basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

ELECTRICAL TECHNOLOGY

GUIDELINES FOR PRACTICAL ASSESSMENT TASKS

GRADE 11

2017

These guidelines consist of 55 pages.

TABLE OF CONTENTS

1. INTRODUCTION

The 16 Curriculum and Assessment Policy Statement subjects which contain a practical component all include a practical assessment task (PAT). These subjects are:

- AGRICULTURE: Agricultural Management Practices; Agricultural Technology
- ARTS: Dance Studies; Design; Dramatic Arts; Music; Visual Arts
- SCIENCES: Computer Applications Technology; Information Technology
- SERVICES: Consumer Studies; Hospitality Studies; Tourism
- TECHNOLOGIES: Civil Technology; Electrical Technology; Mechanical Technology; Engineering Graphics and Design

A practical assessment task (PAT) mark is a compulsory component of the final promotion mark for all learners who offer subjects that have practical components and counts 25% (100 marks) of the end-of-year examination mark. The PAT is implemented across the first three terms of the school year. This is broken down into different phases or a series of smaller activities that make up the PAT. The PAT allows for learners to be assessed on a regular basis during the school year and it also allows for the assessment of skills that cannot be assessed in a written format, e.g. test or examination. It is therefore important that schools ensure that all learners complete the practical assessment tasks within the stipulated period to ensure that learners are promoted at the end of the school year. The planning and execution of the PAT differs from subject to subject.

Practical assessment tasks are designed to develop and demonstrate a learner's ability to integrate a variety of skills in order to solve a problem. The PAT also uses a technological process to inform the learner what steps needs to be followed to derive a solution for the problem.

The 2017 PAT has three focus areas with projects and simulations in each of the following fields:

- Electrical
- Electronics
- Digital Electronics

The PAT task consists of four simulations and a practical project. The teacher may choose any relevant practical project and use a combination of the simulations available.

The teacher has to apply assessment on an on-going basis while the learner is developing the required skills. The learners should complete four simulations and also manufacture a practical project.

The PAT incorporates all the skills the learner developed throughout the year. The PAT ensures that all the different skills will have been acquired by learners on completion of the practical work, that is electrical, analogue and digital electronics as well as the correct use of tools and instruments.

Requirements for presentation

Each learner must present the following:

- PAT file with all the evidence of simulations, design and prototyping. A copy of the PAT 2017 cover page and the relevant simulations and assessment sheets should be copied and handed to each learner to include in the file.
- Practical project with:
  - Enclosure
    - The file must include a design.
    - The enclosure and the design must match.
    - No cardboard boxes are allowed.
    - Plastic and metal enclosures are acceptable.
    - The enclosure should be accessible for scrutiny inside.
    - Lids that are secured with screws are preferred.
  - Circuit board
    - The file should include the PCB design.
    - The PCB must be mounted inside the enclosure in such a manner that it may be removed for scrutiny.
    - Switches, potentiometers, connectors and other items must be mounted.
    - Wiring must be neat and bound/wrapped.
    - Wiring must be long enough to allow for the PCB to be removed and inspected with ease.
  - Logo and Name
    - The file should contain the logo and name design.
    - Logo and name must be prominent on the enclosure.

The PAT will have a financial impact on the school's budget and school management teams are required to make provision to accommodate this particular expense.

PAT components and other items must be acquired timely for use by the learners before the end of the first term at the start of the academic year.

It is the responsibility of the HOD to ensure that the teacher is progressing with the PAT from the start of the school year.

Provincial departments are responsible for setting up moderation timetables and consequently PATs should be completed in time for moderation.

2. TEACHER GUIDELINES

2.1 How to administer the PATs

Teachers must ensure that learners complete the simulations required for each term. The project should be started in January in order to ensure its completion by August. All formal assessment is the teacher's responsibility.

The PAT should be completed during the first three terms and must be ready at the start of PAT moderation. Teachers must make copies of the relevant simulations and hand them to learners at the beginning of each term.

The PAT must not to leave the workshop and must be kept in a safe place at all times when the learner is not working on it.

Adhere to the weightings of the PAT and teachers are not allowed to change the weightings of the different sections.

2.2 How to mark/assess the PATs

The PAT for Grade 11 will be set and assessed internally, but externally moderated. All formal assessment will be done by the teacher.

The teacher is required to produce a **working model and model answer file** which sets the baseline for assessment at a Highly Competent Level for every project choice exercised by the learners. This file must include all the simulations with answers the teacher has done him-/herself. The teacher will use the model answers and project to assess the simulations and projects of the learners.

Once a facet sheet has been completed by the teacher, assessment will be deemed to be complete. **No re-assessment will be done once the facet sheets have been completed** and captured by the teacher. Learners must ensure that the work is done to the standard required before the teacher finally assesses the PAT during each stage of completion.

2.3 PAT assessment management plan

The assessment plan for the PAT is as follows:

TIME FRAME	ACTIVITY	RESPONSIBILITY
	Preparation for PAT 2017	Teacher – Builds the models and works out the model answers for the simulations for 2017. Identifies shortages in tools, equipment and consumable items for simulations which must be procured in 2017. SMT – Receives procurement requests from teachers and processes payments for the acquisition of required items.
January to March 2017	Simulations 1 and 2	Teacher – Copies and hands out simulations. Learners – Complete simulations. Teacher – Assesses simulations. HOD – Checks if tasks have been completed and marked by the teacher before the holiday.
January 2017	PAT Project: Procurement	Teacher – Obtains quotations for PAT projects. Principal – Approves PAT procurement for PAT projects. Teacher – Ensures that PAT projects are ordered and delivered. HOD – Checks on teacher to see if the process is adhered to.
February 2017	PAT Project: Learners commence with project.	Teacher – Ensures that there is secure storage for PAT projects. Teacher – Hands out and takes in PAT projects. Teacher – Includes practical sessions for learners to complete PAT project every week. Learners – Commence with completion of the PAT project. HOD – Checks on teacher to ensure that practical workshop sessions take place weekly.
April to June 2017	Moderation of Simulations 1 and 2	District Subject Facilitator/Subject Specialist will visit the school and moderate Simulations 1 and 2. 10% of learners' work is moderated.
April to June 2017	Simulations 3 and 4	Teacher – Copies and hands out simulations. Learners – Completes simulations. Teacher – Assesses simulations. HOD – Checks if tasks have been completed and marked by the teacher before the holiday.
April to June 2017	PAT project: Learners continue with project	Teacher – Ensures that there is secure storage for PAT projects. Teacher – Hands out and takes in PAT projects. Teacher – Includes practical sessions for learners to complete PAT project every week. Learners – Continue with completion of the PAT project. HOD – Checks on teacher to ensure that practical workshop sessions take place on a weekly basis.
July holiday 2017	PAT intervention	Learners who are behind on the PAT are required to complete the project during this holiday.
July to August 2017	Moderation of Simulations 3 and 4	District Subject Facilitator/Subject Specialist will visit the school and moderate Simulations 3 and 4. Different learners from the previous term. 10% of learners' work is moderated.
July to August 2017	PAT project: completion	Teacher – Ensures that there is secure storage for PAT projects. Teacher – Hands out and takes in PAT projects. Teacher – Completes the PAT project with learners and compiles the PAT file. Learners – Complete the PAT project and file. HOD – Checks to see that 100% of PAT files and project are completed and assessed
September to October 2017	PAT moderation	PAT projects are moderated by provincial subject facilitators/ subject specialists and learners should be available to demonstrate skills. 10% of learners are moderated at random.

2.4 Moderation of PATs

Provincial moderation of each term's simulations will start as early as the following term. Simulations 1 and 2 should be moderated as soon as the second term starts. Similarly, simulations 3 and 4 should be moderated in July. However, the project should only be moderated on completion.

During the moderation of the PAT the learner's file and project must be presented to the moderator.

The moderation process is as follows:

- During moderation learners are randomly selected to demonstrate the various simulations of the PAT. All four simulations will be moderated.
- **The teacher is required to build an exemplar model for each type of project chosen for the school.**
- **This model must be on display during moderation.**
- **The teacher's model forms the standard of the moderation at Level 4 (Highly Competent).**
- **Level 5 assessments must exceed the model of the teacher in skill and finishing.**
- Learners being moderated will have access to their files during moderation and may refer to the simulations they completed earlier in the year.
- Learners may not ask assistance from other learners during moderation.
- All projects and files must be on display for the moderator.
- **If a learner is unable to repeat the simulation or cannot produce a working circuit during moderation, marks will be deducted and circuits will be assessed as not being operational.**
- The moderator will randomly select not fewer than **two projects (not simulations)** and the learners involved will have to explain how the project was manufactured.
- Where required, the moderator should be able to call on the learner to explain the function and principles of operation and also request the learner to exhibit the skills acquired through the simulations for moderation purposes.
- On completion the moderator will, if needed, adjust the marks of the group up or downwards, depending on the outcome of moderation.
- Normal examination protocols for appeals will be adhered to if a dispute arises from adjustments made.

2.5 Absence/Non-submission of tasks

In the absence of a PAT mark in Electrical Technology, **without** a valid reason, the learner will be given three weeks before the commencement of the final end-of-year examination to submit the outstanding task(s). Should the learner fail to fulfill the outstanding PAT requirement, such a learner will be awarded a zero for that PAT component.

2.6 Simulations

Simulations are circuits, experiments and tests which the learner will have to build, test and measure and do practically as part of the development of practical skills. These skills have to be illustrated to the external moderator who visits the school at intervals during the school year.

Teachers who use simulation programs on computers are welcome to use them for learners to practise on. However, it is required that the circuit be built using real components and that measurements be made with actual instruments for the purposes of assessment and moderation.

The correct procedure to complete simulations is outlined below for teachers and school management teams who are responsible for the implementation of the PAT in Electrical Technology.

Step 1: The teacher will choose simulations from the examples provided.
Step 2: Compile a list of the components needed for every simulation. Add extra components as these items are very small and you will need extras because they are lost/damaged very easily when learners work with them.
Step 3: Contact three different electronic component suppliers for comparative quotations.
Step 4: Submit the quotations to the SMT for approval and procurement of the items.
Step 5: Store the components. Collate items for each simulation, thus making it easier to distribute and use during practical sessions. Ensure that the various component values do not get mixed up, as this will lead to components being used incorrectly. This could damage the component and, in extreme cases, the equipment used.
Step 6: Copy the relevant simulations and hand them out to learners at the start of the term.

Teachers are allowed to adjust circuits and component values to suit their environment/resource availability.

Teachers are required to develop a set of model answers in the teacher's portfolio.

Moderators will use the teacher's model answers and artefact when moderating.

2.7 Projects

The projects are construction projects which teachers may choose for their learners. These projects are based on proven circuits provided by schools and subject advisors. The projects are based on working prototypes and require careful construction in order for them to operate correctly.

Projects vary in cost and teachers must ensure that the projects chosen fall within the scope of the school's budget.

Once the teacher has decided on a circuit, he/she must construct the prototype. Thereafter copies of the circuit provided may be made and distributed to learners. Learners MUST redraw these circuits in their portfolios correctly.

The description of the operation of the circuits is NOT complete. Learners are required to interrogate the function of the components in the circuit provided. They should elaborate on the purpose of components in the circuit. It is recommended that learners investigate similar circuits available on the Internet and in the school library/workshop reference books.

2.8 **Working mark sheet**
(A working Excel file is provided with this PAT.)

PAT MARK SHEET		TERM 1		TERM 2		PROJECT		Total = Term1 + Term 2 + Project 250	Mark out of 100	Moderated Mark
No.	Name of Learner	Simulation 1 40	Simulation 2 40	Simulation 3 40	Simulation 4 40	Design and Make Part 1 70	Design and Make Part 2 20			
1										
2										
3										
4										
5										
6										
7										
8										
9										
10										
11										
12										
13										
14										
15										
	Total									
	Average									

Teacher Name: _____ Principal Name: _____ Moderator Name: _____

Signature: _____ Signature: _____ Signature: _____

Date: _____ Date:_____ Date:_____

SCHOOL STAMP

3. LEARNER GUIDELINES

PAT 2017 Cover Page (Place this page at the front of the PAT.)

Department of Basic Education
CAPS for Technical High Schools
Grade 11 Practical Assessment Task
Electrical Technology

Time Allowed: Term 1 to Term 3 (2017)

Learner Name: _____

Class: _____

School: _____

SPECIALISATION (Tick your specialisation):

Electrical (Power systems): ☐ (Simulation 1, 2, 3, 4, 5 & 6) (Any 4)

Electronics: ☐ (Simulation 1, 2, 7, & 8)

Digital Electronics: ☐ (Simulation 1, 2, 7, & 8)

Project (Write the name of the project): _____

EVIDENCE OF MODERATION:

NOTE: When the learner evidence (LE) selected has been moderated at school level, the table will contain evidence of moderation. Provincial moderators will sign the provincial moderation and only sign if re-moderation is needed.

Moderation	Signature	Date	Signature	Date
School-based				
Provincial moderation			Re-moderation	

MARK ALLOCATION:

PAT Component	Maximum mark	Learner mark	Moderated mark
Simulation 1	40		
Simulation 2	40		
Simulation 3	40		
Simulation 4	40		
Design and Make Project – Circuit	70		
Design and Make Project – Enclosure	20		
Total	**250**		

3.1 Instructions to the learner

- This PAT counts 25% of your final promotion mark.
- All work produced by you must be your own effort. Group work and co-operative work are not allowed.
- The PAT must be completed over three terms.
- The PAT file must contain ANY 4 simulations and a practical project.
- Calculations should be clear and include units. Calculations should be rounded off to TWO decimals. SI units should be used.
- Circuit diagrams may be hand-drawn or drawn on CAD. NO photocopies or scanned files are allowed.
- Photographs are allowed and may be in colour or greyscale. Scanned photographs and photocopies are allowed.
- This document must be placed inside your PAT file together with the other evidence.
- Learners with identical photographs will be penalised and receive zero (0) for that section.

3.2 Declaration of authenticity (COMPULSORY)

Declaration:

I _____ (Name) herewith declare that the work represented in this evidence is entirely my own effort. I understand that if proven otherwise, my final results will be withheld.

_____ _____
Signature of learner Date

As far as I know, the above declaration by the learner is true and I accept that the work offered is his or her own.

_____ _____
Signature of teacher Date

_____ _____
Signature of principal Date

SCHOOL STAMP

4. SIMULATIONS

4.1 Simulation 1: Generic

Name of learner: …….. Grade: ……... Date: ……

Practical:

Use the oscilloscope to display voltage wave forms supplied by a function generator.

Requirements:

Function generator
Oscilloscope
Probes (Leads)
Multimeter

Instructions:

4.1.1 Switch on the function generator and select the sine wave function at a frequency of 50 Hz and set the amplitude to maximum.

The learner was able to do a minimal part of the activity correctly, without assistance.	The learner was able to do a part of the activity correctly, without assistance.	The learner was able to do the activity correctly, without assistance.
1	2	3

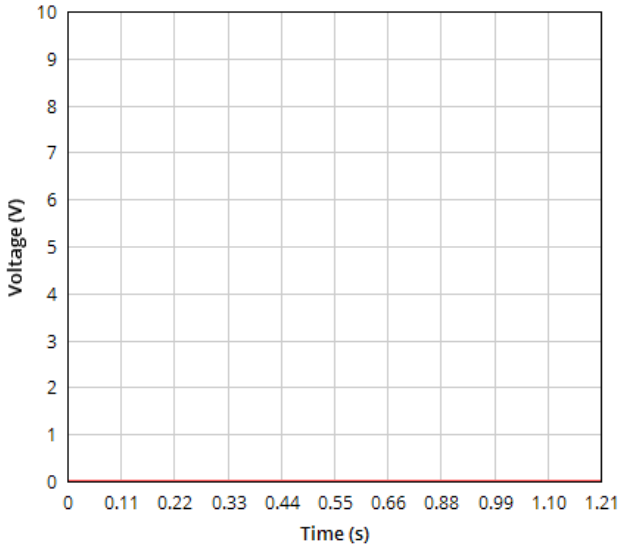
(3)

4.1.2 Switch on the oscilloscope. Set the time base and voltage base to show a clear sinusoidal waveform.

The learner was able to do a minimal part of the activity correctly, without assistance	The learner was able to do a part of the activity correctly, without assistance	The learner was able to do the activity correctly, without assistance
1	2	3

(3)

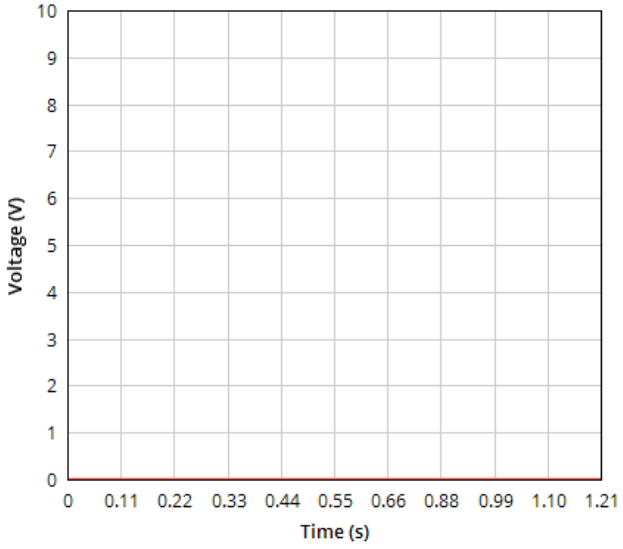
4.1.3 Connect the probe from the function generator output to the channel 1 input of the oscilloscope and sketch what you observe on the oscilloscope display below.



(5)

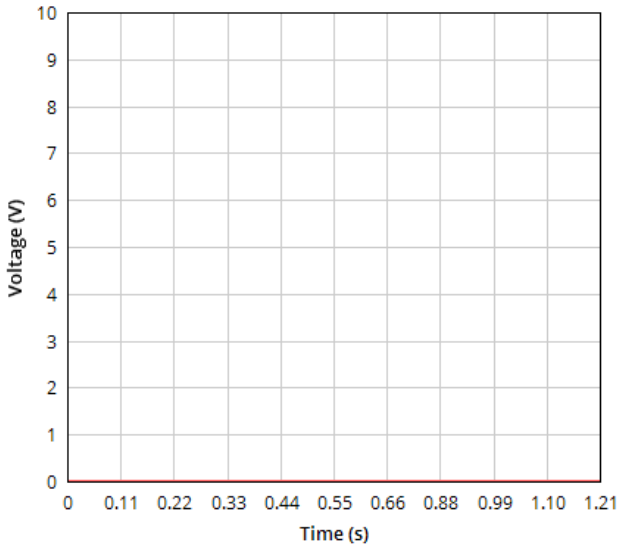
Change the waveform produced by the function generator, using the function selector to produce (a) square waveforms, and (b) triangular waveforms. Sketch what you observe in each case.

Square wave



(5)

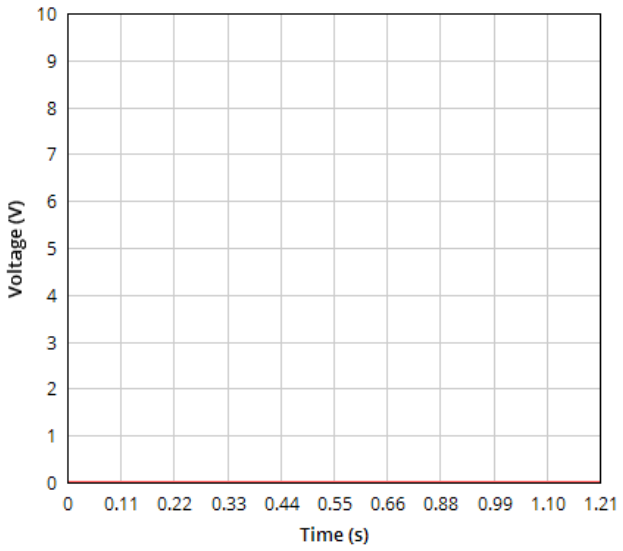
Triangular wave



(5)

4.1.4 The teacher now changes the waveform produced by the function generator and covers it. He also changes the oscilloscope settings.

(a) Name the waveform and sketch it on the grid provided.



(6)

(b) Determine the period of the waveform.

(3)

(c) Determine the frequency of the waveform.

(3)

(d) Determine the peak of the waveform.

(3)

4.1.5 **Housekeeping**

The learner did no housekeeping duties.	The learner did housekeeping after being reminded.	The learner did housekeeping without being reminded.
1	2	4

(4)
[40]

4.2 **Simulation 2: Generic**

Name of learner: …….. Grade: ……... Date: ……

Practical: RLC

Investigate the voltages across a lamp, an inductor and a capacitor at a specific voltage setting and a range of frequencies.

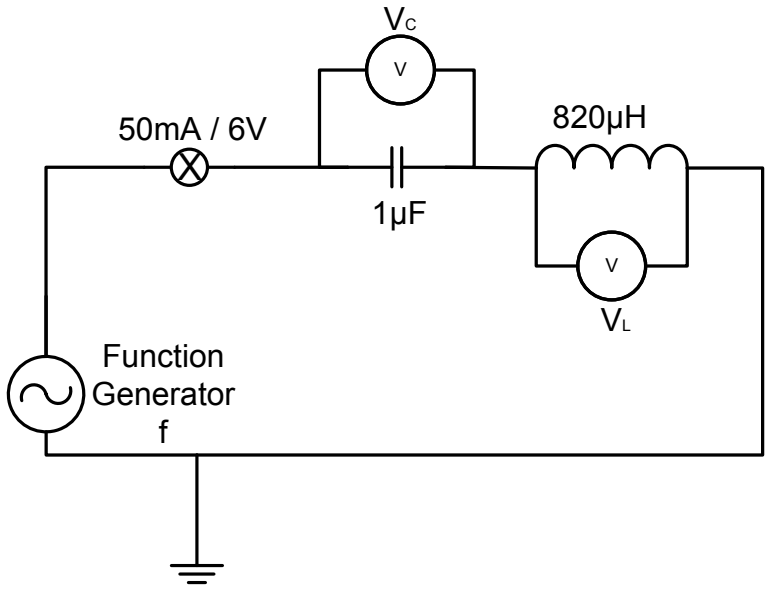
Resources:

Breadboard/Prototype board
Function generator
Dual-trace oscilloscope
Probes (Leads)
Multimeter x 2
1 µF capacitor
820 µH coil
50 mA/6 V lamp

Instructions:

4.2.1 Construct the circuit shown below.

Set the function generator to sine wave and adjust the voltage to around 5 to 6 V. Once the voltage is set do not change the amplitude setting of the voltage. Set the amplitude settings on the oscilloscope to the same for both channel 1 and channel 2.



(a) Adjust the frequency of the function generator until the reading on both meters is the same. Record the reading of the frequency and voltages across each component.

V_C	
V_L	
f	

(3)

(b) State the value of the frequency at this setting. Explain why it is this value.

(3)

(c) Adjust the frequency above this value and record the values of the voltages across the capacitor and resistor. Describe the reason for the readings on the meters.

V_C	
V_L	

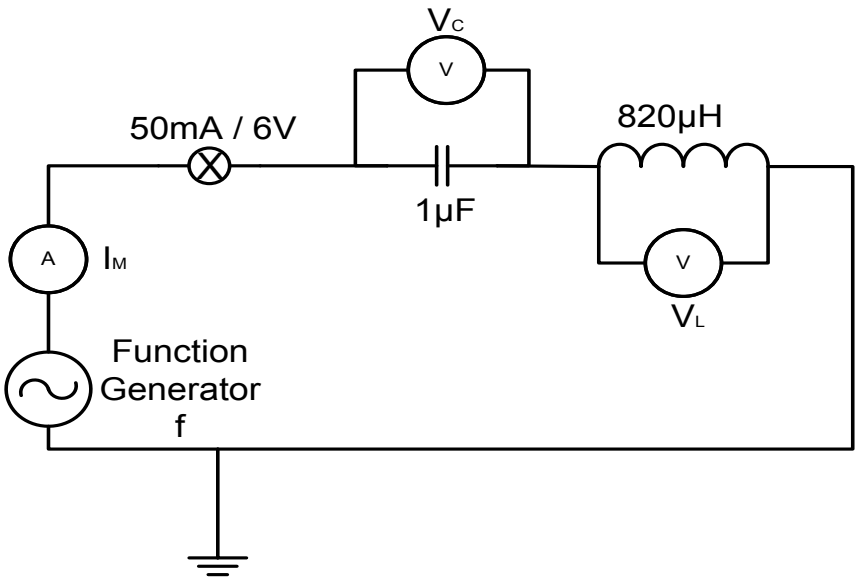
(2)

(d) Adjust the frequency below this value and record the values of the voltages across the capacitor and resistor. Describe the reason for the readings on the meters.

V_C	
V_L	

(2)

4.2.2 Connect an ammeter in the circuit to measure the current flow in the circuit, as shown below.



(a) Adjust the frequency of the function generator until the reading on the meter is at the maximum. Record the reading of the frequency and the current reading.

I_M	
f	

(2)

(b) Describe the state of the frequency when the current is at the maximum.

(2)

(c) Adjust the frequency above this value and record the value of the current. Describe the reason for the reading.

I	

(1)

(d) Adjust the frequency below this value and record the value of the current. Describe the reason for the reading.

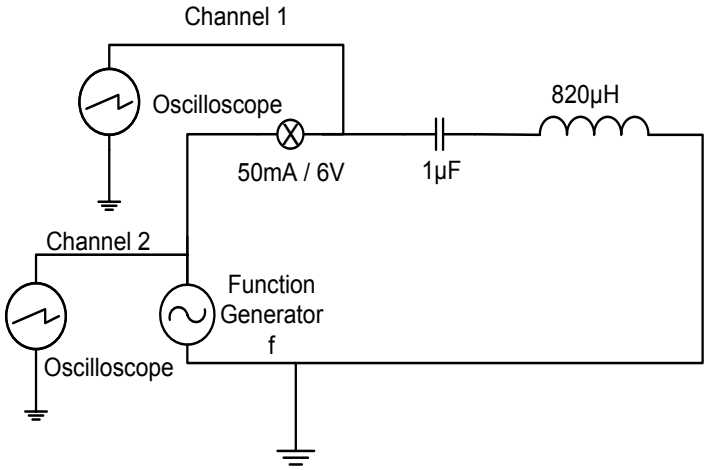
I	

(1)

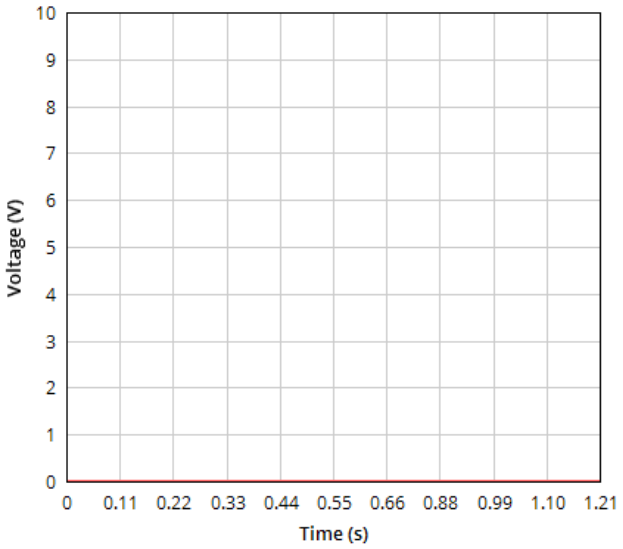
(1)

4.2.3 Connect the oscilloscope to the circuit, as shown below.

Connect channel 1 across the lamp and channel 2 across the supply. Adjust the frequency of the function generator to obtain resonant frequency by observing the changing waveforms on the oscilloscope.



(a) Draw the waveforms at resonant frequency.



(3)

(b) Describe why the waveforms are this shape.

(3)

(c) Adjust the frequency of the function generator and describe what happens to the shape of the waveforms.

(3)
[25]

FACET SHEET: SIMULATION: RLC SERIES CIRCUIT

Task Description	Mark Allocation (Tick the appropriate level next to the task descriptor.)				
	1 Not achieved	2 Not competent yet	3 Competent	4 Highly Competent	5 Outstanding
Breadboard planning and layout	☐The learner was unable to plan the board layout using the circuit diagram provided.	☐The learner was able identify the correct components and meters.	☐The learner was able to plan and place the 3 components correctly on the breadboard.	☐The learner was able to plan successfully and place all the components correctly on the breadboard with links.	☐The learner was able to plan successfully and place all the components correctly on the breadboard connected to the function generator.
Trouble-shooting	☐The learner's circuit was not complete and he/she was unable to conduct trouble-shooting.	☐The circuit was complete, but not functional. The learner was unable to identify the problem.	☐The circuit was complete and the learner was able to identify and rectify 1 mistake.	☐The circuit was complete and the learner was able to identify and rectify 2 mistakes.	☐The circuit was complete and the learner was able to identify and rectify all the mistakes.
Instrument selection and use	☐The learner was unable to select and use any instruments.	☐The learner selected and used the incorrect instruments.	☐The learner was able to select the correct instruments, but used them incorrectly/ unsafely.	☐The learner was able to select and use all instruments correctly.	☐The learner selected instruments quickly and without the help of the teacher. The learner was also able to use instruments correctly in a safe, ergonomic manner.
				Facet Sheet: (15)	
				Questions (25)	
				Total (40)	

[40]

4.3 Simulation 3: Power Systems

Name of learner: …….. Grade: ……... Date: ……

Practical:

Connect a single-phase step-down transformer to a load. The load must consist of two 24 V lamps which will give a visual output.

Resources:

Digital multimeter
220 V to 24 V single-phase transformers
24 V lamps x 2
Lamp holders x 2
Probes (Leads)

Instructions:

4.3.1 Draw and label the circuit. The circuit must show two lamps connected to the transformer and the meter connections.

(8)

4.3.2 Connect a single-phase step-down transformer to a load.

(a) Correct connection to supply (4)

(b) Correct connection to load (4)

(c) Safety precautions observed (4)

4.3.3 Measure the primary and the secondary voltages.
(One mark for the reading; one mark for the correct meter use.)

(a) V_P (2)

(b) V_S (2)

4.3.4 Measure the primary and secondary currents.

(a) I_P (2)

(b) I_S (2)

4.3.5 Connect an additional identical load to the original load and measure the same values. Comment on each value.

(a) V_P (3)

(b) V_S (3)

(c) I_P (3)

(d) I_S (3)

[40]

4.4 Simulation 4: Power Systems

Name of learner: …….. Grade: ……... Date: ……

Practical: PLC Programming

Resources:

Overload unit
Start button
Stop button
Conductors
Lamps
PLC trainer/simulator (Includes: Power supply, PLC, 8 x switches for input simulation, 4 x output status LEDs, a programming cable and software)
A computer
Contactor

Instructions:

4.4.1 Draw the control circuit of a DoL starter.

(4)

4.4.2 Draw the ladder diagram of a DoL starter.

(4)

4.4.3 With the aid a computer, write a program for the PLC for a direct-on-line control system.

(5)

4.4.4 Test the program on the computer.

Program does not work	Program works at third attempt	Program works at second attempt	Program works at first attempt
0	1	3	5

(5)

4.4.5 Load the program from the computer to a PLC.

Could not load the program	Loads the program with too much assistance	Loads the program with minimum assistance	Loads the program without assistance
0	1	3	5

(4)

4.4.6 Draw a circuit diagram for the PLC to control a light.

(5)

4.4.7 Connect the unit to control a light. (3)

4.4.8 Test the circuit.

(5)

4.4.9 Load an existing program from a PLC onto a computer. (5)

[40]

4.5 Simulation 5: Power Systems

Name of learner: …….. Grade: ……... Date: ……

Practical: Capacitor-start motors and capacitor-start-and-run motors

To develop skills for the identification and connection of capacitor-start and capacitor-start-and-run motors

Resources:

Multimeter
Clamp meter
Insulation tester
Demountable single-phase motor set

Instructions:

4.5.1 Perform the following tests on a demountable capacitor-start motor.

(a) Visual: Name FOUR parts checked and state whether they passed or failed the test.

(4)

(b) Continuity of windings

Start winding	
Continuity: Yes No	(1)
Resistance: Give value:	(1)

Run winding	
Continuity: Yes No	(1)
Resistance: Give value:	(1)

Comment on readings

(2)

(c) Insulation resistance test between windings and earth using the insulation tester

Reading:	(1)

Comment on reading

(3)

(d) Insulation resistance test between windings using the insulation tester

Reading	(1)

Comment on reading

	(3)

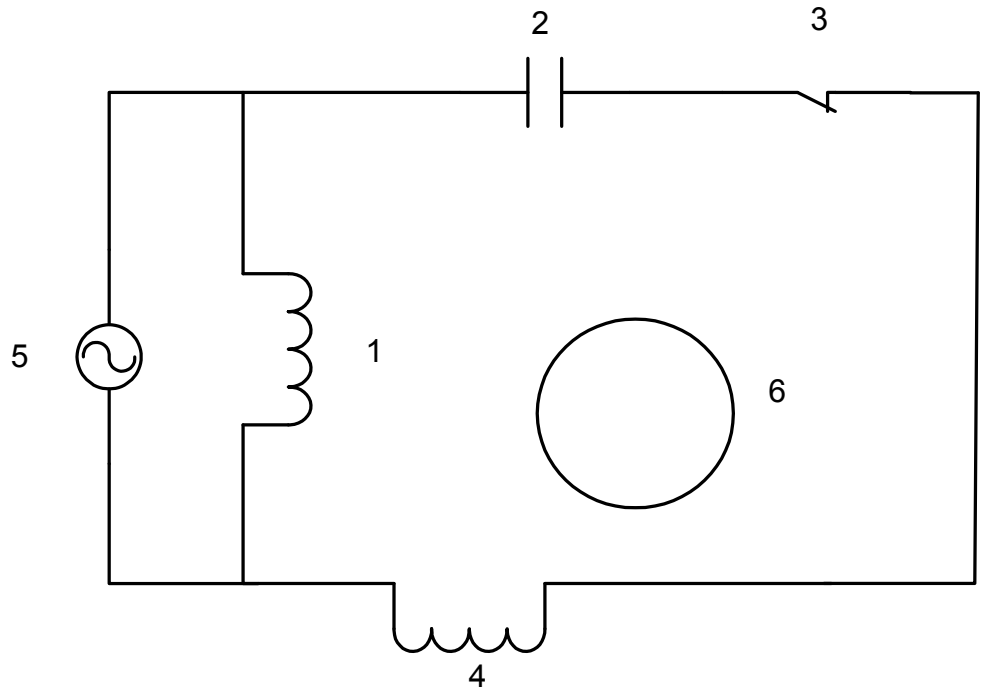
(e) Centrifugal switch

Explain the reason for the test and write down the readings.

	(3)

Reading: Open	
Reading; Closed	(2)

4.5.2 Wire the motor, as shown in the circuit diagram below.



(a) Correct identification of parts.

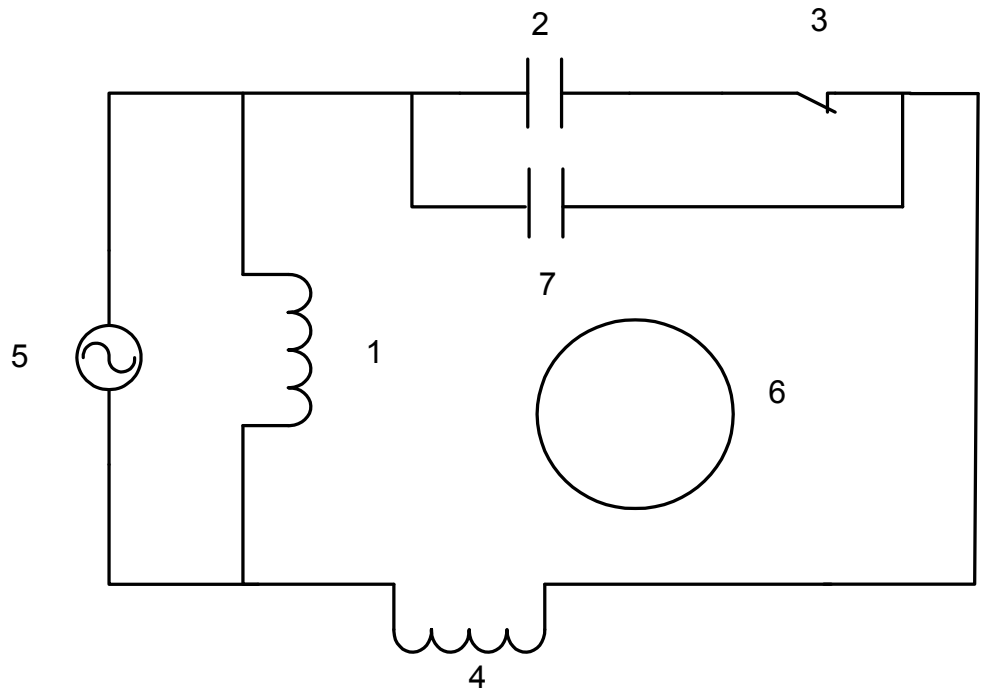
(6)

(b) Correct wiring (See facet sheet below)

Task Description	**Mark Allocation** (Tick the appropriate level next to the task description.)				
	1 Not achieved	**2 Not competent yet**	**3 Competent**	**4 Highly competent**	**5 Outstanding**
Motor Connection	☐The learner was unable to wire the motor	☐The learner made three errors	☐The learner made two errors	☐The learner made one error	☐The learner was able to wire the entire motor correctly

(5)

4.5.3 Wire the motor as per circuit diagram.



(a) Identification of additional part.

(1)

(b) Correct wiring (See facet sheet below)

Task Description	**Mark Allocation** (Tick the appropriate level next to the task description.)				
	1 Not achieved	**2 Not competent yet**	**3 Competent**	**4 Highly competent**	**5 Outstanding**
Motor Connection	☐The learner was unable to wire the motor	☐The learner made three errors	☐The learner made two errors	☐The learner made one error	☐The learner was able to wire the entire motor correctly

(5)

[40]

4.6 Simulation 6: Power Systems

Name of learner: …….. Grade: ……... Date: ……

Practical: DC motor

Explain the working principle of a DC motor.
Identify the parts a DC machine and the function of each.
Connection of a DC machine in series, shunt and compound configurations.
Perform the insulation resistance test and continuity test on motor windings.

Resources:

Function generator
Oscilloscope
Leads (Probes)
Multimeter

Instructions:

4.6.1 Disassemble a DC machine. Identify the following parts of a DC machine and explain the function of each one:

(a) Armature

(2)

(b) Commutator

(2)

(c) Brushes

(2)

(d) Yoke

(2)

(e) Name plate

(2)

(f) Field windings

(2)

(g) Lap winding vs. wave winding (Draw)

(2)

(h) Poles

(2)

(i) Interpoles

(2)

4.6.2 Connect a DC motor in the following configurations with the load and observe the speed of the motor:

(a) Series

(i) Correct connection (4)

(ii) Comment on speed before connection to a load and after connection to load

(2)

(b) Shunt

(i) Correct connection (4)

(ii) Comment on speed before connection to load and after connection to load

(2)

4.6.3 Perform the following:

(a) Insulation resistance test on motor windings:

(i) Selection of correct meter (1)

(ii) Correct setting of meter (1)

(iii) Correcting connection of meter on motor (1)

(iv) Correct reading (2)

(b) Continuity test on motor windings:

(i) Selection of correct meter (1)

(ii) Correct setting of meter (1)

(iii) Correcting connection of meter on motor (1)

(iv) Correct reading (2)
[40]

4.7 Simulation 7: Electronics and digital electronics

Name of learner: …….. Grade: ……... Date: ……

Practical: Clipping and clamping circuits on breadboard using diodes

Resources:

TOOLS AND INSTRUMENTS	MATERIALS
Breadboard	0,5 mm hook-up wire
Side cutters	470 Ω resistor
Combination pliers	10 kΩ
Multimeter	1 MΩ
Oscilloscope	1 x diode (1N4001)
Function generator	4 x1,5 V cells and cell holder
	A capacitor

Instructions:

4.7.1 Construct the simple series clipper circuit in FIGURE 4.7.1 below, on the breadboard in FIGURE 4.7.2 below.
Draw the component layout on the figure.
Set the function generator at max output voltage and a frequency of 1 kHz.
Connect the signal generator across the input of the circuit (Vi).
Connect the one probe of the oscilloscope across the output of the circuit (Vo), and the other probe across the input (Vi). Ensure that the earth terminals of both the oscilloscope and function generator are connected to the same point.

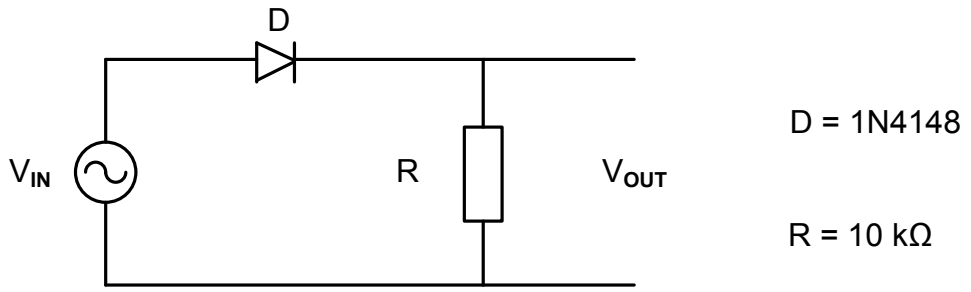


FIGURE 4.7.1

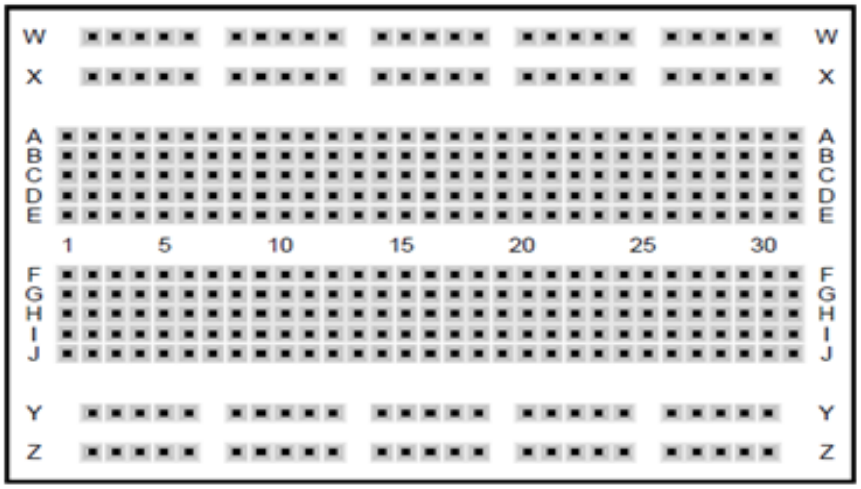


FIGURE 4.7.2 (4)

Connect the circuit to the function generator (as the input) and to the oscilloscope (as the output) only after it has been checked and approved by the teacher.

Sketch the input and the output waveforms on the display in FIGURE4.7.3 below.

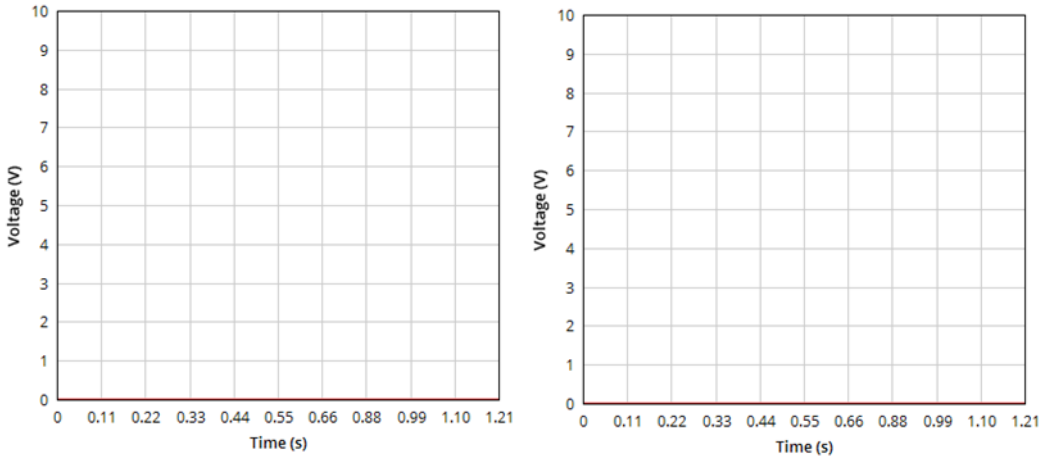


FIGURE 4.7.3 (4)

4.7.2 Construct the series biased clipper circuit in FIGURE 4.7.4 below on the breadboard in FIGURE 4.7.5 below. Draw the component layout on the figure.

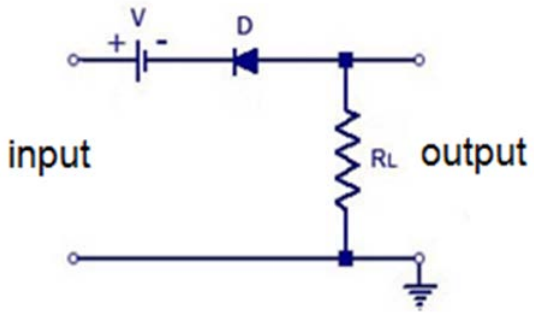


FIGURE 4.7.4

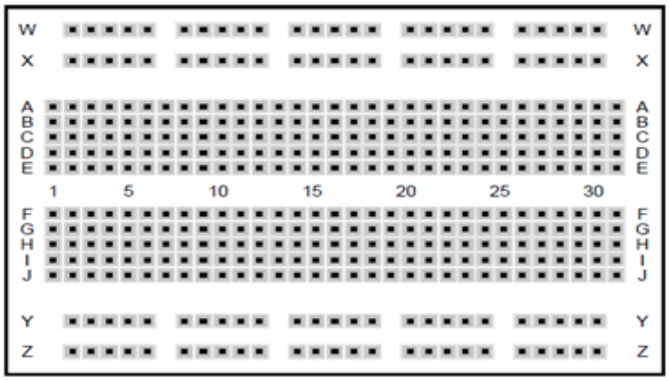


FIGURE 4.7.5 (4)

Connect the circuit to the function generator (as the input) and to the oscilloscope (as the output) only after it has been checked and approved by the teacher.

Sketch the input and the output waveforms on the display in FIGURE4.7.6 below.

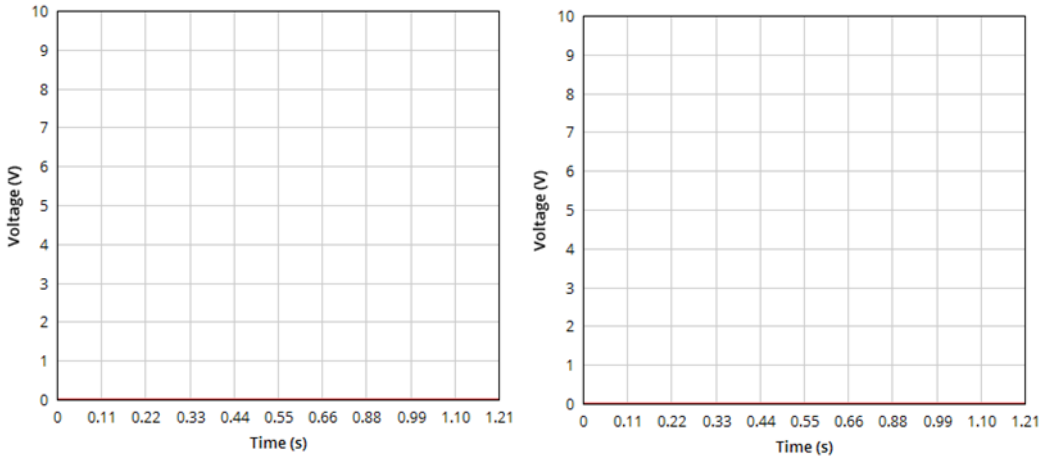


FIGURE 4.7.6 (4)

4.7.3 Construct the simple parallel clipper circuit in FIGURE 4.7.7 below on the breadboard in FIGURE 4.7.8 below. Draw the component layout on the figure.

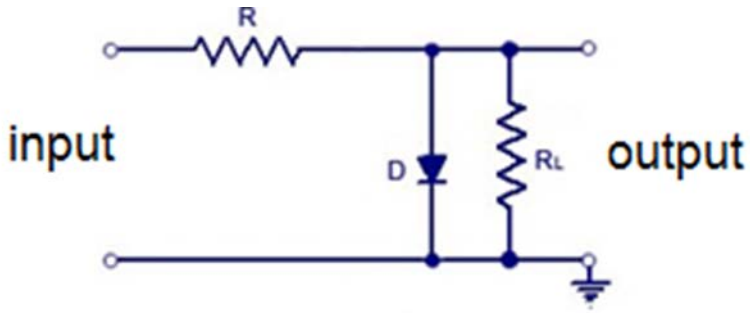


FIGURE 4.7.7

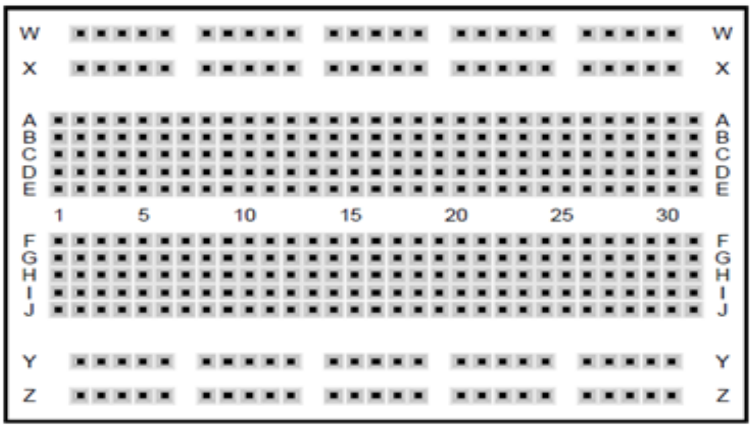


FIGURE 4.7.8 (4)

Connect the circuit to the function generator (as the input) and to the oscilloscope (as the output) only after it has been checked and approved by the teacher.

Sketch the input and the output waveforms on the display in FIGURE4.7.9 below.

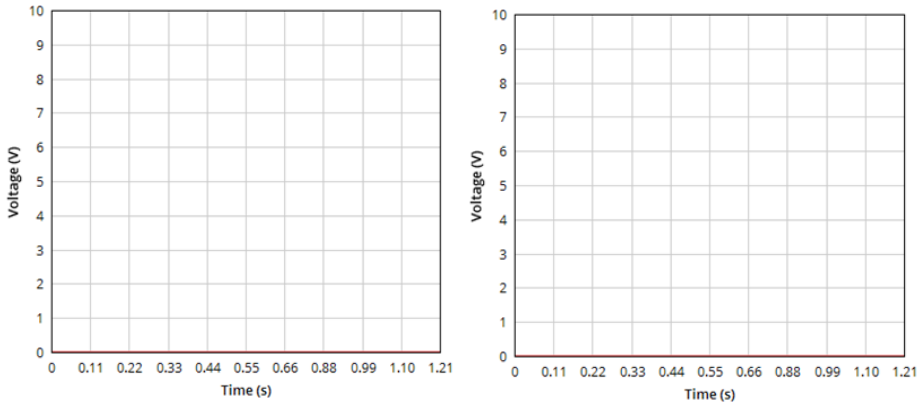


FIGURE 4.7.9 (4)

4.7.4 Construct the parallel biased clipper circuit in FIGURE 4.7.10 below on the breadboard in FIGURE 4.7.11 below. Draw the component layout on the figure.

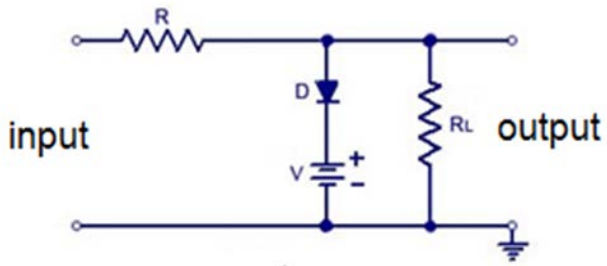


FIGURE 4.7.10

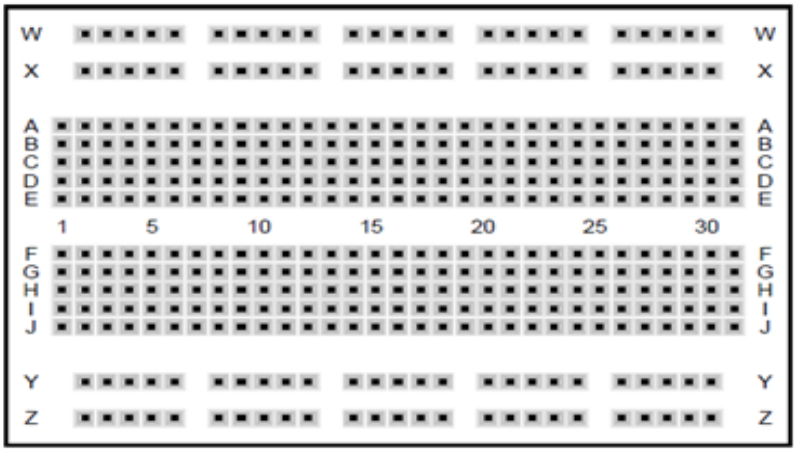


FIGURE 4.7.11 (4)

Connect the circuit to the function generator (as the input) and to the oscilloscope (as the output) only after it has been checked and approved by the teacher.

Sketch the input and the output waveforms on the display in FIGURE 4.7.12 below.

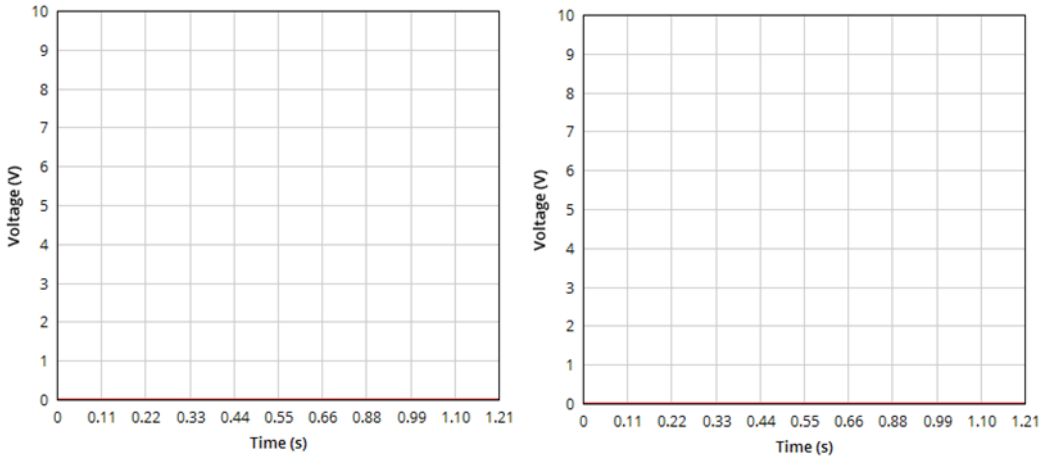


FIGURE 4.7.12 (4)

4.7.5 Construct the simple clamper circuit in FIGURE 4.7.13 on the breadboard in FIGURE 4.7.14 below. Draw the component layout on the figure.

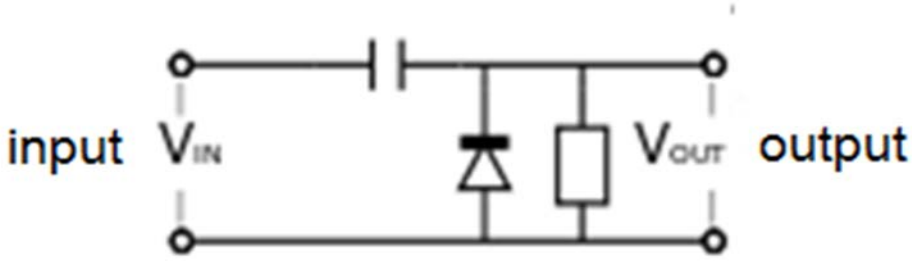


FIGURE 4.7.13

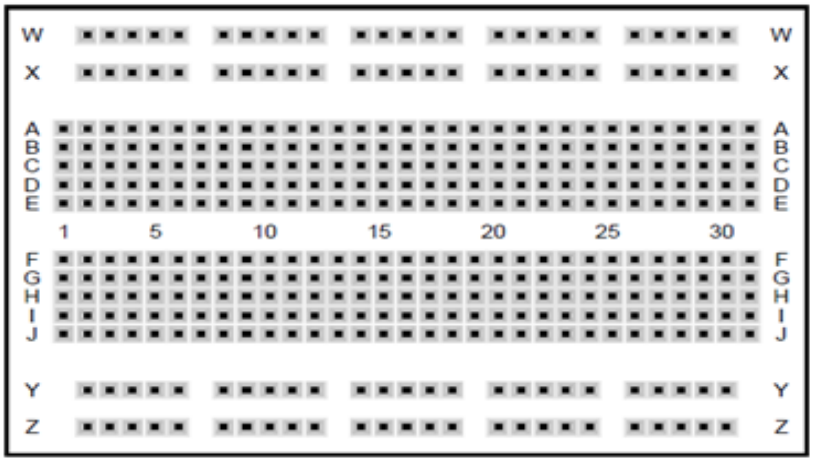


FIGURE 4.7.14 (4)

Connect the circuit to the function generator (as the input) and to the oscilloscope (as the output) only after it has been checked and approved by the teacher.

Sketch the input and the output waveforms on the display in FIGURE 3.7.9 below.

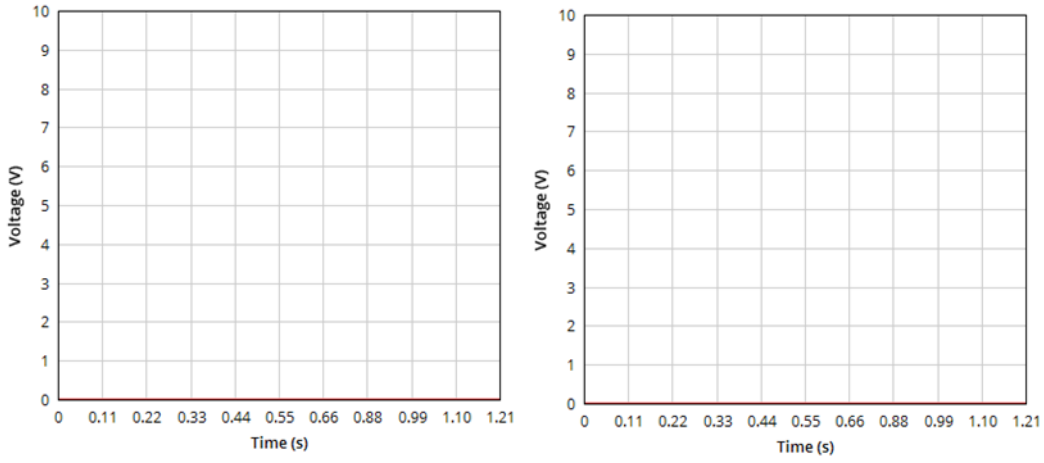


FIGURE 4.7.15 (4)

4.7.6 Construct the integrator circuit in FIGURE 4.7.16 below on the breadboard in FIGURE 4.7.17 below. Draw the component layout on the figure.

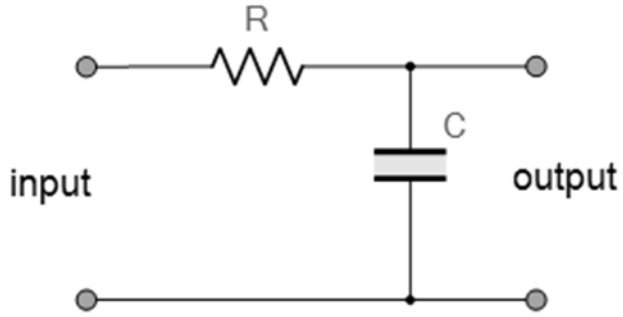


FIGURE 4.7.16

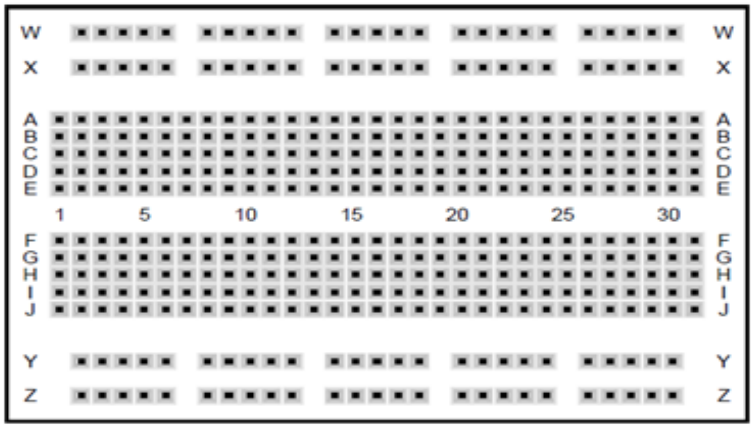


FIGURE 4.7.17 (4)

Connect the circuit to the function generator (as the input) and to the oscilloscope (as the output) only after it has been checked and approved by the teacher.

Sketch the input and the output waveforms on the display in FIGURE4.7.18 below.

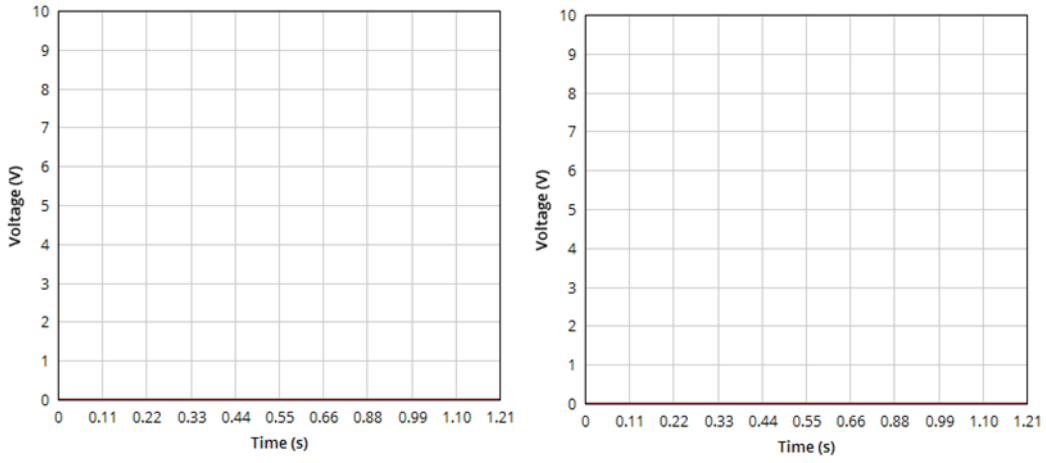


FIGURE 4.7.18 (4)

4.8 Simulation 8: Electronics and digital electronics

Name of learner: …….. Grade: ……... Date: ……

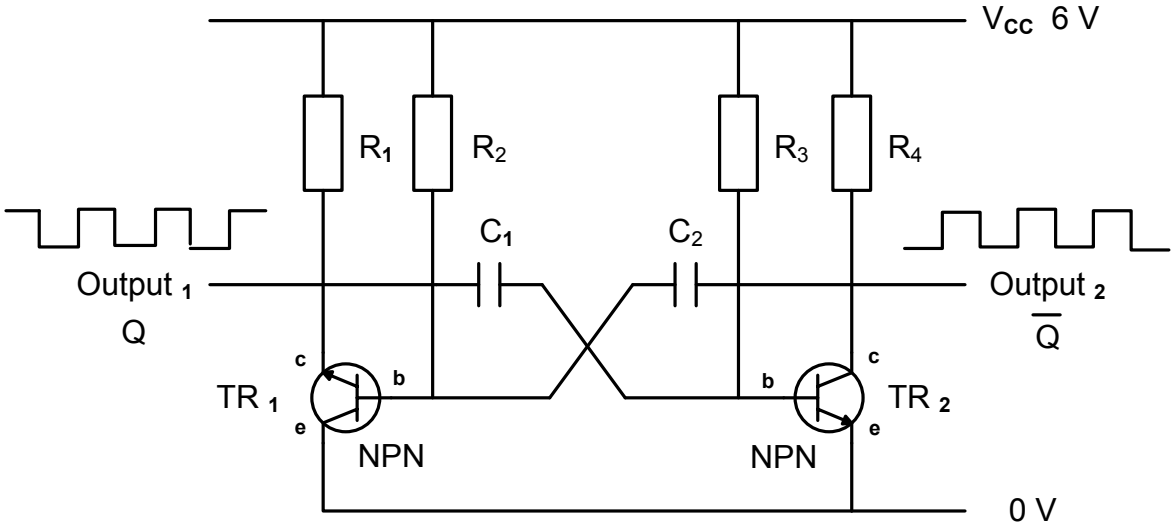
Practical: The astable multivibrator

Resources:

Oscilloscope
Variable DC supply 0–12 V
Breadboard
Connecting leads/probes
C_1 & C_2 10 µF
C_1 & C_2 1 µF
R_1 & R_4 1 kΩ
R_2 & R_3 15 kΩ

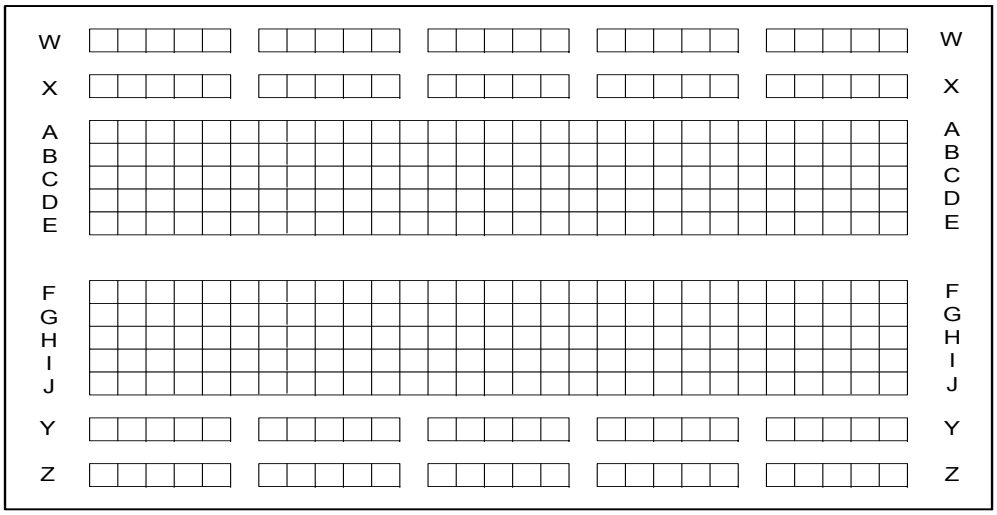
Instructions:

4.8.1 Construct the circuit shown below on the breadboard supplied. Set the supply voltage between 0 V and 12 V.



$C_1 = C_2$ $R_1 = R_2$

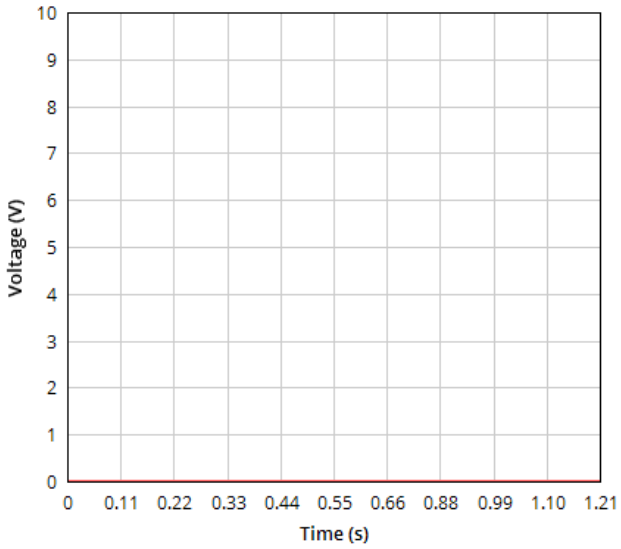
BREADBOARD



(a) Construction of the circuit. (10)

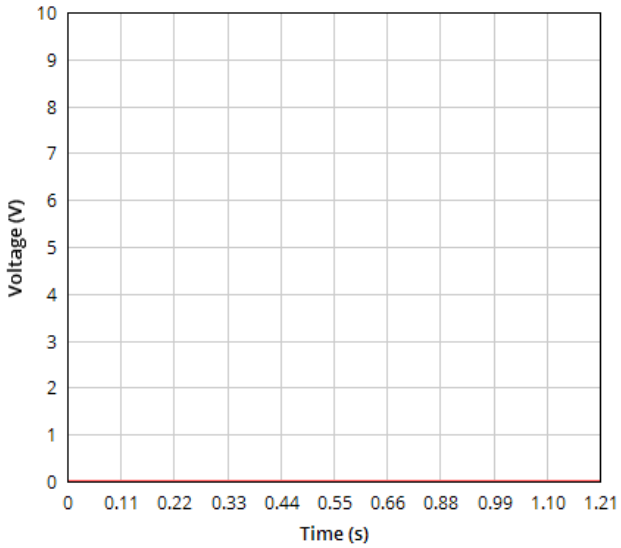
Task Description	**Mark Allocation** (Tick the appropriate level next to the task description)				
	1 Not achieved	**2 Not competent yet**	**3 Competent**	**4 Highly Competent**	**5 Outstanding**
Breadboard planning and layout	☐The learner was unable to plan the board layout using the circuit diagram provided.	☐The learner was able identify the correct components and meters.	☐The learner was able to plan and place the 3 components correctly on the breadboard.	☐The learner was able to plan successfully and place all the components correctly on the breadboard with links.	☐The learner was able to plan successfully and place all the components correctly on the breadboard connected to the function generator.
Trouble-shooting	☐The learner's circuit was not complete and she/he was unable to conduct trouble-shooting.	☐The circuit was complete, but not functional. The learner was unable to identify the problem.	☐The circuit was complete and the learner was able to identify and rectify 1 mistake.	☐The circuit was complete and the learner was able to identify and rectify 2 mistakes.	☐The circuit was complete and the learner was able to identify and rectify all the mistakes.
				Facet Sheet: (10)	

(b) Observe and draw the two output waveforms.



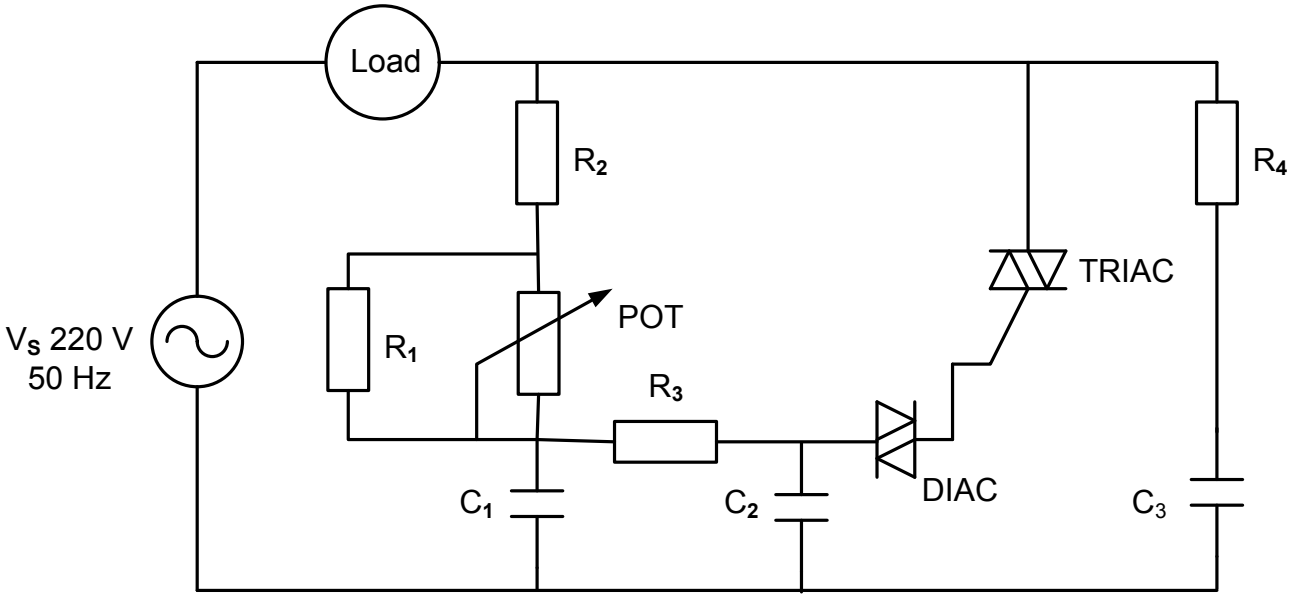
(4)

(c) Replace the 1 µF capacitors with the 10 µF capacitors. Observe and draw the two output waveforms.
Two marks for correct replacement of the components.



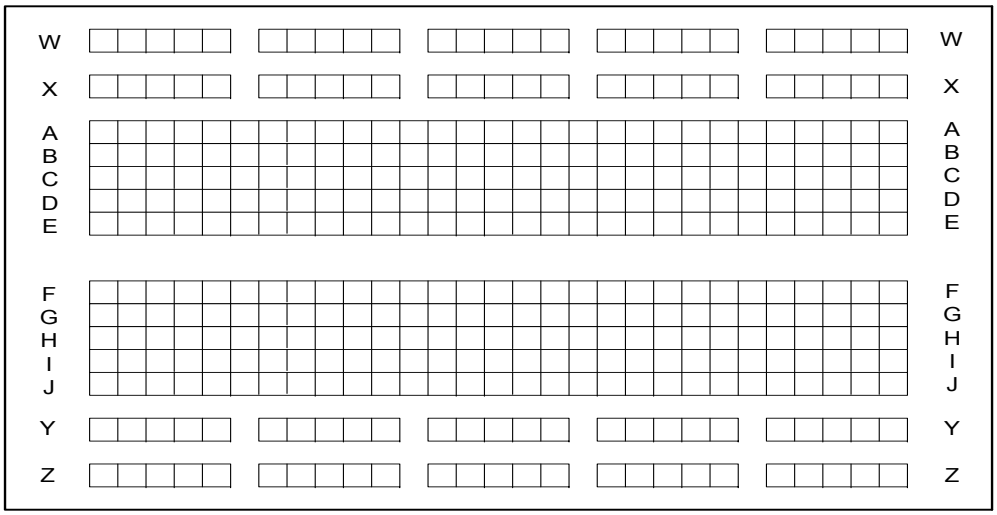
(6)

Construct the circuit shown below on the breadboard supplied. Caution must be taken when the circuit is connected to the 220 V supply.



(10)

BREADBOARD



Task Description	Mark Allocation (Tick the appropriate level next to the task description)				
	1 Not achieved	2 Not competent yet	3 Competent	4 Highly Competent	5 Outstanding
Breadboard planning and layout	☐The learner was unable to plan the board layout using the circuit diagram provided.	☐The learner was able identify the correct components and meters.	☐The learner was able to plan and place the 3 components correctly on the breadboard.	☐The learner was able to plan successfully and place all the components correctly on the breadboard with links.	☐The learner was able to plan successfully and place all the components correctly on the breadboard connected to the function generator.
Trouble-shooting	☐The learner's circuit was not complete and she/he was unable to conduct trouble-shooting.	☐The circuit was complete, but not functional. The learner was unable to identify the problem.	☐The circuit was complete and the learner was able to identify and rectify 1 mistake.	☐The circuit was complete and the learner was able to identify and rectify 2 mistakes.	☐The circuit was complete and the learner was able to identify and rectify all the mistakes.
				Facet Sheet: (10)	

(a) On completion of the circuit, insert a globe and adjust the potentiometer. The lamp should change brightness. Correct operation = 5. (5)

(b) Explain why the lamp changes brightness when the potentiometer's value is changed.

(5)
[40]

5. SECTION B: DESIGN AND MAKE

Design and Make Project

Time: January–August 2017

Learner Name: _____

School: _____

Class: _____

Title/Type of Project: _____

INSTRUCTIONS:

- This section is COMPULSORY for all learners.
- The teacher will choose a circuit for the project.
- In Grade 11 power supply is the suggested project for 2017.
- Any project constructed must include at least (but is not limited to):
  - No fewer than 7 components
  - A variety of components (both active and passive) should be used
  - PCB making in some form
  - Soldering
  - An enclosure with a switch and protection
- The checklist below must be used to ensure that all the required tasks for the PAT have been completed.

PAT Checklist

No.	Description	Tick (☑)	
		No	Yes
Design and Make: Part 1			
1	Circuit diagram drawn	☐	☐
2	Circuit description filled in	☐	☐
3	Component list completed	☐	☐
4	Tools list for circuitry populated	☐	☐
5	Measuring instrument list completed	☐	☐
6	Evidence of prototyping printed and pasted into the file	☐	☐
7	Learner's own Vero-board/PCB planning/design printed and included in file	☐	☐
Design and Make: Part 2			
1	Enclosure design completed and included in the file	☐	☐
2	Unique name written down and included on the enclosure	☐	☐
3	Logo designed and included on the enclosure	☐	☐
Miscellaneous			
1	Enclosure included in the project	☐	☐
2	Enclosure prepared and drilled according to the design	☐	☐
3	Enclosure finished off and completed with name and logo	☐	☐
4	PCB securely mounted in the enclosure using acceptable techniques	☐	☐
5	Circuit inside the enclosure is accessible	☐	☐
6	Internal wiring neat and ready for inspection	☐	☐
7	File and project completed and ready for moderation in the workshop/room	☐	☐

5.1 Design and Make: PART 1

5.1.1 Circuit diagram

Draw the circuit diagram of your project.

5.1.2 Project: Description of operation

Use the space provided below to give an overview of how your project functions. Use your own words and do some research of your own.

5.1.3 **Component list**

Draw up a list of components you will need according to the circuit diagram.

LABEL	DESCRIPTION AND VALUE	QUANTITY

5.1.4 **Tool/Instrument list**

Draw up a list of tools you will need to complete the PAT circuitry. You may add to the list as you proceed through the PAT.

DESCRIPTION	PURPOSE/USE

5.1.5 **Evidence of prototyping**

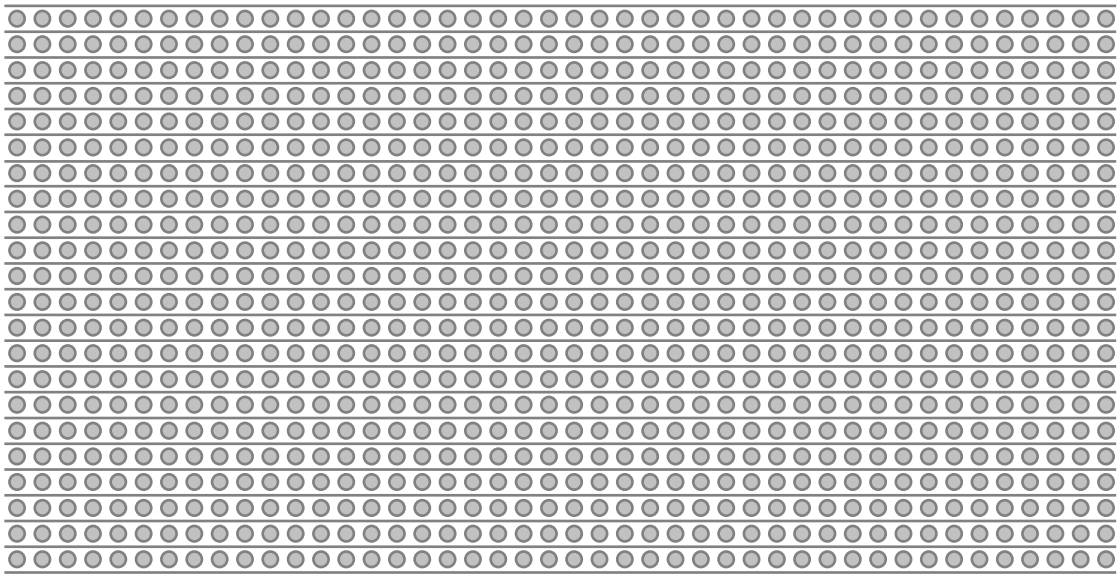
Take photographs of the working circuit on the breadboard using a digital camera or a cellphone and insert below. Add your name on the photographs.

5.1.6 **Vero-board planning/PCB design**

Design a Vero-board **OR** PCB design for the circuit you are going to build. Do EITHER the one OR the other – NOT both! Place your design below!

Final design: Vero-board (same size and placement of components)

Use an **X** to show breaks made on the track



Printed Circuit Board Planning

5.2 Assessment of the design-and-make phase: Part 1

No.	Facet Description	Mark	Achieved ✓ Not Achieved ✗
Circuit Diagram			
1	Circuit diagram was drawn using EGD equipment	1	
2	Circuit diagram was drawn with EGD equipment and CAD	1	
3	Circuit diagram was drawn using correct symbols	1	
4	Circuit diagram has all the labels – R1, C1, Tr1, etc.	1	
5	Circuit diagram has all the component values –100 Ω, 220 µF, etc.	1	
6	Circuit diagram has a name	1	
7	Circuit diagram has a frame and title block (EGD approach)	1	
Component List			
8	Labels correlate with circuit diagram	1	
9	Description and values correlate with circuit diagram	1	
10	Quantities are correct	1	
Description of Operation			
11	Basic function of the circuit is described correctly	1	
12	All components in the circuit diagram and component list are included in the description	1	
13	Purpose of all components in the circuit diagram and component list is described correctly.	1	
14	Learner used own interpretation and did not copy from another source verbatim	1	
15	Sources are acknowledged	1	
Tool/Instrument List			
16	The tool/instrument list is completed	1	
17	The tools/instruments listed all have a purpose for being used	1	
Evidence of Prototyping on Breadboard			
18	Unique original photographs of the prototyping are included – Photos must not match any other learner's	1	
19	Unique original photographs include the learner's name	1	
20	Photographs are clear and in focus – All components are clearly identifiable	1	
21	Prototype is operational – No photograph – no mark	2	
22	Video of working prototype is available for confirmation	3	
Vero-board Planning/PCB Design			
23	Board design is included in the PAT file	1	
24	Component overlay showing placement is included	1	
25	Components are labelled the same as in the circuit diagram	1	
26	Colour is used in the PCB Design	1	
27	The design is original and does not match any other learner's design	1	
28	Board layout (tracks/current flow) is functional and matches the original circuit diagram	1	

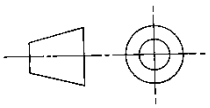
Circuit Board Manufacturing			
29	Circuit board is etched neatly according to the PCB design	5	
30	The PCB is tinned neatly (not with solder)	1	
31	The soldered PCB solder side is covered with a clear protective coating (Plastik 70/clear lacquer)	1	
32	Holes are drilled neatly and are aligned in the middle of the PADS on the PCB	1	
33	Mounting holes of the PCB are drilled symmetrically	1	
34	All burrs are removed	1	
35	The PCB is cut neatly/squarely and edges are filed neatly	1	
36	Axial and radial components are placed neatly and flush with the board	1	
37	Component orientation is aligned between similar components, e.g. the gold band of all resistors is placed on the same side	1	
38	Soldered components – leads are cut off flush and neat on the solder side	2	
39	More than 60% of solder joints are shiny (no dry joints)	2	
40	Wire insulation is stripped to the correct length (no extra copper showing)	2	
41	Wiring is long enough to allow for dismantling and inspection	1	
42	Wiring is wrapped neatly	1	
43	A power switch is included and fitted to the enclosure	2	
44	A fuse/protection is included and fitted correctly	2	
45	Wiring entering/exiting the enclosure is provided with a grommet/applicable fittings/sockets	2	
46	Batteries are mounted using a battery housing/mounting bracket and battery clip (no double-sided tape)	1	
47	The project has a pilot light/LED installed in the enclosure showing when the circuit is operational (switch is on – must go out when fuse is blown)	1	
48	The project is fully operational and commissioned/installed in the enclosure	10	

TOTAL (PART 1 = 70 marks)	

5.3 Design and Make: Part 2

5.3.1 Enclosure design

- Design an enclosure for your project.
- NO FREEHAND DRAWINGS!
- Draw using EGD equipment or use a CAD program.
- Draw in first-angle orthographic projection.



5.3.2 Manufacture the enclosure neatly according to your design.

5.3.3 Choose a name for your device.
Write down the name of the device below.

_____

5.3.4 Design a unique logo for your device below.

5.4 Assessment of the Design-and-Make Phase: PART 2

No.	Facet Description	Mark	Achieved ✓ Not Achieved ✗
Enclosure Design			
49	Enclosure design includes a first-angle orthographic projection	1	
50	Drawn design includes a title box and page border	1	
51	Isometric drawing included additionally	1	
52	Design drawn using EGD equipment	1	
53	Design done in BOTH CAD and EGD	1	
54	Design includes colour	1	
55	Dimensions included	1	
56	Name of the device is written in the PAT document	1	
57	The logo design is in the PAT document	1	
58	The logo design contains colour in the PAT document	1	
	Subtotal (10/2 = 5 marks maximum)		

Enclosure Manufacturing			
59	Enclosure matches the design – Dimensions and placement correlates	1	
60	Name of the device is on the enclosure	1	
61	The logo design is on the enclosure	1	
62	The logo design contains colour on the enclosure	1	
63	The logo design on the enclosure is durable and not merely a piece of paper pasted onto the enclosure (painted/decoupage/ screen-printed/sublimation-printed)	1	
64	The enclosure is manufactured from scratch – **Does not include:** Injection moulded plastic boxes, card board, paper, margarine tubs and recycled enclosures – **Does include:** Sheet metal, Perspex/plexi-glass/wood/glass and other raw materials	4	

65	Holes/Cut-outs in the enclosure are made with the appropriate tools	2	
66	Specification plate with learner name, operating voltage, fuse rating and additional information on the project	1	
67	Enclosure is neatly prepared, painted and aesthetically pleasing	2	
68	The circuit board is mounted using appropriate methods inside the enclosure (NO DOUBLE-SIDED TAPE, Prestik, glue, chewing gum, masking tape)	1	
		Subtotal (15 marks maximum)	

TOTAL (PART 2) **20 marks**	

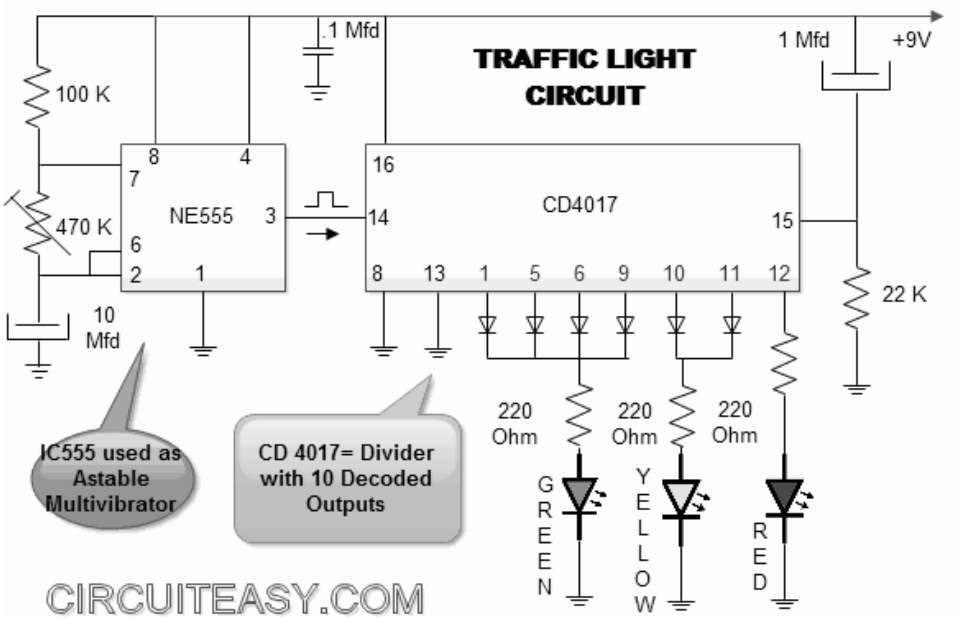
6. PROJECTS

6.1 Traffic Light

6.1.1 Component List

100 kΩ resistor
220 Ω resistor x 3
22 kΩ resistor x1
LED green x 1
LED yellow x 1
LED red x 1
1 µ F capacitor x 2
10 µF capacitor x 1
470 kΩ variable resistor x 1
IC NE555
IC CD4017
1N4007 diode x 6
PCB 150 x 100 mm

6.1.2 Circuit Diagram

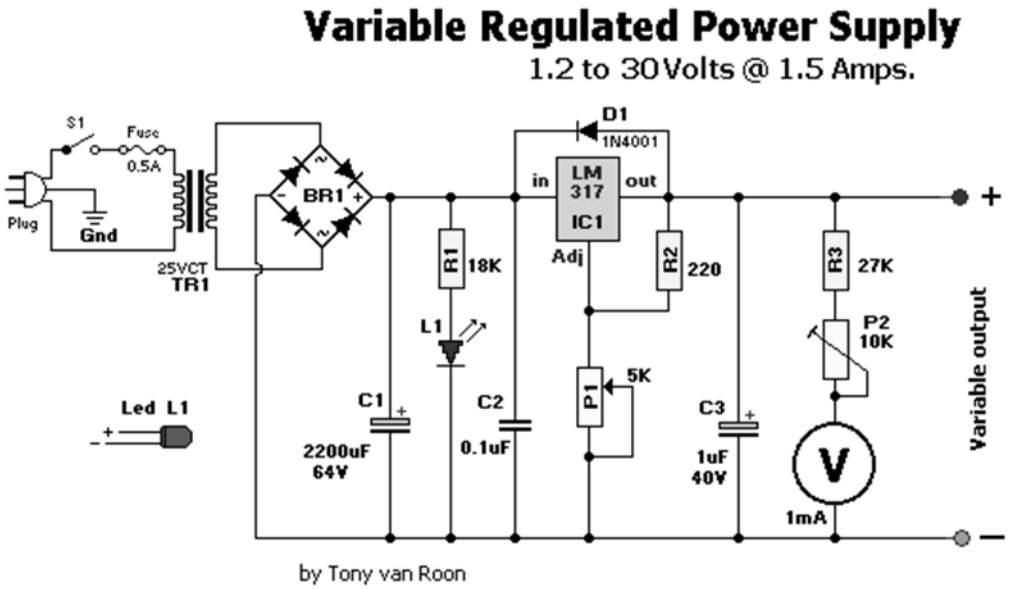


6.2 Regulated Power Supply

6.2.1 Component List

1N4001 diode
Bridge rectifier
2 200 µF/63 V electrolytic capacitor
LM317 adjustable regulator
0,1 µF ceramic capacitor
Voltmeter
1 µF/40 V capacitor
Transformer 220 V/24 V
3-wire plug and cord
1 K 8 resistor
On/Off toggle switch
220 Ω resistor
220 V, 500 mA slow-blow fuse, fuse holder
27 K resistor
Knob
5 K potentiometer
Red and black banana jacks (4 mm)
10 K trim-pot
Red and black banana jacks (4 mm)

6.2.2 Circuit Diagram



6.3 Radio Transmitter

6.3.1 Component list

BC 547 NPN transistor
Electret microphone
47 kΩ
1 nF non-polarised capacitor
10 pF non-polarised capacitor x 2
4,7 pF non-polarised capacitor
330 Ω
22 kΩ
1µF electrolytic capacitor
22 nF non-polarised capacitor
Coil (4 turns on F29 slug 3 mm diameter 0,5 mm wire)

6.3 Circuit Diagram