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# CompTIA® A+® Core 1 (220-1201) and Core 2 (220-1202)

**David Bayne, John Pickard, and Mark Smith**



**CompTIA® A+® Core 1 (220-1201) and Core 2 (220-1202) Exam Cram**

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# We Want to Hear from You!

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# Introduction

Welcome to the *CompTIA A+ Core 1 (220-1201) and Core 2 (220-1202) Exam Cram*. This book prepares you for the CompTIA A+ Core 1 (220-1201) and Core 2 (220-1202) certification exams. Imagine that you are at a testing center and have just been handed the passing scores for these exams. The goal of this book is to make that scenario a reality. Our names are David Bayne, John Pickard, and Mark Smith, and we are happy to have the opportunity to serve you in this endeavor. Together, we can accomplish your goal to attain the CompTIA A+ certification.

## Target Audience

The CompTIA A+ exams measure the necessary competencies for an entry-level IT professional with the equivalent knowledge of at least 12 months of hands-on experience in the lab or field.

This book is for persons who have experience working with desktop computers and mobile devices and want to cram for CompTIA A+ certification exams—*cram* being the key word. This book does not cover everything in the computing world. How could anyone do so in such a concise package? However, this guide is fairly thorough and should offer you a lot of insight—and a whole lot of test preparation.

If you do not feel that you have the required experience, have never attempted to troubleshoot a computer, or are new to the field, then we recommend the following:

- Attend a hands-on A+ class with a knowledgeable instructor.
- Consider purchasing the CompTIA A+ Core 1 (220-1201) and Core 2 (220-1202) Video Course, which goes into a bit more depth than this text and shows technology concepts from a hands-on perspective.

Essentially, we have written this book for three types of people: those who want a job in the IT field, those who want to keep their job in the IT field, and those who simply want a basic knowledge of computers and want to validate that knowledge. For those of you in the first group, the latest version of the CompTIA A+ certification can have a positive career impact, increasing the chances of securing a position in the IT world. It also acts as a stepping stone to more advanced certifications. For those in the second group, preparing for the exams serves to keep your skills sharp and your knowledge up to date, helping you to remain a well-sought-after technician. For those of you in the third group,

the knowledge within this book can be helpful in any career path you decide to take, and it can be beneficial to just about any organization you might work for—as long as that organization uses computers!

Regardless of your situation, one thing to keep in mind is that we write our books to teach you how to be a well-rounded computer technician. While the main goal for this book is to help you become A+ certified, we also want to share our experience with you so that you can grow as an individual.

# About the CompTIA A+ Certification

This book covers the CompTIA A+ 220-1201 and 220-1202 exams, also known as Core 1 and Core 2, respectively. To obtain the CompTIA A+ certification, you must pass *both* exams. These exams are administered by Pearson Vue and can be taken at a local test center or online.

Passing the certification exams proves that you are an experienced problem solver and can support today's IT technologies.

Before doing anything else, we recommend that you download the official CompTIA A+ objectives from CompTIA's website. The objectives are a comprehensive bulleted list of the concepts you should know for the exams. This book directly aligns with those objectives, and each chapter specifies the objective covered in the pages that follow.

For more information about how the A+ certification can help your career or to download the latest objectives, access CompTIA's A+ web page at https://www.comptia.org/certifications/a.

# About This Book

This book covers what you need to know to pass both CompTIA A+ exams. It does so in a concise way that allows you to memorize the facts quickly and efficiently.

We have organized this book into two parts, together comprising 66 chapters, all pertaining to the objectives covered on the exams. The first part of the book—Chapters 1 through 28—applies to the Core 1 (220-1201) exam. The second part of the book—Chapters 29 through 65—applies to the Core 2 (220-1202) exam. At the beginning of each of those parts, you will find a handy checklist you can use as you prepare for the exams. Chapter 66 discusses how to get ready for the real exams and gives some tips and techniques for passing the exams.

For this edition of the book, we decided to organize the content based on the order of the official CompTIA objectives. Typically, you will find one objective per chapter. Less commonly, a chapter will cover two objectives, and in a couple of instances, an objective will stretch across two chapters. The corresponding CompTIA objective or objectives are listed verbatim at the beginning of each chapter. Organizing the book this way enables you to easily locate whatever objective you want to learn more about. In addition, you can use the index to quickly find the concepts you are after.

Regardless of your experience level, we don't recommend skipping content. This book is designed to be read completely. The best way to study is to read the entire book. Then, go back and review the 220-1201 portion and take the real CompTIA 220-1201 exam. Afterward, review the 220-1202 portion and take that exam. The two exams are inextricably linked. It's a good idea to get the whole picture first and then break it down by the exam. While this might not be possible based on time constraints, we still strongly recommend it as the best study method.

> **Note**
>
> We do *not* recommend taking both exams on the same day. Instead, space them apart by at least a week to allow yourself time to prepare.

## Chapter Format and Conventions

Every Exam Cram chapter follows a standard structure and contains graphical clues about important information. The structure of each chapter includes the following:

- **Opening topics list:** This defines the CompTIA A+ objective(s) to be covered in the chapter.
- **Topical coverage:** The heart of the chapter, this text explains the topics from a hands-on and a theory-based standpoint. The text includes in-depth descriptions, tables, and figures geared to build your knowledge so that you can pass the exams.
- **Cram Quiz questions:** At the end of each chapter is a quiz. The quizzes, and ensuing explanations, are meant to help you gauge your knowledge of the subjects you have just studied. If the answers to the questions don't come readily to you, consider reviewing individual topics or the entire chapter. In addition to being in the chapters, you can find the Cram Quiz questions at the book's companion web page, at

www.pearsonitcertification.com. The questions are separated into their respective 220-1201 and 220-1202 categories for easier studying when you approach each exam.

- **Exam Alerts, Sidebars, and Notes:** These are interspersed throughout the book. Watch out for them!

> **ExamAlert**
>
> This is what an Exam Alert looks like. An alert stresses concepts, terms, hardware, software, or activities that are likely to relate to one or more questions on the exams.

- **Challenges:** We've also added skill challenges that are designed to build your hands-on skills for the IT field. Note that these challenges are optional, but we strongly suggest that you attempt them if you have the time.

## Additional Elements

Beyond the chapters, there are a few more elements that we've thrown in for you:

- **Practice exams:** These are located at the end of Part I and Part II. There is one practice exam for each CompTIA A+ exam. These practice exams (and additional exams) are available as part of the custom practice test engine at the companion web page also. They are designed to prepare you for the multiple-choice questions that you will find on the real CompTIA A+ exams.
- **Real-world scenarios:** These are located on the companion web page as PDFs. They describe actual situations with questions that you must answer and potential solutions with supporting videos and simulations. These scenarios are designed to help prepare you for the performance-based questions within the real CompTIA A+ exams.
- **Cram Sheet:** The Cram Sheet located near the end of the book is designed to jam some of the most important facts you need to know for each exam into one short section, allowing for easy memorization. It is also available in PDF format on the companion web page. If you have an e-book version, this might be located elsewhere in the e-book; run a search for the term "cram sheet," and you should be able to find it.

## The Hands-On Approach

It is incredibly important that you apply what you learn in this book to real hardware and software. This is the kinesthetic approach that we have recommended for years. It works! Practice as much as you can on Windows, mobile devices, computer hardware, network devices…whatever you can get your hands on.

In this book, we give as many use cases and actual technology examples as possible, including command usage, operating system navigation, troubleshooting techniques, and so on. We also will reference our real systems along with scenarios we have really experienced throughout the text. By referencing computer technology in actual scenarios, we hope to infuse some real-world knowledge and to solidify the concepts you need to learn for the exams. This hands-on approach can help you to visualize concepts better. We recommend that every computer technician build their own computer at some point (if you haven't already). This can help to reinforce the ideas and concepts expressed in the book.

You should also work with multiple operating systems while going through this book: primarily Windows but also Linux, macOS, Android, iOS, and Chrome OS. Consider dual-boots, virtual machines, and emulators to learn more about these systems. However, if at all possible, the best way to learn is to run individual computers. This will ensure that you discover as much as possible about the hardware and software of each computer system and how they interact with each other.

This book frequently refers to various support websites. Have a browser open all the time and be ready to perform more research as you read through the book.

## Goals for This Book

We have three main goals in mind while preparing you for the CompTIA A+ exams.

Our first goal is to help you understand A+ topics and concepts quickly and efficiently. To do this, we try to get right to the facts necessary for the exam. To drive these facts home, the book incorporates figures, tables, real-world scenarios, and simple, to-the-point explanations. Also, in the introductions for the Core 1 and Core 2 sections, you will find preparation checklists that give you an orderly step-by-step approach to taking the exams. Be sure to complete all items on the checklists! For students of ours who truly complete every item,

there is an extremely high passing rate. Finally, in Chapter 66, you will find some important test-taking tips that we've developed over the years.

Our second goal for this book is to provide you with an abundance of *unique* questions to prepare you for the exams. Between the Cram Quizzes and the practice exams, that goal has been met, and we think it will benefit you greatly. Because CompTIA reserves the right to change test questions at any time, it is difficult to foresee exactly what you will be asked on the exams. However, to become a good technician, you must know the *concepts*; you can't just memorize questions. Therefore, each question has an explanation and maps back to the chapter covered in the text. We've been using this method for more than a decade with our students with great results.

Our final goal is to provide support for this and all our titles, completing the life cycle of learning. We do this through our website (https://greencurtaintraining.com), which provides additional resources for you, including an errata page (which you should check as soon as possible) and is set up to take questions from you about this book. We'll try our best to get to your questions ASAP. All personal information is kept strictly confidential.

Good luck in your certification endeavors. We hope you benefit from this book. Enjoy!

Sincerely,

David Bayne

John Pickard

Mark Smith

https://greencurtaintraining.com

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CHAPTER 23

# Troubleshooting Motherboards, CPUs, RAM, and Power

**This chapter covers the following A+ 220-1201 exam objective:**

- **5.1** – Given a scenario, troubleshoot motherboards, RAM, CPUs, and power.

Let's continue on our troubleshooting quest. This chapter gets into the guts of the PC. Sometimes it can be a bit difficult to figure out which component is causing a problem. In this chapter, we'll give some tips to help you identify whether a problem comes from the motherboard, the CPU, the RAM, or whether it is a power issue.

If you are new to computers, we suggest reviewing the corresponding hardware chapters as well—Chapters 12 through 20.

This chapter refers to only one exam objective, but it is a pretty massive one. We're basically talking about the entire core of a PC. We could fill a book on this subject, but alas, our time and space are limited. So, we've condensed as much as possible. Consider acquiring and breaking down older systems to help develop your troubleshooting skills.

ExamAlert

**Objective 5.1** concentrates on troubleshooting common symptoms related to motherboards, RAM, CPUs, and power, such as lack of power, proprietary crash screens, power-on self-test (POST) beeps, blank screen, no power, sluggish performance, overheating, burning smell, random shutdown, application crashes, unusual noise, capacitor swelling, and inaccurate system date/time.

# Troubleshooting Motherboards

Seeing a motherboard fail is uncommon, but if it does, the problem may be due to a few different issues. Let's look at several of them now.

First and probably the most common of these rarities are UEFI/BIOS firmware issues. We'll refer to this as *BIOS* for simplicity. Remember that you might need to flash the motherboard's BIOS to the latest version. For example, a new CPU or RAM might not be recognized at the correct clock speeds. An adapter card might not be seen properly. Or perhaps the operating system isn't working as it should be with the hardware in the system. Updating the BIOS can fix many of these issues. On a separate note, you might encounter a PC that, instead of booting normally, accesses the BIOS. A drained or faulty CMOS battery could be the culprit. Change out the battery, and the system should boot normally. Often, this is a CR2032 lithium battery. If you are not sure whether the battery is discharged, test it with a multimeter. CR2032 batteries normally have an output of 3 volts. Such a battery is only usable down to 2 V, so if it measures 2.5 V or less, it should be replaced. Also, if the battery is discharged, then the time and date of the system will revert to a default (such as January 1, 2012; note that different systems can have different default dates). Also, any other settings you configured will be lost. After a new battery is installed, the time/date and any other required settings will have to be reconfigured or imported from a backup.

**ExamAlert**

If the time and date on a system have reset, there is a good chance that the rest of the settings have also reset to defaults. Review the BIOS configuration settings, compare them with your organization's documentation, and make any modifications necessary. Remember to save your work!

**Note**

A multimeter is a measuring device used to test electrical properties, including resistance (ohms), current (amps), and voltage (volts). You should have a multimeter in your toolkit!

If the system attempts to boot to an incorrect device, then the reason could be that the intended boot device is new; again, a BIOS flash could fix the problem. Of course, it could also be due to a configuration error. You should know how to change the BIOS boot order and many other settings in the BIOS. You

should also know where to go in the BIOS to view log entries and error messages. The BIOS log can help describe various system problems (though it might require a bit of translation, with the aid of the motherboard manual). We discuss the BIOS further in Chapter 16, "Motherboards and Add-on Cards."

Electrostatic discharge (ESD) and other electrical issues might present intermittently. If you find some intermittent issues (for example, the computer reboots out of nowhere) or you receive random proprietary crash screens, such as blue screens of death (BSODs) in Windows or the spinning pinwheel in macOS, ESD could be the culprit. Or a power surge could cause the problem. A particular wire, circuit, or capacitor on the motherboard could have been damaged. Document when failures occur. Swap out the motherboard with a known good one to see if the issue happens again when running through the same processes. If the issue doesn't recur, chances are the original motherboard is headed for the bit bucket (meaning it is to be disposed of). There are lots of circuits on a motherboard; electrical damage to any one circuit could cause the system to behave "irrationally" at best and trigger intermittent device failure. Beyond this, electrical damage can go right through the power supply to the motherboard, disabling it permanently. Be sure to use a surge suppressor or an uninterruptible power supply (UPS) to protect your equipment and, of course, implement antistatic measures whenever you work inside a system.

**ExamAlert**

A surge suppressor, also known as a surge protector, is an inexpensive and simple device placed between a power outlet and a network component to protect the component from spikes and surges. An uninterruptible power supply (UPS), also called a battery backup, is a system that provides protection against power surges and power outages. During a total power outage, a UPS gives you limited time to safely shut down systems or devices on the network before the temporary power interruption becomes permanent.

**Note**

Antistatic measures such as using an antistatic wrist strap and mat are crucial when working on systems. We'll cover these measures in depth in Chapter 59, "Safety Procedures."

Another issue is component failures. It is possible for a single component of the motherboard (for example, the SATA controller) to fail and for the rest of the motherboard to work fine. This can be verified by doing a power-on self-test (POST) analysis. The POST process starts when the computer first boots.

It can result in visible codes or *audible beeps*. The visible codes could be on the screen or could be part of a two-digit digital readout that is incorporated into the motherboard. Either way, the visible codes or the beep codes can be deciphered with the help of the motherboard manual or the motherboard manufacturer's website.

> **Note**
>
> Keep in mind that different BIOS manufacturers (AMI BIOS, Award BIOS, and Dell) have different beep codes. For example, two or three beeps sounded by a motherboard with AMI BIOS means a memory issue.

To fix a problem such as a SATA controller failure, you can purchase a separate PCIe SATA controller card. Then you can connect the hard drives to the new controller and disable the original integrated SATA controller in the BIOS. A good bench or lab will have extra controller cards of all kinds so that you can test these types of problems. In some cases, a failed controller can be symptomatic of a bigger problem; the entire motherboard might need to be replaced. Some component failures can cause system lockups, where the OS freezes and the keyboard and mouse become nonfunctional. Such failures could be due to controller issues, chipset issues, or faulty hard drives. Check all connections and consider flashing the BIOS. Worst-case scenario: Replace the motherboard. We'll discuss hard drive troubleshooting in Chapter 24, "Troubleshooting Storage Drives and RAID Arrays."

Finally, manufacturing defects and failed motherboard components often occur. Printed circuit boards (PCBs), such as motherboards, are mass-produced at high speed. Problems might be found immediately when receiving a motherboard. In general, defects are uncommon but can occur due to mechanical problems in the machinery or due to engineering errors. If you suspect a manufacturing defect, you should return the motherboard.

Motherboard component failure can also manifest over time. For example, a distended capacitor is one that becomes swollen and possibly leaks electrolytic material; this bulging can cause the system to unexpectedly restart or shut down, cause BSOD, or cause other errors. If possible, the affected capacitor(s) should be replaced right away. If that does not work, the motherboard should be replaced. In the early 2000s, capacitor swelling, or "swollen caps," was somewhat prevalent due to raw material issues; the problem was even dubbed the "capacitor plague." However, the problem is much less common today. In fact, motherboards that are received in a dead-on-arrival (DOA) state are uncommon with reputable manufacturers.

ExamAlert

Remember that capacitor swelling is when a motherboard capacitor fails and expands due to gas generation. This causes the capacitor to rupture and damage the motherboard.

# Troubleshooting CPUs

The most common issue with a CPU is when it isn't installed properly or securely. An improperly installed CPU could possibly cause a complete failure when you try to turn on the system. This failure might be accompanied by a series of beeps from the POST. If this happens, always check the power first, just in case. Then check the main power connections and then the 8- or 4-pin CPU power connection. Another possibility is that the system might turn on and power might be supplied to the system, but nothing else happens: no POST, no display (meaning a blank or black screen), and no drive activity. In any of these situations, after checking power, make sure of the following:

- **Ensure that the fan is connected and functional:** Some motherboards have a safeguard that disables booting if the fan is defective or not plugged in. Or you might get a message on the screen or another type of warning, depending on the motherboard. Be sure that the fan is plugged into the correct power connector on the motherboard (or elsewhere) and verify whether it turns on when the computer is on. If the fan has failed, purchase a replacement fan; just make sure that the new fan is compatible with the heat sink and motherboard.
- **Check other major components:** Remember that the CPU is a part of a bigger system—one in which other components are more likely to be the cause of many problems. These components include the video card, RAM, and motherboard. Be sure to check these other components for simple connectivity problems, which could be the actual culprit. Always check connections first before taking apart the CPU assembly.
- **Make sure the heat sink is connected properly:** Make sure that the heat sink is flush with the CPU cap and that it is securely fastened to the motherboard (or socket housing).
- **Ensure that the CPU is installed properly:** Make sure it was installed flush into the socket and that it was oriented correctly. Of course, this means removing the heat sink. If you do so, you should clean off excess thermal compound and reapply thermal compound to the CPU cap before reinstalling the heat sink.

**ExamAlert**

When troubleshooting the CPU, be sure to first check all connections and then make sure the fan, heat sink, and CPU are secure and installed properly.

Following are a few more possible symptoms of a failing CPU:

- Unexplained crashes (shutdowns) occur during bootup or during use.
- The system locks after only a short time of use.
- Voltage is near, at, or above the top end of the allowable range.

Sometimes a CPU is just plain defective. It could have been received this way, or maybe it overheated. Perhaps there was a surge that damaged it, or maybe someone overclocked it too far, and it was a victim of overvoltage (and subsequent overheating). Regardless of the culprit, the CPU needs to be replaced. Now, by default, CPUs come with a heat sink and fan, and you can install the CPU as you normally would. But in some cases, you can save money by purchasing only the CPU and using the existing heat sink. In this case, remember to clean excess thermal compound and then reapply thermal compound; but reapply it to the CPU cap and not to the heat sink. If the CPU was installed properly, users don't usually have many problems with it (unless they are overclockers). Keep this in mind when troubleshooting the CPU or when troubleshooting an issue that *appears* to be a CPU issue but that might actually be something else altogether.

On a lighter note, sometimes you might get reports from customers about unusual noises coming from inside a PC—a buzzing of sorts (or perhaps even a grinding noise). The noise could be caused by a wire or cable that is brushing up against the CPU fan (or other case fan). Be sure to reroute cables inside the computer so that they are clear of the CPU and any other devices. This will also aid with airflow in the PC and keep the PC cooler. The CPU fan might also make noise due to being clogged with dust, especially in dirtier environmental conditions. If the fan is still functional, you can use compressed air to clean it out. But be careful because too much air movement could cause a static discharge. For example, if the CPU fan (or case fan) is moved due to the air flow of a compressor, it could cause ESD. Use a piece of foam or other plastic stopper to keep the fan(s) in place while you use compressed air. Keep a computer vacuum handy to clean up the mess, if necessary; we've seen computers that had so much dust and dirt inside it could fill a garden! But be careful with computer vacuums and air compressors. Use a plastic nozzle or tip (never metal) and don't actually touch any of the components.

# Troubleshooting RAM

It's not common, but RAM modules can cause intermittent issues, or they can fail altogether. Always make sure that the RAM is fully seated within the RAM slot and that the plastic ears are locking the RAM into place. An unstable system can be caused by several components, including RAM. Remember to check other components in the system as well, including the video card, motherboard, and CPU.

A lot of the issues you see occur because a user has purchased and installed a memory stick that is not compatible, or is semi-compatible, with the motherboard: wrong speed, incorrect capacity, improper configuration, and so on. Be ready for this; check the RAM compatibility against the motherboard, even if the user swears it has been checked already. Remember, a good technician has documentation available, has access to the Internet, and knows how to use both.

**ExamAlert**

Verify compatibility of RAM with the motherboard when troubleshooting!

Perhaps there was some kind of surge inside the computer; maybe the computer is not protected by a surge suppressor or UPS. Another possibility is that the RAM was damaged by ESD, and this damage manifests in intermittent problems. There are expensive hardware-based RAM testers that can tell you if the RAM is electrically sound and if it can process data correctly. If your company owns one, or if you can get your hands on one for a short time, you might narrow the problem. However, we have rarely needed to use these.

Here are some possible symptoms of a RAM issue and corresponding troubleshooting techniques:

- **Computer will not boot/or randomly shuts down:** If there is no RAM in the computer, or if the RAM is damaged or is not installed securely, it can prevent the computer from doing anything at all (aside from draining electricity from your AC outlet). For example, the power supply fan turns but nothing else happens—no beeps and no displays. First, if the RAM was just installed, make sure that the RAM is compatible. Next, and in general, try reseating the RAM before you attempt to troubleshoot a CPU or motherboard. Add RAM if none exists. (Sounds silly, but we've seen this!) If you suspect faulty RAM, corroded contacts, or a faulty RAM slot, you can try taking the RAM out, cleaning the RAM and RAM slot, and putting the RAM back in, being sure to seat the memory module properly. (For cleaning, use contact cleaner on the RAM contacts and use

compressed air on the slot.) Next, try moving memory modules to different slots; check your motherboard documentation for proper orientation. As mentioned, a POST analysis can be helpful in these situations as well. If necessary, replace the memory module with an identical one (if you have an extra one handy) or purchase a new one if you have identified the memory module as the source of the problem. In some cases, RAM can overheat and cause random shutdowns. To prevent this, purchase a heat sink for RAM. These are made of aluminum or copper, just like CPU heat sinks, and are sometimes referred to as heat spreaders. You can also purchase RAM with heat sinks preinstalled. This type of RAM might be necessary for high-end systems.

- **BIOS indicates a memory error:** The BIOS can indicate a memory error through a message on the screen and a flashing cursor or by beeping. If it beeps, you need to reference the motherboard documentation for the specific beep codes. Sometimes a BIOS setting can be incorrect. If the computer has a saved version of the BIOS settings, you can try reverting to them, or you can try loading the BIOS defaults; we can't tell you how many times this has worked for me! Sometimes the BIOS indicates the wrong amount of RAM. If this is the case, check the RAM, as explained in the first bullet. Finally, a BIOS update can be the cure; perhaps the BIOS just doesn't have the programming necessary to identify the latest type of RAM that was installed.
- **An application crashes:** If an application crashes, it could be due to faulty RAM (or, uncommonly, a CPU issue). Make sure that the RAM is compatible with the motherboard and use memory testing programs to verify if there is any damage to the RAM. (More on memory testing in just a bit.)
- **A stop error, aka BSOD (blue screen of death), occurs:** This is a critical system error that causes the operating system to shut down. Most of the time, these errors are due to device driver errors (poor code), but they can be associated with physical faults in memory. One example of this would be a non-maskable interrupt (NMI). An NMI can interrupt the processor to gain its attention regarding nonrecoverable hardware errors, resulting in a BSOD. The BSOD usually dumps the contents of memory to a file (for later analysis) and restarts the computer. If you don't encounter another BSOD, it's probably not much to worry about. But if the BSOD happens repeatedly, you should write down the information you see on the screen and cross-reference it to the Microsoft Support website, at https://support.microsoft.com. Again, if you suspect faulty RAM, try the troubleshooting methods in the first bullet.

> **Note**
>
> We'll cover BSODs in more depth in Chapter 53, "Troubleshooting Microsoft Windows."

Chances are you won't need them often, but memory testing programs such as MemTest86 (https://www.memtest86.com) are available online. In fact, a whole slew of testing and benchmarking software is freely available to you. Search around! Plus, you can use the Windows Memory Diagnostics tool, which you can access by typing **mdsched.exe** in the Run prompt or from the Windows Recovery Environment (more on that in Chapter 53). These steps can help diagnose whether a memory module needs to be replaced. But in general, trust in your senses. Look at and listen to the computer as you try to diagnose any RAM issues that might occur.

# Troubleshooting Power Supply Issues

Many types of power problems can happen. We discuss power in general in Chapter 18, "Power," and Chapter 60, "Environmental Controls," but for now let's focus on power issues related to the power supply within a computer.

Many issues that occur with power supplies are intermittent. This makes the troubleshooting process a little tougher. Your best friends when troubleshooting power supplies are a power supply tester and your eyes and ears.

Of course, always make sure that the power supply cable connects from the power supply to a properly wired AC outlet before troubleshooting further. Next, check all of the internal power connections. Make sure they are connected firmly. To *test* these connections, use a power supply tester.

A power supply tester (or PSU tester) is a tool every computer tech should have in their toolkit. Figure 23.1 shows an example of a PSU tester. These testing devices normally test for 12 V, 5 V, and 3.3 V for most of the connections within the computer, including the main 24-pin ATX power connector, 8- and 4-pin CPU connectors, PCI Express 8-pin and 6-pin connectors, SATA power connector, and Molex power connector. If there are error readings, error lights, no lights, or missing lights for specific voltages on the tester, you should consider replacing the power supply; or if it is modular, you should replace that particular power cable. If all the lights and indicators are normal, then the issue resides somewhere else.




FIGURE 23.1 **PSU Tester Testing a 24-Pin ATX Power Connector**

Here are several of the issues you might encounter with power supplies:

- Fan failure
- Fuse failure
- Quick death
- Slow death

Fan failure can be due to the fact that the power supply is old, the fan is extremely clogged with dirt, or the fan is of a cheaper design (without ball bearings). However, for the A+ exam, the reason doesn't make a difference. As far as the A+ exam is concerned, if the fan fails, the power supply needs to be replaced (and that strategy makes sense). Chances are, if the fan has failed, other components of the power supply are on their way out also. It is more cost-effective to a company to simply replace the power supply than to have a technician spend time opening it and trying to repair it. More importantly, although it is possible to remove and replace the fan by opening the power supply, this can be a dangerous venture because the power supply holds an electric charge. So, the A+ rule is to never open the power supply.

**ExamAlert**

Do not open a power supply! If it has failed, replace it with a working unit.

Fan failure can sometimes cause a loud noise to emanate from the power supply; it might even sound as though the noise is coming from inside the computer. Any fan in the computer (power supply fan, case fan, or CPU fan) can make unusual noises over time. If a customer reports a loud noise coming from the inside of a PC, consider the power supply fan as a suspect.

On the other hand, sometimes the fans spin but no other devices receive power, and the computer doesn't boot. This could be due to improper installation (or failure) of the motherboard, CPU, or RAM.

Fuse failure can occur due to an overload or due to the power supply malfunctioning. Either way, the proper course of action is to replace the power supply. Do not attempt to replace the fuse. If the fuse is blown, chances are that the power supply is faulty.

If the power supply dies a quick death and provides no power, the reason might be several issues, ranging from an electrical spike to hardware malfunction. First, make sure that the IEC power cable is connected properly to the power supply and to the AC outlet. Sometimes it can be difficult to tell whether the power supply has failed or whether the problem is something else inside or outside the computer system. You should check the AC outlet with your trusty receptacle tester, make sure that a circuit hasn't tripped, and verify that any surge protectors and/or UPS devices work properly. Depending on what you sense about the problem, you might decide to just swap out the power supply with a known good one.

A power supply that is dying a slow death may cause intermittent errors or frequent failure of hard drives and other devices, and this can be tough to troubleshoot. If you suspect intermittent issues, first make sure the power cord is connected securely and then try swapping out the power supply with a known good one. Boot the computer and watch it for a while to see if the same errors continue to occur.

**Note**

If a system was recently upgraded, the power supply could cause the system to reboot intermittently because the new components are causing too much power drain. When upgrading components, be sure to check whether you need to upgrade the power supply as well!

Remember that connections sometimes can be jarred loose inside and outside a computer. Check the IEC cord on both ends and all power connections inside the computer, including the main motherboard connector as well as the CPU, Molex, SATA, and PCIe connectors. Any single loose connector can have "interesting" results on the computer!

# Heating and Cooling

Another issue to watch for is the system overheating. This can happen for several reasons:

- Power supply fan failure
- Auxiliary case fan failure
- Inadequate number of fans
- Missing or open slot covers
- Case not being tightly closed and screwed in
- Location of the computer

Air flow is important on today's personal computers because their processors can often operate at hundreds of billions of instructions per second or more (referred to as 100 giga-instructions per second [GIPS]). They typically use 50 to 150 watts of power, and that creates a lot of heat! Add to that the video card and other cards that have their own on-board processors, and you quickly realize it can get *hot* inside the computer case. Plus, environmental factors and higher-temperature areas (such as warehouses and cafeterias) can cause heat to be trapped in the case, producing random shutdowns. Circulation is the key here. Air should flow in the case from the front and should be exhausted out the back. Any openings in the case or missing slot covers can cause circulation to diminish. If you have a computer that has a lot of devices, does a lot of processing, or runs hot for any other reason, your best bet is to install a case fan in the front of the case (which pulls air into the case) and a second case fan in the back of the case (which, with the power supply fan, helps exhaust hot air out the back). Standard sizes for case fans are 80 and 120 mm. Also, try to keep the computer in a relatively cool area and leave space for the computer to expel its hot air! Of course, there are other special considerations and options, such as liquid cooling and special processor cooling methods, such as oversized tower heat sinks; however, for typical workstations, these options will most likely not be feasible.

You should also train your nose for smells and watch for smoke. If a power supply starts to emit a burning smell, or if you see any smoke emanating from it, you should turn off the computer and disconnect the power right away. The power supply is probably about to fail, and it could short out, trip the circuit, or, worse yet, start a fire. Be sure to replace it. In some cases, a power supply has a burn-in period of 24 to 48 hours, during which time you might smell some oils burning off, but it's best to be safe and check/test the power supply if you smell something that seems wrong.

### Troubleshooting Questions in the A+ Exams

Hardware and software troubleshooting make up at least a quarter of the A+ exam objectives. For bench techs, help desk people, and other tech support personnel, it makes up a much larger percentage of work. When we really get down to it, we technicians are here to solve problems, and troubleshooting is a key component of problem solving. So, we have included a lot more cram quiz questions for these troubleshooting chapters than for other chapters. It seemed the proper way.

## Cram Quiz

Answer these questions. The answers follow the last question. If you cannot answer these questions correctly, consider reading this chapter again until you can.

1. What is the best way to tell if a CR2032 lithium battery has been discharged?
   - ❍ **A.** Use a power supply tester.
   - ❍ **B.** Check within Windows.
   - ❍ **C.** Use a multimeter.
   - ❍ **D.** Plug it into another motherboard.

2. A PC reboots without any warning. You rule out any chance of viruses. When you look at the motherboard, you see that some of the capacitors are swelling and appear distended and out of shape. What should you do?
   - ❍ **A.** Replace the motherboard.
   - ❍ **B.** Replace the hard drive.
   - ❍ **C.** Remove and replace the capacitors.
   - ❍ **D.** Reconfigure the BIOS.

3. A computer you are troubleshooting won't boot properly. When you power on the computer, the video display is blank, and you hear a series of beeps. What should you do?
   - ❍ **A.** Check power supply connections.
   - ❍ **B.** Consult the vendor documentation for the motherboard.

- ❍ **C.** Remove all memory and replace it.
- ❍ **D.** Unplug the speakers because they are causing a conflict.

**4.** You are troubleshooting a CPU and have already cut power, disconnected the power cable, opened the case, and put on your antistatic strap. What should you do next?

- ❍ **A.** Check the BIOS.
- ❍ **B.** Check connections.
- ❍ **C.** Remove the CPU.
- ❍ **D.** Test the motherboard with a multimeter.

**5.** What is a possible symptom of a failing CPU?

- ❍ **A.** CPU is beyond the recommended voltage range.
- ❍ **B.** Computer won't boot.
- ❍ **C.** BIOS reports low temperatures within the case.
- ❍ **D.** Spyware is installed in the browser.

**6.** You are repairing a computer that has been used in a warehouse for several years. You suspect a problem with a memory module. What should you do first?

- ❍ **A.** Replace the module with a new one.
- ❍ **B.** Install more eRAM.
- ❍ **C.** Clean the RAM slot.
- ❍ **D.** Install RAM heat sinks.

**7.** You are investigating a computer that is suffering from random shutdowns. You note that the RAM modules are overheating. What is the best solution?

- ❍ **A.** Install a heat sink on the memory controller.
- ❍ **B.** Install more CPU fans.
- ❍ **C.** Install heat sinks on the RAM modules.
- ❍ **D.** Install a heat sink on the chipset.

**8.** You just installed new, compatible RAM into a motherboard, but when you boot the computer, it does not recognize the memory. What should you do?

- ❍ **A.** Flash the BIOS.
- ❍ **B.** Replace the RAM.
- ❍ **C.** Upgrade the CPU.
- ❍ **D.** Add more RAM.

9. You are troubleshooting a computer that won't power on. You have already checked the AC outlet and the power cord, which appear to be functioning properly. What should you do next?
   - ❍ **A.** Test the computer with a PSU tester.
   - ❍ **B.** Plug the computer into a different outlet.
   - ❍ **C.** Check that the RAM is seated correctly.
   - ❍ **D.** Install a UPS.

10. A computer you are troubleshooting shuts down without warning. After a few minutes, it boots back up, but after running for a short time, it shuts down again. Which of the following components could be the cause? (Select the two best answers.)
   - ❍ **A.** Power supply
   - ❍ **B.** SATA hard drive
   - ❍ **C.** RAM
   - ❍ **D.** CPU fan
   - ❍ **E.** Video card

# Cram Quiz Answers

1. **C.** Although there might be a Windows application that monitors the battery, the surefire way is to test the voltage of the lithium battery with a multimeter. A CR2032 lithium battery is designed to run at 3 volts (and they often ship at approximately 3.3 volts). Some UEFI/BIOS programs can also monitor the voltage of the battery.
2. **A.** You should replace the motherboard if it is damaged. It would be much too time-consuming to even attempt replacing the capacitors and probably not cost-effective.
3. **B.** You should check the BIOS version and consult the documentation that accompanies the motherboard. You might need to go online for this information. You can also try performing a POST analysis to discern the problem. The issue could be video based, or RAM based, but the beep code should help identify the problem.
4. **B.** Check connections first as they are a common culprit.
5. **A.** If the CPU is running beyond the recommended voltage range for extended periods of time, it can be a sign of a failing CPU. If the computer won't boot at all, another problem might have occurred, or the CPU might have already failed. Low case temperatures are a good thing (as long as they aren't below freezing). Spyware is unrelated in this case.

6. **C.** Because the computer is being used in a warehouse (and a warehouse is often a fairly dirty environment), you should use compressed air on the RAM slot and clean the memory module with contact cleaner. Clean out all of the dust bunnies within the entire computer. Using MemTest86 or another memory diagnostic tool is another good answer.
7. **C.** The best thing to do in this situation is to install heat sinks on the RAM modules. On older computers, the memory controller in a northbridge doesn't usually overheat because it already has a heat sink; on newer computers, it is within the CPU. A CPU can have only one fan. You can't install more (although an additional case fan might help). The chipset also usually has a heat sink.
8. **A.** If you are sure that the RAM is compatible and the system doesn't recognize it during POST, try flashing the UEFI/BIOS. It could be that the RAM is so new that the motherboard doesn't have the required firmware to identify the new RAM.
9. **A.** You should test the computer with a PSU tester. This can tell you whether the power supply functions properly. You already know that the AC outlet is functional, so there is no reason to use another outlet. The computer would still turn on if the RAM wasn't seated properly. A UPS won't help the situation because it is part of the power flow before the power supply.
10. **A and D.** The two components that could cause the system to shut down are the power supply and the CPU fan. Check the CPU fan settings and temperature in the BIOS first before opening the computer. If those are fine, you most likely need to replace the power supply. The RAM, video card, and hard drive should not cause the system to suddenly shut down.

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Now we are getting deep into troubleshooting. This was a longer chapter (for this book at least), and we recommend that you review it carefully. Great work so far!

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