Part A — Structured Essay
*Answer **all four** questions on this **paper itself**.*

1. (a) (i) State **two** benefits of using Cascading Style Sheets (CSS).

(1) ....

(2) ....

(ii) Write the output of the following HTML code segment when rendered by a web browser.

```
<html>
<body>
<u> Important Sites </u>
<ul>
   <li> <a href="www.nie.lk/index.html">  National Institute of Education </a></li>
    <li> <a href="www.doenets.lk/exam/index.html"> Department of Examinations </a></li>
</ul>
</body>
</html>
```

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(iii) Write the output of the following HTML code segment when rendered by a web browser.

```
<html>
<body>
<p>
<center> Department of Examinations <br> Pelawatta
<br> Battaramulla </center></p><hr>
</body>
</html>
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(b) Consider the following HTML code segment:

```
<body>
   <h1> Introduction to Web Technologies </h1>
   <h3> HTML </h3>
   <p> HTML is the standard markup language for creating web pages </p>
</body>
```

Write down the internal styles required to apply the styles mentioned in the following table for the elements *h1* and *p* in the above code segment.

Element Name	Attribute	Attribute Value
h1	*color*	*blue*
	text-align	*centre*
	font-family	*Arial*
p	*background-color*	*Yellow*
	font-size	*12px*

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(c) Consider the HTML form given below rendered by a web browser:

This is a registration form used for registering students. It is required to enter *Student Name* as a text input, select *Gender*, select *District* and then click *Submit* button. Complete the following HTML code segment by filling the spaces to display the form.

Student Registration

Student Name [   ]

Gender ⦿ Male ○ Female

Selected District : Colombo ⌄
Colombo
Jaffna
Matara

[Submit]

```
<html>
<body>
<h3>Student Registration </h3>
<..................... action="register.php" method="post">
<div>
      Student Name   <input ..................=..................... ....................="name">
</div>
<br>
<div>
  Gender
   <input ..................=.............. ....................="gtype" .................="male" checked> Male

   <input ..................=.................... ...........="gtype" .................="female" > Female
</div>
<br>
<div>
Selected District   :
   <................. ...................="city">

      <option ..................="Colombo"> ................. </option>

      <option ..................="Jaffna" > ................. </option>

      <option ..................="Matara"> ................. </option>

   </.................>
</div>
<br>
    <input .................=................ name="submit" .................="Submit">
</.................>
</body>
</html>
```

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2. (a) Match each of the given phrases (i),-,(viii) relating to e-commerce with the most suitable term from the list below.

    List = {*brick-and-click, content provider, e-commerce, group purchasing, information broker, online marketplace, pure-brick, pure-click, reverse auction, virtual community, virtual storefront*}

    Phrases:

    (i) allows third party businesses (other businesses) to sell their products and services through the website and charge a percentage of the sale value as the fee

    (ii) provides frequently updated material such as news, blogs, videos etc. online

    (iii) allows sharing common interests and ideas over the Internet

    (iv) consumer transactions are processed by the business operator's web portal and then delivered and fulfilled by the participating retailers or wholesalers

    (v) has a physical shop as well as an online shop

    (vi) is a business that collects publicly available data about consumers on the internet, analyzes and summarises them and sells that information to other parties

    (vii) the sellers compete to obtain business from the buyer using the internet and prices may typically decrease as the sellers underbid each other

    (viii) obtain discounts from vendors on the internet based on the collective buying power of members

    Note: Write only the matching term against the phrase number.

    (i) ....

    (ii) ....

    (iii) ....

    (iv) ....

    (v) ....

    (vi) ....

    (vii) ....

    (viii) ....

    (b) (i) Write down the two's complement representation of 12_{10} using 8 bits.

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    ....

    (ii) Write down the two's complement representation of -68_{10} using 8 bits.

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    (iii) Compute $-68_{10} + 12_{10}$ using the above representations (i) and (ii).

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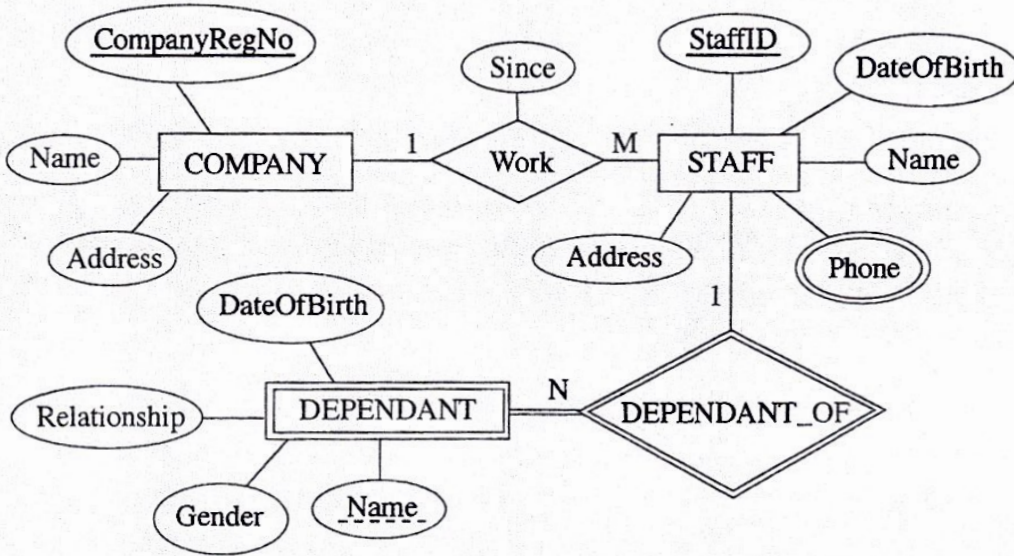   ....

(iv) State **one** advantage of using two's complement representation for data in internal operations of a computer.

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3. (a) Consider the following Entity Relationship (ER) diagram:

(i) Briefly explain why the 'Phone' attribute is shown using a different symbol compared to other attributes.

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(ii) Briefly explain why DEPENDANT entity is shown using a different symbol compared to COMPANY.

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(iii) The following relational tables are constructed using the ER diagram shown above. In each of the tables, the field names are missing.

COMPANY (............Ⓟ............)

STAFF (............Ⓠ............)

STAFF_PHONE (............Ⓡ............)

DEPENDANT (............Ⓢ............)

Identify the missing field names in each table and write them down against Ⓟ - Ⓢ.

Ⓟ - ....

Ⓠ - ....

Ⓡ - ....

Ⓢ - ....

(iv) Write an SQL statement to display *Names* and *Addresses* of all the STAFF.

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(v) Write an SQL statement to display the names of the dependants of staff member with StaffID = 'E001124'.

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(b) (i) Identify and explain the fundamental error in the following Data Flow Diagram (DFD).

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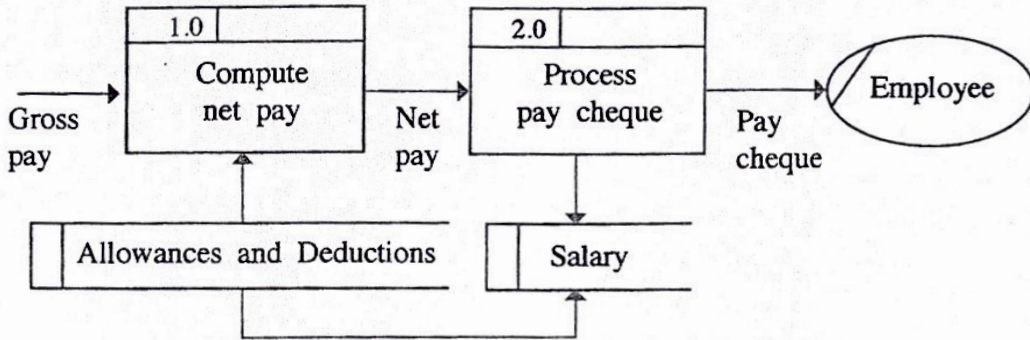
(ii) Write down whether each of the following statements regarding software agents is either True or False.

True/False

(1) A software agent can perform tasks in achieving a goal with minimum or no direct supervision.   ....

(2) Software applications can interact with agent without direct supervision of a user.   ....

(3) A user may obtain answers to a problem directly from an agent.   ....

(4) A multi-agent system is a network of problem-solving entities called agents that work together to find answers to problems that are beyond the individual abilities of each agent.   ....

(5) In a multi-agent system, individual agents may compete or co-operate to achieve the system goals.   ....

4. (a) Consider the following diagram which shows how the abstract layers of a computer system are related.
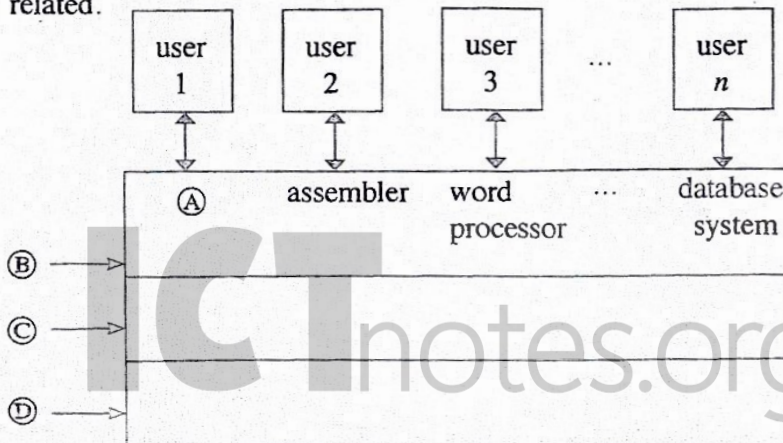
Choose and write down the correct terms from the list given below for labels Ⓐ, Ⓑ, Ⓒ and Ⓓ.

List = {compiler, computer hardware, live-ware, operating system, system /application programs}

Ⓐ ....

Ⓑ ....

Ⓒ ....

Ⓓ ....

(b) Order **four** of the following statements in the correct sequence to describe the operations that take place when a computer is switched on.

(**Note:** Two of the statements will **not** be needed.)

A - The BIOS copies Operating System (OS) files into memory and the OS starts executing.

B - The BIOS looks to the CMOS chip to tell it where to find the OS.

C - The compiler is started.

D - The contents in memory is swapped to the hard disk.

E - The OS loads the device drivers that it needs to control the devices and gives a login interface to the user.

F - Triggered by a series of clock ticks, the CPU executes the startup program's instructions in the BIOS that involves the power on self-test.

The sequence of operations is: (fill in the boxes with relevant letters)

☐ ⇨ ☐ ⇨ ☐ ⇨ ☐
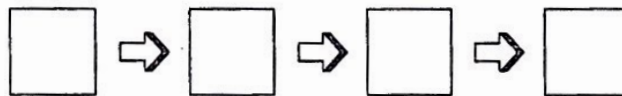
(c) The state transitions that could occur in a process running on a computer with a **multi-tasking** operating system is shown in the following diagram:
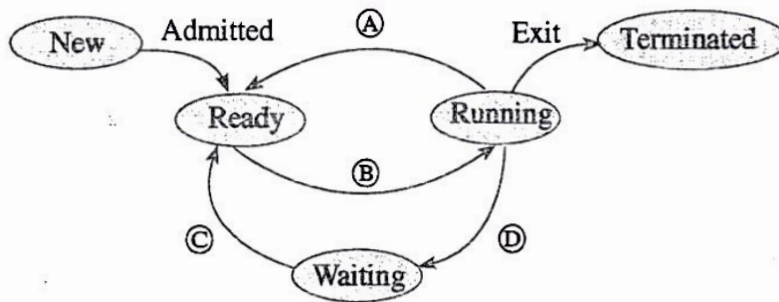
(i) Choose and write down the transition triggers indicated by the labels Ⓐ, Ⓑ, Ⓒ and Ⓓ from the list given.

List = {interrupt, Input/Output (I/O) or event completion, I/O or event wait, scheduler dispatch}

Ⓐ ....   Ⓑ ....

Ⓒ ....   Ⓓ ....

(ii) For the process above, give one possible reason for the following transition trigger:

interrupt : ....

....
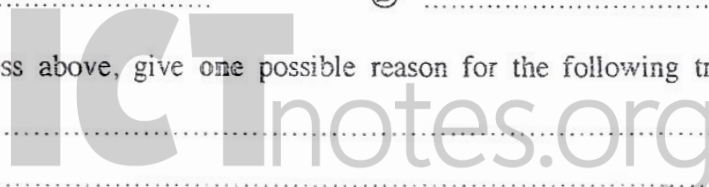
(d) In a certain computer, the physical memory has a total capacity of 4 GB. The size of a memory frame is 4 KB.

(i) Compute the total number of frames in the physical memory.

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(ii) The operating system maintains a data structure named the *page table* in respect of each process running in the computer. For what purpose is it used?

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(iii) With respect to the physical memory size, what is the benefit of using the technique of virtual memory in the above computer?

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தகவல், தொடர்பாடல் தொழினுட்பவியல்	II
Information & Communication Technology	II

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Part B

✳ Answer any four questions only.

1. Suppose a logic circuit needs to be implemented for a digital system that has three inputs A, B and C and one output Z. Its behaviour is as follows:

   If the input C=1, the output Z has the value of A.

   If the input C=0, then output Z has the value of B.

   (a) Obtain the truth table for the output Z.

   (b) Write down **either** a sum of products (SOP) **or** a product of sums (POS) Boolean expression for Z.

   (c) Simplify the Boolean expression for Z obtained in (b) above.

   (d) Using the simplified expression in (c) above, construct a logic circuit for the system using **either** 2-input NAND gates only **or** 2-input NOR gates only.

2. Consider the following scenario.

   The XYZ company has six departments, namely *Production, Accounts, Sales, Administration, Maintenance* and *Information Technology Services (IT)*. The following table shows the number of computers available in each of the departments.

Department No.	Department	Number of Computers
D01	Production	25
D02	Accounts	30
D03	Sales	18
D04	Administration	30
D05	Maintenance	25
D06	IT Services	28

   Each department needs to have their own local area network. Network administrator has received a class C IP address block 192.248.154.0/24. It is required to subnet the IP address block to satisfy the requirements of each department and allocate IP addresses to them.

   (a) (i) How many addresses are available in the IP address block?

   (ii) What are the first and the last addresses of the IP address block?

   (iii) How many host bits are required to create the required subnets?

   (iv) After subnetting, write the relevant network address, subnet mask and allocated range of IP addresses for each department.

   Note: Use the following table format to present your answer.

Department No	Network Address	Subnet Mask	IP Address Range
D01			
D02			
D03			
D04			
D05			
D06			

(b) The XYZ Company links the five departments Production, Accounts, Sales, Administration and Maintenance to the IT Services department and connects those departments to the Internet through the IT Services department. The network has been completed by laying the cables and installing six switches, a router and a firewall. All six departments are situated in six separate buildings.

The administrator allows all subnets to access the Internet through a proxy server. The proxy server and the DNS server are located in the IT Services department.

Draw the labelled network diagram to show the logical arrangement of the computer network of the XYZ company by identifying suitable devices and required cables for all the locations.

(c) After setting up the network any employee of any department was able to access the URL http://www.nie.lk through a web browser in a computer in his/her department. However, one day an employee finds that he cannot access that website from a computer in his department. Write **three** possible reasons for the above problem.

3. (a) A business sells handicraft items such as wooden masks, handmade souvenirs, and batik and handloom cloths for tourists in a certain city of Sri Lanka. At present customers walk to the shop and buy goods with cash. The owner plans to start selling his products online through his own web portal.

   (i) State the type of e-business model the owner plans to start.

   (ii) Assume that a certain tourist hotel situated nearby is willing to publicize the planned online shop in their hotel web site.

      (1) What type of e-business model can be established in the above scenario between the handicraft business and the hotel?

      (2) Briefly explain **one** possible e-business revenue model **each**, for the hotel and the proposed online shop of the handicraft business.

   (iii) State **two** methods that can be used by the planned e-business for processing online payments.

   (iv) Briefly explain **one** e-marketing method that you would propose to attract customers to the planned e-business web portal.

   (v) Explain how the user experience can be improved using intelligent agent technology in the planned e-business web portal

(b) Consider the following figure which shows a simplified view of a multi-agent system.
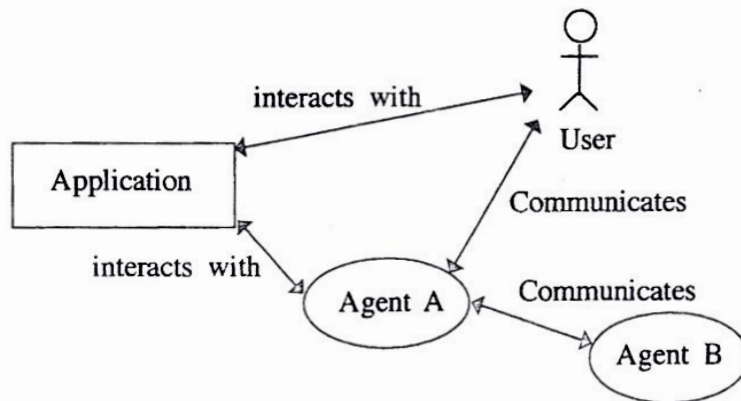
Answer the following question by studying the above figure.

"*A software agent may or may not have a user interface*".
Do you agree with the above statement? State a reason referring to the above figure.

4. (a) Assume an input which contains a sequence of positive numbers. The sequence has at most 100 numbers. If the input sequence has n numbers where n < 100, then the end of the sequence is marked by making $(n+1)^{th}$ number −1.

For e.g., the following input sequence has 8 positive numbers, where the 9th input which is −1 marks the end.

     23   12   54   76   89   22   44   65   −1

Draw a flowchart that represents an algorithm to output the largest number in a given sequence of *n* positive numbers as described above.

(b) Consider the flowchart given below. The algorithm in the flowchart takes two inputs, the first input L is a list of numbers, the second input K is a given number.
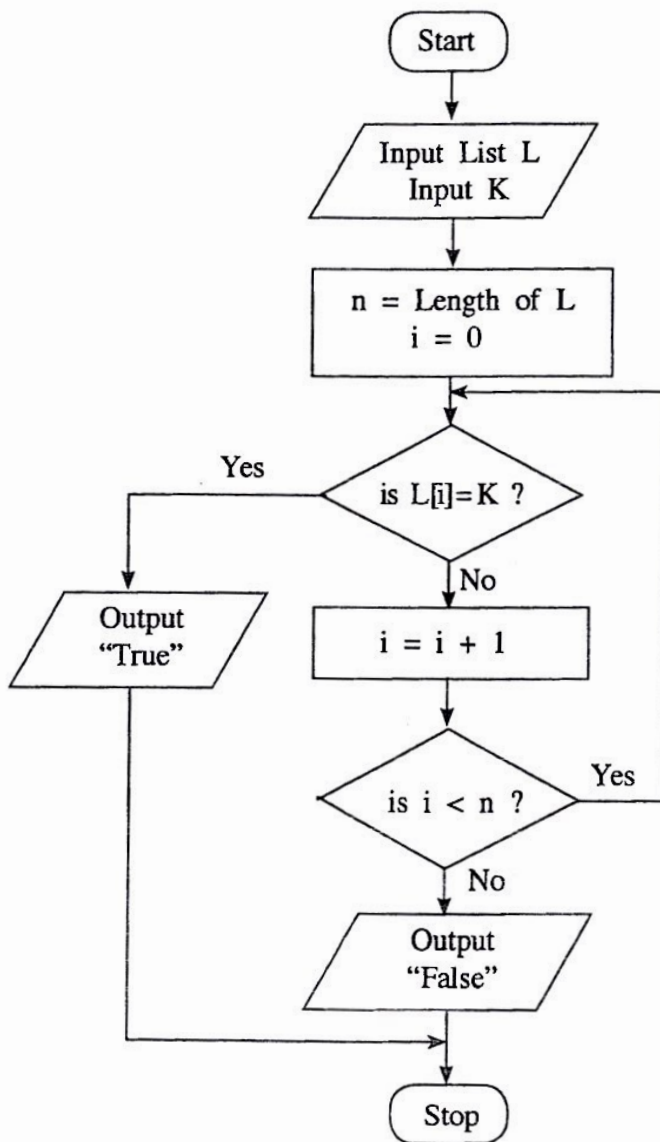
(i) What would be the output if the first input L was 23, 45, 32, 11, 67, 39, 92, 51, 74, 89 and the second input K was 38?

(ii) Briefly explain the aim of this algorithm.

(iii) Develop a Python program to implement the algorithm in the flowchart.

5. The following two tables CLASS and STUDENT are constructed by using the Entity Relationship (ER) diagram shown in Figure.

CLASS Table

ClassID	ClassName	ClassTeacher	Stream	Year
1111	12 - A	A. B. Perera	Physical Science	2017
1112	12 - B	N. Mohamed	Bio Science	2017
1113	13 - A	E. Selvadurai	Arts	2017
1114	13 - B	L. De Silva	Commerce	2018

STUDENT Table

IndexNumber	ClassID	Initials	Surname	DateOfBirth
8991	1112	E.	Nazeer	1999.12.06
8993	1111	S.	Sivalingam	1999.02.06
8995	1112	W.	Fernando	1999.11.11
8997	1113	U. H.	De Silva	1999.08.06
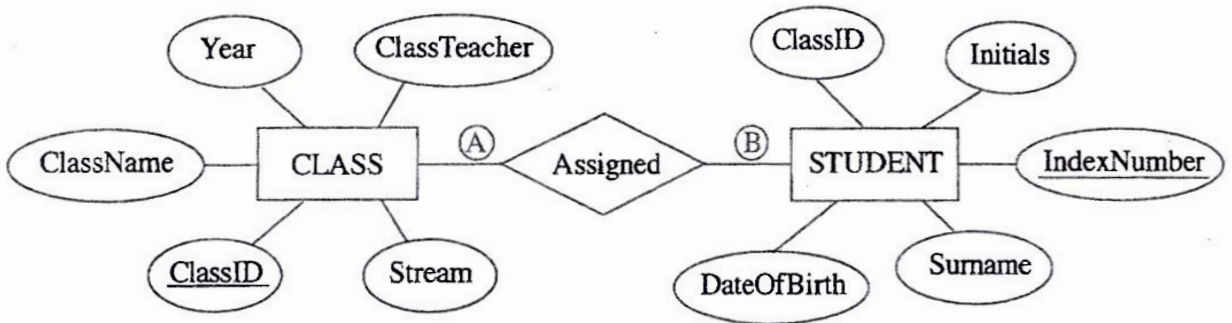
(a) What is the cardinality of the relationship between the entities STUDENT and CLASS, denoted by Ⓐ and Ⓑ above? **Note**: Write down suitable labels for Ⓐ and Ⓑ, respectively.

(b) Explain how a relationship is established between the two tables using primary key(s) and foreign key(s) in the above example.

(c) (i) Are the two tables STUDENT and CLASS, in second normal form (2NF)? Explain a reason for your answer referring to tables.

(ii) Briefly explain **one** key advantage of *normalisation*.

(d) Write an SQL statement to insert the following record to the CLASS table:

1115	13 - C	A.B. Jinasena	Technology	2018

6. (a) The school admission process of a certain country is explained using the description and the data flow diagram given below.

The applicant sends the application to the respective school. The school sends an acknowledgement to the applicant. The school then verifies the information in the application by checking the following.

- Eligibility of applicant : by using the eligibility criteria taken from the data store 'Eligibility Criteria'

- Registration in the electorate : by requesting the electoral list from the Election Authority (Election Authority sends the Electoral list to the school)

- Residential status : by requesting the confirmation of residence from the Divisional Secretariat (Divisional Secretariat sends the confirmation of residence to the school)

After verification of information, the applicant is informed whether the application has been accepted or rejected which is noted in the application and stored in the data store "Applications". The school obtains the valid applications from the data store "Applications" and schedules the qualified applicants for interviews. Then it calls the applicants for interviews and sends the interview schedule to the Education Authority. The interview schedule is stored in the data store "Interview Schedule".
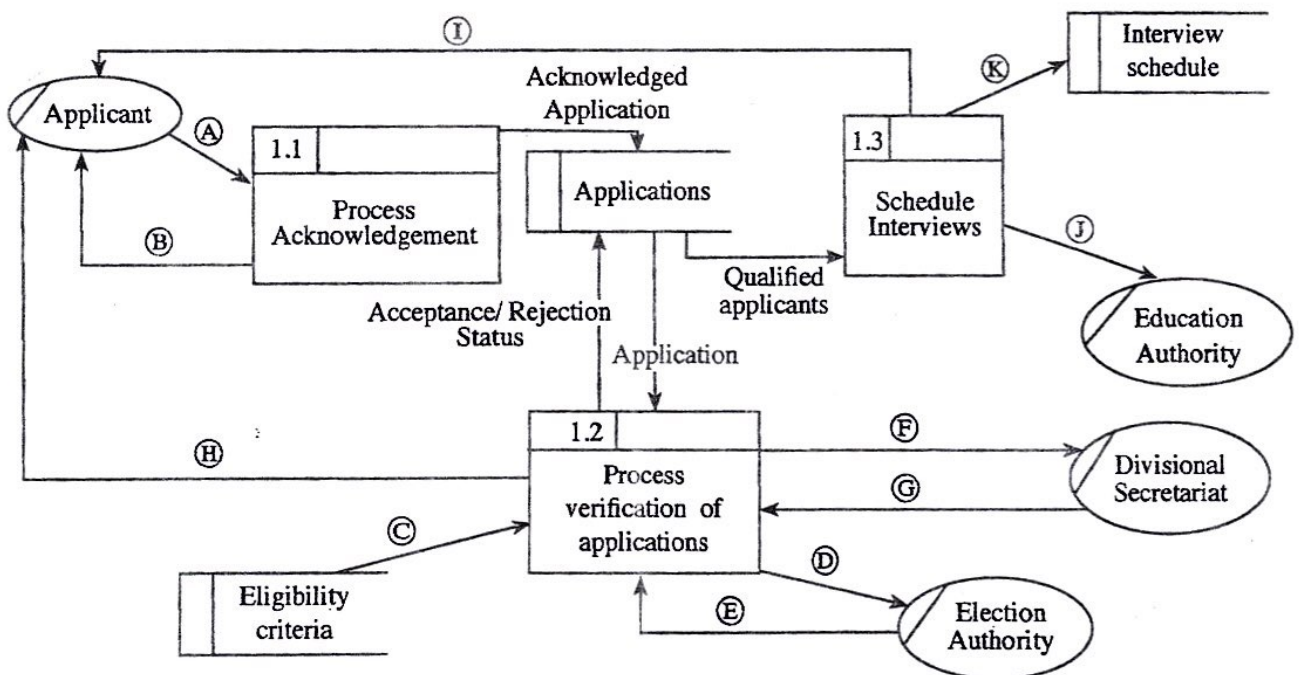
Level 1 DFD

The *Level 1* Data Flow Diagram for the above scenario with some data flows labelled as Ⓐ - Ⓚ is given in figure. Identify and write down the relevant data flows against the labels Ⓐ - Ⓚ.

(b) (i) Briefly explain the key difference between functional and non-functional requirements as used in the system development life cycle.

(ii) The following list includes some functional and non-functional requirements of a proposed e-commerce web portal that plans to sell products on a catalogue:

A – Enable user to find products based on a variety of item characteristics

B – The system should work on any web browser

C – The system should be easy to use

D – Enable user to submit his/her comments on products and read other users' comments on items

E – Data in the system should be preserved even in the case of a system failure

F – Enable user to create and maintain a wish list of desired products

G – Enable user to browse through products on catalogue

H – The system should be available for use 24 hours a day, 7 days a week and 365 days an year

I – The system should authenticate users through usernames and passwords

J – The system should have versions customized for global users, e.g., French, Japanese, German, etc.

Identify and write down the labels of the **non-functional** requirements in Ⓐ - Ⓙ.

✳ ✳ ✳