c) lamp or lamps
(d) parts designed to position the light source

18. Locknuts are sometimes used in making electrical connections on studs. In these cases, the purpose of the locknuts is to ____.

(a) be able to connect several wires to one stud
(b) make it difficult to tamper with the connection
(c) make a tighter connection
(d) prevent the connection from loosening under vibration

19. In the course of normal operation the instrument which will be **least** effective in indicating that a generator may overheat because it is overloaded, is ____.

(a) a wattmeter (b) a voltmeter (c) an ammeter (d) a stator thermocouple

20. Two switches in one box under one face-plate is called a ____.

(a) double-pole switch (b) two-gang switch (c) 2-way switch (d) mistake

21. A conduit body is ____.

(a) a cast fitting such as an FD or FS box
(b) a standard 10 foot length of conduit
(c) a sealtight enclosure
(d) an "LB" or "T", or similar fitting

22. Where the conductor material is not specified in the Code, the conductors are assumed to be ____.

(a) busbars (b) aluminum (c) copper-clad aluminum (d) copper

23. The voltage lost across a portion of a circuit is called the ____.

(a) power loss (b) power factor (c) voltage drop (d) apparent va

24. In a series circuit ____ is common.

(a) resistance (b) current (c) voltage (d) wattage

25. Batteries supply ____ current.

(a) positive (b) negative (c) direct (d) alternating

MASTER OPEN BOOK EXAM #9 25 Questions One Hour Time Limit

1. One who has skills and knowledge related to the construction and operation of the electrical equipment and installations and has received safety training to recognize and avoid the hazards involved, is defined as a/an ____ person.

(a) grandfather (b) acceptable (c) qualified (d) parts changer

2. All outdoor outlets for dwellings, that are supplied by single-phase branch circuits rated 150 volts to ground or less, ____ amperes or less, shall have GFCI protection for personnel.

(a) 50 (b) 60 (c) 70 (d) 75

3. Type NM cable is permitted for use under all the following conditions or locations except ____.

(a) in Type V construction (b) in a multifamily dwelling unit
(c) as a feeder (d) in a damp or wet location

4. Direct-buried cables located in a trench below 2" of concrete shall have a minimum cover of ____.

(a) 6" (b) 12" (c) 18" (d) 24"

5. A 125 volt, 15 amp rated receptacle located in a hallway of a dwelling unit is required to be ____.

(a) GFCI protected (b) on a dedicated circuit
(c) in need of a 20 amp receptacle (d) listed tamper-resistant

6. Residential in sink electrically operated kitchen waste disposers shall be permitted to be cord-and-plug connected however, the flexible cord is to be not less than 18" in length and not over ____ in length.

(a) 24" (b) 30" (c) 36" (d) 48"

7. Isolated ground receptacles that incorporate an isolating equipment grounding conductor connection intended for the reduction of electrical noise or electromagnetic interference, shall be clearly identified by a/an ____ located on the face of the receptacle.

(a) green dot (b) yellow circle (c) red triangle (d) orange triangle

8. All conductors of a multiwire branch circuit shall originate from the same panelboard, simultaneously disconnect all ungrounded conductors and supply only line-to- _____ loads.

(a) line (b) ungrounded (c) primary (d) neutral

9. An unintentional, electrically conducting connection between an ungrounded conductor of an electrical circuit and the normally non-current-carrying conductors, metallic enclosures, metallic raceways, metallic equipment or earth is referred to as a/an ____.

(a) ground fault (b) open circuit (c) short circuit (d) circuit bypass

10. For temporary wiring, a box, conduit body, or other enclosure, with a cover installed shall ____ all for splices.

(a) not be permitted (b) be permitted (c) be required (d) not be required

11. Where no GFCI protection is provided, the mounting height of a paddle fan located above a spa or hot tub shall not be less than ____ feet.

(a) 6 (b) 8 (c) 10 (d) 12

12. Rooms or areas of dwelling units shall be protected by a listed combination-type arc-fault circuit interrupter to provide protection of the entire ____.

(a) feeder (b) branch circuit (c) service (d) load center

13. Equipment or materials to which has been attached a symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction. This mark is _____.

(a) labeled (b) suitable (c) acceptable (d) identified

14. All 15 and 20 amp, 125 and 250 volt, nonlocking receptacles located in a wet location shall be listed ____ type.

(a) weather proof (b) water proof (c) water resistant (d) weather resistant

15. The permitted demand factor for five household clothes dryers in a multifamily dewelling is ____.

(a) 70% (b) 75% (c) 80% (d) 85%

16. A controller that includes motor overload protection ____ for group motor application shall be marked with the motor overload protection and the maximum branch-circuit short-circuit and ground-fault protection for such applications.

(a) required (b) recognized (c) permitted (d) suitable

17. Type UF cable is permitted to be used ____.

(a) as service entrance **(b) in commercial garages**
(c) where subject to physical damage **(d) for wiring in wet, dry, or corrosive locations**

18. Cables with entirely nonmetallic sheaths shall be permitted to enter the top of a surface-mounted enclosure through one or more nonflexible raceways not less than ____ and not more than 10 feet in length, provided all conditions are met.

(a) 12" (b) 16" (c) 18" (d) 24"

19. Utilization equipment weighing not more than 6 pounds shall be permitted to be supported on other boxes or plaster rings that are secured to other boxes, provided the equipment or its supporting yoke is secured to the box with no fewer than two ____ or larger screws.

(a) #6 (b) #8 (c) #10 (d) #12

20. Nonmetallic cable trays shall be made of ____ material.

(a) watertight (b) waterproof (c) fire-resistant (d) flame-retardant

21. For dwelling units, outdoor receptacles that are not ____ and are supplied by a branch circuit dedicated to holiday lighting equipment are required to have GFCI protection for personnel.

(a) accessible (b) guarded (c) covered (d) readily accessible

22. For a service rated 100 through 400 amps, the service conductors supplying the entire load of a one family dwelling shall be permitted to have an ampacity of ____ of the service rating.

(a) 83% (b) 80% (c) 75% (d) 70%

23. AFCI protection is required for all 15 and 20 amp receptacles located in all the following except ____.

(a) residential garages (b) patient sleeping rooms (c) dormitory closets (d) guest suites

24. One or more metal in-ground support structure(s) in direct contact with the earth vertically for ____ feet or more, with or without concrete encasement is a permitted grounding electrode.

(a) 6 (b) 8 (c) 10 (d) 12

25. Which of the following cord types is permitted in wet location and is sunlight resistant?

(a) SPT-2 (b) STOOW (c) THWN (d) XHWN