

GEC INTEGRATED GRADE 9 PROJECT LEARNER'S WORKBOOK



Name of School	
Name of Learner	
Class	



3 ENTREPRENEURSHIP
EMPLOYABILITY
EDUCATION

PROJECT-BASED LEARNING | TECH, MATH & NS



basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA



**GRADE
2026**

9

Summary of Worksheets



Worksheet Number	Subject Total Mark Worksheet MARK	MATH (100)		NS (30)		TECH (70)	
		Ex	Mod	Ex	Mod	Ex	Mod
1A							
1B	30						
2							
3A							
3B	15						
4	10						
5A							
5B	20						
6A	15						
6B	24						
7							
8							
9A	15						
9B	28						
10	18						
11	5 / 35						
12							
13							
TOTAL							



BACKGROUND: ENHANCING SAFETY AT THE SIYAKHANYA COMMUNITY HUB

The Siyakhanya Community Hub is an important space where learners study, use computers, and access learning resources. It supports more than 150 young people every day. Recently, the hub was broken into and valuable equipment, including laptops and a projector, was stolen. As a result, the Hub has been closed, affecting many learners.

Crime remains a serious concern in South Africa, with thousands of burglaries reported at schools and community facilities each year. These incidents do not only result in stolen property but also lost opportunities for communities.

The community now needs a practical and affordable safety solution. You have been appointed as junior engineers to design and build a working model / scale model / prototype of a safety system for the Siyakhanya Community Hub. Your solution must be cost-effective, use recycled materials where possible, and apply knowledge of mechanical and electrical/electronic systems.

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

SCENARIO 1: THE SECURITY & ALARM SYSTEM (INTRUSION DETECTION)

You are required to design and build a working scale model or prototype of an electronic circuit for intrusion detection and safety lighting. The system must automatically detect a change in light intensity to identify a potential break-in attempt.

The prototype must incorporate at least one input sensor—such as a light-dependent resistor (LDR) or motion detector—that triggers the system automatically when light falls on the LDR. A buzzer and an LED must serve as output indicators to signal the intrusion.

The LDR should be visible on the outside of the housing structure of the scale model / prototype.



SCENARIO 2: THE FIRE ALARM

You must design and build a working scale model / prototype of a simple fire detection circuit. The system must automatically detect a rise in temperature (a potential fire) and activate two output devices: a light (LED) and a buzzer. A manual switch must also be included to test or activate the system.

The system will use a heat-sensitive sensor (thermistor or simulated resistor) as the input. The circuit will process this signal and then activate the outputs using a transistor as a switch.

REQUIREMENTS FOR BOTH SCENARIOS

- The alarm system must include two simultaneous outputs: visual e.g. an LED that flashes (to alert people with different abilities) and an audible – a buzzer to scare away the intruders and alert the security company or employees in the case of fire.
- The scale model / prototype must be powered by a battery pack not exceeding 9V to ensure it is portable and safe.
- The batteries should be replaced easily.
- The LED (scenario 1 & 2) should be visible on the outside of the housing structure of the scale model / prototype.
- The circuit must be housed in a container made from recycled or low-cost materials, such as cardboard or plastic container, to minimize the costs.
- The circuit must include a master switch (SPST) to manually activate and deactivate the entire system.
- Use the following dimensions for the housing structure of the scale model / prototype: 120mm x 120mm x 20mm.
- You have 120 minutes to build the alarm system. Manage your time wisely.



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.

Worksheet 1A – TECHNOLOGY [INFORMAL ASSESSMENT]



- 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		



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)



Worksheet 1B – MATHEMATICS [FORMAL ASSESSMENT]

- 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. (2)

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.



- 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)

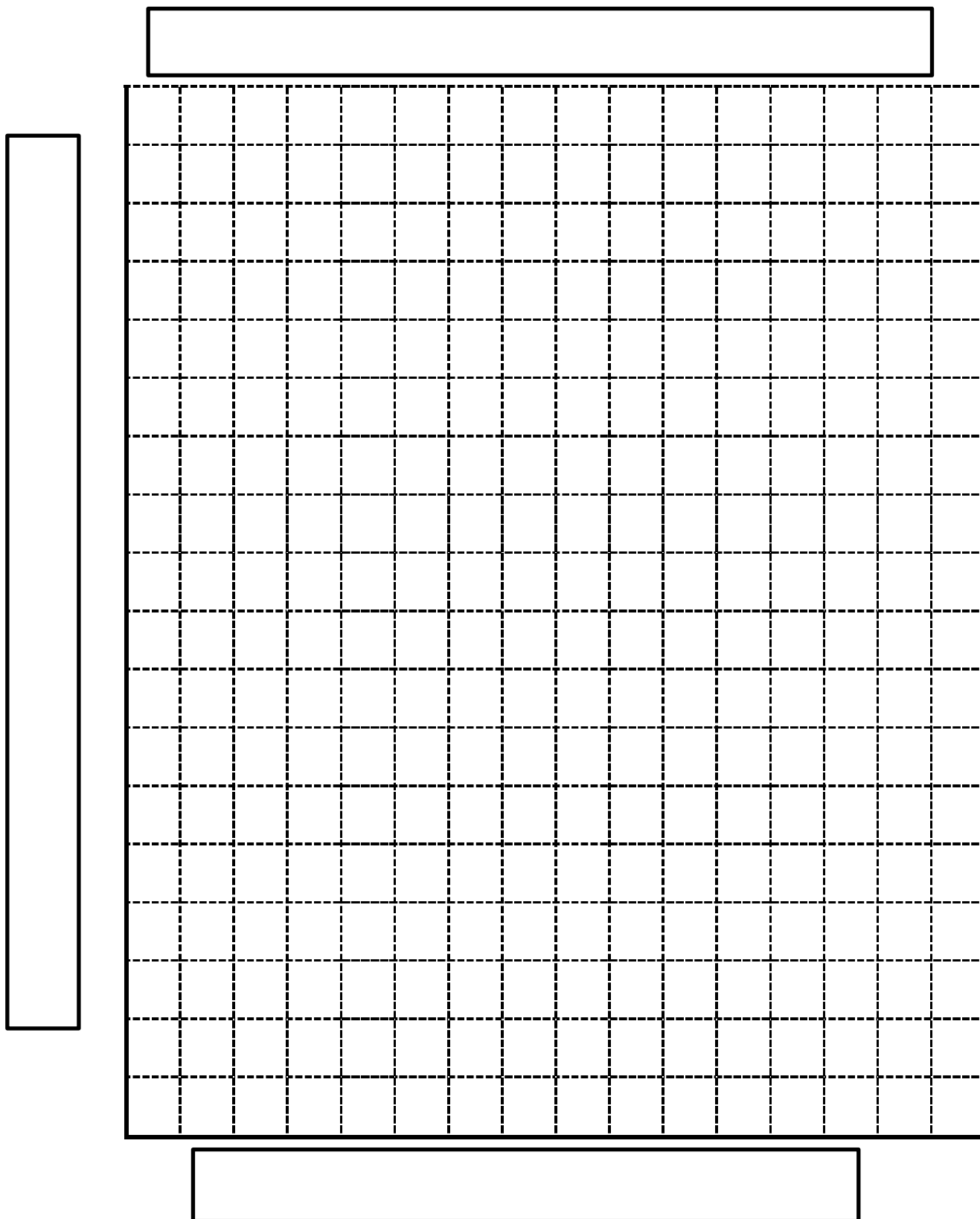
- d) Which group of community centre has a **higher risk of vandalism**? Justify your answer using the probabilities. (1)



QUESTION 5: REPRESENTING DATA

(8)

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



[30]



2.1 Draw the circuit diagram symbol for each component below:

2.2.1 Cell _____

2.2.5 Open switch _____

2.2.2 Battery _____

2.2.6 Connecting wire _____

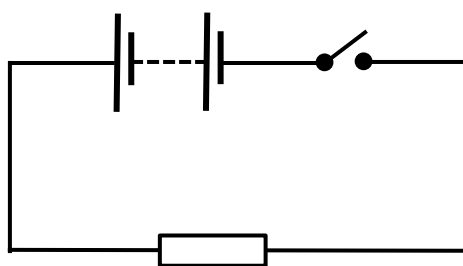
2.2.3 Resistor _____

2.2.7 Ammeter _____

2.2.4 Light bulb _____

2.2.8 Voltmeter _____

2.2 Redraw the following circuit. Then complete the tasks below:

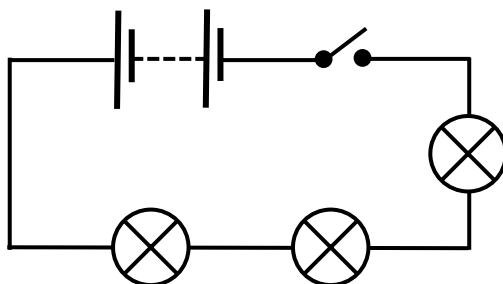


2.2.1 Add an ammeter in the correct position to measure the total current in the circuit.

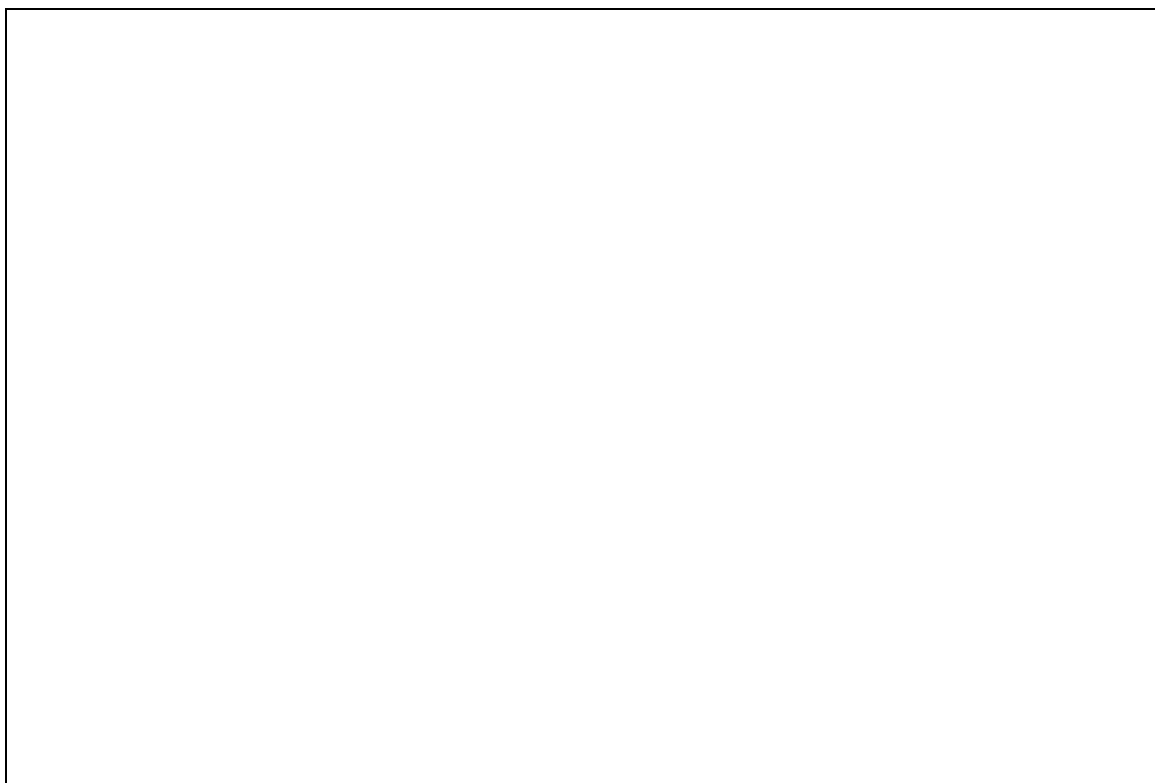
2.2.2 Add a voltmeter in the correct position to measure the potential difference across the resistor.



2.3 Study the circuit diagram below:



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.

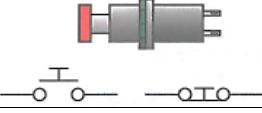
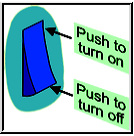
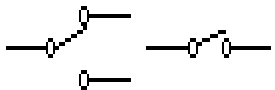
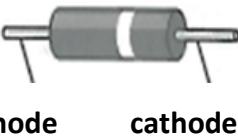
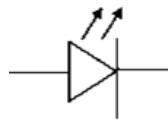
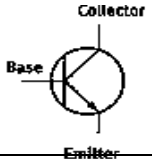
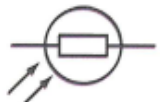
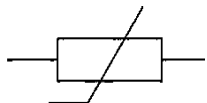
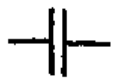


2.3.2 Identify the type of circuit you used in Question 2.3.1. Explain the reason for your choice.



21st Century skill: Critical Thinking & Metacognition

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	



Answer the following 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]

21st Century skill: Critical Thinking & Metacognition

INVESTIGATION

(15)

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

(6)

A	
B	
C	
D	
E	
F	

3.12 Answer the following questions.

Circuit A	Circuit B

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

(2)



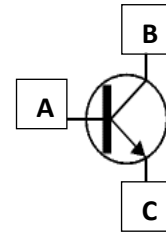
Worksheet 3B - TECHNOLOGY [FORMAL ASSESSMENT]

3.12.2 Identify one output device from each circuit.

(2)

3.13 Explain how the different parts of the transistor are connected.

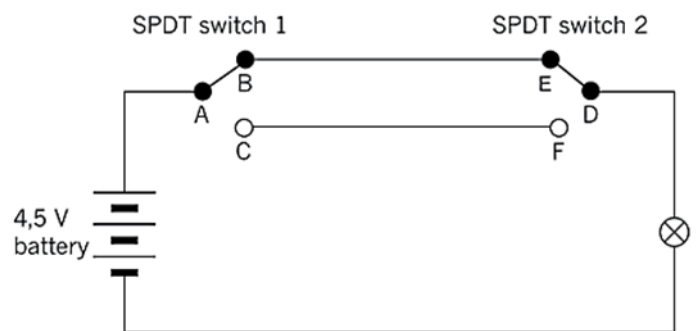
(3)



Labels	Name of leg	How legs are connected to the circuit
A		
B		
C		

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

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.

Identify the variables based on the aim of this investigation.

- 4.1.1 Independent variable (1)

- 4.1.2 Dependent variable (1)

4.2 INVESTIGATIVE QUESTION

- Formulate the scientific investigative question for this investigation. (3)

4.3 HYPOTHESIS

- Formulate a hypothesis for this investigation. (2)



4.4 CONTROLLED VARIABLES

From the list provided below, identify the three controlled variables that are relevant to this investigation.

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

[10]

Worksheet 4 – Natural Sciences [FORMAL ASSESSMENT]



NATURAL SCIENCES MARKING RUBRIC

[10]

WORKSHEET MARKS – WORKSHEET 4					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)



21st Century skill: Critical Thinking & Metacognition

DESIGN SKILLS

Definition of a design brief: It is a short, clear statement that describes what you are going to design and make. It explains the problem you are trying to solve and identifies the specific need or want of the client.

Think of it as the starting point of your project. It is not a list of instructions, but rather a concise paragraph that sets the direction for your entire design process.

KEY ELEMENTS OF A DESIGN BRIEF

To write a good Design Brief, you must answer three main questions:

1. What is the problem?
2. Who has the problem (the client/user)?
3. Why must it be solved (the purpose)?

Sentence Starter

A common sentence starter is:

"I am going to design and make a... (type of product) for... (person/client) so that... (purpose)."

Poor Design Brief:

"I am going to make a bridge." (This is too vague).

Correct Design Brief:

"I am going to design and make a simple, temporary pedestrian bridge for primary school children and parents so that they can cross the busy street safely without interrupting the flow of traffic."



Specifications are the "what you need" list. They are the detailed requirements that your final product or solution must do, have, or be.

- Think of them as the "job description" for your product.
- They describe the features, functions, and qualities needed to solve the problem successfully.
- They are usually things you must include or ensure.

Examples of Specifications (using the pedestrian bridge scenario):

- a) The bridge must be strong enough to hold at least 10 children at once.
- b) It must have safe railings to prevent people from falling.
- c) It must be made from weather-resistant materials.
- d) It must be high enough for a delivery truck to pass underneath.

Constraints are the "what you are stuck with" list. They are the limits or restrictions placed on you and your project. You cannot ignore these; you must work within them.

- Think of them as the "rules of the game" or the "boundaries" you must stay inside.
- They are usually things you cannot change.
- Common constraints in Technology include time, money, and materials.

Examples of Constraints (using the same bridge scenario):

- Budget: The bridge cannot cost more than R500 to build.
- Time: The project must be completed within 3 weeks.
- Materials: We can only use recycled wood and rope found at school.
- Size: The bridge cannot be taller than 3 meters due to airport flight paths nearby.



21st Century skill: Critical Thinking & Collaboration

- 5.1 Write a design brief for your selected scenario. (3)

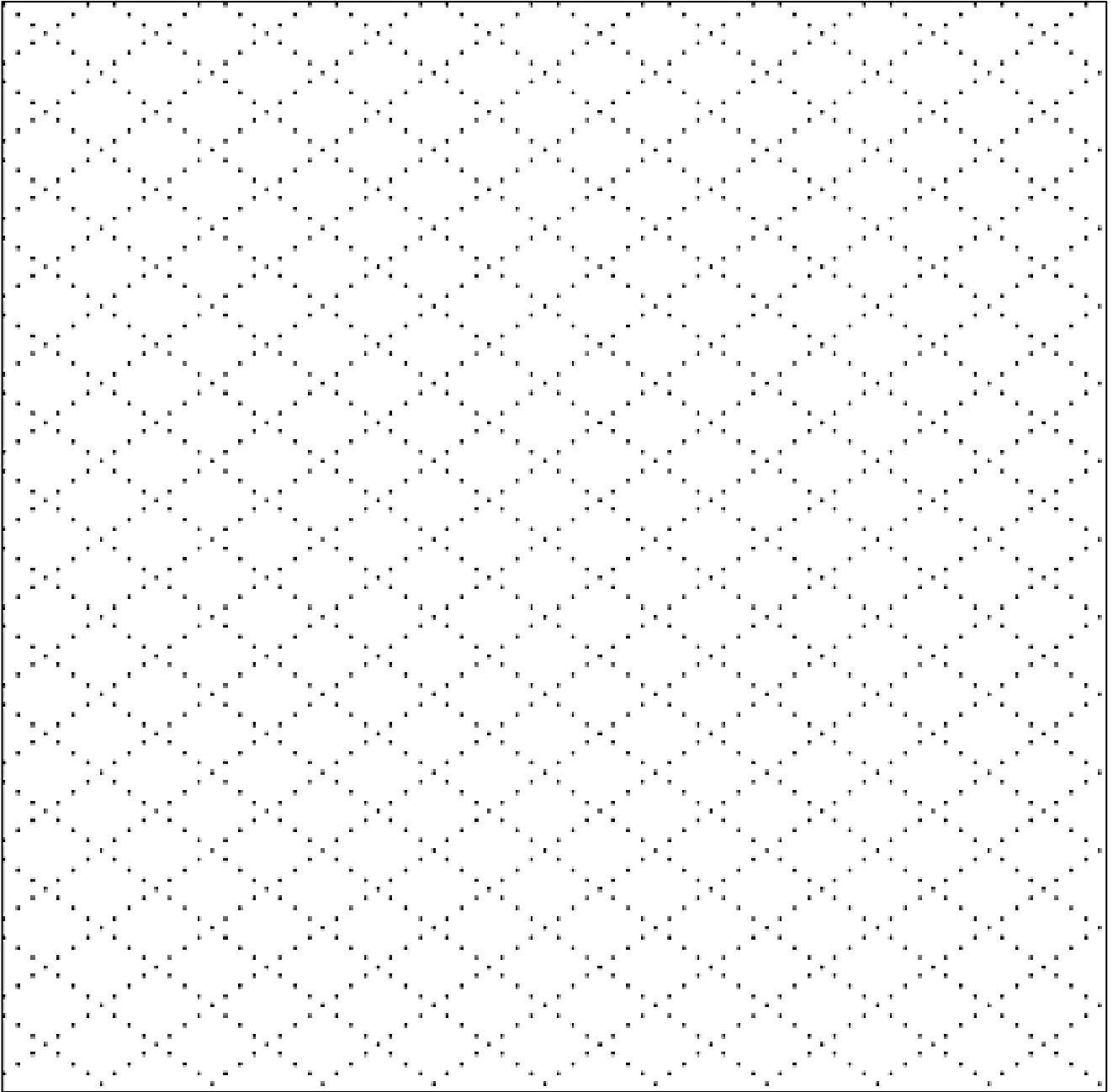
- 5.2 List TWO constraints from the scenario. (2)

- 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)

- Use labels and notes to explain your design.
- Make sure your idea meets all the given specifications and constraints (size and materials).





RUBRIC TO ASSESS THE FREEHAND SKETCH

[20]

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



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.
5.	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.



Worksheet 6A – TECHNOLOGY [INFORMAL ASSESSMENT]

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.

Tools	Materials



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:

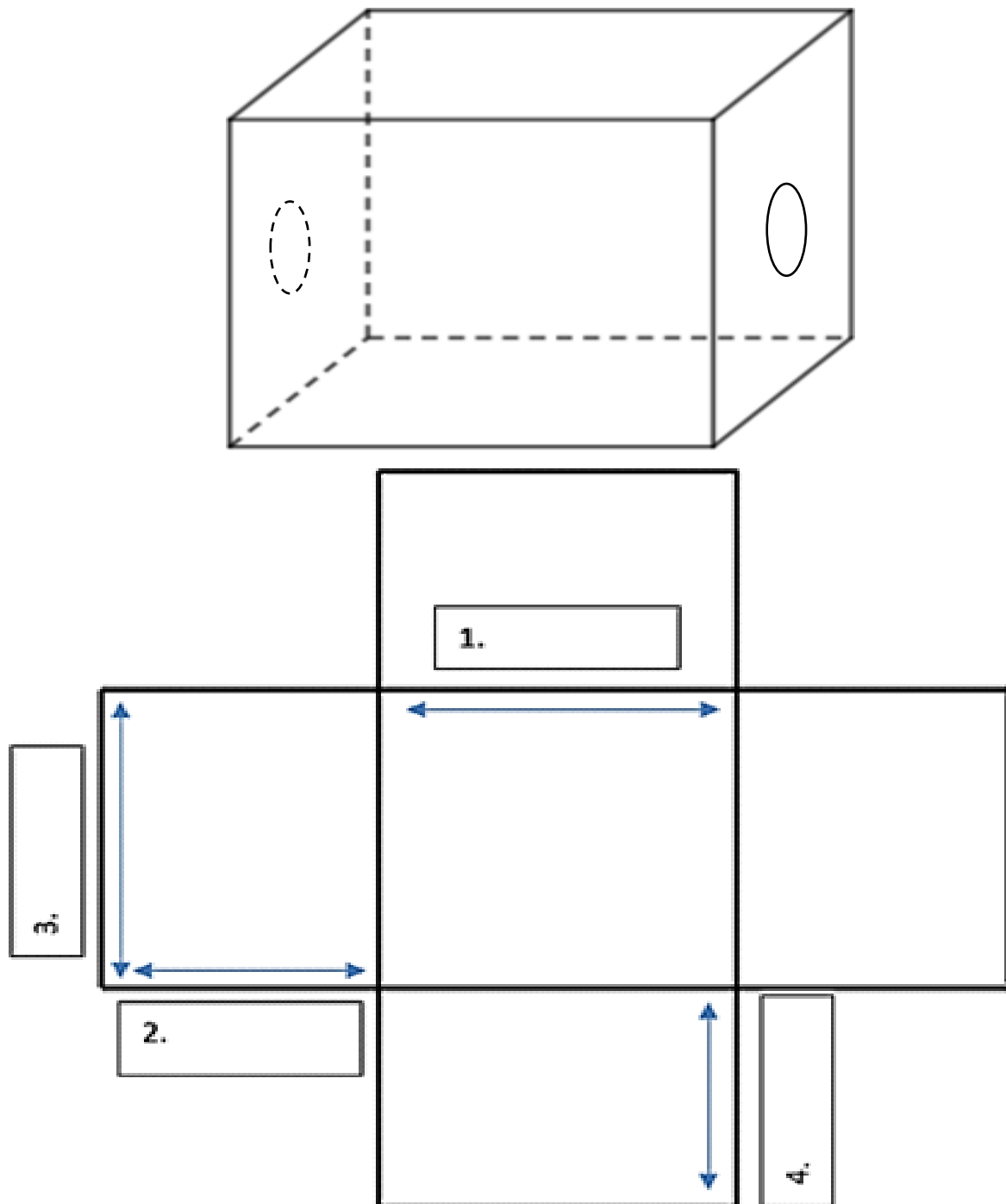
- The faces of the packaging structure must be rectangular, and the packaging structure must be open on the top for people to easily see the circuitry device.
- One pair of opposite faces of the packaging structure must have circular openings that will serve as handles.
- The openings must be on the 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 3-D sketch of the packaging structure. Next to it is the net of the packaging structure with some missing information/ dimensions.



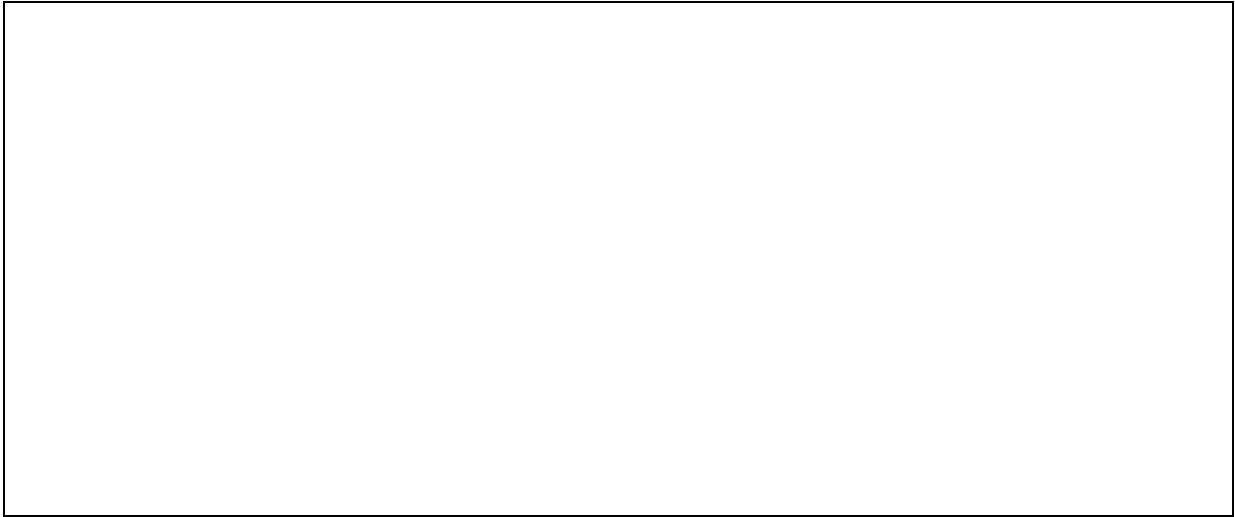
- a) Use the 3-D sketch and the given specifications to fill in all the missing dimensions of the edges of the net above. (4)



- 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.

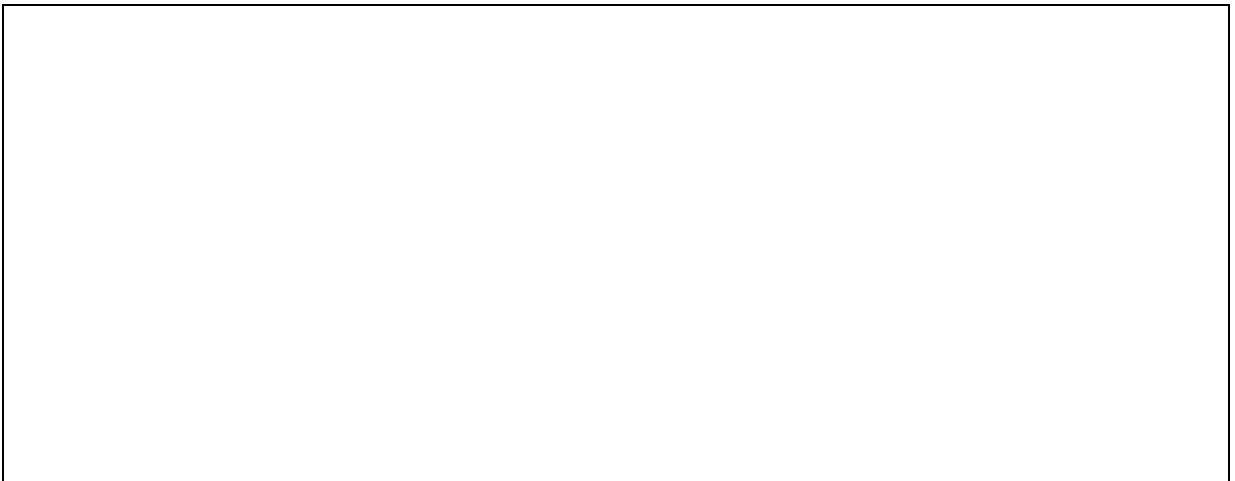
(3)



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]

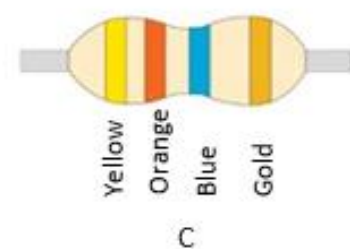
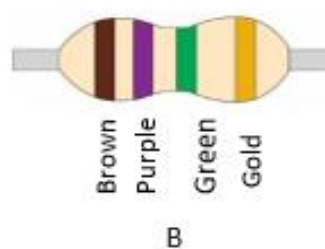
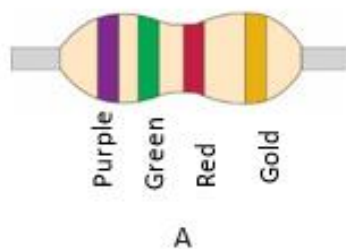


21st Century skill: Critical Thinking

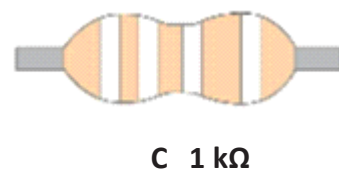
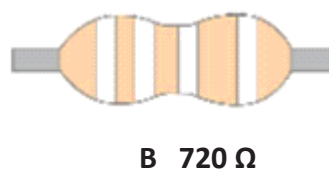
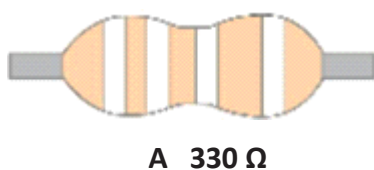
Answer the following questions using the conversion table below:

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.

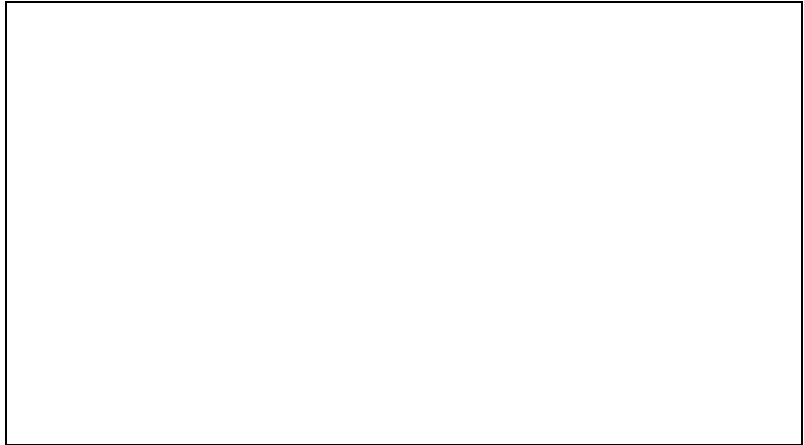
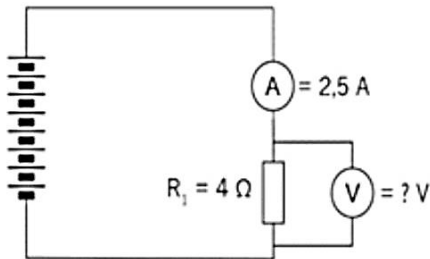


7.2 Indicate the colour codes for the following resistors. If you do not have coloured pencils or pens, write the colour of each band below it.

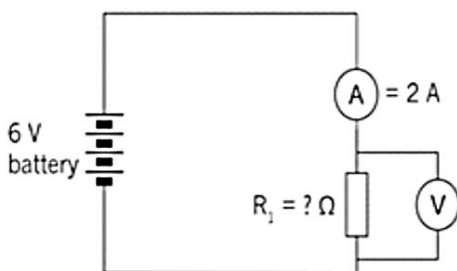




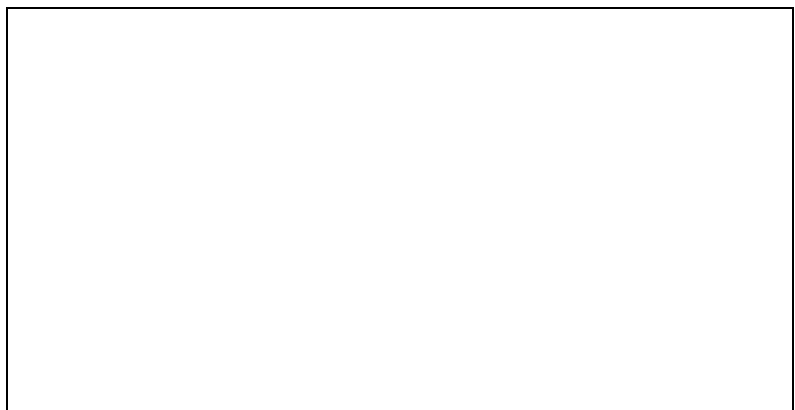
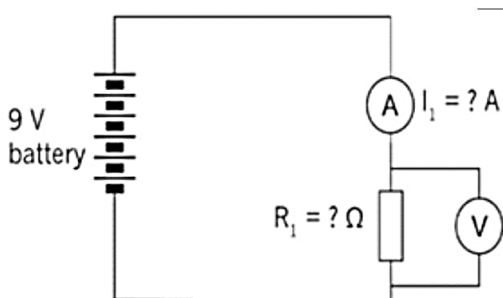
- 7.3 Calculate the value of the voltage supply in the circuit below if the resistor has a value of $4\ \Omega$ and the current through the resistor is $2,5\text{ A}$.



- 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 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 Ω . Calculate the strength of the current when it is lit.

- 7.8 An electronic circuit needs a potential difference of 3,6V across a resistor when a current of 30 mA is in it. Will the voltage be 3,6 V if the resistor had a resistance of 96 Ω ?

- 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.

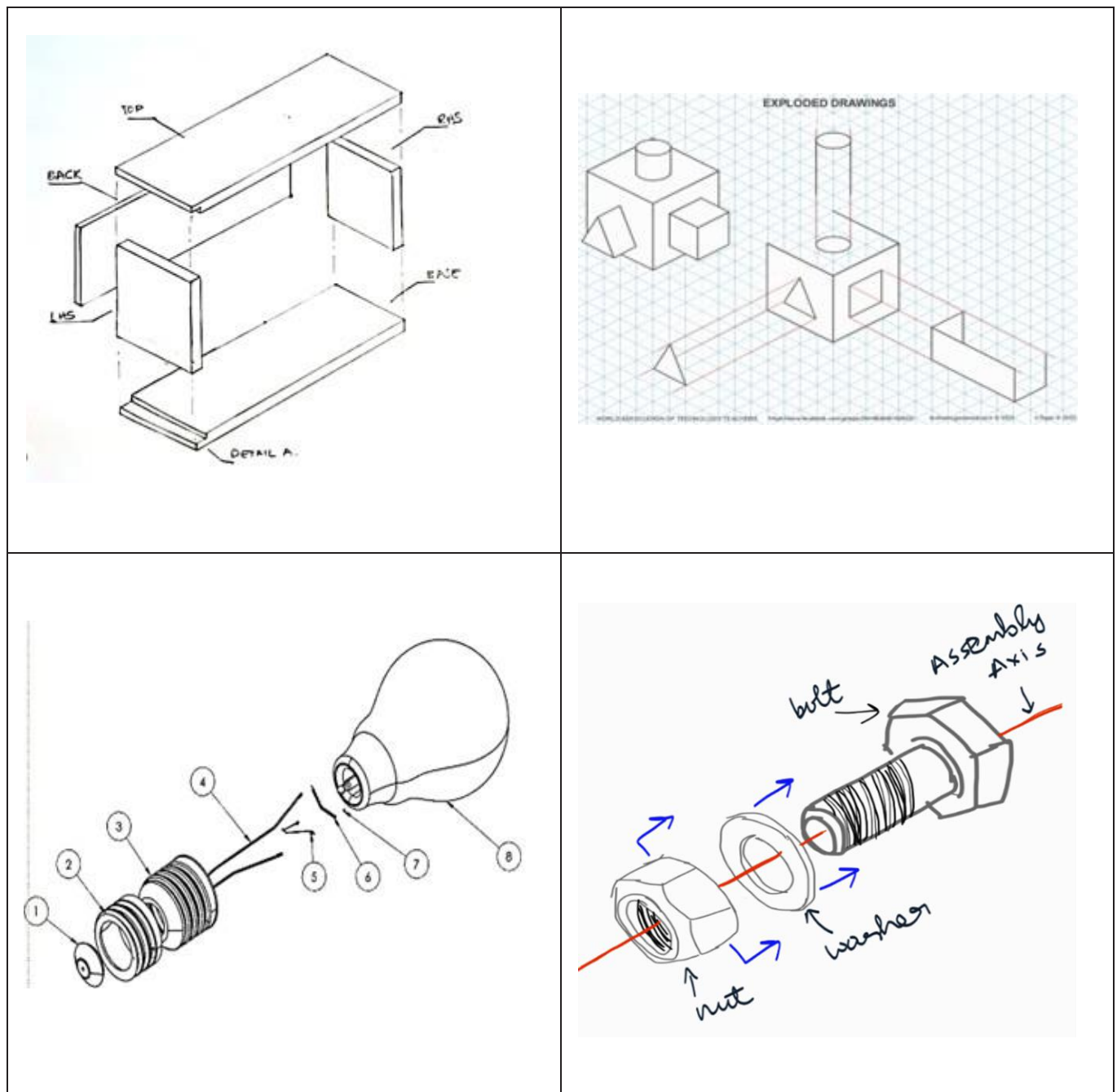
7.13 Draw the symbol for an LDR.



21st Century skill: Critical Thinking

EXPLODED VIEW

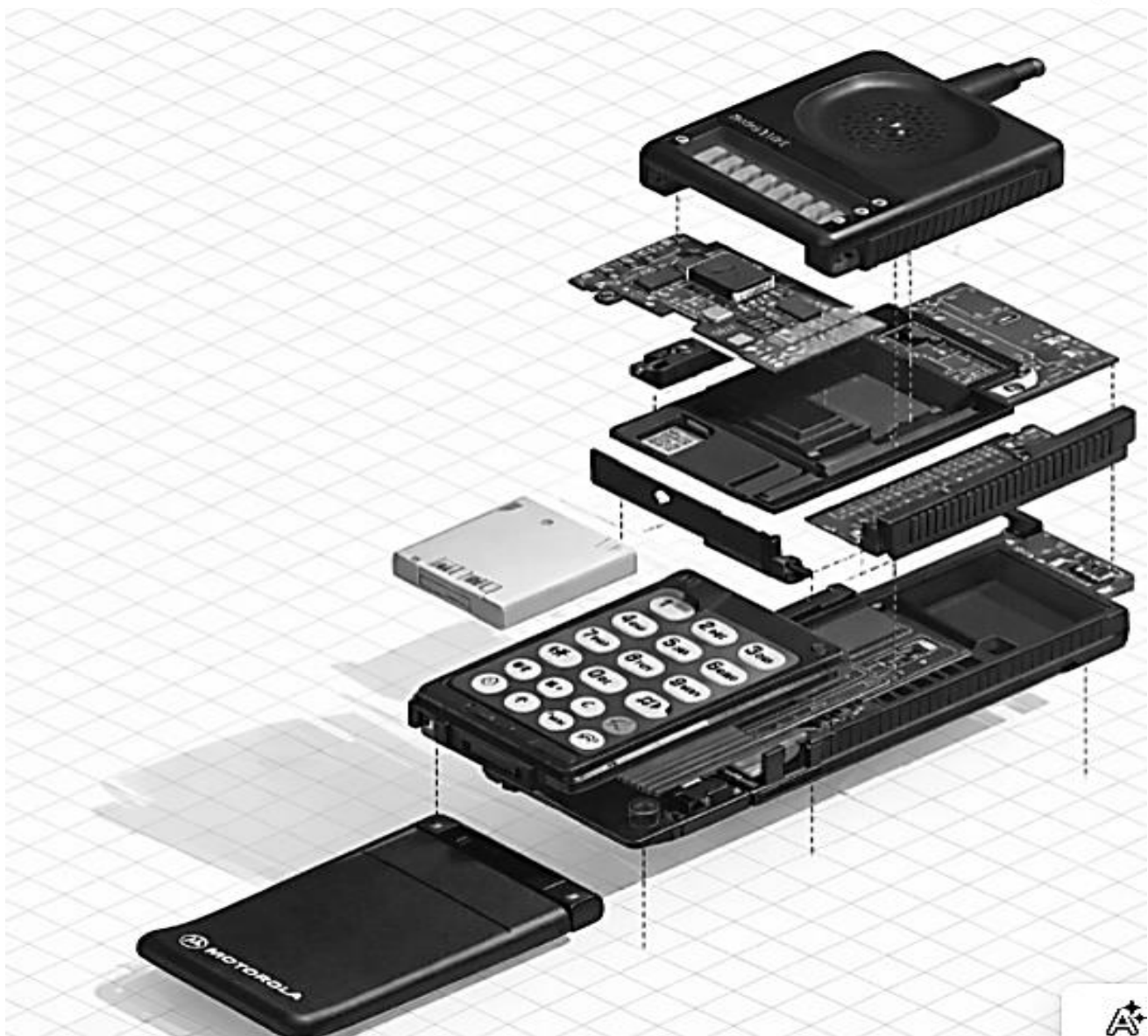
Below are examples of drawings in exploded view:

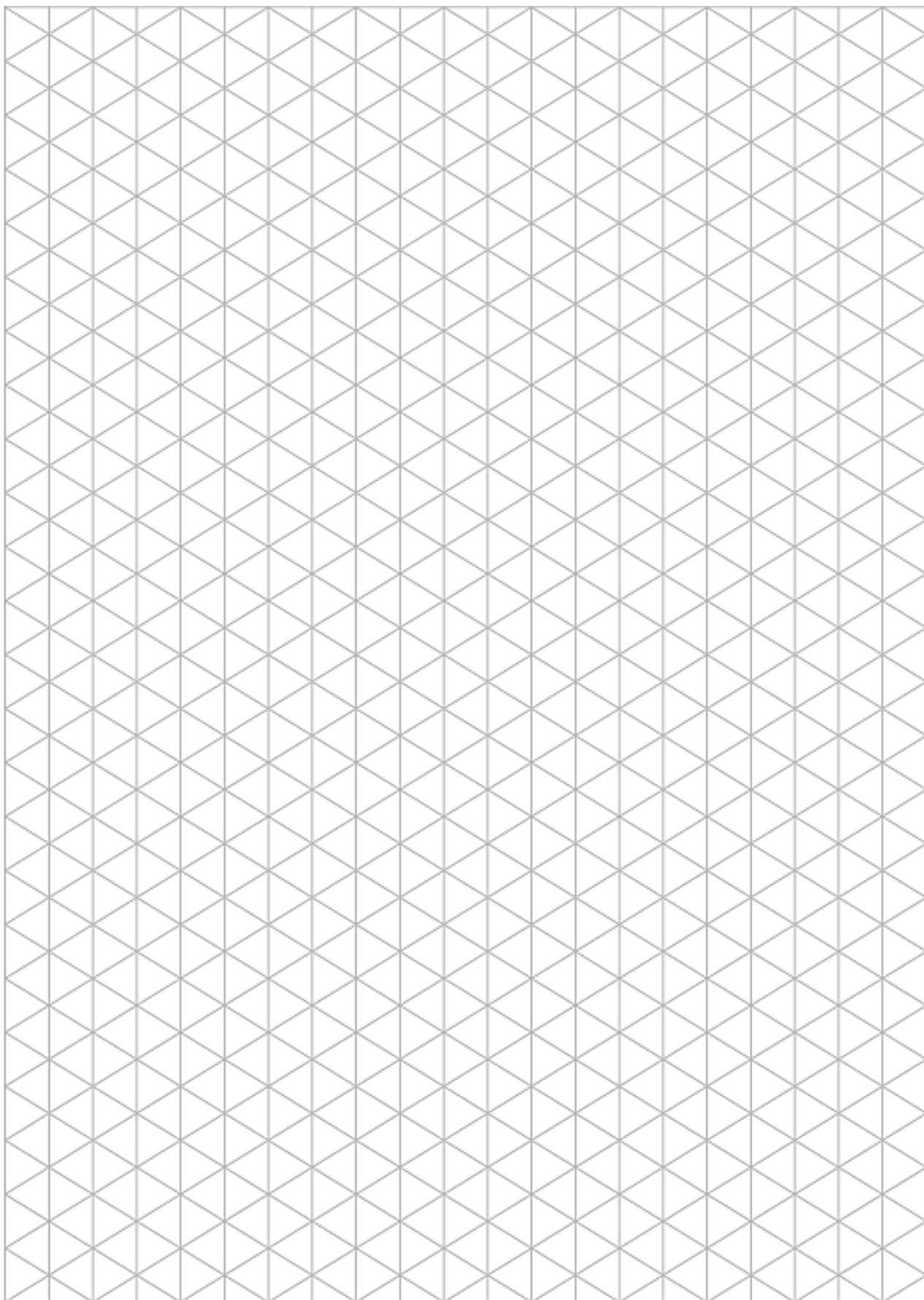




8.1 Practice the following exploded views on isometric grid paper.

8.1.1 Cell phone

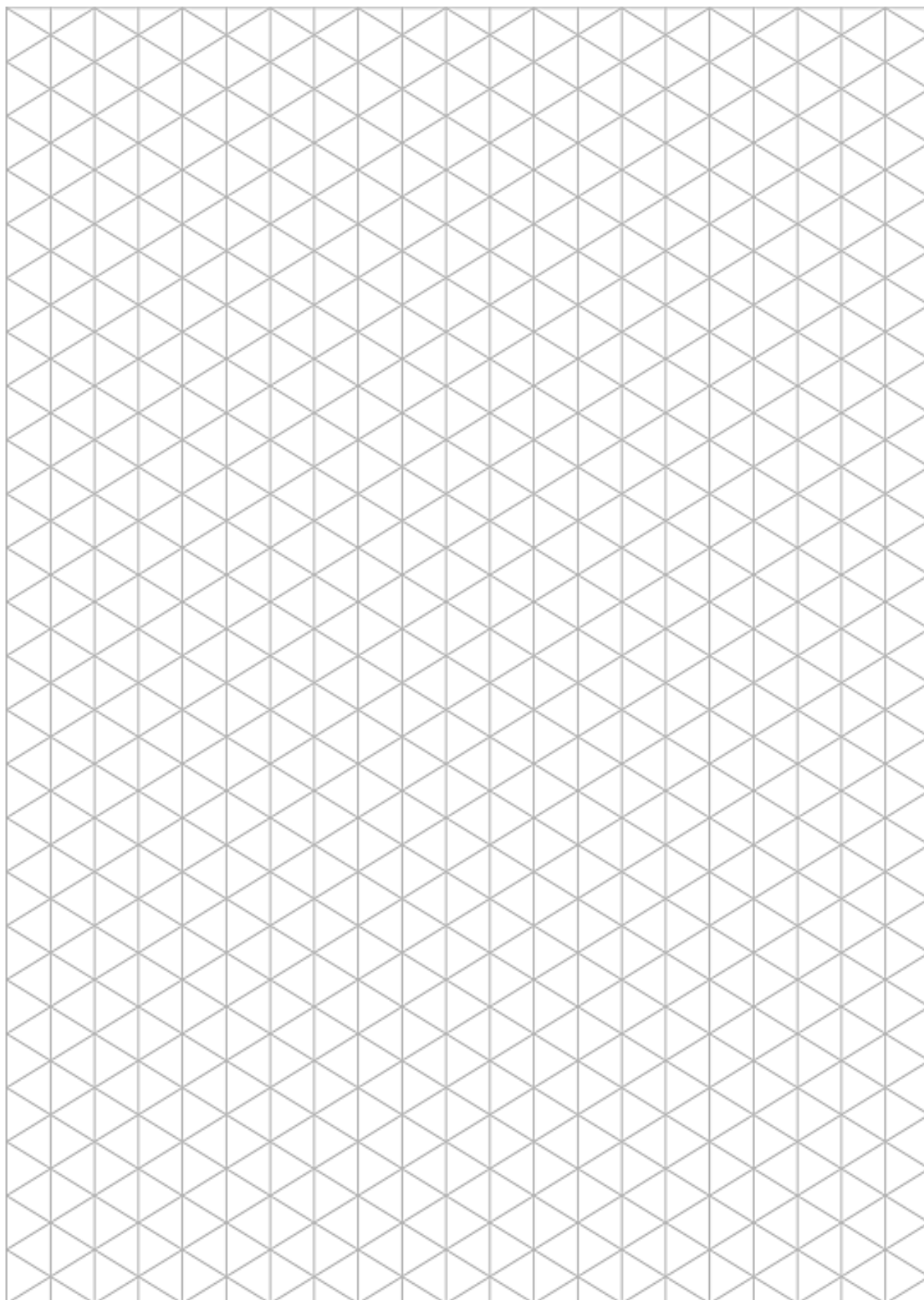






8.1.2 Medicine box

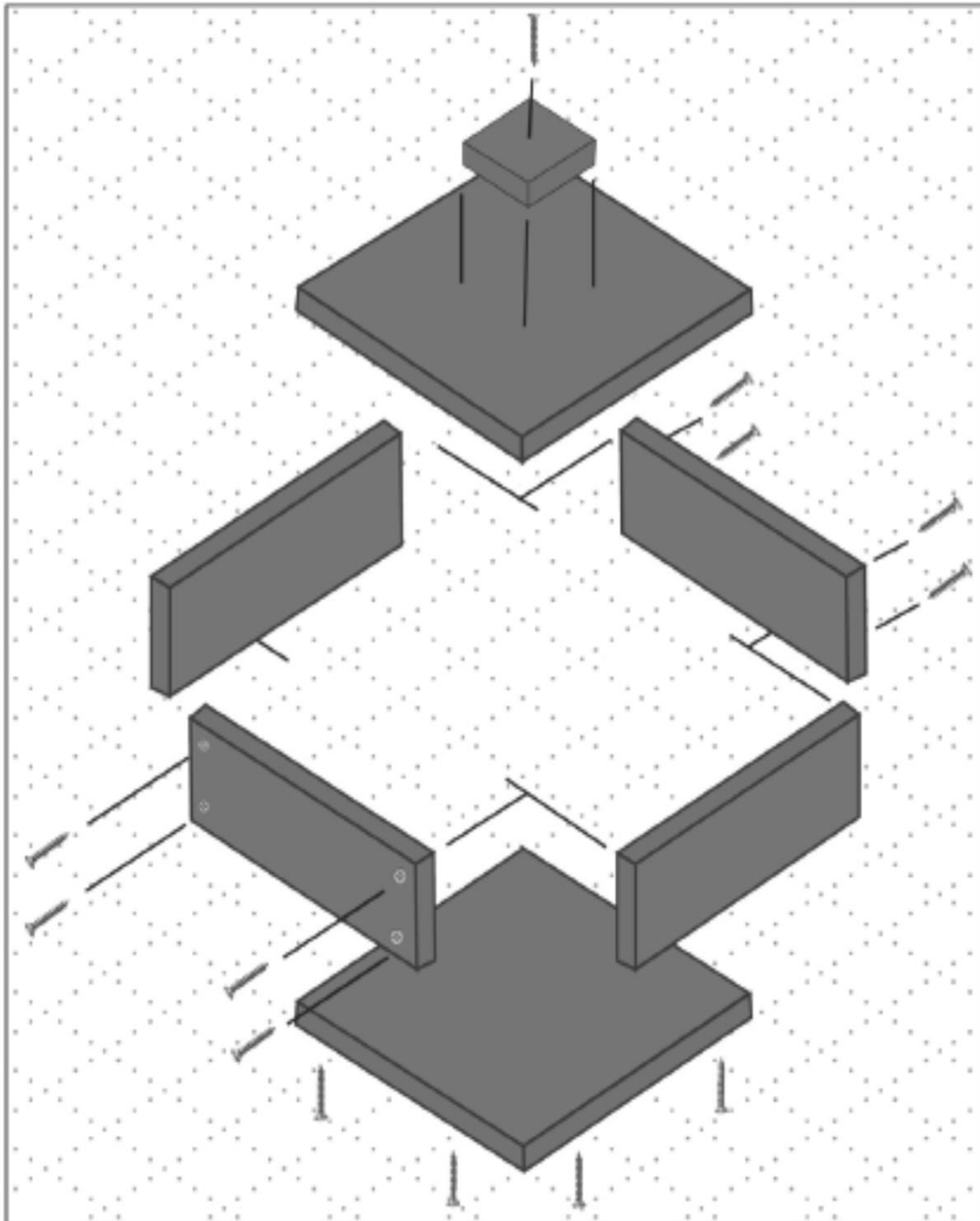






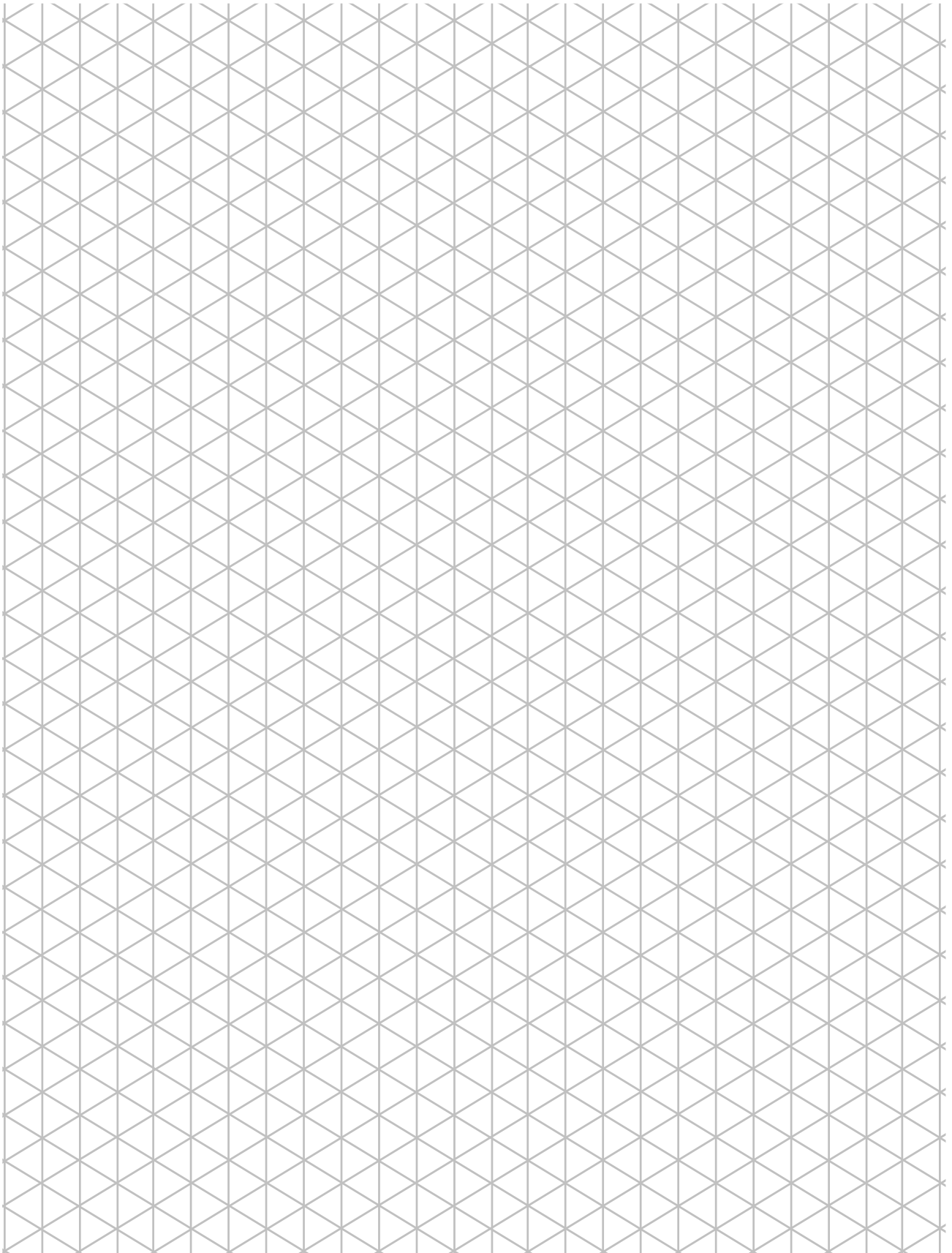
8.1.3 Create design ideas in exploded view.

- Draw the different surfaces and mark the centre of each surface.
- Mark the exploded view guidelines and copy each surface in exploded view.





- 8.2 Make a freehand drawing in exploded view of the housing structure or a section of the housing structure on the grid provided. Label the different parts of the drawing.





21st Century Skills – Collaboration, Critical Thinking

9.1 DATA COLLECTION

(5)

Build a circuit similar to the circuit diagram drawn in informal activity 2.2.

METHOD

1. Connect a 1.5 V cell, a 220 Ω resistor, an open switch, and an ammeter in series. (Any resistor from 120 Ω to 330 Ω can be used.)
2. Connect a voltmeter in parallel across the resistor.
3. Start with the highest scale on the ammeter and voltmeter to prevent damage.
4. Close the switch briefly and record the voltmeter (V) and ammeter (I) readings.
5. A multimeter may be used to take measurements.
6. Repeat the steps to obtain four additional readings, for example: 3 V, 4.5 V, 6 V, 7.5 V, and 9 V.
7. Record all readings on a table.

NOTE

- AA batteries or torch batteries (1.5 V each) can be used.
- A **PhET simulation** can also be used to build the circuit and take readings:
<https://phet.colorado.edu/en/simulations/circuit-construction-kit-dc-virtual-lab> **OR**
https://phet.colorado.edu/sims/html/ohms-law/latest/ohms-law_en.html
- Set the values of the virtual components to match the real-life values given above.
- Convert milliamperes (mA) to amperes (A) by dividing the value by 1000, when necessary.
- **YouTube videos:**
<https://www.youtube.com/watch?v=WEqu2vxjyFc> **OR**
<https://www.youtube.com/watch?v=Vh3XGz7hgU4>
- If the apparatus is not available, use Ohm's Law to determine the current.
- Rearrange the formula to $I = \frac{V}{R}$ and calculate the current through the 220 Ω resistor.



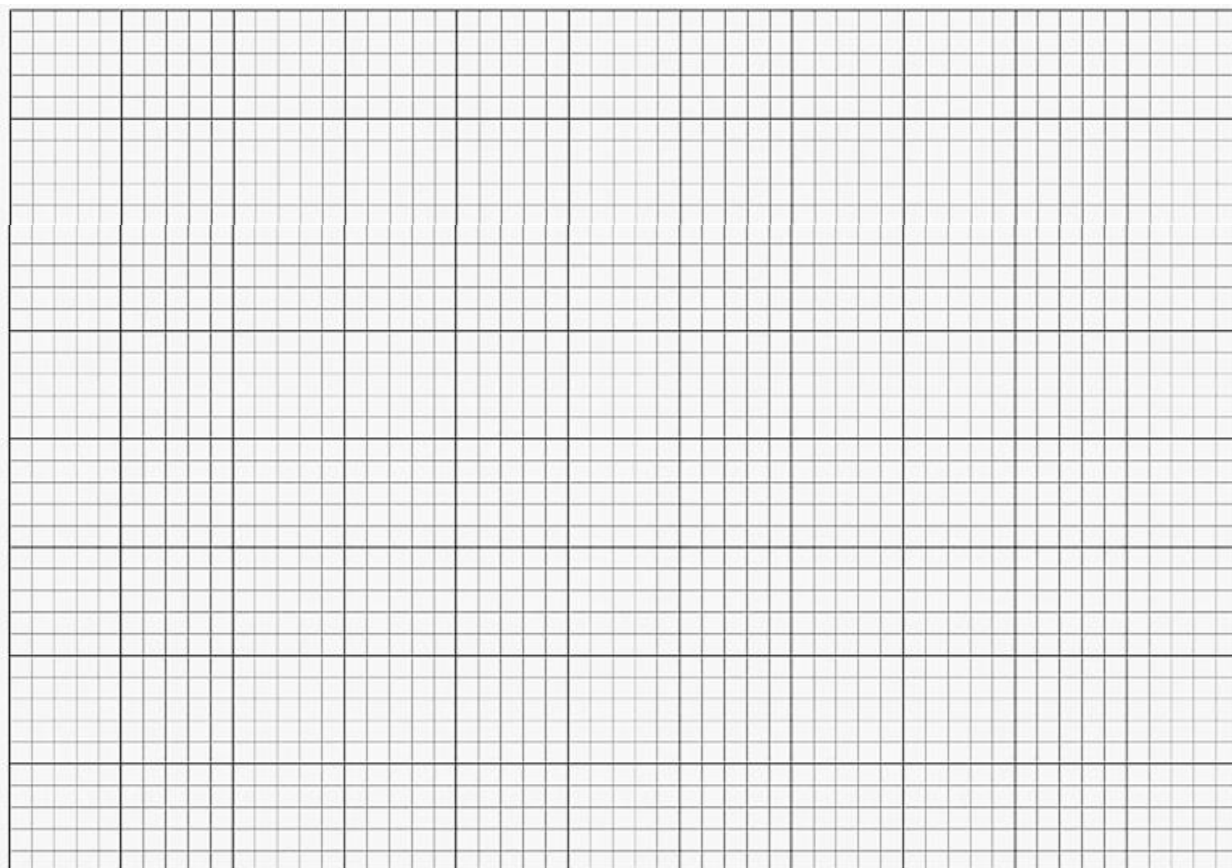
Record the readings taken.

Trial	Voltage, V (V)	Current, I (mA)	Current, I (A)
1	0.0		
2	1.5		
3			
4			
5			
6			
7			

9.2 GRAPH OF CURRENT (I) VERSUS VOLTAGE (V)

(5)

On graph paper, plot the current (I in ampere) on the y-axis and the voltage (V) on the x-axis. Choose a suitable scale, label the axes, give your graph a title, and draw a line of best fit to show the overall trend in your data.



**9.3 ANALYSIS & CONCLUSION****(5)**

9.3.1 What is the shape of the graph?

9.3.2 Describe the relationship between voltage (V) and current (I) as shown in your graph.

9.3.3 State Ohm's Law in words.

9.3.4 Write Ohm's Law in symbols and explain each symbol.

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?

[15]

Worksheet 9A – Natural Sciences MARKING RUBRIC



NATURAL SCIENCES MARKING RUBRIC WORKSHEET 9A

[15]

WORKSHEET MARKS – WORKSHEET 9A					
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 (2) V-I relationship correctly; (3) states Ohm's law correctly in words and (4) in symbols; (5) evaluates the hypothesis with justification; (6) explains why a resistor is needed in series with an LED; (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)



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 $5\ \text{A}$. 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)



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.

FROM

LTech Stationary
2 Sesame Street, Rivonia
Sandton, Johannesburg,
2100, South Africa

LTECH

QUOTE

TO

Customer Name
Customer Address 1234
CA 12345

Quote #: 0000001
Quote Date: 16/08/2026
Due Date: 29/08/2026

ITEM No	Description of Item	QUANTITY	Unit Price (including VAT)	Amount
1	Battery holder	4	.....	R336,00
2	Glue Sticks 100g	.....	R59,00	R295,00
3	LED (pack of 100)	1	.....	R352,00
4	Glue Gun	1	R169,00	R169,00
5	Battery Pack of 4 (Duracell)	2	R96,00	.....
6	Buzzer	1	R26,95	R26,95
7	Connecting wire per meter	1	R5,00	R5,00
8	Resistors	2	R12,35	.....
9	Acrylic Poster Paint (6 colours included)	2	R225,00	.....
10	Cardboard (2m x 2m)	1	R25,88	R25,88

TERMS AND CONDITIONS

Payment is due within 14 days of project completion.

Thank you for your business!

VAT charged	.....
Total	.....



- 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)
- c) How much VAT, at 15%, was paid in total? (3)

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ACTIVITY 2: INDIVIDUAL WORK

(8)

- 2.1 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)

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Worksheet 10: MATHEMATICS [FORMAL ASSESSMENT]



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

TECHNOLOGY INSTRUCTIONS:

- Use the identified materials to construct your device/scale model / prototype/working model.
- The device must clearly demonstrate a practical and workable solution to the identified problem. It must be built on an appropriate scale, be neat and well-finished, and reflect thoughtful and efficient use of the available materials.
- The model must be safe to handle and operate, and all components should function correctly according to the intended design.

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

WORKSHEET 10					
ITEM	EXCELLENT (5)	GOOD (4)	ADEQUATE (3)	POOR (1-2)	OUT OF 5
Model of circuit construction in the scale model / prototype of the alarm system	• Exceptional understanding. • Circuit is fully functional, neat, and creatively constructed. • All components correctly connected and working. • Model/scale 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. • Scale model / prototype shows solid effort. • All group members participated.	• Circuit is mostly correct and functions with minor issues. • Components are connected but may lack neatness or accuracy. • Scale model / prototype is complete. • Most group members contributed.	• Circuit does not work or components are incorrectly connected. • Model/scale model/ prototype incomplete or poorly assembled. • Learners required significant help and motivation. • Minimal contribution from group members.	(5)



21st Century skill: Critical Thinking & Collaboration & Metacognition

GROUP PRESENTATION

12.1 Each group must prepare a presentation on the Integrated Project to present it to a panel consisting of the group leaders from each group.

EVALUATION PANEL

- All group leaders will serve as members of the evaluation panel.
- When a group is presenting, their own group leader may not serve on the panel for that presentation to ensure fairness and avoid bias.

TIME LIMIT

- Each group presentation must be completed in **5 minutes or less**.
- Groups should plan and practice to stay within the time limit.

ASSESSMENT PROCESS

- Each panel member must complete the evaluation checklist while listening to the presentation.
- After the checklist is completed, panel members will provide constructive and encouraging feedback to the presenting group.
- Feedback should highlight strengths and suggest areas for improvement.

CHECKLIST TO ASSESS THE GROUP PRESENTATION

Description / Guiding Questions	COMPETENT Criteria were fully met/ achieved	SATISFACTORY Criteria were Partially met/ achieved	NEED IMPROVEMENT Presentation unclear/ incomplete/ shows minimal understanding
Professional & Engaging Opening: Did the group introduce themselves clearly? Was the tone confident and were roles (even loosely) defined to establish who is presenting which section?			
Context & Justification: Which specific problem or scenario was chosen? Was the reason for choosing this scenario explained clearly? (Connects to IDMEC: Clarify the Problem)			



Description / Guiding Questions	COMPETENT Criteria were fully met/ achieved	SATISFACTORY Criteria were Partially met/ achieved	NEED IMPROVEMENT Presentation unclear/ incomplete/ shows minimal understanding
Methodology & Logic: Did the group effectively explain the steps they followed using the IDMEC (Investigate, Design, Make, Evaluate, Communicate) framework? Was the design process logical?			
Concept to Draft: Was there clear evidence of initial brainstorming? Did the presentation showcase sketches and how they evolved into the final design? (Connects to IDMEC: <i>Investigate & Design</i>)			
Material & Form: How well was the physical design of the housing explained? Did they justify why they chose specific materials or shapes (e.g., durability, aesthetics, weight)?			
Working Model: Can the group explain the general functioning of the working scale model? Does it address the problem identified in design?			
Critical Reflection: Did the group present the challenges they faced? More importantly, did they explain the improvements and modifications they made to overcome them?			
Pacing & Confidence: Did the presenter(s) speak clearly and confidently? Was the presentation well-rehearsed and strictly within the 5-minute time limit?			

**21st Century skill: Metacognition & Collaboration**

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

What did you learn doing this project...

- 13.1 Think about the electronic circuit in your project. Describe a specific problem you encountered with it (e.g., it did not work, a connection was loose) and explain the steps you took to identify and fix the problem.

- 13.2 Identify a moment during the project when you felt frustrated or wanted to give up. What caused this feeling, and what did you personally do to push through and complete the task?

- 13.3 Describe a skill you discovered you have, or a skill you improved, while working on this project. It could be a practical skill (like soldering or using a tool) or a personal skill (like patience, explaining an idea, or leading a part of the task).

- 13.4 Look back at the work you did for Technology, Natural Sciences, and Mathematics. Choose one subject and explain exactly how a fact or skill you learned in that class became useful while building your project.



- 13.5 Think about a mistake you made during the project, either by yourself or with your group. What did you learn from that mistake, and what did you do differently afterwards?

- 13.6 Describe the part of the project that felt the easiest or most natural for you. Was it drawing the designs, doing the calculations, building the structure, or something else? Explain why you think it came easily to you.

- 13.7 If you had to start this project from the beginning, knowing what you know now, what is the one thing you would do differently, and why?

- 13.8 Imagine a younger learner who will do this project next year. What is the most important piece of advice you would give them based on your experience?

- 13.9 Think about your contribution to the group. Describe one specific way your effort helped the group move forward or solve a problem.

- 13.10 The project asked you to solve a problem. Think about your daily life at home or in your community. Name one new problem you would like to solve with an electronic device and explain what your device would do.
