

## Chapter 3 Student Book Answers

### What you should already know

- 1 Memory – an immediate access store is RAM and ROM which are directly accessed by the CPU.  
Storage – an external devices such as HDD, SSD which are not directly accessed by the CPU.
- 2
  - Internal memory is RAM and ROM.
  - RAM stores instructions, data and the part of the OS currently in use.
  - Data in RAM is lost if the power is turned off.
  - RAM is a very fast memory but relatively small and expensive per byte.
  - ROM stores data which can't be lost or deleted but cannot be changed.
  - External storage is much larger than RAM/ROM but is not volatile and less expensive per byte than RAM/ROM.
- 3
  - i) DVD/CD player
  - ii) RAM/ROM
  - iii) SSD
  - iv) HDD
- 4 Online – storage connected to and under the control of a computer.  
Offline – storage not connected to and under the control of the computer.
- 5 Data access time – the time taken to locate and read data on a storage or memory device.  
Data transfer rate – the time taken to transfer data from storage or memory to CPU or other device.

### Activity 3A

- 1 a) i) **RAM**
  - temporary memory (contents can be changed)
  - can be written to/read from
  - used to store data, files, instructions, part of OS currently in use
  - volatile memory (contents lost when power turned off).
- ROM**
  - non-volatile memory (memory contents retained even when power is lost)
  - permanent memory (contents cannot be changed)
  - contents can only be read
  - used to store start up data (e.g. BIOS).
- (ii) **DRAM**
  - needs to be constantly refreshed
  - less expensive to manufacture than SRAM
  - consumes less power than SRAM
  - higher storage capacity than SRAM
  - main memory is constructed from DRAM.

**SRAM**

- no need to constantly refresh since it uses flip-flop circuits
- has a faster data access time than DRAM
- processor memory cache uses SRAM.

**b) Magnetic**

- uses magnetic properties to store data
- uses disk surfaces (coated in magnetic material)
- disks rotate and data is read/written using a read/write head which floats above the disk surface.

**Optical**

- uses disks which are coated in light-sensitive material
- data is read/written by red or blue laser light as disk rotates
- no contact made with disk surface during read/write operation
- DVD uses dual layering to increase data storage capacity.

**Solid state**

- no moving parts
- uses NAND/NOR chips to store data
- relies on flow of electrons to control read/write operations
- can't overwrite data; data needs to be deleted first and new data is written in the same location
- uses a matrix with two transistors at each intersection
- one transistor is floating gate
- one transistor is control gate.

**2 a) Inkjet printer**

- uses ink droplets which are ejected onto paper by piezoelectric or heat
- paper advances line by line during printing as head moves across the page
- ink is in liquid form and contained in cartridges.

**Laser printer**

- uses static electricity to print characters/images
- ink is in the form of a dry powder (known as toner)
- uses an electrostatically charged drum where paper is charged and areas for printing have opposite charge
- ink is charged and only sticks to areas of paper with opposite charge
- print is fixed to paper by passing paper over a heated drum.

**b) i)** Laser – colour leaflets which need to be produced quickly in their 100s.

Inkjet – one-off high-quality photographs.

**ii)** Laser – large capacity paper trays and high speed, high quality printing; ink cartridges last much longer than inkjet before needing to be changed.

Inkjet – for one-off job, printing is just as quick as laser; better quality printing when printing images.

**3**

- preserves the valuable art works
- allows many people to see the paintings since 3D replica can be produced as required
- allows full investigation of a painting without any risk of damaging the original (e.g. close view of brush strokes, amount of paint used on each part of canvass; allows the possibility of authenticating a new painting).

**4**

- the light sensor sends data to the ADC interface
- this changes the data into digital and sends it to the microprocessor
- the microprocessor samples the data every minute (or at some other frequency rate)
- if the data from the sensor  $<$  value stored in memory ...
- ... a signal is sent from the microprocessor to the street lamp
- ... and the lamp is switched on
- the lamp stays switched for 30 minutes before the sensor readings are sampled again (this prevents the lamp flickering off and on during brief heavy cloud cover for example)
- if the data from the sensor  $\geq$  value stored in memory ...
- ... a signal is sent from the microprocessor to the street lamp
- ... and the lamp is switched off
- the lamp stays switched off for 30 minutes before sensor readings are sampled again (this prevents the lamp flickering off and on during heavy cloud cover for example).

**Activity 3B****1 a)**

A	B	X
0	0	<i>1</i>
0	1	<i>0</i>
1	0	<i>0</i>
1	1	<i>1</i>

**b)**

A	B	C	X
0	0	0	<i>1</i>
0	0	1	<i>1</i>
0	1	0	<i>0</i>
0	1	1	<i>1</i>
1	0	0	<i>0</i>
1	0	1	<i>1</i>
1	1	0	<i>0</i>
1	1	1	<i>1</i>

**c)**

A	B	X
0	0	<i>0</i>
0	1	<i>0</i>
1	0	<i>0</i>
1	1	<i>0</i>

d)

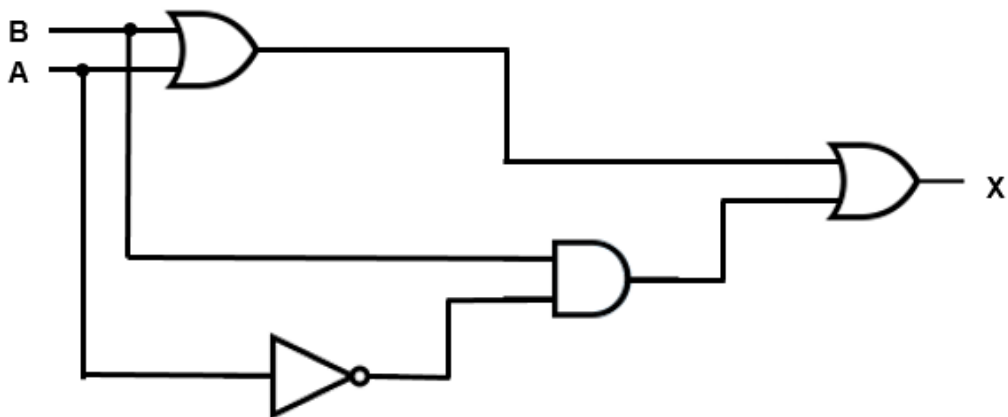
A	B	C	X
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

e)

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

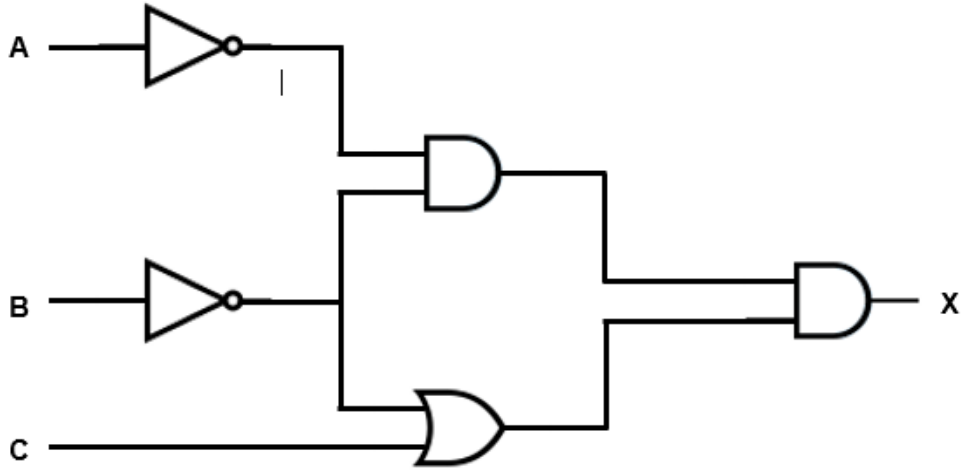
### Activity 3C

a)



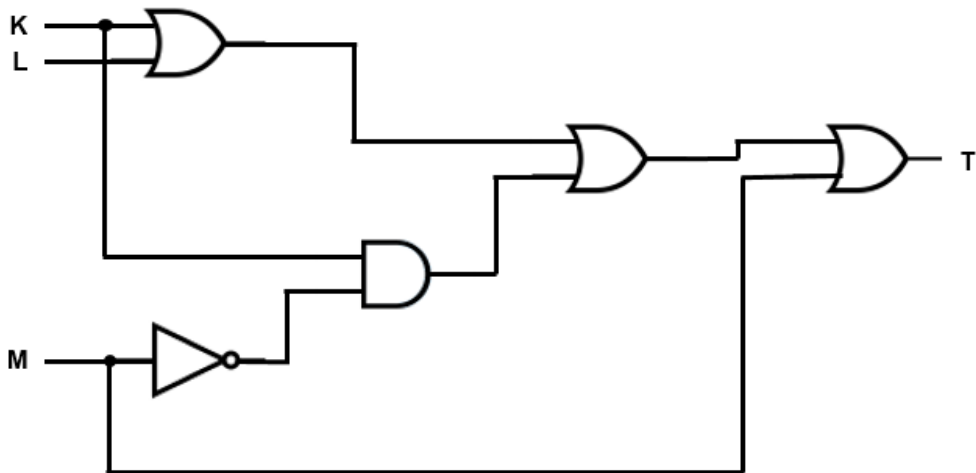
A	B	X
0	0	0
0	1	1
1	0	1
1	1	1

b)



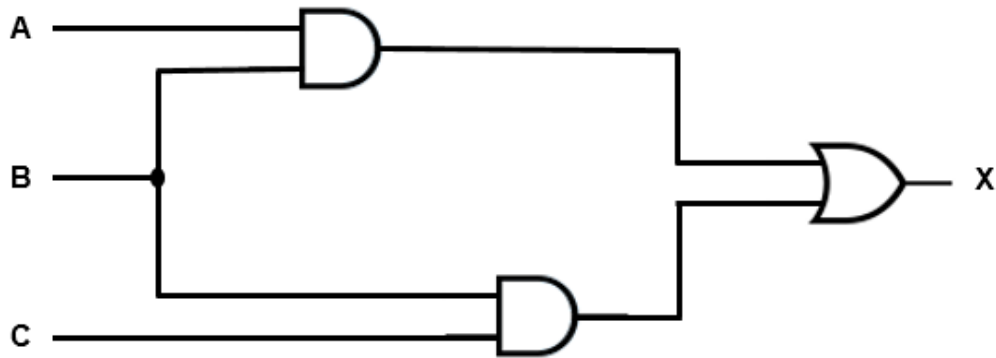
A	B	C	X
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	0

c)  $(K = 1 \text{ OR } L = 1) \text{ OR } (K = 1 \text{ AND } M = \text{NOT } 1) \text{ OR } (M = 1)$



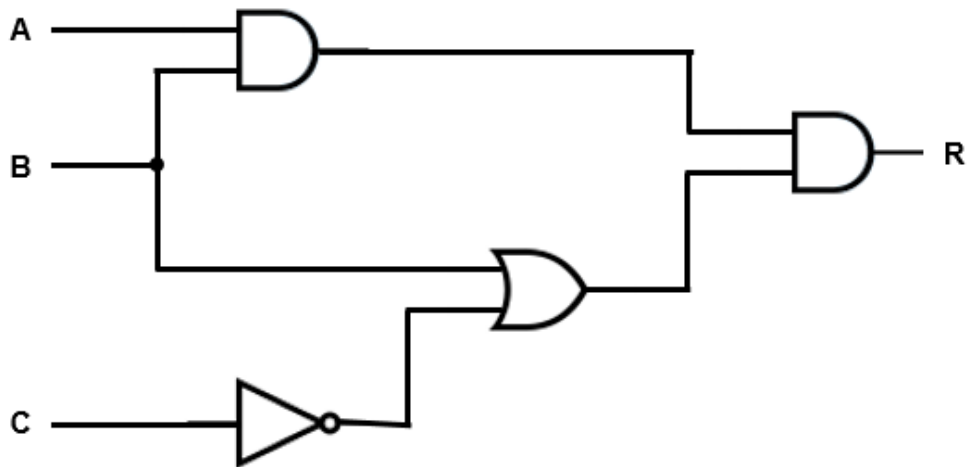
K	L	M	T
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

d)  $X = (A = 1 \text{ AND } B = 1) \text{ OR } (B = 1 \text{ AND } C = 1)$



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

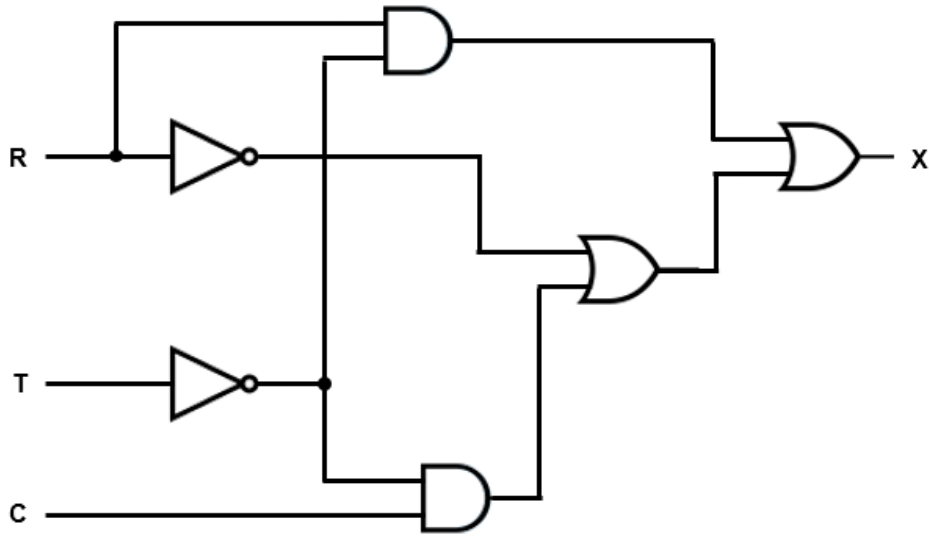
e)  $(A = 1 \text{ AND } B = 1) \text{ AND } (B = 1 \text{ OR } C = \text{NOT } 1)$



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

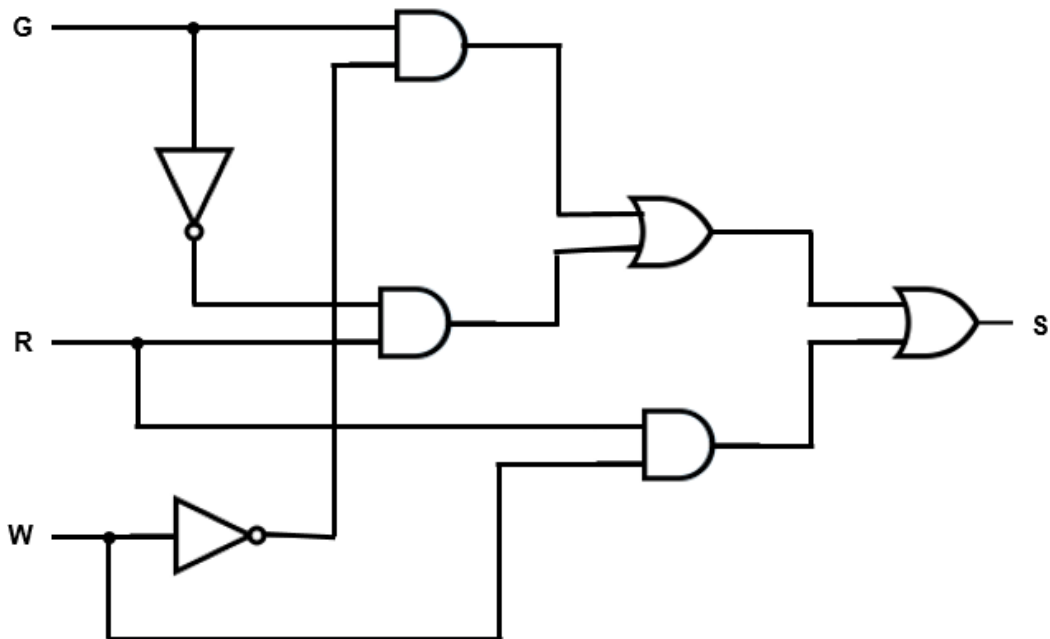
**Activity 3D**

a)  $X = 1$  if  $(R = \text{NOT } 1) \text{ OR } (C = 1 \text{ AND } T = \text{NOT } 1) \text{ OR } (R = 1 \text{ AND } T = \text{NOT } 1)$



R	T	C	X
0	0	0	1
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	0

b)  $(G = 1 \text{ AND } W = \text{NOT } 1) \text{ OR } (G = \text{NOT } 1 \text{ AND } R = 1) \text{ OR } (W = 1 \text{ AND } R = 1)$



G	R	W	S
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

### Activity 3E

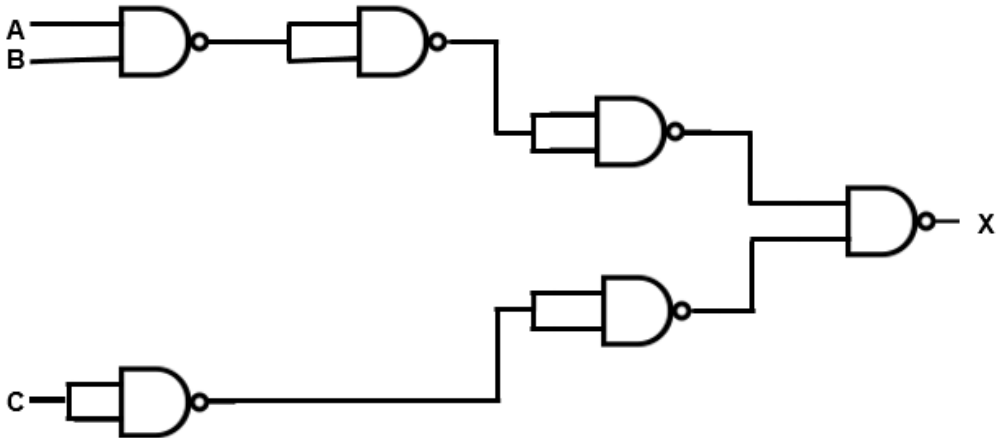
1

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

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

A	B
0	1
1	0

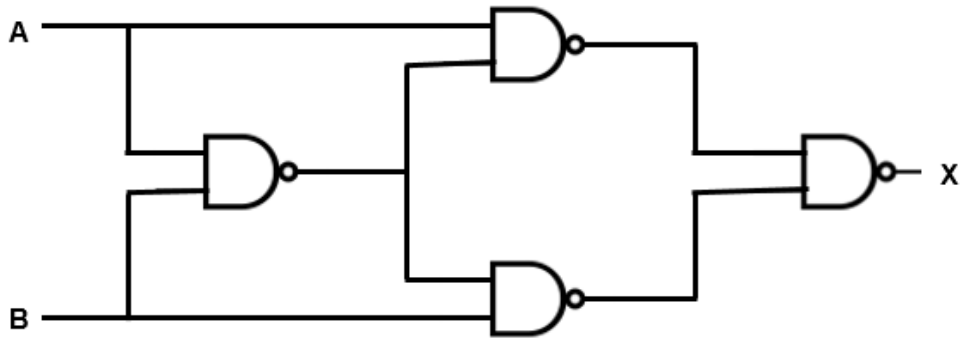
2 a)



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



b)



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

3

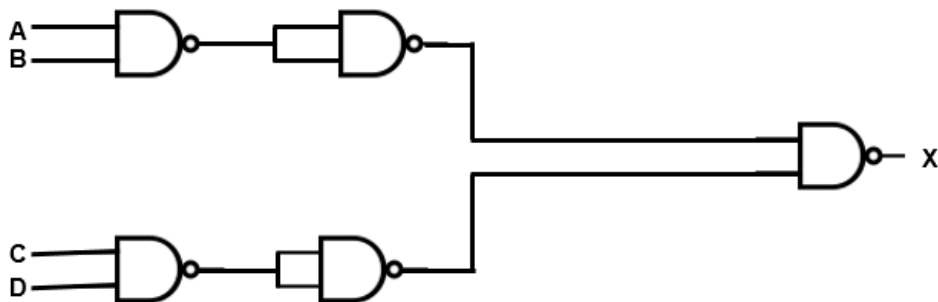
A	B	X
0	0	1
0	1	0
1	0	0
1	1	0

Same as a NOR gate

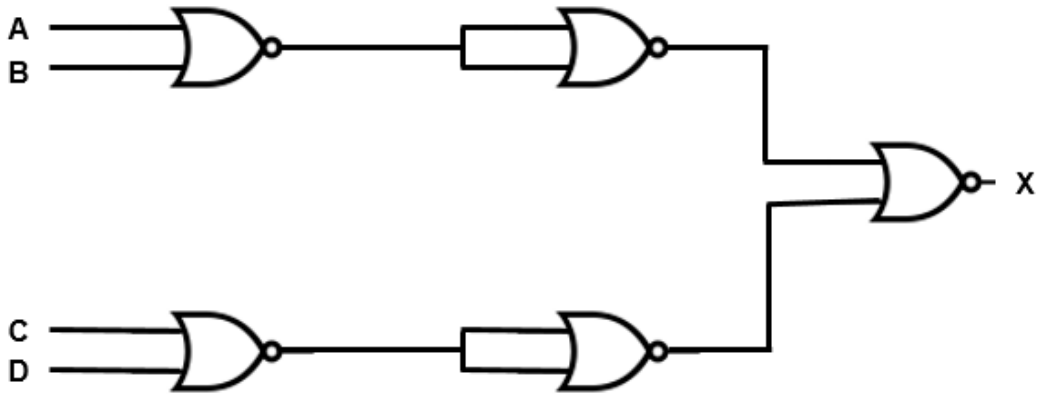
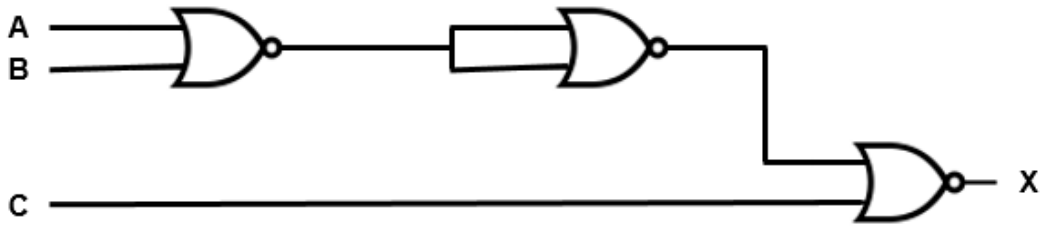
### Activity 3F

1 a)

b) the truth table will only generate a 0 when all inputs are 1



2 a)



b)

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

c)

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

3

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

### Extension Activity 3A

- a) RAM – store user settings, for example, time  
ROM – store factory settings, for example, microwave frequencies
- b) RAM – stores user settings, for example, temperature  
ROM – store cooling logic, sensor readings, and so on
- c) RAM – store directions sent from remote or programmed flight pattern  
ROM – store factory setting such as radio frequencies

### Extension Activity 3E

- 1 a) completes circuit between top and bottom conductive layer  
b) use of keyboard buffers and interrupts
- 2 a) i) movement of wheels allows mouse to know its x-y position  
ii) red light used to allow x-y direction/position to be monitored  
b) USB is direct serial wired data connection with computer  
wireless uses Bluetooth to communicate with computer

### Extension Activity 3G

A	B	$A\bar{B}$	$\bar{A}B$	$A\bar{B} + \bar{A}B$	$A + B$	$\bar{A}\bar{B}$	$(A + B)\bar{A}\bar{B}$
0	0	0	0	0	0	1	0
0	1	0	1	1	1	1	1
1	0	1	0	1	1	1	1
1	1	0	0	0	1	0	0

### Extension Activity 3H

NOR gate

### End of chapter questions

- 1 a) **OLED technology**
- OLED screens are thinner and lighter and therefore more flexible.
  - They have a brighter output than equivalent LED/LCD screens.
  - OLED requires no backlighting.
  - They use less power than equivalent LED/LCD screens (very important on portable devices).
  - Screens can be moulded into any shape required.
  - The colours are more vivid/better contrast.

b)

- human eye has limited detection of different colour hues
- depends whether or not tv is set up properly
- over time screen output deteriorates
- unnecessary to have such a range of colours
- questionable advantage

(many other reasons to consider)

2 a) i)

- can't be changed by users
- software loaded up automatically on powering up
- always available

ii)

- because many changes are made during the development stage
- EPROM can be altered as required
- ROM chip can't be changed once written to
- expensive to replace ROM chip each time a change/update is made

iii)

- fast access for working memory
- values can be written to RAM, for example, current score

iv)

- possibility of saving to a memory stick
- possibility of linking to larger screens
- possibility of connecting to devices such as printers

b)

- less expensive to build prototypes
- other methods require new mould to be made every time design is changed

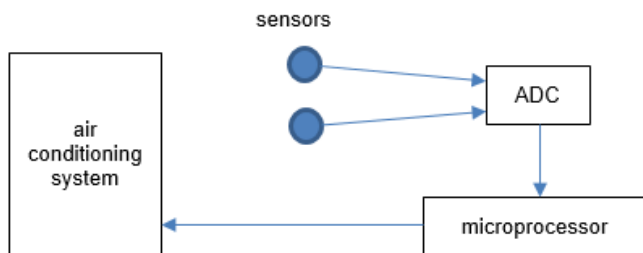
3 a) **Control**

- Sensor data is used by the microprocessor or computer to decide if any action needs to be taken to keep a process within correct parameters.
- The output from the system affects next set of inputs.

**Monitoring**

- Sensor data is used by the microprocessor or computer to check whether it is within stored/set parameters.
- If data is outside set parameters, a warning is sent to the user (on screen warning or sound).
- The microprocessor/computer has no effect on what is being monitored/it simply 'watches' the process.

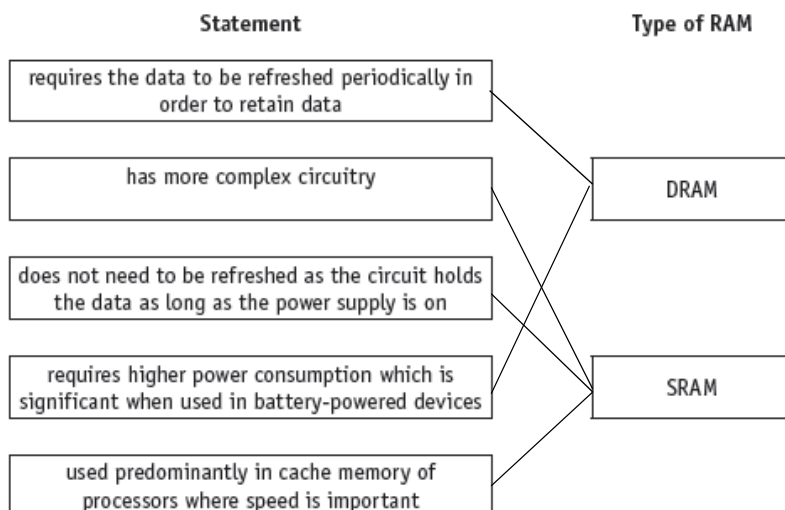
b)



- Sensor 1 measures temperature and sensor 2 measures humidity level.
- Sensor 1 data is continuously sent to the microprocessor via the ADC (if analogue in nature); this converts data to digital format.
- If temperature < temperature setting, then a signal is sent out from the microprocessor to the air con unit to increase heat output.
- If temperature > temperature setting, then a signal is sent out from the microprocessor to the air con unit to increase output of cooling air.
- If the two values are the same, no signals are sent by the microprocessor.
- Sensor 2 data is continuously sent to the microprocessor via ADC (if analogue in nature); this converts data to digital format.
- If humidity > set level, a signal is sent out from the microprocessor to the air con unit to activate the dehumidifier.
- If humidity < set level, a signal is sent out from the microprocessor to the air con unit to increase moisture level in the air being output.
- If the two values are the same, no signals are sent by the microprocessor.

4 order: A – 4, B – 6, C – 1, D – 9, E – 2, F – 7, G – 3, H – 8, I – 5

5 a)



b) RAM

- loses contents when powered off/volatile
- temporary memory (contents can be erased or changed)
- stores files/part of OS/data/instructions currently in use
- data can be read from/written to
- often have larger capacity than ROM.

**ROM**

- doesn't lose contents on powering off/non-volatile
- contents cannot be altered/permanent memory
- read only memory
- can be used to store, for example, BIOS, bootstrap.

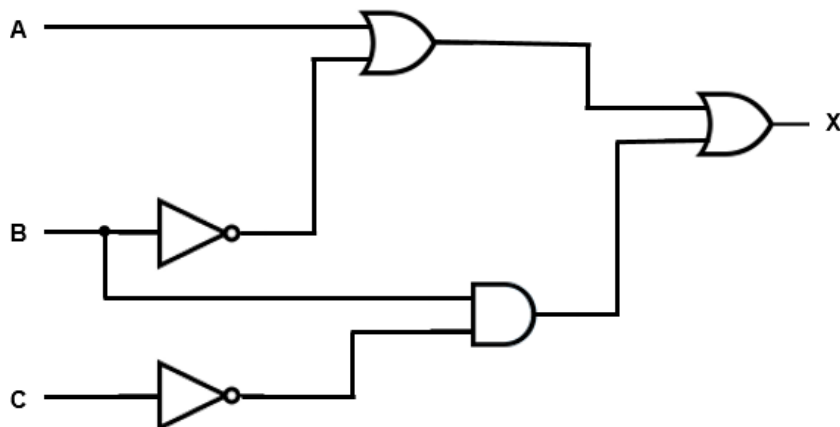
**c DVD**

- laser/optical media
- phase changing recording
- rotating disk and single spiral track (centre to outer rim)
- uses dual layering
- uses red laser (DVD) or blue laser (Blu-Ray DVD).

**Flash memory**

- NAND-based solid state memory
- no moving parts
- uses matrix with two transistors at each intersection
- one transistor is a floating gate
- second transistor is a control gate
- uses movement of electrons to control R/W operations
- can't overwrite data with new data; need to erase existing data and then write new data in the same location.

6 a)



b)

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

c)  $((\text{NOT } A \text{ AND } B) \text{ OR } (\text{NOT } B \text{ OR } C)) \text{ AND NOT } C$   
 $(\bar{A} \cdot B + (\bar{B} + C)) \cdot \bar{C}$