Name:

Teacher:

N5 Physics and Electronics
Electricity 2 – Electronics

	Success Criteria	Test	Prelim	Exam
L1	I can describe the relationship between current and voltage in simple potential divider circuits			
	I can describe what is meant by the phrase 'potential divider'			
	I can calculate missing values of voltage and resistance in potential divider circuits			
L2	I can simulate potential divider circuits in Yenka			
	I can make virtual measurements of voltage in potential divider circuits using Yenka			
	I can describe benefits of using electronic simulation packages such as Yenka			
L3	I can construct potential divider circuits on a breadboard			
	I can make measurements of voltage in potential divider circuits using a multimeter			
	I can compare, calculated, simulated and measured values of voltage in potential divider circuits			
	I can describe common pre-power up and functionality tests that should be carried out in electronics.			
L4	I can draw the circuit symbols for a diode and LED			
	I can describe the function of Diodes and LEDs			
	I can state why LEDs need a protective resistor			
	I can calculate the value of the protective resistor required for an LED			
	I can construct a simple LED circuit			
L5	I can draw the circuit symbols for a capacitor, thermistor and LDR			
	I can describe the function of a capacitor, thermistor and LDR			
	I can describe the relationship between light and resistance for an LDR			
	I can describe the relationship between temperature and resistance for a thermistor			
L6	I can describe the function of 4 basic control circuits			
	I can construct and test 4 basic control circuits			
L7	I can draw the symbols for NPN transistors and n-channel enhancement MOSFETs			
	I can describe the functions of NPN transistors and n-channel enhancement MOSFETs			
	I can describe the operation of the 4 basic transistor switching circuits			
	I can construct and the 4 basic switching circuits			
L8	I can safely solder basic components onto stripboard			
	I can describe the function of a track cutter			
	I can describe the function of a heat sink			
	I can describe the function of the solder sucker			
L9	I can design a simple switching circuit			
	I can solder my own design of a switching circuit			

L1 - Potential Divider Theory

- I can describe the relationship between current and voltage in simple potential divider circuits
- I can describe what is meant by the phrase 'potential divider'
- I can calculate missing values of voltage and resistance in potential divider circuits

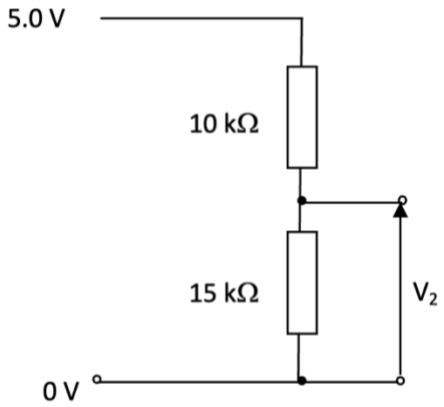
Task 1:Complete the table bellow

$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right) V_s \qquad \frac{V_1}{V_2} = \frac{R_1}{R_2}$$

Symbol	Name	Unit	Unit Symbol
V_1	Potential Difference across Resistor 1	Volts	V
V_2			
V_s			
R_1			
R_2			

Worked Example

Calculate the output voltage, V_2, in the potential divider shown below:



$$V_2 = \left(\frac{R_2}{R_1 + R_2}\right) V_s$$

$$V_2 = \left(\frac{1500}{1000 + 1500}\right) \times 5$$

$$\underline{V_2 = 3.0V}$$

Task 2: **Yellow Books page 50-53**

Task 3: **Fill in the table with calculated values for V_2**

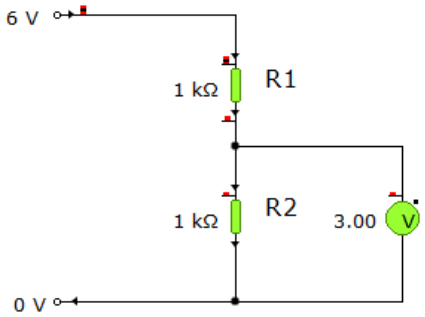
V_S (V)	R_1 (Ω)	R_2 (Ω)	V_2 (V)
6	150	100	
6	150	220	
6	150	1k2	
6	1k2	1k2	
6	1k2	150	
6	68k	68k	

L2 – Potential Divider Simulation

- I can simulate potential divider circuits in Yenka
- I can make virtual measurements of voltage in potential divider circuits using Yenka
- I can describe benefits of using electronic simulation packages such as Yenka

Task 1:Simulation

Aim: To investigate the relationship between the output voltage (V_2) and the resistances of R_1 and R_2 by simulation.



Method:

1. Open a new page in YENKA, Analogue Electronics.
2. Create the above simulation. (Your teacher will demonstrate how to do this)
3. Record the results in the table below and repeat for the other resistor combinations.

Results:

V_S (V)	R_1 (Ω)	R_2 (Ω)	V_2 (V)
6	150	100	
6	150	220	
6	150	1k2	
6	1k2	1k2	
6	1k2	150	
6	68k	68k	
6			
6			

Task 2:In the space below, list some advantages of using circuit simulation software

L3 – Potential Divider Construction

- I can construct potential divider circuits on a breadboard
- I can make measurements of voltage in potential divider circuits using a multimeter
- I can compare, calculated, simulated and measured values of voltage in potential divider circuits
- I can describe common pre-power up and functionality tests that should be carried out in electronics.

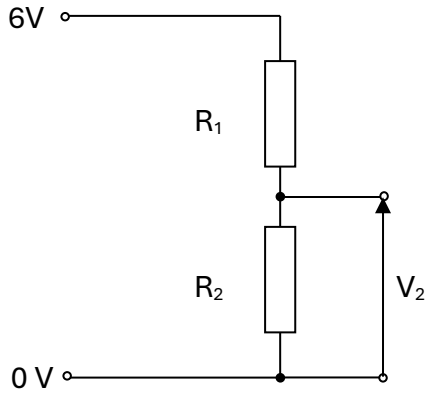
Task 1: **In the space below, list some pre-power up tests that should be completed in electronics**

Task 2: **In the space below, list some functionality tests that should be completed in electronics**

Task 3: **In the space below, describe why testing circuits before switching them on is important**

Practical: **Investigating Potential Dividers**

AIM: To investigate the relationship between output voltage (V_2) and the resistances of R_1 and R_2.



METHOD:

1. Create a labelled prototype plan on the diagram above for the circuit shown. (Teacher check)
2. Construct the circuit
3. Carry out a pre-power up check.
4. Power Up and test
5. Record the below

Pre-Power up testing:

Supply voltage correct value?	
Continuity of wiring (are all connections in place and secure)?	
Resistor values, correct?	

Functionality Test table

V_s (V)	R_1 (Ω)	R_2 (Ω)	V_2 (V)
6	10	100	
6	10	220	
6	10	1k2	
6	1k2	1k2	
6	1k2	10	
6	68k	68k	
6			
6			

Task 4: **describe how the calculate, simulation and measured values compare**

L4 - Diodes

- I can draw the circuit symbols for a diode and LED
- I can describe the function of Diodes and LEDs
- I can state why LEDs need a protective resistor
- I can calculate the value of the protective resistor required for an LED
- I can construct a simple LED circuit

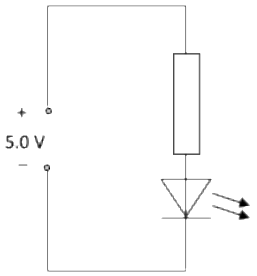
Task 1:Complete the table with the SQA accepted definitions and symbols

Component	Symbol	Function
Diode		
LED		
LED - Protective Resistor		

Worked Example

The operating conditions for a particular LED are as found to be:

Typical Forward Voltage	V_{LED}	2.0 V (max = 2.8 V)
Maximum Forward Current	I_F	12 mA
Voltage of the supply	V_s	5V



Calculate the value of resistance required for the protective resistor (4)

Step 1: Calculate the voltage across the resistor

$$V_S = V_R + V_{LED}$$

$$V_R = V_S - V_{LED}$$

$$V_R = 5.0 - 2.0$$

$$V_R = 3.0\,V$$

Part 2: Calculate the resistance the resistor

$$V = IR$$

$$3 = 0.012 \times R$$

$$R = \frac{3}{0.012}$$

$$R = 250\,\Omega$$

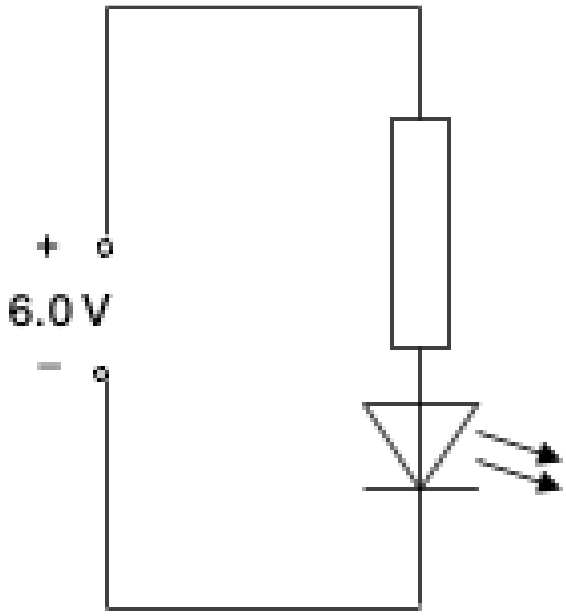
A 250 Ω resistor is not readily available, so the next highest should be chosen i.e. 270 Ω.

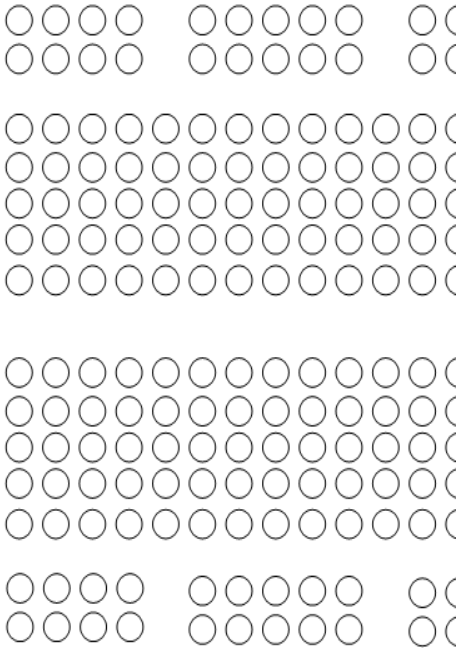
Task 2:Yellow Book Questions 1-5 Page 69 and 70
Practical: Protection of LEDs.

AIM To investigate the current flow in an LED and protection resistor required.

APPARATUS Collect: a 6.0 V dc supply
A red LED (5mm 2.2V Red)
resistor (to be decided by you)
prototype board

METHOD You are going to design and set up the following circuit.





Typical Forward Voltage	V_{LED}	2.0 V
Maximum Forward Current	I_F	10 mA

Results:

PRE-POWER UP CHECK LIST	
What will be tested	**Result**

FUNCTIONALITY TEST	
What will be tested	**Result**
Does LED operate when powered (on or off)?	
Voltage across LED (V)	
Voltage across resistor (V)	
Current (mA)	
Are current and voltage within limits?	

L5 – Special Components

- I can draw the circuit symbols for a capacitor, thermistor and LDR
- I can describe the function of a capacitor, thermistor and LDR
- I can describe the relationship between light and resistance for an LDR
- I can describe the relationship between temperature and resistance for a thermistor

Task 1:Complete the table with the SQA accepted definitions and symbols

Component	Symbol	Function
Capacitor		
LDR		
Thermistor		

Practical: Special Components

- S3 Control Circuit Box
- 1 Red Lead (4mm to 4mm)
- 1 Black Lead (4mm to 4mm)
- 1 Multimeter

Results: Build the 3 circuits and record the values or resistance in each condition below

LDR:

Light Level	High	Low
Resistance (Ω)		

Thermistor:

Temperature	High	Low
Resistance (Ω)		

Variable Resistor:

Dial Position	High	Middle	Low
Resistance (Ω)			

Task 2:Compleat the blanks bellow

When the temperature of thermistor increases the resistance of the thermistor _____.

When the light level on an LDR increases the resistance of the LDR _____.

L6 – Control Circuits

- I can describe the function of 4 basic control circuits
- I can construct and test 4 basic control circuits

Practical: Control Circuits - Voltage

- S3 Control Circuit Box
- 2 Red Lead (4mm to 4mm)
- 2 Black Lead (4mm to 4mm)
- 1 Multimeter
- 5 V Power Supply

Method:

Build Circuits 4 - 7

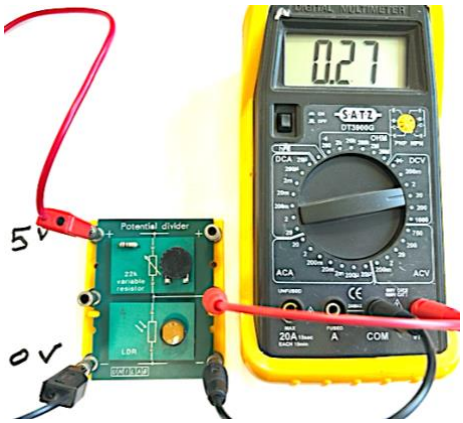
For each circuit, measure the **voltage** in different circumstances and use your results to fill in the blanks below.
You may need to adjust the variable resistor at the start of each of these circuits

Circuit 4 – Low Light Control Circuit

Voltage when light level is

High_____

Low_____



Circuit 5 – High Light Control Circuit

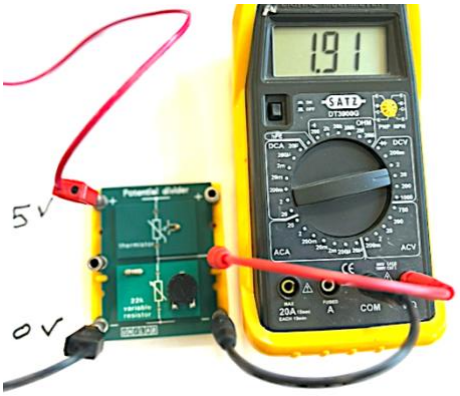
Voltage when light level is

High_____

Low_____

Circuit 6 – Low Temperature Control Circuit

Voltage when Temperature is



High_____

Low_____

Circuit 7 – High Temperature Control Circuit

Voltage when Temperature is

High_____

Low_____

L7 - Switching Circuits

- I can draw the symbols for NPN transistors and n-channel enhancement MOSFETs
- I can describe the functions of NPN transistors and n-channel enhancement MOSFETs
- I can describe the operation of the 4 basic transistor switching circuits
- I can construct and the 4 basic switching circuits

Task 1:Complete the table with the SQA accepted definitions and symbols

Component	Symbol	Function
NPN Transistor		
n-channel enhancement MOSFET		

Practical: Switching voltage of a transistor

- S3 Control Circuit Box
- 2 Red Lead (4mm to 4mm)
- 2 Black Lead (4mm to 4mm)
- 1 Multimeter
- 5 V Power Supply

1. Build Circuit 8
2. Adjust the variable resistor so the LED is off
3. Increase the variable resistor gradually and record the flowing voltages:

Voltage the LED just begins to light _____
Voltage when the LED gets fully bright. _____

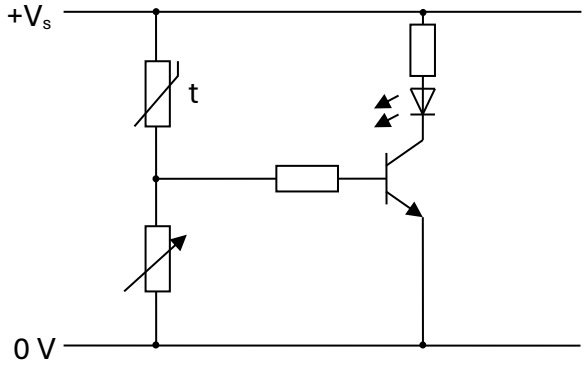
The voltage when the LED first gets fully bright is the **Switching Voltage** of an NPN Transistor.

Circuit 8

Task: Fill in the balnks

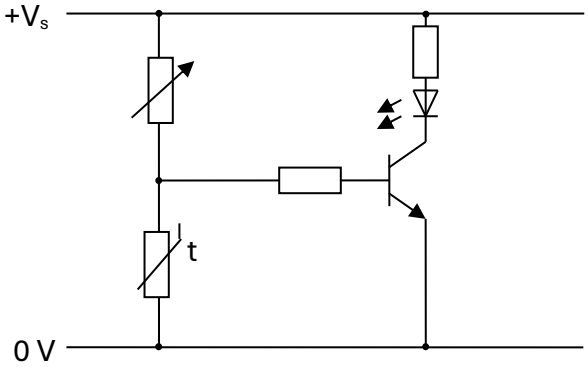
In the circuits below, the **variable resistor** allows the circuit to be adjusted to the temperature or light conditions for which the output device can switch on.

High Temperature Switching circuit. (11)



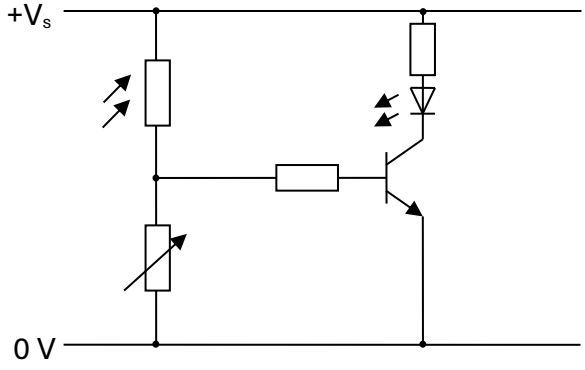
- *When the temperature of thermistor increases The resistance of thermistor _____,*
- *Voltage across thermistor _____, Voltage across resistor variable _____,*
- *When this reaches the **switching voltage** the Transistor and LED switch on*

low Temperature Switching circuit. (12)



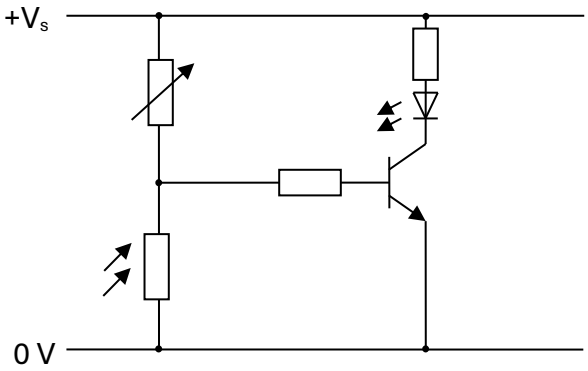
- *When the temperature of thermistor decreases the resistance of thermistor _____*
- *Voltage across thermistor _____,*
- *When this reaches the **switching voltage** the Transistor and _____ switch on*

High Light Switching circuit. (9)



- *When the Light level of LDR _____, The resistance of LDR _____,*
- *Voltage across LDR _____, Voltage across resistor variable _____,*
- *When this reaches the _____ _____ the Transistor and LED switch on*

Low Light Switching circuit. (10)



_____

_____

_____

_____

_____

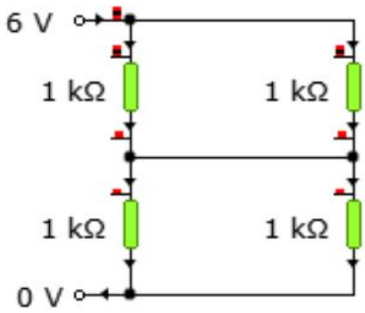
_____

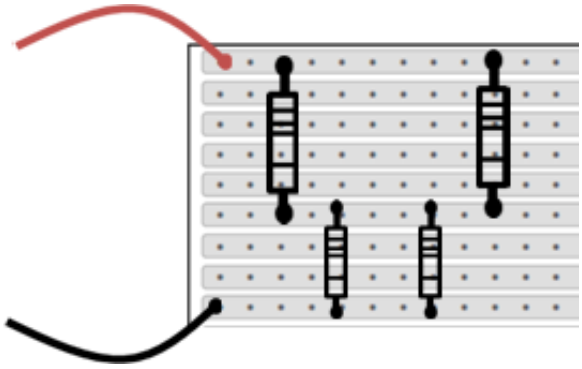
_____

L8 - Soldering

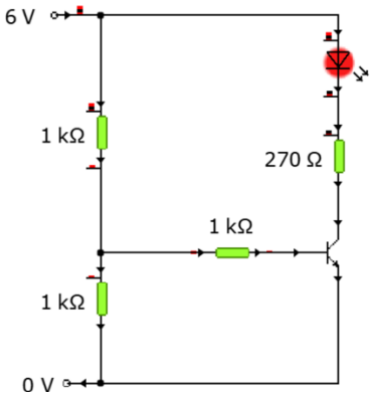
- I can safely solder basic components onto stripboard
- I can describe the function of a track cutter
- I can describe the function of a heat sink
- I can describe the function of the solder sucker

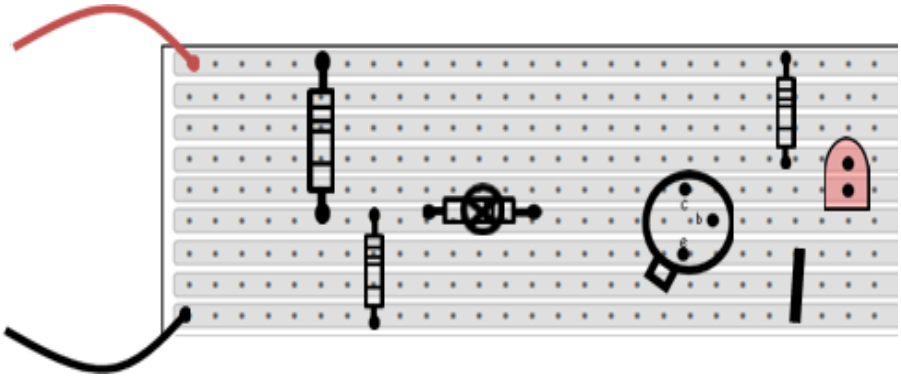
Soldering Practice 1 - Whetstone Bridge





Soldering Practice 2 - Automatic Switching Circuit





Task 1:Complete the table

Tool	Picture	Function
Track Cutter		
Heat Sink		
Solder Sucker		

Review: Check your booklet is up to date
Test yourself on the definitions
Complete Electricity practice test 2
Self-Mark Electricity practice test 2
Fill in your learning Log