

Computer Science 2210/12 Guess Paper, 2019

**Questions and Answers
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O/A Computer Science

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Input Devices/Output Devices

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

- (i) 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

- (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



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- Q. 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.



Input Device to Description
3/4 matches – 3 marks
2 matches – 2 marks
1 match – 1 mark

Description to Application
3/4 matches – 3 marks
2 matches – 2 marks
1 match – 1 mark



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- Q.** (a) An airport uses electronic devices as part of its security systems.
One system matches the face of a passenger with the photograph in their passport.
What two input devices would be needed to do this? Give reasons for your choice of device.
- (b) When the passenger goes to the check-in desk, their luggage is weighed.
- (i) How does the computer system capture the luggage weight? How does it Then check that it does not exceed the airline's weight limit?
- (ii) The computer also prints out a label identifying passenger ID, flight number and destination. This label, which is tied onto the luggage, is computer readable.
Describe a suitable data capture system which could be used to read these labels so that the luggage can be tracked.
- (a) 1 mark for name of device + 1 mark for reason
scanner
to produce an electronic/digital map version of the passport photograph
(scans) into computer readable format
digital camera/video camera
to produce an electronic image of the passenger's face
produces a similar format to the scanned image
- (b) (i) 1 mark for each point
use of a pressure sensor
sends data back to computer system
need for conversion to digital form (ADC)
computer calculates weight based on sensor data
this calculated value is compared / (or equivalent) to stored values
sends weight back to a small screen at check-in

if weight exceeds airline limit, operator warned at check-in by, e.g.,
flashing screen or
beeping sound / if weight below limit luggage accepted [3]
- (ii) 1 mark per point
(labels printed in form of) a barcode
barcode is unique
use of barcode reader/scanner
barcode is used as a key field in passenger record
barcode read at each stage
... and this data is stored in passenger record
thus allowing tracking/whereabouts of luggage at any stage



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- Q. Name a suitable hardware device to enable automatic data capture in each of the following applications. Each device must be different.

5 1 mark for each correct device

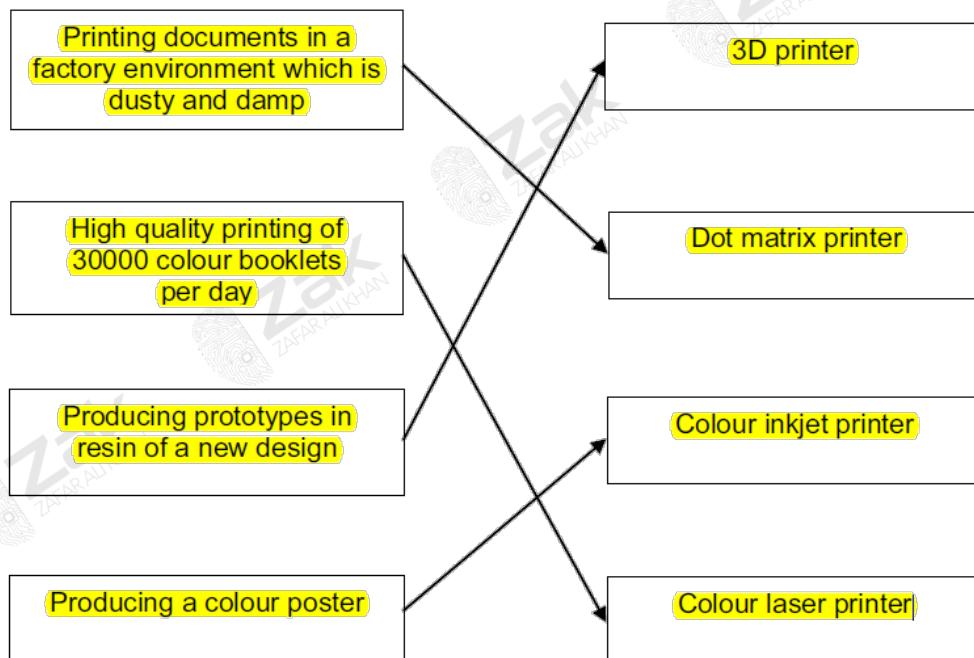
application	hardware device
automatic stock control system in a supermarket	barcode reader/scanner/EFTPOS terminal
keeping track of the live stock on a large farm	barcode/RFID/microchip reader
input data into a computer using speech recognition	microphone

- Q. A list of four printers and four different applications which use printers is shown below.

(a) Using arrows, link each printer to the most appropriate application.

[3]

4 (a)

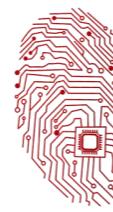


[4]



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- Q.** The following table shows FOUR applications which require specialist INPUT devices.
For EACH application, suggest ONE possible INPUT device and give a reason for your choice.

5

Application	Input Device	Reason for choice of device
Virtual reality application	<ul style="list-style-type: none"> — data gloves — data goggles — sensor suits 	<ul style="list-style-type: none"> — allows user to interact with v/r system directly — system needs to get data directly from its surroundings
Disabled person communicating with a computer system	<ul style="list-style-type: none"> — microphone — head wand — large keyboard 	<ul style="list-style-type: none"> — allows blind person to dictate text directly to the computer — if little hand movement, allows user to select options from the screen — people with poor eye sight can use the keyboard to input text
Automatic stock control system at a supermarket	<ul style="list-style-type: none"> — bar code reader — RFID tag reader 	<ul style="list-style-type: none"> — automatically reads data — fewer data entry errors
Information kiosk at an airport using a GUI interface	<ul style="list-style-type: none"> — touch screen — trackball 	<ul style="list-style-type: none"> — easier for the customers — reduces the number of possible options for the user — select options from a screen — immovable/more secure

*May see other devices e.g. Kimball tag reader
NOT mouse, NOT keyboard*

[8]

- Q.** Describe the difference between speech recognition and speech synthesis. [2]

3 Two points one from each group:

speech recognition is a form of input;

speech recognition requires a microphone;

speech recognition is an example of an expert system

speech synthesis is a form of output

speech synthesis requires speakers

in speech synthesis words are chosen from a database

[2]



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- Q.** Describe three ways you could modify a typical input/output environment to enable people with disabilities to use the computer system. [3]

12 Any three points from: (NB if disability mentioned, shouldn't conflict with method/device)

large/concept keyboards/switches

braille keyboards (for partially sighted/blind)

tracker ball to move pointer if keyboard/mouse can't be used

touch screens (using head wands)

software to predict words (e.g. for dyslexic people)

speech recognition

foot activated control (if no arm movement)

large icons/fonts on screens (– if partially sighted)

braille printers

speech synthesis speakers = 0

large screen

choice of colours

[3]

- Q.** A cinema (movie theatre) uses automatic machines to allow customers to select tickets for movie shows.
Payments are made by credit or debit card.

(a) Identify **two** input devices which could be used by the cinema.

For **each** device, describe what it is used for.

input device 1

use

input device 2

use

(b) Identify **two** output devices which could be used by the cinema.

For **each** device, describe what it is used for.

output device 1

use

output device 2

use

9 (a) 1 mark for input device + 1 mark for its matching use

input device: touch screen

use: select film / cinema seats / price

input device: keyboard / keypad

use: input number of tickets / card PIN

input device: magnetic stripe reader / chip and PIN reader / card reader

use: reading credit / debit card details

input device: scanner

use: to read any promotional vouchers (etc.)

[4]

(b) 1 mark for each different output device + 1 mark for its matching use

output device: screen / monitor

use: show films available / seating plan / prices of each seat / payment details

output device: printer

use: print receipt / tickets

output device: loudspeaker / beeper

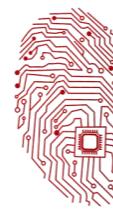
use: to indicate error in input / confirmation of keys pressed

[4]



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- Q.** A digital camera contains a microprocessor. The camera's specification includes:
- 20 megapixel resolution
 - 32 gigabyte memory card
 - autofocus facility
- (a) A more expensive model of the camera has 40 megapixel resolution.
- (i) Describe **one** advantage of increasing the resolution.
- (ii) Describe **one** disadvantage of having 40 megapixel resolution.
- (iii) What is the meaning of the term pixel?
- (iv) Apart from autofocus, describe **one** other feature you would expect to see on a digital camera controlled by a microprocessor.
- (a) (i) – higher quality photos
 - when “blown up” less likely for photo to “pixelate”
- (ii) – uses up more memory (on card)
 - takes longer to upload/download a photo
 - file size will be greater
- (b) (i) – solid state memory
 - flash drive
 - non-volatile
- (ii) – no moving parts (so more robust)
 - can be removed from camera and retain its contents
 - can erase contents and reuse memory card
- (c) (i) – (pic)ture (el)ement
 - 819 or 1638 [1]
- (d) Any one point from: e.g.
 - auto flash
 - anti (hand) shake facility
 - easy deletion of unwanted photos
 - ability to “manipulate” images after they have been taken/special effects
 - “smart” operation e.g. automatically pick out objects, faces, etc.
 - auto capture



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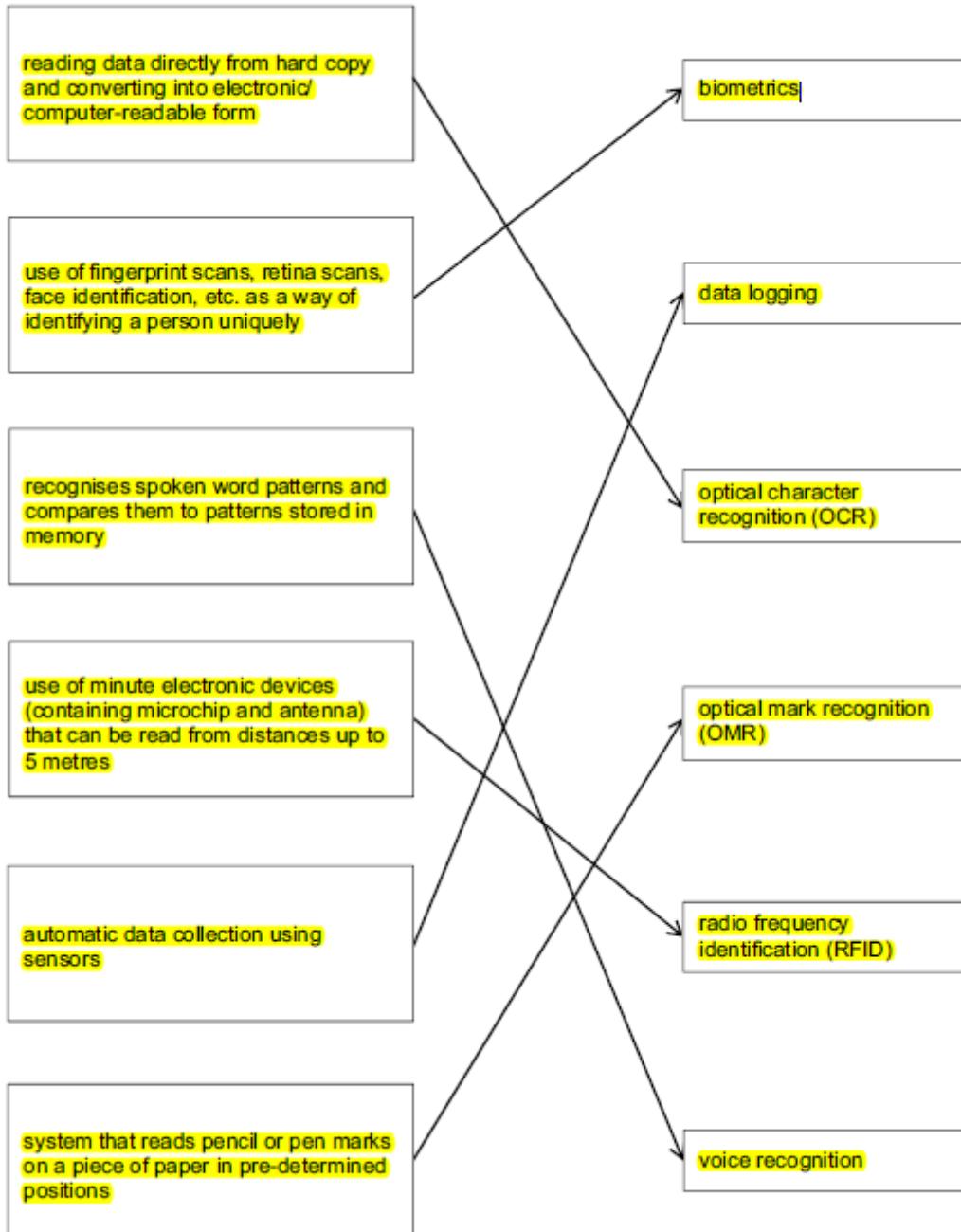
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- Q.** The following diagram shows six descriptions of automatic data capture methods and six terms. Draw lines to connect each description to the correct term.

6 1 mark for each correct link up to maximum of 5 marks



[5]



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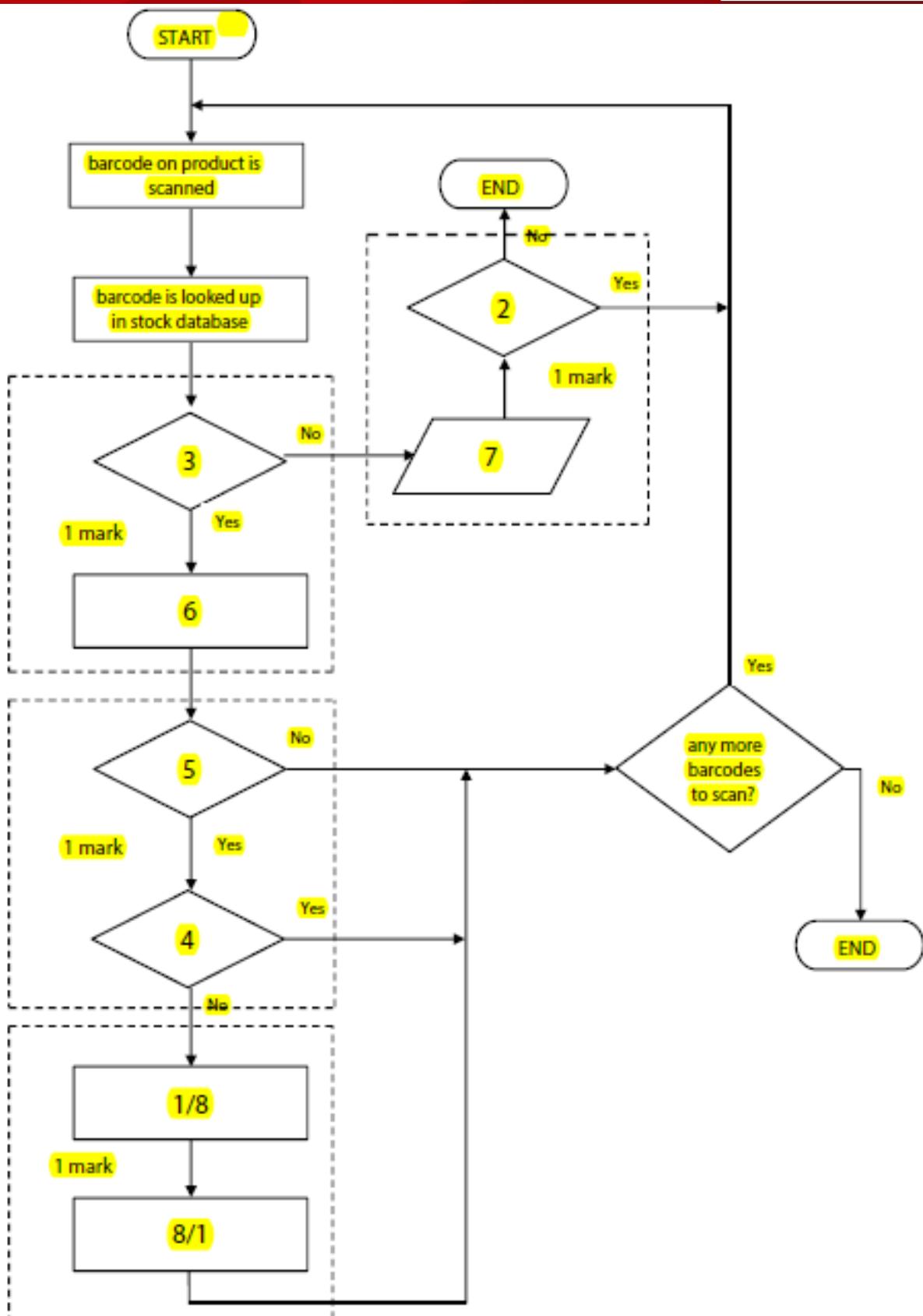
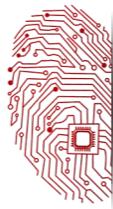


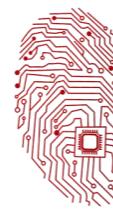
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- Q. The flowchart on the opposite page shows what happens when the barcode on a product is scanned at the checkout in a supermarket. The barcodes are used in an automatic stock control system. Several of the statements in the flowchart are missing.
Using item number only from the list below, complete the flowchart. [5]

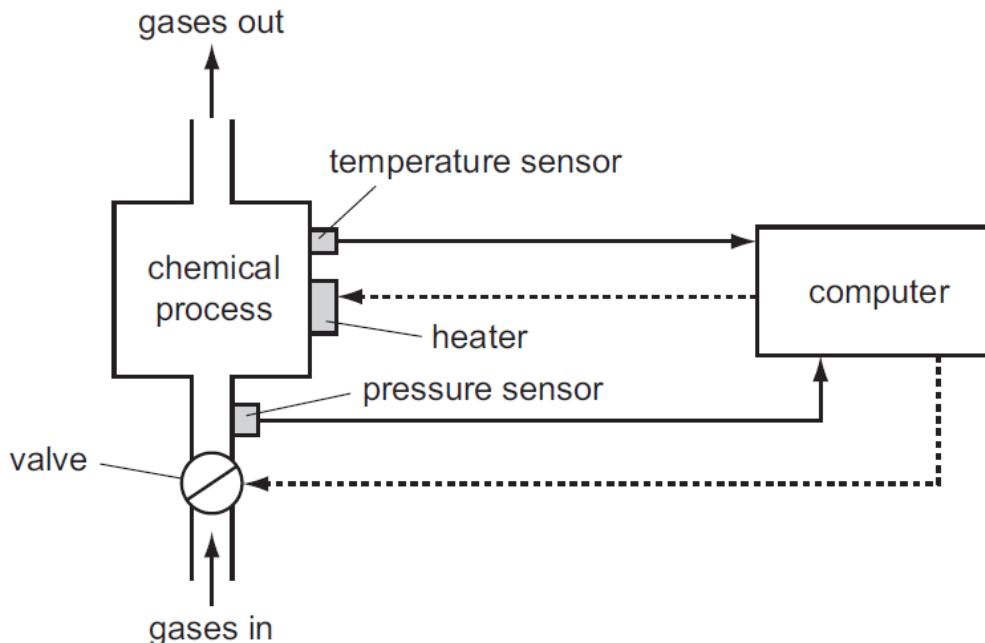
Item number	Statement
1	Add flag to product record to indicate re-order made
2	Any more barcodes to scan?
3	Has the scanned barcode been found in the file?
4	Has the re-order flag already been added to the product record?
5	Is number of product in stock \leq re-order level?
6	Number of product in stock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







Q. A computer system is being used to monitor and control a chemical process.

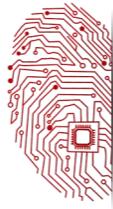


- (a) Data are collected from sensors at regular intervals and compared with stored values.
- (i) Describe how the computer uses this data when monitoring the chemical process. [1]
- (ii) Describe how the computer uses this data when controlling the chemical process. [1]
- (b) What steps are necessary for the computer to control the temperature of the chemical process? [3]
- (c) Name two other sensors and give a different application where they are used.
- (a) Any two from:
- (i) monitoring
- decide if the temperature/pressure are out of range
 - give a warning if out of range/doesn't change the process parameters
- [1]
- (ii) control
- send signal to open/close valve, switch on/off a heater etc.
 - output affects the input
- [1]
- (b) Any three from:
- data from temperature/pressure sensor...
 - ...changed into digital by ADC
 - data is sent to computer
 - data/input is compared to values in memory
 - if temperature too low, signal sent to heater...
 - if pressure too low, signal sent to valve...
 - and heater turned on valve opened
 - use of DAC
 - use of actuators
 - monitoring/control system continues to loop indefinitely
- [3]



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(c) 1 mark for each sensor + 1 mark for each related application

sensor

- light
- sound
- infra red
- moisture
- gas
- pH
- smoke
- motion sensor/accelerometer
- proximity

application

- greenhouse environment
- open/close automatic doors
- burglar alarm
- listening for sounds in pipes etc.
- burglar alarm
- detecting people (e.g. entering a building)
- greenhouse environment
- check if clothes dry in a drier
- detection of gas leaks
- soil acidity in greenhouse
- in buildings for fire detection
- vibrations in machinery
- parking cars

[4]

Q. Name a suitable sensor for each of the following applications.

Choose a different sensor in each application.

- (i) control of a central heating system
- (ii) operation of automatic doors
- (iii) detection of intruders
- (iv) monitoring of a greenhouse environment

A different sensor is needed for each application

[4]

- (i) central heating system
 - temperature sensor
- (ii) automatic doors
 - pressure sensor/pad
 - light sensor
 - infra red sensor
- (iii) detection of intruders
 - pressure sensor/pad
 - light sensor
 - infra red sensor
 - sound/acoustic sensor
- (iv) greenhouse monitoring
 - temperature sensor
 - moisture/humidity sensor
 - light sensor
 - pH sensor
 - CO₂/O₂ (levels) sensor

[4]



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- Q.** Monitoring of patients' vital signs (e.g. heartbeat) in a hospital is done automatically using sensors and computer hardware. Readings are shown on a screen both as a graph and as numbers.
- (a) Why are readings shown in both graphical and numerical form? [2]
- (a) Any two points from:
graphics allows trends to be shown
figures/numbers are easier to read
figures/numbers show actual values
both methods are used for different purposes [2]
- (b) When the heartbeat is being monitored, how does the system decide if the doctor/nurse needs to be warned of an abnormal reading? [1]
- (b) compare new value with stored value [1]
- (c) Give two advantages of using this type of automatic monitoring. [2]
- (c) Any two advantages from:
do not need nurse/doctor to be there all the time
quicker to pick up problem with patient's condition
easier to obtain trends/analysis
more accurate/less likely to make mistakes [2]
- (d) How does this monitoring system differ from a control system? [1]
- (d) Any one point from:
no output influencing the input
no equipment controlled (e.g. valves)
pure monitoring – makes no changes to system being monitored [1]
- Q.** (a) Name an application which makes use of the following sensors. A different application should be used in each case. [3]
- (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) 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]



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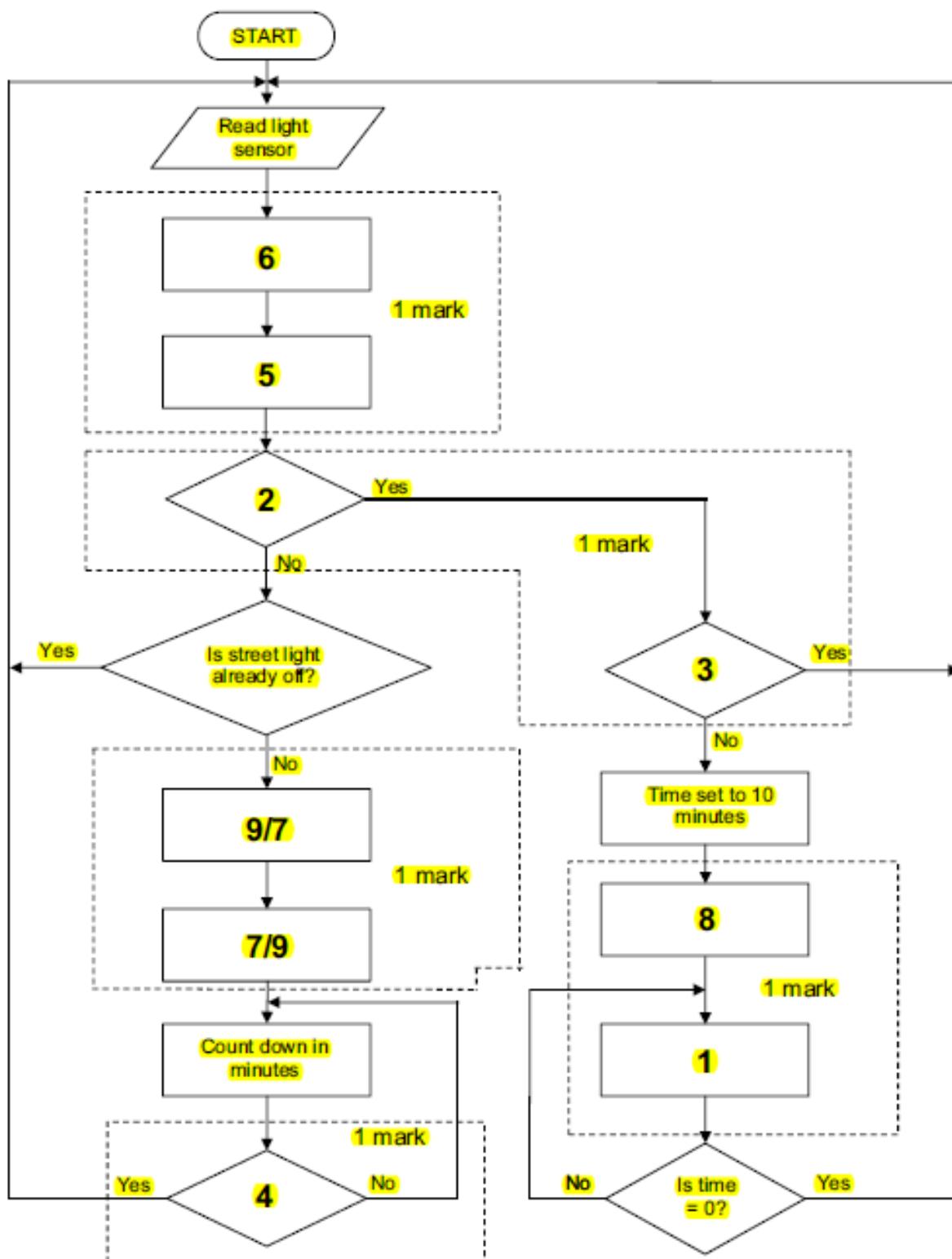
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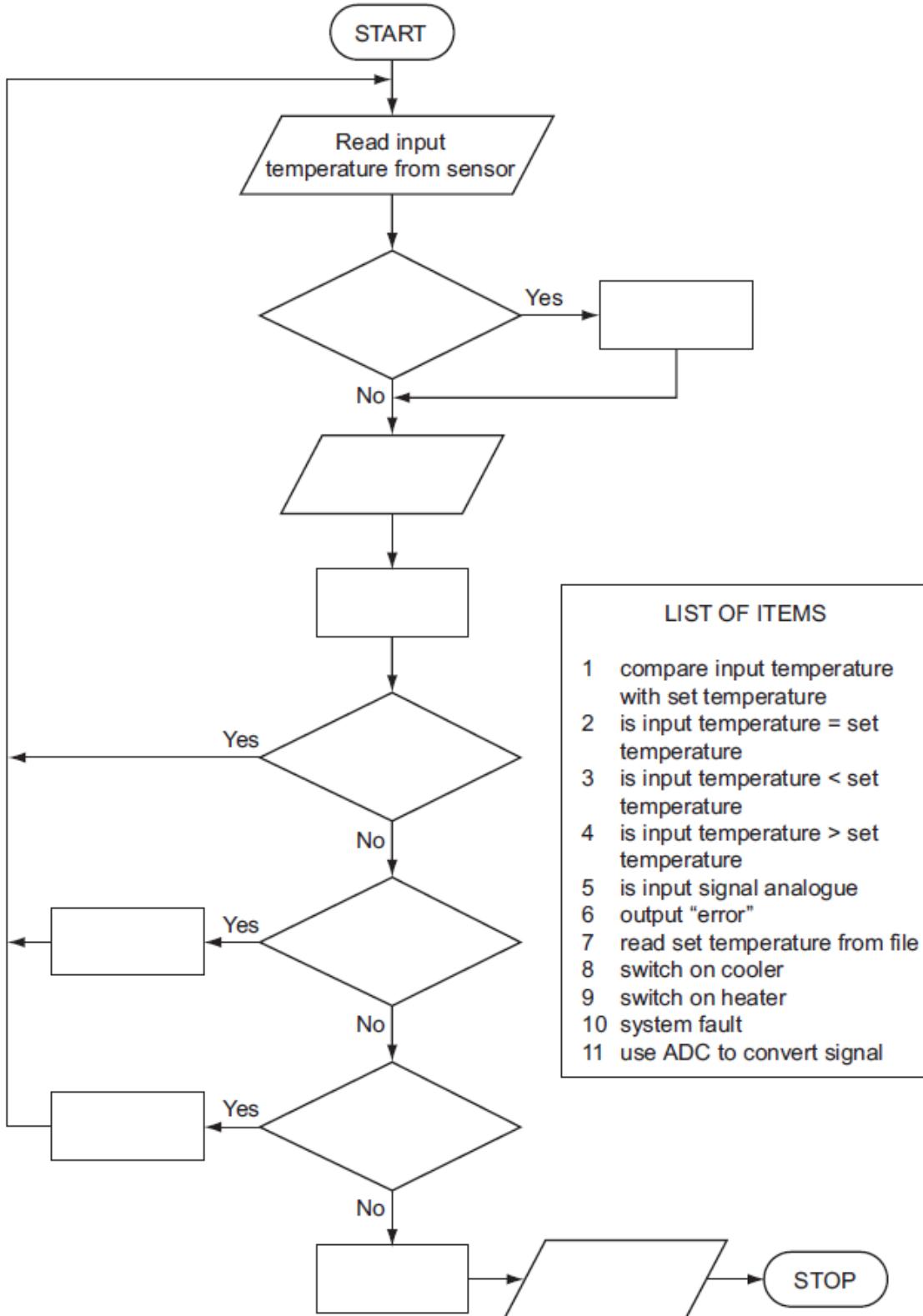
Item number	Instruction
1	Count down in minutes
2	Is light reading ≤ 50 ?
3	Is street lamp already on?
4	Is time = 0?
5	The microprocessor compares the sensor reading with stored values
6	The sensor reading is sent to the microprocessor
7	Switch the street lamp off
8	Switch street lamp on
9	Time set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





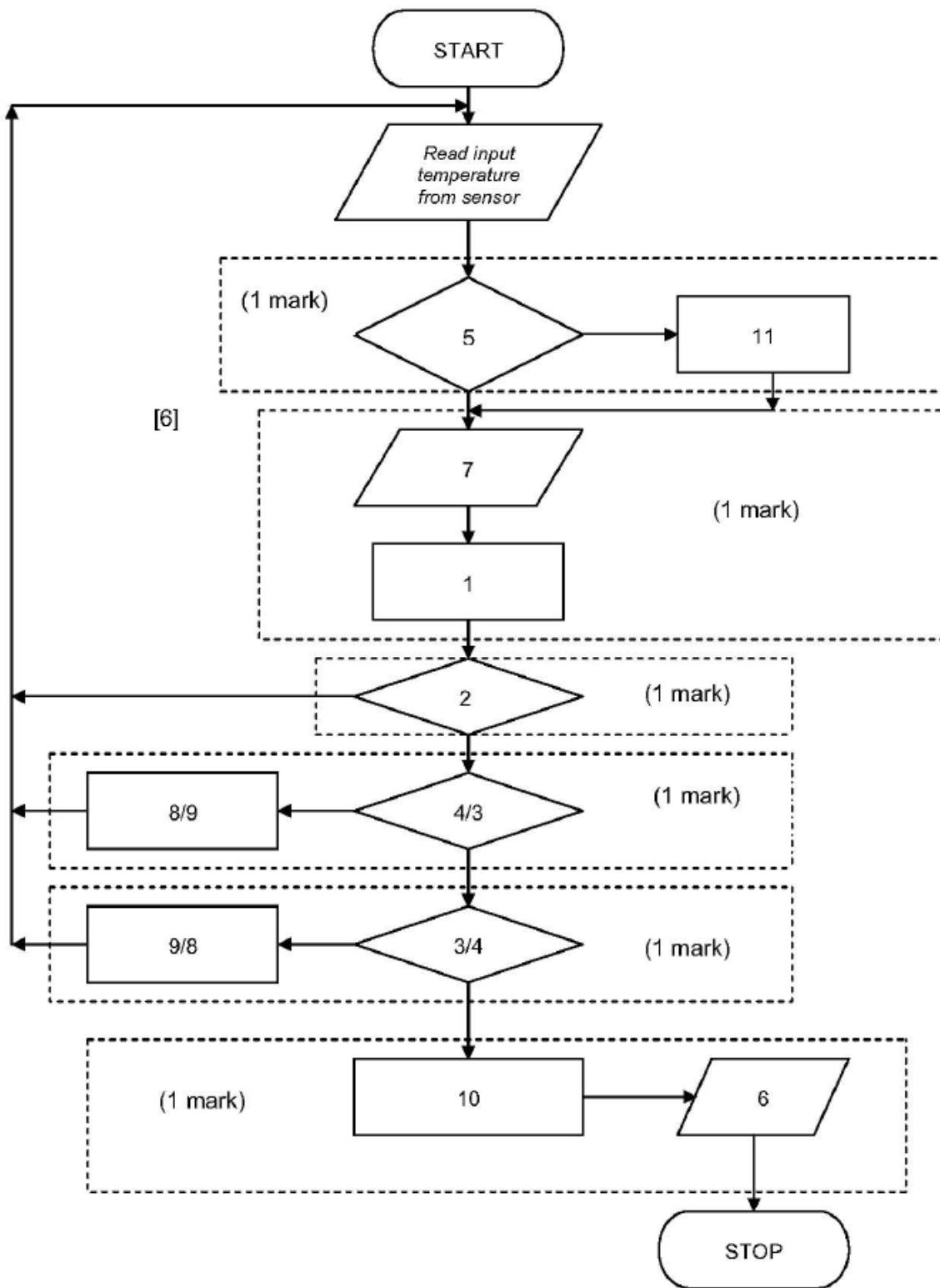


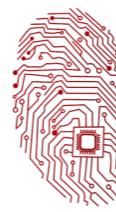
- Q.** The following flowchart shows how sensors (which can be analogue or digital) and a computer are used to control the temperature of a greenhouse for plants. Complete the flowchart using the items from the list below.



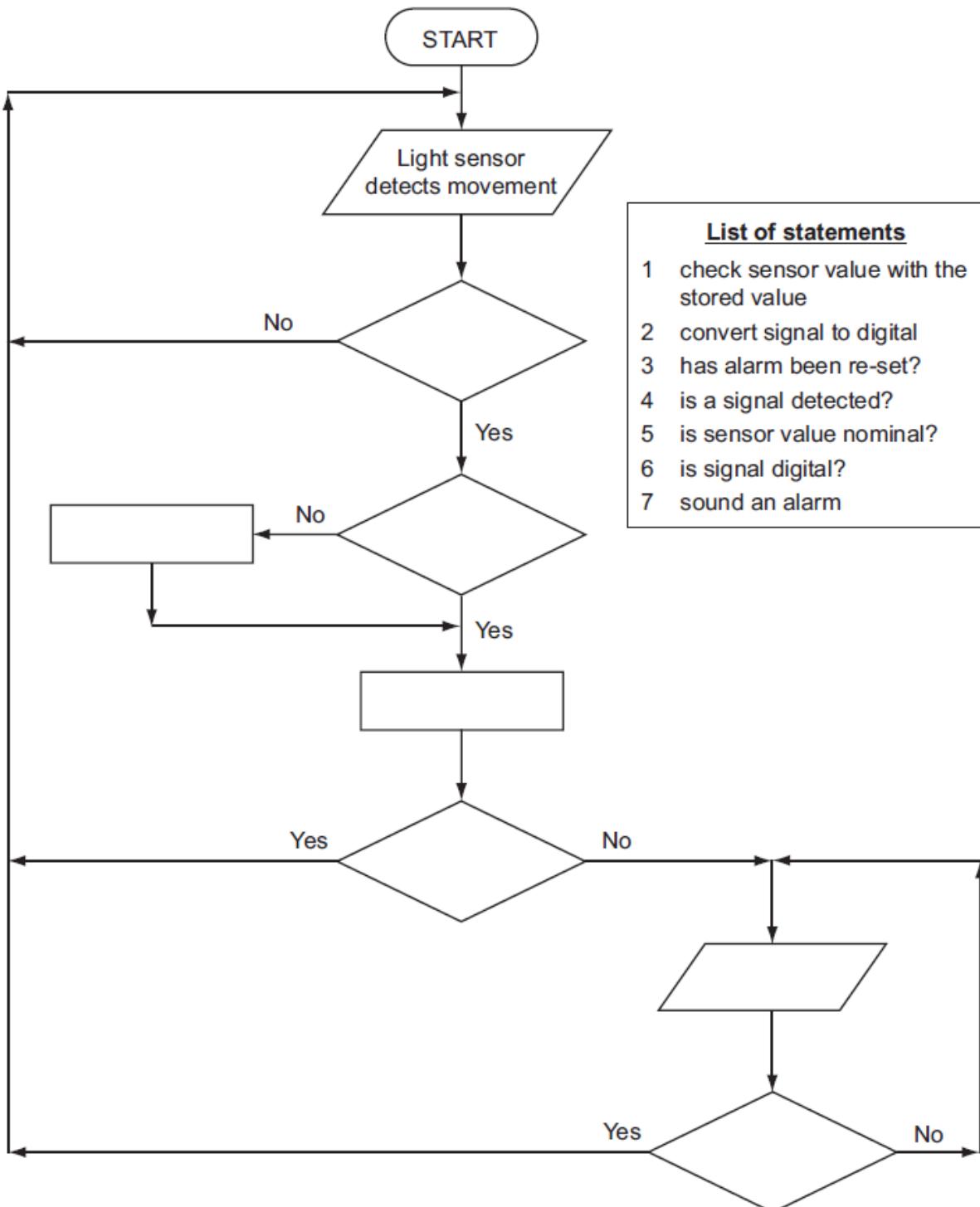


17



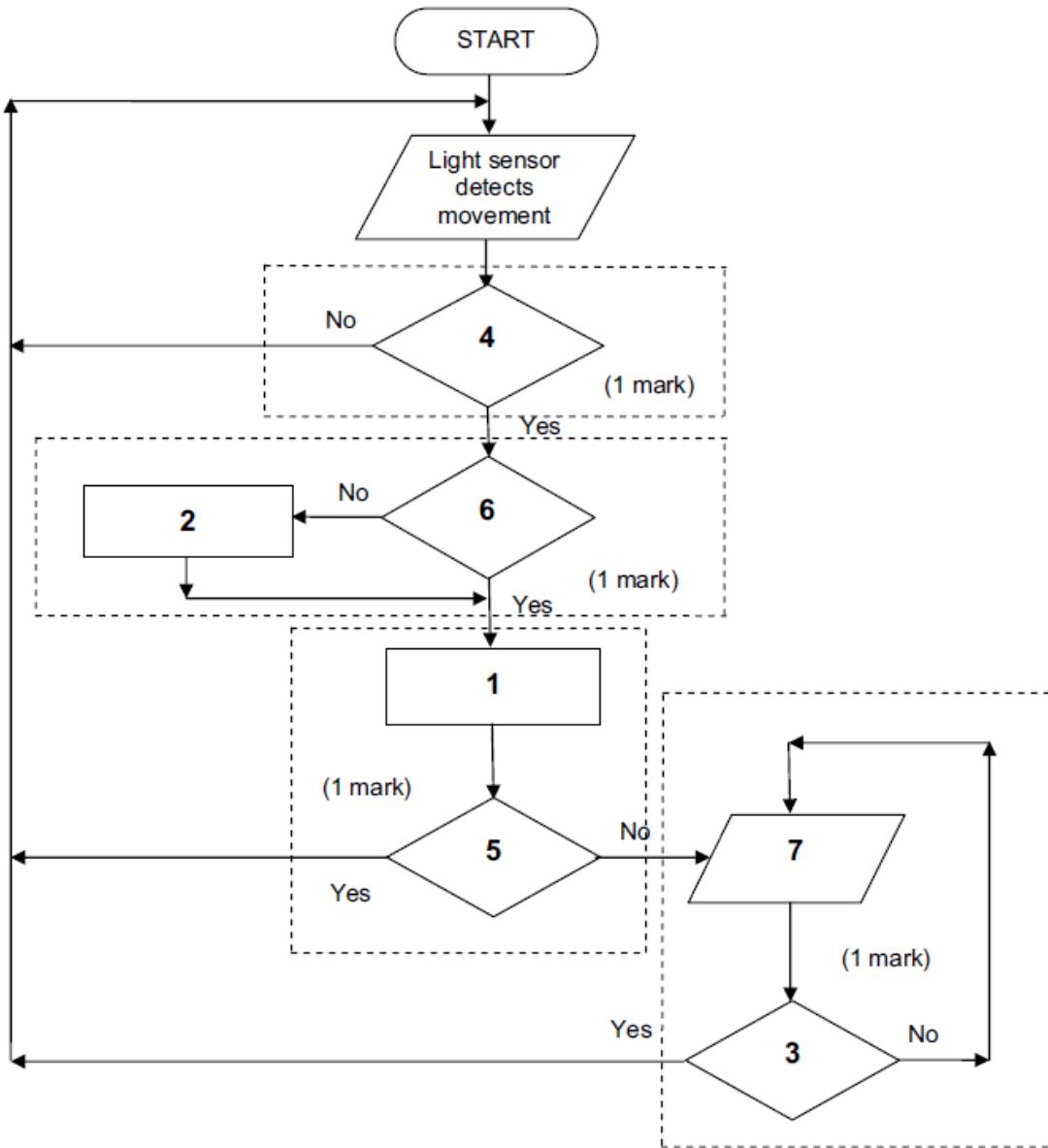


- Q.** The following flowchart shows how a burglar alarm system uses light sensors to determine if an intruder has entered the house and decides to sound an alarm.
Select statements from the list below, using numbers only, to complete the flowchart.





15 Award marks as shown below



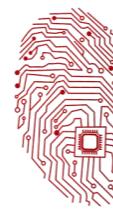
- 1** = check sensor value with stored value
- 2** = convert signal to digital
- 3** = has alarm been re-set
- 4** = is a signal detected?
- 5** = is sensor value normal?
- 6** = is signal digital?
- 7** = sound an alarm

[4]



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- Q.** (a) Sensors are one type of input device.

[3]

For each of the following situations, name a different sensor that could be used.

- (i) air conditioning in an office building
- (ii) maintaining correct growing conditions in a greenhouse
- (iii) detecting an intruder in a building

(b) Sensors are used to monitor seismic activity. At the end of each day, all the data retransmitted 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.

(a) answer requires a different sensor for each part, 1 mark for each part

(i) temperature/thermistor [1]

(ii) moisture, humidity, light/photodiode, temperature, pH [1]

(iii) sound/acoustic, infrared, pressure, motion, microwave [1]

(b) 1 mark for name + 3 marks for description

parity check

- uses even or odd parity which is decided before data sent

- each byte has a parity bit

- parity bit is set to 0 or 1 to make parity for byte correct

- after transmission, parity of each byte re-checked

- if it is different, then an error is flagged

- any reference to use of parity blocks/parity byte to (identify position of incorrect bit)

checksum

- a calculation is carried out on the data to be sent (checksum)

- the result is sent, along with data to recipient

- checksum is re-calculated at receiving end

- if both sums are the same, no error has occurred

- if the sums are different, the data has been corrupted during transmission

- request is sent to re-send data

[4]

- Q.** (a) 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

(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

[4]





- Q.** 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 fiber optic cable rather than transmitting the data over the local broadband network. [2]

(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 = $12 \times 60 \times 24 = 17280$
- memory requirement = $17280/1024 = 16.9$ (16.875)
- $(17\ 280/1000 = 17.28/17.3$ is acceptable)

(c) Any two from:

- (data transmission) is faster
- more secure/safer (because it is a dedicated line)
- (fibre optic transmission) is more reliable



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- Q.** Name the most suitable input or output device for each of the following uses.
Give a different device in each case.

Description of use	Input or output device
input of credit card number into an online form	Keyboard/keypad/numberpad
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. [2]

(ii) Describe one way of ensuring the security of the data against malicious damage. [1]

(b) (i) Any two from:

- 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

[2]

(ii) Any one from:

- 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

[1]





- Q. A computer system in a control room is used to monitor earthquake activity.
An earthquake zone has a number of sensors to detect seismic activity.
The system detects when seismic activity is greater than 3 on the Richter Scale. Whenever this happens, a printer in the control room prints a report.
- (i) Identify the steps that are required in this monitoring system. [4]
- (ii) When the system detects high activity, operators may need to respond rapidly. A printer is useful for hard copies, but may not be the best way to inform operators.
Give a reason why. [1]
- (iii) Name an alternative output device for this monitoring system and give a reason for your choice. [2]

Output device

Reason for choice

(i) any four from:

- sensors send signals / data to a computer
- data / signal converted to digital (using an ADC)
- computer calculates the activity value based on sensor signal strength / data
- if calculated value > 3,
- determine location of sensor
- build up a map of seismic activity
- location and magnitude sent to printer
- ... via USB port / wireless link
- monitoring is continuous

[4]

- (ii) - output / hard copy not picked up in good time** [1]

- (iii) 1 mark for name + 1 mark for reason for choice**

- speaker / buzzer / alarm bell
- gives control room operators an audible warning
- flashing lights
- gives control room operators an visual warning
- monitor
- use of red / flashing colours on monitor gets the attention of operators

[2]



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Q. (a) Describe how a laser mouse operates. [3]

- (a)
- laser/light shines onto a surface
 - through a (polished) ring at the base
 - the light is reflected from the surface through the ring
 - sensor detects reflected light
 - capturing details/photograph of surface (under the ring)
 - at about 1500 times per second
 - as the mouse moves the sensor detects changes in the surface detail/photograph
 - which are translated into movement (change of x and y co-ordinates)
 - the computer/software updates the position of the cursor on the screen

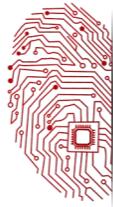
(b) The following table shows a list of five statements which describe the stages when a page is printed using an inkjet printer. Put each statement in the correct sequence by writing the numbers 1 to 5 in the right-hand column. [5]

Statement	Sequence number
Paper feed stepper motor activated; sheet of paper fed from paper tray	3
Printer driver translates data into a suitable format for the printer	1
The print head moves across page; ink is sprayed each time the print head pauses for a fraction of a second	4
Paper feed stepper motor advances paper a fraction of a cm after each complete head pass	5
Printer receives data from the computer and stores the data in the printer's buffer	2



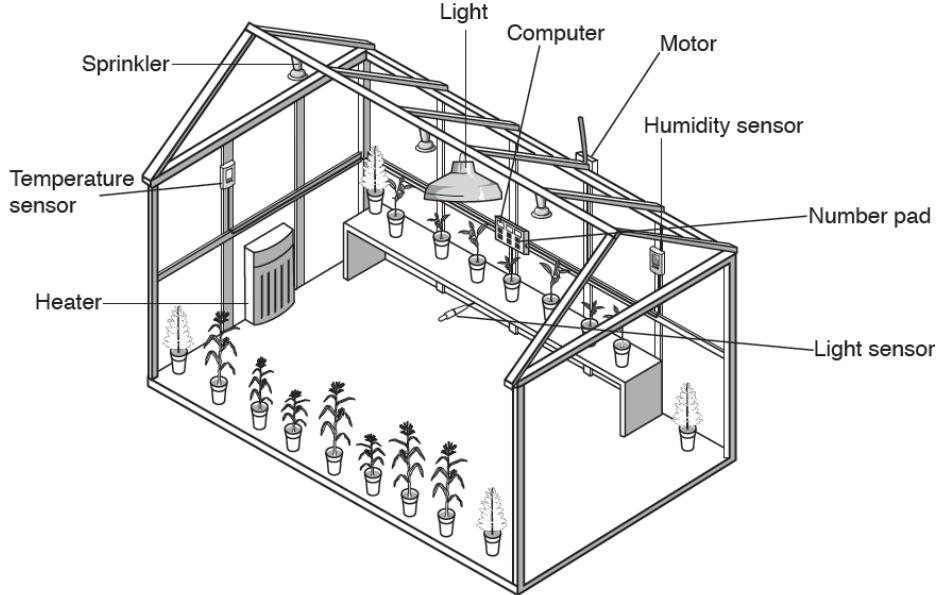
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- Q.** This diagram shows a computer controlled greenhouse.



- (a) Identify three input devices which are shown in the diagram above. [3]
(b) Identify three output devices which are shown in the diagram above. [3]
- (a) Three from: Temperature sensor Light sensor Humidity sensor Number pad [3]
(b) Three from: Sprinkler Heater Light Motor

- Q.** 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								:	B							
128	64	32	16	8	4	2	1		128	64	32	16	8	4	2	1
0	0	0	1	0	0	1	0	:	0	0	1	1	0	1	0	1

Hours Minutes

- (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

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

(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



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maintain the correct brightness of the clock face.

(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.

(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

(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

(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



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- Q.** The doors on a train are opened and closed automatically. Motors are used to operate the doors. The system is controlled by a microprocessor. Each door has a sensor which detects if a passenger enters or leaves the train as the doors are closing. If a passenger is detected, the doors are automatically re-opened.
- (a) Name a sensor which could be used to detect a passenger.
- (a) Any one from:
– infra red (sensor)
– pressure (sensor)
– proximity (sensor) [1]
- (b) If the sensor in one of the doors fails, describe a safety mechanism to prevent injury to a passenger.
- (b) Any one from:
– additional sensors used
– door defaults to open position
– sounds an alarm if a sensor fails [1]
- (c) Describe how the sensors, microprocessor and door motors interact to ensure a passenger is not trapped in a closing door.
- (c) Any four points from:
– sensors continuously send signals/data
– sensor sends signals/data sent to the microprocessor
– signal converted to digital if necessary (using ADC)
– microprocessor checks which door(s) is (are) affected
– microprocessor compares sensor reading with stored values
– if reading indicates passenger detected...
– ...microprocessor sends signal/data to actuators/motor...
– (converted to analogue using DAC)
– ...to operate motors to open doors
– microprocessor also send signal to driver's cab (automatically) to sound an alarm
– monitoring continues until system switched off [4]



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- Q.** 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.

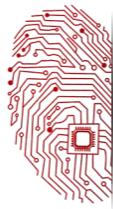
1 mark for each step in correct order. (NOTE: Marks can be awarded for a correct sequence.)

Steps in the printing process	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



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- Q.** 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	inkjet printer
High volume colour printing of advertising flyers	laser printer
Production of an object, which is built up layer by layer; used in CAD applications	3D printer
Converting electrical signals into sound	speaker/headphones
Showing enlarged computer output on a wall or large screen	Projector

- Q.** 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.

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)



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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 barcoded 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

- Q.** 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.

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





Introduction to Computer Memory & Storage

- Q.** (a) State what is meant by the term USB.
(b) Describe two benefits of using USB connections between a computer and a device.
(a) – universal serial bus
– description of USB [1]
(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]
- Q.** 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
(b) The owner needs to be able to enter their own sequence of movements for the model car.
Name a suitable input device.
Give a reason for your choice of device.
(c) Explain why the model car uses a solid state drive rather than another type of secondary storage.
(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, trackball, ... not suitable [2]
(c) Any two from:



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- 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)

Q. 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.

(b) Calculate how much storage would be needed for 2 hours of video footage.

Show your working and give the answer in Gigabytes (GB).

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

– Suitable description of device given [2]

(b) 2 hours = 120 minutes

$$120 \times 180 = 21\,600$$

$$21\,600 / 1024 \text{ (or } 21\,600 / 1000)$$

$$= 21.1 \text{ GB (or } 21.6 \text{ GB)}$$

Q. (a) Examples of primary and secondary storage devices include:

• hard disk

• DVD-RW

• flash memory

For each device, describe the type of media used. [3]

(b) Describe the internal operation of the following devices: [4]

DVD-RW

DVD-RAM

(a) Hard disk – magnetic (storage media)

DVD-RW – optical (storage media)

Flash memory – solid state (memory device) [3]

(b) DVD-RW

– uses a single spiral track

– only allows write OR read operation to occur as separate operations

– requires special packet reading/writing software

– in order to write new data to the disc the existing data must be completely erased

– performance degrades/becomes unreliable after 1000 record/erase cycles

– single sided, 4.7 Gb capacity

– disc rotates at different speeds/constant linear velocity

DVD-RAM

– uses several concentric tracks

– allows simultaneous read/write operations

– requires no special read/write software

– makes use of sectors to store data

– repeatedly read, write and erase/100 000 record/erase cycles possible

– single or double sided, 4.7 Gb capacity per side



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- disc rotates at a constant speed/constant angular velocity [4]

Q. Before it is used, a hard disk is formatted using disk formatter software.

(a) Explain why formatting is needed.

.....
(b) Eventually, the performance of the hard disk deteriorates.

Name **three** other utility programs that might be required. State why each is needed.

1
2
3

(a) Any two from:

- To configure the disc for use / initialise tracks and sectors
- To initialise a file system (e.g. FAT, NTFS) / create a file directory
- To install a boot sector (if creating a bootable disk)
- To check all sectors and mark bad sectors [2]

(b) One mark each named program + one mark for need

Defragmenter

– To rearrange blocks that are used for each file to make blocks contiguous (so that file reading is faster)

– To reduce head movements

(Disk) contents analysis/(disk) repair software/Disc checker

– To identify bad sectors so that they can be marked as unusable

– Verifies file system integrity and fixes logical file system errors

(Disc) compression/file compression

– To compress/decompress the contents of the disc, thus increasing capacity

Backup software

– To store disk contents (somewhere else) in case of disk failure

Anti-malware program

– To scan for/remove/quarantine viruses and/or other malware

(Disc) cleaner

– Finds redundant/unnecessary files, gives the user the option of deleting them if disc getting full

Disc space analysis

– Visually demonstrates the disc usage by showing sizes of files/folders [6]



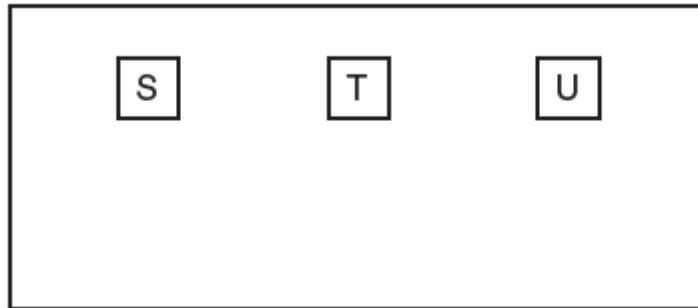
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Q. A touch screen has three squares where a selection can be made:



(a) The x-coordinate of the centre of the three squares is held in three memory locations:
Address Memory contents

	Address	Memory contents
S	40	0000 1011 0100
T	41	0010 0101 0100
U	42	0100 0110 1100

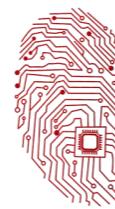
- (i) Give the hexadecimal value of the memory contents for U. [1]
(ii) Convert the denary number 40 into binary. [1]
(b) Bitmap graphics are used to represent squares S, T and U.
These can be saved in a number of different image resolutions.
(i) Give the number of bits required to store each pixel for a black and white bitmap. [1]
(ii) Identify how many bits are required to store each pixel for a 256-colour bitmap.
Explain your answer. [2]

- (a) (i) 46C [1]
(ii) 101000 [1]
(b) (i) 1 bit [1]
(ii) – 8 bits are needed
– Each colour is represented by one of 256 values
– values 0 to 255/0000 0000 to 1111 1111
– $256 = 2^8$ [2]



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- Q. 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.

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			<input checked="" type="checkbox"/>
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	<input checked="" type="checkbox"/>		
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	<input checked="" type="checkbox"/>		(<input checked="" type="checkbox"/>)
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)		<input checked="" type="checkbox"/>	
	(SD/XD card) (USB storage device)			(<input checked="" type="checkbox"/>)
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			<input checked="" type="checkbox"/>



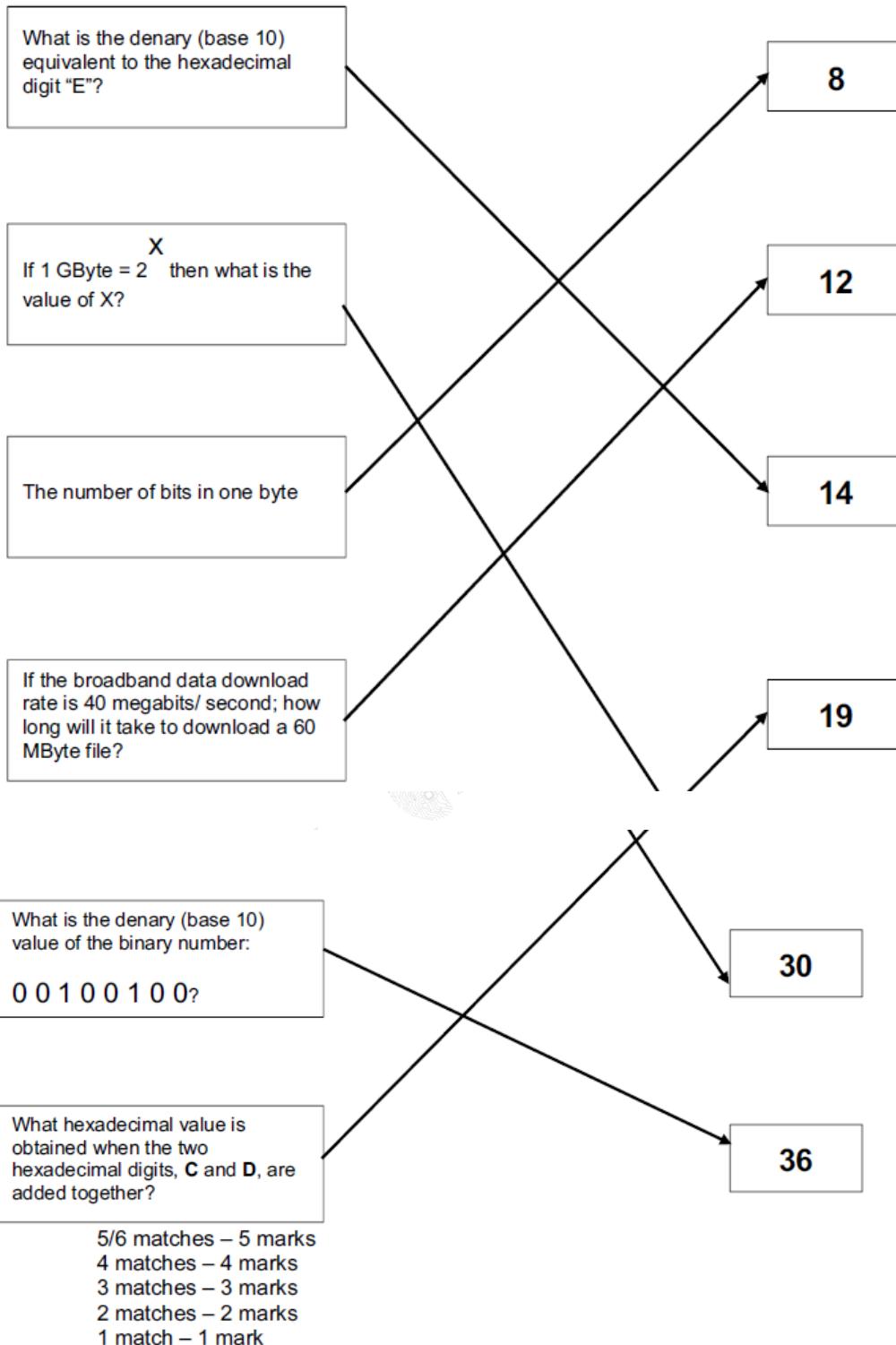
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Q. Draw a line to connect each question to the correct answer.



[5]



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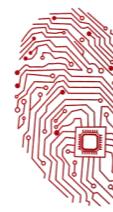
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Page 38 of 126

Computer Science 2210 (P1)

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- Q. A cinema has a number of places where customers can buy their tickets.
Data is input by the cashiers at the terminals and information is produced.
1. (b) State two input devices which would be used at the terminals, justifying their use. [4]
- Q. (a) (i) Explain two differences between ROM and RAM as types of primary memory. [2]
- Contents of RAM can be altered/ROM cannot
 - RAM is usually has a greater capacity than ROM
 - Data held in ROM, after processing, can only be written to RAM
 - RAM is volatile/ROM is non-volatile
- (1 per –, max 2)
- (ii) State an example of what would be stored in ROM and justify your answer. [2]
- The boot-strap program/operating system/system data/BIOS
 - It must be available when power is switched on/to boot up the system/so it can't be changed
- (iii) State an example of what would be stored in RAM and justify your answer. [2]
- Example
- Justification
- e.g. A word processor document/user data
 - User must be able to alter it
- OR
- part of the software being used (application/operating system)
 - the processor needs to fetch the instructions/can be replaced by another program at any time
- (1 per –, max 2)
- (b) (i) Explain the problem of speed mismatch between peripheral and processor.
– Processor works at high speed while peripherals are much slower
- (ii) Describe how this speed mismatch can be overcome. [5]
- use of buffer/temporary storage area
 - Data transferred from primary memory to buffer (or vice versa)
 - When buffer full, processor can carry on with other tasks
 - Buffer is emptied to the peripheral
 - interrupt ...
 - is sent to processor...
 - When buffer empty
 - requesting more data to be sent to buffer.
 - according to priorities
- (1 per –, max 5)



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Q. State an example of each of the following types of storage medium and give a use for each.

- (i) Magnetic
- (ii) Solid state
- (iii) Optical

[2]
[2]
[2]

(i) e.g. – Hard drive/tape

e.g. – Storing OS/Software/User files/Back-up (for tape)/transaction file

[2]

(ii) e.g. – Pen drive/Memory card

e.g. – Take data from one machine to another/use in camera/mobile phone

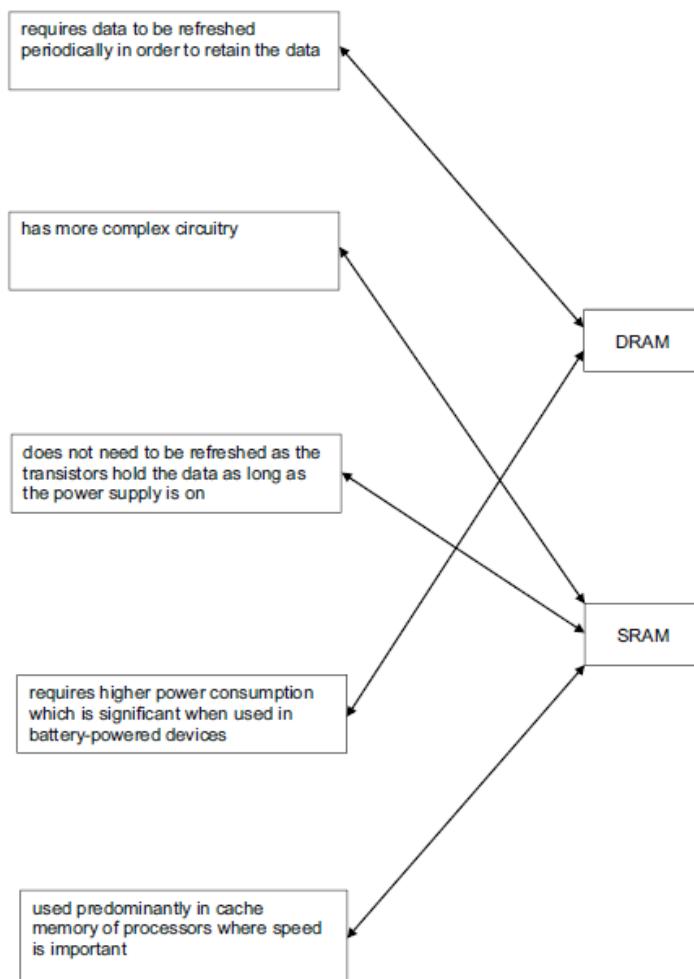
– use as back-up/backing store

[2]

Q. (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.



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- (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]

(b) maximum of two marks for RAM and maximum of two marks for ROM
RAM

- loses contents when power turned off/volatile memory/temporary memory
- stores files/data/operating system currently in use
- data can be altered/deleted/read from and written to
- memory size is often larger than ROM

ROM

- doesn't lose contents when power turned off/non-volatile memory/permanent memory
- cannot be changed/altered/deleted/read only
- can be used to store BIOS/bootstrap [3]

(c) one mark for DVD-RAM, one mark for flash memory.

DVD-RAM

- data is stored/written using lasers/optical media
- DVD-RAM uses phase changing recording, in which varying laser intensities cause targeted areas in the phase change recording layer to alternate between an amorphous and a crystalline state.
- uses a rotating disk with concentric tracks
- allows read and write operation to occur simultaneously

flash memory

- most are NAND-based flash memory
- there are no moving parts
- uses a grid of columns and rows that has two transistors at each intersection
- one transistor is called a floating gate
- the second transistor is called the control gate
- memory cells store voltages which can represent either a 0 or a 1
- essentially the movement of electrons is controlled to read/write
- not possible to over-write existing data; it is necessary to first erase the old data then write the new data in the same location [2]



Computer Science 2210 (P1)

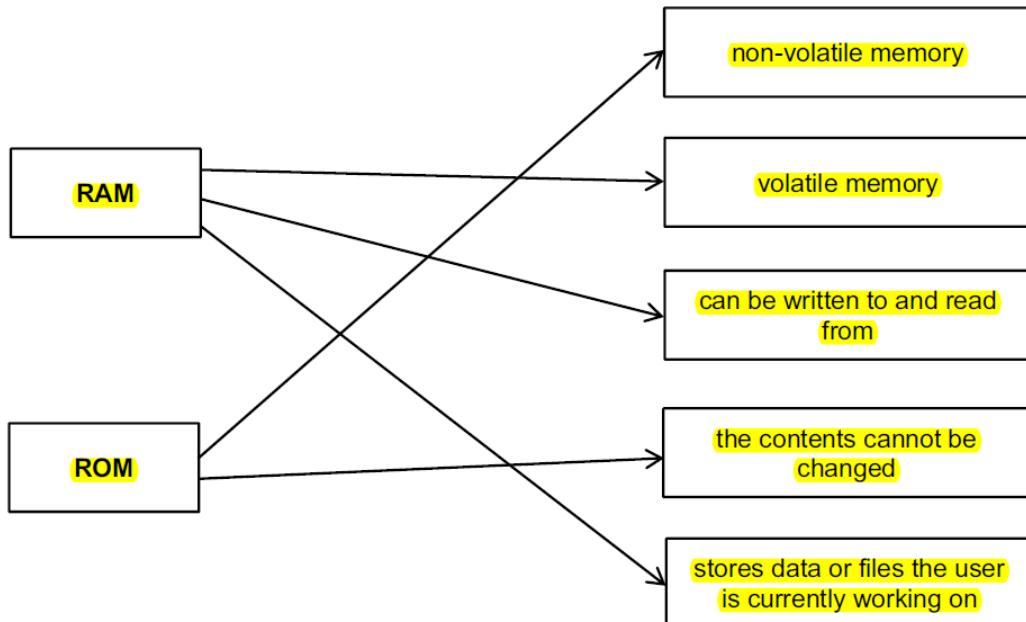
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- Q. In the diagram below, there are **two** types of memory shown on the left and **five** typical memory features shown on the right.
Link each feature to **either RAM or ROM** by drawing connecting lines.

2

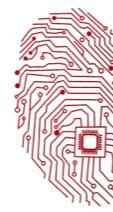


1 mark for each correct line (**max 5**)
Deduct 1 mark for each additional incorrect line.

[5]

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Operating System

- Q.** State three tasks done by the operating system.

[3]

4 Any three points from:

file management/resource management = 0
input/output control/peripheral management
spooling
memory management
multitasking/JCL/batch processing
multiprogramming
handling interrupts
error reporting/handling
security
interfaces with users/WIMP type interfaces
loads/runs programs
processor management
manages user accounts
copy/save/format/DOS utilities

[3]

(i) Explain what is meant by an interrupt.

(ii) Explain the actions of the processor when an interrupt is detected.

(d) (i) • a signal

• from a device/program that it requires attention from the processor [2]

(ii) • at a point during the fetch-execute cycle ...

• check for interrupt

• if an interrupt flag is set/ bit set in interrupt register

• all contents of registers are saved

• PC loaded with address of interrupt service routine [4]

- Q.** Define the following types of software:

(i) System Software

(ii) applications software

[4]

- Q.** Give three file management tasks that are done by a computer operating system. [3]

The operating system is responsible for the following activities in connections with file management:

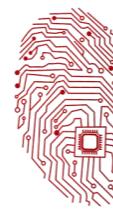
- File creation and deletion.
- Directory creation and deletion.
- Support for manipulating files and directories.
- Mapping files onto secondary storage.
- File backup on stable (nonvolatile) storage media.
- Identify and locate a selected file
- Use a directory to describe the location of all files plus their attributes
- On a shared system describe user access control
- Blocking for access to files
- provide simple and fast algorithms to read and write files
- give and deny access rights on files to users and programs
- allocate and de allocate files to processes
- provide users and programs with simple commands for file handling

- Q.** Some microprocessor-controlled devices do not need an operating system.



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- (i) Give one example of such a device. [1]
(ii) Give one reason why it does not need an operating system. [1]
(i) any typical device such as a microwave oven [1]
(ii) any one reason from:
has only one set of tasks to perform
simple input expected (e.g. keypad on front of device)
simple, never-changing hardware
would increase development and manufacturing costs [1]

Q. Most operating systems provide a user interface.

User interfaces can be either command line interfaces (CLI) or graphical user interfaces (GUI).

Give ONE advantage and ONE disadvantage of both types of interface.

(a) Any one advantage of CLI from:

- direct communication with computer system
- not restricted to a number of pre-determined options
- simple interface using keyboard only
- faster response

Any one disadvantage of CLI from:

- need to learn a number of long/complex commands
- need to type in the commands (possibility of errors)
- slow having to type in commands every time

Any one advantage of GUI from:

- only need to click on one simple picture
- so much easier for the novice
- several instructions are replaced by one icon
- no need to understand how computer systems work

Any one disadvantage of GUI from:

- wasteful of computer memory
- if user wants to communicate with computer system directly, GUI is effectively more complex.

[4]

Q. Explain the meaning of the term utility software. Why they are necessary in a computer system?

[4]

Describe four examples of utility software.

[4]

Utility programs are part of the operating system of a computer and are routines which carry out important tasks which are necessary from time to time on the system.

There are many examples of utility software but we shall limit ourselves to just a few:

Defragmenter

- To rearrange blocks that are used for each file to make blocks contiguous (so that file reading is faster)
- To reduce head movements

(Disk) contents analysis/(disk) repair software/Disc checker

- To identify bad sectors so that they can be marked as unusable
- Verifies file system integrity and fixes logical file system errors

(Disc) compression/file compression

- To compress/decompress the contents of the disc, thus increasing capacity

Backup software

- To store disk contents (somewhere else) in case of disk failure

Anti-malware program

- To scan for/remove/quarantine viruses and/or other malware

(Disc) cleaner

- Finds redundant/unnecessary files, gives the user the option of deleting them if disc



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getting full

Disc space analysis

- Visually demonstrates the disc usage by showing sizes of files/folders

Q. Andrew is sending a large document to a printer.

(a) State the name for the area of memory used to store temporarily the data being sent to the printer.

[1]

(a) Any one from:

- buffer

- RAM

[1]

(b) The printer runs out of paper during the printing job. A signal is sent back to the computer to temporarily stop its current task.

Name this type of signal.

[1]

(b) – interrupt

[1]

(c) When trying to save this document after it was printed, the computer stops responding.

Give two reasons why the computer might stop responding.

[2]

(c) Any two from:

- hardware problem (e.g. head crash on disk drive)

- software “glitch”

- viruses

- disconnected printer cable

- automatic update in progress

- too many applications open

[2]

(d) Andrew ended up losing his electronic document.

How could that have been prevented?

[1]

(d) Any one from:

- backup the document

- enable automatic saving of work

- manually save document every 10 minutes

- save before printing

[1]

Q. State why the process known as handshaking is necessary between a computer and the file server before use.

[3]

To ensure that both are on and ready for communication/to ensure that both are using same protocol.



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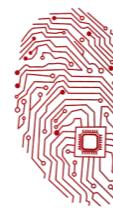
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Page 45 of 126

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- Q.** (i) Explain the role of the buffer and interrupts when a large document of over 200 pages is sent to a laser printer.
[3]
- (ii) The use of two buffers would speed up the printing process.
Explain why.
[3]
- Q.** Describe the stages of the process of transferring data from memory to backing store. Your answer should include references to buffers and interrupts.
- use of buffer/temporary storage area
 - Data transferred from primary memory to buffer (or vice versa)
 - When buffer full, processor can carry on with other tasks
 - Buffer is emptied to the peripheral
 - interrupt ...
 - is sent to processor...
 - When buffer empty
 - requesting more data to be sent to buffer.
 - according to priorities
- (1 per –, max 5)
[5]
- Q.** Which four computer terms are being described below?
- (i) signal sent from a printer requesting attention from the processor; this causes a temporary break in the execution of whatever the processor is doing
 - (ii) exchange of signals between two devices to ensure synchronisation when communication starts
 - (iii) temporary storage area in a printer that holds data waiting to be printed
 - (iv) count of the number of bits before transmission which is sent with the transmission so that the receiver can check to see whether the same number of bits have arrived
- 7 1 mark for each correct term.
- (ii) interrupt [1]
 - (iii) handshaking [1]
 - (iv) (printer) buffer, RAM [1]
 - (v) checksum [1]





Number System

1. Express the denary value 109 as
 - (i) a binary number using an 8-bit byte;
 - (iii) a hexadecimal number.

2. Express the denary number 78 as
 - (i) a binary number stored in an 8 bit byte,
 - (ii) a hexadecimal number,

3. 01011101 and 11010010 are two numbers stored in the computer.
 - (i) Write down the decimal equivalent of 11010010.

4. Convert the following binary numbers into decimal number & hexadecimal number:
 - (i) $(00001100)_2$
 - (ii) $(01011001)_2$
 - (iii) $(00000111)_2$

5. Is there a short cut to working out a binary number that is made of solid ones, such as: $(01111111)_2$?

6. Convert the following Hexadecimal numbers into denary system and binary system:
 - (i) A1
 - (ii) 37
 - (iii) FF
 - (iv) 0D
 - (v) ABC

1. Express the denary value 109 as
 - (i) a binary number using an 8-bit byte;

128	64	32	16	8	4	2	1
Is 109>=128?N	Is 109>=64?Y	Is 45>=32?Y	Is 13>=16?N	Is 13>=8?Y	Is 5>=4?Y	Is 1>=2?N	Is 1>=1?Y
0	1	1	0	1	1	0	1
	=109-64	=45-32		=13-8	=5-4		=1-1
	=45	=13		=5	=1		=0

$$=(01101101)_2$$

(iii) a hexadecimal number.

Is $109<256?Y$

$$=109 \div 16$$

=6 remainder 13

$$=(6D)_{16} \text{ (Note: A=10,B=11,C=12,D=13,E=14,F=15)}$$



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2. Express the denary number 78 as

(i) a binary number stored in an 8 bit byte,

128	64	32	16	8	4	2	1
Is 78>=128?N	Is 78>=64?Y	Is 14>=32?N	Is 14>=16?N	Is 14>=8?Y	Is 6>=4?Y	Is 2>=2?N	
0	1	0	0	1	1	1	0
	=78-64			=14-8	=6-4	=2-2	
	=14			=6	=2	=0	

$$=(01001110)_2$$

(ii) a hexadecimal number,

$$\text{Is } 78 < 255?Y$$

$$=78 \div 16$$

$$=4 \text{ remainder } 14$$

$$=(4E)_{16} \text{ (Note: A=10, B=11, C=12, D=13, E=14, F=15)}$$

3. $(01011101)_2$ and $(11010010)_2$ are two numbers stored in the computer.

Write down the decimal equivalent of $(01011101)_2$.

128	64	32	16	8	4	2	1
0	1	0	1	1	1	0	1
0x128	1x64	0x32	1x16	1x8	1x4	0x2	1x1
0	64	0	16	8	4	0	1

$$=64+16+8+4+1$$

$$=(93)_{10}$$

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4. Convert the following binary numbers into decimal number & hexadecimal number:
 $(00001100)_2$

128	64	32	16	8	4	2	1
0	0	0	0	1	1	0	0
0x128	0x64	0x32	0x16	1x8	1x4	0x2	0x1
0	0	0	0	8	4	0	0

$$=8+4$$

$$=(12)_{10}$$

8	4	2	1	8	4	2	1
0	0	0	0	1	1	0	0
0x8	0x4	0x2	0x1	1x8	1x4	0x2	0x1
0	0	0	0	8	4	0	0
$=0$				$=8+4$			
$=0$				$=12$			
$=0$				$=C$			
$=C$							

$$=(C)_{16}$$

$$(01011001)_2$$

128	64	32	16	8	4	2	1
0	1	0	1	1	0	0	1
0x128	1x64	0x32	1x16	1x8	0x4	0x2	1x1
0	64	0	16	8	0	0	1

$$=64+16+8+1$$

$$=(89)_{10}$$

8	4	2	1	8	4	2	1
0	1	0	1	1	0	0	1
0x8	1x4	0x2	1x1	1x8	0x4	0x2	1x1
0	4	0	1	8	0	0	1
$=4+1$				$=8+1$			
$=5$				$=9$			
$=59$							

$$=(59)_{16}$$

$$(00000111)_2$$

128	64	32	16	8	4	2	1
0	0	0	0	0	1	1	1
0x128	0x64	0x32	0x16	0x8	1x4	1x2	1x1
0	0	0	0	0	4	2	1



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8	4	2	1	8	4	2	1
0	0	0	0	0	1	1	1
0x8	0x4	0x2	0x1	0x8	1x4	1x2	1x1
0	0	0	0	0	4	2	1
$=0$				$=4+2+1$			
$=0$				$=7$			
$=7$							

$$=(7)_{16}$$

5. Is there a short cut to working out a binary number that is made of solid ones, such as: $(01111111)_2$?

127 ($=128-1$)

128	64	32	16	8	4	2	1
0	1	1	1	1	1	1	1
0x128	1x64	1x32	1x16	1x8	1x4	1x2	1x1
0	64	32	16	8	4	2	1

$$=64+32+16+8+4+2+1$$

$$=(127)_{10}$$

63 ($=63-1$)

128	64	32	16	8	4	2	1
0	0	1	1	1	1	1	1
0x128	0x64	1x32	1x16	1x8	1x4	1x2	1x1
0	0	32	16	8	4	2	1

$$=32+16+8+4+2+1$$

$$=(63)_{10}$$

31 ($=32-1$)

128	64	32	16	8	4	2	1
0	0	0	1	1	1	1	1
0x128	0x64	0x32	1x16	1x8	1x4	1x2	1x1
0	0	0	16	8	4	2	1

$$=16+8+4+2+1$$

$$=(31)_{10}$$



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6. Convert the following Hexadecimal numbers into denary system and binary system:

1. A1

Binary:

A1-->(10,1)

10				1			
8	4	2	1	8	4	2	1
1	0	1	0	0	0	0	1

= $(10100001)_2$

Decimal:

10	1
16^1	16^0
16	1
$=10 \times 16$	$=1 \times 1$
$=160$	$=1$
$=160+1$	
$=(161)_{10}$	

2. 37

Binary:

37-->(3,7)

3				7			
8	4	2	1	8	4	2	1
0	0	1	1	0	1	1	1

= $(00110111)_2$

Decimal:

3	7
16^1	16^0
16	1
$=3 \times 16$	$=7 \times 1$
$=48$	$=7$
$=48+7$	
$=(55)_{10}$	

3. FF

Binary:

FF-->(15,15)

15				15			
8	4	2	1	8	4	2	1
1	1	1	1	1	1	1	1

= $(11111111)_2$



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Decimal:

15	15
16¹	16⁰
16	1
=15x16	=15x1
=240	=15
=240+15	
= $(255)_{10}$	

4. ABC

Binary:

$$(A,B,C) \rightarrow (10,11,12)$$

10				11				12			
8	4	2	1	8	4	2	1	8	4	2	1
1	0	1	0	1	0	1	1	1	1	0	0

$$=(101010111100)_2$$

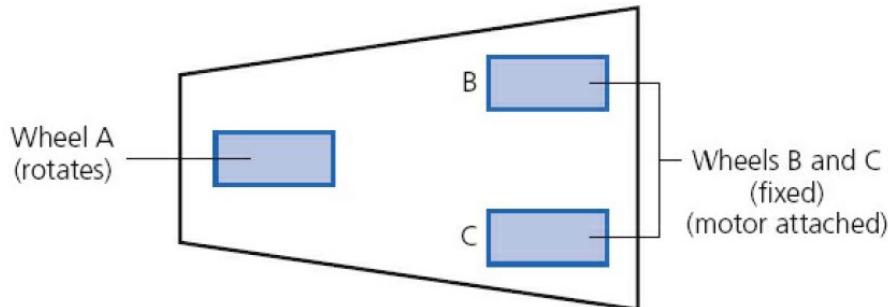
Decimal:

A	B	C
16²	16¹	16⁰
256	16	1
= 10x256	=11x16	=12x1
= 2560	=176	=12
=2560+176+12		
= (2572)₁₀		

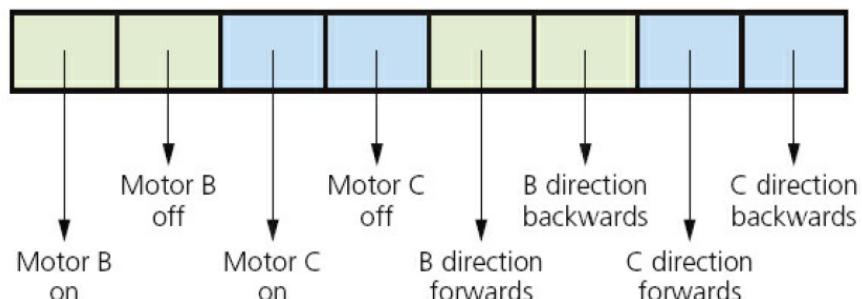




- Q.** A robot vacuum cleaner has three wheels, A, B and C. A rotates on a spindle to allow for direction changes (as well as forward and backward movement); B and C are fixed to revolve around their axles to provide only forward and backward movement, and have an electric motor attached:



An 8-bit register is used to control the movement of the robot vacuum cleaner:



If the register contains 1 0 1 0 1 0 1 0 this means ‘motor B is ON and motor C is ON and both motors are turning to produce FORWARDS motion’. Effectively, the vacuum cleaner is moving forwards.

What would be the effect if the register contained the following values?

- i** 1 0 0 1 1 0 0 0
- ii** 1 0 1 0 0 1 0 1
- iii** 1 0 1 0 0 1 1 0

b What would the register contain if only motor C was ON and the motors were turning in a BACKWARDS direction?

c What would the register contain if motor B and motor C were both ON but B was turning in a backward direction and C was turning in a forward direction?

d What would be the effect if the register contained the following?

1 1 1 1 1 1 1 1



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- Q.** 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.

Letter	Denary 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:

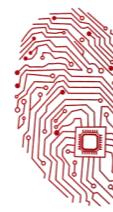
C 2

For the two letters “L” and “G”, shift the binary values one place to the left and convert these values into hexadecimal:

hexadecimal

L:							
G:							





(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

Q. (a) (i) Convert the following two hexadecimal numbers into binary:

F A 7
 D 3 E

F A 7	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
D 3 E	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>

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

<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
---	--	--

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

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



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```
<font color "# F F 0 0 0 0 "> RED </font>
<font color "# 0 0 F F 0 0 "> GREEN </font>
<font color "# 0 0 0 0 F F "> BLUE </font>

<font color "#      X      "> YELLOW </font>
<font color "#      Y      "> MAGENTA </font>
<font color "#      Z      "> CYAN </font>
```

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.....

Following table will help in hexadecimal addition:

1+1 = 2
1+2 = 3
1+3 = 2+2 = 4
1+4 = 2+3 = 5
1+5 = 2+4 = 3+3 = 6
1+6 = 2+5 = 3+4 = 7
1+7 = 2+6 = 3+5 = 4+4 = 8
1+8 = 2+7 = 3+6 = 4+5 = 9
1+9 = 2+8 = 3+7 = 4+6 = 5+5 = A
1+A = 2+9 = 3+8 = 4+7 = 5+6 = B
1+B = 2+A = 3+9 = 4+8 = 5+7 = 6+6 = C
1+C = 2+B = 3+A = 4+9 = 5+8 = 6+7 = D
1+D = 2+C = 3+B = 4+A = 5+9 = 6+8 = 7+7 = E
1+E = 2+D = 3+C = 4+B = 5+A = 6+9 = 7+8 = F
1+F = 2+E = 3+D = 4+C = 5+B = 6+A = 7+9 = 8+8 = 10
2+F = 3+E = 4+D = 5+C = 6+B = 7+A = 8+9 = 11
3+F = 4+E = 5+D = 6+C = 7+B = 8+A = 9+9 = 12
4+F = 5+E = 6+D = 7+C = 8+B = 9+A = 13
5+F = 6+E = 7+D = 8+C = 9+B = A+A = 14
6+F = 7+E = 8+D = 9+C = A+B = 15
7+F = 8+E = 9+D = A+C = B+B = 16
8+F = 9+E = A+D = B+C = 17
9+F = A+E = B+D = C+C = 18
A+F = B+E = C+D = 19
B+F = C+E = D+D = 1A
C+F = D+E = 1B
D+F = E+E = 1C
E+F = 1D
F+F = 1E

(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



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(ii) State why MAC addresses are used.

- (a) (i) For each hex number, 2 marks if all correct, 1 mark for 2 correct conversions

F A 7:

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

D 3 E:

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

[4]

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

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

[2]

- (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]

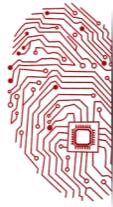
- (ii) Allows all devices to be uniquely identified

[1]



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- Q.** An encryption system gives each letter of the alphabet a value:

A = 1, B = 2, C = 3, , Y = 25, Z = 26.

Each letter is stored in a 12-bit binary register. The letter "S" (19th letter) is stored as:

2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	0	0	0	0	0	1	0	0	1	1

A 4-bit register is used to store the encryption key. This register shows how many places the bits are shifted to the left in the 12-bit register when it is encrypted. So,

8	4	2	1
0	1	0	1

means each bit in the 12-bit register is shifted 5 places to the left and the register now becomes:

2048	1024	512	256	128	64	32	16	8	4	2	1
0	0	1	0	0	1	1	0	0	0	0	0

Therefore, the letter "S" would be transmitted with the 4-bit register and the 12-bit register as follows:

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

(a) "W" is the 23rd letter of the alphabet.

(i) Show how this letter would be stored in the 12-bit register before encryption:

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

(ii) The 4-bit register contains the following value:

8	4	2	1
0	1	1	0

Show how the letter "W" is now stored in the 12-bit register in encrypted form:

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

(b) Find which letter of the alphabet has been encrypted here. (Show all your working.)

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

(c) (i) What is the largest encryption key that can be stored in the 4-bit register?

8	4	2	1

(ii) Convert this into denary (base 10).

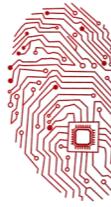
(iii) If this encryption key were used, what problem would it cause?

[3]



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16 (a) (i) 1 mark for correct binary numbers

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

(ii) 1 mark for correct binary numbers

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

[2]

(b) one mark

– letter "Y" or 25th letter

One mark

– the binary number 0 0 0 1 1 0 0 1 0 0 0 has been shifted (to the left) 3 places

– so the binary number becomes 0 0 0 0 0 0 0 1 1 0 0 1

– 1+8+16

[2]

(c) (i) 1 1 1 1

(ii) 15 (allow follow through from (i))

- (iii) – try to move 15 places to the left which is not possible
– only 12 bits in register to store letter; 15 is too large
– you would end up with 12 0s in the register

[3]

Q. An advertising sign uses large LED characters controlled by a microprocessor.
Each letter is formed from a grid made up of eight rectangles numbered 1 to 8:

1	2	3	4
5	6	7	8

For example, the letter "Z" is formed as follows:

1	2	3	4
5		7	8



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Page 59 of 126

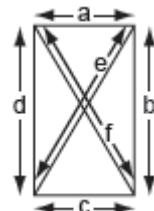
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Each rectangle has six LEDs that can light up; these LEDs are labelled "a" to "f":



The LEDs in a rectangle can be represented in a 6-bit register. For example, rectangle 3 of the letter "Z":



can be represented as:

f	e	d	c	b	a
0	1	0	0	0	1

Thus the letter "Z" can be represented by the 8 registers:

1	2		4
5		7	8

f	e	d	c	b	a
1	0	0	0	0	0
2	0	0	0	0	1
3	0	1	0	0	0
4	0	0	0	0	0
5	0	0	0	0	0
6	0	1	0	1	0
7	0	0	0	1	0
8	0	0	0	0	0

(a) Show how the letter "E" can be represented by the eight 6-bit registers (four registers have been done for you).

1	2	3	4
5	6	7	8



	f	e	d	c	b	a
1	0	0	0	0	0	0
2						
3						
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6						
7						
8	0	0	0	0	0	0

[4]



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Page 60 of 126

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12 (a) 1 mark for each of four rows shown in bold below; there are two possible ways of doing this – one set of answers is shown on the left and the alternative is shown on the right in brackets.

Don't allow mix and match; answers must either be as shown on the left OR as shown on the right

0 0 0 0 0 0

0 0 1 0 0 1

(OR 0 0 1 1 0 1)

- 1 mark

0 0 0 0 0 1

(OR 0 0 0 1 0 1)

- 1 mark

0 0 0 0 0 0

0 0 0 0 0 0

(OR 0 0 1 1 0 0)

- 1 mark

0 0 0 1 0 1

(OR 0 0 0 1 0 0)

- 1 mark

0 0 0 0 0 0

[4]

(b) State which letter of the alphabet is represented by the following eight 6-bit registers.

f	e	d	c	b	a
0	0	0	0	0	0
0	0	1	0	0	0
0	0	0	0	1	0
0	0	0	0	0	0
0	0	0	0	0	0
0	0	1	0	0	1
0	0	0	0	1	1

1
2
3
4
5
6
7
8



letter

[2]

(b) 2 marks for identifying the letter
letter: H [2]



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Page 61 of 126

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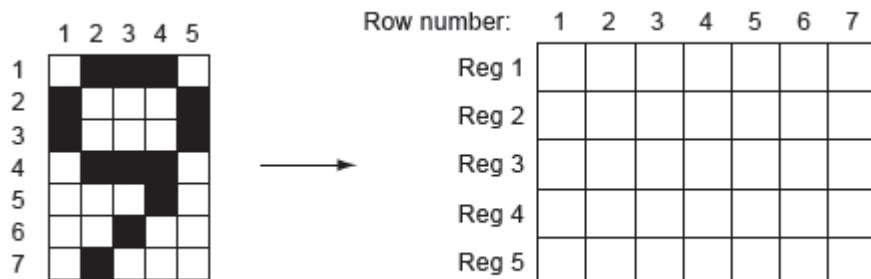
- Q** Digits on an electronic display board can be represented on a 7×5 grid. For example, the digit 3 is represented as:

	1	2	3	4	5
Row 1					
Row 2					
Row 3					
Row 4					
Row 5					
Row 6					
Row 7					

Each column in the grid is represented in a computer as a 7-bit register. Five registers are required to represent the state of the whole digit. The value 1 represents a shaded square and the value 0 represents an unshaded square. For example, the digit 3 is represented as:

Row number:	1	2	3	4	5	6	7
Register 1	0	1	0	0	0	1	0
Register 2	1	0	0	0	0	0	1
Register 3	1	0	0	1	0	0	1
Register 4	1	0	0	1	0	0	1
Register 5	0	1	1	0	1	1	0

- (a)** Show the contents of the five 7-bit registers when representing the digit 9:



[4]

- (b)** In order to prevent errors, an 8-bit register is used. The 8th bit will contain:

- 0 – if the first 7 bits add up to an even number
- 1 – if the first 7 bits add up to an odd number

Complete the 8th bit for each register. The first register has been completed for you.

	1	2	3	4	5	6	7	8
Reg 1	0	1	0	0	0	1	0	0
Reg 2	1	0	0	0	0	0	1	
Reg 3	1	0	0	1	0	0	1	
Reg 4	1	0	0	1	0	0	1	
Reg 5	0	1	1	0	1	1	0	

[3]



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14 (a) Row number:

Reg 1:

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

Reg 2:

Reg 3:

Reg 4:

Reg 5:

Reg 1 + Reg 5 = 1 mark

Reg 2 = 1 mark

Reg 3 = 1 mark

Reg 4 = 1 mark

[4]

(b)

Reg 1:

8
0
0
1
1
0

Reg 2:

Reg 3:

Reg 4:

Reg 5:

Reg 2 + Reg 5 = 1 mark

Reg 3 = 1 mark

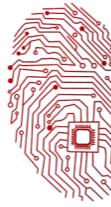
Reg 4 = 1 mark

[3]



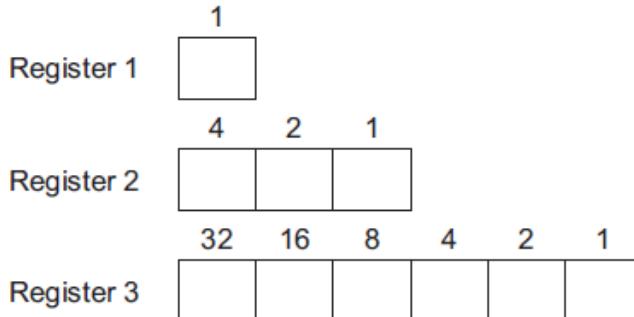
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- Q. A large hotel uses eight lifts (elevators) to carry passengers between its sixty floors. A computer is used to control and monitor the lifts. Each lift has three registers to represent its state.

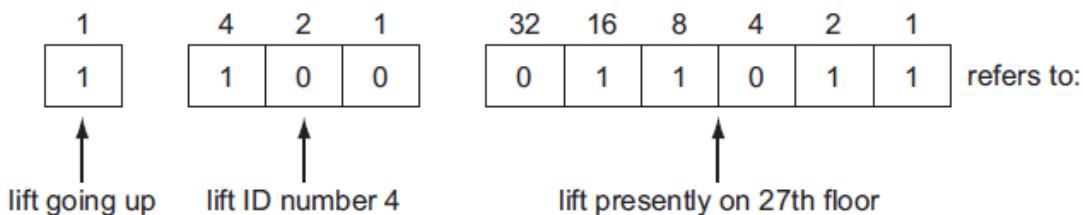


UP/DOWN 1 = lift going up
and 0 = lift going down

Lift ID number 0 to 7

Floor number 0 to 60

Thus



- (a) If the three registers contain the following data:

1	4	2	1	32	16	8	4	2	1
0	1	1	1	1	1	1	0	0	0

what information about the lift is shown?

[2]

- (b) How would the following information be shown in the three registers:
lift 6 presently on the 45th floor and going down

1	4	2	1	32	16	8	4	2	1

[2]

- (c) (i) A customer is on the 14th floor and wants to go to the 50th floor. She presses the button to call the lift.

What two pieces of information would the computer check to identify which of the eight lifts should be made available?

[2]

- (ii) Using your answers to part (i), which of the following lifts would be made available to the customer?



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<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>0</td><td>0</td><td>0</td></tr></table>	0	0	0	<table border="1"><tr><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td><td>0</td></tr></table>	1	0	0	1	0	0	A
1													
0	0	0											
1	0	0	1	0	0								
<table border="1"><tr><td>0</td></tr></table>	0	<table border="1"><tr><td>0</td><td>0</td><td>1</td></tr></table>	0	0	1	<table border="1"><tr><td>0</td><td>0</td><td>1</td><td>1</td><td>1</td><td>1</td></tr></table>	0	0	1	1	1	1	B
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0	0	1	1	1	1								
<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>0</td><td>1</td><td>0</td></tr></table>	0	1	0	<table border="1"><tr><td>1</td><td>1</td><td>0</td><td>0</td><td>1</td><td>0</td></tr></table>	1	1	0	0	1	0	C
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<table border="1"><tr><td>1</td></tr></table>	1	<table border="1"><tr><td>0</td><td>1</td><td>1</td></tr></table>	0	1	1	<table border="1"><tr><td>0</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table>	0	0	1	0	1	0	D
1													
0	1	1											
0	0	1	0	1	0								

[1]

- (d) An engineer wishes to test that this computer system detects incorrect data.
Describe what input the engineer might use to check that the computer can correctly identify a fault condition.

[2]

13 (a)- lift 7

- presently on 56th floor
- going down

[2]

(b)

<table border="1"><tr><td>0</td></tr></table>	0	<table border="1"><tr><td>1</td><td>1</td><td>0</td></tr></table>	1	1	0	<table border="1"><tr><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr></table>	1	0	1	1	0	1
0												
1	1	0										
1	0	1	1	0	1							
< ----- 1 mark ----- >												

[2]

(c) (i) Any two from:

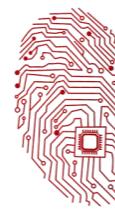
- is lift in service?
- is a lift already on the 14th floor?
- is the ultimate destination of a lift in motion the 14th floor?
- which lift is nearest 14th floor?
- which lifts are going up?
- which floor is the lift on?
- which lifts are below 14th floor?

[2]

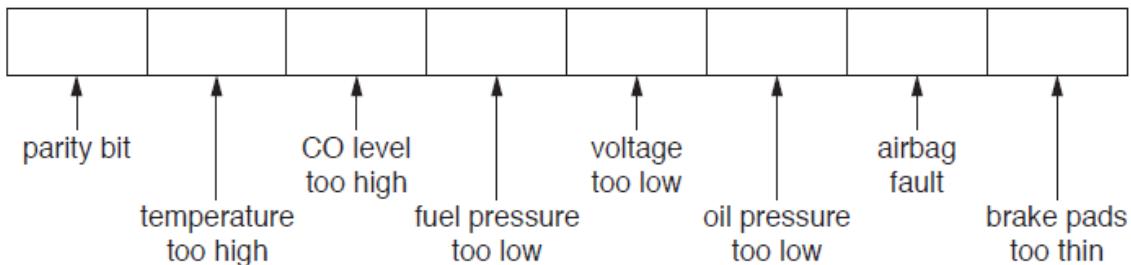
(ii) D

[1]





- Q.** 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.
- (b) 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
---	---	---	---	---	---	---	---

- (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
--	---	---	---	---	---	---	---

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

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

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

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





(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]



Computer Science 2210 (P1)

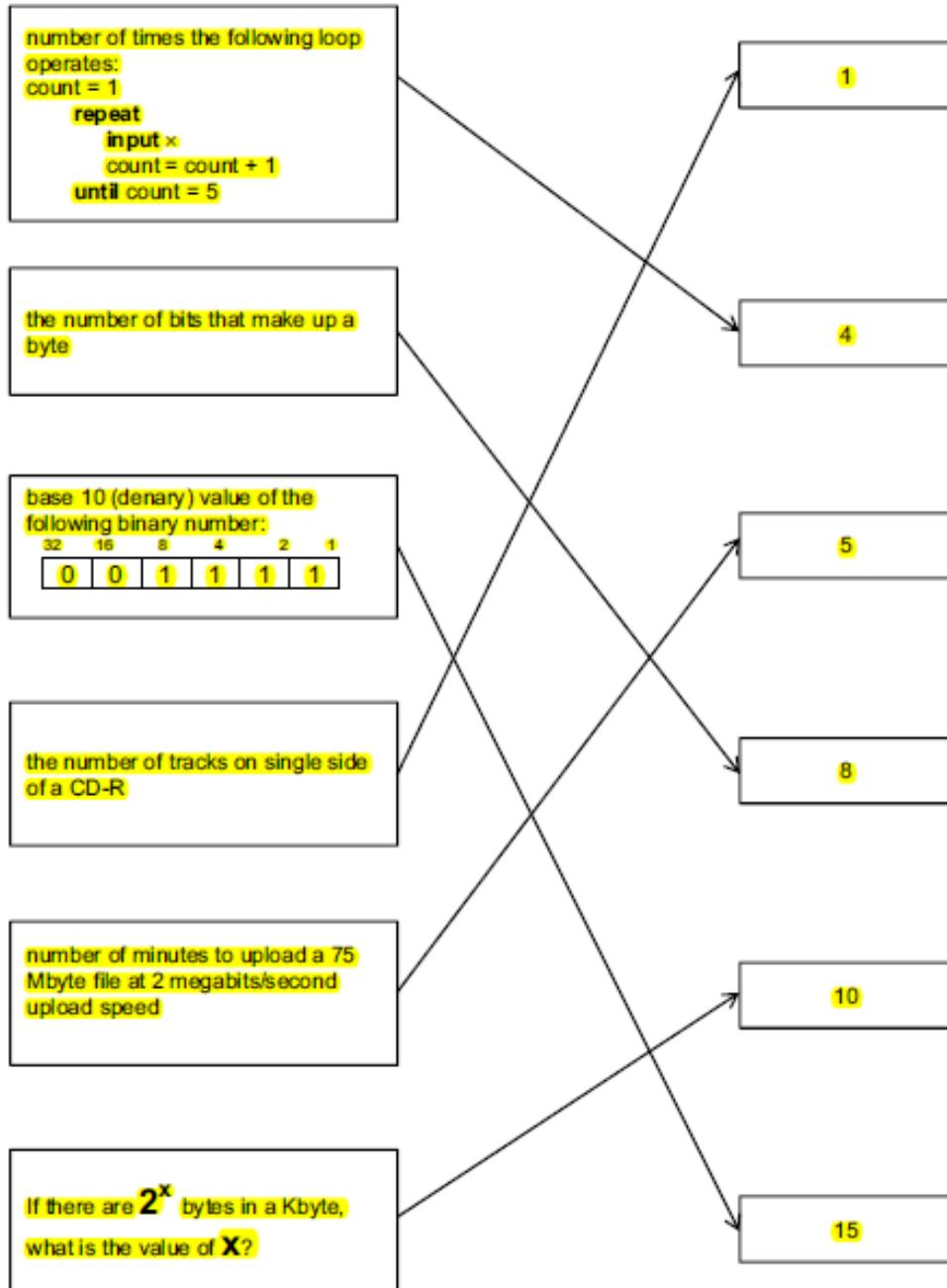
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- Q** Six statements and six values are shown below.
Each statement will generate one possible value.
Draw a line to link each statement to its correct value.

4 1 mark for each correct connection up to the maximum of 5



[5]





File Size Calculation

1. A company produces animation effects using computers rather than producing them manually.
(b) Each image takes about 400 kilobytes of storage. 25 images per second are produced.
How much memory would be needed to store a 30-minute animation?

(b) There are various ways of completing this calculation, the following is one example:
 $\text{number of images needed} = 30 \times 25 \times 60 = 45,000$

$$\begin{aligned}\text{memory needed} &= 45,000 \times 400 \times 1000 \text{ bytes} = 18,000,000,000 \text{ bytes} \\ &= 18,000,000 \text{ Kbytes} \\ &= 18,000 \text{ Mbytes} \\ &= 18 \text{ Gbytes}\end{aligned}$$

(1 mark for showing a **correct** method of working out plus 1 mark for **correct** answer including units) [2]

2. Juan uses a company which offers the following Internet broadband transfer rates:

- 56 megabits per second DOWNLOAD
- 16 megabits per second UPLOAD

- (b) If each music track is 3.5 megabytes in size, how long would it take Juan to download his 40 tracks?
(Show your working.)
(c) He has decided to upload 36 photographs onto his social networking website. Each photograph is 1.8 megabytes in size.

How long would it take to upload his photographs?

(b) 1 mark for showing relevant working + 1 mark for correct answer

$$\begin{aligned}40 \text{ tracks} &= 40 \times 3.5 = 140 \text{ Mbyte} \\ 56 \text{ megabits/sec} &= 7 \text{ Mbyte/sec} \\ \text{time to download tracks} &= 140/7\end{aligned}$$

i.e. **20 seconds**

[2]

(c) 1 mark for showing relevant working + 1 mark for correct answer

$$\begin{aligned}36 \text{ photos} &= 36 \times 1.8 = 64.8 \text{ Mbyte} \\ 16 \text{ megabits/sec} &= 2 \text{ Mbyte/sec} \\ \text{time to upload photos} &= 64.8/2\end{aligned}$$

i.e. **32.4 secs**

[2]

3. John has bought a 4 Gbyte MP3 player.

(You may assume: 1 byte = 8 bits, 1 Mbyte = 1024 kbytes and 1Gbyte = 1024 Mbytes)

- (i) We can assume that each song lasts 3 minutes and is recorded at 128 kbps (kilobits per second).
How much memory is required per song?



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(a) (i) $3 \text{ minutes} = 180 \text{ seconds}$
 $\text{each song} = 180 * 128 = 23\,040 \text{ kbits}$
 $\text{number of bytes} = 23\,040 / 8 = 2\,880 \text{ kbyte}$
 $= 2.8(125) \text{ Mbyte}$

[2]

(ii) $4 \text{ Gbyte} = 4 * 1024 = 4\,096 \text{ Mbyte}$
therefore, number of songs = $4\,096 / 2.8125 = 1456 \text{ songs}$

[2]

4. A digital security camera was set up as shown in the diagram.

The digital CCTV camera is connected to a computer. The computer can make the camera move in any direction by sending out digital signals. The computer system has a 400 gigabyte hard disk.

Each image size is 400 kilobytes (0.4 gigabytes).

- (i) How many images can be stored before the hard disk is full?

(i) $400 / 0.4 = 1000 \text{ images}$
alternative answer $400 / 0.0004 = 1\,000\,000 \text{ images approx}$
(1 048 576 exactly)

[1]

5. Computer memories are measured in terms of the number of bytes.

(i) What is meant by the term byte?

(ii) What is meant by a Gigabyte?

(b) Flash memories and CD-RWs are used as backing media for computers.

Give two differences between these two media.

- (a) (i) Any one from:

- unit of data/memory
- 8 bits
- used to represent a character

[1]

- (ii) Any one from:

- 2^{30} bytes
- 1 073 741 824 bytes
- 1 048 576 kilobytes
- 1024 megabytes

[1]

6. The following statistics refer to a music track being recorded on a CD:

- music is sampled at 44 100 times per second
- each sample is 16 bits
- each track requires separate sampling for left and right speakers of a stereo recording (8 bits = 1 byte, 1 megabyte = 1 048 576 bytes)

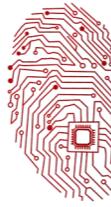
(a) (i) How many bytes are required to represent one second of sampled music?

(ii) If a typical music track is 3 minutes long, how much memory is used on the CD to store one track? (Give your answer in megabytes.)



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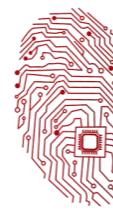


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- (a) (i) $44\ 100 \times 16 \times 2 = 1\ 411\ 200$ bits/second
 $1\ 411\ 200/8 = 176\ 400$ (bytes)
(two marks for correct answer. If answer is incorrect, award one mark for a good attempt at the calculation.) [2]
- (ii) 3 minutes = 180 seconds
 $176\ 400 \times 180 = 31\ 752\ 000$ bytes
= 30.281 (megabytes) (allow 0, 1, 2 or more decimal places)
(two marks for correct answer. If answer is incorrect, award one mark for a good attempt at the calculation, allowing follow through from (i)) [2]

- 7 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.
- 8 An image is 1200 pixels by 1600 pixels. Calculate:
i the total number of pixels in the original image
ii the number of bytes occupied by this file 121
iii the file size of the jpeg image (in kilobytes) if the original image was reduced by a factor of 8.
b A second image is 3072 pixels by 2304 pixels. Calculate:
i the total number of pixels in the original image
ii the number of bytes occupied by this file
iii the file size of the jpeg image (in megabytes) if the original image was reduced by a factor of 5.
iv How many uncompressed files of the size calculated in part (ii) could be stored on a 4-gigabyte memory card?
v How many compressed files of the size calculated in part (iii) could be stored on the same 4-gigabyte memory card?
- 9 Estimate the size of a file for each of the following:
a Text file containing 256 characters.
b Word processor document containing 1000 characters and a small image which is 256×256 pixels in size (assume an extra 14KB for other document features).
c A database is to contain a person's name and their address.
i Decide the maximum number of characters you would need to input a name and an address.
ii Estimate the maximum size of file needed to store the name and address.
d A security system contains a password (16 characters long), a username (20 characters long), a small photo (256×640 pixels in size) and a security question (up to 72 characters long). Estimate the file size needed to store all this data.





Data Transmission

Q. (a) State what is meant by the terms:

Parallel data transmission

Serial data transmission

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

Parallel data transmission

Benefit

Serial data transmission

Benefit

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

Parallel data transmission

Application

Serial data transmission

Application

(a) parallel

any one from:

– 8 bits/1 byte/multiple bits sent at a time

– using many/multiple/8 wires/lines (1 mark)

serial

any one from:

– one bit sent at a time

– over a single wire (1 mark) [2]

(b) parallel

– faster rate of data transmission (1 mark)

serial

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) parallel

any one from:

– sending data from a computer to a printer

– internal data transfer (buses) (1 mark)

serial

– connect computer to a modem (1 mark) [2]

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Q. 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

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

(c) Give the denary (base 10) value of the byte: **1 0 1 1 1 1 1 0**

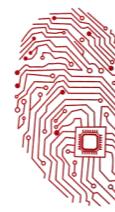
(d) A parity check may not identify that a bit has been transmitted incorrectly.

Describe **one** situation in which this could occur.



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(a) 1 mark per correctly placed tick

Received byte	Byte transmitted correctly	Byte transmitted incorrectly
1 1 0 0 1 0 0 0		<input checked="" type="checkbox"/>
0 1 1 1 1 1 0 0		<input checked="" type="checkbox"/>
0 1 1 0 1 0 0 1	<input checked="" type="checkbox"/>	

[3]

(b) (i) byte number: 7

column number: 6

(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:

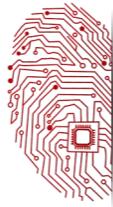
- 2 bits interchanged (e.g. 1 → 0 and 0 → 1) that won't change parity value
- even number of bits/digits are transposed
- If there are multiple errors in the same byte/column, that still produce the same parity bit, the error will not be detected

[1]



Computer Science 2210 (P1)

ZAK's Recommended Question Bank for CAIE M/J 2019.



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- Q.** A satellite television receiver has a number of channels:

Category	Channels
News	10 to 19
Film	20 to 29
Plays and documentaries	30 to 39
Sport	40 to 49
Comedy	50 to 59
Special interest	60 to 69
Motoring and leisure	70 to 79

A user keys in a choice of channel using a handset.

The handset and the receiver are each controlled by a microprocessor.

When a user keys in 34, this value is stored in an 8-bit register as shown below:

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

the 8th bit is the parity bit

- (a)** A user keys in 47.

Show the value stored in the 8-bit register.

[1]

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

- (b)** Calculate which channel has been selected if the 8-bit register contains:

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

[1]

- (c)** Describe what could happen if the handset transmits the following selection:

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

[2]

- (d)** Even parity is used when the handset transmits data to the receiver.

Give the parity bit that is required in the 8-bit register in part (c).

..... [1]

- (e)** The satellite transmits data. Serial, simplex transmission is used.

Describe what is meant by the following two terms:

Serial

Simplex

[4]





(a)

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

[1]

(b) channel 75

[1]

(c) error message would occur

channel 84 is not available // nothing would happen

[1]

(d) 1

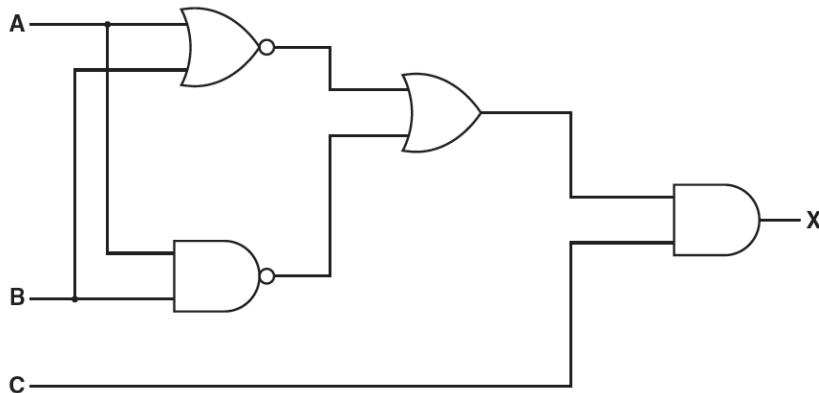
[1]

(e) bits sent one at a time along a single channel

transmission is in one direction only

[2]

- Q.** The following logic circuit is used to monitor part of a chemical process. A, B and C are binary values input to the logic circuit from the chemical process.
X is the binary value output from the logic circuit.



The output, X, from the logic circuit is sampled every 30 seconds by a computer.

The sequence of output values is stored in a block of 1 byte memory locations. Each byte stores seven samples, filling from position 0 to position 6. Position 7 is reserved as a parity bit.

(b) (i) Give the denary value if the byte contains:

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

[1]

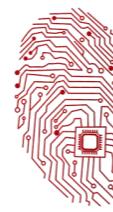
(ii) Show what binary value must be stored in the byte to represent the denary value 43.

7	6	5	4	3	2	1	0

[1]

Computer Science 2210 (P1)

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(c) As soon as ten bytes are filled, the data are sent to a central computer.

(i) The data are sent using half-duplex, serial transmission.

Explain these terms:

Half-duplex [1]

(ii) The transmission uses a protocol.

Describe what is meant by a protocol.

.....

Describe why a protocol is necessary. [4]

(d) Even parity is used to check whether any errors occurred during transmission.

The table below shows the first ten byte samples received by the central computer. An extra byte (the parity byte) is sent after each block of ten bytes.

	bit 7	bit 6	bit 5	bit 4	bit 3	bit 2	bit 1	bit 0
byte 1	0	1	0	0	0	1	1	1
byte 2	1	1	1	0	0	1	1	1
byte 3	0	0	0	0	1	1	0	0
byte 4	1	1	1	0	0	1	0	0
byte 5	1	0	0	1	1	0	1	0
byte 6	1	1	0	0	0	0	1	1
byte 7	1	1	1	1	0	0	0	1
byte 8	0	1	1	0	1	1	0	0
byte 9	1	0	0	0	0	0	0	1
byte 10	0	0	0	1	1	1	1	0
parity byte	0	0	0	1	0	1	1	1

One of the received bytes contains a single error.

(i) Identify the byte that contains the incorrect bit.

..... [1]

(ii) Identify the bit position that contains the incorrect bit.

..... [1]

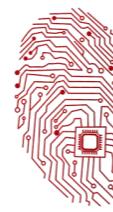
(iii) Explain why, when using this parity block system, that there is no need for the incorrect byte to be re-transmitted.

..... [2]



Computer Science 2210 (P1)

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(b) (i) 120

[1]

(ii)

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

[1]

(c) (i) – transmission can take place in both directions BUT only one direction at a time [2]

– data sent a bit at a time along a single wire/channel

– bits sent sequentially

(ii) – set of rules agreed before data transmission starts

[2]

– so that the transmission is correctly received

// agreed baud rate/parity/duplex or simplex/serial or parallel/synchronous

– so that hardware from different sources is compatible

Q. (a) Explain what is meant by HTML

(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.

(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]



Computer Science 2210 (P1)

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- Q.** (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

- (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.

- (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

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

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

(a) (i) 1 mark for correct check digit and 1 mark for showing the calculation

$$(4 \times 1) + (2 \times 2) + (4 \times 3) + (1 \times 4) + (5 \times 5) + (0 \times 6) + (8 \times 7)$$

$$= 4 + 4 + 12 + 4 + 25 + 0 + 56 = 105$$

$$105/11 = 9 \text{ remainder } 6$$

check digit is: 6

(ii) 1 mark

– No/incorrect check digit

2 marks

– Total is 78

– 78/11 ...

– ... gives 7 remainder 1

– check digit should be 1



Computer Science 2210 (P1)

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

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

parity bit	1	0	0	0	0	0	0	1
	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

Q. Name the hardware device that is being described:

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

..... [1]

Computer Science 2210 (P1)

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- lossy techniques make decision about what parts of sound/sound file are important and discards other information
 - only keeps sounds human ear can process/discards sounds most people cannot hear
 - ... then applies lossless technique, for further reduction
 - lossy compression can reduce to about 10%
 - an example of jpeg, mp3 or other correct examples of compressed formats.
- No double credit to opposite answers, e.g. lossless maintains detail, but lossy loses detail just one mark.

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

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

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

(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

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

Describe the function of these characters.

%20

?

(a)

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

accept words TRUE or FALSE in right hand column

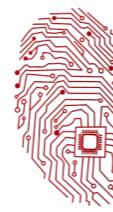
1 mark per tick, -1 mark for each wrong tick if more than 2

[2]



Computer Science 2210 (P1)

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- (b) (i) http – enables browser to know what protocol is being used to access information in the domain cie.org.uk – cie.org.uk is the domain name
computerscience.html – actual web page / file being viewed [3]
- (ii) %20 – because <space> not allowed in a URL, %20 is the coding for a space (32 in denary)
? – separates the URL from all parameters or variables [2]

- Q. A company operates a chemical plant, which has a number of processes. Local computers monitor these processes and collect data.
The computers transfer these data to a central computer 50 km away. A telecommunications company (telco) provides cables.
Engineers at the telco had to decide which type of cable to use. They considered the use of either copper cable or fibre optic cable.

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

Benefits of copper cable

- 1
2

Benefits of fibre optic cable

- 1
2

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

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

[4]

- Q. 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.



Computer Science 2210 (P1)

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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

- Q.** Data are to be transferred between two devices. Parity checks are carried out on the data. Explain what is meant by a parity check. Give an example to illustrate your answer.
(b) any four from:
– parity can be even or odd
– parity check uses the number of 1s in a binary pattern
– if there is an even / odd number of 1s, then the parity is even / odd
– following transmission ...
– parity of each byte checked
– a parity bit is used to make sure binary pattern has correct parity
– example: 1 0 0 1 0 1 1 1 has parity bit set to 1 in MSB since system uses odd parity (original data: 0 0 1 0 1 1 1 which has four 1 bits) [4]
- Q.** When storing music tracks in a computer, the MP3 format is often used. This reduces file size by about 90%. Explain how the music quality is apparently retained.
any three from:
– mp3 is a lossy compressed format
– uses psycho-acoustic modelling
– and perceptual music/noise shaping
– certain parts of the music can be eliminated without significantly degrading the listener's experience
– removes sound that the human ear can't hear
– only keeps sounds human ear can hear better than others
– discards softer sound if two sounds played together [3]
- Q.** (a) An IP address has the following value:
11.64.255.90
(i) Write the above IP address in hexadecimal.
.....
(ii) Explain the format of an IP address.
.....
(b) Study the following sentence:
“When a user enters a URL into their web browser, the DNS service locates the required resource.” Explain how a URL and DNS are used to locate a resource.
.....
(a) (i) 0B . 4 0 . F F . 5 A



Computer Science 2210 (P1)

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1 mark per byte, deduct one mark if no dots or if alternative separator used [4]

(ii) Any two from:

– composed of four (denary or Hexadecimal) integers

– each in the range 0–255/00–FF

– each stored in 1 byte/8 bits/stored in 32 bits

– (in IPv4) separated into network ID and host ID [2]

(b) Maximum 3 marks for URL and maximum 3 marks for DNS

– URL = uniform resource locator

– reference address to a resource/website on the Internet

– includes protocol used /includes domain name

– browser software sends URL to DNS

– DNS = Domain name system // Domain name service // Domain name server

– the true domain name (e.g. cie_exams.co.uk) is resolved/turned into an IP address by DNS

– DNS server stores a database/list of URLs with matching IP address

– a DNS server may need to pass a request onto another DNS server, (if URL not in its database)

– DNS server adds returned IP address and URL to its cache/database

– DNS server may return an error message if requested domain name is invalid or does not exist

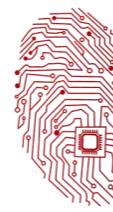
– the DNS service has a hierarchy/or by example

– DNS server returns IP address to browser [4]



Computer Science 2210 (P1)

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- Q.** During transmission data can be corrupted. Check sums and parity checks can be carried out on the data.
(a) Explain how check sums and parity checks are used to detect transmission errors.
-Check sum is the result of adding all the bytes of data (and ignoring the carry out of the byte)
-The result is sent along with the data and
-Checked against the total calculated as the data arrives
-If the two totals differ then a transmission error has occurred
-Parity involves every byte having its bits adding to either an odd or even total
-Type of parity must be agreed between sender and recipient
-Use of a parity bit to make each byte the correct type
-If bit is changed during transmission then the sum of bits will not match parity type
(1 per -, max 2 per type of check, max 4) (4)

- Q.** Calculate the checksum for blocks of data with the following byte sums:

- a** 148
- b** 905
- c** 1450
- d** 4095



Computer Science 2210 (P1)

ZAK's Recommended Question Bank for CAIE M/J 2019.



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Security & Ethics

- Q.** 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 minimise the risk
- Security risk 2
Why it is a risk
How to minimise the risk
- Security risk 3
Why it is a risk
How to minimise the risk

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

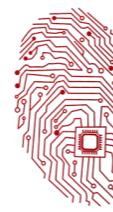
encrypt data/encryption

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



Computer Science 2210 (P1)

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Q. 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.

.....

(ii) Explain what is meant by computer ethics.

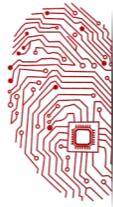
.....

(a) (i) Free software / open source software [1]

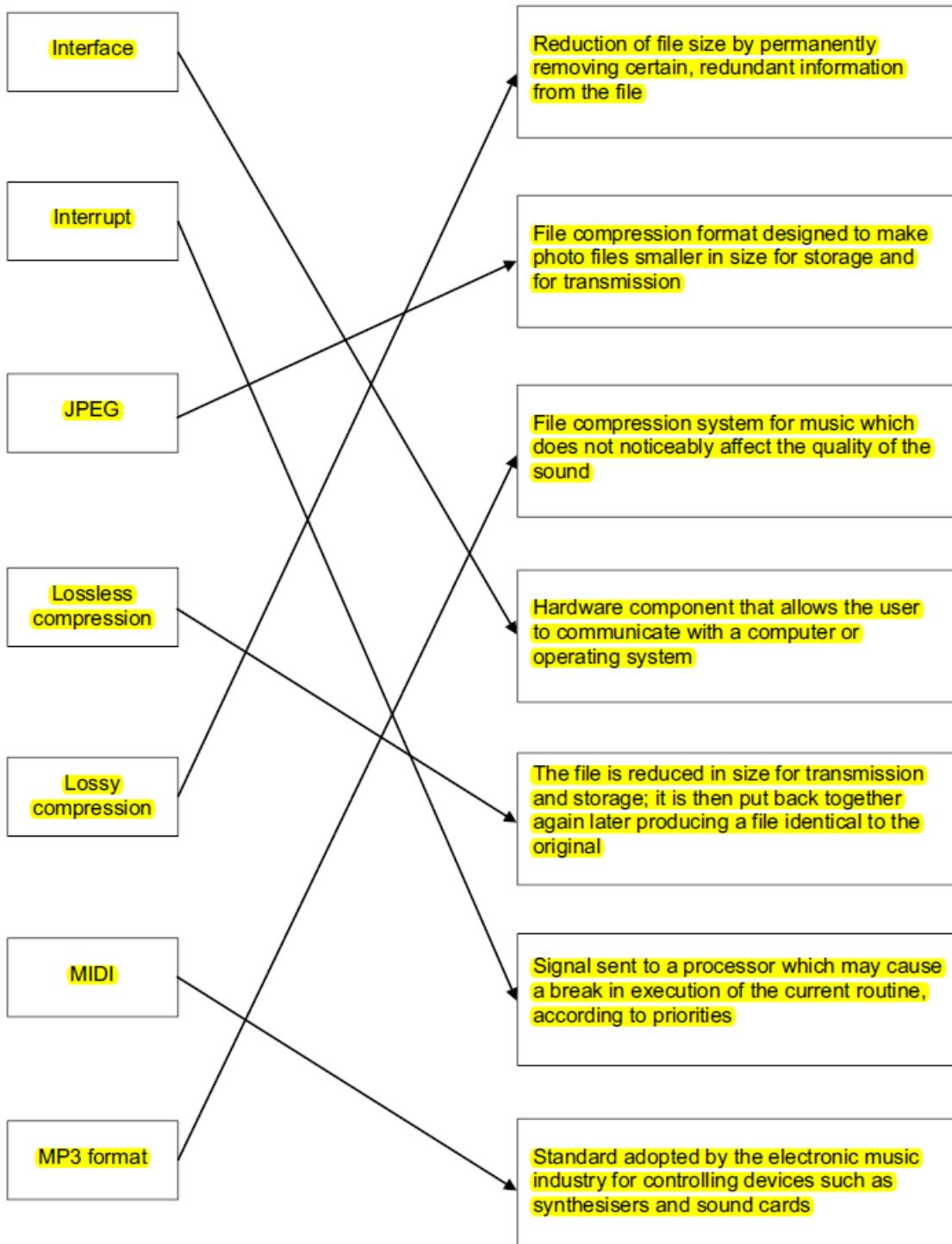
(ii) Any three from:

- 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)





Q. Seven computer terms and seven descriptions are shown below. [5]



Computer Science 2210 (P1)

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- Q. The four statements below refer to firewalls and proxy servers.
Study each statement.
Tick (✓) the appropriate column(s) to indicate whether the statement refers to a firewall and/or a proxy server.

(b) 1 mark for each CORRECT row

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	✓	✓

- Q. Explain three ways of preventing accidental loss or corruption of data.

[5]

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]

- Q. 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.....

Theprocesses the original message.

The output is known as

[5]

Question 06: 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?

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



Computer Science 2210 (P1)

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

(iii) Name another file compression format.

symmetric encryption

encryption key

plain text

encryption algorithm

cipher text [5]

Q. 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. [5]

1 mark per correct word

1 protocol

2 web server name

3 file name



accept these three items in any order

HTML tags/text

firewall

proxy server



Computer Science 2210 (P1)

ZAK's Recommended Question Bank for CAIE M/J 2019.



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- Q.** (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

- (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 the 7 8 digits.

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

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

Name

Description

2	5	1
6	8	3
9	0	4
		7

(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/touchscreen 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]



Computer Science 2210 (P1)

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

(a) Any one from:

- secure sockets layer
- encrypts data being transmitted
- use of https
- use public and private keys

[1]

(b) 1 mark for each number in the correct order, next to the correct stage.

Stage	Sequence number
the encrypted data is then shared securely between the web browser and the web server	6
<i>the web browser attempts to connect to a web site which is secured by SSL</i>	(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

[5]

[5]

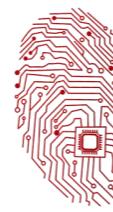
- Q. (a) Four statements about cookies are shown in the table below. Study each statement. Tick (✓) to show whether the statement is true or false.

(a) 1 mark per correctly placed tick

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

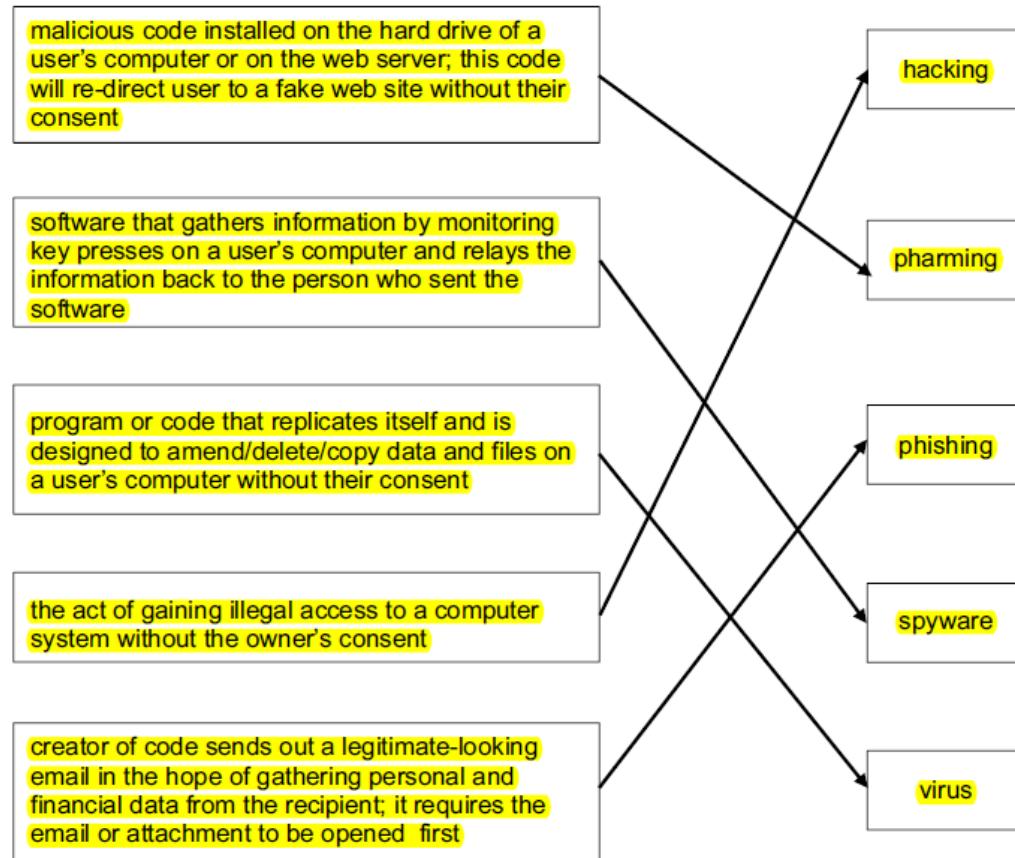
[4]





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

(b)



4/5 matches – 4 marks
3 matches – 3 marks
2 matches – 2 marks
1 match – 1 mark

[4]

[5]

Q. 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.

1.....

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.

2.....

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.

3.....

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.

4.....



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

5.....

[5]

1 mark per correct word

Freeware

Shareware

Free software

(Computer) Ethics

Plagiarism

[5]

Q. A hospital has decided to computerise its administration system.

The hospital will be using a database which holds confidential personal data.

(a) State two precautions that the hospital should take to prevent unauthorised access to the data.

[2]

(b) Describe how the database could be recovered if it became corrupted.

[1]

(c) A school Science department is going to use a database to record details about its equipment. Part of the database is shown below:

Equipment	Code No	Quantity in Stock	Need to re-order?	Supplier Name	Price (\$)	Stock Value (\$)
Beaker	01043	25	Y	Labquip	1.04	26.00
Test tube	01051	200	N	Labquip	0.40	80.00
Clamp stand	01065	51	N	Anglera	3.25	165.75
Tongs	01151	23	Y	Anglera	0.55	12.65
Spatula	01222	62	N	Anglera	0.66	40.92
Flask	01341	15	Y	Labquip	1.70	27.50

(i) As data is entered it needs to be verified. Describe one way this could be done.[1]

(ii) Data also needs to be validated. Using fields from the database as examples,

Describe two different validation checks which could be performed on the Code No and Supplier Name field?

[2]



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7 (a) Any three points from:

deskilling
retraining needed
loss of jobs
frees staff from admin jobs
less time wasted looking for lost paperwork

[3]

(b) Any two from:

passwords (changed regularly)
use of ids/log on ids/user names
firewalls
physical measures (e.g. locked rooms)
logging off after use

encryption = 0
removal of external memory = 0

[2]

(c) Any one point from:

use of back up files
generations of files (GFS)

[1]

(d) amend - change name/address/doctor etc. change of age = 0

- new illness
- re-admission

delete - patient leaves area/country leaves hospital = 0

- patient dies

insert - new patient arrives
- new baby born

[3]



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- Q.** The following five statements about Internet security are incomplete:
- (i) Illegal access to a computer system is known as <-----(a)---->.
 - (ii) <-----(b)----> are programs that self-replicate (copy themselves) and are designed to disrupt computer systems.
 - (iii) <-----(c)----> is where a user is sent legitimate-looking emails; as soon as the email is opened and the recipient clicks on the embedded link, they are sent to a fake website.
 - (iv) Software that monitors key presses on a user's keyboard, and relays the information back to the person who sent the software, is known as <-----(d)---->.
 - (v) <-----(e)----> is malicious code or software installed on the hard drive of a user's computer or on a web server; the code or software will re-direct the user to a fake website without their knowledge.

Complete the five statements using words from the following list:

- cookies
- hacking
- pharming
- phishing
- spam
- spyware
- viruses
- web browsers

- (a) hacking [1]
(b) viruses [1]
(c) phishing [1]
(d) spyware [1]
(e) pharming [1]

- Q.** 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.

- (ii) Explain what is meant by computer ethics.

[5]

- a) (i) Free software / open source software [1]

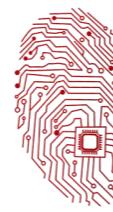
- (ii) Any three from:

- 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)



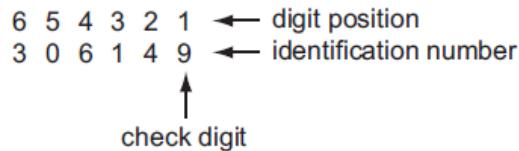
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- Q.** A company selling CDs uses a unique 6-digit identification number for each CD title. The rightmost digit (position 1) is a check digit.
For example,



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 arrived at your answer. [3]

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?

(b) Find the check digit for this identification number. [2]

5 0 2 4 1 _

working:

check digit:

(c) Describe, with examples, two different types of data entry errors that a check digit would detect. [2]



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- (a) 1 mark for the correct working in BOTH parts
1 mark for valid
1 mark for not valid

Identification number 1: working

$$\begin{aligned} &= (4 \times 6) + (2 \times 5) + (1 \times 4) + (9 \times 3) + (2 \times 2) + (3 \times 1) \\ &= 24 + 10 + 4 + 27 + 4 + 3 \\ &= 72 \div 11 \\ &= 6 \text{ remainder } 6 \\ &\underline{\text{valid/not valid: NOT valid}} \end{aligned}$$

Identification number 2: working

$$\begin{aligned} &= (8 \times 6) + (2 \times 5) + (0 \times 4) + (1 \times 3) + (5 \times 2) + (6 \times 1) \\ &= 48 + 10 + 0 + 3 + 10 + 6 \\ &= 77 \div 11 \\ &= 7 \text{ remainder } 0 \\ &\underline{\text{valid/not valid: VALID}} \end{aligned}$$

[3]

- (b) 1 mark for correct working + 1 mark for check digit

working

$$\begin{aligned} &= (5 \times 6) + (0 \times 5) + (2 \times 4) + (4 \times 3) + (1 \times 2) \\ &= 30 + 0 + 8 + 12 + 2 \\ &= 52 \end{aligned}$$

need to add 3 to make the total 55 (i.e. exactly divisible by 11)

check digit: 3

[2]

- (c) 1 mark for each description and example

2 digits transposed

(e.g. 280419 becomes 280149/two digits have been switched)

incorrect digit

(e.g. 280419 becomes 250419/one of the digits has been mistyped)

[2]



Computer Science 2210 (P1)

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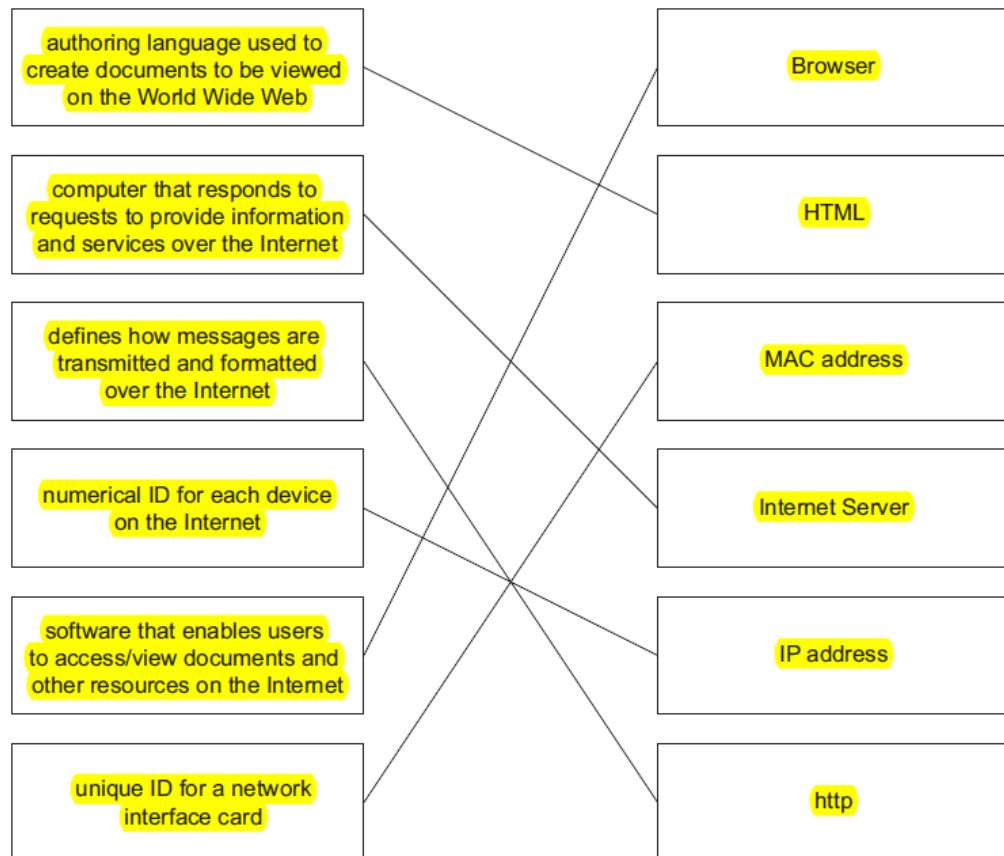


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Q. Ahmed uses the Internet for some time and is puzzled by the terminology.

(a) Draw a line to match each description to the appropriate technical term.

[5]



5/6 matches – 5 marks

4 matches – 4 marks

3 matches – 3 marks

2 matches – 2 marks

1 match – 1 mark

[5]

(b) Ahmed sees the message “Set your browser to accept cookies”. Explain why some websites make this request. [2]

(b) any two from:

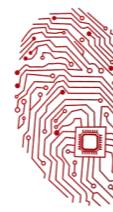
- to enable logon information to be kept on his computer
- to provide pages customised for Ahmed the next time he logs on
- to implement shopping carts and one-click purchasing
- to be able to distinguish between new and repeat visitors to the website

[2]



Computer Science 2210 (P1)

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- Q. 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.

(a) maximum of two marks for firewall description + maximum of two marks for authentication description

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) 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]

(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) 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]

- Q. Paul works part-time for a large software company. The company sells security software to a number of banks. He also runs his own software company that produces and sells computer games.

Six statements about computer ethics are shown below.

Draw lines to indicate whether each statement describes ethical or unethical behaviour.

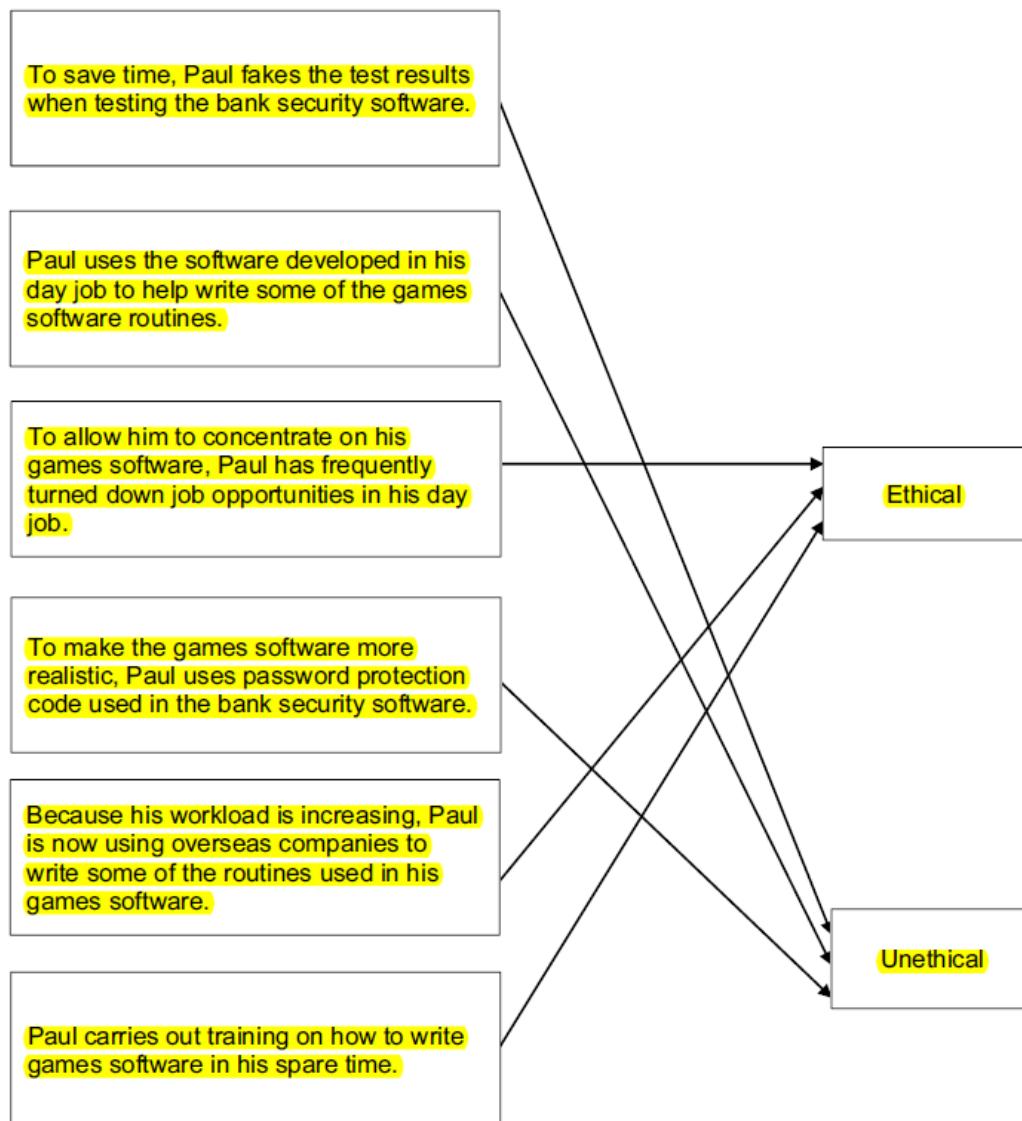


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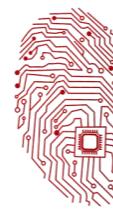


1 mark for each correct line, two lines from one box is incorrect



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- Q.** (a) Give a brief description of each of the following terms:

Validation

Verification

[2]

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

validation

– check whether data is reasonable / meets given criteria

verification

– method to ensure data which is copied / transferred is the same as the original

– entering data twice and computer checks both sets of data

– check entered data against original document / source [2]

- Q.** (a) Explain the term computer virus.

[2]

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

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

[2]

(a) any two from:

– malicious code / software / program

– that replicates / copies itself

– can cause loss of data / corruption of data on the computer

– can cause computer to “crash” / run slowly

– can fill up hard disk with data [2]

(b) any two from:

– checks for boot sector viruses when machine is first turned on

– when an external storage device is connected

– checks a file / web page when it is accessed / downloaded [2]



Computer Science 2210 (P1)

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- Q.** Bobby is a senior programmer at a software house which produces intruder detection software. He also runs his own software company which develops and sells various computer applications. The following table shows seven activities which Bobby carries out. Put a tick (✓) in the appropriate column to identify if the activity is ethical or unethical

One mark for each correctly placed tick.

Activity	Ethical	Unethical
Gives away passwords used in the intruder detection software		✓
Uses source code developed at the software house for the software he develops for his own company		✓
Insists that staff work to deadlines	✓	
Turns down training opportunities offered by his employer		✓
Writes and sells software that reads confidential data from client computers		✓
Fakes test results of safety-critical software		✓
Has the software applications developed overseas for sale in his own country	✓	

- Q.** List ten commandments of computer ethics.

The Computer Ethics Institute has published their "Ten Commandments of Computer Ethics" to guide responsible computer use. They are as follows:

1. Thou shalt not use a computer to harm other people.
2. Thou shalt not interfere with other people's computer work.
3. Thou shalt not snoop around in other people's computer files.
4. Thou shalt not use a computer to steal.
5. Thou shalt not use a computer to bear false witness (aka Lie).
6. Thou shalt not copy or use proprietary software for which you have not paid.
7. Thou shalt not use other people's computer resources without authorization or proper compensation.
8. Thou shalt not appropriate other people's intellectual output.
9. Thou shalt think about the social consequences of the program you are writing or the system you are designing.
10. Thou shalt always use a computer in ways that ensure consideration and respect for your fellow humans.



Computer Science 2210 (P1)

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- Q.** Distinguish between free software, freeware and shareware

Freeware Software:

Freeware is copyrighted software that is licensed to be copied and distributed without charges.

Freeware is free because the license says it is, but it's still under the owners control.

Example:

Netscape

Internet Explorer

Shareware Software:

The software is licensed for copying and sharing for a trial period, but payment must be made to the owner for permanent use.

Free software:

Freedom-respecting software, software libre, or libre software[1][2] is computer software that gives users the freedom to run the software for any purpose as well as to study, change, and distribute the software and any adapted versions.[3][4][5][6][7] The right to study and modify free software grants access to its source code.

- Q.** Many bank customers now bank on-line using the Internet.

(a) State two advantages for the bank of on-line banking.

[2]

(b) State two disadvantages for a bank customer of on-line banking.

[2]

(c) Give two advantages to customers of using Internet banking.

[2]

(d) Give two disadvantages to customers of using Internet banking.

[2]

(a) Two advantages for the bank from

less staff/employment costs/queues in the bank

can close branches/less costs for maintaining branches

less paper/electronic transactions/less cheques/less cash/no cheques/no cash

new international customers

[2]

(b) Two disadvantages for the customer from

need to have/be able to use devices capable of accessing the internet

cannot have the personal service offered by the conventional bank

cannot get cash/cannot put in cash

insecure/security risks/fraud/hacking

cost of ISP/phone bill

if there is no broadband then the phone lines are tied up

[2]

- Q.** List the difference between Copyright Vs. Plagiarism.



Computer Science 2210 (P1)

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- Q. Can you decipher this code? Here's a hint: 11 = A; 10 = Z. Enter the message in the space below.

4	18	15	13	19	11	19	3	22	25	13	11	4	15	14
19	24		22	11	24	17	22	15	9,	6	11.			

Message 3

THE CIA IS LOCATED IN LANGLEY, VA.

- Q. No need for a decoder. Just pick out every third letter!
Use all CAPITAL letters when entering your answer.

WIGSAEPTNENECVRZNALTL QIDXBOXKJNTJORUVSFALON PYIRTS
GFCAIOYUNNDSHLIWEDNKEQURCBEMHD ROTFTHSIE APFETAOPTHLHVJEXER
CJOAIF XCMGKOEMDFZEPGRBAN GHAFIMWEERURDKINYCCCALHN
ZOIQUNAVTORETLUNLEWISKGIBEAGNSPCITE
TAGBRAYMTVWHQIEPFRGWIPVNBZG.

GENERAL DONOVAN IS CONSIDERED THE FATHER OF MODERN AMERICAN INTELLIGENCE GATHERING.



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Page 105 of 126

Computer Science 2210 (P1)

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Computer Architectures and the Fetch-Execute Cycle

1. The next instruction to be carried out is

LDAN 25

which loads the number 25 into the accumulator.

With reference to the special registers in a processor, describe the stages of the fetch-execute cycle when dealing with this instruction. [6]

1.
 - Contents of PC copied into MAR/address of instruction in MAR
 - Contents copied from address into MDR/instruction held in MAR
 - Contents of MDR copied into CIR/instruction is put in CIR
 - Contents of CIR decoded
 - The number/25 from CIR copied into MDR
 - Contents of MDR copied into accumulator/25 is placed in accumulator
 - Incrementing PC at any stage

max 6

(6)

2. Describe the fetch/decode/execute/reset cycle when an ADD instruction is being executed.

You should include

- _ Program Counter (PC)
- _ Memory Address Register (MAR)
- _ Memory Data Register (MDR)
- _ Current Instruction Register (CIR)
- _ Accumulator

in your answer.

[7]

2.
 - Value in PC placed in MAR
 - PC incremented (anywhere)
 - Contents of address in MAR placed in MDR
 - Contents of MDR placed in CIR
 - Op code in CIR is decoded
 - Address is copied from CIR to MAR
 - Contents of address in MAR placed in MDR/sent to accumulator
 - Contents of MDR sent to accumulator
 - Registers reset ready for next instruction

(1 per -, max 7)

(7)

3. (a) Describe what is meant by Von Neumann architecture. [3]

- (b) Explain the purpose of each of the following special registers in a processor.

(i) Program Counter (Sequence Control Register).

[2]

(ii) Current Instruction Register.

[2]

(iii) Memory Address Register.

[2]

(iv) Memory Data Register.

[2]

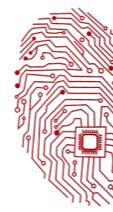
(v) Accumulator.

[2]



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3

- (a) Program is stored in memory along with data
programs and data are indistinguishable
Uses a single processor
Sequential carrying out of instructions
(1 per point, max 3) (3)
- (b) (i) Contains the address of the next instruction to be carried out
Controls the sequence of instructions
(ii) Holds the instruction while it is being executed
Contains both function and address/operand
(iii) Holds the address of the instruction/data that is next to be used
(Must have first mark point before any credit)
(iv) Contents of any address that has been accessed are placed in here first before being used
May be an instruction or a piece of data
OR:
Holds data/instructions
When being passed between memory and CPU/acts as a buffer between memory and CPU
(v) Stores results of calculations/does the arithmetic
All input to and output from processor pass through the accumulator
(1 per point, max 2 per dotty, max 10) (10)

4. JUMP 300 is an instruction to be executed by a processor. It means that the next instruction the processor should process is held in location 300.

Describe the stages of the fetch/decode/execute cycle and the effects on the contents of the registers in the processing of this instruction. [7]

4. -Address of instruction in PC...
-is copied to MAR
-PC is incremented
-Contents of address in MAR...
-copied to MDR
-(Contents of MDR) copied to CIR
-Decode instruction in CIR
-Load address (300) in CIR into PC
(1 per -, max 7) (7)

5. A processor is to carry out the instruction ADD 200. This instruction means that the contents of memory location 200 should be added to the accumulator.



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Describe the steps of the fetch-execute cycle, stating the effect on the registers in the processor, when carrying out this instruction. [8]

- 5. -Address of instruction in PC
 - copied to MAR
 - Contents of address in MAR
 - copied to MDR
 - Contents of MDR copied to CIR
 - Decode instruction in CIR
 - Load address in CIR into MAR
 - Load contents of address in MAR into MDR
 - Add contents of MDR to accumulator
 - Increment PC (at any stage)
- (1 per -, max 8) [8]

6. (a) (i) State what is held in the Program Counter (PC) during the fetch/execute cycle. [1]

- (ii) Explain how the contents of the PC change during the fetch/execute cycle. [4]

6. (a) (i) The address of the next instruction [1]
(ii) Originally set to point to first instruction in the program
-After the contents have been used/passed to memory address register (MAR)
-PC is incremented
-If the current instruction is a jump instruction (whose conditions are met)...
-then the PC is reset to the address in the instruction
(1 per -, max 4) [4]

- (b) Describe the contents of the memory address register (MAR) during the fetch/execute cycle. [4]

- (b) -Holds the address of next instruction...
-when passed from PC
-Holds the address of data location to be accessed...
-when passed from CIR
-Holds the address of memory location currently in use
(1 per -, max 4) [4]

7. Name three different types of bus in a processor and state what each is used for. [6]

7. e.g.-Data bus
-to carry data from one location to another in processor // e.g. from MDR to CIR
-Address bus
-carries the address of a memory location // e.g. Address of location in memory from MAR
-Control bus
-Carries control signals around processor // to synchronise the operation of the processor components // by example: memory read/write completed // each line carries a different signal.



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Accept: system bus, memory bus, firewire, USB, PCI + explanation
(2nd mark is dependent on correct bus name)
(2 per -, max 6)

[6]



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Page 109 of 126



Logic Gates

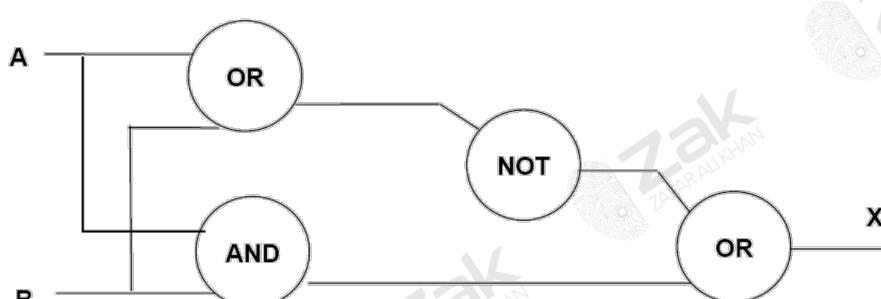
In questions 1 to 6, produce truth tables from the given logic networks. Remember that if there are TWO inputs then there will be four (2²) possible outputs and if there are THREE inputs there will be eight (2³) possible outputs.

i.e.

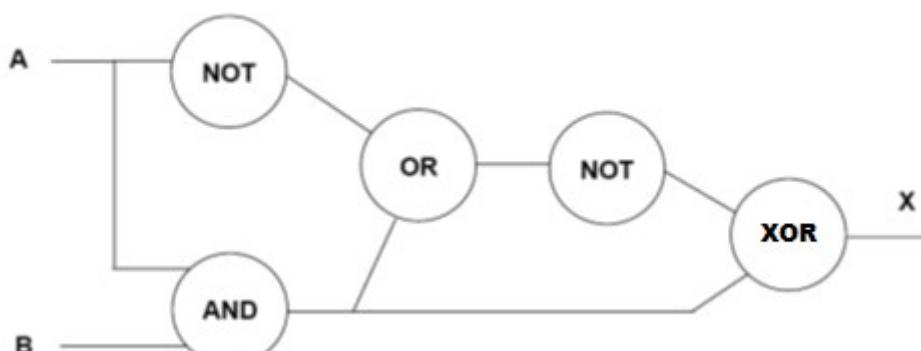
A	B	C	X
1	1	1	
1	1	0	
1	0	1	
1	0	0	
0	1	1	
0	1	0	
0	0	1	
0	0	0	

A	B	X
1	1	
1	0	
0	1	
0	0	

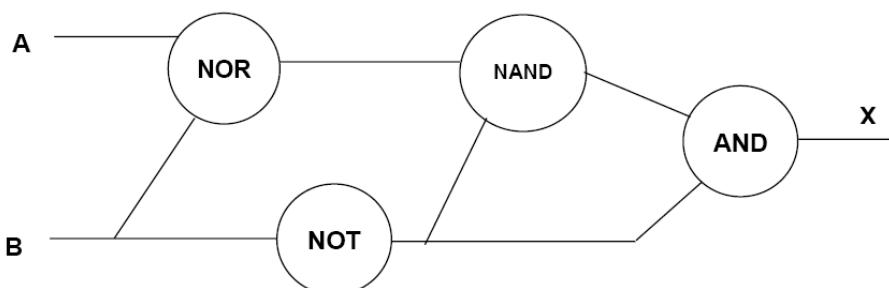
(1)



(2)

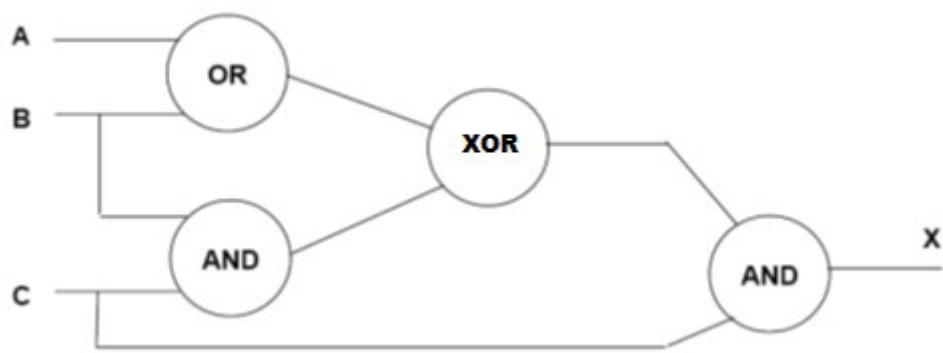


(3)

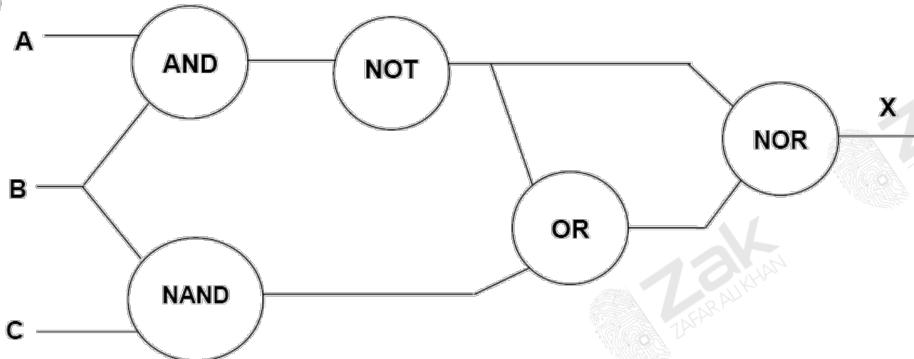




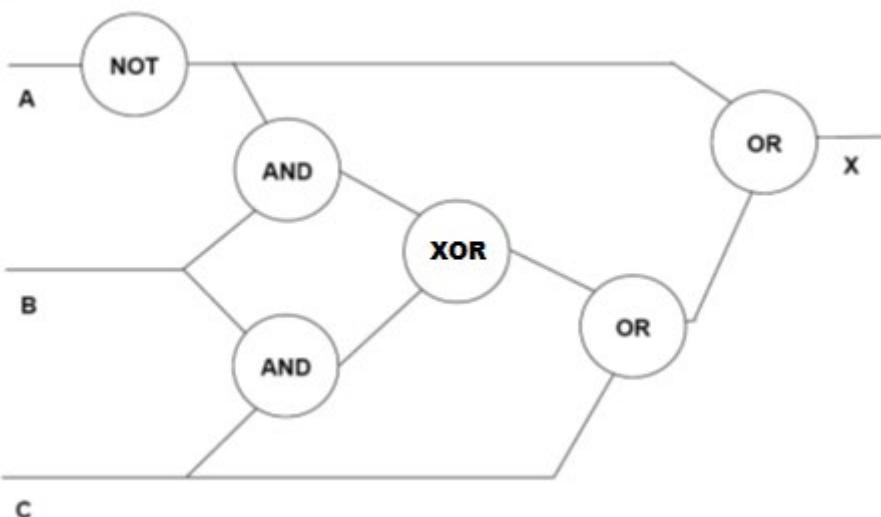
(4)



(5)

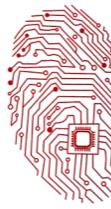


(6)



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Questions 7 to 10 require both the logic network to be created and also the truth table. The truth table can be derived from the logic network, but also from the problem. This is a check that the logic network actually represents the original problem.

(7) A computer will only operate if three switches P, S and T are correctly set. An output signal ($X = 1$) will occur if P and S are both ON or if P is OFF and S and T are ON. Design a logic network and draw the truth table for this network.

(8) A traffic signal system will only operate if it receives an output signal ($D = 1$). This can only occur if:

- either (a) signal A is red (i.e. $A = 0$)
 - or (b) signal A is green (i.e. $A = 1$) and signals B and C are both red (i.e. B and C are both 0)
- Design a logic network and draw a truth table for the above system.

(9) A chemical plant gives out a warning signal ($W = 1$) when the process goes wrong. A logic network is used to provide input and to decide whether or not $W = 1$.

Input	Binary Value	Plant Status
C	1	Chemical Rate = $10 \text{ m}^3/\text{s}$
	0	Chemical Rate < $10 \text{ m}^3/\text{s}$
T	1	Temperature = 87°C
	0	Temperature > 87°C
X	1	Concentration > 2 moles
	0	Concentration = 2 moles

A warning signal ($W = 1$) will be generated if

- either (a) Chemical Rate < $10 \text{ m}^3/\text{s}$
- or (b) Temperature > 87°C and Concentration > 2 moles
- or (c) Chemical rate = $10 \text{ m}^3/\text{s}$ and Temperature > 87°C

Draw a logic network and truth table to show all the possible situations when the warning signal could be received.

(10) A power station has a safety system based on three inputs to a logic network. A warning signal ($S = 1$) is produced when certain conditions occur based on these 3 inputs:

Input	Binary Value	Plant Status
T	1	Temperature > 120°C
	0	Temperature $\leq 120^\circ\text{C}$
P	1	Pressure > 10 bar
	0	Pressure $\leq 10 \text{ bar}$
W	1	Cooling Water > 100 l/hr
	0	Cooling Water $\leq 100 \text{ l hr}$

A warning signal ($S = 1$) will be generated if:

- either (a) Temperature > 120°C and Cooling Water < 100 l hr
- or (b) Temperature < 120°C and (Pressure > 10 bar or Cooling Water < 100 l hr)

Draw a logic network and truth table to show all the possible situations when the warning signal could be received.



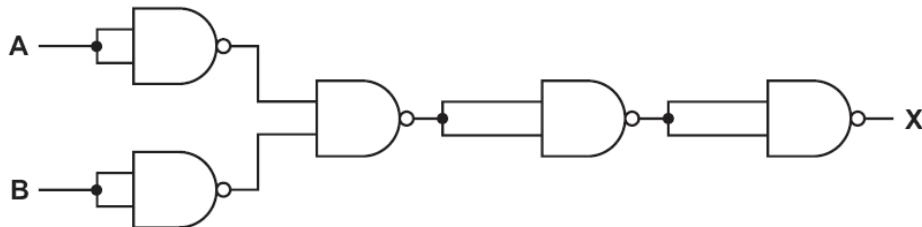
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- 12 (a) (i) Complete the truth table for the following logic circuit, which is made up of NAND gates:



A	B	X
0	0	
0	1	
1	0	
1	1	

[2]

- (ii) What single logic gate has the same function as the above logic circuit?

[1]

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Page 113 of 126

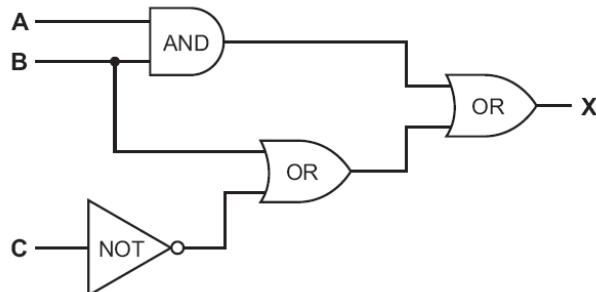
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(b) Complete the truth table for the following logic circuit:

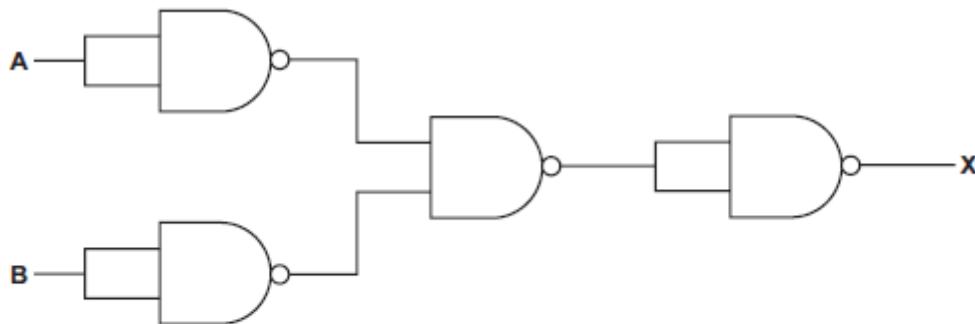


A	B	C	X
0	0	0	
0	0	1	
0	1	0	
0	1	1	
1	0	0	
1	0	1	
1	1	0	
1	1	1	

[4]



10 (a) (i) Complete the truth table for the logic circuit which is made up of **NAND** gates only.



		Working space		
A	B			X
0	0			
0	1			
1	0			
1	1			

[2]

(ii) What single logic gate has the same function as the above logic circuit?

[1]



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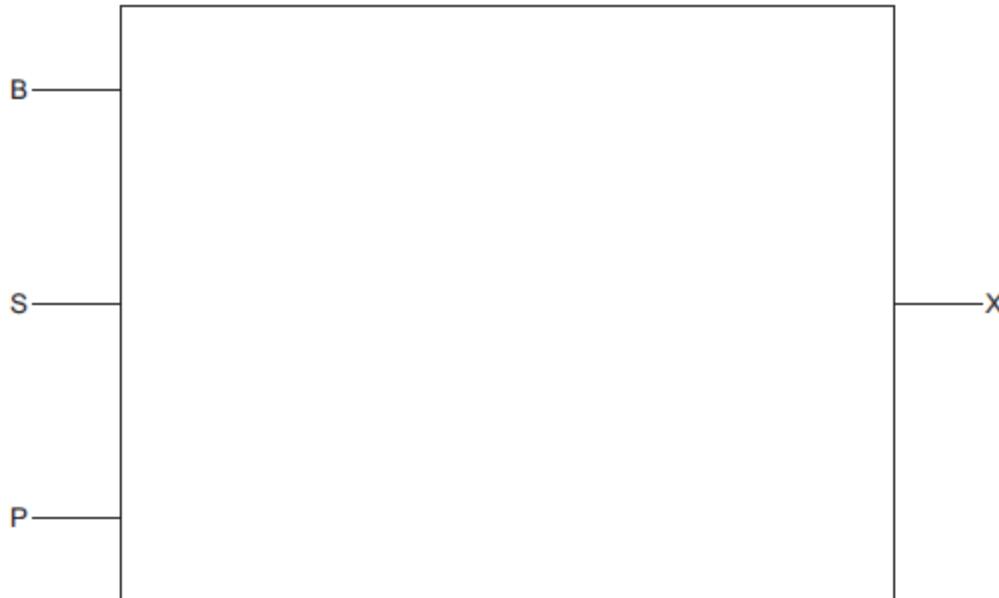
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15 (a) Draw the logic circuit represented by the logic statement:

$$X = 1 \text{ if } (B \text{ is NOT } 1 \text{ AND } S \text{ is NOT } 1) \text{ OR } (P \text{ is NOT } 1 \text{ AND } S \text{ is } 1)$$



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[6]

(b) Complete the truth table for the above logic statement.

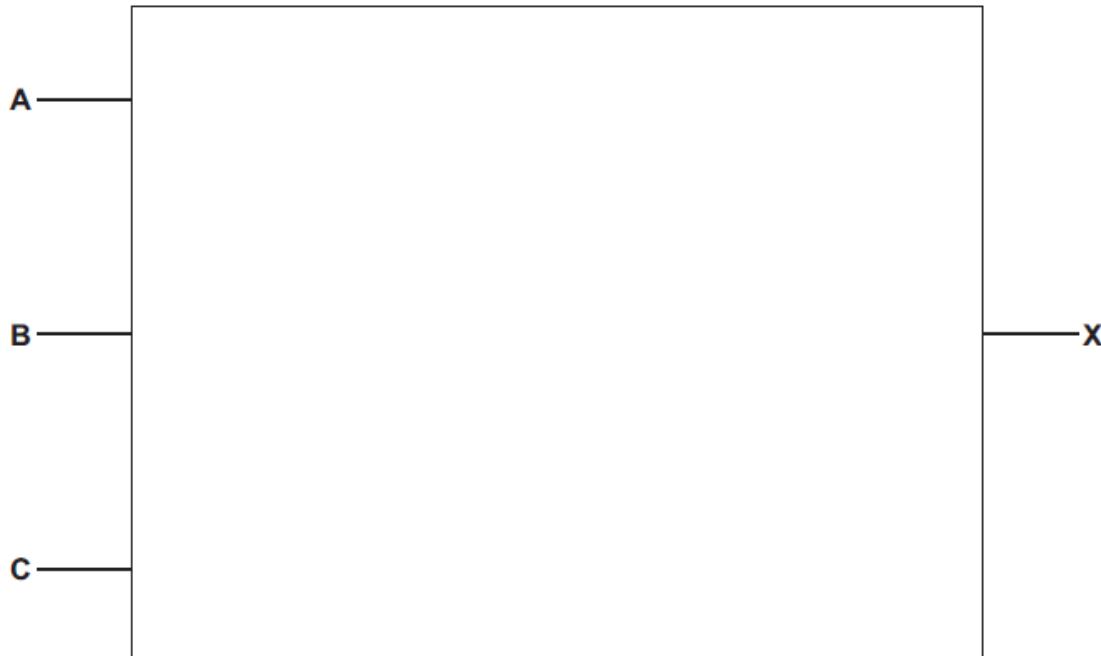
B	S	P	Working space		X
			0	1	
0	0	0			
0	0	1			
0	1	0			
0	1	1			
1	0	0			
1	0	1			
1	1	0			
1	1	1			

[4]



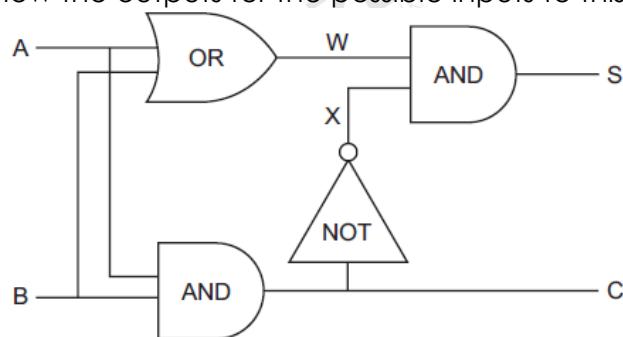


Draw the logic circuit for the following logic statement:
 $X = 1$ if [A is NOT 1 AND B is 1] AND [B is 1 OR C is 1]



[4]

Complete the table to show the outputs for the possible inputs to this circuit.



A	B	W	X	C	S
0	0				
0	1				
1	0				
1	1				

- (b) State a possible use for this circuit in a processor.

[5]
[1]

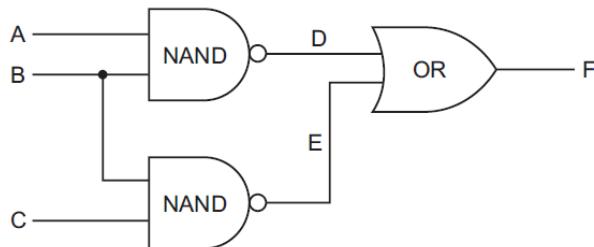


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A	B	C	D	E	F
0	0	0			
0	0	1			
0	1	0			
0	1	1			

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



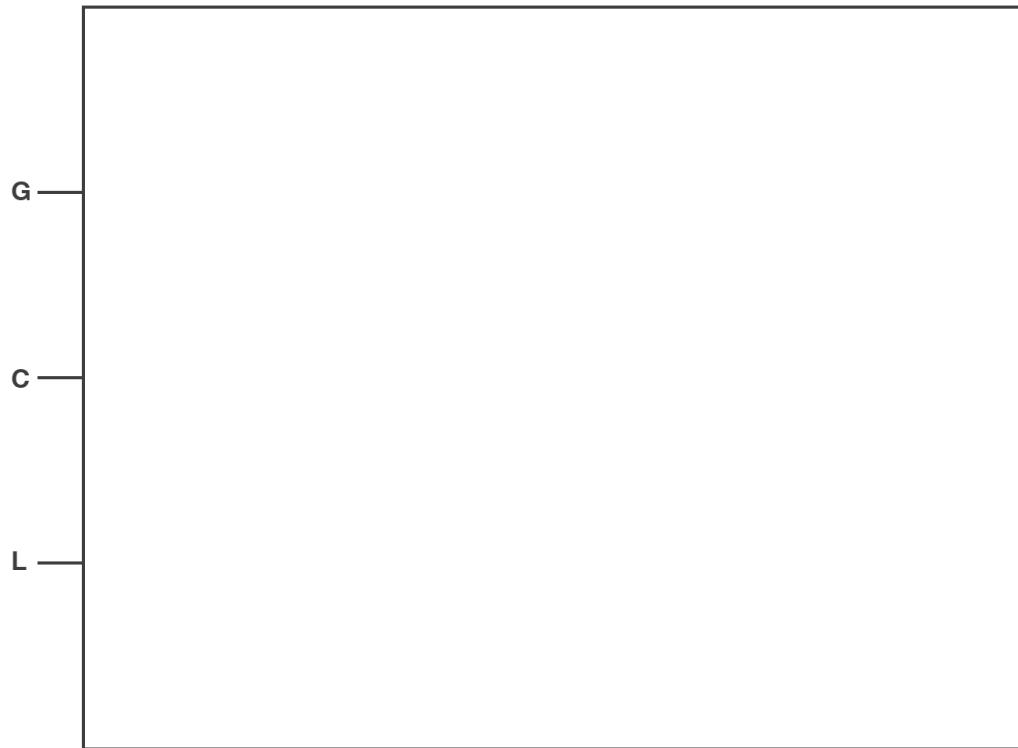
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Draw a logic circuit for this safety system.



[5]

Complete the truth table for the safety system.



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

[4]

Complete the truth table for the XOR gate:



A	B	C
0	0	
0	1	
1	0	
1	1	

[1]



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Page 120 of 126

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High Level & Low Level Languages

a) Give two benefits of using a high-level language for writing programs.

[2]

Two benefits from

- similar to English
- easy to understand
- easy to correct errors/test
- problem orientated
- portable

[2]

(b) State one type of program that would be written in a low-level language rather than a high-level language and give a reason why.

[2]

Award one mark for example and one mark for reason

example e.g. operating system

- defragmenter
- device driver
- booting
- game

reason fast response/execution
no need to compile/compiler is slower
1 → 1 with machine code

[2]

Give two differences between high level languages and low level languages.

Any **two** differences from:

high level

- portable
- problem-oriented
- close to English
- one-to-many relationship
- easier to debug/change/upgrade

low level

- machine-oriented
- can be difficult to read/understand
- one-to-one relationship
- needs assembler needs compiler/interpreter

[2]

Give two advantages of using high level languages when writing new computer software than using low level languages

Any **two** from:

- nearer to English
- portable
- easier to modify/change/understand



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Page 121 of 126

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easier to debug
no need to understand how the machine works
problem oriented

[2]

10 (a) Compilers and interpreters translate high-level languages. Give two differences between compilers and interpreters.

Any **two** differences from:

compiler

- needs to be re-compiled every time changes made
- code can be executed on its own
- translates whole code in one go
- translates source code into object code/machine code
- produces error list at end of compilation

interpreter

- translates instructions one time a change is made at a time...
- then executes the instructions immediately
- only finds errors as each instruction executed
- easier to edit/debug object code/machine code

[2]

(b) Programs can be written using high-level or low-level languages.

Give one advantage of using each method.

High-level language advantage

Any **one** high level advantage:

- fewer instructions
- no need to understand registers/computer architecture
- instructions nearer to human language/English
- not machine specific/portable
- easier to debug programs
- easier to write programs in low-level language

Low-level language advantage

Any one low level advantage:

- gain knowledge of how a computer works
- more control over how registers (etc.) are accessed
- can access registers (etc.) directly

[2]



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Page 122 of 126

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```
1 h = 0
2 c = 0
3 REPEAT
4 READ x
5 IF x > h THEN x = h
6 c = c + 1
7 PRINT h
8 UNTIL c < 20
```

The above code is an example of a high-level language.

Give TWO features of a high-level language.

[2]

Any **two** from:

- close to English
- one statement is equal to many low-level language statements
- portable
- easy to edit/debug/update
- problem oriented
- needs converting to machine code before execution

[2]

(c) The code is to be interpreted rather than compiled.

Give ONE difference between these two methods.

[1]

Any **one** from:

- interpreter – runs line by line and locates errors as it runs
- compiler – converts whole program into object code/gives complete list of errors

[1]

Look at these two pieces of code:

A:

```
CLC
LDX #0
loop: LDA A,X
      ADC B,X
      STA C,X
      INX
      CPX #16
      BNE loop
```

B: FOR Loop = 1 TO 4
 INPUT Number1, Number2
 Sum = Number1 + Number2
 PRINT Sum
 NEXT

(a) Which of these pieces of code is written in a high-level language?

[1]

code B

[1]

(b) Give one benefit of writing code in a high-level language.

[1]

Any **one** from:

- no need to understand workings of a computer
- easier to understand for programmer/closer to English
- much easier to debug
- much easier to test
- one to many when writing commands
- not machine specific/portable

[1]



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(c) Give one benefit of writing code in a low-level language. [1]

Any **one** from:

- can address memory addresses directly
- no need for compilers/interpreters
- shorter code/code requires less storage/RAM
- can (be written to) run faster

[1]

(d) High-level languages can be compiled or interpreted. [2]

Give two differences between a compiler and an interpreter.

- compiler produces object code / interpreter doesn't produce object code
- compiler translates whole program in one go / interpreter translates and executes line at a time
- compiler produces list of all errors / interpreter produces error message each time an error encountered
- compiler produces "stand alone code" / interpreter doesn't produce "stand alone code"
- compilation process is slow but resultant code runs very quickly / interpreted code runs slowly

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.

1 mark per correctly placed tick

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		✓

[5]



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(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 code since the executable code is now in machine code format		✓

[5]

(b) State why a compiler or an interpreter is needed when running a high-level program on a computer. [1]

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) Give one benefit of writing a program in a high-level language. [1]

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]

[1]

(d) Give one benefit of writing a program in a low-level language. [1]

Any one from:

- work directly on registers/CPU
- more control over what happens in computer
- can use machine specific functions

[1]

[1]



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(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:

```
LDA 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 **B**.....

High-level language code **C**.....

Machine code **A**.....

[2]

