Revision Workbook

O Level & IGCSE Computer Science

P1: Theory of Computer Science

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Syllabus content & assessment at a glance

Sections	Topics
Section 1	**Theory of Computer Science** 1.1 Data representation 1.1.1 Binary systems 1.1.2 Hexadecimal 1.1.3 Data storage 1.2 Communication and Internet technologies 1.2.1 Data transmission 1.2.2 Security aspects 1.2.3 Internet principles of operation 1.3 Hardware and software 1.3.1 Logic gates 1.3.2Computer architecture and the fetch-execute cycle 1.3.3 Input devices 1.3.4 Output devices 1.3.5 Memory, storage devices and media 1.3.6 Operating systems 1.3.7High- and low-level languages and their translators 1.4 Security 1.5 Ethics
Section 2	**Practical Problem-solving and Programming** 2.1 Algorithm design and problem-solving 2.1.1 Problem-solving and design 2.1.2 Pseudocode and flowcharts 2.2 Programming 2.2.1 Programming concepts 2.2.2 Data structures; arrays 2.3 Databases

Assessment at a glance

Components	Weighting
Paper 1 Theory 1 hour 45 minutes This written paper contains short-answer and structured questions. All questions are compulsory. No calculators are permitted in this paper. 75 marks Externally assessed.	**60%**
Paper 2 Problem-solving and Programming 1 hour 45 minutes This written paper contains short-answer and structured questions. All questions are compulsory. 20 of the marks for this paper are from questions set on the pre-release material. 1 No calculators are permitted in this paper. 50 marks Externally assessed.	**40%**

Revision Checklist

S No	Learning Outcome	To Read	Have Read	To Revise	Have Revised	Prepared
	1.1.1: Binary systems					
1	Recognize the use of binary numbers in computer systems					
2	Denary-to-binary and binary-to- denary conversion					
3	Concept of a byte and how the byte is used to measure memory size					
4	Use binary in computer registers for a given application (such as in robotics, digital instruments and counting systems)					
	1.1.2: Hexadecimal					
5	Represent integers as hexadecimal numbers					
6	Reasons for choosing hexadecimal to represent numbers					
7	Convert positive hexadecimal integers to and from denary					
8	Convert positive hexadecimal integers to and from binary					
9	Represent numbers stored in registers and main memory as hexadecimal					
10	Identify current uses of hexadecimal numbers in computing, such as defining colours in Hypertext Markup Language (HTML), Media Access Control (MAC) addresses, assembly languages and machine code, debugging					
	1.2.1: Serial and parallel data transmission					
11	Show understanding of what is meant by transmission of data					
12	Distinguish between serial and parallel data transmission					
13	Distinguish between simplex, duplex and half-duplex data transmission					
14	Reasons for choosing serial or parallel data transmission					
15	Show understanding of the need to check for errors					
16	Explain how parity bits are used for error detection					
17	Show understanding of the use of serial and parallel data transmission, in Universal Serial Bus (USB) and Integrated Circuit (IC)					
	1.2.3: Internet principles of operation					
18	Show understanding of the role of the browser and Internet server					
19	What is meant by hypertext transfer protocol (http and https) and HTML					
20	Distinguish between HTML structure and presentation					
21	Show understanding of the concepts of MAC address, Internet Protocol (IP) address, Uniform Resource Locator (URL) and cookies					
	1.3.1: Logic gates					
22	use logic gates to create electronic circuits					
23	Understand and define the functions of NOT, AND, OR, NAND, NOR and XOR (EOR) gates, including the binary output produced from all the possible binary inputs (all gates, except the NOT gate, will have 2 inputs only)					
24	Draw truth tables and recognise a logic gate from its truth table					
25	Produce truth tables for given logic circuits,					
26	Produce a logic circuit to solve a given problem or to implement a given written					

S No	Learning Outcome	To Read	Have Read	To Revise	Have Revised	Prepared
	logic statement					
27	Write down logic statement of given logic circuit					
28	Simplify the logic circuit					
29	Boolean algebra					
30	Solving past paper questions					
	1.3.2: Computer architecture and the fetch-execute cycle					
31	Show understanding of the basic Von Neumann model for a computer system and the stored program concept (program instructions and data are stored in main memory and instructions are fetched and executed one after another)					
32	Describe the stages of the fetch-execute cycle					
	1.3.3: Input devices					
33	Describe the principles of operation (how each device works) of these input devices: 2D and 3D scanners, barcode readers, Quick Response (QR) code readers, digital cameras, keyboards, mice, touch screens, interactive whiteboard, microphones					
34	Describe how these principles are applied to real-life scenarios, for example: scanning of passports at airports, barcode readers at supermarket checkouts, and touch screens on mobile devices					
35	Describe how a range of sensors can be used to input data into a computer system, including light, temperature, magnetic field, gas, pressure, moisture, humidity, ph and motion					
36	Describe how these sensors are used in real-life scenarios, for example: street lights, security devices, pollution control, games, and household and industrial applications					
	1.3.4: Output devices					
37	Describe the principles of operation of a range of output devices, including: inkjet, laser and 3D printers; 2D and 3D cutters; speakers and headphones; actuators; flat-panel display screens, including Liquid Crystal Display (LCD) and Light-Emitting Diodes (LED); and LCD projectors and Digital Light Projectors (DLP)					
38	Describe how these principles are applied to real-life scenarios, for example: printing single items on demand or in large volumes; use of small screens on mobile devices					
	1.3.5: Memory, storage devices and media					
39	Show understanding of the difference between: primary, secondary and off-line storage and provide examples of each, such as, primary: Read Only Memory (ROM), and Random Access Memory (RAM) secondary: hard disk drive (HDD) and Solid State Drives (SSDs); off-line: Digital Versatile Disks (DVDs), Compact Disks (CDs), Blu-ray, USB flash memory and removable disks					
40	Describe the principles of operation of a range of types of storage devices and media including magnetic, optical and solid state					

S No	Learning Outcome	To Read	Have Read	To Revise	Have Revised	Prepared
41	Describe how these principles are applied to currently available storage solutions, such as SSDs, hard disk drives, USB flash memory, DVDs, CDs and Blu-ray					
42	Calculate the storage requirement of a file					
	1.1.3: Data storage					
43	File formats sound (music), pictures, video, text and numbers					
44	Identify and describe methods of error detection and correction, such as parity checks, check digits, checksums and Automatic Repeat requests (ARQ)					
45	Concept of (MIDI) files, jpeg files, MP3 and MP4 files					
46	File compression (lossless and lossy compression algorithms) applied to music/video, photos and text files					
	1.3.6: Operating systems					
47	Describe the purpose of an operating system • the idea of system software as different from applications software • general tasks and facilities of an operating system – for processor management, it is helpful to demonstrate Windows Task Manager • the role of the operating system (OS) in file management • how peripheral devices, such as keyboards and printers, must be controlled and responded to by the operating system • how communication between the computer and peripherals must be controlled and errors detected.					
48	Show understanding of the following terms and the need for interrupts • buffer • polling • interrupts • handshaking • checksum.					
49	Discuss the main differences between command line interfaces CLIs and graphical user interfaces GUIs and their respective advantages and disadvantages.					
	1.3.7: High- and low-level languages and their translators					
50	Show understanding of the need for both high-level and low-level languages					
51	Show understanding of the need for compilers when translating programs written in a high-level language					
52	Show understanding of the use of interpreters with high-level language programs					
53	Need for assemblers when translating programs written in assembly language					
54	Solving past paper questions					
	1.2.2: Security aspects					
55	Show understanding of the security aspects of using the Internet and understand what methods are available to help minimise the risks					
56	Show understanding of the Internet risks associated with malware, including viruses, spyware and hacking					
57	Explain how anti-virus and other protection software helps to protect the user					

S No	Learning Outcome	To Read	Have Read	To Revise	Have Revised	Prepared
	from security risks (this also links into section 1.4 of the syllabus)					
	1.4 Data integrity and security					
58	Show understanding of how data are kept safe when stored and transmitted, including: ○ use of passwords, both entered at a keyboard and biometric ○ use of firewalls, both software and hardware, including proxy servers ○ use of security protocols such as Secure Socket Layer (SSL) and Transport Layer Security (TLS) ○ use of symmetric encryption (plain text, cypher text and use of a key) showing understanding that increasing the length of a key increases the strength of the encryption					
59	Show understanding of the need to keep online systems safe from attacks including denial of service attacks, phishing, pharming					
60	Show understanding of the need to keep data safe from accidental damage, including corruption and human errors					
61	Show understanding of the need to keep data safe from malicious actions, including unauthorised viewing, deleting, copying and corruption					
62	Describe how the knowledge from 1.4.1, 1.4.2 and 1.4.3 can be applied to real-life scenarios including, for example, online banking, shopping					
	1.5: ethics					
63	Show understanding of computer ethics, including copyright issues and plagiarism					
64	Distinguish between free software, freeware and shareware					
65	Show understanding of the ethical issues raised by the spread of electronic communication and computer systems, including hacking, cracking and production of malware					

1.1 Data representation

Chapter at a glance:

The basic building block in all computers is the binary number system.

A **binary digit** is commonly referred to as a **BIT**; 8 bits are usually referred to as a **BYTE**.

The byte is the **smallest unit of memory** in a computer.

It should be pointed out here that there is some confusion in the naming of memory sizes.

The unit was established by the **International Electrotechnical Commission (IEC)** in 1998, has been accepted for use by all major standards organizations, and is part of the International System of Quantities. The kibibyte was designed to replace the kilobyte in those computer science contexts in which the term kilobyte is used to mean 1024 bytes. The interpretation of the kilobyte to denote 1024 bytes, conflicting with the SI definition of the prefix kilo (1000), is still common, mostly in informal computer science contexts.

The IEC convention is now adopted by some organisations. Manufacturers of storage devices often use the denary system to measure storage size. For example:

1 kilobyte = 1000 byte

1 megabyte = 1000000 bytes

1 gigabyte = 1000000000 bytes

1 terabyte = 1000000000000 bytes and so on.

The IEC convention for computer internal memories (including RAM) becomes:

1 kibibyte (1 KiB) = 1024 bytes

1 mebibyte (1 MiB) = 1048576 bytes

1 gibibyte (1 GiB) = 1073741824 bytes

1 tebibyte (1 TiB) = 1099511627776 bytes and so on

Example Question: *A company advertises its backup memory device as having 500 GB of storage. A customer wishes to know how many 8 MB files could be stored on the device. The company claimed that up to 62 500 files (assuming each file is 8 MB) could be stored. The customer calculated that 64 000 files could be stored.*

Explain the difference between these two storage values. Show any calculations you use in your explanation.

.....

.....

–company calculation is based on 1 GByte = 1000 Mbyte – so (500 × 1000)/8 = 62 500 files

– customer calculation based on 1 GByte = 1024 Mbyte – so (500 × 1024)/8 = 64000 files

– giving the difference of 1500 files [3]

Binary-to-Decimal & Denary-to-Binary Conversion –use binary notation (place values) i.e. 128, 64, 32, 16, 8, 4, 2, 1.

For **Binary-to-Hexadecimal** conversion firstly groups of 4 bits are made from right to left and each group is converted separately using 8, 4, 2, 1 notation.

For **Hexadecimal-to-Binary** conversion each hex digit is separated by other and then each hex digit is converted separately using 8 4 2 1 notation.

For **Denary-to-Hexadecimal** conversion LCM of the denary number is taken.

For Hexadecimal-to-Denary conversion hexadecimal notation (place value) is used eg. 4096 256 16 1

Memory Dump is display of memory contents and address in hexadecimal on screen or printed on paper. It is powerful fault-tracing tool for expert programmers.

Hexadecimal are used in HTML to represent colour codes (RGB Model). For example: # ff0000 for bright red and #980000 for darker red.

MAC Addresses are unique number of NIC (Wi-Fi, Bluetooth. or wired connection i.e. Ethernet). They are 48 bit long, but converted into 12 hexadecimal digits (in 6 pairs) making them short and easier to understand. For 00-1C-2A-FF-01. 1st 3 pairs represent manufacturer while the other represent serial number of product.

48 bit long address means there are 281,474,976,710,656 possible MAC addresses in the world.

UAA (Universally Administered MAC Address) are most common. These are the MAC addresses set by manufacturer

LAA (Locally Administered MAC Addresses) are changed locally to bypass firewall, or to assign MAC address of specific format.

URL encoding:

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**www.ruknuddin.com"** is written as:

	r	u	k	n	u	d	d	i	n
in hex	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E

w	w	w	.	r	u	k	n	u	d	d	i	n	.	c	o	m
%77	%77	%77	%2E	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E	%2E	%63	%6F	%6D

Some characters are not allowed in URL. URL encoding converts characters into a format that can be transmitted over the Internet.

For example

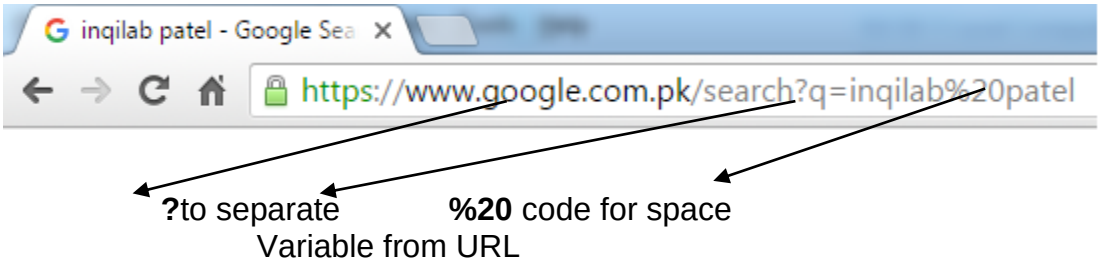
- %20 – is used in URL in place of <space> not allowed in a URL, %20 is the coding for a space (32 in denary)
- ? – separates the URL from all parameters or variables
  e.g. for query to search Inqilab patel in Google

https://www.google.com.pk/search?q=inqilab%20patel

here **"q"** is variable for query "**?**" separates it from URL

"https://www.google.com.pk/search"

while**"%20"**is used for the space between **"inqilab" and "patel"**



Machine code and Assembly code are examples of low-level languages and are used by software developers when producing, for example, computer games. They look difficult but they have many advantages at the development stage of software writing (especially when trying to locate errors in

the code). Using hexadecimal makes it much easier, faster and less error prone to write code compared to binary.
Character: Any text, number or symbol.

Why compress on the Internet?
The Internet can be slow at times, especially in it's early days relying on early 56Kbps modems as opposed to the 3-4 Mbps average. Therefore if you could compress the files that were being sent on the Internet, then you sent smaller files, and smaller file sizes meant faster downloads. It also frees up the network and avoids clogging up the bandwidth.

Compression: The method of reducing file size.

Lossy Compression: The file is reduced in size for transmission and storage; by permanently removing some redundant information from the file

Lossless Compression: The file is reduced in size for transmission and storage; it is then put back together again later producing a file identical to the original

MIDI: A MIDI file consists of a list of commands that instruct a device like an electronic organ, how to produce a particular sound or musical note.

Examples of MIDI commands include:

- note on/off: this indicates that a key has been pressed/released to produce/stop producing a musical note
- key pressure: this indicates how hard the key has been pressed (this could indicate loudness of the music note or whether any vibrato has been used, and so on).

The whole piece of music will have been stored as a series of commands but no actual musical notes. Their size, compared with an MP3 file, is considerably smaller. MIDI is essentially a communications protocol that allows electronic musical instruments to interact with each other. The MIDI protocol uses 8-bit serial transmission with one start bit and one stop bit, and is therefore asynchronous. MIDI is essentially a communications protocol that allows electronic musical instruments to interact with each other.

MP3: File compression system for music which does not noticeably affect the quality of the sound. This is done using file compression algorithms which use **PERCEPTUAL MUSIC SHAPING**; this essentially removes sounds that the human ear can't hear properly.

For example, an 50 megabyte music CD can be reduced to 5 megabytes.
50 MB x 90/100= 45 MB reduced. 50 MB x 10/100=5 MB new file size.

MP3 technology reduces the size of a normal music file by about 90 per cent.

MP4: MPEG-4 (MP4) format allows the storage of multimedia files rather than just sound. Music, videos, photos and animation can all be stored in the MP4 format. Videos, for example, could be streamed over the internet using the MP4 format. It uses lossy compression.

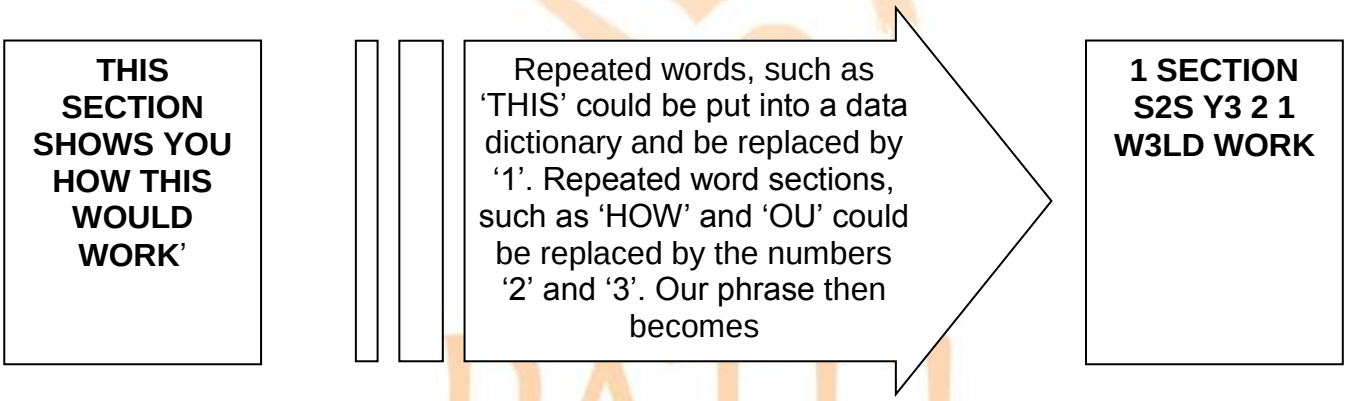
JPEG: File compression format designed to make photo files smaller in size for storage and for transmission. It uses lossy compression and compresses a file between factor of 5 to 15.

Uncompressed raw image

For example 2000 pixels wide and 2000 pixels high image will have 2000 × 2000= 4,000,000 pixels. This is often referred to as a 4-megapixel image. A raw bitmap can often be referred to as a **TIFF** or **BMP** image (file extension **.TIF** or **.BMP**). The file size of this image is determined by the number of pixels. In the previous example, a 4-megapixel image would be 4 megapixels × 3 colours(RGB) =12 megabytes.
This image will be compressed at factor of 5 (12/5=2.5 mb) to factor of 15 (12/15= 0.8mb).

Compressed image, after applying factor of 5

Text and number file formats: Text and numbers are usually stored in an ASCII format. Text files are also compressed. Lossless compression method is used for text and numbers. These use complex algorithms that work on redundancy or repeated sections of words (e.g. OU in yOUr, cOUntry or mOUntain).



The following section shows, in very simple terms, how this could work:
.
Algorithm: step-by-step set of instruction to solve a problem.
Register: Immediate access store in the processor. It can store small piece of data.

Topical Past Paper Questions

Summer 15 P11)

Q1) An alarm clock is controlled by a microprocessor. It uses the 24 hour clock. The hour is represented by an 8-bit register, **A**, and the number of minutes is represented by another 8-bit register, **B**.

(a) Identify what time is represented by the following two 8-bit registers.

A

128	64	32	16	8	4	2	1
0	0	0	1	0	0	1	0

:

B

128	64	32	16	8	4	2	1
0	0	1	1	0	1	0	1

Hours .....Minutes ..... [2]

(b) An alarm has been set for 07:30. Two 8-bit registers, **C** and **D**, are used to represent the hours and minutes of the alarm time. Show how 07:30 would be represented by these two registers:

C									D							
								:								

Hours Minutes [2]

(c) Describe how the microprocessor can determine when to sound the clock alarm

.....

.....

..... [3]

Marking Scheme

a) Hours 18 Minutes: 53 [2]

hours (**"C"**) minutes (**"D"**)

b)

0	0	0	0	0	1	1	1	:	0	0	0	1	1	1	1	0

c) Any three from:

– reads values in registers "C" and "D"

– and checks the values against those stored in registers "A" and "B"

(NOTE: the first two statements can be interchanged, i.e. "A" and "B" read first)

– If values in corresponding registers are the same

– the microprocessor sends a signal to sound alarm/ring [3]

(d) Any three from:

– uses a light sensor

– sends signal/data back to microprocessor

– signal/data converted to digital (using ADC)

– value compared by microprocessor with pre-set/stored value

– if value < stored value, signal sent by microprocessor …

– … to the voltage supply (unit)

– … "value" of signal determines voltage supplied/brightness of LED [3]

Summer 15 P12)

Q2) Letters from the alphabet are represented in a computer by the following denary (base 10) values:

A = 97 G = 103 I = 105 L = 108 N = 110

The word "**A L I G N**" is stored as: 97 108 105 103 110

(a) Convert each of the five values to binary. The first one has been done for you.[2]

Letter	**Binary value**							
A (97):	0	1	1	0	0	0	0	1
L(108):								
I (105):								
G (103):								
N (110):								

(b) An encryption system works by shifting the binary value for a letter one place to the left. "A" then

becomes:

1	1	0	0	0	0	1	0

This binary value is then converted to hexadecimal; the hexadecimal value for "A" will be: **C 2.** For the two letters "L" and "G", shift the binary values one place to the left and convert these values into hexadecimal: [4]

									hexadecimal
L:									.....
G:									.....

Marking Scheme

(a) 1 mark for two correct lines, 2 marks for four correct lines

L (108):	0	1	1	0	1	1	0	0
I (105):	0	1	1	0	1	0	0	1
G (103):	0	1	1	0	0	1	1	1
N (110):	0	1	1	0	1	1	1	0

(b) 1 mark for each correct binary value
1 mark for each correct hexadecimal value

									hexidecimal
L:	1	1	0	1	1	0	0	0	D8
G:	1	1	0	0	1	1	1	0	CE

Winter 15 P12)

Q3a) (i) Convert the following **two** hexadecimal numbers into binary:

F A 7
D 3 E

F A 7											
D 3 E											

[4]

(ii) Now perform the AND (logic) operation on each corresponding pair of binary bits in the two numbers from **part (i)**.

[2]

(iii) Convert your answer in **part (ii)** into hexadecimal.

..... [2]

(b) (i) The following code shows HTML 'tag' pairs on either side of the text stating the colour that each creates.

 RED
 GREEN
 BLUE
 YELLOW
 MAGENTA
 CYAN

Yellow is a combination of red and green, magenta a combination of red and blue and cyan a combination of green and blue.

State what 6-digit hexadecimal values should replace X, Y and Z in the above code.

X .....
Y .....
Z .....[3]

(ii) Describe how other colours, such as a darker shade of blue, are created.

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

(c) 1A – 16 – C5 – 22 – FF – FF is an example of a MAC address.

(i) Identify what the first six and last six hexadecimal digits represent.

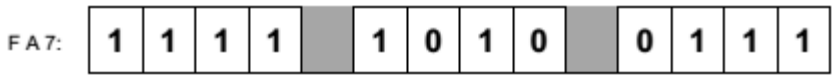
First six digits .....
.....
Last six digits .....
.....
..... [2]

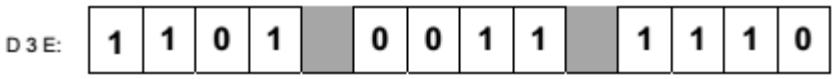
(ii) State why MAC addresses are used.

.....
..... [1]

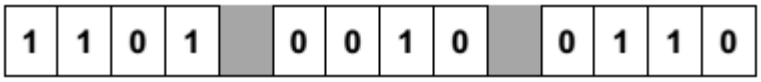
Marking Scheme

Q3a i)





(ii) 2 marks if all correct, 1 mark for 2 correct conversions – Follow through



(iii) 2 marks if all correct, 1 mark for 2 correct conversions – Follow through
D 2 6 [2]
(b) (i) (X) FF FF 00

(Y) FF 00 FF

(Z) 00 FF FF [3]

(ii) – hex values between 0 to F are combined together to create a hex code

– different combinations in hex codes will create different shades/tones/colours [2]

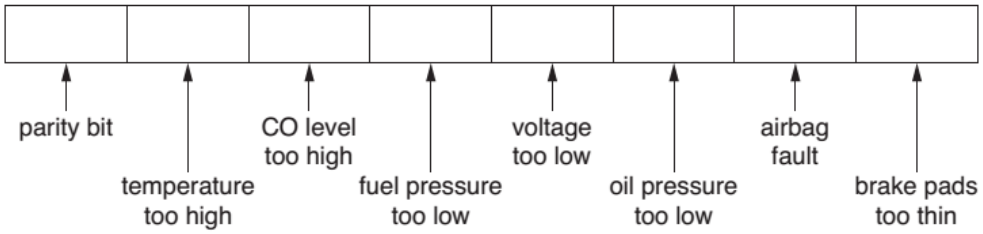
(c) (i) First six digits: manufacturer code/manufacturer ID

Last six digits: serial number/serial ID of device/product [2]

(ii) Allows all devices to be uniquely identified [1]

Winter 15 p13

Q4b) The information from seven sensors is sent to an engine management system in the car. The status of each sensor is stored in an 8-bit register; a value of 1 indicates a fault condition



For example, a register showing **0 1 0 1 1 0 0 0** indicates:

- temperature too high
- fuel pressure too low
- voltage too low

(i) Identify the fault condition(s) that the following register indicates:

0	0	1	0	0	1	0	1

.....

.....[2]

(ii) The system uses **odd** parity.

Write the correct parity bit in each register.

	1	1	1	0	0	1	0

	0	0	0	1	1	1	0

[2]

(iii) A car has a faulty airbag and the CO level is too high.

Write what should be contained in the 8-bit register.

[2]

(iv) Give the hexadecimal value of the binary number shown in **part (iii)**.

.....

.....[1]

Winter 15 P11)

Q5a) Convert the hexadecimal number **B5** into binary:

.....

Convert the binary number **1 1 1 1 0 1 1 0** into hexadecimal:

.....[2]

(b) Give **two** examples where hexadecimal numbers are used in computer science.

1: .....

2: .....

.....[2]

(c) State **two** benefits of using hexadecimal numbers in computer science.

1: .....

.....

2: .....

.....[2]

Q6) A CD is being used to store music. Each minute's worth of recording takes up 12 megabytes.

a The CD contains nine tracks which are the following length (in minutes): 3, 5, 6, 4, 5, 2, 7, 8, 8. How much memory would these nine tracks occupy on the CD?

b If the CD was downloaded to a computer and then all the tracks were put through an MP3 compression algorithm, how much memory would the nine tracks now occupy (you may assume a 90 per cent file reduction size)?

c Find the average size of each of the MP3 tracks, and then estimate how many MP3 files could be stored on an 800 megabyte CD.

..... [3]

Q7 a) Nicolae made the following statement:

"data input is validated by typing it in twice"

State why this statement is incorrect.

..... [1]

(b) Nicolae needs to send 30 photos to a friend and he chooses to send all 30 together as a single email attachment. Each photo is 1.8 MB in size, but the maximum possible attachment size is only 20 MB.

State how Nicolae can solve this problem.

..... [1]

Q8) Characters can be represented in a computer by a numerical code.

The following list shows 16 characters with their numerical codes in denary:

a = 97	d = 100	h = 104	m = 109	t = 116
b = 98	e = 101	i = 105	o = 111	u = 117
c = 99	g = 103	k = 107	r = 114	w = 119

. = 46 (code for the full stop)

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**c a g e**" is written as:

either	99	97	103	101	(in denary)
or	%63	%61	%67	%65	(in hexadecimal)

(a) Complete the conversion of the following web address into hexadecimal: [3]

W	W	w	.	c	i	e	.	o	r	g	.	u	K
%77	%77	%77											

b) Complete the web address from the given hexadecimal codes: [3]

%77	%77	%77	%2E	%72	%6F	%63	%6B	%69	%63	%74	%2E	%63	%6F	%6D
W	W	w												

Summer 2016 2210_0478 qp 11_13

Q9) Hexadecimal codes are used in MAC addresses.

(a) State what is meant by the term MAC.

.....[1]

(b) Explain what the hexadecimal code in a MAC address represents.

.....
.....
.....
.....
.....
.....[3]

Q10) Each seat on a flight is uniquely identified on an LCD above the seat. For example, seat 035C is shown as:

The first three characters are digits that represent the row.
The fourth character is the seat position in that row. This is a single letter, A to F, that is stored as a hexadecimal value.
Each of the four display characters can be stored in a 4-bit register. For example, 0 and C would be represented as:

	8	4	2	1
0:	0	0	0	0
C:	1	1	0	0

(a) Show how the 4-bit registers would store the remaining two characters, 3 and 5. [2]

3

5

(b) Identify which seat is stored in the following 4-bit registers. **[2]**

0	0	0	1	→ .....
1	0	0	1	→ .....
0	1	0	0	→ .....
1	1	1	0	→ .....

Q11) (a) Name the following type of barcode:

.....[1]

(b) The barcode in part (a) contains the denary value 2 6 4 0
Convert this value to hexadecimal.

.....

.....

Write the value as a 12-bit binary number. **[4]**

(c) An airport uses the type of barcode shown in part (a) to advertise local places of interest.
Describe how a visitor landing at the airport could use these barcodes to help plan their visit.

.....

.....

.....

.....

.....

.....

.....[3]

Marking Scheme

Q9) (a) media access control [1]

(b) Any three from:

– hardware/physical address

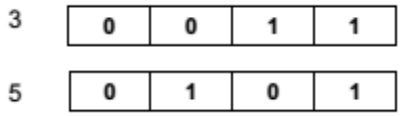
– unique address/number associated (with network card in) a device/computer

– usually 48/64 bits (12/16 hex digits)

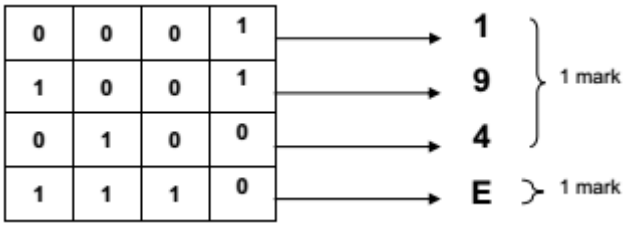
– first 6/8 digits = manufacturer code/ID of device (NIC)

– last 6/8 digits = serial number of device (NIC) [3]

Q10a)

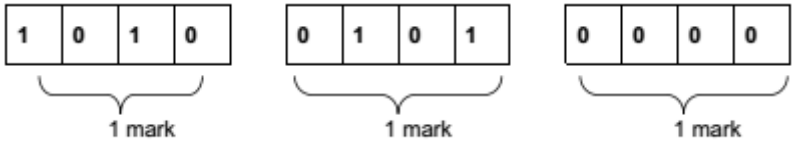


b)



Q11(a) QR (quick response) Code [1]

(b) – A 5 0 (1 mark)



(c) Any three from:

- visitor scans the QR code with (the camera on) the mobile device

- App is used to read/interpret the QR code

- links to a website/opens a document …

- … to access local tourist information

- can store the QR code to refer to again for the information [3]

Summer 2016 2210_0478 P12

Q12)(a) Convert the following hexadecimal number into 12-bit binary:

4 A F [3]

(b) The 2016 Olympic Games will be held in Rio de Janeiro. A timer that counts down to the opening of the Games is shown on a microprocessor-controlled display.
The number of hours, minutes and seconds until the Games open are held in three 8-bit registers.
The present register values are:

0	1	1	0	1	0	0	1	105 hours
0	0	1	0	0	0	0	0	32 minutes
0	0	0	1	0	1	0	0	20 seconds

The timer will count **down** in seconds.

(i) Show the values in each 8-bit register **30 seconds** after the time shown above: [3]

								hours
								minutes
								seconds

(ii) Write the hexadecimal value of the minutes register from part (b)(i).

.....[1]

Winter 15 p13

Q13) MP3 file compression reduces the size of a music file by 90%.

(a) A music track is 80 MB in size.

Calculate the file size after compression.

.....

How many MP3 files of the size calculated above could be stored on an 800 MB CD?

.....[2]

(b) (i) Explain how MP3 files retain most of the original music quality.

.....

.....

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

(ii) State the type of file compression used in MP3 files.

..... [1]

(iii) Name another file compression format.

..... [1]

Marking Scheme

(a) 8MB
100 [2]
(b) (i) Any two from:
– removes sounds human ear can't hear very well
– if two sounds played at same time, softer sound removed
– uses perceptual music shaping [2]
(ii) Lossy [1]
(iii) One from, for example:
– jpeg
– MP4
– zip
– gif [1]

Q14) **(a)** Describe what is meant by lossy and lossless compression when applied to files.

Lossy: .....
.....
.....
Lossless: .....
.....
.....[2]

(b) Name and describe **one** type of file that uses lossy compression.

Name: .....
Description: .....
.....
.....[2]

Summer 16 P12

Q15) Convert the following hexadecimal number into 12-bit binary:

4 A F [3]

(b) The 2016 Olympic Games will be held in Rio de Janeiro. A timer that counts down to the opening of the Games is shown on a microprocessor-controlled display.
The number of hours, minutes and seconds until the Games open are held in three 8-bitregisters.
The present register values are:

0	1	1	0	1	0	0	1	105 Hours
0	0	1	0	0	0	0	0	32 Minutes
0	0	0	1	0	1	0	0	20 Seconds

The timer will count **down** in seconds.

(i) Show the values in each 8-bit register **30 seconds** after the time shown above:[3]

								hours
								minutes
								seconds
0	1	1	0	1	0	0	1	Hours
0	0	1	0	0	0	0	0	Minutes
0	0	0	1	0	1	0	0	Seconds

(ii) Write the hexadecimal value of the **minutes** register from **part (b)(i)**.

.....[1]

Q 16) Nigel wants to send a large text file electronically to Mashuda.

(a) Describe how the size of the text file can be reduced.

.....

.....

.....

.....

.....

.....[3]

(b) This file will be transmitted to Mashuda as an email attachment. Mashuda then stores it on her computer.

Explain how checksums can be used to verify that the file has not been corrupted during transmission or data storage.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

Marking Scheme

Q15) *(a) 1 mark for each nibble*
0100 1010 1111 [3]
(b) (i) 0 1 1 0 1 0 0 1 105 hours 1 mark
0 0 0 1 1 1 1 1 31 minutes 1 mark
0 0 1 1 0 0 1 0 50 seconds 1 mark [3]
(ii) 1F [1]
Q16) *(a) Any three from:*
– The file can be compressed
– The compression that is used is lossless (not lossy)
– use of a compression algorithm
– repeated words can be indexed
– repeated word sections (e.g. "OU") can be replaced by a numerical value
– reference to zip files
– save file as a pdf/convert to pdf [3]
(b) Any four from:
– the checksum for the bytes is calculated
– this value is then transmitted with the block of data
– at the receiving end, the checksum is re-calculated from the block of data received
– the calculated value is then compared to the checksum transmitted
– if they are the same value, then the data was transmitted without any error
– if the values are different, then an error has been found
– if the values are different, then a request is sent for the data to be re-transmitted [4]

Winter 16 p12

Q17 8 Identify whether the four statements about file compression are correct by writing TRUE or FALSE in the following table. [4]

Statement	TRUE or FALSE
MIDI files store the actual music notes in a compressed format	
JPEG files are examples of lossless file compression	
MP3 files are, on average, 90% smaller than the music files stored on a CD	
MP4 files are examples of lossy file compression	

Statement	TRUE or FALSE
MIDI files store the actual music notes in a compressed format	FALSE
JPEG files are examples of lossless file compression	FALSE
MP3 files are, on average, 90% smaller than the music files stored on a CD	TRUE
MP4 files are examples of lossy file compression	TRUE

1.2 Communication and Internet technologies

Chapter at a glance:

A **network** is defined as a collection of computers and peripheral devices (such as printers) connected together.

Generally, a network over short distances is called a **local area network (LAN)** while those over great distances are **wide area networks (WAN)**.

Network adapters: These adapters (also called network interface cards or NICs) connect computers to a network so that they can communicate.

Network hubs and switches: Hubs and switches connect two or more computers to an Ethernet network.

Routers connect computers and networks to each other (for example, a router can connect your home network to the Internet).

Modem: Hardware device that converts signals from analogue to digital and vice versa; typically used to convert signals sent over the public service telephone network.

A **WEB BROWSER** is software which allows a user to display a web page on their computer screen. Web browsers interpret or translate the HTML code from websites and show the result of the translation**.**

SIMPLEX DATA TRANSMISSION: *sending data in one direction only (i.e. from sender to receiver) Example: data being sent from a computer to a printer, from keyboard to processor etc.*

HALF-DUPLEX DATA TRANSMISSION: *Sending data in both directions but only one at a time (i.e. data can be sent from 'A' to 'B' or from 'B' to 'A' along the same line, but not at the same time). Example: a walkie-talkie, fax machine, reading or burning on cds, dvds.*

FULL-DUPLEX DATA TRANSMISSION: *Sending data in both directions simultaneously* (i.e. data can be sent from 'A' to 'B' and from 'B' to 'A' along the same line, *both at the same time*). Example: a phone line, video recording and playing at the same time from DVD-RAM.

SERIAL DATA TRANSMISSION is when data is sent, *one bit at a time*, over *a single wire or channel*

Bit: It is short of binary digit. It is the smallest unit of data in computer. It consists of a 0 or an 1.

Bit rate: the rate of transmitting data

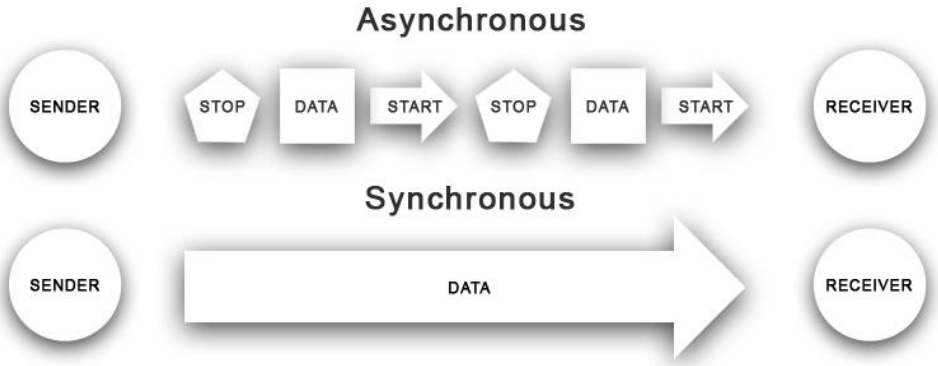
Serial Transmission: transfer of data bit by bit using single wire (bits are sent one after the other in a single stream).

Parallel Transmission: transfer of data in groups of bits using multiple wires.

ASYNCHRONOUS DATA TRANSMISSION refers to data being transmitted in an agreed bit pattern. Data bits (1s and 0s) are grouped together and sent with CONTROL BITS means START bit and STOP bit.

Discussion forums and email are two examples of how asynchronous communication

SYNCHRONOUS DATA TRANSMISSION is a continuous stream of data (unlike asynchronous data which is sent in discrete groups). The data is accompanied by timing signals generated by an internal clock. This ensures that the sender and receiver are synchronized with each other. Chat rooms and online conferences are good examples of synchronous communication.



The UNIVERSAL SERIAL BUS (USB)is an asynchronous serial data transmission method. It has quickly become the standard method for transferring data between a computer and a number of devices.

INTERNET SERVICE PROVIDER (ISP); these are companies that provide the user with access to the internet.

Each device on the internet is given a unique address known as the **INTERNET PROTOCOL (IP) ADDRESS**. This is a 32-bit number

HYPERTEXT MARK-UP LANGUAGE (HTML) is used when writing and developing web pages.

Interference: disturbance that occur in the signals when sending data that may corrupt it.

ISP (Internet Service Provider)*:* Company that provides individual's access to the Internet and other services such as webhosting and emails

MAC Address: Hardware identification number that uniquely identifies each device on a network; it is manufactured into every network card and cannot be altered

They are 48 bit long, but converted into 12 hexadecimal digits (in 6 pairs) making them short and easier to understand. For 00-1C-2A-FF-01. 1st 3 pairs represent manufacturer while the other represent serial number of product.

UAA (Universally Administered MAC Address) are most common. These are the MAC addresses set by manufacturer

LAA (Locally Administered MAC Address)are changed locally to bypass firewall, or to assign MAC address of specific format.

Cascade style sheet:

IP Address: Location of a given computer/device on a network; can be a static or dynamic value. IP addresses are 32 bit long converted into 4 groups of denary numbers. IP address starts from 0.0.0.0 and ends at 255.255.255.255.

URL (Uniform Resource Locator): The standard format for referring to are source on the Internet; also called Uniform Resource Indicator (URI); made up of:

●the protocol, e.g. http
●the domain name, e.g. ruknuddin.com
●the filename e.g. computer.html

URL encoding:

Web addresses can be written using hexadecimal rather than denary. Hexadecimal codes are preceded by a % sign. For example, the word "**www.ruknuddin.com"** is written as:

	r	u	k	n	u	d	d	i	n
in hex	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E

w	w	w	.	r	u	k	n	u	d	d	i	n	.	c	o	m
%77	%77	%77	%2E	%72	%75	%6B	%6E	%75	%64	%64	%69	%6E	%2E	%63	%6F	%6D

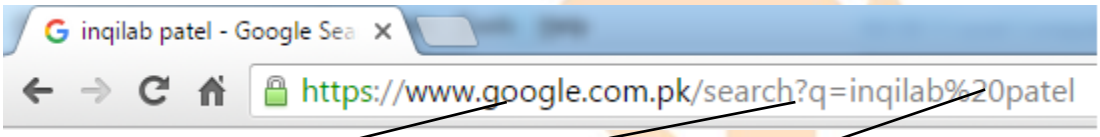
Some characters are not allowed in URL. URL encoding converts characters into a format that can be transmitted over the Internet.
For example

- %20 – is used in URL in place of <space> not allowed in a URL, %20 is the coding for a space (32 in denary)
- ? – separates the URL from all parameters or variables
  e.g. for query to search Inqilab patel in Google

https://www.google.com.pk/search?q=inqilab%20patel

here **"q"** is variable for query "**?**" separates it from URL
"https://www.google.com.pk/search"

while**"%20"**is used for the space between **"inqilab" and "patel"**



Browser: Software application used to locate, retrieve and display content on the World Wide Web e.g

URL **?**to separate Variable from URL **%20** code for space

HT s tags and attributes

HTML uses <tags> which are used to bracket a piece of code;
Some Common HTML tags:

Tag	Description
<a>	Defines an anchor
<b>	Defines bold text
<body>	Defines the document's body
 	Defines a single line break
	Defines a section in a document
<form>	Defines an HTML form for user input
<h1> to <h6>	Defines HTML headings
<head>	Defines information about the document
<hr />	Defines a horizontal line
<html>	Defines the root of an HTML document
<img />	Defines an image
<input />	Defines an input control
	Defines a list item
<p>	Defines a paragraph
<script>	Defines a client-side script
<table>	Defines a table

<td>	Defines a cell in a table
<th>	Defines a header cell in a table
<title>	Defines a title for the document
<tr>	Defines a row in a table

HTML Structure

Presentation describes how elements must be rendered on screen.

HTML Presentation:

HTML presentation is format of webpage.
CSS is used to define presentation for web pages, including the design and variations in display for different devices and screen sizes.

When a browser reads a style sheet, it will format the HTML document according to the information in the style sheet.

Web Server: The computers which host web sites.

Checksum: Technique used in data transmission to validate data by sending a block of data calculated from the contents of preceding blocks. The following algorithm is used to calculate check sum:

1. Calculate file size
2. If file size<256 then
3. Checksum=file size
4. Else
5. Checksum=file size MOD 256
6. Endif

Parity Check: Technique used in data transmission to validate data by sending an additional bit determined by the contents of the preceding bits to make the total number of 1s odd or even.
Parity Block: A parity check carried out on a sequence of bytes. The parity block is an additional byte where the bits are computed from the preceding data bytes. The bytes are arranged in a grid and each parity byte bit is calculated from the bits in the column above.

Check digit: Validation technique that involves calculating an additional digit from the ones that proceed it. Following two Methods are used to calculate check digit

Modulo-11 Method:

(i) The position of each digit is first considered:

10	9	8	7	6	5	4	3	2	1 ← Digit Position
0	2	2	1	4	3	2	5	6	? ← Number

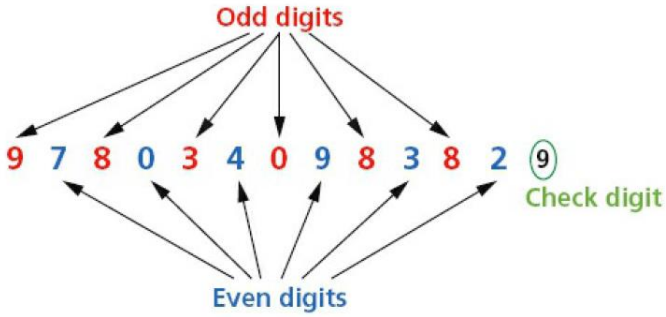
(ii) Each digit in the number is then multiplied by it's digit position and the totals are added together:
i.e. (0x10) + (2x9) + (2x8) + (1x7) + (4x6) + (3x5) + (2x4) + (5x3) + (6x2)
= 0+18+16+7+24+15+8+15+12
= 115 total

(iii) The total is then divided by 11 (modulo 11) and the remainder, if any, is subtracted from 11. The answer then gives the check digit.
i.e. 115/11 = 10 remainder 5
i.e. 11 – 5 = 6 (check digit)
hence, the final number is: 0-221-43256-6

Modulo-10 Method (ISBN-13):

Modulo-10 method is used in check digit calculation in ISBN 13, where the 13th digit of the ISBN code is calculated using the following algorithm.

1 Add all the odd numbered digits together, excluding the check digit.
2 Add all the even numbered digits together and multiply the result by 3.
3 Add the results from 1 and 2 together and divide by 10.
4 Take the remainder, if it is zero use this value, otherwise subtract the remainder from 10 to find the check digit.



Using the ISBN above 9 7 8 0 3 4 0 9 8 3 8 2 without its check digit:
1 9 + 8 + 3 + 0 + 8 + 8 = 36
2 3(7 + 0 + 4 + 9 + 3 + 2) = 75
3 (36 + 75)/10 = 11 remainder 1
4 10 – 1 = 9 the check digit.

AUTOMATIC REPEAT REQUEST (ARQ) is another method used to check whether data has been correctly transmitted.
It uses an **ACKNOWLEDGEMENT** (a message sent by the receiver indicating that data has been received correctly) and **TIMEOUT** (this is the time allowed to elapse before an acknowledgement is received).
If an acknowledgement isn't sent back to the sender before timeout occurs, then the message is automatically resent.
With **ECHO CHECK**, when data is sent to another device, this data is sent back again to the sender. The sender compares the two sets of data to check if any errors occurred during the transmission process.

Sample Question:

a) A web page offers a link for users to request another web page. The requested web page contains HTML code.

Put each statement in the correct sequence by writing the numbers 1 to 5 in the right-hand column.

Statement	Sequence No
The requested web page is displayed on the client computer	
The user clicks on the hyperlink and the web page is requested from the web server	
The requested web page content is transmitted to the client computer	
The client computer processes the html code using the web browser software	
The web server locates the requested web page	

b) HTML code for a website is given below:

```
<html>
<head>
<title> O Level Computer Science with Inqilab Patel</title>
<style>
body {
    background-color: #0000ff;
}
h1 {
    color: #980000;
    margin-left: 40px;
}
</style>
</head>
<body>

<h1>In the name of Allah</h1>
<p>The Cambridge O Level Computer Science syllabus enables learners
to develop an interest in computing and gain confidence in computational
thinking and programming. Cambridge O Level Computer Science
is an ideal foundation for further study at Cambridge International
A Level, and the skills learnt can also be
used in other areas of study and in everyday life.</p>

</body>
</html>
```

(a) Which lines in the webpage script are related to presentation (style) code?

……[1]

(b) By studying the web page script and its use, what is the use in HTML of:

(i) the <h1> tag?

……[1]

(ii) the <p> tag?

……[1]

Summer 15 P11)

Q1 (a) State what is meant by the terms:

Parallel data transmission:

……

……

Serial data transmission:

.....

..... [2]

(b) Give **one** benefit of each type of data transmission.

Parallel data transmission Benefit:

.....

.....

Serial data transmission Benefit:

.....

..... [2]

(c) Give **one** application of each type of data transmission. Each application must be different.

Parallel data transmission Application:

.....

.....

Serial data transmission Application:

.....

..... [2]

2 (a) State what is meant by the term USB.

.....

..... [1]

(b) Describe **two** benefits of using USB connections between a computer and a device.

1: .....

2: .....

..... [2]

Marking Scheme

1 (a) <u>parallel</u>
any one from:
– 8 bits/1 byte/multiple bits sent at a time
– using many/multiple/8 wires/lines (1 mark)
<u>serial</u>
any one from:
– one bit sent at a time
– over a single wire (1 mark) [2]
(b) <u>parallel</u>
– faster rate of data transmission (1 mark)
<u>serial</u>
any one from:
– more accurate/fewer errors over a longer distance
– less expensive wiring
– less chance of data being skewed/out of synchronisation/order (1 mark) [2]
(c) <u>parallel</u>
any one from:
– sending data from a computer to a printer
– internal data transfer (buses) (1 mark)
<u>serial</u>
– connect computer to a modem (1 mark) [2]
2 (a) – universal serial bus
– <u>description of USB [1]</u>

(b) Any two from:
– devices are automatically detected and configured when initially attached
– impossible to connect device incorrectly/connector only fits one way
– has become the industry standard
– supports multiple data transmission speeds
– lots of support base for USB software developers
– supported by many operating systems
– backward compatible
– faster transmission compared to wireless [2]

Summer 15 P12)

Q2) Parity checks are often used to check for errors that may occur during data transmission.
(a) A system uses **even parity**.
Tick (✓) to show whether the following three bytes have been transmitted correctly or incorrectly.

Received byte	Byte transmitted correctly	Byte transmitted incorrectly
1 1 0 0 1 0 0 0		
0 1 1 1 1 1 0 0		
0 1 1 0 1 0 0 1		

(b) A parity byte is used to identify which bit has been transmitted incorrectly in a block of data.
The word “F L O W C H A R T” was transmitted using nine bytes of data (one byte per character). A tenth byte, the parity byte, was also transmitted.
The following block of data shows all ten bytes received after transmission. The system uses **even parity** and column 1 is the parity bit.

	letter	column 1	column 2	column 3	column 4	column 5	column 6	column 7	column 8
byte 1	F	1	0	1	0	0	1	1	0
byte 2	L	1	0	1	0	1	1	0	0
byte 3	O	1	0	1	0	1	1	1	1
byte 4	W	1	0	1	1	0	1	1	1
byte 5	C	1	0	1	0	0	0	1	1
byte 6	H	0	0	1	0	1	0	0	0
byte 7	A	0	0	1	0	0	1	0	1
byte 8	R	1	0	1	1	0	0	1	0
byte 9	T	1	0	1	1	0	1	0	0
parity byte		1	0	1	1	1	1	1	0

(i) One of the bits has been transmitted incorrectly. Write the byte number and column number of this bit:
Byte number .....Column number .....[2]
(ii) Explain how you arrived at your answer for **part (b)(i)**.
.....
.....
..... [2]
(c) Give the denary (base 10) value of the byte: **1 0 1 1 1 1 1 0**
.....
..... [1]

(d) A parity check may not identify that a bit has been transmitted incorrectly.
Describe **one** situation in which this could occur.

.....
.....
..... [1]

Marking Scheme

Q2a)

Received byte	***Byte transmitted correctly***	***Byte transmitted incorrectly***
1 1 0 0 1 0 0 0		✓
0 1 1 1 1 1 0 0		✓
0 1 1 0 1 0 0 1	✓	

(b) (i) byte number: 7
column number: 6 *[2]*
(ii) Any two from:
- letter "A"(byte 7) transmitted as odd parity (three 1s)
- column 6 has odd parity (seven 1s)
- intersection of byte 7 and column 6 indicates incorrect bit value *[2]*
(c) 190 *[1]*
(d) Any one from:
- 2 bits interchanged (e.g. 1 → 0 and 0 → 1) that won't change parity value
- even number of bits/digits are transposed
- If there are multiple errors in the same byte/column, that still produce the same parity bit, the error will not be detected *[1]*

Winter 15 P12)

Q3) **(a)** Check digits are used to ensure the accuracy of input data.
A 7-digit code number has an extra digit on the right, called the check digit.

Digit position	1	2	3	4	5	6	7	8
Digit	–	–	–	–	–	–	–	–

The check digit is calculated as follows:
• each digit in the number is multiplied by its digit position
• the seven results are then added together
• this total is divided by 11
• the remainder gives the check digit (if the remainder = 10, the check digit is X)
(i) Calculate the check digit for the following code number. Show all your working.
4 2 4 1 5 0 8 …

.....
.....
.....
Check digit ..... [2]
(ii) An operator has just keyed in the following code number:
3 2 4 0 0 4 5 X
Has the operator correctly keyed in the code number?
.....

Give a reason for your answer.
.....
.....
.....
..... [3]

(b) When data are transmitted from one device to another, a parity check is often carried out on each byte of data. The parity bit is often the leftmost bit in the byte.
(i) If a system uses even parity, give the parity bit for each of the following bytes:
parity bit [2]

1	**1**	**0**	**0**	**1**	**1**	**0**

parity bit

0	**0**	**0**	**0**	**0**	**0**	**1**

(ii) A parity check can often detect corruption of a byte.
Describe a situation in which it **cannot** detect corruption of a byte.
.....
.....
.....[1]

Q4) **a)** Explain what is meant by HTML.
.....
.....
.....
.....
.....
..... [3]
(b) HTML uses both structure and presentation.
Describe what is meant by the two terms.
Structure:
.....
.....
Presentation:
.....
.....
(c) Explain the function of a web browser.
.....
.....
.....
.....
.....[3]

Marking Scheme
Q3 (a) (i) 1 mark for correct check digit and 1 mark for showing the calculation
(4 × 1) + (2 × 2) + (4 × 3) + (1 × 4) + (5 × 5) + (0 × 6) + (8 × 7)
= 4 + 4 + 12 + 4 + 25 + 0 + 56 = 105
105/11 = 9 remainder 6
check digit is: 6 [2]

(ii) 1 mark

– No/incorrect check digit

2 marks

– Total is 78

– 78/11 …

– … gives 7 remainder 1

– check digit should be 1 [3]

(b) (i) 1 mark for each correct parity bit

parity bit

0	*1*	*1*	*0*	*0*	*1*	*1*	*0*

parity bit

1	*0*	*0*	*0*	*0*	*0*	*0*	*1*

(ii) Any one from:

– an even number of digits are changed

– a transposition error(s) has occurred [1]

Q4) (a) Any three from:

– hypertext mark-up language

– used to create/develop/author webpages

– translated by a browser to display webpages

– uses (opening and closing) tags to display/format content [3]

(b) Structure:

– instructs how the layout of the content is displayed

Presentation:

– instructs how the content will be formatted e.g. colour/style/CSS [2]

(c) Any three from:

– displays web page

– interprets/translates the HTML document

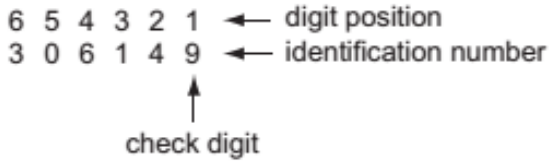
– interprets/translates embedded scripting, for example JavaScript

– provides functions, such as bookmarks and history

– identifies protocols, such as https, SSL [3]

Q5) A company selling CDs uses a unique 6-digit identification number for each CD title. The rightmost digit (position 1) is a check digit.

For example,



The validity of the number and check digit is calculated as follows:

• multiply each digit by its digit position

• add up the results of the multiplications

• divide the answer by 11

• if the remainder is 0, the identification number and check digit are valid.

(a) Show whether the following identification numbers are valid or not. You must show how you arriv ed at your answer.

Identification number 1: 4 2 1 9 2 3

working:.....

.....

.....

Valid or not valid?.....

Identification number 2: 8 2 0 1 5 6

working:.....

.....

.....

Valid or not valid?..... [3]

(b) Find the check digit for this identification number.

5 0 2 4 1 __

working: .....

.....

.....

Check digit ..... [2]

(c) Describe, with examples, two different types of data entry errors that a check digit would detect.

1.....

.....

2 .....

..... **[2]**

(b) When data are transmitted from one device to another, a parity check is often carried out on each byte of data. The parity bit is often the leftmost bit in the byte.

(i) If a system uses even parity, give the parity bit for each of the following bytes:

parity bit							
	1	**1**	**0**	**0**	**1**	**1**	**0**

parity bit							
	0	**0**	**0**	**0**	**0**	**0**	**1**

[2]

(ii) A parity check can often detect corruption of a byte.

Describe a situation in which it **cannot** detect corruption of a byte.

.....

..... [1]

Winter 15 p11)

Q6) Six computer terms and six descriptions are shown below.
Draw a line to link each term to its appropriate description.[5]

Browser	Signal sent to a processor which may cause a break in execution of the current routine, according to priorities
HTML	Company that provides individual's access to the Internet and other services such as webhosting and emails
Internet service provider	Software application used to locate, retrieve and display content on the World Wide Web e.g. web pages, videos and other files
Interrupt	Hardware identification number that uniquely identifies each device on a network; it is manufactured into every network card and cannot be altered
IP address	Authoring language used to create documents on the World Wide Web; uses tags and attributes
MAC address	Location of a given computer/device on a network; can be a static or dynamic value

Q6) Parity checks are used to check for errors during data transmission. A system uses **odd** parity.
(a) Complete the following two bytes of data so that they both have **odd** parity:

	1	1	1	1	0	0	0

	0	0	0	0	1	1	1

(b) Name and describe another method which can be used to check whether data has been correctly transmitted.
Name of method: .....
Description: .....
..... [2]

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Q7) Five computer terms and **seven** descriptions are shown below.
Draw a line to connect each computer term to its correct description. [5]

Computer term	Description
Serial, simplex data transmission	Several bits of data sent down several wires, in both directions, but not at the same time
	Several bits of data sent down several wires, in both directions, at the same time
Parallel, half-duplex data transmission	
	An even or odd number of bits set to 1 in a byte, used to check if the byte has been transmitted correctly
	One bit sent at a time, over a single wire in one direction only
Parity check	
	An additional digit placed at the end of a number to check if the number has been entered correctly
Automatic repeat request (ARQ)	
	A value transmitted at the end of a block of data; it is calculated using the other elements in the data stream and is used to check for transmission errors
Checksum	An error detection method that uses response and time out when transmitting data; if a response is not sent back to the sender in an agreed amount of time, then the data is re-sent

Q8 c) A microprocessor regularly samples the output, X. Each sample value is stored in an 8-bit register as shown below. One bit of this register is reserved as a parity bit.
Five consecutive output values of 1 indicate a fault condition.
Identify which of the following registers shows a fault condition.

	Parity bit							
1	1	1	1	1	0	0	1	**Register Y**
0	1	0	1	1	1	1	1	**Register Z**

Register .....[1]

(d) When eight bytes of data have been collected, they are transmitted to a computer 100km away. Parity checks are carried out to identify if the data has been transmitted correctly. The system uses **even parity** and column 1 is the parity bit.
The eight bytes of data are sent together with a ninth parity byte:

	parity bit	**column 2**	**column 3**	**column 4**	**column 5**	**column 6**	**column 7**	**column 8**
byte 1	1	0	0	0	0	1	0	0
byte 2	1	1	1	1	0	0	1	1
byte 3	0	1	0	0	1	0	0	0
byte 4	0	1	1	1	0	0	0	1
byte 5	1	0	0	0	1	1	1	1
byte 6	0	0	0	0	0	0	0	0
byte 7	1	1	1	0	1	0	0	0
byte 8	1	0	0	0	1	1	1	0
parity byte	1	0	1	1	0	1	1	1

(i) Identify which of the eight bytes contains an error.
byte ..... [1]
(ii) Identify which column contains an error.
column ..... [1]
(iii) The incorrect bit is indicated where the byte number and column cross.
Give the corrected byte. [1]

(iv) Calculate the denary value of the corrected byte.
.....
.....[1]
(v) Considering the fault condition given in **part (c)**, explain why it is very important that the incorrect bit is located and corrected.
.....
.....
.....
..... [2]

Winter 16 P12
Q9 (a) *Explain what is meant by:*
(i) *Serial data transmission*
.....
.....
.....
.....*[2]*
(ii) *Parallel data transmission*
.....
.....
.....
.....*[2]*

(b) *A computer in a factory is connected to a printer. The printer is located in an office 1km away from the factory.*
Identify which data transmission method would be most suitable for this connection.

.....

Give two *reasons for your choice.*

1 .....

.....

.....

2 .....

.....

..... *[3]*

Q10) Nine bytes of data are transmitted from one computer to another. Even parity is used. An additional parity byte is also sent.
The ten bytes arrive at the destination computer as follows:

	parity bit	**bit 2**	**bit 3**	**bit 4**	**bit 5**	**bit 6**	**bit 7**	**bit 8**
byte 1	1	1	1	0	1	1	1	0
byte 2	0	0	0	0	0	1	0	1
byte 3	0	1	1	1	1	0	0	0
byte 4	1	1	0	0	0	0	0	0
byte 5	1	0	1	1	1	1	1	0
byte 6	0	1	0	1	1	0	0	1
byte 7	0	1	1	1	0	0	1	1
byte 8	0	0	1	1	0	1	1	0
byte 9	1	1	0	0	0	0	1	1
parity byte	0	0	1	0	0	0	1	0

One of the bits was corrupted during the data transmission.
(a) Circle the corrupt bit in the corrupt byte in the table above. [1]

(b) Explain how the corrupted bit was found.

.....

.....

.....

.....

.....

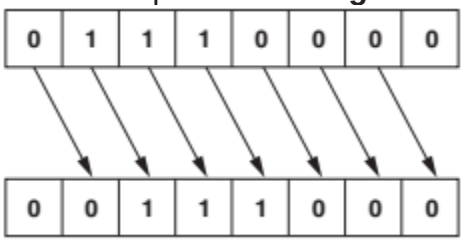
.....[2]

Q11) A computer uses an 8-bit register.
The 8-bit register contains binary integers.
(a) Write the denary (base 10) value represented by:

128	**64**	**32**	**16**	**8**	**4**	**2**	**1**
0	**1**	**1**	**1**	**0**	**0**	**0**	**0**

.....[1]

(b) All the bits in the register are shifted **one** place to the **right** as shown below.



Write the denary number that is represented after this shift.

.....[1]

(c) State the effect the shift to the right had on the original denary number from **part (a)**.

.....[1]

(d) The original number in **part (a)** is shifted **three** places to the **right**.

(i) Show the new binary number: [1]

(ii) Write the equivalent denary number.

.....[1]

(e) Describe the problems that could be caused if the original binary number in **part (a)** is shifted **five** places to the **right**.

.....

.....

.....

.....

.....[2]

Marking Scheme

Q9)

(a) ***(i)*** *Any **two** from:*
serial
– one bit sent at a time // bits sent sequentially
– over a single wire
– synchronous or asynchronous *[2]*

(ii) *Any **two** from:*
parallel
– several bits / a byte sent at a time
– using many / multiple wires
– synchronous *[2]*

(b) *– serial*
*Any **two** from:*
– serial data transmission more reliable over long distances
– less likely for the data to be skewed/out of synchronisation
– less interference as only a single wire
– it is a cheaper connection as only single wire needed // cheaper to set up
– a fast connection is not required as a printer is limited by its printing speed [3]

Q10) (a) *Intersection of Row 7 and column 4 circled [1]*
(b) *– Row (byte number) 7 has an odd number of 1s (five 1s)*
– Column (bit number) 4 has an odd number of 1s (five 1s) [2]
Q11) ***(a)*** *112 [1]*
(b) *56 [1]*
(c) *divided by 2 // value 112 was halved // multiplied by 0.5 [1]*
(d) (i)

0	0	0	0	1	1	1	0

(ii) *14 [1]*
(e) *Any **two** from:*
– run out of places to the right of register / at the end of register
– right-most 1 would be lost
– number would become 3 instead of 3.5
– loss of precision [2]

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Q12 (a) Three descriptions of data transmission are given below. [6]
Tick (✓) the appropriate box in each table to show the:
• type of transmission
• method of transmission

Description 1:
Data is transmitted several bits a ta time down several wires in both directions simultaneously.

Type	**Tick (✓)**
simplex	
half-duplex	
full-duplex	

Method	**Tick (✓)**
serial	
parallel	

Description 2: Data is transmitted in one direction only, one bit at a time, down a single wire.

Type	**Tick (✓)**
simplex	
half-duplex	
full-duplex	

Method	**Tick (✓)**
serial	
parallel	

Description 3:
Data is transmitted one bit at a time down a single wire; the data is transmitted in both directions but not at the same time.

Type	**Tick (✓)**
simplex	
half-duplex	
full-duplex	

Method	**Tick (✓)**
serial	
parallel	

(b) Give **two** reasons why serial transmission, rather than parallel transmission, is used to connect devices to a computer.
1 .....
.....

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

Q10) **11** Describe the use of structure and presentation in a HTML document.
.....
.....
.....
.....
.....
.....
.....
..... [4]

Winter 16 P12

Q11 (a) Describe what is meant by HTML.
.....
.....
.....
.....
.....
.....[3]

(b) The following URL is typed in:

http://www.cie.org.uk/ComputerSciencePapers

This URL is composed of three parts.
State the part of this URL that is the:
File name .....
Protocol .....
Web server name ..... [3]

Marking Scheme

Q11 (a) Any **three** from:
– hyper text mark-up language
– uses both structure and presentation
– web-authoring language/software // used to create websites/webpages
– uses tags to define e.g. colour / font / graphics / layout [3]

(b)
File name: ComputerSciencePapers
Protocol: http(://)
Web server name: www.cie.org.uk [3]

1.3.1 Logic gates

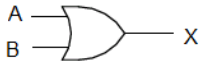
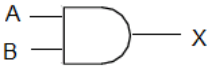
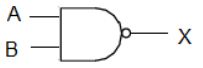
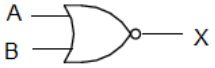
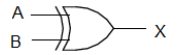
Logic gates are basic components used to construct a logic circuit.

They are used by implementing Boolean algebra. Logic gates have two or more input and one output except NOT Gate which has one input and one output.

Truth tables

A truth table is used to show the output of a logic gate or circuit for all possible combinations of input values; we usually use the binary values, 1 and 0, as shorthand for True and False.

The truth table for a two-input gate needs four rows.

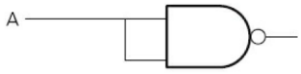
INPUT		OR	AND	NAND	NOR	XOR
A	B					
		X=a+b	X=a.b	$X = \overline{a \cdot b}$	$X = \overline{a + b}$	$X = (a \cdot \overline{b}) + (\overline{a} \cdot b)$
0	0	0	0	1	1	0
0	1	1	0	1	0	1
1	0	1	0	1	0	1
1	1	1	1	0	0	0

Logic 'building blocks'

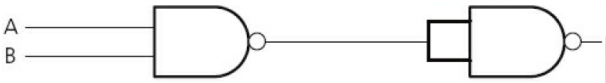
One very common 'building block' is the NAND gate. It is possible to build up any logic gate, and therefore any logic circuit, by simply linking together a number of

NAND gates. For example, the AND, OR and NOT gates can be built from these gates as shown below:

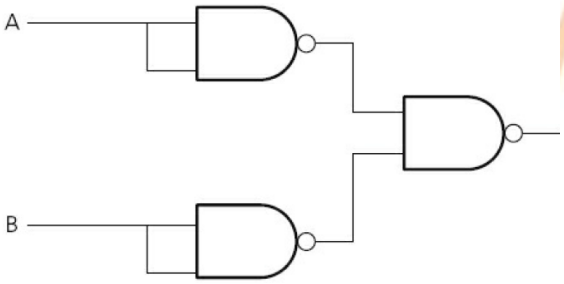
NOT Gate:



AND Gate:



OR Gate:

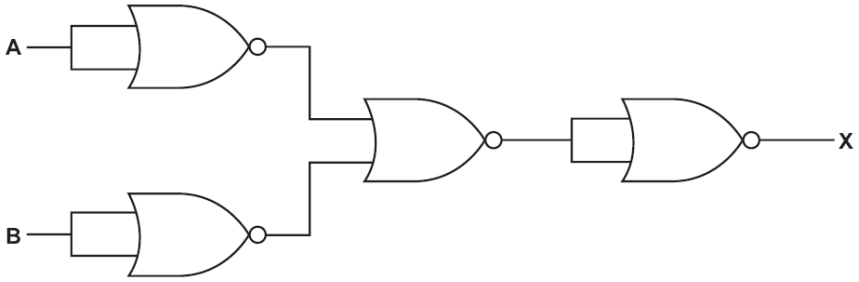


Simplification Logic Circuit:

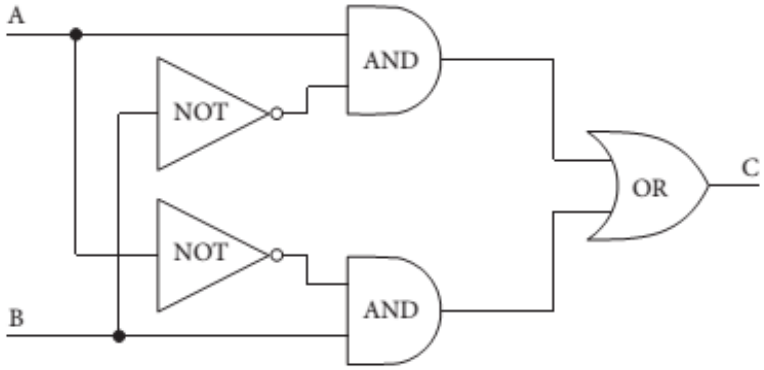
Simplification means reducing the number of components in a logic circuit. As a result of simplification the cost of production can be less. This can also improve reliability and make it easier to trace faults if they occur.

Q20) Show by drawing a truth table which single logic gate or what else has the same function as the logic circuit drawn in

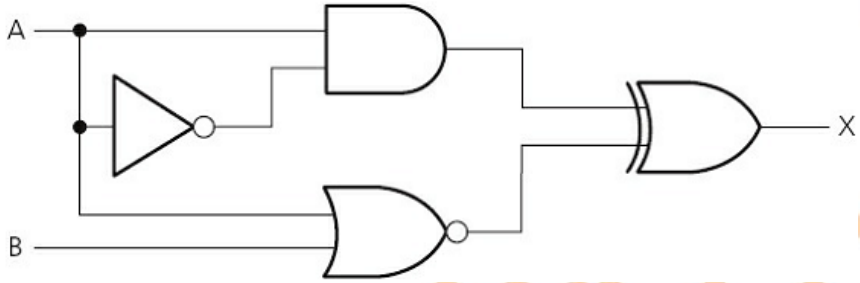
a)



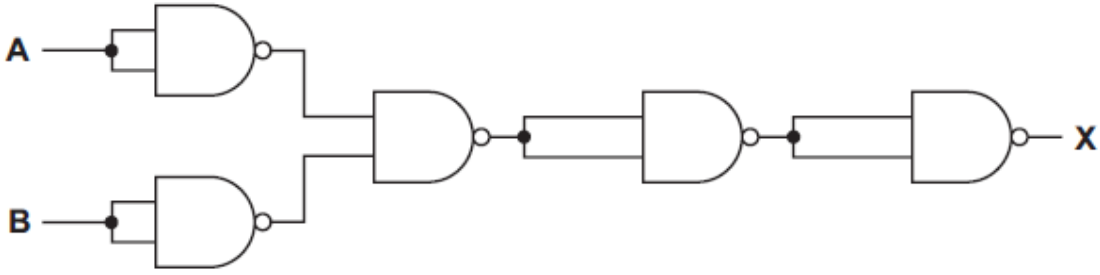
b)



c)



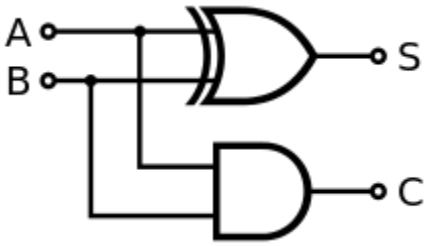
d)



What could replace the whole logic circuit?

Half Adder"

The **half adder** adds two single binary digits *A* and *B.* It has two outputs, sum (*S*) and carry (*C*). The carry signal represents an overflow into the next digit of a multi-digit addition.



The simplest half-adder design, pictured on the right, incorporates an XOR gate for *S* and an AND gate for *C*. With the addition of an OR gate to combine their carry outputs, two half

adders can be combined to make a full adder

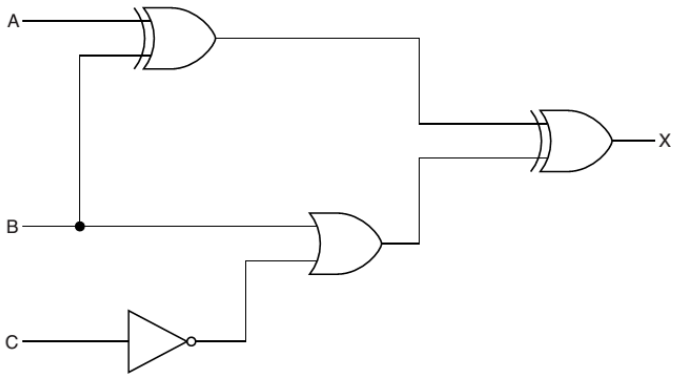
Inputs		Outputs	
A	***B***	***C***	***S***
0	0	0	0
1	0	0	1
0	1	0	1
1	1	1	0

A power station has a safety system controlled by a logic circuit. Three inputs to the logic circuit determine whether the output, S, is 1. When S =1 the power station shuts down.
The following table describes the conditions being monitored.

Parameter description	Parameter	Binary value	Description of condition
gas temperature	G	0	gas temperature <= 160°C
		1	gas temperature > 160°C
reactor pressure	R	0	reactor pressure <= 10 bar
		1	reactor pressure > 10 bar
water temperature	W	0	water temperature <= 120°C
		1	water temperature > 120°C

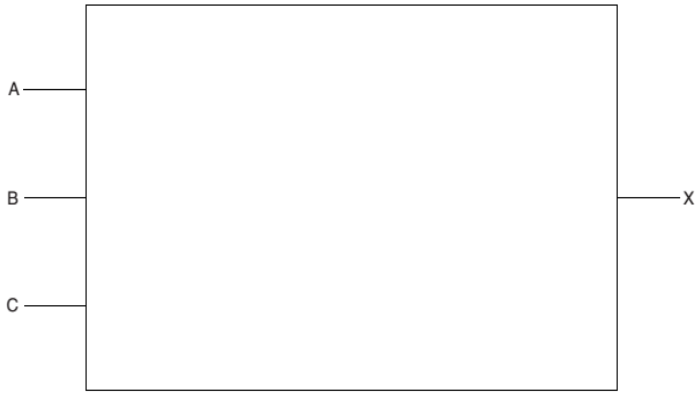
Output, S, will generate a value of 1, if:
either
gas temperature > 160°C AND water temperature <= 120°C
or
gas temperature <= 160°C AND reactor pressure > 10 bar
or
water temperature > 120°C AND reactor pressure > 10 bar

Summer 15 P1)
Q1a) Complete the truth table for the following logic circuit:



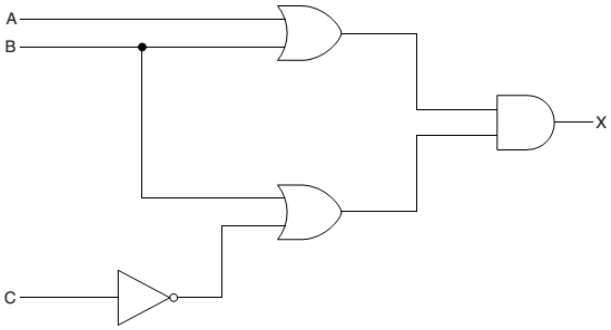
A	B	C	Workspace	X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

(b) Draw a logic circuit which corresponds to the following logic statement:
X = 1 if ((A is **NOT** 1 **OR** B is 1) **AND** C is 1) **OR** (B is **NOT** 1 **AND** C is 1)



[3]

(c) Write a logic statement which corresponds to the following logic circuit:



.....

.....[3]

Summer 15 P12)

Q2)A gas fire has a safety circuit made up of logic gates. It generates an alarm (X = 1) in response to certain conditions.

Input	Description	Binary value	Conditions
G	gas pressure	1	gas pressure is correct
		0	gas pressure is too high
C	carbon monoxide level	1	carbon monoxide level is correct
		0	carbon monoxide level is too high
L	gas leak detection	1	no gas leak is detected
		0	gas leak is detected

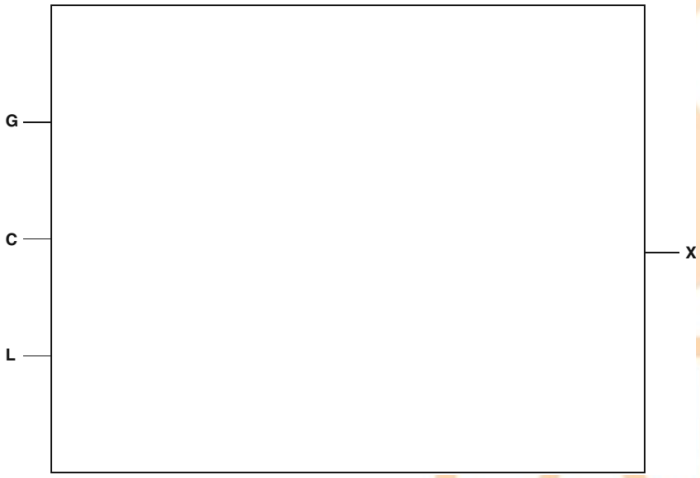
The output X = 1 is generated under the following conditions:

gas pressure is correct **AND** carbon monoxide level is too high

OR

carbon monoxide level is correct **AND** gas leak is detected

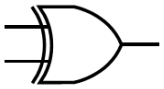
(a) Draw a logic circuit for this safety system. [5]



(b) Complete the truth table for the safety system. [4]

G	C	L	Workspace	X
1	1	1		
1	1	0		
1	0	1		
1	0	0		
0	1	1		
0	1	0		
0	0	1		
0	0	0		

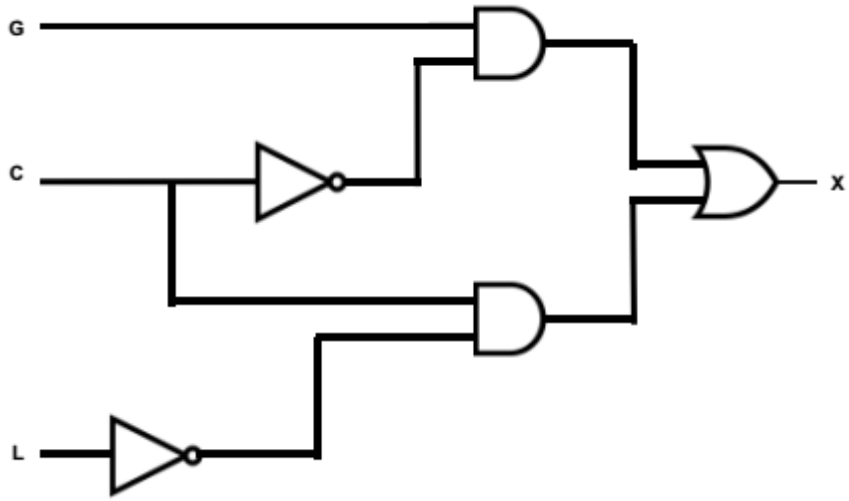
(c) Complete the truth table for the XOR gate:



A	B	C
0	0	
0	1	
1	0	
1	1	

Marking Scheme

a)



b)

G	C	L	Workspace	X
1	1	1		0
1	1	0		1
1	0	1		1
1	0	0		1
0	1	1		0
0	1	0		1
0	0	1		0
0	0	0		0

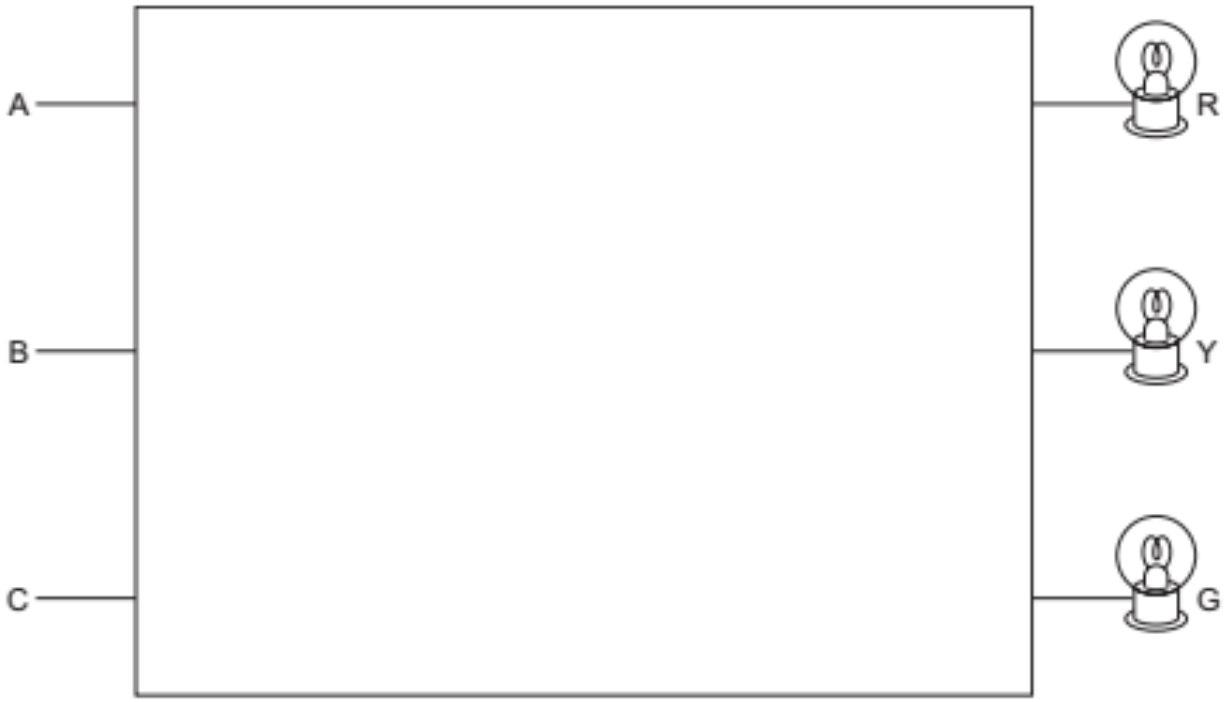
c)

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

Q3) The following three logic statements define the light sequence:

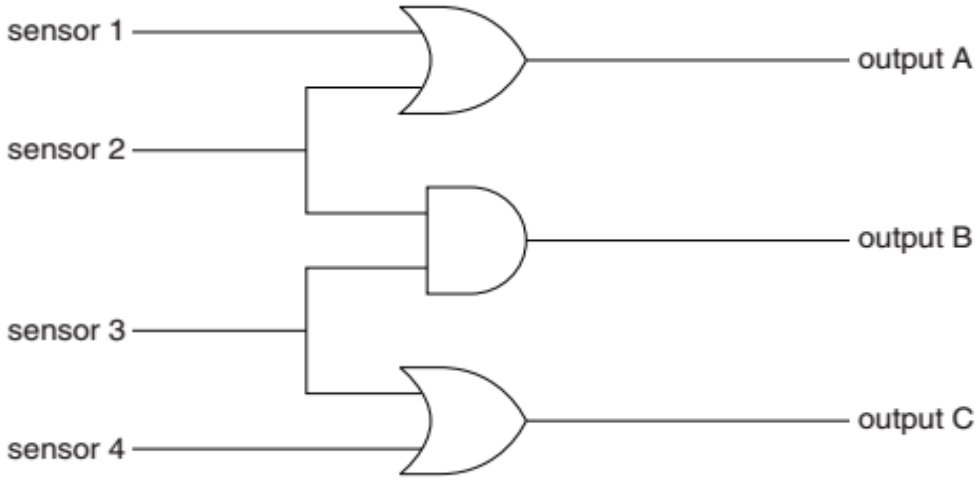
- R = 1 IF (A is NOT 1)
- G = 1 IF (B is 1 AND C is 1)
- Y = 1 IF (A is 1 AND NOT (B is 1 AND C is 1))

Draw the logic circuit that directly combines ALL three of these logic statements and produces three outputs R, G and Y. [5]



			outputs		
A	**B**	**C**	**A**	**B**	**C**
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

Q4) Four sensors (numbered 1 to 4) produce binary output which controls the lights at a rock concert. The diagram shows how the sensors are connected:

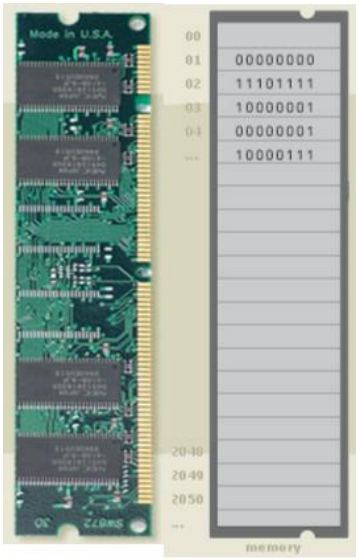


(a) Complete the truth table for this logic circuit. **[4]**

inputs				outputs		
sensor 1	sensor 2	sensor 3	sensor 4	A	B	C
0	0	0	0			
0	0	0	1			
0	0	1	0			
0	0	1	1			
0	1	0	0			
0	1	0	1			
0	1	1	0			
0	1	1	1			
1	0	0	0			
1	0	0	1			
1	0	1	0			
1	0	1	1			
1	1	0	0			
1	1	0	1			
1	1	1	0			
1	1	1	1			

1.3.2Computer architecture and the fetch-execute cycle

Von Neumann Architecture



The idea about how computers should be built was proposed by John von Neumann in 1945. This idea is called the **von Neumann Architecture** or **Model**. This is still the basis for computers today. Using these four components, a von Neumann computer will execute a series of instructions, called a program, which are stored in the computer's memory. This is called the "**stored program concept**".
The components of von Neumann Architecture is:

1. Input/output (I/O)
2. Memory
3. A Control Unit

An Arithmetic Logic Unit (ALU)

Register:

Registers are Immediate Access Store (IAS) located on the CPU, and used temporarily for storing data. Because the registers are close to the ALU, they are made out of fast memory, efficiently speeding up calculations.
There are 14 registers. Some examples are

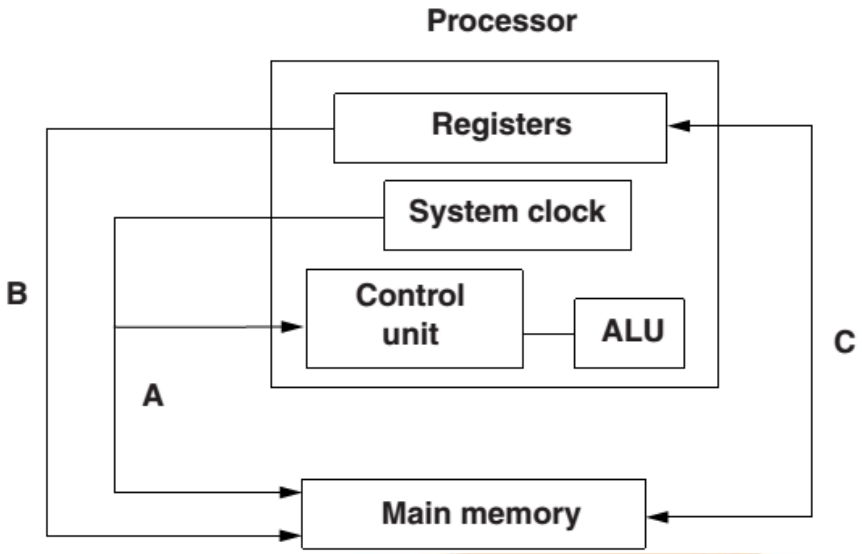
a) **Program Counter (PC)** - an incrementing counter that keeps track of the **next memory address** of the instruction that is to be executed once the execution of the current instruction is completed.
b) **Memory Address Register (MAR)** - the address in main memory that is currently being read or written
c) **Memory Buffer/Data Register (MBR/MBR)** - a two-way register that holds data fetched from memory (and ready for the CPU to process) or data waiting to be stored in memory
d) **Current Instruction register (CIR)** - a temporary holding ground for the instruction that has just been fetched from memory
e) **Accumulator Register (ACC)** is used for storing data for ALU to process and the results those are produced by the ALU.

Buses: "The set of wires used to travel signals to and from CPU and different components of computer is called Bus."

Bus is a group of parallel wires that is used as a communication path. As a wire transmits a single bit so 8-bits bus can transfer 8 bits (1 byte) at a time and 16-bits bus can transfer 16 bits (2 bytes) and so on. There are three types of buses according to three types of signals, these are:

a) **Data Bus:** "The buses which are used to transmit data between CPU, memory and peripherals are called Data Bus."
b) **Address Bus:** "The buses which are connecting the CPU with main memory and used to identify particular locations (address) in main memory where data is stored are called Address Buses."

c) **Control Bus:** The wires which are used to transmit the control signals (instructions) generated by Control Unit to the relevant component of the computer.



d)

e) The diagram above shows a simplified form of processor architecture.
Name the three buses labelled A, B and C.

A .....

B .....

C ..... **[3]**

Summer 15 P11)

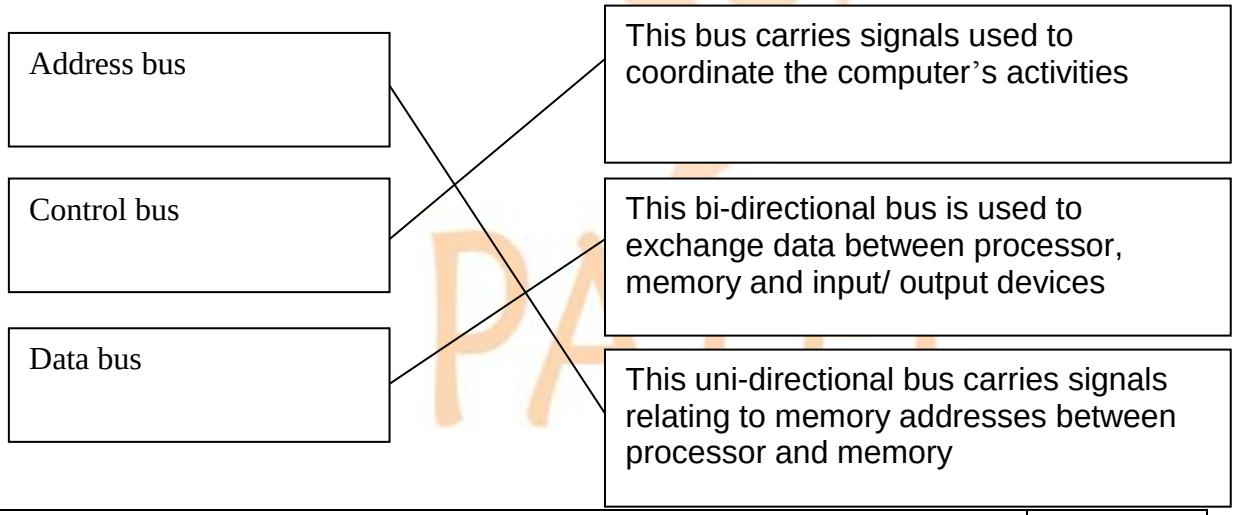
(a) **One of the key features of von Neumann computer architecture is the use of buses.**
Three buses and three descriptions are shown below.
Draw a line to connect each bus to its correct description.

Address bus	This bus carries signals used to coordinate the computer's activities
Control bus	This bi-directional bus is used to exchange data between processor, memory and input/ output devices
Data bus	This uni-directional bus carries signals relating to memory addresses between processor and memory

(b) The seven stages in a von Neumann fetch-execute cycle are shown in the table below. Put each stage in the correct sequence by writing the numbers 1 to 7 in the right hand column. The first one has been done for you.

Stage	Sequence number
the instruction is then copied from the memory location contained in the MAR (memory address register) and is placed in the MDR (memory data register)	
the instruction is finally decoded and is then executed	
the PC (program counter) contains the address of the next instruction to be fetched	1
the entire instruction is then copied from the MDR (memory data register) and placed in the CIR (current instruction register)	
the address contained in the PC (program counter) is copied to the MAR (memory address register) via the address bus	
the address part of the instruction, if any, is placed in the MAR (memory address register)	
the value in the PC (program counter) is then incremented so that it points to the next instruction to be fetched	

Marking Scheme



Stage	Sequence number
the instruction is then copied from the memory location contained in the MAR (memory address register) and is placed in the MDR (memory data register)	3
the instruction is finally decoded and is then executed	7
the PC (program counter) contains the address of the next instruction to be fetched	1
the entire instruction is then copied from the MDR (memory data register) and placed in the CIR (current instruction register)	4
the address contained in the PC (program counter) is copied to the MAR (memory address register) via the address bus	2
the address part of the instruction, if any, is placed in the MAR (memory	6

address register)	
the value in the PC (program counter) is then incremented so that it points to the next instruction to be fetched	5*

The incrementation of the program counter can appear at any stage after 2. All other stages must be in the correct given order.

Winter 15 p13

Q2) A section of computer memory is shown below:

Address	Content
1000 0000	0110 1110
1000 0001	0101 0001
1000 0010	1000 1101
1000 0011	1000 1100
1000 1100	
1000 1101	
1000 1110	
1000 1111	

(a) (i) The contents of memory location 1000 0001 are to be read.
Show the contents of the Memory Address Register (MAR) and the Memory Data Register (MDR) during this read operation:

MAR | | | | | | | | |

MDR | | | | | | | | | [2]

(ii) The value 0111 1001 is to be written into memory location 1000 1110.
Show the contents of the MAR and MDR during this write operation:

MAR | | | | | | | | |

MDR | | | | | | | | | [2]

(iii) Show any changes to the computer memory following the read and write operations in **part (a)(i)** and **part (a)(ii)**. [1]

Address	Content
1000 0000	0110 1110
1000 0001	0101 0001
1000 0010	1000 1101
1000 0011	1000 1100
1000 1100	
1000 1101	
1000 1110	
1000 1111	

(b) Name **three** other registers used in computers.

1 .....

2 .....

3 ..... [3]

(c) The control unit is part of a computer system.

What is the function of the control unit?

.....

.....

.....

.....

.....

..... [3]

Marking Scheme

(a) (i)

1	*0*	*0*	*0*	*0*	*0*	*0*	*1*

0	*1*	*0*	*1*	*0*	*0*	*0*	*1*

[2]

(ii)

1	*0*	*0*	*0*	*1*	*1*	*1*	*0*

0	*1*	*1*	*1*	*1*	*0*	*0*	*1*

[2]

(iii)

Address	*Contents*
1000 0000	*0110 1110*
1000 0001	*0101 0001*
1000 0010	*1000 1101*
1000 0011	*1000 1100*
1000 1100	

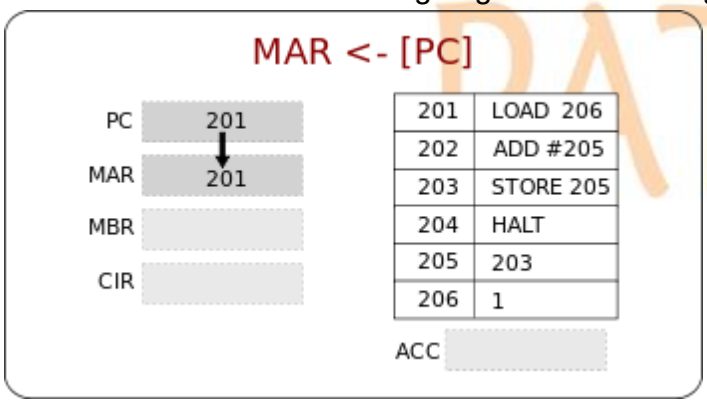
1000 1101	
1000 1110	*0111 1001*
1000 1111	

[1]
(b) – CIR (Current Instruction Register)
– PC (Program Counter)
– Acc (Accumulator) [3]
(c) – Controls operation of memory, processor and input/output
– Instructions are interpreted
– Sends signals to other components telling them "what to do" [3]

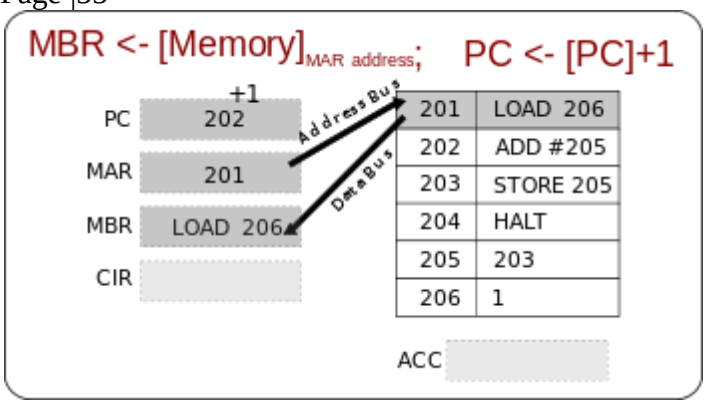
Winter 15 p11)
Q3) **(b)** Two features of Von Neumann architecture are the use of registers and the use of buses. Give the names of **two** registers and **two** buses.
Registers
1: .....
.....
2: .....
.....

Buses
1 .....
.....
2: .....
.....[4]

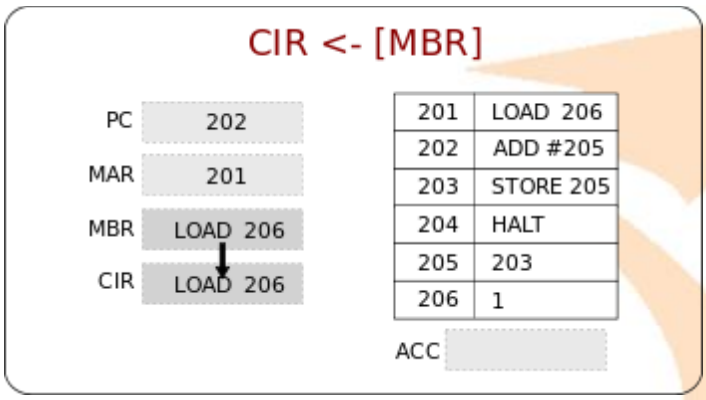
Detailed description of Fetch-Decode-Execute Cycle
To better understand what is going on at each stage we'll now look at a detailed description:



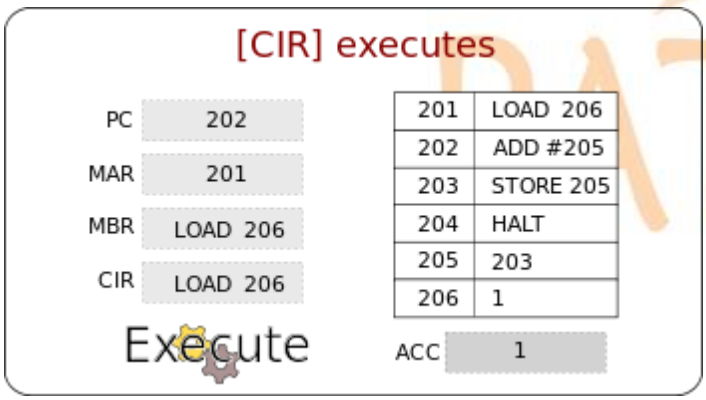
The contents of the Program Counter, the address of the next instruction to be executed, is placed into the Memory Address Register



The address is sent from the MAR along the address bus to the Main Memory. The instruction at that address is found and returned along the data bus to the Memory Buffer Register. At the same time the contents of the Program Counter is increased by 1, to reference the next instruction to be executed.

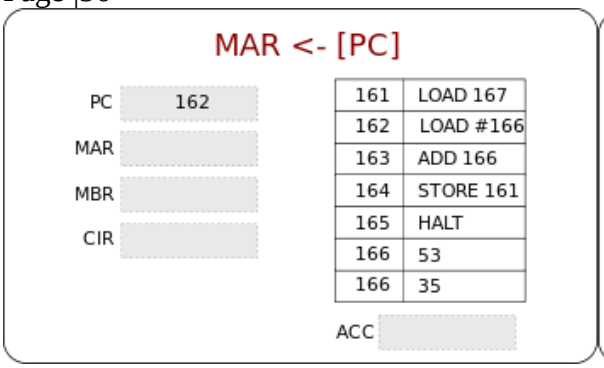


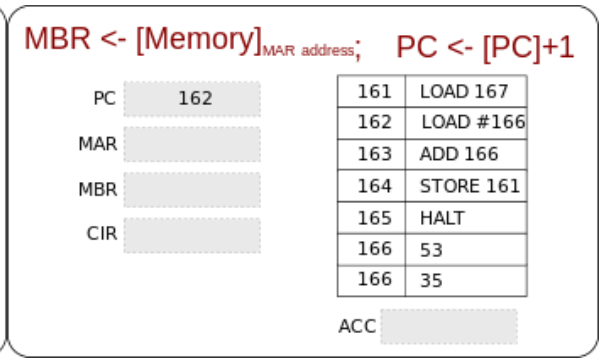
The MBR loads the Current Instruction Register with the instruction to be decoded by decoder of control unit or the MBR loads Accumulator with the data to be executed.

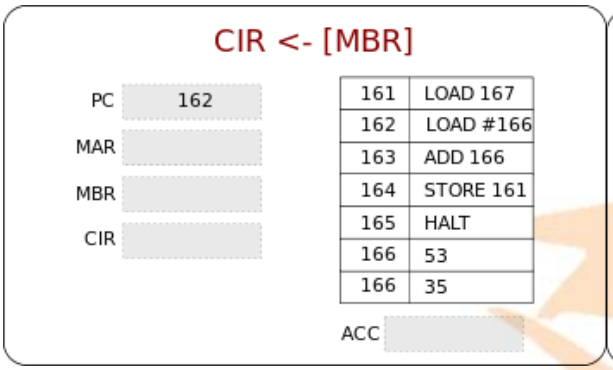


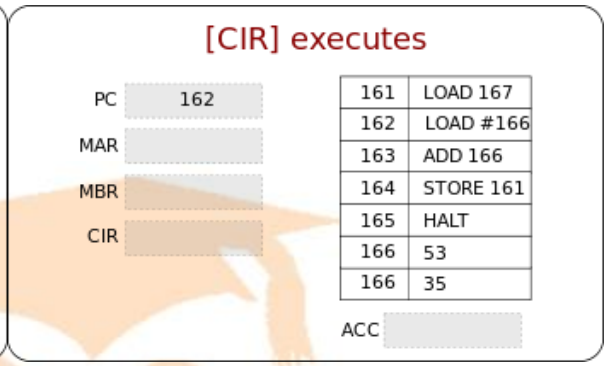
Activity

Complete the following diagrams showing each step of the fetch decode execute cycle:









At a particular point in a program, the program counter (PC) contains the value 200.State the expected value contained in the PC after the instruction held at location 200 has been fetched. Explain your answer.

.....
..... **[1]**

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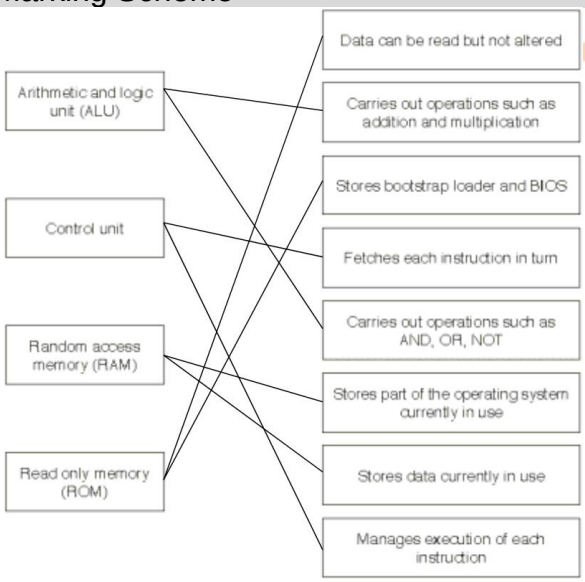
Four computer terms and **eight** descriptions are shown below.

Draw lines to connect each computer term to the correct description(s). [4]

Computer term	Description
Arithmetic and logic unit (ALU)	Data can be read but not altered
	Carries out operations such as addition and multiplication
Control unit	
	Stores bootstrap loader and BIOS
	Fetches each instruction in turn
Random access memory (RAM)	
	Carries out operations such as AND, OR, NOT
	Stores part of the operating system currently in use
Read only memory (ROM)	Stores data currently in use
	Manages execution of each instruction

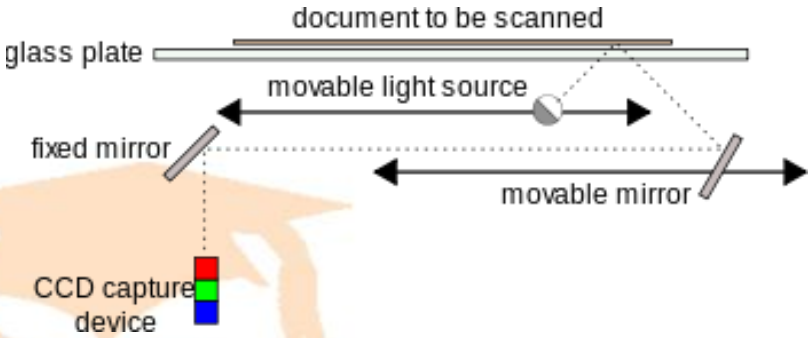
Marking Scheme



1.3.3 Input devices
1.3.4 Output devices
1.3.5 Memory, storage devices and media

Input Devices: Input devices allow us to enter raw data into a computer.

- Scanners
- Barcode readers/scanners
- Quick response (QR) code readers
- Digital cameras
- Keyboards
- Pointing devices (such as a mouse)
- Microphones
- Touchscreens
- Sensors
- Interactive whiteboards.



Two-dimensional scanners

2D scanner or an **image scanner**—often abbreviated to just **scanner**, is a device that optically scans images, printed text, handwriting, or an object, and converts it to a digital image. The image is converted into an electronic form which can be stored in a computer.

The steps of scanning a document:

1	Cover is raised
2	Document is placed in on **glass panel** and cover is closed
3	A bright light illuminates the documents lamp like xenon which produce very bright white light
4	A scan head moves across the document. An image is produced.
5	The image is sent to a lens using series of mirrors. The lens focuses the document image.
6	The focused image fall onto a **charge couple device (CCD)** which consists of number of ICs
7	CCD is made up of **light-sensitive elements (pixels).** Each element of CCD creates an electric charge when light falls on it and the scanned image is converted into **digital form**.
8	Software produces **digital image** from electronic form

Optical character recognition (optical character reader) (**OCR**)

Scanner scans the document and then OCR converts it into machine readable form i.e. text file format. These can be further edited using text editors like MS Word.

It is widely used as a form of data entry from printed paper data records.

Application of 2D scanners at an airport

Passengers fly into an airport from other countries. The airport has a security system that uses:

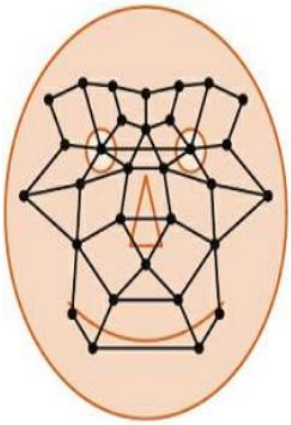
• computers

• scanners

• digital cameras

To gain entry to the country, each passenger must have a passport or identification (ID) card. This must contain a recent photograph and other personal data.

- Passport or ID card is placed on a scanner that reads machine-readable characters and scans the photograph
- Camera takes an image of the passenger's face
- Facial recognition software/ biometric software used to scan face
- Face image converted to digital format/ data by the camera
- Digital image formed from scanned photo/ biometric data stored in passport
- Key features of the face are checked/ compared



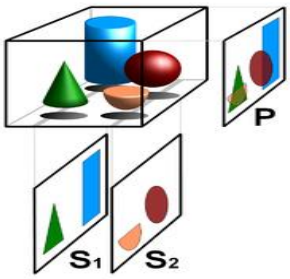
The face shows several of the positions used by the face recognition software. Each position is checked when the software tries to compare two facial images. Data such as:

- distance between the eyes
- width of the nose
- shape of the cheek bones
- length of the jaw line
- shape of the eyebrows

are all used to identify a given face.

When the image from the passport and the image taken by the camera are compared, these key positions on the face determine whether or not the two images represent the same face.

Tomography is a technique for displaying a representation of a cross section through a human body or other solid object using X-rays, radio frequencies, gamma imaging or ultrasound.



CT (COMPUTED TOMOGRAPHIC) Scanners are used to create a 3D image of a solid object.

Steps:

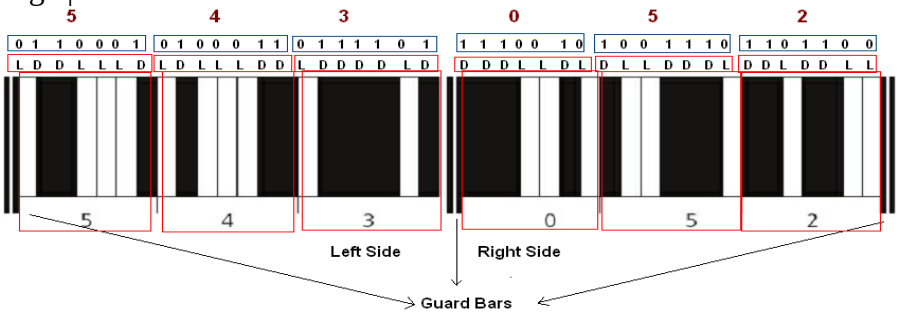
1. At first a series of 2D images of thin slices of object are taken.
2. Each 'slice' is then stored as a digital image in the computer memory.
3. Then these 2D 'slices' are combined to form a 3D image of object.

Bar Code Reader/Scanner

A **barcode** is an optical machine-readable representation of data relating to the object to which it is attached in the form of a series of dark and light parallel lines of varying thickness. Bar codes store code number and serial number. In UPC (Universal Product Code) the actual left-hand and right-hand sides of the barcode have specific codes.

A **barcode** is an optical machine-readable representation of data relating to the object to which it is attached in the form of a series of dark and light parallel lines of varying thickness.

Left side code	Digit	Right side code
0001101	0	1110010
0011001	1	1100110
0010011	2	1101100
0111101	3	1000010
0100011	4	1011100
0110001	5	1001110
0101111	6	1010000
0111011	7	1000100
0110111	8	1001000
0001011	9	1110100

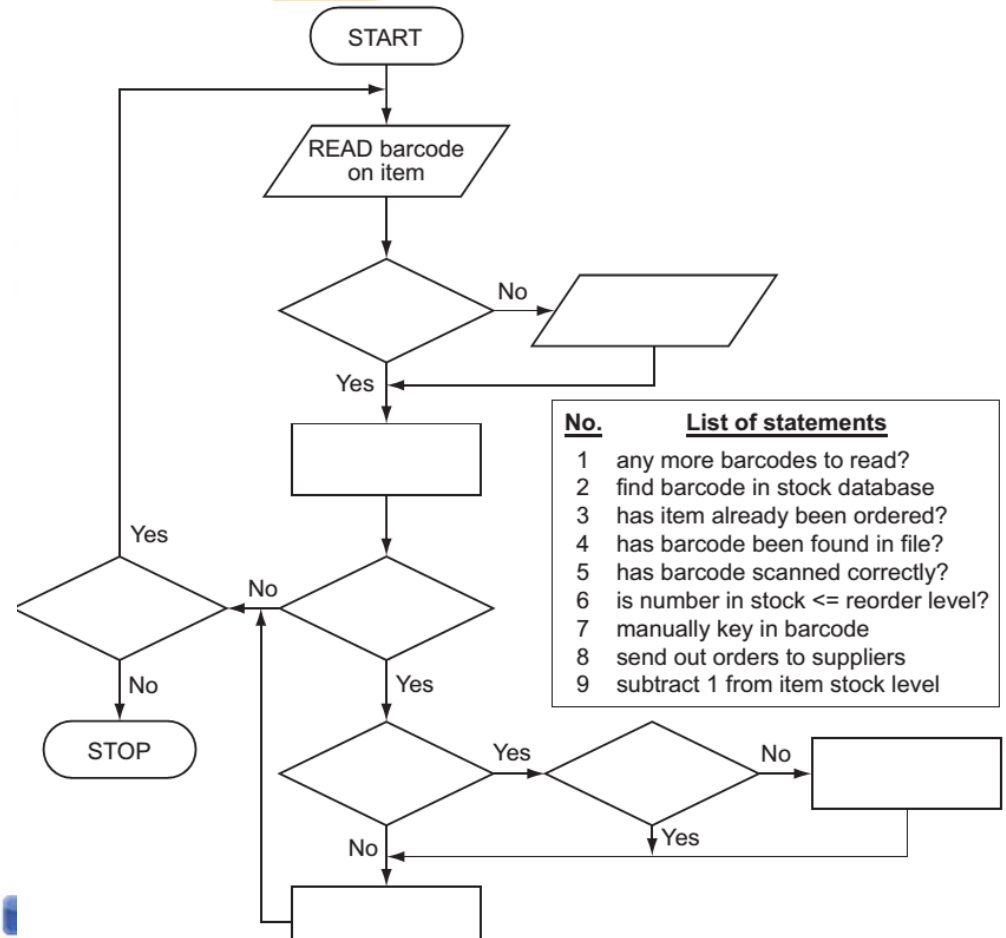


The steps of scanning bar code

1	The barcode is first read by a red laser or red **LED (LIGHT EMITTING DIODE)**.
2	Light is reflected back off the barcode; the dark areas reflect little or no light which allows the bars to be read.
3	The reflected light is read by sensors (photoelectric cells).
4	As the laser or LED light is scanned across the barcode, a pattern is generated which is converted into digital data – this allows the computer to understand the barcode.
5	For example: the digit '3' on the left generates the pattern **L D D D D L D** (where L = light and D = dark); this has the binary equivalent of **0 1 1 1 1 0 1** (where **L** = **0** and **D** = **1**).
6	If barcode are not scanned correctly the bar code number is types in manually using keyboard

When barcode has been read, then what happens?

- The barcode number is looked up in the stock database (the barcode is known as the **KEY FIELD** in the stock item record); this key field uniquely identifies each stock item.
- When the barcode number is found, the stock item record is looked up.
- The price and other stock item details are sent back to the checkout (or **POINT OFSALE TERMINAL (POS)**).
- The number of stock items in the record is reduced by one each time the barcode is read.
- This new value for number of stock items is written back to the stock item record.
- The number of stock items is compared to the re-order level; if it is less than or equal to this value, more stock items are *automatically* ordered.
- Once an order for more stock items is generated, a flag is added to the record to stop re-ordering every time the stock item barcode is read.
- When new stock



items arrive, the stock levels are updated in the database.

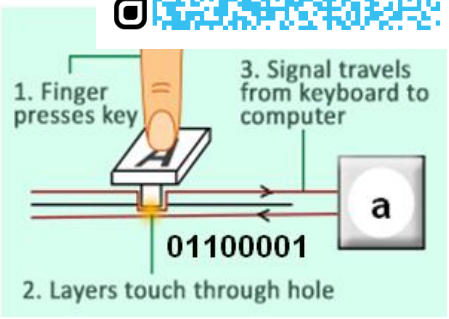
- The following flowchart shows how barcodes are used at the point of sale in an automatic stock control system.
- Select statements from the list below, using numbers only, to complete the flowchart.

- **Q2: Winter2011 P11**
- The following flowchart shows how barcodes are used at the point of sale in an automatic stock control system.
- Select statements from the list below, using numbers only, to complete the flowchart.

Quick response (QR) codes

QR code (abbreviated from **Quick Response Code**) is the trademark for a type of matrix barcode. A QR code uses four standardized encoding modes (numeric, alphanumeric, byte/binary, and kanji) to efficiently store data; extensions may also be used.
A bar code can store up to 30 characters while in QR code 7000 digits can be stored.

How keyboard works



Each individual key is a switch. When a key is pressed it generates a specific binary code, based on ASCII.
For example:

- Pressing **A** key produces binary code 01100001, representi ng lower case letter **a**,
- This binary code is sent to processor.

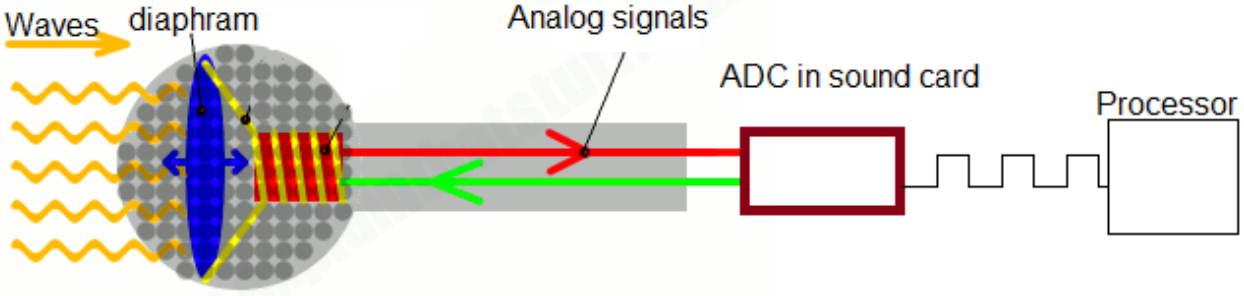
So processor recognises which key is pressed

Principle of operation of laser mouse:

S No	Step
1	laser/light shines onto a surface through a (polished) ring at the base
2	the light is reflected from the surface through the ring
3	sensor detects reflected light
4	capturing details/photograph of surface (under the ring) at about 1500 times per second
5	as the mouse moves the sensor detects changes in the surface detail/photograph
6	These changes are translated into movement (change of x and y co-ordinates)
7	the computer/software updates the position of the cursor on the screen

Microphone:

Microphones are a type of *transducer* - a device which converts energy from one form to another.
Microphones convert acoustical energy (sound waves) into electrical energy (the audio signal).
Microphones have diaphragms.
When a microphone picks up sound, a diaphragm vibrates producing an electric signal. This signal goes to a sound card and is converted into digital values and stored in the computer.



How inkjet printers work:

S No	Step
1	Printer driver translates data into a suitable format for the printer
2	Printer receives data from the computer and stores the data in the printer's buffer
3	Paper feed stepper motor activated; sheet of paper fed from paper tray
4	The print head moves across page; ink is sprayed each time the print head pauses for a fraction of a second
5	Paper feed stepper motor advances paper a fraction of a cm after each complete head pass

How* Laser Printers *work:

S No	Step
1	The printer driver ensures that the data is in a format that the laser printer can understand
2	Data is then sent to the laser printer and stored temporarily in the printer buffer
3	The printing drum is given a positive charge
4	As the printing drum rotates, a laser scans across it; this removes the positive charge in certain areas
5	Negatively-charged areas are then produced on the printing drum; these match exactly with the text and images to be printed
6	The printing drum is coated in positively-charged toner; this then sticks to the negatively-charged parts of the printing drum
7	A negatively-charged sheet of paper is then rolled over the printing drum
8	The toner on the printing drum is now transferred to the paper to reproduce the required text ad images
9	The paper goes through a fuser which melts the toner so it fixes permanently to the paper

How to create a solid object using a 3D printer

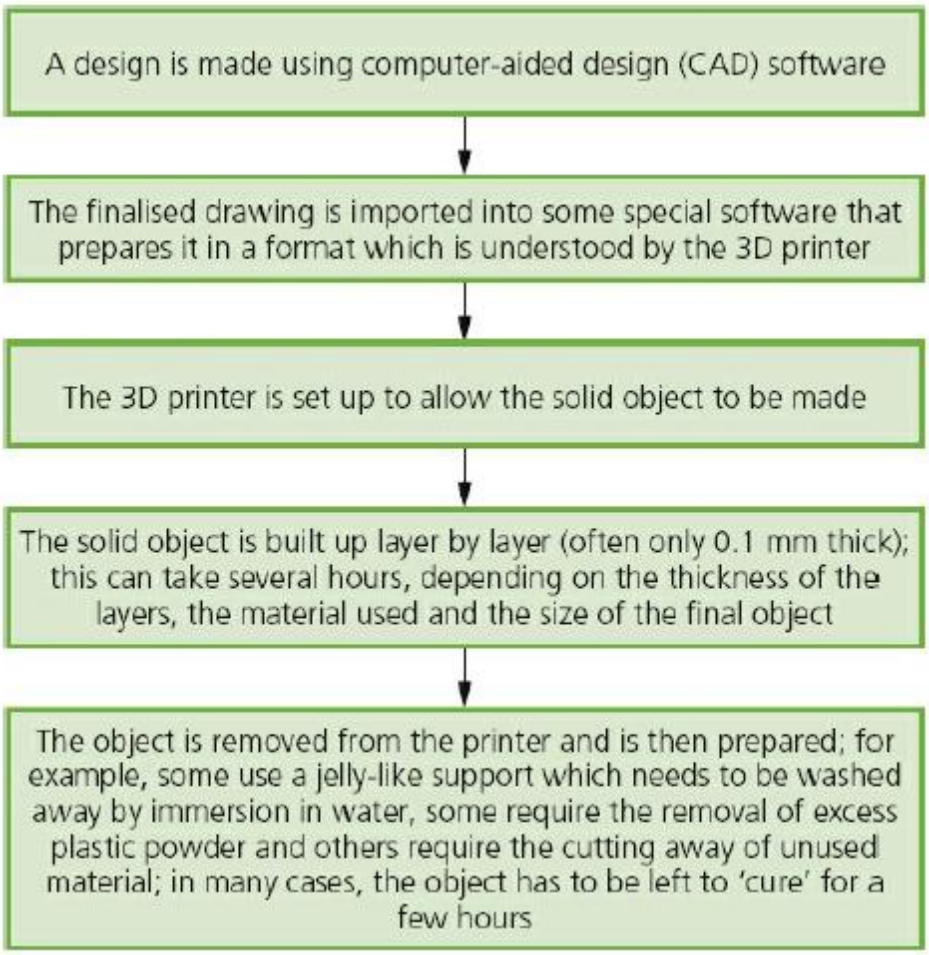
The following describes some of the features of 3D printing:

- Various types of 3D printers exist; they range from the size of a microwave oven up to the size of a small car.
- 3D printers use **ADDITIVE** manufacturing (i.e. the object is built up layer by layer);
- **Direct 3D printing** uses inkjet technology; a print head can move left to right as in a normal printer. However, the print head can also move up and down to build up the layers of an object.
- **Binder 3D printing** is similar to direct 3D printing. However, this method uses two passes for each of the layers; the first pass sprays dry powder and then on the second pass a

binder (a type of glue) is sprayed to form a solid layer.

• Newer technologies are using lasers and UV light to harden liquid polymers; this further increases the diversity of products which can be made.

There are a number of steps in the process of producing an object using these 3Dprinters. The steps are summarized here



Monitoring & Control System

Sensors and actuators

Sensors and **actuators** are devices that are used for automatic input and control in real-time systems.

Sensors are electronic devices which generate signals in the response of an event like if temperature increases beyond of a certain set limit temperature sensor generate signals and send to processor. The signals generated by sensors are generally in analogue form and need to be converted into digital form so as processor can understand it. **ADC (Analogue-to-Digital Converter)** is used to convert these analogue signals into digital signals.

Actuators are parts of machine which are controlled by processor. The processor sends digital signals, which are converted into analogue signals using **DAC (Digital-to-Analogue Converter)** so as actuator can act upon it.

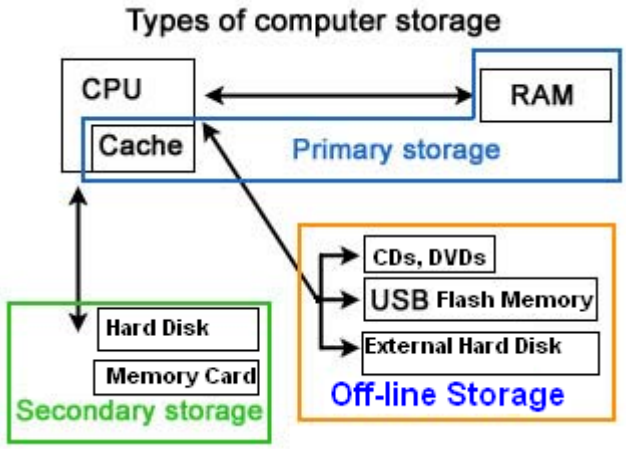
1.3.5 Memory, storage devices and media

Storage Media & Devices

The device that actually holds the data is known as the **storage medium** ('media' is the plural). The device that saves data onto the storage medium, or reads data from it, is known as the **storage device**.

Storage Device: The machine which stores data on storage medium.

Storage Media: The physical material in which a devices stores data.



A computer holds programs and data in three sorts of device:

1. **Primary** — limited-capacity and rapid-access during processing
2. **Secondary** — larger-capacity and slower-access to keep data/programs for future use. They remain inside computer.
3. **Off-line** — portable, they are removed after read/write data.

Measuring the size of memory

4 bits = 1 nibble, 8 bits=1 byte,
2^{10} Bytes = 1024 bytes= 1 Kilo Byte
2^{20} Bytes = 1024 KB= 1 Mega Byte,
2^{30} Bytes = 1024 MB= 1 Giga Byte,
2^{40} Bytes = 1024 GB= Tera Byte
2^{50} Bytes = 1024 TB= 1 Peta Byte

Differences between SRAM & DRAM

SRAM	DRAM
does not need to be refreshed as the transistors hold the data as long as the power supply is on	requires data to be refreshed periodically in order to retain the data
requires less power consumption	requires higher power consumption which is significant when used in battery-powered devices
has more complex circuitry	Has simpler circuitry
used predominantly in cache memory of processors where speed is important	

Differences between RAM and ROM

	RAM	ROM
What does it contain?	Operating system, programs and data which are currently being used.	A program used to start the computer called the 'boot program' or BIOS.
Can the contents be changed? (Is it volatile?)	Yes. The contents of the RAM are changed all the time while the computer is running.	No. The contents of ROM cannot normally be changed.

How big is it?	Typically 3-4Gb. The larger the better because this means that the computer can run more programs at the same time.	Typically 1 -2Mb. Small because it only needs to store the boot program.

Summer 15 P11)

Q1) Five storage devices are described in the table below.
In column 2, name the storage device being described.
In columns 3, 4, or 5, tick (✓) to show the appropriate category of storage.

1	2	3	4	5
Description of storage device	Name of storage device	Category of storage		
		Primary	Secondary	Off-line
optical media which use one spiral track; red lasers are used to read and write data on the media surface; makes use of dual-layering technology to increase the storage capacity				
non-volatile memory chip; contents of the chip cannot be altered; it is often used to store the start up routines in a computer (e.g. the BIOS)				
optical media which use concentric tracks to store the data; this allows read and write operations to be carried out at the same time				
non-volatile memory device which uses NAND flash memories (which consist of millions of transistors wired in series on single circuit boards)				
optical media which use blue laser technology to read and write data on the media surface; it uses a single 1.1 mm polycarbonate disc				

(d) The LCD (liquid crystal display) on the clock face is back-lit using blue LEDs (light emitting diodes). The brightness of the clock face is determined by the level of light in the room. The amount of light given out by the LEDs is controlled by a control circuit.
Describe how the sensor, microprocessor and LEDs are used to maintain the correct brightness of the clock face.

.....
.....
.....
.....
.....
.....
.....[3]

(e) Modern LCD monitors and televisions use LED back-lit technology.

Give **two** advantages of using this new technology compared to the older cold cathode fluorescent lamp (CCFL) method.

1.....

.....

2 .....

..... [2]

Description of storage device	Name of storage device	Category of storage		
		Primary	Secondary	Off-line
optical media which uses one spiral track; red lasers are used to read and write data on the media surface; makes use of dual-layering technology to increase the storage capacity	**DVD**			✓
non-volatile memory chip; contents of the chip cannot be altered; it is often used to store the start-up routines in a computer (e.g. the BIOS)	**ROM**	✓		
optical media which uses concentric tracks to store the data; this allows read and write operations to be carried out at the same time	**DVD-RAM**	✓		(✓)
non-volatile memory device that uses NAND flash memories (which consist of millions of transistors wired in series on single circuit boards)	**Solid State Drive/memory (SSD)**		✓	
	(SD/XD card) (USB storage device)			(✓)
optical media that uses blue laser technology to read and write data on the media surface; it uses a single 1.1 mm polycarbonate disc	**Blue-ray**			✓

(d) Any three from:
– uses a light sensor
– sends signal/data back to microprocessor
– signal/data converted to digital (using ADC)
– value compared by microprocessor with pre-set/stored value
– if value < stored value, signal sent by microprocessor …
– … to the voltage supply (unit)
– … "value" of signal determines voltage supplied/brightness of LED [3]

(e) Any two from:
– no need to warm up
– whiter tint/more vivid colours/brighter image
– higher resolution

– much thinner monitors possible/lighter weight
– more reliable technology/longer lasting
– uses much less power/more efficient [2]

Summer 15 P12)

Q 2) The majority of mobile phones use touch screens. Three common technologies are used by different mobile phone manufacturers. Choose one of the following mobile phone technologies:

• resistive • capacitive • infrared

Chosen technology .....

(i) Describe how your chosen technology works to allow a user to make selections by touching the screen.

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

(ii) Give **one** benefit and **one** drawback of your chosen technology when used on mobile phone touch screens.

Benefit.....
.....
Drawback.....
..... [2]

Q3) Four input devices, four descriptions and four applications are shown below.
Draw a line to connect each input device to its correct description. Then connect each description to its correct application. [6]

Input device	Description	Application
barcode reader	copies paper documents and converts the text and pictures into a computer-readable form	voice recognition
microphone	reads labels containing parallel dark and light lines using laser light or LEDs; the width of each line represents a binary code	reading passports
pH sensor	detects changes in acidity levels; data is often in analogue form	automatic stock control
scanner	device that allows audio signals to be converted into electric signals; these can be interpreted by a computer after being converted into digital form	monitor soil in a greenhouse

Q 4a) Street lighting is controlled automatically. A light sensor and a microprocessor are used to decide when to switch each street light on or off.

Describe how the sensor, microprocessor and light interact to switch the street light on or off. Include in your answer how the microprocessor stops the street lights being frequently switched on and off due to brief changes in the light intensity.

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....[5]

(b) Name **three** different sensors (other than light and pH) and describe an application for each of these sensors.

A different application is needed for each sensor.

Sensor 1 .....
Application .....
.....
Sensor 2 .....
Application .....
.....
Sensor 3 .....
Application .....
..... [6]

Marking Scheme

Q2) Either of the three options, resistive, capacitive or infra-red must be chosen
maximum of two marks from chosen technology:

resistive
- uses multiple layers of material …
- … that transmit electric currents
- when the top layer/screen is pushed/touched into the lower/bottom layer …
- … the electric current changes and location of "touch" is found

capacitive
- current sent/flows out from all 4 corners of the screen
- when finger/stylus touches screen, the current changes
- the location of "touch" is calculated

infra-red
- an "invisible" grid on the screen (pattern of infra-red LED beams)
- sensors detect where the screen has been touched through a break in an infrared beam(s)
- the position where the screen touched is calculated [2]

(ii) 1 mark for benefit, 1 mark for drawback

Resistive
benefits:
- inexpensive/cheap to manufacture
- can use stylus/finger/gloved finger/pen
drawbacks:
- poor visibility in sunlight

- vulnerable to scratching
- wears through time
- does not allow multi-touch facility

capacitive

benefits:

- good visibility in sunlight
- (very) durable surface
- allows multi-touch facility

drawbacks:

- screen (glass) will shatter/break/crack (on impact)
- cannot use when wearing (standard) gloves

infra-red

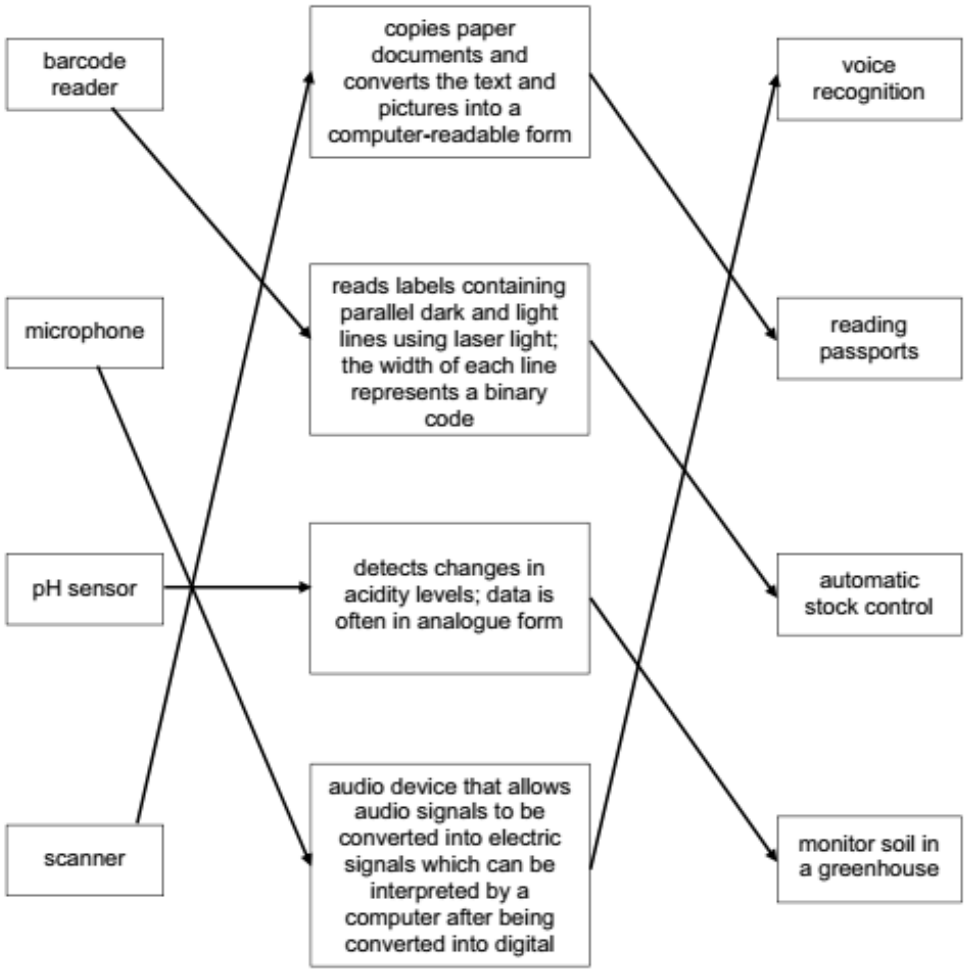
benefits:

- good durability
- allows multi-touch facility
- can use stylus/finger/gloved finger/pen

drawbacks:

- expensive to manufacture
- screen (glass) will shatter/break/crack (on impact)
- sensitive to dust/dirt [2

Q3)



Q4(a) Maximum 5 marks in total for question part
Description of how street light is controlled: (max 4 marks)
- sensor sends signal/data to the microprocessor
- signal/data converted to digital/using ADC
- microprocessor compares value to a stored value
- if input value < stored value …
- … signal sent from microprocessor to actuator
- … and light is switched on/off
- whole process continues in an infinite loop
Avoiding frequent on/off switches: (max 2 marks)
- microprocessor continues to keep light on/off for a pre-determined period
- after pre-determined period, sensor output is again sampled [5]

(b) 1 mark for correct sensor, 1 mark for its matching application
(all THREE applications must be different)

sensor	*application*
infra-red/motion	*automatic doors* *burglar alarm systems*
temperature	*chemical process* *central heating/air con system* *greenhouse environment* *oven*
sound/acoustic	*burglar alarm systems* *leak detection system* *disco lighting*
moisture/humidity	*clothes drier* *environmental control (greenhouse, air con)*
pressure	*burglar alarm system* *traffic light control* *chemical process*
carbon dioxide/ oxygen/gas	*pollution monitoring in a river* *greenhouse environment (growth control)* *confined area (e.g. space craft)* *Fish tank/Aquarium*
magnetic field	*mobile phone* *anti-lock braking* *CD players*

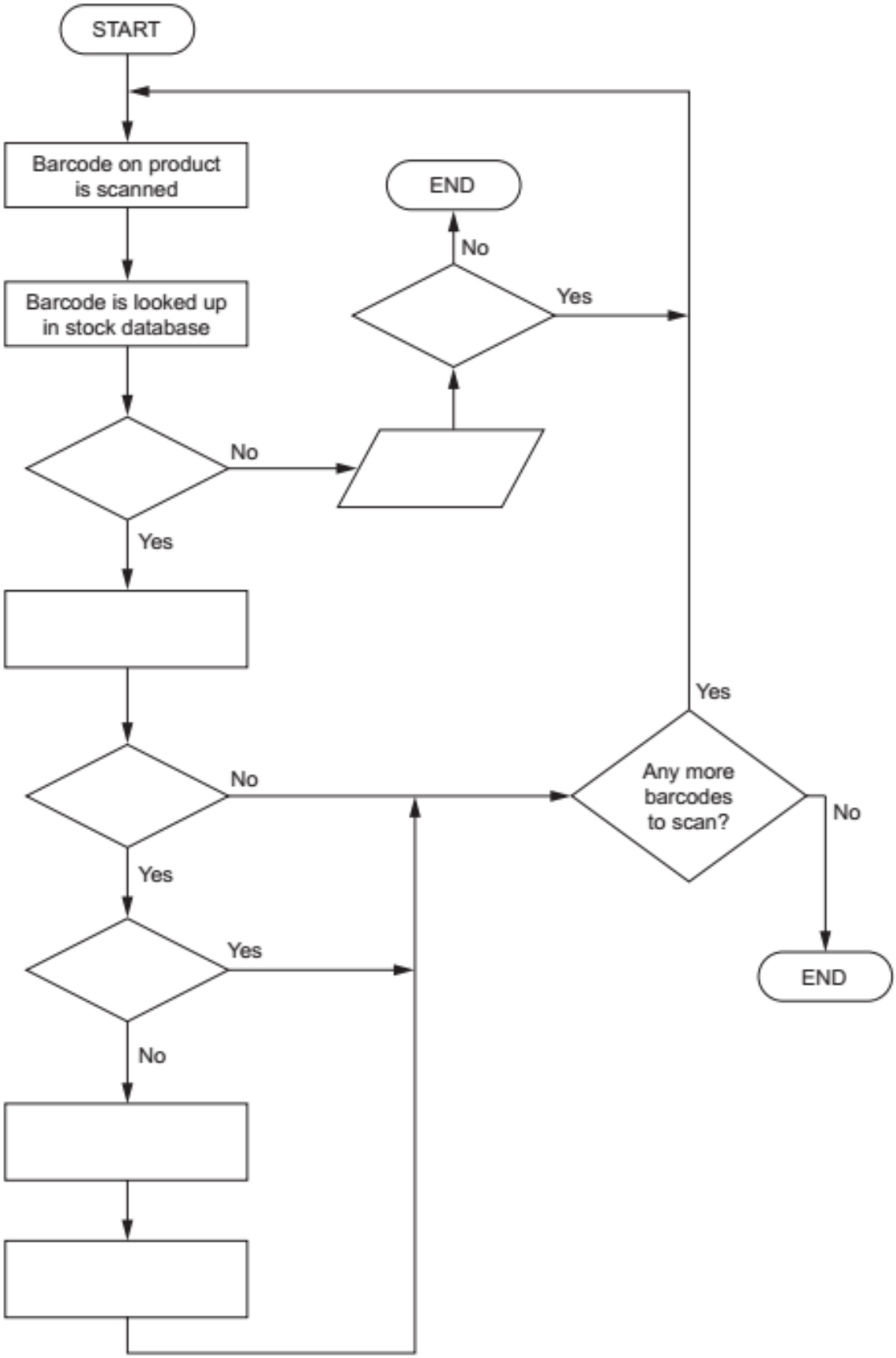
Winter 15 P12)

Q5) Seven computer terms and seven descriptions are shown below.
Draw a line to link each computer term to its most appropriate description.

Computer term	Description
Interface	Reduction of file size by permanently removing some redundant information from the file
Interrupt	File compression format designed to make photo files smaller in size for storage and for transmission
JPEG	File compression system for music which does not noticeably affect the quality of the sound
Lossless compression	Hardware component that allows the user to communicate with a computer or operating system
Lossy compression	The file is reduced in size for transmission and storage; it is then put back together again later producing a file identical to the original
MIDI	Signal sent to a processor which may cause a break in execution of the current routine, according to priorities
MP3 format	Standard adopted by the electronic music industry for controlling devices such as synthesisers and sound cards

Q6) The flowchart on the opposite page shows what happens when the barcode on a product is scanned at the checkout in a supermarket. The barcodes are used in an automatic stock control system.
Several of the statements in the flowchart are missing.
Using **item number only** from the list below, complete the flowchart.

Item number	Statement
1	Add flag to product record to indicate re-order made
2	Any more barcodes to scan?
3	Has the scanned barcode been found in the file?
4	Has the re-order flag already been added to the product record?
5	Is number of product in stock <= re-order level?
6	Number of product in stock is reduced by 1
7	Output an error message
8	Automatically send out order for new product


START
Barcode on product is scanned
Barcode is looked up in stock database
No
Yes
Yes
No
Yes
No
Yes
Yes
No
END
No
Yes
Any more barcodes to scan?
No
END

Q7)A security system uses sensors, a camera and a microprocessor to capture images of each person entering a large shopping mall.

(a) Describe how the sensors, camera and microprocessor interact to identify certain people entering the mall.

.....
.....
.....
.....
.....
.....
.....
.....[5]

(b) Each image taken requires 1 MB of storage. If the camera captures an image every 5 seconds over a 24 hour period, how much storage is required?

Give your answer in **gigabytes** and show all your working.

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

(c) The shopping mall has over 100 cameras. At the end of each day all these cameras send their images, captured over the last 24 hours, to a central computer.

Explain why the mall uses dedicated fibre optic cable rather than transmitting the data over the local broadband network.

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

Q8) The steps to print a document using a laser printer are shown in the table below.

Put each step in the correct order. The first step has been done for you. [8]

Step	**Order**
As the printing drum rotates, a laser scans across it; this removes the positive charge in certain areas	
The printing drum is coated in positively-charged toner; this then sticks to the negatively-charged parts of the printing drum	
The paper goes through a fuser which melts the toner so it fixes permanently to the paper	
The printer driver ensures that the data is in a format that the laser printer can understand	**1**
A negatively-charged sheet of paper is then rolled over the printing drum	
Data is then sent to the laser printer and stored temporarily in the printer buffer	
The toner on the printing drum is now transferred to the paper to reproduce the required text and images	
The printing drum is given a positive charge	
Negatively-charged areas are then produced on the printing drum; these match exactly with the text and images to be printed	

Q9) A remote-controlled model car contains RAM, ROM and a solid state drive. The car receives

radio signals from its remote control. It can only receive radio signals of a certain frequency. The manufacturer sets this frequency and the owner cannot change it. The owner of the model car can input their own sequence of movements from an interface underneath the car.

(a) Describe the purpose of each of the three types of memory supplied with the car.

RAM: .....
.....
ROM: .....
.....
Solid state drive: .....
.....[3]

(b) The owner needs to be able to enter their own sequence of movements for the model car. Name a suitable input device.

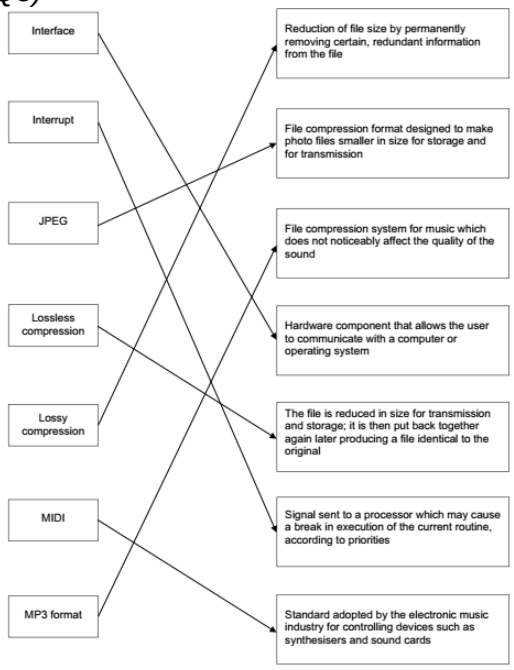
Input device:
.....
.....

Give a reason for your choice of device.
.....
.....
.....[2]

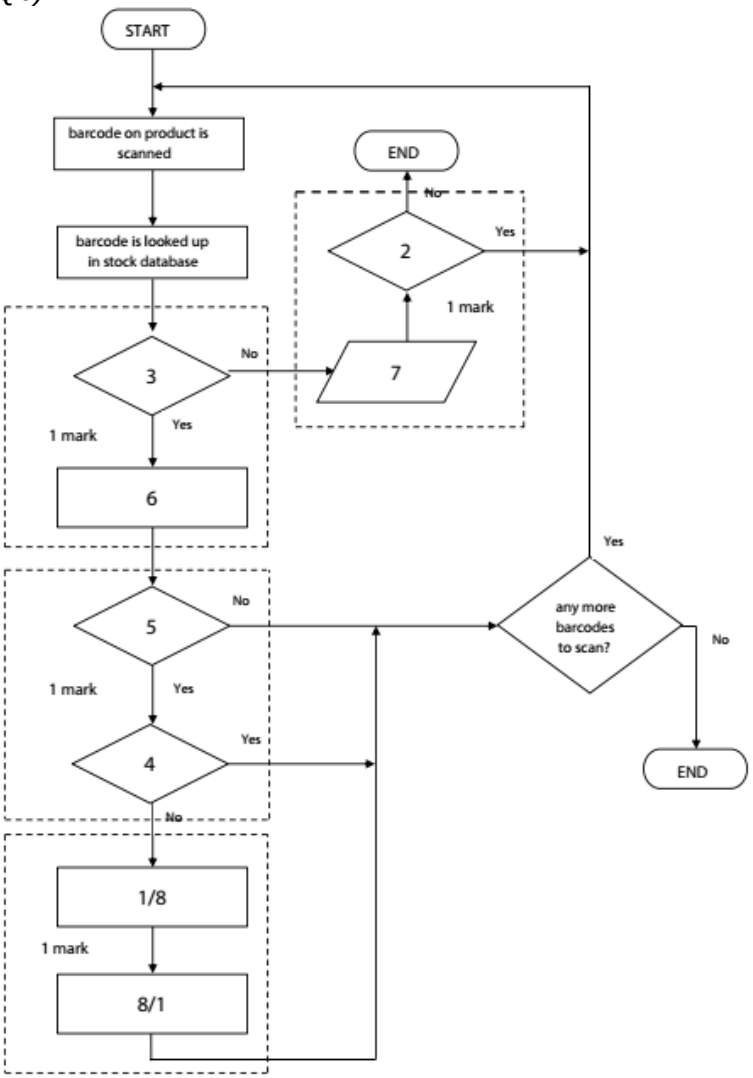
(c) Explain why the model car uses a solid state drive rather than another type of secondary storage.
.....
.....
.....
.....[2]

Marking Scheme

Q5)



Q6)



Q7)

(a) *Any five from:*

– naming a suitable sensor, e.g infra-red, pressure, motion sensors, send signal/data to microprocessor

– signal/data is converted to digital (using an ADC)

– microprocessor instructs/send signals to camera to capture image/video

– captured image/video data sent to microprocessor

either

– microprocessor compares the image/video with stored images/video…

– … if person detected = stored image …

– …alert given to signal a person has been identified

or

– microprocessor compares the biometric data from an image/video with stored biometric data for images/video …

–… if biometric data matched = stored data …

–… alert given to signal a person has been identified

– Continual/repeated process

(b) 1 mark for correct calculation, 1 mark for correct answer

– number of photos = 12 × 60 × 24 = 17280

– memory requirement = 17280/1024 = 16.9 (16.875)
– (17280/1000 = 17.28/17.3 is acceptable) [2]
(c) Any two from:
– (data transmission) is faster
– more secure/safer (because it is a dedicated line)
– (fibre optic transmission) is more reliable [2]

Q8)

Step	Order
As the printing drum rotates, a laser scans across it; this removes the positive charge in certain areas	**4**
The printing drum is coated in positively-charged toner; this then sticks to the negatively-charged parts of the printing drum	**6**
The paper goes through a fuser which melts the toner so it fixes permanently to the paper	**9**
The printer driver ensures that the data is in a format that the laser printer can understand	**1**
A negatively-charged sheet of paper is then rolled over the printing drum	**7**
Data is then sent to the laser printer and stored temporarily in the printer buffer	**2**
The toner on the printing drum is now transferred to the paper to reproduce the required text and images	**8**
The printing drum is given a positive charge	**3**
Negatively-charged areas are then produced on the printing drum; these match exactly with the text and images to be printed	**5**

Q9)
(a) RAM
– contains instructions/program/data currently in use
ROM
any one from:
– contains the start-up/bootstrap program
– contains/stores the setting for frequency (can't be changed)
Solid state drive
– stores the instructions/program/data (to operate the car) [3]
(b) 1 mark for device and 1 mark for corresponding reason
Device:
– touch screen
– key pad (NOT keyboard)
Reason:
– easy to use interface
– limited number of options
– small space/space is limited
– other devices such as mouse, keyboard, trackerball, … not suitable [2]
(c) Any two from:
– A solid state drive has no moving parts
– A solid state drive has faster random access
– A solid state drive has a quick start up/shut down time (reduced latency)
– A solid state drive is very small
– A solid state drive is very light
– A solid state drive consumes very little power

– A solid state drive does not generate a lot of heat (therefore safer in this application) [2]

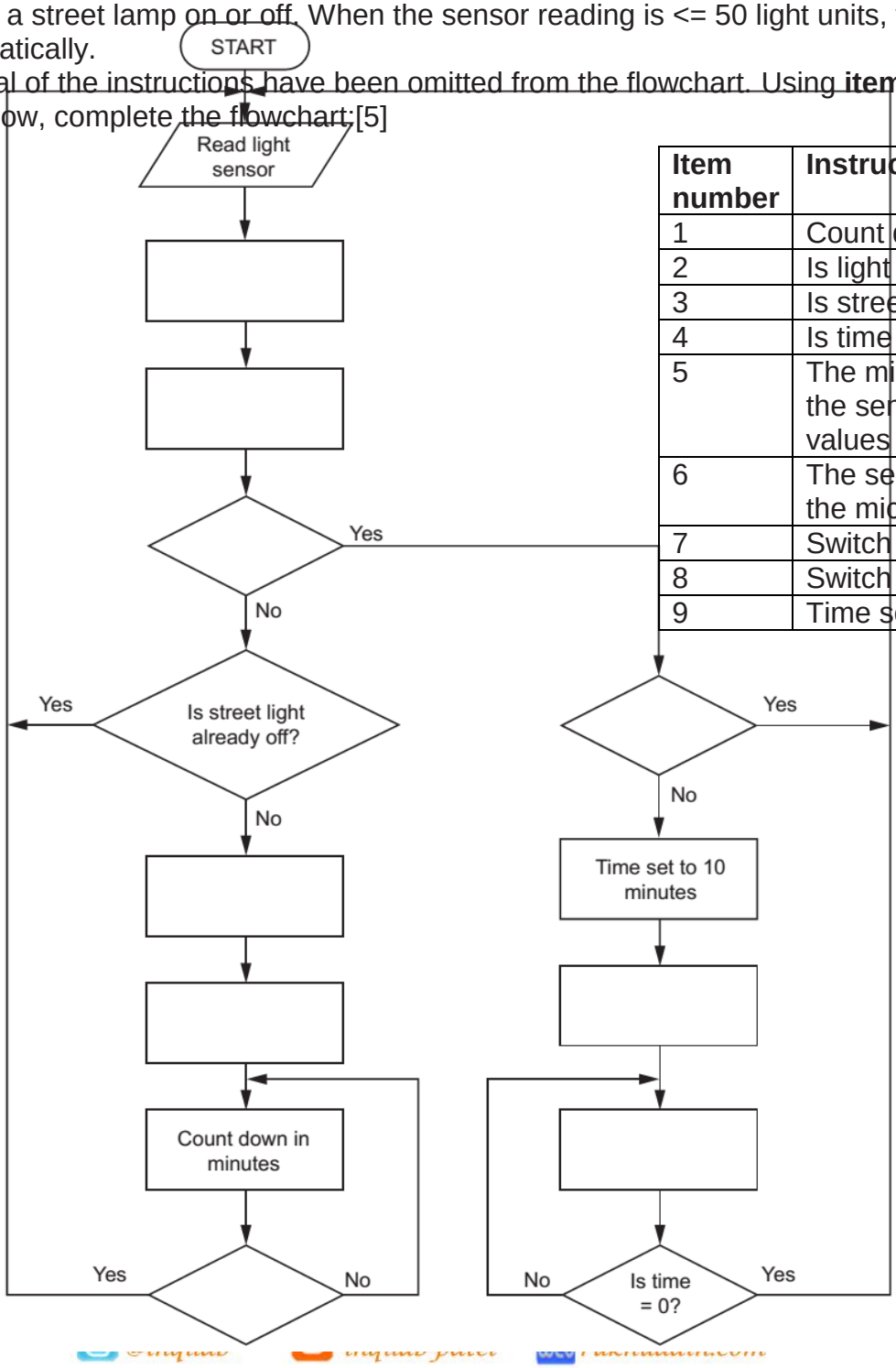
Winter 15 P13)

Q10) a) Name an application which makes use of the following sensors. A different application should be used in each case.

Temperature .....
.....
Magnetic field .....
.....
Motion .....
..... [3]

(b) The flowchart on the opposite page shows how a light sensor and microprocessor are used to switch a street lamp on or off. When the sensor reading is <= 50 light units, the lamp is turned on automatically.

Several of the instructions have been omitted from the flowchart. Using **item numbers only** from the list below, complete the flowchart:[5]



Item number	Instruction
1	Count down in minutes
2	Is light reading <= 50?
3	Is street lamp already on?
4	Is time = 0?
5	The microprocessor compares the sensor reading with stored values
6	The sensor reading is sent to the microprocessor
7	Switch the street lamp off
8	Switch street lamp on
9	Time set to 10 minutes

Q11) Sensors and a microprocessor monitor a car exhaust for high temperature and high carbon monoxide (CO) levels.

(a) Describe how the sensors and microprocessor are used to monitor the temperature and CO levels and warn the driver if either is out of range.

.....
.....
.....
.....
.....
.....
.....
.....[5]

Q12)A security system records video footage. One minute of video requires 180 MB of storage. The recording system can store several hours of video footage.

(a) Name and describe a suitable storage device for this recording system.

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

(b) Calculate how much storage would be needed for 2 hours of video footage.
Show your working and give the answer in Gigabytes (GB).

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

Q13) Passengers fly into an airport from other countries. The airport has a security system that uses:

• computers • scanners • digital cameras

To gain entry to the country, each passenger must have a passport or identification (ID) card. This must contain a recent photograph and other personal data. The passenger must:

• place their passport or ID card on a scanner that reads machine-readable characters and scans the photograph

• look towards a camera that takes an image of the passenger's face

Describe how a computer checks whether the image just taken by the camera matches the scanned photograph.

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

Q14) Name a suitable output device for each of the following applications. A different device should be used for each application.

Application	**Suitable output device**
Production of one-off photographs of very good quality	
High volume colour printing of advertising flyers	
Production of an object, which is built up layer by layer; used in CAD applications	
Converting electrical signals into sound	
Showing enlarged computer output on a wall or large screen	

Q15) Four input devices are shown in the table below.
Give an application which makes use of each device and state a reason why the device is appropriate for that application. Your application must be different in each case.

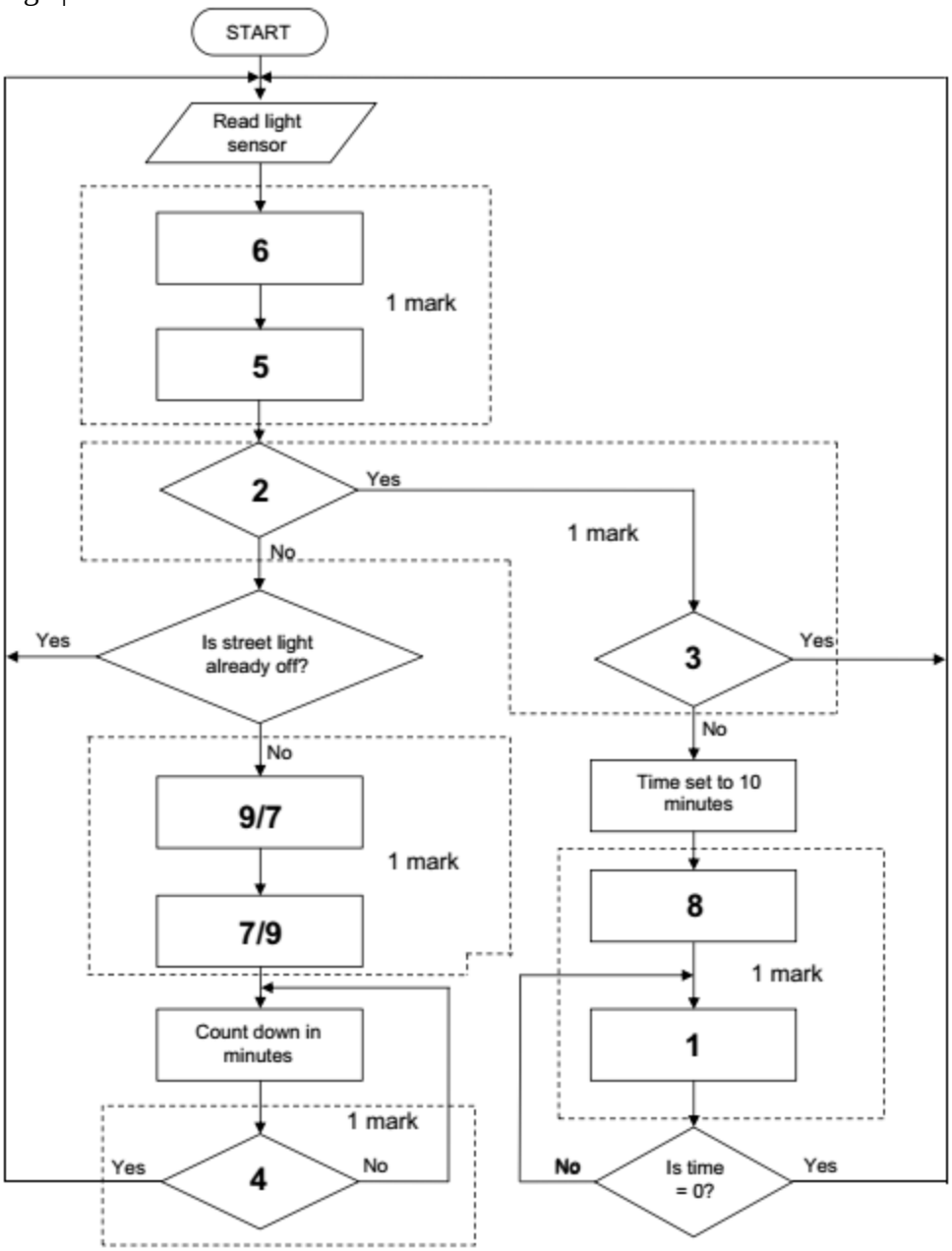
Input device	**Application and reason**
Light sensor	Application ..... Reason ....
Keyboard	Application ..... Reason ....
Barcode reader	Application ..... Reason ....
Touch screen	Application ..... Reason ....

Marking Scheme

Q10)

(a) *Temperature*
– central heating/ air con system
– greenhouse environment
– a chemical reaction/ process
Magnetic field
– anti-lock brakes on a car
– detection of motor vehicles (e.g. at traffic lights)
– reading magnetic ink characters on cheques
– geophysical surveys
Motion
– automatic doors
– burglar alarm [3]

(b)



Q11)

(a) Any five from:

– sensors send signals/ data to microprocessor

– signal/ data converted to digital (by an ADC)

– microprocessor compares temperature/ carbon monoxide level/value with stored level/ value

– if CO level > stored value, microprocessor sends signal…

– if temperature > stored value, microprocessor sends signal…

– …to light warning bulb on dashboard/ sounds alarm [5]

(b) (i) 2 marks for all correct conditions, 1 mark for 2 correct conditions

CO (carbon monoxide) level too high

oil pressure too low

brake pads too thin [2]

(ii) 1 mark for each correct parity bit in

position 1

1	*1*	*1*	*1*	*0*	*0*	*1*	*0*

0	*0*	*0*	*0*	*1*	*1*	*1*	*0*

[2]

(iii) 1 mark for correct parity bit + 1 mark for remainder of binary value

1	*0*	*1*	*0*	*0*	*0*	*1*	*0*

[2]

(iv) A 2 (allow follow through from part (iii)) [1

Q12)

(a) – Memory card/ SSD / HDD/ magnetic tape

– Suitable description of device given [2]

(b) 2 hours = 120 minutes

120 × 180 = 21600

21600/ 1024 (or 21600/ 1000)

= 21.1GB (or 21.6GB)

(1 mark for correct answer and 1 mark for correct calculation) [2]

Q13)

Any two from:

– facial recognition software/ biometric software used to scan face

– face image converted to digital format/ data by the camera

– digital image formed from scanned photo/ biometric data stored in passport

– key features of the face are checked/ compared [2]

Q14)

Application	***Suitable output device***
Production of one-off photographs of very good quality	*Inkjet Printer*
High volume colour printing of advertising flyers	*LaserJet Printer*
Production of an object, which is built up layer by layer; used in CAD applications	*3D Printer*
Converting electrical signals into sound	*Speaker*
Showing enlarged computer output on a wall or large screen	*Multimedia Projector*

Q15)

1 mark for each named application + 1 mark for each matching reason for choice

Input device	*Application and reason*
Light sensor	*Automatic doors* *– detects a person when light beam broken and opens doors* *Street lighting* *– detects change in light and switches on/ off the street lights* *Greenhouse* *– ensures correct lighting conditions for growth of plants*
Keyboard	*Word processor/ spreadsheet/ database* *– need to key in data manually (e.g. report writing)* *Control room interface* *– need to manually key in data (e.g. flow speed of liquid)*
Barcode reader	*Supermarket checkout* *– read barcodes to find prices, description*

	– allows automatic stock control *Library system* *– can track books on loan* *– can link books to borrowers using bar coded cards* *Airport check-ins* *– barcodes on luggage to track whereabouts*
Touch screen	*Ticket/ information kiosk* *– easy method for public to enter data* *– limited number of options* *Mobile phone/ tablet* *– easy method to input data* *– use of icons for application selection* *Control room interface* *– faster/ easier method to input data into system* *– fewer chances of error since number of choices limited*

[8]

Winter 15 P11)

Q14) (a) Four hardware items are shown in the table below.

For each hardware item:

• name a suitable application

• state how it is used in the application

Give a different application in each case. [8]

Hardware item	**Application**	**How the hardware item is used**
Microphone	.....	.....
Barcode reader	.....	.....
Touch screen	.....	.....
Infrared sensor	.....	.....

(b) Describe **two** differences between Blu-ray discs and DVDs.

1: .....

2: .....

.....[2]

(c) Describe **two** differences between DVD-R and DVD-RAM.

1: .....

.....

2:

.....

.....[2]

Q15) **a)** Inkjet printers and laser printers are two common types of printer.
Describe the features and principles of operation of each type of printer.

(i) Inkjet printer

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

(ii) Laser printer

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

(b) Another type of printer is the 3D printer.
Describe 3D printing.

.....
.....
.....
.....
..... [3]

Q16) A passenger logs onto an airline website and types in the reference number for their flight. Once the passenger accesses their account they can choose their seat and also print out a boarding pass which contains a unique barcode. This barcode is scanned at the airport check-in desk.
Name **one** input and **one** output device found at the check-in desk and give a reason for your choice.

Input device: .....
Reason: .....
.....
Output device: .....
Reason: .....
.....[4]

Summer 16 P11_P13

Q17 (a) *Five sensors and five applications are shown below.*
Draw a line to link each sensor to its most appropriate application. *[4]*

Sensor	Application
Light sensor	*Monitor the pollution levels in a river*
Moisture sensor	*Control the switching off and on of street lights*
Gas sensor	*Detect intruders breaking into a building*
pH sensor	*Monitor the amount of water left in clothes in a dryer*
Pressure	*Monitor acidity levels in the soil in a green house*

(b) *Automatic doors in a building are controlled by the use of infrared sensors and a microprocessor.*
Describe how the sensors and the microprocessor are used to automatically open a door as a person approaches.

.....
.....
.....
.....
.....
.....
.....*[4]*

Q18 (a) *Nikita wishes to print out some documents and connects her printer to the computer using one of the USB ports.*
(i) *Identify what type of data transmission is being used.*
.....*[1]*
(ii) *Give* three *reasons for using a USB port.*
1 .....
.....
2 .....

.....

3 .....

..... *[3]*

(iii) *The printer runs out of paper while it is printing the documents. A signal is sent to the processor to request that the problem is dealt with.*

Name this type of signal.

.....*[1]*

(b) *State* one *suitable application for* each *printer below. A different application must be given for each printer.*

Inkjet printer .....

.....

3D printer .....

..... *[2]*

(c) *Name another type of printer and describe* one *way in which it is different from the printers named in* part (b).

Give an application for this printer.

Type of printer .....

Description .....

.....

.....

Application .....

..... *[3]*

Q19) **(a)** Four examples of optical storage media are:

- DVD-RW
- DVD-RAM
- CD-ROM
- Blu-ray disc

The table below shows four features of optical storage media.

Tick (✓) the appropriate boxes in the table to indicate which of the features apply to each example of optical storage media. [4]

	Single track	**Many concentric tracks**	**Blue laser used to read/ write data**	**Red laser used to read/ write data**
DVD-RW				
DVD-RAM				
CD-ROM				
Blu-ray disc				

(b) Solid state drives (SSD) are replacing hard disc drives (HDD) in some computers.

(i) Give **three** reasons why this is happening.

1 .....

.....

2 .....

.....

3 .....

..... [3]

(ii) Explain why many web servers still use hard disc drive (HDD) technology.

.....

.....

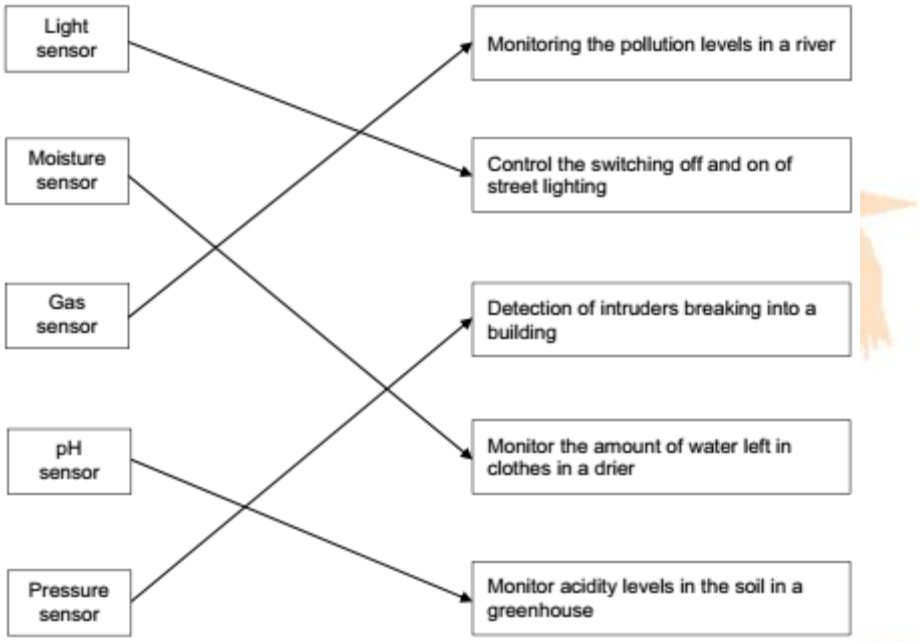
.....

.....

.....[2]

Marking Scheme

Q17a)



(b) Any four from:
– sensor(s) sends signal/data to microprocessor
– signal/data converted to digital (using an ADC)
– microprocessor compares signal/data with pre-set/stored value
–if sensor(s) signal/data indicates the presence of a person / the door needs to be opened / a match is found / door is closed …
–… microprocessor sends a signal to an actuator …
–… to operate/drive a motor to open the door

Q18)

(a) (i) serial	*[1]*	
(ii)	*Any three from:*	
–	*automatically detects the hardware/installs drivers*	
–	*plug only goes in one way/can't connect incorrectly*	
–	*supports different data transmission speeds/a range of data transmission speeds*	
–	*has become the industry standard/universally used*	
–	*backwards compatible (with earlier versions of USB ports)*	*[3]*
(iii) interrupt	*[1]*	

(b) 1 mark each use of printer, max 1 mark per printer.

inkjet printer	*– (small quantities of) documents* *– photographs*
3D printer	*– (physical) prototype (from CAD)* *– (physical) model (from a blueprint)*

(c) 1 mark for naming printer + 1 mark for description + 1 mark for application
Laser printer
– uses toner/powder ink
– uses (positive and negative) charged drums // rotating drum
– uses static charge
– no moving head
– faster at printing
– high volume output/high speed
– producing flyers/leaflets/magazines [3]
This is an example, other types of printers can be credited.

Q19)

	Single track	**Many concentric tracks**	**Blue laser used to read/ write data**	**Red laser used to read/ write data**
DVD-RW	✓			✓
DVD-RAM		✓		✓
CD-ROM	✓			✓
Blu-ray disc	✓		✓	

(b) (i) Any three from:
– don't need to "get up to speed" to work properly/no latency
– lower/less power consumption/more energy efficient
– run cooler
– run quieter
– data access is faster
– occupies less physical space/more compact
– lighter, so more suitable for a portable computer/laptop
– no moving parts so more reliable/durable in a portable computer/laptop [3]
(ii) Any two from:
– HDD is cheaper for larger amounts of storage space
– HDD has greater longevity for read/write functions
– Expensive to change the technology // HDD are trusted technology
– No requirement for the increased speed of SSD

Summer 16 qp12

Q20) Motion sensors are used in a security system to detect intruders.
Name **three** other sensors that could be used in the following applications.
Give a different type of sensor for each application. [3]

Application	**Sensor**
controlling street lights	
monitoring a river for pollution	
controlling traffic lights	

Marking Scheme

Q20)

Application	Sensor
controlling street lights	Light
monitoring a river for pollution	Gas, pH, temperature, light
controlling traffic lights	pressure, magnetic field,

Q21) Six descriptions and **six** devices are shown below.
Draw a line to link each description to the correct device.

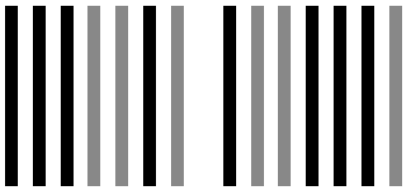
Description	Device
Allows a user to write on a surface using a pen; text and drawings are then captured electronically and stored for later use.	Digital Light Projector
Converts sound into an electrical signal/voltage.	Inkjet printer
Uses thermal bubble and piezoelectric technology to produce a hard copy.	Interactive whiteboard
Uses a bright white light source and micro mirrors (on a chip) to produce an image to be shone onto a wall or screen.	Laser printer
Converts a hard copy document into an electronic form to be stored as a file on a computer.	Microphone
Uses negatively charged images on a rotating drum and positively charged toner to output a hard copy.	Scanner (2D)

Q21) 9 In the following barcode, each binary number is made up of seven bars.

Each bar is black or grey.

A black bar is interpreted as a "1" and a grey bar is interpreted as a "0".

(a) Write the binary numbers that would be produced from this barcode: [2]



Binary number A **Binary number B**

Binary number A:

Binary number B:

(b) This barcode system uses odd parity.

Write the parity bit for each of the binary numbers in **part (a)**:

Parity bit

Binary number A:

Binary number B: [2]

Q22 There are **six** descriptions in the table below.

Complete the table below by writing the correct storage device or media in the box next to each description. [6]

Description	**Storage device or media**
Non-volatile memory that can only be read from and not written to.	
Optical storage media that allows very high storage capacity by using blue/violet laser technology.	
Volatile memory that stores data, programs and the parts of the operating system that are currently in use.	
Optical storage media that uses a single spiral track and uses dual layer technology, allowing high data storage capacity.	
Device that stores data by controlling the movement of electrons within a microchip; there are no moving parts.	
Optical storage media that uses concentric tracks allowing writing and reading to take place at the same time.	

Winter 2016 P12

Q23) A security system is installed in a house. A hexadecimal number is entered to activate or deactivate the alarm.

(a) The alarm code is set to hexadecimal number 2 A F

Show how this number would be stored in a 12-bit binary register.[3]

(b) Identify two sensors that the security system could use to detect intruders.
Describe how each sensor could be used in the security system.
Sensor 1 .....
Description .....
.....
.....
.....
Sensor 2 .....
Description .....
.....
.....
.....[6]

Marking Scheme

(a) *1 mark per nibble*
0010 1010 1111 *[3]*
(b) *1 mark for identification of each sensor, max 2 for each description*
Infrared/motion sensor
– Receives infrared rays/heat
– Sends data to microprocessor
– Receives microwaves
– Placed in the corner of a room, across a doorway
– Used to detect the heat of an intruder // used to detect if an infrared beam has been broken by an intruder
Pressure sensor
– Receives current if circuit created // stops receiving current if circuit is broken
– Sends data to microprocessor
– Placed on a window/door, at the entrance
– Used to detect a change in pressure *[6]*

1.3.6 Operating systems
1.3.7High- and low-level languages and their translators

Summer 15 P11)

Q 1) Five statements about interpreters and compilers are shown in the table below.
Study each statement.
Tick (✓) to show whether the statement refers to an interpreter or to a compiler. [5]

Statement	Interpreter	Compiler
takes one statement at a time and executes it		
generates an error report at the end of translation of the whole program		
stops the translation process as soon as the first error is encountered		
slow speed of execution of program loops		
translates the entire program in one go		

Statement	Interpreter	Compiler
takes one statement at a time and executes it	✓	
generates an error report at the end of translation of the whole program		✓
stops the translation process as soon as the first error is encountered	✓	
slow speed of execution of program loops	✓	
translates the entire program in one go		✓

Summer 15 P12)

Q2) (a) Five statements about interpreters and compilers are shown in the table below.
Study each statement.
Tick (✓) to show whether the statement refers to an interpreter or to a compiler.

Statement	Interpreter	Compiler
creates an executable file that runs directly on the computer		
more likely to crash the computer since the machine code produced runs directly on the processor		
easier to debug since each line of code is analysed and checked before being executed		
slow speed of execution of program loops		
it is more difficult to modify the executable code, since it is in machine code format		

(b) State why a compiler or an interpreter is needed when running a high-level program on a computer.

.....
.....
.....[1]

(c) Give **one** benefit of writing a program in a high-level language.

.....
.....
..... [1]

(d) Give **one** benefit of writing a program in a low-level language.

.....
.....
..... [1]

(e) Study the following three sections of code.

A:
```
1 0 1 0 1 1 0 1
1 1 0 0 1 1 1 0
1 0 1 1 0 1 1 1
```

B:
```
LDD X
INC X
STA Y
```

C:
```
FOR x ← 1 TO 10
READ n
ENDFOR
```

Identify, using the letters A, B or C, which of the above codes is an example of assembly code, high-level language code or machine code:

Assembly code .....
High-level language code .....
Machine code .....[2]

Marking Scheme

a)

Statement	***Interpreter***	***Compiler***
creates an executable file that runs directly on the computer		✓
more likely to crash the computer since the machine code produced runs directly on the processor		✓
easier to debug since each line of code is analysed and checked before being executed	✓	
slow speed of execution of program loops	✓	
it is more difficult to modify the executable code, since it is in machine code format		✓

(b) Any one from:
- code is required to be converted into machine code/binary
- code needs to be produced that can be understood by the computer *[1]*
(c) Any one from:
- close to English/native/human language
- easier/faster to correct errors/read/write
- works on many different machines/operating systems (portable) *[1]*
(d) Any one from:
- work directly on registers/CPU
- more control over what happens in computer

- can use machine specific functions [1]

(e)

Assembly code: *B*
High-level language code: *C*
Machine code: *A*

Winter 15 P11)

Q3) State **three** features of a typical operating system.

1: .....
.....
2: .....
.....
3: .....
.....[3]

Summer 16 qp12

Q4) Complete the following by writing either ***compiler***, ***interpreter*** or ***assembler*** in the spaces provided. [3]

..... – translates source code into object code.
..... – translates low-level language into machine code.
..... – stops the execution of a program as soon as it encounters an error.

Marking Scheme

compiler
assembler
interpreter

Winter 16 p12

Q5) (a) Give **two** reasons why a programmer would choose to write code in a low-level language.

1 .....
.....
.....
2 .....
.....
..... [2]

(b) High-level languages require either an interpreter or a compiler to translate the program.

The table below lists a number of statements about language translators.

Tick (✓) to show which statements refer to interpreters and which refer to compilers. [5]

Statements	**Interpreter (✓)**	**Compiler (✓)**
Translates the source code into machine code all at once		
Produces an executable file in machine code		
Executes a high-level language program one instruction at a time		
Once translated, the translator does not need to be present for the program to run		
An executable file is produced		

Q6) State **four** functions of an operating system.

1 .....
2 .....
3 .....
4 ..... [4]

Marking Scheme

Q5 a) – *direct access to computer processor / special hardware // machine dependent instructions*
– *uses up less memory*
– *can increase the speed of processing a program // executes instructions faster [2]*

Statements	***Interpreter (3)***	***Compiler (3)***
Translates the source code into machine code all at once		✓
Produces an executable file in machine code		✓
Executes a high-level language program one instruction at a time	✓	
Once translated, the translator does not need to be present for the program to run		✓
An executable file is produced		✓

*Q6) Any **four** from:*
– *Provides a user interface*
– *Handles interrupts / errors*
– *Memory management*
– *File management*
– *Manages peripherals (inputs/outputs)*
– *Provides security methods*
– *Allows multitasking*
– *Manages multiprogramming*
– *Enables batch processing*
– *Manages software installation / removal*
– *Allows creation of multiple accounts*
– *Levels of access*

1.4 Security
1.5 Ethics
1.2.2 Security aspects

Malware: *A software that is designed to damage or disrupt a computer*

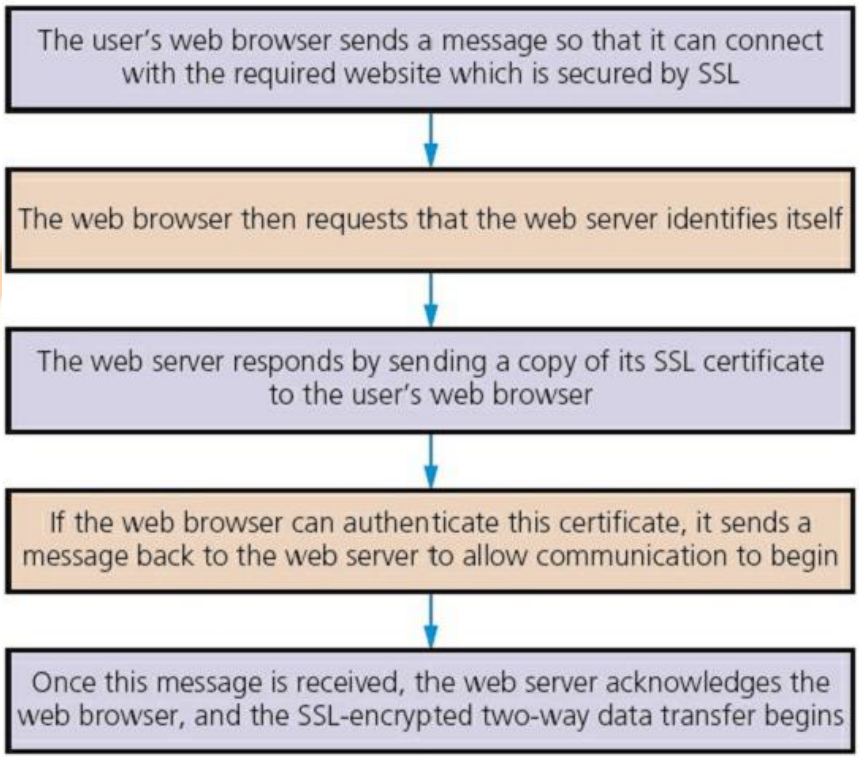
Virus: Program or code that replicates itself and is designed to amend, delete or copy data and files on a user's computer without their consent
Spyware: Software that gathers information by monitoring key presses on a user's computer and relays the information back to the person who sent the software

Hacking: The act of gaining illegal access to a computer system without the owner's consent

Hacker: *A person who tries to gain illegal access to a computer or a network.*

Phishing: Creator of code sends out a legitimate-looking email in the hope of gathering personal and financial data; it requires the recipient to follow a link in the email or open an attachment
Pharming: Malicious code installed on the hard drive of a user's computer or on the web server; this code will re-direct user to a fake web site without their consent
Firewall: is a hardware or a software that is used between the user's computer and the network to examine the data traffic to make sure it meets certain criteria.

Cookies: Information that a website stores about a user on the user's hard disk; this enables the website to remember details about the user when they next visit the website.
Security protocols
There are two forms of security protocols when using the internet:
•Secure Sockets Layer (SSL)
•Transport Layer Security (TLS).
SECURE SOCKETS LAYER (SSL) is a type of protocol (a set of rules used by computers to communicate with each other across a network). This allows data to be sent and received securely over the internet in encrypted form.



TRANSPORT LAYER SECURITY (TLS) is similar to SSL but is a more recent security system. TLS is a form of protocol that ensures the security and privacy of data between devices and users when communicating over the internet. It is essentially designed to provide encryption, authentication and data integrity in a more effective way than its predecessor SSL.

TLS is formed of two layers:

•Record protocol: this part of the communication can be used with or without encryption (it contains the data being transferred over the internet).

•handshake protocol: this permits the website and the client (user) to authenticate each other and to make use of encryption algorithms (a secure session between client and website is established).Only the most recent web browsers support both SSL and TLS which is why the older SSL is still used in many cases. But what are the main differences between SSL and TLS since they both effectively do the same thing?

•It is possible to extend TLS by adding new authentication methods.

•TLS can make use of **SESSION CACHING** which improves the overall performance 158 compared to SSL.

•TLS separates the handshaking process from the record protocol (layer) which holds all the data.

Session caching

When opening a TLS session, it requires a lot of computer time (due mainly to the complex encryption keys being used). The use of session caching can avoid the need to utilise so much computer time for each connection. TLS can either establish a new session or attempt to resume an existing session; using the latter can considerably boost system performance.

Encryption Algorithm:

S	Sender (A)	Recipient (B)
1	The sender uses an encryption algorithm	The recipient uses the same encryption algorithm
2	The sender chooses a secret value (x) e.g. x=2	The recipient chooses another secret value (y) e.g. y=4
3	Take a prime number e.g. 7	Take same prime number e.g. 7
4	Perform following algorithm • Find remainder after dividing Prime power x by 11 i.e. 7^xMOD 11 In our example 7^2 MOD 11=49 MOD 11= 5	Perform following algorithm • Find remainder after dividing Prime power y by 11 i.e. 7^yMOD 11 In our example 7^4 MOD 11=2401 MOD 11= 3
5	This value is sent to recipient	This value is sent to sender
	The receiving value is put in the same algorithm by replacing prime (7) 3^xMOD 11 In our example 3^2 MOD 11=9 MOD 11= 9	The receiving value is put in the same algorithm by replacing prime (7) 5^yMOD 11 In our example 5^4 MOD 11=625 MOD 11= 9
	Now **KEY DISTRIBUTION PROBLEM** is solved both have same key to encrypt and decrypt without distributing over network	

Summer 15 P11)

Q1) Choose **six** correct terms from the following list to complete the spaces in the paragraphs below:

- encryption
- file name
- firewall
- HTML tags/text
- IP address
- protocol
- proxy server
- SSL certificate
- web server name

A user enters a URL. The web browser breaks up the URL into **three** components:

1 .....

2 .....

3 .....

The web server returns the selected web page.

The web browser reads the ..... from the selected page and shows the correctly formatted page on the user's screen.

A ..... is used between the user's computer and the network to examine the data traffic to make sure it meets certain criteria.

To speed up the access to the web pages next time, a ..... is used between the computer and web server; this device uses a cache to store the website home page after it has been accessed for the first time. [6]

Q2(a) Viruses, pharming and phishing are all examples of potential Internet security issues. Explain what is meant by each of these **three** terms.

Virus: .....

.....

Pharming:

.....

.....

Phishing:

.....

.....[6]

(b) An online bank requires a client to supply an 8-digit code each time they wish to access their account on the bank's website.

Rather than ask the client to use a keyboard, they are requested to use an on-screen keypad (shown on the right) to input the 8-digit code.

The position of the digits on the keypad can change each time the website is visited.

The client uses a mouse or touch screen to select each of the8 digits.

2	**5**	**1**
6	**8**	**3**
9	**0**	**4**
	7	

(i) Explain why the bank has chosen to use this method of entering the 8 digits.

.....

.....

.....

..... [2]

(ii) Name and describe **another** measure that the bank could introduce to improve the security of their website.

Name: .....

Description:.....

.....

..... [2]

Marking Scheme

Q1) 1 mark per correct word

1 protocol *2 web server name accept* *3 file name*

HTML tags/text

firewall

proxy server

Q2(a) virus

any two from:

– program/software that replicates/copies itself

– can delete or alter files/data stored on a computer

– can make the computer "crash"/run slow

pharming

any two from:

– malicious code/software installed on a user's hard drive/actual web server

– this code redirects user to a fake website (without their knowledge)

– to obtain personal/financial information/data

phishing

any two from:

– legitimate-looking emails sent to a user

– as soon as recipient opens/clicks on link in the email/attachment …

– … the user is directed to a fake website (without their knowledge)

– To obtain personal/financial information/data [6]

(b) (i) Any two from:

– spyware/key logging software can only pick up key presses

– using mouse/touch screen means no key presses to log

– the numbers on the key pad are in random/non-standard format, which makes it more difficult to interpret [2]

Summer 15 P12)

Q3 (a) Four statements about cookies are shown in the table below. Study each statement. Tick (✓) to show whether the statement is true or false.

Statement	**True**	**False**
they are a form of spyware		
they are used only in advertising		
they are used to track browser use		
they act in the same way as a virus		

(b) Five descriptions and five security issues are shown below.
Draw a line to connect each description to the correct security issue.

Description	Security issue
Malicious code installed on the hard drive of a user's **computer or on the web server; this code will re-direct user to a fake web site without their consent**	hacking
Software that gathers information by monitoring key presses on a user's computer and relays the **information back to the person who sent the software**	pharming
Program or code that replicates itself and is designed to amend, delete or copy data and files on a user's **computer without their consent**	phishing
The act of gaining illegal access to a computer system without the owner's consent	spyware
Creator of code sends out a legitimate-looking email in the hope of gathering personal and financial data; it requires the recipient to follow a link in the email or	virus

Q4 (a) State what is meant by the term SSL.

.....
.....
.....[1]

(b) The following stages take place when a user wishes to access a secure website.
Put each stage in sequence by writing the numbers 1 to 6 in the column on the right. The first one has been done for you. [5]

Stage	Sequence number
the encrypted data is then shared securely between the web browser and the web server	
the web browser attempts to connect to a website which is secured by SSL	**1**
the web server sends the web browser a copy of its SSL certificate	
the web browser requests the web server to identify itself	
the web server will then send back some form of acknowledgement to allow the SSL encrypted session to begin	
the web browser checks whether the SSL certificate is trustworthy; if it is, then the web browser sends a message back to the web server	

Q5) Five computing terms are described below.
Write the name of the term being described.

Software that anyone can download for free from the Internet and then use without having to pay any fees. The usual copyright laws apply and a user license is important.....

Software that gives the user the chance to try it out free of charge before actually buying it. The software is subject to the usual copyright laws. As a rule, not all the features found in the full version are available at this stage. .....
Software where users have freedom to run, copy, change and adapt it. This is an issue of liberty and not of price since the software guarantees freedom and the right to study and modify the software by having access to the actual source code.....

Set of principles that regulates the use of computers in everyday life. This covers intellectual property rights, privacy issues and the effects of computers on society in general.....

The taking of somebody's idea or software and claim that the idea or software code were created by the "taker". ..... [5]

Marking Scheme

Q3)

Statement	***True***	***False***
they are a form of spyware		✓
they are used only in advertising		✓
they are used to track browser use	✓	
they act in the same way as a virus		✓

Q4) (a) Any one from:
- secure sockets layer
- encrypts data being transmitted
- use of https
- use public and private keys
b)

Stage	***Sequence number***
the encrypted data is then shared securely between the web browser and the web server	*6*
the web browser attempts to connect to a website which is secured by SSL	***1***
the web server sends the web browser a copy of its SSL certificate	*3*
the web browser requests the web server to identify itself	*2*
the web server will then send back some form of acknowledgement to allow the SSL encrypted session to begin	*5*
the web browser checks whether the SSL certificate is trustworthy; if it is, then the web browser sends a message back to the web server	*4*

Q5)
Freeware
Shareware

Free software
(Computer) Ethics
Plagiarism

Winter 15 P12)

Q6) 1 There are a number of security risks associated with using the Internet.
Name **three** of these risks. For each, state why it is a risk and describe how the risk can be minimised.

Security risk 1: .....
Why it is a risk: .....
.....
How to minimize the risk:.....
.....
Security risk 2: .....
Why it is a risk: .....
.....
How to minimize the risk: .....
.....
Security risk 3: .....
Why it is a risk: .....
.....
How to minimize the risk: .....
..... [9]

Marking Scheme

1 mark for each risk + 1 mark for corresponding reason why it is a risk and 1 mark for method of minimisation

Risk:	*hacking*
Reason:	*illegal/unauthorised access to data* *deletion/amendment of data*
Minimised:	*use of passwords/user ids* *use of firewalls* *encrypt data/encryption*
Risk:	*virus*
Reason:	*can corrupt/delete data* *cause computer to crash/run slow* *can fill up hard drive with data*
Minimised:	*use of /run anti-virus (software)* *do not download software or data from unknown sources*
Risk:	*spyware/key logging (software)*
Reason:	*can read key presses/files/monitors on a user's computer*
Minimised:	*use of/run anti-spyware (software)* *use data entry methods such as drop-down boxes to minimise risk*
Risk:	*phishing*
Reason:	*link/attachments takes user to fake/bogus website* *website obtains personal/financial data*

Minimised:	*do not open/click emails/attachments from unknown sources* *some firewalls can detect fake/bogus websites*
Risk:	*pharming*
Reason:	*redirects user to fake/bogus website* *redirection obtains personal/financial data*
Minimised:	*only trust secure websites, e.g. look for https* *check the URL matches the intended site*
Risk:	*credit card fraud/identity theft*
Reason:	*loss of money due to misuse of card/stealing data*
Minimised:	*set passwords* *encrypt data/encryption*
Risk:	*cracking*
Reason:	*illegal/unauthorised access to data*
Minimised:	*setting strong passwords* *encrypt data/encryption*

There may be other valid answers given that are outside the provided mark scheme

Winter 15 P13

Q7 (a) Computer ethics involves a number of different topics.

(i) A student made the following statement on an examination paper:

"It allows a user to have the freedom to run, copy, change and adapt the software and then pass it on to a colleague, friend or family member."

Identify which computer term the student was describing.

..... [1]

(ii) Explain what is meant by computer ethics.

.....

.....

.....

.....

.....

..... [3]

(b) The four statements below refer to firewalls and proxy servers. Study each statement.

Tick (9) the appropriate column(s) to indicate whether the statement refers to a firewall and/or a proxy server. [4]

Statement	**Firewall**	**Proxy server**
Speeds up access of information from a web server by using a cache		
Filters all Internet traffic coming into and out from a user's computer, intranet or private network		
Helps to prevent malware, including viruses, from entering a user's computer		
Keeps a list of undesirable websites and IP addresses		

(c) Explain **three** ways of preventing **accidental** loss or corruption of data.

1 .....
.....
.....
.....
2 .....
.....
.....
.....
3 .....
.....
.....
..... [6]

Q8) Choose **five** correct terms from the following list to complete the spaces in the sentences below:

• cypher text • encryption algorithm • encryption key • firewall
• plain text • proxy server • symmetric encryption

..... is a security system.
It uses the same .....to encrypt and decrypt a message.
Before encryption, the message is called ..... .
The ..... processes the original message. The output is known as ..... . [5]

Marking Scheme

Q7) *(a) (i) Free software/ open source software [1]*
(ii) Any three from:
– Set of principles/ laws that regulate the use of computers
– Covers intellectual property rights (e.g. copying of software)
– Privacy issues (e.g. accessing personal information)
– Impact of computers on society (relevant examples can be credited) [3]
(b) 1 mark for each CORRECT row [4]

Statement	*Firewall*	*Proxy server*
Speeds up access of information from a web server by using a cache		✓
Filters all Internet traffic coming into and out from a user's computer, intranet or private network	✓	✓
Helps to prevent malware, including viruses, from entering a user's computer	✓	
Keeps a list of undesirable websites and IP addresses	✓	✓

(c) one mark for method + one mark for linked reason (maximum 6 marks)
– back up files…
– …on a regular basis/ to another device/ to the cloud
– set data to read only…
– …to prevent accidental editing
– save data on a regular basis…
– …to prevent loss/ corruption of data in unexpected shutdown/failure
– use correct shut down/ start up procedures…

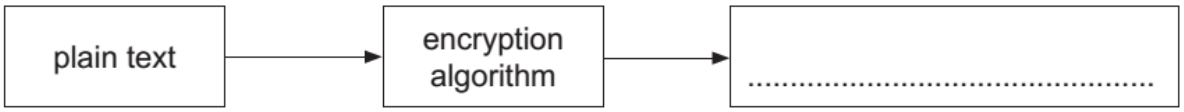
– …to prevent damage to components/ stored files
– use correct procedures before disconnecting portable storage device…
– …to prevent damage to device/ data corruption
– keep storage devices in a safe place…
– …away from fire hazards [6]
Q8) symmetric encryption
encryption key
plain text
encryption algorithm
cypher text [5]

Winter 15 P11)

Q9) (a) Three statements about cookies are shown below.
Study each statement. Tick to show whether the statement is true or false. [3]

Statement	True	False
Cookies can destroy or modify data in a computer without the user's knowledge		
Cookies generate website pop-ups		
Cookies allow a website to detect whether a viewer has viewed specific web pages		

Q10) (a) State what is meant by encryption.
.....
..... [1]
(b) State what is meant by symmetric encryption.
.....
..... [1]
(c) Complete the diagram: [1]



Q11) Identify which **five** computer terms are being described below.
(a) A system designed to prevent unauthorised access to or from a private network or intranet; it examines all data traffic to and from the network and filters out anything that does not meet certain criteria.
..... [1]
(b) Software that can be used on a trial basis before buying the full version; it often does not include all the features of the full version or has a time limit before it stops working.
.....[1]
(c) A protocol for transmitting private documents via the Internet; it uses two keys to encrypt the data – a public key and a private key.
.....[1]
(d) A standard adopted by the electronic music industry for controlling devices that produce music, such as synthesisers and sound cards.
..... [1]
(e) A device that allows audio signals to be converted into electrical signals which can be interpreted by a computer after being converted into digital signals.
.....[1]

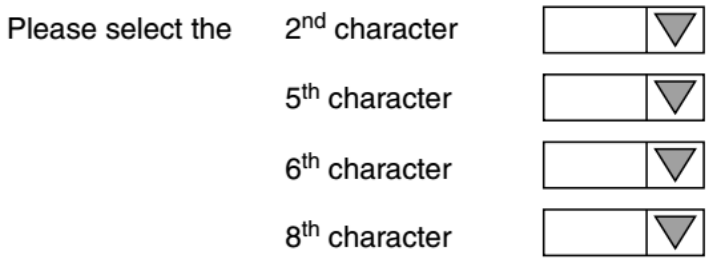
2210_0478_s16_qp_11_13

Q12) Some software can be described as free, freeware or shareware.
Tick (✓) the appropriate boxes in the table below to show which features apply to these three types of software.

Software feature	Free	Freeware	Shareware
Software source code can be freely accessed and modified as required			
All the features of the full version of the software are not made available; the full version needs to be purchased first			
The original software is subject to all copyright laws			
It is possible to distribute modified versions or copies of the software to friends and family			

Q13)Secure socket layer (SSL) is used in the security of information on Internet websites.
(a) State how it is possible for a user to know that a website is secure by looking at the web address.
.....
.....[1]
(b) Describe **three** of the stages a web browser goes through to detect whether a website is secure.
1 .....
.....
.....
2 .....
.....
.....
3 .....
.....
..... [3]

Q14) A bank offers an online service to its customers. The bank has developed a "*SafeToUse*" system that asks each customer to enter four randomly chosen characters from their password each time they log in.
The customer selects these four characters from drop-down boxes. For example:



(a) (i) Explain why it is more secure to use drop-down boxes rather than entering characters using a keyboard.
.....
.....
.....
.....[2]
(ii) Give a reason why the system asks for four characters chosen at random.
.....
.....[1]
(b) Biometrics is an additional form of security.

Give **two** examples of biometrics.

1 .....

2 ..... [2]

Q15) 10 Six *security issues and* six *descriptions are shown below.*

Draw a line to link each security issue to its correct description.[5]

URL	Description
Pharming	*illegal access to a computer system without the owner's consent or knowledge*
Phishing	*software that gathers information by monitoring key presses on a user's keyboard; the data is sent back to the originator of the software*
Viruses	*malicious code installed on the hard drive of a user's computer or on a web server; this code will re-direct the user to a fake website without the user's knowledge*
Hacking	*creator of code sends out a legitimate-looking email in the hope of gathering personal and financial information from the recipient; it requires the user to click on the link in the email or attachment*
Spyware	*a message given to a web browser by a web server; it is stored in a text file; the message is then sent back to the server each time the browser requests a page from the server*
Cookies	*program or code that replicates itself; designed to amend, delete or copy data or files on a user's computer; often causes the computer to crash or run slowly*

Marking Scheme

Q12)

Software feature	Free	Freeware	Shareware
Software source code can be freely accessed and modified as required	✓		
All the features of the full version of the software are not made available; the full version needs to be purchased first			✓
The original software is subject to all copyright laws		✓	✓
It is possible to distribute modified versions or copies of the software to friends and family	✓		

(a) Any one from:
– protocol ends in "s"
– use of padlock [1]

(b) Any three from:
– requests web server to identify itself/view the (SSL) certificate
– receives a copy of the (SSL) certificate, sent from the web server
– checks if SSL certificate is authentic/trustworthy
– sends signal back to web server that the certificate is authentic/trustworthy
– starts to transmit data once connection is established as secure
– if website is not secure browser will display an open padlock/warning message [3]

Q14) (a) (i) Any two from:
– to protect against key logging software/spyware
– can stop key presses being recorded
– can stop key presses being relayed
– drop down boxes cannot be recorded as key presses
– drop down boxes can be placed in different location on the screen each time (to overcome screen capture issues) [2]
(ii) Any one from:
– hacker never finds all characters on the first hack
– makes it more difficult for hackers to find the order of the characters
– hacker needs to hack the system several times to gain the whole password
– shoulder surfing will not give person full password [1]
(b) Any two from:
– fingerprint scanner
– face recognition software
– retina scanner/iris scanner
– voice recognition software [2]

2210_0478_s16_qp_12 Q8
Q15 (b) Describe **three** ethical issues that should be considered when using computers.
1 .....
.....
.....
2 .....
.....
.....

3 .....
.....
..... [3]

(c) Security of data is very important.
Three security issues are viruses, pharming and spyware.
Explain what is meant by each issue.

Viruses: .....
.....
.....
.....

Pharming: .....
.....
.....
.....

Spyware: .....
.....
.....
..... [6]

(d) Describe **three** tasks carried out by a firewall.

1 .....
.....
.....

2 .....
.....
.....

3 .....
.....
.....[3]

(b) Any three from:
– That we should follow Copyright laws/intellectual property rights/work should not be stolen/plagiarised
– That we should follow Data Protection laws
– That we should not create or distribute malware//description of malware
– That we should not hack/crack other computers//description of hacking
– That we should protect our own computers against malware/hacking
– That we should consider privacy issues (when using social networking)
– That we consider anonymity issues (when using social networking)
– That we should consider environmental impacts when using computers
– Loss/creation of jobs from use of computers/robotics
– We should follow codes of practice (for creation of code e.g. ACM/IEEE) [3]
(c) 2 marks for each term described
Viruses:
– program/software/file that replicates (copies) itself
– intends to delete or corrupt files//fill up hard disk space
Pharming:
– malicious code stored on a computer/web server
– redirects user to fake website to steal user data
Spyware:
– *monitors and relays user activity*

e.g. key presses//key logging software
– user activity/key presses can be analysed to find sensitive data e.g. passwords [6]
(d) Any three from:
– examines/monitors traffic to and from a user's computer and a network/Internet
– checks whether incoming and outgoing traffic meets a given set of criteria/rules
– firewall blocks/filters traffic that doesn't meet the criteria/rules
– logs all incoming and outgoing traffic
– can prevent viruses or hackers gaining access
– blocks/filters access to specified IP addresses/websites
– warns users of attempts by software (in their computer) trying to access external data sources (e.g. updating of software) etc. // warns of attempted unauthorised access to the system [3]

Q16 **(a) Five** statements and **three** types of software are shown below.

Draw lines to connect each statement with the correct type of software. [3]

Statement	Type of software
Users have the freedom to pass on the software to friends and family as they wish.	
Users can download this software free of charge, but they cannot modify the source code in any way.	Free software
Users are allowed to try out the software for a trial period only before being charged.	Freeware
Users can study the software source code and modify it, where necessary, to meet their own needs, without breaking copyright laws.	Shareware
Users can obtain a free trial version of the software, but this often does not contain all the features of the full version.	

Winter 2016 P12

Q17(a) Explain what is meant by a denial of service attack.

.....
.....
.....
.....**[2]**

(b) Name and describe two other potential security threats when using the Internet.

Security threat 1 .....
Description .....
.....
.....

Security threat 2 .....

Description .....

.....

..... **[4]**

Q18) Explain the differences between freeware and free software.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....**[4]**

Marking Scheme

Q18) (a) *Any **two** from:*

– a large number of requests are sent to the network/server all at once

– designed to flood a network/server with useless traffic/requests

– the network/server will come to a halt/stop trying to deal with all the traffic/requests

– prevents users from gaining access to a website/server *[2]*

(b) *1 mark for each security threat and 1 mark for matching description*

Security threat	***Description***
Viruses	*– software that replicates* *– causes loss/corruption of data // computer may "crash"/run slow*
Hacking/cracking	*– illegal/ unauthorised access to a system/data*
Phishing	*– a link/attachment sends user to fake website (where personal data may be obtained)*
Pharming	*– malicious code installed on user's hard drive / computer* *– user is redirected to a fake website (where personal data may be obtained)*
Spyware/key logger	*– send/relay key strokes to a third party* *[4]*

Challenging Questions

Challenge 1 Summer 2015 P11)

Draw a line to connect each question to the correct answer. [5]

Question	Answer
What is the denary (base 10) equivalent to the hexadecimal digit **E**?	8
If 1 GB = 2^X then what is the value of X?	12
How many bits are there in one byte?	14
If the broadband data download rate is 40 megabits per second, how many seconds will it take to download a 60 MB file?	19
What is the denary (base 10) value of the binary number 0 0 1 0 0 1 0 0 ?	30
What hexadecimal value is obtained when the two hexadecimal digits **C** and **D** are added together?	36

Challenge 2:

Sensors are one type of input device.
For each of the following situations, name a **different** sensor that could be used.
(i) air conditioning in an office building

.....[1]

(ii) maintaining correct growing conditions in a greenhouse

.....[1]

(iii) detecting an intruder in a building

.....[1]

(b) Sensors are used to monitor seismic activity. At the end of each day, all the data are transmitted to a central computer. This is hundreds of kilometres away.

Describe **one** way of ensuring that the integrity of the data is retained during the transmission stage.

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

Challenge 3

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

Firewall : .....
.....
.....

Authentication: .....
.....
.....

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

.....
.....
.....

(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.

.....
.....
.....

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

.....
.....
.....

Marking Scheme

Firewall

• sits between the computer or LAN and the Internet/WAN and permits or blocks traffic to/from the network
• can be software and/or hardware
• software firewall can make precise decisions about what to allow or block as it can detect illegal attempts by specific software to connect to Internet
• can help to block hacking or viruses reaching a computer
Authentication
• process of determining whether somebody/something is who/what they claim to be
• frequently done through log on passwords/biometrics
• because passwords can be stolen/cracked, digital certification is used
• helps to prevent unauthorised access to data [3]
***(b)** Describe **two** differences between data integrity and data security.*
(b) one mark for security, one mark for integrity:
• integrity deals with validity of data/freedom from errors/data is reasonable
• security deals with protection of data
• security protects data from illegal access/loss
• integrity deals with making sure data is not corrupted after, for example, being transmitted [2]

Challenge 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.
(c) (i) one mark for each way of maintaining data security + one mark for an example/enhancement
• validation (to ensure data is reasonable)
• examples include range checks, type checks, length checks, …
• verification (checks if data input matches original/if transmitted data matches original)
• can use double data entry or visual check/other methods such as parity checks
• doesn't check whether or not data is reasonable [3]
(ii) State **two** ways of maintaining data integrity during data transmission. Use examples to help explain your answer.
(ii) one mark for each way of maintaining data integrity + one mark for an example/enhancement

- *parity checking*
  - *one of the bits is reserved as parity bit*
  - *e.g. 1 0 1 1 0 1 1 0 uses odd parity*
  - *number of 1s must be odd*
  - *parity is checked at receiver's end*
  - *a change in parity indicates data corruption*
- *check sum*
  - *adds up bytes in data being sent and sends check sum with the data*
  - *calculation is re-done at receiver's end*
  - *if not the same sum then the data has been corrupted during transmission [3]*

Challenge: 3

(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.

[6]

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)	

Marking Scheme

(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

- *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*

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

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

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*

(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. [6]

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

Challenge 4

(a) Name and describe **three** buses used in the von Neumann model.
Bus 1.....
Description.....
Bus 2.....
Description.....
Bus 3.....
Description..... [6]

(b) The sequence of operations shows, in register transfer notation, the fetch stage of the fetch execute cycle.
1 MAR ←□[PC]
2 PC ←□[PC] + 1
3 MDR ←□[[MAR]]
4 CIR ←□[MDR]
• [register] denotes contents of the specified register or memory location
• Step 1 above is read as “the contents of the Program Counter are copied to the Memory Address Register”

(i) Describe what is happening at step 2.
..... [1]

(ii) Describe what is happening at step 3.
..... [1]

(iii) Describe what is happening at step 4.
..... [1]

(c) (i) Explain what is meant by an interrupt.
..... [2]

(ii) Explain the actions of the processor when an interrupt is detected.
..... [4]

Marking Scheme

(a) Name and describe **three** buses used in the von Neumann model.

- address bus
  - lines used to transfer address of memory or input/output location
  - unidirectional bus
- data bus
  - used to transfer data between the processor and memory/input and output devices
  - bidirectional bus
- control bus
  - used to transmit control signals
  - e.g. read/write/fetch/ …
  - dedicated bus since all timing signals are generated according to control signal [6]

(b) The sequence of operations shows, in register transfer notation, the fetch stage of the fetch execute cycle.

1 MAR ←□[PC]
2 PC ←□[PC] + 1
3 MDR ←□[[MAR]]
4 CIR ←□[MDR]

• [register] denotes contents of the specified register or memory location
• Step 1 above is read as "the contents of the Program Counter are copied to the Memory Address Register"

(i) Describe what is happening at step 2.
the program counter is incremented

(ii) Describe what is happening at step 3.
the data stored at the address held in MAR is copied into the MDR

(iii) Describe what is happening at step 4.
the contents of the Memory Data Register is copied into the Current Instruction Register

(c) (i) Explain what is meant by an interrupt.
a signal from a device/program that it requires attention from the processor

(ii) Explain the actions of the processor when an interrupt is detected.

- Processor stores the current instruction into interrupt handler
- Then processor deals with the interrupt
- After servicing the interrupt the process resumes the last task from interrupt handler.

Challenge 5:

(a) Name the **most** suitable input or output device for each of the following uses.
Give a different device in **each** case. [5]

Description of use	**Input or output device**
input of credit card number into an online form	
selection of an option at an airport information kiosk	
output of a single high-quality photograph	
output of several hundred high-quality leaflets	
input of a hard copy image into a computer	

(b) All of the uses in **part (a)** involve the input or output of data.
(i) Describe **two** methods of preventing accidental loss of data.
1 .....
.....

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

(ii) Describe **one** way of ensuring the security of the data against malicious damage.
.....
.....[1]

Marking Scheme

Challenge 5: (a) Name the **most** suitable input or output device for each of the following uses. Give a different device in **each** case. [5]

Description of use	Input or output device
input of credit card number into an online form	Keyboard/keypad/number pad
selection of an option at an airport information kiosk	touch screen
output of a single high-quality photograph	ink jet printer
output of several hundred high-quality leaflets	laser printer
input of a hard copy image into a computer	scanner

(b) All of the uses in **part (a)** involve the input or output of data.
(i) Describe **two** methods of preventing accidental loss of data.

- frequent (or equivalent) backup EITHER to secondary media/to 3rd party server/cloud/removable devices/continuous backup OR stored remotely
- disk-mirroring strategy/RAID
- UPS (uninterruptable power supply)/backup generator

(ii) Describe **one** way of ensuring the security of the data against malicious damage.

- protection of data (or equivalent) with passwords/using password and username for logging on include e.g. fingerprint scanning
- encryption
- installation and use of up to date anti-malware/anti-virus
- give different access rights to different users
- use a firewall,
- physical methods/lock doors and use secure entry devices/CCTV

Challenge 6: The incomplete table below shows descriptions and terms relating to malware.
(a) Complete the table with appropriate descriptions and terms. [4]

	Description	Term
A	Unsolicited emails containing advertising material sent to a distribution list.	.....
B	A standalone piece of malicious software that can reproduce itself automatically.	.....
C	....	Pharming
D	.....	Phishing

	....	

(b) For one of the terms, describe:
• a problem that might arise for a user
• a possible solution to the problem
Choose between the terms:
A / B (circle your choice)
Problem .....
Solution .....
.....[2]

(c) Explain the following terms:
Encryption .....
.....
Public key
.....
.....[2]

Challenge 6: The incomplete table below shows descriptions and terms relating to malware.

(a) Complete the table with appropriate descriptions and terms. [4]

	Description	**Term**
A	Unsolicited emails containing advertising material sent to a distribution list.	**Spam**
B	A standalone piece of malicious software that can reproduce itself automatically.	**Virus**
C	**redirect website to fake website by poisoning domain name server, installing code in client computer**	Pharming
D	**through legitimate email attempt to obtain somebody's confidential data / install malware**	Phishing

(b) For one of the terms, describe:
• a problem that might arise for a user
• a possible solution to the problem
Choose between the terms: A / B (circle your choice)

Spam
Problem: • user's inbox is filled by large amount of unwanted email
Solution: • user / email server employs filtering software that can divert / delete spam email

Virus
Problem :• could corrupt user's computer // delete data // consume bandwidth
Solution: • run anti-virus software in the background // not connect to the Internet // keep OS up-to-date[2]

(c) Explain the following terms:
Encryption**: process of turning plain text into cipher text (meaningless for others)**
Public key: **key widely available that can be used to encrypt message that only owner of private key can decrypt // can be used to decrypt a message thereby confirming originator of message** [2]

Challenge 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.

(b) Complete the truth table for this system. [4]

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**		

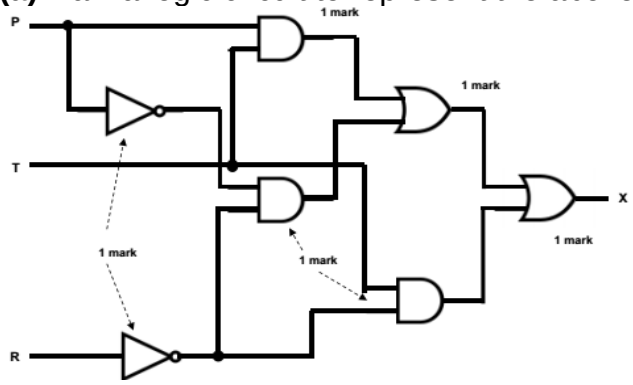
Challenge 7: A system is monitored using sensors. The sensors output binary values corresponding to physical conditions, as shown in the table:

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.



(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

Challenge 8: (a) There are two types of RAM: dynamic RAM (DRAM) and static RAM (SRAM). Five statements about DRAM and SRAM are shown below.
Draw a line to link each statement to the appropriate type of RAM. [5]

Statement	Type of RAM
requires data to be refreshed periodically in order to retain the data	
has more complex circuitry	DRAM
does not need to be refreshed as the circuit holds the data as long as the power supply is on	
requires higher power consumption which is significant when used in battery-powered devices	SRAM
used predominantly in cache memory of processors where speed is important	

(b) Describe **three** differences between RAM and ROM.

.....
.....
.....
.....
.....
..... [3]

(c) DVD-RAM and flash memory are two examples of storage devices.
Describe **two** differences in how they operate.

.....
.....
.....

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

Challenge 9:

(a) The table shows four statements about IP addresses.
Tick (✓) to show which of the statements are true. [2]

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	

(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]

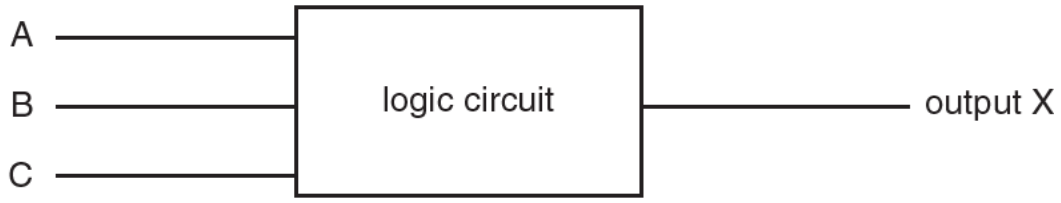
Challenge 9:

(a) The table shows four statements about IP addresses.
Tick (✓) to show which of the statements are true. [2]

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

(b) Consider the URL:
http://cie.org.uk/computerscience.html
(i) Give the meaning of the following parts of the URL.
http:– **enables browser to know what protocol is being used to access information in the domain**
cie.org.uk**is the domain name**
computerscience.html**web page / file being viewed**

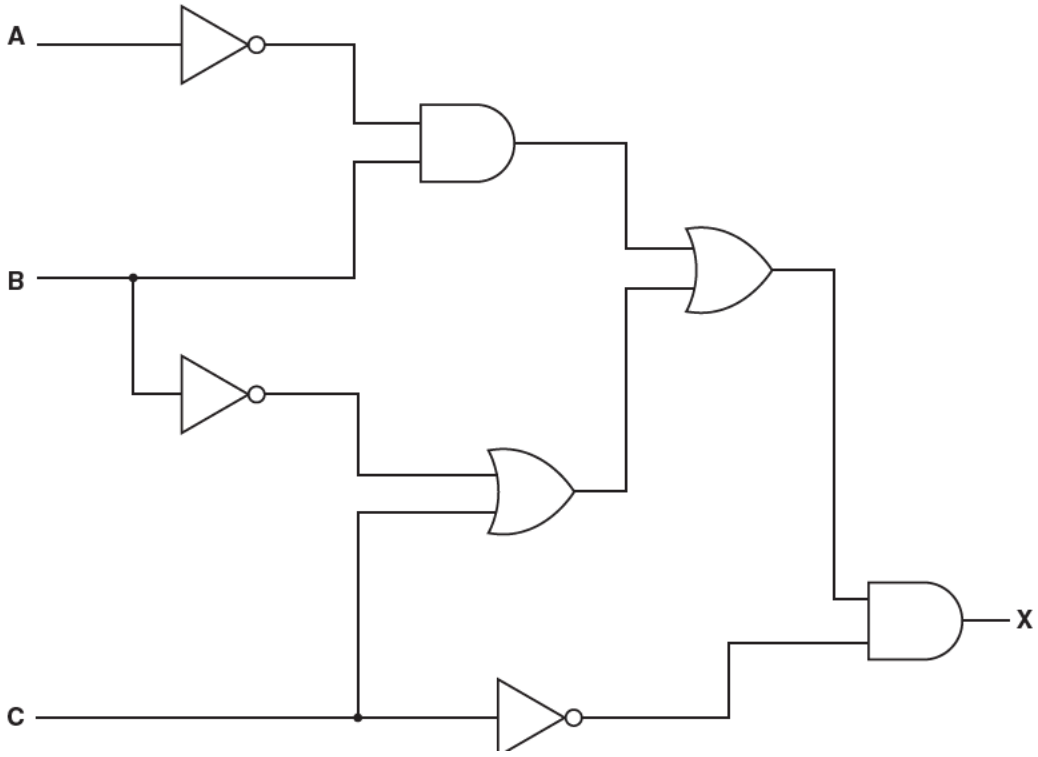
Challenge 10: (a) Three digital sensors A, B and C are used to monitor a process. The outputs from the sensors are used as the inputs to a logic circuit.
A signal, X, is output from the logic circuit:



(b) Complete the truth table for the logic circuit described in **part (a)**. [4]

A	B	C	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		

(c) Write a logic statement that describes the following logic circuit.



.....
.....
.....
..... [3]

Challenge 11: A web page offers a link for users to request another web page. The requested web page contains HTML code and JavaScript code.
Put each statement in the correct sequence by writing the numbers 1 to 5 in the right-hand column.

Statement	Sequence number
The requested web page is displayed on the client computer	
The user clicks on the hyperlink and the web page is requested from the web server	
The requested web page content is transmitted to the client computer	
The client computer processes the JavaScript code using the web browser software	
The web server locates the requested web page	

Challenge 11: A web page offers a link for users to request another web page. The requested web page contains HTML code and JavaScript code.
Put each statement in the correct sequence by writing the numbers 1 to 5 in the right-hand column.

Statement	Sequence number
The requested web page is displayed on the client computer	**5**
The user clicks on the hyperlink and the web page is requested from the web server	**1**
The requested web page content is transmitted to the client computer	**3**
The client computer processes the JavaScript code using the web browser software	**4**
The web server locates the requested web page	**2**

Challenge 12: Computer programs have to evaluate expressions.
Study the sequence of pseudocode statements.
Write down the value assigned to each variable.

```
DECLARE h, w, r, Perimeter, Area : REAL
DECLARE A, B, C, D, E            : BOOLEAN
```

```
h ← 13.6
w ← 6.4
Perimeter ← (h + w) * 2
```

(i) Perimeter ..... [1]

```
r ← 10
Area 3.142 * r^2
```

(ii) Area ..... [1]

```
Z ← 11 + r / 5 + 3
```

(iii) Z ..... [1]

```
A ← NOT(r > 10)
```

(iv) A ..... [1]

2 A programmer uses an Integrated Development Environment (IDE) for all program development.
Describe what is meant by an IDE.

..... [2]

Challenge 12: Computer programs have to evaluate expressions.
Study the sequence of pseudocode statements.
Write down the value assigned to each variable.

```
DECLARE h, w, r, Perimeter, Area : REAL
DECLARE A, B, C, D, E            : BOOLEAN
```

```
h ← 13.6
w ← 6.4
Perimeter ← (h + w) * 2
```

(i) Perimeter 40 ..... [1]

```
r ← 10
Area 3.142 * r^2
```

(ii) Area 314.2 ..... [1]

```
Z ← 11 + r / 5 + 3
```

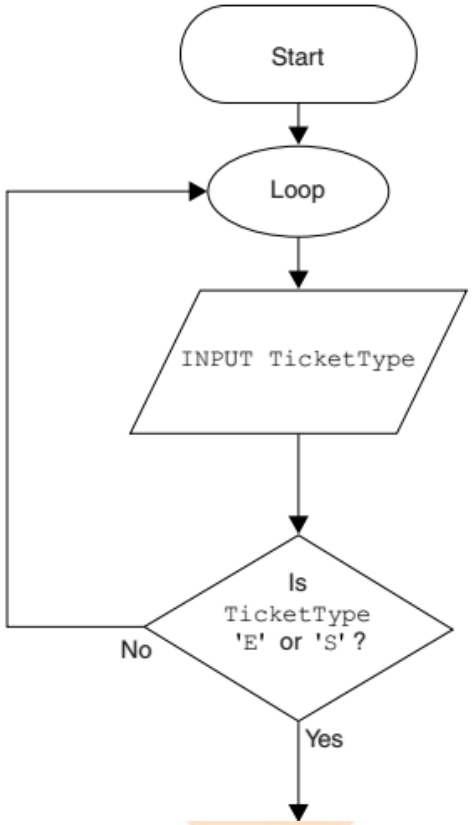
(iii) Z 16 or error as Z has not been declared. ..... [1]

```
A ← NOT(r > 10)
```

(iv) A True ..... [1]

2 A programmer uses an Integrated Development Environment (IDE) for all program development.
Describe what is meant by an IDE.
(Single) software program
Features for:
program editor/writing/editing
translation // interpreter/compiler
testing program code // observe outputs 2 points to score

Challenge 13: A program design is to be amended. The value input by the user for the ticket type is to be validated. Part of the amended flowchart is shown below.



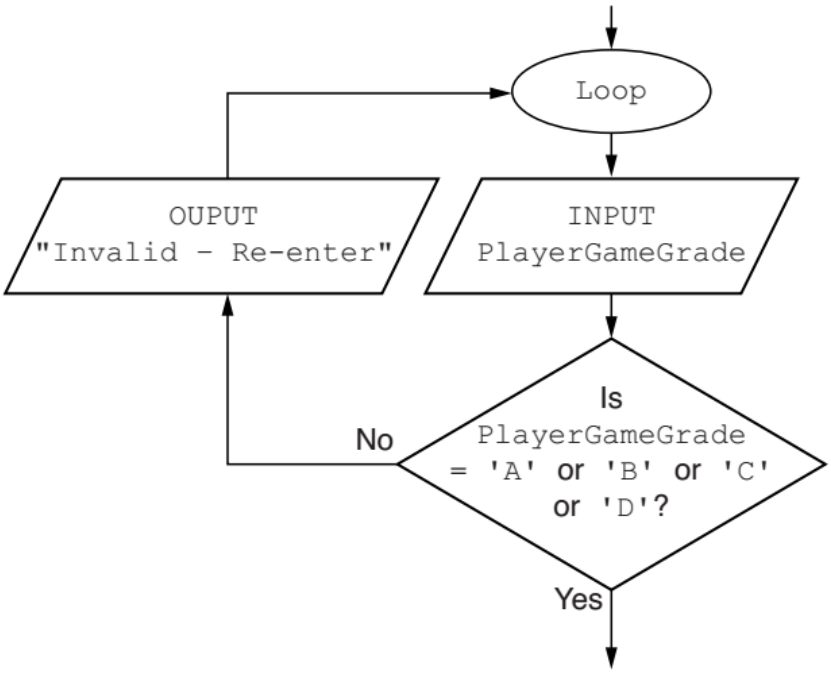
Write **pseudocode** to use a pre-condition loop for this validation.

```
INPUT TicketType
WHILE TicketType<>”E” OR TicketType<>”S”
        INPUT TicketType
ENDWHILE
```

Or

```
INPUT TicketType
WHILE NOT (TicketType = 'E') OR (TicketType = 'S')
    INPUT TicketType
ENDWHILE
```

Challenge 14 The programmer amends the design to validate the value of player game grade that the user inputs.
The amended part of the flowchart is shown below.



Write the equivalent **pseudocode** using a pre-condition loop, for this part of the amended flowchart.

```
INPUT PlayerGameGrade
WHILE PlayerGameGrade <> 'A' ORPlayerGameGrade<> 'B' OR
      PlayerGameGrade <> 'C' ORPlayerGameGrade <> 'D')
      OUTPUT "Invalid – Re-enter"
      INPUT PlayerGameGrade
ENDWHILE
```

Or

```
INPUT PlayerGameGrade
WHILE NOT(PlayerGameGrade = 'A' ORPlayerGameGrade = 'B'
          ORPlayerGameGrade = 'C' ORPlayerGameGrade = 'D')
      OUTPUT "Invalid – Re-enter"
      INPUT PlayerGameGrade
ENDWHILE
```

Challenge 15 A marathon runner records their time for a race in hours, minutes and seconds.
An algorithm is shown below in structured English.

INPUT race time as hours, minutes and seconds
CALCULATE race time in seconds
STORE race time in seconds
OUTPUT race time in seconds

(a) The identifier table needs to show the variables required to write a program for this algorithm.
Complete the table.

Identifier	**Data type**	**Description**
RaceHours	INTEGER	The hours part of the race time.

Identifier	*Data Type*	*Description*
RaceHours	*INTEGER*	*The hours part of the race time*
RaceMinutes	*INTEGER*	*the minute part of the race time*
RaceSeconds	*INTEGER // REAL*	*the seconds part of the race time*
RaceTime	*INTEGER // REAL*	*the race time in seconds*

Challenge 16 Computer programs have to evaluate expressions.
Study the sequence of pseudocode statements.
Give the value assigned to each variable.
The statement may generate an error. If so, write ERROR.
The & operator is used to concatenate strings.

```
DECLARE N1 : INTEGER
DECLARE N2 : INTEGER
DECLARE Answer : REAL
DECLARE Found : BOOLEAN
DECLARE IsValid : BOOLEAN
N1 ← 3
N2 ← 9
Answer ← (N1 + N2) / 6
Answer ← 3 * (N1 – 2) + N2 / 2
IsValid ← (N1 > N2) AND (N2 = 9)
Found ← FALSE
IsValid ← (N1 > N2 / 2) OR (Found = FALSE)
Answer "1034" & " + " & "65"
```

Give the value assigned to each variable
(i) Answer ..... [1]
(ii) Answer ..... [1]
(iii) IsValid ..... [1]
(iv) IsValid ..... [1]
(v) Answer ..... [1]
(i) Answer = 2 [1]
(ii) Answer = 7.5 [1]
(iii) FALSE [1]
(iv) TRUE [1]
(v) ERROR [1]

Challenge 16 Computer programs have to evaluate expressions.
Study the sequence of pseudocode statements.
Give the value assigned to each variable.
The statement may generate an error. If so, write ERROR.
The & operator is used to concatenate strings.

DECLARE N1 : INTEGER
DECLARE N2 : INTEGER
DECLARE Answer : REAL
DECLARE Found : BOOLEAN
DECLARE IsValid : BOOLEAN
N1 ← 3
N2 ← 9
Answer ← (N1 + N2) / 6
Answer ← 3 * (N1 – 2) + N2 / 2
IsValid ← (N1 > N2) AND (N2 = 9)
Found ← FALSE
IsValid ← (N1 > N2 / 2) OR (Found = FALSE)
Answer "1034" & " + " & "65"

Challenge 17 Show what type of programming construct each statement represents.
Complete the table by putting a tick (✓) in the appropriate column for each item.

Item	Statement	Selection	Iteration	Assignment
1	MyScore = 65			
2	FOR IndexVal = 0 TO 99			
3	MyArray[3] = MID(MyString,3,2)			
4	IF MyScore >= 70 THEN			
5	ENDWHILE			
6	ELSE Message = "Error"			

Challenge 17 Show what type of programming construct each statement represents.
Complete the table by putting a tick (✓) in the appropriate column for each item.

Item	Statement	Selection	Iteration	Assignment
1	MyScore = 65			✓
2	FOR IndexVal = 0 TO 99		✓	
3	MyArray[3] = MID(MyString,3,2)			✓
4	IF MyScore >= 70 THEN	✓		
5	ENDWHILE		✓	
6	ELSE Message = "Error"	✓		✓

Challenge 18 Show what type of programming construct each statement represents.
Complete the table by putting a tick (✓) in the appropriate column for each item.

Item	Statement	Selection	Iteration	Assignment
1	WHILE DegF > 37.5			
2	MyName = "Gordon"			
3	DegF = INT(DegF)			
4	ENDIF			
5	CASE OF MyFavourite			
6	UNTIL x = 5			

Item	Statement	Selection	Iteration	Assignment
1	WHILE DegF > 37.5		✓	
2	MyName = "Gordon"			✓
3	DegF = INT(DegF)			✓
4	ENDIF	✓		
5	CASE OF MyFavourite	✓		
6	UNTIL x = 5		✓	

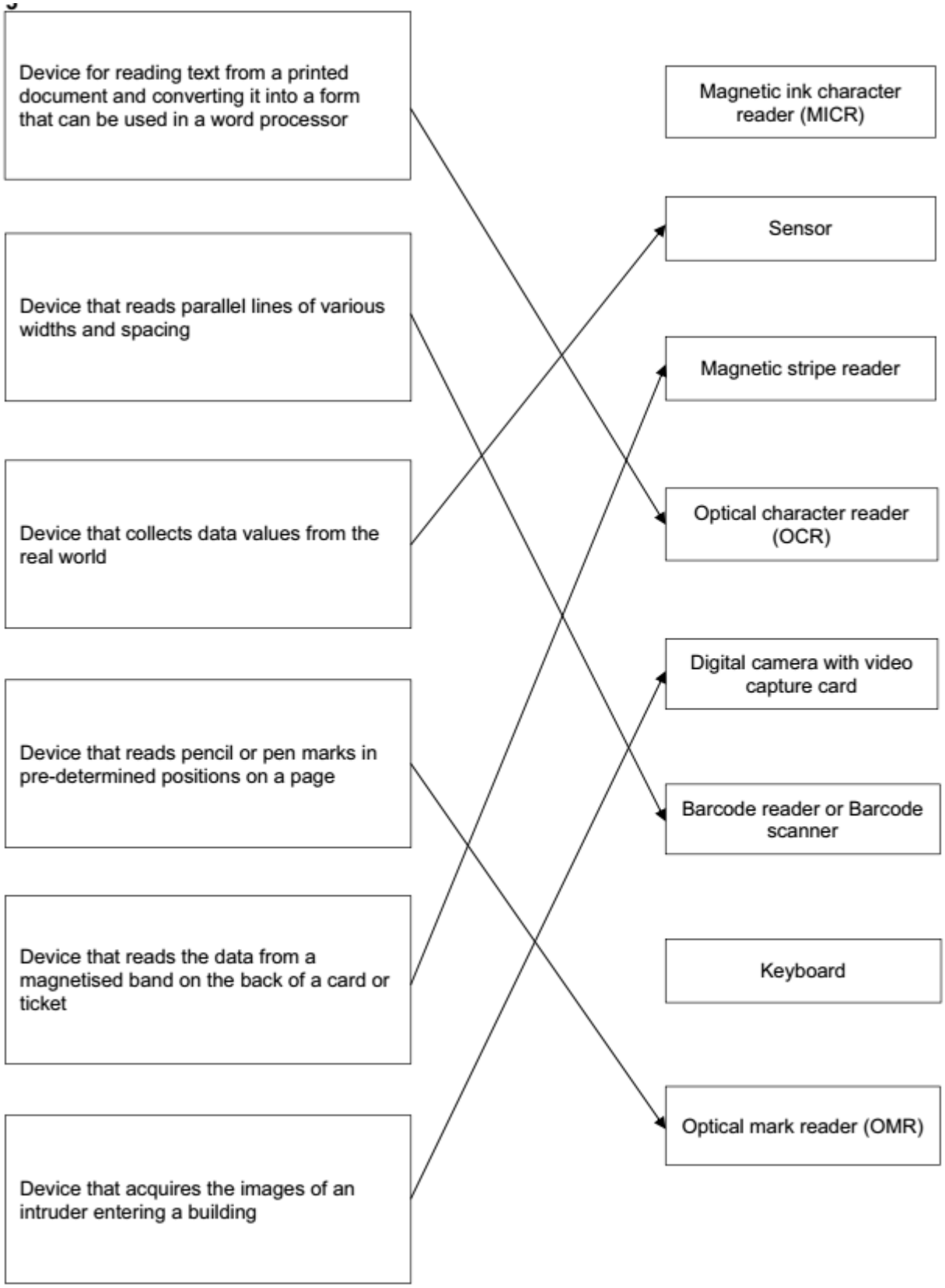
Challenge 19: Computer systems often use several types of storage. This storage is both primary and secondary.
(a) State a use for each of the storage devices shown below.
RAM .....
.....
.....
ROM .....
.....
.....
Hard disk drive .....
.....
.....
Optical storage device .....
.....
.....[4]
(b) Another type of storage device is a solid state drive (SSD).
Give **four** advantages of using an SSD when compared with using a hard disk drive.
1 .....
.....
.....
2 .....
.....
.....
3 .....
.....
.....
4 .....
.....
.....[4]

Challenge 19: (a)
RAM
– stores data/applications/programs software/files/OS currently in use
ROM
– stores BIOS/start-up/files that cannot be altered
Hard disk drive
– stores applications/programs software/user's files //
– stores data/user files/programs when the computer is turned off
Optical storage device
– stores data/or by example – photos/music/files / software that can be transferred between computers any sensible example
– stores applications to be installed
(b) Any four from: [4]
– lightweight/more compact

– no moving parts (so more robust)
– don't have to wait for device to "reach operating speed"/no latency time
– lower power consumption
– doesn't produce a lot of noise/heat
– much higher data access speed
– not affected by a magnetic field
– does not need to be defragmented (to maintain high data transfer rate)Faster is not enough.

Challenge 20: Six statements and eight input devices are shown below.
Draw a line to link each statement to the correct input device.

Statement	Input Device
Device for reading text from a printed document and converting it into a form that can be used in a word processor	Magnetic Ink Character Reader (MICR)
Device that reads parallel lines of various widths and spacing	Sensor
	Magnetic stripe reader
Device that collects data values from the real world	
	Optical Character Reader (OCR)
Device that reads pencil or pen marks in pre-determined positions on a page	Digital camera with video capture card
	Barcode reader or Barcode scanner
Device that reads the data from a magnetised band on the back of a card or ticket	
	Keyboard
Device that acquires the images of an intruder entering a building	Optical Mark Reader(OMR)


Device for reading text from a printed document and converting it into a form that can be used in a word processor
Device that reads parallel lines of various widths and spacing
Device that collects data values from the real world
Device that reads pencil or pen marks in pre-determined positions on a page
Device that reads the data from a magnetised band on the back of a card or ticket
Device that acquires the images of an intruder entering a building
Magnetic ink character reader (MICR)
Sensor
Magnetic stripe reader
Optical character reader (OCR)
Digital camera with video capture card
Barcode reader or Barcode scanner
Keyboard
Optical mark reader (OMR)

Challenge 21:(a) A processor controls a heating system. To do this, it uses:
• a temperature sensor
• a device in which a small electrical input current switches a much larger current for the heater
The following steps, when put into the correct sequence, describe how to switch on the heater. Put the steps into the correct sequence using the numbers 1 to 5.
[4]

Step	Sequence #
Sensor reading is sent to the microprocessor	
Microprocessor checks sensor reading against stored temperature value	
Temperature reading is taken by the analogue sensor	
If the sensor reading is less than the stored value, the microprocessor sends a signal to switch on the heater	
Sensor reading is converted into a digital value using an ADC	

(b) Name a suitable sensor for each of the following applications.
State what the sensor detects in each case.
(i) Intruder detection system
Sensor .....
Reason for choice .....
.....
.....[2]
(ii) Switching on a street lamp when it gets dark.
Sensor .....
Reason for choice .....
.....
.....[2]
(iii) Counting people entering a building.
Sensor .....
Reason for choice .....
.....
.....[2]

Challenge 21

(a) A processor controls a heating system. To do this, it uses:
• a temperature sensor
• a device in which a small electrical input current switches a much larger current for the heater
The following steps, when put into the correct sequence, describe how to switch on the heater. Put the steps into the correct sequence using the numbers 1 to 5. [4]

Step	Sequence #
Sensor reading is sent to the microprocessor	**3**
Microprocessor checks sensor reading against stored temperature value	**4**
Temperature reading is taken by the analogue sensor	**1**
If the sensor reading is less than the stored value, the microprocessor sends a signal to switch on the heater	**5**
Sensor reading is converted into a digital value using an ADC	**2**

(b) Name a suitable sensor for each of the following applications.
State what the sensor detects in each case.
(i) Intruder detection system

Sensor *Reason*
microphone *can detect sound of footsteps, breaking glass, …. [2]*
acoustic *can detect sound of footsteps, breaking glass, ….*
infra-red *detects movement (broken beam) or heat change*
pressure *detects weight of person entering building*
magnetic *detects if a door / window has been opened*

(ii) *Switching on a street lamp when it gets dark.*

Sensor .Light
Reason for choice detects level of ambient light (not "when it gets dark")

(iii) *Counting people entering a building.*

Sensor *Reason for choice*
proximity *detects movement*
infra-red *each time person breaks beam*
pressure *each time person steps on pressure pad*

Challenge 22:

The ISP advertises a download speed of 80 Mbits/second.
(i) State the number of Mbytes/second this is equivalent to.
.....[1]
(ii) Calculate the time taken to download an 80 Mbyte file.
.....
.....[1]
The business complains to the ISP that the actual download speed is only 0.8 Mbits/second.
(iii) Calculate the time taken to download the same 80 Mbyte file.
.....
.....[1]
(iv) Suggest one reason why the download speed is lower than advertised.
.....
.....[1]

Marking Scheme

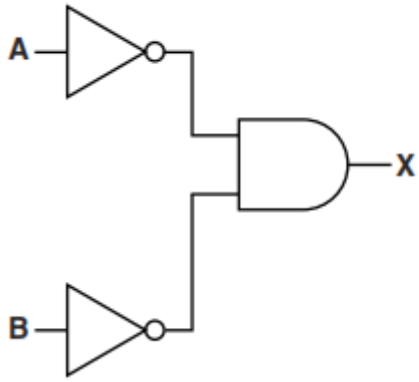
(i) 10 [1]
(ii) 8 seconds [1]

(iii) 800 seconds [1]
(iv) Any one from: [1]
– over-capacity on network lines
– computer virus (sending out spurious messages)
– cabling/modem/filter fault
– connection uses copper cable which is a distance from the main telephone switch

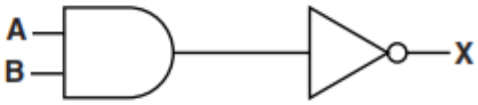
Challenge 23:

For each circuit below, state the equivalent single logic gate.

Circuit 1



Circuit 2



Circuit 1 .....
Circuit 2 .....[2]

Marking Scheme

Circuit 1 – NOR gate [2]
Circuit 2 – NAND gate

Challenge 24

An airport car park is made up of 5 rows, each with 8 bays. When a car enters the car park, a computer system captures its registration plate (number plate) data. The computer system is able to determine the row and bay in which the car is parked.

(a) Outline a suitable method for capturing the registration data of each car.
.....
.....
.....
.....[2]

(b) When a customer wants to leave the car park with their car, they enter their registration plate data at a ticket machine.
The machine calculates and displays the parking fee and the location of the car (for example row 5, bay 4).

(i) Name a suitable device to enter the car registration and display the location of the car.
.....[1]

(ii) Describe how the computer system can calculate the parking fee.
.....
.....
.....
.....[2]

Marking Scheme

(a) [2]
– use of digital video or digital still camera

– use of optical character recognition (software)
– compare the symbols with a library of characters.
(b) (i) touchscreen [1]
(ii) Any two from: [2]
– on entry to car park, date and time stored (e.g. value X)
– on paying the fee, new date and time stored (e.g. value Y)
– computer calculates (Y – X)
– and multiplies number of hours by car park tariff

Challenge 25:

A student wrote the following five statements on a computing exam paper.
Explain why each statement is incorrect.

(i) ***"Backing up data on a pen drive always allows a user to recover data in the event of data loss caused by a virus."***

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

(ii) ***"A stack data structure operates on the first-in, first-out principle and is controlled by two pointers."***

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

(iii) ***"The two bytes 0 1 0 0 1 1 0 0 and 0 1 1 0 1 1 1 0 both have even parity since their denary values, 76 and 110, are even."***

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

(iv) ***"Broadband is a method of communication which is digital in nature; it uses a single channel that uses the entire bandwidth of the medium."***

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

Marking Scheme

Challenge 25:A student wrote the following five statements on a computing exam paper.
Explain why each statement is incorrect.

(i) ***"Backing up data on a pen drive always allows a user to recover data in the event of data loss caused by a virus."***

– backed up data/files may already have a virus
– so recovery procedure may re-infect computer *[2]*

(ii) ***"A stack data structure operates on the first-in, first-out principle and is controlled by two pointers."***

(iii) Any two from: [2]
– a stack operates on 'first-in, last-out'
– a stack requires only one pointer
– this is a description of a queue *[2]*

(iii) ***"The two bytes 0 1 0 0 1 1 0 0 and 0 1 1 0 1 1 1 0 both have even parity since their denary values, 76 and 110, are even."***

(iii) Any two from: [2]
– both binary numbers have odd number of 1s (and 0s)
– so they must both have odd parity
– even / odd (denary) values have no bearing on the parity

(iv) ***"Broadband is a method of communication which is digital in nature; it uses a single channel that uses the entire bandwidth of the medium."***

(iv) Any two from: [2]
– broadband sends data as analogue
– each transmission is assigned only a portion of the bandwidth
– allowing multiple transmissions at the same time across the media
– description given is that of baseband [2]

(v) Any two from: [2]
– ROM is read only
– buffers use RAM memory
– buffer contents always changing / buffers store data temporarily .[2]

PATEL