අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

| 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.

1. Which of the following pairs contains types of software that are **different** with respect to *ownership / licensing*?
   (1) Application software and open-source software
   (2) Application software and utility software
   (3) Proprietary software and open-source software
   (4) Proprietary software and systems software
   (5) Systems software and utility software

2. Which of the following is a good example for *batch processing*?
   (1) an air traffic control system
   (2) driving system in a driver-less (autonomous) car
   (3) Intensive Care Unit (ICU) patient monitoring and care system
   (4) payroll system
   (5) nuclear plant control system

3. There are different storage components which vary in capacity and access speed.
   Consider that the shown diagram portrays capacity and access speed variation of the storage components *L1 cache*, *L2 cache*, *main memory*, *registers* and the *hard disk*. The capacity increases and access speed decreases from top to bottom, as shown. ·

   Capacity   Access speed
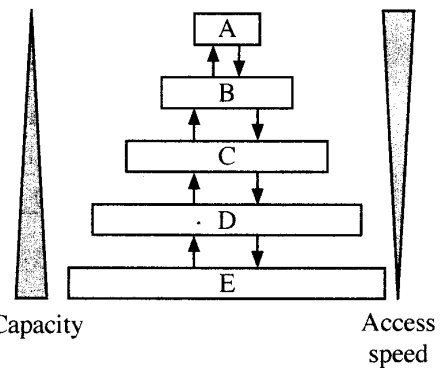
   Which is correct with respect to the A, B, C, D and E above?
   (1) A – hard disk, B – registers, C – L2 cache, D – L1 cache, E – main memory
   (2) A – L1 cache, B – L2 cache, C – registers, D – hard disk, E – main memory
   (3) A – main memory, B – registers, C – hard disk, D – L1 cache, E – L2 cache
   (4) A – registers, B – L1 cache, C – L2 cache, D – main memory, E – hard disk
   (5) A – registers, B – main memory, C – L2 cache, D – L1 cache, E – hard disk

1

4. Consider the following paragraph:

To run a program, the program code is copied from ......A...... into ......B...... The Central Processing Unit's (CPU's) *program counter* register is set to the memory location where the first instruction of the program has been saved and execution of the program starts. The ......C...... implements the fetch – decode – execute cycle.

Which of the following is the correct combination for A, B and C?

(1) A – CPU, B – primary memory, C – secondary storage
(2) A – CPU, B – secondary storage, C – primary memory
(3) A – primary memory, B – secondary storage, C – CPU
(4) A – secondary storage, B – CPU, C – primary memory
(5) A – secondary storage, B – primary memory, C – CPU

5. What is the correct result of bit-wise XOR operation between the two binary numbers 01011100_2 and 11111001_2?

(1) 00000010   (2) 01011000   (3) 01011010   (4) 10100101   (5) 11111101

6. What is the correct 2's complement binary representation of decimal -32_{10} using 8-bits?

(1) 00100000   (2) 10100000   (3) 11011111   (4) 11100000   (5) 11100001

7. What is the correct decimal equivalent of hexadecimal 88.8_{16}?

(1) 88.5_{10} (2) 88.8_{10} (3) 129.5_{10} (4) 136.5_{10} (5) 136.8_{10}

8. A particular command can be used to output the values of every byte in a file in decimal format. Assume a file contains the following text:

Love trees!

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

(1) 76	111	118	101	32	116	114	101	101	115	10	
(2) 76	111	118	101	116	114	101	101	115	33	10	
(3) 76	111	118	101	32	116	114	101	101	115	33	10
(4) 108	111	118	101	116	114	101	101	115	33	10	
(5) 108	111	118	101	32	116	114	101	101	115	33	10

Notes:

(i) Some selected rows from the ASCII table are given below:

Decimal	Character	Decimal	Character
10	(LINE FEED)	108	l
32	(SPACE)	111	o
33	!	114	r
76	L	115	s
101	e	116	t
		118	v

(ii) The file ends with a LINEFEED character.

9. Consider the following Karnaugh map and the logic circuit implemented based on it where A, B and C are the inputs and Z is the output:

AB

|		00	01	11	10
C	0	0	e	f	0
	1	1	g	h	1
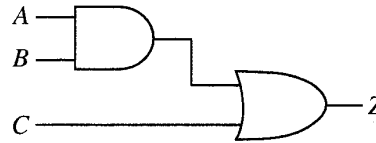
(a) Karnaugh map   (b) Logic circuit based on Karnaugh map

For the logic circuit to correctly implement the logic function represented in the Karnaugh map, what should be the values of **e, f, g, h**?

(1) e=0, f=0, g=1, h=1   (2) e=0, f=1, g=1, h=1
(3) e=1, f=0, g=1, h=1   (4) e=1, f=1, g=0, h=0
(5) e=1, f=1, g=0, h=1

10. Amara logs into a single-processor computer and starts a program to work on his presentation. He opens up a web browser too to get some information as well.
Consider the following process state transition diagram with respect to the process corresponding to Amara's **presentation program.**
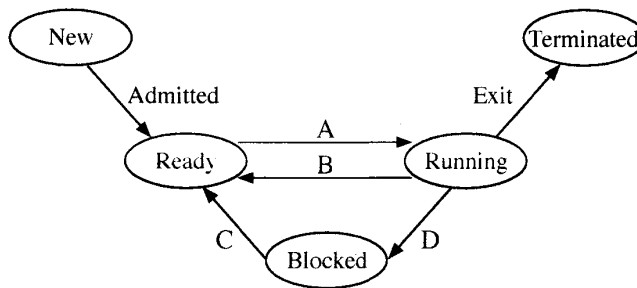
Consider some reasons for above state transitions:

Reason	Description
1	Amara saving his presentation on the hard disk
2	Operating system scheduling the presentation process to run on the processor
3	Operating system suspending the presentation process to let the web browser process to run on the processor
4	The finishing of saving the presentation on the hard disk

Which of the following gives a correct combination of reasons for transitions A to D?

(1) A – 1, B – 2, C – 3, D – 4   (2) A – 2, B – 3, C – 4, D – 1
(3) A – 3, B – 4, C – 1, D – 2   (4) A – 4, B – 1, C – 2, D – 3
(5) A – 4, B – 1, C – 3, D – 2

11. A *page table* is
    (1) a computer hardware unit through which all memory references pass.
    (2) a data structure that keeps information about the pages that are in processor caches.
    (3) a hardware component in memory that facilitates page movement.
    (4) an operating system data structure that keeps virtual to physical address mapping of a process' pages.
    (5) a piece of processor hardware that keeps a count of the number of pages of a process that are in virtual memory.

12. 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 gives the blocks of the *myprog.py* file as well.

FAT

100	101
101	–1
102	
103	100
104	

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

2. 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 *myprog.py* file **and** the disk space allocated for the *myprog.py* file respectively?

(1) 100, 12KB   (2) 101, 12KB   (3) 101, 16KB   (4) 103, 12KB   (5) 103, 16KB

13. Which of the following is/are correct with respect to a *digital signal*?
    A – denoted by a square wave
    B – contains a continuous range of values
    C – uses discrete values to represent information

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

14. Which of the following is/are correct with respect to *guided media* used for data transmission?
    A – a physical path is used for data transmission
    B – signal is broadcast through air
    C – Example: radio waves

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

15. Which of the following could be used to digitally represent analog signals?
(1) attenuation   (2) decoding   (3) distortion
(4) pulse code modulation   (5) synchronization

16. Read the following sentence:
    When devices send and receive data over a network, a protocol is used uniquely identify the sender interface and the correct delivery of the data to the receiver's interface.
What is the protocol that the writer in above sentence is referring to?

(1) FTP   (2) HTTP   (3) MAC   (4) TCP   (5) UDP

17. Given below are some characteristics of *Transmission Control Protocol (TCP)* and *User Datagram Protocol (UDP)*:
    A – best suited for applications that need high reliability and where the transmission time is less critical
    B – faster and requires fewer resources
    C – guarantees that no packets are missing
    D – packets may not arrive in order
    E – used for voice communications over internet
Which of the above are the characteristics of **UDP**?

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

18. Which of the following is/are examples for the use of the *Client-Server* model?
    A – A user printing a document using a printer connected to her computer
    B – A bank customer accessing online banking services with a web browser
    C – A cashier of a shop that accepts payments by credit cards
    (1) A only   (2) B only   (3) C only
    (4) A and C only   (5) B and C only

19. Sender A wants to send the message HELLO to receiver B. Before sending the message, it is converted to IFMMP. Which of the following is correct with respect to this scenario?
    A – HELLO is the *plaintext* while IFMMP is the *ciphertext*.
    B – IFMMP is the result of applying the ASCII code to HELLO.
    C – +1 is the *encryption key* while −1 is the *decryption key*.
    (1) A only   (2) A and B only   (3) A and C only
    (4) B and C only   (5) All A, B and C

20. Consider the following paragraph with three blanks labelled A, B and C:
    When there are multiple computers in an office, each computer can be given a private IP address. The router in the office gets a ......A...... IP address, and each of the computers connected to that router through guided/unguided media gets a private IP address from the ......B...... via the ......C...... protocol.
    Which of the following is the correct combination for the blanks A, B and C?
    (1) A – private, B – file server, C – HTTP
    (2) A – private, B – Internet, C – DHCP
    (3) A – private, B – router, C – FTP
    (4) A – public, B – file server, C – FTP
    (5) A – public, B – router, C – DHCP

21. Consider the information system types in **List A** and some examples in **List B**:

List A	List B
A1 – Enterprise Resource Planning System	B1 – A customer account system in a bank
A2 – Expert system	B2 – A system that facilitates manufacturing, marketing and sales of a garment business
A3 – Transaction processing system	B3 – A system that prescribes ayurvedic medicines using a knowledge base

   A good matching between lists **A** and **B** is:
    (1) A1-B1, A2-B2, A3-B3   (2) A1-B2, A2-B3, A3-B1
    (3) A1-B3, A2-B1, A3-B2   (4) A1-B2, A2-B1, A3-B3
    (5) A1-B3, A2-B2, A3-B1

22. Which of the following is **incorrect** about the *Agile Method*?
    (1) It cannot be used when the project has a fixed set of requirements.
    (2) It recommends a time sliced schedule for task completion.
    (3) It delivers gradual builds of the working product in an iterative manner.
    (4) It facilitates stakeholders (e.g., buyer, user) to review progress and provide feedback at every phase.
    (5) The product of each build is tested independently.

23. Which of the following statements is/are correct with respect to *Object Oriented Programming*?
   A – System output is determined by the object behaviour and their interactions.
   B – System is modelled as a collection of objects.
   C – Writing a program in this method is different from writing one according to the *structured programming* method.
   (1) A only   (2) B only   (3) C only
   (4) A and C only   (5) All A, B and C

24. Which of the following lists the activities of Structured System Analysis and Design Methodology (SSADM) in the correct order?
   (1) Feasibility study, Physical design, Requirement analysis, Requirement specification, System development
   (2) Feasibility study, Requirements analysis, Requirement specification, Logical system specification, Physical design
   (3) Feasibility study, Requirement specification, Requirements analysis, Logical system specification, Physical design
   (4) Requirements analysis, Logical system specification, Feasibility study, Requirement specification, Physical Design
   (5) Requirements analysis, Requirement specification, Feasibility study, Physical design, System development

● A system that gives the list of closest taxi drivers to a passenger is to be developed. Answer questions **25** and **26** with respect to it.

25. Assume that the following is the *Level 1 DFD* for this system:
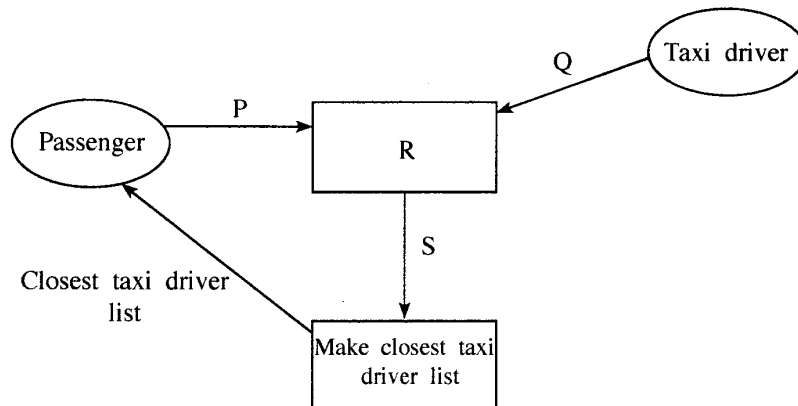
Which of the following contains the suitable replacements for P, Q, R and S in the above diagram?
   (1) P – Location, Q – Driver code, R – Get passenger and driver locations, S – Passenger and driver locations
   (2) P – Location, Q – Driver code and location, R – Get passenger and driver details, S – Passenger and driver details
   (3) P – NIC number, Q – NIC number, R – Get passenger and driver NIC numbers, S – Passenger and driver NIC numbers
   (4) P – Passenger code, Q – Driver code, R – Get passenger and driver codes, S – Passenger and driver codes
   (5) P – Passenger code, Q – Location, R – Get passenger and driver locations, S – Passenger and driver locations

26. Above Level-1 DFD was later improved so that a data store (D1) was connected to the process labelled R. What could be this data store?
   (1) NIC data   (2) Passenger details   (3) Taxi driver details
   (4) Travel cost details   (5) Weather records

27. Which of the following gives a suitable order of activities to follow when developing a system that involves a database?
   (1) Design the database, Draw the DFD, Draw the ER diagrams, Do the coding, Write the pseudo-code
   (2) Design the database, Write the pseudo-code, Draw the ER diagrams, Draw the DFD, Do the coding
   (3) Do the coding, Write the pseudo-code, Design the database, Draw the ER diagrams, Draw the DFD
   (4) Draw the DFD, Draw the ER diagrams, Design the database, Write the pseudo-code, Do the coding
   (5) Draw the ER diagrams, Do the coding, Write the pseudo-code, Design the database, Draw the DFD

28. Which of the following statements is/are correct about *acceptance testing*?
   A – Acceptance testing is done when the user requirements of the software are analysed.
   B – An essential activity in acceptance testing is checking through the conditional statements and loops in the code.
   C – Users may refuse to accept the software after the Acceptance Test.
   (1) A only   (2) B only
   (3) C only   (4) A and C only
   (5) All A, B and C

29. Which of the following statements is correct about software deployment?
   (1) *Direct deployment* has the highest risk of complete failure but may be the only suitable method for some cases.
   (2) *Direct deployment* is the most expensive and offers slowest learning to the users.
   (3) *Parallel deployment* is the least expensive deployment option.
   (4) *Phased deployment* does not provide the freedom for the relevant organization to make any needed adjustments to the system.
   (5) *Pilot deployment* always rolls out the new system to a test user group larger than 50% of the users.

30. Which of the following statements is/are correct?
   A – *Business Process Re-engineering* helps to modify the existing business practices to fit with Commercial-Off-The-Shelf (COTS) software.
   B – Users may have to pay for certain features of COTS even if those are not needed.
   C – A well developed *custom software* can bring a competitive advantage to an organization.
   (1) A only   (2) B only
   (3) A and B only   (4) B and C only
   (5) All A, B and C

31. Which of the following is a (are) good practice(s) to follow in database development?
   A – the use of meaningful names for tables and fields
   B – letting different tables repeat the same information (other than the primary keys)
   C – avoiding a field and and its table having the same name (in order to avoid confusion while writing queries)
   (1) A only   (2) B only
   (3) C only   (4) A and B only
   (5) A and C only

● Consider the following **Results** and **Subjects** tables to answer questions from **32** to **35**:

Results

StudentNo	NIC	FirstName	SubjectID	Grade
S1234	986888457V	Nilam	ENG	B
S1447	992562321V	Praveena	PHY	C
S1234	986888457V	Nilam	ACC	A
S1323	900251452V	Thilan	ENG	S
S1323	900251452V	Thilan	ACC	B

Subjects

SubjectID	SubjectName
ENG	English
PHY	Physics
ECO	Economics
ACC	Accountancy

32. Which of the following is most suited to be selected as the *primary key* of the **Results** table with respect to the given details?
   (1) NIC
   (2) SubjectID
   (3) StudentNo
   (4) StudentNo and NIC
   (5) StudentNo and SubjectID

33. What is the correct SQL statement to retrieve the values of attributes **StudentNo**, **SubjectName** and **Grade**?
   (1) SELECT Results.StudentNo, Subjects.SubjectName, Results.Grade FROM Results INNER JOIN ON Results.SubjectID = Subjects.SubjectID;
   (2) SELECT Results.StudentNo, Subjects.SubjectName, Results.Grade FROM Results INNER JOIN Results.SubjectID = Subjects.SubjectID;
   (3) SELECT Results.StudentNo, Subjects.SubjectName, Results.Grade FROM Results INNER JOIN Subjects IN Results.SubjectID = Subjects.SubjectID;
   (4) SELECT Results.StudentNo, Subjects.SubjectName, Results.Grade FROM Results INNER JOIN Subjects ON Results.SubjectID = Subjects.SubjectID;
   (5) SELECT Results.StudentNo, Subjects.SubjectName, Results.Grade INNER JOIN Results AND Subjects Results.SubjectID = Subjects.SubjectID;

34. Which of the following is the correct statement about the **Results** table?
   (1) All the non-key attributes are fully functionally dependent on the primary key.
   (2) It has one candidate key.
   (3) It is in the *First Normal Form* (1NF).
   (4) It is in the *Second Normal form* (2NF).
   (5) The cardinality of the table is four.

35. Which dependency is removed when converting the **Results** table to next normal form?
   (1) foreign key dependency
   (2) fully functional dependency of non-key attributes on the primary key
   (3) multivalued dependency
   (4) partial dependencies of non-key attributes on the primary key
   (5) transitive dependency of non-key attributes

36. Following are the steps involved in creating an *Entity Relationship* (ER) *Diagram*:

       I. Determine the .....A..... in your diagram.

      II. Add ....**B**.... to each ....**C**....

      III. Include the ....**D**.... between the ....**A**....

      IV. Add ....**E**.... to every relationship

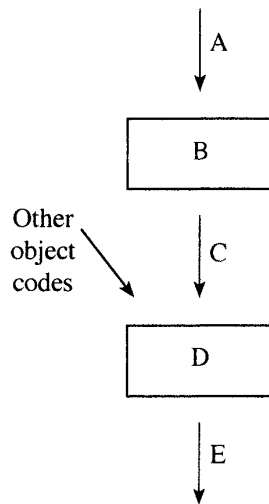Which of the following gives suitable choices for the **A, B, C, D** and **E** blanks in the above steps?

(1) A – attributes, B – entities, C – attribute, D – cardinality, E - entities

(2) A – attributes, B – cardinality, C – attribute, D – entities, E- entity

(3) A- entities, B – attributes, C – entity, D – relationships, E – cardinality

(4) A- entities, B – relationship, C – entity, D – attributes, E – cardinality

(5) A – relationships, B – cardinality, C – relationship, D – attributes, E – entities

37. Which of the following can be modelled with an *Extended Entity Relationship* diagram?

      A – subclasses of an entity

      B – inheritance of attributes

      C – specialization of entities

(1) A only   (2) B only   (3) C only

(4) A and C only   (5) All A, B and C

38. A teacher of a programming class draws the following diagram and asks the students to identify the components indicated by A, B, C, D and E:
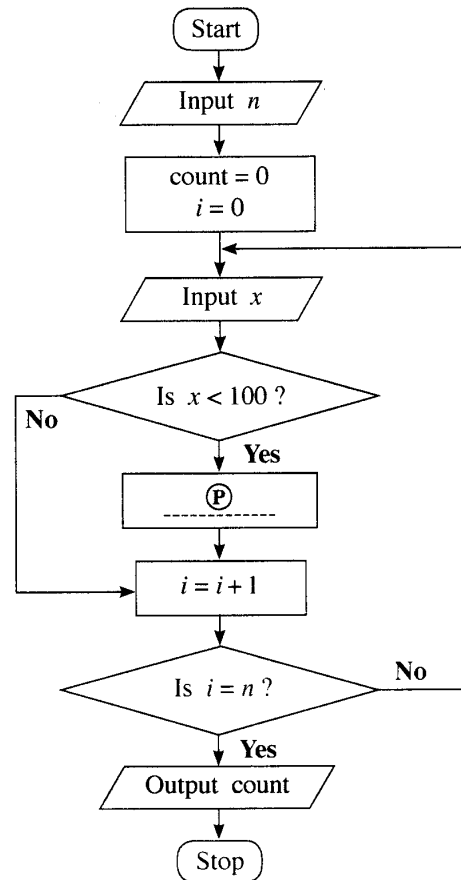

Which of the following gives the correct choices for A, B, C, D and E?

(1) A – compiler, B – executable code, C – source code, D – linker, E – object code

(2) A – compiler, B – source code, C – executable code, D – object code, E – linker

(3) A – linker, B – source code, C – object code, D – executable code, E – compiler

(4) A – source code, B – object code, C – linker, D – compiler, E – executable code

(5) A – source code, B – compiler, C – object code, D – linker, E – executable code

● Consider the algorithm expressed by the flowchart and answer questions **39** and **40**.

This algorithm takes as input first an integer n (≥ 1) followed by a sequence of n integers one by one. The algorithm is expected to output the count of integers that are less than 100 among the sequence of n inputs.

```
Start
  ↓
Input n
  ↓
count = 0
i = 0
  ↓
Input x  ←─────────┐
  ↓                │
Is x < 100 ?       │
  No ──┐   Yes     │
       │   ↓       │
       │   (P)     │
       │   ------- │
       ↓   ↓       │
      i = i + 1    │
       ↓           │
Is i = n ?  No ────┘
   Yes
   ↓
Output count
   ↓
Stop
```

39. For the algorithm to function correctly as expected, what should be inserted at the blank Ⓟ ?

(1) count = count + 1
(2) count = count + i
(3) count = count + x
(4) n = n − 1
(5) n = n + 1

40. Which of the following Python programs implement the algorithm in the flowchart?

```
I   n = int(input())
    count = 0
    for i in range(n):
        x = int(input())
        if (x < 100):
            count = count + i
    print(count)
II  n = int(input())
    count = 0
    for i in range(n):
        x = int(input())
        if (x < 100):
            count += 1
    print(count)
III n = int(input())
    count = i = 0
    while (i < n):
        x = int(input())
        if (x < 100):
            count = count + 1
    print(count)
```

(1) Only I
(2) Only II
(3) Only I and II
(4) Only II and III
(5) All I, II and III

41. What would be the output after executing the following Python code?

```
n = 117
m = (n & 127) // (2 ** 3)
print(m)
```

(1) 1   (2) 14   (3) 14.625   (4) 15   (5) 19

42. What will be the result when the following Python code is executed?

```
x = 10
def myfun(a):
        global x
        a = x + a
        x = 30
        return a
print(myfun(x))
```

(1) 10   (2) 20   (3) 30   (4) 40   (5) an error

43. What will be the output of the following Python code segment?

```
S = ["covid", "pandemic", "vaccine", "booster", "virus"]
V = "aeiou"
count = 0
for i in range(len(S)):
        for j in range(len(S[i])):
                if (S[i][j] in V):
                        count = count + 1
print(count)
```

(1) 0   (2) 5   (3) 12   (4) 13   (5) 32

44. What will be the output when the following Python code is executed?

```
s = 1
for  i  in  range(1,10):

        if (i < 5):
                s = s * i
        elif (i < 8):
                s = s - i
        else:
                s = s + i
                break
print(s)
```

(1) 6   (2) 14   (3) 23   (4) 33   (5) 121

45. Read the following sentence about *website development*.

To make an effective website, it is important to identify its objectives and the target .....A..... and then design the most useful information layout for the website accordingly.

Which of the following is the correct choice for the blank **A** above?
(1) audio   (2) images   (3) text   (4) users   (5) video

46. Which of the following is the correct example for CSS group selector?
(1) h1{text-align:left ; color:blue;}
(2) h1,h2{text-align:left , color:blue;}
(3) h1.h2{text-align:left; color:blue;}
(4) h1:h2{text-align:left; color:blue;}
(5) h1,h2{text-align:left; color:blue;}

47. Consider the following HTML code:

```
<!DOCTYPE  html>
<html>
<head>
<style>
body  {
    background-image:  url('srilanka.jpg');
}
</style>
</head>

<body>
<h2>Sri  Lanka</h2>
<p>Sri  Lanka,  the  island  of  serendipity,  is  really  a  <i>pearl  in  the
orient</i>.</p>
</body>
</html>
```

Which of the following statements is/are correct about the observations when the above code is viewed through a web browser?

A – The srilanka.jpg image (if existing) will be displayed as the background to the web page.
B – The **Sri Lanka** word which is enclosed within <h2> and </h2> tags will appear in italics.
C – The **pearl in the orient** phrase enclosed within <i> and </i> tags will appear in italics.

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

48. Which of the following statements is correct about the following code line when it is rendered through a web browser?

```
<input  type="radio"  name="vaccinate"  value="Yes">
```

(1) It shows a radio button with a label named **vaccinate** at left side.
(2) It shows a radio button with a label named **vaccinate** at right side.
(3) It shows a radio button with a label named **Yes** at left side.
(4) It shows a radio button with a label named **Yes** at right side.
(5) The word **Yes** is not shown to user.

49. Consider the following PHP code line which is used to create a MySQL database connectivity:

```
$conn  =  new  mysqli($var1,  $var2,  $var3,  $var4);
```

Which of the following is the correct representation for the above variables?

(1) $var1 = database, $var2 = server name, $var3 = user name, $var4 = password
(2) $var1 = database, $var2 = user name, $var3 = password, $var4 = server name
(3) $var1 = server name, $var2 = database, $var3 = user name, $var4 = password
(4) $var1 = server name, $var2 = user name, $var3 = password, $var4 = database
(5) $var1 = user name, $var2 = password, $var3 = server name, $var4 = database

50. What would be the output when the following PHP code is executed?

```
<html>
<body>
<?php
    $class = array ("12-A", "12-B", "13-A");
    echo "IT classes are " . $class[1] . " and " . $class[2] ;
?>
</body>
</html>
```

(1) IT classes are 12-A and 12-B   (2) IT classes are "12-A" and "12-B"
(3) IT classes are 12-B and 13-A   (4) IT classes are .12-A. and .12-B
(5) IT classes are .12-B. and .13-B

ශ්‍රී ලංකා විභාග දෙපාර්තමේන්තුව
Department of Examinations, Sri Lanka

අධ්‍යයන පොදු සහතික පත්‍ර (උසස් පෙළ) විභාගය, 2021(2022)
கல்விப் பொதுத் தராதரப் பத்திர (உயர் தர)ப் பரீட்சை, 2021(2022)
General Certificate of Education (Adv. Level) Examination, 2021(2022)

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

20 E II

Part B

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

5. Consider the logic circuit shown in the figure, in which *A*, *B* and *C* are the inputs and *X* is the output.
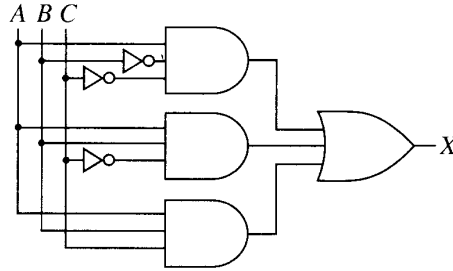
(a) Show the complete truth table for the given circuit. **[02 marks]**

(b) Complete the Karnaugh map, according to the following format.

AB

	00	01	11	10
C 0				
1				

[04 marks]

(c) Using the Karnaugh map, derive an optimal (most simplified) sum-of-products (SOP) expression for the output X. Show the loops clearly on the Karnaugh map. **[03 marks]**

(d) Using the Karnaugh map, derive an optimal (most simplified) product-of-sums (POS) expression for the output X. Show the loops clearly on the Karnaugh map. . **[03 marks]**

(e) Of the optimal SOP and POS expressions you obtained in (c) and (d) above, which is better (or more suitable) to implement a simplified logic circuit? Explain your answer. **[03 marks]**

6. (a) *Parity Check* is a simple technique to detect errors in data communications.

Assume the seven bits 1010110 need to be transmitted. Explain how the odd parity check can be performed to detect any error in its transmission.   **[02 *marks*]**

(b) The **ABC company** has two main divisions, namely **Production** and **Marketing**. Under the **Production** division, there are three units, namely **Stores**, **Supplies** and **Operations** having 10, 12 and 18 computers, respectively. **Marketing** division has 40 computers. ABC company has been given the 192.174.19.0/25 IP address block. All the computers of the ABC company are to be assigned IP addresses after making the subnets from this address block.

The following incomplete table shows the sub-netting. Copy it to your answer sheet and fill the empty entries.

Division/ Unit	Network ID	Broadcast ID	Subnet Mask	No. of Nodes	Usable IP Address Range
Marketing	192.174.19.0			64	
Stores		192.174.19.79		16	
Supplies	192.174.19.96			16	
Operations		192.174.19.159		32	

[06 *marks*]

(c) Mohan has ten (10) desktop computers and a router having 2 ports with a 64 Mbps Internet connection. Each computer has an adequate number of network interface cards. He also has a sufficient number of RJ 45 connected twisted pair cables.

Mohan wants to start an Internet Browsing Center with the above equipment and seeks your advice for it. He informs you that he is not in a position to invest money for any new equipment.

(i) Which network topology will you suggest for Mohan?   **[01 *mark*]**

(ii) Draw the logical arrangement of the network that you propose.   **[02 *marks*]**

(iii) Mohan would like to improve the connection speed to the clients while saving the existing bandwidth of the Internet connection. Further he needs to have the control of the Internet access while ensuring the privacy of the client. What is the technical suggestion you would give for this?   **[01 *mark*]**

(iv) There is a need to protect this private network by filtering the communication traffic and blocking outsiders from gaining unauthorized access. What mechanism will you suggest to achieve this?   **[01 *mark*]**

(v) Include the solutions that you proposed for (iii) and (iv) above in the logical network arrangement that you drew for (ii).   **[02 *marks*]**

7. (a) **PQR Books**, a book shop in your area starts an E-Commerce site to expand its business and to provide services to the customers in other areas. Through it the customers can select their desired books and stationery products and confirm their orders online.

   (i) What is the E-Commerce business type applicable in this scenario?   **[01 mark]**

   (ii) What is the revenue model used in this E-Commerce site of PQR Books?   **[01 mark]**

   (iii) With the successful implementation of its E-Commerce site, PQR Books decides to offer digital learning material such as e-books and audio-visual content to its customers. Do you recommend the same revenue model of (ii) above for this as well? Justify your answer.
                                                                                    [01 mark]

   (iv) For an increased customer base and popularity, PQR Books plans to provide free access to these digital content through its streaming channel.
      Suggest a strategy to increase its business revenue with the help of this proposed streaming channel.   **[01 mark]**

   (v) Write down a key challenge this bookshop has to face when implementing this digital content channel proposed in (iv) above.   **[01 mark]**

   (vi) Name a suitable expansion solution for this E-Commerce site to incorporate both related (e.g., books, stationery etc.) and unrelated (e.g., grocery items, etc.) products or services to enable a more competitive purchasing experience to its customers.   **[01 mark]**

(b) The following description is about **myShopper**, a multi-agent system which enables a buyer to search the entire online marketplace for the best products. In addition to the price, reviews by other buyers, special offers, reputations of the merchants and the lengths and types of warranties are also considered.

   When a **user** (buyer) accesses the **myShopper** website, a **chat-bot** agent starts interacting with the user. User can use voice or text as the input medium to give his/her requirements for a product. During the interaction, the **chat-bot** passes the extracted information to a **search-agent** who will takeover the search for the best product for the user. For this, the **search-agent** will start several **domain-agents** specifying each of them the requirements of the user and specific domains (web sites) to search in. To speedup the search, each **domain-agent** will start several **sub-agents** to search sub-domains under its main domain. After the search, each **sub-agent** will pass the appropriate results back to its parent **domain-agent**. Once all such results from the sub-agents are received, each **domain-agent** compares them and submits the best results to the **search-agent**. The **search-agent** will then compare all such results and gives the details of the best product back to the **chat-bot**. The **chat-bot** will then display it to the **user** as text.

   (i) Draw a simplified agent diagram for the above multi-agent system. Name all the entities in your diagram and clearly indicate the interactions between them.   **[06 marks]**

   (ii) Write **one** major advantage of this multi-agent system.   **[01 mark]**

   (iii) Write down **one** ICT related challenge which has to be faced when developing a **sub-agent**.   **[02 marks]**

8. (a) Suppose the ages (in years) of **n** (**n** > 1) students in a school are in a list **L**. Assuming the list **L** and an integer **k** are inputs, express an algorithm using **either** a flowchart **or** pseudo-code to compute and output the average age of students in **L** whose age is less than **k** years.

[05 *marks*]

(b) Consider the algorithm expressed by the flowchart. L1 and L2 are non-empty lists of integers. Each of L1 and L2 has unique elements (no duplicates). But there can be elements that are in both L1 and L2. The notation L[x] denotes the element at Index x of a list L. If there are N elements in list L, then the indices are from 0, 1, 2, ... to (N-1).

```
              ( Start )
                 |
        /  Input lists L1, L2  /
                 |
        +---------------------+
        | N1 = number of      |
        |     items in L1     |
        | N2 = number of      |
        |     items in L2     |
        | count = 0           |
        | i1 = 0              |
        +---------------------+
                 |
                 •<--------------------------+
                 |                           |
           +-----------+                     |
           |  i2 = 0   |                     |
           +-----------+                     |
                 |                           |
                 •<------------------+       |
                 |                   |       |
      No    < Is L1[i1] = L2[i2]? >  |       |
     <-----------                    |       |
     |           | Yes               |       |
     |    +-----------------+        |       |
     |    | count = count+1 |        |       |
     |    +-----------------+        |       |
     |           |                   |       |
     |    +-------------+            |       |
     +--->| i2 = i2 + 1 |            |       |
          +-------------+            |       |
                 |                   |       |
          < Is i2 < N2? >  Yes-------+       |
                 | No                        |
          +-------------+                    |
          | i1 = i1 + 1 |                    |
          +-------------+                    |
                 |                           |
          < Is i1 < N1? >  Yes---------------+
                 | No
        / Output count /
                 |
             ( Stop )
```
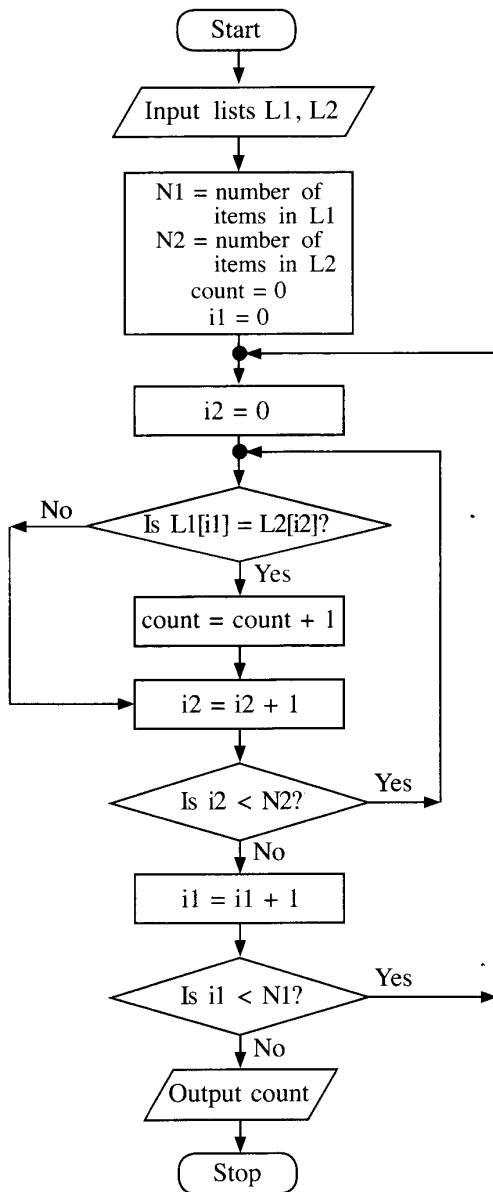
(i) What would be the output if L1= 2, 4, 7, 9, 3, 5 and L2 = 1, 3, 8, 9, 6, 5, 7?

[02 *marks*]

(ii) What is the purpose of this algorithm?   **[02 *marks*]**

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

[06 *marks*]

9. (a) A **virtual** supermarket has registered suppliers to supply the customer orders placed online. The supermarket always fulfils its customer orders through these suppliers. One supplier is responsible only for the customers who live in the supplier's area. A customer has only one supplier. Each supplier is characterized by a code (unique), address and contact numbers. A supplier can have several contact numbers.

Each customer is characterized by an email address (unique), name and location.

A customer can confirm orders. Each order has only one supplier and one customer.

An order is characterized by an order number (unique), description and a value. A supplier can supply more than one order.

Note: Use only the terms from the list given below for your ER diagrams of parts (i) and (ii).

List: {address, agent, code, confirms, contactNo, customer, description, email, hires, location, name, order, orderNo, supplier, supplies, value}

  (i) Draw the Entity Relationship (ER) diagram for the above description. **[07 marks]**

 (ii) Sometimes suppliers hire agents to support the order supplies. However, the supermarket identifies the agents only through registered supplier codes. An agent is characterized by a name and a contact number. Each agent is working only for one supplier and a supplier is also getting only one agent's service.

  Add these details to the ER diagram you drew for part (i). **[04 marks]**

(b) A building construction company signs contracts with its clients. Each contract is handled by an agent of the company.

The **Contracts** table contains the details of the contracts. It has contract number, agent's code, name and mobile phone number represented with **CNo**, **ACode**, **AName** and **AMobile** attributes respectively. The client's name is represented with **Client**. Primary key of the **Contracts** table is **CNo**.

Contracts

CNo	ACode	AName	AMobile	Client
C-112	EP003	Anura	0714545866	Srimal
C-103	EP006	Navod	0774511320	Abish
C-116	EP003	Anura	0714545866	Nehara
C-224	EP015	Virah	0763538147	Srimal

  (i) Write an SQL statement to change in the **Contracts** table, the mobile number of the agent whose agent code is EP003 to 0772222222. **[01 mark]**

 (ii) In which normal form does the **Contracts** table exist? **[01 mark]**

(iii) Convert the **Contracts** table into next normal form. (It is **not** necessary to write the data in derived relations in the next normal form.) **[02 marks]**

10. (a) (i) Explain **one (1)** way in which the *bar code technology* can be beneficial to a library management system.   **[02 *marks*]**

(ii) Most modern computers have multiple processors in them. Explain **one (1)** way in which the multiple processors in such computers can be beneficial.   **[02 *marks*]**

(iii) Explain what is meant by *volatile memory* **and** write down **one (1)** example for such selecting from the list below.

List: {Dynamic RAM (DRAM), Hard disk, L1 cache, Registers}   **[02 *marks*]**

(b) (i) A student asks you how all applications started by him execute simultaneously although he has a **single-processor computer**. Write down your explanation.   **[03 *marks*]**

(ii) Programs whose sizes are even larger than the size of the available physical memory of a computer could be executed on it. How can that be possible?   **[04 *marks*]**

(iii) When *linked allocation* is used for disk space allocation, each file needs slightly more storage space than when *contiguous allocation* is used. Explain the reason for it.   **[02 *marks*]**

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