IT Essentials v7

Companion Guide

Networking Academy

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IT Essentials v7 Companion Guide

Cisco Press

IT Essentials v7 Companion Guide

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Command Syntax Conventions

The conventions used to present command syntax in this book are the same conventions used in the IOS Command Reference. The Command Reference describes these conventions as follows:

- **Boldface** indicates commands and keywords that are entered literally as shown. In actual configuration examples and output (not general command syntax), boldface indicates commands that are manually input by the user (such as a **show** command).
- *Italic* indicates arguments for which you supply actual values.
- Vertical bars (|) separate alternative, mutually exclusive elements.
- Square brackets ([ ]) indicate an optional element.
- Braces ({ }) indicate a required choice.
- Braces within brackets ([{ }]) indicate a required choice within an optional element.

Introduction

IT Essentials v7 Companion Guide is a supplemental book to the Cisco Networking Academy IT Essentials: Version 7 course. The course includes information to allow you to develop working knowledge of how computers and mobile devices operate. It covers information security topics and provides practice experience in computer procedures, networking, and troubleshooting.

Cisco Networking Academy is a comprehensive program that delivers information technology skills to students around the world. *IT Essentials v7 Companion Guide* provides you with the foundational knowledge to be successful in employment in many areas of IT. You will learn techniques to successfully problem-solve and troubleshoot IT functions, understand virtualization technologies, recognize security threats, use mitigation methods and tools, identify and install infrastructure and system components, and enhance your customer service skills.

This book provides a ready reference that explains the same concepts, technologies, protocols, and tools as the online curriculum. You can use the online curriculum as directed by your instructor and then use this *Companion Guide*'s study tools to help solidify your understanding of all the topics.

The course is designed to prepare you to take and pass the CompTIA A+ 1000 series exams. By reading and completing this book, you have the opportunity to review all key concepts that the CompTIA A+ exams cover. If you use this book along with its study tools, you can reinforce those concepts with hands-on exercises and test that knowledge with review questions and exercises.

The IT Essentials: PC Hardware and Software course aligns with the CompTIA A+ (220-1001) exam and CompTIA A+ (220-1002) exam. You must pass both exams to earn the CompTIA A+ certification.

Who Should Read This Book

This book is intended for students in the Cisco Networking Academy IT Essentials: Version 7 course. Such students are usually pursuing careers in information technology (IT) or want to understand how a computer works, how to assemble a computer, and how to troubleshoot hardware and software issues.

Book Features

The educational features of this book focus on supporting topic coverage, readability, and practice of the course material to facilitate your full understanding of the course material.

Topic Coverage

The following features give you a thorough overview of the topics covered in each chapter so that you can make constructive use of your study time:

- **Objectives:** Listed at the beginning of each chapter, the objectives reference the core concepts covered in the chapter. The objectives match the objectives stated in the corresponding chapters of the online curriculum; however, the question format in the *Companion Guide* encourages you to think about finding the answers as you read the chapter.
- **Notes:** These are short sidebars that point out interesting facts, timesaving methods, and important safety issues.
- **Chapter summaries:** At the end of each chapter is a summary of the chapter's key concepts. It provides a synopsis of the chapter and serves as a study aid.
- **Practice:** At the end of chapter is a full list of all the labs, class activities, and Packet Tracer activities to refer to at study time.

Readability

The following features assist your understanding of the networking vocabulary:

- **Key terms:** Each chapter begins with a list of key terms, along with a page-number reference from inside the chapter. The terms are listed in the order in which they are explained in the chapter. This handy reference allows you to find a term, flip to the page where the term appears, and see the term used in context. The Glossary defines all the key terms.
- **Glossary:** This book contains an all-new Glossary with more than 1000 terms.

Practice

Practice makes perfect. This *Companion Guide* offers you ample opportunities to put what you learn into practice. You will find the following features valuable and effective in reinforcing the instruction that you receive:

- **Check Your Understanding questions and answer key:** Review questions are presented at the end of each chapter as a self-assessment tool. These questions match the style of questions that you see in the online course. Appendix A, "Answers to 'Check Your Understanding' Questions," provides an answer key to all the questions and includes an explanation of each answer.

Packet Tracer Activity

Video

Interactive Graphic

- **Labs and activities:** Throughout each chapter, you are directed to the online course to take advantage of the activities created to reinforce concepts. In addition, at the end of each chapter is a Practice section that lists all the labs and Packet Tracer activities to provide practice with the topics introduced in this chapter.
- **Page references to online course:** After headings, you will see, for example, (1.1.2.3). This number refers to the page number in the online course so that you can easily jump to that spot online to view a video, practice an activity, perform a lab, or review a topic.

About Packet Tracer Software and Activities

Packet Tracer Activity

Interspersed throughout the chapters you'll find a few Cisco Packet Tracer activities. Packet Tracer allows you to create networks, visualize how packets flow in the network, and use basic testing tools to determine whether the network would work. When you see this icon, you can use Packet Tracer with the listed file to perform a task suggested in this book. The activity files are available in the course. Packet Tracer software is available only through the Cisco Networking Academy website. Ask your instructor for access to Packet Tracer.

How This Book Is Organized

This book corresponds closely to the Cisco Networking Academy CCNA IT Essential v7 course and is divided into 14 chapters, an appendix, and a glossary of key terms:

- **Chapter 1, "Introduction to Personal Computer Hardware":** This chapter introduces you to all the components that go inside a computer case. A computer system consists of hardware and software components. This chapter discusses hardware components in a computer system as well as safety guidelines you should follow to prevent electrical fires, injuries, and fatalities while working inside a computer. You will also learn about electrostatic discharge (ESD) and how it can damage computer equipment if it is not discharged properly.
- **Chapter 2, "PC Assembly":** In this chapter, you will learn about PC power supplies and the voltages they provide to other computer components. You will learn about the components that are installed on the motherboard, including the CPU, RAM, and various adapter cards. You will learn about different CPU architectures and how to select RAM that is compatible with the motherboard and the chipset. You will also learn about various types of storage drives and the factors to consider when selecting the appropriate drive.

- **Chapter 3, "Advanced Computer Hardware":** This chapter covers the computer boot process, protecting a computer from power fluctuations, multicore processors, redundancy through multiple storage drives, and protecting the environment from hazardous materials present in computer components.
- **Chapter 4, "Preventive Maintenance and Troubleshooting":** In this chapter, you will learn general guidelines for creating preventive maintenance programs and troubleshooting procedures. Troubleshooting is a systematic process used to locate the cause of a fault in a computer system and to correct the relevant hardware and software issues. In this chapter, you learn general guidelines for creating preventive maintenance programs and troubleshooting procedures. These guidelines are a starting point to help you develop your preventive maintenance and troubleshooting skills.
- **Chapter 5, "Networking Concepts":** This chapter provides an overview of network principles, standards, and purposes. IT professionals must be familiar with networking concepts to meet the expectations and needs of customers and network users.
- **Chapter 6, "Applied Networking":** Virtually all computers and mobile devices today are connected to some type of network and to the Internet. This means that configuring and troubleshooting computer networks is now a critical skill for IT professionals. This chapter focuses on applied networking, with a discussion on the format and architecture of Media Access Control (MAC) addresses and Internet Protocol (IP) addresses, both IPv4 and IPv6, that are used to connect computers to a network. Technicians must be able to set up, configure, and troubleshoot networks. This chapter also teaches you how to troubleshoot problems when networks and Internet connections fail.
- **Chapter 7, "Laptops and Other Mobile Devices":** This chapter focuses on the many features of mobile devices and their capabilities, including configuration, synchronization, and data backup. With the increase in demand for mobility, the popularity of mobile devices will continue to grow. During the course of your career, you will be expected to know how to configure, repair, and maintain these devices.
- **Chapter 8, "Printers":** This chapter provides essential information about printers. You learn how printers operate, what to consider when purchasing a printer, and how to connect printers to an individual computer or to a network.
- **Chapter 9, "Virtualization and Cloud Computing":** Organizations both large and small are investing heavily in virtualization and cloud computing. It is therefore important for IT technicians and professionals to understand these two technologies. While the two technologies do overlap, they are, in fact, two different technologies. Virtualization software allows one physical server to run

several individual computing environments. Cloud computing is a term used to describe the availability of shared computing resources (software or data) as a service and on demand over the Internet. In this chapter, you will learn about both virtualization and cloud computing.

- **Chapter 10, "Windows Installation":** As a technician, you will be required to install operating systems of many types, using a variety of methods. This chapter focuses on the Windows 10, Windows 8.x, and Windows 7 operating systems. The components, functions, system requirements, and terminology related to each operating system are explored. The chapter also details the steps to install a Windows operating system and the Windows boot sequence.
- **Chapter 11, "Windows Configuration":** In this chapter, you learn about support and maintenance of the Windows operating system after it has been installed. You learn how to use tools that optimize and maintain the operating system. You also learn methods for organizing and managing Windows computers on a network, the domain, and the workgroup, and how to share local computer resources, such as files, folders, and printers, on the network. This chapter also explores the CLI and PowerShell command line utility.
- **Chapter 12, "Mobile, Linux, and macOS Operating Systems":** In this chapter you learn about operating systems such as iOS, Android, macOS, and Ubuntu Linux and their characteristics. The portable nature of mobile devices puts them at risk for theft and loss, so this chapter discusses mobile security features.
- **Chapter 13, "Security":** Technicians need to understand computer and network security. Failure to implement proper security procedures can have impacts on users, computers, and the general public. This chapter covers why security is important, security threats, security procedures, how to troubleshoot security issues, and how you can work with customers to ensure that the best possible protection is in place.
- **Chapter 14, "The IT Professional":** As a computer technician, you not only fix computers but also interact with people. In fact, troubleshooting is as much about communicating with customers as it is about knowing how to fix computers. In this chapter, you learn to use good communication skills as confidently as you use a screwdriver. You also learn about scripting to automate processes and tasks on various operating systems.
- **Appendix A, "Answers to 'Check Your Understanding' Questions":** This appendix lists the answers to the "Check Your Understanding" review questions that are included at the end of each chapter.
- **Glossary:** The Glossary provides definitions for all the key terms identified in each chapter.

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CHAPTER 4

Preventive Maintenance and Troubleshooting

Objectives

Upon completion of this chapter, you will be able to answer the following questions:

- What are the benefits of preventive maintenance?
- What are the most common preventive maintenance tasks?
- What are the elements of the troubleshooting process?
- What are common problems and solutions when troubleshooting a PC?

Key Terms

This chapter uses the following key terms. You can find the definitions in the glossary at the end of the book.

closed-ended questions *page 170*

cloud storage *page 168*

data backup *page 168*

Device Manager *page 171*

Event Viewer *page 170*

open-ended questions *page 170*

preventive maintenance *page 164*

Task Manager *page 172*

troubleshooting *page 167*

troubleshooting process steps *page 169*

Introduction (4.0)

Preventive maintenance is often overlooked, but good IT professionals understand the importance of regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems. Effective preventive maintenance reduces part, material, and system faults and keeps hardware and software in good working condition.

Preventive maintenance doesn't just apply to hardware. Performing basic tasks such as checking what programs run on startup, scanning for malware, and removing unused programs helps a computer function more efficiently and can keep it from slowing down. Good IT professionals also understand the importance of troubleshooting, which requires an organized and logical approach to problems with computers and other components.

In this chapter, you will learn general guidelines for creating preventive maintenance programs and troubleshooting procedures. These guidelines are a starting point to help you develop your preventive maintenance and troubleshooting skills. You will also learn the importance of maintaining an optimal operating environment for computer systems that are clean, free of potential contaminants, and within the temperature and humidity ranges specified by the manufacturer.

At the end of the chapter, you will learn the six-step troubleshooting processes and common problems and solutions for different computer components.

Preventive Maintenance (4.1)

Preventive maintenance can be the key to keeping computer systems from experiencing serious problems, such as data loss and hardware failures, and it also helps systems have a longer life span. In this section, you study the need for preventive maintenance of a computer system. Following a good preventive maintenance plan can keep computer problems from being too troublesome.

PC Preventive Maintenance Overview (4.1.1)

Preventive maintenance is the regular and systematic inspection, cleaning, and replacement of worn parts, materials, and systems. Effective preventive maintenance reduces part, material, and system faults and keeps hardware and software in good working condition.

Benefits to Preventive Maintenance (4.1.1.1)

Preventive maintenance plans are developed based on at least two factors:

- **Computer location or environment:** Dusty environments, such as construction sites, require more attention than an office environment.

- **Computer use:** High-traffic networks, such as a school network, might require additional scanning and removal of malicious software and unwanted files.

Regular preventive maintenance reduces potential hardware and software problems, computer downtime, repair costs, and the number of equipment failures. It also improves data protection, equipment life, and stability and saves money.

Preventive Maintenance - Dust (4.1.1.2)

The following are considerations to keep dust from damaging computer components:

- Clean/replace building air filters regularly to reduce the amount of dust in the air.
- Use a cloth or a duster to clean the outside of the computer case. If using a cleaning product, put a small amount onto a cleaning cloth and then wipe the outside of the case.
- Dust on the outside of a computer can travel through cooling fans to the inside.
- Accumulated dust prevents the flow of air and reduces the cooling of components.
- Hot computer components are more likely to break down.
- Remove dust from the inside of a computer using a combination of compressed air, a low-air-flow ESD vacuum cleaner, and a small lint-free cloth.
- Keep the can of compressed air upright to prevent the fluid from leaking onto computer components.
- Keep the compressed air can a safe distance from sensitive devices and components.
- Use the lint-free cloth to remove any dust left behind on the component.

Caution

When you clean a fan with compressed air, hold the fan blades in place. This prevents overspinning the rotor or moving the fan in the wrong direction.

Preventive Maintenance - Internal Components (4.1.1.3)

This is a basic list of components to inspect for dust and damage:

- **CPU heat sink and fan assembly:** The fan should spin freely, the fan power cable should be secure, and the fan should turn when the power is on.
- **RAM modules:** The modules must be seated securely in the RAM slots. Ensure that the retaining clips are not loose.

- **Storage devices:** All cables should be firmly connected. Check for loose, missing, or incorrectly set jumpers. A drive should not produce rattling, knocking, or grinding sounds.
- **Screws:** A loose screw inside the case can cause a short circuit.
- **Adapter cards:** Ensure that adapter cards are seated properly and secured with the retaining screws in their expansion slots. Loose cards can cause short circuits. Missing expansion slot covers can let dust, dirt, or living pests inside the computer.
- **Cables:** Examine all cable connections. Ensure that pins are not bent or broken and that cables are not crimped, pinched, or severely bent. Retaining screws should be finger-tightened.
- **Power devices:** Inspect power strips, surge suppressors (surge protectors), and UPS devices. Make sure the devices work properly and that there is clear ventilation.
- **Keyboard and mouse:** Use compressed air to clean the keyboard, mouse, and mouse sensor.

Preventive Maintenance - Environmental Concerns (4.1.1.4)

An optimal operating environment for a computer is clean, free of potential contaminants, and within the temperature and humidity ranges specified by the manufacturer, as shown in Figure 4-1 and defined in the list that follows.

Figure 4-1 Temperature and Humidity

Follow these guidelines to help ensure optimal computer operating performance:

- Do not obstruct vents or airflow to the internal components.
- Keep the room temperature between 45 and 90 degrees Fahrenheit (between 7 and 32 degrees Celsius).

- Keep the humidity level between 10% and 80%.
- Temperature and humidity recommendations vary by computer manufacturer. Research the recommended values for computers used in extreme conditions.

Preventive Maintenance - Software (4.1.1.5)

Verify that installed software is current and follow the policies of the organization when installing security updates, operating system, and program updates.

Create a software maintenance schedule to:

- Review and install the appropriate security, software, and driver updates.
- Update the virus definition files and scan for viruses and spyware.
- Remove unwanted or unused programs.
- Scan hard drives for errors and defragment hard drives.

Interactive Graphic

Check Your Understanding 4.1.1.6: Preventive Maintenance

Refer to the online course to complete this Activity.

Troubleshooting Process (4.2)

Troubleshooting is a systematic process used to locate the cause of a fault in a computer system and correct the relevant hardware and software issues. Approaching problem solving using a logical and methodical approach is essential to successful resolution. Although experience is very useful to problem solving, following a troubleshooting model will enhance effectiveness and speed.

Troubleshooting Process Steps (4.2.1)

In this section, you will learn that to troubleshoot a problem quickly and effectively, you need to understand how to approach the issue. Troubleshooting is a way of discovering what is causing a problem and fixing it.

Introduction to Troubleshooting (4.2.1.1)

Troubleshooting requires an organized and logical approach to problems with computers and other components. Sometimes issues arise during preventive maintenance. At other times, customers may contact you with problems. Taking a logical approach to troubleshooting allows you to eliminate variables and identify causes of problems in a systematic order. Asking the right questions, testing the right hardware, and examining the right data helps you understand the problem and form a proposed solution.

Troubleshooting is a skill that you refine over time. Each time you solve a problem, you increase your troubleshooting skills by gaining more experience. You learn how and when to combine steps, or skip steps, to reach a solution quickly. The troubleshooting process is a guideline that is modified to fit your needs.

This section presents an approach to problem solving that you can apply to both hardware and software.

Note

The term *customer*, as used in this book, refers to any user who requires technical computer assistance.

Before you begin troubleshooting problems, always follow the necessary precautions to protect data on a computer. Some repairs, such as replacing a hard drive or reinstalling an operating system, might put the data on the computer at risk. Make sure you do everything possible to prevent data loss while attempting repairs. If your work results in data loss for the customer, you or your company could be held liable.

Data Backup

A ***data backup*** is a copy of the data on a computer hard drive that is saved to another storage device or to cloud storage. ***Cloud storage*** is online storage that is accessed via the Internet. In an organization, backups may be performed on a daily, weekly, or monthly basis.

If you are unsure about whether a backup has been done, do not attempt any troubleshooting activities until you check with the customer. Here is a list of items to verify with the customer regarding whether a backup has been performed:

- Date of the last backup
- Contents of the backup
- Data integrity of the backup
- Availability of all backup media for a data restore

If the customer does not have a current backup and you are not able to create one, ask the customer to sign a liability release form. A liability release form contains at least the following information:

- Permission to work on the computer without having a current backup available
- Release from liability if data is lost or corrupted
- Description of the work to be performed

Troubleshooting Process Steps (4.2.1.2)

The *troubleshooting process steps* are as follows:

Step 1. Identify the problem.

Step 2. Establish a theory of probable cause.

Step 3. Test the theory to determine the cause.

Step 4. Establish a plan of action to resolve the problem and implement the solution.

Step 5. Verify full system functionality and, if applicable, implement preventive measures.

Step 6. Document findings, actions, and outcomes.

Identify the Problem (4.2.1.3)

The first step in the troubleshooting process is to identify the problem. During this step, gather as much information as possible from the customer and from the computer.

Conversation Etiquette

When you are talking to a customer, follow these guidelines:

- Ask direct questions to gather information.
- Do not use industry jargon.
- Do not talk down to the customer.
- Do not insult the customer.
- Do not accuse the customer of causing the problem.

Table 4-1 lists some of the information to gather from the customer.

Table 4-1 Step 1: Identify the Problem

Customer information	■ Company name ■ Contact name ■ Address ■ Phone number
Computer configuration	■ Manufacturer and model ■ Operating system ■ Network environment ■ Connection type

Problem description	■ Open-ended questions ■ Closed-ended questions
Error messages	
Beep sequences	
LEDs	
POST	

Open-Ended and Closed-Ended Questions

Open-ended questions allow customers to explain the details of the problem in their own words. Use open-ended questions to obtain general information.

Based on the information from the customer, you can proceed with ***closed-ended questions***. A closed-ended questions generally requires a yes or no answer.

Documenting Responses

Document the information from the customer in the work order, in the repair log, and in your repair journal. Write down anything that you think might be important for you or another technician. The small details often lead to the solution of a difficult or complicated problem.

Beep Codes

Each BIOS manufacturer has a unique beep sequence, a combination of long and short beeps, for hardware failures. When troubleshooting, power on the computer and listen. As the system proceeds through the POST, most computers emit one beep to indicate that the system is booting properly. If there is an error, you might hear multiple beeps. Document the beep code sequence and research the code to determine the specific problem.

BIOS Information

If the computer boots and stops after the POST, investigate the BIOS settings. A device might not be detected or configured properly. Refer to the motherboard documentation to ensure that the BIOS settings are correct.

Event Viewer

When system, user, or software errors occur on a computer running Windows, the Event Viewer is updated with information about the errors. The ***Event Viewer***, shown in Figure 4-2, records the following information about the problem:

- What problem occurred
- The date and time of the problem

- The severity of the problem
- The source of the problem
- The event ID number
- Which user was logged in when the problem occurred

Figure 4-2 Event Viewer

Although the Event Viewer lists details about an error, you might need to further research the problem to determine a solution.

Device Manager

The ***Device Manager***, shown in Figure 4-3, displays all the devices that are configured on a computer. The operating system flags the devices that are not operating correctly with an error icon. A yellow triangle with an exclamation point indicates that the device is in a problem state. A red X means that the device is disabled or removed or that Windows can't locate the device. An downward-pointing arrow means the device has been disabled. A yellow question mark indicates that the system does not know which driver to install for the hardware.

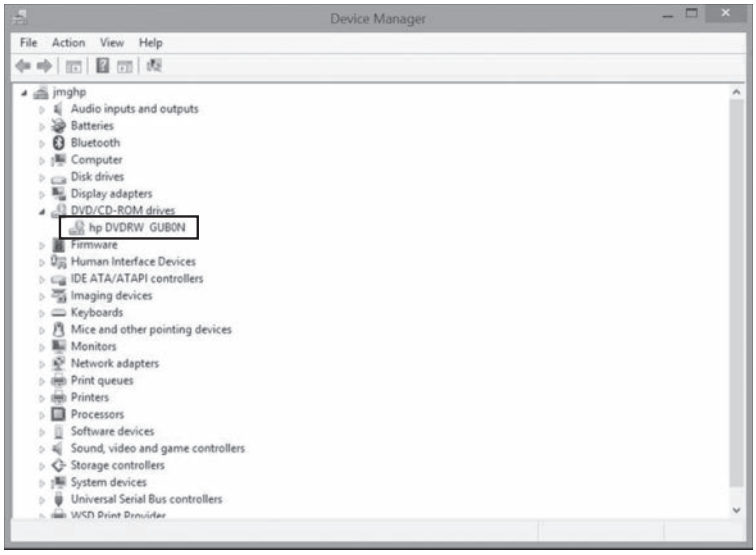

Figure 4-3 Device Manager

Task Manager

The ***Task Manager***, shown in Figure 4-4, displays the applications and background processes that are currently running. With the Task Manager, you can close applications that have stopped responding. You can also monitor the performance of the CPU and virtual memory, view all processes that are currently running, and view information about the network connections.

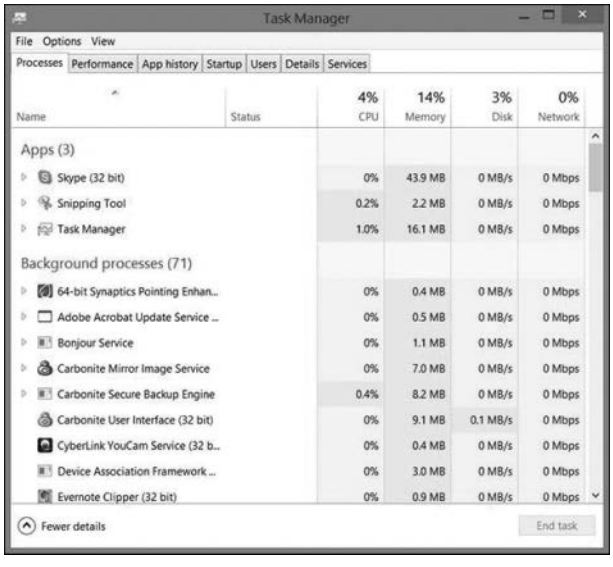

Figure 4-4 Task Manager

Diagnostic Tools

Conduct research to determine what software is available to help diagnose and solve problems. Many programs can help you troubleshoot hardware. Manufacturers of system hardware usually provide diagnostic tools of their own. For instance, a hard drive manufacturer might provide a tool to boot the computer and diagnose why the hard drive does not start the operating system.

Interactive Graphic

Check Your Understanding 4.2.1.4: Identify the Problem

Refer to the online course to complete this activity.

Establish a Theory of Probable Cause (4.2.1.5)

The second step in the troubleshooting process is to establish a theory of probable cause. First, create a list of the most common reasons for the error. Even if the customer thinks there is a major problem, start with the obvious issues before moving to more complex diagnoses, as outlined here:

1. Check whether the device is powered off.
2. Determine whether the power switch for an outlet is turned off.
3. Check whether the surge protector is turned off.
4. Ensure that there are no loose external cable connections.
5. Check whether there is a non-bootable disk in the designated boot drive.
6. Look for the incorrect boot order in the BIOS setup.

List the easiest or most obvious causes at the top. List the more complex causes at the bottom. If necessary, conduct internal (logs, journal) or external (internet) research based on the symptoms. The next steps of the troubleshooting process involve testing each possible cause.

Test the Theory to Determine the Cause (4.2.1.6)

You can determine an exact cause by testing your theories of probable causes one at a time, starting with the quickest and easiest. Some common steps to determine the cause of the problem are as follows:

1. Ensure that the device is powered on.
2. Ensure that the power switch for an outlet is turned on.
3. Ensure that the surge protector is turned on.
4. Ensure that external cable connections are secure.
5. Ensure that the designated boot drive is bootable.
6. Verify the boot order in the BIOS setup.

Once the theory is confirmed, you can determine the steps to resolve the problem. As you become more experienced at troubleshooting computers, you will work through the steps in the process faster. For now, practice each step to better understand the troubleshooting process.

If you cannot determine the exact cause of a problem after testing all your theories, establish a new theory of probable cause and test it. If necessary, escalate the problem to a technician with more experience. Before you escalate, document each test that you tried, as shown in Figure 4-5.

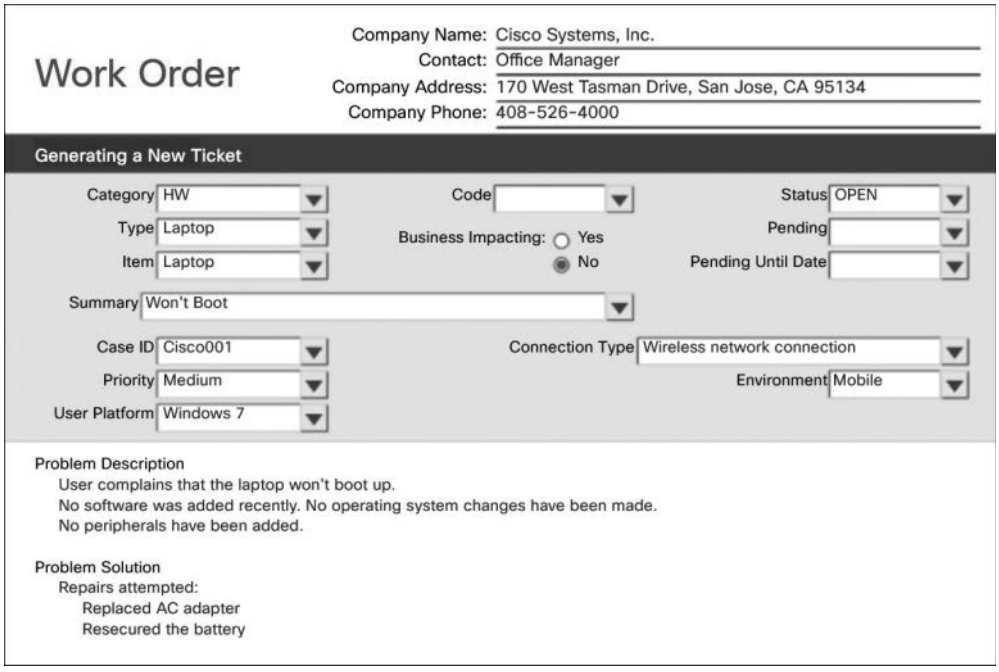

Figure 4-5 Work Order

Establish a Plan of Action to Resolve the Problem and Implement the Solution (4.2.1.7)

After you have determined the exact cause of the problem, establish a plan of action to resolve the problem and implement the solution. Sometimes quick procedures can correct the problem. If a quick procedure does correct the problem, verify full system functionality and, if applicable, implement preventive measures. If a quick procedure does not correct the problem, research the problem further and then return to Step 2 to establish a new theory of the probable cause.

Note

Always consider corporate policies, procedures, and impacts before implementing any changes.

After you have established a plan of action, you should research possible solutions such as the following:

- Help desk repair logs
- Other technicians
- Manufacturer FAQs
- Technical websites
- News groups
- Computer manuals
- Device manuals
- Online forums
- Internet search

Divide large problems into smaller problems that can be analyzed and solved individually. Prioritize solutions starting with the easiest and fastest to implement. Create a list of possible solutions and implement them one at a time. If you implement a possible solution and it does not correct the problem, reverse the action you just took and then try another solution. Continue this process until you have found the appropriate solution.

Verify Full Functionality and, if Applicable, Implement Preventive Measures (4.2.1.8)

After the repairs to the computer have been completed, continue the troubleshooting process by verifying full system functionality and implementing the preventive measures needed, as outlined here:

1. Reboot the computer.
2. Ensure that multiple applications work properly.
3. Verify network and Internet connections.
4. Print a document from one application.
5. Ensure that all attached devices work properly.
6. Ensure that no error messages are received.

Verifying full system functionality confirms that you have solved the original problem and ensures that you have not created another problem while repairing the computer. Whenever possible, have the customer verify the solution and system functionality.

Document Findings, Actions, and Outcomes (4.2.1.9)

After the repairs to the computer have been completed, finish the troubleshooting process with the customer. Explain the problem and the solution to the customer verbally and in writing. The steps to take when you have finished a repair are as follows:

1. Discuss the solution implemented with the customer.
2. Have the customer verify that the problem has been solved.
3. Provide the customer with all paperwork.
4. Document the steps taken to solve the problem in the work order and in the technician's journal.
5. Document any components used in the repair.
6. Document the amount of time spent on resolving the problem.

Verify the solution with the customer. If the customer is available, demonstrate how the solution has corrected the computer problem. Have the customer test the solution and try to reproduce the problem. When the customer can verify that the problem has been resolved, you can complete the documentation for the repair in the work order and in your journal. Include the following information in the documentation:

- Description of the problem
- Steps to resolve the problem
- Components used in the repair

Interactive Graphic

Check Your Understanding 4.2.1.10: Number the Steps

Refer to the online course to complete this activity.

Common Problems and Solutions for PCs (4.2.2)

As a technician, you will run into technical problems in your day-to-day routine that need your attention. As the issues arise, take the time to better understand the causes of problems and work through possible fixes. Be sure to document all that you do. This section discusses several common PC problems and suggested solutions.

PC Common Problems and Solutions (4.2.2.1)

Computer problems can be attributed to hardware, software, networks, or some combination of the three. You will resolve some types of problems more often than others.

Some common hardware problems are as follows:

- **Storage device:** Storage device problems are often related to loose or incorrect cable connections, incorrect drive and media formats, and incorrect jumper and BIOS settings.
- **Motherboard and internal components:** Motherboard and internal component problems are often caused by incorrect or loose cables, failed components, incorrect drivers, and corrupted updates.
- **Power supply:** Power problems are often caused by a faulty power supply, loose connections, and inadequate wattage.
- **CPU and memory:** Processor and memory problems are often caused by faulty installations, incorrect BIOS settings, inadequate cooling and ventilation, and compatibility issues.
- **Displays:** Display problems are often caused by incorrect settings, loose connections, and incorrect or corrupted drivers.

Common Problems and Solutions for Storage Devices (4.2.2.2)

Table 4-2 shows the probable causes and possible solutions for storage devices.

Table 4-2 Common Problems and Solutions for Storage Devices

Identify the Problem	Probable Causes	Possible Solutions
The computer does not recognize a storage device.	The power cable is loose.	Secure the power cable.
	The data cable is loose.	Secure the data cable.
	The jumpers are set incorrectly.	Reset the jumpers.
	A storage device failed.	Replace the storage device.
	The storage device settings in BIOS are incorrect.	Reset the storage device settings in BIOS.
The computer does not recognize an optical disc.	The disc is inserted upside down.	Insert the disc correctly.
	There is more than one disc inserted in the drive.	Ensure that there is only one disc inserted in the drive.
	The disc is damaged.	Replace the disc.
	A disc is the wrong format.	Use the correct type of disc.
	The optical drive is faulty.	Replace the optical drive.

Identify the Problem	Probable Causes	Possible Solutions
The computer will not eject an optical disc.	The optical drive is jammed.	Insert a pin in the small hole next to the eject button on the drive to open the drive.
	The optical drive has been locked by software.	Reboot the computer.
	The optical drive is faulty.	Replace the optical drive.
The computer does not recognize a removable external drive.	The removable external drive cable is not seated properly.	Remove and re-insert the drive cable.
	The external ports are disabled in the BIOS settings.	Enable the ports in the BIOS settings.
	The removable external drive is faulty.	Replace the removable external drive.
A media reader cannot read a memory card that works properly.	The media reader does not support the memory card type.	Use a different memory card type.
	The media reader is not connected correctly.	Ensure that the media reader is connected correctly in the computer.
	The media reader is not configured properly in the BIOS settings.	Reconfigure the media reader in the BIOS settings.
	The media reader is faulty.	Install a known good media reader.
Retrieving or saving data from the USB flash drive is slow.	The motherboard does not support USB 3.0 or 3.1.	Replace the motherboard with a USB 3.0-capable motherboard or add a USB 3.0 expansion card.
	The USB Flash drive might be connected to a USB port rated slower or not configured properly.	The port is set to full speed in the BIOS settings.

Common Problems and Solutions for Motherboards and Internal Components (4.2.2.3)

Table 4-3 shows common problems and solutions for motherboards and internal components.

Table 4-3 Common Problems and Solutions for Motherboards and Internal Components

Identify the Problem	Probable Causes	Possible Solutions
The clock on the computer is no longer keeping the correct time or the BIOS settings are changing when the computer is rebooted.	The CMOS battery may be loose.	Secure the battery.
	The CMOS battery may be drained.	Replace the battery.
After updating the BIOS firmware, the computer will not start.	The BIOS firmware update did not install correctly.	Contact the motherboard manufacturer to obtain a new BIOS chip. (If the motherboard has two BIOS chips, the second BIOS chip can be used.)
The computer displays incorrect CPU information when the computer boots.	The CPU settings are not correct in the advanced BIOS settings.	Set the advanced BIOS settings correctly for the CPU.
	BIOS does not properly recognize the CPU.	Update the BIOS.
The hard drive LED on the front of the computer does not light.	The hard drive LED cable is not connected or is loose.	Reconnect the hard drive LED cable to the motherboard.
	The hard drive LED cable is incorrectly oriented to the front case panel connections.	Correctly orient the hard drive LED cable to the front case panel connection and reconnect it.
The built-in NIC has stopped working.	The NIC hardware has failed.	Add a new NIC to an open expansion slot.
The computer does not display any video after a new PCIe video card is installed.	BIOS settings are set to use the built-in video.	Disable the built-in video in the BIOS settings.
	The monitor cable is still connected to the built-in video.	Connect the monitor cable to the new video card.
	The new video card needs auxiliary power.	Connect any required power connectors to the video card.
	The new video card is faulty.	Install a known good video card.

Identify the Problem	Probable Causes	Possible Solutions
The new sound card does not work.	The speakers are not connected to the correct jack.	Connect the speakers to the correct jack.
	The audio is muted.	Unmute the audio.
	The sound card is faulty.	Install a known good sound card.
	BIOS settings are set to use the on-board sound device.	Disable the on-board audio device in the BIOS settings.
System attempts to boot to an incorrect device.	Media was left in a removable drive.	Check that the removable drives do not contain media that is interfering with the boot process and ensure that the boot order is configured correctly.
	Boot order configured incorrectly.	Check that the removable drives do not contain media that is interfering with the boot process and ensure that the boot order is configured correctly.
User can hear fans spinning, but the computer does not start, and there are no beeps from the speaker.	POST procedure is not executing.	Faulty cabling or damaged or mis-seated CPU or other motherboard component needs to be replaced.
Motherboard capacitors are distended, swollen, emitting residue, or bulging.	Damage has occurred due to heat, ESP, power surge, or spike.	Replace the motherboard.

Common Problems and Solutions for Power Supplies (4.2.2.4)

Table 4-4 lists common problems and solutions for power supplies.

Table 4-4 Common Problems and Solutions for Power Supplies

Identify the Problem	Probable Causes	Possible Solutions
The computer will not turn on.	The computer is not plugged into the AC outlet.	Plug the computer into a known good AC outlet.
	The AC outlet is faulty.	Plug the computer into a known good AC outlet.
	The power cord is faulty.	Use a known good power cord.
	The power supply switch is not turned on.	Turn on the power supply switch.
	The power supply switch is set to the incorrect voltage.	Set the power supply switch to the correct voltage setting.
	The power button is not connected correctly to the front panel connector.	Correctly orient the power button to the front case panel connector and reconnect.
	The power supply has failed.	Install a known good power supply.
The computer reboots and turns off unexpectedly; or there is smoke or the smell of burning electronics.	The power supply is starting to fail.	Replace the power supply.

Common Problems and Solutions for CPUs and Memory (4.2.2.5)

Table 4-5 lists common problems and solutions for CPUs and memory.

Table 4-5 Common Problems and Solutions for CPUs and Memory

Identify the Problem	Probable Causes	Possible Solutions
The computer will not boot or it locks up.	The CPU has overheated.	Reinstall the CPU.
	The CPU fan is failing.	Replace the CPU fan.
	The CPU has failed.	Add fan(s) to the case. Replace the CPU fan. Replace the CPU.
The CPU fan is making an unusual noise.	The CPU fan is failing.	Replace the CPU fan.

Identify the Problem	Probable Causes	Possible Solutions
The computer reboots without warning, locks up, or displays error messages.	The front-side bus is set too high.	Reset to the factory default settings for the motherboard.
		Lower the front-side bus settings.
	The CPU multiplier is set too high.	Lower the multiplier settings.
	The CPU voltage is set too high.	Lower the CPU voltage settings.
After upgrading from a single-core CPU to a dual-core CPU, the computer runs more slowly and shows only one CPU graph in the Task Manager.	The BIOS does not recognize the dual-core CPU.	Update the BIOS firmware to support the dual-core CPU.
A CPU does not install onto the motherboard.	The CPU is the incorrect type.	Replace the CPU with a CPU that matches the motherboard socket type.
The computer does not recognize the RAM that was added.	The new RAM is faulty.	Replace the RAM.
	The incorrect type of RAM was installed.	Install the correct type of RAM.
	The RAM that has been added is not the same type of RAM that was already installed.	Install the correct type of RAM.
	The new RAM is loose in the memory slot.	Secure the RAM in the memory slot.
After upgrading Windows, the computer runs very slowly.	The computer does not have enough RAM.	Install additional RAM.
	The video card does not have enough memory.	Install a video card that has more memory.

Common Problems and Solutions for Displays (4.2.2.6)

Table 4-6 lists common problems and solutions for displays

Table 4-6 Common Problems and Solutions for Displays

Identify the Problem	Probable Causes	Possible Solutions
Display has power but no image on the screen.	The video cable is loose or damaged.	Reconnect or replace the video cable.
	The computer is not sending a video signal to the external display.	Use the Fn key along with the multi-purpose key to toggle to the external display.
The display is flickering.	Images on the screen are not refreshing fast enough.	Adjust the screen refresh rate.
	The display inverter is damaged or malfunctioning.	Disassemble the display unit and replace the inverter.
The image on the display looks dim.	The LCD backlight is not properly adjusted.	Check the repair manual for instructions about calibrating the LCD backlight. Adjust the LCD backlight properly.
Pixels on the screen are dead or not generating color.	Power to the pixels has been cut off.	Contact the manufacturer.
The image on the screen appears to flash lines or patterns of different color and size (artifacts).	The display is not properly connected.	Disassemble the display and check the connections.
	The GPU is overheating.	Disassemble and clean the computer, checking for dust and debris.
	The GPU is faulty or malfunctioning.	Replace the GPU.
Color patterns on a screen are incorrect.	The display is not properly connected.	Disassemble the display and check the connections.
	The GPU is overheating.	Disassemble and clean the computer, checking for dust and debris.
	The GPU is faulty or malfunctioning.	Replace the GPU.

Identify the Problem	Probable Causes	Possible Solutions
Images on a display screen are distorted.	Display settings have been changed.	Restore the display settings to the original factory settings.
	The display is not properly connected.	Disassemble the display to a point where you can check the display connections.
	The GPU is overheating.	Disassemble and clean the computer, checking for dust and debris.
	The GPU is faulty or malfunctioning.	Replace the GPU.
The display has a "ghost" image.	The display is experiencing burn-in.	Power off the display and unplug it from the power source for a few hours.
		Use the degauss feature, if it is available.
		Replace the display.
The images on the display have distorted geometry.	The driver has become corrupted.	Update or reinstall the driver in safe mode.
	The display settings are incorrect.	Use the display's settings to correct the geometry.
The monitor has oversized images and icons.	The driver has become corrupted.	Update or reinstall the driver in safe mode.
	The display settings are incorrect.	Use the display's settings to correct the geometry.
The projector overheats and shuts down.	The fan has failed.	Replace the fan.
	The vents are clogged.	Clean the vents.
	The projector is in an enclosure.	Remove the enclosure or ensure proper ventilation.
In a multiple-monitor setup, the displays are not aligned or are incorrectly oriented.	The settings for multiple monitors are not correct.	Use the display control panel to identify each display and set the alignment and orientation.
	The driver has become corrupted.	Update or reinstall the driver in safe mode.
The display is in VGA mode.	The computer is in safe mode.	Reboot the computer.
	The driver has become corrupted.	Update or reinstall the driver in safe mode.

Apply Troubleshooting Process to Computer Components and Peripherals (4.2.3)

Troubleshooting requires that you always have a plan of action. Asking the right questions, narrowing down the cause, re-creating the problem, and attempting to fix the issue based on your plan is a good process for both internal and peripheral components. Once you start troubleshooting, write down each step you take for your future use and that of other technicians.

Personal Reference Tools (4.2.3.1)

Good customer service includes providing the customer with a detailed description of the problem and the solution. It is important for a technician to document all services and repairs and that this documentation be available to all other technicians. The documentation can then be used as reference material for similar problems.

Personal reference tools include troubleshooting guides, manufacturer manuals, quick reference guides, and repair journals. In addition to an invoice, a technician keeps a journal of upgrades and repairs:

- **Notes:** Make notes as you go through the troubleshooting and repair process. Refer to these notes to avoid repeating steps and to determine what needs to be done next.
- **Journal:** Include descriptions of the problem, possible solutions that have been tried to correct the problem, and the steps taken to repair the problem. Note any configuration changes made to the equipment and any replacement parts used in the repair. Your journal, along with your notes, can be valuable when you encounter similar situations in the future.
- **History of repairs:** Make a detailed list of problems and repairs, including the date, replacement parts, and customer information. The history allows a technician to determine what work has been performed on a specific computer in the past.

Internet Reference Tools (4.2.3.2)

The Internet is an excellent source of information about specific hardware problems and possible solutions. Visit the following for helpful information:

- Internet search engines
- News groups
- Manufacturer FAQs
- Online computer manuals
- Online forums and chat
- Technical websites

Interactive Graphic

Check Your Understanding 4.2.3.3: Reference Tools

Refer to the online course to complete this activity.

Advanced Problems and Solutions for Hardware (4.2.3.4)

Table 4-7 lists advanced problems and solutions for hardware.

Table 4-7 Advanced Problems and Solutions for Hardware

Identify the Problem	Probable Causes	Possible Solutions
RAID cannot be found.	The external RAID controller is not receiving power.	Check the power connection to the RAID controller.
	The BIOS settings are incorrect.	Reconfigure the BIOS settings for the RAID controller.
	The RAID controller has failed.	Replace the RAID controller.
RAID stops working.	The external RAID controller is not receiving power.	Check the power connection to the RAID controller.
	The RAID controller has failed.	Replace the RAID controller.
The computer exhibits slow performance.	The computer does not have enough RAM.	Install additional RAM.
	The computer is overheating.	Clean the fans or install additional fans.
The computer does not recognize a removable external drive.	The OS does not have the correct drivers for the removable external drive.	Download the correct drivers for the drive.
	The USB port has too many attached devices to supply adequate power.	Attach external power to the device or remove some of the USB devices.
After updating the BIOS firmware, the computer will not start.	The BIOS firmware update did not install correctly.	Restore the original firmware from the onboard backup, if one is available.
		If the motherboard has two BIOS chips, the second BIOS chip can be used.
		Contact the motherboard manufacturer to obtain a new BIOS chip.

Identify the Problem	Probable Causes	Possible Solutions
The computer reboots without warning, locks up, or displays error messages or the BSOD.	RAM is failing.	Test each RAM module to determine if they are operating correctly.
	The front-side bus is set too high.	Reset to the factory default settings of the motherboard.
		Lower the FSB settings.
	The CPU multiplier is set too high.	Lower the multiplier settings.
		Lower the CPU voltage settings.
After upgrading from a single-core CPU to a multi-core CPU, the computer runs more slowly and shows only one CPU graph in Task Manager.	The BIOS does not recognize the multi-core CPU.	Update the BIOS firmware to support the multi-core CPU.

Lab 4.2.3.5: Use a Multimeter and a Power Supply Tester

In this lab, you will learn how to use and handle a multimeter and a power supply tester.

Lab 4.2.3.6: Troubleshoot Hardware Problems

In this lab, you will diagnose the causes of various hardware problems and solve them.

Summary (4.3)

In this chapter, you learned that there are many benefits of conducting preventive maintenance, such as fewer potential hardware and software problems, less computer downtime, lower repair costs, and less frequent equipment failures. You learned how to keep dust from damaging computer components by keeping air filters clean, cleaning the outside of the computer case, and using compressed air to remove dust from the inside of the computer.

You learned that there are components that should be regularly inspected for dust and damage. These components include the CPU heat sink and fan, RAM modules, storage devices, adapter cards, cables and power devices, and keyboards and mice. You also learned about guidelines for ensuring optimal computer operating performance, such as not obstructing vents or airflow and maintaining proper room temperature and humidity.

In addition to learning how to maintain the hardware of a computer, you learned that it is important to perform regular maintenance on computer software. This is best accomplished with a software maintenance schedule that covers security software, virus definition files, unwanted and unused programs, and hard drive defragmenting.

At the end of the chapter, you learned the six steps in the troubleshooting process as they pertain to preventive maintenance.

Practice

The following activities provide practice with the topics introduced in this chapter. The labs are available in the companion *IT Essentials v7 Labs & Study Guide* (ISBN 9780135612033).

Labs

Lab 4.2.3.5: Use a Multimeter and a Power Supply Tester

Lab 4.2.3.6: Troubleshoot Hardware Problems

Check Your Understanding Questions

Complete all the review questions listed here to test your understanding of the topics and concepts in this chapter. The appendix "Answers to 'Check Your Understanding' Questions" lists the answers.

1. A user has noticed that the hard drive LED on the front of the computer has stopped working. However, the computer seems to be functioning normally. What is the most likely cause of the problem?

   A. The motherboard BIOS needs to be updated.
   B. The power supply is not providing enough voltage to the motherboard.
   C. The hard drive LED cable has come loose from the motherboard.
   D. The hard drive data cable is malfunctioning.

2. After a problem is identified, what is the next step for the troubleshooter?

   A. Document the findings.
   B. Establish a theory of probable causes.
   C. Implement a solution.
   D. Verify the solution.
   E. Determine the exact cause.

3. What is the best way to determine if a CPU fan is spinning properly?

   A. Visually inspect the fan when the power is on to ensure that it is spinning.
   B. Spin the blades of the fan quickly with a finger.
   C. Spray compressed air on the fan to make the blades spin.
   D. Listen for the sound of the fan spinning when the power is on.

4. Which of the following is a symptom of a failing power supply?

   A. The power cord will not attach properly to either the power supply, the wall outlet, or both.
   B. The computer sometimes does not turn on.
   C. The computer displays a POST error code.
   D. The display has only a blinking cursor.

5. In which step of the troubleshooting process would a technician have to do more research on the Internet or using the computer manual in order to solve a problem?

   A. Document findings, actions, and outcomes.
   B. Identify the problem.
   C. Establish a plan of action to resolve the problem and implement the solution.
   D. Verify full system functionality and, if applicable, implement preventive measures.
   E. Test the theory to determine the cause.

6. A user has opened a ticket which indicates that the computer clock keeps losing the correct time. What is the most likely cause of the problem?

   A. The operating system needs to be patched.
   B. The CPU needs to be overclocked.
   C. The CMOS battery is loose or failing.
   D. The motherboard clocking crystal is damaged.

7. Members of a scientific expedition team are using laptops for their work. The temperatures where the scientists are working range from –13 degrees Fahrenheit (–25 degree Celsius) to 80 degrees Fahrenheit (27 degrees Celsius). The humidity level is around 40%. Noise levels are low, but the terrain is rough, and winds can reach 45 miles per hour (72 kilometers per hour). When needed, the scientists stop walking and enter the data using the laptop. Which condition is most likely to adversely affect a laptop that is used in this environment?

   A. wind
   B. humidity
   C. rough terrain
   D. temperature

8. What is the most important reason for a company to ensure that computer preventive maintenance is done?

   A. Preventive maintenance enables the IT manager to check on the location and state of the computer assets.
   B. Preventive maintenance allows the IT department to regularly monitor the contents of user hard drives to ensure that computer use policies are being followed.
   C. Preventive maintenance helps protect computer equipment against future problems.
   D. Preventive maintenance provides an opportunity for junior technicians to obtain more experience in a nonthreatening or problem environment.

9. Which cleaning tool should be used to remove dust from components inside a computer case?

   A. compressed air
   B. damp cloth
   C. cotton swabs
   D. duster

10. What task should be completed before escalating a problem to a higher-level technician?

   A. Redo each test to ensure the accuracy of the results.
   B. Document each test that was tried.
   C. Ask the customer to open a new support request.
   D. Replace all hardware components with components that are known to work.

11. What are two effects of not having a preventive maintenance plan for users and organizations? (Choose two.)

   A. increased number of regular updates
   B. increased management tasks
   C. increased downtime
   D. increased repair costs
   E. increased documentation needs

12. Which procedure is recommended when cleaning inside a computer?

   A. Clean the hard drive heads with a cotton swab.
   B. Hold the CPU fan to prevent it from spinning and blow it with compressed air.
   C. Invert the can of compressed air while spraying.
   D. Remove the CPU before cleaning.

13. Which task should be performed on a hard drive as part of a preventive maintenance plan?

   A. Blow out the inside of the drive with compressed air to remove dust.
   B. Ensure that the disk spins freely.
   C. Ensure that cables are firmly connected.
   D. Clean the read and write heads with a cotton swab.

14. A customer reports that recently several files cannot be accessed. The service technician decides to check the hard disk status and the file system structure. The technician asks the customer if a backup has been performed on the disk, and the customer replies that the backup was done a week ago, and it was stored to a different logical partition on the disk. What should the technician do before performing diagnostic procedures on the disk?

    A. Perform a file restore from the existing backup copy at the logical partition.
    B. Install a new hard disk as the primary disk and then make the current disk a slave.
    C. Run the CHKDSK utility.
    D. Back up the user data to a removable drive.

15. Which of these tasks should be part of a hardware maintenance routine?

    A. Review security updates.
    B. Update virus definition files.
    C. Remove dust from inside the hard drive.
    D. Check for and secure any loose cables.
    E. Adjust the monitor for optimum resolution.

16. During what step in the troubleshooting process does a technician demonstrate to the customer how the solution corrected the problem?

    A. Document the findings, actions, and outcomes.
    B. Establish a theory of probable cause.
    C. Verify full system functionality.
    D. Establish a plan of action to resolve the problem.

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