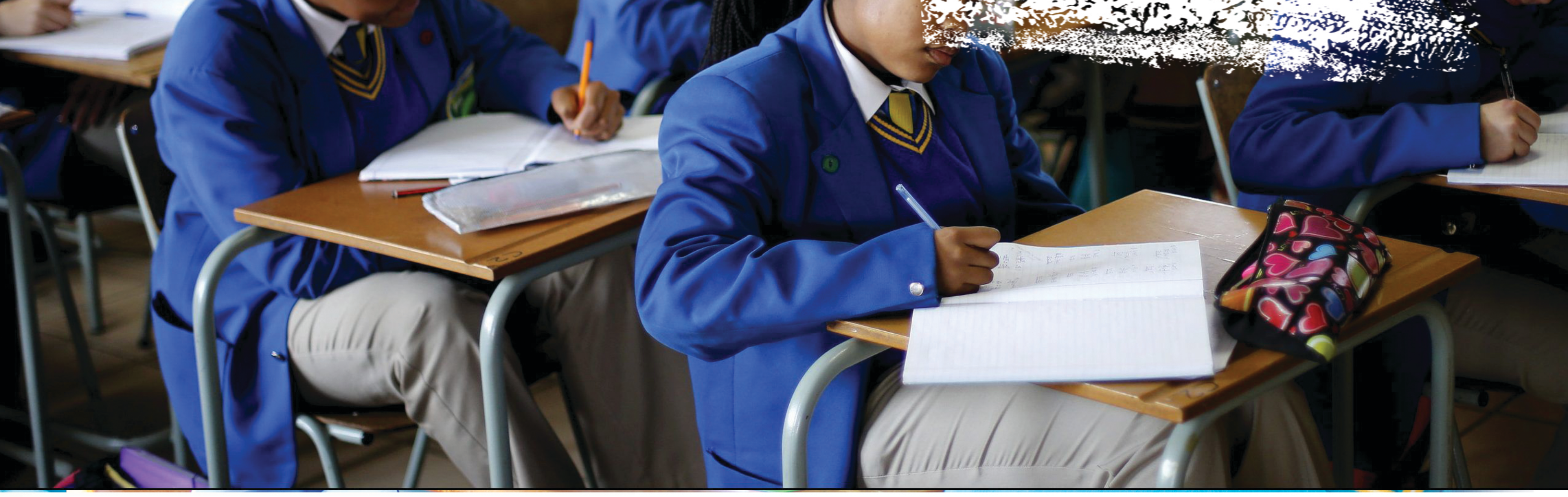
FURTHER EDUCATION & TRAINING PHASE (FET)

ELECTRICAL TECHNOLOGY

SBA EXEMPLAR BOOKLET

GRADES 10-12



basic education
Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

Read to Lead
A Reading Nation is a Leading Nation

2030 NDP

FOREWORD

The Department of Basic Education has pleasure in releasing a subject exemplar booklet for School Based Assessment (SBA) to assist and guide teachers with the setting and development of standardised SBA tasks and assessment tools. The SBA booklets have been written by teams of subject specialists to assist teachers to adapt teaching and learning methods to improve learner performance and the quality and management of SBA.

The primary purpose of this SBA exemplar booklet is to improve the quality of teaching and assessment (both formal and informal) as well as the learner's process of learning and understanding of the subject content. Assessment of and for learning is an ongoing process that develops from the interaction of teaching, learning and assessment. To improve learner performance, assessment needs to support and drive focused, effective teaching.

School Based Assessment forms an integral part of teaching and learning, its value as a yardstick of effective quality learning and teaching is firmly recognised. Through assessment, the needs of the learner are not only diagnosed for remediation, but it also assists to improve the quality of teaching and learning. The information provided through quality assessment is therefore valuable for teacher planning as part of improving learning outcomes.

Assessment tasks should be designed with care to cover the prescribed content and skills of the subject as well as include the correct range of cognitive demand and levels of difficulty. For fair assessment practice, the teacher must ensure that the learner understands the content and has been exposed to extensive informal assessment opportunities before doing a formal assessment activity.

The exemplar tasks contained in this booklet, developed to the best standard in the subject, is aimed to illustrate best practices in terms of setting formal and informal assessment. Teachers are encouraged to use the exemplar tasks as models to set their own formal and informal assessment activities.

MR HM MWELI

DIRECTOR-GENERAL

DATE: 13/09/2017

Table of Contents

1. INTRODUCTION

The School-Based Assessment Booklet

The booklet is intended as a guide for the development of Electrical Technology Assessment tasks. This SBA booklet has exemplars tasks for Grades 10 and 11. It provides provinces, districts and schools with examples of quality assured School-Based Assessment tasks for Electrical Technology. Whilst the purpose of the guideline is to focus on formal assessment tasks in SBA, it needs to be emphasised that informal assessments must be given the same degree of importance and attention. Assessment tasks in this booklet include term tests and examinations. These tests and examinations (theory and practical) are a collection of assessment methods and questions which samples a domain of knowledge and/or skills.

The CAPS refer to informal assessment as daily assessment, which can be done through observations, discussions, classroom activities, homework, investigation (research), etc. It should not be seen in isolation from formal assessment. Informal assessments are important as they lay the foundation for learners to do formal assessments. Informal assessments are integral to learners achieving the required standards of knowledge and skills needed to achieve successful results in their formal-assessment tasks. Therefore, *informal daily assessment activities need to be well-planned and developed to meet the required standards to support learners to achieve the desired good results*.

This booklet makes Subject advisors and teachers aware of the three compulsory components when developing assessment tasks:

- The assessment task
- The assessment tool
- The analysis grid

1.1.1 SCHOOL-BASED ASSESSMENT.

School-based assessment (SBA) is a form of assessment that is embedded in the teaching and learning process and is an integral part of learners' preparation for the final examinations. It has a number of important characteristics which distinguish it from other forms of assessment:

- It involves the teacher from the beginning to the end: from planning the assessment programme to identifying and/or developing appropriate assessment tasks right through to making the assessment judgments.
- It allows for the collection of a number of samples of learner performance over a period of time.
- It can be adapted and modified by the teacher to match the teaching and learning goals of the particular class and learners being assessed.
- It is carried out in the classroom and is conducted by the learners' own teacher.
- It takes place at different stages of the learning process, as required in Chapter 4 of the Curriculum and Assessment Policy Statement (CAPS).

- It involves learners more actively in the assessment process, especially if self and/or peer assessment is used in conjunction with teacher assessment.

- It allows the teacher to give learners immediate and constructive feedback on how they perform individually, as well as in relation to their peers (teamwork).
- It provides teachers with feedback that enables them to adapt their teaching strategies to effectively and efficiently meet the needs of their learner.

- It stimulates continuous evaluation and adjustment of the teaching and learning

1.1.2 AIMS AND OBJECTIVES

School-Based Assessment should:

- Provide a more balanced and trustworthy assessment system, increasing the range and diversity of assessment tasks.
- Improve the validity of practical assessment in particular by including aspects that cannot be assessed in formal examination settings.
- Improve the reliability of assessment because judgements will be based on many observations of the learners over an extended period of time.
- Have a beneficial effect on teaching and learning, particularly in relation to the development of teaching and assessment practices.
- Empower teachers to become part of the assessment process.
- Enhance collaboration and sharing of expertise within and across schools.
- Have a professional developmental function, building up knowledge and skills.

Unless assessment criteria are communicated clearly to learners, assessment will not improve learning (or teaching).It is only when learners understand the assessment criteria, and how they are applied to the responses they produce, that they can actually take responsibility for their own learning.

1.1.3 THE SEVEN ROLES OF A TEACHER [Emilia Potenza, M& G, Feb. 2002]

Emilia Potenza (Feb. 2002) identified the following **roles** of a teacher:

- **Learning Mediator**-the teacher is sensitive to diverse needs of his/her learners, he/she becomes an inspiration to his/her learners
- **Interpreter and designer of learning programme and materials**-The teacher should understand and interpret the already existing learning programmes and design/prepare appropriate textual and visual resources for learning.
- **Scholar, researcher and lifelong learner**- Teachers are expected to pursue their own ongoing personal, academic, occupational and professional growth.
- **Community, citizenship and pastoral role**- Teachers are to ensure that learners develop a sense of respect and responsibility toward others upholding the Constitution and promoting democracy

- **Assessor**-Continuous Assessment is an integral part of any meaningful teaching and learning
- **Subject Specialist**-The teacher should be well-grounded in his/her subject in terms of pedagogical content knowledge, skills and procedures of the subject and
- In addition to these roles, the teacher is also **a Leader** who continually **inspire, motivate** and **guide** his/her learner towards the accomplishment of the subject set target.

1.1.4 ACKNOWLEDGEMENTS

This booklet was made possible by the contributions of teachers, Subject Advisors and Provincial Subject coordinators from the nine provinces.

1.1.5 PRINCIPLES UNDERPINNING EFFECTIVE ASSESSMENT PRACTICE

- Assessment provides complete information about learner achievement
- Assessment is a complementary part of the teaching process (of learning and of teaching).
- Assessment is based on making use of multiple different methods
- Assessment is a continuous process.
- Assessment is fair, transparent, valid and reliable

1.1.6 THE PRINCIPLES OF ASSESSMENT

The SBA must always demonstrate equal opportunity to learning, consistency and realistic expectations by being validity, realible, fair, suffiecient, etc.

Valid assessment

The assessment task is valid when it is based on the content and standards as set out in the CAPS. The content, skills, values and attitudes included in the assessment task must be based on the work learners have completed as per the Annual Teaching Plan (ATP) in the CAPS.

Reliable assessment

Reliable assessment also means that when the assessment is developed, the input processes are well organised and based on sound theoretical and assessment principles. An assessment is deemed reliable when the results obtained from a formal assessment produce the same results every time it is used to assess learners.

Fair assessment

The method of assessment should not present any barriers to the learners' achievements. It must be free of bias and sensitive to contextual factors. The types of questions asked must be age appropriate. The questions must be based on the content, skills, values and attitudes that have been taught to the learner over a period of time. In addition, the distribution of the cognitive levels (low-, medium- and high-order questions) must be aligned to the requirements as stipulated in Section 4 of the CAPS for Electrical Technology.

Sufficient assessment

Sufficient assessment within the context of the Grades R – 12 means that the spread of content, skills and values assessed are based on the work done during the term or year/phase according to the Annual Teaching Plan. Learners should be able to complete the assessment task within the stipulated time.

1.1.7 THE FIVE STEPS OF QUALITY SCHOOL-BASED ASSESSMENT

Step 1: Generating and collecting evidence of learners' performance.
This is done through the various assessment tasks given to learners by the teacher.

Step 2: Assessing learners' performance
This is achieved when the teacher marks the learners' responses using an appropriate assessment tool in order to arrive at a mark that indicates the learners' understanding of the topic(s) covered by the assessment task.

Step 3: Recording learners' performance.
The teacher records the learners' marks to track their progress throughout the year and also records specific challenges experienced by the learners in order to plan intervention.

Step 4: Analysing learners' performance to improve the process of learning and teaching.
By analysing learner responses, the teacher may choose to repeat certain aspects of the content or use a variety of strategies to improve learning. This can be followed by extended opportunities for learners to improve their learning.

Step 5: Feedback to learners.
Feedback from the teacher is essential to improve the learners' confidence, self-awareness and enthusiasm for learning. It should be done in such a way that it maximises the learners' potential at different stages of the learning and teaching process.

1.1.8 THE THREE FUNCTIONS OF A QUALITY ASSESSMENT PROGRAMME

- ASSESSMENT ***FOR*** LEARNING - teachers monitor learners' progress to inform their teaching.
- ASSESSMENT ***AS*** LEARNING - learners reflect on their progress to inform their future learning.
- ASSESSMENT ***OF*** LEARNING - teachers use evidence of learners' performance to make judgments on learner achievement against clearly stated standards.

School-based Assessment needs to be continuous and integrated naturally into every stage of the teaching-learning cycle, not just at the end.

1.1.9 FORMATIVE AND SUMMATIVE ASSESSMENT

The difference between formative and summative assessment
School-based assessment tasks can be used for *formative* as well as *summative* purposes.

Summative assessment
Refers to more formal, planned assessments at the end of a unit or term/year, which are used primarily to assess learners' progress.

Formative assessment
Is usually more informal and more frequent, involving the gathering of information about learners and their learning needs while they are still learning.

Formative assessment has two key functions: informing and forming. In other words, formative assessment shapes the decisions about what to do next by helping the teacher to select what to teach in the next lesson, or even in the next moment in the lesson and the learners to understand what they have learnt and what they need to learn next.

1.1.10 INFORMAL OR DAILY ASSESSMENT (ASSESSMENT *FOR* LEARNING)

Assessment for learning has the purpose of continuously collecting information on learners' achievements, which can be used to improve their learning. Informal assessment is a daily monitoring of learners' progress. This is done through observations, discussions, practical demonstrations, learner-teacher communication, informal classroom interactions, etc. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss with learners how learning is progressing. Informal assessment should be used to provide feedback to the learners and to inform planning for teaching, but need not be recorded. It should not be seen as separate from learning activities taking place in the classroom. Learners or teachers can mark these assessment tasks.

1.1.11 FORMAL ASSESSMENT (ASSESSMENT *OF* LEARNING)

All assessment tasks that make up a formal programme of assessment for the year are regarded as formal assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All formal-assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that proper standards are maintained.

Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include projects, oral presentations, demonstrations, performances, tests, examinations, practical tasks, etc. This form of assessment should be marked by the teacher and not the learner.

All formal assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that proper standards are maintained.

The teacher must submit the annual formal programme of assessment to the School Management Team (SMT). This will be used to draw up a school assessment plan in each grade. The school assessment plan should be provided to learners and parents in the first week of the first term. Formal assessment tasks form part of a year-long formal Programme of assessment in each grade and subject.

1.1.12 QUALITY ASSURANCE PROCESS

Quality assurance of SBA is the planned and systematic process of ensuring that SBA tasks are valid, reliable, practicable, as well as equitable and fair, and thus increasing public confidence in SBA. This would include all the activities that take place before, during and after the actual assessment, that contribute to the improved quality of SBA. Quality assurance helps to support teachers and build expertise and capacity in the education system to deliver positive outcomes for learners. Through sharing, understanding and applying standards and expectations, quality assurance helps to raise standards and expectations, and levels of consistency across teachers

2. THE PROGRAMME OF ASSESSMENT FOR ELECTRICAL TECHNOLOGY

All assessment tasks that make up a formal programme of assessment for the year are regarded as formal assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All formal-assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that proper standards are maintained.

Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments include projects, oral presentations, demonstrations, performances, tests, examinations, practical tasks, etc. Formal assessment tasks form part of a year-long formal Programme of Assessment in each grade and subject. The formal assessment requirements for Electrical Technology are as follows:

- In Grades 10 and 11 all SBA is set and moderated internally.
- In Grade 12 the formal assessment (25%) is internally set and marked but externally moderated.

PROGRAMME OF ASSESSMENT		
School-Based Assessment (SBA)	Practical Assessment Task (PAT)	Final examination
25%	**25%**	**50%**

- **Practical Assessment Task (PAT):** PAT accounts for the skills the learner has mastered. It is assessed at intervals and requires the learner to engage in multiple practical sessions. During these weekly sessions, skills such as simulation, experimentation, hand skills, tool skills, machine skills and workshop practice are honed and perfected to the point where the learner may engage in the tasks set out for that particular term. The PAT accounts for 25% of the learner's promotion mark.

- In Grades 10 and 11, the Practical Assessment Task is set and marked internally but externally moderated.

- In Grade 12 the Practical Assessment Task is externally set, internally marked and externally moderated.

- **Final examination:** At the end of each academic year, every learner is required to write a final examination, which is compiled in such a way that it represents the entire theoretical content covered throughout the year. The final examination paper accounts for 50% of the learner's promotion mark and is externally set, marked and moderated.

Formal assessments should cater for the range of cognitive levels and abilities of learners as shown below:

Cognitive Levels	Percentage of Task
Lower-order: knowledge	30%
Middle-order: comprehension and application	50%
Higher-order: analysis, evaluation and synthesis	20%

3. COGNITIVE AND DIFFICULTY LEVELS

The cognitive demand of a question is the kind and level of thinking required of learners in order to successfully engage with and answer a question.

- High-order cognitive questions are those that demand that the learners manipulate bits of information previously learnt to create and support an answer with logically reasoned evidence. This sort of question is usually interpretive, evaluative, inquiry-based, inferential, synthesis-based and open-ended.

- Lower-order cognitive questions are more basic. They ask learners to recall material previously presented and learnt. No or very little thinking and reasoning is required. These questions are generally direct, closed, recall-related and questions that measure knowledge only – factual and process orientated

The following is the Programme of Assessment for Grades 10 and 11

<table>
<tr><th colspan="8">GRADE 10 AND 11 ASSESSMENT REQUIREMENTS</th></tr>
<tr><th>ASSESSMENT TASKS</th><th>TERM 1</th><th>TERM 2</th><th>TERM 3</th><th>TERM 4</th><th colspan="2">% OF FINAL PROMOTION</th><th>MARK Weighting</th></tr>
<tr><td>Tests</td><td>1</td><td></td><td>1</td><td></td><td>10</td><td rowspan="2">25</td><td rowspan="2">250 total converted to mark out of 100</td></tr>
<tr><td>Mid-year</td><td></td><td>1</td><td></td><td></td><td>15</td></tr>
<tr><td>Practical Assessment Task (PAT)</td><td>√</td><td>√</td><td>√</td><td>√</td><td colspan="2">25</td><td>100</td></tr>
<tr><td>Final Examination</td><td></td><td></td><td></td><td>1</td><td colspan="2">50</td><td>200</td></tr>
<tr><td colspan="7">TOTAL – PROMOTION MARK</td><td>400</td></tr>
</table>

The table below shows the compilation of the SBA mark:

Description	Time Frame	Weighting of final mark	Mark Allocation
Control test 1	**Term 1** January – April	5%	50
Mid-year examination	**Term 2** May – June	15%	150
Control test 2	**Term 3** July – October	5%	50
Total		**25%**	**250**

4. RECORDING AND REPORTING

Recording is a process in which the teacher documents the level of a learner's performance in a specific assessment task. It indicates learner progress towards the achievement of the knowledge as prescribed in the Curriculum and Assessment Policy Statements. Records of learner performance should provide evidence of the learner's conceptual progression within a grade and her / his readiness to progress or be promoted to the next grade. Records of learner performance should also be used to verify the progress made by teachers and learners in the teaching and learning process. Teachers will record actual marks against the tasks by using a record sheet and also report in percentages against the subject on the learner's report cards.

Reporting is a process of communicating learner performance to learners, parents, schools, and other stakeholders. Learner performance can be reported in a number of ways which include report cards, parents' meetings, school visitation days, parent-teacher conferences, phone calls, letters, class or school newsletters, etc. Teachers in all grades report in percentages against the subject. The following rating scale will apply for reports: • In order for the school to report back to the parents on the progression of the learner from term to term, regular feedback is given in the form of report cards. When compiling term marks it is proposed that teachers make use of the SBA and PAT marks to show how the learner is progressing. • The weighting of the term mark should be 50% for the SBA and 50% for the PAT mark. The term mark

5. SETTING OF TASKS

The following are guidelines towards setting quality SBA tasks:

- Know the curriculum and its requirements to identify the knowledge, understanding and skills that are to be assessed.
- Ensure that the assessment allows learners to show that they have the acquired knowledge, understanding and skills to meet the national standards.
- Ensure that the scenarios or contexts are open and comprehensible to all learners.
- Ensure that the appropriate reading level is used. Tools to determine the reading level of a document are available in most word-processing software.
- Ensure that no part of the assessment has an adverse impact on specific groups of learners, e.g. learners with disabilities.
- Ensure that all illustrative material reflects an inclusive view of society and promotes equality.
- Consider time.
- Check that the diagrams, pictures or photographs used are necessary, helpful and of high quality.

- Place the text close to the relevant diagrams or pictures to enable the candidates relate the two effectively. Comprehension text and questions should be set on the same page or on adjacent page

6. CONSTRUCTION FEATURES TO CONSIDER WHEN SETTING TESTS AND EXAMINATIONS:

- The language used in the question paper should not be a barrier.
- The weighting given to a particular part of the question paper reflects its relative importance.
- Sampling is systematic but unpredictable to avoid question ‘spotting’.
- The cognitive demand of the paper is appropriate, i.e. includes lower-order, middle-order and higher-order demands to the prescribed ratio.
- The level of difficulty of the individual questions is appropriate and the level of difficulty of the overall paper is appropriate to the level of the grade.
- The mark available for each question matches the demands of the task and the test specification.
- The memorandum allows for a range of valid answers, especially for open-ended questions

7. DEVELOPING A MARKING MEMORANDUM

- The marking guideline should be accurate
- It should corresponds with the questions in the paper
- The marking guideline must makes allowance for alternative responses
- The marking guideline should be laid out clearly and neatly typed
- The marking memo must be complete with mark allocation and distribution within the questions

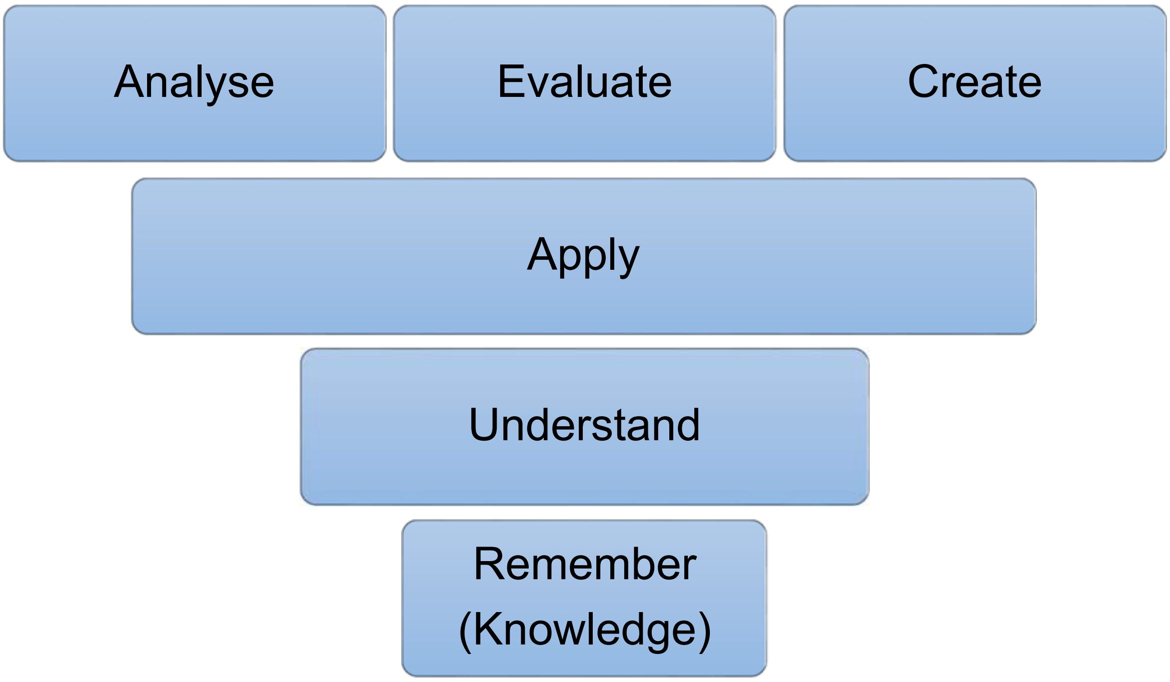
8. TESTS and EXAMINATIONS

- A test for formal assessment should not consist of a series of small tests, but should cover a substantial amount of content. The duration should be at least 60 minutes with a minimum of 50 marks (allocate one mark per fact).
- Each test must cater for a range of cognitive levels.
- The forms of assessment used should be appropriate to the grade and development level. The design of these tasks should cover the content of the subject and include a variety of tasks designed to achieve the objectives of the subject.

EXAMINATIONS

- Each examination must cater for a range of cognitive levels.
- For Grades 10, 11 and 12, the three-hour final examination in Electrical Technology comprises 50% (200 marks) of a learner's total mark. All question papers set by the teacher throughout the year, including the final examination paper, must be moderated by the head of department at the school and approved by the district curriculum advisor/facilitator. This is done to ensure that the prescribed weightings are adhered to by the teacher.
- In the Grade 12 examination, only Grade 12 content will be assessed. However, prior knowledge from Grades 10 and 11 may be necessary to interpret and answer some of the questions.

Bloom's revised taxonomy illustrates the different cognitive levels:



Bloom (1956) has provided us with his taxonomy to assist us to compose questions on different levels of thinking. This taxonomy ranges from lower to higher levels of cognitive thinking. These levels are :

(1) Knowledge
(2) Comprehension
(3) Application
(4) Analysis
(5) Synthesis
(6) Evaluation

Examples of questions in the taxonomy

Dalton and Smith[1] (1986) provide the following examples:

USEFUL VERBS
- Tell - List - Describe - Relate - Locate - Write - Find - State - Name

USEFUL VERBS
- Explain - Interpret - Outline - Discuss - Distinguish - Predict - Restate - Translate - Compare - Describe

USEFUL VERBS
- Solve - Show - Use

- Illustrate
- Construct
- Complete
- Examine
- Classify

USEFUL VERBS

- Analyse
- Distinguish
- Examine
- Compare
- Contrast
- Investigate
- Categorise
- Identify
- Explain
- Separate
- Advertise

USEFUL VERBS
- Create - Invent - Compose - Predict - Plan - Construct - Design - Imagine - Propose - Devise - Formulate

EVALUATION
USEFUL VERBS
- Judge - Select - Choose - Decide - Justify - Debate - Verify - Argue - Recommend

- Assess
- Discuss
- Rate
- Prioritise
- Determine

Interpretation of cognitive levels

Cognitive level		**Comment**	**Context**
C1	Knowledge Recall of factual/process knowledge *in isolation*, i.e. one step/set of steps/ instruction/process at a time.	Requires recalling or recognising only Practised or learnt the isolatable bit, e.g. fact/skill/ process/steps before.	*Exactly* the *same context* as a textbook example of a classroom-based exercise. Explicitly part of the curriculum
C2	Understanding Convert from one form of representation to another.	Requires knowledge and understanding of steps/process/-isolatable bits Translating 'words', pictures, symbols, diagrams into, e.g. programming code.	Familiar context Includes interpreting, exemplifying, classifying, summarising, inferring, comparing, and explaining.
C3	Application Using *known routines/ steps/ processes* in order to complete a task. *All of the information required is immediately available to the learner*	Requires knowledge, understanding and use of steps/*routines/processes* Application of appropriate abstraction without having to be prompted, and without having to be shown how to use it in a familiar context.	*Familiar context* but with *new* elements/*new* circumstance Learners have seen the same or -very similar steps working with different data or other circumstances.
C4	Analysis Understand how parts relate to a whole (pinpoint the core/main	Requires reasoning/investigation/-developing a plan or	New context Unseen, unfamiliar problems/ tasks.

	aspects) or interact with each other and use appropriate methods to complete task/solve problem.	algorithm; has some complexity Completing task could have more than one possible approach. Organising component parts to achieve an overall objective.	
C5	Evaluation Judging or deciding according to some set of criteria, generally without real right or wrong answers.	Requires weighing possibilities, deciding on most appropriate Testing to locate errors.	
C6	Create Putting elements together to form a coherent or functional whole; or re-organising elements into a new pattern or structure	Requires familiarisation with the task by exploring different approaches, interpreting and analysing relevant approaches. Generalisation	Novel situation The learner has *no familiarity with completed functional whole*.

9. AN EXAMPLE OF AN ASSESSMENT GRID

The marking grid is used to analyse the tasks which has been set in order to check whether the task meets the question distribution requirements.

Question	Lower order	Middle order	Higher order	Total marks

10. EXAMPLES OF FORMAL ASSESSMENT TASKS

GRADE 10 TERM 1 TEST

Please note: This term test is common to all specialisations,-namely Digital Electronics, Electronics and Power systems, all term 1 content is generic to all three specialisation subjects

ELECTRICAL TECHNOLOGY: POWER SYSTEMS, ELECTRONICS, DIGITAL

GRADE 10

MARKS: 50

TIME: 1 HOUR

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. ALL calculations must be shown and must be correctly rounded off to TWO decimal places.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Non-programmable calculators may be used.
6. Show the units of answers for all calculations.
7. A formula sheet is attached at the end of this question paper.
8. Write neatly and legibly.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1	Define an accident.	(2)
1.2	Describe ONE way in which you can prevent the spread of diseases in the workshop.	(2)
1.3	Signs are divided into four categories, each with its own colour and shape. Describe the meaning of the colour-coding of signs below:	
	1.3.1 Red	(1)
	1.3.2 Green	(1)
	1.3.3 Yellow	(1)
	1.3.4 Blue	(1)
1.4	List TWO precaution steps to take when handling PCB chemicals.	(4)
		[10]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 Identify the following hand tool in Figure 2.1. (1)

FIGURE 2.1: HANDTOOL

2.2 Describe the function of the following hand tools:

2.1.1 Wire stripper (2)

2.1.2 Solder sucker (2)

2.1.3 Breadboard (2)

2.3 You are required to measure the EMF of a battery. Figure 2.2 shows the multimeter that you will use to do the measurement.

Figure 2.2

2.3.1 Which of the three sockets should the Red Test Lead be plugged into? (1)

2.3.2 Which of the three sockets should the Black Test Lead be plugged into? (1)

2.4 Figure 2.3. Shows the reading obtained on a multimeter when testing the continuity of different conductors. Interpret the reading in the figure. (2)

FIGURE 2.3: DIGITAL MULTIMETER

2.5 When bending copper or PVC conduit, explain how a bending spring can help. (2)

2.6 Decscribe the function of a continuity tester. (2)

[15]

QUESTION 3: BASIC PRINCIPLES OF ELECTRICITY

3.1 State the charge of an electron. (1)

3.2 State the net charge of the nucleus of an atom. (1)

3.3 Name the component that has a change in resistance with a change in temperature. (1)

3.4 Determine the colour code of a 27 k Ω resistor that has a 5% tolerance. (4)

3.5 Give the definition of:

3.5.1 A conductor (2)

3.5.2 An insulator (2)

3.6 Provide TWO examples of conductive materials. (2)

3.7 Provide TWO factors affecting the resistance of a material. (2)

3.8 A resistor combination circuit is shown in Figure 3.1.

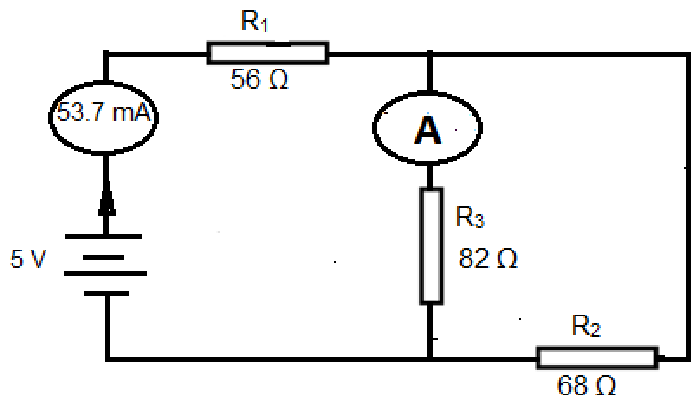


FIGURE 3.1: RESISTOR COMBINATION CIRCUIT

3.8.1 Calculate the voltage across R1. (3)

3.8.2 Calculate the voltage across R3. (3)

3.8.3 Calculate the current through R3. (3)

3.8.4 Determine whether there is an open or short circuit across R3 if the reading on the ammeter in series with R3 shows a value of 53.7 mA. (1)

3.8.5 Figure 3.2 shows three equal value resistors connected in series across a 6 V power supply.

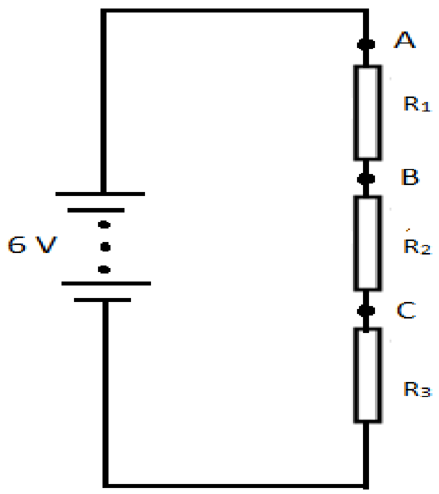


FIGURE 3.2: SERIES CONNECTED RESISTORS

Determine the voltage across point A and negative terminal of the supply. (1)

Determine the voltage across point B and negative terminal of the supply. (2)

[25]

TOTAL: 50

THE END

FORMULA SHEET

PRINCIPLES OF ELECTRICITY

Charge

$Q = I \times t$ (C)

Specific resistance

$R = \dfrac{\rho \times l}{A}$ (Ω)

Ohm's law

$R = \dfrac{V}{I}$ (Ω)

Resistors in series

$R_T = R_1 + R_2 + ... + R_n$ (Ω)

$I_T = I_1 = I_2 = ... + I_n$ (A)

Resistors in parallel

$\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + ... + \dfrac{1}{R_n}$ (Ω)

$I_T = I_1 + I_2 + ... + I_n$ (A)

Kirchhoff's law (voltage divider)

$V_T = V_1 + V_2 + ... + V_n$ (V)

Kirchhoff's Law (current divider)

$I_T = I_1 + I_2 + ... + I_n$ (A)

Power

$P = V \times I$ (W)

$\text{Energy} = P \times t$ (kW.h)

Light-emitting diode (LED)

$R_{series} = \dfrac{V_T - V_{LED}}{I_{LED}}$ (Ω)

POWER SOURCES

Potential difference

$V = \dfrac{E}{Q}$ (V)

Electromotive force (emf)

$V_{emf} = V_{pd} + V_r$ (V)

or

$V_{emf} = I(R + r)$ (V)

Capacity and power rating

$\text{Battery capacity} = I_{charge} \times T_{charge}$ (A.h)

ELECTRONIC COMPONENTS

Electrostatic charge

$Q = CV$ (C)

Time constant

$\tau = RC$ (s)

$T = 5RC$ (s)

Charging rate

$V_{capasitor} = V_{supply} \times 0{,}623$ (V)

$I_{capasitor} = I_{max} \times 0{,}364$ (A)

Capacitors in series

$\dfrac{1}{C_T} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + ... + \dfrac{1}{C_n}$ (F)

Capacitors in parallel

$C_T = C_1 + C_2 + ... + C$ (F)

PRINCIPLES OF MAGNETISM

Coils in series

$L_T = L_1 + L_2 + L_3 + ... + L_n$ (H)

Coils in parallel

$\dfrac{1}{L_T} = \dfrac{1}{L_1} + \dfrac{1}{L_2} + \dfrac{1}{L_3} + ... + \dfrac{1}{L_n}$ (H)

Please note that this memorandum is not inclusive.All relevant alternative answers must also be considered

ELECTRICAL TECHNOLOGY: POWER SYSTEMS, ELECTRONICS, DIGITAL

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1 It is an unplanned event often caused by unsafe acts and/or conditions ✓ which result in damage to property and or injury. ✓ (2)

1.2
- Frequent and thorough washing of hands ✓ to remove any possible contamination. ✓
- When coughing and sneezing, one should cover their mouth to avoid the spreading of germs.
- Wear rubber gloves when dealing with injured persons.
- Wash or wipe off work surfaces frequently.

(2)

1.3 Signs are divided into four categories, each with its own colour and shape. Describe the meaning of the colour-coding of signs below:

1.3.1 You are not allowed to take action (Action prohibited). ✓ (1)

1.3.2 Information about safety conditions. ✓ (1)

1.3.3 Warning of risk or danger. ✓ (1)

1.3.4 Action must be carried out. ✓ (1)

1.4 List TWO precaution steps to take when handling PCB chemicals. Any two of the following:

- How to work safely ✓ with tools and equipment in the workshop. ✓
- Maintaining passageways and floors ✓
- Free of slip and trip hazards. ✓
- Keeping work areas neat and orderly.
- Removing waste materials and other fire hazards from work areas.
- Tool and equipment maintenance.

(4)

[10]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 Long nose plier (1)

2.2

2.2.1 To cut off insulation from the ends of a wires. (2)

2.2.2 To remove solder on a joint so that components may be removed. (2)

2.1.3 To build and test circuits. (2)

2.3

2.3.1 VΩmA (1)

2.3.2 COM (1)

2.4 The reading shows continuity through the circuit. (2)

2.5 To bend the conduit without damaging or breaking theconduit. (2)

2.6 To test for continuity in the wire, component or circuit. (2)

[15]

QUESTION 3: BASIC PRINCIPLES OF ELECTRICITY

3.1 Negative. (1)

3.2 Neutral. (1)

3.3 Thermistor.

(1)

3.4 Determine the colour code of a 27 k Ω resistor that has a 5% tolerance.

Red Violet Orange Gold (4)

3.5 Give the definition of:

3.5.1 A material that allows the free flow of current/A material with a larger number of free electrons. (2)

3.5.2 A material that does not allow the free flow of current/A material with very few or no free electrons. (2)

3.6 Gold, silver, copper, aluminium, lead.

[Any two] (2)

3.7 [Any two]

- *The material of which it is made.*
- *The length of the material.*
- *The cross-sectional area of the material.*
- *The temperature of the material.*

(2)

3.8

3.8.1 $V_1 = I_T \times R_1$

$V_1 = 53.7 \times 10^{-3} \times 56$ (3)

$V_1 = 3\ V$

3.8.2 $V_P = V_S - V_1$

$V_P = 5 - 3$

$V_P = 2\ V$ (3)

3.8.3 $I_1 = \frac{V_P}{R_3}$

$I_1 = \frac{2}{82}$

$I_1 = 24.39\ mA$ (3)

3.8.4 Short circuit (1)

[25]

TOTAL: 50

THE END

GRADE 10 TERM 2 MID YEAR EXAMINATION

ELECTRICAL TECHNOLOGY:

Power Systems, Electronics, Digital

GRADE 10

MARKS: **150**

TIME: **2½ HOURS**

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. ALL calculations must be shown and must be correctly rounded off to TWO decimal places.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Non-programmable calculators may be used.
6. Show the units of answers for all calculations.
7. A formula sheet is attached at the end of this question paper.
8. Write neatly and legibly.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1 List TWO unsafe conditions in an electrical workshop. (2)

1.2 Identify the following safety signs:

1.2.1 (1)

1.2.2 (1)

1.3 In the event of an emergency in an electrical workshop, certain steps need to be taken for a successful evacuation of the workshop. List THREE steps for a successful evacuation. (3)

1.4 What is the correct thing to do when your clothing is on fire? (2)

1.5 A learner gets electrocuted while working in the workshop. State the first step you would take to assist the learner. (1)

1.6 If somebody gets hurt in the workshop and is bleeding, explain how you will help the person. (3)

1.7 Explain what is meant by the term 'housekeeping' in the workshop. (2)

[15]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 Explain the function of the following tools.

2.1.1 Combination plier (2)

2.1.2 Wire stripper (2)

2.1.3 Solder sucker (2)

2.1.4 Breadboard (2)

2.1.5 Drill press (2)

2.2 Explain why the handles of electrical tools are insulated. (2)

2.3 Write ONE safety precaution to be observed when using an ammeter to measure voltage. (2)

2.4 Tell how a voltmeter must be connected in an electrical circuit to measure voltage. (2)

2.5 Describe the characteristics of the following soldered joints:

2.5.1 A good joint (1)

2.5.2 A poor joint (1)

2.6 Oscilloscopes and multimeters are measuring instruments. Compare an oscilloscope and a multimeter. (2)

2.7 Redraw the circuit diagram in Figure 2.1 and illustrate how you would connect an ammeter and a voltmeter in the circuit. Also indicate polarity of ammeter and voltmeter leads. (5)

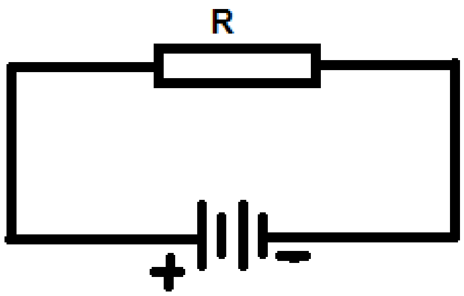


FIGURE 2.1: A RESISTOR CONNECTED ACROSS THE BATTERY

[25]

QUESTION 3: BASIC PRINCIPLES OF ELECTRICITY

3.1 Name TWO examples of electrical insulation materials. (2)

3.2 Draw the symbols of the following:

3.2.1 A potentiometer (1)

3.2.2 A rheostat (1)

3.3 There are two conductors, one is thick and the other is thin. Compare the resistance of both conductors if they have the same length. (2)

3.4 Explain what is meant by the Negative Temperature Co-efficient (NTC) of a material. (2)

3.5 A five band resistor is marked Blue, Grey, Orange, Black and Red. Determine its resistance value and tolerance? (2)

3.6 The ammeter and voltmeter in Figure 3.1 reads 5 mA and 150 V respectively. Calculate the value of the resistor. (3)

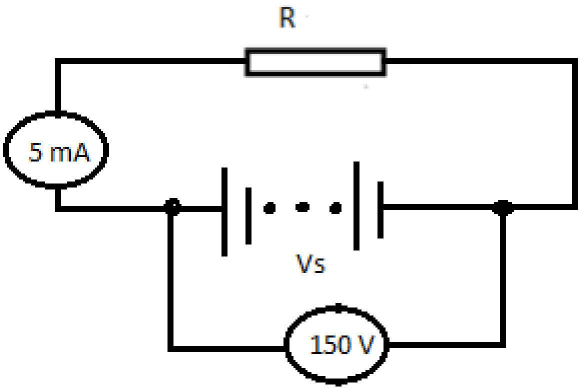


FIGURE 3.1:SIMPLE CIRCUIT

3.7 Figure 3.2 shows resistors connected together. Are these resistors connected in series or in parallel? (1)

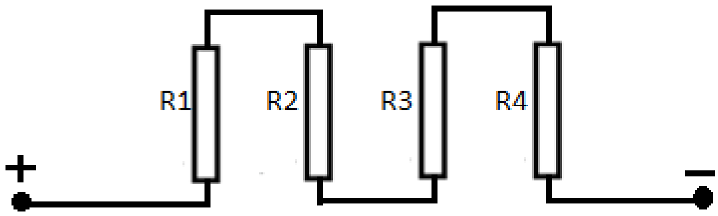


FIGURE 3.2: RESISTORS CONNECTED TOGETHER

3.8 Determine without calculation the voltage of each resistor in the circuit in Figure 3.3. (1)

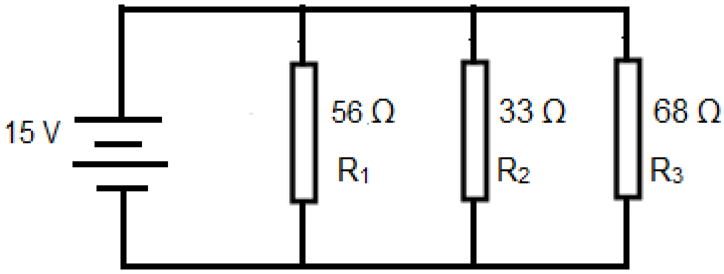


FIGURE 3.3: RESISTORS CONNECTED IN PARALLEL

3.9 Provide the colour code for resistors with the following values:

3.9.1 180 kΩ ± 5% (3)

3.9.2 390 Ω ± 5% (3)

3.10 Explain the function of the resistor in the electrical circuit. (2)

Consider the circuit in Figure 3.4 and calculate the following:

3.11

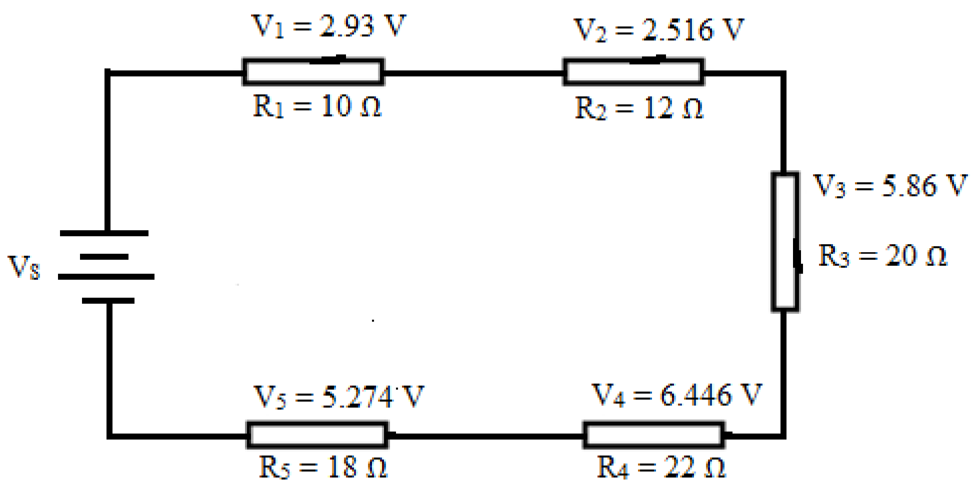


FIGURE 3.4 A circuit consisting of resistors connected in series.

3.11.1 The supply voltage (V_S). (3)

3.11.2 Total resistance of the circuit (R_T). (3)

3.11.3 Total current of the circuit (I_T). (3)

3.11.4 The power consumed by the circuit (P_T). (3)

3.12 Figure 3.5 shows resistors connected in series/parallel combination.

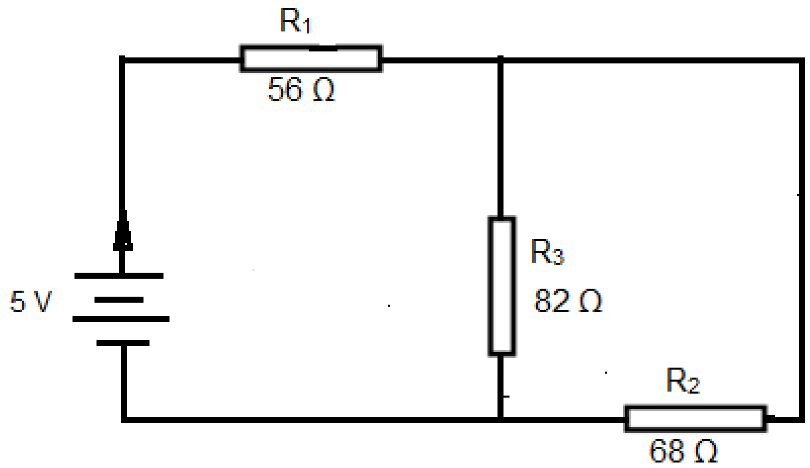


FIGURE 3.5A Circuit consisting of a series parallel combination.

3.12.1 Calculate the total resistance of the circuit. (6)

3.12.2 Calculate the current through R1. (3)

3.12.3 Calculate the voltage across R1. (3)

3.12.4 Calculate the voltage across R2 and R3. (3)

[50]

QUESTION 4: POWER SOURCES

4.1 Define the term energy. (2)

4.2 State any TWO forms of energy. (2)

4.3 Explain the function of solar cell. (2)

4.4 Identify the parts of the solar-electricity generation system in Figure 4.1. (4)

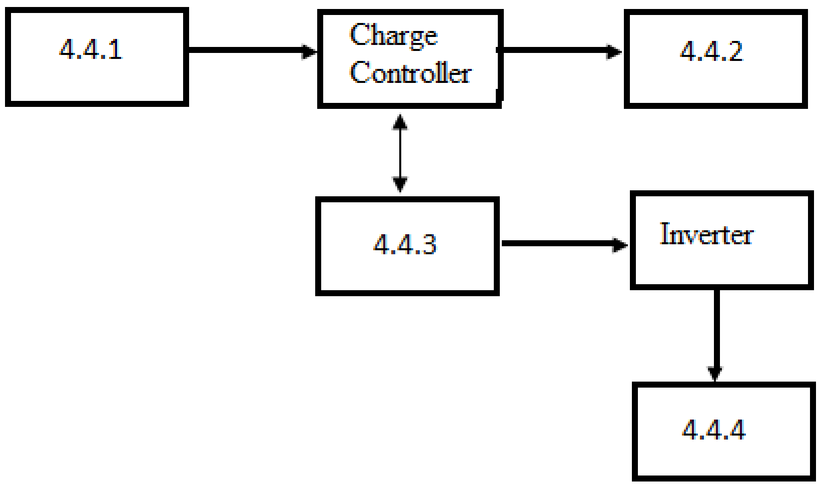


FIGURE 4.1: A block diagram of a solar electricity generation system for domestic use.

4.5 Compare Pd and Emf. (3)

4.6 THREE cells, each with 1.5 V Emf and an internal resistance of 0.1 ohms are connected in parallel across a 6 ohm load resistor. Calculate the following:

4.6.1 Total battery terminal EMF. (3)

4.6.2 Total battery internal resistance. (3)

4.6.3 Total circuit current. (3)

4.7 List ONE factor that affects the capacity and the lifespan of a battery. (1)

4.8 Calculate the capacity rating for secondary cells: 70 amp-hours at 3.5 A. (3)

4.9 Explain why a lead acid battery should be tested regularly? (2)

4.10 Explain why a rechargeable battery is not 100% efficient? (2)

[30]

QUESTION 5: ELECTRONIC COMPONENTS

5.1 Identify the following components:

5.1.1 (1)

5.1.2 (1)

5.1.3 (1)

5.1.4 (1)

5.2 Draw a fully labelled I.E.C symbol of the following components:

5.2.1 A diode (1)

5.2.2 Polarised capacitor (1)

5.2.3 Light Emitting Diode (1)

5.2.4 Reversed Biased PN junction. (2)

5.3 Compare the slow blow and fast blow fuses. (3)

5.4 Figure 5.1 shows capacitors connected in series. Calculate the total capacitance of the circuit. (3)

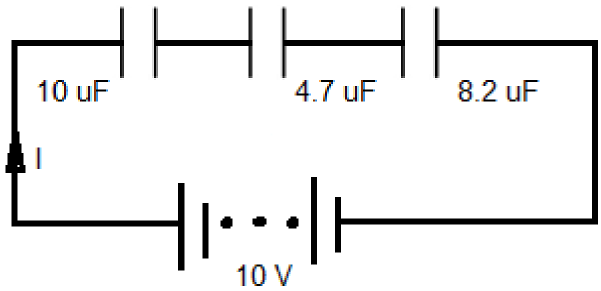


FIGURE 5.1:Capacitors connected in series

5.5 Figure 5.2 shows capacitors connected in parallel. Calculate the total capacitance of the circuit. (3)

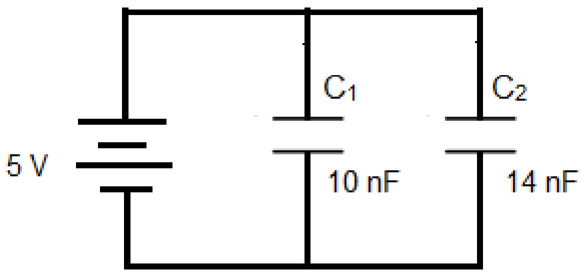


FIGURE 5.2: Capacitors connected in parallel

5.6 Draw a circuit to show how a diode is connected for:

5.6.1 Reverse biasing (3)

5.6.2 Forward biasing (3)

5.7 Calculate the current that will flow through the LED in Figure 5.3. (3)

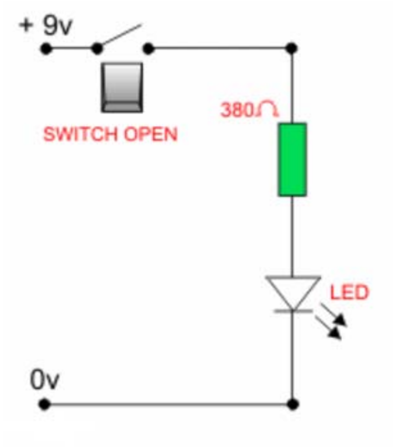


FIGURE 5.3:A simple LED circuit

5.8 Explain how you would discharge a capacitor before testing it with a multimeter. (2)

5.9 Explain why a capacitor rated at 250 V should not to be used on a 240 V A.C supply? (1)

5.10 Figure 5.4 shows a diode being tested with a multimeter. Based on the multimeter reading, state with reason whether the diode is reverse bias or forward bias from the reading on the meter. (3)

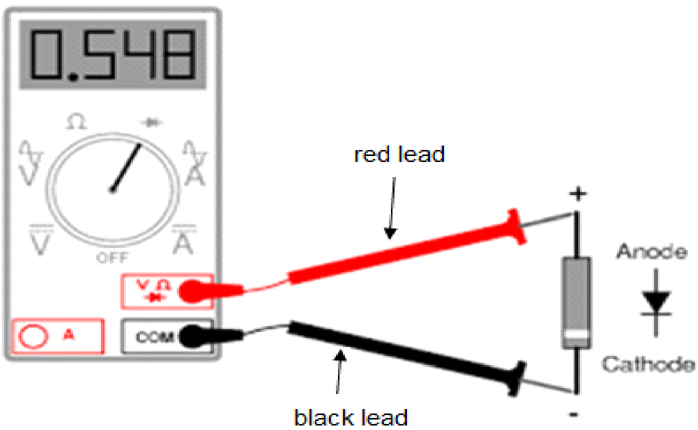


FIGURE 5.4:Diode Testing **[30]**

TOTAL: 150

FORMULA SHEET

PRINCIPLES OF ELECTRICITY

Charge
$Q = I \times t \quad (C)$

Specific resistance
$R = \dfrac{\rho \times l}{A} \quad (\Omega)$

Ohm's law
$R = \dfrac{V}{I} \quad (\Omega)$

Resistors in series
$R_T = R_1 + R_2 + ... + R_n \quad (\Omega)$

$I_T = I_1 = I_2 = ... + I_n \quad (A)$

Resistors in parallel
$\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + ... + \dfrac{1}{R_n} \quad (\Omega)$

$I_T = I_1 + I_2 + ... + I_n \quad (A)$

Kirchhoff's law (voltage divider)
$V_T = V_1 + V_2 + ... + V_n \quad (V)$

Kirchhoff's Law (current divider)
$I_T = I_1 + I_2 + ... + I_n \quad (A)$

Power
$P = V \times I \quad (W)$

$\text{Energy} = P \times t \quad (kW.h)$

Light-emitting diode (LED)
$R_{series} = \dfrac{V_T - V_{LED}}{I_{LED}} \quad (\Omega)$

POWER SOURCES

Potential difference
$V = \dfrac{E}{Q} \quad (V)$

Electromotive force (emf)
$V_{emf} = V_{pd} + V_r \quad (V)$

or

$V_{emf} = I(R + r) \quad (V)$

Capacity and power rating
Battery capacity $= I_{charge} \times T_{charge} \quad (A.h)$

ELECTRONIC COMPONENTS

Electrostatic charge
$Q = CV \quad (C)$

Time constant
$\tau = RC \quad (s)$

$T = 5RC \quad (s)$

Charging rate
$V_{capacitor} = V_{supply} \times 0{,}623 \quad (V)$

$I_{capacitor} = I_{max} \times 0{,}364 \quad (A)$

Capacitors in series
$\dfrac{1}{C_T} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + ... + \dfrac{1}{C_n} \quad (F)$

Capacitors in parallel
$C_T = C_1 + C_2 + ... + C \quad (F)$

PRINCIPLES OF MAGNETISM

Coils in series
$L_T = L_1 + L_2 + L_3 + ... + L_n \quad (H)$

Coils in parallel
$\dfrac{1}{L_T} = \dfrac{1}{L_1} + \dfrac{1}{L_2} + \dfrac{1}{L_3} + ... + \dfrac{1}{L_n} \quad (H)$

ELECTRICAL TECHNOLOGY:

Power Systems, Electronics, Digital

GRADE 10

MARKS: **150**

TIME: **2½ HOURS**

INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Sketches and diagrams must be large, neat and fully labelled.
3. ALL calculations must be shown and must be correctly rounded off to TWO decimal places.
4. Number the answers correctly according to the numbering system used in this question paper.
5. Non-programmable calculators may be used.
6. Show the units of answers for all calculations.
7. A formula sheet is attached at the end of this question paper.
8. Write neatly and legibly.

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1	Faulty tools or equipment Poor or missing guards on machinery Overcrowding in the workshop Poor housekeeping Excessive noise Poor ventilation Lack of knowledge of emergency procedures [Any two]	(2)
1.2	1.2.1 First aid equipment	(1)
	1.2.2 Danger 230V	(1)
1.3	Move in an orderly manner towards the emergency exit. Follow the standard evacuation procedure as displayed in your workshop. If in a tall building, never use the lift instead use the stairs. Move directly to the designated assembly point.	(3)
1.4	The correct response is to stop, drop to the floor and then roll on the ground to put out the flames. ✓ Cover your face with your hands to protect your face and lungs. ✓ Name TWO causes of fire in an electrical workshop.	(2)
1.5	A learner gets electrocuted while working in the workshop. ✓	(1)
1.6	Apply pressure to the wound with a suitable wound dressing✓ to stop the bleeding. ✓Do not touch the blood with your bare hands. ✓	(3)

1.7 Good housekeeping in a workshop means the orderly arrangement/management✓ of tools✓, equipment, operations, storage facilities and materials to their respective places✓. **OR** (2)
Good housekeeping can also be defined as everything in its place and a place for everything.

[15]

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 2.1.1 Used for gripping, twisting, cutting, bending wires or cables and crimping lugs. ✓✓ (2)

2.1.2 To strip off insulation from the ends of the wire. ✓✓ (2)

2.1.3 Used to remove solder on a joint so that components may be removed. ✓✓ (2)

2.1.4 Used to build and test circuits. ✓✓ (2)

2.1.5 To drill holes by pressing drill into the work piece. ✓✓ (2)

2.2 To prevent electric shock or other injuries ✓that may result from direct or indirect energised electrical conductors. ✓ (2)

2.3 An ammeter must be connected in series✓ with the components under test. An ammeter has a low resistance and if connected in parallel a high fault current will flow. ✓ (2)

2.4 The voltmeter must be connected in parallel with✓the components under test and the voltage must be set to the highest practically readable scale. ✓ (2)

2.5 2.5.1
- Looks bright and shiny (1)
- Solder should completely cover the joint and solder pad
- Sides should have a slightly inward curve

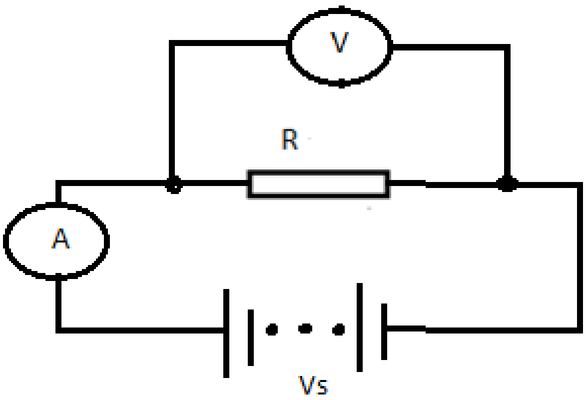
[Any of the above]

2.5.2
- Has been overloaded with solder causing a large bubble shape. (1)
- A joint has a dull, grainy look, often with small holes.
- Solder has not spread over the pad properly.

[Any of the above]

2.6 The oscilloscope displays and measures electrical signals while the multimeter only displays values measured quantities. (2)

2.7 (5)

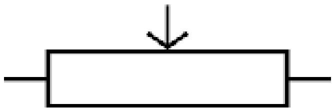


[25]

QUESTION 3: BASIC PRINCIPLES OF ELECTRICITY

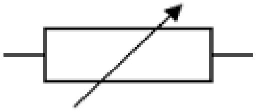
3.1 Glass, ✓wood, ✓rubber, plastic, porcelain. (2)

3.2 3.2.1



(1)

3.2.2



(1)

3.3 The thin conductor will have a higher resistance✓. From the formula, dividing a large area will give a smaller resistance value, so the thicker conductor will have a lower resistance. ✓ (2)

3.4 Means when a material's temperature is increased, ✓ resistance decreases or when the temperature of a material is decreased, its resistance increases. ✓ (2)

3.5 683 Ω✓ ± 2% ✓ (2)

3.6 $R = \frac{V_S}{I}$ ✓

$R = \frac{150}{5}$ ✓

$I_T = 30\ k\Omega$ ✓ (3)

3.7 The resistors are connected in series. ✓ (1)

3.8 $V = V_1 = V_2 = V_3 = 15V$✓ (1)

3.9 Provide the colour code for resistors with the following values:

3.9.1 Brown Grey✓ Yellow ✓Gold ✓ (3)

3.9.2 Orange White✓ brown✓ Gold ✓ (3)

3.10 To limit the current flowing through the circuit. ✓✓ (2)

3.11 3.11.1 $V_S = V_1 + V_2 + V_3 + V_4 + V_5$ ✓

$= 2.93 + 2.516 + 5.86 + 6.446 + 5.274$ ✓

$= 23.026\ V$ ✓ (3)

3.11.2 $R_T = R_1 + R_2 + R_3 + R_4 + R_5$ ✓

$= 10 + 12 + 20 + 22 + 18$ ✓

$= 82\ \Omega$ ✓ (3)

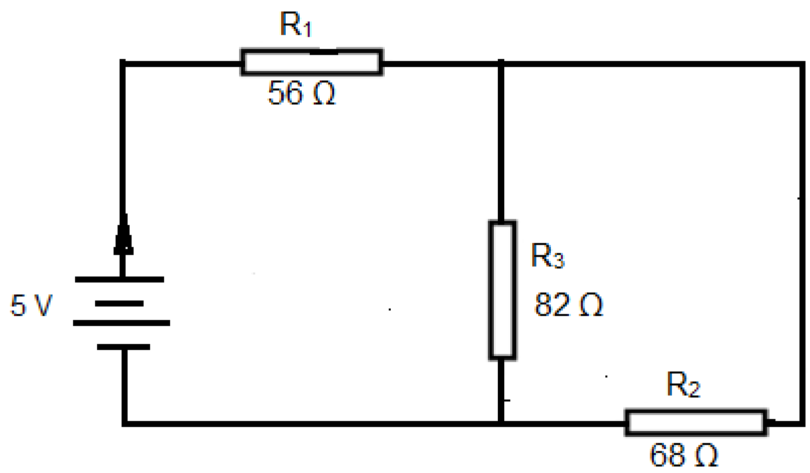
3.11.3 $I = \frac{V_T}{R_T}$ ✓ $= \frac{23.026}{82}$ ✓ $= 0.28\ A$ ✓ (3)

3.11.4 $P_T = I^2 R_T$ ✓

$= (0.28)^2 \times 82$ ✓

$= 6.47$ ✓ (3)

3.12 FIGURE 3.2 shows resistors connected in series/parallel combination.



3.12.1 $R_P = \frac{R_3 \times R_2}{R_3 + R_2}$ ✓

$R_P = \frac{82 \times 68}{82 + 68}$ ✓

$R_P = 37{,}17\ \Omega$ ✓

$R_T = R_1 + R_P$ ✓

$R_T = 56 + 37{,}17$ ✓

$R_T = 93{,}17\ \Omega$ ✓ (6)

3.12.2 $I_T = \frac{V_S}{R_T}$ ✓

$I_T = \frac{5}{93{,}17}$ ✓

$I_T = 0{,}054\ A$ ✓ (3)

3.12.3 Calculate the voltage across R1.

$V_1 = I_T \times R_1$ ✓ (3)

$V_1 = 0.054 \times 56$ ✓

$V_1 = 3{,}024\ V$ ✓

3.12.4 Calculate the voltage across R2 and R3.

$V_P = V_S - V_1$ ✓

$V_P = 5 - 3{,}024$ ✓

$V_P = 1{,}906\ V$ ✓ (3)

[50]

QUESTION 4: POWER SOURCES

4.1 Energy is the ability to ✓do work such as the capacity to move an object by the application of force. ✓ (2)

4.2 Nuclear energy (2)

Hydro energy

Geothermal energy ✓✓

Solar energy

Wind energy

Fossil energy

[Any two]

4.3 To convert sunlight or sun rays to electrical energy. ✓✓ (2)

4.4 4.4.1 Solar array/panels ✓ (4)

4.4.2 DC Load ✓

4.4.3 Battery ✓

4.4.4 AC Load ✓

4.5 EMF: The electrical pressure measured across the terminals of a cell or battery when there is no current flow and it is measured in volts. ✓ (3)

Pd: The electrical pressure measured across the terminals of a cell/ battery or load when there is current flow✓ and it is measured in Volts. ✓

4.6 THREE cells, each with 1.5 V EMF and an internal resistance of 0.1 ohm, are connected in parallel across a 6 ohm-load resistor. Calculate the following:

4.6.1 Battery terminal EMF when cells are connected in parallel remains constant. ✓ (3)

Therefore Emf = Emf 1=Emf2=Emf3✓

Emf = 1.5 V ✓

4.6.2 1/ rINT= 1/ r1 + 1/ r2 + 1/ r3 ✓ (3)
1/ rINT= 1/0.1+1/0.1+1/0.1✓
rINT= 0.02Ω ✓

4.6.3 It = EMT / R+ rINT ✓ (3)

It = 1.5 V / 6 Ω + 0.02 Ω✓

It = 0.249 A ✓

4.7 (1)

- Depth of the discharge. ✓
- Impact of charging and discharging rate.
- Temperature.
- Age and history of the battery.
- Use and applications of batteries.

[Any applicable answer]

4.8 It means the battery will take 70 hours✓ to charge✓ with a constant current of 3.5 A✓. (3)

4.9 To check that the battery is not going under the supplier specifications. ✓✓ (2)

4.10 The internal resistance of a battery causes energy losses during the Charge and discharge process. ✓ It does not deliver as much energy as it was given to it. ✓ (2)

[30]

QUESTION 5: ELECTRONIC COMPONENTS

5.1 Identify the following components:

5.1.1 Rotary switch (1)

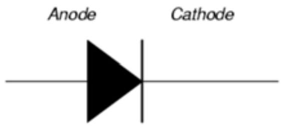
5.1.2 Rocker switch (1)

5.1.3 Push to make (1)

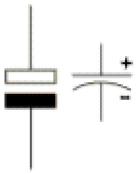
5.1.4 SPDT (toggle type) (1)

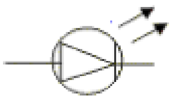
5.2 Draw a fully labelled I.E.C symbol of the following components:

5.2.1 A diode (1)

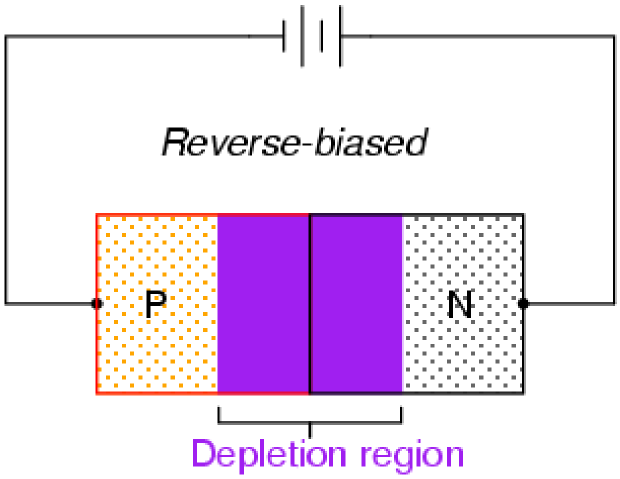


5.2.2 (1)



5.2.3  (1)

5.2.4 (2)



5.3 A quick (fast) blow fuse is a fuse designed to blow within a very short period during an overload. ✓ (3)

A slow blow fuse must be able to carry the overload current exceeding 50%✓ for a few seconds before it blows. ✓

5.4 $\frac{1}{C_T} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$ ✓ (3)

$\frac{1}{C_T} = \frac{1}{10} + \frac{1}{4.7} + \frac{1}{8.2}$ ✓

$C_T = 2.3\, uF$ ✓

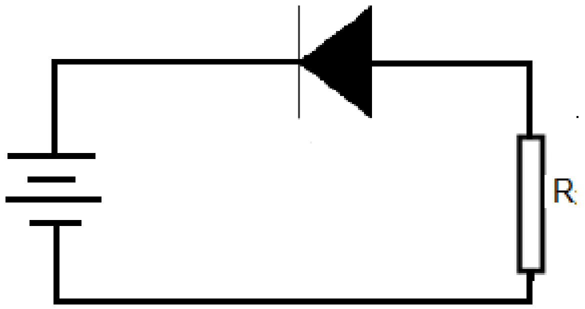
5.5 $C_T = C_1 + C_2$

$C_T = 10 + 14$ ✓

$C_T = 24\, nF$ ✓ (3)

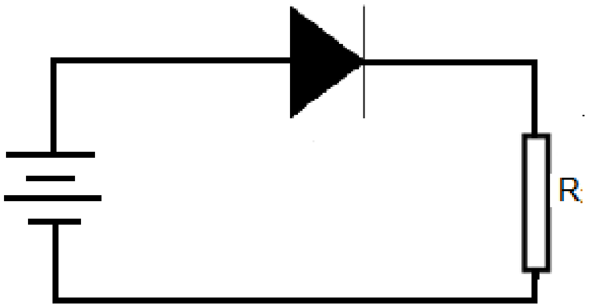
5.6 Draw a circuit to show how a diode is connected for:

5.6.1



(3)

5.6.2



(3)

5.7 Calculate the current that will flow through the LED in Figure 5.3.

ILED = VT- VLED / RS✓
ILED = 9V-2V / 380Ω
ILED= 18.24mA✓
NOTE: Red LED (longer wavelength)- drop between 1.8Vand 2V
Blue/White (shorter wavelength)-drop between 3.3V and 4V✓ (3)

5.8 You can discharge a capacitor by using a high wattage resistor of about 5 –50 ✓ohms for every volt of the working voltage of the capacitor and then connect a voltmeter across it to make sure that the capacitor has discharged. ✓ (2)

5.9 The peak value is of a 240 V a.c supply is 250V which exceeds the rated voltage.✓ (1)

5.10 The diode is forward biased ✓ since the forward voltage of a silicon diode is 0,5 V – 0,7V. ✓✓ (3)

[30]

TOTAL: 150

THE END

FORMULA SHEET

PRINCIPLES OF ELECTRICITY

Charge
$Q = I \times t \quad (C)$

Specific resistance
$R = \dfrac{\rho \times l}{A} \quad (\Omega)$

Ohm's law
$R = \dfrac{V}{I} \quad (\Omega)$

Resistors in series
$R_T = R_1 + R_2 + ... + R_n \quad (\Omega)$

$I_T = I_1 = I_2 = ... + I_n \quad (A)$

Resistors in parallel
$\dfrac{1}{R_T} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + ... + \dfrac{1}{R_n} \quad (\Omega)$

$I_T = I_1 + I_2 + ... + I_n \quad (A)$

Kirchhoff's law (voltage divider)
$V_T = V_1 + V_2 + ... + V_n \quad (V)$

Kirchhoff's Law (current divider)
$I_T = I_1 + I_2 + ... + I_n \quad (A)$

Power
$P = V \times I \quad (W)$

$\text{Energy} = P \times t \quad (kW.h)$

Light-emitting diode (LED)
$R_{series} = \dfrac{V_T - V_{LED}}{I_{LED}} \quad (\Omega)$

POWER SOURCES

Potential difference
$V = \dfrac{E}{Q} \quad (V)$

Electromotive force (emf)
$V_{emf} = V_{pd} + V_r \quad (V)$

or

$V_{emf} = I(R + r) \quad (V)$

Capacity and power rating
$\text{Battery capacity} = I_{charge} \times T_{charge} \quad (A.h)$

ELECTRONIC COMPONENTS

Electrostatic charge
$Q = CV \quad (C)$

Time constant
$\tau = RC \quad (s)$

$T = 5RC \quad (s)$

Charging rate
$V_{capasitor} = V_{supply} \times 0{,}623 \quad (V)$

$I_{capasitor} = I_{max} \times 0{,}364 \quad (A)$

Capacitors in series
$\dfrac{1}{C_T} = \dfrac{1}{C_1} + \dfrac{1}{C_2} + ... + \dfrac{1}{C_n} \quad (F)$

Capacitors in parallel
$C_T = C_1 + C_2 + ... + C \quad (F)$

PRINCIPLES OF MAGNETISM

Coils in series
$L_T = L_1 + L_2 + L_3 + ... + L_n \quad (H)$

Coils in parallel
$\dfrac{1}{L_T} = \dfrac{1}{L_1} + \dfrac{1}{L_2} + \dfrac{1}{L_3} + ... + \dfrac{1}{L_n} \quad (H)$

GRADE 11: Term 1 Test

GRADE 11

ELECTRICAL TECHNOLOGY

MARKS: 50

TIME: 1 hour

This question paper consists of seven pages and two formula sheets.

INSTRUCTIONS AND INFORMATION

1. This question paper consists of six questions.

2. Learners offering Electrical must only answer the following questions:

QUESTION	1	2	3	4
TICK AFTER ANSWERING				

3. Learners offering Electronics and Digital Electronics must only answer the following questions:

QUESTION	1	2	5	6
TICK AFTER ANSWERING				

4. Sketches and diagrams must be large, neat and fully labelled.

5. Show ALL calculations and round off correctly to TWO decimal places.

6. Number the answers correctly according to the numbering system used in this question paper.

7. You may use a non-programmable calculator.

8. Show the units for all answers of calculations

9. A formula sheet is provided at the end of this question paper.

10. Write neatly and legibly

Electrical – Electronics – Digital

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1 State the main function of the Occupational Health and Safety Act. (2)

1.2 Define the term “unsafe act” with regards to safety in the workshop. (2)

1.3 Name the colour of the paint used to demarcate walkways. (1)

[5]

Electrical – Electronics – Digital

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 State the application of a function generator. (1)

2.2 Explain in which situation a person use of a solder sucker would. (2)

2.3 Describe why an insulation resistance tester (Megger) would be used instead of a digital multimeter to test the insulation between conductors with reference to domestic installation. (2)

[5]

Electrical

QUESTION 3: DC MACHINES

3.1 Describe the difference between a generator and a motor with reference to their functions. (4)

3.2 The National Electrical Manufacturer's Association (NEMA) specifies that every motor nameplate must show specific items. List TWO specifications that should appear on the nameplate. (2)

3.3 State the purpose of each of the following components of a DC machine:

3.3.1 Brushes (2)

3.3.2 Field windings (2)

3.4 State ONE factor that could cause the bearing temperature of a DC machine to rise above 90degrees. (1)

3.5 Explain with a reason what will happen to the speed of a shunt wound motor when the load is increased. The increase is within the limits of the motor. (2)

3.6 Describe how the number of pole pairs will affect the speed of a DC motor. (2)

3.7 A 4 kW DC electric motor draws a current of 20 A from 220 V supply. Calculate the efficiency of the motor. (5)

[20]

Electrical

QUESTION 4: SINGLE PHASE AC GENERATION

4.1 Domestic electric energy from a socket outlet is at an effective value of 220V.

Answer the following questions:

4.1.1 Explain the term effective value of a voltage. (2)

4.1.2 Calculate the maximum value of the socket outlet. (3)

4.2 Name THREE factors that determine the voltage induced in a conductor moving relative to a magnetic field. (3)

4.3 A coil with 400 turns has a cross sectional area of 30 cm^2 and rotates at a speed of 2 400 rpm in a magnetic field with density of 0.85 tesla

4.3.1 Calculate the induced voltage (emf). (3)

4.3.2 Explain what will happen to the EMF generated in a conductor rotating within the magnetic field if the flux density of the magnetic field is doubled. (3)

4.4 An electromagnet is exhibited from a solenoid wound around a cylindrical core. The current measured from the conductor of the electromagnet is 5 A when it is connected to a voltage source. The solenoid has 150 turns and the core has a length of 10 cm. The flat side of the cylindrical core has a surface area of 9 cm^2. The magnetic field strength creates a flux density of 4 mT in the core. Calculate the following:

4.4.1 The magneto motive force (MMF) (3)

4.4.2 The magnetic field strength (H) (3)

[20]

Electronics – Digital

QUESTION 5: RLC CIRCUITS

5.1 Explain the term 'impedance'. (2)

5.2 Discuss the effect of increasing frequency in a series resonant RLC circuit on the current delivered by the supply. (3)

5.3 A series RLC circuit consists of a 10 Ω resistor, a 47 mH inductor and a 200 µF capacitor. This circuit is supplied by a 20 V supply that oscillates at 45 Hz. Calculate the following:

5.3.1 The capacitive reactance of the capacitor (3)

5.3.2 The inductive reactance of the inductor (3)

5.4 The series circuit in Figure 5.1 consists of a capacitor with a capacitive reactance of 20 Ω, an inductor with an inductive reactance of 40 Ω and a resistor with a resistance of 30 Ω connected across a 240 V/50 HZ supply.

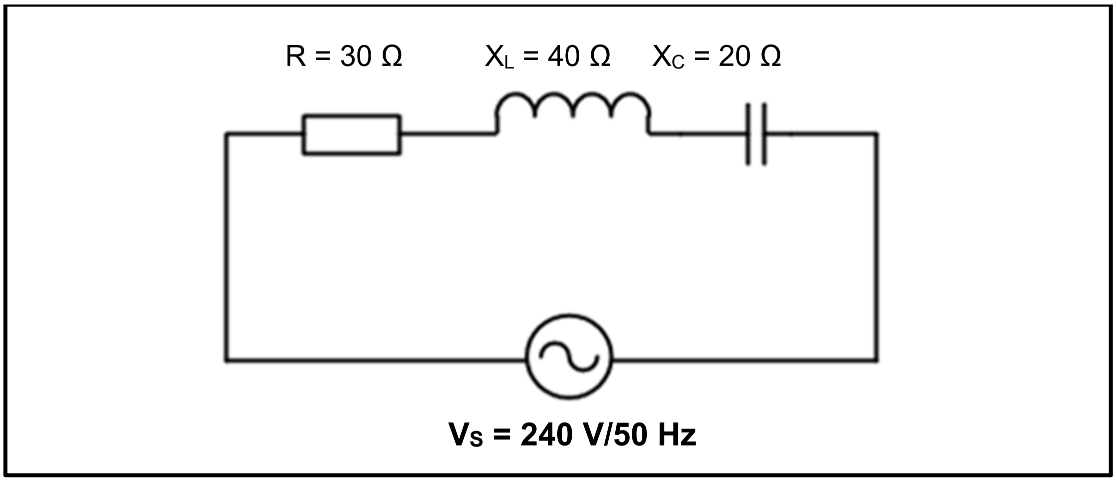


FIGURE 5.1: RLC SERIES CIRCUIT

5.4.1 Calculate the impedance of the circuit. (3)

5.4.2 State with a reason whether the phase angle is leading or lagging. (3)

5.5 The circuit in Figure 5.2 is at resonance. Calculate the frequency of the supply. (3)

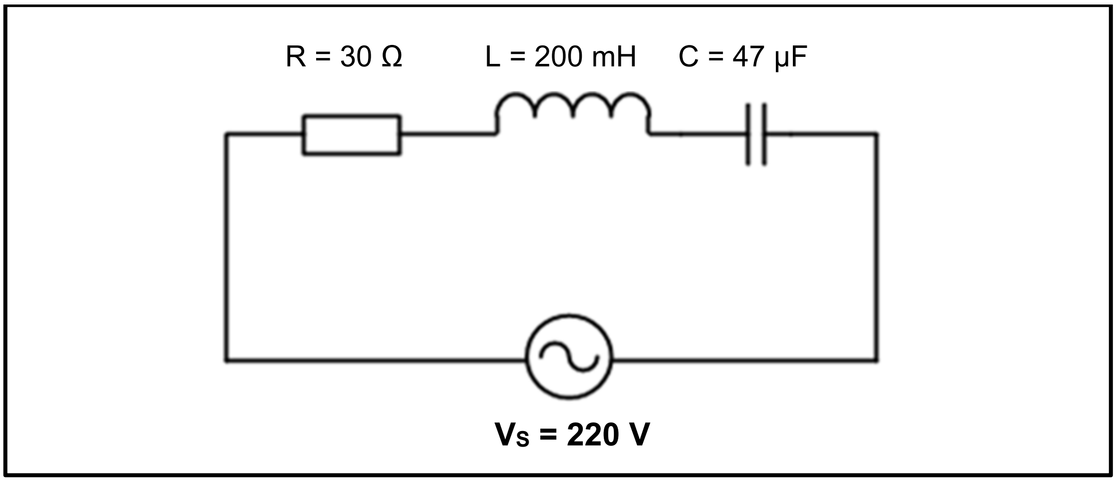


FIGURE 5.2 **RLC SERIES CIRCUIT**

[20]

QUESTION 6: WAVEFORMS

6.1 List THREE types of wave forms. (3)

6.2 Define the term "wave length" with reference to waves. (2)

6.3 Distinguish between leading edge and trailing edge in pulses. (3)

6.4 Figure 6.1 shows the oscilloscope trace of a pulse waveform. The scale settings is as follows: Horizontal axis = 10 ms per division
Vertical axis = 5 mV per division

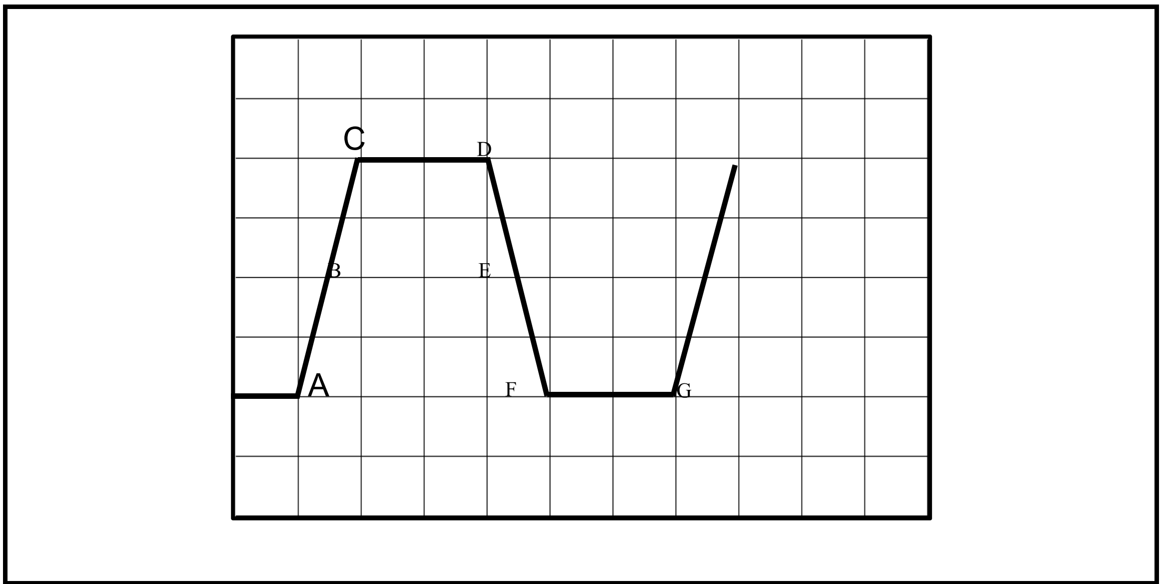


FIGURE 6.1 √√The oscilloscope trace of a pulse waveform

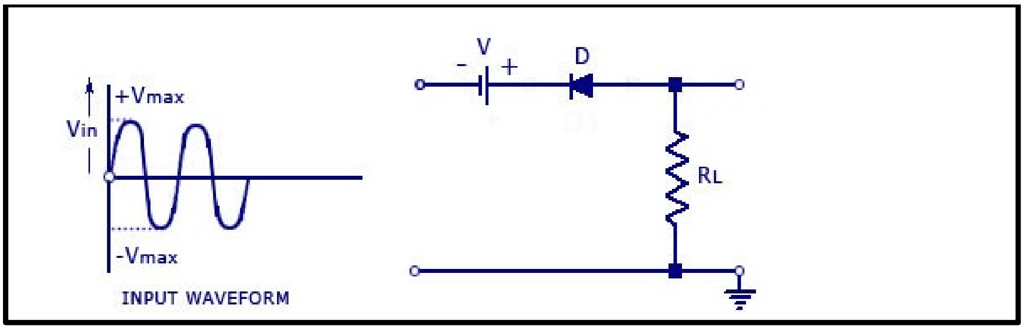
Calculate the following:

6.4.1 The amplitude (3)

6.4.2 The period (3)

6.5 Figure 6.2 show circuit diagrams of series bias diode clippers and the input waveforms supplied.Draw the output labelled waveform of each of the circuits.

6.5.1



(3)

FIGURE 6.2 series bias diode clippers and the input waveform

6.5.2 Refer to Figure 6.2 and explain what will happen to the output waveform if the polarity of the battery is reversed (3)

[20]

FORMULA SHEET

Single Phase AC Generation

Magnetic field strength

$$H = \frac{N \times I}{l} \left(A/m \right)$$

Flux density

$$\beta = \frac{\phi}{A} (\text{Tesla})$$

Pole pairs

$$p = \frac{\text{number of poles}}{2}$$

Area of the coil

$$A = lb \left(m^2 \right)$$

Frequency of rotation

$$F = \frac{1}{T} (Hertz)$$

$$f = p \times n$$

Instantaneous value

$$\omega = 2\pi f (\text{radian})$$

$$\theta = \omega t (\text{degree})$$

$$i = I_{max} \times \sin\theta (V)$$

$$v = V_{max} \times \sin\theta (V)$$

Single Phase Transformer

Power

$$P = VI\cos\theta (\text{Watt})$$

$$S = VI (VA)$$

$$Pr = VI\sin\theta (\text{Watt})$$

Ration calculation

$$\frac{V_p}{V_S} = \frac{N_P}{N_S} = \frac{I_S}{I_P}$$

$$\eta = \frac{Po}{Pin} \times 100\%$$

RLC Circuit

Inductive reactance

$$X_L = 2\pi f L (\Omega)$$

Capacitive reactance

$$X_C = \frac{1}{2\pi f C} (\Omega)$$

Impedance

$$Z = \sqrt{R^2 + (X - X)^2}\ \Omega$$

Power

$$P = VI\cos\theta (\text{Watt})$$

Power Factor

Maximum value

$$V_{max} = V_{RMS} \times 1.414 (V)$$

$$V_{max} = 2\pi\beta AnN (V)$$

$$E = \beta l v (V)$$

RMS value

$$V_{RMS} = V_{max} \times 0.707 (V)$$

Average value

$$V_{Average} = V_{max} \times 0.637 \ (V)$$

Control devices

$$I_{op} = I_{max} \times 125\% (Ampere)$$

Power supply

$$P = V_Z \times I_Z$$

$$R_S = \frac{V_S - V_Z}{I_Z}$$

$$I_L = \frac{V_Z}{R_L}$$

Amplifiers

$$I_C = \frac{V_{CC}}{R_C + R_E}$$

$$Cos\theta = \frac{R}{Z}$$

$$Cos\theta = \frac{V_R}{V_Z}$$

Phase angle

$$\Theta = Cos^{-1} \frac{R}{Z} (deg)$$

$$\Theta = Cos^{-1} \frac{V_R}{V_Z} (deg)$$

Resonance frequency

$$f_r = \frac{1}{2\pi\sqrt{LC}} (Hertz)$$

Q Factor

$$q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$q = \frac{1}{R}\sqrt{\frac{L}{C}}$$

$$q = \frac{X_C}{R}$$

Bandwidth

$$BW = \frac{f_r}{q} (Hertz)$$

$$l =$$

GRADE 11

ELECTRICAL TECHNOLOGY

MARKS: 50

TIME: 1 hour

This Memo consists of SIX pages.

Electrical – Electronics – Digital

QUESTION 1: OCCUPATIONAL HEALTH AND SAFETY

1.1 To provide for the health and safety of persons at work. √
To protect workers from health and safety hazards on the job√ (2)

1.2 Any activity that is conducted in a manner that may threaten the health or safety of workers. √√ (2)

1.3 Yellow√ (1)

[5]

Electrical – Electronics – Digital

QUESTION 2: TOOLS AND MEASURING INSTRUMENTS

2.1 For the production of different types of wave signals. √ (1)

2.2 When a component has to be de-soldered from a PC board. √
For de-soldering electronic components√ (2)

2.3 To maintain or sharpen tool √and also smooth out the edges of a rough-cut material. √ (2)

2.4 A multimeter measures the electrical resistance of a conductor (coil), √ while a Megger measures the insulation resistance of an isolated group (two coils relative to mass), something that a multimeter is unable to do. √

The insulation resistance is mandatorily measured using a Megger (or a similar device), able to generate a high voltage that creates a moment of stress in the insulation (something that a multimeter is unable to do). (2)
[5]

Electrical

QUESTION 3: DC MACHINES

3.1 A generator converts electrical energy to mechanical energy, √while a motor converts mechanical energy to electrical energy. √
In a generator, a shaft attached to the rotor is driven by a mechanical force and electric current is produced in the armature windings, √ while the shaft of a

motor is driven by the magnetic forces developed between the armature and field current has to be supplied to the armature winding√.
Motors (generally a moving charge in a magnetic field) obey the Fleming`s Left √Hand Rule, while the generator obeys Fleming's Right Hand Rule√ (4)

3.2 Manufacturer's name;

Rated volts and full load amperes

Rated frequency & number of phases;

Rated full load speed;

Rated temperature rise or the insulation system class;

Time rating;

Rated horsepower;

Locked rotor indicating code letter; √√

Service factor;

Efficiency;

Frame size;

design code. (2)

3.3 3.3.1 Collect current from the commutator segments √or transfer current to the commutator segments. √√ (2)

3.3.2 Form an electromagnet that produces the field flux within √which the armature of DC motor rotate√ (2)

3.4 Losses due to wind friction and bearing friction. √ (1)

3.5 The speed will remain constant. Because the speed of a shunt wound motor does not depend on the load driven by the motor. √It is a constant speed motor. (2)

3.6 The speed is inversely proportional to the pole pairs from this formula:

$f = N \times P$ (Hz) and therefore the speed of the motor will be reduced if the pole pairs is doubled. √√ (2)

3.7 $\text{Pi} = \text{V x I}$√

$\text{Pi} = 220 \text{ x } 20$

$\text{Pi} = 4400 \text{ W}$√

$\eta = \frac{\text{Po}}{\text{Pi}} \text{ x } 100\%$ √

$\eta = \frac{4000}{4400} \text{ x } 100\%$ √

$= 90.91\ \%$√ (5)

[20]

Electrical

QUESTION 4: SINGLE PHASE AC GENERATION

4.1 4.1.1 Effective value is the AC value that is equivalent to a DC value that effect/produces the desired output. √√ (2)

4.1.2 $V_{max} = V_{RMS} \times 1.414\ (V)$ √
$= 230 \times 1{,}414$ √
$= 325{,}22\ V$ √ (3)

4.13 $V_{p\text{-}p} = 2V_{max}\ (V)$ √
$= 2 \times 325{,}22$ √
$= 650{,}44\ V$ √ (3)

4.2 B − flux density √
L − length of the conductor √
V − the speed at which the conductor moves√ (3)

4.3 4.3.1 $E = 2\pi BnN \sin\theta$ √
$= 2\pi \times (3 \times 10^{-3} \times 2400\ / \ 60 \times 400 \times \sin 90°)$ √
$= 309{,}59\ V$ √ (3)

4.3.2 The induced EMF is directly proportional to the flux density√ and by doubling the magnetic flux density will result in the EMF being doubled. √√ (3)

4.4 4.4.1 $\text{MMF} = NI$ √
$= 150 \times 5$ √
$= 750\ At$ √ (3)

4.4.2 $H = \frac{MMF}{l}$ √

$= \frac{750}{0,1}$ √

$= 7500\ At/m$ √ (3)

[20]

Electronics – Digital

QUESTION 5: RLC CIRCUITS

5.1 The opposition offered to the flow of current due to the combination of the resistor and the reactances. √√ (2)

5.2 When the frequency increases, the impedance of the circuit will increase √which will result in decrease√ in the current flowing through the circuit because current is inversely proportional to the impedance of the circuit. √ (3)

5.3 5.3.1

$X_C = \frac{1}{2\pi fC}$ √

$= \frac{1}{2 \times \pi * \times 45 \times 200 10^{-6}}$ √

$= 17,68\,\Omega$ √ (3)

5.3.2

$X_L = 2\pi fL$ √

$= 2 \times \pi \times 45 \times 0,047$ √

$= 13,28\ \Omega$ √ (3)

5.4 5.4.1

$Z = \sqrt{R^2 + (X_C - X_L)^2}$ √

$= \sqrt{30^2 + (40 - 20)^2}$ √

$= 36,05\ \Omega$ √ (3)

5.4.2 The circuit is inductive because the inductive reactance is greater √than the capacitive reactance and current is lagging the voltage by an θ in an inductive circuit, √ therefore the phase angle is lagging. √ (3)

5.5

$f_r = \frac{1}{2\pi\sqrt{LC}}$ √

$= \frac{1}{2 \times \pi \times \sqrt{0,2 \times 47 \times 10^{-6}}}$ √

$= 51,8Hz$ √ (3)

[20]

QUESTION 6: WAVEFORMS

6.1 Sinusoidal wave√
Saw tooth wave√
Square wave√ (3)

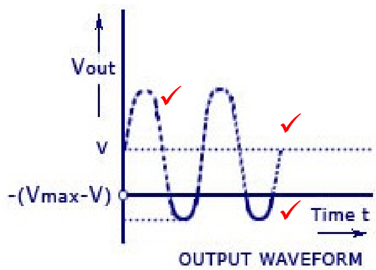
6.2 The distance between one positive peak and the next. √
The distance between any identical points on consecutive cycles√ (2)

6.3 For low pulse, leading edge is falling and trailing edge is rising. √
A leading edge is a transition from low to high and a trailing edge is a transition from high to low√√ (3)

6.4 6.4.1 Amplitude $= 4 \text{ division} \times 5 \text{ mV per division}$ √
$= 4 \times 5 \text{ mV}$ √
$= 120 \text{ mV}$ √
(3)

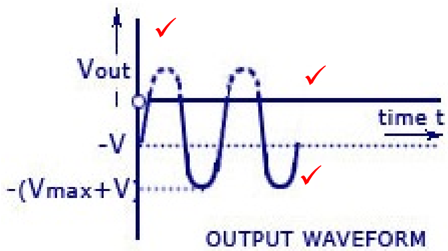
6.4.2 Period $= 8 \text{ division} \times 10 \text{ ms per division}$ √
$= 8 \times 10 \text{ ms}$ √
$= 80 \text{ ms}$ √ (3)

6.5 6.5.1



(3)

6.5.2



The output will be clipped at a higher point. √Because at 0 V the diode is already conducting and there will be a voltage across the resistor. When the positive half cycle increases from zero, it will be opposing the voltage of the battery until it reaches the voltage of the battery√ and at that point the diode is no longer conducting as is now reverse biased√
until the signal is equal to the voltage of the battery again.

(3)
[20]

TOTAL 50

11. CONCLUSION

Improving learner performance

"If our aim is to improve learner performance, not just measure it, we must ensure that learners know the performance expected of them, the standards against which they will be judged, and have opportunities to learn from the assessment in future assessments."

(Grant Wiggens, 2002)

222 Struben Street, Pretoria, 0001
Private Bag X895, Pretoria, 0001, South Africa
Tel: 012 357 3000 • Fax: 012 323 0601

Private Bag X9035, Cape Town, 8000, South Africa
Tel: 021 486 7000 • Fax: 021 461 8110
Call Centre: 0800 202 933

ISBN 978-1-4315-3127-1

Department of Basic Education

www.education.gov.za

www.twitter.com/dbe_sa

www.facebook.com/BasicEd