

# GEC INTEGRATED GRADE 9 PROJECT LEARNER'S WORKBOOK



**3** ENTREPRENEURSHIP  
EMPLOYABILITY  
EDUCATION

**PROJECT-BASED LEARNING | TECH, MATH & NS**



**basic education**  
Department:  
Basic Education  
REPUBLIC OF SOUTH AFRICA



**GRADE  
2023**

**9**



## POSSIBLE SCENARIOS

**NOTE:** Below, you will find two different scenarios. Select ONE scenario that will be used for the completion of the project.

### SCENARIO 1:

Amy works in a small clothing shop, and she loves to read. She often gets so engrossed in her book that she doesn't notice when clients enter the store. Help Amy to build a small door alarm that sounds a buzzer and indicates by means of a LED when clients enter.

### SCENARIO 2:

Khotso sometimes looks after his sick grandmother in the afternoons. When he plays soccer with his friends outside the house, he cannot hear when she calls for him. Please help him to design and build a device so he can hear and see when his grandmother is calling him when she needs him. Present your solution to an audience. Explain your outputs using graphs and calculated values.

### REQUIREMENTS FOR THE DEVICE / PROTOTYPE / MODEL.

- The structure (house) should protect the components of the electronic circuit.
- The electronic components should be securely joined to the base board.
- The batteries should be replaced easily.
- The cost of the electronic circuit of the device / prototype / model should not exceed R50.
- The size of the structure (house) the electronic circuit should be 150 mm x 100 mm x 20 mm.

#### 1.1 Identify the problem from the selected scenario.

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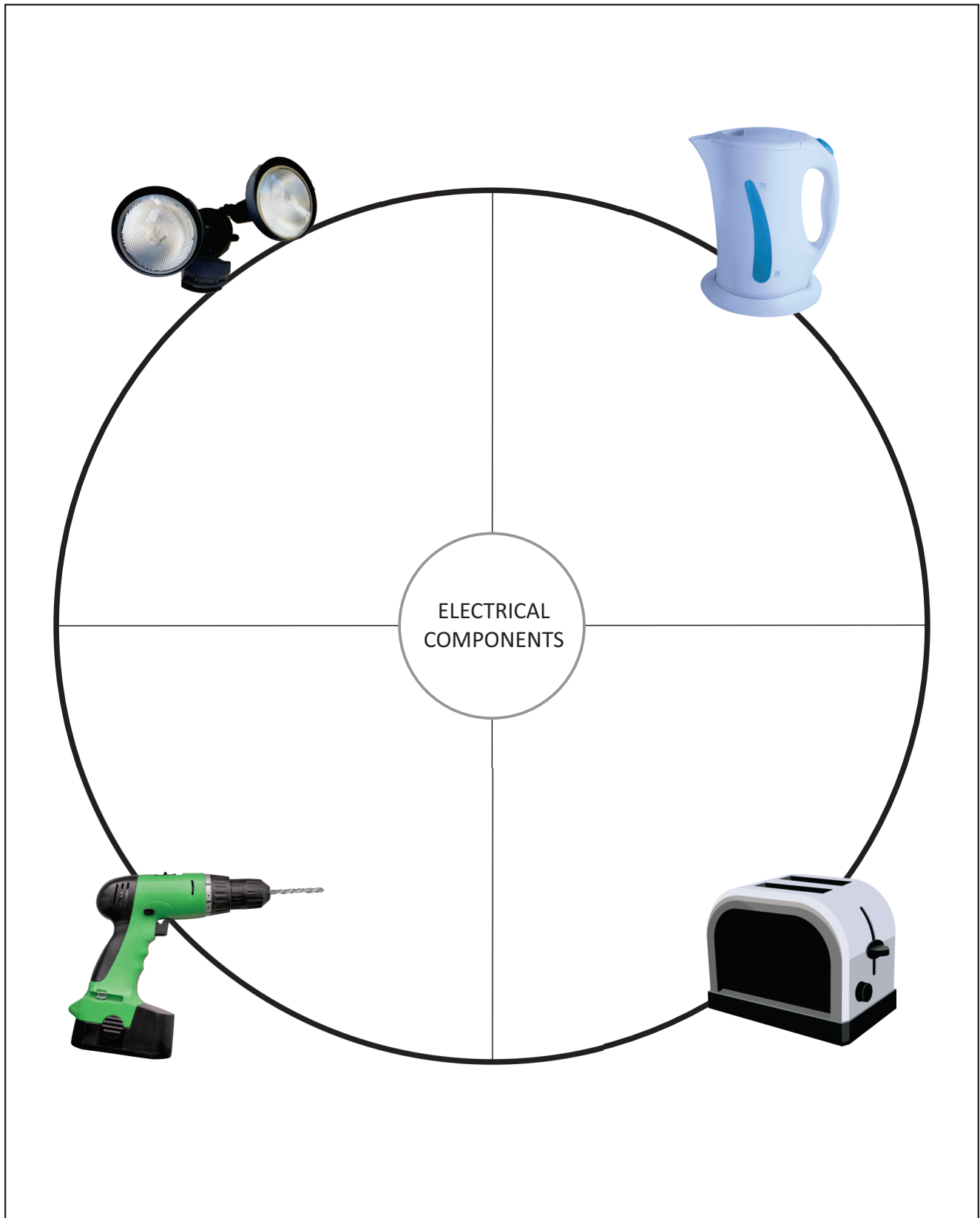
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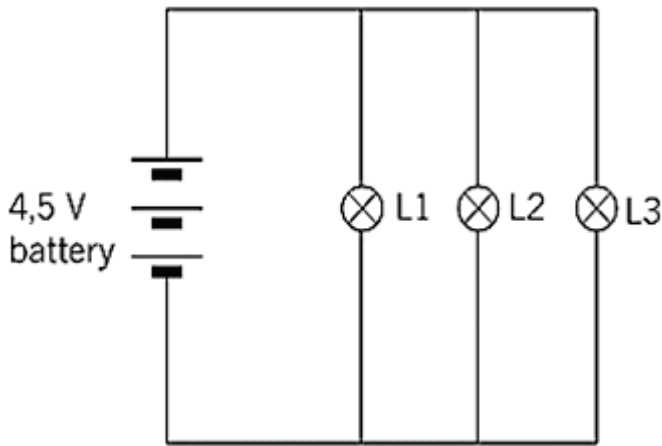


Different electronic appliances are illustrated below. List the electronic components used in the different appliances in the provided space.

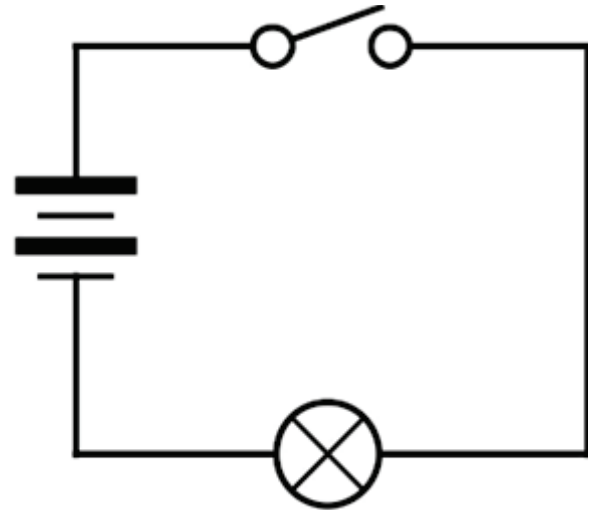




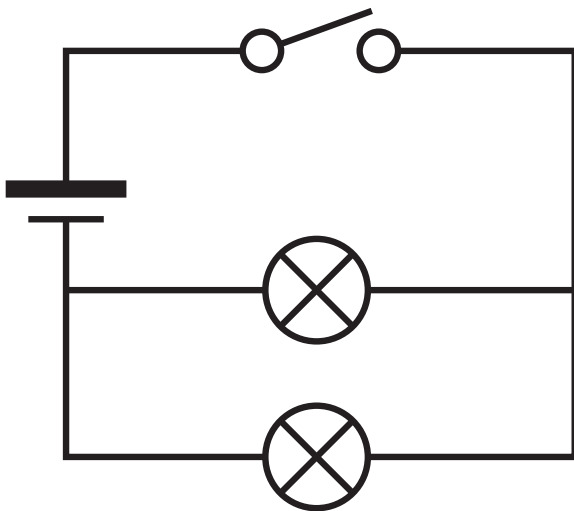
Look at the simple Circuit Diagram below. Can we tell if the components (bulbs) are connected in Series or Parallel in the circuit diagrams below? Please label the components in every circuit. Also show in which direction current flow takes place.



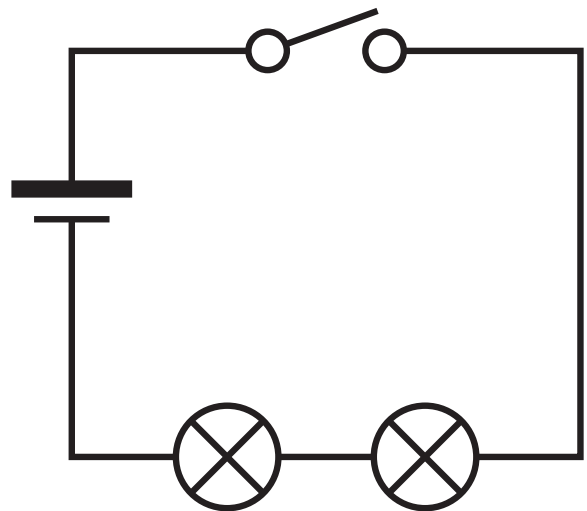
Circuit type: .....



Circuit type: .....



Circuit type: .....



Circuit type: .....

CIRCUIT TYPE	CIRCUIT DIAGRAM SYMBOL
Wire	_____
Resistor	_____⚡_____
Light bulb	_____⊗_____

CIRCUIT TYPE	CIRCUIT DIAGRAM SYMBOL
Cell	_____  _____
Battery	_____   _____
Switch	_____⏏_____



Study the electronic / electrical components below. Identify the component, draw the symbol and give the function of each component in the provided spaces.

ELECTRONIC / ELECTRICAL COMPONENT	NAME OF COMPONENT	SYMBOL	FUNCTION
3.1 	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
3.2 	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
3.3 	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
3.4 	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....
3.5 	..... ..... ..... .....	..... ..... ..... .....	..... ..... ..... .....



## Worksheet 4 - NS - FORMAL

Formulate an investigative question for your project. Research questions can help to direct your research and make you think deeper about ordinary problems. An example of a research question is provided in line with scenario's.

EXAMPLE	<i>Formulate your own investigative question</i>
What is the effect of increasing the number of cells in series on the brightness of the light when the buzzer sounds. (inclusive example)	<div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div>
	<b>Example of research question 1</b> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div>
	<b>Example of research question 2</b> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div> <div>.....</div>



## WORKSHEET 5 - TECHNOLOGY/NS FORMAL (DESIGN)

5.1 Write a design brief for the identified problem mention in the scenario.

(3)

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5.2 List **THREE** specifications from the scenario.

(3)

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5.3 List **TWO** constraints from the scenario

(3)

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5.4 Draw a relevant circuit diagram to solve the identified problem from the selected scenario.







Use the space below to note the decisions your group must make and/or problems you must solve to build an actual working device (OR a 3D model of a device made from found materials that looks exactly like the components in the circuit).

PROBLEM YOU NEED TO SOLVE/DECISION YOU HAVE TO TAKE	POSSIBLE SOLUTIONS
Example: Where will we get a battery? .....	Look in old toys, look for old radios that still have batteries .....
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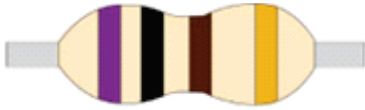


## Worksheet 6b - TECHNOLOGY: [INFORMAL]

Answer the following questions:

1. Work out and write down the resistance of each of these resistors:

A



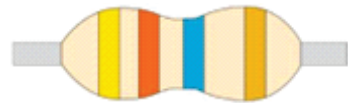
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B



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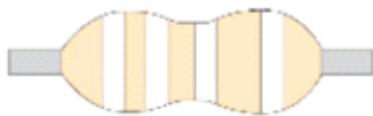
C



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2. Provide the colour codes for the following resistors. If you don't have coloured pencils or pens, write the colour of each band above it.

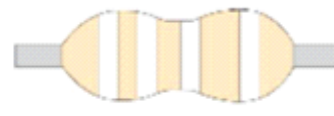
A



7500 $\Omega$

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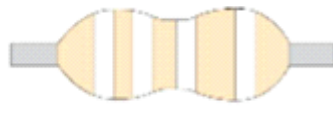
B



2600k $\Omega$

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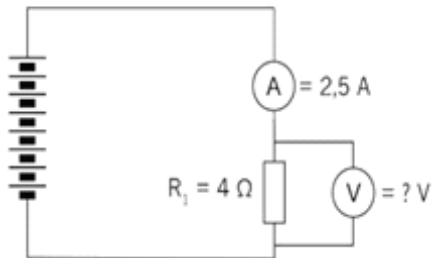
C



0,57m $\Omega$

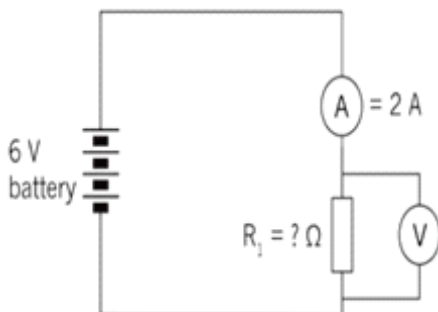
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3. Calculate the value of the voltage supply in the circuit below if the resistor has a value of 4  $\Omega$  and the current through the resistor is 2,5 A.



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4. Calculate the resistance value of the resistor.

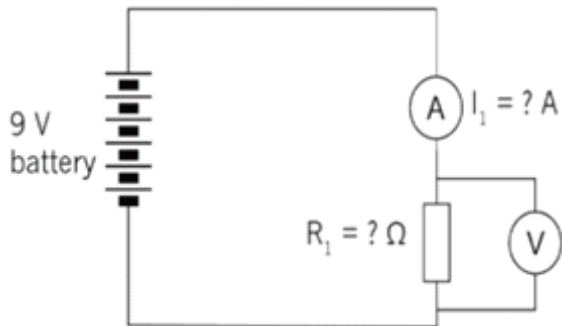


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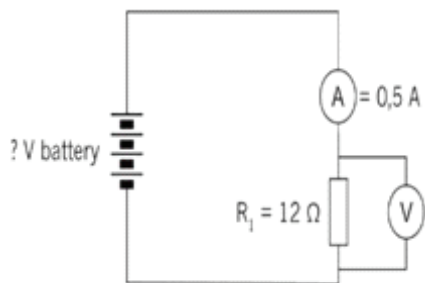


## Worksheet 6b - TECHNOLOGY: [INFORMAL]

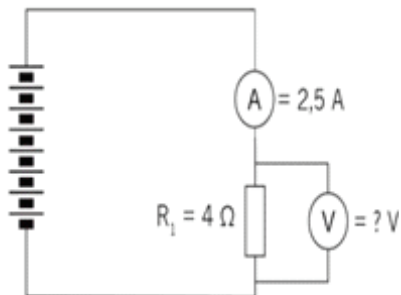
5. If two more cells are added to the circuit, will the current increase or decrease? Check your prediction using the formula.



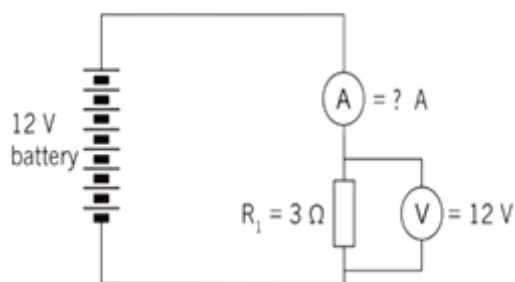
6. Calculate the battery voltage for the circuit below.



7.



8.





## Worksheet 6b - TECHNOLOGY: [INFORMAL]

9. Given  $V = 10\text{ V}$  and  $R = 1\text{ k}\Omega$ , what will the value of the current be in a circuit?

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10. Given  $V = 20\text{ V}$  and  $R = 5\text{ k}\Omega$ , solve for the current.

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11. A tumble dryer in a laundry service uses a  $220\text{ V}$  power source. The coil of the heater provides an average resistance of  $12\text{ }\Omega$ . What is the current flowing through the heating coils?

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12. A  $9\text{ V}$  battery maintains a current of  $3\text{ A}$  through a radio. What is the resistance in the circuit?

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13. Describe the function of a diode in your own words.

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## Worksheet 6b - TECHNOLOGY: [INFORMAL]

14. List at least four places where LEDs are used. Don't use the examples already given

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15. How can you make sure that a diode is connected correctly?

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16. Draw the circuit symbols for a diode and for a LED.

Diode

LED

## Worksheet 7 - TECHNOLOGY – GROUP WORK [INFORMAL]



7.1 Use the criteria in the table below to analyse and evaluate the individual designs according to the requirements mentioned in the scenario. Suggest improvements and select the final idea.

NAMES OF MEMBERS	ASPECTS TO EVALUATE Refer To Specifications & Constraints mentioned in the scenario	SUGGESTIONS IN WHICH THE DESIGN CAN BE MODIFIED TO IMPROVE IT
7.1.1 _____	<ul style="list-style-type: none"> <li>● Size:</li> <li>● Stability of structure:</li> <li>● Are the electronic components securely joined to the base board?</li> <li>● Will the batteries be easily replaced?</li> </ul>	
7.1.2 _____	<ul style="list-style-type: none"> <li>● Size:</li> <li>● Stability of structure:</li> <li>● Are the electronic components securely joined to the base board?</li> <li>● Will the batteries be easily replaced?</li> </ul>	
7.1.3 _____	<ul style="list-style-type: none"> <li>● Size:</li> <li>● Stability of structure:</li> <li>● Are the electronic components securely joined to the base board?</li> <li>● Will the batteries be easily replaced?</li> </ul>	
7.1.4 _____	<ul style="list-style-type: none"> <li>● Size:</li> <li>● Stability of structure:</li> <li>● Are the electronic components securely joined to the base board?</li> <li>● Will the batteries be easily replaced?</li> </ul>	
7.1.5 _____	<ul style="list-style-type: none"> <li>● Size:</li> <li>● Stability of structure:</li> <li>● Are the electronic components securely joined to the base board?</li> <li>● Will the batteries be easily replaced?</li> </ul>	

We have decided on \_\_\_\_\_'s design as the best solution to the identified problem.

REASONS for our choice:

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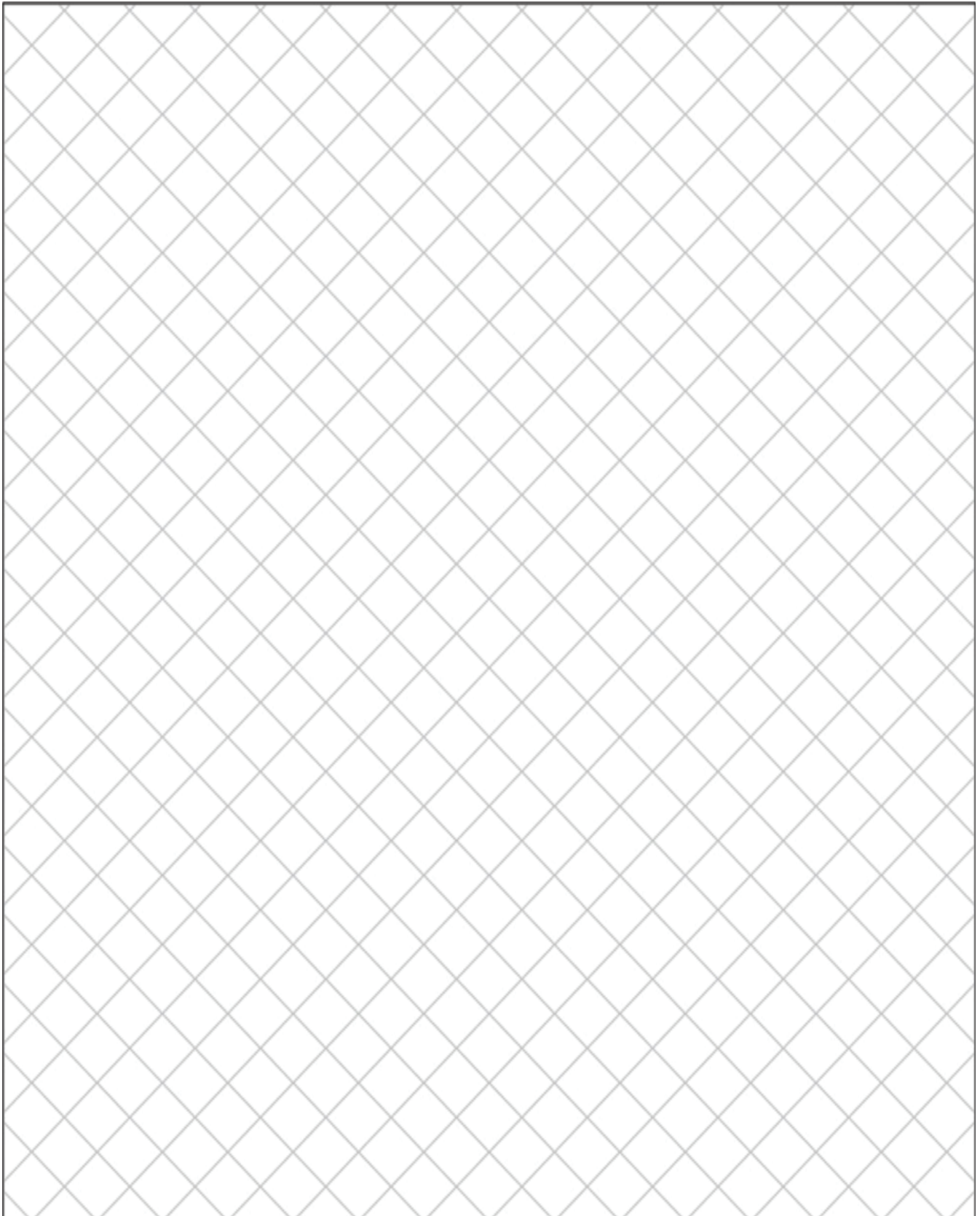
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7.3 Use the isometric grid to make an exploded view of any component of the device / prototype / model to show how the model fits together. Label the different parts of the drawing.





## Activity 1 : Group work

- 1.1 Below you will find a table showing some of the possible tools, equipment and prices as obtained from a hardware store to build the circuit. The last two columns indicate the number of items required and the cost.

Item No.	Tool / Equipment	Price per item (including 15% VAT)	Number required	Cost
1	Glue Gun	.....	5	.....
2	Glue sticks 1 kg	R 160	.....	R2320
3	Battery pack of 60 (Penonsing batteries)	R 199	2	.....
4	Battery holder	R 12,88	.....	R772,80
5	LED (pack of 300)	R 199	1	.....
6	Buzzer	R13,23	.....	R264,60
7	Connecting wire per m	.....	20	R51,80
8	Resistor (pack of 10)	R 7,62	10	.....
9	Paint per litre	.....	3	R477
Total				.....

Glue Gun: R 250  
SPECIAL:  
10% off

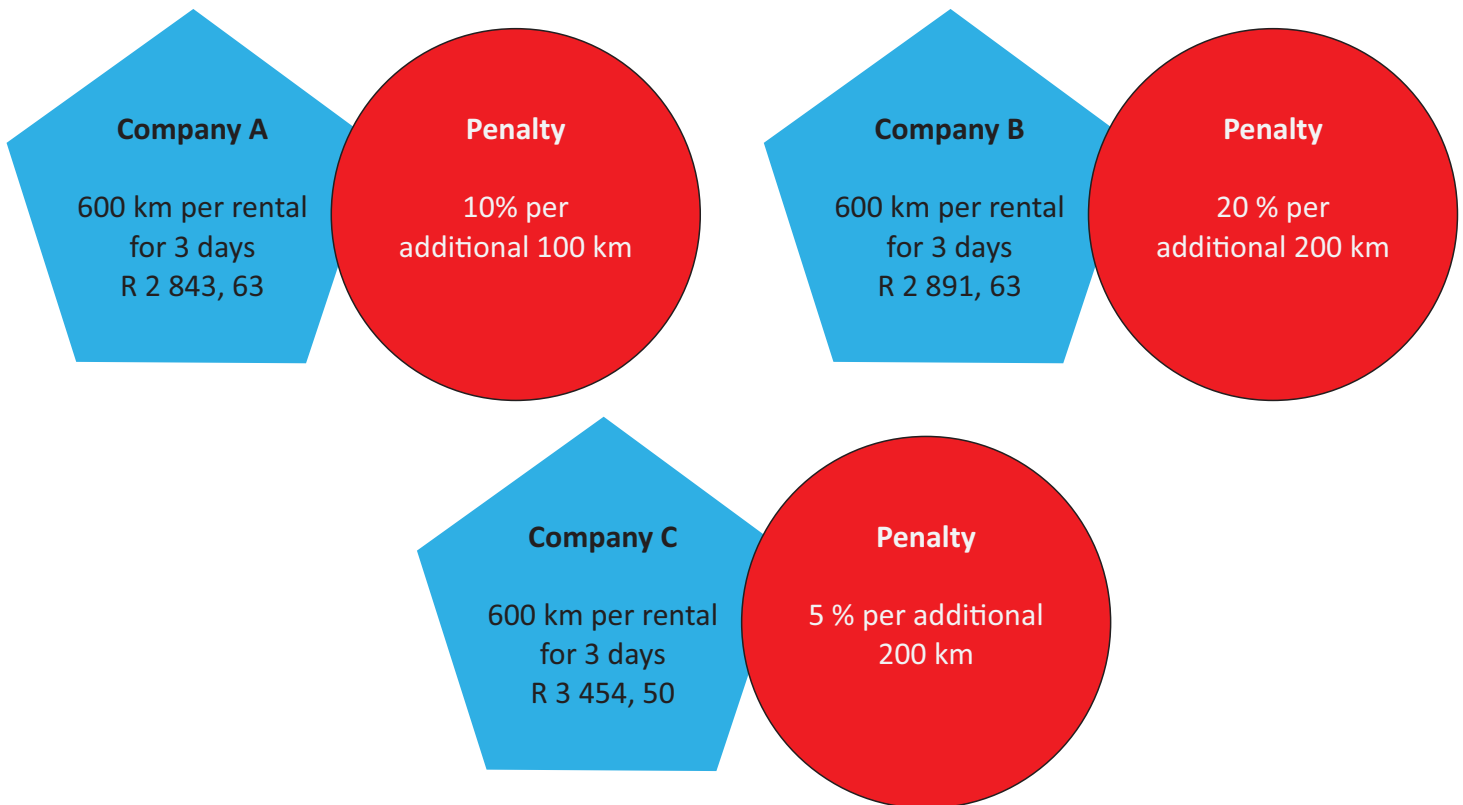
- Complete the table by calculating the missing values (amount and quantity where applicable)
- What is the total cost of all the items?
- How much VAT, at 15%, was paid in total?

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**Activity 2: Group work**

- 2.1 Suppose you don't have a car to deliver the material. Your school principal offers to assist you. He also wants to complete some tasks for the school and those tasks need a car. You have to advise the school principal which option on car rentals is better. Below are the prices for car rentals



Which option will you advise the school principal to choose, if the estimated distance to be traveled is 800 km? Show your calculations

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## Worksheet 8a - MATHS

2.2 The amount of money you have fundraised as a class is R 1 200 less than the total amount for the material/ equipment, excluding the car hire. How much more money do you need?

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2.3 Suppose your class teacher offers to get a loan on your behalf. What will be the compound interest of the amount in 2.2 above at a rate of 8% per annum over 12 months?

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2.4 What will be the monthly repayment of the amount in 2.3?

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## Worksheet 8a - MATHS

### Activity 3: Individual work

3.1 Use the flyers in 2.1 of Activity 2 to determine your second choice of the car rental if your first choice as a group is no longer available and calculate

- a) The extra money you will require for your second option if the amount of money you have fundraised as a class is R 1 200 less than the total amount for the material/ equipment, excluding the car hire?

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- b) Simple interest of the amount in 3.1(a) above at a rate of 12% per annum over 2 years if your class teacher offers to get a loan on your behalf.

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- c) What will be the monthly repayment of the amount in 3.1 (b)?

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## Worksheet 8b - MATHS

### Activity 1: Group work

- 1.1 State ohm's law and write the formula down, showing the relation between  $V$  (voltage),  $I$  (current) and  $R$  (resistance).

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- 1.2 Calculate the following:

- a) Calculate the voltage if the current is 5 A and the resistance is  $46\ \Omega$ .

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- b) Calculate the current, if the voltage is 1150 V and the resistance is  $200\ \Omega$ .

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- c) If the current is 6 A and the voltage is 420 V, calculate the resistance.

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## Worksheet 8b - MATHS

### Activity 2: Group work

2.1 Study the table below if the values for the Voltage (V) and the Current (I) for your circuit were as indicated below and answer the questions that follow:

Voltage (V)	4	8	12	16	20
Current(I)	0,4	0,8	1,2	.....	.....

- a) Complete the table
- b) Show that the relationship between V and C is given by I

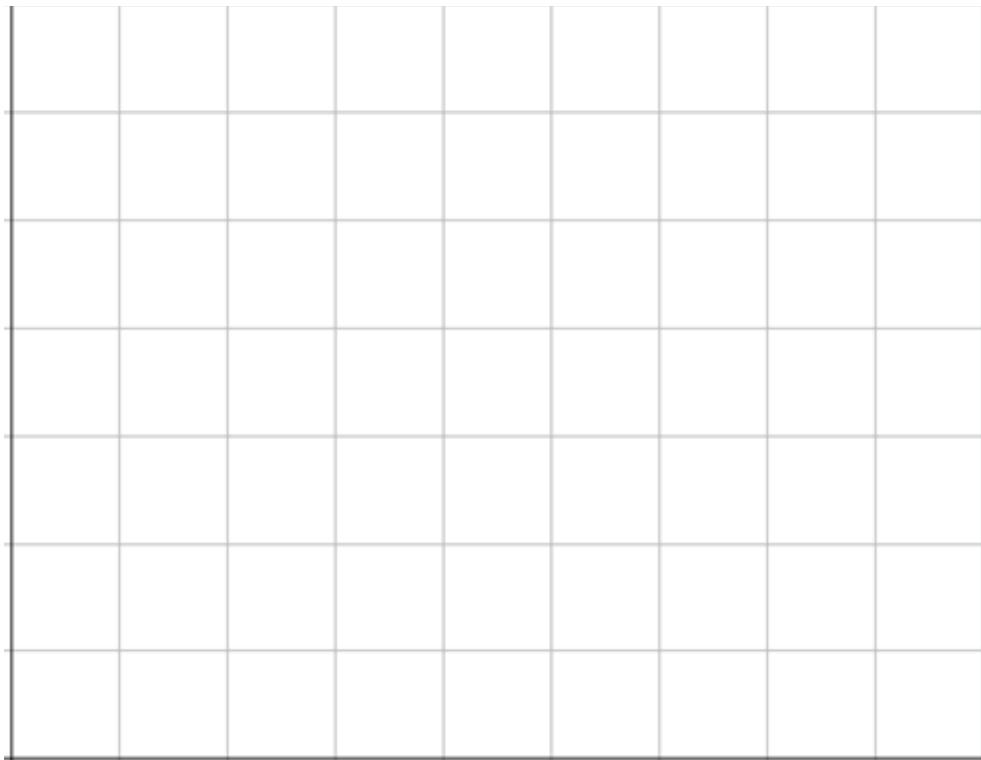
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2.2 Use the grid provided to answer the questions that follow:



- a) Plot the graph showing the relationship above where V is the x-axis and I is the y-axis



## Worksheet 8b - MATHS

- b) Is the graph of the relationship between  $V$  and  $I$  an example of direct or indirect proportion?  
Justify your answer

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- c) Use any two points on the graph to determine the gradient of the graph, hence the equation in the form of  $y = mx + c$

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- d) Substitute for  $V$  and  $I$  in the equation above?

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**Activity 1: Group work** - Designing a packaging for the model

- 1.1 A company has asked you to design an attractive box to fit or display a similar device circuit that you have designed. They have these prerequisites: The faces of the box must be rectangular and the box must be open on the top for people to easily see the circuitry device. One pair of opposite faces of the box must have circular openings that will serve as handles. The circular openings must be on the faces with equal dimensions.

Considerations when designing the packaging should be given to the following:

- i) The height of the box should be 60 cm
- ii) The breadth of the box should be equal to the height of the box
- iii) The length of the box should be 20 cm more than the height of the box
- iv) The distance between the circumference of the circular openings and the vertex of the box should be 35,5 cm.
- v) The centre of the circle should be at the midpoint of the diagonal ( Use  $\pi \approx \frac{22}{7}$  )
- vi) For proper design the box should have overlapping flaps to glue the faces

**N.B.** Use recyclable material

- a) Draw the shape of the box and show the opened side with dots.

**N.B.** The ratio of the real box to the drawing of the box should be 10 cm: 1 cm



## Worksheet 8c - MATHS

b) Calculate the total surface area for the box using the real values

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c) Classify what prism is the box? Justify your answer

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### Activity 2: Group work

2.1 What volume of paint will be needed to paint your packaging if about 100 ml of paint is needed to cover 1 square metre per coating? **N.B.** For the purpose of durability of the packaging, the paint should be applied on the interior and the exterior part of the packaging including underneath.

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### NS Calculations

Can you calculate the output of your device? Do the calculations below and also plot the output on a graph. If you don't have access to a multimeter/ammeter/voltmeter, use these values. Draw a conclusion about the relationship between variables.

9V Battery

150  $\Omega$  output

Do the rest of the calculations



### INSTRUCTIONS:

- Use the identified materials to build the device / prototype/working model.
- The device must showcase a viable solution to the problem. It should be to scale, neat and show intelligent use of available materials.
- Use safe working practices to build the device/prototype/working model.



Give this worksheet to the panel when you present your idea for feedback.

ITEM	FEEDBACK (HOW WE CAN IMPROVE)	PERSON GIVING FEEDBACK
General circuit design	<div></div> <div></div> <div></div> <div></div>	<div></div> <div></div> <div></div> <div></div>
Design of housing/box	<div></div> <div></div> <div></div> <div></div>	<div></div> <div></div> <div></div> <div></div>
Output values calculations	<div></div> <div></div> <div></div> <div></div>	<div></div> <div></div> <div></div> <div></div>
Graphs to demonstrate outputs and calculations	<div></div> <div></div> <div></div> <div></div>	<div></div> <div></div> <div></div> <div></div>
Any other improvements?	<div></div> <div></div> <div></div> <div></div>	<div></div> <div></div> <div></div> <div></div>





## Worksheet 13 - TECHNOLOGY / NS / MATHS

It is always necessary to stand back and reflect on what you have done or experienced. Please answer the questions below:

1. What did you learn doing this project...

1.1 About electronics?

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1.2 About your personal abilities?

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1.3 About the actual reason for subjects such as Tech, NS and Math?

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2. What did you find difficult about the project?

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3. What did you find easy about the project?

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4. Will you be able to do this on your own (e.g. at home) some day?

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5. Why? Why not?

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6. If you could make any other electronic device, what would it be?

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