සියලුම හිමිකම් ඇවිරිණි / முழுப் பதிப்புரிமையுடையது / All Rights Reserved]

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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2022(2023)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2022(2023)
General Certificate of Education (Adv. Level) Examination, 2022(2023)

තොරතුරු හා සන්නිවේදන තාක්ෂණය I தகவல், தொடர்பாடல் தொழினுட்பவியல் I **Information & Communication Technology I**	**20 E I**	පැය දෙකයි இரண்டு மணித்தியாலம் ***Two hours***

Instructions:

* *Answer **all** the questions.*
* *Write your **Index Number** in the space provided in the answer sheet.*
* *Instructions are also given on the back of the answer sheet. Follow those carefully.*
* *In each of the questions **1** to **50**, pick one of the alternatives from (1), (2), (3), (4), (5) which is **correct or most appropriate** and **mark your response on the answer sheet with a cross (×) in accordance with the instructions given on the back of the answer sheet.***
* *Use of calculators is **not allowed**.*

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1. Which of the following statements is/are correct?

A – *Firmware* is a computer program that is usually embedded in the volatile memory of a computer.

B – A *printer driver* is an example for an application software.

C – *Linux* is an example for a system software.

(1) A only (2) B only (3) C only
(4) A and B only (5) B and C only

2. Which of the following require(s) *real-time* processing?

A – generating monthly electricity bills of customers

B – updating the bank account balance of a customer when she/he withdraws money from an ATM

C – updating the stock balance in a store upon successful completion of each transaction

(1) A only (2) B only (3) C only
(4) A and B only (5) B and C only

3. Which of the following lists a computer memory hierarchy in the **descending order** of access speed?

(1) hard disk, registers, L2 cache, L1 cache, main memory
(2) main memory, L1 cache, registers, L2 cache, hard disk
(3) registers, main memory, hard disk, L1 cache, L2 cache
(4) registers, L1 cache, L2 cache, main memory, hard disk
(5) L1 cache, L2 cache, registers, main memory, hard disk

4. Which of the following gives the correct results of bit-wise AND and bit-wise OR operations between the two binary numbers 01010100_2 and 11101001_2 respectively?

(1) 01000000_2, 11111101_2
(2) 00000010_2, 10111001_2
(3) 10111101_2, 11001010_2
(4) 11000000_2, 00101100_2
(5) 11111101_2, 01010011_2

5. What is the correct binary equivalent of decimal 12.75_{10}?

(1) 1011.01_2 (2) 1011.11_2 (3) 1100.00_2 (4) 1100.11_2 (5) 1100.01_2

6. What is the correct 2's complement binary representation of decimal -41_{10} using 8-bits?

(1) 00101001 (2) 01010110 (3) 10101001 (4) 11010110 (5) 11010111

7. The address of an instruction was shown as **10f9** in hexadecimal. What is that address in decimal?
(1) 25 (2) 1249 (3) 4345 (4) 10159 (5) 16249

8. A particular command can be used to output a text file in its binary format.

Assume a file contains the following text:

0 Waste!

Referring the **Important notes** (i) and (ii) given below, select the correct output that will result when the said command is run on that file.

(1) 00110000 00100000 01010111 01100001 01110011 01110100 01100101 00001010
(2) 00110000 01010111 01100001 01110011 01110100 01100101 00100001 00001010
(3) 00110000 00100000 01010111 01100001 01110011 01110100 01100101 00100001 00001010
(4) 00110000 00100000 01110111 01100001 01110011 01110100 01100101 00100001 00001010
(5) 00110000 00100000 01010111 01100001 01110011 01110100 01100101 00100000 00001010

Important notes:

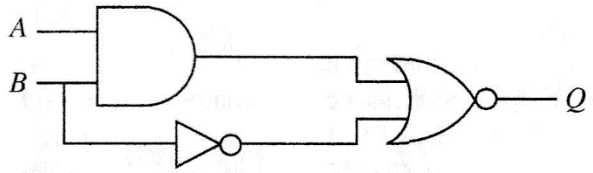
(i) The file ends with a LINE FEED character.

(ii) Some selected rows from the 7-bit ASCII table are given below:

Character	Binary
(LINE FEED)	0001010
(SPACE)	0100000
!	0100001
0	0110000
W	1010111

Character	Binary
a	1100001
e	1100101
s	1110011
t	1110100
w	1110111

9. Consider the following logic circuit:



When B=1, what would **definitely** be the output at Q?
(1) A (2) $\overline{A}$ (3) B (4) $\overline{B}$ (5) 0

10. Simplified Boolean expressions help to obtain simpler circuits.
Which of the following is a simplified form of $X + \overline{X}Y$?
(1) X (2) Y (3) XY (4) $\overline{X}Y$ (5) $X + Y$

11. Consider the following truth table:

A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

What is the correct Karnaugh map for the above truth table?

(1)

A \ BC	00	01	10	11
0	0	0	1	1
1	1	1	0	0

(2)

A \ BC	00	01	11	10
0	0	0	1	1
1	1	1	0	0

(3)

A \ BC	00	10	01	11
0	0	1	0	1
1	1	0	1	0

(4)

A \ BC	00	10	11	01
0	0	1	1	0
1	1	0	0	1

(5)

A \ BC	00	11	10	01
0	0	1	1	0
1	1	0	0	1

12. A program in execution in a computer is called a *process*. Such a process transits between several states during its lifetime. Which of the following correctly represents a possible state transition sequence of a process?

(1) New → Ready → Running → Waiting → Ready → Running → Terminated
(2) New → Ready → Waiting → Running → Waiting → Running → Terminated
(3) New → Running → Ready → Waiting → Running → Ready → Terminated
(4) New → Running → Waiting → Ready → Waiting → Running → Terminated
(5) New → Waiting → Running → Ready → Running → Ready → Terminated

13. Which of the following is **not** a task of a computer operating system?

(1) selecting a memory *frame* for a *page* of a process
(2) maintaining a list of free memory *frames*
(3) maintaining a *page table* for each process
(4) monitoring the usage of binary files on a hard disk
(5) swapping processes between main memory and hard disk

14. The *block size* of a disk is 4KB. A portion of its File Allocation Table (FAT) at a particular time is shown below. The portion shown indicates the blocks of the *average.py* file as well.

FAT

200	202
201	200
202	–1
203	201
204	205

Notes: **I.** The last block of a file is indicated by –1.

II. The *directory entry* of a file contains the block number of the first block of the file

Which of the following gives the *directory entry* for the *average.py* file **and** the disk space allocated for the average.*py* file respectively?

(1) 200, 12KB (2) 200, 16KB (3) 200, 20KB (4) 203, 16KB (5) 203, 20KB

15. Which of the following are *Transport Layer* protocols of the TCP/IP stack?

A – Transmission Control Protocol (TCP)
B – User Datagram Protocol (UDP)
C – File Transfer Protocol (FTP)
D – Internet Protocol (IP)

(1) A and B only (2) A and C only (3) B and C only
(4) B and D only (5) All A, B, C and D

16. Which of the following statements is/are correct about MAC and IPv4 addresses?

A – MAC addresses are 32 bits in length and are used in the network layer.
B – MAC addresses are 48 bits in length and are used in the datalink layer.
C – IPv4 addresses are 32 bits in length and are used in the network layer.

(1) A only (2) B only (3) C only
(4) A and C only (5) B and C only

17. Which of the following is/are correct regarding a *firewall*?

A – It can monitor and filter outgoing traffic from an internal network.
B – It protects a network from unauthorized accesses.
C – It can be a hardware, a software or a combination of both.

(1) A only (2) A and B only (3) A and C only
(4) B and C only (5) All A, B and C

18. An organization with the assigned IP address block 193.1.1.0/24 needs to define **eight** subnets. Each subnet should provide for more than 25 IP addresses. Which of the following correctly lists the number of bits needed to identify the given network, the total number of bits needed to identify the subnets, and the number of bits needed to assign unique IP addresses for this requirement, respectively?

(1) 24, 3, 5 (2) 24, 5, 3 (3) 24, 27, 5 (4) 27, 3, 5 (5) 27, 30, 2

19. Which of the following statements is correct regarding network topologies?

(1) In *bus topology*, a central network hub is used to connect all nodes.
(2) In *star topology*, a linear cable is used to connect all nodes.
(3) In *ring topology*, messages are sent only clockwise.
(4) In *ring topology*, each node is directly connected only to two of its neighbors.
(5) In *mesh topology*, each node is always connected to one other node only.

20. Consider the seven layer OSI reference model and match each of the given layers labeled from P to S to the corresponding responsibility of it labeled from 1 to 4.

Layer	Responsibility
P – Application layer	1 – binary transmission over the communication medium
Q – Physical layer	2 – route determination
R – Transport layer	3 – user services that include file transfer, remote access etc.
S – Network layer	4 – data delivery from process to process

(1) P – 1, Q – 3, R – 2, S – 4 (2) P – 2, Q – 4, R – 3, S – 1
(3) P – 3, Q – 1, R – 2, S – 4 (4) P – 3, Q – 1, R – 4, S – 2
(5) P – 4, Q – 2, R – 1, S – 3

21. Which of the following statements is/are correct?

A – A *digital signature* ensures the authenticity of a message.
B – In *asymmetric key encryption*, different keys are used for encryption and decryption.
C – The encryption process transforms plaintext to ciphertext.

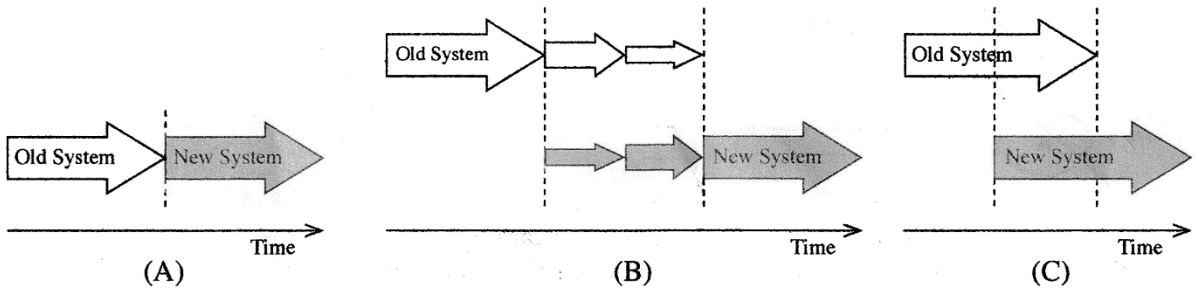
(1) A only (2) B only (3) C only
(4) A and B only (5) All A, B and C

22. Match each of the given data communication protocols labelled from P to T to the corresponding descriptions labelled from 1 to 5.

Protocol	Description
P – Hyper Text Transfer Protocol (HTTP)	1 – provides directory lookup service for given web addresses and URLs
Q – Transmission Control Protocol (TCP)	2 – provides a very reliable data transfer service
R – Domain Name System (DNS) Protocol	3 – used in the world wide web
S – Internet Protocol (IP)	4 – provides a connection-less transport service
T – User Datagram Protocol (UDP)	5 – handles unique addressing of hosts in the Internet

(1) P – 2, Q – 4, R – 1, S – 5, T – 3
(2) P – 2, Q – 5, R – 4, S – 1, T – 3
(3) P – 3, Q – 2, R – 1, S – 5, T – 4
(4) P – 3, Q – 4, R – 5, S – 1, T – 2
(5) P – 4, Q – 2, R – 3, S – 1, T – 5

23. The following diagrams labelled (A), (B) and (C) illustrate three software deployment types.



Which of the following correctly represents (A), (B) and (C) deployment types respectively?

(1) Direct, Phased and Parallel (2) Direct, Pilot and Parallel
(3) Parallel, Phased and Direct (4) Parallel, Pilot and Phased
(5) Phased, Direct and Pilot

24. Consider the information system types in **List A** and the descriptive examples in **List B**. Identify the most suitable matching between the items in lists **A** and **B**.

List A	List B
A1 – Decision Support System (DSS)	**B1** – a system that allows to update, create, and manage the details in a news website
A2 – Content Management System (CMS)	**B2** – a system that handles electronic fund transfers
A3 – Transaction Processing System (TPS)	**B3** – a system that combines data and analytical tools for sales forecasting based on historical data

(1) A1 – B1, A2 – B2, A3 – B3
(2) A1 – B2, A2 – B1, A3 – B3
(3) A1 – B2, A2 – B3, A3 – B1
(4) A1 – B3, A2 – B1, A3 – B2
(5) A1 – B3, A2 – B2, A3 – B1

25. Which of the following statements is/are correct regarding System Development Life Cycle (SDLC) models?

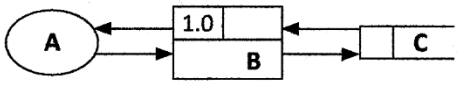
A – In the *agile* model, small portions of systematically developed working software are delivered to the client frequently.
B – Late changes in the requirements can be easily accomodated in the *waterfall* model.
C – *Prototyping* model can be practiced without client interactions.

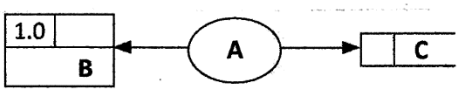
(1) A only (2) B only (3) C only
(4) A and B only (5) A and C only

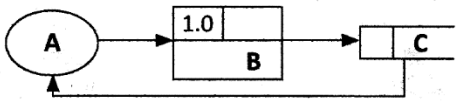
26. *Non-functional requirements* specify quality attributes of a system. Which of the following is an example for a *non-functional requirement*?

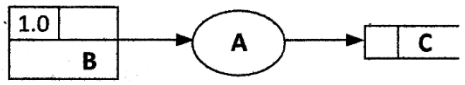
(1) the email system should allow users to attach files
(2) each page of the website must load within 4 seconds
(3) administrator of the E-commerce website should be able to view a list of customers
(4) a user of the online banking system should be able to view the last transactions
(5) the ATM machine should allow users to print a receipt

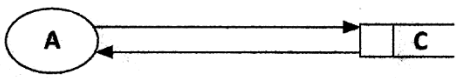
27. Which of the following Data Flow Diagrams (DFDs) is correct with respect to the rules of data flow modelling? (Note: A – an external entity, B – a process, C – a data store)

(1) 

(2) 

(3) 

(4) 

(5) 

28. Which of the following statements is correct regarding *software testing*?

(1) Integration testing is usually carried out before unit testing.
(2) Black-box testing techniques are usually used in acceptance testing.
(3) White box testing examines the behaviour of a software based only on the inputs to a system.
(4) Unit testing examines the entire system's functionality as a whole.
(5) System testing is usually carried out after the user acceptance testing.

29. Consider the following relational schema:
Student (StudentId, StudentName, Address, Gender, DateOfBirth)

Study (StudentId, SubjectId, Grade)

Subject (SubjectId, SubjectName)

Which of the following is the most suitable *Entity Relationship (ER)* diagram to correctly represent the relationship between **Student** and **Subject** entities?

Note: In the ER diagrams, the entities are drawn without attributes.

(1) 

(2) 

(3) 

(4) 

(5) 

- The tables which are partially extracted from a database used in an information system developed for **a shop are shown below. Answer the questions from 30 to 32 using those tables.**

Customer

CusId	Fname	Lname	Location
C001	Saman	Perera	Dehiwala
C002	Kalum	Gamage	Galle
C003	Shiromi	Silva	Galle
C004	Kalum	Perera	Kandy

Product

ProdId	Name
PR001	Refrigerator
PB401	Blender
PM025	Mobile Phone
PP009	Inkjet Printer

Order

OrderId	CusId	OrderDate	SellerId
A001	C002	2022-07-14	S001
A002	C003	2022-07-14	S001
A003	C002	2022-07-18	S002
A004	C004	2022-07-20	S002

Order_Product

OrderId	ProdId
A003	PR001
A001	PR001
A002	PB401
A003	PM025
A004	PP009

30. Which of the following shows the most suitable *primary keys* for **Order** and **Order_Product** relations?

(1) **Order**: CusId, **Order_Product**: OrderId
(2) **Order**: OrderId, **Order_Product**: OrderId
(3) **Order**: OrderId, **Order_Product**: OrderId + ProdId
(4) **Order**: CusId + SellerId, **Order_Product**: ProdId
(5) **Order**: OrderId + CusId, **Order_Product**: OrderId

31. What will be the output after executing the following SQL statement?

```
SELECT Customer.Fname, Customer.Lname, Order.OrderId
FROM Customer INNER JOIN Order ON Customer.CusId = Order.CusId
WHERE Customer.Location="Galle";
```

(1)

Fname	Lname	OrderId
Kalum	Gamage	A001
Kalum	Gamage	A003
Shiromi	Silva	A002

(2)

Fname	Lname	OrderId
Kalum	Gamage	A004
Kalum	Perera	A001
Kalum	Gamage	A003
Shiromi	Silva	A002

(3)

Fname	Lname	OrderId
Kalum	Gamage	A001
Kalum	Perera	A003
Shiromi	Silva	A002

(4)

Lname	Fname	OrderId
Gamage	Kalum	A001
Gamage	Kalum	A003
Silva	Shiromi	A002

(5)

Fname	Lname	OrderId
Kalum	Gamage	A001
Shiromi	Silva	A002

32. Which of the following is correct regarding the **Order** relation?

(1) CusId attribute uniquely identifies each tuple in the relation.
(2) The relation is in First Normal Form (1NF).
(3) The relation is in Second Normal Form (2NF).
(4) Orders of each customer are handled by a unique salesperson.
(5) The relation consists of a composite primary key.

33. Which of the following statements is/are correct regarding the *normalization* concept?

A – In first normal form, atomic attributes are **removed** from a relation.
B – In second normal form, partial dependency of attributes on the primary key **are removed**.
C – In third normal form, transitive dependency of attributes are **removed**.

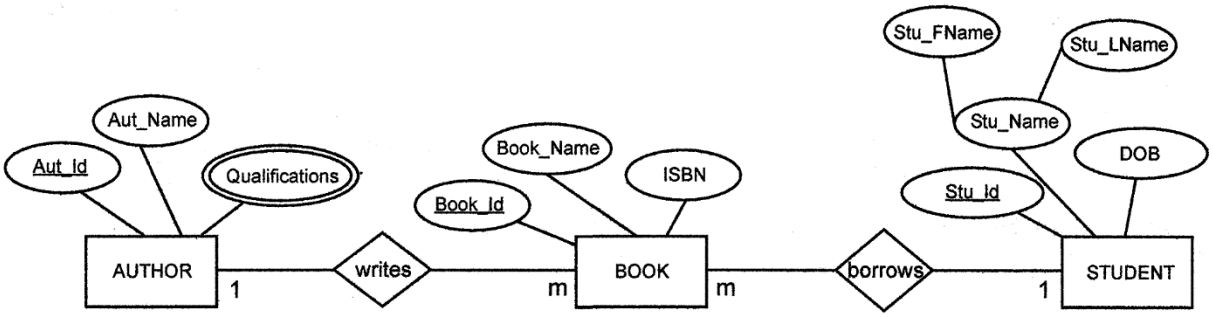
(1) B only (2) A and B only (3) A and C only
(4) B and C only (5) All A, B and C

34. Which of the following statements is/are correct regarding *Entity Relationship (ER) modelling*?

A – A weak entity is dependent on another entity.
B – A derived attribute is represented as an attribute in a relation.
C – An entity can contain a multi-value attribute and a composite attribute at the same time.

(1) A only (2) B only (3) A and C only
(4) B and C only (5) All A, B and C

35. The following ER diagram represents a scenario of students borrowing books from a library. Which of the following gives the most suitable relation list for the given ER diagram?



(1) BOOK (Book_Id, Book_Name, ISBN, Stu_Id, Aut_Id)
STUDENT (Stu_Id, Stu_FName, Stu_LName, DOB)
AUTHOR (Aut_Id, Aut_Name)
AUTHOR_QUALIFICATION (Aut_Id, Qualifications)

(2) BOOK (Book_Id, Book_Name, ISBN)
STUDENT (Stu_Id, Stu_FName, Stu_LName, DOB)
AUTHOR (Aut_Id, Aut_Name)
AUTHOR_QUALIFICATION (Aut_Id, Qualifications)

(3) BOOK (Book_Id, Book_Name, ISBN, Stu_Id, Aut_Id)
STUDENT (Stu_Id, Stu_FName, Stu_LName, DOB)
AUTHOR (Aut_Id, Aut_Name, Qualifications)

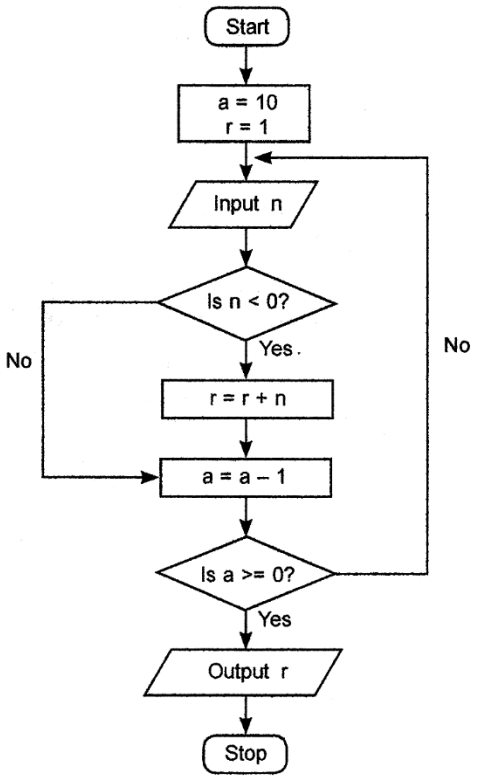
(4) BOOK (Book_Id, Book_Name, ISBN, Stu_Id, Aut_Id)
STUDENT (Stu_Id, Stu_Name, DOB)
AUTHOR (Aut_Id, Aut_Name)
AUTHOR_QUALIFICATION (Aut_Id, Qualifications)

(5) BOOK (Book_Id, Book_Name, ISBN, Stu_Id, Aut_Id)
STUDENT (Stu_Id, Stu_Name, DOB)
AUTHOR (Aut_Id, Aut_Name)
AUTHOR_QUALIFICATION (Aut_Id, Qualifications)
BORROW (Aut_Id, Book_Id)
WRITE (Aut_Id, Book_Id)

36. Which of the following statements is/are correct about the algorithm expressed by the given flowchart?

A – An input is taken from the user only once.
B – The output of the algorithm is always 9.
C – The algorithm outputs the summation of all the numbers entered.

(1) A only
(2) B only
(3) C only
(4) A and B only
(5) B and C only



37. What would be the output of the following Python code if the input was 25?

```
x = int(input())
x = (x % (x – 21)) **3
print(x)
```

(1) 0 (2) 1 (3) 3 (4) 12 (5) 25

38. What would be the output of the following Python code?

```
def fun(para1, para2):
    x=foo(para2, para1)
    return x

def foo(para3, para4):
    return para3 – para4

result=fun(2, 4)
print("Result is " + str(result))
```

(1) Result is 0 (2) Result is 2 (3) Result is –2
(4) Result is (2, 4) (5) Result is +2

39. What would be the output of the following Python code?

```
def foo(name, age=18, address="Kandy"):
    print(name, address, age)

foo("Nimal", 25, "Colombo")
```

(1) Nimal Colombo 25 (2) Nimal, Colombo, 25
(3) Nimal, Kandy, 18 (4) Nimal Kandy 18
(5) Nimal 18 Kandy

40. What would be the output of the following Python code?

```
numbers=[10, 20, 30, 40, 50]
numbers.pop(1)
numbers.append(60)
numbers.pop(2)
print(numbers)
```

(1) [10, 50, 60] (2) [10, 20, 40, 60] (3) [10, 30, 50, 60]
(4) [20, 30, 40, 50] (5) [20, 30, 50, 60]

41. What would be the output of the following Python code?

```
val = 9
for i in range(5):
    for j in range(2, 3, 1):
        val += 1
        if (val % 2) == 0:
            continue
            val += 2
        else:
            val += 2
print(val)
```

(1) 18 (2) 24 (3) 29 (4) 38 (5) 39

42. Which of the following is/are correct regarding Python functions?

A – A Python function can return a data structure that contains multiple values.
B – A Python function can be used without passing any parameters to it.
C – Parameters can be passed to a python function by value or by reference.

(1) B only (2) C only (3) A and C only
(4) B and C only (5) All A, B and C

43. Which of the following HTML tags can be used to change the appearance of a word in a text?

(1) <i>, , <li>,
 (2) <b>, <i>, , <h1>
(3) <b>, , <sup>, <li> (4) <i>, <u>, <br>, <sup>
(5) <u>, <i>, <ol>, <b>

44. What would be the output of the following HTML code segment?

```
<dl>
      <dt> Vegetable </dt>
        <dd> Potato </dd>
      <dt> Fruit </dt>
        <dd>  Orange </dd>
</dl>
```

(1)
```
• Vegetable
    • Potato
• Fruit
    • Orange
```

(2)
```
Vegetable
  Potato
Fruit
  Orange
```

(3)
```
• Vegetable
    Potato
• Fruit
    Orange
```

(4)
```
1. Vegetable
    Potato
2. Fruit
    Orange
```

(5)
```
• Vegetable
    - Potato
• Fruit
    - Orange
```

45. Which of the following statements is/are correct regarding HTML and CSS?

A – CSS can be used to describe how HTML elements are to be displayed on screen.
B – External CSS can be used to define the style for many HTML pages.
C – Inline CSS can be used to apply a style to a single HTML element.

(1) A only (2) A and B only (3) A and C only
(4) B and C only (5) All A, B and C

46. Which of the following HTML code line can be used to create a hyperlink to the website of the National Institute of Education? (The URL of the website is http://nie.lk)

(1) National Institute of Education
(2) National Institute of Education
(3) National Institute of Education
(4) <a href = "http://nie.lk"National Institute of Education>
(5) <a src = http://nie.lkNational Institute of Education>

47. Which of the following could be used to create an array in PHP?

A – $city[ ] = array("Colombo");
B – city[ ] = "Colombo";
C – $city = array("Colombo");

(1) A only (2) B only (3) C only
(4) A and C only (5) B and C only

48. Given below is a partially completed PHP script used to connect to a database named **Employees** using MySQLi (procedural method). Which option is most suitable to fill in the blank spaces Ⓐ, Ⓑ and Ⓒ respectively?

```
<?php
     $servername = "127.0.0.1";
     $username = "username";
     $password = "password";
     $conn = mysqli_connect($servername, $username, $password);
     if (!$conn)  {
          die("Connection failed: " . mysqli_connect_error());
     }
     $sql = "CREATE DATABASE _____Ⓐ____";
     if (mysqli_query(___Ⓑ__, Ⓒ___) {
          echo "Database created successfully";
     } else {
          echo "Error creating database: " . mysqli_error($conn);
     }
     mysqli_close($conn)
?>
```

(1) $sql, $conn, $Employees
(2) $conn, $sql, Employees
(3) $Employees, $conn, $sql
(4) Employees, $conn, $sql
(5) Employees, $sql, $conn

49. Which of the following statements is/are correct?

A – Quantum computing could be an alternative to overcome the limitations of the existing microprocessors.
B – Natural phenomena such as the behaviour of ant colonies could be used to develop new computing models to solve complex problems.
C – An inference engine of an expert system utilizes the facts in a knowledge base to support decision making.

(1) A only
(2) A and B only
(3) A and C only
(4) B and C only
(5) All A, B and C

50 Which of the following statements is/are correct?

A – E-Commerce encourages to minimize physical interactions between buyers and sellers.
B – The main purpose of sending a One Time Password (OTP) to a credit card holder's mobile phone during an online payment is to identify the current location of the card owner.
C – Bitcoin is a leading virtual currency.

(1) A only
(2) B only
(3) C only
(4) A and C only
(5) B and C only

* * *

සියලු හිමිකම් ඇවිරිණි/(முழுப் பதிப்புரிமையுடையது)/[All Rights Reserved]

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2022(2023)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2022(2023)
General Certificate of Education (Adv. Level) Examination, 2022(2023)

තොරතුරු හා සන්නිවේදන තාක්ෂණය II
தகவல், தொடர்பாடல் தொழிநுட்பவியல் II
Information & Communication Technology II

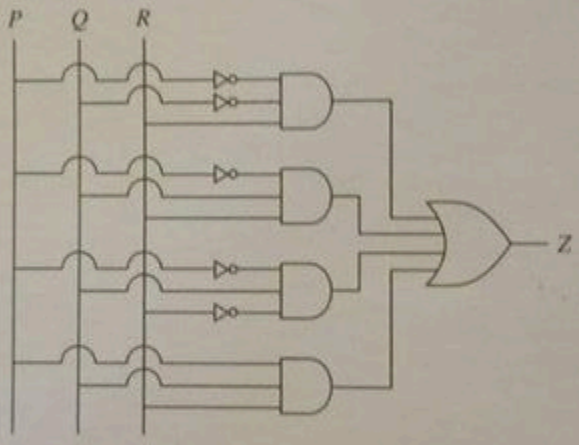
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Part B

* *Answer any* ***four*** *questions only.*

5. (*a*) Consider the logic circuit shown in the following figure in which P, Q and R are the inputs and Z is the output.



(i) Draw the complete truth table for the above circuit.

(ii) Complete the Karnaugh map relevant to the above circuit according to the following format.

		PQ = 00	01	11	10
R	0				
	1				

(iii) Using the Karnaugh map, derive the most simplified sum-of-products expression for the output Z. Show the loops clearly on the Karnaugh map.

(*b*) (i) Using Boolean algebra, show that the Boolean expression $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$ is equivalent to $BC + AC + AB$.

(ii) Draw a logic circuit for the above **simplified** expression in (*b*)(i) by only using OR and AND gates.

(iii) Draw a logic circuit for the above **simplified** expression in (*b*)(i) by only using NAND gates.

[see page ten

6. (*a*) Write down the most suitable terms to replace the blanks labelled Ⓟ to Ⓤ in the following paragraph related to data encryption.

There are two types of encryption techniques used namely, *symmetric key encryption* and *asymmetric key encryption*. In ..... Ⓟ ..... key encryption, the same key is used for encrypting and decrypting the information. In this scheme, to exchange information, users must share a ..... Ⓠ ..... key among themselves. In ..... Ⓡ ..... key encryption, different keys are used for encrypting and decrypting the information. In this technique, users usually have a pair of dissimilar keys known as a ..... Ⓢ ..... key and a ..... Ⓣ ..... key. When one key is used for encryption, the other key can decrypt the ..... Ⓤ ..... back to the original plain text.

(*b*) Suppose that the ABC Company has received the 192.248.154.0/25 IP address block to be distributed among its four departments.

It is required to subnet the above IP address block to satisfy the following requirements. Assume that each department is located in a separate building.

Subnet Number	Department Name	Number of Computers
S001	Accounts	30
S002	Sales	28
S003	Service	18
S004	Administration	24

(i) Write the first address and the last address in the given address block.

(ii) Write the subnet mask of the given address block in dotted decimal notation.

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

(iv) Once subnetting is done, fill the following table.

Subnet Number	Network Address	Subnet mask	First usable IP address	Last usable IP address	Broadcast Address
S001					
S002					
S003					
S004					

(*c*) (i) Write **one** difference between User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) transport layer protocols.

(ii) Write **two** main functions of a router.

(*d*) (i) What is the functionality of a Domain Name System (DNS) server?

(ii) What is the functionality of a Dynamic Host Configuration Protocol (DHCP) server?

[*see page eleven*

7. (*a*) An IoT setup to water a plant in a greenhouse is shown in Figure 1. A mobile application is used to operate the water-releasing tap. As shown, the setup includes a sensor, a controller, and a microcontroller (Arduino Board) with a communication module.

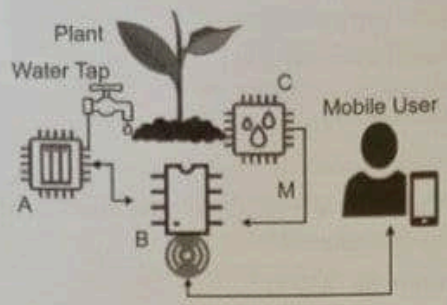


Figure 1

(i) Match the IoT components labelled as A, B and C to components described in the scenario.

(ii) Explain the reason why the arrow M is shown in a single direction.

(*b*) The moisture sensor provides 10 levels of moisture intensity with 1 being "the driest" and 10 being "the wettest"; 8 is the desired level to be maintained. The algorithm on the right can be used to automate the task of opening the tap when the soil is dry and to stop the water flow when enough watering is done. Write down the most suitable entries for the places labelled X, Y and Z. [**Note – While (true)** block represents the continuous loop function in Arduino]

```
While (true){
      Read Moisture Level as M_L
      If [X]
            If Tap Closed
                  Then [Y]
            End if
      Else
            If Not Tap Closed
                  Then [Z]
            End if
      End if
}
```

(*c*) What could be monitored in the greenhouse using an LDR sensor?

(*d*) A multi-agent system is proposed for this greenhouse (Figure 2). In this system the images that are captured using a mobile phone are stored in the plant database. The multi-agent system works as follows:

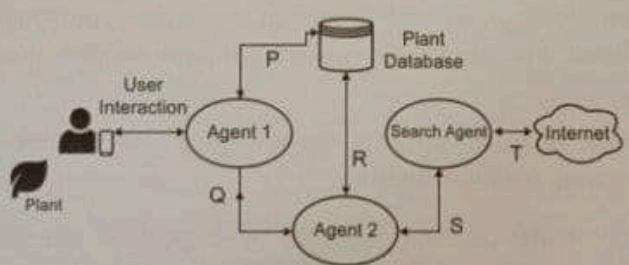


Figure 2

- Agent 1 handles the user interactions, user access to data, and triggers Agent 2.
- Agent 2 processes the images, identifies anomalies if any, and triggers Search Agent if needed.
- Search Agent searches relevant information from the Internet, feeds the search results to Agent 2 who updates the database after processing, and notifies Agent 1 if an alert is to be raised.

(i) In the given scenario, who is/are the self-autonomous agent(s)?

(ii) The interaction P involves saving plant details in the database and retrieving those for Agent 1. The interaction R involves reading the database and writing search results to the database. Explain the interactions Q and S.

(iii) After long-term use of the system, it was decided to remove Search Agent assuming that the database contains all the information needed. Write down the main disadvantage of this removal.

(*e*) The owner has started an online shop to sell the harvest from this greenhouse to buyers who are nearby.

(i) State **one** advantage of limiting sales to the community nearby the greenhouse.

(ii) State an alternative payment method that can be used until an online payment facility is setup.

(iii) He cultivated tomatoes and sells salted dried tomatoes online (as a snack). This, known as value addition, gives higher profits. Give another advantage of this value-addition to his e-business.

[*see page twelve*

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8. (*a*) (i) What is the output of the following python script if 1002 is given as the input?

```
A = int(input("Enter a number:"))
B = 0
while(A > 0):
    C = A % 10
    B = B + C
    A = A // 10      # // is integer division
print(B)
```

(ii) What would be the modification required to the `B = B + C` code line of the above code if the reverse of a given positive number is to be printed?

(Example: if the input is 1234, the output should be 4321)

(*b*) Assume that your class is having a party, and each student is asked to bring one food item. The class teacher has decided to make the party interesting by introducing one rule: the first and last letters of the name of the food item must match with the first and last letters of the student name.

For example, ***percy*** is allowed to bring ***potato curry*** and ***prageeth*** is allowed to bring ***pepper fish***.

Write a Python function called Party() that takes the student name and the name of the food item as parameters. The function should return **True** or **False** to indicate whether the student is allowed to bring the food item to the party or not.

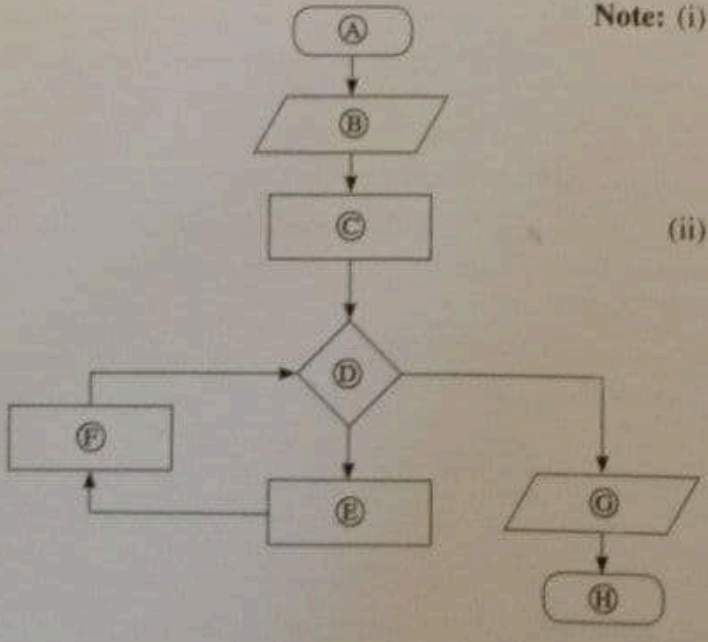
Example:

Party ("percy", "potato curry") should return **True**

Party ("fareena", "fried rice") should return **False**

Note: You can assume that student name and food item name are always lowercase strings and have at least two letters. There may be hyphens and spaces in the names, but these will not appear at the beginning or end of the string. The names will not contain numerals.

(*c*) Write down the most suitable statements for labels Ⓐ to Ⓗ in the flowchart given below which is drawn to calculate the factorial of a given positive integer.



Note: (i) The factorial of a positive integer is defined as the product of that integer and all the integers below it. E.g. factorial of 5 is $5 \times 4 \times 3 \times 2 \times 1 = 120$. The factorial of 0 is defined as 1.

(ii) A process box in this flowchart may contain one or more statements.

(see page thirteen)

9. (*a*) Draw the Entity Relationship (ER) diagram for the following scenario.

A student uses the following data to register for subjects. Each subject is represented by its subject number (subjectNumber), subject name (subjectName) and prerequisite subject. A student can register for more than one subject during a semester. Each student has a first name (studentFname), a last name (studentLname) and a unique student number (studentId). Student age (age) is required to register for subjects. Subjects are offered based on the availability of the resources. Hence some subjects will not be offered during a semester. A subject offered in a semester (subject_offering) includes subjectNumber, year, semester, teacher identifier (teacherId), and classroom. One subject_offering is assigned to a single teacher who is represented by a teacherId, name of the teacher (teacherName), and qualifications. Teacher can have several qualifications. Marks are awarded to students for each subject that they register.

Use only the terms from the list given below for the entities and attributes in your ER diagram. You have the freedom to choose relationship names.

List : {age, classroom, DOB, marks, qualification, semester, student, studentFname, studentId, studentLname, subject, subject_offering, subjectName, subjectNumber, teacher, teacherId, teacherName, year}

Note: DOB – Date of Birth

(*b*) Use the following **Employee**, and **Assign_Project** denormalized tables to answer parts (i), (ii), (iii), (iv) and (v). Please note that primary key(s) of each table is(are) underlined.

Employee

EmployeeId	FullName	DOB	Salary
E001	Saman Perera	12/02/1978	140000
E002	Upul Fernando	23/05/1982	44000
E005	Chris Peris	11/08/1980	44000
E007	Kamala Gamage	08/08/1973	52000
E008	Sunil Perera	25/04/1969	115000
E011	Vipul Namal	09/02/1977	38000

Assign_Project

ProjectId	EmployeeId	PName	Description
P04	E002	Sales	Implement sales management system
P04	E008	Sales	Implement sales management system
P06	E007	HRM	Implement HRM system
P07	E002	Library	Implement library management system
P09	E001	Inventory	Implement inventory management system
P09	E007	Inventory	Implement inventory management system

(i) Write down the output of the following SQL statement:

```
SELECT Employee.FullName, Employee.Salary
FROM Employee, Assign_Project
WHERE Assign_Project.EmployeeId = Employee.EmployeeId;
```

(ii) Write an SQL statement to display the names of the employees who are assigned to project **P04**.

(iii) In which normal form does the **Assign_Project** table exist?

(iv) What needs to be done to convert the **Assign_Project** table into its next normal form? Justify your answer.

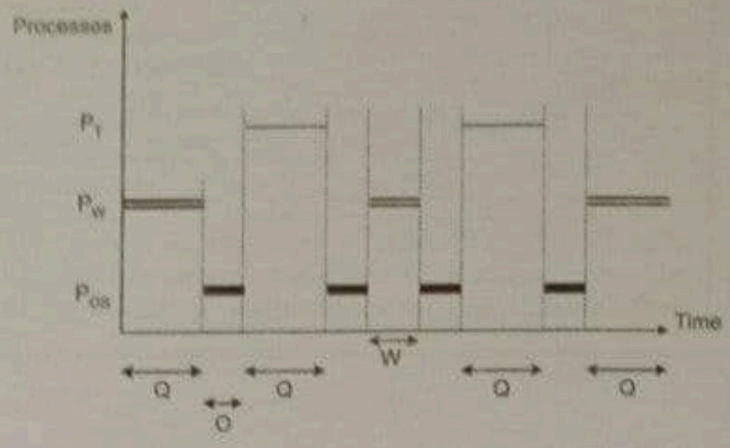
(v) Give an example SQL query where the update anomaly can occur in **Assign_Project** table.

[see page fourteen

10. (a) A user starts a web browser on her single processor computer to go through some Python tutorials. She also starts a text editor to work on her Python program.

The diagram shows how the *web browser* (P_W) and the *text editor* (P_T) processes run on the processor along with the *operating system* (P_{OS}) since the time the user started the web browser.

What important work related to P_W and P_T will be performed by the operating system during the time period indicated by 'O'?



(b) Assume that the time period the operating system allocates to each process to run on the processor in a single instance is Q.

Explain why W (the time period the web browser process runs at the second instance) is less than Q as shown in the graph.

(c) Assume that we have a computer that can use 16-bit virtual addresses from 0 up to 64 K. Assume further that this computer has only 32 KB of physical memory and that the page size in this computer is 4 KB.

The above 16-bit virtual address is made up of the *bits of the page number* followed by *offset bits*.

User runs a particular program having a size of 32 KB on this computer. A few selected fields of the page table of that process at a particular time are shown in the figure below.

Page number	Frame number	Present/ absent
0	011	1
1	101	1
2	000	0
3	000	0
4	000	0
5	000	0
6	000	0
7	000	0

Notes:

- The frame number is indicated in binary.
- The virtual addresses on page 0 are from 0 to 4095 and on page 1 are from 4096 to 8191 and so on.
- The Present/absent bit indicates the validity of the entry. If this bit is 1, the entry is valid and can be used. If it is 0, then the relevant virtual page is not in physical memory.

Assume that in the above process the virtual address 0001 0000 0000 0011 is wanted. Is that page available in physical memory? If your answer is 'yes', then write down the 15-bit physical address that the above virtual address will be mapped into. If your answer is 'no', then write down the actions that the operating system will take on behalf of that process for the said requirement.

(d) Give **two** reasons as to why a page of a process may not be in physical memory.

(e) Explain how the operating system could find the blocks of a file when the files are stored on a hard disk using

(i) contiguous allocation and

(ii) index allocation.

(**Hint:** the use of the directory entry)

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இலங்கைப் பரீட்சைத் திணைக்களம்
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2022(2023)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2022(2023)
General Certificate of Education (Adv. Level) Examination, 2022(2023)

තොරතුරු හා සන්නිවේදන තාක්ෂණය II தகவல், தொடர்பாடல் தொழினுட்பவியல் II **Information & Communication Technology II**	**20 E II**

පැය තුනයි மூன்று மணித்தியாலம் ***Three hours***	අමතර කියවීම් කාලය - මිනිත්තු 10 යි மேலதிக வாசிப்பு நேரம் - 10 நிமிடங்கள் **Additional Reading Time - 10 minutes**

Use additional reading time to go through the question paper, select the questions you will answer and decide which of them you will prioritise.

Index No. : .....

Important:

- *This question paper consists of* **14** *pages.*
- *This question paper comprises of two parts,* **Part A** *and* **Part B**. *The time allotted for* ***both parts*** *is* ***three hours***.
- *Use of calculators is* ***not allowed***.

PART A — Structured Essay:
(pages 2 - 8)

- *Answer* ***all*** *the questions* ***on this paper itself***. *Write your answers in the space provided for each question. Note that the space provided is sufficient for your answers and that extensive answers are not expected.*

PART B — Essay:
(pages 9 - 14)

- *This part contains* ***six*** *questions, of which,* ***four*** *are to be answered. Use the papers supplied for this purpose.*
- *At the end of the time allotted for this paper, tie the* ***two parts together*** *so that* **Part A** *is* ***on top*** *of* **Part B** *before handing them over to the Supervisor.*
- *You are permitted to remove* ***only*** **Part B** *of the question paper from the Examination Hall.*

For Examiners' Use Only

For the Second Paper		
Part	**Question No.**	**Marks**
A	1	
	2	
	3	
	4	
B	5	
	6	
	7	
	8	
	9	
	10	
Total		

Final Marks

In numbers	
In words	

Code Number

Marking Examiner 1	
Marking Examiner 2	
Marks checked by :	
Supervised by :	

[see page two

Part A – Structured Essay

Answer all four questions on this paper itself.

Do not write in this column

1. (*a*) Draw the expected output of the following HTML code segment when rendered by a web browser.

```
<html>
<body>
<table  border=1>
       <tr>  <th>Designation</th> <th> Contact Telephone Numbers </th>  </tr>
       <tr>  <td rowspan=2> Principal</td> <td> 061-2223211 </td>  </tr>
       <tr>  <td> 067-5557772</td> </tr>
       <tr>  <td> Vice Principal</td> <td> 061-5557771 </td>  </tr>
       <tr>  <td  colspan=2> Common Phone Number: 019-2233445</td>  </tr>
</table>
</body>
</html>
```

Note: Consider the following dotted line box as the display area of the browser.

(*b*) Rewrite the following HTML code by applying internal CSS with grouping selectors.

```
<html>
<head> <title>Cascading Style Sheets</title> </head>
<body>
<h1 style="color:blue;text-align:center"> Introduction to Cascading Style Sheets</h1>
<h2 style="color:blue"> CSS can be applied to html documents in three different ways.</h2>
</body>
</html>
```

[see page three

(c) Consider the HTML form given in Figure 1 rendered by a web browser.

Do not write in this column

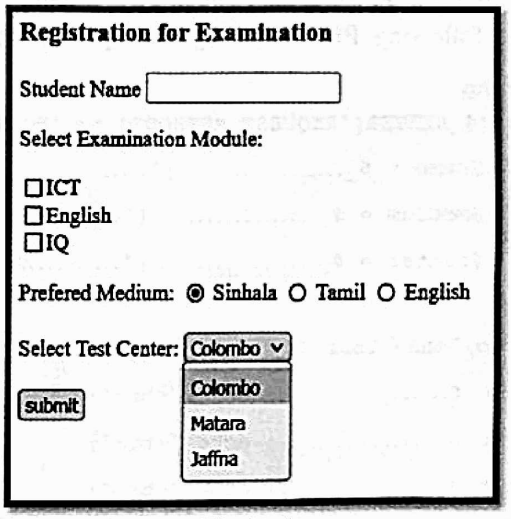


Figure 1

The relevant HTML code (incomplete) is given below. Fill the blanks in it in order to get the output shown in Figure 1.

```
<html>
<head>Registration Form</head>
<body>
<h3>Registration for Examination</h3>

<form ..... ="process.php" ..... ="post">

<div> ..... <input ..... ="....." ..... ="name"> </div>

<p>
 <div>
  Select Examination Module: <p>

  <input ..... ="....." ..... ="module[]" ..... ="ICT" /> ..... <br>

  <input ..... ="....." ..... ="module[]" ..... ="English" /> ..... <br>

  <input ..... ="....." ..... ="module[]" ..... ="IQ" /> ..... <br>
 </div>
  <br>
 <div>
  Prefered Medium:

  <input ..... ="....." ..... ="language" ..... ="Sinhala" ...../> Sinhala

  <input ..... ="....." ..... ="language" ..... ="Tamil" /> Tamil

  <input ..... ="....." ..... ="language" ..... ="English" /> English
 </div>
 <div>
  <br>
 Select Test Center:

  <..... name="Center">

   <..... .....="Colombo"  selected>..... </.....>

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

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

  </..... >
 </div>
  <br>
  <input type="submit"  name="submit"  value="submit" >
</form>
</body>

</html>
```

[see page four

(*d*) The process.php script is invoked after submitting the above form in part (*c*). After submitting the form, it is required to display the name, medium and test center. Complete the following PHP code segment (process.php) to fulfil this requirement.

Do not write in this column

```
<?php
if ($_SERVER["REQUEST_METHOD"] == "POST") {
    $name = $_.....["....."];
    $medium = $_.....["....."];
    $center = $_.....["....."];
}

echo "<h2> Your Input:</h2>";
echo $.....; echo "<br>";
echo $.....; echo "<br>";
echo $.....; echo "<br>";
?>
```

2. (*a*) Fill the blanks in the following statements by selecting the most suitable items from the given list.

A few of your friends who study ICT for A/L at your school decided to improve the school library by introducing an online library management system. Assuming they know the requirements, they started system development as the first step and completed a system which includes a mobile user interface and a database. After completing the system, they met the school principal and the library staff for a demonstration and possible deployment of their system. Their completed solution requires a computer at each classroom to access the library system.

At the meeting they got to know that the library already has a database to keep the records of books and borrowings, and it is functioning well with a simple user interface.

List: {*preliminary investigation*, *technical feasibility*, *economic feasibility*, *operational feasibility*, *organizational feasibility*, *problem definition*, *system deployment*}

(i) This team of students could have found out about the existing library system at the beginning if they did not skip the .....

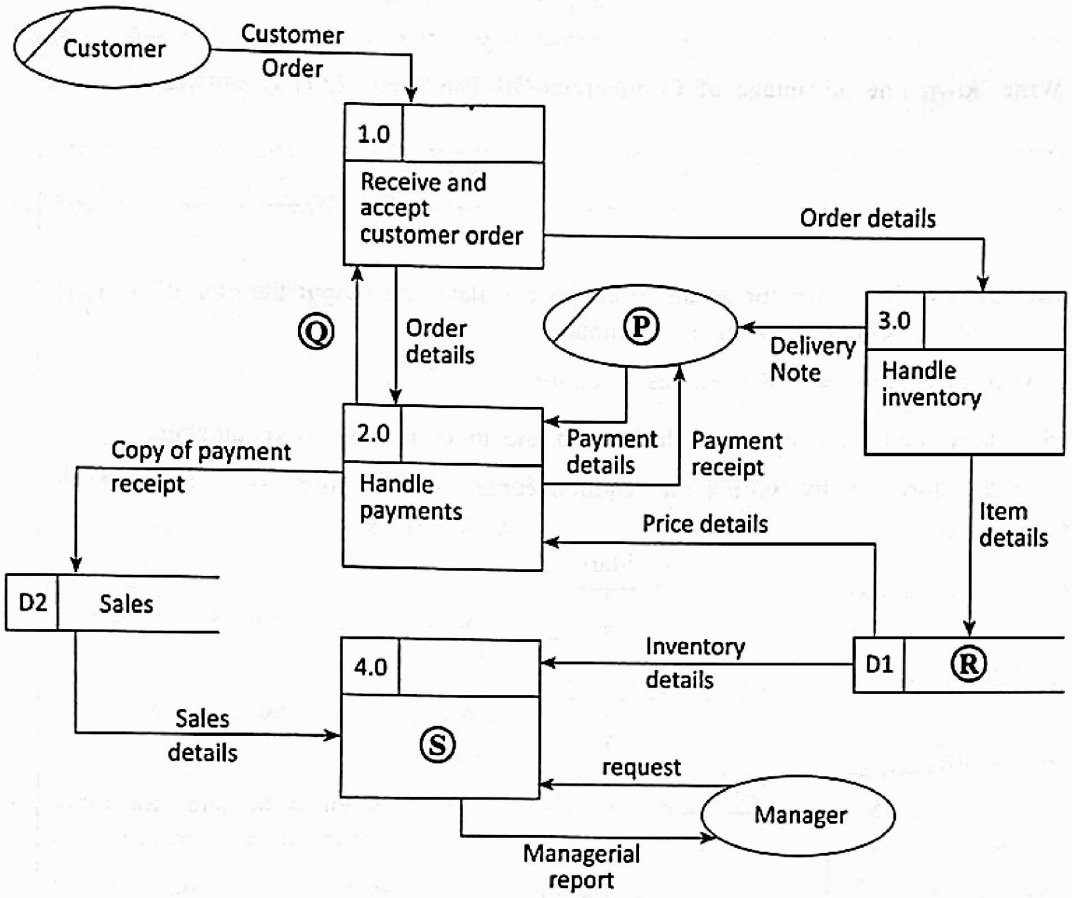
(ii) The school principal refuses to accept this proposed solution due to resource constraints and the limited benefits compared to the investment. This indicates the solution developed by students lacks .....

(iii) The library staff says that they will accept and use this demonstrated system only if the existing database is used as a part of the new solution. This indicates the solution developed by students lacks .....

[*see page five*

(*b*) The following is a labelled data flow diagram (DFD) to represent purchasing activities at a furniture shop.

Do not write in this column



Note:  symbol denotes duplicated external entities.

(i) Write down the most suitable item for Ⓟ, Ⓠ, Ⓡ and Ⓢ by selecting from the given list.

List: {Generate reports, Inventory, Copy of payment receipt, Customer, Customer details, Item details, Manager, Sales person, Sales}

Ⓟ – ..... Ⓠ – .....

Ⓡ – ..... Ⓢ – .....

(ii) How many processes, external entities and data stores are shown in the above diagram?

No. of Processes : .....

No. of External entities : .....

No. of Data stores : .....

[*see page six*

Do not write in this column

(c) (i) Write down **one** difference between parallel deployment and pilot deployment.

.....

.....

(ii) Write down **one** advantage of Commercial-Off-The-Shelf (COTS) software.

.....

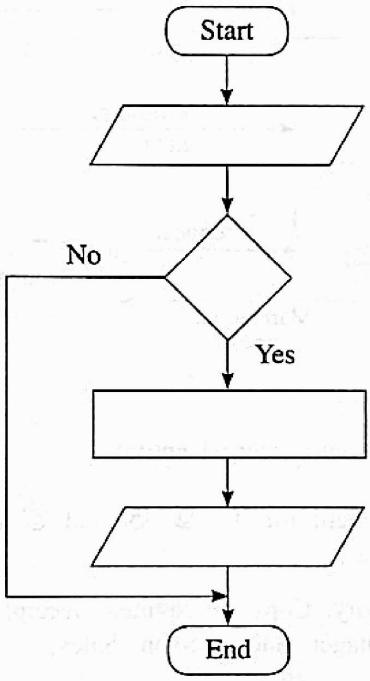
.....

3. (a) A flowchart is to be drawn for an algorithm to calculate and output the area of a circle. The radius of the circle is given as an input.

Note: Area of a circle = 3.14 × Radius × Radius

The algorithm should not calculate the area if the input is a negative number.

Complete the flowchart by writing the required content for the four (4) components left blank.



(b) What is the output of the following Python code?

```
S = "Advanced level"
S1 = " "
for c in S :
    if c in ( "a" , "e" , "i" , "o" , "u" ):
        pass
    else:
        S1 = S1 + c
print (S1)
```

.....

(c) What code line(s) in part (b) is/are to be removed to get 'aeee' as the output?

.....

.....

.....

[see page seven

(*d*) Fill in the blank spaces of the following Python code assuming that the purpose of the code is to copy the content of a text file (A) to another text file (B).

Do not write in this column

```
A = input("Enter the name of text file A")
B = input("Enter the name of text file B")

f1 = ..... (A, .....)

f2 = ..... (B, .....)

for line in ..... :

    f2.write (.....)

f1.  .....

f2.  .....
```

4. (*a*) Write down the most suitable items from the given list for the following statements.

List: {*e-marketplace*, *group purchasing*, *online auctions*, *online reverse auctions*}

(i) In ....., sellers bid for the prices at which they are willing to sell their goods or services.

(ii) ..... allows buyers to compare multiple online sellers within the same online platform.

(*b*) Write the most appropriate word or phrase to answer the following questions based on the description given below.

Recently introduced National Fuel Pass system in Sri Lanka is an example of how ICT can be used to overcome national challenges successfully. It is observed that for a given week, the maximum server hardware resource utilization happens only for a short period (e.g., few hours) and the rest of the time the system operates at a very low resource demand.

(i) One of the views on resource provision is to purchase computer hardware permanently considering the maximum demand. What is the main **disadvantage** with this approach?

.....

.....

(ii) What is the alternative solution to overcome the disadvantage mentioned in (*b*)(i) above, while satisfying the maximum resource demand instances?

.....

[*see page eight*

Do not write in this column

(c) The steps in the fetch-execute cycle are as follows:

1. The ..... Ⓟ ..... is loaded with the memory address of the relevant instruction of the program.
2. The instruction is loaded into the instruction register.
3. The instruction present in the instruction register is decoded.
4. The control unit of the CPU passes the decoded instruction as a sequence of control signals to the relevant ..... Ⓠ ..... of the CPU.
5. The program counter is changed to point to the next instruction.
6. Steps from Step 2 are repeated.

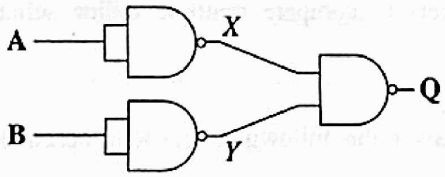
Select the most suitable items to replace the labels Ⓟ and Ⓠ from the following list.

List: {file, functional unit, instruction, memory, page, program counter}

Ⓟ – .....

Ⓠ – .....

(d) (i) Complete the truth table for the given logic circuit.



A	B	X	Y	Q
0	0			
0	1			
1	0			
1	1			

(ii) What is the basic logic gate that has the above truth table (with inputs **A**, **B** and the output **Q**)?

.....

(e) The diagram below shows the OSI reference model and its mapping to the TCP/IP model. Write the correct names of the layers indicated by the labels P, Q, R, S, T and U.

OSI Reference Model	TCP/IP Model
P	S
Presentation Layer	
Session Layer	
Transport Layer	T
Q	U
R	Network Access Layer
Physical Layer	

P .....

Q .....

R .....

S .....

T .....

U .....

* *

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இலங்கைப் பரீட்சைத் திணைக்களம்
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අධ්‍යාපන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2022(2023)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2022(2023)
General Certificate of Education (Adv. Level) Examination, 2022(2023)

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தகவல், தொடர்பாடல் தொழில்நுட்பவியல் II
Information & Communication Technology II

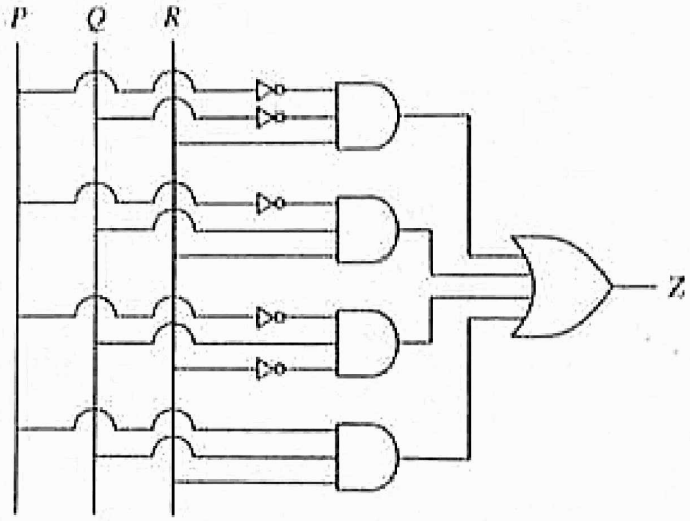
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Part B

* *Answer any four questions only.*

5. (*a*) Consider the logic circuit shown in the following figure in which *P*, *Q* and *R* are the inputs and *Z* is the output.



(i) Draw the complete truth table for the above circuit.

(ii) Complete the Karnaugh map relevant to the above circuit according to the following format.

		PQ			
		00	01	11	10
R	0				
	1				

(iii) Using the Karnaugh map, derive the most simplified sum-of-products expression for the output *Z*. Show the loops clearly on the Karnaugh map.

(*b*) (i) Using Boolean algebra, show that the Boolean expression $\bar{A}BC + A\bar{B}C + AB\bar{C} + ABC$ is equivalent to $BC + AC + AB$.

(ii) Draw a logic circuit for the above **simplified** expression in (*b*)(i) by only using OR and AND gates.

(iii) Draw a logic circuit for the above **simplified** expression in (*b*)(i) by only using NAND gates.

[see page ten

6. (*a*) Write down the most suitable terms to replace the blanks labelled Ⓟ to Ⓤ in the following paragraph related to data encryption.

There are two types of encryption techniques used namely, *symmetric key encryption* and *asymmetric key encryption*. In ..... Ⓟ ..... key encryption, the same key is used for encrypting and decrypting the information. In this scheme, to exchange information, users must share a ..... Ⓠ ..... key among themselves. In ..... Ⓡ ..... key encryption, different keys are used for encrypting and decrypting the information. In this technique, users usually have a pair of dissimilar keys known as a ..... Ⓢ ..... key and a ..... Ⓣ ..... key. When one key is used for encryption, the other key can decrypt the ..... Ⓤ ..... back to the original plain text.

(*b*) Suppose that the ABC Company has received the 192.248.154.0/25 IP address block to be distributed among its four departments.

It is required to subnet the above IP address block to satisfy the following requirements. Assume that each department is located in a separate building.

Subnet Number	Department Name	Number of Computers
S001	Accounts	30
S002	Sales	28
S003	Service	18
S004	Administration	24

(i) Write the first address and the last address in the given address block.

(ii) Write the subnet mask of the given address block in dotted decimal notation.

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

(iv) Once subnetting is done, fill the following table.

Subnet Number	Network Address	Subnet mask	First usable IP address	Last usable IP address	Broadcast Address
S001					
S002					
S003					
S004					

(*c*) (i) Write **one** difference between User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) transport layer protocols.

(ii) Write **two** main functions of a router.

(*d*) (i) What is the functionality of a Domain Name System (DNS) server?

(ii) What is the functionality of a Dynamic Host Configuration Protocol (DHCP) server?

[see page eleven

7. (*a*) An IoT setup to water a plant in a greenhouse is shown in Figure 1. A mobile application is used to operate the water-releasing tap. As shown, the setup includes a sensor, a controller, and a microcontroller (Arduino Board) with a communication module.

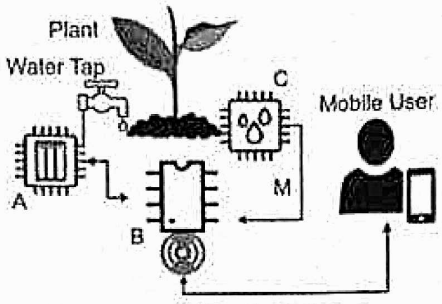


Figure 1

(i) Match the IoT components labelled as A, B and C to components described in the scenario.

(ii) Explain the reason why the arrow M is shown in a single direction.

(*b*) The moisture sensor provides 10 levels of moisture intensity with 1 being "the driest" and 10 being "the wettest"; 8 is the desired level to be maintained. The algorithm on the right can be used to automate the task of opening the tap when the soil is dry and to stop the water flow when enough watering is done. Write down the most suitable entries for the places labelled X, Y and Z. [**Note – While (true)** block represents the continuous loop function in Arduino]

```
While (true){
      Read Moisture Level as M_L
      If [X]
            If Tap Closed
                  Then [Y]
            End if
      Else
            If Not Tap Closed
                  Then [Z]
            End if
      End if
}
```

(*c*) What could be monitored in the greenhouse using an LDR sensor?

(*d*) A multi-agent system is proposed for this greenhouse (Figure 2). In this system the images that are captured using a mobile phone are stored in the plant database. The multi-agent system works as follows:

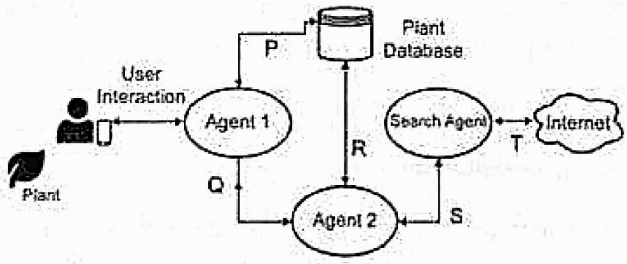


Figure 2

- Agent 1 handles the user interactions, user access to data, and triggers Agent 2.
- Agent 2 processes the images, identifies anomalies if any, and triggers Search Agent if needed.
- Search Agent searches relevant information from the Internet, feeds the search results to Agent 2 who updates the database after processing, and notifies Agent 1 if an alert is to be raised.

(i) In the given scenario, who is/are the self-autonomous agent(s)?

(ii) The interaction P involves saving plant details in the database and retrieving those for Agent 1. The interaction R involves reading the database and writing search results to the database. Explain the interactions Q and S.

(iii) After long-term use of the system, it was decided to remove Search Agent assuming that the database contains all the information needed. Write down the main disadvantage of this removal.

(*e*) The owner has started an online shop to sell the harvest from this greenhouse to buyers who are nearby.

(i) State **one** advantage of limiting sales to the community nearby the greenhouse.

(ii) State an alternative payment method that can be used until an online payment facility is setup.

(iii) He cultivated tomatoes and sells salted dried tomatoes online (as a snack). This, known as value addition, gives higher profits. Give another advantage of this value-addition to his e-business.

[see page twelve

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8. (a) (i) What is the output of the following python script if 1002 is given as the input?

```
A = int(input("Enter a number:"))
B = 0
while(A > 0):
    C = A % 10
    B = B + C
    A = A // 10      # // is integer division
print(B)
```

(ii) What would be the modification required to the `B = B + C` code line of the above code if the reverse of a given positive number is to be printed?

(Example: if the input is 1234, the output should be 4321)

(b) Assume that your class is having a party, and each student is asked to bring one food item. The class teacher has decided to make the party interesting by introducing one rule: the first and last letters of the name of the food item must match with the first and last letters of the student name.

For example, *percy* is allowed to bring *potato curry* and *prageeth* is allowed to bring *pepper fish*.

Write a Python function called Party() that takes the student name and the name of the food item as parameters. The function should return **True** or **False** to indicate whether the student is allowed to bring the food item to the party or not.

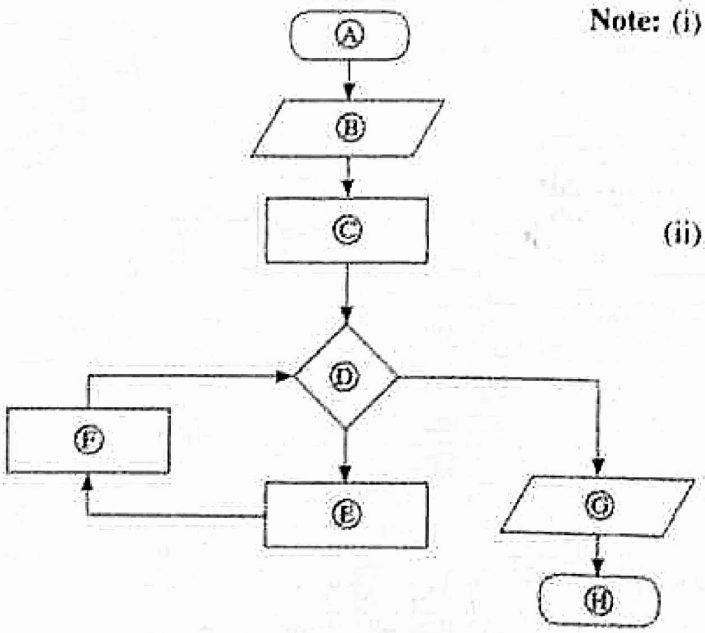
Example:

Party ("percy", "potato curry") should return **True**

Party ("fareena", "fried rice") should return **False**

Note: You can assume that student name and food item name are always lowercase strings and have at least two letters. There may be hyphens and spaces in the names, but these will not appear at the beginning or end of the string. The names will not contain numerals.

(c) Write down the most suitable statements for labels Ⓐ to Ⓗ in the flowchart given below which is drawn to calculate the factorial of a given positive integer.



Note: (i) The factorial of a positive integer is defined as the product of that integer and all the integers below it. E.g. factorial of 5 is $5 \times 4 \times 3 \times 2 \times 1 = 120$. The factorial of 0 is defined as 1.

(ii) A process box in this flowchart may contain one or more statements.

[see page thirteen

9. (*a*) Draw the Entity Relationship (ER) diagram for the following scenario.

A student uses the following data to register for subjects. Each subject is represented by its subject number (subjectNumber), subject name (subjectName) and prerequisite subject. A student can register for more than one subject during a semester. Each student has a first name (studentFname), a last name (studentLname) and a unique student number (studentId). Student age (age) is required to register for subjects. Subjects are offered based on the availability of the resources. Hence some subjects will not be offered during a semester. A subject offered in a semester (subject_offering) includes subjectNumber, year, semester, teacher identifier (teacherId), and classroom. One subject_offering is assigned to a single teacher who is represented by a teacherId, name of the teacher (teacherName), and qualifications. Teacher can have several qualifications. Marks are awarded to students for each subject that they register.

Use only the terms from the list given below for the entities and attributes in your ER diagram. You have the freedom to choose relationship names.

List : {age, classroom, DOB, marks, qualification, semester, student, studentFname, studentId, studentLname, subject, subject_offering, subjectName, subjectNumber, teacher, teacherId, teacherName, year}

Note: DOB – Date of Birth

(*b*) Use the following **Employee**, and **Assign_Project** denormalized tables to answer parts (i), (ii), (iii), (iv) and (v). Please note that primary key(s) of each table is(are) underlined.

Employee

EmployeeId	FullName	DOB	Salary
E001	Saman Perera	12/02/1978	140000
E002	Upul Fernando	23/05/1982	44000
E005	Chris Peris	11/08/1980	44000
E007	Kamala Gamage	08/08/1973	52000
E008	Sunil Perera	25/04/1969	115000
E011	Vipul Namal	09/02/1977	38000

Assign_Project

ProjectId	EmployeeId	PName	Description
P04	E002	Sales	Implement sales management system
P04	E008	Sales	Implement sales management system
P06	E007	HRM	Implement HRM system
P07	E002	Library	Implement library management system
P09	E001	Inventory	Implement inventory management system
P09	E007	Inventory	Implement inventory management system

(i) Write down the output of the following SQL statement:

```
SELECT Employee.FullName, Employee.Salary
FROM Employee, Assign_Project
WHERE Assign_Project.EmployeeId = Employee.EmployeeId;
```

(ii) Write an SQL statement to display the names of the employees who are assigned to project **P04**.

(iii) In which normal form does the **Assign_Project** table exist?

(iv) What needs to be done to convert the **Assign_Project** table into its next normal form? Justify your answer.

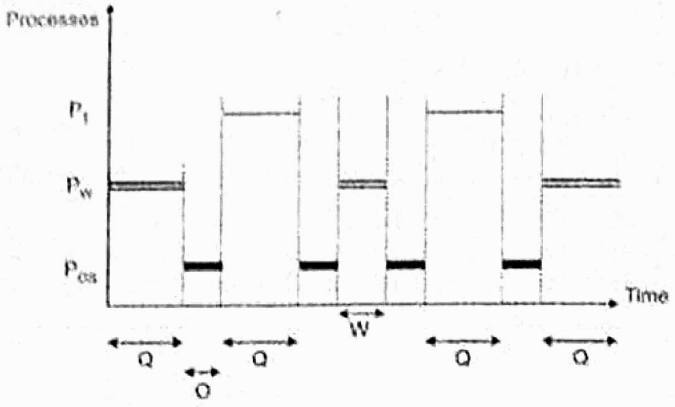
(v) Give an example SQL query where the update anomaly can occur in **Assign_Project** table.

[see page fourteen

10. (a) A user starts a web browser on her single processor computer to go through some Python tutorials. She also starts a text editor to work on her Python program.

The diagram shows how the *web browser* (P_W) and the *text editor* (P_T) processes run on the processor along with the *operating system* (P_{OS}) since the time the user started the web browser.

What important work related to P_W and P_T will be performed by the operating system during the time period indicated by 'O'?



(b) Assume that the time period the operating system allocates to each process to run on the processor in a single instance is Q.

Explain why W (the time period the web browser process runs at the second instance) is less than Q as shown in the graph.

(c) Assume that we have a computer that can use 16-bit virtual addresses from 0 up to 64 K. Assume further that this computer has only 32 KB of physical memory and that the page size in this computer is 4 KB.

The above 16-bit virtual address is made up of the *bits of the page number* followed by *offset bits*.

User runs a particular program having a size of 32 KB on this computer. A few selected fields of the page table of that process at a particular time are shown in the figure below.

Page number	Frame number	Present/ absent
0	011	1
1	101	1
2	000	0
3	000	0
4	000	0
5	000	0
6	000	0
7	000	0

Notes:

- The frame number is indicated in binary.
- The virtual addresses on page 0 are from 0 to 4095 and on page 1 are from 4096 to 8191 and so on.
- The Present/absent bit indicates the validity of the entry. If this bit is 1, the entry is valid and can be used. If it is 0, then the relevant virtual page is not in physical memory.

Assume that in the above process the virtual address 0001 0000 0000 0011 is wanted. Is that page available in physical memory? If your answer is 'yes', then write down the 15-bit physical address that the above virtual address will be mapped into. If your answer is 'no', then write down the actions that the operating system will take on behalf of that process for the said requirement.

(d) Give **two** reasons as to why a page of a process may not be in physical memory.

(e) Explain how the operating system could find the blocks of a file when the files are stored on a hard disk using

(i) contiguous allocation and

(ii) index allocation.

(Hint: the use of the directory entry)

itpanthiya.com by Kosala Rajapaksha