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TRUE/FALSE

1. All information is stored in the computer using binary numbers.

   ANS: T
   The computer is a digital device meaning that it stores information in one of two states using binary. We must determine then how to represent meaningful information (such as a name or a program instruction or an image) in binary.

2. Java is an object-oriented programming language.

   ANS: T
   Java is classified as a high-level programming language but it is also classified as an object-oriented programming language because it allows the programmer to implement data structures as classes.

3. `System.out.print` is used in a program to denote that a documentation comment follows.

   ANS: F
   Documentation comments follow `//` marks or are embedded between `*/` and `*/`. `System.out.print` is an instruction used to output a message to the screen (the Java console window).

4. Java byte codes are directly executable whereas Java source code is not.

   ANS: F
   Neither Java source code nor Java byte codes are executable. Both must be compiled or interpreted into machine code. Java byte codes are useful however in that they are machine-independent but semi-compiled code that allows your Java code to be transmitted over the Internet and executed on another computer even if that other computer is a completely different type.

5. The Java compiler is able to find all programmer errors.

   ANS: F
   The Java compiler can find syntax errors but cannot find either logical errors (errors that are caused because of poor logic in writing the program) or run-time errors (errors that arise during the execution of the program).

6. Java is a case-sensitive language which means `Current`, `CURRENT`, and `current` will all reference the same identifier.

   ANS: F
   Java is case sensitive which means that `Current`, `CURRENT`, and `current` will all be recognized as different identifiers. This causes problems with careless programmers who do not spell an identifier consistently in terms of upper and lower case characters.

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7. Code placed inside of comments will not be compiled and, therefore, will not execute.

   ANS: T
   The compiler discards comments; therefore, any code inside a comment is discarded and is not compiled. Your executable program consists only of the code that is compiled.

8. The word `Public` is a reserved word.

   ANS: F
   `public` is a reserved word, but since Java is case sensitive, `Public` differs from `public` and therefore `Public` is not a reserved word.

9. Reserved words in Java can be redefined by the programmer to mean something other than their original intentions.

   ANS: F
   Java reserved words cannot be redefined.

10. In a Java program, dividing by zero is a syntax error.

    ANS: F
    Dividing by 0 is not detected at compile time, and because a computer cannot divide by 0, this is a run-time error.

11. In a Java program, dividing by zero is a syntax error.

    ANS: F
    Dividing by 0 is not detected at compile time, and because a computer cannot divide by 0, this is a run-time error.

12. During translation, the compiler puts its output (the compiled Java program) into ROM.

    ANS: F
    ROM stands for read-only-memory. The compiled output (the byte codes) may be placed into RAM (writable random access memory) or into a file (on your hard drive, for example).

13. Objects are defined by a class that describes the characteristics common to all instances of the class.

    ANS: T
    An object is an instance of a class. And, the purpose of a class is to describe these common characteristics.

14. Inheritance is a form of software reuse.

    ANS: T

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Inheritance allows us to capitalize on the similarities among various kinds of classes that have a common base (parent) class. Thus we reuse the base class each time a class inherits from it.

15. Polymorphism is the idea that we can refer to multiple types of related objects in consistent ways.

    ANS: T
    Polymorphism allows us to use the same name for similar behaviors that occur among diverse and possibly unrelated objects. For example, to "open" may refer to a file, or to a device, or to a communications line, etc. The same term, "open," is being used even though the objects that are being opened are quite different.

16. In Java, identifiers may be of any length up to a limit determined by the compiler.

    ANS: F
    Java (and Java compilers) do not limit the length of the identifiers you use. Identifiers may be as long as you wish. Good programming practice, however, will limit the lengths of the identifiers you create.

MULTIPLE CHOICE

1. A Java program is best classified as

   a. hardware
   b. software
   c. storage
   d. processor
   e. input

   ANS: B
   Programs are classified as software to differentiate them from the mechanisms of the computer (hardware). Storage and the processor are two forms of hardware while input is the information that the program processes.

2. Six bits can be used to represent _____ distinct items or values.

   a. 6
   b. 20
   c. 24
   d. 32
   e. 64

   ANS: E
   With n bits, we can represent 2^n different values. 2^6 = 64.

3. When executing a program, the processor reads each program instruction from

   a. secondary memory (storage)
   b. the Internet
   c. registers stored in the processor
   d. main memory
   e. Any of these

   ANS: D

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The program is first loaded from secondary memory into main memory before it is executed so that the processor is not slowed down by reading each instruction. This idea of executing programs stored in memory is called the Stored Program Computer and was pioneered by John Von Neumann in the 1940s.

4. Which memory capacity is the largest?

   a. 1,500,000,000,000 bytes
   b. 100 gigabytes
   c. 3,500,000 kilobytes
   d. 10 terabytes
   e. 12,000,000 megabytes

   ANS: E
   We convert each of these capacities to bytes (rounding off) to compare them. The value in A remains the same, 1 1/2 trillion bytes. The value in B is 100 billion bytes. The value in C is 3 1/2 billion bytes. The value in D is 10 trillion bytes. The answer in E is 12 trillion bytes.

5. Binary numbers are composed entirely of

   a. 0s
   b. 1s
   c. 0s and 1s
   d. any digits between 0 and 9
   e. 0s, 1s, and 2s

   ANS: C
   Binary is base 2. In Mathematics, numbers in base n are composed entirely of digits between 0 and n-1.

6. Volatility is a property of

   a. RAM
   b. ROM
   c. disk
   d. software
   e. computer networks

   ANS: A
   Volatility means that the contents of memory are lost if the electrical power is shut off. This is true of RAM (Random Access Memory), but not ROM (Read Only Memory) or disk. Software and computer networks are not forms of memory.

7. The ability to directly obtain a stored item by referencing its address is known as

   a. random access
   b. sequential access
   c. read-only access
   d. fetch access
   e. volatility

   ANS: A

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Random access is meant to convey the idea that accessing any item is equally easy, and that any item is retrievable based solely on its address. Random access is the form of access used by both RAM and ROM memory. Disk access, called direct access, is a similar idea, and direct and random access are sometimes referred to synonymously. Sequential access is used by tape.

8. Which phase of the fetch-decode-execute cycle might use a circuit in the arithmetic-logic unit?

   a. fetch
   b. decode
   c. execute
   d. during fetch or execute, but not decode
   e. any of the phases

   ANS: C
   The fetch phase retrieves (fetches) the next program instruction from memory. The decode phase determines which circuit(s) needs to be used to execute the instruction. The instruction is executed during the execute phase. If the instruction is either an arithmetic operation (like add or multiply) or a logical operation (like comparing two values), then it is carried out by the ALU.

9. In order for a computer to be accessible over a computer network, the computer needs its own

   a. MODEM
   b. communication line
   c. network address
   d. packet
   e. router

   ANS: C
   In order to differentiate between the computers on a network, each is given its own, unique, network address. In this way, a message intended for one computer can be recognized by that computer through the message's destination address. A MODEM is a device that is used to allow a computer to communicate to another computer over a telephone line. A communication line is the network media itself. A packet is a collection of data that is sent over a network. A router is a hardware device used to take a message from one network and move it to another based on the message's destination address.

10. For a computer to communicate over the Internet, it must use

    a. the TCP protocol
    b. the IP protocol
    c. the combined TCP/IP protocol
    d. the Ethernet protocol
    e. the ARPANET protocol

    ANS: C
    IP is the Internet Protocol, but the TCP (Transmission Control Protocol) also must be used because it handles such problems as how to piece together packets of the same message that arrive out of order. Ethernet is a LAN protocol, which might be used in addition to TCP/IP in some networks, but it is not needed to communicate over the Internet. There is no such thing as the ARPANET protocol.

11. A URL (Uniform Resource Locator) specifies the address of a

    a. computer on any network
    b. computer on the Internet
    c. local area network (LAN) on the Internet

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d. a document or other type of file on the Internet
e. a Java program on the Internet

ANS: D
URLs are used to locate documents (or other types of files such as an image or sound file) anywhere on the Internet. A URL contains the address of the LAN or WAN and the specific computer from which the file is to be retrieved; it specifies the file's address, not just the computer's address.

12. It is important to dissect a problem into manageable pieces before trying to solve the problem because

a. most problems are too complex to be solved as a single, large activity
b. most problems are solved by multiple people and it is easy to assign each piece to a separate person
c. ir is easier to integrate small pieces of a program into one program than it is to integrate one big chunk of code into one program
d. the first solution may not solve the problem correctly
e. All of these

ANS: A
Any interesting problem will be too complex to solve easily as a single activity. By decomposing the problem, we can build small solutions for each piece and then integrate the pieces. Answer D is true, but it is not the reason why we will break a problem into pieces.

13. Once we have implemented a solution, we are not done with the problem because

a. the solution may not be the best (most efficient)
b. the solution may have errors and need testing and fixing
c. the solution may, at a later date, need revising to handle new specifications
d. the solution may, at a later date, need revising because of new programming language features
e. All of these

ANS: E
A program should not be considered as a finished product until we are reasonably assured that it is efficient and error-free. Further, it is common that programs require modification in the future because of a change to specifications or a change to the language or computer running the program.

14. Java is an example of a(n)

a. machine language
b. Assembly language
c. high-level language
d. fourth generation language
e. both high-level and fourth generation language

ANS: E
While Java was created during the fourth generation, it is clearly also a high-level language. Machine language is the executable language of a machine, with programs written in 1s and 0s only. Assembly language uses mnemonics. Fourth generation languages are tools wrapped inside of programs so that the user has the flexibility to write some code to executed from within the program.

15. Of the following, which statement is not true regarding Java as a programming language?

a. Java is a relatively recent language; it was introduced in 1995.

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b. Java is a language whose programs do not require translating into machine language before they are executed.
c. Java is an object-oriented language.
d. Java is a language that embraces the idea of writing programs to be executed with the World Wide Web.
e. All of these are true

ANS: B
All languages require translation into machine language. The other statements are all true about Java.

16. Comments should

a. rephrase all the code to explain it in English
b. be insightful and explain the intention of an instruction or block of code
c. only be included with code that is difficult to understand
d. be used to define variables that have hard to understand names
e. All of these

ANS: B
Comments should not rephrase in English what an instruction says, but instead should explain what that instruction is doing in relation to the program. Introductory programmers often have difficult explaining their code and wind up stating the obvious in their comments. While answer D is partially correct, it is not entirely true even though all variables should have comments that explain their use.

17. The `main` method for a Java program is defined by

a. `public static main()`
b. `public static main(String[] args);`
c. `public static main(String[] args)`
d. `private static main(String[] args)`
e. The `main` method could be defined by all of these except B

ANS: C
In A, the parameter is missing. The parameters are defined later in the text, but in effect, they allow the user to run the program and include some initial arguments if the program calls for it. In B, the semicolon at the end of the statement is not allowed. In D, `private` instead of `public` would make the program non-executable by anyone and thus makes the definition meaningless.

18. What does the following line of Java code do?

```
//System.out.println("Hello");
```

a. nothing
b. cause `Hello` to be output
c. cause a syntax error
d. cause `("Hello")` to be output
e. There is no way to tell without executing the code.

ANS: A
The characters `//` denote the beginning of a comment. The comment is not compiled and so, nothing would happen when this code is executed.

19. What comment might be added to explain the following instruction?

```
System.out.println("Hello World");
```

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a. `// prints "Hello World" to the screen`
b. `//prints a message`
c. `//used to demonstrate an output message`
d. `//`
e. `// meaningless instruction`

ANS: C
Comments in A and B state the obvious while the comments in D and E are meaningless. The comment in C explains why the instruction appears in the program.

20. Which character belowis not allowed in an identifier?

a. `$`
b. `_`
c. `0`
d. `1`
e. `^`

ANS: E
Java identifiers can consist of any letter, digit, $ or _ as long as the identifier starts with a letter or _. `^` is not a legal character.

21. Which of the following is not syntactically legal in Java?

a. `System.out.println("Hi");`
b. `public class Foo`
c. `s t a t i c main(String[] args)`
d. `{}`
e. only A is legally valid; all the others are illegal

ANS: C
The Java compiler would not recognize "`s t a t i c`" as "`static`" because the Java compiler treats white space (blanks) as separators between entities. The other statements are all legal, including "`{}`" which is a block that happens to have no statements within it.

22. Which of the following is a legal Java identifier?

a. `i`
b. `class`
c. `1likeclass!`
d. `idon'tlikeclass`
e. `i-like-class`

ANS: A
Java identifiers cannot have the characters `!, '` or – in them so answers C, D and E are wrong. The word `class` is a reserved word in Java and cannot be used as an identifier. The identifier `i` is perfectly legal although it is not necessarily a good identifier since it is not descriptive of its use.

23. A unique aspect of Java that allows code compiled on one machine to be executed on a machine with a different hardware platform is Java's

a. bytecodes
b. syntax
c. use of objects

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d. use of exception handling
e. All of these

ANS: A
The translation process for a Java program is to first compile it into bytecodes, which are architecturally neutral (that is, they can be used no matter what the architectural platform is). To execute the program, the bytecodes must be further compiled by a Java compiler or interpreted by a Java Virtual Machine.

24. Java is similar in syntax to which of the following high-level languages?

a. Pascal
b. Ada
c. C++
d. FORTRAN
e. BASIC

ANS: C
The creators of Java decided to use syntax similar to C++ so that C++ programmers could easily learn Java. Variable declarations, assignment statements, loops, selection statements and comments are among the features that have nearly identical syntax. There are many differences however, so don't assume that any C or C++ programmer will easily or instantly be able to program in Java.

25. An error in a program that results in the program outputtinh $100 instead of the correct answer, $250, is a

a. compiler error
b. syntax error
c. run-time error
d. logical error
e. snafu

ANS: D
While this is an error, programmers classify the type of error in order to more easily solve the problem. Syntax errors are caught by the compiler and the program cannot run without fixing all syntax errors. Run-time errors arise during program execution and cause the program to stop running. Logical errors are errors whereby the program can run to completion, but gives the wrong answer. If the result should have been $250, then the logic of the program is wrong since it output $100. A snafu is a term expressing a messed up situation in combat and should not be used by respectable programmers!

26. Which of the following is true regarding Java syntax and semantics?

a. A Java compiler can determine if you have followed proper syntax but not proper semantics.
b. A Java compiler can determine if you have followed proper semantics but not proper syntax.
c. A Java compiler can determine if you have followed both proper syntax and proper semantics.
d. A Java compiler cannot determine if you have followed either proper syntax or proper semantics.
e. A Java compiler can determine if you have followed proper syntax but not proper semantics only if you follow the Java naming convention rules.

ANS: A

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Compilers for all languages have the ability to detect syntax errors because improper use of the syntax leads to situations where the compilers cannot translate the code properly. However, compilers are unable to follow the semantics of a program because this requires a degree of understanding what the program is intended to do and computers have no sense of understanding (at least at this point).

27. Using Java naming convention, which of the following would be a good variable name for the current value of a stock?

    a. `curstoval`
    b. `theCurrentValueOfThisStock`
    c. `currentStockVal`
    d. `csv`
    e. `current`

    ANS: C
    Java allows long variable names but the programmer must find a good compromise between an excessive long name (as with B) and names too short to understand their use (A and D). The name `current` possibly might be reasonable if there are no other "current" values being referenced in the program.

28. Which of the following is a legal Java identifier?

    a. `1ForAll`
    b. `oneForAll`
    c. `one/4/all`
    d. `1_4_all`
    e. `1forall`

    ANS: B
    Java identifiers cannot start with a number (so the answers in A, D and E are illegal) and cannot include the / character, so the answer in C is illegal.

29. A color image is broken down into individual pixels (points), each of which is represented by

    a. a 1 for white and a 0 for black
    b. 3 values denoting the intensity of red, green, and blue in the image
    c. a single number indicating the intensity of color between white and black
    d. two numbers, where one indicates where the color is between white and black and the other denotes the brightness
    e. None of these; it is not possible to represent color

    ANS: B
    Black and white images are stored using 0s and 1s while color images are stored using three values, one each for the degree of red, the degree of blue, and the degree of green.

30. Which of the following characters does not need to have an associated closing character in a Java program?

    a. `{`
    b. `(`
    c. `[`
    d. `<`
    e. All of these require closing characters

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ANS: D
{ is used to open a block, and so } is needed to close the block. (is used to open an expression and so) is needed to close an expression. [is used to start an array index so] is needed to close the array index. < is "less than" and > is "greater than" and these are not needed together, so < requires no closing character.

31. Mistyping `println` as `printn` will result in

    a. a syntax error
    b. a run-time error
    c. a logical error
    d. no error
    e. the statement being converted to a comment

    ANS: A
    If the Java compiler cannot make sense of a command, the compiler cannot convert it and responds with a syntax error. While `println` is recognized as a command, `printn` is not, and so the compiler provides a syntax error.

PROBLEM

1. What is wrong with the following class definition?

```
public class Program1
{
      public static void main(String[ ] args)
      {
            System.out.println("My first Java program")
      }
}
```

    ANS:
    The one executable statement in the main method is missing a `";"` at the end of the line. Executable statements end with `";"`.

2. What is wrong with the following class definition?

```
public class Program2
      public static void main(String[] args)
      {
            System.out.println("My second Java program");
      }
```

    ANS:
    The definition of a class is placed within { } statements, which are missing here.

3. Given the following class definition, what are the reserved words and what are the identifiers?

```
public class Program3
{
      public static void main(String[] args)
      {
            System.out.println("My third Java program");
```

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```
        }
    }
```

ANS:
The reserved words are `public`, `class`, `static`, `void`. The identifiers are `main`, `String`, `System.out`, `Program3`, and `args`. `main` is the name of a method defined within the `Program3` class. `string` and `System.out` are classes already defined in Java and `println` is a method of `System.out`. `Program3` is a class, defined here, and `args` is a variable.

4. Provide a brief explanation of the role of main memory, the control unit, the arithmetic logic unit, and registers. (Refer to figure 1.13 in the text)

ANS:
Main memory is used to store the currently executing processes along with their data. The control unit performs the fetch-decode-execute cycle, which fetches an instruction from memory, decodes it and determines how it is to be executed. The arithmetic logic unit comprises a number of circuits that execute arithmetic and logic instructions. Registers are used to store values in the CPU temporarily while the current instruction(s) need them.

5. What is the output of the following code when the `main` method is executed?

```
public class Question4
{
   public static void main(String[] args)
   {
     System.out.println("hi there");
     System.out.println("    ");
     System.out.println("how are   you doing   today?   ");
   }
}
```

ANS:
```
hi there

how are   you doing   today?
```

Notice that while the Java compiler ignores "white space", blanks that appear in a `println` statement inside of quote marks are retained and output in that manner.

6. What is wrong with the following `println` statement?

```
System.out.println("My fourth Java Program);
```

ANS:
It is missing a closing `"`. The compiler will look for a second `"` before the end of the statement. So, like `{}`, `()`, and `[]`, an initial `"` must have a corresponding closing `"`.

7. Provide identifier names that would be used to represent a person's social security number, income tax withheld, and net pay.

ANS:

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`socialSecurityNumber`, or `ssn`, `incomeTaxWithheld` or `incomeTax`, and `netPay` all would be reasonable.

8. There are a number of reserved words in Java that have no current meaning (denoted with an * in figure 1.18 in the text). Why?

   ANS:
   Java language designers anticipate introducing these statements in future versions, but have not yet implemented them because they are lower priority, or it has not been decided how they will be implemented or precisely what they will mean.

9. A document of text is 15 pages long. Each page contains approximately 200 words and the average length of each word is 5 characters. Also assume one blank space between each word and no punctuation. How many bytes will it take to store this document in memory or on disk using ASCII?

   ANS:
   A character is stored in ASCII using 8 bits or 1 byte. Therefore, 5 characters per word plus 1 blank space between words take 6 bytes per word (except for the first). Each page stores 200 words and there are 15 pages. So we need 15 * 200 * 6 - 1 (no blank space to start the text) = 17,999 bytes which is 17.58 kilobytes, or nearly 18 Kbytes.

10. Provide a brief description of the roles of the following hardware elements (that is, what each is used for):
    a) CPU
    b) Main memory
    c) Secondary memory devices
    d) Input/Output devices

    ANS:
    a) The CPU is the processor. It executes all program instructions. It does this through the fetch-decode-execute cycle where the next program instruction is fetched from memory, decoded in the CPU, and then executed by one or more circuits.

    b) Main memory is stored on chips on the motherboard and is used for quick access to the current program for the fetch-decode-execute cycle and to store data being used by this program.

    c) Secondary memory devices are storage devices, used to store programs and data not currently being used. Storage devices, such as the hard disk, also are used to store things for permanence and archives.

    d) Input/Output devices are used to communicate with the computer. Input devices, like the keyboard, take commands and data from the user and output devices, like the monitor, display the results of the process/computation.

11. Examine figure 1.7 before answering this question. What 8-bit value comes immediately before and what 8-bit value comes immediately after `10010111`?

    ANS:
    `10010110` comes immediately before `10010111` and `10010100` comes immediately after `10010111`.

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12. Rewrite the following comment so that is can appear over multiple lines.

```
//  This is one really enormously long comment that might run off
the page
```

ANS:
We can do this in two ways, preceding each line with `//` or by enclosing the comment in `/*` and `*/`.

```
/* This is one really enormously
 long comment that might run
 off the page   */
```

or

```
    //  This is one really enormously
    //  long comment that might run
    //  off the page
```

13. Rewrite the following program with better formatting to make it easier to read.

```
public
class
MyProgram
{    public static void
main(
String[]
args)
{   System.out.println(
"Wow, this is messed up!"
);
} }
```

ANS:
There are many ways this program might appear. The following would be very acceptable:

```
public class MyProgram
{
   public static void main(String[] args)
   {
        System.out.println("Wow, this is messed up!");
   }
}
```

14. Write a Java program that will output on two separate lines the names of the authors of this textbook.

ANS:

```
public class OutputNames
{
  public static void main(String[] args)
  {
    System.out.println("John Lewis"); // 1st author's name
    System.out.println("William Loftus");// 2nd author's name
   }
}
```

15. Correct all the syntax errors in the following program.

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```
Public Class Program     \\ A problem program
(
   Public static voided main[Strings() args]
   {
      system.out.println('This program'); \* oh, my... *\
      system.out.println('has several syntax errors');   \*
                                    lots of errors *\
   }
)
```

ANS:

```
public class Program     // A problem program
{
   public static void main(String[] args)
   {
      System.out.println("This program");    /* oh, my... */
      System.out.println("has several syntax errors"); /*
                                    lots of errors */
   }
}
```

16. Write a Java program that will display the following three lines when it is run:

```
      *
    * * *
  * * * * *
```

ANS:

```
public class Stars
{
    public static void main(String[] args)
    {
        System.out.println("    *");
        System.out.println("  * * *");
        System.out.println("* * * * *");
    }
}
```

17. Name five of the fundamental terms which encompass object-oriented programming.

ANS:
There are seven terms to choose from: object, attribute, method, class, encapsulation, inheritance, and polymorphism.

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