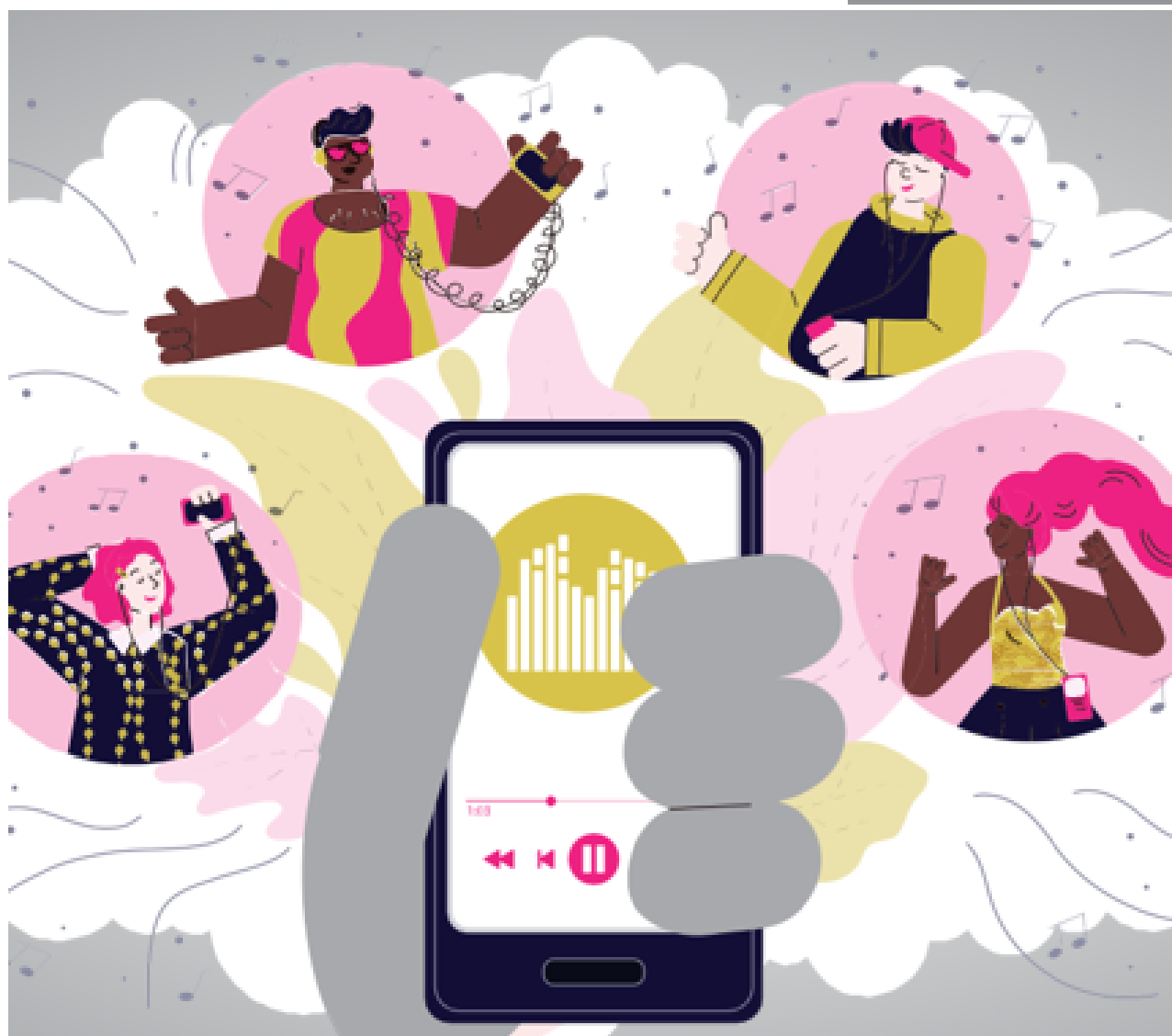


GEC INTEGRATED GRADE 9 PROJECT TEACHER'S GUIDE



3 ENTREPRENEURSHIP
EMPLOYABILITY
EDUCATION

PROJECT-BASED LEARNING | TECH, MATH & NS



basic education
Department
Basic Education
REPUBLIC OF SOUTH AFRICA



GRADE
2026

9

Table of contents



Table of contents	1
Letter to teachers	2
Project summary	3
Part 1: Inquiry-based learning	4
<i>Step 1: Prior knowledge</i>	4
<i>Step 2: New knowledge</i>	4
<i>Step 3: Order</i>	5
<i>Step 4: Apply</i>	5
Part 2: Problem-based learning	6
<i>Step 5: Define</i>	6
<i>Step 6: Explore</i>	6
<i>Step 7: Brainstorm</i>	7
<i>Step 8: Present</i>	8
Part 3: Design-based learning	8
<i>Step 9: Evaluate</i>	8
<i>Step 10: Prototype</i>	8
<i>Step 11: Feedback</i>	9
<i>Step 12: Integration</i>	9
<i>Step 13: Present</i>	9
Assessment rubrics	10

Dear Teacher

We would like to welcome you as an integral part and research partner in a representative sample group for piloting the new, revised General Education Certificate, or GEC.

The GEC forms part of the National Assessment Framework (NAF) and our hope is that it will assist learners in developing a holistic skill set after ten years of schooling, and to test and learn how best we can enable Districts and Provinces to prepare for the actual GEC roll out in a few years' time.

Therefore, we are testing and implementing the 360-degree assessment model which will include an Inclinations Quiz, School-based assessment for

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Therefore, we are testing and implementing the 360-degree assessment model which will include an Inclinations Quiz, School-based assessment for

Term 3 (the Integrated Project) and Curriculum tests.

This Integrated Project forms part of the school-based assessment. It is one of two projects that will replace the 9 projects (one for each subject) in the third term. The integrated projects are modeled on a Project-based learning methodology, creating activities that more closely replicate real-life experiences, and thus develop real-life competencies.

The integrated project includes SBA project marks for all subjects (as per the amended ATP) and is aligned to the CAPS amended ATP in each subject. This means that teachers will not have to do any extra work.

To assist teachers in implementing the Integrated Project, there is a step-by-step guide (Teacher's Project Notes), a Resource Pack with extra information, electronic resources (like instructional videos) and a Learner's Workbook.

All rubrics have been added to the Teacher's Project Notes to simplify implementation and create less work for teachers who are stepping into uncharted territory.

Teachers from all the subjects integrated into this project will have to plan and work together towards a common goal. We suggest that you form a PLC at school where teachers can support and assist each other during the third term.

Thank you for taking on this important role in the holistic development of our learners. You will enjoy much support from the district, province and nationally, as well as the E³ team in each province.

We acknowledge your commitment and honour all your hard work. The DBE team.



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Project summary

Summary Focus: Enhancing Safety at the Siyakhanya Community Hub Project Task

Learners act as junior engineers to design and build a **working scale model / prototype** of a safety system for the Siyakhanya Community Hub.

- The solution must be **cost-effective**, use **recycled materials where possible**, and apply **mechanical and electrical/electronic knowledge**.
- Learners must select **ONE scenario** to complete the project.

SCENARIO 1: SECURITY & ALARM SYSTEM (INTRUSION DETECTION)

What must be done:

- Build an electronic circuit that detects a break-in attempt.
- Use a **sensor** (e.g., LDR or motion detector) to sense changes in light intensity.
- When triggered, the system must automatically activate:
 - **Buzzer** (sound alert)
 - **LED light** (visual alert)

Focus: Preventing crime by detecting intruders and warning the community.

SCENARIO 2: FIRE ALARM WITH EMERGENCY DOOR RELEASE

What must be done:

- Build a fire detection circuit that senses rising temperature.
- Use a **heat-sensitive sensor** (thermistor or resistor) as input.
- Outputs must include:
 - **Buzzer** (sound alarm)
 - **LED light** (visual alarm)
- Include a **manual switch** to test or activate the system.
- Use a **transistor as a switch** to process the signal.

Focus: Protecting lives and property by detecting fire and enabling emergency response

OBSERVING 21ST CENTURY SKILLS DURING THE IMPLEMENTATION OF GEC-INTEGRATED PROJECTS

As a teacher you already know that you play an **essential role as a facilitator of learning**. You know that rather than simply giving knowledge to learners, you create an environment in which your learners can **explore, discover**, and **construct** their own understanding of the subject matter. As a facilitator you

- create an **emotionally and psychologically safe learning environment** so that learners feel safe to participate in the lesson,
- provide **prompts** when learners get stuck,
- provide **constructive and timely feedback** to learners,
- and make adjustments to your lesson based on what you observe (this is assessment as learning) so that learners can grow their understanding and grow their skills and competencies.

While learners are working on this project, your role as a facilitator is to **observe, listen, and record the process of their learning (21st century skills)** during the project. If you're new to formally observing these skills, we have provided guidance for each task by suggesting 21st century skills you might focus on. You will find these suggestions in the boxes entitled '*21st century skills to look out for.*' These suggestions are not exclusive; they're intended to simplify your observation process, so you do not need to try and observe everything all at once. Once the process becomes more familiar to you, you can begin to explore ways to observe additional or different skills. To find out more about the 21st Century Skills please read the 'Teachers guide to 21st Century Skills' as well as the GEC Manual, under the section 21st century skills.

PART 1

EXPLORING THE WORLD (INQUIRY-BASED LEARNING)



Please note: This project covers 100% of the Technology third term task mark (70 marks), 50% of Mathematics third term task marks (50 marks) and 50% of the Natural Sciences third term task marks (30 marks).

STEP 1: Prior knowledge



Build on what you already know and add new knowledge

Purpose of this step: The learner reflects on and shares his/her own knowledge, experiences and perspectives (stimulating prior knowledge and evaluating baseline knowledge).



21st century skills to look out for

In this step, learners are reflecting on and sharing his/her own knowledge, experiences, and perspectives. In this step, you may have the opportunity to observe elements of **Metacognition**. Metacognition is about being aware of how we think, what we know, and how we know it. Metacognition helps us to reflect on our thinking, set goals, and monitor and evaluate our learning. Some of the Sub-skills that make up Metacognition include

5.1 Setting goals and planning: Did the learner set goals and make a plan during the project?

5.2 Monitoring progress against plans: Did the learner monitor their progress against their plans? **5.3 Reflecting on planned work:** Did the learner reflect on their project and or their prior knowledge?

(TECH & NS) Learners start to answer questions based on the scenarios on **Worksheet**

1A: They answer questions based on the security of the Community Hub and identify electronic and electrical components in real life appliances. Learners study the two scenarios. They choose one of the scenarios to work on.

- 1.1 (+Maths) The understanding of relevant data, measures of central tendencies, percentages the increase/decrease as well as probability and risk are tested.
- 1.2 Data of burglaries and fires is shared with the learners in **Worksheet 1B**. They must interpret the data provided from the table in answering the questions.
- 1.3 Learners must calculate the mean and median number of fires/burglaries, depending

- on the scenario they have chosen.
- 1.4 Application and understanding of the data provided are assessed in calculations on probability and risk as well as drawing a tree diagram of data provided on security cameras.
 - 1.5 Lastly, learners must draw a double bar graph representing the information based on the security cameras.

STEP 2: New knowledge



Build on what you already know and add new knowledge

Purpose of this step: Learner observes or takes part in something new that is an extension / expansion of prior knowledge.



21st Century skills development

In this step, learners observe or take part in something new that is an extension/expansion of their prior knowledge. In this step, you may have the opportunity to observe elements of **Critical Thinking**. Critical thinkers ask questions, find the right information, and apply it to solve a problem. Some of the sub-skills that make up critical thinking include **1.1 Asking questions**: did the learner ask appropriate questions to find out more information? **1.2 Evaluating ideas/information**: was the learner able to identify what information was useful to solve the problem? **1.3 Identifying patterns**: did the learner use tools (e.g. mind maps and diagrams) to help them to organise information?

- 2.1 (+NS) Now is the time to revise what learners know/have learnt about circuits. In **Worksheet 2 learners** draw symbols of electrical components used in circuits.
- 2.2 (+NS) Electrical components that they don't recognize in the circuit drawing need to be researched. They can be allowed to do this research by using their handbooks, the internet, asking each other or any other method to identify the new components.
- 2.3 (+NS) Learners must apply their knowledge and investigative skills to redraw circuits, placing the ammeter and voltmeter in the correct position of a circuit to take measurements. They must redesign a series circuit into a parallel circuit.

STEP 3: Order



Order and categorize your existing knowledge

Purpose of this step: To order and make sense of information and knowledge that emerged in *Knowledge* and *New knowledge* steps.

- 3.1 (+Tech) Learners use **Worksheets 3A & 3B** to answer questions on electronic components. Understanding and application of knowledge on circuit diagrams, input, process and output components are addressed and assessed.



STEP 4: Apply

Apply your knowledge on the scientific investigation

Purpose of this step: To use knowledge to answer the driving question

- 4.1 (+NS) The aim, investigative question, and hypothesis of a scientific investigation each include variables, as they define what is being tested, what is being asked, and what is predicted. Together, they clarify the relationship between independent, dependent, and controlled variables.

PART 2

EMBRACING THE CHALLENGE (PROBLEM-BASED LEARNING)



STEP 5: Define

Ask lots of questions to help you define your problem



Purpose of this step: Push for clarity on the problem/questions.



21st century skills to look out for

In this step learners will be defining their problem. In this step, you may have the opportunity to observe elements of **Communication**. Communication is the process of sharing information, attitudes, and values. Both “what we say” (verbal communication) and “how we say it” (non-verbal communication) are important). Some of the sub-skills that make up Communication include: **2.1 Non-verbal communication**: did the learner recognise nonverbal cues such as tone of voice and expression? **2.2 Articulation**: Did the learner uses the correct language for the situation? **2.3 Empathising**: Did the learner try to understand how others were feeling?

- 5.1 On **Worksheet 5A** learners are reminded about the definition of a design brief, specifications and constraints
- 5.2 On **Worksheet 5B** learners **5.1** write a design brief for the identified problem or scenario, followed by specifications **5.2** and constraints **5.3**. Learners draw a relevant circuit diagram **5.4** to solve the problem from the selected scenario. In **5.5** learners draw a 3D isometric freehand sketch of the housing structure that will enclose the electronic circuit.

STEP 6: BRAINSTORM



Consider different points of view to help you understand more

Purpose of this step: Research phase – what do we need to answer the question/solve the problem?



21st century skills to look out for

In this step learners carry out research to consider different points of view to help them to understand more about the problem or task. In this step, you may have the opportunity to observe elements of **collaboration** and **metacognition**.

- 6.1 (+TECH) Group work. On **Worksheet 6A**, learners analyse and evaluate the individual designs according to the requirements mentioned in the scenario. Suggest improvements and select the final idea.
- 6.2 (+Maths) Group work **Worksheet 6B**: Learners apply their knowledge and skills to design a packaging structure for the scale model / prototype. They must calculate the dimensions of a provided net for packaging.

STEP 7: EXPLORE



Present the point of view and options to an audience

Purpose of this step: Discuss and share possible solutions



21st century skills to look out for

In this step, learners discuss and share possible solutions to their problems. In this step, you may have the opportunity to observe elements of **Critical thinking** and **Metacognition**.

- 7.1 (+TECH) Learners use **Worksheet 7** to require and practice new knowledge, calculate values in circuits and resistors, and solve everyday problems by applying their knowledge.



STEP 8: Present

Present the point of view and options to an audience

Purpose of this step: Presenting the possible solutions for iteration/change



21st century skills to look out for

In this step learners present possible solutions to their problem. In this step, you may have the opportunity to observe elements of **Communication** and **Metacognition**.

- 8.1 Learners use the space **Worksheet 8** to develop and practice their graphic communication skills when making an exploded view of the housing structure to show how the model fits together.

PART 3

DESIGNING THE FUTURE (DESIGN-BASED LEARNING)



STEP 9A: Explore

Make the prototype of your best solution

Purpose of this step: Build a circuit similar to the circuit diagram drawn in informal activity 2.2.



21st century skills to look out for

In this step, learners do calculations on Ohm's Law. You may have the opportunity to observe elements of **Metacognition & Critical Thinking**

- 9.1 (+NS) In **Worksheet 9A**, learners apply their knowledge and skills to build a circuit, using the apparatus provided. An alternative application e.g. PhET simulation can also be used to build the circuit when taking the volt- and ammeter readings; drawing a graph of the current versus voltage; analysing the data and drawing a conclusion.



Your concern: It might concern you that your learners might not have access to these electrical components or even recycled/second-hand sourced ones. This should not matter. Even if there is ONE working example of each device that you can build and use to demonstrate to all classes, the learning experience would be worthwhile. The curiosity is there ☐, the research has been done ☐ and even the construction of the 3D circuit can take place ☐ because they must study what these components look like to reproduce them specifically ☐. In other words, some active learning has taken place.

- 9.2 (+Maths) in **Worksheet 9B**, learners must determine the equation when analysing the data. Calculations on Ohm's law will be done by the learners when addressing direct or *indirect proportion. Learners will reason and interpret the information/data to do the calculations.

STEP 10: Interpreting data



Analyse data, do calculations and make an informed choice of repayment.

Purpose of this step: Learners will apply their knowledge and skills to interpret and analyse data from an invoice.



21st century skills to look out for

In this step, learners will analyse data on an invoice, apply their knowledge to draw conclusions on the provided information. You may have the opportunity to observe elements of **Metacognition & Critical Thinking and Communication**

- 10.1 (+Maths): In **Worksheet 10**, learners will have the opportunity to analyse the information from an invoice to calculate the missing values (Unit price, Quantity and Amount where applicable), calculate the total cost of the items and determine how much the VAT will be at 15 %.
- 10.2 Learners will also make a choice on repayment with simple interest at 12% per annum for 2 years as well as repayment with compound interest at 12% per annum for 2 years. They will justify their choice of repayment.

STEP 11: Prototype



Make the prototype of your best solution

Purpose of this step: Build or make the prototype based on the design



21st century skills to look out for

In this step, learners build or make a prototype based on their design. In this step, you may have the opportunity to observe elements of **Collaboration, Critical Thinking and Communication**.

- 10.1 Learners build their device/circuit with real components (or create mock components from recycled material). They use the instructions on **Worksheet 11**. Please also make the building rubric available to them.
- 10.2 Learners test their product (if they are building the real one).
- 10.3 Learners build a housing structure and circuit for the scale model / prototype..

STEP 12: Feedback



Speak to experts or the community to get REAL feedback

Purpose of this step: To get expert feedback about possible improvements or design changes



21st century skills to look out for

In this step, learners seek expert feedback on their work. In this step, you may have the opportunity to observe elements of **Creativity** and **Metacognition**.

- 12.1 Learners show their prototypes (the actual build, not only plans) to a panel consisting of the group leaders from each group who use a checklist to assess the 5 min presentation on the scale model / prototype in **Worksheet 12**.
- 12.2 They make the final changes as per feedback and practice their presentation.



STEP 13: Reflect

Learners will reflect on the project

Purpose of this step: Learners will identify areas for improvement and reflect on what they have learned and experienced



21st century skills to look out for:

This step might present an opportunity to observe elements of **Communication**, **Collaboration** and **Metacognition**.

WORKSHEET 1A: TECHNOLOGY [INFORMAL ASSESSMENT]



21st Century Skills: Metacognition, Critical thinking

- 1.1 Identify the problem from the selected scenario.
- 1.2 Why is a security system important for community spaces like the Siyakhanya Community Hub?
- 1.3 A security system protects valuable resources, deters crime, and ensures a safe environment for community members, especially youth who rely on the hub for learning and development.
- 1.3.1 List two challenges that the communities face that were mentioned in different scenarios.
- 1.3.2 Explain why early warning systems are important in communities.
- 1.4 Name ONE example of an alarm system and ONE example of a fire alert system used in our daily lives.
- 1.5 Different electrical appliances are illustrated below. Name the **ELECTRICAL COMPONENTS (NS)** and electronic components (Tech), used in the different appliances:

A.



B.



C.



D.



Appliance	Technology Electronic component	Natural Science Electrical component
A	○	
B	○	
C	○	
D	○	

WORKSHEET 1B: MATHEMATICS [FORMAL ASSESSMENT] [30]



21st Century Skills: Critical Thinking and Metacognition

QUESTION 1: UNDERSTANDING THE DATA

(4)

Based on the scenario you selected in Technology, answer the following questions:

The table below shows the number of reported incidents of burglary and fire cases in South Africa over five years.

	Number of Burglaries (Scenario 1)	Number of Fires (Scenario 2)
2020	1 145	116
2021	1 981	215
2022	1 203	197
2023	1 579	256
2024	1 050	239
2025		

- 1.1 In which year was the number of fire/burglary incidents the highest? (1)
- 1.2 In which year was the number of fire/burglary incidents the lowest? (1)
- 1.3 Calculate the range of fire/burglary incidents. (2)

QUESTION 2: MEASURES OF CENTRAL TENDENCY

(7)

Using the data above:

- 2.1 Calculate the **mean** number of fire/burglary incidents over the five years. (3)
- 2.2 Determine the **median** number of fire/burglary incidents over the five years. (2)
- 2.3 Explain what the mean tells us about incidents of fire/burglary trends in South Africa over the five years. (2)

QUESTION 3: PERCENTAGE INCREASE AND DECREASE

(6)

- 3.1 Calculate the percentage decrease in fire/burglary incidents from 2023 to 2024. (3)
- 3.2 The number of reported fire or burglary incidents increased by an average of 9% from 2024 to 2025.
Using the number of incidents recorded in 2024, calculate and predict the number of incidents for 2025. (3)

QUESTION 4: PROBABILITY AND RISK

(5)

- 4.1 A survey also recorded whether community centre had **security cameras** installed. Study the table below regarding the survey and answer the questions.

	Vandalism	No Vandalism	Total
Cameras Installed	10	90	100
No Cameras Installed	15	85	100
Total	25	175	200

- a) Draw a **tree diagram** to represent the information in the table.

Your tree diagram must show the different possible outcomes for:

- Community Hub **with cameras installed**, and
 - Community Hub **without cameras installed**, and whether **vandalism** occurred or **did not occur**. (2)
- b) What is the probability that a randomly selected community centre **has cameras and reported vandalism**? (1)
- c) Determine the probability, as a percentage, that a community centre **did not have cameras and experienced vandalism**. (1)
- d) Which group of community centre has a **higher risk of vandalism**? Justify your answer using the probabilities. (1)

QUESTION 5: REPRESENTING DATA

(8)

Use the information above to draw a double bar graph representing the information presented in Question 4.

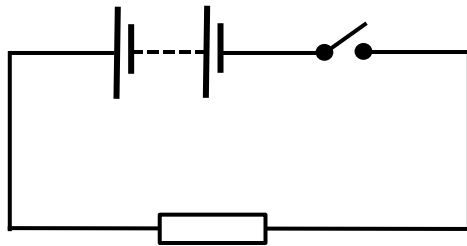
WORKSHEET 2: NATURAL SCIENCES [INFORMAL ASSESSMENT]



21st Century Skills: Critical Thinking, Creative Thinking, Collaboration

- | | |
|------------------|-----------------------|
| 2.2.1 Cell | 2.2.5 Open switch |
| 2.2.2 Battery | 2.2.6 Connecting wire |
| 2.2.3 Resistor | 2.2.7 Ammeter |
| 2.2.4 Light bulb | 2.2.8 Voltmeter |

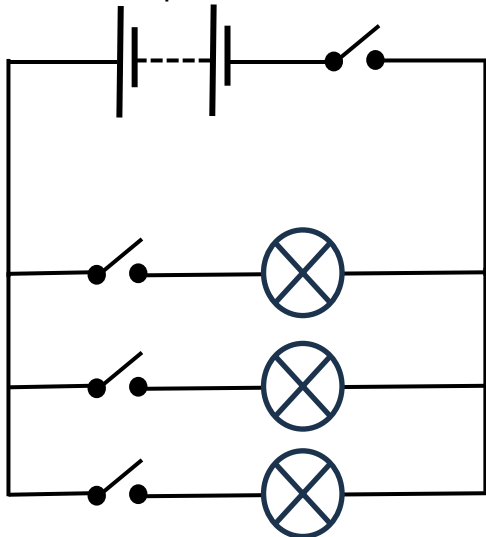
2.2 Circuit diagram:



2.2.1 Add an ammeter in the correct position to measure the total current in the circuit.

2.2.2 Add a voltmeter in the correct position to measure the potential difference across the resistor.

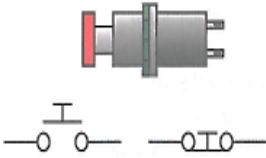
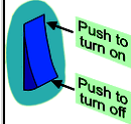
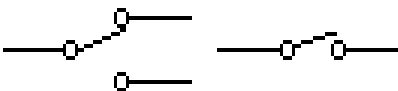
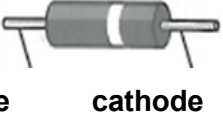
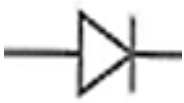
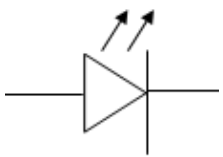
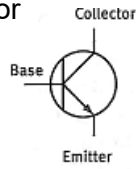
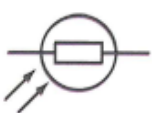
2.3.1 Redesign and redraw the circuit diagram so that each bulb can be switched on and off independently. Use the same battery and bulbs, but you may add any additional components that are needed



2.3.2 Identify the type of circuit you used in Question 2.3.1. Explain the reason for your choice.


21st Century Skills: Critical Thinking

Electrical systems use different components to control and direct current.

COMPONENT	FUNCTION	SYMBOL
Switch SPST, SPDT, DPDT. 	opens and closes a circuit 	
Diode 	allows current to flow in one direction only.	
LED (Light Emitting Diode) 	allows current in one direction and produces light	
Resistor 	resists / restricts / opposes the flow of the current through the circuit.	
Transistor 	acts as a switch and amplifies a small current into a larger current.	NPN transistor 
LDR (Light Dependent Resistor) 	changes resistance according to light intensity.	
Thermistor 	changes resistance according to temperature.	
Capacitor 	stores and releases electrical energy.	
Buzzer 	an audio signalling device that converts electrical signals into sound —to immediately notify people of danger, intrusion, or a specific event	

Questions

- 3.1 What is the function of a switch in a circuit?
- 3.2 What happens to a circuit when a switch is open?
- 3.3 In which direction does a diode allow current to flow?
- 3.4 State ONE difference between a diode and an LED.
- 3.5 Besides acting as a switch, what else can a transistor do?
- 3.6 Why is a transistor useful in a sensor circuit?
- 3.7 What happens to the resistance of an LDR when light increases?
- 3.8 What happens to the resistance of a negative temperature coefficient (NTC) thermistor when temperature increases?
- 3.9 Give ONE example where a touch or moisture sensor could be used.
- 3.10 What is the main function of a capacitor in a circuit?

WORKSHEET 3B: TECHNOLOGY [FORMAL ASSESSMENT] [15]



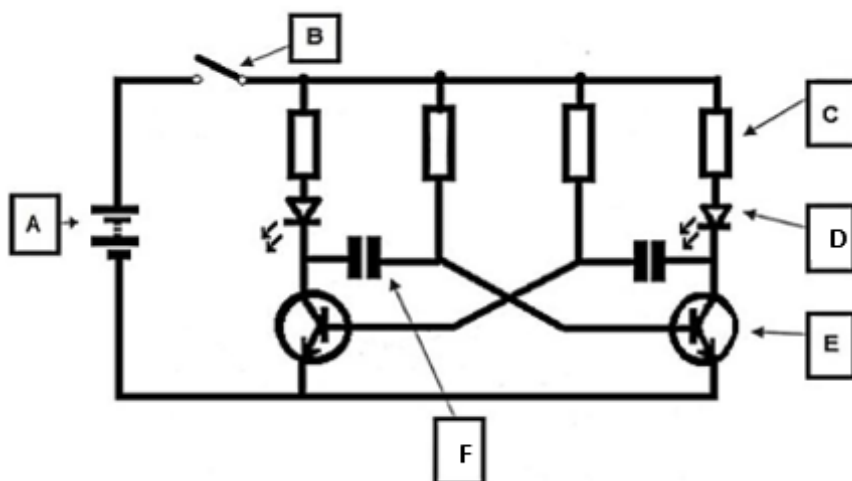
21st Century skill: Critical Thinking & Metacognition

INVESTIGATION

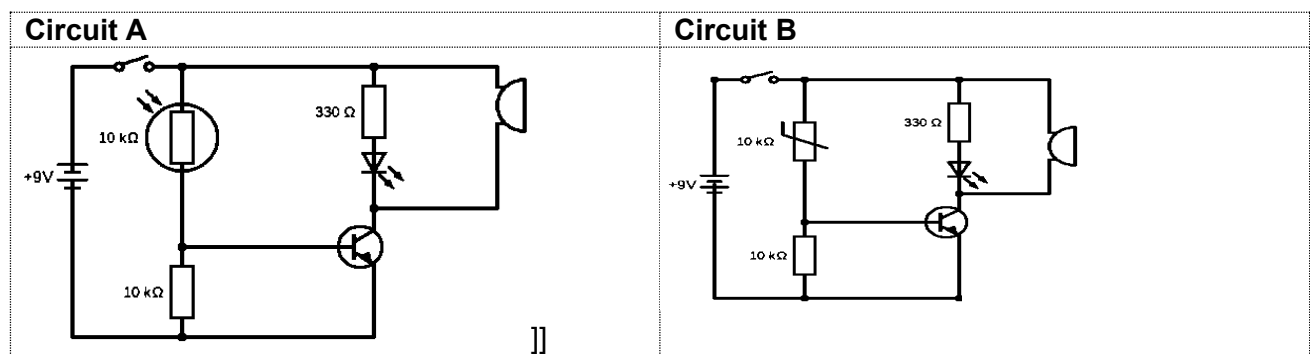
(15)

- 3.11 Identify the electronic components (A – F) used in the given circuit diagram

(6)



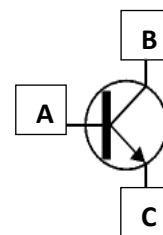
3.12 Answer the following questions.



3.12.1 Identify ONE sensor (input device) from each circuit. (2)

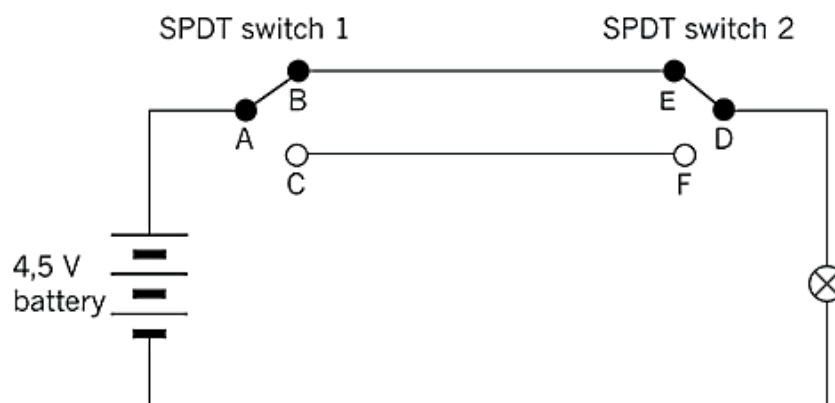
3.12.2 Identify one output device from each circuit. (2)

3.13 Explain how the different parts of the transistor are connected. (3)



3.14 A circuit with two SPDT switches is often used to control a lamp with one switch at each end of a long passage. It is also used to control a lamp with one switch at the bottom of a staircase, and the other switch at the top of the staircase.

Answer the questions based on the circuit.



3.14.1 When will the bulb turn on? Refer to the connection of the switches. (1)

3.14.2 Motivate your answer. (1)

[15]

**21st Century skill: Critical Thinking & Creative Thinking****Tip for Teachers (Before Investigating Ohm's Law):**

Before learners begin the practical investigation on Ohm's Law, take a moment to review the Scientific Process using the flow diagram provided in the Teacher's Resource Pack.

Ensure that learners understand how to:

Identify and classify variables (independent, dependent, and controlled).

Formulate a clear investigative question that can be tested experimentally.

Develop a logical hypothesis based on scientific reasoning.

Background information:

The aim, investigative question, and hypothesis of a scientific investigation each include variables, as they define what is being tested, what is being asked, and what is predicted. Together, they clarify the relationship between independent, dependent, and controlled variables.

4.1 The aim of this investigation is to determine how increasing the input voltage affects the current in a circuit that contains an LED and a fixed resistor.

4.1.1 **Independent variable**

(1)

4.1.2 **Dependent variable**

(1)

NOTE: The variables in 4.1.1, 4.1.2 and 4.4 has a total of 5 marks – refer to the rubric.

4.2 **Investigative question:**

How does an increase in voltage (potential difference) affect the current in a circuit containing an LED and a fixed resistor?

OR

How does current change when the input voltage increases?

Marking criteria for investigative question	Mark
Independent variable mentioned: Voltage/Potential difference	1
Dependent variable mentioned: Current	1
A question is asked about the relationship between the variables.	1

(3)

4.3 **Hypothesis:**

Marking criteria for hypothesis	Mark
Both variables are mentioned: Voltage/potential difference and Current	1
The relationship between the two variables is indicated.	1

NOTE: 4.2 and 4.3 have a combined total of 5 marks – refer to the rubric.

(2)

Marking criteria for the Investigative question and Hypothesis (4.2 and 4.3)	Marks
The (1) independent variable and (2) dependent variable are both correctly reflected in the (3) investigative question and the hypothesis. (4) A well-formulated question clearly asks about the relationship between the variables. (5) The hypothesis clearly describes the expected relationship between the two variables.	5
Four of the criteria are met. One element may be incomplete, unclear, or slightly inaccurate.	4
Three of the criteria are met. The remaining elements show partial understanding, are vague, or contain errors.	3
Only one or two criteria are met. Most elements are missing, incorrect, or do not reflect the relationship between the variables.	1 to 2

4.4 Controlled variables:

The three controlled variables that are relevant to this investigation:

- Use the same resistor throughout.
- Do not change the direction of the current in the circuit.
- Keep the temperature of the resistor constant (switch the current off between readings).
- Keep the brightness of bulbs in the circuit constant.
- Do not change the length, thickness, or material of the resistor / connecting wires. (3)

Marking criteria for the variables in 4.1 and 4.4	Marks
Both the independent and dependent variable and all three controlled variables are correctly identified.	5
Both the independent and dependent variable and at least two controlled variables are correctly identified.	4
Any three of the independent, dependent and controlled variables have been correctly identified.	3
Any one to two of the independent, dependent and controlled variables have been correctly identified.	1 to 2

[10]

WORKSHEET 5A: TECHNOLOGY [INFORMAL ASSESSMENT]



21st Century skill: Critical Thinking & Metacognition

Do revision on the following concepts. It is important for learners to understand what a design brief, specification and constraints are.

Make use of real-life examples to indicate the difference between a specification and constraint.

WORKSHEET 5B: TECHNOLOGY [FORMAL ASSESSMENT] [20]



21st Century skill: Critical Thinking & Collaboration

NOTE: The design brief for the two scenarios differs from one another. It depends on the scenario that learners have chosen A/B.

- 5.1 Write a design brief for your selected scenario. (3)
- 5.2 List TWO constraints from the scenario. (2)
- 5.3 Explain how ONE of these constraints influenced your design decisions. (2)
- 5.4 List THREE specifications from the scenario. (3)
- 5.5 Draw a 3D isometric freehand sketch of the housing structure that will enclose the electronic circuit. (10)

RUBRIC TO ASSESS THE FREEHAND SKETCH

LEVEL	CRITERIA	MARKS
1	- The learner did not complete drawing. - No or minimal labelling and or notes were provided. - Learners need much help and motivation to draw properly. - Incorrect selection of material for the labelling. - No or little evidence of specifications being covered	0 – 2
2	- Learners were able to complete the drawing with some labelling and guiding notes although it is not noticeably clear. - Drawing is not fully complete. - Selection of material and specifications is well presented in the labelling.	3 – 4
3	- The drawing is aesthetically pleasing and mostly covers the design specifications with correct labelling and guiding notes that are properly structured. - Suitable selection of material is evident.	5 – 7
4	- Drawing is aesthetically pleasing with relevant creativity and covers design specifications completely. - The labelling and guiding notes are well explained and fully cover all specifications. - Well, considered (spot - on) selection of material	8 – 10
	TOTAL	/ 10

[20]

**21st Century skill: Collaboration & Critical Thinking**

6.1 Use the criteria below to analyse and evaluate the individual designs according to the requirements mentioned in the scenario. Suggest improvements and select the final idea. Aspects to evaluate each member's device:

- A. Size:
- B. Stability of structure:
- C. Are the electronic components securely joined to the base board?
- D. Will the batteries be easily replaced?

NAME OF GROUP MEMBER	EVALUATION AGAINST THE SPECIFICATIONS
1.	A. B. C. D.
2.	A. B. C. D.
3.	A. B. C. D.
4.	A. B. C. D.

6.2 Select the best design, motivate your choice, and make improvements if necessary.

6.2.1 We have decided on _____'s design as the best solution to the identified problem.

6.2.2 Motivate your choice from the different designs.

6.2.3 Suggest possible improvements to your design.

6.3 Identify possible challenges that might occur during the making of the scale model / prototype / scale model.

6.4 List possible solutions for the identified challenges.

6.5 List the tools, resources, and materials to build the scale model / prototype / scale model.

**21st Century Skills: Critical Thinking, Communication and Metacognition****ACTIVITY 1: GROUP WORK****(24)**

Design a packaging structure for the scale model / prototype.

A company has asked you to design a packaging structure to fit or display a similar device circuit that you have designed.

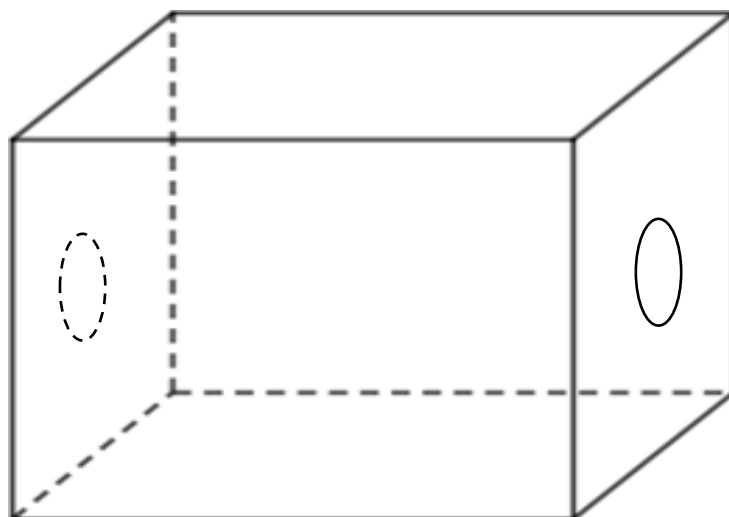
They have these prerequisites:

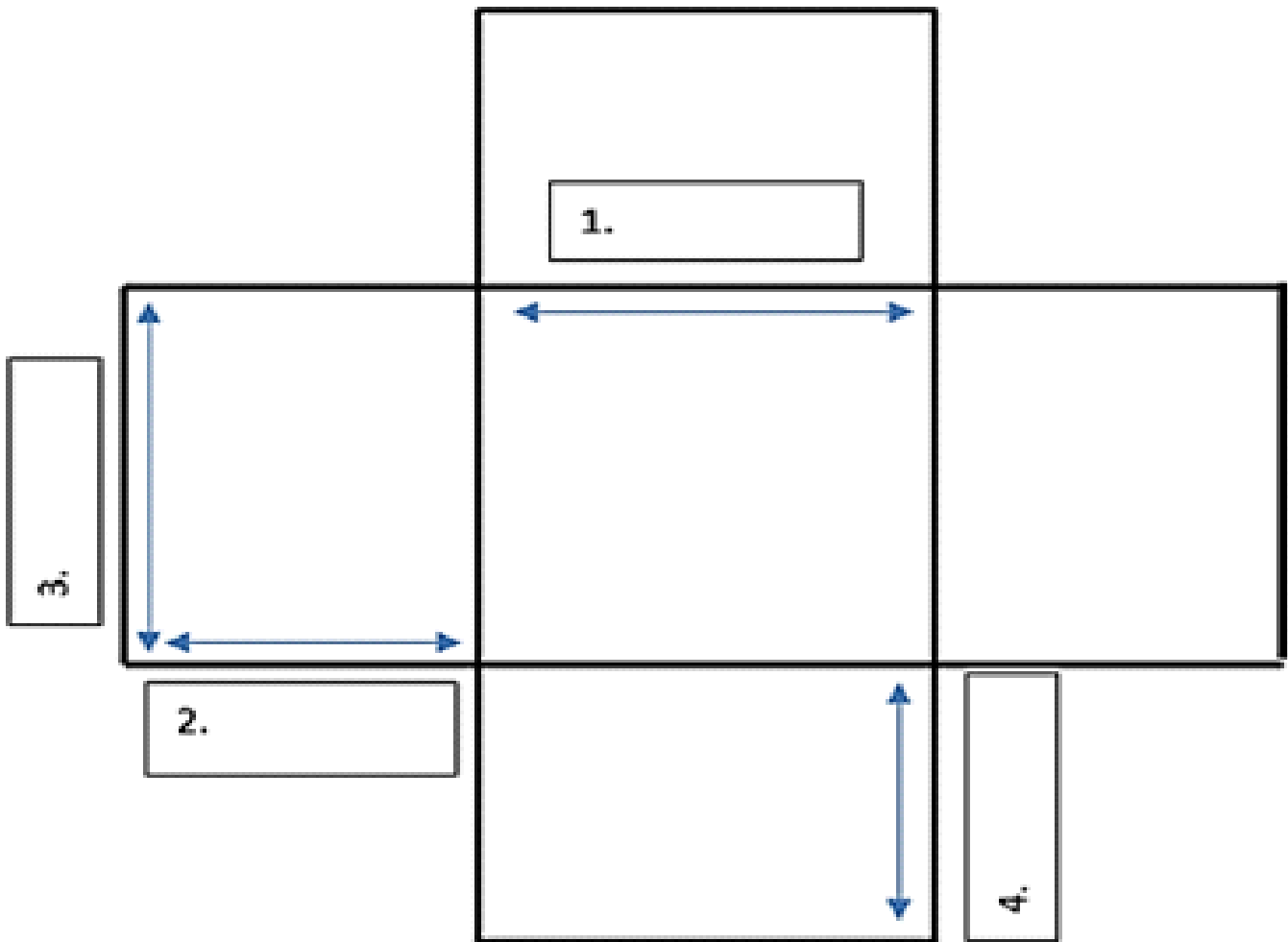
- The faces of the packaging structure must be rectangular, and the packaging structure must be open on the top for people to easily see the circuitry device.
- One pair of opposite faces of the packaging structure must have circular openings that will serve as handles.
- The openings must be on the faces with dimensions of 15 cm by 8 cm.

Consider the following specifications when designing the packaging structure:

- The height of the packaging structure should be 8 cm.
- The length and breadth of the packaging structure is 15 cm.
- The distance between the circumference of the circular openings and the vertex of the box should be 6 cm.
- The centre of the circle should be at the midpoint of the diagonal.

- 1.1 Below is a 3D sketch of the packaging structure. Next to it is the net of the packaging structure with some missing information/ dimensions.





- a) Use the 3D sketch and the given specifications to fill in all the missing dimensions of the edges of the net below. (4)
- b) Draw the circular openings on the correct sides of the net. Show the dimensions of the circle clearly on your sketch using the following scale:
Scale: 1 cm represents 5 cm. (3)

1.2 Use the measurements from 1.1 (a) to calculate the following:

- a) The length of the diagonal of the face that contains the circular openings. (3)
- b) The radius of the circular openings. (2)
- c) The area of the two circular openings. (3)
- d) The area of the bottom face. (2)
- e) The total surface area of the packaging structure. Give your answer in mm^2 . (7)

[24]



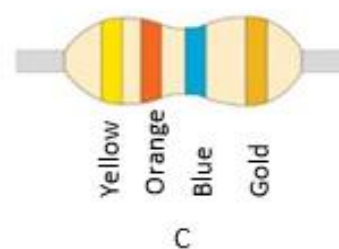
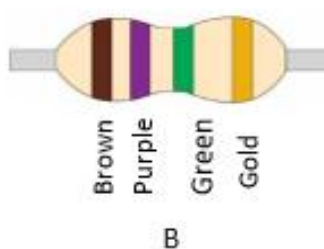
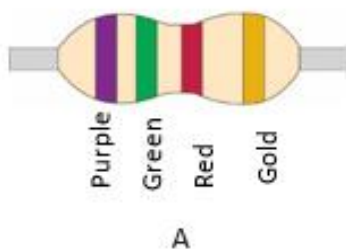
WORKSHEET 7: TECHNOLOGY [INFORMAL ASSESSMENT]

21st Century skill: Critical Thinking

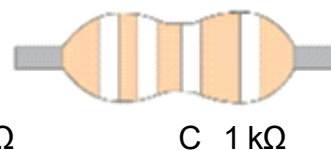
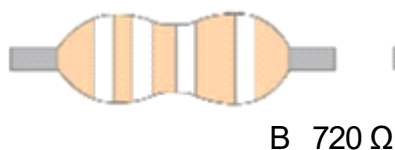
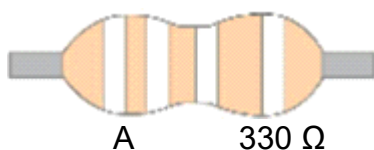
Answer the following questions using the conversion table below:

TABLE 1			
Colours	Band 1	Band 2	Band 3
Black	0	0	
Brown	1	1	0
Red	2	2	00
Orange	3	3	000
Yellow	4	4	0000
Green	5	5	00000
Blue	6	6	000000
Violet/Purple	7	7	0000000
Grey	8	8	00000000
White	9	9	000000000

7.1 Calculate the value of the following resistors.

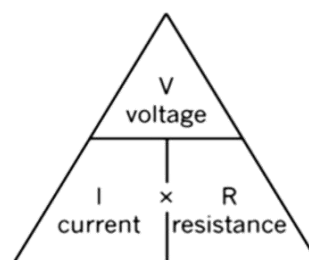


7.2 Indicate the colour codes for the following resistors. If you do not have coloured pencils or pens, write the colour of each band below it.

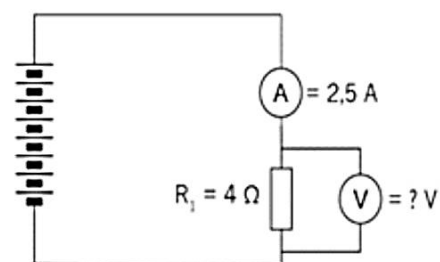


In the formula for Ohm's Law:

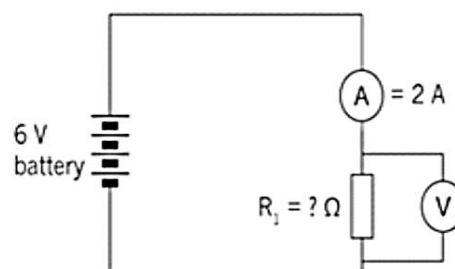
- V is the **potential** or **voltage difference** measured in volts,
- I is **current** measured in amps, and
- R is **resistance** measured in ohms.



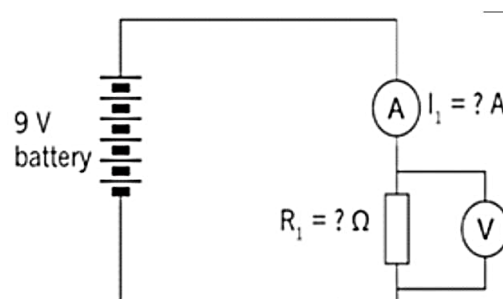
- 7.3 Calculate the value of the voltage supply in the circuit below if the resistor has a value of $4\ \Omega$ and the current through the resistor is $2,5\text{ A}$.



- 7.4 Calculate the resistance of the resistor.



- 7.5 Will the current increase or decrease, if two more cells are added to the circuit in 7.4? Check your prediction using the formula.



- 7.6 Calculate the resistance across the filament in a lamp with a current of $0,5\text{ A}$ when it is connected to a supply of 220 V .
- 7.7 A bulb operates from a 220 V supply. The resistance is $550\ \Omega$. Calculate the strength of the current when it is lit.
- 7.8 An electronic circuit needs a potential difference of $3,6\text{ V}$ across a resistor when a current of 30 mA is in it. Will the voltage be $3,6\text{ V}$ if the resistor had a resistance of $96\ \Omega$. *No, the voltage is only $2,88\text{ V}$*
- 7.9 Describe the function of a resistor.
- 7.10 List at least four places where LEDs are used. Do not use the examples already given.
- 7.11 How can you make sure that a diode is correctly connected?
- 7.12 Draw the symbol for a thermistor.
- 7.13 Draw the symbol for an LDR.

WORKSHEET 8: TECHNOLOGY [INFORMAL ASSESSMENT]



21st Century skill: Critical Thinking

EXPLODED VIEW

Teacher: Introduce exploded views by showing, disassembling, sketching, and labeling. Start with everyday objects, then move to technical ones. The goal is for learners to understand that exploded drawings make hidden parts visible and show how things fit together.

Purpose

An exploded view drawing shows how the parts of an object fit together by “pulling them apart” slightly in the drawing.

- It helps learners see each component clearly.
- It shows the relationship between parts and how they assemble into the whole.
- Commonly used in manuals, textbooks, and engineering design.

How Teachers Can Introduce It:

1. **Start with a familiar object**
 - Use something learners know well (e.g., a pen, a chair, or a cell phone charger).
 - Show the complete object first.
2. **Disassemble the object in front of learners**
 - Take the pen apart: cap, barrel, ink tube, spring.
 - Place the parts on the desk in the order they fit together.
3. **Sketch step by step**
 - Draw the pen as a whole.
 - Then redraw it with the parts separated slightly but still aligned in the correct order.
 - Use arrows or dashed lines to show how the parts fit back together.
4. **Explain the “exploded” idea**
 - Tell learners: *“We are not breaking the object; we are just pulling the parts apart in the drawing so we can see them better.”*
 - Emphasize that the parts must stay in the correct sequence and alignment.
5. **Practice with simple classroom items**
 - Examples: a box with a lid, a stapler, or a simple toy.
 - Learners sketch the object whole, then sketch it “exploded.”

Tips for Teachers

- Keep the drawings **simple and neat**—no need for advanced shading.
- Use **labels** for each part (e.g., “cap,” “spring”).
- Encourage learners to use **arrows** to show assembly direction.
- Reinforce that exploded views are about **clarity, not decoration**.

Elementary Example for Learners

Imagine a **burger drawing**:

- Whole burger first.

- Then draw the bun, patty, cheese, tomato, and lettuce separated slightly, stacked in order.
- Arrows show how they come together. This fun analogy helps learners grasp the concept before moving to technical items.

WORKSHEET 9A: NATURAL SCIENCES [FORMAL ASSESSMENT] [15]



21st Century Skills – Collaboration, Critical Thinking

Tip for Teachers:

Before conducting the experiment, ensure learners know how to take accurate readings and record results neatly in a table with clear headings and units. Show them how to select a suitable scale on the graph paper provided in the Teacher's Resource Pack—one that fits all their data and uses simple, equal intervals. Remind learners to label both axes correctly with variable names and units.

NOTE: The investigation shows that increasing the input voltage increases current when resistance stays constant. This supports Ohm's Law ($V = IR$). Understanding this relationship is essential for designing the alarm system because the LED must be protected from excessive current by using a suitable resistor.

9.1 Table of results: Voltage and Current Readings Across a $220\ \Omega$ Resistor (measured using an ammeter and a voltmeter) (5)

Marking criteria for collection of data (recording of data in a results table)	Marks
Table is drawn with correctly labelled columns and rows, with at least 4 corresponding pairs of values accurately recorded.	5
Table is drawn with correctly labelled columns and rows, with at least 3 corresponding pairs of values accurately recorded.	4
Table is drawn with correctly or semi-correctly labelled columns and rows, with 2 or more corresponding pairs of values accurately recorded.	3
Table is drawn with incorrectly labelled columns and rows, with 1 or more corresponding pairs of values accurately recorded.	1 to 2

9.2 Graph of current (I) versus voltage (V) (5)

Marking criteria for drawing the graph (graphical representation)	Marks
Neatly presented with a correct heading, suitable scales, clearly labelled axes with units, variables placed on the correct axes, all points plotted accurately, and a best-fit straight line drawn through the origin.	5
Graph is mostly neat and correctly labelled, with an appropriate scale. Most points are plotted accurately, with a reasonable best-fit line, but there may be one or two minor errors.	4
Graph is drawn with some correct features (e.g., labels or scale), but contains several errors in plotting, labelling, or neatness. The line of best fit may be poorly drawn or inappropriate.	3
Learner attempted to draw the graph; however, it is incomplete, poorly labelled, untidy, and largely inaccurately plotted. The scale is either unsuitable or missing, and the line of best fit is absent or incorrectly drawn.	1 to 2

9.3 Analysis & Conclusion

9.3.1 Shape of the graph

9.3.2 The relationship between V and I

9.3.3 Ohm's Law in words

9.3.4 Ohm's Law in symbols

9.3.5 Do your results support your hypothesis? Explain.

9.3.6 Explain why it is necessary to connect a resistor in series with the LED in the alarm system's electric circuit.

9.3.7 How does this investigation help with building the alarm system?

(5)
[15]

Marking criteria for the Conclusion and Analysis on the relationship between the variables	Marks
Meets all seven criteria: (1) states the graph shape and the (2) V–I relationship correctly; (3) states Ohm's law in words and (4) in symbols; (5) evaluates the hypothesis with justification; (6) explains why a resistor is needed in series with an LED; and (7) shows how this supports building the alarm system.	5
Adhere to 5 to 6 of the criteria.	4
Adhere to 3 to 4 of the criteria.	3
Adhere to 1 to 2 of the criteria.	1 to 2

**21st Century Skills: Critical Thinking, Communication and Metacognition****QUESTION 1: DETERMINING THE EQUATION****(8)**

Study the graph you drew in Worksheet 9A and use it to answer the questions that follow.

- 1.1 Is the graph of the relationship between V and I an example of direct or indirect proportion? Justify your answer. (2)
- 1.2 Use the first and last two points from table/graph to determine the gradient of the graph and write the equation in the form of $y = mx + c$. (4)
- 1.3 Write V in terms of I by using the equation above. (2)

QUESTION 2: UNDERSTANDING OHM'S LAW**(6)**

Given: $V = IR$, answer the following questions.

- 2.1 Is the formula given above a representation of **direct** or **indirect** proportion? Explain answer. (2)
- 2.2 Use the formula given above to make R the subject of the formula. (2)
- 2.3 Is your answer in 2.2 a representation of **direct** or **indirect** proportion? Explain your answer. (2)

QUESTION 3: CALCULATIONS USING OHM'S LAW**(9)**

- 3.1 A circuit has a resistance of $40\ \Omega$ and a current of 5 A . Calculate the voltage across the resistor. (3)
- 3.2 The voltage supplied to a circuit is 240 V and the resistance is $60\ \Omega$. Calculate the current flowing in the circuit. (3)
- 3.3 A kettle operates at 12 A when connected to a 240 V supply. Calculate the resistance of the kettle. (3)

QUESTION 4: REASONING AND INTERPRETATION**(5)**

- 4.1 A resistor has a constant resistance of $10\ \Omega$.
- a) Calculate the current when the voltage is 20 V . (2)
- b) Calculate the current when the voltage is increased to 40 V . (2)
- c) What happens to the current when the voltage is doubled? (1)

[28]

**21st Century Skills: Critical Thinking, Communication and Metacognition****ACTIVITY 1: GROUP WORK**

- 1.1 The table below lists various tools, materials, and components needed to construct a basic circuit project. Prices already include 15% VAT. Some values are missing and must be calculated.
- a) Complete the table by calculating the missing values (Unit price, Quantity and Amount where applicable). (6)
 - b) Complete the total cost of all the items in the table above. (1)
 - d) How much VAT, at 15%, was paid in total? (3)

ACTIVITY 2: INDIVIDUAL WORK**(8)**

1. Your teacher has decided to **borrow your group R2000** to assist with the project. However, you are required to choose between the following 2 options to **repay the teacher later**.

Option 1: Repayment with **simple interest** at **12% per annum for 2 years**.

Option 2: Repayment with **compound interest** at **12% per annum for 2 years**.

- a) Calculate the total amount that must be repaid if you choose **Option 1 (simple interest)** (3)
- b) Calculate the total amount that must be repaid if you choose **Option 2 (compound interest)** (3)
- c) Compare the two options and justify which repayment option is cheaper. (2)

[18]**MAKE SKILLS: BUILD THE SCALE MODEL / SCALE MODEL / PROTOTYPE****21st Century skill: Collaboration & Critical Thinking, Communication**

Learners are tasked with designing and building a working scale model / prototype that provides a practical safety solution for the Siyakhanya Community Hub.

- The model must be cost-effective, use identified/recycled materials and demonstrate a functional system that addresses either burglary prevention or fire safety.

- It must be built to scale, neat and well-finished, and show efficient use of materials.
- Safety is essential: the prototype must be safe to handle, and all components must work correctly according to the intended design.

Learners select ONE scenario:

1. Intrusion Detection (Security & Alarm System) – using sensors (e.g., LDR) to detect break-ins and trigger buzzer + LED alerts.
2. Fire Alarm with Emergency Door Release – using a heat sensor (thermistor) to detect rising temperature, activating buzzer + LED, with a manual switch for testing.

PURPOSE OF THE PROJECT

- To give learners hands-on experience in applying mechanical and electrical/electronic knowledge.
- To encourage problem-solving and creativity in addressing real-world community challenges.
- To develop skills in designing, building, and testing prototypes that meet specifications and constraints.
- To promote teamwork, responsibility, and efficient use of materials.
- To connect classroom learning with community needs (crime prevention and fire safety).

Assessment Focus (Rubric Overview)

Teachers will assess learners' prototypes using the rubric (35 marks), focusing on:

- Completion & functionality of the model.
- Adherence to specifications and constraints.
- Neatness, accuracy, and scale.
- Effort and teamwork.
- Safe and efficient use of materials.

 **Note to teachers:** The GEC project is not just about building a model—it's about developing engineering thinking skills in learners. Teachers should guide learners to focus on:

- Choosing one scenario clearly.
- Building safely and neatly.

- Ensuring the prototype works as intended.
- Reflecting real-world application.

TECHNOLOGY RUBRIC TO ASSESS THE MAKING OF THE SCALE MODEL / PROTOTYPE [35]

Level	Criteria	Marks
1	• Learners could not complete the working scale model / prototype. • Little to no consideration for specifications and constraints. • Learners and groups need a lot of help and motivation. • The working scale model / prototype does not work at all, and the components were not connected. • The working scale model / prototype was not made to scale. • Waste of material; working scale model / prototype does not function.	1 - 7
2	• Learners were able to complete the working scale model / prototype. • Some specifications and constraints were adhered to. • All learners in the group attempted to put in effort to complete the model. • The working scale model / prototype was partially made to scale. • Model appears acceptable and the components are functioning. • Materials were used well and safe to use, but minor modifications must be done.	8 - 17
3	• Learners were able to build a functional working scale model / prototype. • All specifications and constraints were adhered to. • The model was neat and the components were functioning. • All learners in the group put in an effort to complete the model. • Materials were used optimally; working scale model / prototype will be safe to use and without minor modifications.	18 - 27
4	• Learners were able to build a functional and creative scale model / prototype. • All specifications and constraints were adhered to. • Accurate dimensions were used when building the scale model / prototype; all the components were functioning. • All learners in the group contributed the necessary effort to complete the model. • Relevant materials were used optimally, the scale model / prototype is safe to use and to manufacture. It will work well without any modifications.	28 - 35

NATURAL SCIENCES INSTRUCTIONS:

21st Century Skills – Collaboration, Critical Thinking

BUILDING THE MODEL

[5]

Learners bring the scale model / prototype they built in Technology to the Natural Sciences class. The NS teacher evaluates the circuit in the scale model / prototype and allocates a mark out of 5.

NATURAL SCIENCES MARKING RUBRIC TO ASSESS THE SCALE MODEL/SCALE MODEL / PROTOTYPE

Model of circuit construction in the prototype of the alarm system	Marks
Exceptional understanding: • Circuit is fully functional, neat, and creatively constructed. • All components correctly connected and working. • Model/prototype shows high effort and quality. • All group members contributed meaningfully.	5
Good understanding: • Circuit works correctly and is neatly assembled. • Components are correctly connected and functional. • Prototype shows solid effort. • All group members participated.	4
Moderate understanding: • Circuit is mostly correct and functions with minor issues. • Components are connected but may lack neatness or accuracy. • Prototype is complete. • Most group members contributed.	3
Poor understanding: • Circuit does not work or components are incorrectly connected. • Model/prototype incomplete or poorly assembled. • Learners required significant help and motivation. • Minimal contribution from group members.	1 to 2

WORKSHEET 12: TECHNOLOGY [INFORMAL ASSESSMENT]



21st Century skill: Critical Thinking & Collaboration & Metacognition

GROUP PRESENTATION

The document outlines how learners must present their integrated project to a panel and how the presentation will be assessed. Its purpose is to:

- Guide learners in preparing a short, structured presentation (maximum 5 minutes) that explains their project clearly and confidently.
- Ensure fairness by having group leaders serve as panel members, while excluding the leader of the presenting group from their own evaluation.

- Provide a checklist that standardizes assessment, focusing on clarity, logic, teamwork, and confidence.
- Encourage constructive feedback from the panel, highlighting strengths and suggesting improvements.

Key focus areas for teachers and learners

1. Professional opening – clear introductions, confident tone, and defined roles.
2. Context & justification – explain which scenario/problem was chosen and why.
3. Methodology & logic – show how the project followed the IDMEC process (investigate, design, make, evaluate, communicate).
4. Concept to draft – present sketches and how ideas developed into the final design.
5. Material & form – justify choice of materials and design decisions.
6. Working model – demonstrate how the prototype functions to solve the identified problem.
7. Critical reflection – share challenges faced and improvements made.
8. Pacing & confidence – speak clearly, stay within the 5-minute limit, and show preparation.

Overall purpose

The group presentation process ensures that learners:

- Practice communication and teamwork skills.
- Demonstrate their understanding of the design process.
- Reflect on both successes and challenges.
- Receive peer-based evaluation and feedback that builds confidence and improves learning outcomes.

WORKSHEET 13: TECH, NS & MATHS [INFORMAL ASSESSMENT]



21st Century skill: Metacognition & Collaboration

REFLECTION: These reflection questions are not just an “add-on.” They are a **core part of the learning process**, helping learners see themselves as capable problem-solvers who can learn from challenges, connect knowledge across subjects, and prepare for future projects.

PURPOSE OF THE REFLECTION QUESTIONS

The reflection questions are designed to:

- Help learners think critically about their project experience, not just the final product.
- Encourage problem-solving awareness (how they identified and fixed issues).
- Build emotional resilience by recognizing frustration and strategies to overcome it.
- Highlight skills gained or improved (both technical and personal).
- Connect cross-curricular learning (Technology, Natural Sciences, Mathematics) to real application.
- Promote self-awareness of strengths, mistakes, and areas for growth.
- Foster future-oriented thinking (what they would do differently, advice for others, new problems to solve).

In short, the questions develop learners’ ability to **evaluate their own learning process**, making them more independent, reflective, and confident problem-solvers.

How Teachers Can Facilitate Reflection

1. Set the tone

- Explain that reflection is not about “right or wrong answers” but about honest thinking.
- Emphasize that mistakes and frustrations are part of learning.

2. Model reflection

- Share a simple example from your own teaching or a classroom activity (e.g., “*I once struggled with a loose wire in a circuit, but testing each connection helped me find the problem*”).

3. Use guided discussion before writing

- Let learners talk in pairs or small groups about one or two questions.
- This helps them verbalize ideas before putting them into words.

4. Encourage detail and evidence

- Ask learners to give specific examples (e.g., “Which wire was loose?” or “Which skill improved?”).
- Push them beyond one-word answers.

5. Link to the rubric and IDMEC process

- Show how reflection connects to Evaluate and Communicate in the design cycle.
- Reinforce that reflection is part of being a good engineer or problem-solver.

6. Celebrate growth

- Highlight positive discoveries (new skills, perseverance, teamwork).
- Use reflections to encourage learners that they are **developing real-world abilities**.

GRADE 9 INTEGRATED PROJECT – NATURAL SCIENCES RUBRIC

30 MARKS

WORKSHEET MARKS – WORKSHEET 4 [10 MARKS]					LEARNER'S MARK
ITEM	EXCELLENT (5)	GOOD (4)	ADEQUATE (3)	POOR (1-2)	OUT OF 5
Identify independent, dependent, and controlled variables. (4.1 and 4.4)	Both the independent and dependent variable and all three controlled variables are correctly identified.	Both the independent and dependent variable, and at least two controlled variables are correctly identified.	Any three of the independent, dependent or controlled variables have been correctly identified.	Any one to two of the independent, dependent, and controlled variables have been correctly identified.	(5)
Investigative question and Hypothesis (4.2 and 4.3)	The (1) independent variable and (2) dependent variable are both correctly reflected in the (3) investigative question and the hypothesis. (4) A well-formulated question clearly asks about the relationship between the variables. (5) The hypothesis clearly describes the expected relationship between the two variables.	Four of the criteria are met. One element may be incomplete, unclear, or slightly inaccurate.	Three of the criteria are met. The remaining elements show partial understanding, are vague, or contain errors.	Only one or two criteria are met. Most elements are missing, incorrect, or do not reflect the relationship between the variables.	(5)
WORKSHEET MARKS – WORKSHEET 9A [15 MARKS]					OUT OF 5
ITEM	EXCELLENT (5)	GOOD (4)	ADEQUATE (3)	POOR (1-2)	OUT OF 5
Collection of data (9.1)	Table is drawn with correctly labelled columns and rows, with at least 4 corresponding pairs of values accurately recorded.	Table is drawn with correctly labelled columns and rows, with at least 3 corresponding pairs of values accurately recorded.	Table is drawn with correctly or semi-correctly labelled columns and rows, with 2 or more corresponding pairs of values accurately recorded.	Table is drawn with incorrectly labelled columns and rows, with 1 or more corresponding pairs of values accurately recorded.	(5)
Graphical Representation (9.2)	Neatly presented with a correct heading, suitable scales, clearly labelled axes with units, variables placed on the correct axes, all points plotted accurately, and a best-fit straight line drawn through the origin.	Graph is mostly neat and correctly labelled, with an appropriate scale. Most points are plotted accurately, with a reasonable best-fit line, but there may be one or two minor errors.	Graph is drawn with some correct features (e.g., labels or scale), but contains several errors in plotting, labelling, or neatness. The line of best fit may be poorly drawn or inappropriate.	Learner attempted to draw the graph; however, it is incomplete, poorly labelled, untidy, and largely inaccurately plotted. The scale is either unsuitable or missing, and the line of best fit is absent or incorrectly drawn.	(5)
Conclusion and analysis on the relationship between the variables (9.3)	Meets all seven criteria: (1) states the graph shape and the (2) V–I relationship correctly; (3) states Ohm's law in words and (4) in symbols; (5) evaluates the hypothesis with justification; (6) explains why a resistor is needed in series with an LED; and (7) shows how this supports building the alarm system.	Adhere to 5 to 6 of the criteria.	Adhere to 3 to 4 of the criteria.	Adhere to 1 to 2 of the criteria.	(5)
WORKSHEET MARKS – WORKSHEET 11 [5]					OUT OF 5
ITEM	EXCELLENT (5)	GOOD (4)	ADEQUATE (3)	POOR (1-2)	OUT OF 5
Model of circuit construction in the prototype of the alarm system	Exceptional understanding: • Circuit is fully functional, neat, and creatively constructed. • All components correctly connected and working. • Model/prototype shows high effort and quality. • All group members contributed meaningfully.	Good understanding: • Circuit works correctly and is neatly assembled. • Components are correctly connected and functional. • Prototype shows solid effort. • All group members participated.	Moderate understanding: • Circuit is mostly correct and functions with minor issues. • Components are connected but may lack neatness or accuracy. • Prototype is complete. • Most group members contributed.	Poor understanding: • Circuit does not work or components are incorrectly connected. • Model/prototype incomplete or poorly assembled. • Learners required significant help and motivation. • Minimal contribution from group members.	(5)