basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

TECHNICAL SCIENCES

GUIDELINES FOR PRACTICAL ASSESSMENT TASKS

GRADE 12

2023

These guidelines consist of 20 pages.

TABLE OF CONTENTS

1. INTRODUCTION

The 18 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, Technical Sciences, Technical Mathematics
- SERVICES: Consumer Studies, Hospitality Studies, Tourism
- TECHNOLOGY: 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 candidates offering subjects that have a practical component and counts 25% (100 marks) of the examination mark at the end of the year. The practical assessment task for Technical Sciences Grade 12 consists of THREE experiments. The experiments are COMPULSORY for all candidates offering Technical Sciences in Grade 12. The practical component counts 25% of the final promotion mark.

The PAT is implemented during the first three terms of the school year. The formal experiments allow learners to be assessed regularly during the school year and it also allows for the assessment of skills that cannot be assessed in a written format, such as tests or examinations. 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.

2. TEACHER GUIDELINES

The practical assessment tasks for Technical Sciences Grade 12 consists of three experiments. The experiments are COMPULSORY for all candidates offering **Technical Sciences in Grade 12**. The practical component counts 25% of the final promotion mark.

2.1 Moderation of the PATs

The experiments should be administered under supervised conditions. Moderation of the experiments may take place on site and can include learners redoing the experiments in the presence of the moderator.

For moderation, the following are required either in a separate class or in a laboratory:

- List of names of learners who are sampled for district moderation
- Equipment/Apparatus/Chemicals placed ready at workstations
- Instruction sheets and worksheets (empty) for sampled learners to answer questions

For moderation, the following documents are required in the teacher's file:

- Index stating all tasks with raw and weighted marks
- All instruction sheets for all experiments
- Marking guidelines for all experiments
- Composite working mark sheet for all learners showing raw and weighted marks
- Evidence of internal moderation

For moderation, the following documents are required in the learner's file:

- Index stating all tasks with raw and weighted marks
- Answer sheets for all experiments
- Declaration of authenticity

2.2 Procedure for administering the formal experiments

- All formal experiments have the following documents:
  - Instructions sheets explaining the procedure to be followed for the experiments
  - The worksheet consisting of questions to be answered under supervision
  - The teacher's guide with instruction sheets, worksheets and marking guidelines (The teacher's guide should NOT be released to the learners.)

  NOTE: Teachers should compile marking guidelines for the actual results of the experiments conducted (The teacher should perform the experiment prior to the learners performing the experiment.)
- The teacher should hand out ONLY the **instruction sheet** for the conduct of the experiment.
- The experiments should be done individually or in pairs.
- In the case where there is insufficient apparatus, the experiments can be performed in groups. Groups may not have more than FIVE learners.
- Each learner should record his/her OWN data or observations.
- **Each learner should be provided with the worksheet to answer the questions under supervision conditions.**

- Teachers should only hand out the worksheets to each learner once learners have conducted the experiment and are ready to answer the questions under supervision conditions.
- If it is not possible to perform the experiment and complete the worksheet on the same day, the teacher should keep the data collected by the learners at the school after part of the experiment has been done. The data should only be handed back to the learners when they have to complete the worksheet.

3. LEARNER GUIDELINES

3.1 This practical component for Grade 12 consists of THREE experiments.

3.2 Compilation of the PAT should start in Term 1, monitored through Terms 2 and 3 and completed in Term 3.

3.3 The practical components count 25% of the final promotion mark for Grade 12.

3.4 All the work in the practical components must be the learner's own work. Group work will NOT be allowed.

3.5 Show ALL calculations clearly and include units. Round off answers to a minimum of TWO decimal places. Use correct SI units.

4. EVIDENCE OF MODERATION

LEARNER'S NAME: _____

SCHOOL: _____

	SIGNATURE OF TEACHER	DATE	SIGNATURE OF HOD	DATE
MODERATION: SCHOOL-BASED				

PRACTICAL COMPONENT	MAX. MARK	WEIGHTING	LEARNER'S MARK (TEACHER)	MODERATED MARK (SCHOOL)	MODERATED MARK (DISTRICT)	MODERATED MARK (PROVINCE)
EXPERIMENT 1	**40**	**40**				
EXPERIMENT 2	**30**	**30**				
EXPERIMENT 3	**30**	**30**				
TOTAL	**100**	**100**				

SCHOOL STAMP

5. EXAMPLE OF PAT MARK SHEET

TECHNICAL SCIENCES GRADE 12									
PAT WORKING MARK SHEET 2023									
SCHOOL:									
			TERM 1		TERM 2		TERM 3		TOTAL PAT
			Experiment 1: PAT		Experiment 2: PAT		Experiment 3: PAT		
			Raw	Weighted	Raw	Weighted	Raw	Weighted	
No.	SURNAME	NAME	40	40	30	30	30	30	100
1.									
2.									
3.									
4.									
5.									
6.									
7.									
8.									
9.									
10.									
11.									
12.									
13.									
14.									
15.									
16.									
17.									
18.									
19.									
20.									
21.									
22.									
23.									
24.									
Average									

6. DECLARATION OF AUTHENTICITY

NAME OF SCHOOL: ..……..

NAME OF LEARNER: ……..……...
(FULL NAME(S) AND SURNAME)

CLASS: ……..……

NAME OF TEACHER: ……

I hereby declare that the tasks submitted for assessment is my own original work and have not been submitted for assessment or moderation previously.

_____ _____
SIGNATURE OF CANDIDATE **DATE**

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

_____ _____
SIGNATURE OF TEACHER **DATE**

SCHOOL STAMP

7. CONCLUSION

On completion of the practical assessment task learners should be able to demonstrate their understanding of the industry, enhance their knowledge, skills, values and reasoning abilities as well as establish connections to life outside the classroom and address real-world challenges. The PAT furthermore develops learners' life skills and provides opportunities for learners to engage in their own learning.

8. EXPERIMENT INSTRUCTIONS AND WORKSHEETS

EXPERIMENT 1

DETERMINE THE POWER OUTPUT OF AN INDIVIDUAL

1. AIM: To determine the power output of an individual

2. APPARATUS/EQUIPMENT

- Flight of stairs
- Measuring tape/Ruler
- Bathroom scale
- Stopwatch or electronic device with digital timing function

3. PROCEDURE

3.1 Find a staircase at your school (or any nearby building with staircase).
3.2 Using a ruler or measuring tape, measure the height of one step in centimetres and record the value in Table 1.
3.3 Count the number of steps you are planning to use and record the value in Table 1.
3.4 Calculate the total height of the identified staircase in centimetres.
3.5 Convert the total height of the staircase from centimetres to metres.
3.6 Decide which learner will conduct the climbing activity and who will record the time of the climber.
3.7 Measure the mass of the stair climber and record the value in the space provided.
3.8 Calculate the weight of the stair climber in the space provided.
3.9 The stair climber then needs to walk up the staircase. Record the time it takes in seconds in Table 2. Repeat the procedure THREE times by maintaining the same pace and determine the average time taken.

3.10 Repeat Step 3.9, with the stair climber now walking faster. Record your readings in Table 3.
3.11 Calculate the average work done (in joules) on the stair climber in Steps 3.9 and 3.10. Record your data in Table 4.
3.12 Calculate the average power output (in watts) in Steps 3.9 and 3.10. Record your data in Table 5.

4. DATA REPRESENTATION

TABLE 1

Vertical height of one step in (cm)	
Total number of steps to be climbed in the staircase	
Total vertical height of the steps to be climbed in (cm)	
Total vertical height of the steps to be climbed in (m)	

- Mass of the climber (kg): _____
- Weight of the climber (N): _____

_____

_____

TABLE 2: Walking

Trial runs	1	2	3	Average
Time (s)				

TABLE 3: Walking faster

Trial runs	1	2	3	Average
Time (s)				

TABLE 4

Climbing stairs	Walking	Walking faster
Work done (J)		

TABLE 5

Climbing stairs	Walking	Walking faster
Power (W)		

WORKSHEET FOR EXPERIMENT 1

DETERMINE THE POWER OUTPUT OF AN INDIVIDUAL

PRACTICAL SKILLS

CRITERIA	MARKS
Taking measurements: • The length of the stairs • The mass of the climber	2
Stopwatch used correctly	2
Following the sequences of the instruction logically	2

(6)

DATA REPRESENTATION

TABLE 1

Vertical height of one step in (cm)	
Total number of steps to be climbed in the staircase	
Total vertical height of the steps to be climbed in (cm)	
Total vertical height of the steps to be climbed in (m)	

NOTE:

TABLE 1: ONE mark for each row (4)

- Mass of the climber (kg): _____ (1)
- Weight of the climber (N): _____

_____ (2)

TABLE 2: Walking

Trial runs	1	2	3	Average
Time (s)				

TABLE 3: Walking faster

Trial runs	1	2	3	Average
Time (s)				

NOTE:

TABLE 2 and TABLE 3: ONE mark for correctly calculating the average for each table (2)

TABLE 4

Climbing stairs	Walking	Walking faster
Work done (J)		

(5)

TABLE 5

Climbing stairs	Walking	Walking faster
Power (W)		

(5)

QUESTIONS

1. The same individuals must be used for climbing and recording the time, for the entire experiment. Give TWO reasons for this. (2)

2. Compare and explain the work done observed when the climber walks slow and faster up the staircase. (1)

3. Compare and explain the power output when the climber walks slow and faster up the staircase. (2)

4. Convert the average power in Table 5 to horsepower. (2)

5. The same climber now carries his/her school bag up the SAME FLIGHT OF STAIRS while MAINTAINING THE SAME PACE for both scenarios.

   Explain how this change will affect the following:

   5.1.1 Work done (3)

   5.1.2 Energy transferred (2)

   5.1.3 Power output (3)

[40]

EXPERIMENT 2

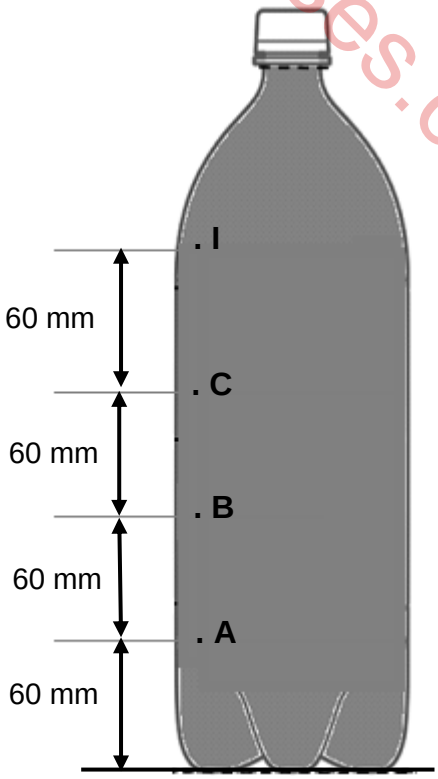
THE RELATIONSHIP BETWEEN WATER PRESSURE AND DEPTH OF WATER

1. AIM: To determine the relationship between water pressure and depth

2. APPARATUS/EQUIPMENT

- 2ℓ plastic bottle
- 5 mm drill bit
- Clean water
- Measuring tape
- Insulation tape/Plug

3. PROCEDURE



3.1 Use a 5 mm drill bit to drill three holes on the side of the 2ℓ plastic bottle at 60 mm intervals, from the bottom to the top.
3.2 Label the holes as points **A**, **B**, **C** and **I** (top).
3.3 Plug/Seal each hole tight so that water cannot escape.
3.4 Fill the plastic bottle with clean water up to point **I**.
3.5 Add a few drops of food colour to the water.
3.6 Place the water bottle on a stable horizontal surface.
3.7 Measure the depth of the water level to each hole. Record your results.
3.8 Carefully remove the plug from point **A** and measure the horizontal distance that the water squirts. Record your results in the table provided.
Repeat THREE times and each time refill the bottle to point **I**.
3.9 Refill the bottle with water to point **I**. Carefully remove the plug from point **B** and measure the horizontal distance that the water squirts. Record your results in the table provided.
Repeat THREE times and each time refill the bottle to point **I**.
3.10 Refill the bottle with water to point **I**. Carefully remove the plug from point **C** and measure the horizontal distance that the water squirts. Record your results in the table provided.
Repeat THREE times and each time refill the bottle to point **I**.
3.11 Compare the squirting distance that was observed in Steps 3.8, 3.9 and 3.10.

4. DATA REPRESENTATION: Hole C

Depth of water (mm)	**Distance water squirts (mm)**	**Pressure (Pa)** (ρ_{water}: 1 kg.ℓ$^{-1}$)
	Average:	

DATA REPRESENTATION: Hole B

Depth of water (mm)	**Distance water squirts (mm)**	**Pressure (Pa)** (ρ_{water}: 1 kg.ℓ$^{-1}$)
	Average:	

DATA REPRESENTATION: Hole A

Depth of water (mm)	**Distance water squirts (mm)**	**Pressure (Pa)** (ρ_{water}: 1 kg.ℓ$^{-1}$)
	Average:	

WORKSHEET FOR EXPERIMENT 2

THE RELATIONSHIP BETWEEN WATER PRESSURE AND DEPTH OF WATER

PRACTICAL SKILLS

CRITERIA	MARKS
• Collecting and setting up all the apparatus/tools as per the instruction/ procedure	2
Measuring skills: • Drilling THREE holes with correct intervals of 60 mm on the plastic bottle • Marking/Labelling points **A**, **B C** and **I** • Sealing each hole drilled on the bottle • Filling the bottle with water and removing the plug	6
Safety precautions: • Switching off the power supply when the drill is not in use • Safe handling of the drill	2

(10)

DATA REPRESENTATION: Hole C

Depth of water (mm)	Distance water squirts (mm)	Pressure (Pa) (ρ_{water}: 1 kg.ℓ^{-1})
	Average:	

(4)

DATA REPRESENTATION: Hole B

Depth of water (mm)	Distance water squirts (mm)	Pressure (Pa) (ρ_{water}: 1 kg.ℓ^{-1})
	Average:	

(4)

DATA REPRESENTATION: Hole A

Depth of water (mm)	Distance water squirts (mm)	Pressure (Pa) (ρ_{water}: 1 kg.ℓ^{-1})
	Average:	

(4)

QUESTIONS

1. For this practical investigation, formulate:

   1.1 An investigative question (2)

   1.2 A hypothesis (2)

2. Identify the following variables:

   2.1 Independent variable (1)

   2.2 Dependent variable (1)

   2.3 Two controlled variables (2)

[30]

EXPERIMENT 3

DETERMINE THE ELECTRODE POTENTIAL OF A MAGNESIUM-COPPER ELECTROCHEMICAL CELL

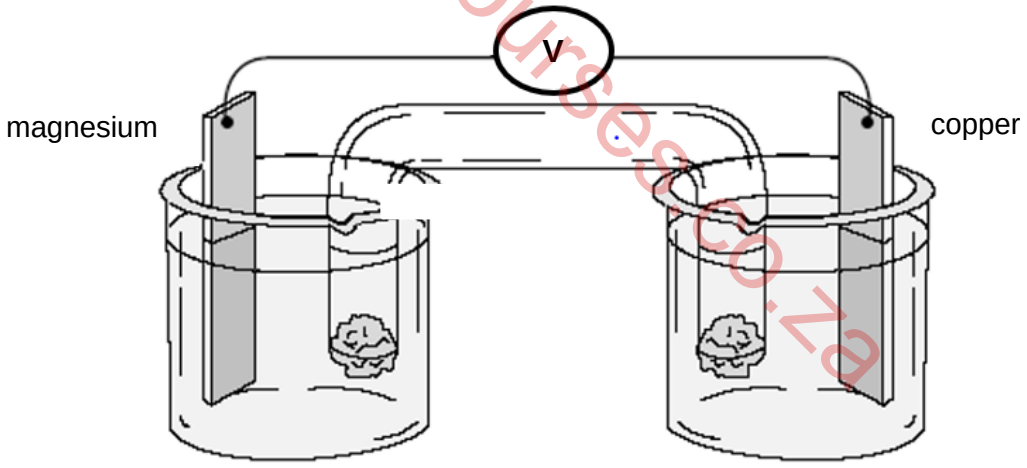
1. AIM: To determine the electrode potential of a magnesium-copper electrochemical cell

2. APPARATUS/EQUIPMENT

- Two beakers
- Magnesium rod/plate
- Copper rod/plate
- Magnesium sulphate solution (1 mol·dm^3)
- Copper sulphate solution (1 mol·dm^3)
- Salt bridge (U-tube)
- Cotton wool
- Electrolyte for the salt bridge (e.g. NaCl/KNO_3/Na_2SO_4)
- Voltmeter
- Conducting wires
- Sandpaper/wire brush/steel wool
- Measuring scale (e.g. meter balance)

3. PROCEDURE

3.1 Assemble the apparatus as shown in the diagram below.



3.2 Clean both the magnesium and copper rods/plates using the sandpaper/wire brush/ steel wool.
3.3 Measure the initial mass of the magnesium and copper rods/plates and record the values in the table.
3.4 Pour $CuSO_4$ solution in one beaker and $MgSO_4$ solution in the other beaker. (Use approximately 200 mℓ of each solution).
3.5 Record the initial reading on the voltmeter in the table.
3.6 Fill the U-tube with NaCl/KNO_3/Na_2SO_4 and then seal the opening with cotton wool.
3.7 Place the U-tube so that one end is in the $MgSO_4$ solution and the other in the $CuSO_4$ solution. Do this very quickly.
3.8 Record the reading on the voltmeter in the table once again.
3.9 Allow the experimental setup to stand for a minimum of SIX hours.
3.10 Disconnect the apparatus and then measure the mass of both electrodes. Record the values in the table.

4. DATA REPRESENTATION

TABLE

Measurements	Initial	Final
Mass of Mg electrode		
Mass of the Cu electrode		
Voltmeter reading		
Colour of $CuSO_4$		

WORKSHEET FOR EXPERIMENT 3

DETERMINE THE ELECTRODE POTENTIAL OF A MAGNESIUM-COPPER ELECTROCHEMICAL CELL

PRACTICAL SKILLS

CRITERIA	MARKS
Follow all safety precautions	1
Correct and safe handling of apparatus	1
Ensure that electrodes are cleaned	1
Correct setting up of apparatus	1

(4)

DATA REPRESENTATION

TABLE

Measurements	Initial	Final
Mass of Mg electrode (g)		
Mass of the Cu electrode (g)		
Voltmeter reading (V)		
Colour of $CuSO_4$		

(4)

QUESTIONS

1. State THREE safety precautions that should be observed in this experiment. (3)

2. How will you ensure that the results obtained are reliable? (2)

3. Give a reason for the initial reading on the voltmeter. (1)

4. Is the reaction taking place in this electrochemical cell SPONTANEOUS or NON-SPONTANEOUS? Explain. (3)

5 Write down:

   5.1.1 Which electrode (Mg or Cu) will experience loss in mass (1)

   5.1.2 A half reaction to motivate the answer to QUESTION 5.1.1 (2)

6. Which ONE of Mg or Cu^{2+} is the oxidising agent? Explain. (3)

7. If the voltmeter is removed and replaced with a light bulb, will the light bulb glow? Write down only YES or NO. (1)

8. The concentrations of both electrodes are now changed to 0,5 mol·dm^{-3}.

   8.1.1 Will the voltmeter reading remain the same? Write down only YES or NO. (1)

   8.1.2 Explain the answer to QUESTION 8.1.1. (2)

9. Write down a cell notation for the cell. (3)

[30]

TOTAL: 100