1 (i) B 8 [1]

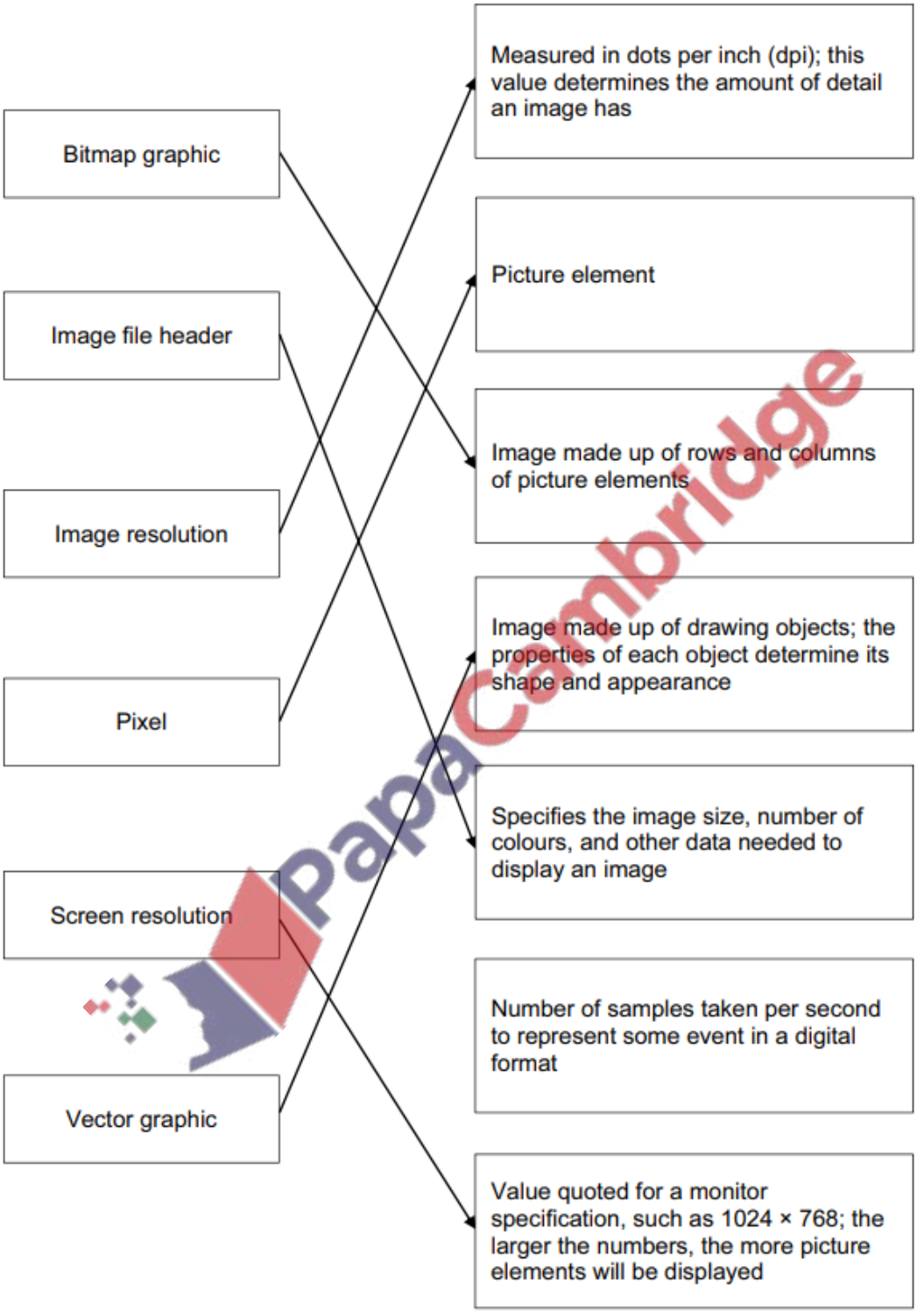
(ii) 1 0 0 1 0 1 1 1 [1]

(iii)

114	0	1	1	1	0	0	1	0
– 93	1	0	1	0	0	0	1	1

[2]

8 (a)



1 mark for each correct line, two lines from one box is incorrect [6]

(b) (i) $\frac{512 \times 256}{8 \times 1024}$ = 16 KB

1 mark for numerator + 1 mark for denominator [2]

(ii) so it is possible to estimate how many images can be stored / to decide if it can be sent as an email attachment [1]

2 (a) 00110111 **[1]**

(b) 83 **[1]**

(c) 10011010 **[2]**

Marks allocated as follows:

1 mark for the most significant bit
1 mark for the remaining 7 bits

(d) 78 **[1]**

4 (a) **Three** from: **[3]**

- The height/amplitude of the (sound) wave is determined.
- At set (time) intervals // by example of sensible time period.
- To get an approximation of the sound wave
- And encoded as a sequence of binary numbers // and converted to a digital signal.
- Increasing the sampling rate will improve the accuracy of the recording.

(b) (i) **No mark** awarded for identifying method. **Three marks** for justification. **[3]**

Lossy – Three points from:

- The human ear will not notice that the decompressed stream will not be identical to the original (file) / that parts of the original data have been discarded / removed / deleted.
- File size reduction is greater than using lossless.
- Email has limits on file sizes (on attachments) / a smaller file will take less time to transmit.
- The file may not need to be of high precision / accuracy.
- The producer has requested an mp3 file.

Lossless – Three points from:

- The file needs to be high precision / accuracy.
- None of the original data is lost / the decompressed file will be identical to the original.
- The producer has requested a flac file.

(ii) **Three** points from: **[3]**

- Lossless method of compression.
- Reduces (the physical size of) a string of adjacent, identical characters/pixels / bytes etc..
- The repeating string (a run) is encoded into two values.
- One value represents the number of (identical) characters in the run (the run count).
- The other value is the code of the character / colour code of pixel etc. in the run (the run value).
- The run value and run count combination may be preceded by a control character.
- Any valid example given.

(iii) **Two marks** for **three** correct rows, **one mark** for **two** correct rows. **[2]**

Row 1: 153 10 255 3 153 3
Row 2: 153 9 255 6 153 1
Row 3: 153 7 255 9

Alternative correct answer:

Row 1: 153 9 255 2 153 2
Row 2: 153 8 255 5 153 0
Row 3: 153 6 255 8

5 (a)

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) **maximum** of **two marks** for Internet references and **maximum** of **two marks** for world wide web references

Internet

- massive network of networks/interconnected network of computer devices
- Internet stands for Interconnected Networks
- uses TCP/IP protocol

World Wide Web (www)

- is a collection of (multimedia) web pages/documents
- ...stored on websites
- http/protocols used to transmit data
- web pages are written in HTML
- URLs specify the location of the web pages
- web documents are accessed using browsers **[3]**

(c) (i) router **[1]**

(ii) gateway **[1]**

(iii) server **[1]**

3 (a)

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	

accept words TRUE or FALSE in right hand column
1 mark per tick, –1 mark for each wrong tick if more than 2 [2]

(b) (i) http – enables browser to know what protocol is being used to access information in the domain

cie.org.uk – cie.org.uk is the domain name

computerscience.html – actual web page / file being viewed [3]

(ii) **%20** – because <space> not allowed in a URL, %20 is the coding for a space (32 in denary)

? – separates the URL from all parameters or variables [2]

6 any **four** points from (maximum 3 marks per type of cable):

- fibre optic cables have greater bandwidth
- fibre optic cables need less signal boosting // can transmit over longer distances
- fibre optic cables have greater security (more difficult to "tap" into)
- fibre optic cables are immune to electromagnetic and other effects
- fibre optic cabling is lighter in weight (easier to install)
- fibre optic cables consume less power
- copper cabling is less expensive to install
- copper cable is easier to install <u>because</u> it is more flexible
- it is easier to make terminations using copper cabling
- the expertise in use of copper cabling is more extensive
- has been around for years … so very little is "unknown" about installations using this type of cabling [4]

7 (a) **Internet Protocol** **[1]**

(b) **[4]**

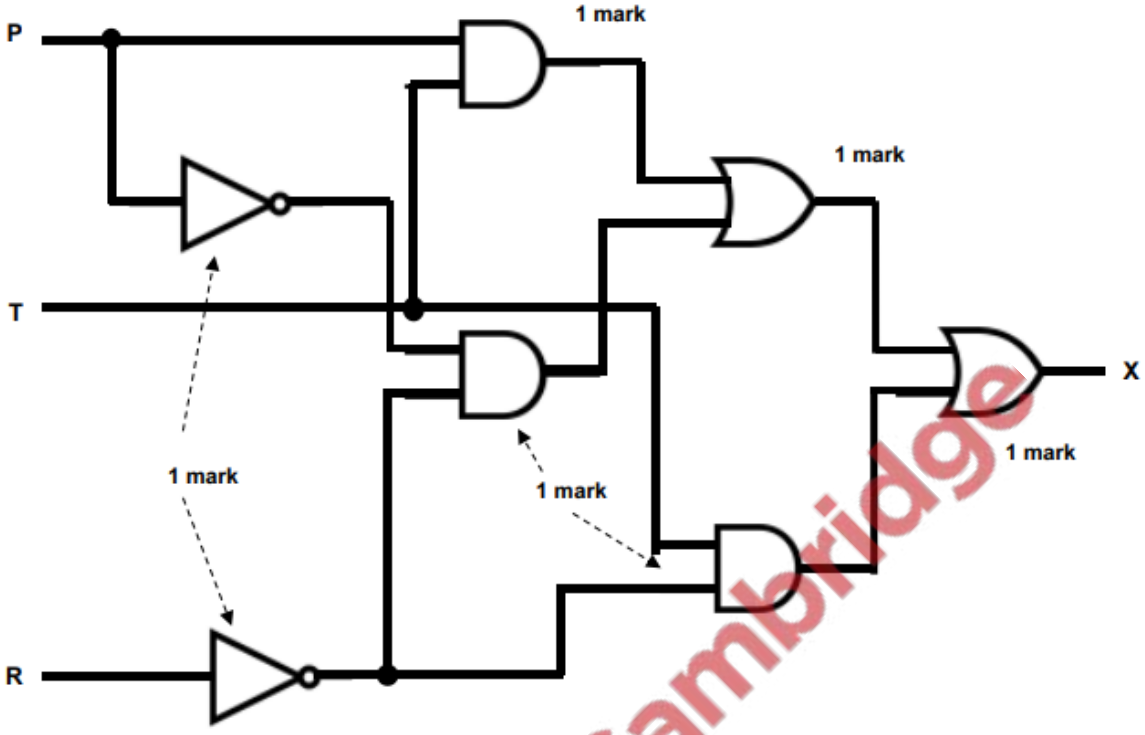
Address	Denary / Hexadecimal	Valid or Invalid	Reason
3.2A.6AA.BBBB	Hexadecimal	Invalid	**One** point from: • This is more than 32 bits • 6AA /BBBB in Hex is bigger than FF / 255 in denary • 6AA / BBBB uses more than 8 bits / a byte • The third / fourth group is bigger than FF / 255 in denary • The third / fourth group uses more than 8 bits / a byte
2.0.255.1	Denary	Valid	There are 4 bytes, each 255 or below // All the values are in the range 0 - 255
6.0.257.6	Denary	Invalid	257 is above 255 // The third group is above 255
0A.78.F4.J8	Hexadecimal	Invalid	J is not a valid hexadecimal digit // J8 is not a valid Hex number

One mark for each combination of valid or invalid **and** the reason.

(c) **Two** points from: **[2]**

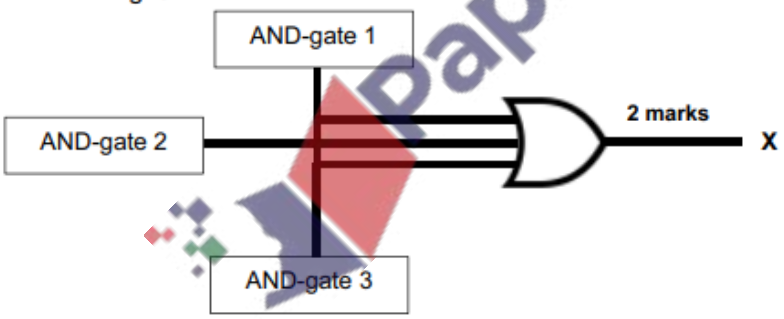
- Public address can be reached across the Internet.
- Private address can only be reached internally/through the LAN/Intranet // private address cannot be reached across the Internet.
- NAT (Network Address Translation) is necessary for a private IP address to access the Internet directly.
- A private address is more secure than a public address // A public address is less secure than a private address.
- Public addresses are provided by ISP / assigned by InterNIC // Private addresses are assigned by the router (of the network concerned).
- Public addresses are unique (to the Internet) // Private addresses (are unique within their network, but) can be duplicated within other (discrete) networks.
- 10.0.0.1 to 10.255.255.254 and 172.16.0.1 to 172.31.255.254 and 192.168.0.1.to 192.168.255.254 form the private address space // IP addresses from the private address space are never assigned as public.

7 **(a)** Since it is possible to simplify the original conditions, at least 3 possible answers exist for the logic circuit.

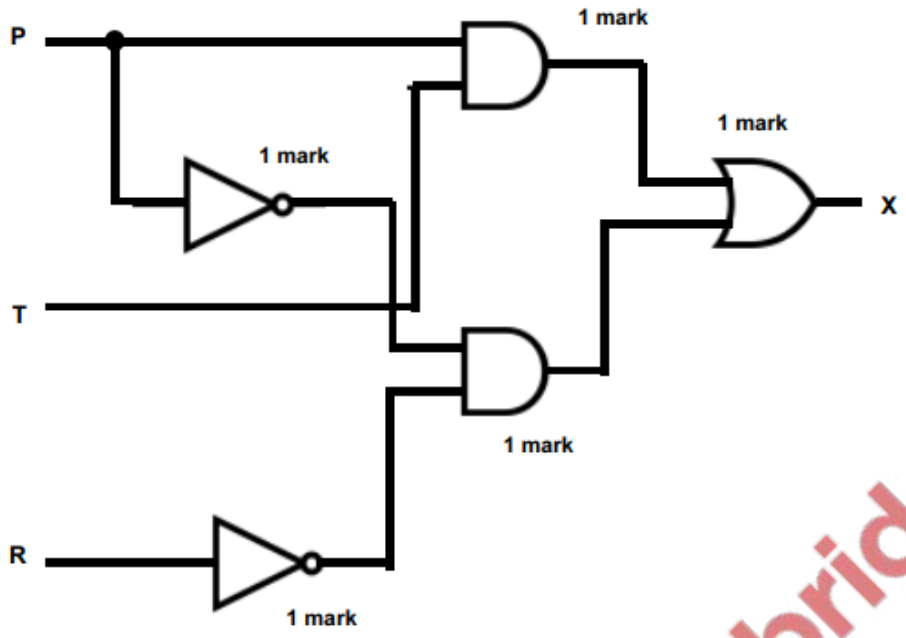


Note: input T has 2 cross overs that should not be connections

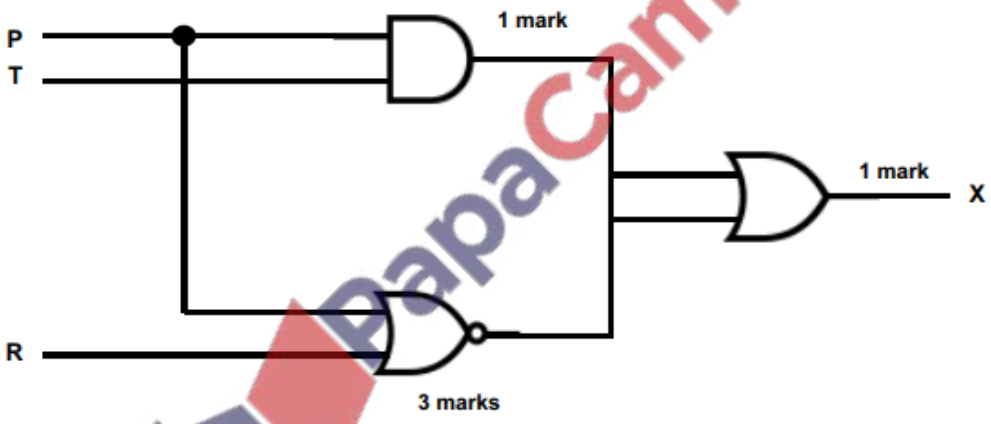
Note: it is possible to use a 3-input OR gate rather than the two 2-input OR gates on the top right:



Alternative solution 1:



Alternative solution 2:



[5]

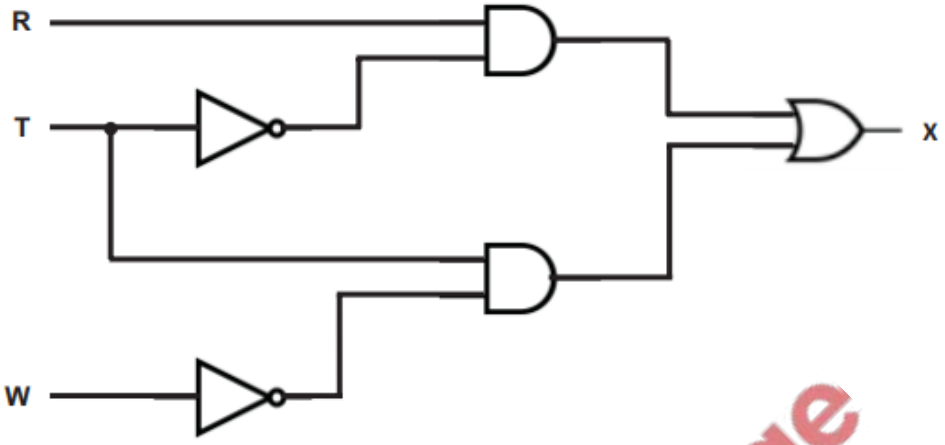
Note: other solutions may be possible depending on how simplification of the original statement is done

(b)

P	T	R	Workspace	X	
0	0	0		1	} 1 mark
0	0	1		0	
0	1	0		1	} 1 mark
0	1	1		0	
1	0	0		0	} 1 mark
1	0	1		0	
1	1	0		1	} 1 mark
1	1	1		1	

[4]

5 (a) (i) **One mark** for each correct gate.



[5]

(ii) $\underline{(R.\bar{T})} + \underline{(T.\bar{W})}$ // <u>(R AND NOT T)</u> <u>OR (T AND NOT W)</u> [2]

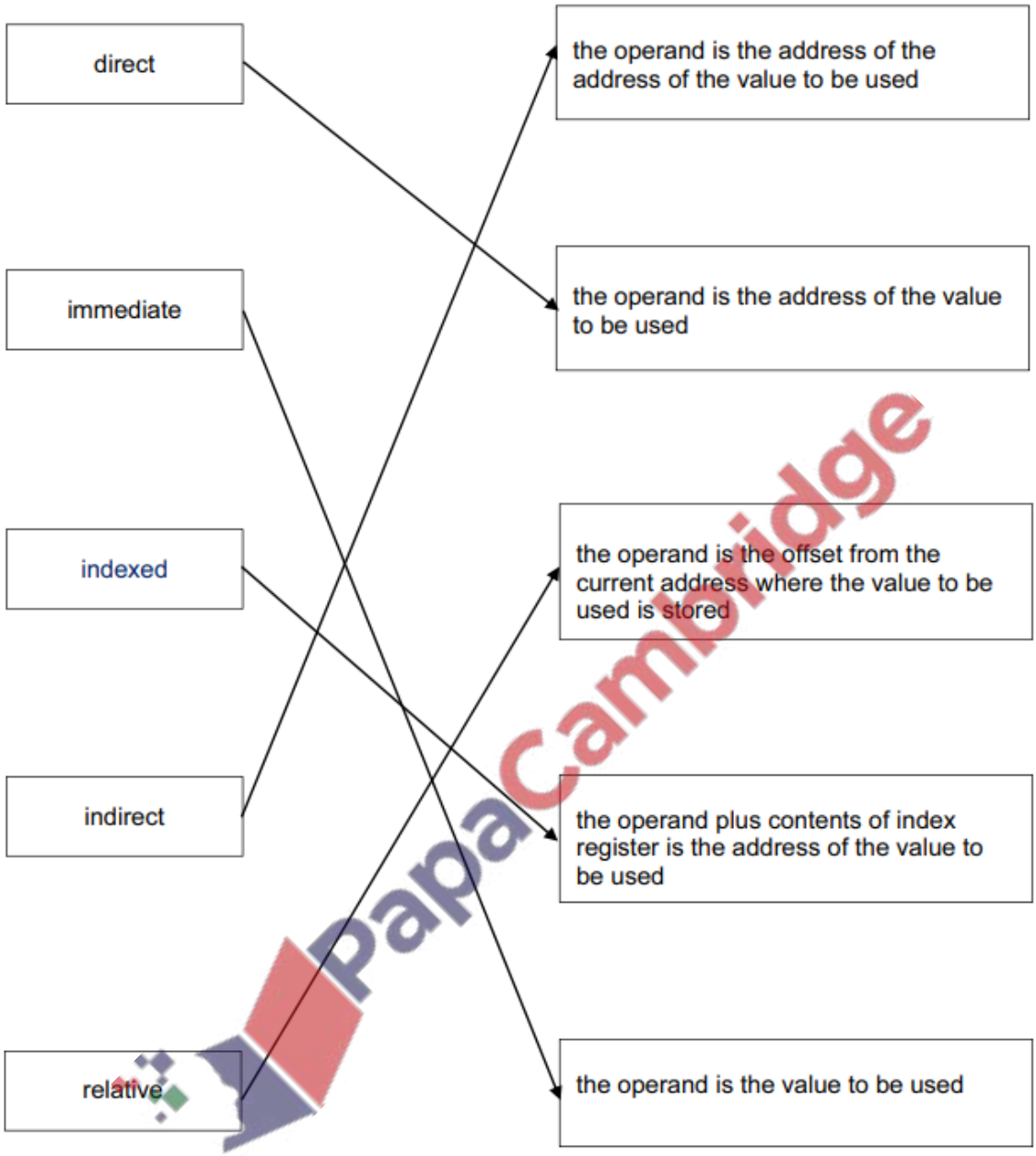
(iii) **One mark** for each pair of lines as shaded.

INPUT			Working space	OUTPUT X
R	T	W		
0	0	0		0
0	0	1		0
0	1	0		1
0	1	1		0
1	0	0		1
1	0	1		1
1	1	0		1
1	1	1		0

[4]

Question	Answer	Marks
5(a)(i)	**Three marks** from: ∞ Diaphragm / cone ∞ (Voice) coil of wire ∞ Spider / Suspension ∞ (Permanent) Magnet ∞ Basket ∞ Dust cap ∞ Outer frame	**3**
5(a)(ii)	**Four marks** from: ∞ Takes an electrical signal and translates it into physical vibrations to create sound waves ∞ An electric current in the coil creates an electro-magnetic field ∞ Changes in the audio signal causes the direction of the electric current to change ∞ The direction of the current determines the polarity of the electro-magnet // changing the direction of the current changes the direction of the polarity of the electro-magnet ∞ The electro-magnet is repelled by or attracted to the permanent magnet ∞ Causing the coil to vibrate ∞ The movement of the coil causes the cone / diaphragm to vibrate ∞ That vibration is transmitted to the air in front of the cone / diaphragm as sound waves ∞ The amount of movement will determine the frequency and amplitude of the sound wave produced	**Max 4**
5(b)(i)	**One mark** from: ∞ External hard disk drive // SSD ∞ External CD / DVD drive ∞ Pen drive ∞ Blu-ray drive	**1**
5(b)(ii)	**Two marks** from: ∞ Additional secondary file storage // storing files ∞ Backup of files ∞ Archiving of files ∞ Transfer files to second computer	**Max 2**

3



[4]

8 (a) **maximum** of **2 marks** for data bus width and **maximum** of **2 marks** for clock speed

data bus width

- the width of the data bus determines the number of bits that can be simultaneously transferred
- increasing the width of the data bus increases the number of bits/amount of data that can be moved at one time (or equivalent)
- …hence improving processing speed as fewer transfers are needed
- By example: e.g. double the width of the data bus moves 2x data per clock pulse

clock speed

- determines the number of cycles the CPU can execute per second
- increasing clock speed increases the number of operations/number of fetch-execute cycles that can be carried out per unit of time
- ...however, there is a limit on clock speed because the heat generated by higher clock speeds cannot be removed fast enough **[3]**

(b) Any **two** from:

- devices automatically detected and configured when first attached/plug and play
- it is nearly impossible to wrongly connect a device
- USB has become an industrial standard
- supported by many operating systems
- USB 3.0 allows full duplex data transfer
- later versions are backwards compatible with earlier USB systems
- allows power to be drawn to charge portable devices **[2]**

(c)

Description of stage	Sequence number
the instruction is copied from the Memory Data Register (MDR) and placed in the Current Instruction Register (CIR)	**3**
the instruction is executed	**6**
the instruction is decoded	**5**
the address contained in the Program Counter (PC) is copied to the Memory Address Register (MAR)	**1**
the value in the Program Counter (PC) is incremented so that it points to the next instruction to be fetched	**4**
the instruction is copied from the memory location contained in the Memory Address Register (MAR) and is placed in the Memory Data Register (MDR)	**2**

[6]

2 **(a)** A = control bus

B = address bus

C = data bus [3]

(b) Program Counter – stores the address of next instruction to be executed

Memory Data Register – stores the data in transit between memory and other registers // holds the instruction before it is passed to the CIR

Current Instruction Register – stores the current instruction being executed

Memory Address Register – stores the address of the memory location which is about to be accessed [4]

3 **(a)** **Four** points from: **[4]**

- The Program Counter (PC) holds the address of the next instruction to be fetched
- The address in the Program Counter (PC) is copied to the Memory Address Register (MAR)
- The Program Counter (PC) is incremented
- The instruction is copied to the Memory Data Register (MDR)
  - …. from the address held in the Memory Address Register (MAR)
- The instruction from the Memory Data Register (MDR) is copied to the Current Instruction Register (CIR)

(b) **One mark** for each statement or letter in the correct place. **[4]**

At the end of the cycle for the current instruction **B**
If the interrupt flag is set, **D**, **A** and **C**
The interrupted program continues its execution

At the end of the cycle for the current instruction the processor checks if there is an interrupt.
If the interrupt flag is set, the register contents are saved, the address of the Interrupt Service Routine (ISR) is loaded to the Program Counter (PC) and when the ISR completes, the processor restores the register contents.

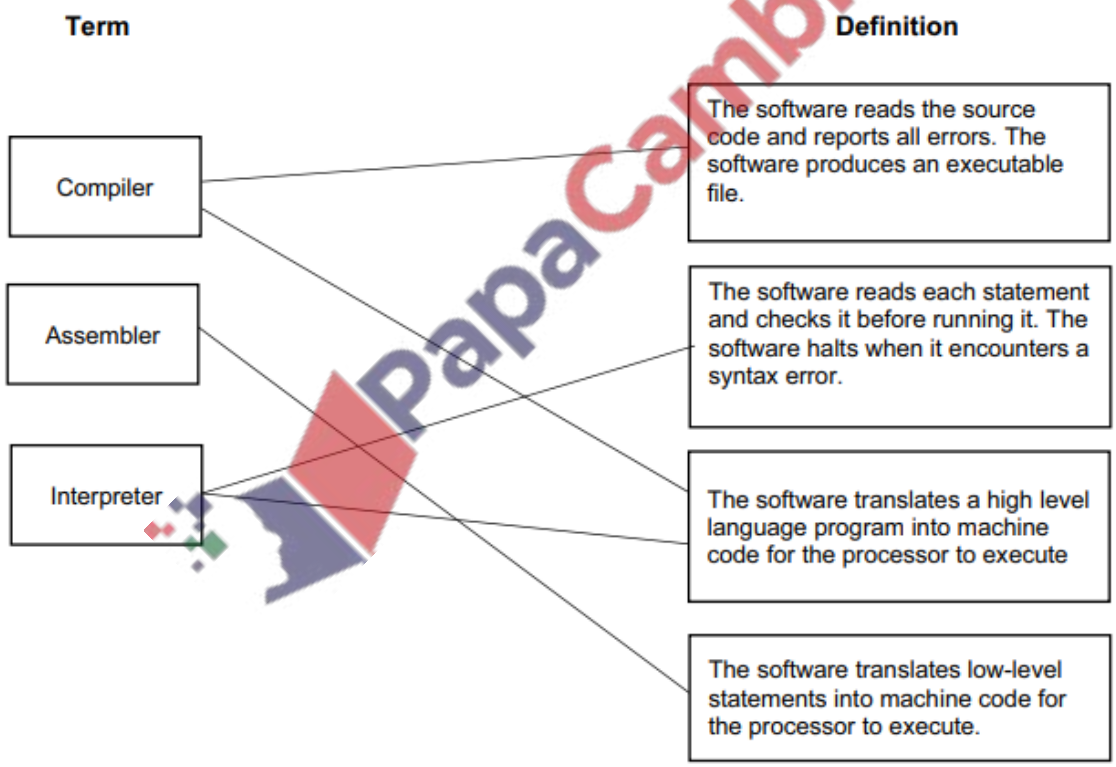
The interrupted program continues its execution.

11

Statement	Interpreter	Compiler
This translator creates an executable file		✓
When this translator encounters a syntax error, game execution will halt	✓	
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 supplied to the user		✓

1 mark for each correct row [5]

1 **One mark** for each box on the left. **[3]**



Marks allocated as follows:

Compiler – **1 mark** for **two** correct connecting lines
Assembler – **1 mark** for **one** correct connecting line
Interpreter – **1 mark** for **two** correct connecting lines

2 b) (i) Any **two** from

- The hardware is unusable without an OS // hides complexity of hardware from user
- Acts as an interface / controls communications between user and hardware / hardware and software
- Provides software platform / environment on which other programs can be run [2]

(ii) Any **two** from:

- Process / task / resource management
- Main memory management
- Peripheral / hardware / device management
- File / secondary storage management
- Security management
- Provision of a software platform / environment on which other programs can be run – only if not given in part (b)(i)
- Interrupt handling
- Provision of a user interface run – only if not given in part (b)(i) [2]

(c) Any **two** from:

- A DLL file is a shared library file
- Code is saved separately from the main .EXE files
- Code is only loaded into main memory when required at run-time
- The DDL file can be made available to several applications (at the same time) [2]

7 (a) **One mark** for the name and **one mark** for the explanation for **three** utility programs

- Disk formatter
- Prepares a hard disk to allow data to be stored on it

- Virus checker
- Checks for viruses and then quarantines removes any virus found

- File compression
- Reduces file size by removing redundant details (lossy / lossless)

- Backup software
- Makes copy of files on another medium in case of corruption / loss of data

- Firewall
- Prevents unauthorised access to computer system from external sources [6]

9 (a) One mark for validation, one mark for verification.

validation

– check whether data is reasonable / meets given criteria

verification

– method to ensure data which is copied / transferred is the same as the original
– entering data twice and computer checks both sets of data
– check entered data against original document / source [2]

(b) any **four** from:

– parity can be even or odd
– parity check uses the number of 1s in a binary pattern
– if there is an even / odd number of 1s, then the parity is even / odd
– following transmission …
– parity of each byte checked
– a parity bit is used to make sure binary pattern has correct parity
– example: 1 0 0 1 0 1 1 1 has parity bit set to 1 in MSB since system uses odd parity (original data: 0 0 1 0 1 1 1 which has four 1 bits) [4]

10 (a) any **two** from:

– malicious code / software / program
– that replicates / copies itself
– can cause loss of data / corruption of data on the computer
– can cause computer to "crash" / run slowly
– can fill up hard disk with data [2]

(b) any **two** from:

– checks for boot sector viruses when machine is first turned on
– when an external storage device is connected
– checks a file / web page when it is accessed / downloaded [2]

7 (c) (i)
- Hackers can still access the data (and corrupt it, change it or delete it)
- Encryption simply makes data incomprehensible (without decryption key / algorithm) [2]

(ii) Any **two** from:

- This is an explanation of data verification (not validation)
- Data validation ensures that data is reasonable / sensible / within a given criteria
- Original data may have been entered correctly but is not reasonable (e.g. age of 210) [2]

(iii)
- A password does not prevent unauthorised access, it makes it more difficult
- Password can be guessed (if weak) // Password can be stolen // A relevant example of misappropriation of password [2]

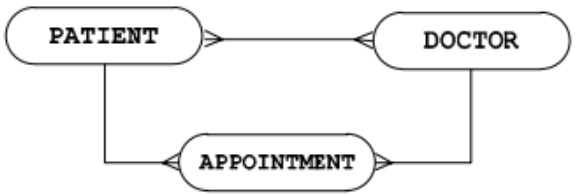
Question	Answer	Marks
5(a)(i)	∞ Count the number of one bits in the first seven bit positions 1 ∞ Add a 0 or 1 to bit position 0, to make the count of one bits an odd number 1	2
5(a)(ii)	A = 1 B = 1	1
5(a)(iii)	**Two** from: ∞ A parity bit is worked out for each column 1 ∞ The computer checks the parity of each bit position in parity byte // the computer generates copy of the parity byte and compares 1 ∞ If incorrect parity then there is an error in the data received // No parity error means no error in the data received 1 ∞ The position of the incorrect bit can be determined 1	2

Question	Answer	Marks
6(a)	**Two marks** from: ∞ A system of moral principles ∞ That guide behaviour / decision making ∞ Based on philosophical / religious views ∞ By example, e.g. respectful and considerate behaviour	**Max 2**
6(b)	**One mark** for identifying the issue **One mark** for correct principle **One mark** for possible action **Max 2** issues (2 × 3 marks) 1 Uncomfortable with one of his colleagues Client and Employer // Management / Colleagues // Judgement // Self For example: Team building exercises // arranged meeting 2 Unfamiliar with programming language Self // Client and Employer //Product // Profession // Colleagues For example: Undergo training 3 Visit to unfamiliar workplace Client and employer // Management // Judgement // Profession // Colleagues For example: He should speak to his manager to discuss situation	**Max 6**

6 **One mark** for identifying the principle, **one mark** for an example that is in the context of this scenario.

Maximum of two marks per principle. **Maximum of three** principles. **[6]**

- PUBLIC / Software engineers shall act consistently with the public interest.
  - Example in context
- CLIENT AND EMPLOYER / Software engineers shall act in a manner that is in the best interests of their client and employer (consistent with the public interest.)
  - Example in context
- PRODUCT / Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.
  - Example in context
- JUDGEMENT / Software engineers shall maintain integrity and independence in their professional judgment.
  - Example in context
- MANAGEMENT / Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance.
  - Example in context
- PROFESSION / Software engineers shall advance the integrity and reputation of the profession (consistent with the public interest).
  - Example in context
- COLLEAGUES / Software engineers shall be fair to and supportive of their colleagues.
  - Example in context
- SELF / Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession.
  - Example in context

Question	Answer	Marks
7(a)(i)	PatientID DoctorID } (1) AppointmentDate, AppointmentTime (1)	2
7(a)(ii)	 One PATIENT attends many APPOINTMENTs One DOCTOR takes many APPOINTMENTs Special case for 1 mark only (only if no one to many relationships shown) Many PATIENTs are seen by many DOCTORs	2
7(b)	**Two marks** from: Either: ∞ Add an attribute (for example Attended) ∞ To the appointment table // APPOINTMENT Or: ∞ Add an attribute (for example AppointmentsMissed) ∞ To the patient table // PATIENT	2
7(c)(i)	Available to work at both SITE-A and SITE-B	1
7(c)(ii)	APPOINTMENT(Site, AppointmentDate, AppointmentTime, DoctorID, PatientID)	1
7(d)(i)	**One mark** per line UPDATE DOCTOR SET DoctorID = '017' WHERE DoctorID = '117';	3
7(d)(ii)	**1 Mark** per bullet, max 2 ∞ Referential integrity should be maintained // Referential integrity could be violated. ∞ Data becomes inconsistent ∞ There may be records in the APPOINTMENT table showing doctor ID 117 ∞ The APPOINTMENT table might not be automatically updated ∞ Records in the APPOINTMENT table will become orphaned	Max 2
7(e)	**One mark** per line SELECT AppointmentDate, AppointmentTime FROM APPOINTMENT WHERE PatientID = '556';	3

9 **(a)** Any **one** from:

- (ShopSales) table has repeated group (of attributes)
- each sales person has a number of products
- FirstName, Shop would need to be repeated for each record **[1]**

(b) **One mark** for `SalesPerson` table

table: `SalesPerson`

FirstName	Shop
Nick	TX
Sean	BH
John	TX

table: SalesProducts

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

(**1 mark** for FirstName column + **1 mark** for remainder of table)

[3]

(c) (i) Any **two** from:

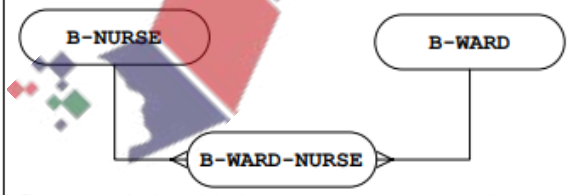
- primary key of SalesPerson table is FirstName
- links to FirstName in SalesProducts table
- FirstName in SalesProductsS table is foreign key **[2]**

(ii)
- There is a non-key dependency
- Manufacturer is dependent on ProductName, (which is not the primary key of the SalesProducts table) **[2]**

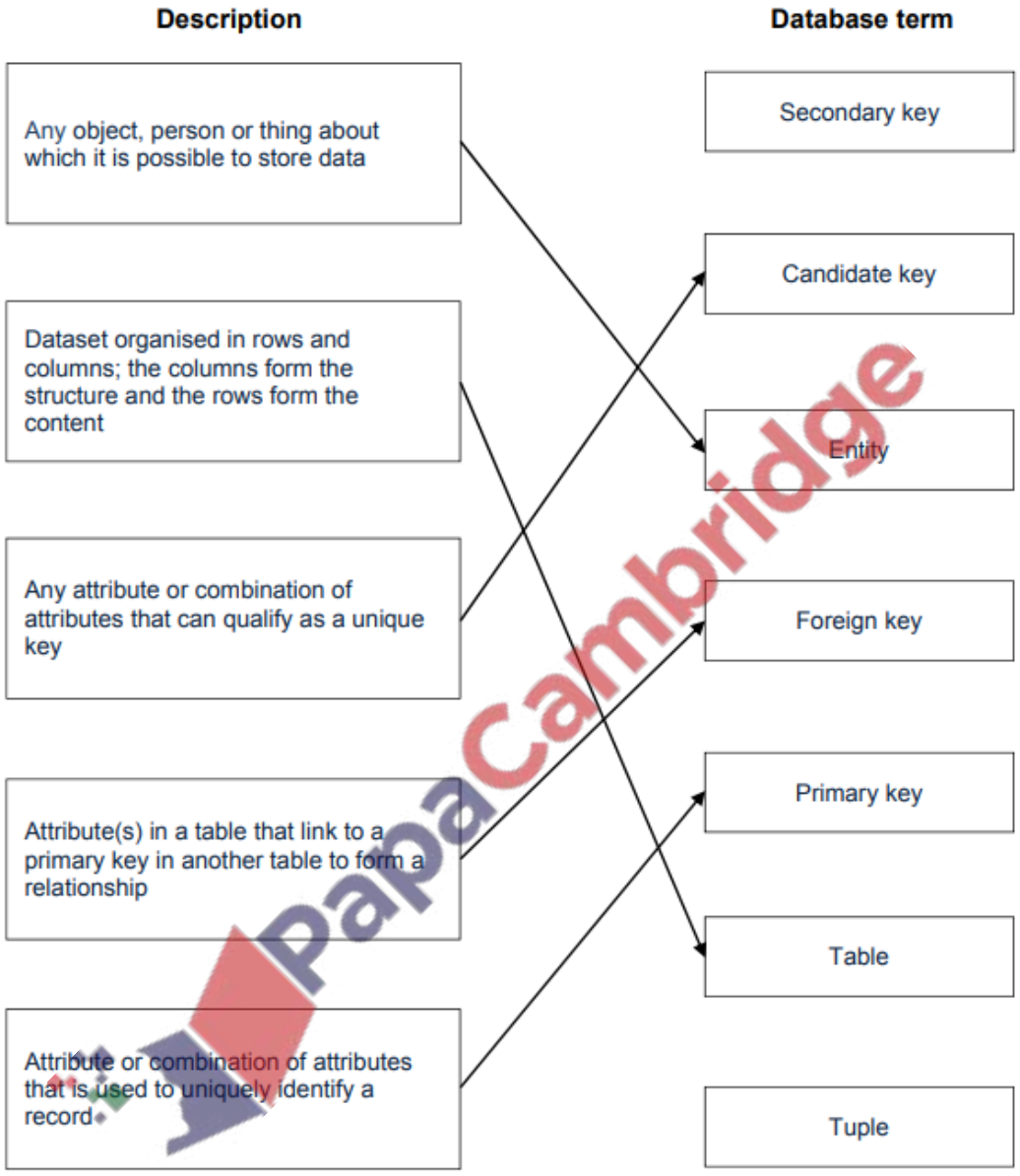
(iii)
```
SalesPerson (FirstName, Shop)
-SalesProducts (FirstName, ProductName, NoOfProducts) OR
  SalesProducts(SalesID, FirstName, ProductName, NoOfProducts)

-Product (ProductName, Manufacturer)
```

1 mark for correct attributes in `SalesProducts` and `Product` tables and **1 mark** for correct identification of both primary keys **[2]**

Question	Answer	Marks
1(a)	Many-to-one	**1**
1(b)(i)	A-NURSE(NurseID, FirstName, FamilyName, **WardName**)	**1**
1(b)(ii)	∞ The primary key WardName in the A-WARD table … 1 ∞ … links to the foreign key WardName in the A-NURSE table. 1	**2**
1(c)(i)	Many-to-many relationship	**1**
1(c)(ii)	B-WARD-NURSE(WardName, NurseID) Both attributes (with no additions) 1 Joint primary key correctly underlined 1	**2**
1(c)(iii)	 Correct relationship between B-NURSE and B-WARD-NURSE 1 Correct relationship between B-WARD and B-WARD-NURSE 1	**2**
1(d)(i)	SELECT NurseID, FamilyName 1 FROM B-NURSE 1 WHERE Specialism = 'THEATRE'; 1	**3**
1(d)(ii)	UPDATE **B-NURSE** 1 SET **FamilyName = 'Chi'** 1 WHERE **NurseID = '076'**; 1	**3**

1 (a) **One mark** for each correct line.
Two lines from any box on left means no mark for that description.



[5]

(b) Any **three** from:

- Ensures related data in tables are consistent

- If one table has a foreign key (the 'foreign' table)…
- … then it is not possible to add a record to that table / the 'foreign' table
- … unless there is a corresponding record in the linked table with a corresponding primary key (the 'primary' table)
- Cascading delete
- If a record is deleted in the 'primary' table…
- all corresponding linked records in 'foreign' tables must also be deleted

- Cascading update
- If a record in the 'primary' table is modified…
- … all linked records in foreign tables will also be modified [3]