**Perth Academy**

**S3 Physics**

**![C:\Users\Mary\AppData\Local\Microsoft\Windows\Temporary Internet Files\Low\Content.IE5\98EH48ES\MP900316539[1].JPG]()**

**Basic Electronics**

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**Activity Booklet**

INSTRUCTIONS: Always put today’s date and copy each HEADING carefully.

A good scientist always dates their work. Your jotter will form a complete set of notes on Basic Electronics. It is important that you keep a useful record of work in your jotter. Full sentence answers are required for questions and experiments should be fully written up with a conclusion checked by your teacher. If you are off it is your responsibility to ‘catch up’. Speak to your teacher or friends to find out what you missed and get a copy.

Symbols used in this booklet:



**Copy**

The little pencil symbol means that you copy the passage neatly into you Physics Jotter. It is important that the Copy Passages are copied accurately since the content may appear in the End of Unit Test.



**Read**

The little book symbol means that you must read the passage carefully so you can extract the required information and so that knowledge is gained for the test.

**What to do**

This little symbol means you must collect apparatus and carry out an experiment OR follow instructions in an activity. Remember, apparatus may be delicate and costly and should be treated as such. Please return all apparatus to its appropriate place of storage.

![MCj04077340000[1]]()

**Questions Answer in full sentences**

This little question symbol means that there are some questions to be answered as best as you can. If you are unsure of an answer, your teacher may help or you can find out the answer from other sources like a text book or internet. A full sentence answer means you can tell what the question was from reading the answer.

**More to do**

The plus sign means that if you have the time there is more work that can be done.

![MC900325644[1]]()**Watch a video**

This symbol means that your teacher may show you a short video clip.

![MC900195258[1]]()**See something on the internet**

Your teacher may show you something on the internet to help your understanding.

**SIMPLE ELECTRONICS**

**HEADING Activity 1 Constructing a Title Page**

Start this Basic Electronics Unit with a Title Page.

 A title page should contain both text and graphics.

Use colours where possible. Here is an example:

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***Basic Electronics***

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![C:\Users\Mary\AppData\Local\Microsoft\Windows\Temporary Internet Files\Low\Content.IE5\WJ9WQN6E\MP900382845[1].JPG]()

**HEADING Activity 2 Electronic Systems**

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**Read**

Every electronic system is made up of three parts. They are the input, process and output of the system. This can be shown in a diagram called a block diagram. It looks like this:

output

process

input

The following shows the block diagram for a system that sounds an alarm when the temperature in a room gets too low.

buzzer

processor

Temperature

sensor

The output of an electronic system can be either digital or analogue.

Digital outputs can only have two values they can either be on or off. Analogue outputs have continuously varying values.

Analogue and digital signals can be identified from their waveform as shown. A is analogue and B is digital.



![MCj04077340000[1]]()

**Questions Answer in full sentences**

1. What is the name of the three parts of an electronic system?
2. Draw a block diagram showing the main parts of a system used to make announcements at public events.
3. Explain the difference between an analogue signal and a digital signal.

**HEADING Activity 3 Analogue and digital signals**



**Read**

**Aim**: **To study digital and analogue signals using an oscilloscope.**



 **What to do**

Watch the teacher demonstration of the production of analogue and digital signals.



 **Copy**

Copy the Heading, Aim and the following diagrams into your jotter.

Pulse

generator

Pulse

generator

oscilloscope



microphone

oscilloscope



 **What to do**

Under the block diagrams of each system draw the corresponding trace from the oscilloscope.

**HEADING Activity 4 The microphone**

**Aim: To study the function of a microphone**



**Read**

The microphone is an input device that changes sound energy into electrical energy.



**Copy**

Copy the Heading, Aim and the diagrams below into your jotter.



microphone

oscilloscope



 **What to do**

1. Connect the microphone to the input terminals of the oscilloscope.
2. Adjust the controls of the oscilloscope so that there is a clear pattern on the screen when you make sounds into the microphone.
3. Try speaking different letters into the microphone of different volumes and pitch.
4. Draw some of the traces you see into your jotter below your block diagram.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. What energy transformation takes place in the microphone?
2. Does the microphone produce an analogue or digital signal?

**HEADING Activity 5 The switch**

**Aim: To study the function of a switch.**



**Read**

A simple switch can be used as an input device. A switch has different resistances when it is open (off) or closed (on). Changing the resistance of the switch also changes the voltage produced across it. When the resistance of the switch is low the voltage across it will also be low, when the resistance of the switch is high the voltage across it will also be high.



**Copy**

Copy the Heading, Aim and the diagrams below into your jotter.

switch

ohmmeter



 **What to do**

1. Collect a selection of switches and an ohmmeter.
2. Copy the following table.

|  |  |  |
| --- | --- | --- |
| Switch type | Resistance (ohms)Switch open (off) | Resistance (ohms)Switch closed (on) |
| Toggle |  |  |
| Push |  |  |
| Plug |  |  |

1. Connect the ohmmeter leads to both ends of the switches.
2. Operate the switches and complete the table.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. What is common about the resistance for all the switches when they are open?
2. Does the switch produce an analogue or digital signal?
3. If the switches were connected to a 5 volt supply what would you predict the voltage across them would be when they were:
4. Open
5. Closed?

(hint – read the information at the start of the activity)

**HEADING Activity 6 The thermistor**

**Aim To study the function of a thermistor.**



 **Read**

The resistance of a thermistor depends on temperature. As temperature increases resistance decreases.



 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.

thermistor

ohmmeter



 **What to do**

1. Copy and complete the following table.

|  |  |
| --- | --- |
| Temperature | Resistance ofthermistor |
| Cold |  |
| hot |  |

1. Connect the ohmmeter leads to the thermistor.
2. Record the resistance of the thermistor at room temperature.
3. Warm the thermistor by holding it in your fingers and record the resistance.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. What happens to the resistance of the thermistor as it is heated
2. Is the thermistor an input or output device?

**HEADING Activity 7 The LDR (light dependent resistor)**

**Aim To study the function of a LDR.**

****

 **Read**

The resistance of a LDR depends on light level. As the light level increases the resistance decreases.



 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.

LDR

ohmmeter



 **What to do**

1. Copy and complete the following table.

|  |  |
| --- | --- |
| Light level | Resistance ofLDR |
| Bright |  |
| Dark |  |

1. Connect the ohmmeter leads to the LDR.
2. Record the resistance of the LDR in darkness and bright light.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. What happens to the resistance of the LDR as the light level decreases?
2. Is the LDR an input or output device?

**HEADING Activity 8 The LDR and thermistor tutorial.**



 **What to do**

Use the relationship below to help answer the questions.

**Resistance, current and voltage (Ohm’s Law).**

$$voltage=current x resistance$$

Symbols: V I R

Units: volt ampere ohm

Abbreviation V A Ω

1. What would be the most suitable input device for the following applications.
2. A lightmeter for a camera.
3. A temperature control for an aquarium.
4. A Karaoke machine.
5. A thermistor has a resistance of 36 ohms when hot. The voltage across it is 9 volts. Calculate the current through the thermistor.
6. An LDR has a current of 0.01 ampere in it and has a resistance of 400 ohms. Calculate the voltage across it.
7. A thermistor has a resistance of 200 ohms at 20 °C. What is the current through it when it is connected to a 10 volt supply?

 **More to do**

1. An LDR has a current of 10 mA in it and a voltage of 6 V across it. Calculate its resistance.
2. An LDR at a certain light level has a current of 20 mA passing through it. If the resistance of the LDR at this light level is 250 Ω, calculate the voltage across it.

**More to do**

**HEADING Activity 9 The solar cell (optional)**

**Aim: To study the function of a solar cell.**



 **Read**

The solar cell is an input device that can produce a voltage when exposed to light. The solar cell has many uses. Solar cells are very useful in powering space vehicles such as satellites and telescopes (e.g. Hubble). They provide a very economical and reliable way of powering objects which would otherwise need expensive and cumbersome fuel sources. Solar powered cars are cars which are powered by an array of solar cells. The electricity created by the solar cells either directly powers the vehicle through a motor, or goes into a storage battery. These days many of us own calculators powered by solar cells.

 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.

Solar cell

voltmeter



 **What to do**

1. Cover the cell completely so that no light reaches it and record the reading on the voltmeter.
2. Uncover the cell and measure the voltage again.
3. Investigate how the output voltage is affected by the brightness or colour of light or the area of the solar cell.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. Describe how the voltage is affected when the light level increases.
2. Does the colour of light affect the output voltage?

 **More to do**

**HEADING Activity 10 The capacitor (optional)**

**Aim: To study the function of a capacitor.**



 **READ**

Capacitors store electric charge. Just as it takes a certain time to fill a jug with water, so it takes a certain time to fill a capacitor with charge.

 **Copy**

Copy the Heading, Aim and the diagram below into your jotter.

R

C



 **What to do**

1.

1. Set up the circuit above with the help of you teacher.

2. Close the switch and observe what happens to the voltmeter reading.

3. Repeat this with different values of capacitor and resistor.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. Describe what happens to the voltage across the capacitor when the switch is closed.
2. How does the value of R or C affect this?

**HEADING Activity 11 The loudspeaker**

**Aim: To study the function of a loudspeaker.**



 **Read**

A loudspeaker usually consists of a paper cone, which is attached to a fine coil of wire suspended between the poles of a permanent magnet. When a varying current passes through the coil it becomes magnetized and reacts with the permanent magnet to move the cone backwards and forwards, producing sound waves in the surrounding air.

 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.



G

Signal

generator

loudspeaker

 **What to do**

1. Set the output of the signal generator to a very low frequency (about 5Hz) and observe the movement of the spheres in the cone.
2. Gradually increase the frequency and observe the movement of the spheres.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. What is the energy change taking place in the loudspeaker?
2. Is the loudspeaker an input or output device?
3. Is the loudspeaker an analogue or digital device?

**HEADING Activity 12 The buzzer**

**Aim: To study the function of a buzzer.**



 **Read**

Buzzers are another output device that emit sound energy.



 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.



Power supply

buzzer

 **What to do**

1. Connect the battery to the buzzer the correct way round so that it makes sound

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. Describe the sound from the buzzer in terms of the frequency.
2. What energy change takes place in the buzzer?
3. Is the buzzer an analogue or digital output device?
4. Name a system that would use a buzzer as an output device?

**HEADING Activity 13 The motor**

**Aim: To study the function of the electric motor**



 **Read**

Electric motors are used in a variety of electronic equipment. Washing machines, tumble dryers and fan ovens are a few examples. An ordinary household will have many appliances that contain an electric motor.

 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.

Variable

power supply

Electric motor



 **What to do**

1. Connect the motor to the power supply and operate it.
2. Find out how to change its speed.
3. Find out what happens if the connections are reversed.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. What is the energy change in the motor?
2. Is the motor an output or input device?
3. Is the motor an analogue or digital device?
4. Name four applications of the electric motor.

**HEADING Activity 14 The Solenoid**

**Aim: To study the function of the solenoid**



 **Read**

A solenoid is a device which uses an electric current to produce movement in a straight line. For example, in the central locking system in a car, a solenoid is used to operate the locks.



 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.



Power supply

Solenoid



 **What to do**

1. Connect the circuit shown above.
2. Operate the switch and observe the movement of the bolt in the solenoid.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. Is the solenoid an input or output device?
2. What is the energy change in the solenoid?
3. Is the solenoid an analogue or digital device?
4. Name an application where a solenoid would be used.

 **More to do**

**HEADING Activity 15 The relay (optional)**

**Aim To study the function of the relay.**



 **Read**

A relay is an electronically operated switch. Sometimes it is useful to be able to operate a circuit from a distance; for example, inside a nuclear reactor. This can be done by sending an electrical signal to a relay, which will then switch on the required circuit.

A relay allows an operator to switch on a low voltage, low current circuit to turn on machinery that works from a high voltage and/or current.

In an industrial situation the relay voltage might be about 12 volts and the current about 0.1 ampere. This could be used to switch on and off a 240 volt circuit carrying a current of 10 ampere.



 **What to do**

Watch your teacher demonstrate and explain the function of the relay.

**HEADING Activity 16 Light emitters**

**Aim: To study the function of a lamp and a light emitting diode (LED).**



 **Read**

A torch lamp is a useful output device. A more modern device is the LED. Both of these devices change electrical energy into light energy.



 **Copy**

Copy the Heading, Aim and the diagrams below into your jotter.



Variable Power supply

lamp

Variable

Power supply

LED

 **What to do**

1. Build the two circuits shown above.
2. Note the current flowing in each device.
3. Investigate the effects of reversing the battery connections for each device.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. Which device needs the greater current when in use?
2. Which device must be connected the correct way round?
3. Which device is analogue and which is digital?
4. Draw the circuit symbol for an LED.
5. Why do you think the series resistor is in the LED circuit?
6. Name a system that would use
7. a lamp as an output device
8. an LED as an output device.

**HEADING Activity 17 The 7 segment display**

**Aim: To study the function of the 7 segment display.**



 **Read**

Many instruments use a 7 segment display to indicate numbers. One type of this output device can be made from 7 bar-shaped LEDs. Each segment can be made to light by connecting the LED to a power supply in series with a switch and resistor. Some calculators use displays which are LED type displays but most use liquid crystal displays (LCDs).



 **Copy**

Copy the Heading, Aim and the diagram below into your jotter.

7 segment

display

Switches



 **What to do**

1. Connect the 7 segment display as shown by your teacher.
2. Make sure that the switches are set to ‘off’.
3. Use the switches labeled ‘a’ to ‘g’ to generate the numbers 0 to 9.

![MCj04077340000[1]]()

 **Questions Answer in full sentences**

1. Name a system that would use a 7 segment display as an output device.
2. Examine which segments light when you operate each of the switches and see if you can label each of the segments from ‘a’ to ‘g’ for a 7 segment display.

**HEADING Activity 18 The Angus System Board**

**Aim: To become familiar with the Angus System Board.**

Use a 5V supply or the battery pack provided.

Set the switching temperaturtre by adjusting resistor.

Thermistor – warm with thumb or heel of hand. **Do not rub.**



Use pre-wired plug-on connector to connect torch, fan etc to the relay.

Connections to GATES

LDR – alter characteristics by slipping a short piece of tubing over LDR.

TESTING GATES – use push switches as inputs and the test probe as output to check truth tables for NOT, AND, OR gates.

**HEADING Activity 19 The NOT gate**

**Aim: To determine the truth table for a NOT gate.**



 **Read**

In the next few activities you will be examining process devices called logic GATES. You will be looking at the most basic gates which are the NOT, AND and OR gates. Logic gates are made up of a number of transistors made on a silicon chip, called an integrated circuit.



 **Copy**

Copy the Heading, Aim and the diagram below into your jotter.

Switch

NOT gate

LED



  **What to do**

1. Connect the Angus board to the battery pack.
2. Use the leads to connect push switch A to the input of the NOT gate.
3. Connect the output of the NOT gate to the test probe.
4. Copy and complete the table below.

|  |  |
| --- | --- |
| Input | Output |
| (Low) 0 |  |
| (High) 1 |  |

Remember that when the push switch is off the input is low or logic 0. When the push switch is on the input is high or logic 1.

**HEADING Activity 20 The AND gate**

**Aim: To determine the truth table for an AND gate.**



 **Copy**

Copy the Heading, Aim and the diagram below into your jotter.



Switch A

AND gate

LED

Switch B

 **What to do**

1. Connect the Angus board to the battery pack.
2. Use the leads to connect push switch A to one input of the AND gate and switch B to the other.
3. Connect the output of the AND gate to the test probe.
4. Copy and complete the table below.

|  |  |  |
| --- | --- | --- |
| Input A | Input B | Output |
| 0 | 0 |  |
| 0 | 1 |  |
| 1 | 0 |  |
| 1 | 1 |  |

**HEADING Activity 21 The OR gate**

**Aim: To determine the truth table for an OR gate.**



 **Copy**

Copy the Heading, Aim and the diagram below into your jotter.



Switch A

OR gate

LED

Switch B

 **What to do**

1. Connect the Angus board to the battery pack.
2. Use the leads to connect push switch A to one input of the OR gate and switch B to the other.
3. Connect the output of the OR gate to the test probe.
4. Copy and complete the table below.

|  |  |  |
| --- | --- | --- |
| Input A | Input B | Output |
| 0 | 0 |  |
| 0 | 1 |  |
| 1 | 0 |  |
| 1 | 1 |  |

**HEADING Activity 22 Temperature control**

**Aim: To use my knowledge of electronic components and switching devices, to help design an electronic system to provide a practical solution to a real-life situation.**



 **Read**

**Problem**

People in an office find it gets too hot in the summer. An electronic system is required to turn the motor of a fan on when it is too hot.

**Subsystems available:**

The output is logic 1 when it is hot.

The output is logic 1 in bright light.

OR gate

NOT gate

Switches

Temperature sensor

Light sensor

The output is logic 1 when the switch is on.

AND gate

Motor

Relay



  **What to do**

1. Copy the Heading and Problem.
2. Draw a block diagram for your system.
3. Connect the system using the Angus board.
4. Adjust the switching temperature so that the output is just off.
5. Heat the thermistor to see if the output operates.
6. Get your teacher to check your system.
7. Under your block diagram write an explanation of how your system works. Include a logic diagram.

**HEADING Activity 23 Getting out of bed**

**Aim: To use my knowledge of electronic components and switching devices, to help design an electronic system to provide a practical solution to a real-life situation.**



 **Read**

**Problem**

At certain times of the year a farmer would like an alarm to wake him up when it gets light. He would like his alarm to sound only when it gets light and when he has switched it on.

**Subsystems available:**

The output is logic 1 when it is hot.

The output is logic 1 in bright light.

OR gate

NOT gate

Switches

Temperature sensor

Light sensor

The output is logic 1 when the switch is on.

AND gate

Buzzer



  **What to do**

1. Copy the Heading and Problem.
2. Draw a block diagram for your system.
3. Connect the system using the Angus board.
4. Test your system to see if it works.
5. Get your teacher to check your system.
6. Under your block diagram write an explanation of how your system works. Include a logic diagram.

**HEADING Activity 24 Security Lights**

**Aim To use my knowledge of electronic components and switching devices, to help design an electronic system to provide a practical solution to a real-life situation.**



 **Read**

**Problem**

A shop has had a number of break-ins at night. The shopkeeper wants an electronic system to turn a light on at night.

**Subsystems available:**

The output is logic 1 when it is hot.

The output is logic 1 in bright light.

OR gate

NOT gate

Switches

Temperature sensor

Light sensor

The output is logic 1 when the switch is on.

AND gate

lamp



  **What to do**

1. Copy the Heading and Problem.
2. Draw a block diagram for your system.
3. Connect the system using the Angus board.
4. Test your system to see if it works.
5. Get your teacher to check your system.
6. Under your block diagram write an explanation of how your system works. Include a logic diagram.

**HEADING Activity 25 Keeping watch**

**Aim: To use my knowledge of electronic components and switching devices, to help design an electronic system to provide a practical solution to a real-life situation.**



 **Read**

**Problem**

Many outdoor lights are also used as security devices. An electronic system is required that turns on a lamp when heat is detected during the hours of darkness.

**Subsystems available:**

The output is logic 1 when it is hot.

The output is logic 1 in bright light.

OR gate

NOT gate

Switches

Temperature sensor

Light sensor

The output is logic 1 when the switch is on.

AND gate

lamp



  **What to do**

1. Copy the Heading and Problem.
2. Draw a block diagram for your system.
3. Connect the system using the Angus board.
4. Test your system to see if it works.
5. Get your teacher to check your system.
6. Under your block diagram write an explanation of how your system works. Include a logic diagram.

**HEADING Activity 26 Camping out**

**Aim: To use my knowledge of electronic components and switching devices, to help design an electronic system to provide a practical solution to a real-life situation.**



 **Read**

**Problem**

Darren likes to play in his tent in the garden but his mother worries about him being too cold. An electronic system is required to sound a buzzer in the house if it gets too cold. The system should also have a switch that will allow Darren to alert his mother in an emergency.

**Subsystems available:**

The output is logic 1 when it is hot.

The output is logic 1 in bright light.

OR gate

NOT gate

Switches

Temperature sensor

Light sensor

The output is logic 1 when the switch is on.

AND gate

buzzer



  **What to do**

1. Copy the Heading and Problem.
2. Draw a block diagram for your system.
3. Connect the system using the Angus board. Warm the temperature sensor and adjust the switching temperature so that the output is just off.
4. Test your system to see if it works.
5. Get your teacher to check your system.
6. Under your block diagram write an explanation of how your system works. Include a logic diagram.