

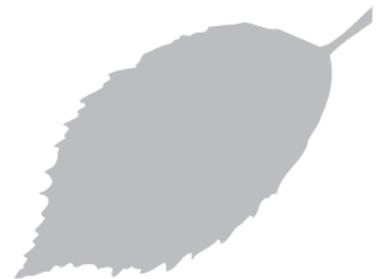
**Massachusetts  
Tests for Educator Licensure® (MTEL®)**



**Digital Literacy and Computer  
Science (71)**

**PRACTICE TEST APPENDIX:**

**Multiple-Choice Question  
Analyses**



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**MULTIPLE-CHOICE QUESTION  
ANALYSES**

1. Which of the following strategies is recommended to prevent eyestrain when looking at a computer screen?
- A. taking a two-minute break every four hours and looking into the distance
  - B. placing the screen an arm's length away and slightly below eye level
  - C. adjusting the room lighting so that it is as bright as possible
  - D. changing the color of the text to a light color against a white background

**Correct Response: B.** "Placing the screen an arm's length away and slightly below eye level" prevents eyestrain. Focusing on the screen at this distance allows the ciliary muscles, which control the shape of the eyes' lenses, to be at rest. Humans see more visual field below the horizon than above. This is why the screen should be slightly below eye level. **A** is incorrect because the computer user should take a two-minute break looking into the distance every fifteen minutes, not every 4 hours (**A**). **C** is incorrect because bright lighting (**C**) should be avoided. It can cause glare and increase eyestrain. It also gives the screen a washed out look that makes it more difficult to view. **D** is incorrect because black print on a white background is the best combination for eye comfort. Light colored print against a white background (**D**) increases eyestrain.

2. Researchers have found that interventions designed to reduce the time children spend viewing screens, playing video games, and using computers result in declines in which of the following health risks?
- A. obesity
  - B. infectious disease
  - C. bipolar disorder
  - D. nutritional deficiencies

**Correct Response: A.** Studies have found that children in screen time reduction intervention groups had statistically significant decreases in body mass index. **B** is incorrect because, while a link via general improvements in physical fitness is possible, interventional studies have not been conducted to demonstrate any causal relationship. **C** is incorrect because bipolar disorder is a complex psychological diagnosis experienced by a subset of the population without obvious mechanistic or studied causal links to screen time (**C**). **D** is incorrect because improvements in healthy lifestyle choices may include, but don't necessarily include, a more nutritious diet (**D**).

3. The primary difference between an email in a phishing attack and an email in a spear phishing attack is that an email in a spear phishing attack:
- A. is personalized or includes personal information to make it appear legitimate.
  - B. is designed to mimic an email coming from a known business or organization.
  - C. attempts to trick a user into sharing sensitive account or financial information.
  - D. provides a link to a website where the user can enter the data requested.

**Correct Response: A.** A spear phishing attack email is personalized or includes personal information about the target. The inclusion of personal information increases the chances that the target will open the email and carry out other actions such as opening infected attachments. **B**, **C**, and **D** are incorrect because, while a spear phishing attack email may be designed to mimic an email coming from a known business or organization (**B**), attempt to trick a user into sharing sensitive account or financial information (**C**), or provide a link to a website where the user can enter the data requested (**D**), these are not what makes a spear phishing attack different from other types of phishing attacks.

4. A student playing an online video game receives a chat message that appears to come from a friend's account that includes a link to a new plugin. The student installs and uses the new plugin. Soon after, the student learns their friend did not send the message and discovers unexplained activity and unauthorized purchases in their online gaming account. The student has been the victim of a:
- A. trojan.
  - B. worm.
  - C. direct denial-of-service attack.
  - D. social engineering attack.

**Correct Response: A.** One type of trojan, called a game-thief trojan, is a piece of malware that, when installed, steals a user's game account information. This can result in "unexplained activity and purchases in their online gaming account." **B**, **C**, and **D** are incorrect because a trojan is different from a worm program (**B**), which automatically spreads copies of itself between computers, a direct denial-of-service attack (**C**), where thousands of computers from around the world send traffic to a website thousands of times per second shutting out legitimate users and crashing the website, or a social engineering attack (**D**), which exploits human psychology to trick people into handing over sensitive information.

5. A proxy server is most likely to improve the security of an organization's network in which of the following ways?
- A. Critical data and system files can be backed up if the network is compromised.
  - B. The traffic load on the network can be balanced so that no one server is overloaded.
  - C. The IP addresses of network computers will be less vulnerable to attacks from hackers.
  - D. Data transmitted to and from the Internet will be blocked whenever a threat is detected.

**Correct Response: C.** A proxy server acts as an intermediary between the computers on an organization's network and the Internet. This guards the IP addresses of the individual computers from being visible from outside of the organization. **A**, **B**, and **D** are incorrect because a proxy server is not involved in the backing up of files (**A**), the balancing of network traffic loads (**B**), or the blocking of threatening data from the Internet (**D**). These functions are typically carried out by network hard drives or cloud back-up services, routers, and firewalls respectively.

6. A student computer user downloads and installs an antivirus software program. The user manually runs the software regularly, but opts to update only manually and infrequently. This situation is most likely to result in which of the following outcomes?
- A. Only files modified since the last update will be scanned.
  - B. The software may not identify files infected with newer virus signatures.
  - C. Data files scanned previously will not be scanned again.
  - D. The software may not be able to quarantine the infected files it finds.

**Correct Response: B.** Antivirus software must be updated frequently because new viruses appear on a regular basis. Without the latest updates, the antivirus software cannot detect the latest viruses. **A**, **C**, and **D** are incorrect because updates have no effect on which files will be scanned (**A** and **C**), or on the quarantining of infected files (**D**).

7. Websites that comply with the European Union's General Data Protection Regulation (GDPR) must give visitors the option to opt out of the use of some cookies. Which of the following factors could jeopardize the privacy of visitors using this process?
- A. Opting out also prevents the use of security-enhancing cookies.
  - B. First-party cookies used by websites for functionality follow users from website to website.
  - C. Losing tracking data due to opt-outs could decrease the advertising revenue of a website.
  - D. Opt-out options may be hidden or deemphasized to prevent visitors from selecting them.

**Correct Response: D.** While websites may meet the literal requirements for cookie opt-out options under GDPR, these options may be "hidden or deemphasized to prevent visitors from selecting them." **A** is incorrect because if "security-enhancing cookies" (**A**) are part of the essential services of the website, for example to store user cookie preferences, they are exempt from the GDPR policy and do not necessarily need to be covered under the opt-out option. This must be covered under the website's cookie policy. **B** is incorrect because first-party cookies are tied to the website and do not "follow users from website to website"(**B**). **C** is incorrect because decreasing "the advertising revenue of a website" (**C**) does not jeopardize the privacy of visitors.

8. A student changes the settings in a Web browser to enable the private browsing mode. This action will have which of the following effects?
- A. The student will not be able to send or receive email while the browser is open.
  - B. The student's computer will not be visible on the Internet.
  - C. The websites the student visits will not be stored in the browser history.
  - D. The student's Internet activity will not be tied to the computer being used.

**Correct Response: C.** The purpose of private browsing mode is to keep any evidence of browsing activities from being stored on a device after the private browsing session is closed. Such evidence includes browser history and saved cookies. **A** is incorrect because during a private browsing session, email can still be sent and received. **B** and **D** are incorrect because private browsing does not provide the anonymity protections of a virtual private network or proxy server, such as blocking visibility of the computer from the Internet (**B**), or disassociating Internet activities from the computer being used (**D**).

9. Which of the following strategies is likely to be most effective in preventing cyberbullying in a school setting?
- A. blocking personal mobile devices from logging on to the school network
  - B. encouraging students who have conflicts to meet with peer mediators to help resolve differences afterward
  - C. using specific cyberbullying incidents as examples of inappropriate online behavior
  - D. developing a school climate that emphasizes social-emotional learning, team building, and inclusion

**Correct Response: D.** Cyberbullying in schools is fueled by a lack of empathy and compassion exhibited by both perpetrators and bystanders. To prevent cyberbullying, this situation needs to be addressed by building a "school climate that emphasizes social-emotional learning, team building, and inclusion" (**D**). **A** is incorrect because "blocking personal mobile devices" (**A**) will not prevent cyberbullying on school devices. **B** and **C** are incorrect because focusing on "students who have conflicts," (**B**) or "using specific cyberbullying incidents as examples" (**C**), misses the point that cyberbullying is a reflection of the emotional health of the school community as a whole, and not of just the perpetrators.

10. To avoid unintentional software piracy, students should:
- A. refer to end-user license agreements for terms and conditions.
  - B. use software on computers in their own homes.
  - C. download software from peer-to-peer sites.
  - D. share copies of original software only after receiving an upgraded version.

**Correct Response: A.** Students must understand software end-user license agreements in order to avoid unintentional software piracy. These agreements specify exactly how the software can and cannot be used legally. **B** is incorrect because even personal use in students' own homes can constitute piracy. **C** is incorrect because peer-to-peer sites have a reputation for sharing pirated software. **D** is incorrect because even after receiving an upgraded software version, it is not legal to share copies of the earlier version.

11. Which of the following actions involving technology would most likely be considered unethical but not illegal?
- A. A hacker gains access to a company's network, copies personal financial data, and saves it on a hard drive for use at a later date.
  - B. The owner of a website that sells nutritional supplements allows customers to freely purchase medications that require a prescription from a doctor in their regions.
  - C. A theater teacher uses the school's network to send an email encouraging colleagues to attend an upcoming school fundraising performance.
  - D. An Internet blogger with thousands of followers knowingly posts partial statistics and slanted evidence related to a regional environmental issue.

**Correct Response: D.** Posting misleading information to deceive readers is unethical even though it is legal under freedom of speech. **A** is incorrect because hacking into a company's network to steal personal and financial data is neither ethical nor legal. **B** is incorrect because supplying prescription medication without required documentation is illegal. **C** is incorrect because there is nothing unethical or illegal about a teacher using their school's network to send an email promoting a school event.

12. The Children's Internet Protection Act (CIPA) requires that schools and libraries receiving E-Rate discounts have in place technologies to:
- A. store usernames and passwords safely and securely.
  - B. prevent minors from viewing obscene or harmful material.
  - C. deny access to questionable website content to all users.
  - D. monitor and log minors' total Internet usage time.

**Correct Response: B.** According to the Federal Communications Commission (FCC), "The protection measures must block or filter Internet access to pictures that are: (a) obscene; (b) child pornography; or (c) harmful to minors (for computers that are accessed by minors)." **A** is incorrect because CIPA says nothing about the storage of usernames and passwords. **C** is incorrect because the requirements pertain only to minors and not to all users. **D** is incorrect because the requirements do not say anything about monitoring and logging minors' total Internet usage time.

13. A digital literacy teacher plans to make a year-end video showcasing their fifth-grade class and the work students have done. One of the students in the class does not have a video/image release form on file with the school office. In which of the following ways can the student be represented in the class video without violating the Children's Online Privacy Protection Act (COPPA)?
- A. video of the class that shows the student, but not their face
  - B. images of work products captioned with the student's name
  - C. anonymous video samples of the student's digital art
  - D. audio interviews with the student in which they are not identified by name

**Correct Response: C.** Samples of a minor's artwork may be shared without permission from parents/guardians as long as they do not contain any identifying information. **A** is incorrect because videos of student minors may not be shared without parent/guardian permission, even if they do not show students' faces. **B** is incorrect because minor students' names may not be shared without permission from parents/guardians. **D** is incorrect because audio interviews with minor students may not be shared without parent/guardian permission, even if the students are not identified by name.

14. During a lesson on cyberbullying prevention, an elementary teacher discusses characteristics of cyberbullying with students. Which of the following additional strategies would best promote positive and responsible digital citizenship skills among students in the context of this lesson?
- A. illustrating for students strategies and techniques that will help them distinguish between real and cyber experiences in the same way that adults do
  - B. familiarizing students with cyberbullying techniques, such as creating a fake persona or website to harass someone or hacking into someone's account and sharing private details and images
  - C. posting on the school's website links to parental control and monitoring software and step-by-step protocols for preventing or blocking student access to social media accounts
  - D. increasing students' knowledge of and empathy for the effects of cyberbullying, and emphasizing the necessity of not sharing, tolerating, or providing feedback to cyberbullying posts

**Correct Response: D.** Responsible digital citizens have empathy for victims of cyberbullying, and they avoid supporting this behavior through the sharing, tolerating, or providing of feedback to cyberbullying posts. **A** is incorrect because bullying should not be tolerated, no matter the medium. **B** is incorrect because knowledge of techniques may help students protect themselves, but does not get at the root issues around cyberbullying and its spread. **C** is incorrect because monitoring student Internet activity and blocking student access to social media will not provide opportunities to promote positive and responsible digital citizenship skills among students.

15. Which of the following strategies would be most appropriate for student computer users who are interested in minimizing their passive digital footprint?
- A. sharing only videos created by well-known influencers
  - B. refraining from liking or sharing social media content
  - C. ensuring that all online subscription services are set to be renewed manually
  - D. avoiding posting photos of school events on the school's social media site

**Correct Response: B.** A passive digital footprint consists of information about a person that can be collected based on their online activities such as liking or sharing social media content. **A** is incorrect because even sharing videos created by well-known influencers will contribute to a user's passive digital footprint. **C** is incorrect because online subscription services, regardless of how they are renewed, contribute to a user's passive digital footprint. **D** is incorrect because posting photos of school events on any site will contribute to a user's passive digital footprint.

16. Which of the following uses of copyright-protected information is most likely to be permissible under fair use guidelines?
- A. A book reviewer quotes verbatim a few lines from a new novel as part of a review that appears in an online magazine.
  - B. A language arts teacher scans an anthology of poetry and distributes digital copies to students at the start of the school year.
  - C. A student downloads a graphic image from a non-profit website and uses it on their own site, attributing it to the original website.
  - D. A researcher uses references at the end of a journal article as background information for their own research.

**Correct Response:** **A.** Quoting a small excerpt from a copyrighted written work for the purpose of commenting upon or critiquing the work is permissible under fair use guidelines. **B** is incorrect because scanning and distributing digital copies of an entire anthology of poetry adds no value and hurts the owner's ability to profit from the work. It is therefore not permissible under fair use guidelines. **C** is incorrect because attribution is irrelevant to fair use guidelines. **D** is incorrect because background research is permitted and one of the main purposes of reference lists and thus needs no fair use doctrine protection.

17. A teacher has instructed students working on a research project to maintain separate files for their own writing and excerpts from outside sources. The teacher notices that a student has cut and pasted an academic journal excerpt into the file intended for their own writing. After instructing the student to move the excerpt to the file intended for outside sources, which of the following scenarios illustrates the best way to respond ethically in this situation?
- A. sharing this information with the student's other teachers so that they can reinforce appropriate use of resources
  - B. guiding the student away from the journal and toward similar open-access articles and works in the public domain
  - C. showing the student how to cite the journal article while describing basic copyright guidelines
  - D. instructing the student to sufficiently paraphrase the excerpt so that it does not need to be cited

**Correct Response: C.** If the student believes that the excerpt may be useful to the research project, the teacher should instruct the student in the ethical use of the excerpt. **A** is incorrect because rather than involving other teachers, the teacher should take advantage of this learning opportunity to cover proper citation methods. **B** is incorrect because there is no reason to guide the student away from the journal since it can be used with proper citation. **D** is incorrect because to sufficiently paraphrase the excerpt in order to avoid the need for citation is not an ethical option.

18. A software developer has created a new software application. Creating a software license that users must review and accept before downloading the application will allow the developer to:
- A. disclose warranty disclaimers for the software.
  - B. ensure that the software is not shared with other individuals.
  - C. set the price the purchaser will pay for the software.
  - D. explain how to download and install the software.

**Correct Response: A.** By requiring the acceptance of warranty disclaimers before the software is downloaded, the software developer is absolved of liability for harm done using the software, within the limitations of the law. **B** is incorrect because accepting an agreement cannot keep the user from sharing the software with other individuals. **C** is incorrect because the establishment of the purchase price is not part of the software license. **D** is incorrect because while it might be beneficial to provide installation information, it would not be bundled with the license, a legal document.

19. A student downloads open-source code under the GNU General Public License from an online repository. Under this type of license, the student is allowed to:
- A. modify the code and then embed it in software that is distributed under a proprietary license.
  - B. use the original code for profit if licensing fees are paid to the repository.
  - C. freely modify and redistribute the code under the same copyright licensing terms.
  - D. distribute the code along with a school proprietary application.

**Correct Response: C.** The GPL allows users to freely modify and redistribute the code under the same copyright licensing terms. **A** is incorrect because code covered under the GPL may not be included (in original or modified form) in a product distributed under a proprietary license. **B** is incorrect because code covered under the GPL may not be used for profit. **D** is incorrect because school proprietary applications may not be distributed, even if included with code covered under the GPL.

20. A digital literacy teacher creates a website to explain project guidelines to students and parents/guardians and to model Web design. The teacher tests the site on several popular browsers before deploying it, but later receives feedback that the site does not display properly and cannot be easily read on smartphones or other mobile devices. Students would be at a disadvantage in this case if their households:
- A. tend to adopt new technologies early.
  - B. rely on mobile-based translation apps.
  - C. prioritize mobile devices and connections based on cost.
  - D. prefer mobile devices because heads-of-house are younger adults.

**Correct Response: C.** To be disadvantaged is to be deprived of equal advantages due to lack of resources, such as money to buy a computer. **A** is incorrect because early adopters still have access to computers if they need them. **B** is incorrect because students can access the site on a computer and still use their mobile devices for translation. **D** is incorrect because, while they prefer to use mobile devices, they can still choose to use computers.

21. Which of the following uses of digital imaging is an example of the application of artificial intelligence to medicine?
- A. reviewing images of eyes with an algorithm to identify glaucoma risk
  - B. attaching CT scans to an electronic health care record
  - C. allowing review of X-rays by doctors and patients via mobile application
  - D. tracking the height and weight of children over time

**Correct Response: A.** Artificial intelligence allows computers to analyze incoming data and use the results to make a decision. In this case, the incoming data is the image file, the analysis is the algorithm, and the decision is the identified risk of glaucoma. **B** is incorrect because it does not involve any data analysis or decision making. **C** is incorrect because the analysis is conducted by the doctors and patients, and not by a computer. **D** is incorrect because the data is not analyzed or used to make any decisions.

22. The presence of near field communication (NFC) in mobile devices facilitates:
- A. seamless video chat while on the same network.
  - B. tap-to-pay mobile payments.
  - C. collection of step counts and other movement data.
  - D. instantly geotagging photographs.

**Correct Response: B.** NFC is an extremely short-range (4 cm or less) wireless communication protocol for small amounts of data. This makes it an excellent choice for communication between a credit/debit card and a reader during the tap-to-pay process. **A** is incorrect because video chats require large amounts of data and long distances. **C** is incorrect because collection of movement data is done either using a device's internal accelerometer or through a wired or wireless connection of a remote accelerometer. When wireless technology is used, it is over distances larger than 4 cm. **D** is incorrect because the instant geotagging of photographs is done using a global positioning system and does not involve extremely short-range wireless communication.

23. A student uses a Bluetooth®-connected hearing aid to take in audio media, including from a clip-on microphone worn by their teacher during class. Which of the following factors is most important for the teacher to consider in order to facilitate the student's full participation in class activities?
- A. the distance between the student and the transmitting media source
  - B. whether the student has logon credentials for local Wi-Fi networks
  - C. the available bandwidth over cellular networks in the classroom
  - D. if the media volume is lower than an unaided student could hear

**Correct Response: A.** While Bluetooth® has a theoretical range of approximately 30 feet, many factors in this particular application can reduce the actual range. These factors include power constraints due to small batteries, antenna constraints due to small size, and signal attenuation due to obstacles such as the bodies of other students in the classroom. **B** is incorrect because Bluetooth® operates independent of local Wi-Fi networks. **C** is incorrect because Bluetooth® operates independent of cellular networks. **D** is incorrect because the media volume is adjusted by the student and not by the teacher.

24. A common low-vision assistive technology is a screen magnifier, which enlarges a portion of the text on a screen. Which of the following features of screen magnification would most impede a student's ability to find information efficiently?
- A. cost of the device
  - B. amount of scrolling required
  - C. blurry magnified text
  - D. non-magnified mouse pointer

**Correct Response: B.** The student can only read a portion of the text on the screen at one time. This makes it necessary to scroll in order to read the entire page. **A** is incorrect because a screen magnifier is an included accessibility feature of most devices free of cost. **C** is incorrect because embedded rasterizing algorithms assure that text is sharply displayed regardless of magnification. **D** is incorrect because screen magnification includes magnification of the entire selected portion, including the mouse pointer. Additionally, another common accessibility feature is mouse pointer magnification for the entire screen.

25. A teacher is expected to respond to parent/guardian emails within 24 hours and regularly upload content to the school's learning management system (LMS). The primary benefit of this type of electronic communication is that it:
- A. helps students assume greater accountability for their performance.
  - B. creates a public record to support assessment results.
  - C. allows the teacher to interact more frequently with students.
  - D. builds rapport and trust between home and school.

**Correct Response: D.** A strong partnership between home and school promotes student learning and success. To build and support this partnership, teachers should provide parents/guardians with thorough and timely communications. **A** and **C** are incorrect because these communications include the parents/guardians, and not just students. **B** is incorrect because these communications are mostly student-specific and would not be public record.

26. Which of the following statements best describes a significant disadvantage of real-time photo and video sharing during times of crisis?
- A. False and inflammatory information regarding events can be communicated just as quickly.
  - B. Governments can choose to block specific types of information from being disseminated.
  - C. The speed at which information can be delivered decreases as the number of people viewing it increases.
  - D. Businesses can also instantly capitalize on people's communication about particular events through targeted advertising.

**Correct Response:** **A.** Because information is no longer curated by networks or regulated by authorities, the public has become extremely vulnerable to false and misleading content. **B** is incorrect because anybody can post anything instantly and there is no time for the government to block it quickly enough. **C** is incorrect because the Internet is so robust that it can handle massive numbers of users without any reduction in speed. **D** is incorrect because targeted advertising does not depend on speed of posts and it is equally applicable at times when there is no crisis.

27. Two students are discussing a controversial article that they read on their favorite social networking platform. The teacher can best help the students evaluate if the story is reliable by recommending that they:
- A. identify how many other people shared the story.
  - B. discuss the story with classmates to determine if they feel that the story is factual.
  - C. research the author's credentials and affiliations and consider potential bias.
  - D. find out if any of the network's most influential users have commented on the story.

**Correct Response: C.** To evaluate the reliability of content on the Internet, it is important to investigate the author's credentials as well as any affiliations that could motivate their agenda or create a bias. **A** and **B** are incorrect because the popularity of an article and its ability to persuade do not prove its reliability. **D** is incorrect because even influential users can either be fooled, or be biased.

28. A student is conducting online research on the health benefits and effectiveness of a particular type of nutritional supplement. The student has found two websites that discuss the benefits of the supplement and include testimonials from satisfied customers who have used it. Which of the following questions would best help the student determine whether the information found on these websites is accurate?
- A. When was the content last updated by the site owner?
  - B. Can the content be verified by other credible sources?
  - C. Do the links on the home page connect to other websites?
  - D. Has the content been reviewed and revised by others?

**Correct Response: B.** The most reliable evidence of the accuracy of information on a website is corroboration from separate, unaffiliated, credible sources. **A** is incorrect because even dishonest claims can be easily updated. **C** is incorrect because external links on a home page have no bearing on the accuracy of a website. **D** is incorrect because external reviewers can bring their own agendas.

29. Middle school students will be conducting a research project on historical figures. Group members will collaborate with one another and groups researching the same figures will collaborate with one another. Individual students will conduct and contribute their own research, eventually creating a single, dynamic body of knowledge about each figure. Which of the following digital tools would best allow students to collaborate in this way?
- A. updateable Web page (wiki)
  - B. instant messaging
  - C. video recording (vlog)
  - D. photo editing suite

**Correct Response: A.** A classroom wiki is a collection of webpages that is designed to be created and revised collaboratively. The teacher can design it to fit the needs of the project. It would be an excellent platform for the described collaborative research project. **B** is incorrect because blog posts are sequential and do not provide enough flexibility for a creative, collaborative project. **C** and **D** are incorrect because, while video recordings (**C**) and photos (**D**) could be incorporated into the project, they are not collaborative tools.

30. Teachers at several schools across the country will be discussing and making changes to a national set of digital safety guidelines for later presentation at a conference. Which of the following types of tools would best facilitate this collaboration?
- A. repository hosting service
  - B. videoconferencing application
  - C. shared email distribution list
  - D. message board

**Correct Response: B.** Given that the teachers are not local to one another, the best way for them to work together to revise the guidelines would be to meet virtually using a videoconferencing application. **A**, **C**, and **D** are incorrect because a repository hosting service (**A**), a shared email distribution list (**C**), or a message board (**D**) would not provide the required real-time interactions necessary for the teachers to work together collaboratively.

31. A student needs to scan a printed document so that the scanned document can be edited in a word processing program. The student is using a scanner that connects to the computer via a wireless network. To obtain an editable version of the scanned document, which of the following types of software must be installed on the computer?
- A. an up-to-date device driver
  - B. an image editing application
  - C. optical character recognition software
  - D. data encryption/decryption software

**Correct Response: C.** A scanner creates an image of a document. In order to turn this image into an editable word processing document, the image must be analyzed to recognize each individual character. This function is performed by optical character recognition software. **A** is incorrect because a device driver allows a computer to communicate with a device such as a scanner, but it cannot convert an image into editable text. **B** is incorrect because an image editing application can manipulate an image, but it cannot convert an image into editable text. **D** is incorrect because data encryption/decryption software is used for information security and not for converting an image into editable text.

32. A student is creating a report using a word processing application. The student wants to include a graph from a spreadsheet program and would like the graph to be updated each time the report is opened. Knowledge of which of the following concepts will be most helpful in accomplishing this task?
- A. templates and styles
  - B. page layouts
  - C. macros and shortcuts
  - D. object linking

**Correct Response: D.** Many office productivity software suites allow different types of documents to be linked together so that changes in one document are reflected in the other. This feature is known as object linking. **A**, **B**, and **C** are incorrect because templates and styles (**A**) allow the use of preset layouts and formatting, page layouts (**B**) allow the setting of paper size, margins, and other layout and printing details, and macros and shortcuts (**C**) allow frequently used operations and keystrokes to be automated for increased productivity. However, none of these are specifically related to automatic updates between documents.

33. Which of the following types of software would be most useful for including styled text, images, and video in the same file while allowing for quick, simple edits and large-group visibility?
- A. presentation software
  - B. database software
  - C. word processing software
  - D. graphic design software

**Correct Response: A.** As suggested by the name, presentation software is specifically designed for creating, editing, and showing presentations to large groups of people, typically online or through the use of a projector. This software includes easy-to-use tools to create and edit attractive multimedia slides that can be sequenced manually or automatically. **B**, **C**, and **D** are incorrect because while database software (**B**), which is used to store and manipulate data, word processing software (**C**), which is used to create and edit primarily text documents, and graphic design software (**D**), which is used to create and manipulate images can all also create documents to be shared with large groups, none of these are specifically designed for this purpose.

34. On a Web page, one significant difference between streaming video and traditional video is that streaming video:
- A. is saved on a hard drive before being viewed.
  - B. can be compressed for faster transfer across networks.
  - C. is permitted by only a limited number of Web browsers.
  - D. begins playing before the entire video is downloaded.

**Correct Response: D.** Streaming video is sent from the host to a Web browser continuously as the video is being played. This allows the viewer to watch a long video immediately without having to wait until the entire file is downloaded. **A** is incorrect because while packets of streaming video are stored in a buffer before being viewed, the buffer typically uses system RAM instead of a hard drive because of its greater speed. **B** is incorrect because both streaming video and traditional video are typically compressed for this reason. **C** is incorrect because both can be used with an unlimited number of Web browsers.

35. A teacher would like to move classroom roster data from a desktop spreadsheet application to an open-source gradebook software program that has been security vetted and approved by their district. Which of the following file types would the teacher most likely export from the spreadsheet application?
- A. .html
  - B. .csv
  - C. .pdf
  - D. .ods

**Correct Response: B.** When data from a spreadsheet is exported for use by another software program, it is typically exported in the Comma-Separated Value (.csv) file type. This file type is recognized by most software programs designed to import spreadsheet data. It stores the spreadsheet data in rows and columns without any formatting, graphics, formulas, macros, etc. **A** is incorrect because the HyperText Markup Language (.html) file type is used for files to be displayed in Web browsers. **C** is incorrect because the Portable Document Format (.pdf) file type is used for easily shared and printed documents that cannot be edited. **D** is incorrect because the OpenDocument Spreadsheet (.ods) file type is used by many open source spreadsheet software programs. It contains all of the formatting, formulas, etc. that are used by the spreadsheet software. However, when raw data needs to be exported for use by a non-spreadsheet software program, .csv, and not .ods, is the most common file type.

36. A software application to create digital portfolios should grant student users the ability to:
- A. create and delete user accounts in large batches.
  - B. view and comment on the portfolios of others along with an up/down vote system.
  - C. upload or delete work samples in various common file types.
  - D. log on from multiple devices including smart televisions and watches.

**Correct Response: C.** Student portfolios should be able to include a wide variety of student work products. This requires compatibility with a variety of file types including graphic, audio, and video documents. **A** is incorrect because only the teacher should have such administrative privileges. **B** is incorrect because any peer assessment needs to be well controlled by the teacher, and should not be as simplistic as up/down votes. **D** is incorrect because this type of access is not necessary and could lead to unsupervised or unauthorized access.

37. High school students from different parts of the country are participating in a collaborative research project that will include professionals in the field who will help guide the research. Which of the following statements illustrates an important guideline that students should keep in mind when communicating with others via email or discussion group?
- A. Professionals are expected to easily understand new communication contexts.
  - B. Using all capital letters is the best way to emphasize a point.
  - C. Abbreviations and slang can be used in moderation.
  - D. Humor in electronic communication can be easily misinterpreted.

**Correct Response: D.** Students need to understand that, without visual and audio cues, online communications can be easily misconstrued. Written communications do not have the added information that can be gleaned from tone of voice and facial expression. **A** is incorrect because professionals are not necessarily technology-savvy and familiar with online culture. **B** is incorrect because the use of all capital letters can be interpreted as shouting in anger. This is not good online etiquette. **C** is incorrect because abbreviations and slang assume a shared understanding of their meaning. This cannot be assumed and so this practice should be avoided.

38. A teacher would like to support the open-access movement in information services. In which of the following ways could the teacher most effectively promote the principles of open access in the school environment?
- A. by subscribing personally to as many completely open resources as possible to remain up to date on free online resources
  - B. by suggesting that the school pay for most open-access content used in order to ensure fair copyright for authors
  - C. by conducting workshops for teachers and students on how to access, evaluate, and use open-access resources
  - D. by reminding teachers and students that open-access materials are not peer-reviewed and can be published by anyone

**Correct Response: C.** The biggest barrier to the more widespread use of open-access resources is awareness. Most people don't know how to access, evaluate, and use open-access resources. Therefore, it is an excellent idea to spread this knowledge through workshops. **A** is incorrect because the teacher's personal use of open-access resources may not be seen by others, let alone followed by them. **B** is incorrect because open-access content does not cost money. **D** is incorrect because this would discourage the use of open-access materials rather than show people how to find quality open-access materials.

39. Which of the following search techniques would be most effective for determining if an image posted to a nature photography blog is actually the work of the listed photographer?
- A. reverse image searching the picture, sorted by date, to see if the oldest version of it is in the photographer's name
  - B. looking at the WHOIS information for the blog to determine the page's owner and the country in which they reside
  - C. viewing the social media accounts of the photographer to see if they have also personally posted the photo
  - D. checking the camera metadata for the image to see if it was taken with the same device as other photos by the same photographer

**Correct Response: A.** One of the best ways to check the authenticity of an image is to use a reverse image search to see where else the image shows up on the Internet. If the image was misappropriated, this is a quick way to find the original. **B** is incorrect because the WHOIS information reveals the ownership of the website, but not of the content it contains. **C** is incorrect because the named photographer could have posted the photo in several places even if it was not their original work. **D** is incorrect because even if available, this type of camera metadata provides only indirect support for the identity of the image owner.

40. A student group is digitally collecting data on students' favorite lunch items served in the school cafeteria. Which of the following formats would best capture this data?
- A. closed-ended surveys
  - B. open-ended surveys
  - C. unstructured questionnaires
  - D. one-on-one interviews

**Correct Response: A.** Categorical and interval/ratio data consist of information that can be counted up and displayed numerically. Values must come from a set collection of categories (categorical) or they must be numerical (interval/ratio). Therefore, they are best collected through closed-ended surveys where possible responses are limited and well defined. **B**, **C**, and **D** are incorrect because open-ended surveys (**B**), unstructured questionnaires (**C**), and one-on-one interviews (**D**) do not restrict the possible answers.

41. As part of a project, a student plans to collect anonymous height and weight data from classmates using an online form. Which of the following techniques should be applied earliest in the data collection process to maximize the quality of the data collected?
- A. fitting a trendline to a graph of height versus weight data and removing points that do not fall on the trendline
  - B. filtering out values that are impossibly large or small based on knowledge of human physiology
  - C. using regular expressions to check potential inputs and prevent the entry of non-numeric characters
  - D. manually reviewing submitted values and deleting those that appear to include entry mistakes

**Correct Response: C.** The first step in maximizing quality of data collected is to disallow any data entries that are outside of the expected values. In this case, any non-numerical entries should not be allowed. This can be achieved by using code in the back end of the online form. This sort of code that checks for allowable patterns in data is called a regular expression. **A** is incorrect because a reliable trendline cannot be fit until after all of the data has been entered. **B** is incorrect because such filtering can only be done after non-numerical entries have been removed. **D** is incorrect because it would be more efficient to use software algorithms to catch easily identified mistakes before conducting a manual review of the values.

42. Which of the following techniques would best allow students to compare research questions on the history and social impact of computing tools?
- A. posting a list of potential research questions to social media and asking followers to vote for one
  - B. reading and comparing the first-returned search result for each potential research question
  - C. evaluating information from an influential technology blogger and taking their written recommendation
  - D. searching the text of potential questions on news and scholarship databases and comparing the numbers of results returned

**Correct Response: D.** The best way to compare research questions is to examine their prevalence in real world usage. A well-worded question will return more results from a search of existing work. **A** is incorrect because one's social media followers consist of a small and biased sample set. **B** is incorrect because first returned results are not necessarily the most relevant. **C** is incorrect because an influential blogger will not necessarily know which questions will be most productive.

43. A teacher periodically assigns small groups of students to conduct Internet searches on topics related to class units of study. Students gather and summarize information and collaboratively develop products resulting from the searches, including Web pages, video clips, informational brochures, and oral reports. This practice demonstrates the teacher's awareness of the importance of:
- A. promoting students' development of study skills that support achievement.
  - B. maximizing the amount of class time during which students engage in computer work.
  - C. encouraging students to use reading and analysis skills for inquiry and research.
  - D. prompting students to develop criteria for identifying potential bias in Web-based content.

**Correct Response: C.** The act of students collaboratively searching, gathering, and summarizing information, and then synthesizing that information to create a variety of work products, demonstrates a high level of research, analysis, inquiry, and creativity skills. **A**, **B**, and **D** are incorrect because the activity goes far beyond study skills (**A**), engagement in computer work (**B**), and identifying potential bias in Web-based content (**D**).

44. A middle school teacher wants to encourage students to use the Internet as a resource for research but is concerned that they will consult Internet sites that are not reliable sources of information. The teacher could best address this concern by implementing which of the following strategies before asking students to use online resources for a research project?
- A. engaging students in analyzing various Internet resources related to the project and establishing criteria for evaluating a resource
  - B. informing students that they will be required to provide a full citation of each Internet site from which information is taken
  - C. establishing a limit on the number of Internet sources students will be permitted to cite as research for their project
  - D. providing students with a list of general government Internet sites related to the project that are known for reliable information

**Correct Response: A.** It is important for students to learn how to evaluate Internet resources using concrete criteria. **B** and **C** are incorrect because neither a full citation requirement (**B**) nor a limit on the number of sources used (**C**) will guarantee that only reliable sources will be used. **D** is incorrect because it will not help students learn how to evaluate Internet resources.

45. A computer science student encounters a problem using a recently updated package in a larger project. The student consults a popular programming forum with a question-and-answer format and finds another user has posted a question very similar to the student's own problem. The question has generated many potential answers from other users. Which of the following characteristics should the student consider *first* to find relevant information?
- A. the length of time each writer has been active on the forum
  - B. the quality of each writer's forum profile biography
  - C. the number of upvotes the question has received from other users
  - D. the length of each response

**Correct Response: C.** A more upvoted answer implies the response has the confidence of the forum community. If the community is reliable, the answer is likely to be as well. **A** is incorrect because the amount of time a writer has spent in this particular forum does not indicate their level of expertise relative to the student's question. **B** is incorrect because profile biographies may or may not be accurate, depending on the forum's identity verification policies. **D** is incorrect because the length of a response is unrelated to its validity.

46. The Web address or URL of online journal articles may change or become invalid over time. An author can best address this issue in citations by:
- A. including the source's digital object identifier (DOI).
  - B. bookmarking the websites in the Web browser.
  - C. keeping a record of when the source was accessed.
  - D. downloading and printing a copy of the online resource.

**Correct Response: A.** When available, a DOI should be used in citations instead of a URL. This is because a DOI is static and will never change over time. **B** is incorrect because a bookmark will become invalid if the URL changes. **C** is incorrect because the date of last access is not helpful after a URL has changed. **D** is incorrect because the printed copy will not be accessible from the online journal.

47. Which of the following steps would allow a student to use an image found on the Internet in a student publication?
- A. cropping and color correcting the image, then citing it as their own work
  - B. writing a citation including the URL of the Web page where they found the image
  - C. citing the image with a disclaimer that the student is not the rights holder
  - D. researching the license under which the image is published and following its guidelines

**Correct Response: D.** The only legal way to include an image found on the Internet in a publication is to abide by the owner's licensing agreement, which may or may not allow use without paying a fee. **A** is incorrect because, under fair use, you would have to change the image so dramatically that it no longer has the same meaning or purpose. Even then, the owner should be given credit for the original form of the image. **B** and **C** are incorrect because citations (**B** and **C**) and disclaimers (**C**) are not sufficient for the legal use of an image without permission.

48. A computer user is editing a word-processing document, downloading a file from the Internet, and printing an email message. It appears to the user that these tasks are occurring simultaneously. The operating system accomplishes this by:
- A. assigning each process to a separate processor core in the computer.
  - B. allocating time slices to each process that needs to run.
  - C. waiting until each process is complete before starting a new one.
  - D. prioritizing the processes that require the fewest resources.

**Correct Response: B.** A computer uses scheduling to switch back and forth between different processes that appear to be running simultaneously. **A** is incorrect because the number of possible processes that can appear to be running simultaneously is far greater than the number of processor cores. **C** is incorrect because this would be extremely inefficient. It is more efficient, for example, when one process is waiting for external information, to move on to another process. **D** is incorrect because the processes requiring the most resources might never be attended to under this strategy.

49. The primary task of a computer system's central processing unit (CPU) is to:
- A. manage available storage space on a hard drive.
  - B. facilitate communication between a peripheral and the computer.
  - C. carry out instructions of computer programs stored in memory.
  - D. send requests to Web servers and display the returning information.

**Correct Response: C.** The sole function of a CPU is to retrieve and execute instructions. **A** is incorrect because hard drive management is carried out by the storage controller, and not the CPU. **B** is incorrect because device drivers, and not CPUs, facilitate communication between peripherals and the computer. **D** is incorrect because Web browsers, and not CPUs, send requests to Web servers and display the returning information.

50. Which of the following computer components is most closely associated with the Boolean operators AND, OR, and NOT?
- A. logic gates
  - B. read-only memory (ROM)
  - C. address buses
  - D. random access memory (RAM)

**Correct Response: A.** Logic gates perform Boolean operations on binary inputs and output a binary result. They are the logical building blocks of all computer processing. **B**, **C**, and **D** are incorrect because ROM (**B**) is a passive read-only storage medium, an address bus (**C**) carries data location addresses from the CPU to peripherals, and RAM (**D**) is a passive read-and-write storage medium. None of these components perform Boolean operations.

51. A computer user on a home network finds a document on the Web and wants to print it. The user sends the document to the wireless network printer, but receives an error message indicating that the printer is offline. The printer had been working well the day before, the power is on, and the printer screen does not indicate that anything is wrong. Which of the following *initial* questions will best help the user identify the source of the problem?
- A. Is the printer connected to the home network?
  - B. Are the printer USB and network cables connected securely?
  - C. Is the Web server hosting the document experiencing heavy traffic?
  - D. Have there been any operating system updates?

**Correct Response: A.** Each of the responses is situationally an appropriate troubleshooting step, but given that the printer is wireless and the document has already been accessed, the network should be checked first. **B** is incorrect because wireless printing does not depend on data cables. **C** is incorrect because the Web server is not involved with the connection between the computer and the printer. **D** should not be the first possibility tried.

52. A computer system is slow to boot up and slow to switch between open applications. Which of the following steps would be most appropriate to take *first* when attempting to resolve the problem?
- A. restoring the operating system to a previous working version and rebooting
  - B. updating all software applications and device drivers and rebooting
  - C. deleting or archiving any desktop icons that are no longer being used and rebooting
  - D. minimizing the number of programs that launch when the computer starts and rebooting

**Correct Response: D.** Slow boot up is most often caused by the time it takes for the computer to launch background programs during system boot. These background programs perform specialized functions such as checking for updates when associated software is loaded, launching associated programs when certain peripherals are connected, or facilitating specialized processes that most users never need. Not only does the time taken to load all of these programs slow down the boot process, but also all of these background programs take up memory and processing resources and thereby slow down everything that the computer does. Therefore, a first step in this case would be to disable unneeded startup programs. **A**, **B**, and **C** are incorrect because while restoring a previous operating system (**A**), updating software and drivers (**B**), and removing unnecessary desktop icons (**C**) are all possible steps to take, none of these would be a *first* step to take since none address the most likely cause of the problem.

53. Which of the following developments is a major factor responsible for the modern increase in the availability of Internet-connected smart home devices?
- A. the sharp decrease in the price of microprocessors
  - B. the increased availability of high-speed data over cellular networks
  - C. the growing adoption of the CAT 6 standard for cabling
  - D. the improvement of data security and privacy measures for consumers

**Correct Response: A.** Every smart home device contains an embedded microprocessor. The sharp decrease in the price of microprocessors has allowed manufacturers to make smart home devices available at affordable prices. **B** is incorrect because most smart home devices do not require high speed data. **C** is incorrect because smart home devices tend to be wireless, and hence do not depend on cabling. **D** is incorrect because strong data security and privacy measures predate the modern increase in smart home devices. However, the advent of smart home devices has led to improvements in data security and privacy measures.

54. Which of the following tasks is best accomplished through the use of a Global Positioning System (GPS)?
- A. locating a lost item carrying an electronic tag within a residential home
  - B. finding a landscape feature of interest while hiking
  - C. navigating to a particular floor in a high-rise building
  - D. measuring finish times for Olympic-qualifying marathoners

**Correct Response: B.** A GPS device can be very useful for determining one's location relative to a known landmark or destination. It accomplishes this through triangulation of satellite signals. **A** is incorrect because electronic tags typically use Bluetooth Low Energy radio signals, and not GPS to locate items. GPS does not work well within a house because satellite signals do not penetrate solid structures very well. Additionally, GPS technology is not precise enough to locate items within a house. **C** is incorrect because GPS does not work well within a building, especially for determining altitude. **D** is incorrect because GPS is not precise enough to determine exactly when a runner reaches the finish line.

55. Rapid advancements in information storage capacity and performance have contributed most directly to explosive growth in which of the following areas of technology?
- A. automated manufacturing
  - B. online video gaming
  - C. data mining
  - D. mobile device technology

**Correct Response: C.** Data mining uses artificial intelligence to detect patterns in data. Before this is possible, the program must be trained by examining an extremely large data set. In general, this technology requires the processing of millions or even billions of pieces of data. This is made possible by rapid advancements in data storage capacity and performance. **A** is incorrect because manufacturing automation can be carried out by basic microprocessors and small data sets. **B** is incorrect because online video gaming does not require extremely large data sets. **D** is incorrect because mobile devices are constrained by physical size and tend to have less computing power than larger devices, relying on cloud services for more complex computational tasks.

56. Which of the following systems would function most efficiently under a human-in-the-loop model to which both humans and autonomous systems contribute?
- A. playing chess at a grandmaster level
  - B. finding the line of best fit through experimental data
  - C. locating each instance of a given word in a digital text
  - D. moderating objectionable post content for a social network

**Correct Response: D.** While autonomous systems can flag potential objectionable content, it requires a human to be the judge based on context and subtleties of meaning. **A**, **B**, and **C** are incorrect because playing chess (**A**), finding the line of best fit (**B**), and locating each instance of a given word (**C**) can all be done autonomously without human assistance. All of these tasks benefit from a computer's ability to perform large numbers of operations quickly. None of them require a human's judgment capabilities.

57. An online company uses a content delivery network (CDN) so that when a user visits the website, the site content is delivered from the server that is closest to the user's geographic location. Which of the following network characteristics is most likely to be affected by the use of a CDN?
- A. network bandwidth
  - B. data security
  - C. network latency
  - D. data privacy

**Correct Response: C.** Network latency is caused by the time taken by data to travel between a server and a user. The use of a CDN shortens the distance data travels between a server to a user. Therefore, a CDN should reduce network latency. **A**, **B**, and **D** are incorrect because bandwidth (**A**), security (**B**), and privacy (**D**) are not related to the distance that data travels.

58. A customer at a coffee shop connects to the public Wi-Fi. Which of the following steps will best help the customer protect personal data while using the coffee shop's Wi-Fi connection?
- A. avoiding social media sites
  - B. using a virtual private network
  - C. refraining from sending email attachments
  - D. scanning for viruses frequently

**Correct Response: B.** Because a proxy server hides the user's Internet Protocol Address, it prevents others from accessing the user's computer. **A** is incorrect because there are many other malicious sites besides social media sites. **C** is incorrect because sending email attachments is only one of many vulnerabilities of unprotected use of public Wi-Fi. A proxy server can protect attachments as well as many other vulnerabilities. **D** is incorrect because viruses and malware can do damage before they are detected by a scan.

59. Compared to a wired network, the privacy of data in a wireless network more heavily depends on which of the following technologies?
- A. software firewall
  - B. password protection
  - C. virus scanning
  - D. data encryption

**Correct Response: D.** A major distinction between wireless and wired networks is that outsiders can access a wireless network without a physical connection and without being within a close physical proximity. This means that no data on a wireless network is secure unless it is encrypted. **A**, **B**, and **C** are incorrect because a software firewall (**A**), user authentication with passwords (**B**), and virus scanning (**C**) are all equally important whether the network is wired or wireless.

60. A significant difference between a wired local-area network (LAN) and a wireless local-area network (WLAN) is that a wired LAN:
- A. loses fewer packets during data transmission.
  - B. is more difficult to secure and monitor.
  - C. cannot operate during a power outage.
  - D. is more prone to infections by viruses and other malware.

**Correct Response: A.** Since a wired LAN operates over dedicated copper cables, the transmission is extremely reliable. In contrast, a wireless LAN operates through the air where there are many opportunities for interference from other wireless transmissions, electrical devices, and physical obstacles. Hence lost data packets are more common in a wireless LAN. **B** is incorrect because a wired LAN is less difficult to secure and monitor. **C** is incorrect because the two types of LANs are equally vulnerable to power outages. **D** is incorrect because, while both are susceptible to infections, wireless LANs are more vulnerable.

61. Voice over Internet Protocol (VoIP) services use a network connection to relay phone calls under the User Datagram Protocol (UDP). At which layer of the TCP/IP model does this data exchange take place?
- A. application
  - B. transport
  - C. Internet
  - D. link

**Correct Response: B.** The transport layer is responsible for data reliability and flow control. Depending on the requirements of the data transmission, the transport layer uses either the Transmission Control Protocol (TCP) or the User Datagram Protocol (UDP) to encode the data for transport. The latter is used for VoIP because of its high speed and low latency. **A** is incorrect because the application layer consists of the higher-level applications that the host uses to interface with the transport layer. **C** is incorrect because the Internet layer is only responsible for routing data packets between hosts based on destination addresses. **D** is incorrect because the purpose of the data link layer is to control the flow of data across the physical network medium.

62. What is the most common function provided by network switches?
- A. managing access to network resources
  - B. providing a secure Internet connection
  - C. creating a virtual private network (VPN)
  - D. supporting voice over Internet Protocol (VoIP) communication

**Correct Response: A.** A switch allows several devices to share access to a network. It does this by switching device ports based on data destination information. **B** is incorrect because a switch does not provide any extra security. **C** is incorrect because a switch does not create a VPN. **D** is incorrect because, while VoIP communications can be carried out over a standard network switch, it is not a common use case because specialized switches exist for this task.

63. Which of the following recommendations is most likely to improve the performance of a long-range fiber optic network struggling with data loss and slow speeds over long distances?
- A. replacing the receiving-end router to increase the bandwidth it can process
  - B. installing a transponder to receive and send optical data midway through the network
  - C. adjusting the optical signal transmitter to increase its transmission frequency
  - D. installing a transceiver to supplement optical data with electrical data through the middle part of the network

**Correct Response: B.** A transponder automatically receives, amplifies, and then retransmits signals in a fiber optic network. In this way, the weakened signal at the midpoint of the network is made stronger so that it can reach its destination with better reliability. **A** is incorrect because the issue of weakening signals over long distances is unrelated to bandwidth. **C** is incorrect because information is conveyed over fiberoptic networks by pulsing lights, not varying frequencies, at best this would be nonfunctional, at worst, it could make the network non-operational. **D** is incorrect because the optical data will still be attenuated (weakened) at the other end of the network, and the electrical data lacks all of the advantages of using fiber optics such as speed, bandwidth, and reliability.

64. A social networking company can use data mining, a deep analysis of internal data, to best address which of the following research questions?
- A. What types of advertisements attract the most interest in each region of a country?
  - B. Which user of the network has the longest contact list?
  - C. How many users will sign up to join the social network in the next year?
  - D. Which of the company's advertising relationships are most profitable?

**Correct Response: A.** Data mining uses artificial intelligence to analyze large amounts of data to look for patterns. In this case, the data would be the characteristics of the advertisements and the geographic profiles of those who react to those advertisements. The patterns would predict the performance of different types of advertisements in different regions of the country. **B**, **C**, and **D** are incorrect because they are all simple statistical questions that do not require the advanced analytical abilities of artificial intelligence.

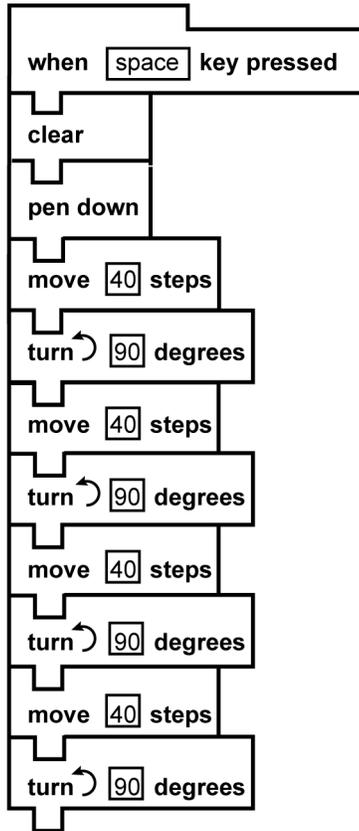
65. Quality of Service (QoS) technologies most commonly manage network data traffic by:
- A. minimizing the time that networks are down.
  - B. compressing data before it is sent through the network.
  - C. setting priorities for certain types of data on the network.
  - D. increasing the speed at which user authentication occurs.

**Correct Response: C.** QoS technologies are designed to ensure that high-priority traffic runs dependably even when network resources are limited. This is accomplished by allocating a higher priority to the most important data, such as video conferencing data. **A** is incorrect because QoS technologies do not manage network reliability. **B** is incorrect because QoS is responsible for data prioritization and not data compression. **D** is incorrect because QoS is involved with managing data traffic, and not with user authentication.

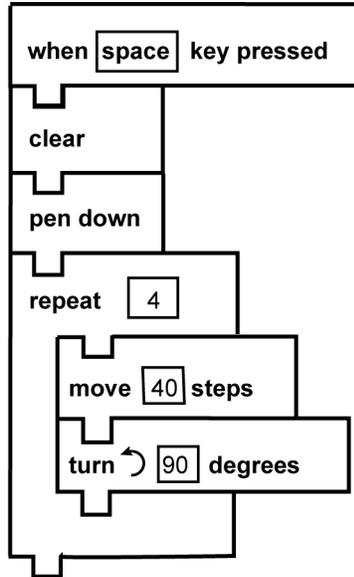
66. Which of the following effects is the most important advantage of using algorithmic abstraction in computer programming?
- A. It allows for easier modification.
  - B. It makes programs run faster.
  - C. It removes platform dependence.
  - D. It takes up less working memory.

**Correct Response: A.** The more abstract an algorithm, the more understandable it is and, therefore, the easier to modify. **B** is incorrect because abstraction often slows down running time. **C** is incorrect because an abstract algorithm might be dependent on a particular platform. **D** is incorrect because an abstract algorithm could take up more memory.

67. Use the diagrams below to answer the question that follows.



Code A



Code B

- A. recursion
- B. inheritance
- C. encapsulation
- D. iteration

**Correct Response: D.** The *repeat* structure is an iteration method; **A** is incorrect because recursion occurs when a function calls itself. **B** is incorrect because inheritance has to do with object-oriented programming. **C** is incorrect because encapsulation deals with restricting access to data to only the code that needs access.

68. Use the pseudocode below to answer the question that follows.

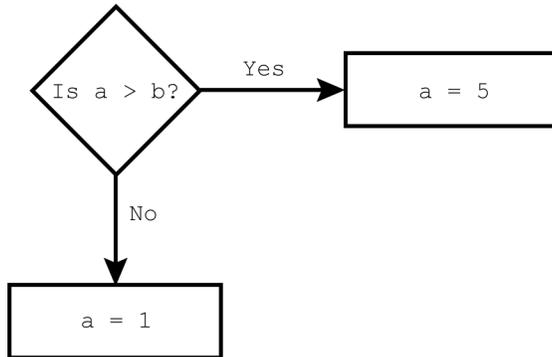
```
function f(n)
  if(n == 0)
    return 1
  else
    return n * f(n - 1)
```

Which of the following pseudocode algorithms is an alternative representation of the algorithm above?

- A.
- ```
function f(n)
  result = 1
  for (i = 1; i <= n; i = i + 1)
    result = result * n
  return result
```
- B.
- ```
function f(n)
  result = 1
  for (i = 1; i <= n; i = i + 1)
    result = result * i
  return result
```
- C.
- ```
function f(n)
  result = n
  for (i = 1; i <= n; i = i + 1)
    result = (n - 1) * i
  return result
```
- D.
- ```
function f(n)
  result = n
  for (i = 1; i <= n; i = i + 1)
    result = n * (n - i)
  return result
```

**Correct Response: B.** Response **B** multiplies together the numbers  $n * (n - 1) * \dots * 1$ , analogous to the recursive function listed in the question. **A** is incorrect because the code multiplies  $n$  by itself  $n$  times. **C** is incorrect because it calculates the value  $n * (n - 1)$ . **D** is incorrect because it calculates  $n * 0 = 0$ .

69. Use the diagram below to answer the question that follows.



Which of the following pseudocode segments produces the same output as the flowchart shown above?

- A.
 

```

if (a > b)
  a = 5
else
  a = 1
      
```
- B.
 

```

if (a > b)
  a = 1
  a = 5
      
```
- C.
 

```

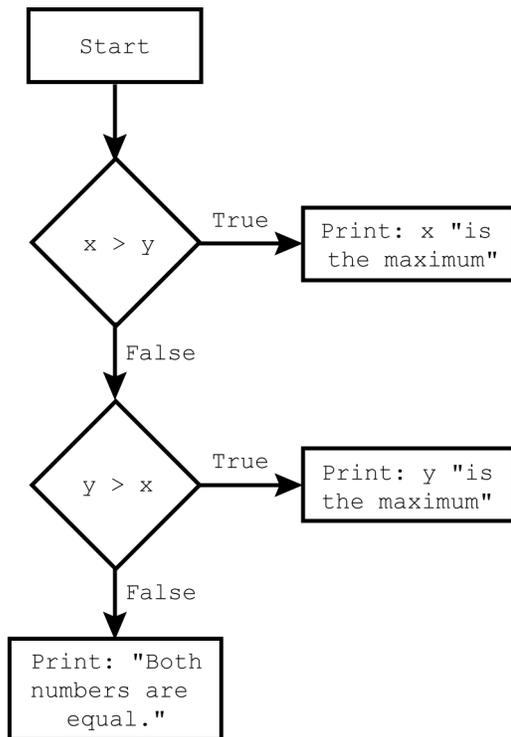
if (a > b)
  a = 5
if (a < b)
  b = 1
      
```
- D.
 

```

if (a > b)
  a = 5
  a = 1
      
```

**Correct Response: A.** This pseudocode exactly implements the flowchart. **B** is incorrect because if  $a \leq b$ , then  $a$  does not have the value 1 when the *if* statement terminates. **C** is incorrect because if  $a == b$ , then  $a$  is not assigned the value 1. Additionally, when  $a < b$ , then the value of  $b$  is changed to 1. **D** is incorrect because if  $a > b$  then  $a$  does not have the value 5 when the *if* statement terminates and if  $a \leq b$  then  $a$  does not have the value 1 when the *if* statement terminates.

70. Use the flowchart below to answer the question that follows.



Which of the following pseudocode segments correctly represents the flowchart?

- A.
- ```

if (x > y)
    print(x + " is the maximum")
else
    print(x + " is the maximum")
else
    print("Both numbers are equal")
    
```
- B.
- ```

if (x > y)
    print(x + " is the maximum")
else
    if (y > x)
        print(y + " is the maximum")
    else
        print("Both numbers are equal")
    
```
- C.
- ```

if (x > y)
    print(x + " is the maximum")
else
    if (y > x)
        print(y + " is the maximum")
print("Both numbers are equal")
    
```
- D.
- ```

if (x > y)
    print(x + " is the maximum")
if (y > x)
    print(y + " is the maximum")
print("Both numbers are equal")
    
```

**Correct Response: B.** This pseudocode exactly implements the flowchart. **A** is incorrect because this pseudocode will never print “Both numbers are equal.” **C** is incorrect because this pseudocode will always print “Both numbers are equal” even if it also prints one of the other messages. **D** is incorrect because this pseudocode will also always print “Both numbers are equal” even if it also prints out one of the other messages.

71. Use the pseudocode segment to answer the question that follows.

```
function g(n)
  if (n == 0)
    return n
  else
    return 3 + g(n - 1)
print(g(4))
```

What will this code segment print?

- A. 6
- B. 9
- C. 12
- D. 24

**Correct Response: C.** This pseudocode adds 3 to itself 4 times for a total of 12. **A** is incorrect because `print(g(2))` would produce 6. **B** is incorrect because `print(g(3))` would produce 9. **D** is incorrect because `print(g(8))` would produce 24.

72. Assume that `sum` is initialized to 0. Which of the following algorithms finds the sum of the even integers from 2 to 20?

- A.  
for (`i = 20; i > 2; i = i - 2`)  
  `sum = i + 2`
- B.  
for (`i = 20; i > 2; i = i - 2`)  
  `sum = sum + i`
- C.  
for (`i = 2; i <= 20; i = i + 2`)  
  `sum = i + 2`
- D.  
for (`i = 2; i <= 20; i = i + 2`)  
  `sum = sum + i`

**Correct Response: D.** This pseudocode results in `sum` holding the sum of the even integers from 2 to 20: 110. **A** is incorrect because the variable `sum` will hold the value 6. **B** is incorrect because the variable `sum` will hold the value 108. **C** is incorrect because the variable `sum` will hold the value 22.

73. A user is asked to input any 10 positive integers. An algorithm is applied to find the sum of only the even positive integers that were input by the user. Part of the algorithm is shown below.

```
i = 1      # loop variable
sum = 0    # variable to hold the sum
num = 0    # variable to get input from user

#execute selected code here

print("The sum of the even numbers you input is: " + sum)
```

Which of the following missing code segments correctly completes the algorithm?

- A.
- ```
if ((num % 2) == 0)
    while (i <= 10)
        print("Input a number")
        num = get_user_input()
        sum = num + sum
        i = i + 1
```
- B.
- ```
while (i <= 10)
    if ((num % 2) == 0)
        print("Input a number")
        num = get_user_input()
    sum = num + i
    i = i + 1
```
- C.
- ```
while (i <= 10)
    print("Input a number")
    num = get_user_input()
    if ((num % 2) == 0)
        sum = num + sum
    i = i + 1
```
- D.
- ```
while (i <= 10)
    print("Input a number")
    num = get_user_input()
    if ((num % 2) == 0)
        sum = num + i
    i = i + 1
```

**Correct Response: C.** This pseudocode correctly sums the even integers entered by the User. **A** is incorrect because this pseudocode does not check for evenness at the correct point in the code. **B** is incorrect because after asking the user for an initial number, this pseudocode then only asks the user for a new number if they previously entered an even number. **D** is incorrect because this pseudocode prints out the 10 + the last even number entered by the user.

74. The decimal number 125 is equivalent to which of the following hexadecimal numbers?
- A. 7D
  - B. C5
  - C. 77
  - D. 80

**Correct Response: A.** Response **A** is correct because  $D = 13$ ,  $(7 \times 16) + D = 125$ . **B** is incorrect because  $C = 12$ ,  $(C \times 16) + 5 = 197$ . **C** is incorrect because  $(7 \times 16) + 7 = 119$ . **D** is incorrect because  $(8 \times 16) + 0 = 128$ .

75. The original basic ASCII character set was developed prior to the invention of the computer and was used for teletype machines. It encoded a set of characters using the decimal numbers from 0 to 127. How many bits were needed to encode a character in ASCII?
- A. 4
  - B. 7
  - C. 8
  - D. 16

**Correct Response: B.** 7 bits can encode 128 characters or decimal numbers 0 – 127. **A** is incorrect because 4 bits can encode 16 characters or decimal numbers 0 – 15. **C** is incorrect because 8 bits can encode 256 characters or decimal numbers 0 – 255. **D** is incorrect because 16 bits can encode 65,536 characters or decimal numbers 0 – 65,535.

76. A computer user compresses several executable files into a single ZIP file. Which of the following statements best describes a characteristic of the ZIP file?
- A. The compressed file can be read by more file systems than the individual files.
  - B. The files will be merged into a single file of the same type when they are compressed.
  - C. When the files are decompressed, they will be identical to the original files.
  - D. Redundant bits of information are lost during compression.

**Correct Response: C.** ZIP file compression is lossless, meaning that decompressing ZIP files results in the original files. **A** is incorrect because the compressed file will not be readable by the program that runs executable files, so the compressed file is readable by fewer programs. **B** is incorrect because multiple executable files will not be compressed into an executable file. **D** is incorrect because there is no loss of information during ZIP compression, so no information is discarded.

77. The concept of file synchronization is most relevant to which of the following situations?
- A. Online video gamers interact with each other in real time.
  - B. A company schedules a backup program to run automatically each night.
  - C. Employees collaborating from separate locations need their project files to contain the most recent modifications.
  - D. A photographer uses a cloud storage account to manually upload and store images taken from a variety of mobile devices.

**Correct Response: C.** File synchronization relates to getting all users of the file the most up-to-date information. **A** is incorrect because online video gamers communicate through cameras, audio, and chat—not a synchronized data file. **B** is incorrect because a back-up program captures the data when it runs at night and is not concerned with the changes made the next day until it runs again the following night. **D** is incorrect because only a single photographer is adding photos and is doing so manually, so no automated syncing will occur.

78. A person wants to search a large database for books that contain the following words in the title: "History", "America", "Government". Which of the following searches will return the fewest results?
- A. "History" OR "America" OR "Government"
  - B. ("History" AND "America") OR "Government"
  - C. ("History" OR "America") AND "Government"
  - D. "History" AND "America" AND "Government"

**Correct Response: D.** Since all three words must appear in a title, this search will return the fewest results compared with just one or two of the words appearing. **A** is incorrect because only one of the three search terms must be in the title, so many more results will be found. **B** is incorrect because either the first two words must both appear or the third word must appear, but not all three, so more results will appear. **C** is incorrect because the third word and either the first or second words must appear, but not all three, so more results will appear.

79. Use the table below to answer the question that follows.

Id	FirstName	LastName	City	Country
1	Francoise	Okeke	Paris	France
2	Abal	Bashir	Doha	Qatar
3	Patricia	Ruiz	Madrid	Spain

The table represents a small section of a large database of customers from all over the world. A person would like to search for all the customers from the countries of France and Spain with a last name of Ruiz who have an annual purchase of at least \$10,000. Which of the following database queries should be used?

- A. `SELECT * FROM Customers WHERE LastName = "Ruiz" OR (Country = "France" AND "Spain") OR Purchase >= 10,000`
- B. `SELECT * FROM Customers WHERE LastName = "Ruiz" OR (Country = "France" AND "Spain") AND Purchase >= 10,000`
- C. `SELECT * FROM Customers WHERE LastName = "Ruiz" AND (Country = "France" OR "Spain") OR Purchase >= 10,000`
- D. `SELECT * FROM Customers WHERE LastName = "Ruiz" AND (Country = "France" OR "Spain") AND Purchase >= 10,000`

**Correct Response: D.** This answer presents the logic that will extract the desired information. **A** is incorrect because it includes three mistakes, including that the customers have to be from France and Spain simultaneously instead of from either France or Spain. **B** is incorrect because it includes two mistakes, including the one specified for **A**. **C** is incorrect because it returns customers whose annual purchase is at least \$10,000 or are named Ruiz, but not both.

80. Which of the following techniques is an example of the application of machine learning to the development of language learning software?
- A. loading a dictionary into a database
  - B. using native speakers to gather feedback on performance
  - C. encoding linguist-created rules on the structure of the target language
  - D. analyzing large bodies of translated text for patterns

**Correct Response: D.** Looking for patterns is a key feature of machine learning. **A** is incorrect because loading a dictionary into a database does not involve looking for patterns. **B** is incorrect because getting human feedback does not involve a machine looking for patterns. **C** is incorrect because encoding linguistic rules is different than having a machine look for correlated patterns.

81. Which of the following statements identifies the most common relationship between data mining and Web scraping?
- A. Data mining and Web scraping are used to gather raw information for analysis.
  - B. Data mining may be used to find insights in data gathered through Web scraping.
  - C. Web scraping skims useful patterns from large data sets that have been mined.
  - D. Web scraping gathers Internet comments to compare to data-mined sentiment analysis.

**Correct Response: B.** Web scraping is a way to gather data while data mining analyzes gathered data. **A** is incorrect because data mining does not gather data. **C** is incorrect because Web scraping occurs before data mining. **D** is incorrect because Web scraping could be used to gather Internet comments but then data mining could be performed on the Internet comments to find patterns related to sentiment.

82. Biology and computer science students are collaborating on a model of how a group of 50 bees pollinates a two-acre field of flowers. Which of the following factors would be the biggest limitation to the accuracy of the model?
- A. insufficient computing power to simulate the entire group of bees
  - B. insufficient scientific data on bee behavior
  - C. insufficient ability to collect data on the precise movement of bees
  - D. insufficient mathematical tools to calculate speed and acceleration values

**Correct Response: A.** Even a relatively low-powered computer should be able to model 50 points moving in three dimensional space. **B** is incorrect because ample data should exist, as bees are a common creature and raised at scale in an agricultural setting. **C** is incorrect because students are unlikely to have access to sensors of a size and resolution to track individual bees. **D** is incorrect because calculating speed and acceleration calculations from position and time data are trivial.

83. A programmer wants to represent the number 1234 as a string. The programmer creates a string variable named `num_text`. Which of the following statements will correctly assign the string 1234 to this variable?

A. `num_text = 1234`

B. `num_text = /*1234*/`

C. `num_text = "1234"`

D. `num_text = [1234]`

**Correct Response: C.** Quotation marks surround the characters of a string. **A** is incorrect because without the surrounding quotation marks, 1234 is a number. **B** is incorrect because surrounded by `/*` and `*/`, 1234 is a comment. **D** is incorrect because surrounded by `[` and `]`, 1234 is an element of a list or array.

84. For which of the following purposes is the concatenation operator + used?
- A. adding two decimal numbers
  - B. changing a single-digit integer into a single character
  - C. rounding a decimal number to the nearest whole number
  - D. joining two strings to make a larger string

**Correct Response: D.** Two strings of characters can be concatenated using the + operator. **A** is incorrect because two decimal numbers are added together, not concatenated. **B** is incorrect because changing a single-digit integer into a character is not a concatenation operation. **C** is incorrect because rounding is not a concatenation operation.

85. Use the information below to answer the question that follows.

**Ticket Prices**

Adult	\$12
Student (18 and under)	\$6
Senior (65 and over)	\$8

Prices for Adult, Student, and Senior tickets to a community theater vary depending on the age of the attendee, as shown. Which of the following segments of pseudocode could be used to determine the price of a ticket?

- A.
- ```
if (age <= 18)
    price = 6
if (age >= 65)
    price = 8
if (age > 18)
    price = 12
```
- B.
- ```
if (age >= 65)
    price = 8
else
    if (age <= 18)
        price = 6
    else
        price = 12
```
- C.
- ```
if (age > 18)
    price = 12
else
    if (age <= 18)
        price = 6
    else
        price = 8
```
- D.
- ```
if (age <= 18)
    price = 6
if (age > 18)
    price = 12
else
    price = 8
```

**Correct Response: B.** This pseudocode determines the correct price of a ticket. **A** is incorrect because a 65-year-old would be assigned the price of 12, which is incorrect. **C** is incorrect because a 65-year-old would be assigned the price of 12, which is incorrect. **D** is incorrect because an 18-year-old would be assigned the price of 8 and a 65-year-old would be assigned the price of 12, both of which are incorrect.

86. Use the information below to answer the question that follows.

```

bonus = 0

if (qtr_sales >= 5000)
    commission = qtr_sales * 0.25
    if (qtr_sales + commission > 6500)
        bonus = 500
else
    if (qtr_sales >= 3000 AND qtr_sales < 5000)
        commission = qtr_sales * 0.20
    else
        commission = qtr_sales * 0.10

total_payment = qtr_sales + commission + bonus
print(total_payment)

```

Salesperson	Quarter Sales
1	6000
2	3000
3	5000
4	2500

The segment of pseudocode above calculates the total payment for each of four sales people with the quarterly sales given in the table. What will be the output of the pseudocode?

- A. 8000, 3600, 6250, 2750
- B. 8000, 3300, 6250, 3000
- C. 7500, 3600, 6750, 2750
- D. 7500, 3300, 6750, 3000

**Correct Response: A.** The pseudocode produces these outputs for the table of inputs. **B** is incorrect because the output for 3000 is not 3300. **C** is incorrect because the output for 6000 is not 7500 due to the bonus. **D** is incorrect because the outputs for the inputs 6000 and 3000 are incorrect.

87. In which of the following situations is it more appropriate to use a `while` loop than a `for` loop?
- A. The number of times a loop will execute is not known in advance.
  - B. The loop is called from within a procedure.
  - C. The number of statements in the loop body is greater than 10.
  - D. The loop continues until a condition is satisfied.

**Correct Response: A.** While either type of loop could technically be used in this case, a `for` loop is generally associated with numeric counters, while a `while` loop continues to execute until a statement evaluates to a predetermined Boolean value. **B** is incorrect because either type of loop could be called from within a function or procedure. **C** is incorrect, as the number of statements does not limit either kind of loop. **D** is incorrect because both types of loop continue until a condition is satisfied.

88. Use the pseudocode below to answer the question that follows.

```
x = 0
y = 0
for (i = 0; i <= 2; i = i + 1)
    if (x > y)
        y = x + 3
    else
        x = y + 2
print(x + ", " + y)
```

When this segment of pseudocode executes, what will be printed?

- A. 0, 2
- B. 2, 5
- C. 5, 2
- D. 7, 5

**Correct Response: D.** At the end of each pass through the loop, x and y have the values 2 and 0, 2 and 5, and finally 7 and 5. **A** is incorrect because y never takes the value 2. **B** is incorrect because x and y have the value 2 and 5 after the second pass through the loop. **C** is incorrect because y never takes on the value 2.

89. Use the pseudocode below to answer the question that follows.

```
1  function calc_score(suit, value)
2      score = 0
3
4      if (suit is "heart" OR suit is "red")
5          score = 2 * value
6      else
7          score = value
8
9      return score
10
11 #main body of program
12
13 score = calc_score("heart", 4)
14 print(score)
```

Which line in the segment of pseudocode illustrates the passing of arguments?

- A. line 1
- B. line 2
- C. line 9
- D. line 13

**Correct Response: D.** The function is called and actual arguments are passed. **A** is incorrect because the name and arguments of the function are defined but not called. **B** is incorrect because a local variable is initialized to the value 0. **C** is incorrect because the function returns a value to the variable on the line where the function was called.

90. In an `array` data type, the index is used for which of the following purposes?
- A. identifying the size of the array
  - B. locating elements within the array
  - C. defining the first value in the array
  - D. identifying duplicate data in the array

**Correct Response: B.** The index specifies the location within the array. **A** is incorrect because the largest value of the index is one less than the size of the array. **C** is incorrect because the index specifies the addresses of the array, not any of its values. **D** is incorrect because the index specifies the addresses of the array and does not identify duplicate values in the array.

91. Use the pseudocode below to answer the question that follows.

```
1 # the index of list_one begins at 0
2
3 list_one = ["March", "April", "May", "June", "July"]
4
5 # execute selected code here
6     print(list_one[i])
```

A student wants to print out the elements in `list_one`. Which of the following replacements for `# execute selected code here` on line 5 is correct?

- A. `for (i = 0; i < 4; i = i + 1)`
- B. `for (i = 0; i <= 4; i = i + 1)`
- C. `for (i = 1; i < 5; i = i + 1)`
- D. `for (i = 1; i <= 5; i = i + 1)`

**Correct Response: B.** The index needs to start at 0, end at 4, and increase by 1. **A** is incorrect because the index ends at 3. **C** is incorrect because the index starts at 1. **D** is incorrect because the index starts at 1 and ends at 5.

92. Which of the following lists of programming languages is ordered from lowest level to highest level of abstraction?
- A. machine, assembly, procedural, object-oriented
  - B. object-oriented, machine, procedural, assembly
  - C. machine, assembly, object-oriented, procedural
  - D. procedural, assembly, machine, object-oriented

**Correct Response: A.** Machine language is a sequence of bit patterns, assembly is a low-level language that maps almost directly into machine language, procedural is a high-level language involving subroutines and functions, object-oriented is at the highest level abstraction allowing data and its procedures to be accessible only through the proper channels; all the other answers (**B, C, D**) are mis-ordered.

93. In a C-like programming language, which of the following outcomes will occur if a function's local variable has the same name as a global variable?
- A. The value of the local variable will be assigned to the global variable.
  - B. Within the function, the variable name will refer to the local variable.
  - C. The function will not compile and will give an error message.
  - D. The values of the global and local variables will always be the same.

**Correct Response: B.** The variable names of local variables take precedence and shield access to global variables of the same name. **A** is incorrect because same-named local and global variables do not interact in this way. **C** is incorrect because it is syntactically allowable to give a local and global variable the same name. **D** is incorrect because same-named local and global variables do not interact in this way.

94. Use the table below to answer the question that follows.

The table displays the output of a method call to the objects `my_table` and `table_2`.

Input	<code>print(my_table.set(4, "formal"))</code>	<code>print(table_2.set(4, "formal"))</code>
Output	a      0 0 0 1	Plates:      4
	b      0 0 1 0	Glasses:     4
	c      0 1 0 0	Spoons:      8
	d      1 0 0 0	Forks:        8

Which of the following statements is the most likely explanation for the behavior of the `set` method in the two cases shown?

- A. An attribute of one of the objects triggers a conditional statement in `set`.
- B. The "`set`" method is overloaded and different arguments trigger different versions.
- C. The first argument is interpreted as an `int` in one case and a `float` in the second, altering `set`.
- D. The two objects are of different classes that each have a `set` method that accepts similar arguments.

**Correct Response: D.** The name "set" is a method of two objects from two different classes and "set" is defined differently in the two different classes. **A** is incorrect because, since the input arguments are identical, a conditional does not have different information by which to make different decisions. **B** is incorrect because, since the input arguments are identical, an overloaded method should most likely behave the same in both cases. **C** is incorrect because, based on the output, there is no evidence that the input 4 is interpreted as an integer in one case and a floating point in the other.

95. Which of the following is an advantage of using an iterative design process for creating a software product?
- A. facilitating the release of new versions to meet changing market demands
  - B. providing programmers with an opportunity to contribute to all phases of development
  - C. creating opportunities to incorporate user feedback throughout the process
  - D. ensuring that each phase of development is completed before moving to the next phase

**Correct Response: C.** An iterative process cycles among prototyping, testing, and improving the code, so the testing phase could easily incorporate testing and feedback by users. **A** is incorrect because the release of new versions to meet new marketing demands is an aspect of all commercial software that is not distinctly tied to an iterative process. **B** is incorrect because a particular programmer may not be part of all the steps of the iterative process—they may not be part of testing, for example. **D** is incorrect because the iterative design process may include revisiting previous stages rather than a strictly sequential ordering.

96. Which of the following activities is generally addressed during the maintenance phase of software development?
- A. rewriting the software to incorporate all new technologies
  - B. improving the documentation and readability of the code
  - C. fixing bugs and incorporating customer feedback
  - D. creating and testing new algorithms and prototypes

**Correct Response: C.** Maintenance of software is usually concerned with fixing bugs. These may be reported via customer feedback. Other change requests may also come in through the same channel. **A** is incorrect because it is unreasonable to expect all new technologies to be supported over some indefinite time interval. **B** is incorrect because maintenance does not typically refer to documentation or code readability. **D** is incorrect because the development of novel software tools typically occurs sooner in the development process.

97. For which of the following purposes would a Web developer want to gain access to an application programming interface (API)?
- A. creating a script to add interactivity to a Web page
  - B. building a style sheet to define a Web page's fonts and background colors
  - C. accessing the nodes of a Web page's document object model (DOM)
  - D. embedding a map from a search engine company onto a Web page

**Correct Response: D.** The web page under development needs to communicate with a search engine to get a map to display, so it will use an API. **A** is incorrect because adding interactivity to a web page through a script does not require talking to another application, so no API access is needed. **B** is incorrect because building a style sheet does not require talking to another application, so no API access is needed. **C** is incorrect because accessing a web page's DOM does not require talking to another application, so no API access is needed.

98. A programmer would most likely use the standard library of a programming language in order to:
- A. look up definitions of programming terms.
  - B. access pre-built classes and modules for use in a project.
  - C. download open-source software programs written in the language.
  - D. search through documentation that explains the programming language.

**Correct Response: B.** Standard libraries most likely include common modules, data structures, classes, macros, subroutines, etc. **A** is incorrect because a standard library would not have a text document containing verbal definitions of terms. **C** is incorrect because open-source software would most likely not be considered commonly used enough to be in the standard library. **D** is incorrect because a standard library holds common code, not documentation.

99. Creating a trace table is an effective method for:
- A. converting a flowchart into source code.
  - B. searching an array for a given value.
  - C. analyzing a loop that has an off-by-one error.
  - D. storing numerical values in a database.

**Correct Response: C.** Debugging a loop or any construct can be helped by a trace table because the table keeps track of the progressive values of variables in the code. **A** is incorrect because a trace table is useful for testing and debugging algorithms, not converting flowcharts into source code; **B** is incorrect because a trace table is not a search method in an array. **D** is incorrect because a trace table is not a storage structure for a database.

100. A programmer who is uploading a coding project to an open-source software hosting site would include a `README.txt` file in order to provide:
- A. a text version of the source code for others to access.
  - B. a list of people who have downloaded and tested the software.
  - C. a clear description of what the project does along with user instructions.
  - D. a hypertext link and embedded multimedia to promote the sale of the project.

**Correct Response: C.** The `README.txt` describes what the code does and how to use it. **A** is incorrect because the `README.txt` is not the text of the source code. **B** is incorrect because the `README.txt` is not a list of users. **D** is incorrect because the `README.txt` is not for promoting the sale of the code.