1 **(i)** Convert the following binary number into hexadecimal.

1 0 1 1 1 0 0 0

.....[1]

(ii) Convert the following denary number into BCD format.

9 7

.....[1]

(iii) Using two's complement, show how the following denary numbers could be stored in an 8-bit register:

114

- 93

[2]

8 **(a)** Six computer graphics terms and seven descriptions are shown below.

Draw a line to link each term to its correct description.

Term	Description
	Measured in dots per inch (dpi); this value determines the amount of detail an image has
Bitmap graphic	
	Picture element
Image file header	
	Image made up of rows and columns of picture elements
Image resolution	
	Image made up of drawing objects. The properties of each object determine its shape and appearance.
Pixel	
	Specifies the image size, number of colours, and other data needed to display the image data
Screen resolution	
	Number of samples taken per second to represent some event in a digital format
Vector graphic	
	Value quoted for a monitor specification, such as 1024 × 768. The larger the numbers, the more picture elements will be displayed.

[6]

(b) **(i)** A black and white image is 512 pixels by 256 pixels.

Calculate the file size of this image in kilobytes (KB) (1 KB = 1024 bytes).
Show your working.

.....

.....

.....

.....

.....[2]

(ii) Give a reason why it is important to estimate the file size of an image.

.....

.....

.....[1]

2 **(a)** Convert the following denary integer into 8-bit binary.

55

[1]

(b) Convert the following Binary Coded Decimal (BCD) number into denary.

10000011

.....[1]

(c) Convert the following denary integer into 8-bit two's complement.

-102

[2]

(d) Convert the following hexadecimal number into denary.

4E

.....[1]

4 A group of students broadcast a school radio station on a website. They record their sound clips (programmes) in advance and email them to the producer.

(a) Describe how sampling is used to record the sound clips.

.....

.....

.....

.....

.....

.....[3]

(b) The students use software to compress the sound clips before emailing them.

(i) Circle your chosen method of compression and justify your choice.

Lossy / Lossless

Justification: .....

.....

.....

.....[3]

Students also email images to the radio station for use on its website.

These are compressed before sending using run-length encoding (RLE).

(ii) Explain what is meant by run-length encoding.

.....

.....

.....

.....

.....

.....[3]

(iii) The following diagrams show:

- the denary colour code that represents each colour
- the first three rows of a bitmap image

Colour symbol	Colour code (denary)
B	153
W	255

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	B	B	B	B	B	B	B	B	B	B	W	W	W	B	B	B
1	B	B	B	B	B	B	B	B	B	W	W	W	W	W	W	B
2	B	B	B	B	B	B	B	W	W	W	W	W	W	W	W	W
...																
95																

Show how RLE will compress the first three rows of this image.

Row 1: .....

Row 2: .....

Row 3: .....[2]

5 **(a)** Telephone calls can be made by using:

- conventional telephones (using the Public Service Telephone Network (PSTN) system) over a wired network
- a computer, equipped with speakers and microphone, connected to the Internet

Put a tick (✓) in the correct column to match each description to the appropriate communication method.

Description	Conventional telephone using PSTN	Internet-based system
connection only in use whilst sound is being transmitted		
dedicated channel used between two points for the duration of the call		
connection maintained throughout the telephone call		
encoding schemes and compression technology used		
lines remain active even during a power outage		

[5]

(b) Distinguish between the Internet and the World Wide Web (WWW).

.....

.....

.....

.....

.....

.....[3]

(c) Name the hardware device that is being described:

(i) A device that transfers data from one network to another in an intelligent way. It has the task of forwarding data packets to their destination by the most efficient route.

.....[1]

(ii) A device used between two dissimilar LANs. The device is required to convert data packets from one protocol to another.

.....[1]

(iii) A device or software that provides a specific function for computers using a network. The most common examples handle printing, file storage and the delivery of web pages.

.....[1]

3 **(a)** The table shows four statements about IP addresses.

Tick (✓) to show which of the statements are true.

Statement	True (✓)
The IP address consists of any number of digits separated by single dots (.)	
Each number in an IP address can range from 0 to 255	
IP addresses are used to ensure that messages and data reach their correct destinations	
Public IP addresses are considered to be more secure than private IP addresses	

[2]

(b) Consider the URL:

http://cie.org.uk/computerscience.html

(i) Give the meaning of the following parts of the URL.

http .....

.....

.....

cie.org.uk .....

.....

.....

computerscience.html .....

.....

.....

[3]

(ii) Sometimes the URL contains the characters **%20** and **?**.

Describe the function of these characters.

%20 .....

.....

? .....

.....

[2]

6 A company operates a chemical plant, which has a number of processes. Local computers monitor these processes and collect data.

The computers transfer these data to a central computer 50 km away. A telecommunications company (telco) provides cables.

Engineers at the telco had to decide which type of cable to use. They considered the use of either copper cable or fibre optic cable.

State **two** benefits of each type of cable. Each benefit must be clearly different.

Benefits of copper cable

1 .....

.....

2 .....

.....

Benefits of fibre optic cable

1 .....

.....

2 .....

.....

[4]

7 Access to World Wide Web content uses IP addressing.

(a) State what IP stands for.

.....[1]

(b) The following table shows four possible IP addresses.

Indicate for each IP address whether it is valid or invalid and give a reason.

Address	Denary / Hexadecimal	Valid or Invalid	Reason
3.2A.6AA.BBBB	Hexadecimal		
2.0.255.1	Denary		
6.0.257.6	Denary		
A.78.F4.J8	Hexadecimal		

[4]

(c) Describe **two** differences between public and private IP addresses.

1 .....

.....

2 .....

.....[2]

7 A system is monitored using sensors. The sensors output binary values corresponding to physical conditions, as shown in the table:

Parameter	Description of parameter	Binary value	Description of condition
P	oil pressure	1	pressure >= 3 bar
		0	pressure < 3 bar
T	temperature	1	temperature >= 200°C
		0	temperature < 200°C
R	rotation	1	rotation <= 1000 revs per minute (rpm)
		0	rotation > 1000 revs per minute (rpm)

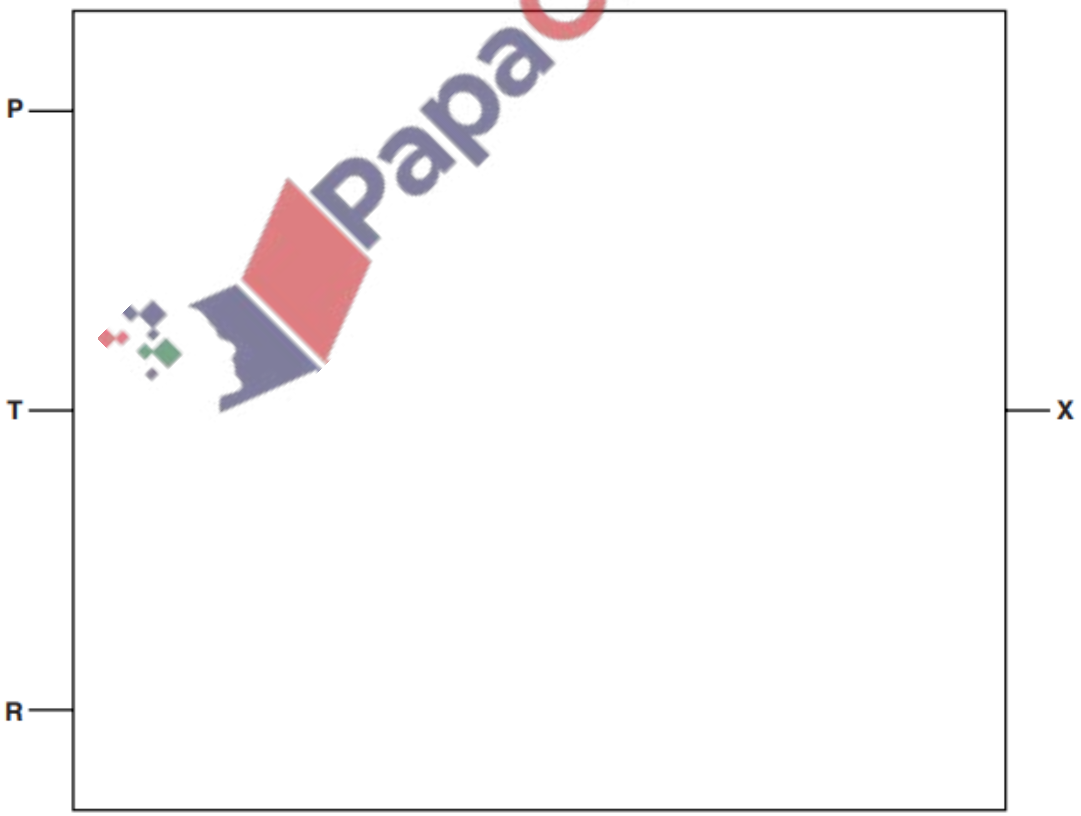
The outputs of the sensors form the inputs to a logic circuit. The output from the circuit, X, is 1 if any of the following three conditions occur:

either oil pressure >= 3 bar **and** temperature >= 200°C

or oil pressure < 3 bar **and** rotation > 1000 rpm

or temperature >= 200°C **and** rotation > 1000 rpm

(a) Draw a logic circuit to represent the above system.



[5]

(b) Complete the truth table for this system.

P	T	R	Workspace	X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

5 A motor is controlled by a logic circuit. The circuit has inputs (0 or 1) from three sensors R, T and W. The motor is switched off when the output from the logic circuit is 1.

The following table shows the three sensors and the conditions being monitored.

Sensor	Description	Binary value	Condition
R	rotation	0	rotation < 4000 rpm
		1	rotation >= 4000 rpm
T	temperature	0	temperature >= 90 °C
		1	temperature < 90 °C
W	water flow rate	0	water flow rate >= 50 litre/min
		1	water flow rate < 50 litre/min

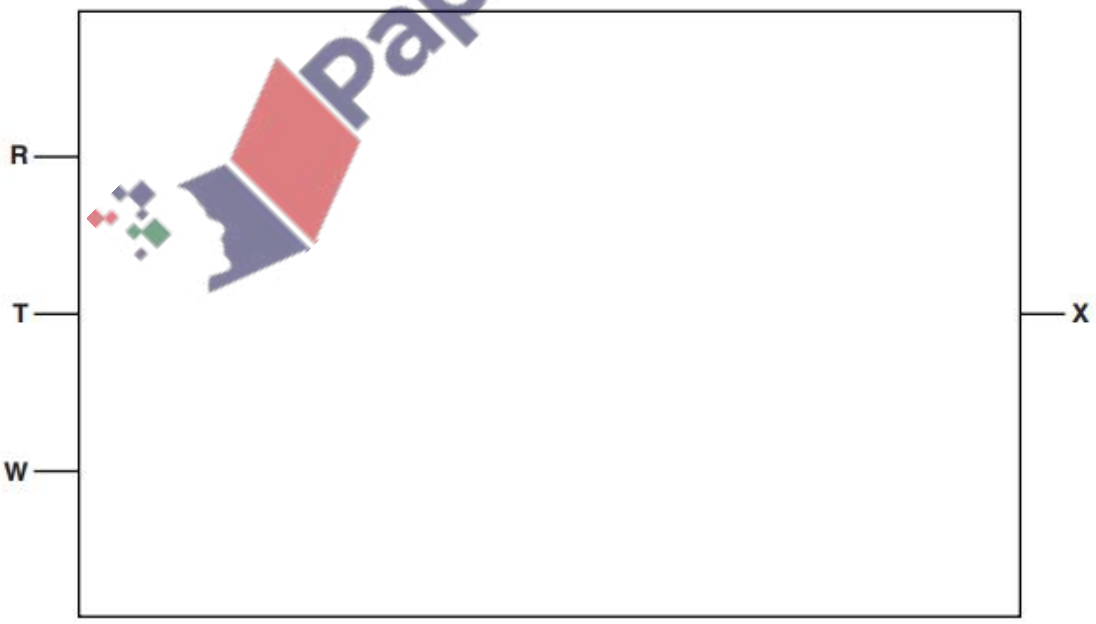
The output, X, is 1 if:

temperature >= 90 °C and rotation >= 4000 rpm

or

temperature < 90 °C and water flow rate >= 50 litre/min

(i) Draw a corresponding logic circuit.



[5]

(ii) Give a logic statement corresponding to the logic circuit in part **(i)**.

.....

.....[2]

(iii) Complete the truth table for this system.

INPUT			Workspace	OUTPUT
R	T	W		X
0	0	0		
0	0	1		
0	1	0		
0	1	1		
1	0	0		
1	0	1		
1	1	0		
1	1	1		

[4]

5 A Personal Computer (PC) has a number of input and output devices.

(a) (i) Name **three** components of a speaker.

1 .....

2 .....

3 .....

[3]

(ii) Explain the basic internal operation of a speaker.

.....

.....

.....

.....

.....

.....

.....[4]

(b) (i) The user is considering the purchase of a removable device for secondary storage.

Name **one** suitable device.

.....[1]

(ii) Describe **two** possible uses for this device on a home Personal Computer (PC).

1 .....

.....

2 .....

.....

[2]

3 Five modes of addressing and five descriptions are shown below.

Draw a line to connect **each** mode of addressing to its correct description.

Mode of addressing	Description
direct	the operand is the address of the address of the value to be used
immediate	the operand is the address of the value to be used
indexed	the operand is the offset from the current address where the value to be used is stored
indirect	the operand plus the contents of the index register is the address of the value to be used
relative	the operand is the value to be used

[4]

8 **(a)** Explain how the width of the data bus and system clock speed affect the performance of a computer system.

Width of the data bus .....

.....

.....

.....

Clock speed .....

.....

.....

.....[3]

(b) Most computers use Universal Serial Bus (USB) ports to allow the attachment of devices.

Describe **two** benefits of using USB ports.

1 .....

.....

2 .....

.....[2]

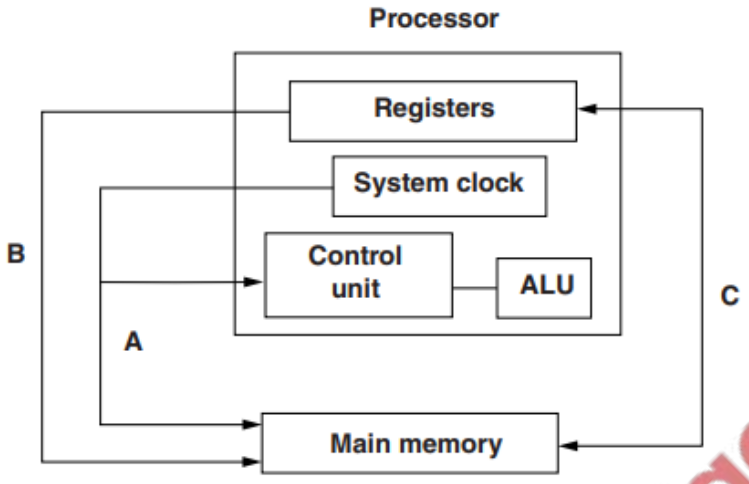
(c) The table shows six stages in the von Neumann fetch-execute cycle.

Put the stages into the correct sequence by writing the numbers 1 to 6 in the right hand column.

Description of stage	Sequence number
the instruction is copied from the Memory Data Register (MDR) and placed in the Current Instruction Register (CIR)	
the instruction is executed	
the instruction is decoded	
the address contained in the Program Counter (PC) is copied to the Memory Address Register (MAR)	
the value in the Program Counter (PC) is incremented so that it points to the next instruction to be fetched	
the instruction is copied from the memory location contained in the Memory Address Register (MAR) and is placed in the Memory Data Register (MDR)	

[6]

2 **(a)**



The diagram above shows a simplified form of processor architecture.

Name the three buses labelled A, B and C.

A .....

B .....

C .....

[3]

(b) State the role of each of the following special purpose registers used in a typical processor.

Program Counter .....

.....

Memory Data Register .....

.....

Current Instruction Register .....

.....

Memory Address Register .....

.....

[4]

3 **(a)** Describe how special purpose registers are used in the fetch stage of the fetch-execute cycle.

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) Use the statements A, B, C and D to complete the description of how the fetch-execute cycle handles an interrupt.

A	the address of the Interrupt Service Routine (ISR) is loaded to the Program Counter (PC).
B	the processor checks if there is an interrupt.
C	when the ISR completes, the processor restores the register contents.
D	the register contents are saved.

At the end of the cycle for the current instruction ..... .

If the interrupt flag is set, ... , ... and ..... .

The interrupted program continues its execution.

[4]

11 A game program is written which can be either interpreted or compiled. The table below shows five statements about the use of interpreters and compilers.

Tick (✓) to show whether the statement refers to an interpreter or to a compiler.

Statement	Interpreter	Compiler
This translator creates an executable file		
When this translator encounters a syntax error, game execution halts		
The translator analyses and checks each line just before executing it		
This translator will produce faster execution of the game program		
Use of this translator makes it more difficult for the user to modify the code of the game		

[5]

1 Three examples of language translators and four definitions are shown below.

Draw lines to link each language translator to the correct one or more definitions.

Language translator	Definition
Compiler	The software reads the source code and reports all errors. The software produces an executable file.
Assembler	The software reads each statement and checks it before running it. The software halts when it encounters a syntax error.
Interpreter	The software translates a high-level language program into machine code for the processor to execute.
	The software translates low-level statements into machine code for the processor to execute.

[3]

2 **(b)** **(i)** Explain why a computer needs an operating system.

.....

.....

.....

.....[2]

(ii) Give **two** key management tasks carried out by an operating system.

1 .....

.....

2 .....

.....[2]

(c) New program code is to be written in a high-level language. The use of Dynamic Link Library (DLL) files is considered in the design.

Describe what is meant by a DLL file.

.....

.....

.....

.....[2]

7 A small company produces scientific magazines. The owner buys some new desktop computers. The computers are used to store thousands of colour images (diagrams and photographs). All the computers have Internet access.

(a) Name **three** utility programs the company would use on all their computers. Describe what each program does.

1 .....

Description .....

.....

2 .....

Description .....

.....

3 .....

Description .....

.....[6]

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

Validation .....

.....

.....

Verification .....

.....

.....[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.

.....

.....

.....

.....

.....

.....

.....

.....[4]

10 **(a)** Explain the term computer virus.

.....

.....

.....

.....[2]

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

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

1 .....

.....

2 .....

.....

[2]

7 (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."*

.....

.....

.....

.....[2]

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

.....

.....

.....

.....[2]

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

.....

.....

.....

.....[2]

5 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.

.....

.....

.....[2]

6 Raj has joined a software company as a trainee programmer. He was given the company's Code of Conduct document during his induction training. The handbook has a section headed 'Ethical Behaviour'.

(a) Describe what is meant by **ethics**.

.....

.....

.....[2]

(b) Raj is assigned to work as a new member of a development team.

In his first week, Raj feels uncomfortable working with one of his colleagues. He is unfamiliar with the programming language used by the team. Next week, he will be working on the site of one of the company's clients with a colleague. Raj is very nervous about working in an unfamiliar workplace.

Raj has a review with his manager after his first three weeks.

The Code of Conduct document was produced by the Human Resources section. It closely follows the ACM/IEEE Software Engineering Code of Ethics that uses these eight key principles:

Public	Client and Employer	Product	Judgement
Management	Profession	Colleagues	Self

There are issues Raj will want to raise with his manager.

- Describe **two** of these issues.
- Circle the key ACM/IEEE principle this comes under.
- Suggest what action should be taken to demonstrate ethical behaviour.

Issue 1

Description .....

.....

.....

ACM/IEEE principle (Circle one only)

Public	Client and Employer	Product	Judgement
Management	Profession	Colleagues	Self

Possible action .....

.....

.....

Issue 2

Description .....

.....

.....

ACM/IEEE principle (Circle one only)

Public	Client and Employer	Product	Judgement
Management	Profession	Colleagues	Self

Possible action .....

.....

.....

[6]

6 A team of software engineers is developing a new e-commerce program for a client.

State **three** of the principles of the ACM/IEEE Software Engineering Code of Ethics. Illustrate each one, with an example, describing how it will influence their working practices.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

3 .....

.....

.....

.....[6]

7 A clinic is staffed by several doctors. The clinic serves thousands of patients. Each day and at any one time, there is only one doctor in the clinic available for appointments.

The clinic stores patient, doctor and appointment data in a relational database.

(a) (i) Underline the primary key for each table in the following suggested table designs.

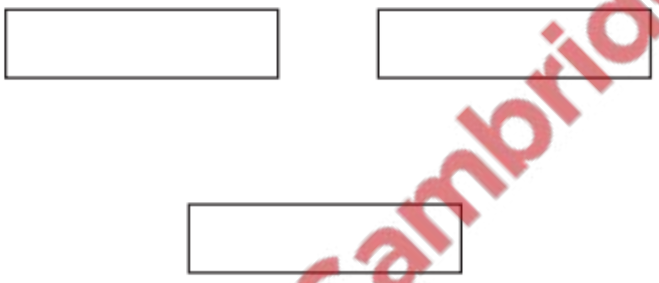
```
PATIENT(PatientID, PatientName, Address, Gender)

DOCTOR(DoctorID, Gender, Qualification)

APPOINTMENT(AppointmentDate, AppointmentTime, DoctorID, PatientID)
```

[2]

(ii) Complete the following entity-relationship (E-R) diagram for this design.



[2]

(b) The doctors are concerned that many patients make appointments but do not attend them.

Describe the changes to the table designs that could be made to store this information.

.....

.....[2]

(c) The doctors are about to set up a new clinic in the neighbouring village, SITE-B.

The original location is identified as SITE-A.

A new table is designed to store the ID of the doctor who is able to work at each site.

DOCTOR-AVAILABILITY(DoctorID, Site)

Five entries stored in the table are:

DoctorID	Site
098	SITE-A
074	SITE-A
117	SITE-B
098	SITE-B
033	SITE-B

(i) State what this data shows about the availability of the doctor with the ID of 098.

.....

.....[1]

(ii) Opening a new clinic in the neighbouring village will not require any additional table for storing appointments. It will need a change to the existing appointment table design.

Show the revised APPOINTMENT table.

APPOINTMENT(.....

.....) [1]

(d) The doctor with the ID of 117 has recently been allocated a new DoctorID of 017.

(i) Write an SQL script to update this doctor's record in the database.

UPDATE .....

SET.....

WHERE .....

[3]

(ii) Describe why this update could cause problems with the existing data stored.

.....

.....

.....[2]

(e) Write an SQL script to display the date and time of all appointments made by the patient with the `PatientID` of 556.

.....

.....

.....[3]

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

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

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

The table `ShopSales` was the first attempt at designing the database.

FirstName	Shop	ProductName	NoOfProducts	Manufacturer
Nick	TX	television set refrigerator digital camera	3 2 6	SKC WP HKC
Sean	BH	hair dryer electric shaver	1 8	WG BG
John	TX	television set mobile phone digital camera toaster	2 8 4 3	SKC ARC HKC GK

(a) State why the table is **not** in First Normal Form (1NF).

.....

.....[1]

(b) The database design is changed to:

SalesPerson (FirstName, Shop)

SalesProducts (FirstName, ProductName, NoOfProducts, Manufacturer)

Using the data given in the first attempt table (ShopSales), show how these data are now stored in the revised table designs.

Table: SalesPerson

FirstName	Shop

Table: SalesProducts

FirstName	ProductName	NoOfProducts	Manufacturer

[3]

(c) **(i)** A relationship between the two tables has been implemented.

Explain how this has been done.

.....

.....

.....

.....

.....[2]

(ii) Explain why the `SalesProducts` table is **not** in Third Normal Form (3NF).

.....

.....

.....

.....[2]

(iii) Write the table definitions to give the database in 3NF.

.....

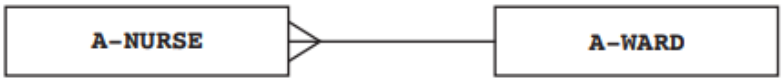
.....

.....

.....[2]

1 A hospital is divided into two areas, Area A and Area B. Each area has several wards. All the ward names are different.

A number of nurses are based in Area A. These nurses always work on the same ward. Each nurse has a unique Nurse ID of `STRING` data type.



(a) Describe the relationship shown above.

.....

.....[1]

(b) A relational database is created to store the ward and nurse data. The two table designs for Area A are:

```
A-WARD(WardName, NumberOfBeds)

A-NURSE(NurseID, FirstName, FamilyName, .....)
```

(i) Complete the design for the `A-NURSE` table. [1]

(ii) Explain how the relationship in **part (a)** is implemented.

.....

.....

.....

.....[2]

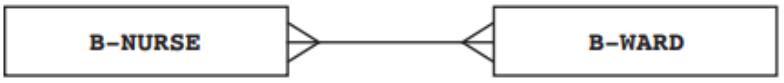
(c) In Area B of the hospital, there are a number of wards and a number of nurses.

Each Area B ward has a specialism.

Each Area B nurse has a specialism.

A nurse can be asked to work in any of the Area B wards where their specialism matches with the ward specialism.

The relationship for Area B of the hospital is:



(i) Explain what the degree of relationship is between the entities `B-NURSE` and `B-WARD`.

.....

.....[1]

(ii) The design for the Area B data is as follows:

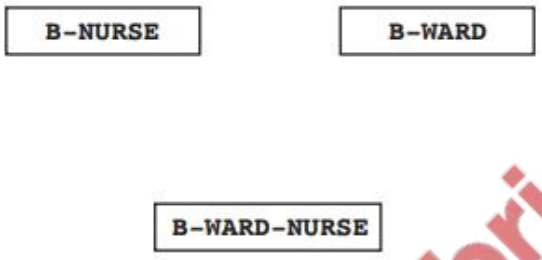
```
B-NURSE(NurseID, FirstName, FamilyName, Specialism)

B-WARD(WardName, NumberOfBeds, Specialism)

B-WARD-NURSE( ..... )
```

Complete the attributes for the third table. Underline its primary key. [2]

(iii) Draw the relationships on the entity-relationship (E-R) diagram.



[2]

(d) Use the table designs in **part (c)(ii)**.

(i) Write an SQL query to display the Nurse ID and family name for all Area B nurses with a specialism of 'THEATRE'.

.....

.....

.....[3]

(ii) Fatima Woo is an Area B nurse with the nurse ID of 076. She has recently married, and her new family name is Chi.

Write an SQL command to update her record.

```
UPDATE .....

SET .....

WHERE .....
```

[3]

1 **(a)** Five descriptions and seven relational database terms are shown below.

Draw a line to link each description to its correct database term.

Description	Database term
Any object, person or thing about which it is possible to store data	Secondary key
Dataset organised in rows and columns; the columns form the structure and the rows form the content	Candidate key
Any attribute or combination of attributes that can act as a unique key	Entity
Attribute(s) in a table that link to the primary key in another table to form a relationship	Foreign key
Attribute or combination of attributes that is used to uniquely identify a record	Primary key
	Table
	Tuple

[5]

(b) Explain what is meant by referential integrity.

.....

.....

.....

.....

.....

.....[3]