

Security, Privacy and Data integrity

Question 1

A computer program makes use of data validation routines and verification of data input.

(a) Complete these two sentences about data validation and verification.

1. checks that the data entered is reasonable. One example is

2. checks that the data entered is the same as the original. One example is [4]

(b) The program is installed on a computer system that has security measures in place to protect its data.

Security measure	Description
.....	Data are written on two or more disks simultaneously.
Encryption
.....	A copy of the data is taken and stored in another location.

121

Question 2

(d) The company needs to keep the data on its servers secure from online threats.

(i) Describe how a firewall will help to protect the data on the servers from online threats.

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.....[2]

(ii) Give one additional security measure that the company can use to protect the data on the servers from online threats.

..... [1]

Question 3

(a) He wants to make sure the source code is secure on his laptop. Explain how encrypting the source code can keep it secure.

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..... [3]

Question 4

(b) The software development company uses data backup and disk-mirroring to keep their data secure. Explain how data backup and disk-mirroring allow the company to recover from data loss.

Data backup
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.....
Disk-mirroring
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..... [4]

Question 5

Frankie is a software developer. He is developing a program to manage customer records for a client with an online retail business. He must ensure that data stored about each customer are both secure and private.

(a) State the difference between security and privacy.

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..... [2]

(b) Computer systems can be protected by physical methods such as locks. Describe two non-physical methods used to improve the security of computer systems.

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..... [6]

(c) A computer uses parity blocks to check the data that has been received is the same as the data that has been transmitted.

The following is an example of a parity block.

Parity byte	Parity bit	Data						
	1	1	1	1	0	0	0	1
	0	0	0	0	1	1	1	0
	1	1	0	1	1	0	0	1
1	1	1	0	1	1	0	0	1

(i) Describe how a parity block check can identify a bit that has been corrupted during transmission.

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..... [4]

(ii) Give a situation where a parity block check cannot identify corrupted bits.
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..... [1]

Question 6

ii) The supermarket is concerned about the security and integrity of the data on the server. Identify two methods that can be used to minimise the security risk to the data, and one method to protect the integrity of the data.

Security 1
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Security 2
.....

Integrity
..... [3]

Question 7

- 6 Parity bits can be used to verify data.
- (a) The following binary number is transmitted using **even** parity.
- Add the missing parity bit.

Parity bit							
	1	0	1	1	0	1	0

[1]

- (b) In the following parity block, the first column contains the parity bits, and the last row contains the parity byte. A device transmits the data using **even** parity.

(i) Circle the error in the data transmitted.

	Parity bit	Data					
	1	1	0	1	0	1	1
	1	0	0	0	1	1	0
	0	1	0	0	1	0	1
	1	1	1	0	1	1	1
Parity byte	1	1	1	1	1	0	0

[1]

(ii) Explain how you identified the error.

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.....[2]

(c) The data received can contain errors that are not detected using parity bits.

Explain how this can happen.

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.....[2]

(d) Parity is not the only method to verify the data has been sent correctly. Name and describe one other method of data verification during data transfer.

Name

Description

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.....

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..... [3]

Answer 8

3 Parity bits can be used to verify data.

(a) The following binary number is transmitted using **odd** parity.

Add the missing parity bit.

Parity
bit

	0	1	0	0	0	0	0
--	---	---	---	---	---	---	---

[1]

(b) In the following data transmitted, the first column contains the parity bits, and the last row contains the parity byte. A device transmits the data using **even** parity.

Circle the error in the data transmitted.

Parity bit	Data						
1	0	1	0	1	1	1	1
0	1	1	0	0	1	1	0
1	1	0	0	0	0	0	0
0	1	0	0	0	0	0	0
Parity byte	0	0	0	0	1	0	1

[1]

(c) The following table shows five error detection measures.

Put **one** tick (✓) in each row to indicate whether the measure is validation or verification.

Measure	Validation	Verification
Checksum		
Format check		
Range check		
Double entry		
Check digit		

[5]

Question 9

Parity bits can be used to verify data.

- (a) The following binary number is transmitted using **odd** parity.

Add the missing parity bit.

**Parity
bit**

	0	1	1	1	0	1	0
--	---	---	---	---	---	---	---

[1]

- (b) In the following parity block, the first column contains the parity bits, and the last row contains the parity byte. A device transmits the data using **even** parity.

Circle the error in the data being transmitted.

	Parity bit	Data						
	0	0	1	1	0	1	0	1
	1	1	1	1	1	0	0	1
	1	0	1	0	1	0	0	0
	0	0	0	1	1	0	1	1
Parity byte	0	1	1	1	1	1	0	1

[1]

- (c) Four error detection measures are shown.

Draw **one** line from each error detection measure to indicate whether it is verification or validation.

Error detection measure

Type check

Proof reading

Check digit

Checksum

Verification

Validation

[4]

Question 10

A computer receives data from a remote data logger. Each data block is a group of 8 bytes. A block is made up of seven data bytes and a parity byte.

Each data byte has a parity bit using odd parity. The parity byte also uses odd parity.

The following table shows a data block before transmission. Bit position 0 is the parity bit.

Bit position							
7	6	5	4	3	2	1	0
1	1	0	0	1	1	0	1
0	0	1	0	0	0	0	0
1	0	0	1	1	1	0	A
1	1	0	0	0	0	1	0
1	1	0	0	0	0	1	0
1	1	0	0	0	1	1	B
0	0	0	0	0	0	0	0

Data bytes

0	1	1	0	1	1	0	0
---	---	---	---	---	---	---	---

Parity byte

(a) (i) Describe how the data logger calculates the parity bit for each of the bytes in the data block.

.....

.....

.....[2]

(ii) State the two missing parity bits labelled A and B.

A =

B = [1]

(iii) Describe how the computer uses the parity byte to perform a further check on the received data bytes.

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.....[2]

(b) (i) A second data block is received as shown in the following table. There are errors in this data block.

Identify and then circle **two** bits in the table which must be changed to remove the errors.

Bit position							
7	6	5	4	3	2	1	0
1	0	0	0	1	1	0	0
0	0	1	0	0	0	0	0
0	0	1	1	0	1	0	1
1	1	1	1	0	0	0	1
1	1	0	0	0	0	1	0
0	0	1	0	0	1	0	0
0	0	0	0	0	0	0	1

0	1	0	1	1	0	0	0
---	---	---	---	---	---	---	---

[2]

(ii) Explain how you arrived at your answers for part (b)(i).

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.....[3]

Question 11

A Local Area Network is used by staff in a hospital to access data stored in a Database Management System (DBMS). (a) Name two security measures to protect computer systems.

1

2 [2]

(b) A frequent task for staff is to key in new patient data from a paper document. The document includes the patient’s personal ID number. (i) The Patient ID is a seven digit number. The database designer decides to use a check digit to verify each foreign key value that a user keys in for a Patient ID. When a user assigns a primary key value to a Patient ID, the DBMS adds a modulus-11 check digit as an eighth digit. The DBMS uses the weightings 6, 5, 4, 3, 2 and 1 for calculating the check digit. It uses 6 as the multiplier for the most significant (leftmost) digit.

Show the calculation of the check digit for the Patient ID with the first six digits 786531.

Complete Patient ID[4]

(ii) Name and describe two validation checks that the DBMS could carry out on each primary key value that a user keys in for a Patient ID.

1 Validation check

Description

.....

2 Validation check

Description

..... [4]

Question 12

A Local Area Network is used by school staff who access data stored in a Database Management System (DBMS).

(a) (i) Explain the difference between security and privacy of data.

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..... [3]

(ii) Give an example for this application where privacy of data is a key concern.

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.....[1]

(b) Name and describe two security measures the Network Manager has in place to protect the security of the data held in the DBMS.

1

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2
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.....
..... [4]

(c) A task for staff at the start of the school year is to key in new pupil data from a paper document.
The data is entered to a screen form and includes the data verification of some fields.

Describe what is meant by verification.
.....
.....
.....
.....[2]

Question 13

5 (a) A Database Management System (DBMS) provides the following features.

Draw a line to match each feature with its description.

Feature	Description
Data dictionary	A file or table containing all the details of the database design
Data security	Data design features to ensure the validity of data in the database
Data integrity	A model of what the database will look like, although it may not be stored in this way
	Methods of protecting the data including the uses of passwords and different access rights for different users of the database

[3]

A school stores a large amount of data that includes student attendance, qualification and contact details. The school is setting up a relational database to store these data.

(b) The school needs to safeguard against any data loss.

Describe three factors to consider when planning a backup procedure for the data.

Justify your decisions.

- 1
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- 2.....
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- 3.....
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.....6]

Question 14

A bank holds personal data about its customers and their financial data.

(a) Describe the difference between security and integrity of data.

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.....[4]

(b) Describe three security measures that the bank could implement to protect its electronic data.

Security measure 1

Description

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Security measure 2

Description

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Security measure 3

Description

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.....[6]

Question 15

(c) Employees using the new computers receive training. At the end of the training, each employee completes a series of questions.

Three answers given by an employee are shown below.

Explain why each answer is incorrect.

(i) *“Encryption prevents hackers breaking into the company’s computers.”*

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.....[2]

(ii) *“Data validation is used to make sure that data keyed in are the same as the original data supplied.”*

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.....[2]

(iii) *“The use of passwords will always prevent unauthorised access to the data stored on the computers”*

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.....[2]

Question 16

(a) Give the definition of the terms firewall and authentication. Explain how they can help with the security of data.

Firewall

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Authentication

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..... [3]

(b) Describe two differences between data integrity and data security.

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..... [2]

(c) Data integrity is required at the input stage and also during transfer of the data.

(i) State two ways of maintaining data integrity at the input stage. Use examples to help explain your answer.

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..... [3]

(ii) State two ways of maintaining data integrity during data transmission. Use examples to help explain your answer.

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.....

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..... [3]

Question 17

(a) Give a brief description of each of the following terms:

Validation

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Verification

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..... [2]

(b) Data are to be transferred between two devices. Parity checks are carried out on the data.

Explain what is meant by a parity check. Give an example to illustrate your answer.

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..... [4]

Question 18

(a) Explain the term computer virus.

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.....[2]

(b) A virus checker has been installed on a PC.

Give two examples of when a virus checker should perform a check.

1

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2

..... [2]

Question 19

- 7 (a) The string of characters, "BINARY CODE", was transmitted using 11 bytes of data. An additional byte, called the parity byte, was also transmitted.

Parity bytes can be used to identify exactly which bit has been transmitted incorrectly.

The table shows bit patterns for all 12 bytes after transmission. Even parity was used and the first bit is the parity bit.

	character	bit 1	bit 2	bit 3	bit 4	bit 5	bit 6	bit 7	bit 8
byte 1	B	0	1	0	0	0	0	1	0
byte 2	I	1	1	0	0	1	0	0	1
byte 3	N	0	1	0	0	1	1	1	0
byte 4	A	0	1	0	0	0	0	0	1
byte 5	R	1	1	0	1	0	0	1	0
byte 6	Y	0	1	1	1	1	0	0	1
byte 7		1	0	1	0	0	0	0	0
byte 8	C	1	1	0	0	0	0	1	1
byte 9	O	1	1	0	0	1	1	1	1
byte 10	D	0	1	0	0	0	1	0	0
byte 11	E	1	1	0	0	0	1	0	1
parity byte		0	0	1	0	0	0	1	0

(i) There is one error in the transmission.

Indicate the byte number and bit number of the bit which has been incorrectly transmitted.

Byte number

Bit number[2]

(ii) Explain your answer to part (i).

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.....[2]

(b) Verification and validation can be applied during data entry.

Describe what is meant by these terms. For each method, explain why it is needed.

Verification
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Validation
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.....
.....[4]

Question 20

- (a) A communication line uses half duplex.

State what is meant by half duplex.

.....
 [1]

- (b) A computer system uses **even parity**. The leftmost position of each byte is the parity bit.

- (i) Complete the byte below:

	1	0	1	0	0	0	1
--	---	---	---	---	---	---	---

[1]

- (ii) The parity bit is used to perform a parity check when a byte is transmitted from computer **A** to computer **B**.

Explain how computer **B** will establish whether or not the byte has been transmitted correctly.

.....

 [2]

- (c) In addition to a parity bit check on a byte, a parity block check is also carried out. Computer **A** transmits four bytes followed by a parity byte. The following sequence of bytes has just been received by computer **B**.

```

1 0 1 1 0 1 1 1
0 1 1 1 1 0 0 0
0 0 0 1 1 0 1 0
0 1 1 1 0 0 0 1
-----
1 0 1 0 1 1 0 0 ← parity byte
    
```

One of the four bytes has an error in one of the bits.

- (i) Identify the byte where the error has occurred with an arrow.
 Circle the bit that has been altered.

[2]

- (ii) Write down the corrected byte:

--	--	--	--	--	--	--	--

[1]

- (iii) Explain what the computer system needs to do if more than 1 bit has been transmitted wrongly.

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..... [2]

Question 21

- (a) What is meant by a computer virus?

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..... [1]

- (b) It is important to protect a computer system from viruses.

Describe **three** different ways to do this.

1

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3

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..... [3]

Question 22

- (b) The word **COMPUTING** is to be transmitted as nine bytes of data. Each character in the word has an ASCII value.

The system uses even parity and the left most bit is added to make each byte even parity.

- (i) Complete the codes so that they all have even parity.

C		1	0	0	0	0	1	1
O		1	0	0	1	1	1	1
M		1	0	0	1	1	0	1
P		1	0	1	0	0	0	0
U		1	0	1	0	1	0	1
T		1	0	1	1	0	0	0
I		1	0	0	1	0	0	1
N		1	0	0	1	1	1	0
G		1	0	0	0	1	1	1

[2]

- (ii) Fill in the parity byte in the final row in the table above.

[1]

- (iii) The character 'P' is received incorrectly as **0 1 0 1 1 0 0 0**

Describe how horizontal and vertical parity checking would be used to detect the erroneous bit.

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[3]

Question 23

The term **LOGIC GATES** is to be transmitted as 12 bytes of data.

Each character in the term has an ASCII value. The system is using **odd parity** and the left-most bit is used as the parity bit. An additional parity byte is also sent after the term.

The following bytes arrived at their destination:

		1	2	3	4	5	6	7	8
	letters	bytes received							
1	L	0	1	0	0	1	1	0	0
2	O	0	1	0	0	1	1	1	1
3	G	1	1	0	0	0	1	1	1
4	I	0	1	0	0	1	0	0	1
5	C	0	1	0	0	0	0	1	1
6	<Space>	0	0	1	1	0	0	1	0
7	G	1	1	0	0	0	1	1	1
8	A	1	1	0	0	0	1	0	1
9	T	0	1	0	1	1	0	0	0
10	E	0	1	0	0	0	1	0	1
11	S	0	1	0	1	0	1	1	1
12	parity byte	0	1	0	0	1	1	1	1

(a) One of the bytes has an error after transmission.

(i) Locate which character contains the error.

..... [1]

(ii) Indicate which bit has been transmitted incorrectly.

column number

row number [1]

(iii) Explain how you arrived at your conclusion.

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..... [3]

(b) The following bytes were sent during a data transmission:

```
00110001
10011011
11100000
```

Explain how a checksum is used to check whether the bytes have been corrupted during data transmission.

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[3]

Question 24

3 (a) Describe the difference between *verification* and *validation* of data.

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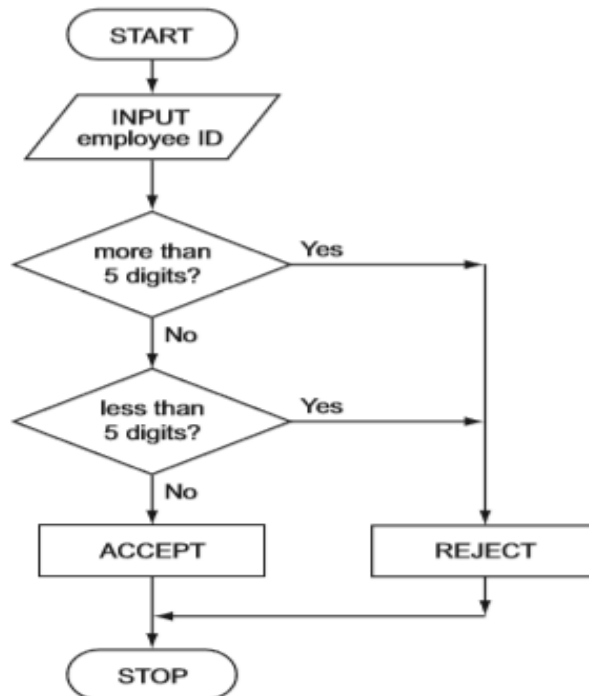
.....

[2]

(b) Two different validation checks are described using each of the following flowcharts.

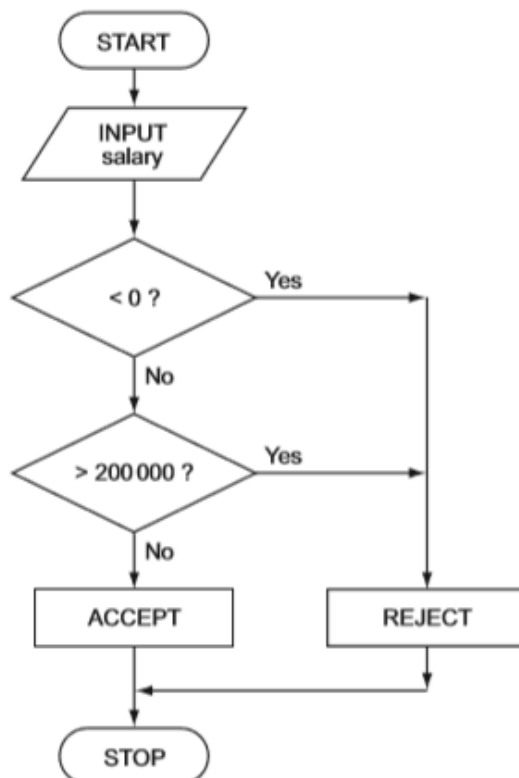
Name the types of validation check.

(i)



Type of validation check [1]

(ii)



Type of validation check [1]

- (c) Check digits are another validation method. The *modulo-11* method multiplies each digit by its digit position, adds the totals together and divides the result by eleven. The remainder is the check digit.

Note: the check digit is digit position 1.

- (i) Calculate the check digit () for the following number:

3 0 4 5 _

Show your working.

.....

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..... [2]

- (ii) The employee ID **39421** was entered into the computer as **34921**.

Explain how the check digit validation check will flag **34921** as an invalid employee ID.

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..... [2]