GEC INTEGRATED GRADE 9 PROJECT
TEACHER'S PROJECT NOTES

3 ENTREPRENEURSHIP

EMPLOYABILITY

EDUCATION

PROJECT-BASED LEARNING | TECH, MATH & NS

basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Read to Lead
A Reading Nation is a Leading Nation

NDP 2030

GRADE
2025
9

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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 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-E³ team

basic education

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3 **ENTREPRENEURSHIP**

EMPLOYABILITY

EDUCATION

Project summary

Revise your knowledge on electrical circuits, learn more about resistance in circuits and use this new knowledge to research, design and build a simple device that solves the problem for one of these two scenarios

1. Amy works in a small clothing shop and she loves to read. She often gets so engrossed in her book that she doesn't notice when clients enter the store. Help Amy to build a small door alarm that sounds a buzzer when clients enter.
2. Khotso sometimes looks after his sick grandmother in the afternoons. When he plays soccer with his friends outside the house, he cannot hear when she calls for him. Please help him to create a calling bell so he can hear his grandmother calling him when she needs him.

Present your solution to an audience. Explain your output using graphs and calculated values.

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 particular 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.

Project-based Learning

Thinking | Connection | Character

PART 1 — EXPLORING THE WORLD (INQUIRY-BASED LEARNING)
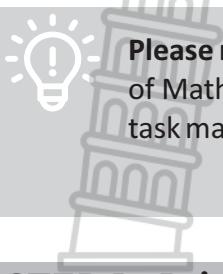
Please note: This project covers 100% of the Technology third term task mark (70 marks), 50% of Mathematics third term task marks (50 marks) and 50% of the Natural Sciences third term task marks (30 marks).

STEP 1: Prior knowledge

Think about what you already know

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?

1.1 (+NS +TECH) Learners start with Circle Map on **Worksheet 1**: They list the electronic components used in the different appliances in the provided space

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+TECH) Now is the time to revise what learners know/have learnt about circuits. Learners use the circuit drawing on **Worksheet 2** to add labels to the items they already recognize.

2.2   (+NS+TECH) Items 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   (+TECH) This is a good time to introduce new knowledge and practice investigative skills. On **Worksheet 3** learners study the electronic/electrical components in the left column, draw the symbol and give the function of each component in the space provided.

STEP 3: Order

Order and categorise your existing knowledge

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

21ˢᵗ century skills to look out for
In this step, learners order and make sense of information and knowledge that emerged in the previous two steps.
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, 1.2 Evaluating ideas/information, 1.3 Identifying patterns.*

3.1   (+NS) Learners use **Worksheet 4** to formulate an investigative question and hypothesis for the project.

STEP 4: Apply

Apply your knowledge to your context (driving question)

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

21ˢᵗ century skills to look out for
In this step learners use knowledge to answer the driving question.
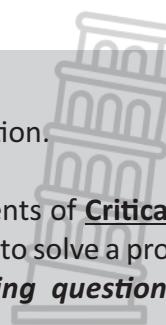
In this step, you may have the opportunity to observe elements of __Critical Thinking__. Critical thinkers ask questions, find the right information, and apply it to solve a problem. Some of the sub-skills that make up critical thinking include *1.1 Asking questions, 1.2 Evaluating ideas/information, 1.3 Identifying patterns.*

4.1   (+NS+TECH) Learners study the two scenarios. They choose one of the scenarios to work on.

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 recognises 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 5**, **5.1** Learners 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: Explore

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   (+NS) Groupwork. On **Worksheet 6a** learners note the decisions the group must make and/or problems they need to solve to build their device.

6.2   (+TECH) Learners use **Worksheet 6b** to require and practice new knowledge, calculate values in circuits, and solve everyday problems by applying their knowledge.
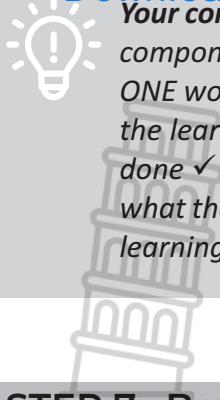
Your concern: It might concern you that your learners might not have access to these electrical components or even recycled/second-hand sourced ones. This should not matter. Even if there is ONE working example of each device that you can build and use to demonstrate to all classes, the learning experience 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.

STEP 7: Brainstorm*

Brainstorm as many solutions to your problem as possible

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) Groupwork. Using the criteria in **Worksheet 7**, learners analyse and evaluate their individual designs according to the requirements mentioned in the scenario. They suggest improvement and select a final idea which they will build.

7.2   (+TECH) Learners use the space (**Worksheet 7: 7.3.1**) to make an exploded view of the housing structure to show how the model fits together.

7.3   (+MATH) Groupwork. This is a great opportunity to introduce practical mathematics and how it will help solve the research problem, or aspects of it. Learners use **Worksheet 8a: Activity 1** to work on pricing of components. Activity 2 and 3 (**Worksheet 8a**) is individual work.

7.4   (+MATH) Learners now continue to **Worksheet 8b**. In groups, they study ohm's law and use it in follow-up calculations. They plot points on a linear graph and interpret the graph according to the worksheet questions.

7.5   (+MATH) (+MATH) In groups, learners use **Worksheet 8c** to design a housing structure for similar models and they calculate surface area.

7.6   (+NS) Learners use the calculations they have practiced in ohm's law (MATH worksheets) to complete **Worksheet 9** on their own. Please note, if they can use the real values on their built circuits, it would be perfect. But some values are provided to assist in calculations where learners do not have access to a multimeter/ammeter/voltmeter

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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 In this step learners can present their ideas to a panel of Technology, Natural Science and Mathematics teachers. They are seeking feedback on their viability of working design, design presentation, calculated values and graph presentations.

8.2 The panel uses **Worksheet 11** to give feedback for iteration.

PART 3 DESIGNING THE FUTURE
(DESIGN-BASED LEARNING)

STEP 9: Evaluate

Evaluate and select your best solution

Purpose of this step: Look at the best solution for the problem/choose the best option.

> **21ˢᵗ century skills to look out for**
> In this step, learners determine the best solution to their chosen problem. In this step, you may have the opportunity to observe elements of **Metacognition.**

9.1 All feedback is considered, and small adjustments are made to parts of the plan where necessary.

9.2 Learners also finalise their plans before they start building their product.

STEP 10: Prototype

Make the prototype of your best solution

> **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.**

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

10.1 Learners build their device/circuit with real components (or create mock components from recycled material). They use the instructions on **Worksheet 10**. Please also make the build rubric available to them.

10.2 Learners test their product (if they are building the real one).

10.3 Learners build a housing for the device.

Project-based Learning

Thinking | Connection | Character

STEP 11: 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.**

11.1 Learners show their prototypes (the actual build, not only plans) to members of their family, or community who would be able to give real feedback *Worksheet 12.*

11.2 They make the final changes as per feedback and practice their presentation.

STEP 12: Integration

Integration in The MADD Space – present your work using Music, Art, Drama, Dance

Purpose of this step: To iterate learning in a fun way, but also an opportunity for another creative arts assessment activity if the activity is designed by your Creative Arts colleague.

21st century skills to look out for
In this step, learners will present their work using, Music, Art, Dance, or Drama. In this step, you may have the opportunity to observe elements of **Creativity** and **Collaboration.**

12.1 Groups can choose to create their own composition (song, rap song, etc.) to use during the demonstration of their device.

STEP 13: Present

Public exhibition

Purpose of this step: Present and celebrate the products

21st century skills to look out for
This step might present an opportunity to observe elements of **Communication, Collaboration** and **Metacognition.**

13.1 At this event (which can be an exhibition in class or in the school hall/library) learners exhibit their device.

13.2 They present their process, actual product and calculations as a group (they can take turns to present parts of it).

13.3 Learners interact with members of the audience (parents, teachers, other learners, even community members) to demonstrate their product.

13.4 Learners take time in class after the public exhibition to reflect on their experience of the project. They use *Worksheet 13* for this reflection.

Assessment rubrics

GRADE 9 INTEGRATED PROJECT – NATURAL SCIENCES RUBRIC   **30 MARKS**

NOTE TO TEACHERS:
First revise the scientific investigative skills regarding investigative question, hypothesis, variables, and conclusion.
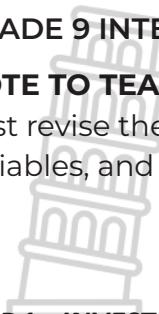
WORKSHEET 4:

STEP 1 – INVESTIGATIVE QUESTION

Possible answers:
What is the effect of <u>increasing the number of cells in series</u> on the <u>output-power</u> / <u>loudness of the buzzer</u>?
OR
How will the <u>number of cells in series</u> affect the <u>loudness</u> / <u>output-power</u> of the buzzer?

Step 1 Marking criteria Assess the INVESTIGATIVE QUESTION developed by the learner	
The independent variable is mentioned (Number of cells in series)	/ 1
The dependent variable is mentioned (Output-power **OR** Loudness)	/ 1
A QUESTION is asked about the RELATIONSHIP between the variables	/ 1
SUBTOTAL	**/ 3**

TRANSFER THE MARK OUT OF 3 TO THE MARKING RUBRIC

STEP 2 – HYPOTHESIS:

Possible answers:
If the <u>number of cells in series</u> increases, <u>then</u> the <u>output-power</u> of the buzzer will also increase.
**OR**
If <u>more cells are connected in series</u>, **then** the <u>buzzer will be louder</u>.
(NOTE: The learner will evaluate the hypothesis in STEP 5, when the conclusion is formulated.)

Step 2 Marking criteria Assess the HYPOTHESIS developed by the learner	
BOTH variables are mentioned (Number of cells in series; Output-power **OR** Loudness)	/ 1
A RELATIONSHIP between the variables must be indicated.	/ 1
SUBTOTAL	**/ 2**

TRANSFER THE MARK OUT OF 2 TO THE MARKING RUBRIC

Project-based Learning   Thinking | Connection | Character
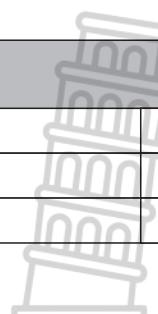
Assessment rubrics

GRADE 9 INTEGRATED PROJECT – TECHNOLOGY RUBRIC   **70 MARKS**

WORKSHEET 3:

Worksheet 3   Formal   Investigation (15 marks)

Component	Name of component	Symbol	Function
3.1	Resistor		Is a component that limits or regulates the flow of electrical current in a circuit/ can also use to provide a specific voltage for an device such as a transistor
3.2	Switch		To make or break the electric circuit/ to turn current on or off in an electrical appliance
3.3	LED		It produce light when current flows through it/ converts voltage into light
3.4	Buzzer		A buzzer is a device that makes a sound/ creates an audible tone when the circuit is complete/ switch is on in the form of a buzzing or a beeping sound
3.5	Transistor		Transistors regulates or control current or voltage/ it amplify the electric current in a circuit which produce a higher output electrical current

Assessment rubrics

WORKSHEET 5

WORKSHEET 5.1 - DESIGN BRIEF

Scenario 1:
I am going to design/ build:
A housing structure✓ for a small door alarm that sounds a buzzer✓ and indicates a LED when✓ clients enter the shop.

(3)

OR

Scenario 2:
I am going to design/ build:
A housing structure✓ that he (Khotso) can hear and✓ see when his grandmother calls him ✓ when she needs him.

(3)

WORKSHEET 5.2 - SPECIFICATIONS

The structure must make a noise; ✓ the LED must go on when someone enters the shop; ✓
The structure house should protect the components of the electronic circuit ✓
the structure must not exceed 150mmx100mmx20mm; ✓

(any three)   (3)

WORKSHEET 5.3 - CONSTRAINS

- the cost of the structure must not exceed R50
- The electronic components should be securely attached to the base board ✓
- The batteries should be replaced easily ✓

(any two)   (2)

Project-based Learning   Thinking | Connection | Character

12

Assessment rubrics

WORKSHEET 5.4 - DRAWING OF THE CIRCUIT DIAGRAM
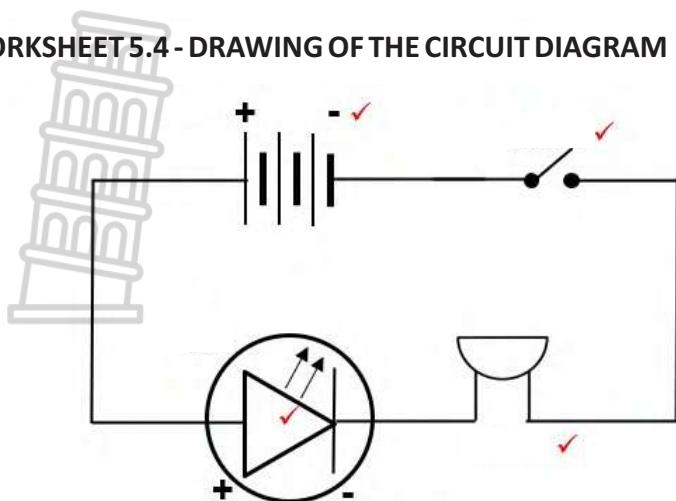
	Marking criteria Draw a final circuit diagram	Marks
Design	All components are connected in series ✓	/ 2
	LED connected correctly ✓	
Labelling	Buzzer present and labelled correctly ✓	/ 3
	LED present and labelled correctly ✓	
	Cells or battery and open or closed switch (BOTH PRESENT) ✓	
TOTAL MARK		**/ 5**

TRANSFER THE MARK OUT OF 5 TO THE MARKING RUBRIC.
Administered and marked by TECH and the marks shared with the NS teacher.

Project-based Learning

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Assessment rubrics

WORKSHEET 5.5 - RUBRIC TO ASSESS THE CIRCUIT DIAGRAM & FREEHAND SKETCH

Level	Criteria	Marks
1	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 - 1
2	Learners were able to complete the drawing with some labelling and guiding notes although it is not very clear. Drawing is not fully complete. Selection of material and specifications is well presented in the labelling.	2 - 3
3	The drawing is aesthetically pleasing and mostly covers the design specifications with correct labelling and guiding notes that are properly structured. Good selection of material is evident.	4 - 5
4	Drawing is aesthetically pleasing with relevant creativity and covers design specifications completely. The labelling and guiding notes are well explained and fully covers all specification. Well considered (spot - on) selection of material.	6 - 7

Assessment rubrics

GRADE 9 INTEGRATED PROJECT – NATURAL SCIENCES RUBRIC   **30 MARKS**

WORKSHEET 9: STEP 3 - IDENTIFY THE VARIABLES

	Step 3 Marking criteria Identify variables	Marks
Independent variable	Number of cells in series✓	/ 1
Dependent variable	Output-power✓ **OR** Loudness of the buzzer✓	/ 1
Controlled variable	Resistance/Size/Type of the buzzer✓	/ 1
TOTAL MARK		**/ 3**

USE THE RUBRIC TO INTERPRET THE MARK OUT OF 3 TO A MARK OUT OF 5.

WORKSHEET 9: STEP 4 – OUTPUT POWER VS INPUT VOLTAGE; GRAPHICAL REPRESENTATION

NOTE TO TEACHERS:
Do a demonstration experiment to confirm that when the number of cells in series is increased, the loudness of the buzzer also increases.

STEP 4.1 – OUTPUT POWER VS INPUT VOLTAGE (CALCULATIONS)

Calculations of current (I) and power (P) to complete the table.

Input-voltage, V (V)	$I = \frac{V}{R}$ (A)	P = VI (W)	Loudness of the buzzer
3 V	$I = \frac{V}{R}$ $I = \frac{3\,V}{20\Omega}$ = 0,15 A	P = VI = 3 V x 0,15 A = 0,45 W	Loud
6 V	$I = \frac{V}{R}$ $I = \frac{6\,V}{20\Omega}$ = 0,30 A	P = VI = 6 V x 0,30 A = 1,80 W	Louder✓ (1)
9 V	$I = \frac{V}{R}$ $I = \frac{9\,V}{20\Omega}$ = 0,45 A	P = VI = 9 V x 0,45 A = 4,05 W	Loudest✓ (1)
TOTAL MARK			**/ 2**

Project-based Learning   Thinking | Connection | Character

Assessment rubrics

STEP 4.2 – GRAPHICAL REPRESENTATION OF THE RESULTS

Explain why the graph should be drawn from the origin, (0;0).

The graph should be drawn from the origin because if the input-voltage (number cells) is zero, there will be no output-power, thus the buzzer will not beep.
OR
For $P = VI$, if $V = 0$ V, then $P = 0$ W.

Graph of the output-power of a buzzer versus the input-voltage
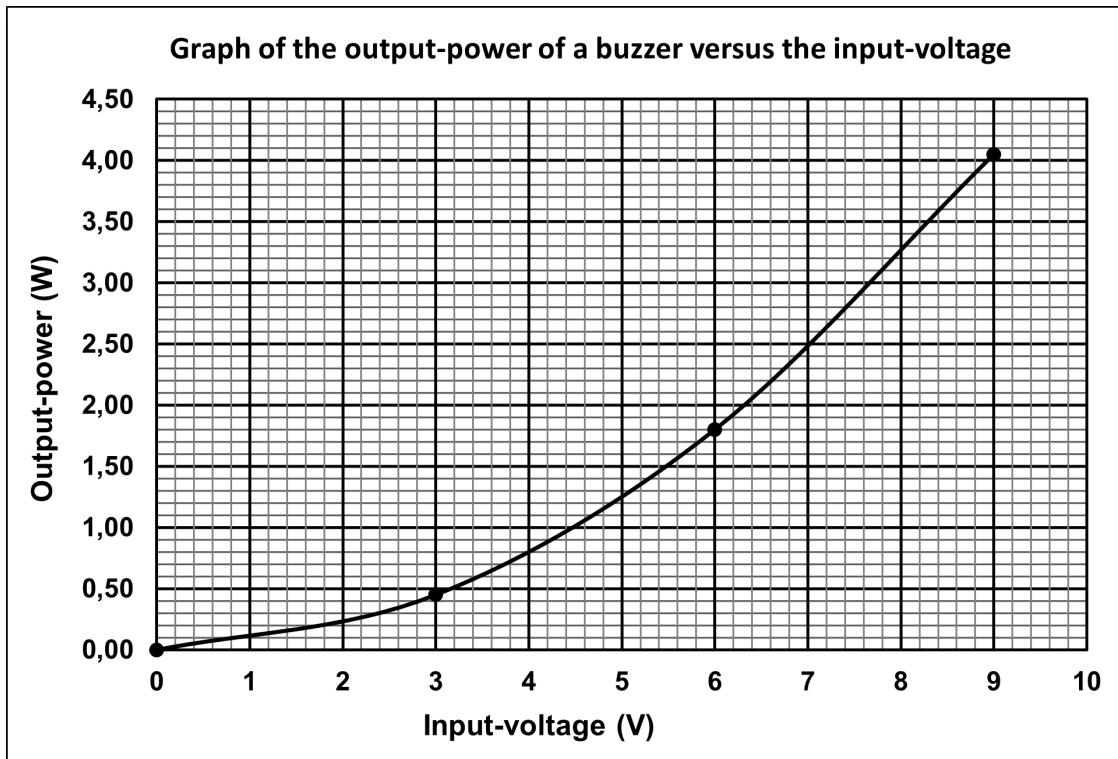
Step 4 Marking criteria Output-power versus input-voltage; Graphical representation	Marks
Award a mark for: Louder✓ Loudest✓ in the table	/ 2
Each of the four points are plotted correctly: (0;0) ✓ (3; 0,45) ✓ (6; 1,80) ✓ (9; 4,05) ✓	/ 4
Line (a curve) of best fit is drawn through the points.	/ 1
TOTAL MARK	/ 7

USE THE RUBRIC TO INTERPRET THE MARK OUT OF 7 TO A MARK OUT OF 5.

Project-based Learning

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Assessment rubrics

STEP 5 – CONCLUSION

Possible answer

The results prove that when <u>more cells are connected in series</u>, the <u>output-power</u> / <u>loudness of the buzzer increases</u>. Therefore, the <u>hypothesis can be accepted</u>.

Step 5 Marking criteria Drawing a conclusion on the relationship between the variables and evaluate the hypothesis	Marks
Hypothesis is evaluated and accepted or rejected.	/ 1
Both variables are mentioned.	/ 2
The relationship between the variables is correctly indicated.	/ 2
TOTAL MARK	**/ 5**

TRANSFER THE MARK OUT OF 5 TO THE MARKING RUBRIC.

WORKSHEET 10: STEP 6 – MODEL OF CIRCUIT CONSTRUCTION / PROTOTYPE / DEVICE

Use the level descriptors in the rubric to assess the circuit construction

Item	Excellent (5)	Good (4)	Adequate (3)	Poor (1-2)	Learner's mark
Step 6: Model of circuit construction	Excellent understanding of circuit construction. Innovative use of found materials to create mock components.	Good understanding of circuit construction. Good use of found materials to create mock components.	Adequate understanding of circuit construction. Could be more creative in the use of found materials to create mock components.	Limited understanding of circuit construction. Unsuccessful use of found materials to create mock components.	/ 5

TRANSFER THE MARK OUT OF 5 TO THE MARKING RUBRIC. **[5]**

SUBTOTAL STEPS 3 TO 6: 20
GRAND TOTAL: 30

Assessment rubrics

GRADE 9 INTEGRATED PROJECT – NATURAL SCIENCES RUBRIC   **30 MARKS**

Worksheet marks	Learner's mark
WORKSHEET 4 (Step 1): Assess the investigative question developed by learner	/ 3
WORKSHEET 4 (Step 2): Assess the hypothesis formulated by learner	/ 2
WORKSHEET 5.4: Draw final circuit diagram (Assessed by TECH)	/ 5
Subtotal Steps 1 and 2	/ 10

Circuit construction and build (WORKSHEET 9: Steps 3 to 5 & WORKSHEET 10: Step 6)					
Item	**Excellent (5)**	**Good (4)**	**Adequate (3)**	**Poor (1-2)**	**Learner's mark**
Step 3: Identify the dependent, independent, and controlled variables.	Independent, dependent, and controlled variables are correctly identified.	Only the independent and dependent variables are correctly identified.	Any two of the three variables are correctly identified.	Only one of the variables is correctly identified	**/ 5**
Step 4: **Step 4.1:** Output-power vs input-voltage. **Step 4.2:** Graphical representation.	Neatly laid out. Axes clearly labelled. All points plotted correctly as well as linked.	Everything was neatly plotted according to calculations, with small errors for example not giving a heading, or could have been neater.	In general, neatly done but due to some calculation errors, the graph is not a true presentation.	Untidy work, wrong calculations, missing the relationship between input-voltage and output-power completely.	**/ 5**
Step 5: Drawing conclusion on the relationship of variables	Hypothesis evaluated and correct relationship between variables stated, including control variables.	Hypothesis evaluated and correct relationship between variables stated,	Correct relationship between variables stated, but hypothesis not evaluated	Meaningful relationship between variables stated but incorrect (2) No valid relationship stated but mentions one variable (1)	**/ 5**
Step 6: Model of circuit construction	Excellent understanding of circuit construction. Innovative use of found materials to create mock components.	Good understanding of circuit construction. Good use of found materials to create mock components.	Adequate understanding of circuit construction. Could be more creative in the use of found materials to create mock components.	Limited understanding of circuit construction. Unsuccessful use of found materials to create mock components.	**/ 5**
Subtotal Steps 3 to 6					/ 20
FINAL MARK					**/ 30**

No	Learner names (Group members)
1	
2	
3	
4	
5	

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Assessment rubrics

GRADE 9 INTEGRATED PROJECT – TECHNOLOGY RUBRIC

70 MARKS

Worksheet marks	
Worksheet 3: Investigation skills	15
Worksheet 5: 5.1, 5.2, 5.3	3 + 3 + 2 = 8

WORKSHEET 5.5:   **RUBRIC TO ASSESS THE CIRCUIT DIAGRAM & FREEHAND SKETCH**

Level	Criteria	Marks
1	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 - 1
2	Learners were able to complete the drawing with some labelling and guiding notes although it is not very clear. Drawing is not fully complete. Selection of material and specifications is well presented in the labelling.	2 - 3
3	The drawing is aesthetically pleasing and mostly covers the design specifications with correct labelling and guiding notes that are properly structured. Good selection of material is evident.	4 - 5
4	Drawing is aesthetically pleasing with relevant creativity and covers design specifications completely. The labelling and guiding notes are well explained and fully covers all specification. Well considered (spot - on) selection of material.	6 - 7

Worksheet 5.5: Subtotal	/ 7

Project-based Learning

Thinking | Connection | Character

Assessment rubrics

GRADE 9 INTEGRATED PROJECT – TECHNOLOGY RUBRIC   **70 MARKS**

WORKSHEET 10   **RUBRIC: MAKE**

Level	Criteria	Marks
1	● Learners could not complete the device / prototype / model. ● Little to no consideration for specifications and constraints. ● Learners and group needed a lot of help and motivation. ● The device / prototype / model does not work at all, and the components were not connected. ● The device / prototype / model was not made to scale. ● Safe working practices were not followed while learners attempt to make the device / prototype / working model.	**1 - 7**
2	● Learners were able to complete the device / prototype / model. ● Some specifications and constraints were adhered to. ● All learners in the group attempted to put in effort to complete the model. ● The device / prototype / model was partially made to scale. ● Evidence of some safe working practices were illustrated while learners attempted to make the device / prototype / working model. ● Model appears acceptable and the components, buzzer/ LED are functioning.	**8 - 17**
3	● Learners were able to build a functional device / prototype / model. ● All specifications and constraints were adhered to. ● The model was neat, the components, buzzer / LED are functioning. ● All learners in the group attempted to put in effort to complete the model. ● Evidence of good safe working practices were illustrated while learners attempted to make the device / prototype / working model.	**18 - 27**
4	● Learners were able to build a functional and creative device / prototype / model. ● All specifications and constraints were adhered to. ● The model was accurately built to scale, the components, buzzer / LED are functioning. ● All learners in the group contributed the necessary effort to complete the model. ● Evidence of excellent safety and working practices were illustrated while learners attempted to make the device / prototype / working model.	**28 - 35**

Worksheet 10: Subtotal	/ 35
FINAL MARK	**/ 70**

Project-based Learning   Thinking | Connection | Character

20

Assessment rubrics

Mathematics ATP covered in project

WORKSHEET #	CONTENT AREA	TOPIC	CONCEPTS AND SKILLS
8A	Numbers, Operations and Relationships	Whole numbers	Calculations with whole numbers and decimal fractions
			Solving problems in financial context such as: • Discount and VAT • Simple Interest • Compound Interest • Rentals
		Decimal fractions	Calculations with whole numbers and decimal fractions
8B	Patterns, Functions and Algebra	Whole numbers	Direct and indirect proportion
		Numeric and geometric patterns	• Investigate and extend numeric patterns represented in tables • Describe general rules for patterns
		Functions and relationships	Justify equivalence represented by: • tables, • equations • by graphs on a Cartesian plane
		Algebraic equations	Solve equations using additive and multiplicative inverses
		Graphs	Determine equations from linear graphs
8C	Space and Shape	Geometry of 2D shapes	Classifying 2 D shapes
		Geometry of 3D objects	Classifying 2 D shapes
	Measurement	Area and perimeter of 2D shapes	Area of polygons and circles
		Surface area and volume of 3D objects	Surface area of rectangular prisms
		the Theorem of Pythagoras	Solve problems using the Theorem of Pythagoras

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Project-based Learning

Thinking | Connection | Character

Assessment rubrics

GRADE 9 INTEGRATED PROJECT – MATHEMATICS RUBRIC　　　　　　**50 MARKS**

	Concepts and skills	5 Marks	4 Marks	3 Marks	0-2 Marks
Worksheet 8a	**Calculations with whole numbers and decimal fractions**	Learner shows great understanding of working with whole numbers and decimal fractions. Completing the table with 0 mistakes.	Learner shows good understanding, making a few (1-3) mistakes in the table.	Learner shows some understanding of the work. Fair number of answers correct (4 – 8) in the table.	Learner shows little or no understanding of the work. Many mistakes in the table.
	Solving problems in financial context such as: • **Discount and VAT** • **Simple Interest** • **Compound Interest** • **Rentals**	Activity 2 and 3 with no mistakes. Learners shows excellent financial maths skills and understanding.	Activity 2 and 3 have a few mistakes. Learner had a good understanding of financial maths, using the correct values and formulae where needed. Even if answers are wrong, the learner still carried it over to the new question as questions expected and understands the terminology used.	Activity 2 and 3 have a fair amount of mistakes. Learner shows some understanding of financial maths. Learner used some formulae correct, carried over values where needed and shows a good measure of understanding of the terminology.	Activity 2 and 3 with many mistakes. Learner struggles with financial maths. Using the incorrect formulae, shows little understanding of the terminology, does not carry over values or make up values and formulae.
Worksheet 8b	**Solve equations by using the inverse operation and substituting**			Learner shows great understanding of substitution and using the inverse operation in activity 1.	Learner struggles to substitute correctly and shows little understanding on the inverse operation in activity 1.
	Investigate and extend numeric patterns represented in tables. **Describe general rules for patterns.**	Learner shows great understanding of the work in activity 2 with zero mistakes.	Learners shows a good understanding of the work in activity 2 with 1 – 7 mistakes.	Learner shows a fair understanding, had to be guided through activity 2, couldn't do it on his/her own. Made 8 – 14 mistakes.	Learner shows little to no understanding for the work in activity 2. Learner made more than 14 mistakes.
	Justify equivalence represented by: • **Tables** • **Equations** • **Graphs on a Cartesian plane**	Learner shows great understating of using the values in a table and to plot on a graph. Learner used appropriate increments on the graph for x and y axis.	Learner shows a good understanding of the plotting of the values on the graph from the table.	Learner struggle to plot values from a table onto a graph or made mistakes with the increments or drawing of the graph.	Learner shows little or no understanding of the correlation between the values in a table and the coordinates on a Cartesian plane.
	Direct and indirect proportion			Learner knows the difference between direct and indirect proportion.	Learner struggles to differentiate between direct and indirect proportion.

Project-based Learning　　　　　　　　　　　　　　　　　　　Thinking | Connection | Character

Assessment rubrics

GRADE 9 INTEGRATED PROJECT – MATHEMATICS RUBRIC

50 MARKS

|					
Worksheet 8c	**Measurements and dimensions**	Learners shows a great understanding of using measurements and dimensions in creating a packaging. Correct height, length and breadth was used. The circle is also on the correct place.	Learners shows a good understanding of using measurements and dimensions in creating a packaging. Only small mistakes were made when using the height, length and breadth. The circle is close to the correct place.	Learner shows adequate understanding of measurements and dimensions. Minor mistakes.	Learner shows little or no understanding of measurements and dimensions in 2D/3D shapes.
	Area of polygons and circles	Learner understands the concept of area and surface area. Correct formulae and substitution for different faces. Minor mistake.	Learner has a good concept of area and surface area of polygons and circles. Few mistakes in formulae of substitution.	Learner shows a fair understanding of the measure and dimensions concept in area and surface area in polygons and circles.	Learner shows little to no understanding of measurement and dimensions in area and surface area. Learners used incorrect formulae and substitution. Left out values or used wrong values.
	Conversions	Learner has an excellent understanding of conversions. Area conversions and conversions between area and volume done without mistakes.	Learner has a good understanding of conversions. Learner used correct methods with small mistakes in calculations.	Learner has a fair understanding of conversions. Used correct methods with incorrect conversion values. Couldn't convert cm^2 to m^2	Learner struggles with conversions and the concepts of area and volume.
	Drawing a 3D prism on scale.	Learner used scale without mistakes.	Learner made a minor mistake or 2.	Learner had a fair idea of what to do and how to use the scale, needed some help.	Learner struggle to use the scale, made no attempt to draw the prism on scale.
	Solve problems using the Theorem of Pythagoras		Learner has an excellent understanding of the Theorem of Pythagoras and how to use it in context.	Learner used the Theorem with some help.	Learner does not know the Theorem of Pythagoras or how to apply it in context.
	Total:	**8a:** /10	**8b:** /16	**8c:** /24	**/50**

Project-based Learning

Thinking | Connection | Character

Worksheet 6b - TECHNOLOGY: [INFORMAL]

Answer the following questions:

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

A — Purple Black Brown Orange

B — Brown Violet Green Orange

C — Yellow Orange Blue Gold
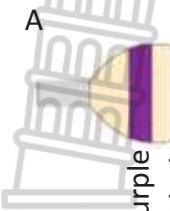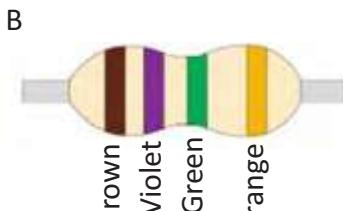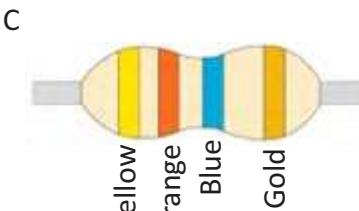
700Ω   **1700 000Ω → 1700 kΩ**   **42 000 000Ω → 42MΩ**

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

A   B   C
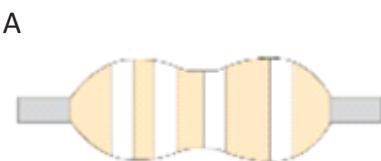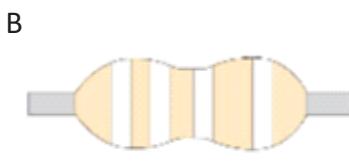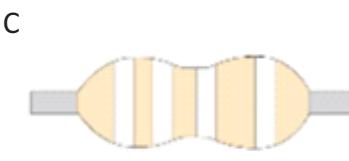
7500Ω   2600kΩ   0,57mΩ

Violet   Green   Red   **Red   Blue   Green**   **Green   Violet   Yellow**

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

$A = 2,5 A$

$R_1 = 4 Ω$ $V = ? V$

V = I x R

= 2.5A x 4Ω
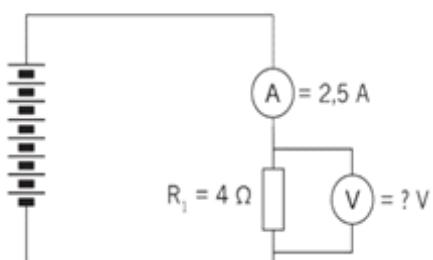
= 10V

4. Calculate the resistance value of the resistor.

$A = 2 A$

6 V battery

$R_1 = ? Ω$ V

$R = \dfrac{V}{I}$

$I = \dfrac{6V}{2A}$

$= 3Ω$

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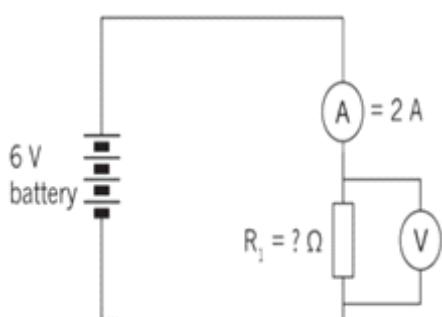
5. If two more cells are added to the circuit, will the current increase or decrease? Check your prediction using the formula.

$I = \frac{V}{R}$

$= \frac{9V}{3\Omega}$

$I_1 = ? A$ = 3A   CURRENT INCREASES

$R_1 = ? \Omega$
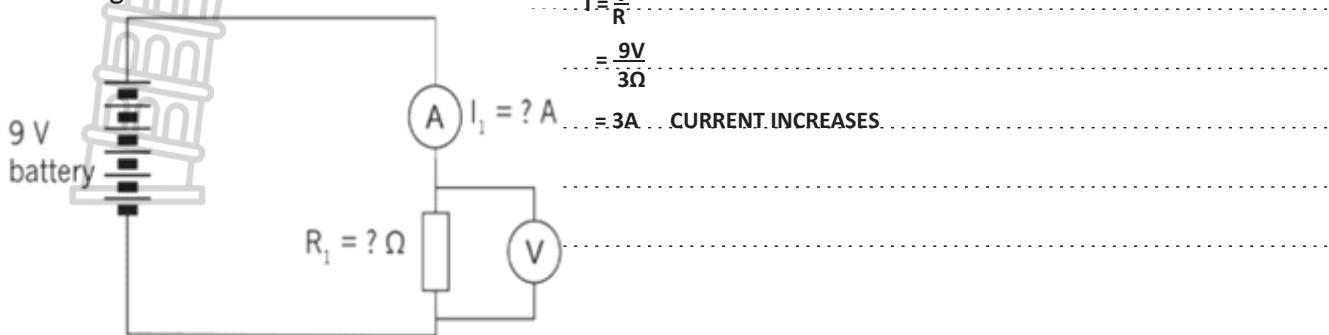
9 V battery

6. Calculate the battery voltage for the circuit below.

? V battery

$A = 0.5 A$

$R_1 = 12 \Omega$

V = I x R

= 0.5A x 12Ω

= 6V

7.

$A = 2.5 A$

$R_1 = 4 \Omega$ $V = ? V$

V = I x R

= 2.5A x 4Ω

= 10V

8.

12 V battery

$A = ? A$

$R_1 = 3 \Omega$ $V = 12 V$

$I = \frac{V}{R}$

$= \frac{12V}{3\Omega}$

= 4A

---
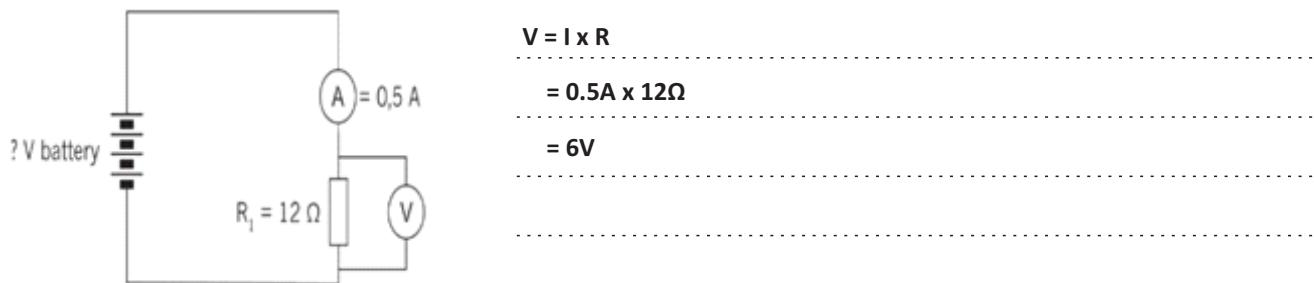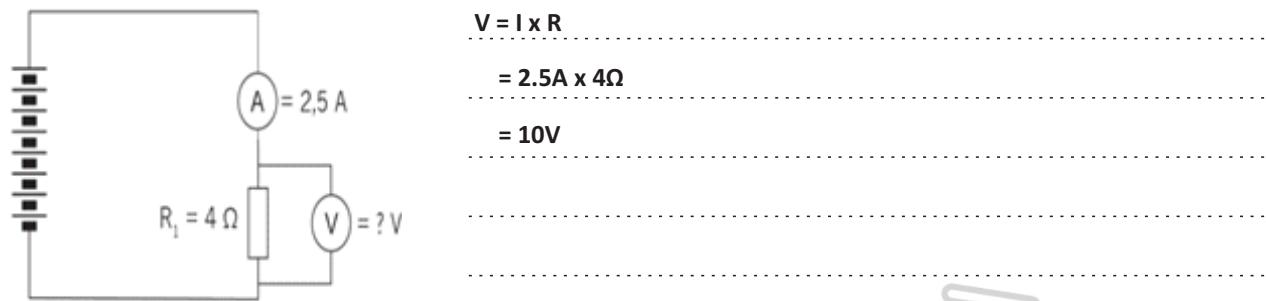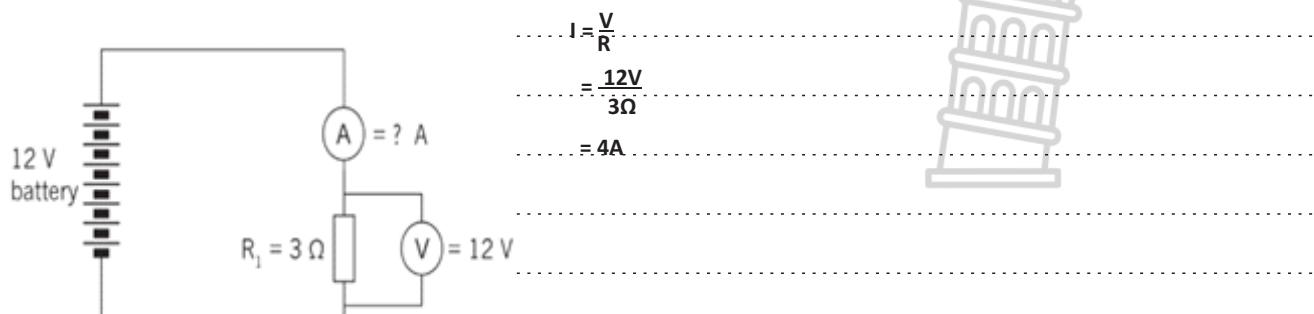
9. Given V = 10 V and R = 1 kΩ, what will the value of the current be in a circuit?

$I = \dfrac{V}{R}$

$= \dfrac{10V}{1000\Omega}$ **NOTE: CONVERT kΩ to Ω**

$= 0.01A$

10. Given V = 20 V and R = 5 kΩ, solve for the current.

$I = \dfrac{V}{R}$

$= \dfrac{20V}{5000\Omega}$ **NOTE: CONVERT kΩ to Ω**

$= 0.004A$

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

$I = \dfrac{V}{R}$

$= \dfrac{220V}{12\Omega}$

$= 18.33\ A$

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

$R = \dfrac{V}{I}$

$= \dfrac{9V}{3A}$

$= 3\Omega$

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

- Diodes are **electronic devices** that are **used to control the flow of current in electrical circuits**.
- A diode allows the **current to flow in one direction only**.
- Diodes are **control devices**.
- A diode is a component with **two terminals that can be connected in a circui**t
- **A silicone diode is mostly used.**
- It is a **semiconductor consisting of 'p-type' and 'n-type, junctions**.
- All diodes are **polar,** so they must be inserted the correct way in a circuit, with the negative pole of the diode to the negative pole of the battery.
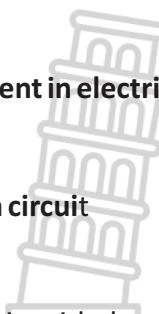
> **Key words**
> - **diodes** – electronic devices that are used to control the flow of current in electrical circuits

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*21st century skills*   Thinking | Connection | Character

Worksheet 6b - TECHNOLOGY: [INFORMAL]

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

- KETTLES
- Tvs
- CD players
- Microwaves
- Remotes of cars, etc

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

- The **cathode (NEGATIVE)** side and
- The **anode (POSITIVE)** side.

- If the **anode** is connected to a **higher voltage** than the cathode, the **current will flow from the anode to the cathode**. This is called **"forward bias"**.

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

Diode

LED
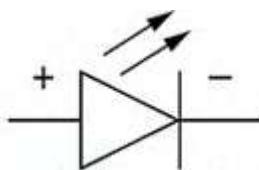
Worksheet 8a - MATHS

Activity 1 : Group work

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

Item No.	Tool / Equipment	Price per item (including VAT)	Number required	Cost
1	Glue Gun	✓✓ R270.00	5	✓ R1 350.00
2	Glue sticks 50g	R 170	✓ 13	R2 210
3	Battery pack of 60 (Penlight batteries)	R 189	5	✓ R945
4	Battery holder	R 15,88	✓ 50	R794
5	LED (pack of 300)	R 199	3	✓ 597.00
6	Buzzer	R14.95	✓ 25	R373.75
7	Connecting wire per m	✓ R2.05	30	R61.50
8	Resistor (pack of 10)	R 7,62	10	✓ 76.20
9	Paint per litre	✓ R73.50	8	R588
	Total			✓ R6 995.45

Glue Gun (VAT Included: R 300 SPECIAL: 10% off)

a) Complete the table by calculating the missing values (amount and quantity where applicable)   (11)

b) What is the total cost of all the items?   (1)

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

Price before VAT:

$$\frac{R6995.45}{1} \times \frac{100}{115} \checkmark$$

= R6 083,00 ✓

VAT Paid: R6995.45 - R6 083,00

= R 912,45 ✓

Worksheet 8a - MATHS

Activity 2: Group work

2.1 The material needs to be delivered to the school. The principal offers to assist but needs to rent a vehicle. You must advise the school principal which option on car rentals is better. Below are the prices for car rentals

Company A

600 km per rental
for 3 days
R 2 847,53

Penalty

20% simple
interest per
additional 200 km

Company B

600 km per rental
for 3 days
R 2 885,73

Penalty

10% simple
interest per
additional 100 km

Company C

600 km per rental
for 3 days
R 3 564,50

Penalty

5% simple interest
per additional 200
km
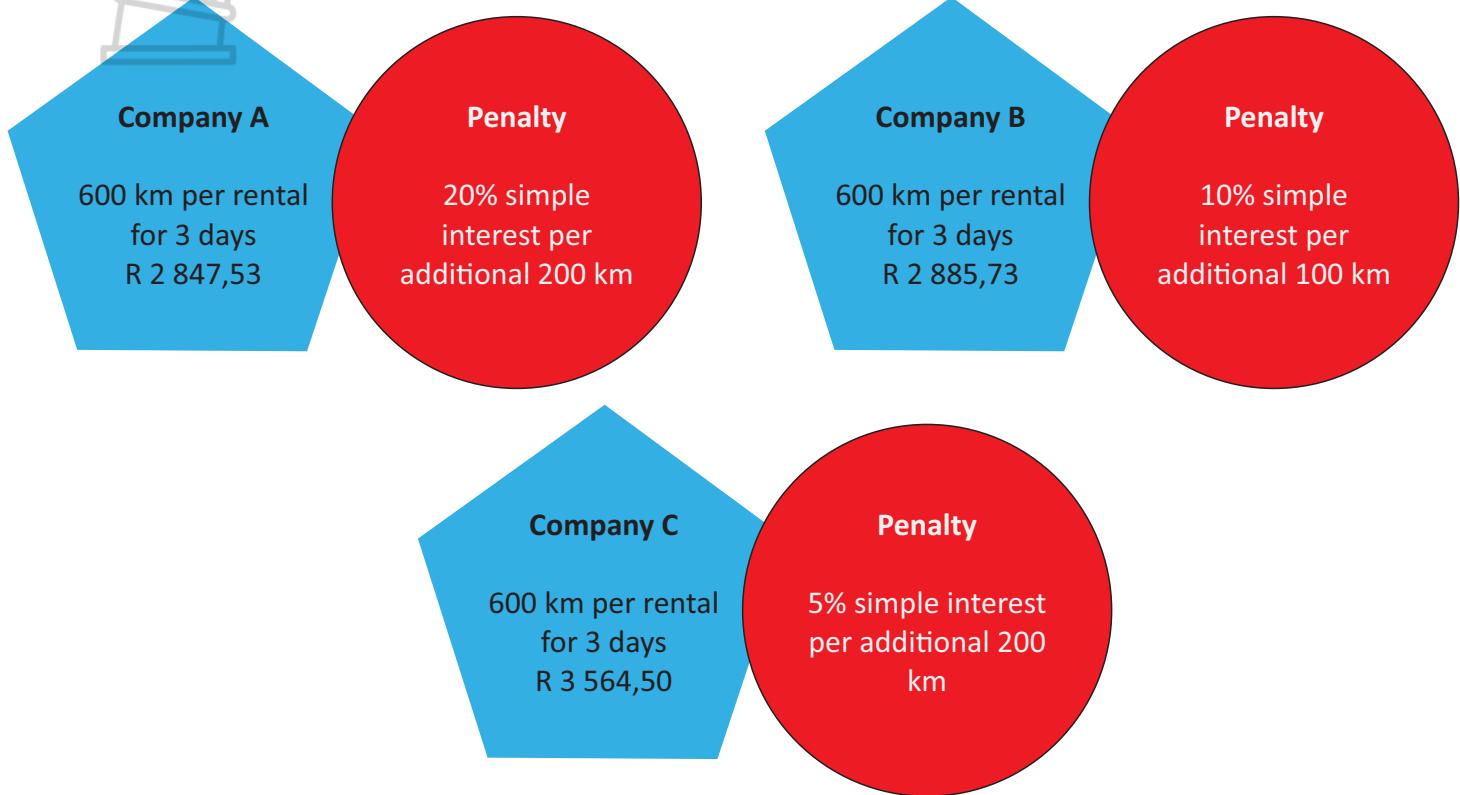
The estimated distance to be traveled is 800 km.

Calculate the costs for each company. Show all calculations

Company A	Company B	Company C
$A = P\left(1 + \dfrac{nr}{100}\right)$	$A = P\left(1 + \dfrac{nr}{100}\right)$	$A = P\left(1 + \dfrac{5}{100}\right)$
$A = 2847,53\left(1 + \dfrac{20}{100}\right)$ ✔ ✔	$A = 2885,73\left(1 + \dfrac{2(10)}{100}\right)$ ✔	$A = 3564,50\left(1 + \dfrac{5}{100}\right)$ ✔
$A = 2847,53(1,2)$ ✔	$A = 288$ ✔ $5,73(1,2)$	$A = 3564,50(1,05)$ ✔
$A = R\ 3\ 417,04$ ✔	$A = R\ 3\ 462,88$ ✔	$A = R\ 3\ 742,73$ ✔
OR	OR	OR
2847,53 x 1,20 x 1 ✔✔ ✔	2885,73 x 0,1 x 2 + 2885,73 ✔ ✔	3564,51 x 1,05 x 1 ✔ ✔
= 3417,04 ✔	= 3462,88 ✔	= 3742,74 ✔
(4)	(3)	(3)

2.2 Which option will you advise the school principal to choose?

Company A ✔

Math

Thinking | Connection | Character

Worksheet 8a - MATHS

2.3 The amount of money you have fundraised as a class is R 1 350 less than the total amount for the material/ equipment, excluding the car hire. How much more money do you need to include the car hire? (4)

Amount Raised = 6995,45 − 1350 = 5645,45 ✓

Total amount required to be raised = 6995,45 + 3417,04 = 10412,49 ✓ ✓

Amount more required = 10412,49 − 5645,45 = 4767,04 ✓

OR

Amount needed: R 1 350 + R 3 417,04 ✓ = R 4 767,04 ✓✓

2.4 Suppose your class teacher offers to get a loan on your behalf for the amount required in 2.3.

a) Calculate the accrued amount if on the loan, if interest is compounded at a rate of 12% per annum over 36 months? (3)

Accrued AMT = 4767,04 (1 + 0,12)³ ✓ ✓

=R 6 697,35 ✓

b) What is the interest amount? (1)

Interest amount = 6 697,35 − 4767,04 = R 1 930, 31 ✓

2.5 What will be the monthly repayment of the amount in 2.4 a)? (3)

Monthly repayment = 6 697,35/36 ✓

= R 186,04 ✓

Math

Thinking | Connection | Character

Worksheet 8a - MATHS

Activity 3: Individual work

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

a) How much money would you require for your second option if the amount of money you have fundraised as a class amounts to R 7 137,45. (2)

Amount required = 7137,45 − 6995,45 + 3462,88 ✓

= R 3 604,88 ✓

b) Simple interest of the amount in 3.1 a) above at a rate of 12% per annum over 2 years if your class teacher offers to get a loan on your behalf. (3)

Simple Interest = 3604,88 x 0,12 x 2 ✓ ✓

= R 865,17 ✓

c) What will be the monthly repayment of the amount in 3.1 b)? (3)

Monthly repayment = (3604,88 + 865,17)/24 ✓ ✓

= 186,25 ✓

Math

Thinking | Connection | Character

Worksheet 8b - MATHS

Activity 1: Group work

1.1 State ohm's law and write the formula down, showing the relation between V (voltage), I (current) and R (resistance). (3)

Current flow through a conductor is directly proportional to the voltage across the conductor if the resistance is constant.

V = IR ✓

1.2 Calculate the following:

a) Calculate the voltage if the current is 6 A and the resistance is 56 Ω. (3)

V = 6 × 56 ✓ ✓

= 336V ✓

b) Calculate the current, if the voltage is 1 350 V and the resistance is 200 Ω. (3)

$I = \dfrac{V}{R}$

$= \dfrac{1350}{200}$ ✓

= 6.75 A ✓ ✓

c) If the current is 8 A and the voltage is 480 V, calculate the resistance. (3)

$R = \dfrac{V}{I}$

$= \dfrac{480}{8}$ ✓

= 60 Ω ✓ ✓

Worksheet 8b - MATHS

Activity 2: Group work

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

Voltage (V)	3	6	9	12 ✓	15	18 ✓
Current(I)	0,5	1	1,5 ✓	2	2,5 ✓	3

a) Complete the table (4)

b) Show that the relationship between V and C is given by I (2)

6/1 = 6   3/0,5 = 6

12/2 = 6   9/1,5 = 6   (Any two)✓✓

18/3 = 6   15/2,5 = 6

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

a) Plot the graph showing the relationship above where V is the *x*-axis and and I is the *y*-axis (6)

X and Y axis calibrated and labelled✓✓
Any two or more points plotted✓✓
Straight line ✓
Straight line passing through 0 ✓

Math

Thinking | Connection | Character

34
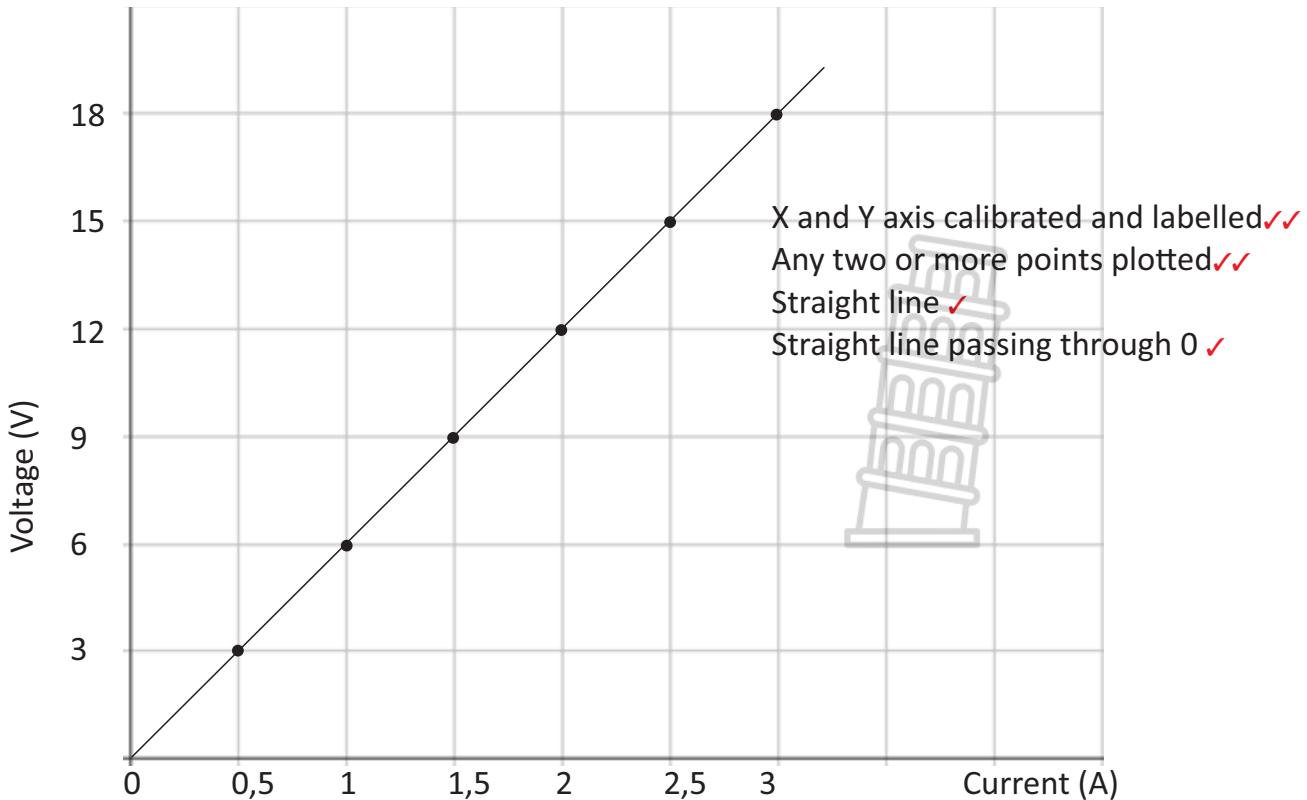
Worksheet 8b - MATHS

b) Is the graph of the relationship between V and I an example of direct or indirect proportion? Justify your answer (2)

Direct proportion ✓

From the graph – as I increases V increases ✓
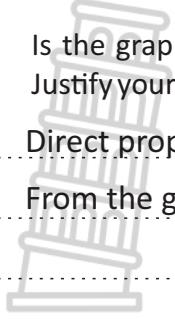
c) Use any two points on the graph to determine the gradient of the graph, hence the equation in the form of $y = mx + c$ (4)

Choose any two points (3,18) & (2, 12)

gradient (m) = 18 - 12 / 3 - 2 = 6 ✓ ✓

y = 6x + 0 ✓ ✓   accept $y = 6x$ ✓ ✓

d) Write V in terms of I by using the equation above? (2)

V = 6 I ✓✓

Math

Thinking | Connection | Character

Worksheet 8c - MATHS

Activity 1: Group work - Design a housing structure for a similar model.

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

They have these prerequisites:
• The faces of the housing structure must be rectangular, and the housing structure must be open on the top for people to easily see the circuitry device.
• One pair of opposite faces of the housing structure must have circular openings that will serve as handles.
• The openings must be on the faces with dimensions of 60 cm by 80 cm.

Consider the following specifications when designing the housing structure:
• The height of the housing structure should be 60 cm.
• The length and breadth of the housing structure is 20 cm more than the height.
• The distance between the circumference of the circular openings and the vertex of the box should be 43 cm.
• The centre of the circle should be at the midpoint of the diagonal.

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

Math

Thinking | Connection | Character
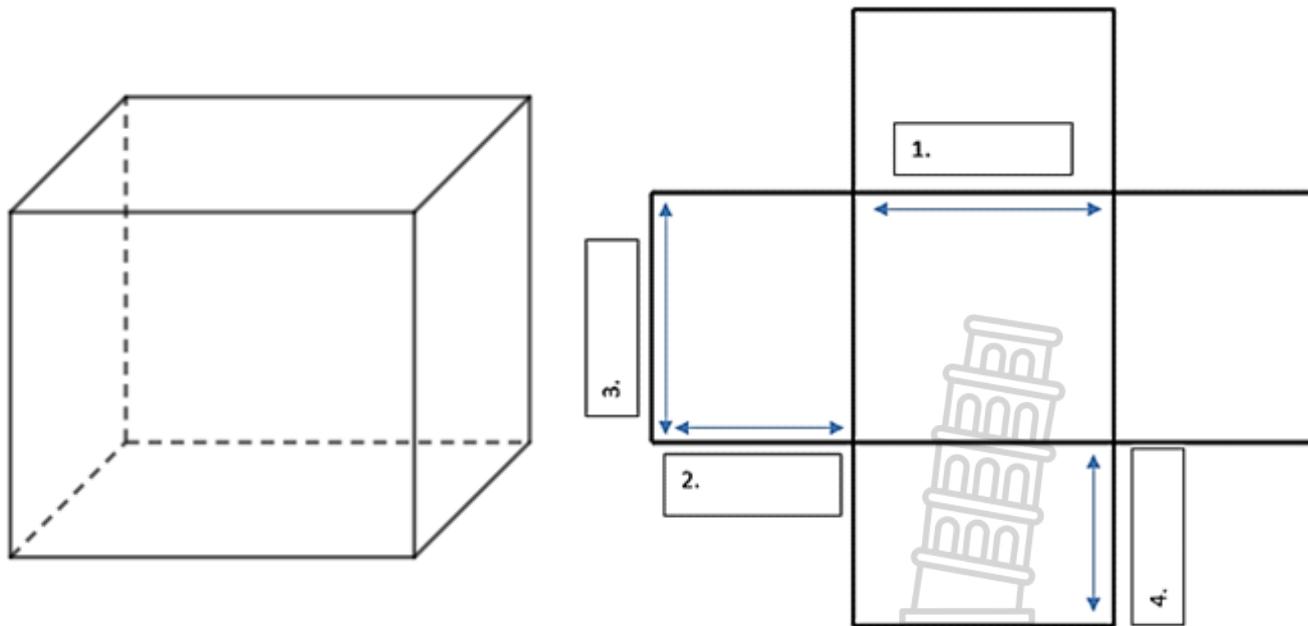
Worksheet 8c - MATHS

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 in the circular openings on the correct sides in the net of the housing structure. Show the dimensions of circle on the sketch. (3)

1. 80 mm

3. 80 mm

2. 60 mm

14 mm

60 mm

4.
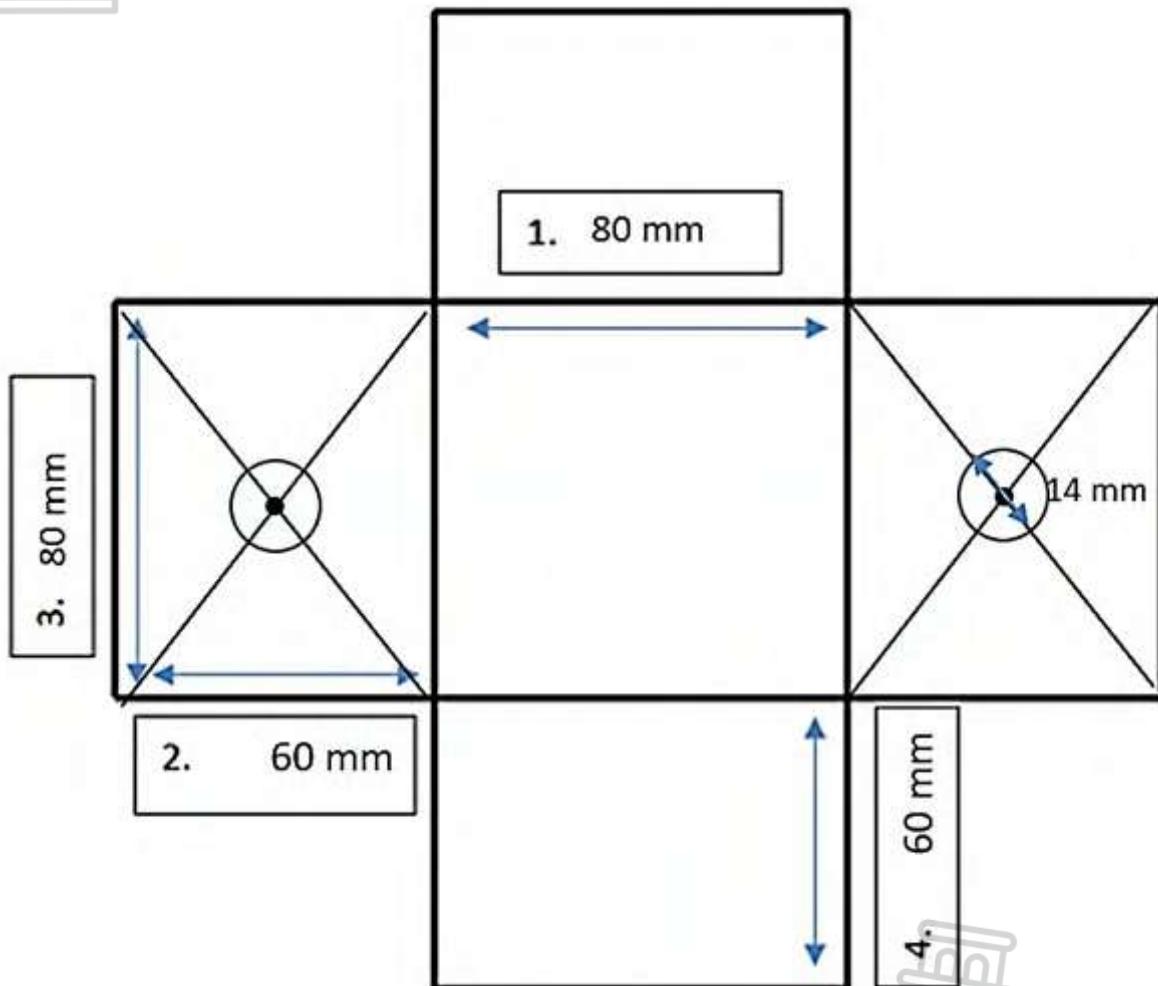
Marking Guidelines:
1. 80 mm ✓
2. 60 mm ✓
3. 80 mm ✓
4. 60 mm ✓

Circles:
Circles on opposite sides ✓
Centre of circle at the intersection of the diagonals ✓
Diameter 14 mm or radius 7 mm ✓ (7)

Math

Thinking | Connection | Character

Worksheet 8c - MATHS

1.2   Calculate the following:

a)   The length of the diagonal of the face containing the circular openings.   (3)

Diagonal $= \sqrt{(80^2+60^2)}$ ✓ [Pythagoras]✓

                $= \sqrt{(6400 + 3600)}$

                $= \sqrt{10\,000}$

                $= 100$ cm   ✓

b)   The radius of the circular openings.   (2)

Distance to the midpoint = 50 cm ✓

Radius = 50-43 = 7 cm ✓

c)   The area of the two circular openings.   (3)

                        ✓ ✓
Area of 2 circular openings = 2 x (22/7) x 7 x 7

                = 308 cm² ✓

d)   The area of the bottom face.   (3)

                        ✓   ✓
Area of bottom face = 80 x 80

                = 6400 cm² ✓

e)   The total surface area of the housing structure. Give your answer in m².   (7)

Area of 4 remaining faces = 4 x 60 x 80 ✓✓

                = 19200 cm²✓

Total surface area = 19200 + 6400 − 308 = 25292 cm²   (100cm = 1 m)

100 cm = 1 m ✓ → 10000 cm² = 1 m² ✓

25292 cm² = 25292/10000 = 2,5292 m² ✓

Math   Thinking | Connection | Character