3. Hardware

3.2 Input and output devices

Marking Scheme

Q1)

(c) Any **three** from:

- reads values in registers "C" and "D"
- and checks the values against those stored in registers "A" and "B"
  (**NOTE**: the first two statements can be interchanged, i.e. "A" and "B" read first)
- If values in corresponding registers are the same
- the microprocessor sends a signal to sound alarm/ring [3]

(d) Any **three** from:

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

(e) Any **two** from:

- no need to warm up
- whiter tint/more vivid colours/brighter image
- higher resolution
- much thinner monitors possible/lighter weight
- more reliable technology/longer lasting
- uses much less power/more efficient [2]

Q2)

(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 [2]

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

Resistive

benefits:
- inexpensive/cheap to manufacture
- can use stylus/finger/gloved finger/pen

drawbacks:
- poor visibility in sunlight
- vulnerable to scratching
- wears through time
- does not allow multi-touch facility

capacitive

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

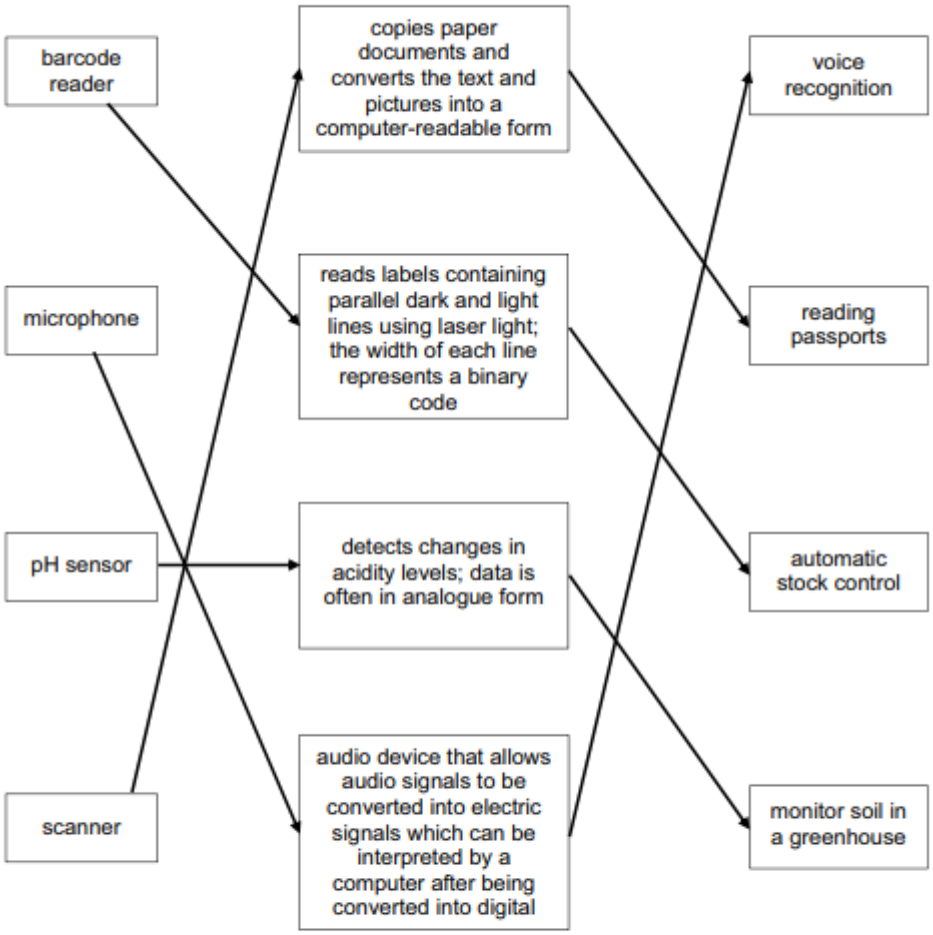
drawbacks:
- screen (glass) will shatter/break/crack (on impact)
- cannot use when wearing (standard) gloves

infra-red

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

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

Q3)



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

[6]

Q4)

(a) Maximum 5 marks **in total** for question part

Description of how street light is controlled: **(max 4 marks)**

- sensor sends signal/data to the microprocessor
- signal/data converted to digital/using ADC
- microprocessor compares value to a stored value
- if input value < stored value …
- … signal sent from microprocessor to actuator
- … and light is switched on/off
- whole process continues in an infinite loop

Avoiding frequent on/off switches: **(max 2 marks)**

- microprocessor continues to keep light on/off for a pre-determined period
- after pre-determined period, sensor output is again sampled

[5]

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

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

[6]

Q5)

(a) 1 mark for each name of application + 1 mark for description of use

Hardware item	Application and how the hardware item is used
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 checkouts – barcodes on luggage to track whereabouts
Microphone	Voice recognition system – allows computer to recognise spoken words and use them as input to, e.g., a word processor Multimedia presentations – allows voice-overs on presentations Video conferencing/VoIP – allows users to speak to each other
Touch screen	Mobile telephone/tablet – allows user to select apps/icons – easy method to input data Ticket/information kiosk – limits the options available for ease of use
Infrared sensor	Burglar/intruder detection system – detects presence of a person by breaking beam/change of temperature Automatic doors – breaking i/r beam allows detection of person approaching door Counting, e.g. people/cars – every time beam is broken it can automatically send data and allow automatic counting

[8]

(b) Any **two** from:
- Blu-ray discs use blue/violet lasers rather than red lasers as used by DVDs
- storage capacity of Blu-ray discs is much higher than standard DVDs
- Blu-ray discs use one polycarbonate layer; DVDs use two layers
- Blu-ray discs have a built-in secure encryption system

[2]

(c) Any **two** from:
- DVD has one spiral track; DVD-RAM has several concentric tracks
- DVD-RAM can be written to and read from at the same time; DVD-R only allows the read operation to occur
- DVD-R only allows data to be read (can't write to it) whereas DVD-RAM allows reading and writing operation

[2]

Q6)

(a) (i) Inkjet printer

Any **four** from:
- uses cartridges/liquid ink
- makes use of thermal bubble/piezoelectric technology
- sprays ink in droplets on the paper
- uses a moving print head
- suitable for low volume (high quality) output, e.g. a photo

[4]

(ii) Laser printer

Any **four** from:
- uses powdered ink/toner cartridges
- uses a (charged) printing drum
- makes use of static electricity charges
- uses a fuser to fix/melt ink onto the paper
- uses a discharge lamp to remove static charge from the drum
- useful for high volume (high quality) output, e.g. leaflets

[4]

(b) Any **three** from:
- produces solid, 3D objects/prototypes
- used in CAD/CAM
- makes use of tomography/slices of an object
- solid built up in thin layers
- uses resin, powdered metal, paper, plastic…

[3]

Q7)

1 mark for each input device + 1 mark for correct MATCHING reason for each device

Input Devices

- Barcode scanner
- … to scan the barcode on boarding pass/mobile phone screen

- keyboard
- … to key in data in case barcode fails to scan

- (electronic) scales
- … weigh luggage at check-in

1 mark for each output device + 1 mark for correct MATCHING reason for each device

Output Devices

- beeper/speaker
- … confirm barcode read/indicate error if barcode not read

- (LCD) screen
- … select options (e.g. airline) at check-in

- printer
- … produce bag labels

[4]

Q8)

(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 [5]

(b) 1 mark for correct calculation, 1 mark for correct answer
- number of photos = **12 × 60 × 24** = 17 280
- memory requirement = 17 280/1024 = **16.9 (16.875)**
- (17 280/1000 = 17.28/17.3 is acceptable) [2]

(c) Any **two** from:
- (data transmission) is faster
- more secure/safer (because it is a dedicated line)
- (fibre optic transmission) is more reliable [2]

Q9)

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**

[8]

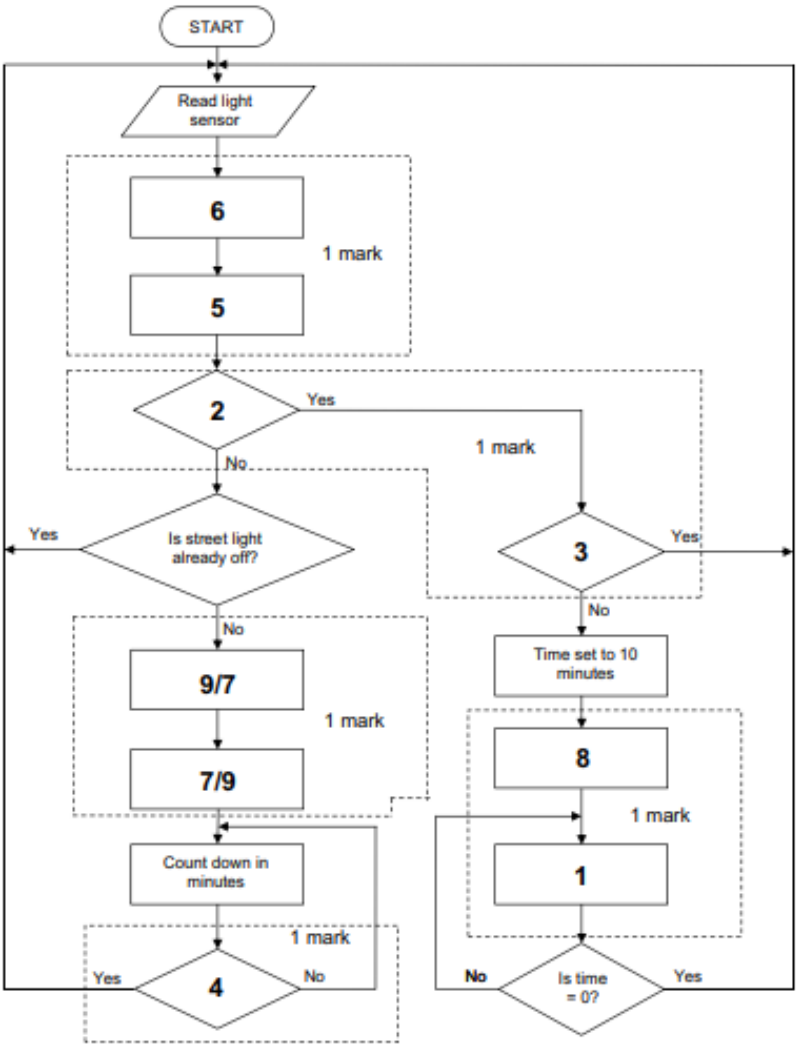
Q10)

(a) Temperature
– central heating / air con system
– greenhouse environment
– a chemical reaction / process

Magnetic field
– anti-lock brakes on a car
– detection of motor vehicles (e.g. at traffic lights)
– reading magnetic ink characters on cheques
– geophysical surveys

Motion
– automatic doors
– burglar alarm [3]

(b)



[5]

Q11)

(a) Any **five** from:
– sensors send signals / data to microprocessor
– signal / data converted to digital (by an ADC)
– microprocessor compares temperature / carbon monoxide level / value with stored level / value
– if CO level > stored value, microprocessor sends signal…
– if temperature > stored value, microprocessor sends signal…
– …to light warning bulb on dashboard / sounds alarm [5]

Q12)

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**

[5]

Q13)

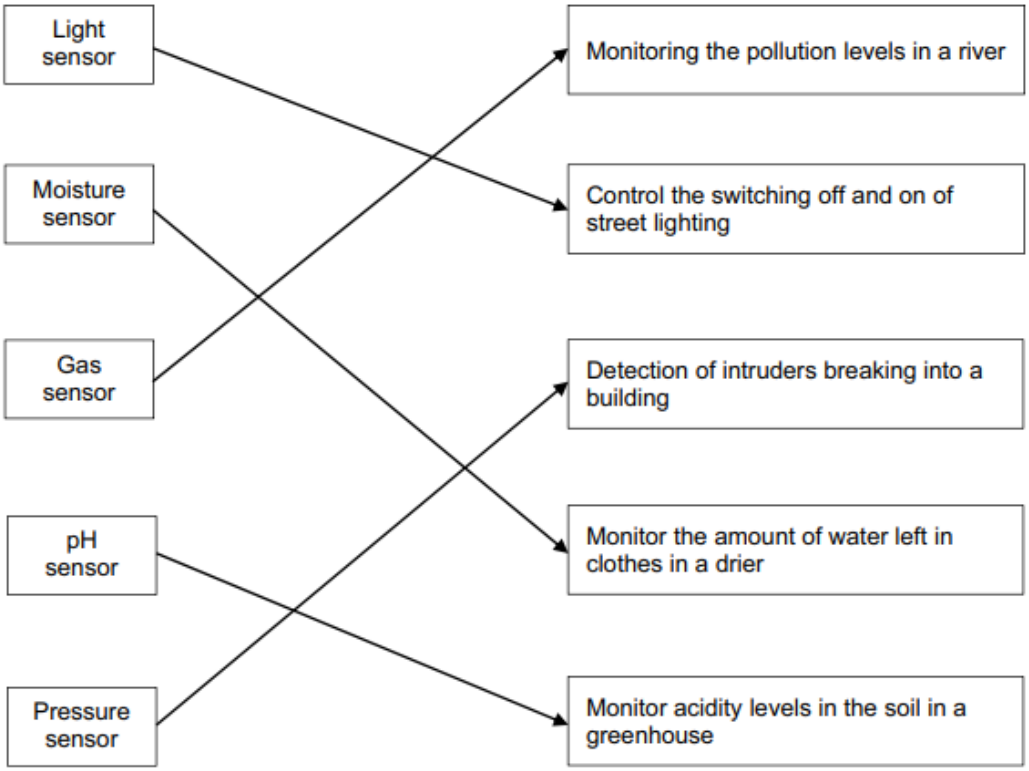
1 mark for each named application + 1 mark for each matching reason for choice

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

[8]

Q14)

(a)



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

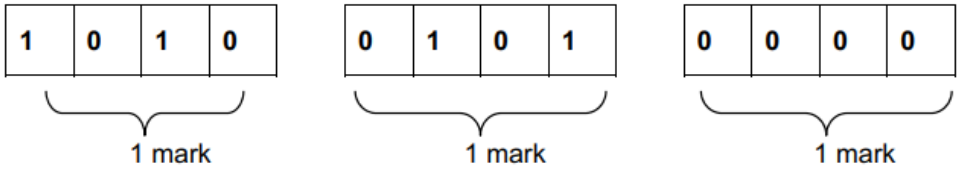
(b) Any **four** from:

- sensor(s) sends signal/data to microprocessor
- signal/data converted to digital (using an ADC)
- microprocessor compares signal/data with pre-set/stored value
- if sensor(s) signal/data indicates the presence of a person / the door needs to be opened / a match is found / door is closed …
- … microprocessor sends a signal to an actuator …
- … to operate/drive a motor to open the door [4]

Q15)

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

(b) – A 5 0 (1 mark)



[4]

(c) Any **three** from:

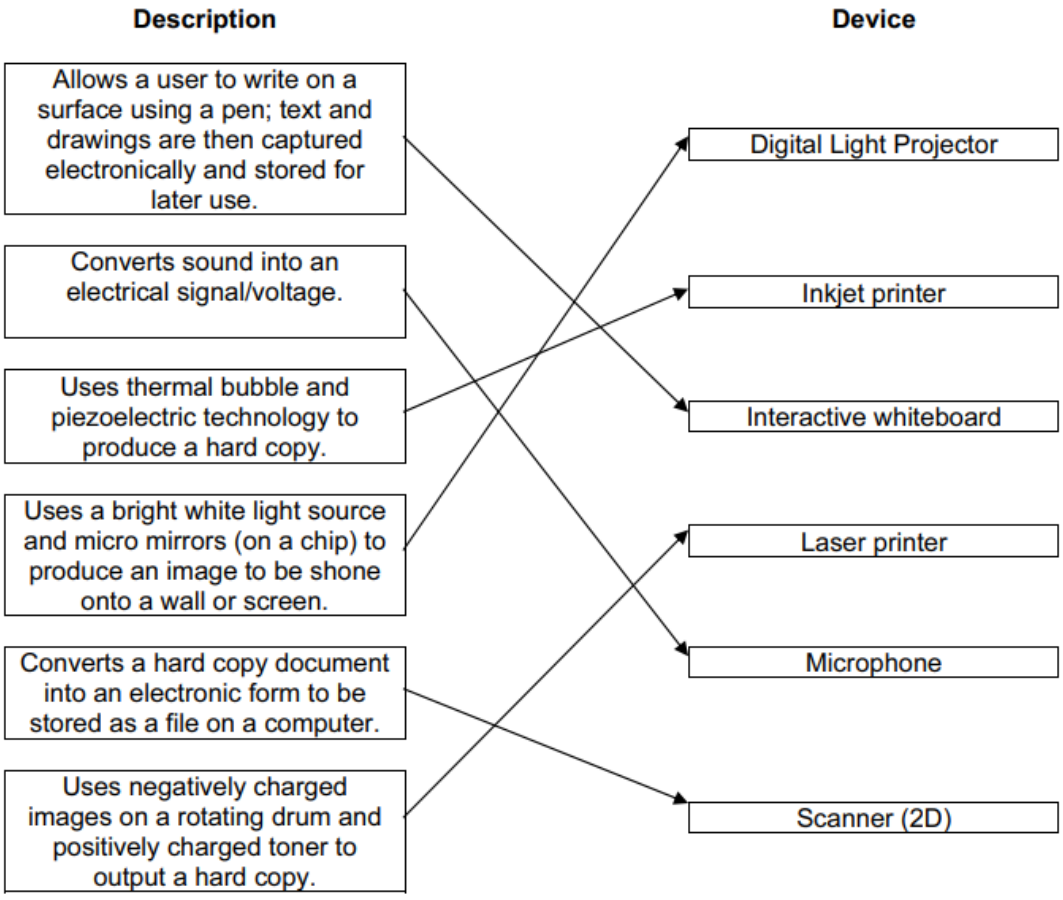
- visitor scans the QR code with (the camera on) the mobile device
- App is used to read/interpret the QR code
- links to a website/opens a document …
- … to access local tourist information
- can store the QR code to refer to again for the information [3]

Q16)

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

NOTE: The same sensor cannot be given twice [3]

Q17)



5/6 matches – 5 marks
4 matches – 4 marks
3 matches – 3 marks
2 matches – 2 marks
1 match – 1 mark

[5]

Q18)

Any **six** from:

- infrared / motion / pressure (sensor) // sensor detects movement/pressure
- signals/data sent (continuously) to microprocessor
- converted from analogue to digital (using ADC)
- microprocessor compares value with those stored in memory
- if sensor value does not match the stored value(s) …
- … signal sent to switch on the light
- … signal sent to keep the light on
- … light remains on for a period of time (30 seconds)
- if sensor value matches the stored value(s) …
- … light will remain off
- … will turn off after period of time (30 seconds)
- works in a continues loop [6]

Q19)

Question	Answer	Marks
	Any **three** from: ∞ barcode 1D **and** QR code 2D ∞ barcodes contain vertical lines **and** QR codes contain 'squares' ∞ QR code can hold more data than a barcode ∞ QR code can be read from any angle, some barcode readers have to be lined up with the barcode // QR codes are more error tolerant / faster to scan than barcodes ∞ barcodes are frequently used at checkouts / libraries // QR codes are used for advertising // QR codes are frequently used by mobile phones to obtain information	**3**

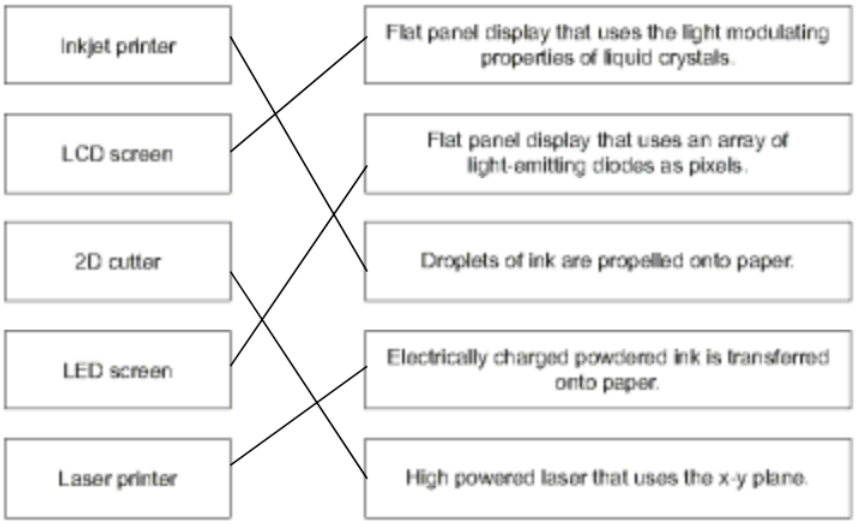
Q20)

Question	Answer	Marks
	1 mark for appropriate device name and 1 further mark for appropriate purpose. **Input devices** **Two** from: ∞ **Keypad / Keyboard** … ∞ … e.g. to allow customer to input the quantity of an item ∞ **Touchscreen** … ∞ … e.g. to allow a customer to select a payment method ∞ **Barcode scanner / Barcode reader** … ∞ … e.g. to allow a customer to scan in their shopping ∞ **Card reader // Cash deposit / intake** … ∞ … e.g. to allow a customer to pay for their shopping ∞ **Weighing scales** … ∞ … e.g. to allow a customer to weigh fresh produce **Output devices** **One** from: ∞ **Display / Touchscreen** … ∞ … e.g. to allow a customer to see the running total of their shopping ∞ **Speaker** … ∞ … e.g. to give audio instructions to a customer about how to use the self-checkout ∞ **Printer** … ∞ … e.g. to print a receipt for the customer	**6**

Q21)

Question	Answer	Marks
(a)	1 mark for appropriate sensor and 1 further mark for appropriate use. **Two** from: ∞ **Gas (sensor)** … ∞ … e.g. to measure the levels of oxygen/carbon dioxide / nitrogen in the factory to make sure they are not too high / low ∞ **Temperature (sensor)** … ∞ … e.g. to measure the temperature of the chemicals to make sure it is not too high/low ∞ **Motion / Infra-red (sensor)** … ∞ … e.g. to detect any persons in an unauthorised area of the factory ∞ **Pressure (sensor)** … ∞ … e.g. to measure the pressure of chemicals flowing through pipes to check that level are not too high / low ∞ **pH (sensor)** … ∞ … to measure the pH to make sure the acidity / alkalinity of the chemicals is correct ∞ **Light (sensor)** … ∞ … to measure the level of light to make sure it remains at a constant level for the chemical process	**4**
(b)	**Five** from: ∞ Sensors send signals to microprocessor ∞ Analogue signals are converted to digital (using ADC) ∞ Microprocessor compares value to stored value … ∞ … If out of range / matches stored values … ∞ … signal sent to alert workers (e.g. sound alarm) ∞ … microprocessor send signal to cause an action to occur e.g. cool a process down, heat a process up, add a chemical ∞ … no action taken ∞ Output/record readings ∞ Monitoring is continuous	**5**

Q22)

Question	Answer	Marks
	 1 mark for each correct line to a max of 4 marks.	4

Q23)

Question	Answer	Marks
	1 mark for correct name of code, up to a further 3 marks for appropriate explanation ∞ Quick response (QR) Code **Three** from: ∞ Barcode is captured / scanned / imaged, by a camera / scanner / barcode reader / QR code reader ∞ Read using a laser ∞ Processed by an app ∞ Light is reflected back ∞ Black squares reflect less light than white squares ∞ Modules are used for orientation / alignment ∞ Squares / data are decoded	4

Q24)

Question	Answer	Marks
	Six from: ∞ temperature sensor ∞ analogue data / temperature is converted to digital data (with an ADC) ∞ sensor sends signal to the microprocessor ∞ microprocessor compares input values with stored values/pre-set values … ∞ … if the temperature value input is too high/low … ∞ … a signal is sent from the microprocessor to turn on / off / up / down the cooling unit ∞ … if temperature matches the stored values … ∞ … no action is taken ∞ an actuator is used to turn the cooling unit on / off / up / down ∞ the process is a continuous loop	**6**

Q25)

Question	Answer	Marks
	Any **six** from: 2D – (Scanner) shines a light onto the surface of a document // Light moves across document – Reflected light is captured – Uses mirrors and lenses – Captured image is converted into a digital file – Produces a 2D digital image 3D – Scanners shines a laser (or light) over the surface of a 3D object – Records measurements of the geometry/dimensions of the object – Measurements are converted to digital file – Produces a 3D digital model	**6**

Q26)

Question	Answer	Marks
(a)	∝ It is an input device ∞ It measures/takes (physical) readings of the surrounding environment / environment by example / physical properties	2
(b)	1 mark for each sensor, 2 marks for each description: Moisture (sensor) ∞ To measure the water content of the soil ∞ To alert when the soil is too dry or too wet/needs watering pH (sensor) ∞ To measure how acidic/alkaline the soil is ∞ To alert when there may be something polluting the soil Light (sensor) ∞ To measure the brightness of the environment ∞ To alert when the fruit has too little/too much light Temperature (sensor) ∞ To measure the temperature of the environment ∞ To alert when it is too hot/too cold for the fruit to grow Gas (sensor) ∞ To measure the amount of CO2/oxygen present ∞ To alert when too much CO2/oxygen present Humidity (sensor) ∞ To measure the water content in the air ∞ To alert when the air is too dry Infra-red / motion (sensor) ∞ To measure level of infra-red/microwaves deflected ∞ To alert to any intruders e.g. animals stealing the fruit	6

Q27)

Question	Answer	Marks
(a)	Any **four** from: – Shines light / (red) laser at barcode – Light is called an illuminator – Light is reflected back // White lines reflect light // Black lines reflect less light/absorbs light – Sensors / photoelectric cells detect the light – Different reflections / bars will give different binary values / digital values // pattern converted to digital values – A microprocessor interprets the data	**4**
(b)	Any **three** from: – barcode identifies a (unique) product – barcode can be used to look up product (in a database) – data about stock levels can be stored on a system – stock can be automatically deducted from the system – can check stock is below a certain level // check stock level – automatic re-order // Alerts when stock is low – automatically update new stock level – to locate if an item of stock is available in another location	**3**

Question	Answer	Marks
(c)	Any **four** from: – (Infrared) rays are sent across screen (from the edges) – Has sensors around edge // Sensors capture beams – (Infrared) rays form a grid across the screen – (Infrared) ray is broken (by a finger blocking a beam) – **Calculation** is made (on where beam is broken) to locate the 'touch' // Co-ordinates are used to locate the touch	**4**
(d)	Secondary Storage – any **two** from: – Not directly accessed by the CPU – Non-volatile storage – Secondary is internal to the computer/device – An example of secondary storage would be HDD/SSD Off-line storage – any **two** from: – Non-volatile storage – Off-line storage is storage that is removable from a computer/device // not internal // portable – An example of off-line storage would be CD/DVD/USB stick/SD card/magnetic tape/ external HDD/SSD	**4**

Q28)

Question	Answer	Marks
	Any **six** from: – Suitable biometric device, such as fingerprint scanner/retina/eye/iris scanner/face recognition/voice recognition/palm scanner // description of use e.g. use fingerprint on device – Sensor (in biometric device) captures/takes data/readings (of user) – Data/readings are converted from analogue to **digital** (using ADC) – Data/reading sent to the microprocessor – Data/readings compared to stored values/data … – … if data/readings **match** user can enter – … if data/readings **do not match** user is declined entry // user asked to try again … – … alert may be sent to security // alarm may sound	**6**

Q29)

Question	Answer	Marks
(a)	QR/Quick response	**1**
(b)	Any **four** from: – Read/scanned using **app** (on mobile device) – It is the **camera** that is used to scan/capture the image – The three large squares are used to define the alignment // uses alignment targets/modules – Black squares reflect less light // white squares reflect more light – The app/device processes the image – Each small square/pixel is converted to a binary value	**4**

Q30)

Question	Answer	Marks
(a)	Any **four** from: – Conductive layer – An electrostatic/electric field is created – **Sensor(s)** (around the screen) monitor the electrostatic field – When touched (electrostatic) charge is transferred to finger – Location of touch is **calculated** // Co-ordinates used to **calculate** touch	**4**

Question	Answer	Marks
(b)(i)	Any **two** from: – Gloves are not conductive // Gloves are an insulator – Block current/charge from finger / body / person – Stop the electrostatic field being disturbed/changed	**2**
(b)(ii)	Any **two** from e.g. (1 mark for method, 1 for expansion): – She could use a (conductive) stylus… – … this will allow the charge to be charged/disturbed – She could use capacitive gloves… – … this will allow the charge to be charged/disturbed – She could use a natural language interface/voice operated interface … – … she could give vocal commands to the device	**2**

Q31)

Question	Answer	Marks
	Any **six** from: – Suitable sensor (motion/infra-red) – Data converted (from analogue) to digital (using ADC) – Data sent to microprocessor – Data is compared to stored value/range … – … if data matches/out of range data security light turned on … – … waits for suitable period/until no motion detected … – … light turned off – Continuous loop/process	6

Q32)

Question	Answer	Marks
(a)	Any **three** from: – Does not require peripherals (mouse or keyboard) – Number of possible inputs limited / menu driven interface – Less chance of input error – Resistant to weather	3
(b)	– Uses two/multiple layers – When top layer touched / pushed two layers make contact – Circuit is completed when layers touch – Point of contact is determined/calculated	4

Q33)

Question	Answer	Marks
(a)	1 mark for the correct ticks (✓) for each statement	4
(b)	Computer Aided Design/CAD	1
(c)	**Three** from: ∞ Uses a large number of tiny mirrors ∞ Mirrors are laid out in a grid/matrix ∞ Each mirror creates a pixel in the image ∞ Mirrors can tilt toward or away from light source ∞ The mirrors reflect light toward a (projection) lens ∞ Colour is produced using a colour wheel // Light passes through colour wheel // filters light into red/green/blue ∞ Can be used to display an image on a wall/screen	3

Statement	3D printer (✓)	3D cutter (✓)
Outputs a physical 3D product	✓	✓
Uses a high powered laser to create the output		✓
Creates 3D prototypes	✓	✓
Uses layers of material to create the output	✓	

Q34)

Question	Answer	Marks
	Five from: ∞ The data is sent to the microprocessor ∞ The analogue data is converted to digital (using ADC) ∞ The microprocessor compares the data to a stored value of 5 kg … – … If the value is greater than 5 kg … – … a counter is added to/incremented ∞ The process is continuous	5

Q35)

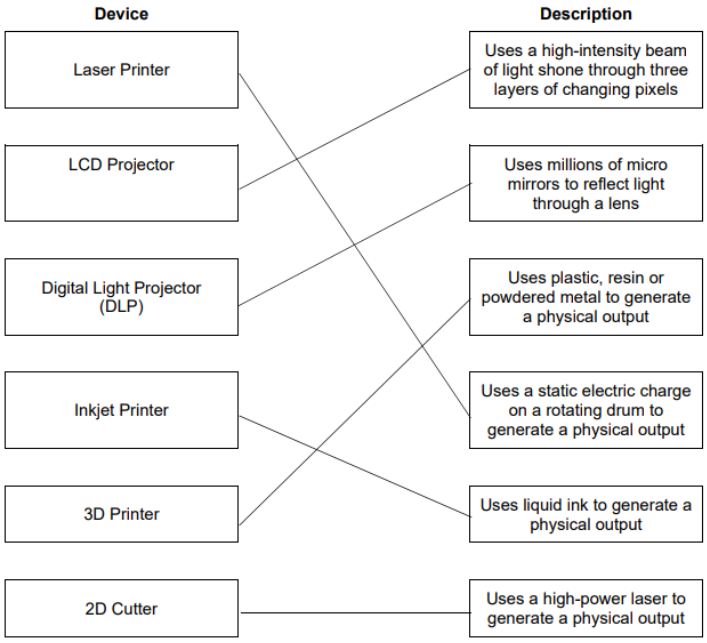
Question	Answer	Marks
(a)(i)	2D/3D cutter	1
(a)(ii)	Liquid crystal display // LCD	1
(a)(iii)	Actuator	1
(b)	1 mark for each correct missing word, in the given order: ∞ interactive whiteboard ∞ inkjet ∞ thermal bubble ∞ laser ∞ rotating	5

Q36)

Question	Answer	Marks
	Five from: ∞ The sensor sends data to the microprocessor ∞ The analogue data is **converted to digital** (using ADC) ∞ The microprocessor compares the reading to the set range/stored values/stored data (6 to 8) … – … If the reading is >8 or <6 / outside range … o … the **microprocessor** sends a signal to output the alert ∞ The **process** is continuous/repeated	5

Q37)

Question	Answer	Marks
	1 mark for each correct line, maximum 5 marks	5



Q38)

Question	Answer	Marks
	1 mark for each correct device	5

Description of input or output device	Name of device
This is an input device that works by shining a light onto the surface of a document. The light source is automatically moved across the document and the reflected light is captured by mirrors and lenses.	**2D Scanner**
This is an input device where a laser or a light source is moved across an object. The width, height and depth of the object are measured to allow a model to be created.	**3D scanner**
This is a large input device that is usually fixed to a wall. A user can calibrate the device to make sure the sensors align with a projected image. The user can use either their finger or a special pen to make selections.	**Interactive whiteboard**
This is an output device that uses many small mirrors to reflect light towards a lens. This will display an image.	**Projector**
This is an output device that creates an object by building layer upon layer of material.	**3D printer**

Q39)

Question	Answer	Marks
(a)	**Three** from e.g.: – Keyboard – Mouse – Microphone – 2D scanner – 3D scanner – Touchscreen – Webcam // digital camera – Joystick – Trackpad – Sensor – Interactive whiteboard	3
(b)	**Three** from e.g.: – Monitor // touchscreen – Inkjet printer – Laser printer – 3D printer – Speaker – Headphones – LED Projector – DLP – 2D cutter – 3D cutter – Actuator	3

Q40)

Question	Answer	Marks
(a)	**Six** from: – Motion sensor is used – Sensor sends data/signal to microprocessor – Data/Signal is converted from analogue data to digital data (using ADC) – Value to compared to stored value(s) // – If value is outside range/matches … – … **microprocessor** sends signal to switch lights on – … actuator used to switch light on/off – … timer is set for 2 minutes – Every time movement is detected the timer is reset – When timer reaches **0/120/times out microprocessor** sends signal to switch lights **off** – **Process** is continuous	6
(b)	**Three** from: – Read only memory – Non-volatile memory // Contents of memory are retained when power is turned off//permanent storage – Primary storage // directly accessed by the CPU – Holds firmware/boot-up instructions/start-up instructions/BIOS – Cannot be written to	3

Q41)

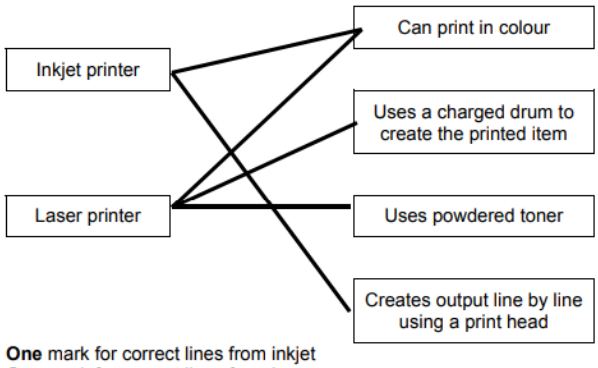
Question	Answer	Marks
	Four from: – **Electrical** field/charge is spread across the screen – Sensors are located around the screen // sensors are used to read the electric field – When finger touches screen, the charge/ is transferred to the user – … as it is affected by the conductivity of another object – Coordinates of touch determined/calculated/measured	4

Q42)

Question	Answer	Marks
(a)	**Four** from: – Screen has two / multiple layers – Visitor presses on top layer – Top layer connects to bottom layer – … creating a circuit – Calculation is carried out on where layers are connected	**4**
(b)	**Two** from: – Speaker – Headphones – Printer	**2**

Question	Answer	Marks
(c)	**Four** from (max. 2 marks per type): **Primary** – Memory that is directly accessed by the CPU – An example is RAM / ROM – RAM stores programs and data that are currently in use and ROM stores boot-up instructions – RAM is volatile and ROM is non volatile **Secondary** – Storage that is not directly accessed by the CPU – An example is HDD / SSD – Stores data / files that can be accessed at a later stage – Non volatile	**4**

Q43)

Question	Answer	Marks
(a)	**Printer** **Statement**  **One** mark for correct lines from inkjet **One** mark for correct lines from laser	**2**
(b)	∝ Laser	**1**
(c)	**Two** from: ∞ Design is created on the computer / software / CAD ∞ Material is loaded to cutter ∞ Different types of material can be used ∞ Uses lasers to cut material … ∞ … that use infra-red ∞ … that produces extreme heat ∞ … that is focussed using a special lens ∞ Can work on both the *x*,*y* and *z* axis	**2**

Q44)

Question	Answer	Marks
(a)	**One** from: ∞ Touch screen ∞ Keyboard ∞ Microphone ∞ Mouse	1
(b)	**One** from: ∞ Headphones ∞ Speakers ∞ Printer ∞ Light / LED	1
(c)	**One** from: ∞ HDD ∞ SSD ∞ USB drive	1
(d)	**Four** from: ∞ QR code is scanned using a camera on a mobile device … ∞ … and read / decoded using an application / software ∞ Illuminator shone on code ∞ Squares reflect light differently ∞ Corners of code are used for orientation ∞ Opens document with information // Directs to website with information ∞ QR code can be saved for future reference	4

Q45)

Question	Answer	Marks
(a)	**One** from: ∞ Continuous data // by description ∞ Non-discrete data // by description ∞ By example, e.g. data such as a sound wave	1
(b)	**One** from: ∞ Discrete data that has only two values ∞ By example, e.g. binary data / 1's and 0's	1

Q46)

Question	Answer	Marks
	One mark for each correct tick	6

Statement	Resistive (✓)	Capacitive (✓)
This touch screen has multi-touch capabilities		✓
This touch screen cannot be used whilst wearing gloves		✓
This touch screen is made up of two layers with a small space in between	✓	
This touch screen uses the electrical properties of the human body		✓
This touch screen is normally cheaper to manufacture	✓	
This touch screen has a quicker response time		✓

Q47)

Question	Answer	Marks
(a)	**Four** from: ∞ Membrane / matrix / circuit board present at base of keys ∞ A key is pressed that presses a switch ∞ When a key is pressed it completes a circuit // changes the current in a circuit ∞ The location of the keypress is calculated ∞ An index of characters is searched to find the corresponding keypress ∞ Each character has an ASCII / Unicode value ∞ The ASCII / Unicode value has a binary value ∞ Keypress generates an interrupt ∞ Each character / keypress is added to a buffer to wait to be processed ∞ The binary can then be processed by the CPU to action the key press	4

Q48)

Question	Answer	Marks
(a)(i)	**Two** from: ∞ 2D scanner ∞ Touchscreen ∞ Keypad/keyboard ∞ Card reader ∞ Mouse ∞ Digital camera	**2**
(a)(ii)	**Two** from: ∞ HDD ∞ SSD ∞ USB flash memory drive ∞ SD card ∞ Any optical	**2**
(a)(iii)	**Two** from: ∞ Monitor/Touch screen ∞ Speaker ∞ Printer ∞ LED // Light	**2**
(d)	**Five** from: ∞ The display is made up of pixels … ∞ … that are arranged together as a matrix ∞ Each pixel has three filters, red, blue and green ∞ Shades of colour are achieved by mixing red, blue and green ∞ The screen is backlit ∞ Light is shone through the liquid crystals ∞ The liquid crystals can be made to turn solid or transparent/on or off … ∞ … by changing the shape of the crystal	**5**

Q49)

Question	Answer	Marks
(a)	Any **one** from: – Microphone – Touchscreen – Camera – Button	1
(b)	Any **two** from: – Speaker – Touchscreen – Light/flash	2
(c)(i)	Any **one** from: – Media access control – Unique address given to each device	1
(c)(ii)	Any **three** from: – Uses hexadecimal values – Normally 48/64 bits in length (accept any other reasonable value) – First half is manufacturer number/code/ID – Second half is serial number	3
(d)	– It needs RAM to store the data and programs currently in use – It needs ROM to permanently store the boot up instructions	2
(e)(i)	Any **two** from: – Fingerprint scanner – Voice recognition – Retina/iris recognition – Facial recognition	2
(e)(ii)	Any **two** from: – Adds extra level of security – Biometric device requires properties unique to individual – Allows quicker access as no need to input password // don't need to remember password	2

Q50)

Question	Answer	Marks
	Sensor / **Scenario** Pressure / motion / infra-red — Detecting when a person is approaching an automatic door system pH / light — Monitoring the pollution level in a river Temperature — Checking if a tropical aquarium is 25 degrees Celsius Magnetic field / pressure / motion / infra-red — Counting the number of cars that cross a bridge One mark per each correct sensor (each sensor **must** be different)	4

Q51)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>(a)</td><td>– Interrupt</td><td>1</td></tr>
<tr><td>(b)</td><td>One mark for benefit, two marks for drawbacks
Benefit:
– Printing may be higher quality
– Can use larger paper sizes
– Can print onto different media
– No warm-up time

Drawbacks:
– Printing will be slower
– Ink is more expensive per page
– Ink can be smeared // ink is not smudge proof</td><td>3</td></tr>
<tr><td>(c)</td><td><table><tr><th>Statement</th><th>Inkjet (✓)</th><th>Laser (✓)</th></tr><tr><td>Uses a rotating drum to transfer the image to the paper</td><td></td><td>✓</td></tr><tr><td>Uses powdered toner</td><td></td><td>✓</td></tr><tr><td>Uses nozzles to spray droplets on to the paper</td><td>✓</td><td></td></tr><tr><td>Uses a print head mechanism that moves side to side</td><td>✓</td><td></td></tr></table>One mark per each correct row</td><td>4</td></tr>
</table>

Q52)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td></td><td><table><tr><th>Statement</th><th>Capacitive (✓)</th><th>Resistive (✓)</th></tr><tr><td>Needs pressure to be applied to create a circuit</td><td></td><td>✓</td></tr><tr><td>May not register a touch if the user is wearing gloves</td><td>✓</td><td></td></tr><tr><td>More commonly used in smartphones</td><td>✓</td><td></td></tr><tr><td>More responsive to a touch</td><td>✓</td><td></td></tr><tr><td>Needs an electrical field to be changed to register a touch</td><td>✓</td><td></td></tr><tr><td>Cheaper to manufacture</td><td></td><td>✓</td></tr></table>One mark per correct tick</td><td>6</td></tr>
</table>

Q53)

Question	Answer	Marks
(a)		6

Hardware device	Input (✓)	Output (✓)	Storage (✓)
Solid state drive (SSD)			✓
Sensor	✓		
Headphones		✓	
Microphone	✓		
USB flash drive			✓
Actuator		✓	

One mark for each correct tick

Question	Answer	Marks
(b)	– Input – Black – White – Sensors – Binary **One** mark for each correct term in the correct place	5

Q54)

Question	Answer	Marks
		6

Statement	3D (✓)	Inkjet (✓)	Laser (✓)
Uses a moving print head	✓	✓	
Uses liquid ink		✓	
Produces output using materials such as plastic and resin	✓		
Uses piezoelectric or thermal technology	(✓)	✓	
Uses a rotating drum to transfer the image to the paper			✓
Uses layer upon layer of material to create the output	✓		

One mark per each correct row.

Q55)

Question	Answer	Marks
	One mark per each correct row: **Device** / **Input** (✓) / **Output** (✓) / **Storage** (✓) Keyboard: ✓ Sensor: ✓ 3D Cutter: ✓ 2D Scanner: ✓ Microphone: ✓ Hard disk drive (HDD): ✓	**6**

Q56)

Question	Answer	Marks
(a)	Any **three** from: – Light emitting diodes (technology) – The **display** is made up of pixels – … that are arranged together as a matrix – … each is formed of three LEDs/filters – Shades of colour are achieved by mixing red, blue and green – The screen can be back-lit/edge-lit NOTE: Use of liquid crystals with LED technology can also be awarded	**3**

Question	Answer	Marks
(b)	Any **three** from: – Energy efficient // low power consumption – Long lasting // longevity – Focussed beam // less light strays from beam – Brighter/vivid colours – High resolution – No flicker – Display is thinner – Mercury free technology // environmentally friendly – Fewer pixel failure – Increased viewing in sunlight	**3**
(c)	– LCD	**1**

Q57)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>(a)</td><td>One mark for each correct row:
<table><tr><th>Statement</th><th>True (✓)</th><th>False (✓)</th></tr><tr><td>It is a flat panel display</td><td>✓</td><td></td></tr><tr><td>It creates images using red, green and blue diodes</td><td>✓</td><td></td></tr><tr><td>It is not very energy efficient and gives off heat</td><td></td><td>✓</td></tr><tr><td>It is also used in mobile devices such as smartphones and tablets</td><td>✓</td><td></td></tr><tr><td>It is a front-lit display</td><td></td><td>✓</td></tr></table></td><td>5</td></tr>
</table>

Q58)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td></td><td>One mark for each correct row:
<table><tr><th>Device</th><th>Input (✓)</th><th>Output (✓)</th><th>Storage (✓)</th></tr><tr><td>Solid state drive (SSD)</td><td></td><td></td><td>✓</td></tr><tr><td>Headphones</td><td></td><td>✓</td><td></td></tr><tr><td>2D cutter</td><td></td><td>✓</td><td></td></tr><tr><td>LCD projector</td><td></td><td>✓</td><td></td></tr><tr><td>Microphone</td><td>✓</td><td></td><td></td></tr></table></td><td>5</td></tr>
</table>

Q59)

Question	Answer	Marks
(a)	Any **three** from: – Liquid crystal display – The **display** is made of pixels – … arranged in a matrix – Uses a flat panel display – Backlit display – … with CCFLs/LEDs – Uses light-modulating properties of liquid crystals – Crystals can be turned between opaque and transparent (to allow light to pass) – Colours created using RGB	3
(b)	Any **three** from: – Low power consumption – Runs at cool temperature – Do not suffer image burn – Do not suffer flicker issues – Bright image/colours – High resolution image – Cheaper to purchase than e.g. LED screen	3

Q60)

	Six from: – Suitable sensor used e.g. motion sensor/pressure sensor – (Analogue) data is converted to digital (using ADC) – Sensor sends data to microprocessor – Data compared to stored data … – … if value outside range/within range water is sprayed – … signal sent to actuator to spray water – … if value within range/outside range no action taken – Continuous loop	**6**

Q61)

Question	Answer	Marks
	Eight from: – Sensor send data/readings/signal to microprocessor – Data is converted from analogue to digital (using ADC) – Microprocessor compares/checks data to stored values/range of values … – … If data is greater than 30 / above the range microprocessor sends **signal** to open window and to turn heater off – … If data is below 25 the microprocessor sends **signal** to turn on heater and to close window – … If data is between 25 and 30 / within the range no action taken – Actuator is used to operate heater/window – **Whole** process is continuous	**8**

Q62)

(a)	– Light sensor – Motion sensor // infra-red sensor	**2**

Question	Answer	Marks
(b)	**Eight** from: – Sensors send data to microprocessor – Data is converted to digital (using ADC) – Microprocessor compares data to stored value(s) … – … if one value or neither values are within range/out of range/match no action is taken – … If **both** values are out of range/in range/match microprocessor sends **signal** to switch light on … – … 1-minute timer is started – Actuator used to switch on/off light – When timer reaches 1 minute, microprocessor sends **signal** to switch light off – **Whole** process is continuous	**8**

Q63)

	One mark for each correct term in the correct order – Switch – Circuit – Current – Calculated – Character – Binary	**6**

Q64)

Question	Answer	Marks
(a)	**One** mark per each correct term, in the correct place. – LED – Photoelectric – Lens – Magnifies – Microswitch – USB	**6**
(b)	Any **two** from: – Keyboard – Microphone – 2D/3D Scanner – Sensor – Touchscreen – Keypad – Webcam – Joystick	**2**

Q65)

<table>
<tr><th>Question</th><th>Answer</th><th>Marks</th></tr>
<tr><td>(a)</td><td>One mark per each correct sensor
<table>
<tr><th>Task</th><th>Sensor</th></tr>
<tr><td>Check if a vehicle is too high</td><td>Infrared/light</td></tr>
<tr><td>Count the vehicles entering the car park</td><td>Magnetic field // pressure</td></tr>
<tr><td>Check if a vehicle is parked in a parking space</td><td>Pressure // magnetic field // infrared/light</td></tr>
</table></td><td>3</td></tr>
</table>

Question	Answer	Marks
(b)	**Six** from: – Sensor sends data to microprocessor – Data is converted from analogue to digital (using ADC) – Data is compared to stored value … – … If data is greater than stored value microprocessor sends signal to turn red light on and the green light off – … If data is less than stored value microprocessor sends signal to turn green light on the red light off – … If data still within range, no action taken/existing light remains on – Lights turned on/off using actuator – Process is continuous	**6**

Q66)

Question	Answer	Marks
(a)	– Microphone	1
(b)	– capacitive	1
(c)	– interrupt	1

Q67)

Question	Answer	Marks
(a)	One mark per each correct sensor. **Task** / **Sensor** checking the water is 30 °C – **Temperature** checking the water acidity level after detergent is added – **pH** checking the weight of the clothes to make sure that the machine is **not** overloaded – **Pressure**	3
(b)	**Six** from: – Sensor sends data to microprocessor – Data is converted from analogue to digital (using ADC) – Data is compared to stored value (of 30) If data is below 30 then a **microprocessor sends signal** is sent to a heater to heat the water up/add hot water – if data is above 30 then a **microprocessor sends signal** is sent to turn the heater off to allow the water to cool down/add cold water – Actuator used to turn headset on/off // Actuator used to add water – If data is 30 then no action is taken – It is a continuous process	6

Q68)

Question	Answer	Marks
	One mark per each correct term in the correct order. – Capacitive – Conductive // Capacitive – Change – Coordinates – Resistive – Circuit – Manufacture	7

Q69)

Question	Answer	Marks
	One mark per each correct row.	5

Statement	3D scanner (✓)	Barcode reader (✓)	QR code reader (✓)
uses position and alignment markers for orientation when scanning			✓
scans the shape and appearance of an object	✓		
uses reflected light from a laser to convert a black-and-white pattern into binary		✓	(✓)
can often be built into an Electronic Point Of Sale (EPOS) terminal, for example, a supermarket checkout		✓	(✓)
it is an example of an input device	✓	✓	✓

Q70)

Question	Answer	Marks
	Seven from: – Timer is started – Pressure sensor (within each mat) – Sensor sends data to microprocessor – Analogue data is converted to digital (using ADC) – Microprocessor compares data to stored value(s) – If data matches / in/out range **microprocessor** stops timer – If data matches / in/out range **microprocessor** checks if **data has come** from **correct** colour mat **sensor** – If data matches / in/out range **microprocessor** checks to see if **timer** is stopped at less than 1 second – If data matches / in/out range **microprocessor** increments counter if timer is less than 1 second and colour/mat is correct – If correct colour/mat is hit, timer is reset and the whole process is repeated – If **data has not come** from the **correct** colour mat **sensor** the game ends	7

Q71)

Question	Answer	Marks
	One mark for each correct device: • Actuator • Printer • Speaker	3

Q72)

(d)	Any **two** from: e.g. • Keyboard // Keypad • Mouse • Touchscreen • Digital camera • QR code scanner • Barcode scanner • 2D scanner • Microphone	2
(e)	• Any **one** from: • Speakers • Headphones	1
(f)	• random access memory (RAM) • read only memory (ROM)	2

Q73)

A student uses a computer and several hardware devices to complete his schoolwork.

The computer has a central processing unit (CPU).

(a) The student uses a keyboard to complete his schoolwork.

Tick (✓) **one** box to show which type of device the keyboard is.

A input ☑

B memory ☐

C output ☐

D storage ☐

[1]

(b) The student uses a printer to print his schoolwork.

Tick (✓) **one** box to show which type of device the printer is.

A input ☐

B memory ☐

C output ☑

D storage ☐

[1]

Q74)

Question	Answer	Marks
(a)	Any **two** from e.g. – Barcode **scanner** – QR code **scanner** – Digital camera	**2**
(b)	Any **six** from: – Proximity/infrared/pressure sensor used – Sensor **continually** sends **digitised** data to microprocessor // When driver pushes button, sensor sends **digitised** data to the microprocessor – Microprocessor compares data to stored value(s) – If in range/out of range/matches, microprocessor sends **signal** to close the door – **Actuator** used **to close door** – If not in range/out of range/does not match door will not close // If not in range/out of range/does not match actuator not activated/signal not sent as passenger in door // If not in range/out of range/does not match a timer is set to check again // If not in range/out of range/does not match a signal is sent to alert the driver/output a message – This process repeats **until the door can close**	**6**

Q75)

Question	Answer	Marks
(a)	Any **two** from e.g.: – Touchscreen – Microphone – Keyboard – Keypad – Digital camera – Sensor // by example – Biometric device – Button	**2**
(b)	Any **one** from e.g.: – Screen – Speaker – LED/Light – Actuator/Motor	**1**
(c)(i)	– 8	**1**
(c)(ii)	– 1024	**1**
(d)	Any **three** from: – It **performs** the basic functions of a computer – It **manages** the hardware – It provides a platform to run software – It provides a user interface – It performs tasks such as (any example of function of an operating system)	**3**

Q76)

Question	Answer	Marks
(a)	Any **two** from: Example: • Touch screen • Microphone • Button • Webcam // (digital) camera • Accelerometer • Biometric device	**2**
(b)	Any **one** from: Example: • Screen • Speaker • LED	**1**
(c)	SSD // Solid-state drive // Solid-state (device)	**1**

Q77)

Question	Answer	Marks
(a)	touch screen microphone keyboard	3
(b)	Any **two** from: Example: • **Data** can be **collected** without human intervention • Gathers **data** faster than a human • It will be accurate at taking readings • It can take readings continuously (24/7) • It can take readings in dangerous environments	2
(c)	**One** mark for each use (**Max 1**) per sensor: Example: Temperature • Checking whether the water in a kettle is boiling • Monitoring the temperature in a room that is climate controlled Humidity • Checking whether the air is dry enough in a spray-painting garage • Checking whether the air is moist enough in a greenhouse Infra-red • Detecting motion in a room for a security system • Detecting whether a person is approaching automatic doors Magnetic field • Counting vehicles that cross a bridge • Monitoring vehicles that enter a car park	4

Q78)

Question	Answer	Marks
(a)	Any **four** from: • A check digit is **calculated** from/using the **barcode data** • … using an algorithm // by example e.g. Modulo 11 • … and added to the **barcode** • When/after the **barcode is scanned** the check digit is **recalculated …** • … using the **same** algorithm • If the **check digits** do not match an error has occurred when scanning the barcode // If the **check digits** match no error has occurred when scanning the barcode	4