



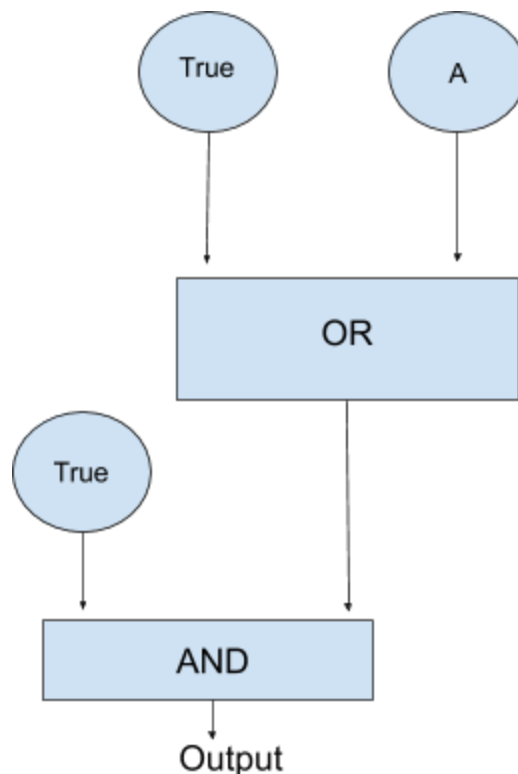
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1. What value of A would make the output of the logic circuit false?



- (A) true
- (B) false
- (C) The output will be false no matter what the value of A is
- (D) There is no value of A such that the output of the logic circuit will be false

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
2.2 Multiple levels of abstraction are used to write programs or to create other computational artifacts	2.2.3 Identify multiple levels of abstractions being used when writing programs. [P3]	P3 Abstracting	2.2.3F	4
(A) This option is incorrect. <code>true OR true = true</code> , <code>true AND true = true</code>				
(B) This option is incorrect. <code>true OR false = true</code> , <code>true AND true = true</code>				
(C) This option is incorrect. Both 'A' being true and 'A' being false results in an output of true				
(D) This option is correct. The output of the OR-gate will always be true, making the output of the circuit always true as well				

2. In the following code block, assume that the variables Rainy and too_cold are boolean.

```
IF (NOT (Rainy OR too_cold))
{
    DISPLAY("It's a good beach day")
}
```

Which of the following are equivalent to the above code block?

- (A) IF ((NOT rainy) OR (NOT tooCold))
{
 DISPLAY("It's a good beach day")
}
- (B) IF ((NOT rainy) AND tooCold)
{
 DISPLAY("It's a good beach day")
}
- (C) IF ((NOT rainy) AND (NOT tooCold))
{
 DISPLAY("It's a good beach day")
}
- (D) IF (rainy AND tooCold)
{
 DISPLAY("It's a good beach day")
}

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
5.5 Programming uses mathematical and logical concepts	5.5.1 Employ appropriate mathematical and logical concepts in programming	P1 Connecting computing	5.5.1E	3
(A) This option is incorrect. NOT can't be distributed over OR				
(B) This option is incorrect. NOT needs to be applied to the second clause as well				
(C) This option is correct. This option makes sense in a real-world setting and also adheres to DeMorgan's law				
(D) This option is incorrect. NOT needs to be applied to each clause				

3. In the process of digging, a landscaping company cuts a fiber line. Transmission of Internet traffic is still possible through additional pathways that provide alternate routes between the source and destination. The additional pathways describe a concept known as:

- (A) bandwidth
- (B) hierarchy
- (C) latency
- (D) redundancy

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
6.1 The Internet is a network of autonomous systems.	6.1.1 Explain the abstractions in the Internet and how the Internet functions.	P3 Abstracting	6.1.1B	3
(A) This option is incorrect. Bandwidth is the data throughput of a network. If a connection is broken, there will be no throughput.				
(B) This option is incorrect. Designing networks in a hierarchal manner allows a complex problem to be broken into smaller manageable parts.				
(C) This option is incorrect. Network latency is an expression of how much time it takes for a packet of data to get from one point to another.				
(D) This option is correct. Network redundancy is a process through which additional or alternate instances of network devices, equipment and communication mediums are installed within network infrastructure. It is a method for ensuring network availability in case of a network device or path failure and unavailability.				

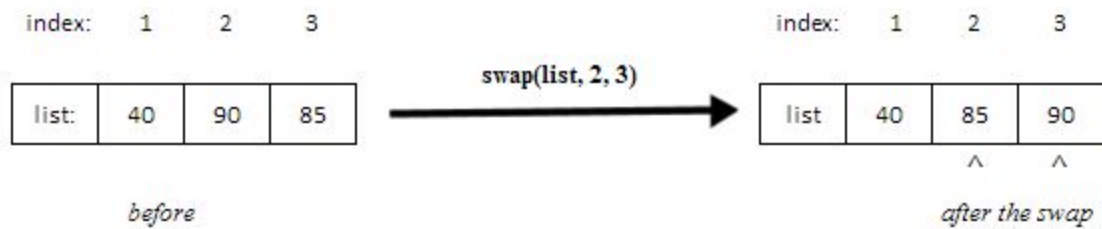
4. You decide you are going to take your internet privacy seriously. Which of the following action poses the greatest risk to your internet privacy?

- (A) Sharing your email address with those who request it.
- (B) Connecting to secured networks using the provided network name and password when visiting hotels.
- (C) Encrypting your files and sharing your private key to ensure others who you choose to share files with can read them.
- (D) Using cloud storage to ensure access to your files from all your devices.

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
6.3 Cybersecurity is an important concern for the Internet and the systems built on it.	6.3.1 Identify existing cybersecurity concerns and potential options to address these issues with the Internet and the systems built on it.	P1 Connecting computing	6.3.1C	2
(A) This option is incorrect. While sharing your email is a privacy concern as it will increase the likelihood of Spam, it is not the greatest privacy infraction of the options.				
(B) This option is incorrect. Given that the network is part of the hotel infrastructure, requires a username and password, it is not a major privacy concern unless the hotel IT structure is compromised.				
(C) This option is correct. When encrypting files using asymmetric methods, one should always share the public key. If a private key is shared, all files encrypted by this user are able to be able to be unencrypted which is a major privacy risk.				
(D) This option is incorrect. Cloud storage itself is not a privacy risk. While one should ensure proper security settings when signing up for any cloud storage, the risk is minimal compared to other options given.				

5. You are writing a function called `swap (list, x, y)` which will exchange the position of the two values at indexes `x` and `y` in the list.

Example: before and after a call to `swap (list, 2, 3)` on the list shown below



The function header is defined below. Choose the three lines of code that will perform the swap correctly.

```
procedure swap (list, x, y) {  
    <MISSING CODE>  
}
```

(A) `var temp ← list[y];`
 `list[x] ← temp;`
 `list[y] ← list[x];`

(B) `list[x] ← temp;`
 `var temp ← list[y];`
 `list[y] ← list[x];`

(C) `list[y] ← list[x];`
 `var temp ← list[y];`
 `list[x] ← temp;`

(D) `var temp ← list[y];`
 `list[y] ← list[x];`
 `list[x] ← temp;`

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
5.4 Programs are developed, maintained, and used by people for different purposes.	5.4.1 Evaluate the correctness of a program.	P4 Analyzing Problems and Artifacts	5.4.1F	3
(A) This option is incorrect. The data at index x is being overwritten by the data in temp <i>before</i> storing it at index y. Resulting array: list[40, 85, 85]				
(B) This option is incorrect. The value of temp is being assigned <i>before</i> the variable has been initialized leading to unpredictable results. Resulting array: unpredictable				
(C) This option is incorrect. The data at index y is overwritten by the data at index x and is thereby lost before the swap is complete. Resulting array: list[40, 90, 90]				
(D) This option is correct. It's important to note that swapping x to y, and then y to x will not work. It is necessary to temporarily store the data of one of the variables to successfully swap the numbers. To do this, create a temp variable that holds the data at index y. Swap the data at y with x (move data from index x to index y), and then set the data at x to temp which holds the original value of the index y. Resulting array: list[40, 85, 90]				

6. What is a disadvantage of the open standard of Internet addressing and routing?

Select two answers.

- (A) censorship
- (B) possibility of denial of service attacks
- (C) redundancy
- (D) hierarchy

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
6.3 Cybersecurity is an important concern for the Internet and the systems built on it.	6.3.1 Identify existing cybersecurity concerns and potential options that address these issues with the Internet and the systems built on it.	P1 Connecting computing	6.3.1C	2
(A) This option is correct. The open standard of addressing used on the Internet makes it easy to censor websites by redirecting internet traffic from the censored website to another website.				
(B) This option is correct. The open standard of addressing and routing used on the Internet makes it vulnerable to security issues such as DDoS attacks.				
(C) This option is incorrect. Redundant nature of Internet addressing is an advantage because it provides multiple paths between users on the Internet. Having different paths makes the Internet more reliable.				
(D) This option is incorrect. The hierarchical structure of Internet addressing is an advantage since it makes the Internet scalable.				

7. If Alice wishes to send Bob an encrypted message using public-key encryption, she should encrypt her message with _____,

- (A) her private key
- (B) her public key
- (C) Bob's private key
- (D) Bob's public key

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
6.3 Cybersecurity is an important concern for the Internet and the systems built on it.	6.3.1 Identify existing cybersecurity concerns and potential options that address these issues with the Internet and the systems built on it.	P1 Connecting computing	6.3.1L	3
(A) This option is incorrect. Alice uses her private key to decrypt a message that was encrypted using her public key.				
(B) This option is incorrect. Anyone wanting to send Alice a message would use her public key to encrypt the message.				
(C) This option is incorrect. Alice does not have Bob's private key, only Bob should have Bob's private key.				
(D) This option is correct. In order for Alice to send an encrypted message to Bob, she uses Bob's public key. Bob will use his private key to decrypt the message.				

8. A student is taking a survey of her class in order to determine their average hours of sleep per night. She is tracking the number of students in her class that have replied. She sees that the number of students who have replied is represented by the digits “12” but she does not remember what base she used. Which of the following are possible bases that the number 12 could be in?

- I. Binary (base 2)
- II. Decimal (base 10)
- III. Hexadecimal (base 16)

- (A) I and II
- (B) I and III
- (C) II and III
- (D) I, II, and III

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
2.1 A variety of abstractions built upon binary sequences can be used to represent all digital data.	2.1.2 Explain how binary sequences are used to represent digital data.	P3 Abstracting	2.1.1D	3
(A) This option is incorrect. 12 is a number in base 10, it is not a number that can be represented in binary because there is no 2 digit in binary.				
(B) This option is incorrect. 12 is a number in base 16, but it is not a number that can be represented in binary				
(C) This option is correct. 12 is a number in both base 10 and base 16. 1 and 2 are both valid digits in base 10 and base 16.				
(D) This option is incorrect. 12 is a number in base 10 and base 16, but not base 2.				

9. Which of the following can be represented by a sequence of 3 bits?

- I. The seven days of the week
- II. Between zero and eight pints of ice cream
- III. The nine innings in a standard baseball game

- (A) I only
- (B) I and II
- (C) I, II and III
- (D) None of the Above

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
2.1 A variety of abstractions built upon binary sequences can be used to represent all digital data.	2.1.2 Explain how binary sequences are used to represent digital data.	P3 Abstracting	2.1.2F	3
(A) This option is correct. The numbers 0-7 can be represented with 3 bits, so you can represent the 7 days of the week.				
(B) This option is incorrect. The number 8 cannot be represented with just 3 bits, while zero through seven can be represented, you would need one more bit to represent 8 pints of ice cream.				
(C) This option is incorrect. The number 9 cannot be represented with just 3 bits, so you would need one more bit to represent 9 innings.				
(D) This option is incorrect. The numbers 0-7 can be represented with 3 bits, making Option I correct				

10. Which type of chart would best display the individual data from 1,000 individuals' daily time spent in social media?

- (A) Pie Chart
- (B) Bar Chart
- (C) Line Chart
- (D) Scatter Plot

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
3.1 People use computer programs to process information to gain insight and knowledge	3.1.3 Explain the insight and knowledge gained from digitally processed data by using appropriate visualizations, notations, and precise language	P2 Creating Computational Artifacts	3.1.3B	2
(A) This option is incorrect. Pie Charts require categorization so it would not show 1000 individual data points				
(B) This option is incorrect. Bar Charts require categorization so it would not show 1000 individual data points.				
(C) This option is incorrect. Line Charts are designed to show change over time which does not occur in this data set.				
(D) This option is correct Scatter Plots can show a large number of individual data points				

11. An architecture company is planning to build a tower in California but they are worried about earthquakes. They decide to use a computer simulation in order to test the safety of different designs when an earthquake occurs. Which of the following are reasons to use a simulation in this context?

- I. Using the simulation software can save the company money because it allows them to test building materials for safety without purchasing physical materials.
- II. Using the simulation software will perfectly predict what will happen in the event of an earthquake.
- III. Using the simulation software can help ensure the safety of the building during an earthquake without endangering people.

(A) I only

(B) III only

(C) I and III only

(D) I, II and III

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
2.3 Models and simulations use abstraction to generate new understanding and knowledge	2.3.1 Use models and simulations to represent phenomena	P3 Abstracting	2.3.1D	2
(A) This option is correct. A is correct because only I a correct answer.				
(B) This option is incorrect. B is incorrect because it does not include I which is also a correct answer.				
(C) This option is incorrect. C is incorrect because III is not a correct answer.				
(D) This option is incorrect. D is incorrect because II is incorrect. Simulations cannot make perfect predictions				

12. FOUR INDEPENDENT ALGORITHMS listed below can be executed on a row of NUMBER cards (Not FACE cards) on a table. There are an EVEN number of cards, and they are in no special order. Which of the Algorithms involves BOTH Selection and Iteration?

For this question select TWO correct answers

- (A) Look over all the cards to find the smallest one, and move it to the leftmost position.
- (B) Compare the first two cards. If the one on the left is greater, switch them
- (C) Compare the values of each pair of cards. For example, compare cards 0 and 1, compare cards 2 and 3, and so on for all pairs. Swap positions when the first card is greater than the second of the pair.
- (D) Find the middle card and switch it with the card in the rightmost position

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
4.1 Algorithms are precise sequences for processes that can be executed by a computer and are implemented using programming languages.	4.1.1 Develop an algorithm for implementation in a program	P2 Creating computational artifact	4.1.1A	3
(A) This option is correct. The algorithm utilizes both iteration (look over all the cards) as well as selection (move to leftmost position)				
(B) This option is incorrect. This algorithm only uses selection (if one is greater, switch)				
(C) This option is correct This algorithm utilizes both iteration (compare the values of each pair of cards) and selection (swap positions)				
(D) This option is incorrect. This algorithm only utilizes selection (find the middle and move)				

13. A crime investigator is accessing an online database of crimes within a certain radius of the city center. The database contains the following information:

Date of crime

Name of offender

Neighborhood of crime

The investigator is looking for other crimes that occurred in a certain area on a certain date.

Which of the following algorithms can be used to find all crimes that occurred in a certain neighborhood on a certain day?

I. Make a new list by filtering the data so only the crimes from a certain neighborhood are on the list. Perform multiple binary searches to find all crimes that occurred in that neighborhood on a certain day, adding each new occurrence to a final list.

II. Make a new list by filtering the data so only the crimes from a certain neighborhood are on the list. Perform multiple linear searches to find all crimes that occurred on the given day, adding each new occurrence to a final list.

(A) Both algorithms work correctly

(B) Algorithm I always works correctly, but Algorithm II only works correctly when the date data is sorted.

(C) Algorithm II always work correctly, but Algorithm I only works correctly when the date data is sorted.

(D) Neither algorithm will correctly find all crimes.

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
4.1 Algorithms are the precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages.	4.1.1 Develop an algorithm for implementation in a program	P2 Creating computational artifact	4.1.1B	3
(A) This option is incorrect. The binary sort only works if the data has been sorted				
(B) This option is incorrect. Algorithm II will work regardless of whether the data is sorted or not. and Algorithm I's binary sort algorithm needs the Date data to be sorted				
(C) This option is correct. Algorithm II (Linear search) will work regardless of whether the data is sorted or not. Algorithm I (Binary sorting) will work once the Date data is sorted				
(D) This option is incorrect.				

14. Imagine you are playing an online game with your friends. You are at a crucial stage in the basketball game and need just one more free throw to win the game. You see the entire complex scene display quickly. You aim at the hoop to shoot your free throw. You click the shoot button but there is a momentary freeze on your screen only to discover that you have lost the game. What is demonstrated by this situation?

- (A) High bandwidth, high latency
- (B) Low bandwidth, high latency
- (C) High bandwidth, low latency
- (D) Low bandwidth, low latency

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
EU 6.2 Characteristics of the Internet influence the systems built on it	LO 6.2.2 Explain how the characteristics of the Internet influence the systems built on it	P4 Analyzing problems and artifacts	6.2.2K	3
(A) This option is correct. The screen loads immediately indicates high bandwidth and the momentary freezing of the screen and losing the game indicates high latency.				
(B) This option is incorrect. The screen will not load immediately with low bandwidth and the momentary freezing of the screen and losing the game indicates high latency.				
(C) This option is incorrect. The screen loads immediately indicates high bandwidth, low latency would have resulted in the player being able to shoot the ball.				
(D) This option is incorrect. The screen will not load immediately with low bandwidth, low latency would have resulted in the player being able to shoot the ball.				

15. The Domain Name System (DNS) is designed to

- I. Allow for nested domain naming (e.g., digitalportfolio.collegeboard.org)
- II. Allow for centralized access and administration
- III. Use cache and redundant servers for quick matching of IP addresses to domain names
- IV. Use a static database for matching IP address to domain names

(A) I only

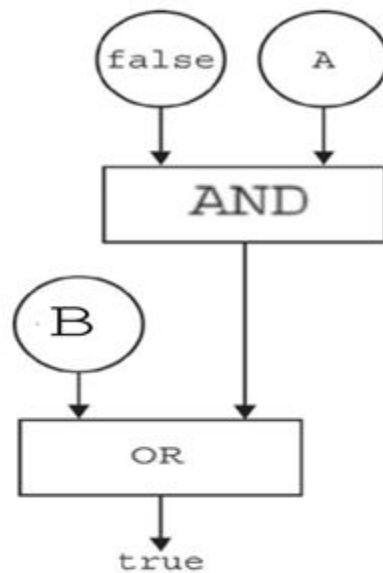
(B) II only

(C) I and III only

(D) II and IV only

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
EU 6.2 Characteristics of the Internet influence the systems built on it.	LO 6.2.1 Explain characteristics of the Internet and the systems built on it	P4 Analyzing problems and artifacts	6.2.1B	3
(A) This option is incorrect. DNS syntax is hierarchical so sub domains are nested within the main domain name but there is one additional characteristic that also defines the DNS.				
(B) This option is incorrect. DNS does not have a centralized administration, it is designed on distributed administration and access.				
(C) This option is correct. DNS syntax is hierarchical so sub domains are nested within the main domain name and it uses cache and redundant servers to quickly match the IP address to the domain name.				
(D) This option is incorrect. DNS does not have a centralized administration, it is designed on distributed administration and access. DNS database is constantly updated to accommodate new devices and networks.				

16. The figure below shows a circuit composed of two logic gates. The output of the circuit is true.



Which of the following is a true statement about input A and B?

- (A) Input A must be `true` regardless of Input B's value
- (B) Input A must be `false` regardless of Input B's value
- (C) Input A can be either `true` or `false` if Input B is `true`
- (D) There is no possible value of Input A or Input B that will cause the circuit to have the output `true`

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
2.2 Multiple levels of abstraction are used to write programs or to create other computational artifacts	2.2.3 Identify multiple levels of abstractions being used when writing programs	P3 Abstracting	2.2.3F	2
(A) This option is incorrect. If Input B is <code>false</code> then the entire logic gate will be <code>false</code> .				
(B) This option is incorrect. While Input A can be <code>false</code> , if Input B is then <code>false</code> the entire logic gate will be <code>false</code> .				
(C) This option is correct. The <code>and</code> gate needs both inputs to be <code>true</code> in order for the output to be <code>true</code> . So, the output of the <code>and</code> gate will be <code>false</code> regardless of Input A's value because one of the inputs is already <code>false</code> . The <code>or</code> gate needs only one of the inputs to be <code>true</code> for the output to be <code>true</code> . Therefore, since one of the inputs from the <code>and</code> gate will be <code>false</code> , Input B must be <code>true</code> .				
(D) This option is incorrect. Answer choice C illustrates that there is a possible value that works.				

17. A high school surveys all of its 1,750 students to determine the average number of hours U.S. high school students sleep per night. Which of the following is a true statement?

- (A) The high school should not use the data from this study because it is based on direct observation.
- (B) The high school can use this data to determine the average number of hours U.S. high school students sleep per night.
- (C) The high school cannot draw meaningful conclusions from this data because the sample size is too small.
- (D) The high school can use the results of this survey to conclude that U.S. high school students do not get enough sleep.

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
3.2 Computing facilitates exploration and the discovery of connections in information.	3.2.1 Extract information from data to discover and explain connections or trends. [P1]	P1 Connecting computing	3.2.1	1
<hr/>				
(A) This option is incorrect. The study is not based on direct observation because a survey was used to gather the data.				
<hr/>				
(B) The school cannot draw conclusions about all U.S. high school students because the sample size is too small and not randomly distributed.				
<hr/>				
(C) This option is correct. The results from one high school in the U.S. cannot be extrapolated out to a nationwide scale.				
<hr/>				
(D) This option is incorrect. This is a value judgement that in any case is not supported by the data that was gathered.				
<hr/>				

18. Which algorithm best describes the program below?

```

items ← 0
FOR EACH name IN nameList
    items ← items + 1
DISPLAY items

```

- (A) An algorithm to find a specific name in a list of names
- (B) An algorithm to find the number of names in a list.
- (C) An algorithm to find the name stored at the end of a list
- (D) An algorithm to search a list of names

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
5.2 Programs can be developed to solve problems.	5.2.1 Develop a correct program to solve problems.	P4 Analyzing problems and artifacts	5.2.1A	3
(A) This option is incorrect because the loop block does not reference a specific name in the list.				
(B) This option is correct because the loop block increments by one for each name in the list.				
(C) This option is incorrect because the last name in the list is not referenced.				
(D) This option is incorrect because the loop block does not perform a test on any name in the list.				

19. Frances wants to develop an algorithm to compute the **arithmetic mean** of a list of numbers. After four attempts to implement the algorithm, the following code was tested and found to correctly compute and display the **total sum** of all the numbers in the list.

```

total ← 0

items ← 0

FOR EACH number IN numList {
    total ← total + number
    <MISSING CODE 1>
}

DISPLAY total

DISPLAY items

<MISSING CODE 2>

```

Which lines of code need to be added so that the algorithm displays the arithmetic mean of the numbers in numList?

- (A) Missing code 1: `items ← items+1`, Missing code 2: `DISPLAY average`
- (B) Missing code 1: `average ← items / total`, Missing code 2: `DISPLAY average`
- (C) Missing code 1: `total ← total+1`, Missing code 2: `DISPLAY (total / items)`
- (D) Missing code 1: `items ← items+1`, Missing code 2: `DISPLAY (total / items)`

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
5.1 Programs can be developed to solve problems.	5.1.2 Develop a correct program to solve problems.	P4 Analyzing problems and artifacts	5.1.2A	4
(A) This option is incorrect because it never defines <i>average</i> .				
(B) This option is incorrect because <i>items</i> is never iterated.				
(C) This option is incorrect because it results in a divide by zero error.				
(D) This option is correct. <i>Items</i> is properly updated inside the loop block and <i>total over items</i> gives the mean.				

20. A student draws a gorgeous digital image on her school computer. She decides she wants to show her brother, so she saves it and later downloads the image onto her home computer. When she opens and resizes the image at home, the quality is noticeably inferior to the original she saved. Which of the following is a reasonable explanation for the reduced quality?

- (A) Low bandwidth of her Wi-Fi connection caused a slow download.
- (B) High latency of her Wi-Fi connection caused a delay in starting the download.
- (C) The process she used to save the image utilized a "lossless" compression algorithm.
- (D) The process she used to save the image utilized a "lossy" compression algorithm.

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
3.3 There are trade-offs when representing information as digital data.	3.3.1 Analyze how data representation, storage, security, and transmission of data involve computational manipulation of information.	P4 Analyzing Problems and Artifacts	3.3.1D	3
(A) This option is incorrect. Low bandwidth can result in perceived slow downloads however the quality of the data transmitted is not affected.				
(B) This option is incorrect. High latency can result in perceived slow downloads however the quality of the data transmitted is not affected.				
(C) This option is incorrect. Lossless compression allows complete reconstruction of the original data. so this type of compression can not be responsible for data loss resulting in a lower quality image.				
(D) This option is correct. Lossy compression trades some data loss for increased compression. As a result computers are only able to reconstruct an approximation of the original data				

21. Consider the following algorithms to store a color digital image. Which algorithms are examples of "lossy" compression?

Select two answers:

- (A) The algorithm breaks the image into quadrants, and those quadrants into sub-quadrants creating 16 uniformly sized parts. The parts are saved in separate smaller files along with the information needed to completely reassemble the original image.
- (B) The image is divided into squares that are 2 by 2 pixels each. Each square is translated into a single pixel whose color is the average of the color values from the 4 pixels in the square.
- (C) The algorithm find runs of identical pixels. It saves the same information by saving the pixel value once and then the number of consecutive identical pixels.
- (D) The algorithm translates a color image into a grayscale version of the color original storing only averages of the data used to store the original colors in the picture.

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
3.3 There are trade-offs when representing information as digital data.	3.3.1 Analyze how data representation, storage, security, and transmission of data involve computational manipulation of information.	P4 Analyzing Problems and Artifact	3.3.1C	4
(A) This option is incorrect. A lossy algorithm can not be used to completely reassemble an image. Some of the original data is normally lost				
(B) This option is correct. An average can not be reversed into its original components so this algorithm reduces the amount of data in a way that can not be reliably reversed.				
(C) This option is incorrect. Lossy compression techniques result in files with less information than the originals.				
(D) This option is correct. The stored averages are enough to produce a grey version of a color image but not enough to restore the original colors.				

22. What will be displayed when the following program is executed?

```
list ← [1, 3, 5]
FOR EACH item IN list
{
    DISPLAY (item MOD 3)
}
```

- (A) 4 6 8
- (B) 0 1 1
- (C) 3 9 15
- (D) 1 0 2

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
4.1 Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages.	4.1.2 Express an algorithm in a language.	P5 Communicating	4.1.2A	4
(A) Incorrect. This student, unsure of the meaning of MOD, added 3 to each item in the list.				
(B) (B) Incorrect. This student, aware that MOD was associated with division, reported the number of times each number could be divided by 3 (rather than the remainder).				
(C) (C) Incorrect. This student multiplied the list items by 3.				
(D) This option is correct. This student correctly reported the remainder when each list item was divided by 3.				

23. Consider the following program that is intended to calculate the sum of all items in a list:

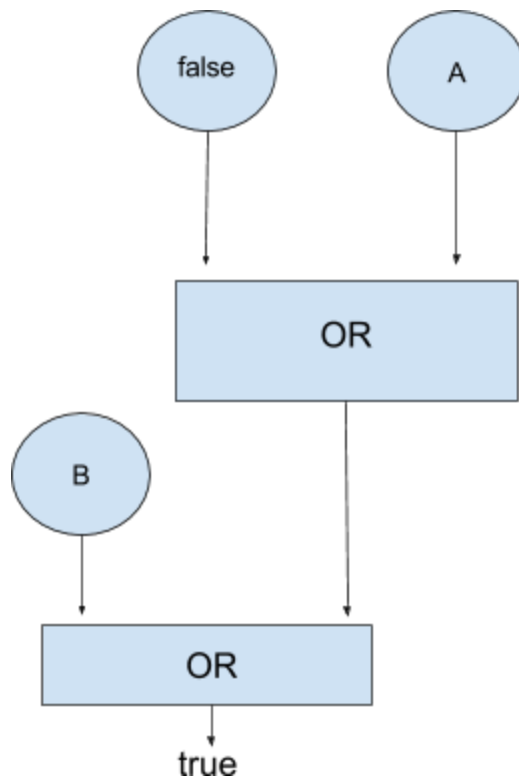
```
FOR EACH item IN list
{
    sum ← 0
    sum ← sum + number
}
DISPLAY ( sum )
```

What will be the output printed if `list ← [0, 5, -3, 4]`?

- (A) 6
- (B) 0
- (C) 4
- (D) 9

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
4.1 Algorithms are precise sequences of instructions for processes that can be executed by a computer and are implemented using programming languages.	4.1.2 Express an algorithm in a language.	P5 Communicating	4.1.2A	4
(A) This option is incorrect. Although 6 is the intended answer to this code, the logic of the code will not calculate this correctly. The variable named 'sum' is assigned the value of 0 EVERY TIME the list is iterated through. This will cause the code to not meet its intended purpose.				
(B) This option is incorrect. Assuming that the initial value of the variable sum will continue to persist after the for loop is executed				
(C) This option is correct. Since sum is initialized INSIDE the for loop, it gets reset to 0 every time the loop is executed. Thus only the last value in the list is added onto the variable named 'sum'.				
(D) This option is incorrect. This student is incorrectly assuming that negative numbers will be ignored				

24. The figure below shows a circuit composed of two logic gates. The output of the circuit is true.



Which of the following is a true statement about inputs A and B?

- (A) Both inputs must be `false`
- (B) At least one input must be `true`
- (C) Both inputs must be `true`
- (D) There are no values of A and B that will make the output of the circuit `true`

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
2.2 Multiple levels of abstraction are used to write programs or to create other computational artifacts	2.2.3 Identify multiple levels of abstractions being used when writing programs	P3 Abstracting	2.2.3F	4
(A) This option is incorrect. The output will be <code>false</code> if both inputs are <code>false</code>				
(B) This option is correct. So long as A or B are <code>true</code> , the entire circuit is <code>true</code>				
(C) This option is incorrect. It is only necessary for one input to be <code>true</code>				
(D) This option is incorrect. The output will be <code>true</code> so long as one input is <code>true</code>				

25. In the following code block, assume that the variables `rainy` and `too_Cold` are boolean.

```
IF (NOT(rainy) AND NOT(too_Cold))
{
    DISPLAY("It's a good beach day")
}
```

Which of the following are equivalent to the above code block?

(A) IF ((NOT rainy) OR (NOT too_Cold))
 {
 DISPLAY("It's a good beach day")
 }

(B) IF (NOT (rainy OR too_Cold))
 {
 DISPLAY("It's a good beach day")
 }

(C) IF ((NOT rainy) AND too_Cold)
 {
 DISPLAY("It's a good beach day")
 }

(D) IF (rainy AND too_Cold)
 {
 DISPLAY("It's a good beach day")
 }

Enduring Understandings	Learning Objectives	Computational Thinking Practices	Essential Knowledge	Difficulty
5.5 Programming uses mathematical and logical concepts	5.5.1 Employ appropriate mathematical and logical concepts in programming	P1 Connecting computing	5.5.1E	4
(A) This option is incorrect. This is a literal replacement of AND and OR				
(B) This option is correct. This option makes sense in a real-world setting and also adheres to DeMorgan's law				
(C) This option is incorrect. NOT would need to be applied to the second clause as well				
(D) This option is incorrect. This option eliminates NOT without making other changes				