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1. (a) State one difference between Random Access Memory (RAM) and Read Only Memory (ROM). [1]

RAM	*ROM*
• *.RAM is volatile*	• *ROM is non-volatile*
• *Data can be edited/changes*	• *Data cannot be edited*
• *Data can be deleted*	• *Data cannot be deleted*
• *Working area*	• *Non-working area*

(b) An embedded processor contains all the software needed to control an automatic washing machine.

i) State why the software is stored in ROM. [1]
- *Readily available when switch on computer*
- *No need to alter software*

ii) Explain why the software is stored in ROM has some of the characteristics of RAM. [2]
- *Needs to be random access or access to data would be slow*
- *To allow upgrading of software*

(c) State three types of data stored in RAM. [3]
- *Operating system*
- *Parts of application software in use*
- *User files currently being executed*
- *Instruction awaiting processing*
- *Data awaiting to be written to storage media*
- *Immediate results of processing awaiting output.*

2. (a) Give any five points that need to be considered when a system analyst produces a feasibility study, [5]
- *Is solution technically possible*
- *Is solution economic to produce*
- *Is the solution economic to run*
- *What will be the social implications of change*
- *Is the skill level in the available workforce high enough/ training requirements*
- *Is the solution legal*
- *What will be the effects on the customer*
- *Time constrains*

(b) Describe what is involved in the analysis stage of the systems development life cycle. [6]
- *Information collection*

- *Analysis of information collected*
- *Requirements specification. i.e. user, software and hardware requirements*
- *Feasibility study.*

3. (a) Computer system controls an automated teller machine (ATM). For each of the following, state one device that could be used in the ATM and explain its function**:**

i) Input
- *Keyboard/magnetic stripe reader/chip reader/touch screen*
- *Input pin or amount or other request/cardholder details.*

ii) Output
- *Screen/printer*
- *Output results of request/or hard copy for customer to take away.*

iii) storage
- hard drive/tape
- to store customer request for statements/ store transaction.[6]

(b) The operating system used by computer controlling the ATM must work in both batch and real- time mode'

i) State what is meant by batch operating system and explain why it would be necessary. [3]
- *Data is collected over a period of time and processed periodically*
- *Requests for statements/data about transaction*
- *Saved for later input to mainframe/ during off period*
- *Data is collected in batches/groups for later use/processing*

ii) State what is meant by real-time operating system and explain why it would be necessary. [3]
- *Data must be processed immediately*
- *Request for money must be accompanied by processing to establish identity/ sufficient funds*
- *Must be one in real time or lose customers*
- *Data is quickly updated.*

4. A small manufacturing business invests in a computer system and an integrated software package.

a) Explain what is meant by integrated software package. [1]
- *A number of individual pieces of software with different parts of the package that can communicate with each other and share data.*

b) State any four different programs that you would expect to be in the integrated software package and explain the use of each program. [8]
- *Word processor – to produce letters for sending to customers and suppliers*
- *Desktop publisher – to produce posters and brochures to advertise the company's products*

- *Spreadsheet - to keep the company accounts/produce invoices for the customers/suppliers/stock*
- *Database – to keep details of customers/suppliers or stock*
- *Web Authoring software – to produce websites to advertise the company*
- *Presentations software – to produce presentations for seminars/lectures*
- *Graphical software – graphical design e.g. Art.*

c) Explain why the off-the-shelf software is turned into customised software. [4]

- *Generic/designed to do many things/solve many problems*
- *Most solutions do not relate to the business in which it is to be used*
- *The large number of options in off the shelf software will be confusing/ will increase the need for training of personnel.*
- *Customisation allows input screens to be created according to input documents having to be created to match the software.*
- *Allows output screens to reflect the company (by use of colours and logo)*
- *Customisation meets specific user request/removes unnecessary things*

d) Describe how the customisation of software in (c) is done. [4]

- *System analyst studies the requirements of the organisation*
- *Works out the types of input and output required*
- *Assess abilities of the staff and gauges the level of training that will be required.*
- *Programmer uses the macros /wizards within the software*
- *Produce designs from the analysis as the default for the system*
- *Select or deselect features during software installation.*

5. (a) Explain what is meant by:

i) a source code [1]

- *code produced by the programmer*
- *program code in HL/Assembly*
- *code typed in by the programmer*

ii) an object code [1]

- *executable code/machine code/binary*
- *a code produced after translation*

(b) Explain the need for translator programs in a computer system. [2]

- *Code produced by programmer not understandable by computer/ computers require code in binary form hence need for translator program.*
- *Translator changes HLL/LLL to binary form /source code into object code*
- *Provide error diagnostic*

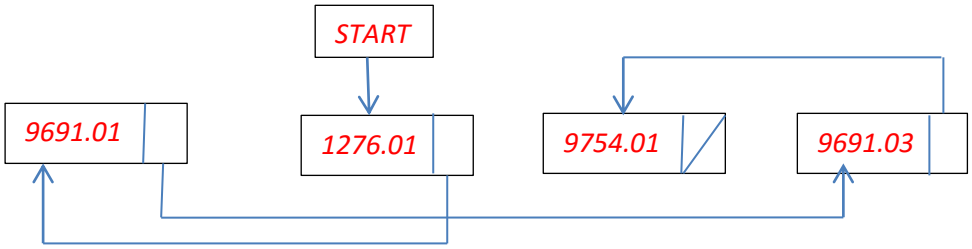
(c) When a programmer runs a program, the program may fail to run successfully because there are errors in the code.

Describe three types of errors that may be present giving an example of each. [9]

- ***Syntax error**/ error in the language or rules of the program e.g. Prant instead of Print*
- ***Logic error**/error that allows the program to run but gives wrong result e.g. a jump to the wrong instruction/adding instead of subtracting*
- ***Runtime/execution e**.g. arithmetic error/ request to carry out inappropriate or impossible arithmetic e.g. division by zero.*

6. (a) Draw a diagram of linked list to show the codes following examination papers when they are stored in numerical order.

9691.01 1276.02 9754.01 9691.03



(b) (i) Explain what is meant by LIFO and FIFO data structures. [2]

- *LIFO – last data item to be inserted into the structure wil be the first tobe used*
- *FIFO – first data item to be inserted into the structure wil be the first to used.*

(i) Give one advantage and one disadvantage of using a linked list structure to store a queue rather than using an array structure. [2]

Advantage

- *No maximum size of list*
- *Does not tie up large amounts of memory unnecessarily*
- *Allows use of multiple index pointers*

Disadvantage

- *Reading from/writing to the structure can be a lengthy process*
- *There is unnecessary overheads due to pa*

(ii) Explain why a linked list is a more sensible structure than an array for storing a stack. [3]

- *No maximum size of stack*
- *Linked list and stack are both dynamic data structures which change size during execution.*
- *Reading and writing can be done on both ends.*

7. (a) The water level in reservoir is controlled by a computer system. During normal operation the water level (W) is between high water (H) and low water (L) marks, at these times the input valve (I) and output valve (O) are both open.

If the level reaches H then the input valve is shut off until the level falls below H again. IF the level falls below L then the output valve is shut off until the level rises above L again. If the level falls below L for more than 1 hour the system sends an alarm signal to the operation. Using the variables W, H, L, I, O produce an algorithm to control the water level in the reservoir. [9]

- *Initialise I and O to open*
- *Initialise alarm to off*
- *Loop to keep system working with sensitive condition*
- *Read value of water level within the loop*
- *Condition W >= H then I is off*
- *Correct use of I*
- *With loop an condition*
- *Condition W < L with correct use of O*
- *Set alarm*
- *Timer in loop O*
- *Condition to set off alarm*

(b) The alarm signal together with all the other valves from the system is sent to a central control room. Al the water supplies in the city are controlled from this central room by a single operator.

Explain the importance to the operator of good interface design, stating any features which should be considered, [5]

- Shows the importance of some of the information being received
- Makes operation of the machine easier
- Minimized operational errors
- Enhanced sped in the operation of the machine

Features

- Use of colour/layout
- Use of flashing/bold/video
- Use of graphics/sound

8. (a) List the input, processing, output and storage for each of these applications

i) email [4]

Processing

- *processing done in the user's computer and the computer of the company that provides access to the internet/[IPS]*
- *encoding of data*
- *preparing of text for transmission*

Input

- *details about the account holder e.g. email address, password through the keyboard, voice recognition devices, touch screens and mouse*

Output

- *through the monitor/screen if its soft copy and printer if need of hard copy, voice output*
- *message/letter/attachment*

Storage

- *hard drive and hard disk at the firm which keeps your emails for you until you delete them*
- *mail box*

ii) weather forecasting [4]

Processing

- *involve the computer applying rules to information about the weather to work out what the weather should be like later*
- *predicting the weather*
- *weather simulation*
- *using mathematical models*

Input

- *information about weather conditions at the moment which is probably sent automatically from weather station to the system by such things as electronic thermometers/sensors/wind speed/barometer*

Output

- *consists of maps to show what the weather will be like, probably drawn by some form of plotting/graphs/simulated movement of winds/cloud/on screen/printed output*

Storage

- *a very large hard disk because weather forecasting uses a lot of data*

iii) computer games [4]

Processing

- *involve the computer keeping the game moving by responding to the player's input*

Input

- *instructions from player*
- *instructions are from such devices as wheels, pedals and joystick, tracker ball*

Output

- *consists of fast moving colour images on a screen with high resolution*
- *sound through speakers*

Storage

- *stores information about the game e.g. levels/position*

(b) For each one in (a), say what sort of communication device is necessary, if any. [5]

Email

- *modem*
- *wireless adaptors*
- *network cables*
- *router*
- *satellite*

Weather forecasting

- *network cables*
- *satellite system*
- *router*
- *wireless adaptor*

Computer games

- *network cables*
- *satellite system*
- *router*
- *wireless adaptor*
- *speakers*
- *joystick*
- *keyboard*
- *mouse*

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1. Transmission of data over a wide area network may be out by circuit or packet switching.

a) Explain the difference between circuit switching and packet switching. [2]

Circuit switching

- *Dedication communication channel is established*
- *The path is dedicated for the duration of the call*
- *Make use of telephone lines*

Packet switching

- *Divides the message into packets which may take different routes in transmission*
- *Packets are reassembled at the receiving end*

b) Give any three advantages of packet switching compared over circuit switching. [3]

- *Packet switching charges during the use of network only*
- *A damaged packet can be re-sent*
- *Cost depend only on number of packets sent and not on distance*
- *Data can be transmitted at local rates*
- *Less likely to be affected by network failure*
- *Multiple routes available to transmit data packets*
- *Better security/data is likely to be intercepted*
- *Network not tied up/congested*
- *All routes available*

c) State any three items that will be transmitted with a data packet in addition to the data itself. [3]

- *Destination address*
- *A packet sequence number so that the whole message can be correctly reassembled*
- *A checksum for error checking*
- *Source address*

2. (a) State any one function of a modem. [1]

- *Modulates and demodulates signals*
- *Converts digital signals to analogue form or vice versa*
- *Digital to analogue for transmission along telephone lines*
- *Connects a computer to the telephone network/internet*

(b) State one reason why the use of ISDN telephone system eliminates the use of a modem when computing is connected to a wide Area Network. [1]

- *ISDN (integrated services digital network) transmits digital data hence no need to convert signals.*

3. (a) Explain the difference between serial and parallel transmission [2]

Serial transmission

- *Data sent* one *bit at a time over a single communication channel*
- *Used for long distance*

Parallel transmission

- *Bits are sent simultaneous along separate data lines/ at the same time*
- *Used for short distances e.g. from computer to printer*

(b) Outline the circumstances under which it would be appropriate to use parallel transmission. **[2]**

- *When transmitting data over short distances*
- *Transmission of data between components within the computer system.*
- *Where transmission rates will be high*

4. Describe what happens when a processor which is currently working on a job receives an interrupt from an external source. **[3]**

- *Current fetch-execute cycle is completed*
- *PC contents are saved for later reference*
- *Contents of al active user program registers are saved for later reference*
- *Source of interrupt is identified*
- *Interrupts of lower priority are disabled*
- *PC is loaded with start address of the relevant interrupt service routine*
- *Interrupt service routine is executed*
- *Saved values of user program's active register (except PC) are restored to the processor register*
- *PC restored joint to next instruct to be fetched in user program.*

5. The CPU is connected to main memory by three separate buses.

Explain the term:

a) Control bus

- *A uni-directional (one-way) line which transmits control signals from control unit to system components*

b) Data bus

- *A bi-directional path for moving data and instructions between system components*

c) Address bus.

- *A uni-directional bus which transmits source and destination address of data /instruction to be used in the computer system* **[3]**

6. The Database Management System (DBMS) provides an interface between the operating system and the user in order to make access to the data as simply as possible.

a) Identify any other three functions of a DMBS> **[3]**

- *Multi-user Access Control*
- *Data, retrieval and update (data storage management)*
- *Creation and maintenance of data dictionary*
- *Managing facilities for sharing database*
- *Backup and recovery management*
- *Security management*
- *Data integrity management*
- *Creation management*
- *Transaction management*

b) A database may be considered from several different levels of views known as schemas. Explain the terms:

i) External schema [1]

- *An individual's view of the Database according to their needs and access rights*

ii) Conceptual/logical scheme [1]

- *Overall view of the entire database including entities and attributes as designed by database designer.*

iii) Internal/storage schema. [1]

Describes how the data will be stored and is concerned with file organisation and access methods.

c) Data integrity is very important when processing data using computer systems.

i) Define the term data integrity. [1]

- *Refers to validity and accuracy of data and its correctness*

ii) Outline any two ways in which data integrity may be compromised. [2]

- *At point of entry, wrong information may be typed*
- *Data corrupted during transmission*
- *Data lost during transmission*

iii) Name any two methods of ensuring the integrity of data. [2]

- *Applying different validation techniques*
- *Data verification*
- *Data protection methods e.g., check digit, virus checking*

d) If multiple users attempt to update a database table simultaneously one or more of the updates may be lost unless measures are taken to prevent this.

i) Outline any three measures which can be used to prevent loss of data due to simultaneous updating of records. [3]

- *Open the entire database in exclusive mode*
- *Lock all records in the table being modified*
- *Lock the record being edited*
- *Open a record in read only mode*
- *Lock the field/column being edited*
- *Lock the whole database.*

ii) **Deadlock or deadly embrace occurs when two users are attempting to update two related records in the same table. Neither of the two users' proceeds as each will wait for a resource which is locked by another user.**

Give any two ways of avoiding deadlock in a database management system. **[2]**

- *Abort one of the users task*
- *Ensure the records are updated in sequences*

7. **The choice of file organisation is considered vital by a designer. A number of questions need to be asked.**

a) **Explain any two important questions to be considered by the designer.** **[4]**

- *Must the user have immediate access to the data, with a response time of no more than a few seconds*
- *Must the information be completely up to date or will last nights or last week's information be sufficient*
- *Can request for information be batched, sequenced and processed all together?*
- *What is the most suitable storage medium for the volume of data involved?*
- *What will happen if the information on the files is lost or destroyed?*
- *What is the hit rate and volatility of the file*

b) (i) **Give an example of an application where it is sensible to use the following file systems:**

1) **Serial –** *Transaction file*
2) **Sequential –** *payroll/ applications with high hit rate*
3) **Random** - *online booking system/applications with high volatility* **[3]**

(ii) **Explain why each file system in (i) is appropriate.** **[3]**

- ***Serial*** *– Transaction files are recorded in the order in which events takes place*
- ***Sequential*** *– Are efficient where hit rate is very high, payrolls have high hit rate*
- ***Random*** *– are used where extremely fast access of individual records is required like in online booking system.*

c) **When calculating the address of a record in a random file system using a hashing algorithm, synonymous addresses are bound to occur where two records generate the same address.**

i) **Give any two properties of a good algorithm.** **[2]**

- *It can generate any of the available address on the file*
- *It is fast to calculate*
- *It minimise collisions*

ii) **Explain any two ways in which synonymous addresses can be resolved.** **[2]**

- *Place the record that caused collision into the next available free space*

- *Place the record in the overflow area*

d) Explain how these operations can be performed in a random file.

i) Access a record **[2]**

- *Apply hashing algorithm on key field to produce a disk address*
- *Use the address to directly access the record*

ii) Delete a record **[2]**

- *Access the record using a disk address calculated from record key*
- *Set a flag to the record labelling it deleted. The record will be logically detected but physically there.*

8. (a) When an organisation decides to computerise an area of its business, a decision has to be made whether to buy an off-the –shelf software package or have the software tailor made.

Give any four advantages of buying off-the-shelf software. **[4]**

- *Less expensive solution as the cost of the developing the software is shared across a wider customer base.*
- *Software can be bought and installed straight away.*
- *The software is tried and tested and likely to contain fewer bugs than newly written software.*
- *Software is usually well documented.*
- *Training may be available.*
- *It may be possible to speak to other users of the package for their evaluation before spending money.*

(b) A college uses a range of software packages from different suppliers. The college is considering changing its software from one supplier to a common user interface.

Give four advantages of having a common user interface. **[4]**

- *Increased sped of learning*
- *Ease of use*
- *Easy sharing of documents*
- *A greater range of software accessible to the average user.*

9. (a) A job control language is used to control how jobs are to be run in batch processing.
List any three pieces of information which might be specified in the job control script for a particular job. **[3]**

- *Who owns the job?*
- *Job priority*
- *The maximum processor time to allow the job*
- *The maximum lines to be printed*
- *The name of data files used*

- *What action to be taken if there is an error*

(b) Explain the terms:

i) Multiprogramming **[1]**

- *Two or more programs are executed simultaneously.*

ii) Batch **[1]**

- *Data to be input are collected together before being processed as a single operation.*

iii) interactive processing **[1]**

- *Provide the user with direct immediate response from the system. This is some kind of dialogue with the system.*

(c) State the function of each of the following devices:

i) the processor **[1]**

- *fetches the next instruction*
- *decodes the instructions*
- *execute the decoded instructions*

ii) main memory **[1]**

- *Hold the program currently being executed and the data used by this program.*

iii) Secondary storage. **[1]**

- *Stores software including OS, other system software, application programs and data for long term storage.*

10. Third generation programming languages may be compiled or interpreted before they can run on a computer.

(a) Explain the functions performed by:

i) a compiler **[2]**

- *A compiler translates the whole HLL source code into object code, which can then be executed without the presence of compiler.*

ii) an interpreter **[2]**

- *An interpreter analyse the source code statement by statement as execution proceeds, decoding each statement and calling routines to carry out each instruction.*

(b) Give any three advantages of using a compiler. **[3]**

- *An object code can be saved on disk and run whenever required without the need to recompile.*
- *The object code execute faster than interested code.*
- *The object code can be distributed or executed without having to have the compiler present.*
- *The object code is more secure as it cannot be read without a great deal6 of reverse engineering.*

(c) Outline the stages involved in compilation. **[3]**

- ***Lexical -*** *where comments, white space are removed and simple errors are flagged out. Symbol table is partial created.*

- ***Syntax and semantics –*** *Parsing the lexical string to check that it is grammatical correct using BNF notation and syntax diagram. Symbol table is completed*
- ***Code generation and optimisation*** *- Producing machine code and storing it as an object file, Allocates memory locations to variables and constants. Optimizes the machine code to reduce the use of memory or speed it*

11. (a) Explain the following database structures giving examples.

i) Dynamic **[2]**

- *The memory space taken by the data structure varies at run time. E.g. binary tree*

ii) State **[2]**

- *A data structure of a size declared before the program is executed. e.g. array*

(b) Explain the steps which are followed when creating a binary tree. **[4]**

- *Place the 1st item in the root node.*
- *Insert the items in order in which they are given.*
- *Follow the left pointer if the item comes before the current node in alphabetic (or numeric) sequence.*
- *Follow the right pointer if the item comes after the current node.*

(c) Convert then following numbers to decimal showing your working.

i) 0 1 1 0 1 0 0 0 0 0 0 0 0 1 1 **[2]**

$0.1101 \times 2^3 = 0110.1$

$= \underline{6.5}$

ii) 0 1 0 0 0 0 0 0 0 0 1 1 1 1 1 0 **[2]**

$0.1 \times 2^{-2} = 0.001$

$= \underline{0.125}$

(d) Give any two advantages of normalising in floating point binary. **[2]**

- *Maximum precision for a given number of bits*
- *Only one representation for each number.*

12. (a) Describe how e-commerce works. **[2]**

- *Variety of goods and services is available on internet.*
- *Can buy or sell stocks and shares on-line*
- *Do your banking and apply for a job.*
- *Swop DVD, book, a d buy anything from groceries to car.*

(b) Explain how the use of e-commerce could be beneficial to an organisation. [3]

- *Huge saving on overheads; no costly warehouse space, rent, heating or employs facilities.*
- *It is a variable market research tool.*
- *The virtual shop can stock anything.*

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1. (a) Outline four reasons that have led to the widespread use of electronic mail in business, industry and education. [4]

- ✓ *Emails are fast in communication. An email can be sent to an email subscriber in any part of the world in a matter of seconds.*
- ✓ *Messages can be sent across the world for the price of a local phone call*
- ✓ *Files of different formats can be attached to an email.*
- ✓ *You can use an address book to send the same message to several different people*

(b) Discuss two security problems that have arisen with electronic mail system and indicate what steps can be taken to overcome them. [4]

- ✓ *Phishing*
  - *Phishing is a fraudulent operation involving the use of emails*
  - *The creator sends out a legitimate looking email hoping to gather personal and financial information from the recipient of the email*

  Countermeasure
  - *Don't open e-mails from senders you are not familiar with.*
  - *Don't ever click on a link inside of an e-mail unless you know exactly where it is going.*
  - *To layer that protection, if you get an e-mail from a source you are unsure of, navigate to the provided link manually by entering the legitimate website address into your browser.*
- ✓ *Spam*
  - *Spam is electronic junk mail and is a type of advertising from a company sent out to a target mailing list*
  - *It is harmless but can clog up networks and slow them down*

  Countermeasure
  - *It is often necessary to put a legitimate email address into a contact list to ensure wanted emails are not filtered out by mistake*
- ✓ *Virus*
  - *Viruses are malicious computer programs that are often sent as an email attachment or a download with the intent of infecting your computer, as well as the computers of everyone in your contact list.*

  Countermeasure
  - *Install antivirus and keep it up to date*
  - *Scan all attachment*
  - *Delete email from sender you do not know*

2. Discuss the effects of computerisation of a bank from the user's point of view. [4]

- ✓ *No need to stand in queues*
- ✓ *Do all their transactions in the comfort of their homes*
- ✓ *No need to carry around hard cash*
- ✓ *It doesn't offer face to face service which might make it difficult to sort out problems*

- ✓ *Cause unemployment to computer literate workers*
- ✓ *Inconvenient in the event of network failure*

3. Chindumu Municipality Council uses computer controlled equipment to monitor and control the equality of drinking water. Sensors are placed in various positions in the equipment to take digital measurements every minute. The computer has been programmed to respond to feedback from the sensors and input from the operator.

a) Identify the data elements that are likely to be captured by the sensors. [2]

- ✓ *ph (acidity)*
- ✓ *ph (alkaline)*

b) Describe the situation in which the computer will respond to:

i) Feedback

- ✓ *If ph is <7 indicates the water is acidic*
- ✓ *If ph > 7 indicates the water is alkaline*

ii) Input from the operator

- ✓ *Treat the water if the ph is not normal* **[4]**

4. The introduction of e-learning has brought about change in the educational field.

a) Define the term e-learning. [1]

- ✓ *The use of computers or electronic devices in learning and teaching*

b) State two advantages of using e-learning to students. [2]

- ✓ *Learners can learn at times that are more suitable to them*
- ✓ *Learners have more control over the pace of their learning*
- ✓ *Easier to repeat parts learners have not understood*
- ✓ *No need to have more textbooks (hardcopies)*

5. (a) List three duties carried out by the database administrator in a database management system. [3]

- ✓ *Setting up the database together with the programmers.*
- ✓ *Control, manage and maintain the database.*
- ✓ *Define, implement and control database storage.*
- ✓ *Ensure that policies and procedures are established.*
- ✓ *Define the strategy of backup storage and recovering from system breakdown*
- ✓ *Supervise amendments to the database.*
- ✓ *Ensures that the data is secure from unauthorised access*
- ✓ *To standardize the use of database and associated software*

(b) Describe the following record types and give an advantage of using the record type:

i) Fixed length record

- ✓ *Records with fixed number of fields and number of characters in any field are fixed*

Advantages

- ✓ *Records can be updated in situ*
- ✓ *Easy to estimate size of file*
- ✓ *Easy processing of files*

ii) Variable length record

- ✓ *Records in which number of characters in any field varies between records and records have a varying number of fields*

Advantages

- ✓ *Less space wasted on the storage medium*
- ✓ *No truncation of data occurs*
- ✓ *It may reduce time taken to read a file because the records are more tightly packed.* **[4]**

6. (a) Describe an appropriate method of data security for the following applications and in each case, explain how data will be recovered in the event of data loss:

i) A batch payroll system

- ✓ *Access levels can be used to avoid those without authority to reach certain data cannot get access .*
- ✓ *We can recover data when we backup our system*

ii) A real-time airline seat reservation. [6]

a. *Duplicates of components e.g. 3 computers performing identical task running concurrently*

b. *In the case system failure the duplicate computers can be used*

(b) Distinguish between the following file organisation methods, outlining the most suitable application for each:

i) serial and direct access [4]

Serial	*Direct*
✓ *This is whereby records are stored one after another as they occur, without any definite order as on magnetic tapes. Data is not stored in any particular sequence.* ✓ *Suitable for temporary/ transaction file*	✓ *This is whereby records are not in any order but stored and accessed according to their disk address or relative position, calculated from the primary key of the record* ✓ *Airline booking system* ✓ *File with high volatility*

ii) sequential and indexed sequential [4]

Sequential	*Indexed sequential*
✓ *This is whereby records are stored one after another and are sorted into a key sequence, that is, in ascending or descending order of a given key filed as on magnetic tapes.* ✓ *Appropriate for files with a high hit rate like payroll processing.*	✓ *This is whereby records are ordered in sequence based on the value of the index or disk address as supported by hard disks.* ✓ *It is also suitable for real time processing applications like stock control*

(c) **With reference to the primary key, secondary key and composite key, explain how access to records can be established through the use of these keys.** **[3]**

- ✓ **Primary Key**
  It is a candidate key that is used to identify a unique (one) record from a relation.
- ✓ ***Secondary Key***
  A field used to identify more than one record at a time, e.g. records of same department
- ✓ ***Composite Key***
  is a key that contains more than one attribute, Used to uniquely identify a single record.

7. **A clothing shop offers credit facilities to its customers. Its computer system supports online enquiry during the day and batch processing at night.**

List any three tasks which the shop's computer might perform in batch processing. **[3]**

- ✓ *Processing monthly statements for customer*
- ✓ *Processing the payroll*
- ✓ *Updating the master file using the transaction file*

8. **(a)** **Express the following decimal numbers in twos compliment binary using 8 bits:**

i) **127** *0111 1111*

ii) **-27** *1110 0101* **[2]**

(b) **Explain using the above example, how hexadecimal can be used as a shorthand for expressing bytes that consist of 8 bits.** **[3]**

- ✓ *Divide the bits into nibbles*
- ✓ *Change each nibble into decimal equivalent*
- ✓ *E.g.* *0111 | 1111*
  7 | F
- ✓ $0111\ 1111_2 = 7F_{hex}$

(c) **Convert 1 0 1111 0010_2 to:**

i) **Octal**

- ✓ *001 011 110 010_2*
  1 3 6 2
- ✓ $1011110010_2 = 1362_8$

ii) **Hexadecimal**

- ✓ *0010 1111 0010*
  2 F 2
- ✓ $1011110\ 010_2 = 2F2_{hex}$ **[2]**

(d) **A sort program inputs an unordered list of names and stores them in**

memory in the form of a binary tree. Fig 8.1 represents this data structure with the first six names entered.

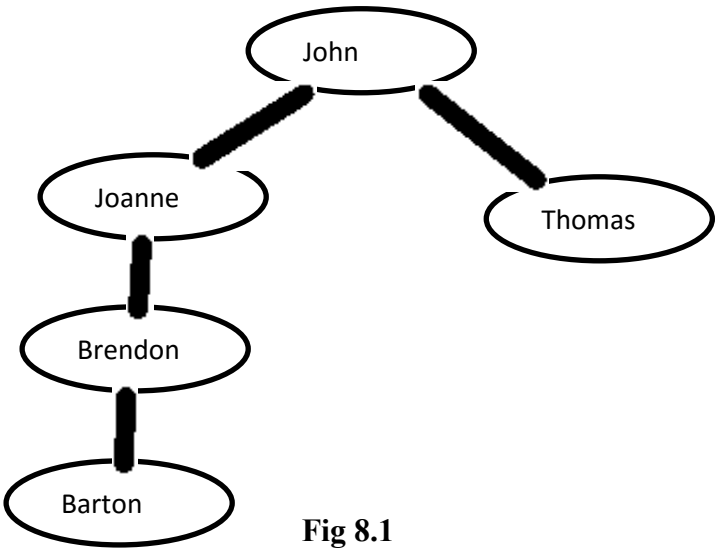


Fig 8.1

i) Define a binary tree

✓ *A binary tree is a data structure consisting of a root node and 2 sub trees*

ii) State

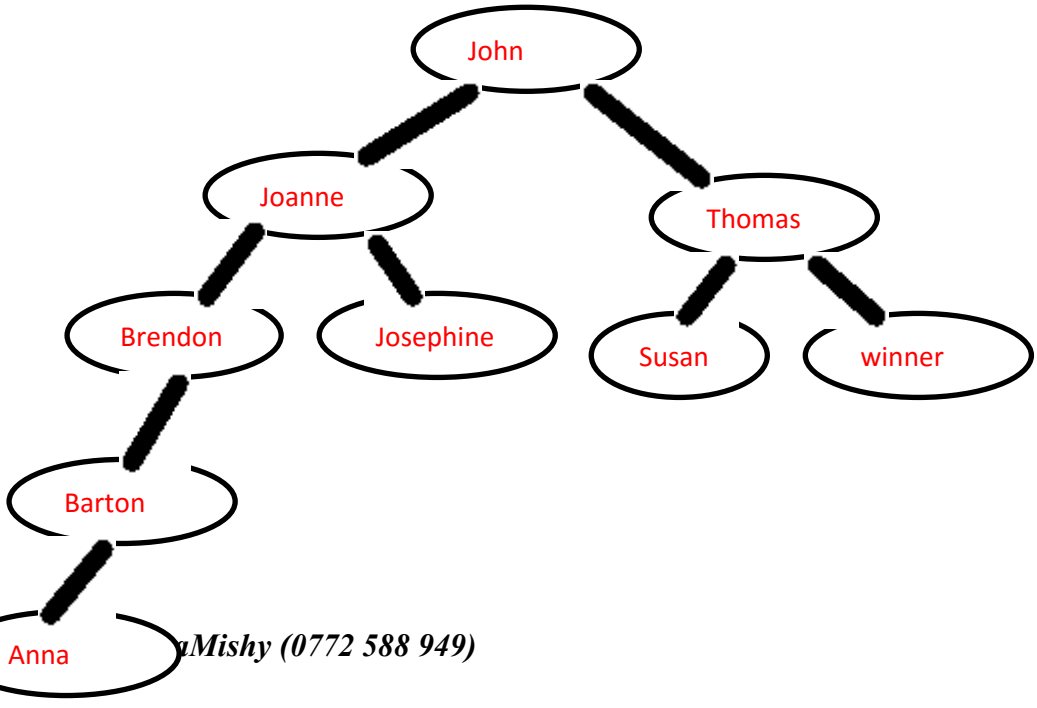
- **The parent of Brendon,**

✓ *Joanne*

- **The name of the root tree**

✓ John

iii) Copy the diagram and add notes for Susan, Winnet, Anna and Josephine on the list. [7]



(e) Music is often recorded digitally. Write any four advantages of this method of representing sound. [4]

- ✓ *No need for analogue to digital converter*
- ✓ *It can easily be edited*
- ✓ *Fast because no need for sound sampling*
- ✓ *Less storage space*

9. Officials of Ruthata area health authority have made appointments for all one year old children within the area to be vaccinated. Details of the children and their appointments are maintained in a computer file.

(a) Explain how a word processor could be used to generate personalised letters to send to families to give details of the appointments. [3]

- ✓ *Use mail merge*
- ✓ *A standard letter is written using the word processor*
- ✓ *The standard letter is merged with the details of children in computer file*
- ✓ *Personalised letters are printed.*

(b) Continuous use of computer by data capture clerks can cause some health problems for operators.

i) Give any two healthy problems that can arise due to continuous use of computers.

- ✓ Back and neck problems/strain
- ✓ Repetitive strain injury (RSI)
- ✓ Eyestrain
- ✓ Headache
- ✓ Ozone irritation caused by laser printers in an office [2]

ii) List any tow precautions that may be used to prevent the above risks.

- ✓ *Back and neck problems/strain*
  - *Use adjustable chairs- correct posture*
  - *Use foot rests to reduce posture problems*
  - *Tilted screens- ensure neck is at correct angle*
- ✓ *Repetitive strain injury (RSI)- damage to fingers and wrists*
  - *Ensure correct posture (e.g. correct angle of arms to keyboard)*
  - *Take regular breaks*
  - *Use ergonomic keyboards*
- ✓ *Eyestrain*
  - *Ensure there is no screen Flickr*
  - *Take regular breaks*
  - *Change to LCD screens- Flickr is less of a problem than with CRT screens*
- ✓ *Headaches*
  - *Use an anti-glare screen to cut out light reflections*
  - *Take regular breaks*
  - *Have eyes tested regularly*
- ✓ *Ozone irritation caused by laser printers in an office*

- *Proper ventilation- removes ozone gas quickly*
- *Put the house laser printers in a designated printer room*
- *Change to other types of printers (inkjet printer)* **[2]**

10. (a) Describe how each of the following methods is used to transfer data into a computer and in each case give an appropriate application.

i) MICR (Magnetic Ink Character Recognition), **[2]**

✓ *The bank's code number and cheque number are printed on the cheques with a special type of ink that contains particles of magnetic material that are machine readable. This reading process is called Magnetic Ink Character Recognition MICR*

✓ *Used to process cheques in banking operation*

ii) OCR (Optical Character Recognition)

✓ *Optical Character recognition is a software that takes scanned text and converts it into a computer readable form*

Application

✓ *Processing of passports and Identity cards*

✓ *OCR is used when scanning documents to modify them using suitable software*

(b) Use of magnetic tape is still widespread although large disk drives are now available for computer systems. Describe two distinct uses of magnetic tape. **[4]**

✓ *Used where extremely large amounts of data need to be backed up*

✓ *Used where speed of reading/writing of data is NOT a priority*

✓ *Used for backups of computer networks in schools and business*

11. (a) Explain the meaning of the term intranet **[2]**

✓ *It is an internal website that is setup internally for companies and can be accessed by employees for the purpose of standard documents or information and many items of information and data.*

(b) Many colleges are changing to intranet.
State three befits to a college of setting up an intranet. **[3]**

✓ *Safer and less chance of hacking*

✓ *Possible to prevent employees from accessing unwanted sites*

✓ *Companies ensure that info. available is specific to their needs*

✓ *Easier to send sensitive messages that remain within a company*

(c) Explain the meaning of the following access methods:

i) CSMA/CD – Carrier Sense Multiple Access with collision Detection

✓ *Means that each node checks that the media is not being used before placing its message on the line* **[1]**

ii) Token passing

✓ *Used in a ring network where a node which want to send data attaches it on a token.* **[1]**

(d) (i) Describe the Von Neumann architecture.

- ✓ *Single processor*
- ✓ *Single bus for data and instructions*
- ✓ *Single memory for both data and instructions*
- ✓ *Sequential/serial processing of instructions.*

(ii) Explain what the accumulator holds and how the contents change during the fetch-execution cycle.

- ✓ *Accumulator holds the results of the calculations before being passed to memory unit*
- ✓ *Contents changes when next instruction is executed add data is added to the accumulator changing the value which was already there.*
- ✓ *E.g. when executing a program to add two numbers*

(iii) Explain what the program counter (PC) holds and how the contents change during fetch-execute cycle.

- ✓ *The address of the next instruction*
- ✓ *Contents incremented after being read*
- ✓ *Contents change by a jump instruction.* [9]

12. A large magazine concern has a multi-access system which supports 200 terminals. As the number of users increase there is a gradual degradation of performance which rapidly worsens as the number of the users increase to 150.

Interpret the phrase "gradual degradation of performance" and suggest how it could be remedied.

"Gradual degradation of performance", means that the performance of the concern decreases as the number of users increase. This can be remedied

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SECTION A

1. (a) (i) Explain the term *Visual Basic Event*. [2]

A visual basic event is a message sent by an object within a program to the main program loop, informing it that something has happened

(ii) Give two examples of a Visual Basic Event. [2]

- *Clicking a button*
- *Closing a window*
- *Moving mouse pointer*
- *Resizing form*

(b) List any five data types in Visual Basic

- *Integer*
- *Double*
- *Single*
- *Character*
- *String*

(c) Explain any two differences between a constant and a variable

Constant	Variable
It maintains a single value throughout the program's execution.	*Its value may change in program execution.*
Declared using CONST statement	*Declared using DIM statement*

2. (a) List any four rules used in naming a variable.

- *If two words are used, they are to be joined by an underscore.*
- *They must start with an alphabetical letter as their first character.*
- *No reserved words must be used.*
- *It must be unique.*
- *Must not contain a period*
- *Can have up to 25characters*
- *No use of special characters*

(b) Name three primary steps involved in building a Visual Basic Project

- *Design the interface*
- *Set properties*
- *Write the code*

3. The Visual Basic code is supposed to compute the factorial of any given number. The number is accepted using a textbox named txtNum and the factorial is displayed in a text box named txtFact. Identify the errors or missing VB statements in the following code.

```
Private Fact-click()
txtFact = 1
For i = 1 to txtNum
txtFact = txtxFact  + i
End Sub
```
[4]

Errors

- *Line 1 missing word sub and that hyphen must be an underscore*
- *Line 2 must be txtFact.Text = 1*
- *Line 3 must be For I = 1 to txtNum.Text*
- *Line 4 : Must be txtFact.Text = txtFact*i*

Missing lines

- *Declarations after the first line. Number must be declared*
- *Next before last line.*

4. DP Repairs offer repair series at a rate of $20 per hour for labour. Costs of supplies are subject to 15% sales tax.

   (a) Design a Visual Basic form which presents the bill for the situation. The customer's name, labour hours and the cost of supplies are to be captured using textboxes. Clicking of a command should trigger the display of the client name and the costs (labour cost, supplies' cost and total cost). Names for controls are required. The display should be a list box. [8]

Object	Name
Text Box 1	*txtcustname*
Text Box 2	*txtlabourhours*
Text Box 3	*txtcostofsupplies*
List Box	*lstinfo*
Button 1	*btnRun*

   (b) Using the situation given in (a) above, write a code that will calculate the total cost, labour cost, supplies cost and display the client name, labour cost, supplies cost and the total cost. [10]

```
Public Class Form1

Private Sub btnRun_Click(sender As Object, e As EventArgs) Handles btnRun.Click
    Dim labour_hours, Total_cost, labour_cost, Supplier_cost As Double
    Dim name As String
    name = txtcustname.Text
    labour_hours = txtlabourhours.Text
    Supplier_cost = txtcostofsupplies.Text
```

```
        labour_cost = labour_hours * 20
        Supplier_cost = (15 / 100 * Supplier_cost) + Supplier_cost
        Total_cost = labour_cost + Supplier_cost

        lstinfo.Items.Add("Customer name" & vbTab & "Labour cost" & vbTab & "supplies
cost" & vbTab & "Total cost")
        lstinfo.Items.Add(name & vbTab & "                " & labour_cost & vbTab & "
" & Supplier_cost & vbTab & "              " & Total_cost)

    End Sub
End Class
```

5. Write a Visual Basic code which will classify any mark captured in a textbox named txtMark according to the following grades:

A	-	70 – 100
B	-	60 – 69
C	-	50 – 59
D	-	40 – 49
E	-	30 – 39
U	-	0 – 29

The grades should be displayed on a label named display. Make use of CASE STATEMENTS. [8]

```
Public Class Form1
    Dim mark As Integer
    Dim grade As Char

    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
             mark = txtMark.Text
        grade = lblgrade.Text
        Select Case mark
            Case 70 To 100
                lblgrade.Text = "A"
            Case 60 To 69
                lblgrade.Text = "B"
            Case 50 To 59
                lblgrade.Text = "C"
            Case 40 To 49
                lblgrade.Text = "D"
            Case 30 To 39
                lblgrade.Text = "E"
            Case 0 To 29
                lblgrade.Text = "U"

        End Select
```

```
    End Sub
End Class
```

SECTION B

Answer any two questions in this section.

6. (a) Explain the four basic aspects of the design stage in system analysis [4]

- *Input design.*
- *Output design.*
- *File design.*
- *Program design.*

(b) Give three reasons why maintenance of a system is necessary. [3]

- *To add new features that may be seen necessary to include in the system.*
- *To improve system response time.*
- *To correct some errors that may have been encountered so as to ensure a smooth running of the system*.

(c) You have been hired by an organisation to develop a Management Information System,

(i) Illustrate the approach you would take to ensure that you develop a system that meets the client's specifications.

- Problem identification
- Fact Finding
- Feasibility study
- Analysis
- Design
- Developing and testing
- Documentation and user-training
- Implementation
- Evaluation
- Maintenance [8]

(ii) Give an explanation for each of the development of the components in the approach to the development of c (i) Management Information System [8]

- Problem identification -
- Feasibility study - it is preliminary investigation conducted to determine if there is need for a new system or modification of the existing one.
- Data collection – these are fact finding methods that can be used to collect data about the system and they include: interviews, record inspection, questionnaires, observations…
- Analysis -
- Design – creating the system and fully test it
- Developing and testing
- Implementation -
- Evaluation -
- Maintenance

7. (a) A mail order company has a multi-user centralised database to allow employees to access orders and deal with customer enquiries as they come in to customer service department.

(i) Explain why different staff will have passwords allowing them different levels of access to the data stored. [2]

Because different staff will need to access only the tables they need to perform their tasks.

(ii) Give two other reasons why passwords would be used for this type of system. [2]

- To avoid unauthorised access
- To avoid identity theft

(b) A record within the main stock file is locked whenever one person is making changes to it.

(i) Explain the term 'locked'. [1]

Locked means it restricted other users to alter the record when one person opened it

(ii) Explain why it is necessary in this case to lock records. [2]

It necessary because it is a multiuser system and multiple users can open a single table at the same time

(c) A stock master file is updated by a transaction file using sequential file access. The purpose of the stock master file is to ensure that the levels of stock will met demand.

(i) Give four essential fields for the stock master file. [4]

- Product id
- Product supplier name and the product name
- Quantity of a product
- Price of each item
- Bar code
- Reorder level
- Supplier ID

(ii) Give three essential fields for the transaction file. [3]

- Product name
- Quantity of products
- Price of each item and the total price
- The change given field and maybe the name the dates of transaction

(iii) Explain why the transaction file should be sorted and in what order, prior to updating the master file [3]

- To order transaction file records to same order of master file records
- Reduce time to update master file
- No need for rewinding master file tape during update

(d) A student on work experience at Salary Service Bureau (SSB) was alone in the office. The student logged into the computer system by guessing the administrator's user ID and password. The student then accessed the company's pay roll file and changed the gross pay of several employees.

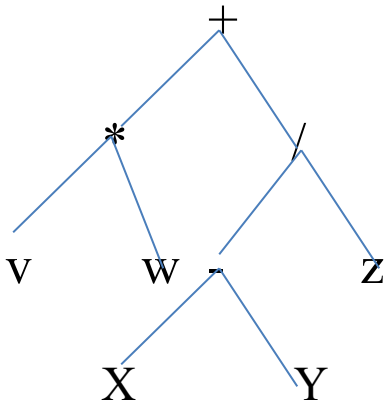
(i) State the two offences the student committed.

- Gaining unauthorised access to data or programs on a computer
- Intentional unauthorised modifications of content of the computer

(ii) Explain any three methods of security the company could have used to prevent the offences [8]

- Encryption of data
- Use of biometric security
- Firewall

8. An algebraic expression is represented by the following binary tree.



(a) Show the output if the tree is traversed using:
(i) Post order VW*XY-Z/+
(ii) In- order (V*W)+(X-(Y/Z))
(iii) Pre-order +*VW/-XYZ [12]

(b) (i) Show how the decimal numbers 13 and 32 would be represented as 8-bit binary integers,
- 13 – 00001101
- 32 – 00100000

(ii) Given that the ASCII Code for the character 1 is 110001, show how the test string '1332' would be held in a 4-byte word. [5]

1332 – 110001 110011 110011 110010

(c) The sum of 3.39 + 0.678 is to be worked out using only 3 significant figures. Find the actual and relative errors if truncation is used. [3]

Actual errors.

Actual error = exact value – computed value. *The* **exact v**alue would be the value obtained without any error

3.39 + 0.678 = 4.068 (exact vlue)

4.068 to 3 significant figures = 4.06 (computed value)

Therefore actual error = exact value – computed value
= 4.068 – 4.06
= 0.008

Relative errors.

Relative error = actual error / exact value
Therefore Relative error = (exact value – computed value)/exact value

Relative error = (4.068 – 4.06) / 4.068
= 0.0019665683

(d) Convert 27 into
(i) Binary, 11011
(ii) BCD, 0010 0111 [3]

(e) Convert ABC_{16} to decimal. 2 748 [2]

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(a) Explain why banks hold customer account information online. [2]

- ✓ *So that customer can do online banking*
- ✓ *Customers can pay their credits online*
- ✓ *Customers can use their cards on point of sale to pay for their goods*

(b) (i) Outline any two possible threats to a computer system. [2]

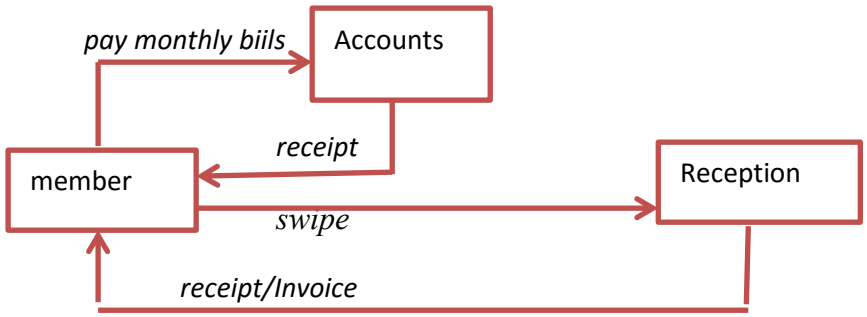
- ✓ *Virus*
- ✓ *Hackers*
- ✓ *Natural disasters*

(ii) Explain how to provide security to counter threats in b (i) [2]

- ✓ *Updated antivirus*
- ✓ *Passwords and Encryption*
- ✓ *Backups off the site*

2. A rental club has computerised its accounts. Membership for the club is renewed annually and each member is issued with a swipe card. When renting a car, the client swipes on terminal at the reception of the club outlet and the members will be required to settle their monthly bills by cheque.

a) Illustrate how the swipe card system collects and processes data relating to a member's expenditure. [5]



b) Evaluate any two benefits of the system to the club. [2]

- ✓ *Up-to-date file*
- ✓ *Automatic calculations*
- ✓ *No need for hard cash*

c) A report can be generated which identifies monthly utilisation and income generated for each car. Draw a detailed report of this report. [4]

Car ID	*Monthly income*	*Monthly Expense*	*Profit/Loss*
001	*xxxx*	*xxxx*	*xxxx*
002	Z	Z	Z
003			
Total	***xxxx***	***xxxx***	***xxxx***

3. (a) Suggest

i) The criteria that can be used in choosing a file organisation type. [4]

- ✓ *How the file is going to used*
- ✓ *How many record are processed each time the file is updated*
- ✓ *Whether individually records need to be quickly accessed*
- ✓ *What type of medium is going to be used*

ii) Two different ways in which the records in an indexed sequential file may be accessed. [4]

- ✓ *Randomly when accessing the index*
- ✓ *Sequentially when accessing the records*

(b) Outline the purposes and the main steps in

i) Backups [3]

- ✓ *The purpose of the backup is to create a copy of data that can be recovered in the event of a data loss due to hardware or software failure, data corruption, malicious attack, or accidental deletion of data*

Steps

- ✓ *Identify the volume of useful data to be backed up and categorize file system as files or folders*
- ✓ *Choose the backup media*
- ✓ *Back up your data*
- ✓ *Check that it works*
- ✓ *Store it safely of the site*

ii) Archiving [3]

- ✓ *Data archiving is the process of moving data that is no longer actively used to a separate storage device for long term retention for future reference*

Steps

- ✓ *Inventorying and determine which data must be archived*
- ✓ *Assign a retention period schedule for each category*
- ✓ *Develop archive policy*
- ✓ *Proactive protection of the data archive's integrity*
- ✓ *Choosing a data archive product*

4. (a) Explain what is meant by

i) Primary key [1]

- ✓ *A field which uniquely identifies a record*

ii) Candidate key [1]

- ✓ *An attribute that is not a primary key but has the property of uniqueness*

(b) Write the relationship between

i) Teacher and student [1]

ii) Class and student [1]

(c) Illustrate the relationship identified in b(i) and b(ii) using entity-relationship

diagrams **[6]**

5. (a) (i) Distinguish between static and dynamic data structure. **[2]**

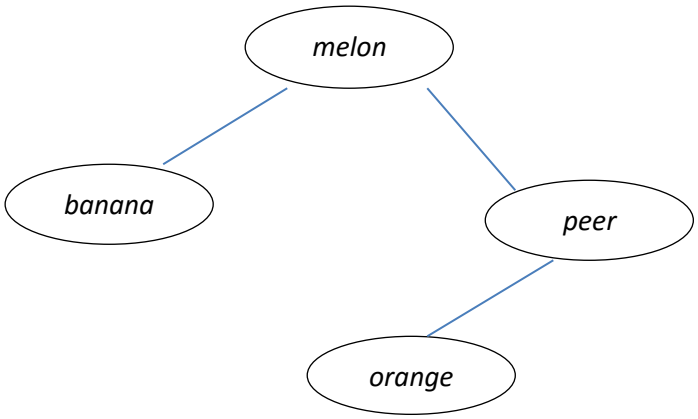
Static data structure	*Dynamic data structure*
✓ *Uses space required* ✓ *Efficient use of memory* ✓ *Emptied storage can be returned to the system* ✓ *change size when program is running* ✓ *difficult to program* ✓ *serial access* ✓ *e.g Binary tree, queue, stack, linked list etc*	✓ *Space allocated during compilation* ✓ *Waste space when only partially used* ✓ *do not change size when program is running* ✓ *Easier to program* ✓ *easier to check for overflow* ✓ *random access* *e.g. Array*

(ii) Outline one benefit that would be gained from using a dynamic data structure to implement a binary tree. **[1]**

✓ *Access time to an individual node is much quicker than by using a simple serial search*

(iii) An initially empty tree has the following items added in the order: melon, peer, banana, orange.

Draw the binary tree after the four items have been added. **[3]**



(b) Differentiate the terms nibble and byte **[2]**

✓ *A nibble is a group of 4 bits*
✓ *A byte is a group of 8 bits*

6. (a) Analyse the sorting algorithm that is best if the list is already sorted. **[3]**

✓ *Merging sort is best if the lists are sorted*
✓ *Is used when combining two ordered files into one ordered file*

- ✓ *Read first values from each file*
- ✓ *Compare the values and write the smaller value to the new list*
- ✓ *Read the next value in the file that had a value copied*
- ✓ *Repeat until end of one file and then copy remainder of the other file into new file.*

(b) Compute the maximum possible number of nodes in a binary tree at level 6. [2]

- ✓ *Root node is level 1 which is 2^0= 1 node*
- ✓ *Total number of nodes at level 6* $= 2^{(6-1)}$
  $= 2^5$
  $= \underline{32}$

(c) Convert to decimal

i) Binary 1 0 1 0 1 1 0 1 **[1]`**

128	64	32	16	8	4	2	1
1	0	1	0	1	1	0	1

✓ $128+32+8+4+1 = 173_{10}$

ii) Octal 2753 **[1]**

512	*64*	*8*	*1*
2	*7*	*5*	*3*

(512 x 2) + (64 x 7) + (8 x 5) + (1 x 3) = 1024 + 448 + 40 + 3
= 1515

7. Determine a possible application area of the following computer accessory:

a) Joystick - *Video/computer games / simulators* **[1]**

b) Scanner - *used to scan in documents and convert them into a format for use in various software packages e.g. books/ non digital photographs etc* **[1]**

c) Bar code recorder – *supermarkets where goods are marked with bar codes/libraries to scan bar codes on books* **[1]**

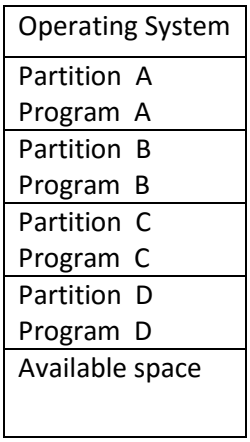
d) Touch screen - *where selections are made on screen e.g. point of sale/ ATMs/ mobile phones/satellite navigation systems etc.* **[1]**

e) Plotter - *used to produce large drawings e.g. blueprints of buildings/ large pictures e.g. billboards* **[1]**

8. (a) Outline any three main purpose of an operating system. [3]

- ✓ *Provides a user interface*
- ✓ *Manages applications*
- ✓ *Manages files*
- ✓ *Manages computer memory*
- ✓ *Manages system security*
- ✓ *Provides error handling*
- ✓ *Handles interrupts*

(b) With the aid of a diagram, illustrate any three major activities of an operating system with regard to memory management. [6]



- ✓ *Keep track of which parts of memory are currently being used and by whom*
- ✓ *Decide which processes are to be loaded into memory when memory space becomes available.*
- ✓ *Allocate and de-allocate memory space as needed*

1. Describe any two features of a multi-tasking operating system. [4]

- ✓ *It allows several applications to be available simultaneously*
- ✓ *The tasks are allocated time slices in turn*

(d) Evaluate any difficulty that a programmer must overcome in writing any operating system for real time environment. [2]

- ✓ *The main difficulty is keeping the operating system within the fixed time constraints of a real-time system*
- ✓ *Real-time system has fixed time constraints on its operations of a processor and flow of data. This means that the system will fail if some process takes too long to complete. Therefore, programmers have to pay a lot of attention to optimization and resource allocation.*

9. (a) Outline the advantages of computer networks. [5]

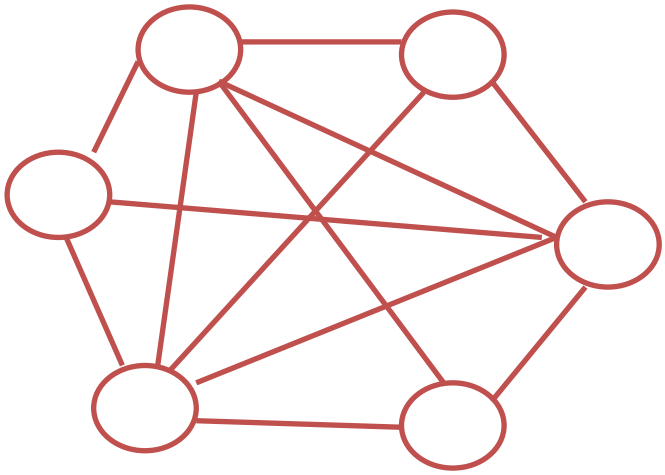
- ✓ *Data can be pooled and therefore accessed by a wide range of users. This helps to ensure integrity.*
- ✓ *Hardware resources such as printers and scanners can be shared. This is a more cost-effective solution than providing each user with his own set of peripheral devices.*
- ✓ *Software resources can be shared.*
- ✓ *Security is centralised and so improved.*
  - *The network manager can control access by setting access rights and user permission and auditing computer use.*
  - *Centrally located virus checking software can be used to check all files on the network.*
- ✓ *Backup procedures are easier to complete if centrally located and managed.*

(b) Explain any three benefits of using fibre optic cable as transmission medium. [6]

- ✓ It has less attenuation and therefore fewer repeaters are needed,
- ✓ has very high bandwidth and cannot corrode (not affected by corrosion),
- ✓ it is thin and therefore has less weight.
- ✓ It allows very fast data transfer,

- ✓ has no electromagnetic interference,
- ✓ is physically secure.

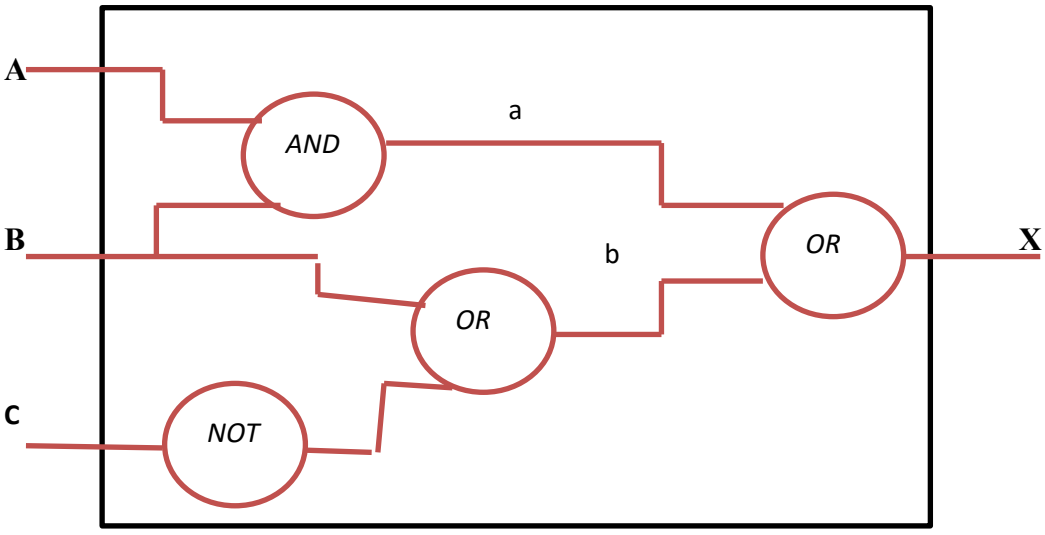
(c) With the aid of a diagram, illustrate a mesh topology. **[3]**



- ✓ *A network in which each computer serves as a relay point for directly sending information to any other computer on the network.*
- ✓ *No central device oversees a mesh network, and no set route is used to pass data back and forth between computers.*

10. (a) Draw the logic circuit corresponding to

X = 1 if (A is 1 and B is 1) OR (B is 1 or C is NOT 1)



b) Come up with the truth table for the logic statement in (a)

Inputs			**Working area**			**Output**
A	**B**	**C**	**NOT C**	**a**	**b**	**X**
0	*0*	*0*	*1*	*0*	*1*	*1*
0	*0*	*1*	*0*	*0*	*0*	*0*
0	*1*	*0*	*1*	*0*	*1*	*1*
0	*1*	*1*	*0*	*0*	*1*	*1*
1	*0*	*0*	*1*	*0*	*1*	*1*
1	*0*	*1*	*0*	*0*	*0*	*0*
1	*1*	*0*	*1*	*1*	*1*	*1*
1	*1*	*1*	*0*	*1*	*1*	*1*

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SECTION A

1. (a) Giving an example in each case, explain what is meant by the following types of programing errors:

(i) Syntax [2]

A syntax error is whereby the programmers conflict with the grammatical rules governing sentence construction and layout of different programming languages.eg misspelling reserved words.

(ii) Logic [2]

(iii) Logical refers to an error in the sequencing of instructions, modules and specifying wrong formulae that will produce undesirable results. - For example, specifying a jump instruction to the wrong procedure or instructing the computer to display result before any processing has been done. - Logic errors cannot be detected by the computer. - The user just finds wrong and unintended results of a process. - For example: NetSalary = GrossSalary + Deductions + AidsLevy

(iv) Arithmetic [2]

Arithmetic error is whereby an instruction performs inappropriate Arithmetic.eg dividing a number by zero

(b) Discuss how procedures and the programing construct selection can be used to Code a simple menu system for user. [2]

- Procedures are used to code sub tasks of the program separately.
- Construct selection is used to make a good choice of the procedure to execute according to the choice of food made.

2. (a) The code below was proposed by a programmer

```
Total = 10
Repeat
Read K
If K > 2 Then
        Total = Total + K
Else
K = K*k
Total = Total + K
End If
Print Total
Until K = 2
Print Total
End
```

Represent the output for this code using a trace table with the following input string:

3, 5, 1, 2, 4, 0

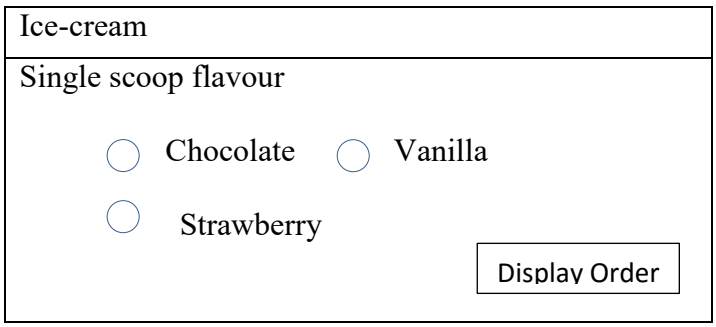
K	TOTAL
-	10
3	13
5	18
1	19
2	23

Total = 23

(b) Describe any three different methods that can be used by a programmer to make a code understandable to someone who has to maintain it. [6]

- *Indenting – this is writing the code in a way that all the statements are not in the same line but rather systematically away from the margin*
- *Using comments – this is explaining what every piece of code you write is going to mean to the system.*
- *Using blank lines this creates space so that each statement can be read easily*

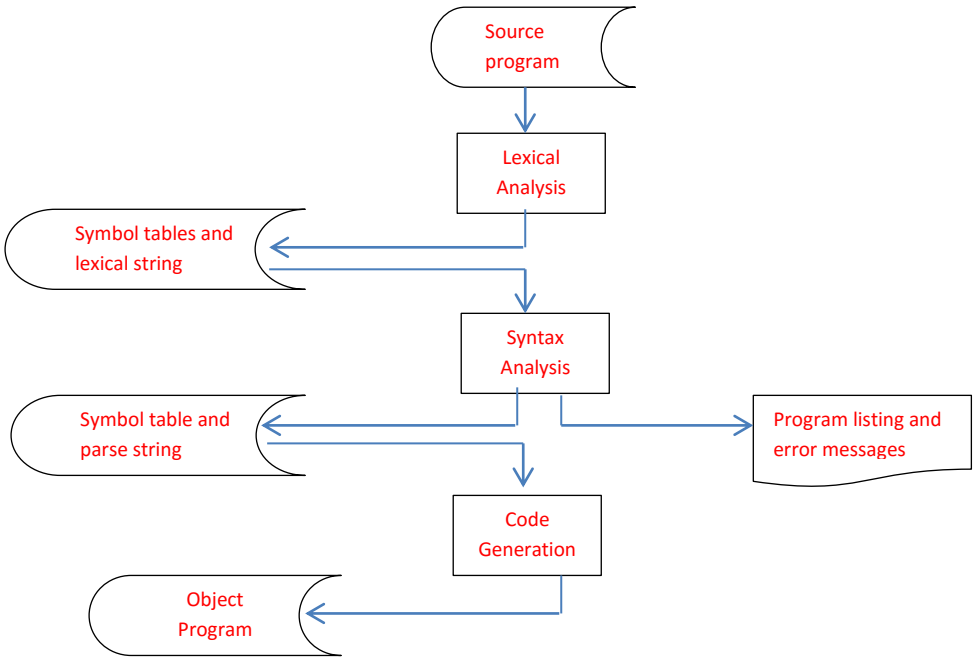
3. Construct a Visual Basic (VB) program to determine what flavour of ice-cream is selected by a user. If a user has picked a flavour, display the flavour in a message box, and if a user has not selected a flavour, use a message box to notify the user of the error. The form below is an example of what the ice-cream flavour form might look like. State clearly the names of controls used.




```
Public Class Form1
    Dim strawberry, vanilla, chocolate As String

    Private Sub btnexit_Click(sender As Object, e As EventArgs) Handles btnexit.Click
        End
    End Sub

    Private Sub btndisplayorder_Click(sender As Object, e As EventArgs) Handles btndisplayorder.Click

        If rbtchocolate.Checked = True Then
            MsgBox("YOU HAVE SUCCESSFULLY CHOSEN CHOCOLATE AS YOUR FLAVOUR FOR TODAY")
            lstorders.Items.Add("chocolate")
        ElseIf rbtstrawberry.Checked = True Then
            MsgBox("YOU HAVE SUCCESSFULLY CHOSEN STRAWBERRY AS YOUR FLAVOUR FOR TODAY")
            lstorders.Items.Add("strawberry")
        ElseIf rbtvanilla.Checked = True Then
            MsgBox("YOU HAVE SUCCESSFULLY CHOSEN VANILLA AS YOUR FLAVOUR FOR TODAY")
            lstorders.Items.Add("vanilla")
        ElseIf MsgBox("NO FLAVOUR ,PLEASE SELECT YOUR FLAVOUR ROF TODAY") Then
        End If

    End Sub

   End Class
```

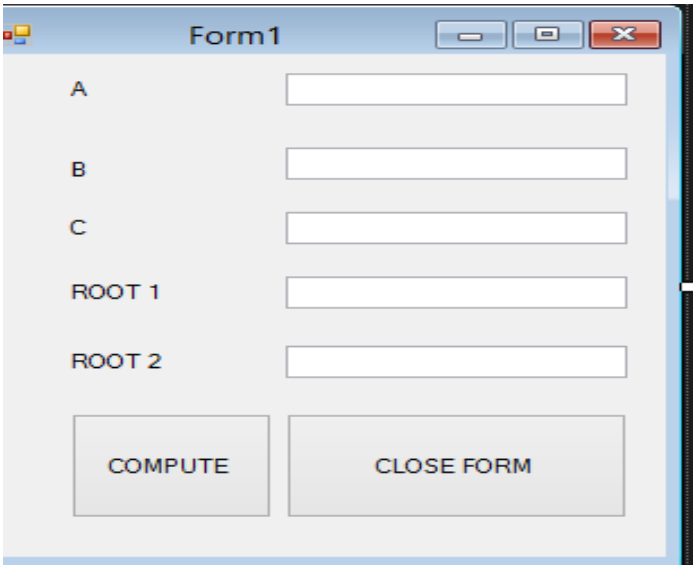
Control	Caption
Display order	btndisplayorder
Exit	btnexit
lstorders	lstorders
Chocolate	Rbtchocolate
Vanilla	Rbtvanilla
Strawberry	rbtstrawberry

4. Construct a diagram illustrating how a program passes through the three main phases of compilation. [6]



5. Write a Visual Basic (VB) code to find the roots of an equation given the condition:

   If $b^2 - 4ac > 0$, then the equation has two real roots and $b^2 - 4ac = 0$, then the equation has one real root or else it has no real roots. [12]




```
Public Class Form1

    Private Sub btncompute_Click(sender As Object, e As EventArgs) Handles
btncompute.Click
        'declaring variables
        Dim a, b, c, x, root1, root2 As Double
        'passing values
        a = txtA.Text
        b = txtB.Text
        c = txtC.Text
        ' calculating
        x = (b * b - (4 * a * c) ^ 0.5)
        root1 = (-b + (x)) / (2 * a)
        root2 = (-b - (x)) / (2 * a)
        txtr1.Text = root1
        txtr2.Text = root2

    End Sub

    Private Sub btnclose_Click(sender As Object, e As EventArgs) Handles
btnclose.Click
        End
    End Sub
   End Class
```

SECTION B

6. (a) A computer system controls an Automated Teller Machine (ATM) cash card. Determine any one device, clearly stating its purpose that could be in the ATM for the following functions.

   (i) Input

   - Numeric Keypads - where customers can key in their personal identification number (PIN), or an amount of money

   (ii) Output

- VDU – where messages appear, such as "Enter personal number". The screen gives instructions to the customer.

(iii) Storage

- Magnetic Tape / Magnetic tape – to store all the transaction [6]

(b) The operating system used by a computer controlling the ATM must work in two modes.

(i) Name the two modes [2]

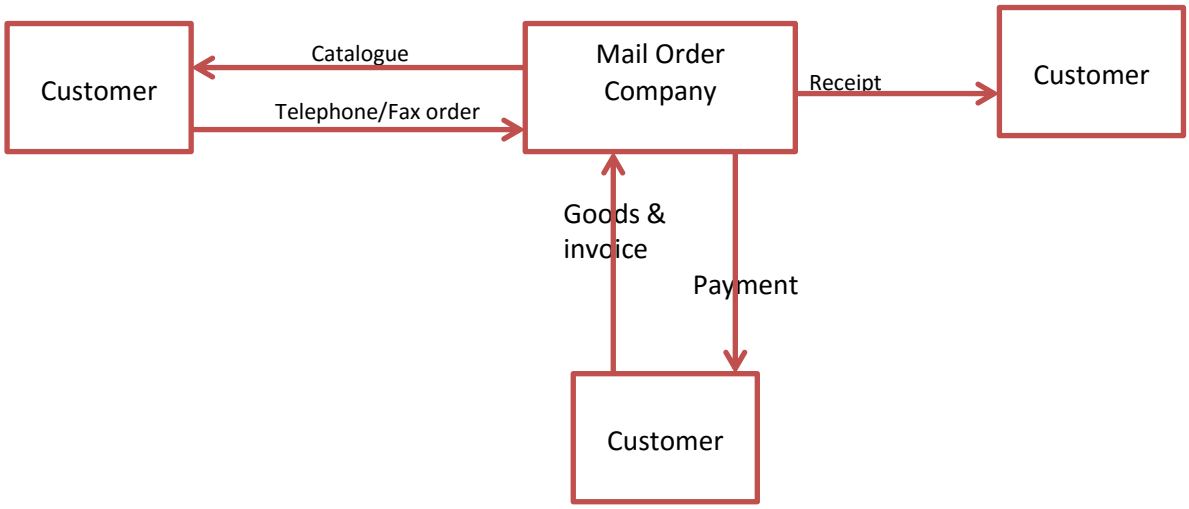
- Batch processing
- Real time transaction processing

(ii) Justify the answer in b(i) using real life situations in a bank. [4]

- Batch processing –
- Real time transaction processing – getting money from the ATM

(c) Suppose you are given the details of a small mail order catalogue system that allows people to shop from home. When a customer receives the catalogue and wants to buy something, the customer can telephone, fax or mail their order to the company. The company gets the order and sends the goods and an invoice. When the customer receives the goods with a delivery note, the customer sends payment and receives a receipt for their payment.

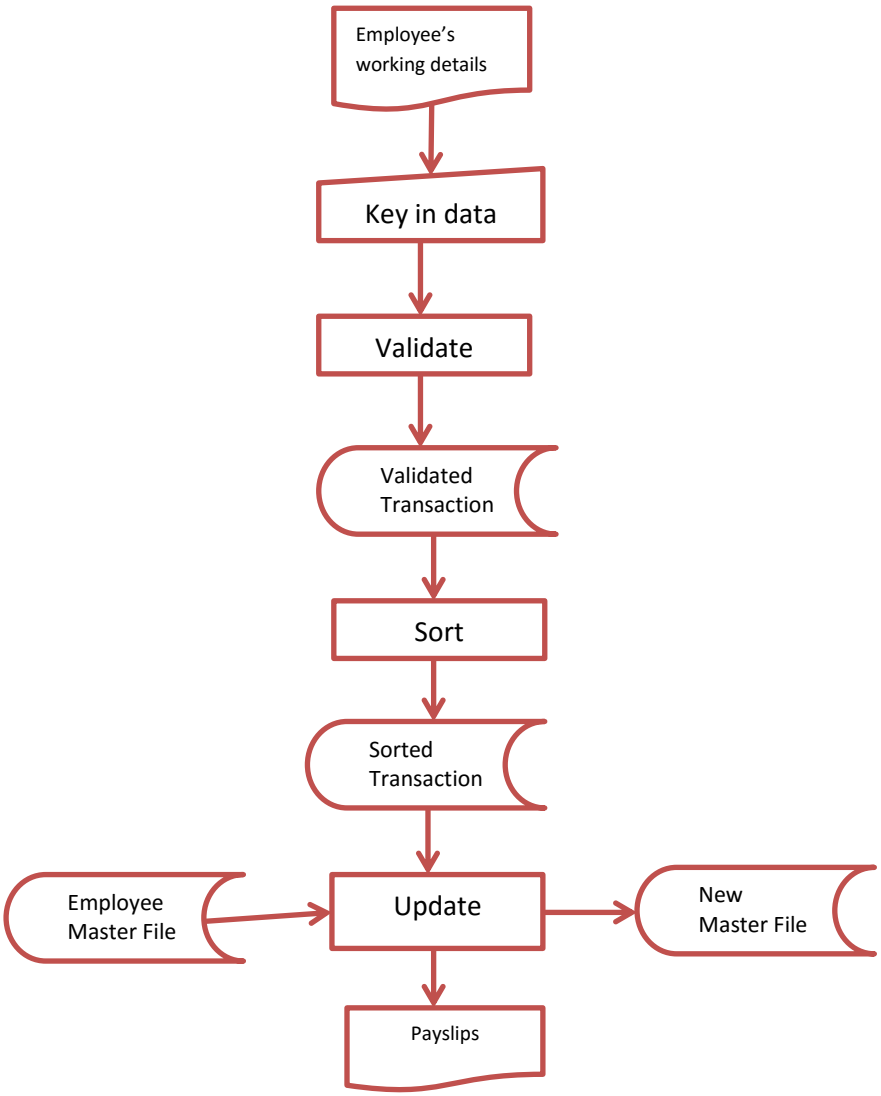
Given, the above scenario, produce a data flow diagram (DFD) for the mail order. [6]



(d) An industrial cleaning company employs some of its workers at an hourly rate. The company uses a computer to produce their payslips and pay cheques each week. The payroll program updates the sequential payroll master file from a validated transaction file which has previously been sorted into the correct order. The payroll program retrieves personal data such as name, address and

rate of pay from the Employee Master file which has been indexed in sequential file organisation.

Draw a system flow chart for weekly payroll. [7]



7. (a) A college keeps its student files on paper which is kept in filing cabinets. A decision has been taken to computerise these files.

Justify any three measures that can be taken to ensure that stored information remains confidential. [6]

- Use access rights -
- Use passwords2
- Use biometric data to gain 468

(b) Explain the meaning of each of the following in relation to database:

(i) Entity - *is a thing of interest on which information or data is being collected.* [2]

(ii) Secondary key - – *it is a field used to identify more than one record at a time.* [2]

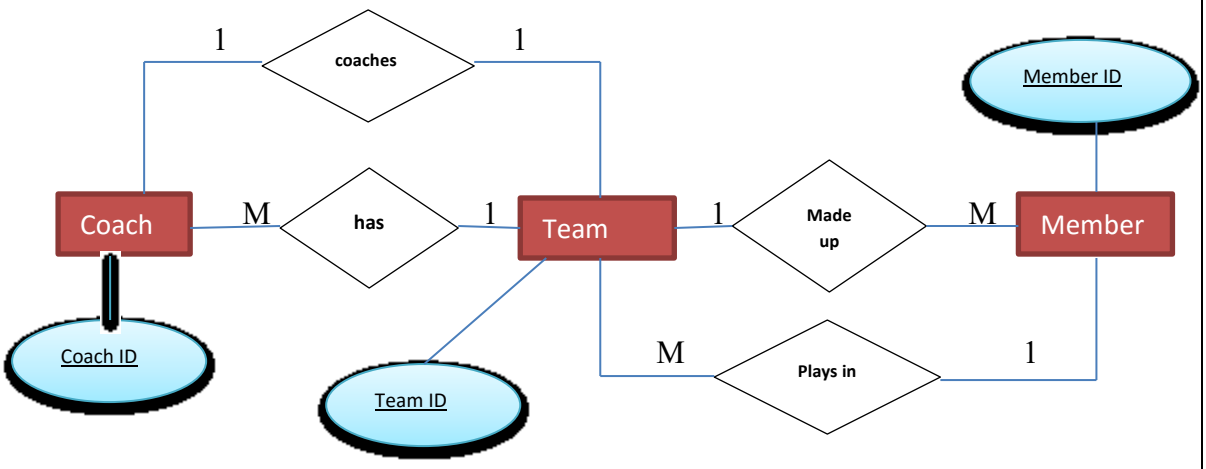
(iv) Foreign key- *it is a primary key in one file that is found in another file*. [2]

(v) Tuple *it is a row in a relational database, and it usually denotes a record in a relation* [2]

(vi) Data type *these are special statements that describe the nature of data handled by programs*. [2]

(c) A sports club runs a number of sports teams. Each team is made up of a number of members of the club and each member may play for more than one team, each team has a number of coaches, but the coach's job is so time consuming that each coach can only coach one team.

Represent the above information on an entity relation diagram (ERD), stating the primary key for each entity. [9]



8. (a) Express the denary 78 as:

(i) Binary number stored in 8 bit byte 0100 1110 [2]

(ii) A hexadecimal number, 4E [2]

(iii) A number stored in binary coded decimal (BCD). 0111 1000 [2]

(b) Explain how the binary value of 78 can be used to write down the equivalent octal value with a minimum amount of calculation. [2]

- Group bits in threes, starting on right
  001 001 110
- Convert to octal digits
  001 001 110
  1 1 6

(c) Real numbers are stored in floating point representation with:

- 8 bits for the mantissa, followed by
- 4 bits for the exponent

Two's compliment used for both the mantissa and the exponent.

Consider the binary pattern:

1	0	1	0	1	0	0	0		0	1	1	1

Calculate this binary pattern to denary. [4]

1.0101000 +7

Move the decimal point 7 places to the right 10101000

Convert the negative number to positive 01011000

Convert the binary number to decimal - 88

COMPUTING PAPER 1 9195/1 NOVEMBER 2017

1. (a) Sate the functions of the following computer components

i) Processor **[2]**

- ✓ *Fetches –decodes and execute instructions*
- ✓ *It performs all operations on data according to the given instruction*

ii) Main memory **[2]**

- ✓ *Hold the programs currently being executed and data used by these programs*
- ✓ *Hold programs awaiting processing*
- ✓

iii) Secondary storage **[2]**

- ✓ *Store software including OS, other system software, application software*
- ✓ *Stores data for long term storage*
- ✓ *Supplement the main memory*

(b) Describe a register in computing context. **[1]**

- ✓ *Register is a temporary location that can store data temporarily.*

2. (a) Identify any five general application areas of computers. **[5]**

- ✓ *Agriculture*
- ✓ *Banking Systems*
- ✓ *Education*
- ✓ *Health Care*
- ✓ *Research And Development*

(b) i) Explain how it is possible to protect computer data from:

- **Physical damage**
  - ➢ *Use Security guards*
  - ➢ *Use burglar bars and screen doors*
  - ➢
- **Theft and misuse** **[3]**
  - ➢ *Passwords*
  - ➢ *encryption*

ii) Discuss the techniques that can be used to prevent unauthorised access to computer systems. **[9]**

- ✓ *Physical security- security which prevents physical access to a computer.*
  - *Locks*
  - *CCTV*
  - *Security guards*
- ✓ *Authentication- security which prevents access to a computer even if the user has physical access,*
  - *Passwords*
  - *Biometrics*
  - *Access rights*

- ✓ *Firewalls – is a security technology that monitors incoming and outgoing traffic. It provides a protective barrier between the computer and other computers*
- ✓ *Proxy servers- a way to prevent direct access to the server. It is an intermediary server.*

3. (a) Explain any four functions of a computer operating system. [4]

- ✓ *Provides a user interface*
- ✓ *Manages applications*
- ✓ *Manages files*
- ✓ *Manages computer memory*
- ✓ *Manages system security*
- ✓ *Provides error handling*
- ✓ *Handles interrupts*

41b) i) Define serial data transmission. [1]

A system in which data is send one bit at a time over a single wire from source to destination, until all data has been send.

ii) Explain the difference between serial and parallel data transmission. [2]

- ✓ *Serial data transmission is whereby data is send one bit at a time over a single wire from source to destination, until all data has been send.*
- ✓ *Parallel data transmission is whereby several bits are send simultaneously over a number of parallel lines linking the sender and the receiver.*

iv) Identify the circumstances where it is would be appropriate to use parallel data transmission. [1]

- ✓ *Suitable for short distance communication, i.e, inside the computer system using buses, e.g. from processor to hard drive, processor to printer*

v) Justify the need for protocols in data communication. [2]

- ✓ *A protocol is a set of rules that govern how data is transferred in a network. It defines the rules on how network devices communicate.*
- ✓ *A network communication protocol: a standard method for transmitting data from one computer to another across a network*

This includes:

- *how to interpret signals*
- *how to identify 'oneself' and other computers on a network*
- *how to initiate and end networked communications*

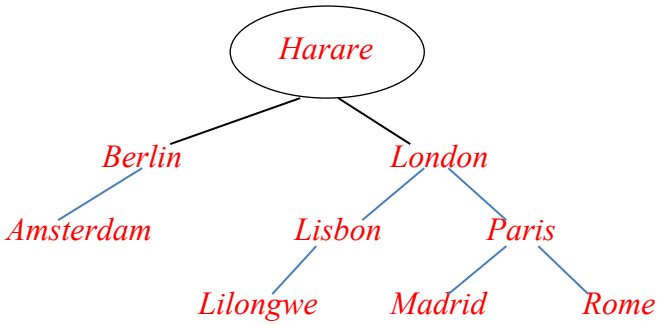
4. (a) Give any two differences between dynamic and static data structures. [2]

Static data structure	*Dynamic data structure*
✓ *Uses space required* ✓ *Efficient use of memory* ✓ *Emptied storage can be returned to the system* ✓ *change size when program is running* ✓ *difficult to program* ✓ *serial access* ✓ *e.g Binary tree, queue, stack, linked list etc*	✓ *Space allocated during compilation* ✓ *Waste space when only partially used* ✓ *do not change size when program is running* ✓ *Easier to program* ✓ *easier to check for overflow* ✓ *random access* *e.g. Array*

(b) The following data items are to be entered into binary search tree in the order given:

Harare, London, Paris, Rome, Berlin, Amsterdam, Lisbon, Madrid, Lilongwe.

i) Draw a diagram to show how these values (data items) will be stored and circle the root node. [5]



ii) If Madrid is being searched for in this binary tree, list the data items which will have to be accessed. [1]

✓ *Harare, London, Paris, Madrid*

5. (a) Perform the following arithmetic:

i) $10000000_2 - 1001100_2$ [2]

✓ *$0011\ 0100_2$*

ii) A73 + B412 + 52D [2]

✓ *C3B2*

(b) Convert the Hexadecimal number ABCD to octal [2]

✓ *125 715*

(c) Represent 101010_2 using BCD [2]

✓ *First change the number to Decimal = 42*
✓ *Then change the decimal number to BCD*
✓ *0100 0010*

6. (a) Describe the following terms in computing:

i) System software **[2]**

ii) Antivirus **[2]**

✓ *Software that identifies computer viruses and deals with them by not allowing them access to files or by erasing them. It usually protects against other forms of malware.*

iii) Disk formatting **[2]**

✓ *Is the process of dividing disk surface into a number of tracks and each track is divided into smaller blocks called sectors. The surface of a disk can store so much data that the computer cannot handle it all at once so it needs to be split up so that data stored on it can be found again.*

iv) Defragmentation **[2]**

✓ *It is the process of reorganising the files and unused space on a computer's hard disk so that the operating system accesses data more quickly and programs run faster. When an operating system stores data on a disk, it places the data in the first available sector on the disk. It attempts to place data in sectors that are contiguous (next to each other), but this is not always possible. When the contents of a file are scattered across two or more non-contiguous sectors, the file is fragmented.*

v) File compression **[2]**

✓ *It is the process of reducing the size of files while keeping or transmitting the file from one computer to another as the communication is speeded up.*

(b) Translators are essential in computing:

Give the difference in the way in which the three main translators Translate data. **[6]**

Interpreter

An interpreter translates high –level language into machine code one line at a time and executes it. No object code is produced so the program has to be interpreted each time it is to be run

Compiler

A compiler translates a complete program in high level language into object code before it is executed

Assembler

An assembler is a program which translates an assembly code program into machine code ready for the computer to execute it. Since each type of computer has its own assembly language, it also has its own assembler

(c) Compiling is done in a number of stages.
Outline what happens at stage of compilation, in the correct sequence.

Lexical Analysis

- ✓ *Removes white space, blank lines and comments*
- ✓ *Keywords , constants and identifiers are replaced by tokens*
- ✓ *A symbol table is partial created*
- ✓ *Some illegal identifiers are flagged out*

Syntax Analysis

- ✓ *Parsing the lexical string to check that it is grammatical correct using BNF notation and syntax diagram*
- ✓ *Symbol table is completed*

Code generation

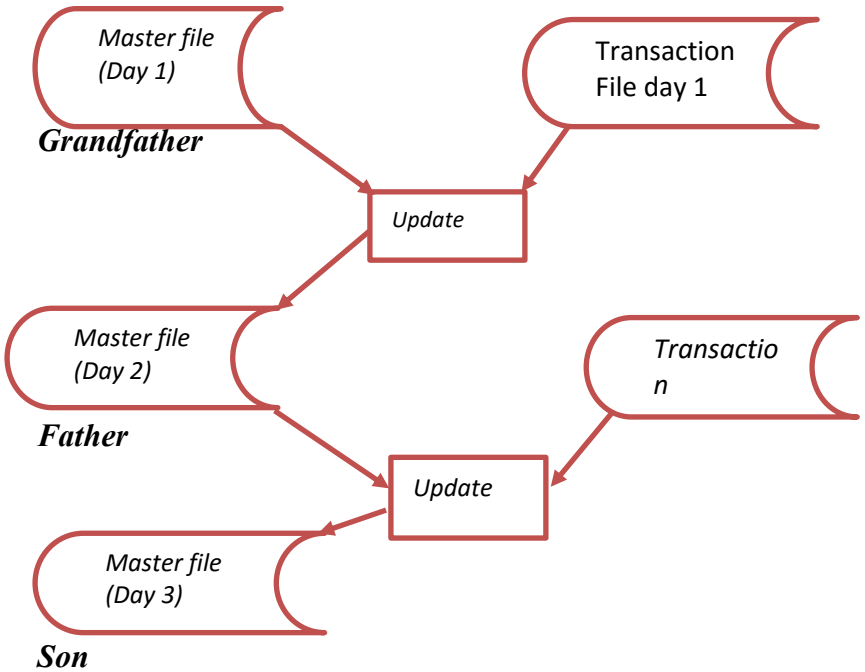
- ✓ *Producing machine code and storing it as an object file,*
- ✓ *Allocates memory locations to variables and constants*
- ✓ *Optimizes the machine code to reduce the use of memory or speed it*

7. Compare and contrast batch processing and real time processing on an Automated Teller Machine (ATM). [6]

Batch Processing	***Real time processing***
• *Processing is done later after data has been collected into batches.* • *It is usually done offline* • *For example total of all withdrawal transaction of the day*	• *Processing is done as soon as data is received.* • *It is done online* • *For example checking balance*

8. A new copy of a sequentially organised master file is made whenever records are added, a program is written to add a single record to the master file.

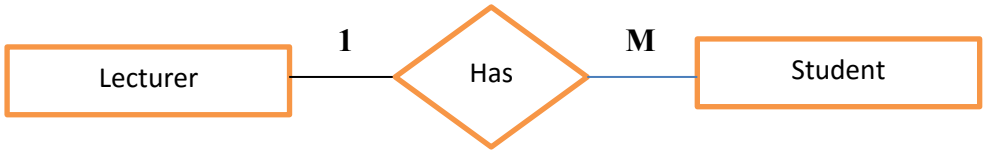
Draw a diagram to show the steps for this program that generate an amended copy of the master file. [6]



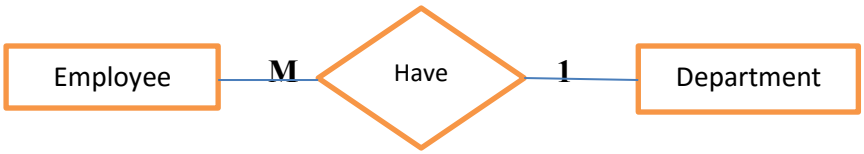
9. Draw an entity relationship diagram for the following relations:

i) Lecturer and student **[3]**

ii)



iii) Employee and department **[3]**



10. Programmers prefer interpreters over compilers. Justify this statement. [7].

- ✓ *Easier to debug than compiler*
- ✓ *Easier to create multi-platform code, as each different platform would have an interpreter to run the same code.*
- ✓ *Useful for prototyping software and testing basic logic*
- ✓ *Programmers can use interpreters whilst they are still developing their programs instead of waiting until it is complete then compile it.*

COMPUTER SCIENCE 9195/2 NOVEMBER 2017

SECTION A

1. The following is a fragment of a computer program Integer n-records.

```
.
.
.
Procedure display-records (n)
Integer linemax
.
.
.
If (n < n-records) then
Display error message box (.)
End if
.
End procedure
```

(a) Describe the following

(i) Local variable **[1]**

- *These are variables that are defined within a procedure and are accessible just within the procedure they are declared*

(ii) Global variable **[1]**

- *They are public variables that can be accessed and used by any procedure or function within the same program*

(iv) parameter **[1]**

- *is data item being supplied to a function or procedure when it is called*

(b) Identify the three terms in a (a) from the program fragment. **[3]**

- *local variable – linemax, n*
- *global variable – n-records*
- *Parameter – (.)*

2. Given that:

T(0) = 1
T(1) = 1
T(2) = 2
T(3) = T(2) * T(1) = 2
T(4) = T(3) * T(2) = 4
T(n) = T(n - 1) * T(n - 2)

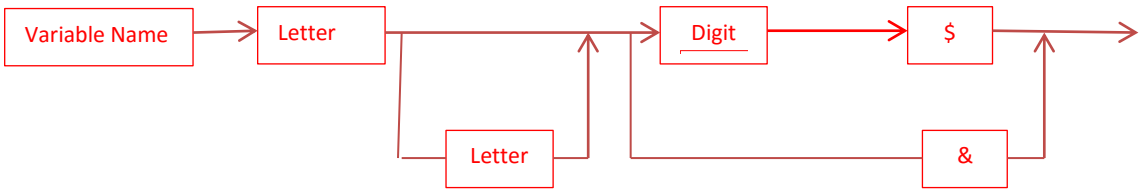
Write a recursive faction in pseudocode that takes any number as input and displays the value of T as output **[6]**

```
Function Time

    If T = 0 and T = 1 Then
        Return 1
    Else
        If T = 2 Then
            Return 2
        Else Return T(n-1) * T(n-2)
        End If
    End If

End Function
```

3. **A variable name is defined in a particular system as:**

- **One or two letters, followed by**
- **Any number of digits (including zero) followed by either a**
  - ✓ **$ sign if there are no digits**
  - ✓ **& sign if there are any digits**

(a) **Draw a syntax diagram which describes a variable name.** **[6]**



(b)

```
INPUT A, B
IF B = 0 THEN C = A
    ELSE C = A/B
ENDIF
PRINT A, B
PRINT C
END
```

Write down the outputs produced by the algorithm if

(i) **A = 8, B = 2** **4**

(ii) **A = 6, B = 0** **6**

(c) **An automatic fan is designed so that it turns on only when a person is in the room and the temperature is above a set value (D).**

The fan receives information from two sensors.

1. **A motion sensor which retains a value (M), dependent upon a person being sensed in the room,**

2. **A thermistor (electronic thermometer) which retains the temperature in the room (T).**

Produce an algorithm to control the fan/ the algorithm may be expressed in any form. **[6]**

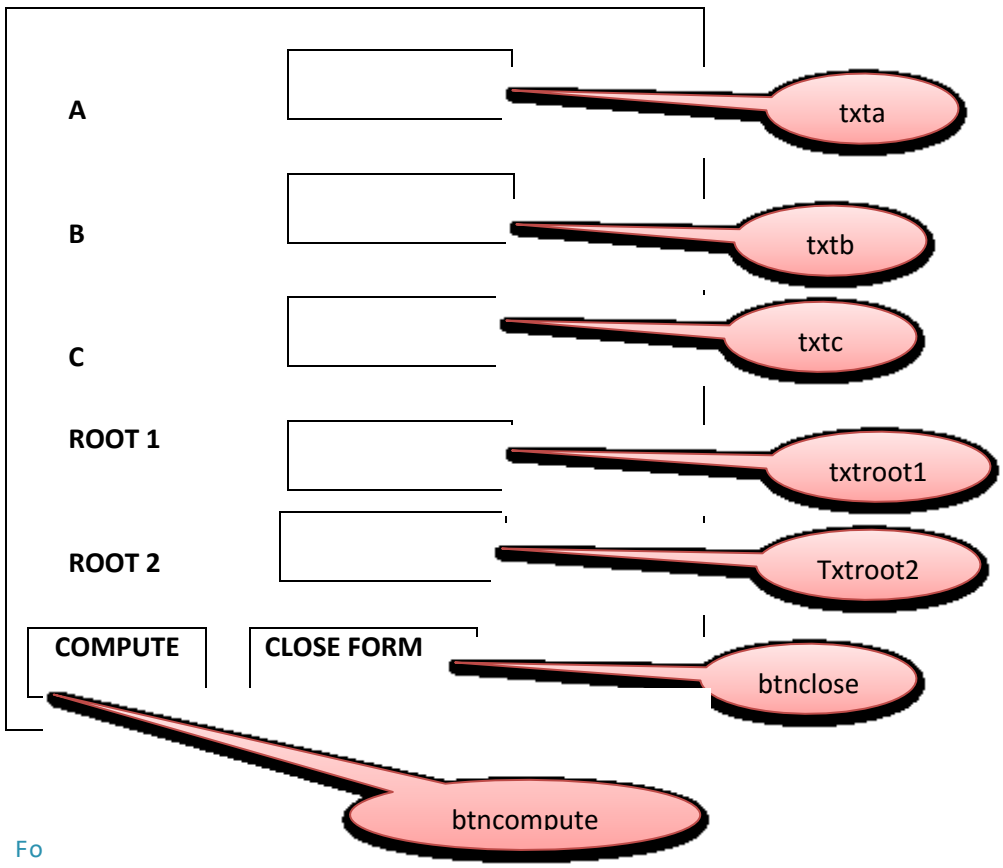
START

If M = 1 and T >= D Then
F = 1
Else
If M = 0 and T <= D Then
F = 0
(1 = ON, 0 = OFF)
End if
End if

END

4. **Given the following interface, interface, code a program that calculates and display the roots of a quadratic equation.** **[10]**

INTERFACE FORM BASED




```
Public Class Fo
    Dim A, B, C As Integer
    Dim ROOT_1, ROOT_2 As Integer
    Dim numroot As Integer
    Dim det As Double
```

```
    Private Sub btncompute_Click(sender As Object, e As EventArgs) Handles
btncompute.Click
        A = txta.Text
        B = txtb.Text
        C = txtc.Text

        det = (B ^ 2) - (4 * A * C)
        ROOT_1 = (-B + Math.Sqrt(det)) / (2 * A)
        ROOT_2 = (-B - Math.Sqrt(det)) / (2 * A)

        txtroot1.Text = ROOT_1
        txtroot2.Text = ROOT_2
    End Sub

Private Sub btncloseform_Click(sender As Object, e As EventArgs) Handles
btncloseform.Click
        Me.Close()
    End Sub
End Class
```

5. Create a Visual Basic program using the SELECT CASE that display a message on a message box depending on the day temperature input, through a textbox using the following temperature ranges:

   Temperature < = 0: freezing
   Temperature > = 1 and < = 20: moderate
   Temperature > = 21: Hot [12]

```
Public Class Temperature

    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
        Dim temp As Double
        temp = txttemp.Text
        Select Case temp
            Case Is <= 1
                MsgBox("freezing")
            Case 1 To 20
                MsgBox("moderate")
            Case Is > 20
                MsgBox("hot")

        End Select
    End Sub
End Class
```

SECTION B

Answer any two questions in this section.

6. (a) Explain the following units of storage giving examples:

(i) Bit - *is the smallest unit of data that a computer can process. E.g. 1 or 0*

(ii) Word - *Is a group of bits that can be addressed, transferred and manipulated as a single unit by the central larger than a byte, possibly consisting of 16, 32, 64 bits*

(iii) Nibble - *Is a group of four bits* **[3]**

(b) (i) Describe the operation of a static data structure. [1]

- *Static data structure does not change in size while the program is running e.g. an array. Once you declare the size of an array, it cannot be change*

(ii) Identify and explain an application in the operation of a computer system where a static data structure would be required. [4]

- *Static data structures will be required when working with arrays and fixed length records where the amount of storage is known and they are easier to program also it becomes easy to check for overflows.*

(c) Convert the following to base 10

(i) 27_8 23_{10}

(ii) $4\ 307_8$ 2247_{10}

(iii) $2F_{16}$ 47_{10}

(iv) $BC12_{16}$ $48\ 146_{10}$ **[7]**

(d) Suppose the Array A is defined as:

34	54	87	90	101

Trace the value using a binary search to find

(i) 101 [5]

Low	Middle	High	Found
1	*3*	*5*	*False*
4	*4*	*5*	*False*
5	*5*	*5*	*True*
101 is found on the list at position 5			

(ii) 88 [5]

Low	Middle	High	Found
1	3	5	False
4	4	5	False
4	4	4	False
4	3	3	False
88 is not in the list. high is now lower than Low			

7. (a) Describe the following terms:

(i) Tuple - *is a row in a relational database, that denotes a record in a relation* [2]

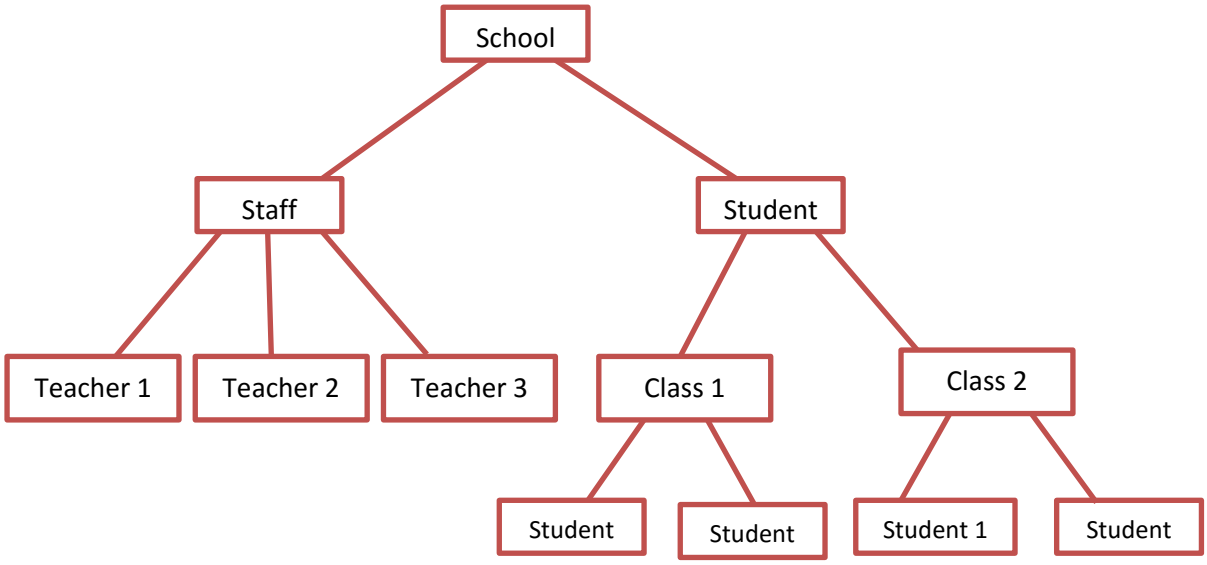
(ii) Relation - *is a table with columns and rows in relational database*. [2]

(iii) SQL - *is a computer language used to communicate with a relational database management system.* [2]

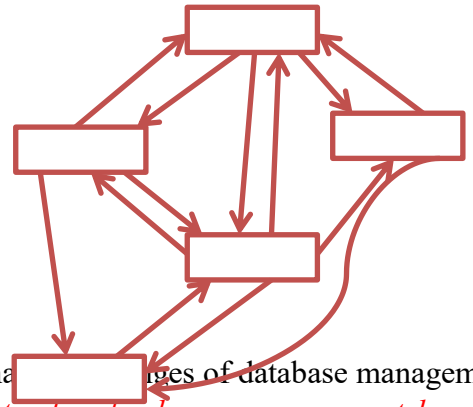
(iv) Schema - *refers to the overall design of the database and it provides a logical classification of objects in the database* [2]

(b) Illustrate using diagrams, the

(i) Hierarchical database model [6]



(ii) Network database model [6]



(c) (i) Illustrate three ma ges of database management systems [3]

- *If the computer breaks down, you may not be able to access the data.*

- *Computer data can be easily copied illegally*
- *It is costly to initially setup the database.*
- *Takes time and costs to train users of the systems.*
- *Expensive to employ a database administrator who will manage the database*

(ii) Prescribe solutions for any two of the challenges in (i). [2]

- *Use backups*
- *Use passwords*

8. A systems analyst is designing the Human Computer Interface (HCI) for a control room in a work site

(a) Analyse any three factors the analyst should consider when designing the HCI. [6]

- **Colour** – colour can be used as an indicator of the data being highlighted. For example, red is often as a warning colour and green to signify that there is no problem.
- **Layout –** the more important information should be positioned on the screen where the user will read. The information must be read from left to right. Maintain a similar layout across software which is part of a software suite, e.g. common commands should be placed in the same screen locations in all the software that controls a chemical factory, so that users get used to the layout of the interface.
- **Content –** the content of the information presented is important.

(b) Modularity has become a very popular programming concept.

Justify this statement, giving appropriate examples of where modularity is suitable. [7]

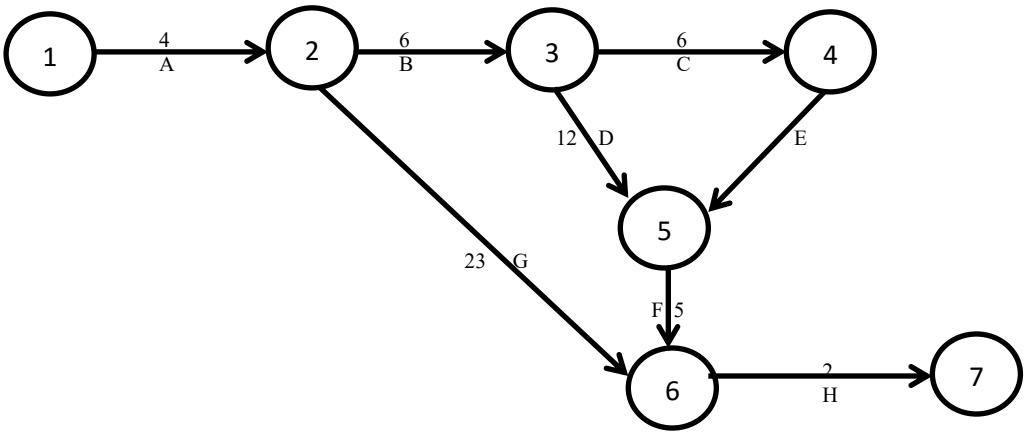
- Modularity is a method of organising a large computer program into self-contained parts that can be developed simultaneously by different programmers or teams of programmers.
- Program maintenance is easier because affected modules are quickly identified.
- Modules can be tested independently thereby shortening the time taken to get the whole program working
- A large project becomes easier to monitor and control.
- Some modules will be standard procedures used from time to time in different programs or parts of the program.
- A module is small enough to be understandable as a unit of code. It is therefore easier to understand and debug, especially if its purpose is clearly defined and documented.
- In a very large project, several programers may be working on a single program.

(c) Explain any four advantages of using bottom up approach. [4]

(d) A complex problem is to be solved. The analyst has split the problem up into a number of different tasks to be carried out.

A	-	Represents the collection of information about the problem
B	-	Represents the analysis of the information
C	-	Represents the design of the solution.
D	-	Represents the creation of data files.
E	-	Represents the writing of the software
F	-	Represents the testing of the software
G	-	Represents the creation of the documentation.
H	-	Represents the installation of the finished project.

The units used on the chart are days.



The Program Evaluation and Review Technique chart (PERT) has been drawn to allow critical path analysis of the problem

(i) Explain what the chart shows about the relationships between the various tasks. [6]

(ii) Write the critical path and at least time required to complete the project. [2]

- *A B D F H / A G H*
- *Least time = 23 days*

COMPUTER SCIENCE 6023/1 NOVEMBER 2018

1. (a) Explain why computers use binary numbers. [1]

*Computers use voltages and since voltages changes often, no specific voltage is set for each number in the decimal system. For this reason binary is measured as a two-state system i.e. on or off. Binary digits are **0** and **1**, that is **0** for **Off** and **1** for **On**.*

(b) Express the denary number 78 as:

i) a binary number stored in an 8 bit byte [2]

128	64	32	16	8	4	2	1
0	1	0	0	1	1	1	0

$78_{10} = 0100\ 1110$

ii) a hexadecimal number [2]

0100	1110
4	E

$78_{10} = 4E_{hex}$

iii) a number stored in Binary Coded Decimal (BCD) [2]

7	8
0111	1000

78 = 0111 1000 BCD

2. A computer stores numbers in Floating Point Form, using 8 bits for the mantissa and 8 bits for the exponent. Both the mantissa and the exponent are stored in two's complement form.

a) Explain the effect of this on the

i) range [2]

Range is decreased because power of two which the mantissa is multiplying by is decreased

ii) accuracy [2]

of the numbers that can be stored if the number of bits in the exponent is reduced.

Accuracy is increased because more digits are represented after the binary point.

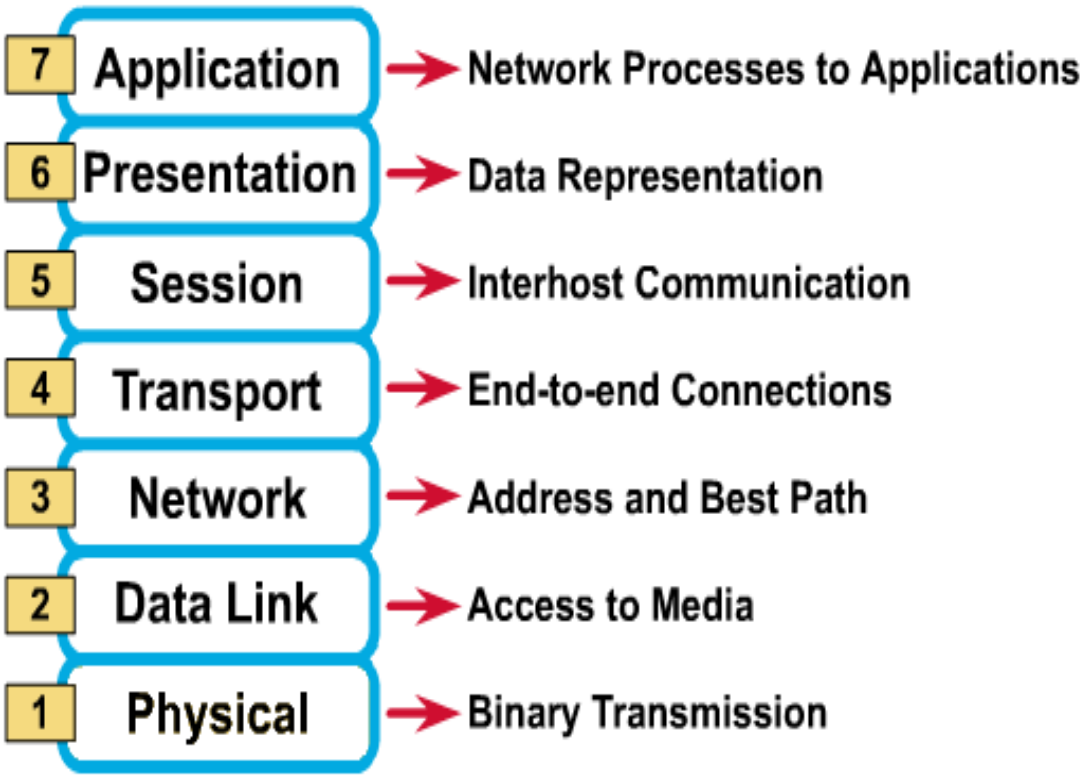
b) Calculate the denary number which would have 01000000 00000010 as its binary, floating point representation in this computer. [2]

01000000 00000010
Exponent = +2
Mantissa = 0.1000000 Move the decimal point 2 places to the right

= 010.0
= 2

c) Explain why it is not possible to represent zero as a normalised floating number.
*A normalised number must have the first two bits of the mantissa different. A negative number start with **10** and a positive number start with **01.** Zero is neither a positive nor a negative number.*

3. a) Draw the OSI Model. **[7]**



b) Explain each layer of OSI model

7. ***Application layer***
   - *This is the highest level closest to the user.*
   - *It supports the transfer of information between end user, applications programs and devices.*
   - *Several types of protocol exist in this layer, covering specific and general applications such as accounting, entry control and user identification.*

6. ***Presentation layer***
   - *The aim of protocols in this layer is to ensure that different devices using data in different formats can communicate with each other, for example handling conversation between ASCII and EBCDIC.*
   - To translate, encrypt and compress data
   - *It may also carry out encryption to ensure data security during transmission.*

5. ***Session layer***
   - *The session layer is the user's interface into the network.*

- *When a user requests a particular service from the network, the session layer handles the dialogue.*
- *The session layer is the network dialog controller.*
- *It establishes, maintains, and synchronizes the interaction among communicating systems.*

4. ***Transport Layer***
   - *The transport layer is responsible for process-to-process delivery of the entire message.*
   - *A process is an application program running on a host.*
   - *The transport layer ensures that the whole message arrives intact and in order, overseeing both error control and flow control at the source-to-destination level to ensure a high quality data transmission service for the network.*

3. ***Network layer***
   - *The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links), the network layer ensures that each packet gets from its point of origin to its final destination.*
   - *If two systems are connected to the same link, there is usually no need for a network layer. However, if the two systems are attached to different networks (links) with connecting devices between the networks (links), there is often a need for the network layer to accomplish source-to-destination delivery.*
2. ***Data link layer***
   - *The physical data transmission media used in a network are subject to interference which can corrupt data and this layer handles data transmission errors*

1. ***Physical layer***
   - *The physical layer coordinates the functions required to carry a bit stream over a physical medium.*
   - *It deals with the mechanical and electrical specifications of the interface and transmission medium.*
   - *It also defines the procedures and functions that physical devices and interfaces have to perform for transmission to Occur.*
   - *It is concern with how the binary data is transmitted along the channel.*

4. Describe how each of the following elements would be used in the OSI model.

a) Switch **[2]**

A switch is a device that is used at the Access or OSI layer 2 and utilises MAC Address to determine the path through where frames are to be forwarded. It can be used to connect multiple hosts (PCs) to the network.

b) Modem **[2]**

Dc A modem works at the Physical layer of the OSI model. It is a device that modulates an analogue carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information

c) Bridge **[2]**

A bridge connects two LAN segments into one larger continuous LAN. Bridges operate at the Data Link Layer of the OSI Model. They can distinguish between local and remote data, so data traveling from one workstation to another in the same segment do sent have to cross the bridge.

5. a) Explain how the width of the data bus and the system clock speed affect performance of a computer. [3]

- *A wider data bus will allow more data to be sent at a time, and therefore the processor will perform more efficiently.*
- *A wider address bus will increase the number of memory addresses a computer may use, e.g. an 8 bit bus will only allow a value between 0 and 255 to be transmitted at a time.*
- *A processor with a faster clock speed will perform faster, since more pulses will be sent out in the same time frame.*

b) (i) Differentiate the Von Neumann and Harvard architecture [2]

Von Neumann Architecture	*Harvard Architecture*
✓ *The data and program processing that data are stored in the same memory* ✓ *Has only one bus which is used for both data transfers and instruction fetches*	✓ *Contains two separate areas for commands or instructions and data* ✓ *Use separate buses for data and commands*

(ii) Explain three buses used in the Von Neumann Model. [6]

control

- ✓ bi-directional bus
- ✓ its purpose is to transmit commands, timing and specific information between system components

Address

- ✓ one directional bus
- ✓ used to transmit the address from processor to memory
- ✓ Also used to address I/O ports during input/output operations

data

- ✓ bi-directional bus
- ✓ used to transmit data and instructions between system components

6. The next instruction to be carried out is LDA25, which loads the number 25 into the accumulator.

a) With reference to special registers in the processor illustrates the stages of the fetch and execute cycle when dealing with the instruction above. [6]

The Fetch Stage:

- *Copy the address in the PC into the MAR*
- *Increment PC*
- *Load the instruction(LDA25) that is in the MAR into MDR*

- *Load instruction (LDA25) in MDR into CIR.*

The decode stage

- *Identify the type of addressing being used.*
- *Load the address part (operand) into MAR and retrieve the contents of the address*

The Execute stage

- *Load the retrieved contents (25) into MDR*
- *Load the contents in MDR into Accumulator*

b) Explain what is meant by an interrupt. [1]

An interrupt is a signal to the processor emitted by hardware or software indicating an event that needs immediate attention.

c) Determine the actions of the processor when an interrupt is detected after an instruction has been fetched. [2]

- *The current fetch-execute cycle is completed.*
- *The contents of the program counter are stored safely for later restoration*
- *The source of the interrupt is identified*
- *The interrupt service routine is executed.*
- *The program counter is restored to point to the next instruction to be fetched and executed in user program*

7. Schools in a district are connected to a WAN. It has been observed that files are being manipulated and there is violation of confidential information.

Suggest measures that could be put in place to secure the WAN, giving reasons. [10]

- *All users should connect to WAN via a Virtual Private Network (VPN). A VPN creates a secure tunnel that protects your data and allows al traffic, voice or data to pass through a public WAN as it was on private LAN.*
- *Install a trustworthy Firewall – A firewall is a hardware or software designed to block unauthorised access to computers and networks*
- *Cloud Computing security - applications and services are moved into the cloud.*
- *Use strong passwords which are updated frequently*
-

8. A student is trying different ways of designing the process of entering data into an array.

He declares a variable called ArraySize and set it to 3.
He declares an array number [ArraySize]
He then writes the following pseudocode:

```
Element ⟵ 1
        While Element < ArraySize Do
        Input Number [Element]
        Element ⟵Element + 1
Endwhile
```

a) In the following table, trace the effects of entering 24, 57,12. [8]

ArraySize	Element	Element < ArraySize	Number		
			(1)	(2)	(3)
3					
	1				
		true			
			24		
	2				
		true			
				57	
	3				
		false			

b) (i) State the type of error in the pseudocode [1]

Logic error

(ii) The error can be corrected by changing one line. Write the correct line of the pseudocode.

While Element <= ArraySize Do

c) Rewrite the code using REPEAT…UNTIL Loop [2]

```
Element ←1
    REPEAT
      Input Number [Element]
      Element ←Element + 1
      UNTIL Element > ArraySize Do
End Repeat
```

d) The student wants to increase the size of the array to 500. This is too large to trace with the trace Table.

Show how one would check that the logic of the pseudocode is correct for 500 iterations.

- *Variable dump – see values of all variables at a particular place in the code*
- *Break points – to stop execution at significant points*
- *Black box testing- set results against expectations*
- *Cross referencing – identifies errors caused by duplication of variable names across procedures.*

9. A database has been designed to store the data about sales persons and the products they have sold.

The following facts help to define the structure of the database:

- **Each salesperson works in a particular shop.**
- **Each salesperson has a unique first name.**
- **Each shop has one or more salespersons.**
- **Each product sold is manufactured by one company only.**
- **Each person can sell any of the products**
- **The number of products sold by each salesperson is recorded.**

The table Shopsales was the first attempt at designing the database.

Table: ShopSales

FirstName	Shop	ProductName	Number of products	manufacture
Nick	TX	Television set Refrigerator Digital camera	3 2 6	SKC WP HKC
Sean	BH	Hair dryer Electric shaver	1 8	WG BG
John	TX	Television set Mobile phone Digital camera Toaster	2 8 4 3	SKC ARC HKC GK

a) Explain why the table is not in the First Normal Form(1NF) [1]
There are repeating groups in ProductName and Manufacturer columns

b) The database has been changed to:

SalesPerson (First Name, Shop)
SalesProduct (FirstName, ProductName, Number of Product, Manufacturer)

Using the data in the first attempt table, ShopSales, show how the data is now stored in the revised table designs below.

(i) Table: SalesPerson [1]

FirstName	Shop
Nick	*TX*
Sean	*BH*
John	*TX*

(ii) **Table: SalesProduct**

FirstName	ProductName	No. Of Products	Manufacture
Nick	*Television set*	*3*	*SKC*
	Refrigerator	*2*	*WP*
	Digital camera	*6*	*HKC*
Sean	*Hair dryer*	*1*	*WG*
	Electric shaver	*8*	*BG*
John	*Television set*	*2*	*SKC*
	Mobile phone	*8*	*ARC*
	Digital camera	*4*	*HKC*
	toaster	*3*	*GK*

c) (i) Suggest a primary key for the tables in (b) giving a reason. [2]

- *FirstName & ProductName*
- *Each salesperson has a unique first name & Each person can sell any of the products. Hence you can uniquely identify each record.*

(ii) Explain why the SalesProduct table is not in Second Normal Form (2NF) [2]

There are partial key dependencies. No of Products and Manufacturer depends on part of the primary key that is ProductName only.

(iii) Write the table definition to give the database in (2NF)

SalesPerson (First Name, ProductName)
SalesProduct (ProductName, Number of Product, Manufacturer)

10. A software company is interested in the project a student developed at Advanced Level and they are proposing commercialising it. They are worried about the authenticity of the project.

a) Suggest four points to look at to maintain product originality. [4]

- ✓ *Naming conventions – focuses on the way identifiers, procedures and functions have been declared. Use meaningful names that convey the raison-d'etre of the data value*
- ✓ *Annotations or comments- these should allow another programmer to follow the logic of the program*
- ✓ *Indentation and formatting – Indentation allows you to separate the different block of program code. The purpose of indentation is to convey the program structure at a quick glance; it makes program code more structured and readable.*

- ✓ *Proper documentation-technical documentation is used ensure that a system can be maintained in the long term by the same or a different group of analysts/programmers. Maximum information on the system must therefore be included.*

b) There is risk that the software company may steal the benefit. Discuss how to safe guard it. **[6]**

- ✓ By making sure that patent rights are being observed by agreeing to sign user licences that contain rights to use the system.
- ✓ By having licence keys which activates the software after it has been purchased

COMPUTER SCIENCE 6023/2 2018

Section A [20 marks]

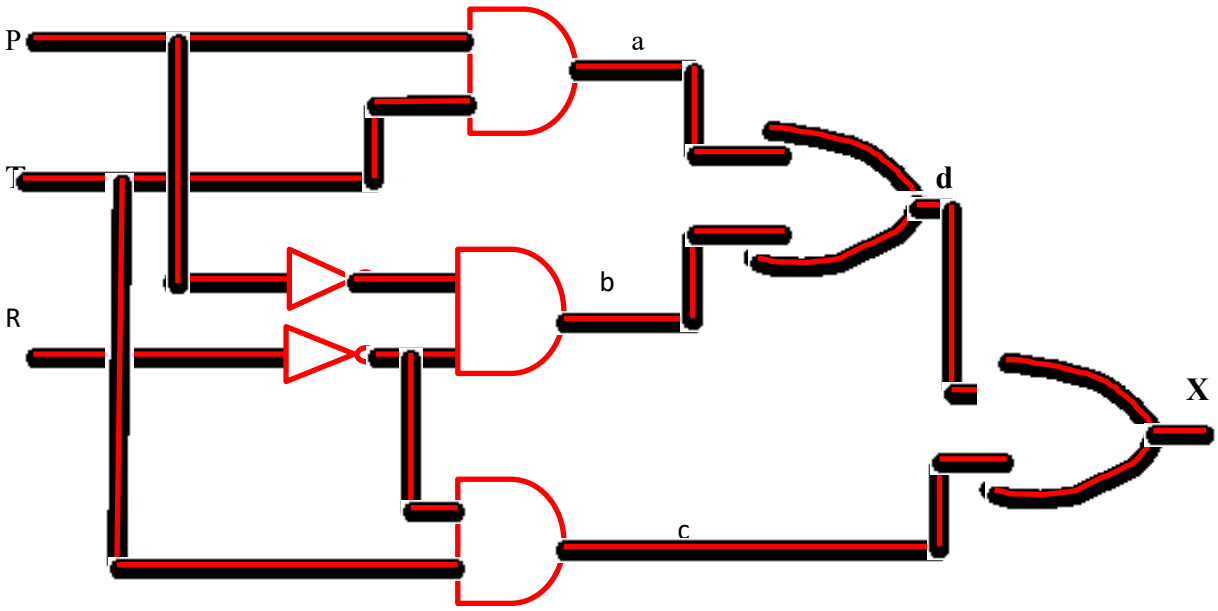
1. (a) A system is monitored using a sensor. The sensors output binary values corresponding to physical conditions as shown in the table.

Parameter	Description of parameter	Binary value	Description of condition
P	Oil pressure	1	Pressure >= 3 bar
		0	Pressure < 3 bar
T	Temperature	1	Temperature >= 200^0C
		0	Temperature < 200^0C
R	Rotation	1	Rotation <= 1 000 revs per minute (rpm)
		0	Rotation > 1 000 revs per minute (rpm)

The outputs of the sensors form the inputs to a logic circuit. The output from the circuit X is 1, if any of the following conditions occur:

either oil pressure > = 3 bar and temperature > = 200^0C or oil pressure < 3 bar and rotation > 1000 rpm or temperature > = 200^0C and rotation > 1000 rpm.

i) Draw a logic circuit to represent the above system. [5]

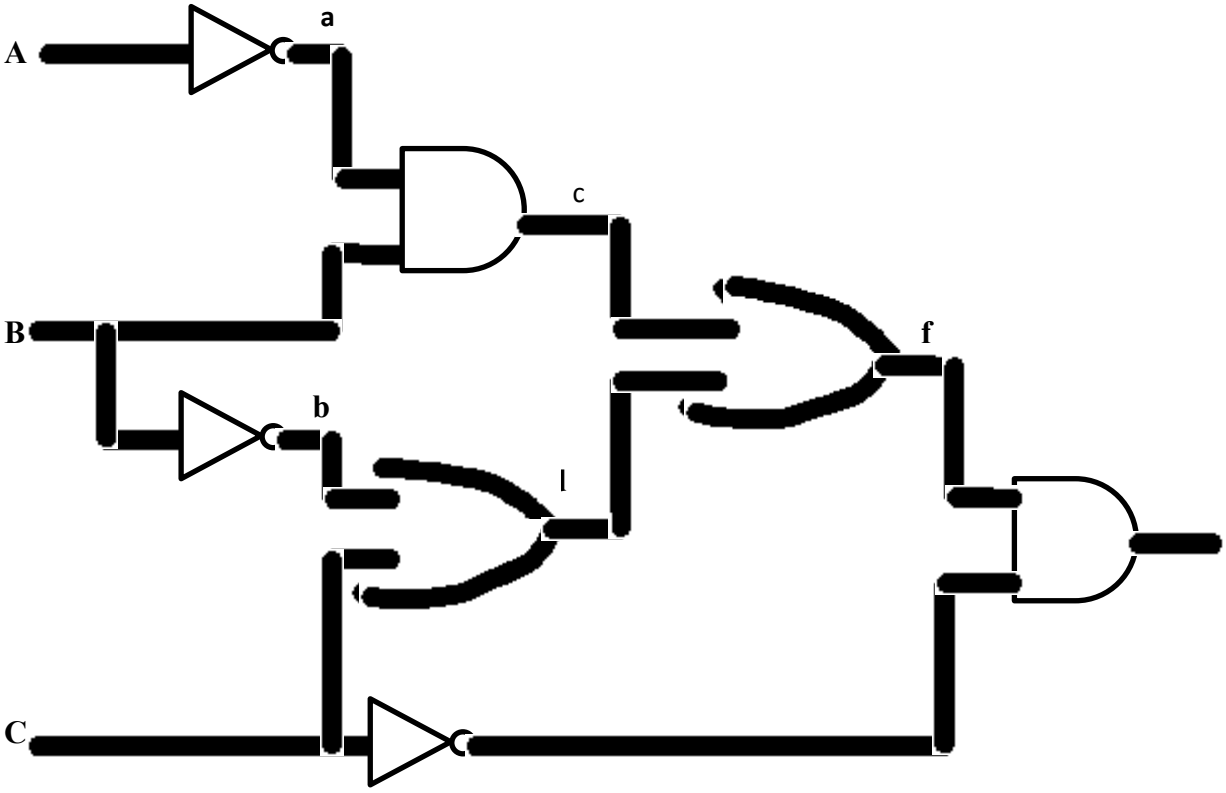


ii) Complete the truth table below for this system. **[4]**

P	T	R	Workspace				X
			a	b	c	d	
0	0	0	0	1	0	1	1
0	0	1	0	0	0	0	0
0	1	0	0	1	1	1	1
0	1	1	0	0	0	0	0
1	0	0	0	0	0	0	0
1	0	1	0	0	0	0	0
1	1	0	1	0	1	1	1
1	1	1	1	0	0	1	1

(b) Using a spreadsheet application program, or otherwise simulate the following logic circuit. Use only the following logic gates.

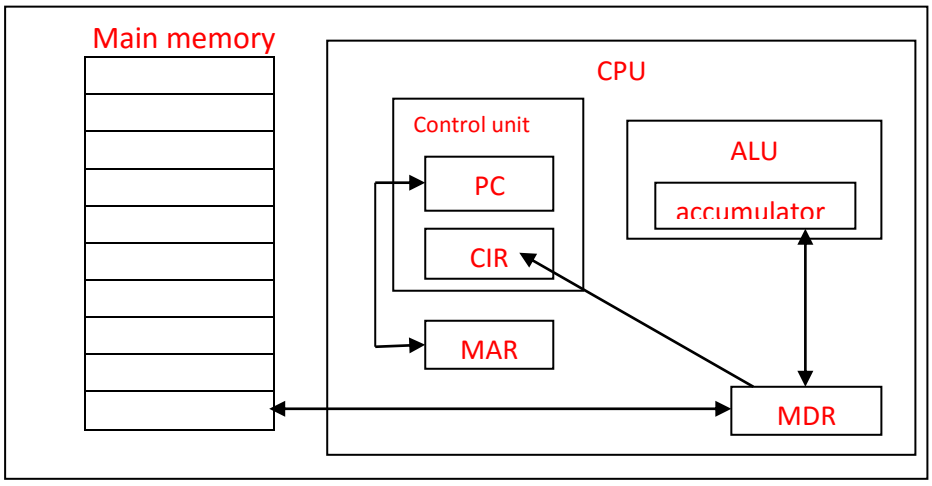
Logic Gate	Spreadsheet Formula
	= NOT (. . .)
	= AND (. . .)
	= OR (. . .)
	= XOR (. . .)



Hint: Print the spreadsheet application program showing the formulas and the completed truth table with all the intermediate results.

	A	B	C	D	E	F
1	1	=NOT(A1)				
2			=AND(B1;B3)			
3	1	=NOT(A3)		=OR(C2;C5)		
4						
5			=OR(A7;B3)		=AND(B3;B7)	
6						
7	1	=NOT(A7)				
8						
9						

2. (a) Draw a well labelled diagrams showing the Main Memory, Central Processing Unit (CPU) and the following registers Memory Address Registers (MAR), Memory Data Register (MDR), Current Instruction Register (CIR) and Program Counter (PC) which illustrates the Fetch Decode –Execute Cycle. [10]



(b) An alarm sounds when certain conditions occur in a nuclear reactor. The output, X, of a logic circuit that drives the alarm must have a value of 1 if:

Either carbon dioxide pressure is too low and temperature < = 300^0C or water pressure > 10 bar and temperature > 300^0C.

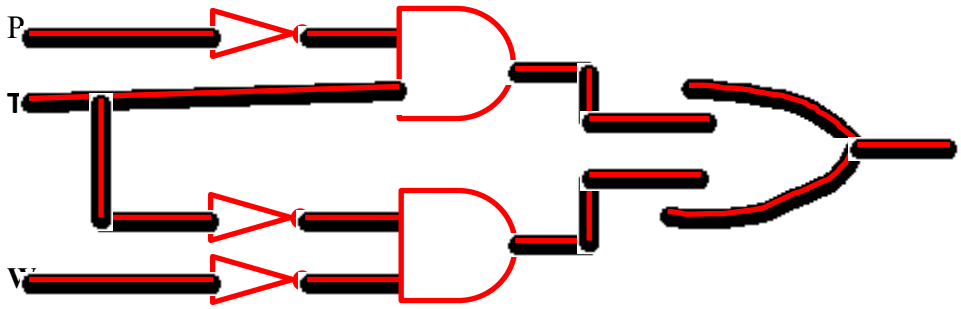
The inputs to the system are:

Input	Binary	Condition
P	Oil pressure	Carbon dioxide pressure too low
		Carbon dioxide pressure acceptable
T	Temperature	Temperature > 300^0C
		Temperature < = 300^0C
W	Rotation	Water pressure > 10 bar
		Water pressure <= 10 bar

i) Produce a logic statement for the scenario given above **[1]**

X = (NOT P AND T) OR (NOT W AND NOT T)

ii) Draw a logic circuit for the alarm system **[5]**



iii) Produce the truth Table for the alarm system **[4]**

P	T	W	Working Place					X
			P'	T'	W'	P'.T	T'.W'	
0	0	0	1	1	1	0	1	*1*
0	0	1	1	1	0	0	0	*0*
0	1	0	1	0	1	1	0	*1*
0	1	1	1	0	0	1	0	*1*
1	0	0	0	1	1	0	1	*1*
1	0	1	0	1	0	0	0	*0*
1	1	0	0	0	1	0	0	*0*
1	1	1	0	0	0	0	0	*0*

SECTION B (50 marks)

3. **A student writes a program using a** relaxed form of structured English**. The student uses identifiers that contain illegal characters such as the arithmetic operators to name variables.**

Assuming that the identifiers should have been made up of small alphabetic characters and the maximum length of each identifier is 32 characters, write functions that will validate variables on the following basis.

(a) (i) **The length check** **[5]**

```
Public Function Length Check (ByVal identif As string) Returns Boolean

If identif.length >32 Then
        Return False
Else
        Return True
End If
End Function
```

(ii) **Whether or not it contains the illegal characters.** **[10]**

```
Public Function Character Check (ByVal identif As string) Returns Boolean

Dim i as integer
Dim flag As Boolean
Flag = True

For I = 1 to identif.length
If mid(identif, I, 1> "z" Or mid (identif, I, 1) < "a" Then
        Flag = False

End If

Next i

Return flag

End Function
```

(b) **Write code snippets that will accept an invalid identifier and perform the following tasks:**

(i) **If it is too long truncate it and discard the right most part.** **[5]**

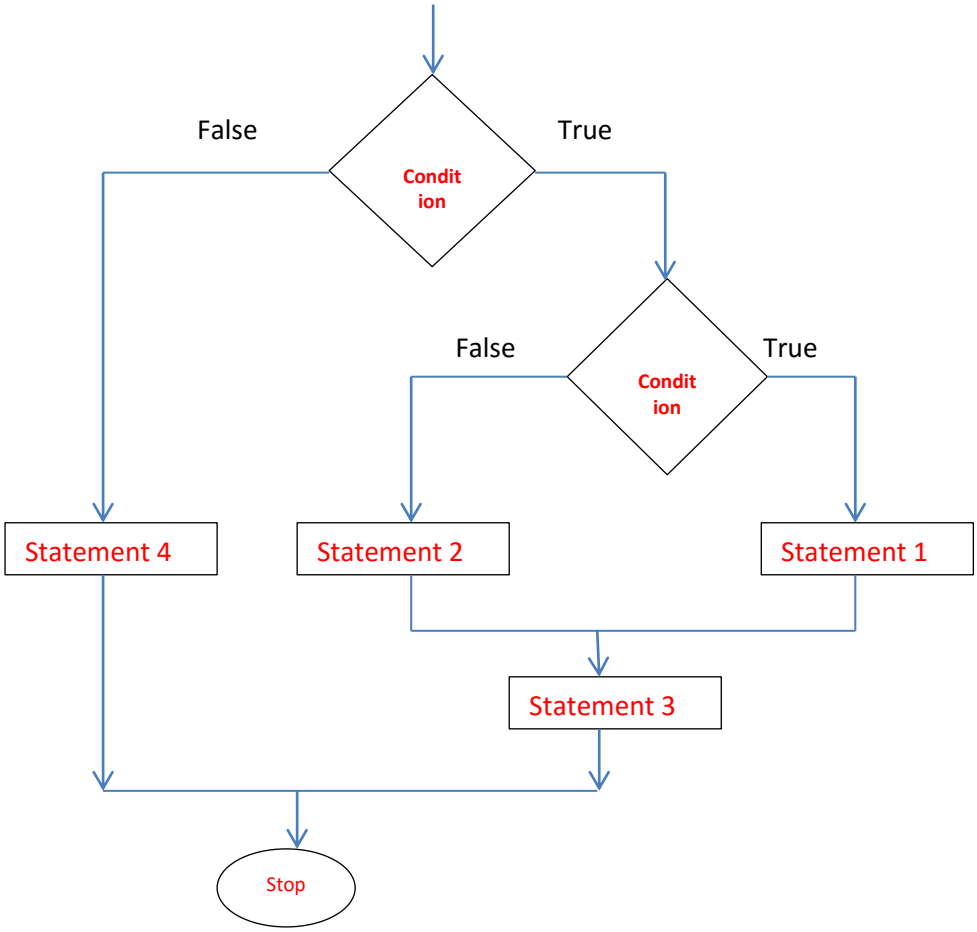
```
Dim TestString as String
TestString = Console.Readline
If not lengthCheck(TestString) Then
        TestString = left (TestString.32)
End If
Console.Writeline(TestString)
```

(ii) **It then checks if there are any illegal characters and removes them.** **[12]**

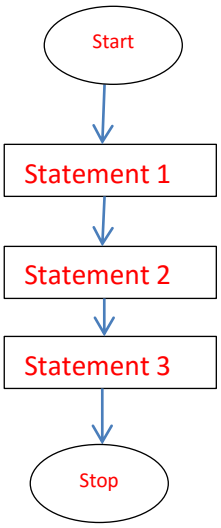
Hint: **You may use the function defined in part (a) to perform checks by calling them.**

(c) **Construct flowcharts of the following programming constructs:**

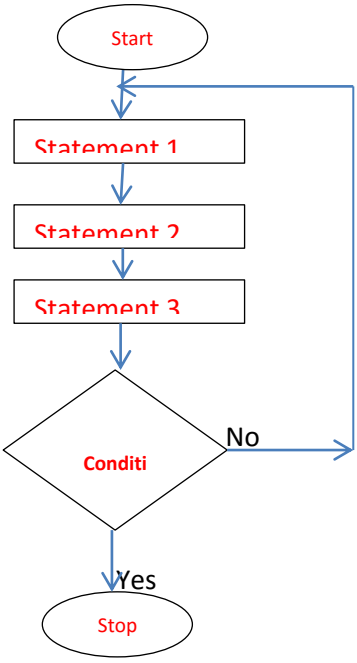
(i) **Nested if statement** **[3]**



(ii) Sequence **[2]**



(iii) Bottom tested loop **[3]**



(d) (i) Using a programming language of your choice, state any four statements used with random access files. Give the purpose of each statement. **[8]**

- *OPEN "MyFile.txt" FOR Random Read Lock As #1*
- *Used to **Open** a file in random access mode and restrict access to read only mode*

- *Close #1, #2,#3*
- *Used to **close** all files that have been opened; in this case 3 files*

- *Put #1, 4, WorkRecord*
- *Used to **write** the content of WorkRecord at position 4 in file 1*

- *Get # 1,4, WorkRecord*
- *Used to **read** a record on position 4 from the file*

(ii) Write any two statements which are common to both sequential and random files. [2]

- *CLOSE **#filenumber***
- *OPEN "**Filename**" FOR **mode** AS **#filenumber***

4. (a) Write an algorithm of a program that accepts 50 numbers through the keyboard and outputs the smallest, highest and average of all the numbers entered.

Begin **[10]**

Smallest =2000
Highest = 0
Counter = 1
Total = 0
Average = 0

While counter <= 50 Do
Input number
Total = total + number
Counter = counter +1

```
If number > largest Then
   Largest = number
Else
   If number < smallest Then
       Smallest = number
   End If
End If
```

End While
Average = Sum/50
Display Highest, Smallest, Average

End.

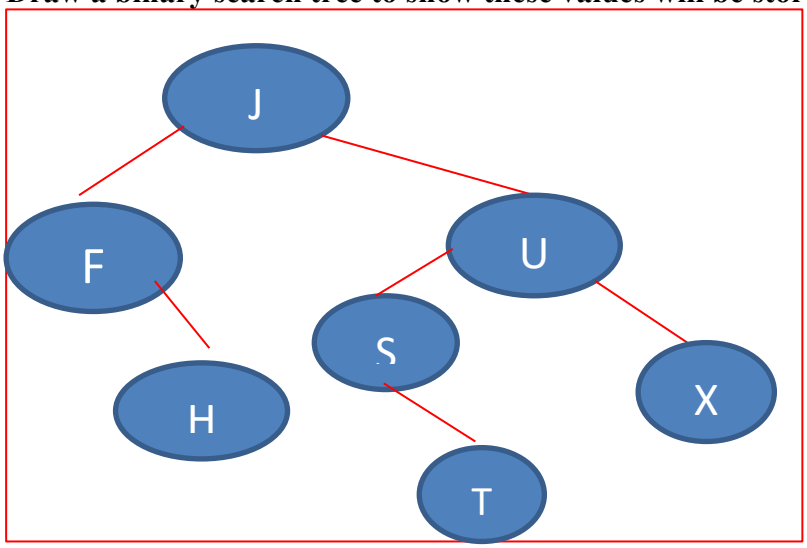
(b) Convert the above algorithm in (a) into a program. Use a text editor or IDE environment to produce the code. [11]

```
Public Class Form1

    Private Sub btnclik_Click(sender As Object, e As EventArgs) Handles
btnclik.Click
        Dim count, sum, smallest, largest, average As Integer
```

```
        Dim num As Integer
        average = 0
        sum = 0
        largest = 0
        smallest = 2000
        For count = 1 To 50
            num = InputBox("Enter number")
            sum = sum + num
            If num > largest Then
                largest = num
            Else
                If num < smallest Then
                    smallest = num
                End If

            End If

        Next count

        average = sum / 50
        MsgBox("Average is:" & average)
        MsgBox("Largest is:" & largest)
        MsgBox("Smallest:" & smallest)

    End Sub
End Class
```

(c) (i) A series of characters J, F, H, U, S, X, T are to be entered into binary search tree in the order given.

Draw a binary search tree to show these values will be stored. [7]



(iii) The following data is to be in arrays Data, L and R.

Data

"J"	"F"	"H"	"U"	"S"	"X"	"T"
[1]	[2]	[3]	[4]	[5]	[6]	[7]

L

2	0	0	5	0	0	
[1]	[2]	[3]	[4]	[5]	[6]	[7]

R

4	3	0	6	7	0	
[1]	[2]	[3]	[4]	[5]	[6]	[7]

Using the array above, dry run the following pseudocode by completing the trace table below it. **[6]**

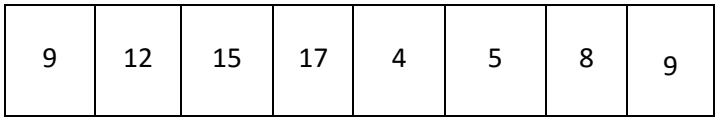
```
Item = "T"
Ptr =  1
While Dat[Ptr] <> Item Do
        Print Data[Ptr]
        If Data [Ptr] > Item The
                Ptr = L [Ptr]
        Else
                Ptr = R [Ptr]
        End If
End While

        Print Dat [Ptr]
```

Item	*Ptr*	*Printed Output*
"T"	*1*	*"J"*
"T"	*4*	*"U"*
"T"	*5*	*"S"*
"T"	*7*	*"T"*

Write a pseudocode of a program that will output the square root of any input number. The program must stop when the number input is zero (0) **[7]**

```
Display "Enter a number or zero to stop"
Input number
WHILE number < >0 Do
  Square root = number ^ 0.5
  Display "The square root is," square root
  Display "Enter a number or zero to stop"
ENDWHILE
```


Write a program code that will use a loop to create the array given below and accept its values.




```
Module Module1


    Sub Main()
        Dim Array(7) As Integer
        Dim counter As Integer
        For c = 0 To 7
            Array(counter) = InputBox("enter number")
            Console.ReadLine()
        Next c

        Console.ReadKey()
    End Sub

End Module
```

SECTION C

5. (a) Using text editor or IDE environment, writ SQL statements to perform the following;

(i) Create a table called "students with the following details:

Field Name	**Data type**	**Size**
Student ID	Integer	4
Surname	Character	20
First name	Character	20
Class	Character	2
Fees paid	number	4

[14]

NB: Student ID is the primary

CREATE TABLE Student
Student_ID ***int (4)*** *PRIMARY KEY*
Surname ***char(20)***
FirstName ***char (20)***
Class ***char (2)***
Fees_paid **number (4)**

(ii) Display the surname and first name fields only of students whose class is 1A and fees paid is les than100. [6]

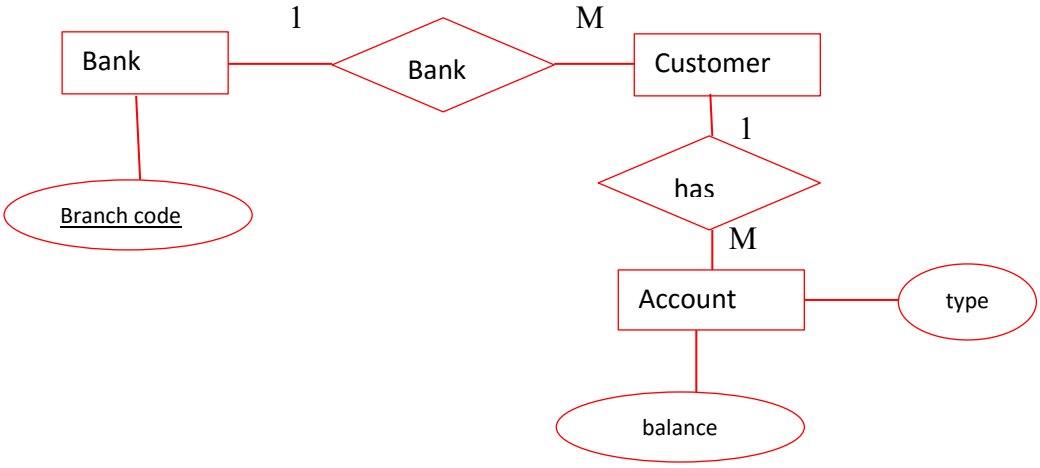
SELECT Surname, FirstName
FROM Student
Where Class = "1A" and Fess_Paid <100

(iii) Delete a student record whose first name is Ralph from the student's table. [3]

DELETE FROM Student WHERE FirstName = "Ralph"

(b) Draw an ER diagram for the situation given below:

An account is a relationship between customer and a bank. A bank has a branch code. A customer may have several accounts of different types and balance [7]



6. (a) Using text editor or IDE environment, writ SQL statements to perform the following:

(i) Create a database called **"school fees".** [1]

CREATE DATABASE Schoolfees;

(ii) Create the tables "**Student Details"** and "**Invoice"** with the following details: [13]

Students_details

Field_Name	**Data Type**	**Size**
Student_name	text	30
Class	text	10
Address	text	50
Student_ID [Primary Key]	text	5

Invoice

Field Name	**Data Type**	**Size**
Student_ID	Text	5
Fees_amount	currency	
Fees_paid	currency	
Invoice_number	text	5
Fees_balance	currency	
Due_Date	Date/time	

NB: student_ID is the foreign key
Invoice_number is the primary key

Student_Details tables

```
CREATE TABLE Student_details
(student_name  text (10),
Address text (50),
Student_ID text (5) PRIMARY KEY,
Class text (10),
);
```

Invoice table

```
CREATE TABLE Invoice
(Student_ID text (5) FOREIGN KEY,
Fees_amount currency,
Fees_paid currency,
Invoice_number text (5),
Fees_Balance currency,
Due_date  Date/Time
);
```

(iii) Create a calculated field to calculate balance fees by subtracting paid fees from fees amount using a query. The query should display all fields from the Invoice table including the new calculated field. [6]

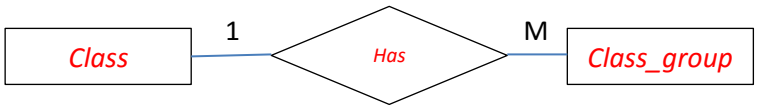
```
SELECT Student_ID, Fees_amount, Fees_paid,
       invoice_number, due_date, fees_amount
       fees_paid as fees_balance
FROM  Invoice

WHERE Fees Balance >0

ORDERED BY Invoice_number
```

(b) A database design has three tables to store the classes that students attend.

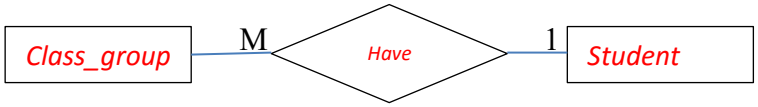
Student (Student _ID, FirstName, LastName, Year, TutorGroup)
Class (ClassID, Subject)
Class_Group(Student_ID, ClassID)

(i) Draw a digram to illustrate the relationship between

- Class and Class-group [1]



- Class_group and Student [1]



(ii) Write an SQL statement to display the StudentID and FirstName of all students who are in the Tutor-group 3W. display the list in alphabetical order of LastName. [4]

```
SELECT StudentID, FirstName
FROM Student
WHERE tutor_group = "3w"
ORDERED by Last_Name ASC
```

(iii) Write an SQL statement to display the LastName of all students who attend the class whose classID is NO. 13. [4]

```
SELECT LastName
FROM Student, Class_group
WHERE ClassID = "No13"
AND Clas_group.StudentID = Student.StudentID
```

COMPUTER SCIENCE PAPER 1 6023/1 NOVEMBER 2019

1. (a) Express the number 79_{10} as:

i) a binary number stored in an 8 bit byte, **[1]**

✓ *0100 1111*

ii) a hexadecimal number, **[1]**

✓ *4F*

iii) a number stored in binary coded decimal (BCD) **[1]**

✓ *0111 1001*

iv) an octal. **[1]**

✓ *117*

(b) Convert -60 and -90 into twos compliment, 8 bit binary numbers. **[4]**

✓ *+60 = 0011 1100*

1100 0011 (one's complement)

+ 1

-60 = 1100 0100 (two's complement)

✓ *+90 = 0101 1010*

1010 0101 (one's compliment)

+ 1

1010 0110 (two's compliment)

2. Normalise the following numbers which are held with a 10 bit mantissa and 6 bit exponent.

a) 0000110101 000010 **[2]**

0.110101000 +2

Exponent = +2 - 3 = -1

Normalised number = 0 110101000 111111

b) 1111100100 000011 **[2]**

1.001000000 +3

Exponent = +3 - 4 = -1

Normalised number = 1 001000000 11111

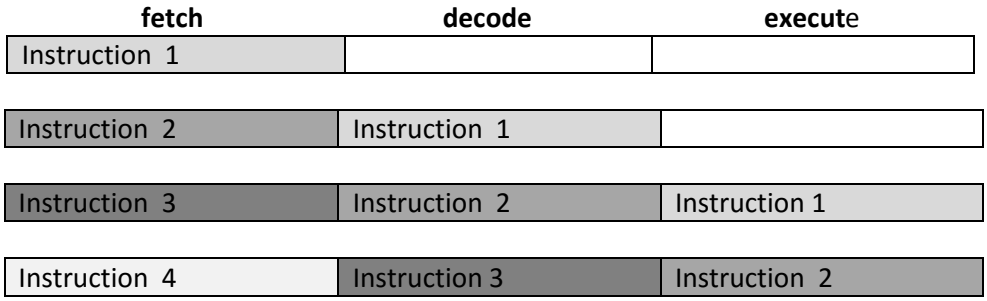
3. Given that the ASCII code for small letter a is 1100001, find the ASCII codes for

a) b = *1100010*

b) c = *1100011*

c) h = *1101000* **[3]**

4. With the aid of a diagram, explain how pipelining would improve the processing speed of a computer. [6]



- ✓ *Pipelining is a technique where fetch-execute-cycle is overlapped for different instruction.*
- ✓ *At most 3 different instructions are processed at the same time; with each instruction in different fetch execute stages at the same time.*
- ✓ *This improves the speed of processing since the computer does not wait for one instruction to undergo all the three stages before the next instruction is fetched.*

5. Using examples, explain the difference between direct and indirect addressing [4]

Direct

- ✓ *The operand part is the actual address from which the data value is retrieved*
- ✓ *e.g. LDA 10*

Indirect

- ✓ *The operand h+*
- ✓ *olds the address of te location that holds the value to be used.*
- ✓ *e.g. LDA (10)*

6. (a) Define the term interrupt. [2]

- ✓ *An interrupt is a signal generated by a peripheral or software when it requires the attention of processor which may cause the break in the execution of the current routine.*

(b) Give an example of an:

i) Internal interrupt. [1]

- ✓ *Timer interrupts which signals that a time-critical activity needs attention.*

ii) external interrupt [1]

- ✓ *machine check interrupts caused by malfunctionining hardware*

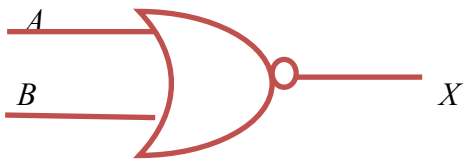
(c) Explain why modern computers are interrupt based. [2]

- ✓ *In order to obtain processor time for higher priority task and to avoid data loss*

(d) (i) Design a truth table for a two input NOR gate. [2]

Inputs		*Outputs*
A	*B*	*X*
0	*0*	*1*
0	*1*	*0*
1	*0*	*0*
= *1*	*1*	*0*

(ii) Design a NOR gate. **[2]**



7. (a) State and explain any four reasons why privacy has become one of the key topics in information security at the beginning of the 21st century. [7]

- ✓ *The internet is by no means a secure medium of communication, and yet individuals choose to divulge personal details on it including financial information such as credit card numbers. There are many ways in which motivated individuals can gain access to insecure internet transactions.*
- ✓ *An inevitable consequence of the trend for commercial companies and public institutions to store personal records electronically is that one's personal details are likely to be held on a number of databases. The level of security applied to these databases varies widely, leaving open the possibility that such personal details may be accessed by individuals who should have no authority to do so.*
- ✓ *The use of internet, and email facilities is widespread in places of work. An increasing number of organisations use specialist applications to monitor both web surfing activities and the email traffic of their employees. Employees, on the other hand, may feel that their privacy is under threat from such monitoring.*
- ✓ *National security organisations and law enforcement agencies have successfully argued that they are justified in monitoring electronic communication, including email because they are used in the commission of criminal acts and terrorist atrocities. While most people would support measures taken against criminals and terrorist activity, there are many individuals and groups who believe that the individual's right privacy is being undermined by the technology sophistication and secretive nature of such systems.*

(b) Identify any three positive impacts of social media on 'A' level students. [3]

- ✓ *Collaborating with other A 'level students*
- ✓ *Share educational like e-books.*
- ✓ *Receive and send assignments from/to their teachers*

(c) State and describe any three dimensions of ethics in information technology. [3]

- ✓ *Personal Privacy*
- ✓ *Access rights*

8. (a) Explain the role of Domain Name System (DNS). [2]

To translate domain names into IP Addresses which computers can understand.

(b) Compare and contrast public and private IP addresses. [6]

Public IP Address	*Private IP Address*
• *can be accessed over the Internet* • *is globally unique IP address assigned to a computer device*	• *used to assign computers within your space without letting them directly expose to the Internet* • *it is allocated by InterNIC (network Information centre) to allow organisations to create their own private network*

(c) Analyse the role of the physical layer in the OSI model. [5]

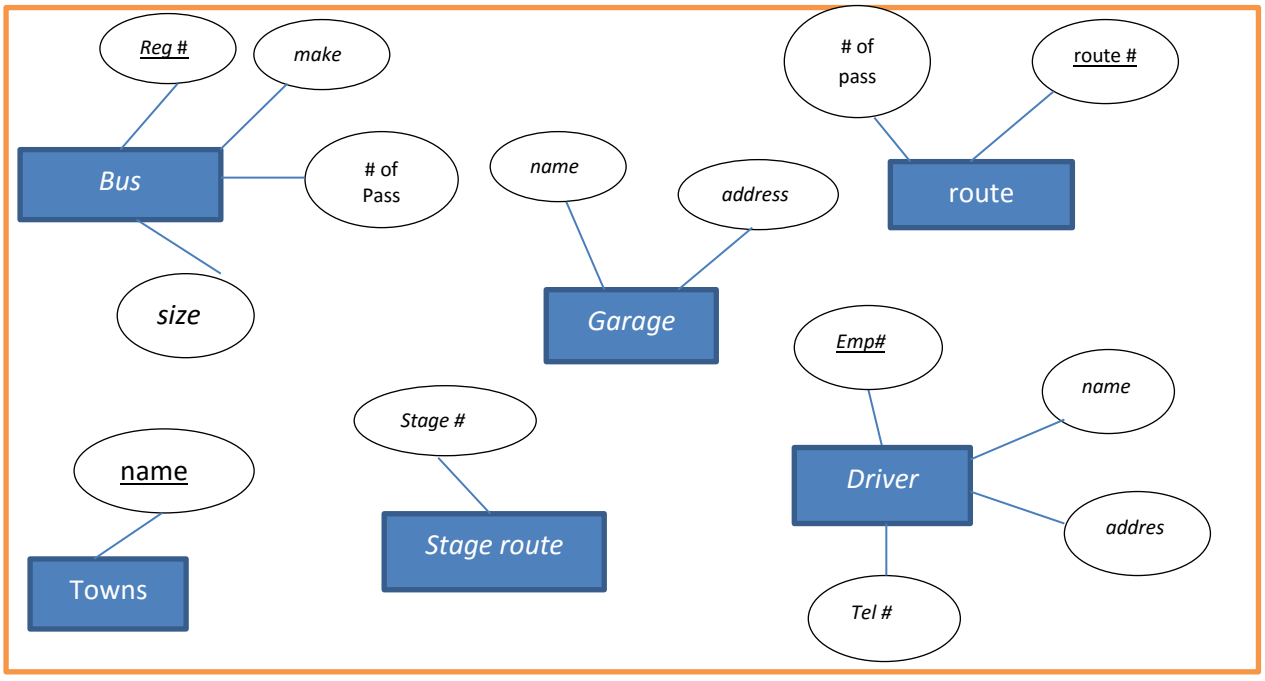
- ✓ *The physical layer coordinates the functions required to carry a bit stream over a physical medium.*
- ✓ *It deals with the mechanical and electrical specifications of the interface and transmission medium.*
- ✓ *It also defines the procedures and functions that physical devices and interfaces have to perform for transmission to occur.*
- ✓ *The physical layer is also concerned with the following:*
  - *Physical characteristics of interfaces and medium.*
  - *Representation of bits.*
  - *Data rate.*
  - *Synchronization of bits*
  - *Line configuration*
  - *Physical topology.*
  - *Transmission mode.*

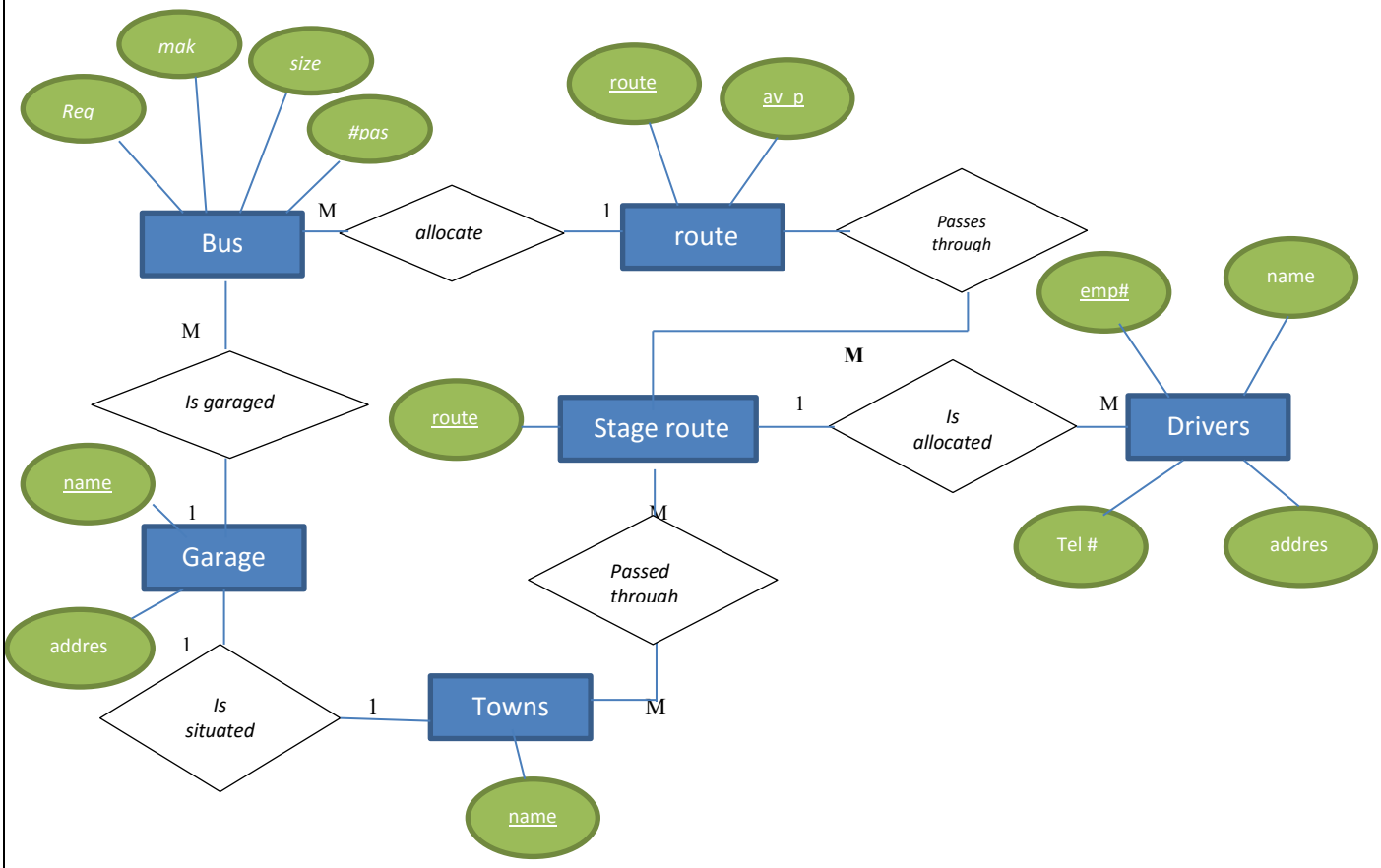
(d) Compare the OSI and TCP/IP models clearly showing any four differences between these two models. [4]

OSI (Open System Interconnection)	*TCP/IP(Transmission Control Protocol/Internet Protocol)*
1. It has seven layers	*1. It has 4 layers*
2. Follows vertical approach	*2. It follows a horizontal approach*
3. Is a generic protocol independent standard, acting as a communication gateway between the network and end user.	*3. TCP model is based standard protocols around which the Internet has developed, it is a communication protocol, which allows connection of hosts over a network*
4. In OSI model the transport layer guarantees the delivery packets	*4. In TCP/IP model the Transport layer does not guarantees delivery of packets.*
5. Transport Layer is Connection Oriented	*5. Transport Layer is both Connection Oriented and Connection less.*
6. Network Layer is both Connection Oriented and Connection less.	*6. Network Layer is Connection less.*
7. Protocols are hidden in OSI model and are easily replaced as the technology changes	*7. In TCP/IP replacing protocols is not easy*

9. A country bus company owns a number of buses. Each bus is allocated to a particular route, which corresponds to a journey through a number of towns. One or more drivers is allocated to each stage route, which corresponds to a journey through some or all of the towns on a route. Some of the towns have a garage where buses are kept and each of the buses is identified by a registration number and can carry different number of passengers. The vehicles vary in size and can be single or double decked. Each route is identified by a route number. Information is available on the average number of passengers carried per day for each route. Drivers have an employee number, name, address and sometimes a telephone number.

a) Link six entities to their attributes from the above given scenario. [6]





10. (a) Describe a recursive procedure. [2]

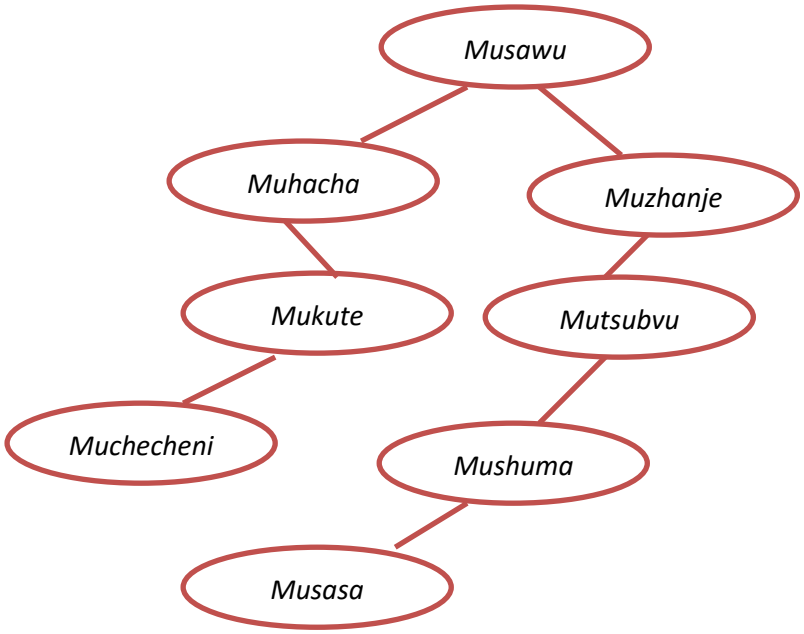
✓ *Recursive procedure is a procedure which calls itself*

✓ *Recursive procedure is one which is defined by itself*

(b) Using pseudocode, write down a recursive procedure for calculating the factorial of a given number. [8]

```
Function factorial (n)
Begin
        If n = 1
           Then factorial = 1
          Else factorial = n * factorial (n-1)
        End if
End
```

11. Contrast a binary tree for the following list:
Musawu, Muzhanje, Mutsubvu, Mushuma, Musasa, Muhacha, Mukute, Muchecheni. [5]



12. (a) List any three questions that may be in a marketing plan. [3]

- ✓ Is there a market?
- ✓ Is your product or service already being offered?
- ✓ What will you be doing/offering that no-one else is?
- ✓ What will you are doing better than anyone else is?
- ✓ What sets you apart?

(b) State and describe any seven features of e-commerce technology which make online shops better than the traditional methods. [7]

- ✓ *E-commerce enables the use of credits cards, debit cards, smart cards, EFT via bank's website and other modes of electronic payment such as Ecocash, Telecash, One Money and ZimSwitch Instant Payment Interchange Technology (ZIPIT) to make non-cash payments.*
- ✓ *E-commerce increases the reach of advertising of products and services of business. It helps better marketing management of products and services.*
- ✓ *Orders of the products can be generated anytime, anywhere without any human intervention and this improves the business sales.*
- ✓ *E-commerce provides various ways to provide pre-sales and post sales assistance to provide belter services to customer.*
- ✓ *Inventory management of products is automated and becomes very efficient and easy to maintain.*
- ✓ *E-commerce provides ways of faster, efficient and reliable communication with customers and partners.*

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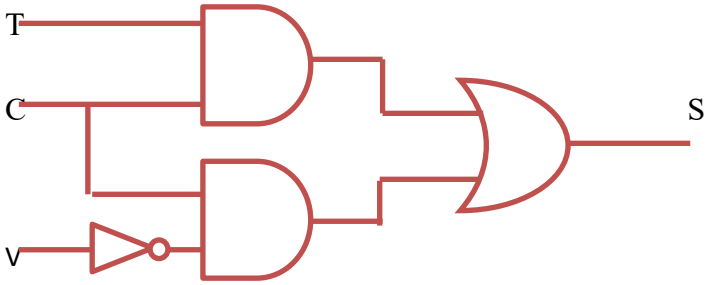
SECTION A [20 marks]

Answer any one question from this section

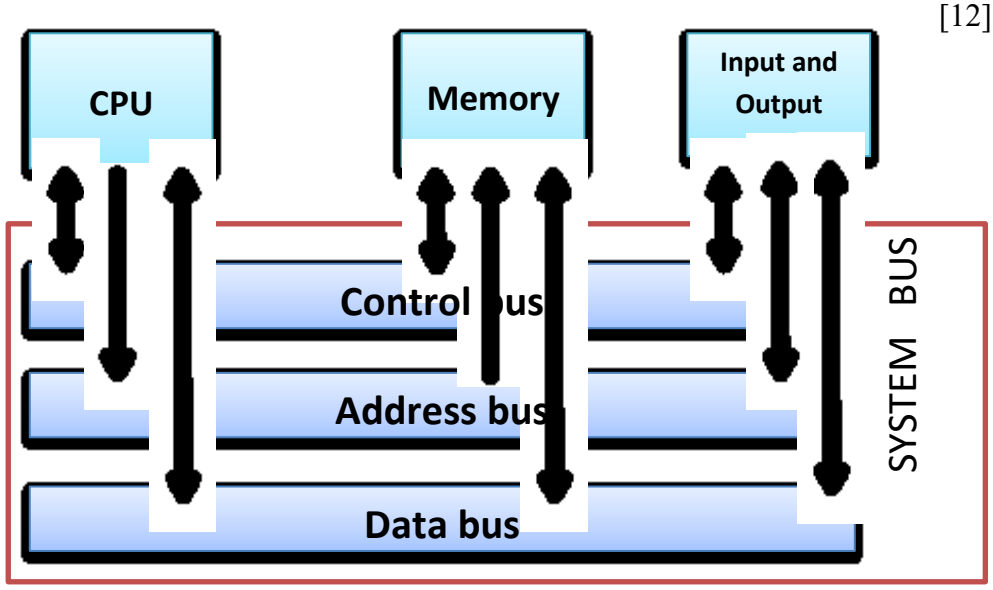
1. (a) Draw a logic network and truth table for the following logic problem:

A sprinkler(s) is ON if either temperature alarm (T) is ON and cooler alarm (C) is ON or vent alarm (V) is OFF and cooler alarm (C) is ON. [8]

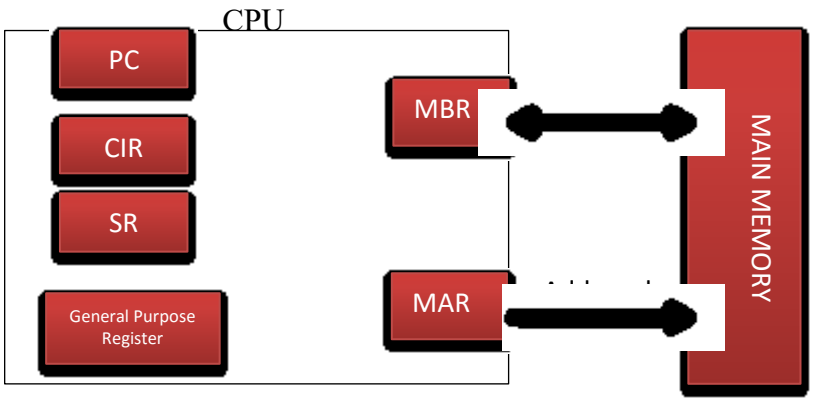


INPUTS			*WORKING AREA*			*OUTPUT*
T	*C*	*V*	*NOT V*	*T.C*	*C. NOT V*	*S*
0	*0*	*0*	*1*	*0*	*0*	*0*
0	*0*	*1*	*0*	*0*	*0*	*0*
0	*1*	*0*	*1*	*0*	*1*	*1*
0	*1*	*1*	*0*	*0*	*0*	*0*
1	*0*	*0*	*1*	*0*	*0*	*0*
1	*0*	*1*	*0*	*0*	*0*	*0*
1	*1*	*0*	*1*	*1*	*1*	*1*
1	*1*	*1*	*0*	*1*	*0*	*1*

(b) Construct a diagram to illustrate system buses in a Von Neumann architecture. [12]



2. (a) Illustrate with a diagram, the buses connecting the processor to memory. [5]



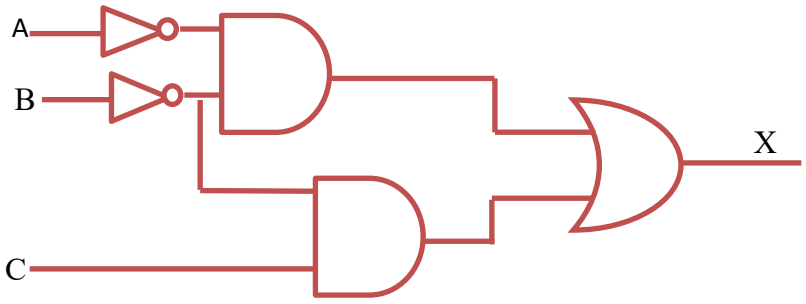
(b) With the aid of a diagram, show how pipelining can increase the throughput of a computer. [5]

Fetch	Decode	Execute
Instruction 1		
Instruction 2	Instruction 1	
Instruction 3	Instruction 2	Instruction 1
	Instruction 3	Instruction 2
		Instruction 3

(c) Draw a logic circuit represented by the statement below.

X= 1 if (A is NOT 1 AND B is NOT 1)
OR
(B is NOT 1 AND C is 1).

Provide the truth table [10]



Section B [50 marks]

Answer any one question from this section.

3. (a) A gas board has about 500 customers, each with a gas meter identified by a unique code of 8 digits which include a check digit. The meter readings are taken every 3 months. If a meter cannot be read, an estimated reading is calculated.

(i) Write specifications of the data structure for the customer including the following details; field name, type size and validation. [4]

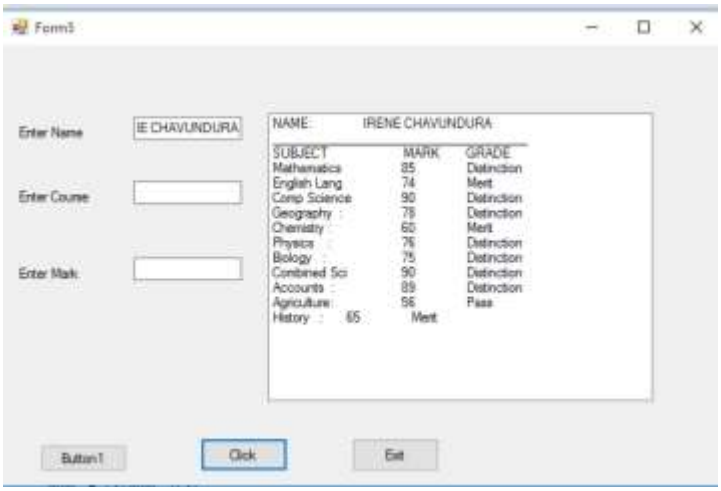
```
Type Customer
        Surname      :      String(20)
        Firstname    :      String (15)
        MeterCode    :      integer (8)
        Metereading  :      String (6)
EndType
```

(ii) Write a program that accepts gas meter code, previous reading, current reading and calculates the amount of gas used using a rate of $3 per kg., calculates the amount due for payment and displays the information on the screen. [14]

```
Public Class Form1

    Private Sub Form1_Load(sender As Object, e As EventArgs) Handles
MyBase.Load

    End Sub

    Private Sub btnCal_Click(sender As Object, e As EventArgs) Handles
btnCal.Click
        Dim name As String
        Dim code As Integer
        Dim previous, current As Integer
        Dim Amt_Of_Gas_Used As Integer
        Dim amtdue As Double

        name = txtName.Text
        code = txtCode.Text
        previous = txtPrevious.Text
        current = txtCurent.Text

        Amt_Of_Gas_Used = current - previous
        txtAmount.Text = Amt_Of_Gas_Used
        amtdue = Amt_Of_Gas_Used * 3.0
        txtAmtDue.Text = amtdue

    End Sub
End Class
```

(b) Write a program to grade marks for 12 courses for a college student. Use any selection statement of your choice. The grades are as follows:

>= 75 Distinction
60 – 74 Merit
50 – 59 Pass
40 – 49 Supplementary
<=39 Fail [12]




```
Public Class Form5
    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
        Dim name As String
        Name = txtName.Text
        ListBox1.Items.Add("NAME:" & vbTab & "           " & name)
        ListBox1.Items.Add("_____________________________________")

        ListBox1.Items.Add("SUBJECT" & "            " & "MARK" & "        " & "GRADE")
    End Sub

    Private Sub btnClick_Click(sender As Object, e As EventArgs) Handles btnClick.Click
        Dim Mark As Integer
        Dim Subject As String
        Dim grade As String

        Subject = txtSubject.Text
        Mark = Val(txtMark.Text)

            If Mark >= 75 And Mark <= 100 Then
                grade = "Distinction"
            ElseIf Mark >= 60 And Mark <= 74 Then
                grade = "Merit"
            ElseIf Mark >= 50 And Mark <= 59 Then
                grade = "Pass"
            ElseIf Mark >= 40 And Mark <= 49 Then
                grade = "Supplimentary"
            Else
            grade = "Pass"
            End If
       ListBox1.Items.Add(Subject & vbTab & "      " & Mark & vbTab & "         " & grade)
           txtMark.Text = ""
           txtSubject.Text = ""

    End Sub
End Class
```

(c) (i) Produce a trace table for the following algorithm using the number 8271. [4]

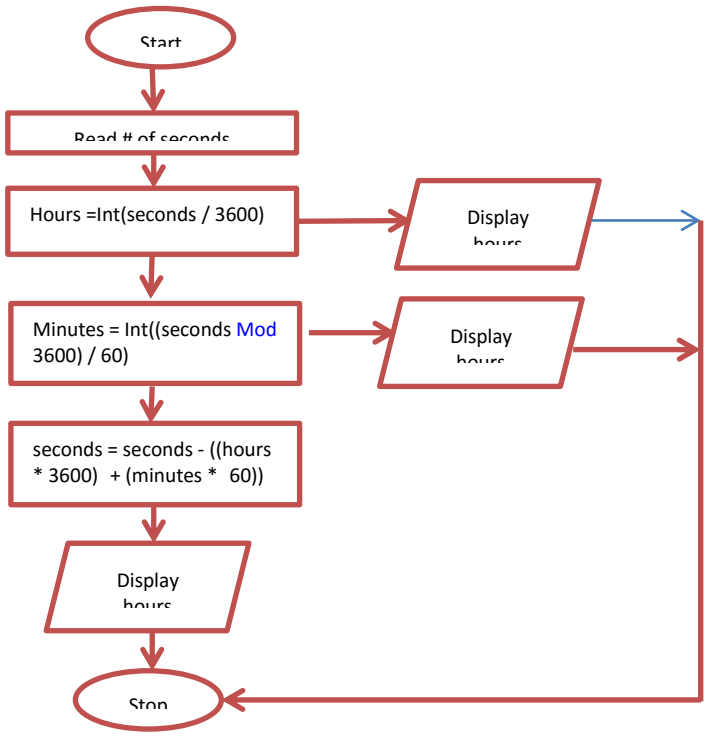
```
1   INPUT N
2   LET x = INT (N/10)
3   PRINT N – 10*x
4   IF x = 0 THEN STOP
5   N = x
6   GOTO 2
```

N	*x*	*PRINT(N-10*x)*
8271	*827*	*1*
827	*82*	*7*
82	*8*	*2*
8	*0*	*8*

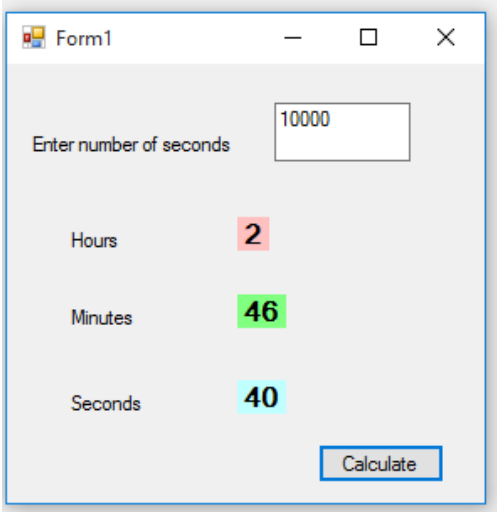
(ii) Deduce the purpose of the algorithm. [1]

Print the original number in reverse order

(d) (i) Draw a flowchart of a program that reads a number of seconds from the user and display the number of hours, minutes and seconds. For example, if 10 000 is typed in, the program should display 2 hours, 46 minutes and 40 seconds. [6]



(ii) Write a program and print the source code for the scenario in (i). [9]




```
Public Class Form1


    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
        Dim seconds, seconds1, hours, minutes As Integer

        seconds = Val(TextBox1.Text)

        hours = Int(seconds / 3600)
        minutes = Int((seconds Mod 3600) / 60)
        seconds = seconds - ((hours * 3600) + (minutes * 60))

        Label3.Text = hours
        Label4.Text = minutes
        Label5.Text = seconds

    End Sub
End Class
```

4. (a) Study the following algorithm:

```
1    x = 1
2    repeat
3    A = x * x
4    Output X, A
5    X = x + 1
6    Until x = 3
7    End
```

Using a trace table, dry run the algorithm. [8]

X	A	OUTPUT
1	*1*	*1, 1*
2	*4*	*2, 4*
3	*9*	*3, 9*

(b) Factorial is a mathematical function which is defined as follows:

Factorial of n = n * factorial of n – 1
If n > 1
Otherwise factorial of 0 = 1

This function is defined for all positive integers, i.e. whole numbers greater or equal to zero.

$$\text{Factorial (n)} = \begin{cases} n^* \text{ factorial } (n-1) \text{ where } x > 0 \\ 1 \text{ where } x = 0 \end{cases}$$

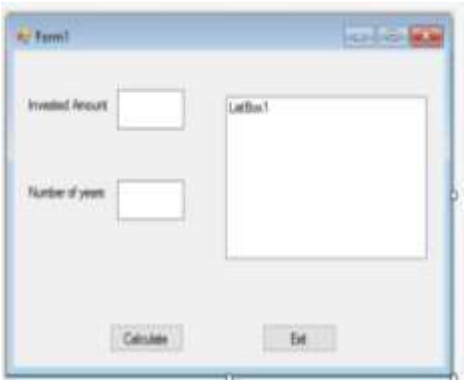
Code a recursive function which returns the factorial, given a positive integer argument. [9]

```
Function factorial(ByVal n As Integer) As Integer
        If n = 0 Then
            Return 1
        Else
            Return n * factorial(n - 1)
        End If
End Function
```

(c) A bank allows its customers to invest a minimum of $500 and accrue interest using the interest rates below:

Amount invested	**interest rate**
>= 50 and <= 1000	10%
> 1000 and <= 2000	15%
>2000	20%

(i) Design and print an interface for the above scenario. [3]



(ii) Code a program that
- Accepts the invested amount and number of years,
- Calculates interest, balance and interest rate

- Displays interest, rate, balance, invested amount and number of years [30]

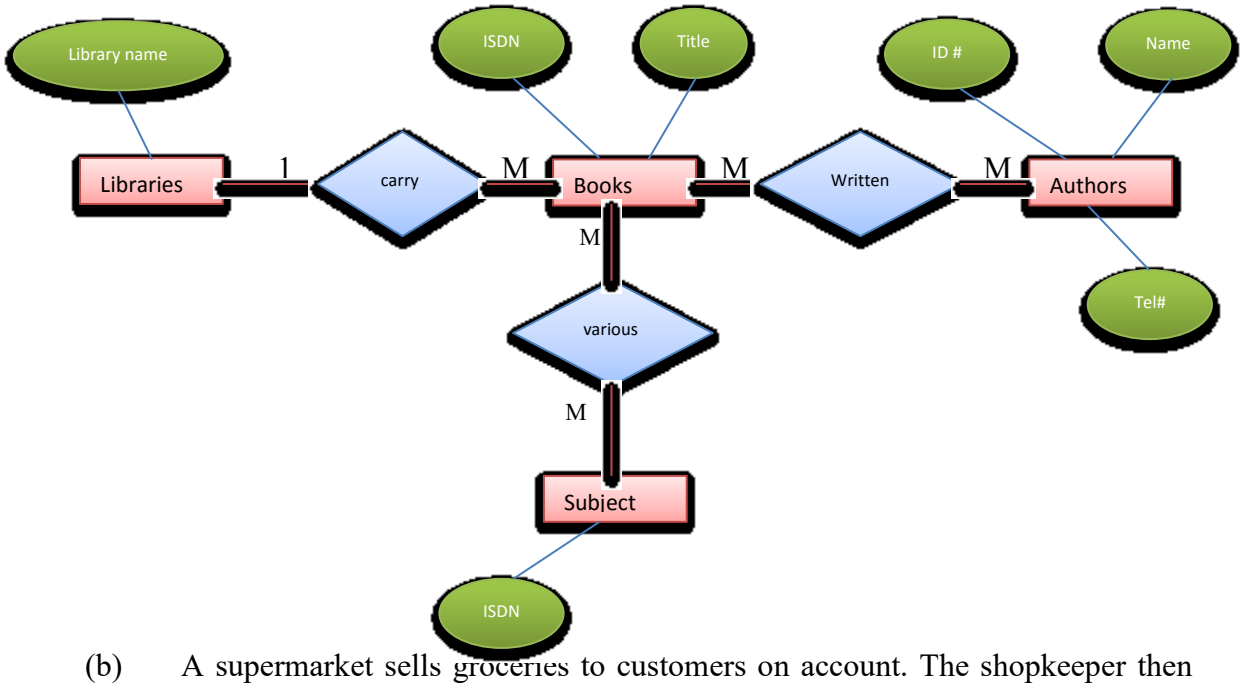
```
Public Class Form1

    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
        Dim amount_invested As Double
        Dim number_of_years As Integer
        Dim interest, interest_rate, balance As Double

        amount_invested = TextBox1.Text
        number_of_years = TextBox2.Text

        If amount_invested >= 500 And amount_invested <= 1000 Then
            interest_rate = 0.1
        ElseIf amount_invested > 1000 And amount_invested <= 2000 Then
            interest_rate = 0.15

        ElseIf amount_invested > 2000 Then
            interest_rate = 0.2
        End If
        interest = (interest_rate * amount_invested * number_of_years)
        balance = amount_invested + interest

        ListBox1.Items.Add("Amount invested is:" & amount_invested)
        ListBox1.Items.Add("Number of years are" & number_of_years)
        ListBox1.Items.Add("Interest rate is:" & interest_rate)
        ListBox1.Items.Add("Interest:" & interest)
        ListBox1.Items.Add("Balance:" & balance)

    End Sub
End Class
```

Section C [30 marks]

Answer any one question from this section

5. (a) In a library database, authors have written books about various subjects. Different libraries in the system may carry those books. Authors have ID number, name, and telephone number. Books have an ISDN and title. Subjects have a subject name. Libraries have a library name.

Produce a normalised ER diagram to depict the scenario above. [14]



(b) A supermarket sells groceries to customers on account. The shopkeeper then produces an invoice as shown below produces an invoice as shown below

Customer A/C Ruth Chakanyuka Ngozil Mine Bulawayo Cell: 0772 023 011	6065913	Date: 21/01/17 Time: 10:42 am INV: D10059012		
Code	**Qty**	**Description**	**Unit**	**Sub Total**
60092317651	10	Chimombe milk 500ml	0.65	6.50
60051621153	1	Mazoe Raspberry 2L	2.39	2.39
60031005913	4	Bakers In Superior	0.90	3.60
Sub Total				10.62
VAT Tax	@15.06			1.87
Total				12.49

(i) Present all the information in the above invoice as a database in first Normal

Cust A/C	CustName	Cell #	Date	City	Code	Qty	Description	Unit	Sub Total
6065913	*Ruth Chakanyuka*	*0772 023 011*	*21/01/17*	*Bulawayo*	*60092317651*	*10*	*Chimombe milk 500ml*	*0.65*	*6.50*
6065913	*Ruth Chakanyuka*	*0772 023 011*	*21/01/17*	*Bulawayo*	*60051621153*	*1*	*Mazoe Raspberry 2L*	*2.39*	*2.39*
6065913	*Ruth Chakanyuka*	*0772 023 011*	*21/01/17*	*Bulawayo*	*60031005913*	*4*	*Bakers In Superior*	*0.90*	*3.60*

(ii) Normalise your answer in (i) into second Normal Form showing all relationships amongst the resulting tables. [12]

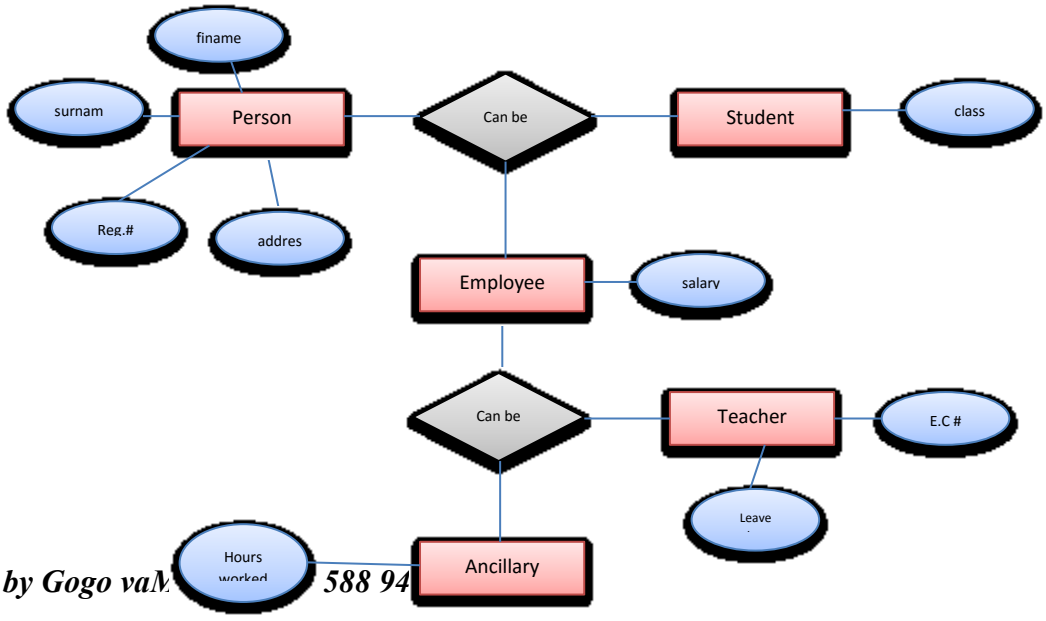
Cust A/C	CustName	Cell #	City
6065913	*Ruth Chakanyuka*	*0772 023 011*	*Bulawayo*
6065913	*Ruth Chakanyuka*	*0772 023 011*	*Bulawayo*
6065913	*Ruth Chakanyuka*	*0772 023 011*	*Bulawayo*

Code	Qty	Description	Date	Cust A/C	Unit	Sub Total
60092317651	*10*	*Chimombe milk 500ml*	*21/01/17*	*6065913*	*0.65*	*6.50*
60051621153	*1*	*Mazoe Raspberry 2L*	*21/01/17*	*6065913*	*2.39*	*2.39*
60031005913	*4*	*Bakers In Superior*	*21/01/17*	*6065913*	*0.90*	*3.60*

The two tables are related using the Customer Account number

6. (a) There are persons at a school. Each person has a surname, first name, Registration number and address. The person can be an employee or a student. Each employee has a salary while each student has a class. The employee can be a teacher or ancillary worker. Each teacher has an E.C. number and leave days. Each ancillary worker is paid according to hours worked.

Draw a normalised ER diagram to illustrate the above scenario. [15]



(b) A company realised that some of its customers are defaulting in payment. It is decided to add an extra file for the debtors, which include the following fields: Customer name, address, 30 days, 60 days, 90 days and 120 days.

The company wants to produce a mailing list for customers with 60 days debts of at least $30, in descending order of debts.

Write an SQL statement to retrieve the required information. [8]

SELECT *Customer name, address, 60 days*
FROM *Debtors*
WHERE *60 days >= $30*
ORDERED BY *60 days DESC;*

(c) One of the debtors, Mr Mara has fully cleared his debt. The company wants to remove his name from the list,

Write the correct command for this action. [3]

DELETE FROM Debtors WHERE Customer name = "Mr Mara"

(d) Create a database and show how to connect the IDE *language*. [4]

CREATE DATABASE Employees

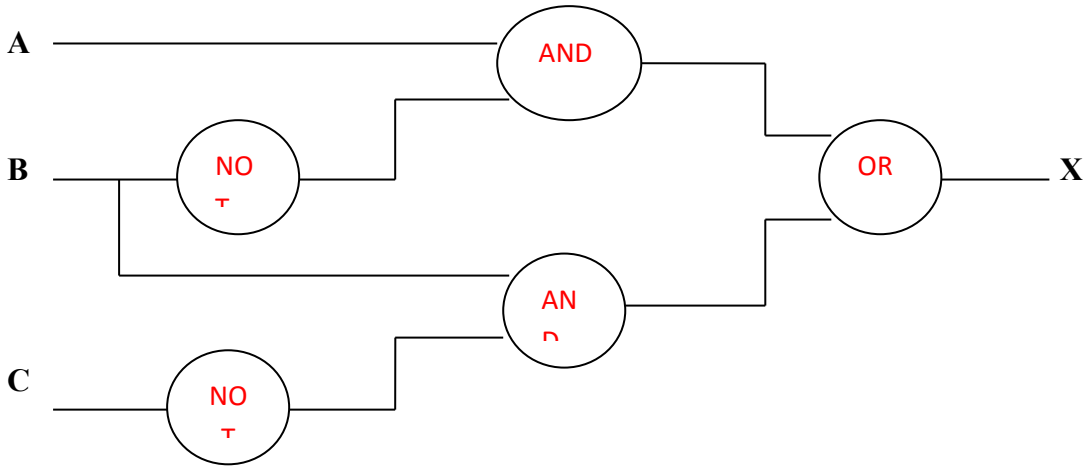
SPECIMEN PAPER 2 6023/2

SECTION A

1. a) Given the following logic statement:

X=1 if (A=1 AND B=NOT 1) OR (B=1 AND C=NOT 1);

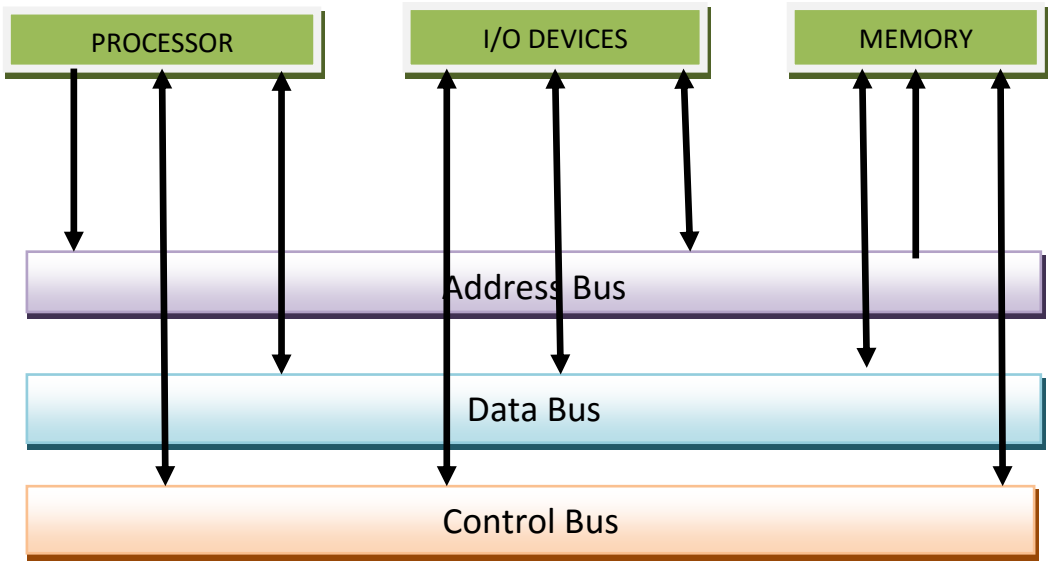
(i) draw the logic circuit, [6]



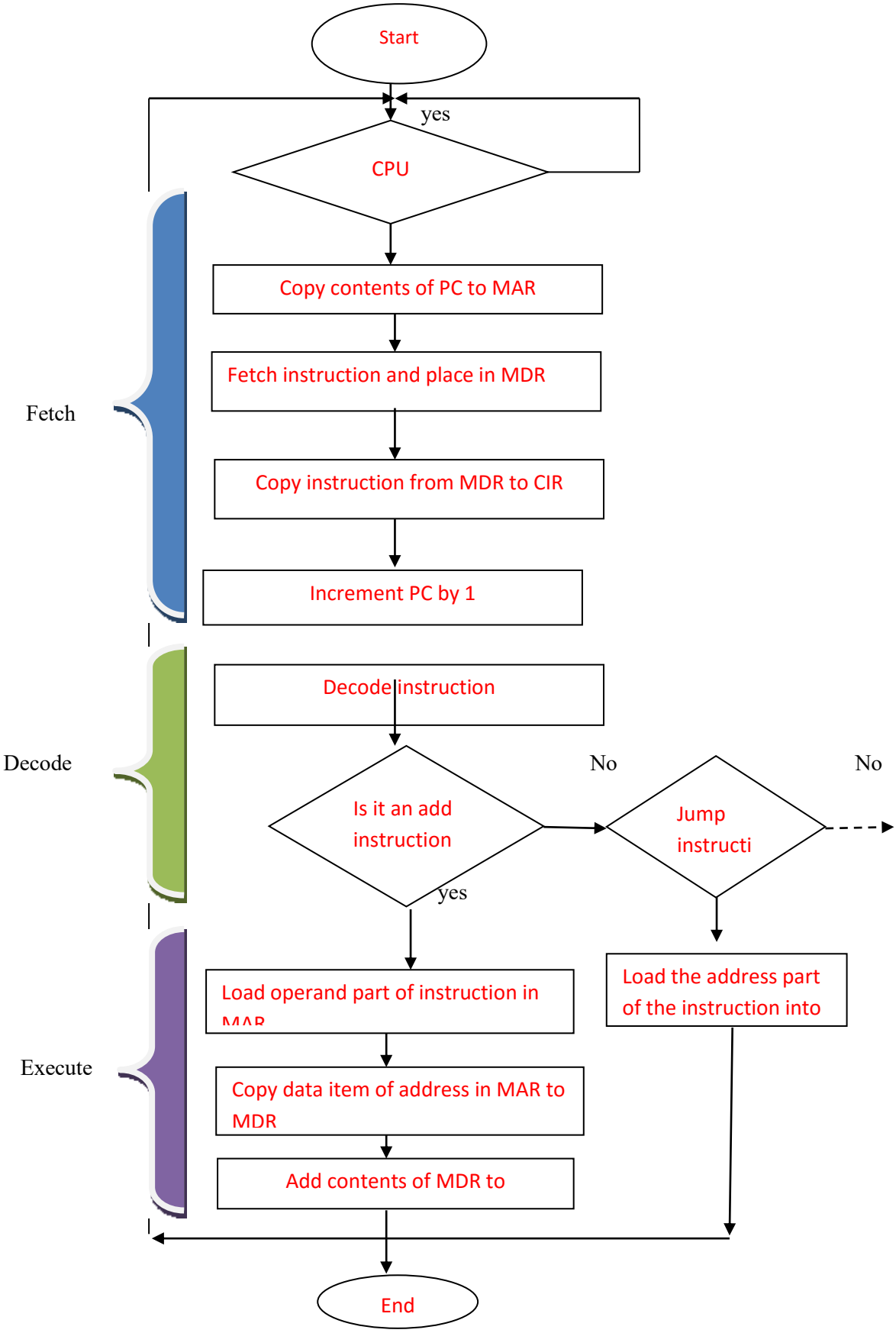
(ii) Create the truth table. [8]

A	B	C	X
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

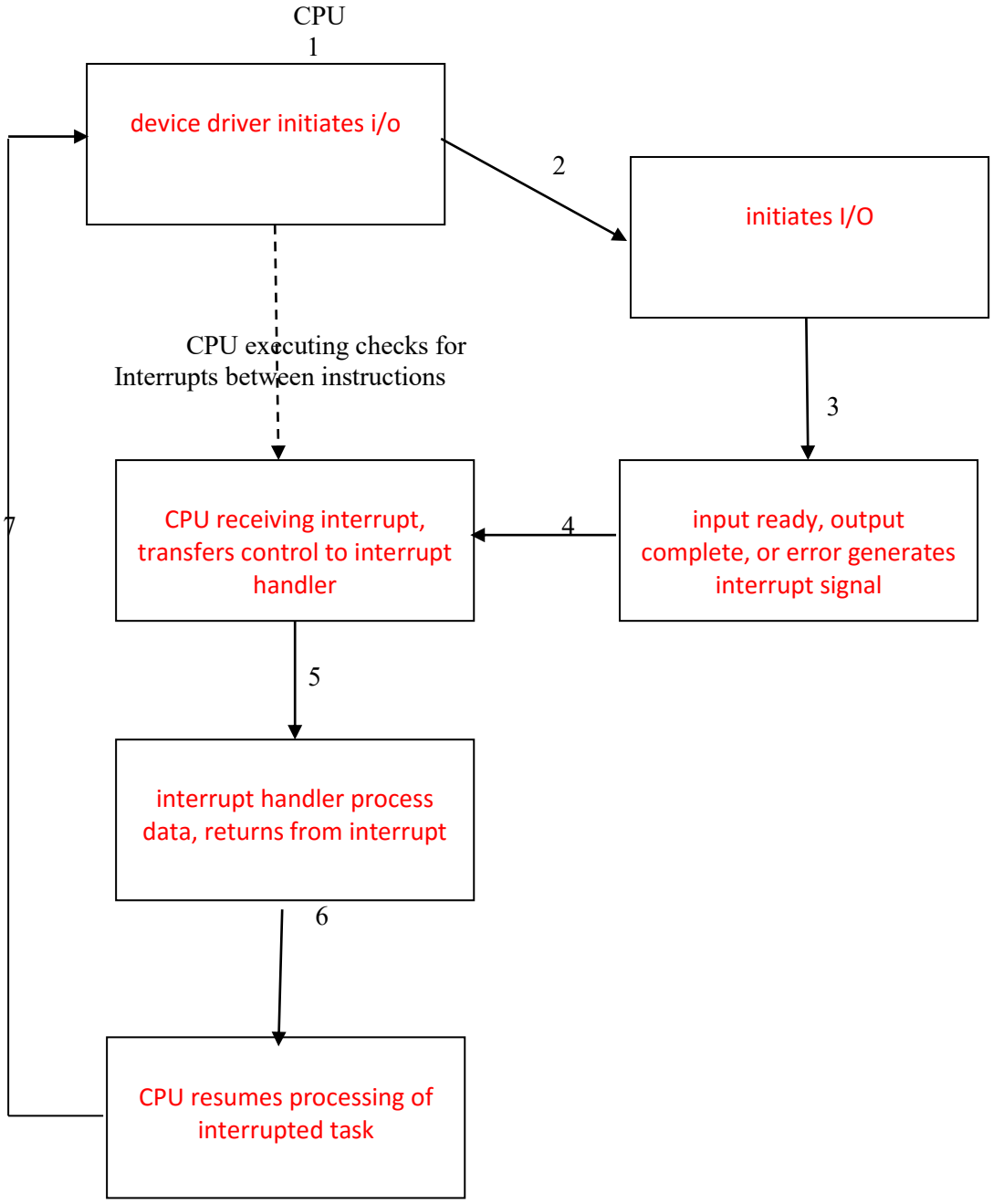
b) **Draw a well-labelled diagram that illustrates how a processor, 1/0 devices and the memory unit are linked by connections known as buses.**
[6]



2. a) Produce a flowchart showing the 3 stages of the straight line sequencing of the fetch-execute cycle, describing each stage. [8]

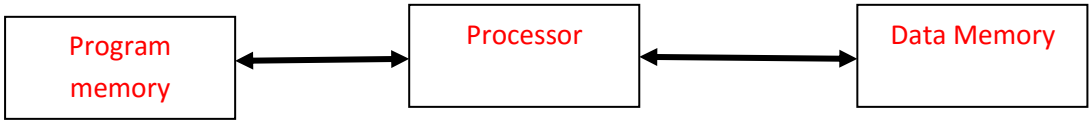


(b) Draw a diagram that illustrates the sequence of instructions that are carried out during interrupt servicing. [8]



(c) Draw a well-labelled diagram showing the structure of Harvard computer architecture. [4]

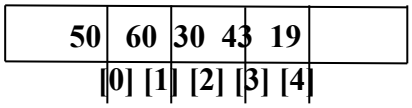
Harvard architecture



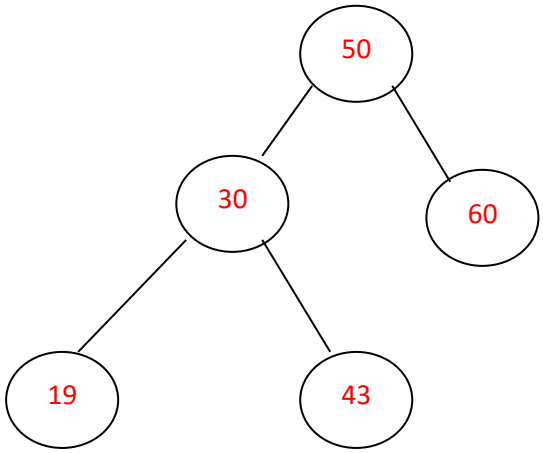
SECTION B

3. The following is an array named Exams that stores 5 examination marks. Index positions are in square brackets below the array elements.

Exams

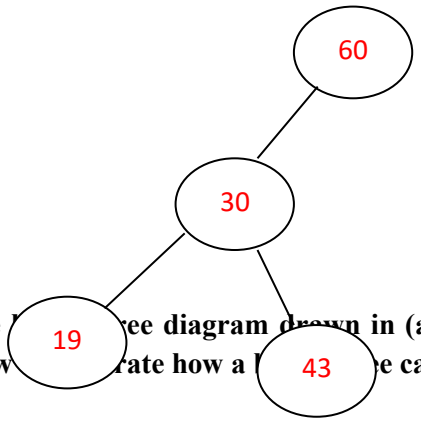


a) Produce a binary tree of the array elements. [5]



0

b) Assuming that the element 50 is completely deleted and removed from the tree structure drawn in (a), draw the new binary tree structure after 50 has been removed. [2]



c) -Using the ... ee diagram drawn in (a) and the Exams array structure, complete the table below ... rate how a ... e can be implemented using an array.

	Data	Left Pointer	Right Pointer
Exams [0]	**50**	**2**	**1**
Exams [1]	**60**	**0**	**0**
Exams [2]	**30**	**4**	**3**
Exams [3]	**43**	**0**	**0**
Exams [4]	**19**	**0**	**0**

[8]

d) Using a programming language of your choice;

(i) declare the Exams array as in this question paper. [3]

Using Vb.net

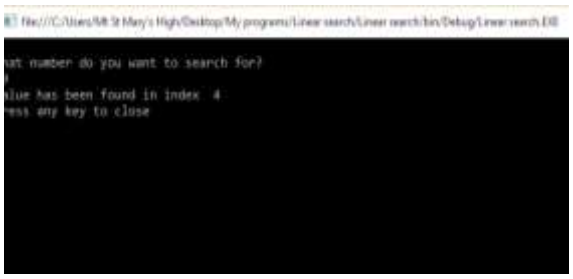
```
Dim Exam(4) As Integer = {50, 60, 30, 43, 19}
```

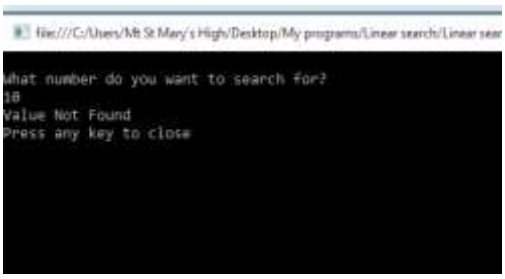
(ii) declare a 2-dimensional array called STUDENTS that stores student names using 4 rows and 3 columns. [4]

```
Dim STUDENTS (3, 2) As String
```

e) Write a program code that implements a linear search algorithm to find the value 19 from the array Exams. If the value exists in the array, it displays the message "Value has been Found", otherwise it displays "Value does not exist". Use a text editor to type the program code. [17]

```
Module Module1

    Sub Main()
        Dim Exams As Integer() = New Integer(5) {11, 13, 15, 17, 19, 21}
        Console.WriteLine("")
        Console.WriteLine("What number do you want to search for?")
        Dim searchKey As Integer = Console.ReadLine
        Dim element As Integer = LinearSearch(searchKey, Exams)
        If element <> -1 Then
            Console.WriteLine("Value has been found in index  " & element)
        Else
            Console.WriteLine("Value Not Found")
        End If
        Console.WriteLine("Press any key to close")
        Console.ReadKey()
    End Sub8
    Function LinearSearch(ByVal key As Integer, ByVal numbers As Integer()) As Integer
        Dim n As Integer
        ' structure iterates linearly through array
        For n = 0 To numbers.GetUpperBound(0)
            If numbers(n) = key Then
                Return n
            End If
        Next
        Return -1
    End Function ' LinearSearch

    End Module
```



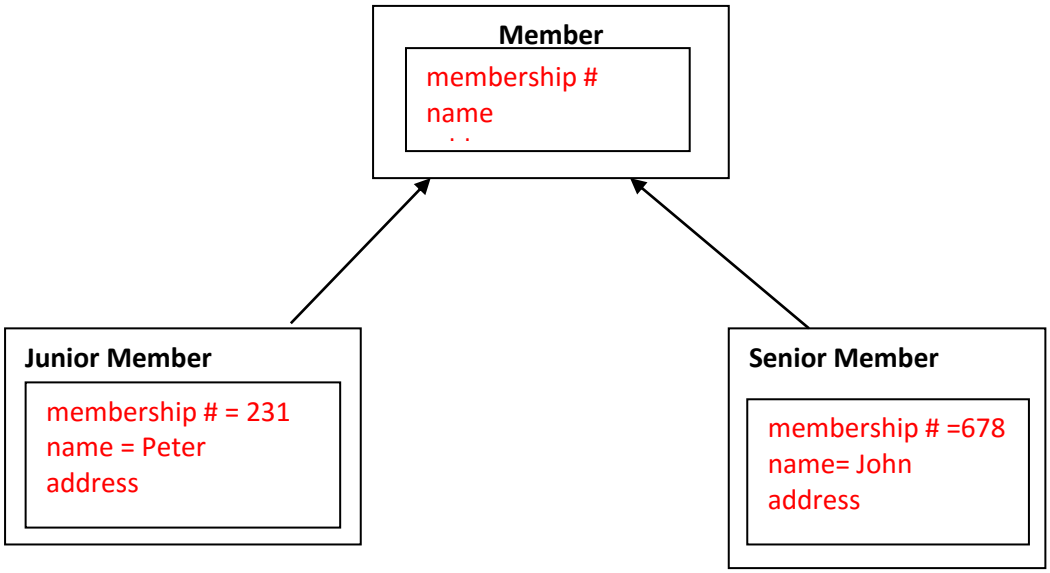


f) A sailing club has both junior and senior members. Each member has a unique membership number, name and address recorded. Three classes have been identified, namely:

Member, Junior Member, Senior Member

The classes Junior Member and Senior Member are related by single inheritance to the class member

i) Draw an inheritance diagram for the classes. [3]



ii) Programs that use objects of the class member need to add a new member's details and show member's details and also amend a member's details. No other form of access is to be allowed. Write a class definition for this class.

member = class [8]

Member = Class
(Procedure) AddNewMembers; }
(Procedure) AmendMembers; } ;
(Procedure)ShowMembers; }

Prepared by Gogo vaMishy (0772 588 949)

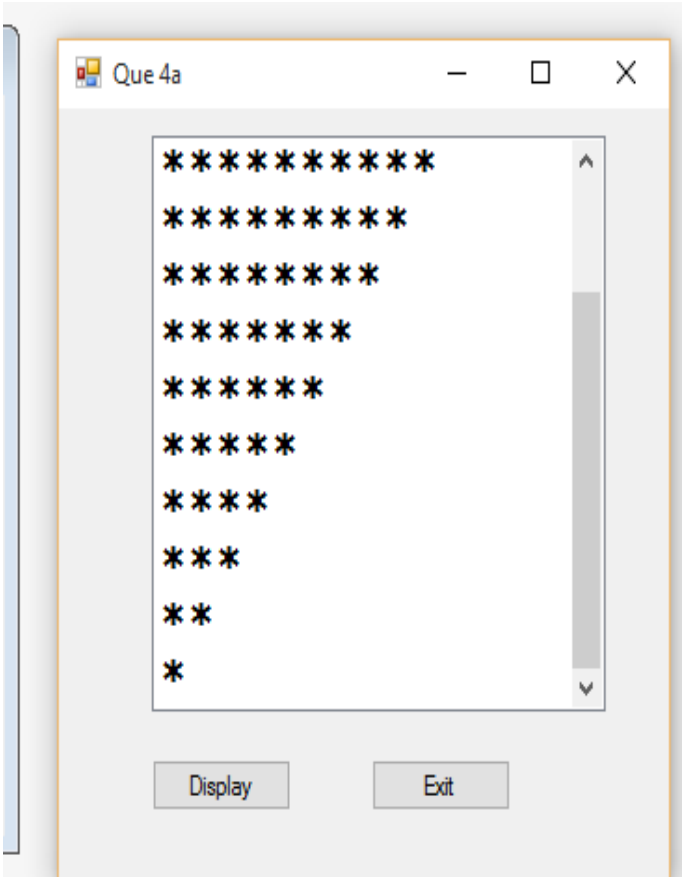
```
Private ;
        MembershipNo : Integer
        Name : String;
        Address : String; ;;
End;
```

4 (a) Using a looping structure of your choice, write a program which outputs the following result.

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

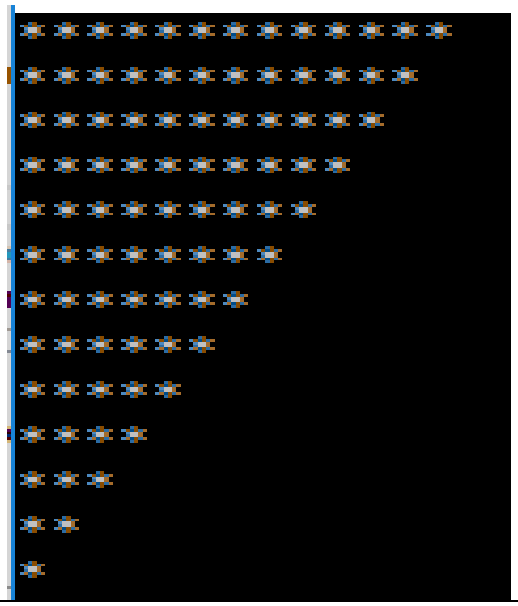
[12]

```
Private Sub Button1_Click(sender As
Object, e As EventArgs) Handles
Button1.Click
        Dim pattern(0 To 12, 0 To 12) As
Char
        Const j = 0
        For m = 0 To 12
            For n = 0 To 12 - m

                pattern(m, n) = InputBox("Enter
the pattern for" & m & "" & n)
            Next n
        Next m
        For i = 0 To 12

            lstResults.Items.Add(pattern(i, j) &
pattern(i, j + 1) & pattern(i, j + 2) &
pattern(i, j + 3) & pattern(i, j + 4) &
pattern(i, j + 5) & pattern(i, j + 6) &
pattern(i, j + 7) & pattern(i, j + 8) &
pattern(i, j + 9) & pattern(i, j + 10) &
pattern(i, j + 11) & pattern(i, j + 12))

        Next i

    End Sub
End Class
```



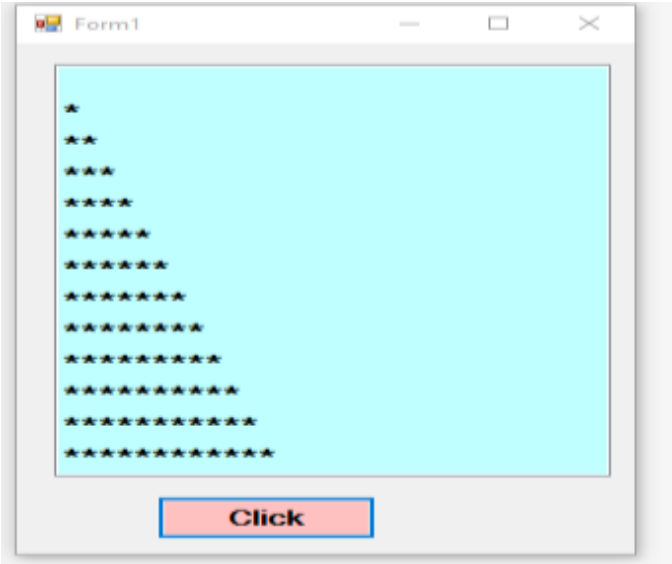
Using console application

```
Module Module1
 Sub Main()
    Dim i, j As Integer
    For i = 0 To 11
       For j = 1 To 8 - i
          Console.Write("*")
       Next
       Console.WriteLine()
    Next
    Console.ReadLine()
 End Sub
End Module
```



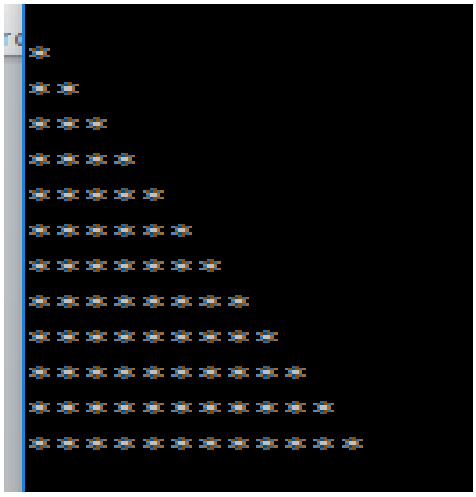
(b) Modify the code you wrote in (a) so that it prints the shape upside down. [6]

```
Public Class Form1

   Private Sub Button1_Click(sender As
Object, e As EventArgs) Handles
btnClick.Click, btnClick.Click

      Dim pattern(0 To 12, 0 To 12) As
Char
      Const j = 0
      For m = 0 To 12
         For n = 0 To m - 1

            pattern(m, n) = InputBox("Enter
the pattern for" & m & "" & n)
         Next n
      Next m
      For i = 0 To 12
         lstResult.Items.Add(pattern(i, j) &
pattern(i, j + 1) & pattern(i, j + 2) &
pattern(i, j + 3) & pattern(i, j + 4) &
pattern(i, j + 5) & pattern(i, j + 6) &
pattern(i, j + 7) & pattern(i, j + 8) &
pattern(i, j + 9) & pattern(i, j + 10) &
pattern(i, j + 11) & pattern(i, j + 12))
      Next i
   End Sub
End Class
```



Using console application

```
Module Module1

    Sub Main()
        Dim i, j As Integer
        For i = 0 To 11
            For j = 0 To i
                Console.Write("*")
            Next
            Console.WriteLine()
        Next
        Console.ReadLine()

    End Sub

End Module
```



(c) The following is a pseudo code of a program that was designed to add 10 positive numbers.

1. Counter = 1
2. For counter = 1to 10
3. Repeat
4. Print "Enter a positive whole number"
5. Input number
6. Until number <0
7. Total = Total + counter
8. Counter = counter +1
9. Output Total
10. Next

(i) The pseudo code contains several errors. Identify and write down all the errors. [7]

Line	Error
1	No need to initialise the counter it is initialised in the For loop
2 & 3	Cannot use both the For and Repeat –Until statements together. Only one is needed
5	Input number must be below the Repeat statement
6	Wrong statement It must be Until counter = 10
6	Until statement is wrong. It must be until count = 10
7	Number must be added instead of the counter
8	This statement is not needed when we use the For--Loop
9	Output statement must be the last statement

(ii) Rewrite the algorithm so that it is effective and error free. [5]

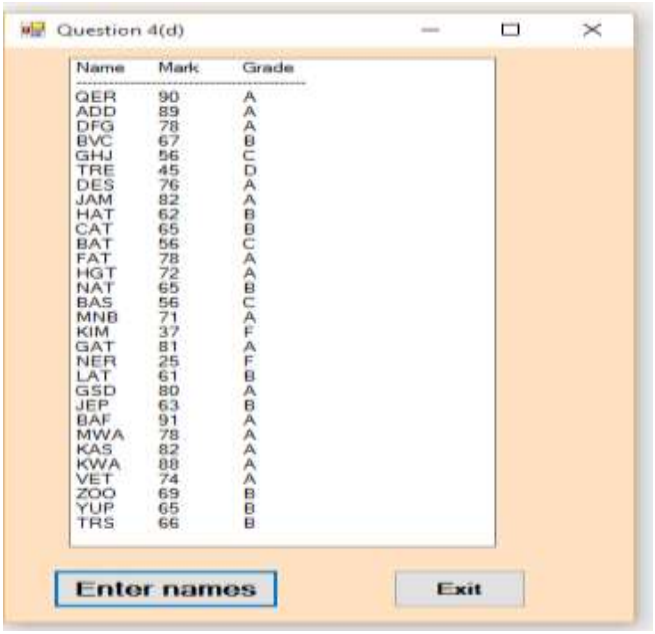
1. **Total = 0**
2. **For count = 1 to 10**
3. **Input number**
4. **Total = Total + number**
5. **Next count**
6. **Output Total**

OR

1. **Count = 0**
2. **Total = 0**
3. **Repeat**
4. **Input number**
5. **Total =total + number**
6. **Count = count + 1**
7. **Until count = 10**

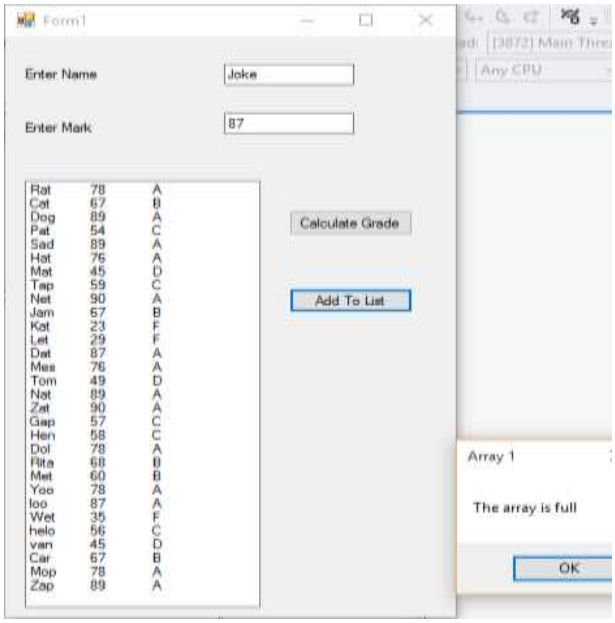
(d) Write a program that accepts names of 30 students and the marks they obtain in a test. The program then displays the name, mark and grade in one line. Grades are obtained using the following grading scale:

70 – 100	A
60 – 69	B
50 – 59	C
45 – 49	D
40 – 44	E
0 – 39	F



```
Public Class Form2

    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
        Dim num As Integer
        Dim Student(29) As String
        Dim grade As Char
        Dim marks As Integer
            lstNames.Items.Add("Name"& " " & vbTab & "" &"Mark" &" "& vbTab &"" &
"Grade")
        lstNames.Items.Add("----------------------------------------")
        For num = 0 To 29
            Student(num) = InputBox("Enter the customer name", "Enter Name")
            marks = InputBox("Enter the mark")
            'Calculate grades
            Select Case marks
                Case 70 To 100
                    grade = "A"
                Case 60 To 69
                    grade = "B"
                Case 50 To 59
                    grade = "C"
                Case 45 To 49
                    grade = "D"
                Case 40 To 44
                    grade = "E"
                Case 0 To 39
                    grade = "F"
                Case Else
                    MsgBox("Invalid Input")
            End Select
            lstNames.Items.Add(Student(num) & vbTab & marks & vbTab & grade)
        Next
    End Sub
End Class

Private Sub Button2_Click(sender As Object, e As EventArgs) Handles Button2.Click
        Me.Close()
    End Sub
End Class
```

A' level past exam papers




```
Public Class Form1

    Dim grade As Char
    Dim mark As Integer
    Dim num(29) As Integer
    Dim index As Integer
    Dim name As String

    Private Sub Button2_Click(sender As Object, e As EventArgs) Handles Button2.Click
        lstresult.Items.Add("Name" & "   " & vbTab & "" & "Mark" & "   " & vbTab & "" &
"Grade")
    End Sub

    Private Sub Button1_Click(sender As Object, e As EventArgs) Handles Button1.Click
        Dim name As String
        name = TextBox1.Text
        mark = TextBox2.Text
        Select Case mark
            Case 70 To 100
                grade = "A"
            Case 60 To 69
                grade = "B"
            Case 50 To 59
                grade = "C"
            Case 45 To 49
                grade = "D"
            Case 40 To 44
                grade = "E"
            Case 0 To 39
                grade = "F"
            Case Else
                MsgBox("Invalid Input")
```

```
        End Select
        If index <= 30 Then
            lstresult.Items.Add(name & vbTab & mark & vbTab & grade)
            TextBox1.Clear()
            TextBox1.Focus()
            TextBox2.Clear()
            index = index + 1
        Else
            MsgBox("The array is full")
        End If
    End Sub
End Class
```

SECTION C

5. The following is an un-normalised table named Delivery Note.

Delivery Note

Cust Numb	Cust Name	City	Country	Prod Numb	Prod Description
209	Peter	Mutare	Zim	19, 20, 21, 22	Bag, shoes, socks, Umbrella
198	Bruce	Gwanda	Zim	20, 21	Shoes, socks

(a) (i) Draw the 1NF of the above table. Underline Primary Key field(s). [5]

Cust Numb	Cust Name	City	Country	Prod Numb	Prod Description
209	Peter	Mutare	Zim	19	Bag
				20	shoes
				21	socks
				22	umbrella
198	Bruce	Gwanda	Zim	20	Shoes
				21	socks

(ii) Come up with the 2NF of the table you created, indicating Primary Key field(s). [14]

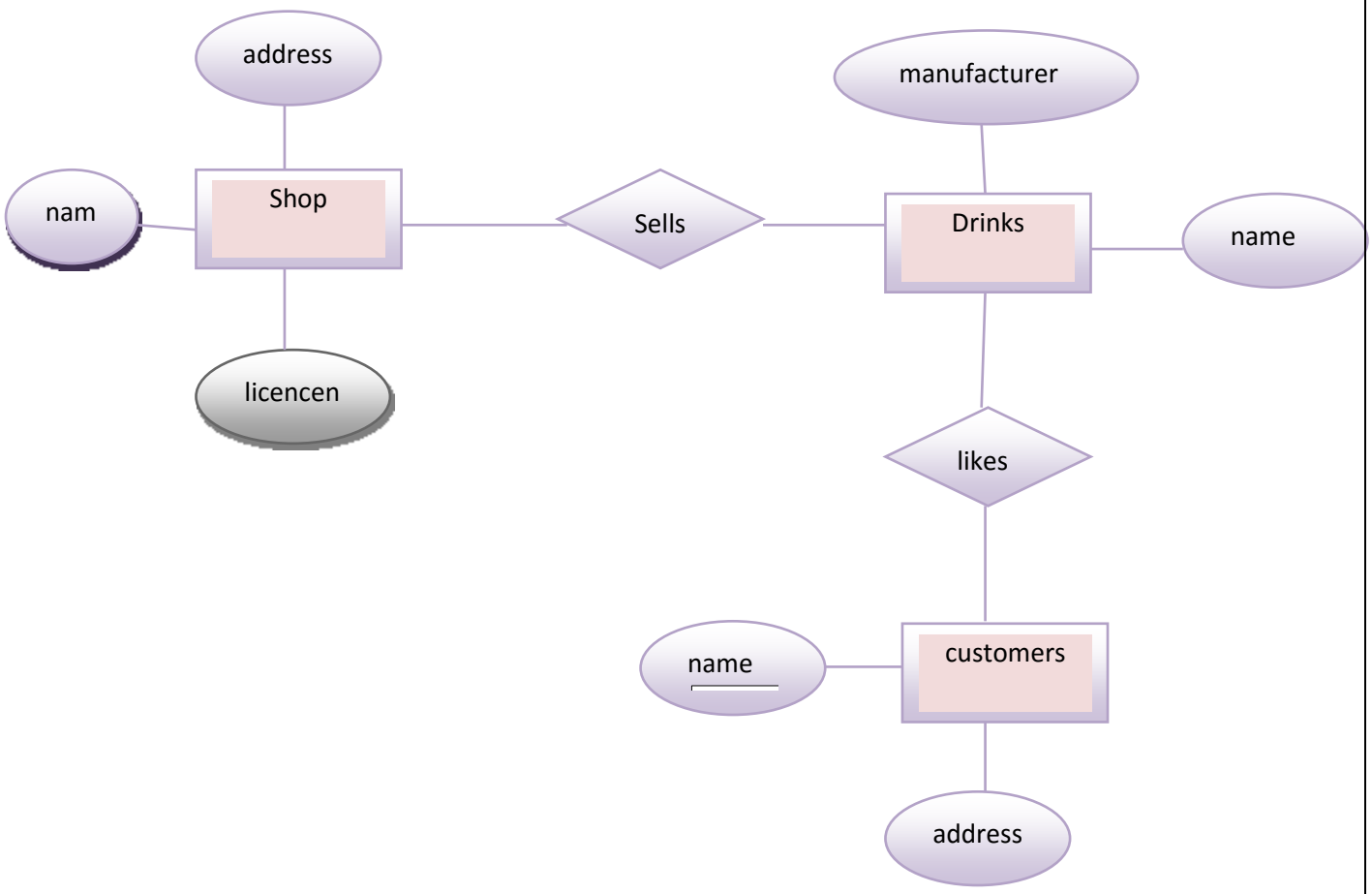
Delivery note

Cust Numb	Cust Name	City	Country	Prod Numb
209	Peter	Mutare	Zim	19
				20
				21
				22
198	Bruce	Gwanda	Zim	20
				21

Product

Prod Numb	Prod Description
19	Bag
20	shoes
21	socks
22	umbrella
20	Shoes
21	socks

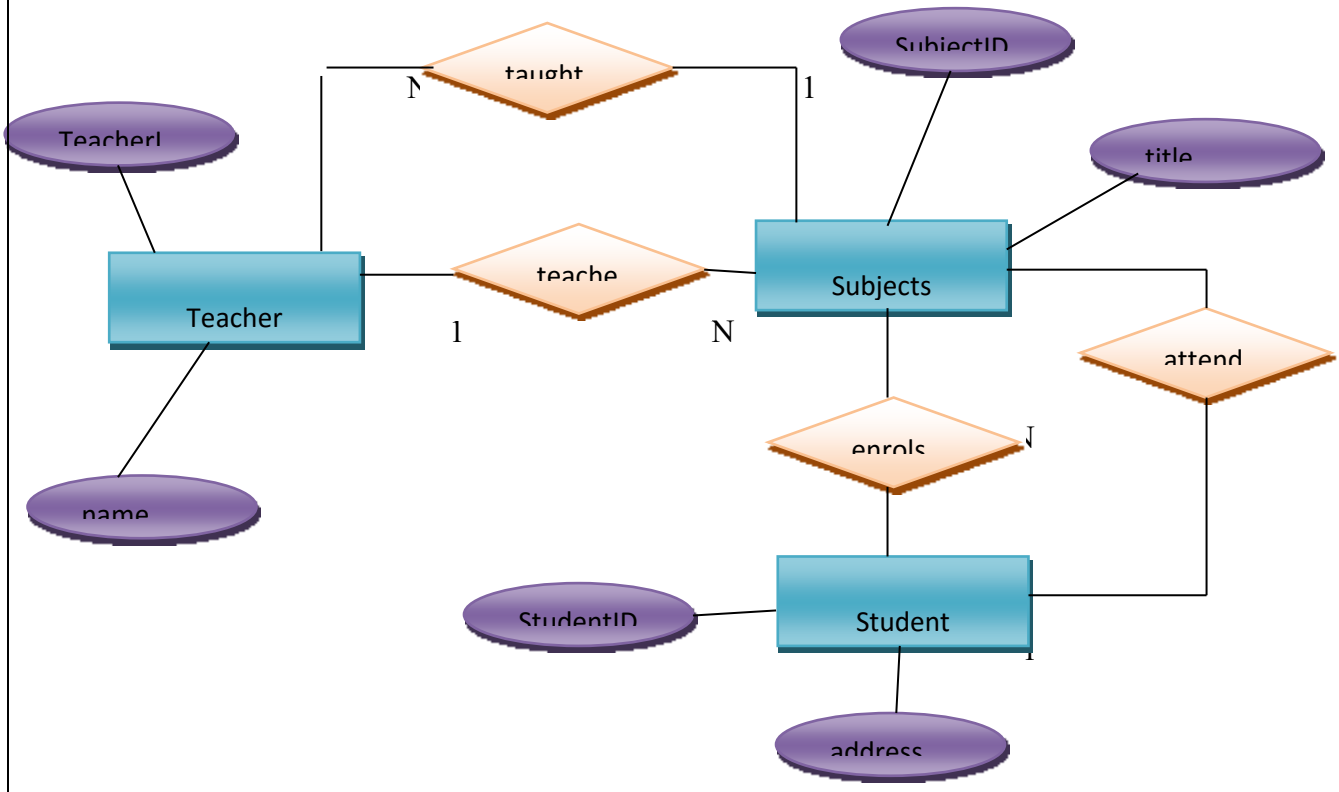
(b) A shop sells drinks. The shop has name, address and licenceno fields. Drinks have name and manufacturer fields. Customers like drinks. Customers have name and address.
Draw an ER Diagram to illustrate the above relationship. [11]



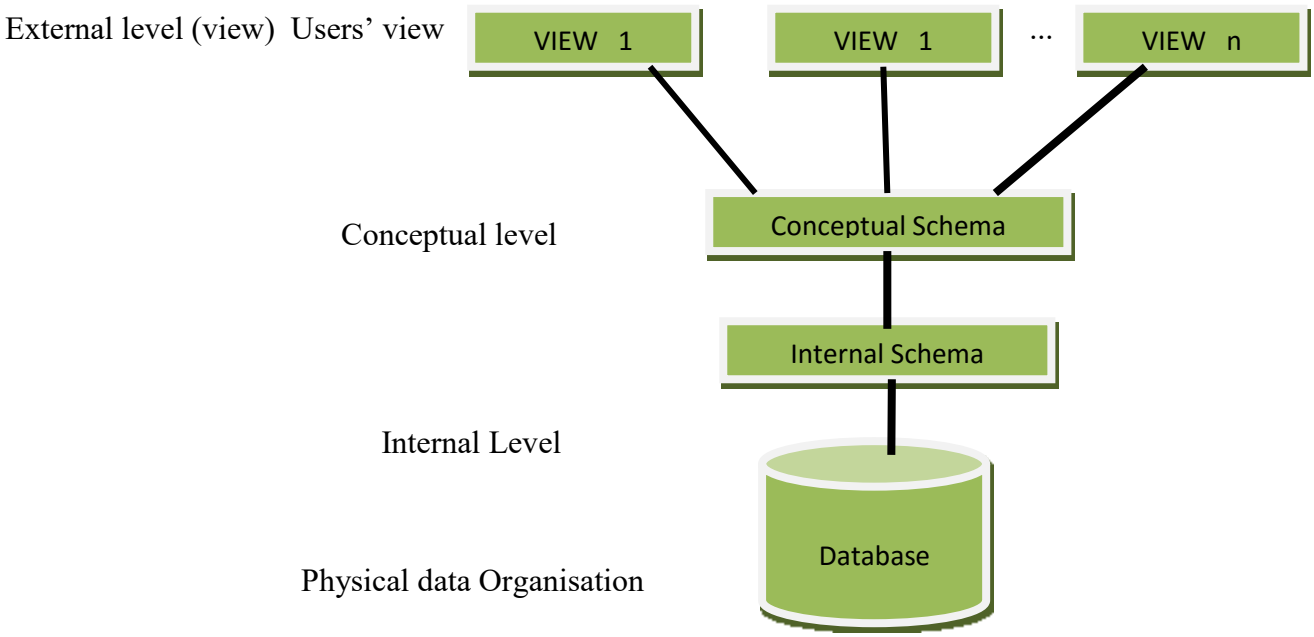
6. At ABC High School, a teacher teaches many subjects. A student enrols in many subjects and attends four lessons per week for each subject. Each subject is taught by several teachers.

   Draw an entity-relation diagram to show relationships between the entities. On the diagram, show the primary key and at least one attribute for each entity.

   [15]



(b) (i) Draw a well-labelled diagram showing the different views of the Database Management System Structure. [8]



(ii) Using examples, describe the different views of the Database Management System. 7]

External level (view)

- Users' view of the database.
- It refers to different views of the data seen by each user of the database.
- Each user of a database has his/her own views of the database, e.g. general database users see and describe the database differently as done by the managers because they have different views of the same database.
- Describes that part of database that is relevant to a particular user.
- Thus other users cannot view some data that the managers can views.

Conceptual (logical) Level (view)

- It is seen as an integration of all user views of the data
- This is an abstract representation of the whole database.
- Describes what data is stored in database and relationships among the data
- Describes the data as seen by the application that is making use of the DBMS
- Involves identification of entity types, unique identifiers,
- Logical level describes what data are stored in the database
- Describes what relationships exist among those data.
- Logical level describes the entire database in terms of a small number of simple structures.
- Database administrator uses the logical level of abstraction.

Internal level (view)

- Physical representation of the database on the computer.
- Describes how the data is stored in the database
- It refers to the structure used for storage of data.
- Also called the physical level
- It encompasses the logical arrangements of the data for storage.
- Describes how data will be stored on the physical media
- The physical level describes complex low-level data structures in detail
-

SPECIMEN PAPER 2 9195

1 (a) Explain the term:

(i) data integrity, [1]

Data integrity refers to the completeness and correctness of data during processing, storage, copying and transmission.

(ii) data privacy, [1]

Data privacy refers to confidentiality of data. It involves trying to prevent unauthorised access to data, accidental disclosure through inappropriate procedures, such as placing un-shredded documents in a waste bin, leaving a computer screen at a reception desk visible to visitors

(iii) data security, [1]

Data security involves the use of various methods to make sure that data are correct and kept confidential and safe. Data security includes ensuring the integrity and the privacy of data as well as preventing the loss or destruction of the data.

(iv) biometric system. [1]

Biometric security is a security mechanism used to authenticate and provide access to a facility or system based on the automatic and instant verification of an individual's physical characteristics

(b) Discuss any three biometric techniques. [6]

Fingerprint recognition *- This is the most popular method of authentication that is used and it's based on the valleys and ridges that are unique on every person's fingers.*

Facial recognition *- It works by analysing the facial characteristics that identifies a person and is used for surveillance and identification purposes.*

Iris recognition *- this involves looking at the ring around the pupil of your eye, which is uniquely coloured.*

Palm Prints *- combines the ridge flow and ridge structure of a palm to identify a person. It works by capturing the vein pattern image of an individual while radiating it with near-infrared rays. Its specialty is that it can detect the vein pattern on the human palm with utmost precision*

2. Explain the following:

(a) character set, [2]

- *The complete set of characters that the computer uses, e.g. ASCII and UNICODE.*
- *Each of the characters in a character set must have its own binary value which is the code by which the computer can recognise it.*

(b) ASCII, [2]

- *American Standard Code for Information Interchange.*
- *The system uses 7 bits to represent each character and the eighth bit as a means of checking the rest.*
- *128 different characters can be represented in the standard ASCII character set.*

(c) EBCDIC. [2]

- *Extended Binary coded Decimal Interchange code.*
- *Uses 8 bits to encode each character*
- *Used by mainframe computers*

3. (a) Using the binary number 11100111111101 as an example, show how to use the binary representation of a number to work out its value in hexadecimal with minimum amount of calculation. [3]

0011 1001 1111 1101
3 9 F D = ***39FD$_{16}$***

(b) A floating point number system uses 8-bit numbers, 5 bits for the mantissa and 3 bits for exponent. Convert the following binary number to denary 01101010 *[2]*

01101 010
0.1101 +2
011.01 = 3.25

(c) Using an 8-bit byte for the mantissa and an 8- bit byte for the exponent, show – 15 ½ as a 2 byte, normalised, floating point number. [4]

00001111.1

11110000.1 = 1.0000100 0 – 4

= **10000100 11111100**

4. (a) Describe the purpose of each of the following parts of a DBMS.

(i) Data dictionary, [2]

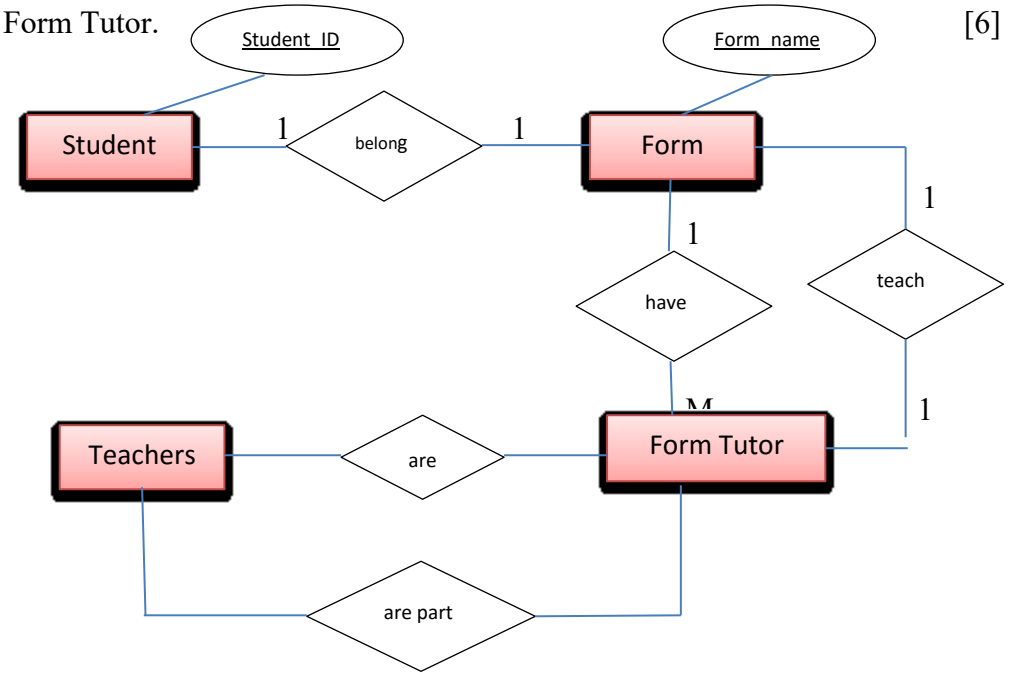
- *It is a table holding information about a database*
- *A file (table) with description of the structure of data held in a database*

(ii) Data Manipulation Language (DML). [2]

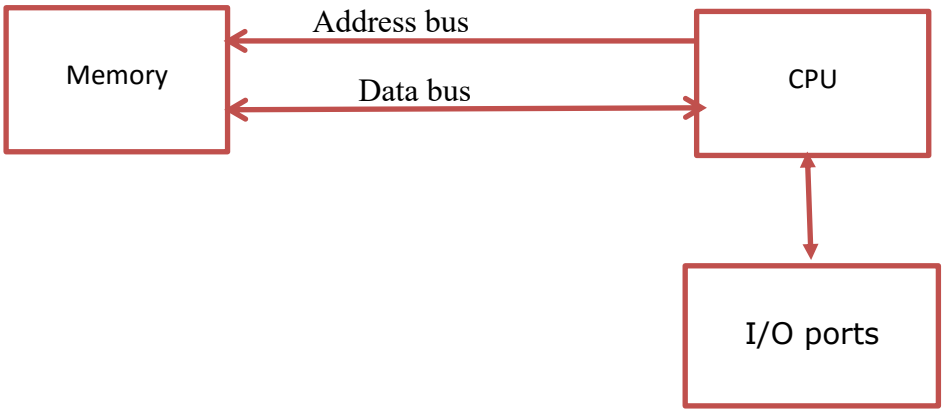
DML is used to select, insert, update, or delete data in the objects defined with DDL

(b) Every student in a school belongs to a Form. Every Form has a Form Tutor. All the form tutors are teachers and some teachers are part-time. Some forms have more than one Form Tutor although no Form Tutor can teach more than one form. Students are identified by a student-ID and each form has a unique form name.

Draw an ERD to show the relationship between the entities student, form and Form Tutor. [6]



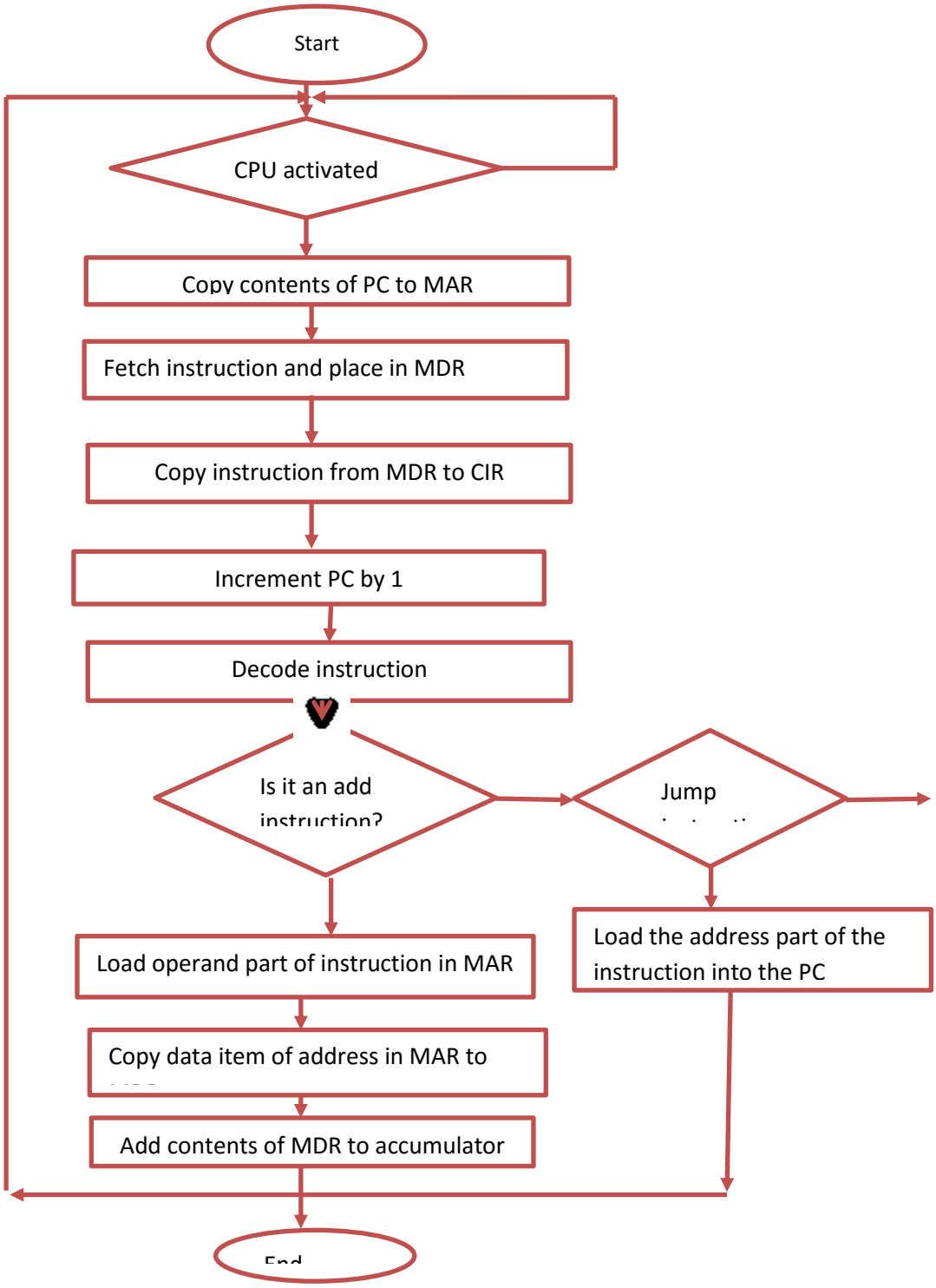
5. (a) (i) Draw a diagram to represent the Von Newmann Architecture. [4]

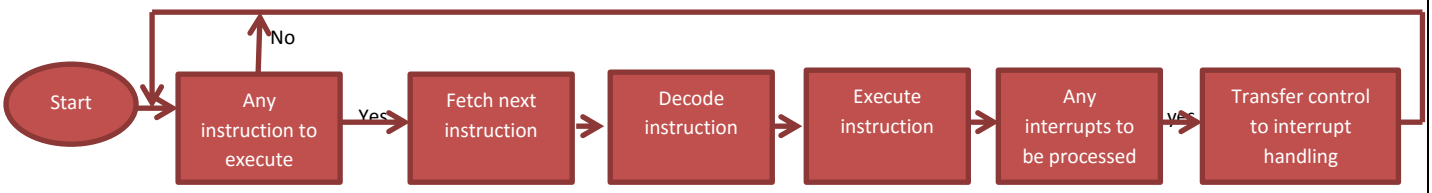


n (ii) Explain the role of an accumulator in the Fetch Execute Cycle. [2]

- *A general-purpose register used to accumulate results of it processing*
- *is where the results from other operations are stored temporarily before being used by other processes.*
- *Used for performing arithmetic functions*

(iii) With the aid of a diagram, illustrate the Fetch Execute Cycle. [4]

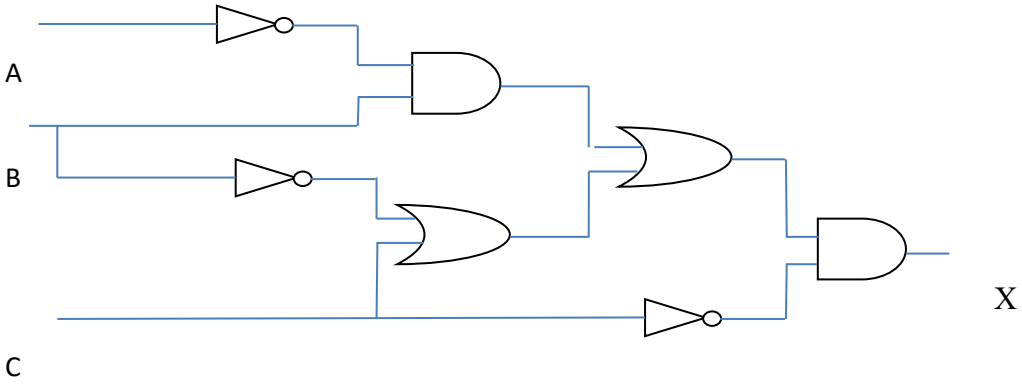




b) Compare features of the Von Newmann Architecture and the Harvard Architecture. [4]

a) Von Neumann Architecture	*b) Harvard Architecture*
✓ *The data and program processing that data are stored in the same memory* ✓ *Has only one bus which is used for both data transfers and instruction fetches*	✓ *Contains two separate areas for commands or instructions and data* ✓ *Use separate buses for data and commands*

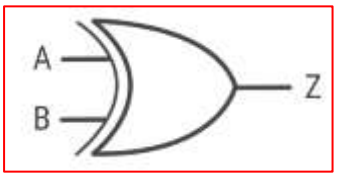
6. (a) The following is a logic circuit



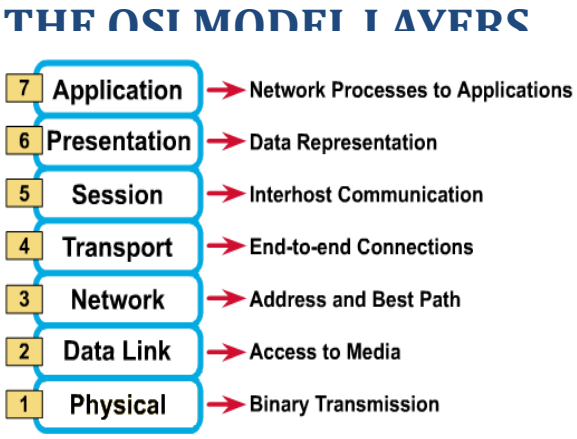
Write a logic statement that describes the above logic circuit. [3]

X = 1 If ((NOT A AND B) OR (NOT BOR C)) AND (NOT C)

(b) Use a diagram to represent the XOR gate. [3



7. (a) Draw the diagram for the OSI Model. [7]



(b) Describe the following protocols as they are related to TCP/IP suite:

(i) TCP [2]

The transmission control protocol (TCP) potion divides the data/message that is transmitted into smaller pieces called ***packets.***

(ii) IP [2]

The IP portion sends each packet by specifying the address of both the sending and receiving computers.

(iii) HTTP [2]

The ***Hypertext Transfer Protocol*** *(HTTP) is used to transfer the files that make up the Web pages of the World Wide Web*

(c) State which layer each of the protocols in (b) belong to. [3]

TCP - Transport layer

IP - Network layer

HTP - Application layer

8. (a) Explain the term Domain Name System (DNS). [2]

DNS *is a distributed database of information that is used to translate domain names which are easy for humans to remember and use into IP addresses.*

(b) Distinguish between private IP and public IP. [2]

Public IP Address	***Private IP Address***
• *can be accessed over the Internet* • *is globally unique IP*	• *used to assign computers within your space without letting them directly expose to the Internet*

address assigned to a computer device	• *it is allocated by InterNIC (network Information centre) to allow organisations to create their own private network*

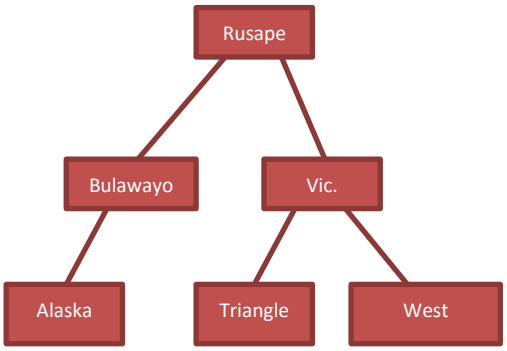
9 (a) Explain the difference between static and dynamic data structures. [2]

Dynamic data structure	***Static data structure***
✓ *space allocated before compilation* ✓ *change size when program is running*	✓ *pace allocated during compilation* ✓ *do not change size when program*

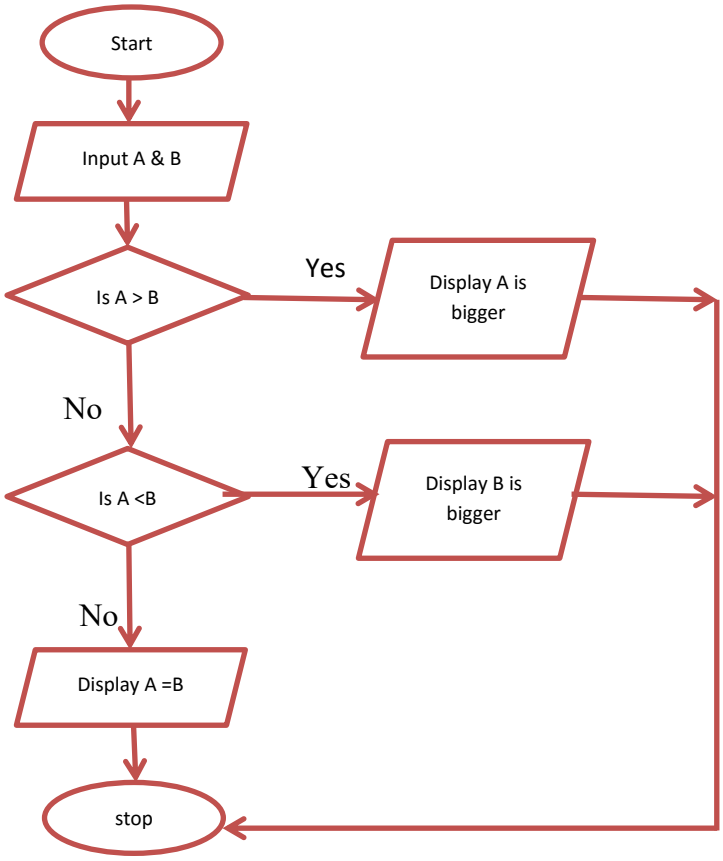
(b) The details of a car part are stored in a binary tree according to the following algorithm.

```
Read Value New Part
   Start at Root Node
      While Node Not Empty Do
       If New- Part < Value At Node
          Then follow Left Subtree
       Else
          Follow Right subtree
       Endif
      End While
       Insert New- Part At Node
      End
```

(i) Show the binary tree after the following values have been input **Rusape, Victoria Falls, Bulawayo, Triangle, Alaska, West Nichelson.** [3]



(ii) Illustrate an algorithm using a flowchart for a program that accepts two numbers A and B. If A>B then display "A is bigger", if A<B then display "B is bigger" else display "A and B are equal" [6]



(c) Arrange the following numbers in ascending order using the bubble sort algorithm **17** **8** **2** **11** **0** [4]

Original list	P1	P2	P3	P4
17	8	2	2	0
8	2	8	0	2
2	11	0	8	8
11	0	11	11	11
0	17	17	17	17

10. A software company has developed a new product for industrial usage.

(a) Define e-business. [1]

e-bussiness is doing business and providing services over the internet.

(b) Outline how an organisation can use any 3 Ps of marketing in launching and marketing this newly developed product. [9]

Product

In marketing, a product is anything that can be offered to a market that might satisfy a want or need. Managing the product includes product planning, product

development, product design, product mix, product innovation, standardisation and branding. Positioning is an important aspect which helps the people to categorize the product. Positioning is "how organisations want their consumers to see their product". What message about the product or service is the company trying to put across?

Price

The management is required to determine the basis for fixing the price of the product and then establish policies for dealing with discounts, subsidies, freight payments and price related situation. Various Pricing strategies generally adopted by the firms are:

- ***Penetration Pricing Strategy**: Here the product is introduced throughout the market at a lower cost. The strategy aims to encourage customers to switch to the new product because of the lower price.*
- ***Skimming Pricing Strategy**: Skimming pricing strategy emphasizes on launching the product at a high price. This strategy is effective when the potential market size is limited, buyers are willing to pay high price and potential competition is limited.*

Promotion

It includes all the activities carried out to make people aware about the product. Advertising, Personal selling and various promotional programmes are the major activities which do the work of informing and persuading the prospects to buy the products. Advertising is any paid form of personal or non-personal communication. It is a notice or an announcement to the public with the use of printing materials, pictures, or written words, audio or visual media.

Push & Pull strategies of Promotion are:

***Push Strategy**: A "Push" promotional strategy uses company's sales force and trade promotion activities to generate consumer demand for a product. The manufacturer promotes the product to wholesalers, wholesalers promote it to retailers and retailers promote it to consumers. Here the product is pushed on to the final consumer therefore the name- Push.*

***Pull strategy:** A "Pull" strategy is based on huge advertisements and promotional activities carried out by the manufacturer to create demand for the product. Consumer pull the product through the distribution channel forcing the wholesalers and retailers to stock it, hence the name pull strategy.*

Depending upon the decision relating to the amount to be spent on promotion one can decide how to promote a product effectively which reaches the target audience.