PiXL Independence:

Computer Science – Student Booklet

KS5

Contents:

I. Multiple Choice Quizzes

Complete the quizzes. 10 credits each.

Data Representation

1. What is the denary representation of 11001010?

    a. 198
    b. 200
    c. 202
    d. 210

2. What is the binary representation of 155?

    a. 10011001
    b. 10010001
    c. 10010111
    d. 10011011

3. Using two's complement what is the binary representation of -87?

    a. 10101001
    b. 01010111
    c. 10011111
    d. 10100111

4. What is the denary representation of the hexadecimal value C4?

    a. 114
    b. 79
    c. 108
    d. 104

5. In floating point numbers which direction should the decimal in the mantissa move if the exponent is negative?

    a. Right
    b. Left

6. How many characters can be represented using ASCII?

    a. 127
    b. 255
    c. 256
    d. 128

7. Which of the following statements are true?

    a. In floating point numbers a normalised number will only have a 1 before the decimal place.
    b. Increasing the amount of bits in an exponent will increase the range of numbers that can be represented.
    c. Floating point numbers cannot represent negative numbers.
    d. Floating point numbers contain of two parts an exponent and a number base.

Databases

1. Which SQL statement would you use to change information within a database?

    a. SELECT
    b. UPDATE
    c. INSERT
    d. ALTER

2. What keyword is used to add a condition to an SQL statement?

    a. WHEN
    b. FROM
    c. WHERE
    d. ONLY

3. What is the definition of 3rd Normal Form?

    a. Data is dependent on the key, only the key and nothing but the key.
    b. There are no duplicated data.
    c. All relationships are one to one.
    d. There are only primary and foreign keys.

4. What is a composite key?

    a. A field with multiple data types.
    b. An alternative name for a foreign key.
    c. When data is encoded.
    d. When multiple fields make up a primary key.

5. To make a new table within a database you would need to use which SQL command?

    a. CREATE TABLE
    b. CREATE DATABASE
    c. INSERT
    d. ALTER

6. What is an entity relationship diagram used to represent?

    a. The relationship between databases
    b. The relationship between tables
    c. How many fields are in a table
    d. The data type of each field in a table.

Programming Techniques

1. What type of loop should be used if the amount of iterations is know?

    a. While
    b. For
    c. Either

2. What is the difference between a procedure and a function?

    a. A function returns a value and a procedure doesn't
    b. A procedure returns a value and a function doesn't
    c. A function has to have a parameter and a procedure doesn't
    d. There is no difference, they are just different names.

3. What technique should be used to re-write a subroutine that has been inherited from a parent class?

    a. Encapsulation
    b. Rewriting
    c. Polymorphism
    d. Inheritance

4. A variable that can be accessed from all subroutines is called what?

    a. Parameter
    b. Constant
    c. Local variable
    d. Global variable

5. Which data type only has two options?

    a. Boolean
    b. Integer
    c. Character
    d. Float

6. What is the term for a when a subroutine calls itself?

    a. Go To
    b. Encapsulation
    c. Recursion
    d. Call Back

7. What type of error occurs when a user enters incorrect data?

    a. Run time
    b. Syntax
    c. Logical
    d. Semantic

8. A parameter is a method of passing data from one subroutine to another?

    a. True
    b. False

Networking

1. What does the term topology mean?

    a. The structure of something
    b. The way something is made
    c. The length of something
    d. How fast something works

2. What are the layers of the TCP/IP stack?

    a. Application, Transmit, Network, Link
    b. Program, Transport, Network, Link
    c. Application, Transport, Network, Link
    d. Application, Transport, Network, Communicate

3. If something is encrypted with Public Key B, how do you decrypt it?

    a. Public Key A
    b. Private Key B
    c. Private Key A

4. What is the standard subnet mask?

    a. 255.255.255.0
    b. 0.255.255.255
    c. 0.0.0.0
    d. 255.255.255.255

5. The gateway is the link between different parts of a network?

    a. True
    b. False

6. Which of the below is not a protocol?

    a. HTTP
    b. POP3
    c. FTP
    d. HTML

7. What is the name of the protocol when two computers are setting up agreements to transfer data?

    a. Data Transfer Protocol
    b. Handshake Protocol
    c. Packet Switching
    d. File Transfer Protocol

Computer Architecture

1. Magnetic memory reads and writes data with a laser.

    a. True
    b. False

2. Optical memory is more expensive than magnetic memory.

    a. True
    b. False

3. Solid state memory is faster than magnetic and optical memory.

    a. True
    b. False

4. Cache memory can be classed as RAM.

    a. True
    b. False

5. A CPU with 4 cores will process tasks at the same speed as a CPU with 2 cores.

    a. True
    b. False

6. Which bus is the MAR connected to?

    a. Address
    b. Control
    c. Data

7. What does the MDR do in the fetch execute cycle?

    a. Fetch memory addresses
    b. Run an operation
    c. Fetch data from the main memory
    d. Stores in the instructions from main memory

8. The Harvard Architecture is made up of just Input, Memory and Output?

    a. True
    b. False

Boolean Algebra

1. An XOR gate has two inputs that are 1s, what is the output?

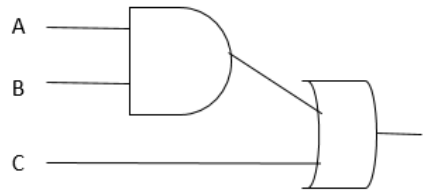
    a. 1
    b. 0

2. Using De Morgan's Law what is the answer to the following $\overline{\overline{A}.\overline{B}}$

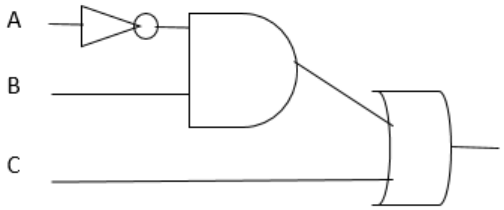
    a. A.B
    b. (NOT A) . (NOT B)
    c. A+B
    d. (NOT A) + (NOT B)

3. Which is the correct gate for ((NOT A).B)+C

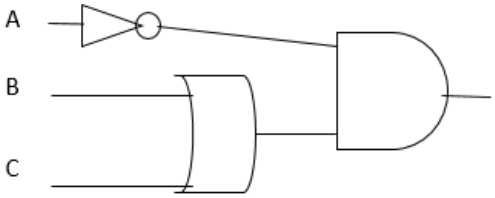
    a.



    b.



    c.



4. What is the answer to the following Boolean equation $\overline{A.(A+B)}$

    a. A.B
    b. A+B
    c. $\overline{A.B}$
    d. $\overline{}\,\overline{A.B}$

Algorithms

1. The Big O notation is used to measure what?

    a. How complex an algorithm is
    b. The execution time of an algorithm
    c. How long an algorithm is
    d. The amount of data an algorithm can handle

2. Identify the sorting algorithm

    a. Binary
    b. Linear
    c. Merge
    d. Dijkstra

3. Which is the most efficient time complexity?

    a. n
    b. n^2
    c. log n
    d. e^n

4. An intractable algorithm is…

    a. An algorithm that can be solved but not in enough time for it to be useful
    b. An algorithm that can be solved quickly
    c. An algorithm that cannot be solved

5. Which algorithm has the time complexity O(n log n)

    a. Bubble
    b. Merge
    c. Binary
    d. Insertion

6. Which algorithm has the time complexity $O(n^2)$

    a. Insertion
    b. Dijkstra's
    c. Linear
    d. Quick

Software

1. What are two types of translators called?

    a. Compiler and Interpreter
    b. Compiler and Transcriber
    c. Interpreter and Explainer
    d. Transcriber and Explainer

2. What generation of language is SQL?

    a. 1st
    b. 2nd
    c. 3rd
    d. 4th

3. Which of the below is the operating system not responsible for?

    a. IO Control
    b. Memory Management
    c. Running the Internet
    d. Visual Display

4. Which of these statements about open source code is true?

    a. Open source code is only created by companies.
    b. Anyone can adapt open source code.
    c. Open source is always charged.
    d. Open source code is not safe.

5. Which of the below is a piece of utility software?

    a. Database management software
    b. Web Browser
    c. Drivers
    d. Word Processor

6. Which of the below is a piece of application software?

    a. Photo Editing Software
    b. Operating System
    c. IO Controllers
    d. Hardware Driver

Compression & Encryption

1. Which of the below are files that uses lossy compression?

    a. JPEG & WAV
    b. JPEG & MP3
    c. MP3 & PNG
    d. WAV & PNG

2. When compressing the same file, what is the difference between lossy and lossless compression?

    a. Lossy is a larger file size and worse quality than lossless.
    b. Lossless is a smaller file size and worse quality than lossy.
    c. Lossy is a smaller file size and worse quality than lossless.
    d. Lossless is a larger file size and worse quality than lossy.

3. How does Run Length Encoding Work?

    a. It compresses each byte to one bit.
    b. It compresses by reallocating bit lengths to different letters.
    c. It compresses by taking long running bit patterns and representing it with a number and a bit pattern
    d. It compresses by coding everything into numbers.

4. What type of encryption is Run Length Encoding?

    a. Lossy
    b. Lossless

5. What does collision mean when related to hashing?

    a. Two pieces of data being saved in the same memory location
    b. Two pieces of data having the same hashing value
    c. Two piece of data being read as the same data
    d. Two pieces of data that are the same

6. Which of the below is a way of resolving collisions in hashing?

    a. Rehash the hash value
    b. Overwrite the data
    c. Rehash the original data
    d. Inform the user the data cannot be saved.

Data Structures

1. What is an array?

    a. Multiple variables used to store data.
    b. A list of data that is not related.
    c. A list of data that is related.
    d. A table where data can be stored.

2. What does LILO, FIFO, FILO, LIFO relate to when in relation of data structures?

    a. The way data is entered and exited.
    b. The order in which data is entered and exited.
    c. The speed of data structures.
    d. The maximum amount of storage in data structures.

3. What is the different between a static and dynamic data structure?

    a. Dynamic can change size, static remains the same size.
    b. Dynamic remains the same size, static can change size.

4. What is a heap?

    a. The amount of data a data structure can use.
    b. Unused memory that a data structure hasn't used.
    c. Unused memory that a data structure can access when it has run out of memory.
    d. Extra processing power for bigger programs.

5. Which one of the below is not a type of graph?

    a. Directed
    b. Undirected
    c. Weighted
    d. Locked

6. A tree cannot contain which of the below?

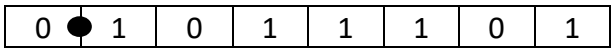
    a. Duplicated data
    b. Loops
    c. More than 10 pieces of data
    d. Unconnected pieces of data

II. Exam Style Questions

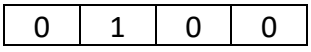
10 credits per question.

1.

a. Calculate the decimal equivalent for the floating point number below.



Mantissa



Exponent

[2 marks]

_____

_____

_____

Answer: _____

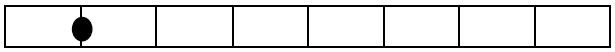
b. Convert the -14.125 below into a floating point number.

[3 marks]

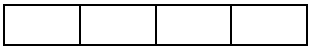
_____

_____

_____



Mantissa



Exponent

2. An object-oriented program is being written to store details about products that a supermarket sells. Products can be either food or clothes.

   Figure 1 below is the class diagram from the Products class.

Figure 1

```
Products = Class {
        Public:
                Function GetName
                Function GetPrice
                Function GetQuantity
                Procedure SetDetails
        Private:
                Name: String
                Price: Float
                Quantity: Integer
}
```

   a. Draw an inheritance diagram for the object-orientated program.

[2 marks]

   b. The food class identifies the expiry date, whether it should be chilled and whether it should be frozen. This is done through the SetDetails Procedure.

      Produce a class diagram for the Food class.

[4 marks]

3. Mobile technology has undergone significant developments in recent years. Discuss the legal, ethical and cultural issues that have arisen as a consequence of these developments.

[9 marks]

4.

a. Use Boolean Algebra to simplify the below equation.

$$\overline{\overline{(A.B) + (B + A)}}$$

[3 marks]

_____

_____

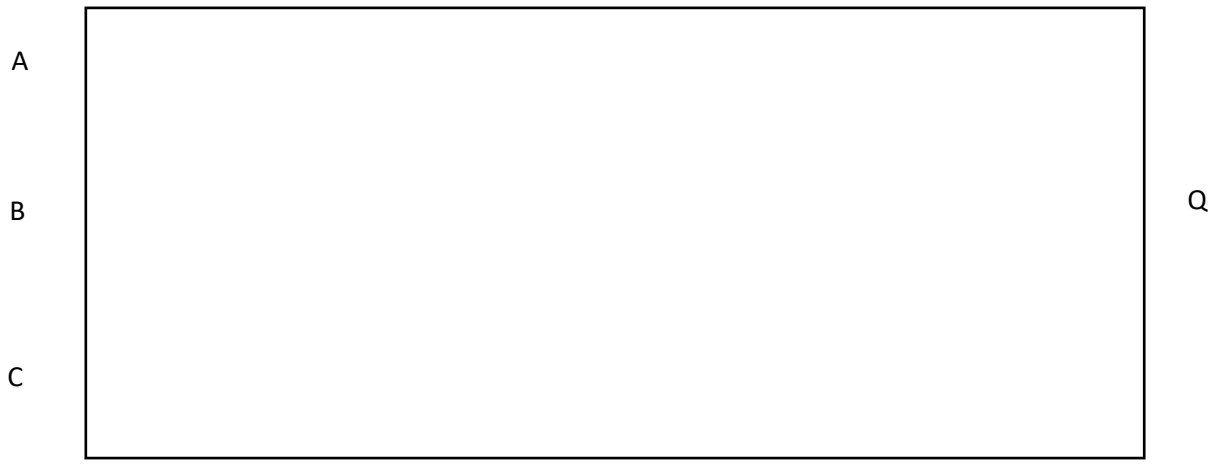
_____

Answer: _____

b. A safe door, Q, is operated by three different levers, A, B and C. The safe will only open when either B and C is pushed but not A, or when A and C is pushed but not B.

Display the following scenario in a logic circuit below.

[3 marks]



c. Express the above logic circuit in a Boolean expression.

[2 marks]

_____

5.

A client is trying to decide which type of memory to use: Magnetic, Optical or Solid State. The client would need to transport the data stored in this memory device and would need to store a large amount of data.

Discuss the features of each type of storage that would make them appropriate for the client's needs.

[6 marks]

6. System Software is a vital part of a computer system and how it operates.

   a. State the four types of System Software.

[4 marks]

1. _____
2. _____
3. _____
4. _____

   b. Describe the functions of compilers, interpreters and assemblers.

[3 marks]

_____

_____

_____

_____

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_____

   c. Describe how Real Time and Embedded Operating Systems differ from one another.

[4 marks]

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7. Encryption is a key aspect in keeping our data safe. There are many ways of encrypting data such as digital signatures, Vernam cipher and the Cesar cipher.

a) Explain how digital signatures work to encrypt our data.

[4 marks]

b) Figure 3 displays the ASCII table, using the Vernam cipher, encrypt the word HELLO. Use the key 11000011

Figure 3

Letter	ASCII Code	Letter	ASCII Code	Letter	ASCII Code
A	01000001	J	01001010	S	01010011
B	01000010	K	01001011	T	01010100
C	01000011	L	01001100	U	01010101
D	01000100	M	01001101	V	01010110
E	01000101	N	01001110	W	01010111
F	01000110	O	01001111	X	01011000
G	01000111	P	01010000	Y	01011001
H	01001000	Q	01010001	Z	01011010
I	01001001	R	01010010		

[3 marks]

8. An online store is using a normalised database that contains three tables: Product, Order and OrderLine.

   The details of the tables in seen in Figure 2.

Figure 2

Product (ProductID, ProductName, Price, Quantity)

Customer (CustomerID, FirstName, Surname, DoB)

Order (OrderID, CustomerID, OrderDate, DeliveryDate, Cost)

OrderLine (OrderID, ProductID, Quantity)

a) Complete the Entity Relationship Diagram below.

[4 marks]

b) Write the SQL instructions that are required to create the Order table.

[3 marks]

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_____

_____

_____

c) Write an SQL query that will retrieve the First Name, Surname and DoB of customers who ordered the product with the ID 1234 where the customers' surname is Jones. The query should be ordered from oldest to youngest.

[5 marks]

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_____

_____

9.

a) Define the term, “time complexity”, ensuring you make reference to algorithms in your answer.

[2 marks]

_____

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_____

b) State the time complexity for the following algorithms.

i) Binary Search

[1 mark]

_____

ii) Bubble Sort

[1 mark]

_____

iii) Merge Sort

[1 mark]

_____

c) Sort the algorithms from question **9b** in order of time complexity.

[2 marks]

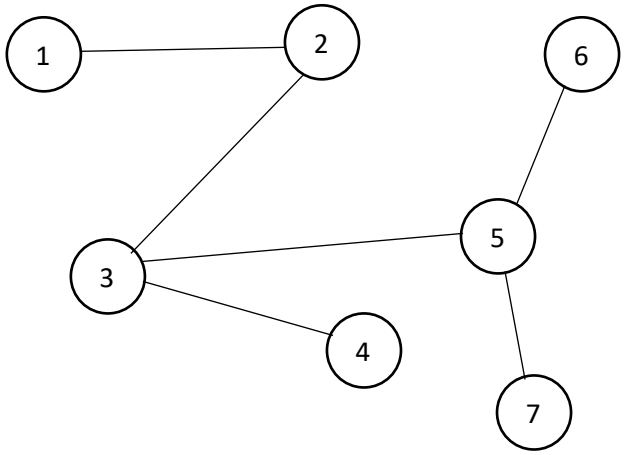
_____

_____

_____

10. A company has seven shops in different town. Deliveries are done in a certain pattern which is displayed in the graph below in figure 2.

Figure 2



a) Represent the graph in figure 2 in an adjacency matrix.

[2 Marks]

b) Explain whether it would be more appropriate to represent the graph in figure 2 as an adjacency matrix or an adjacency list.

[2 marks]

_____

_____

_____

c) State two differences between a tree and a graph.

[2 marks]

_____

_____

_____

d) Explain how a programmer would represent the graph in a programming language that doesn't support graphs.

[4 marks]

_____

_____

_____

_____

_____

III. Academic Articles

50 credits each.

1. Floating Point Numbers
   http://www.cprogramming.com/tutorial/floating_point/understanding_floating_point_representation.html

2. Object Orientated Programming
   https://www.codeproject.com/Articles/22769/Introduction-to-Object-Oriented-Programming-Concep

3. Handshaking Protocol
   https://www.baeldung.com/cs/handshakes

4. Firewalls
   https://www.secureworks.com/blog/firewall-security

5. Big O Notation
   https://www.freecodecamp.org/news/big-o-notation-why-it-matters-and-why-it-doesnt-1674cfa8a23c/

6. CPU
   https://www.lifewire.com/what-is-a-cpu-2618150

7. Boolean Algebra
   https://www.allaboutcircuits.com/textbook/digital/chpt-7/demorgans-theorems/

8. Compression
   http://www.soundonsound.com/techniques/what-data-compression-does-your-music

Commissioned by The PiXL Club Ltd.