basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

TECHNICAL SCIENCES

GUIDELINES FOR PRACTICAL ASSESSMENT TASKS

GRADE 12

2024

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 of not more than FIVE learners. Each learner must submit individual work. NO group work will be allowed.

- 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. EXEMPLAR OF PAT MARK SHEET

TECHNICAL SCIENCES GRADE 12									
PAT WORKING MARK SHEET 2024									
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

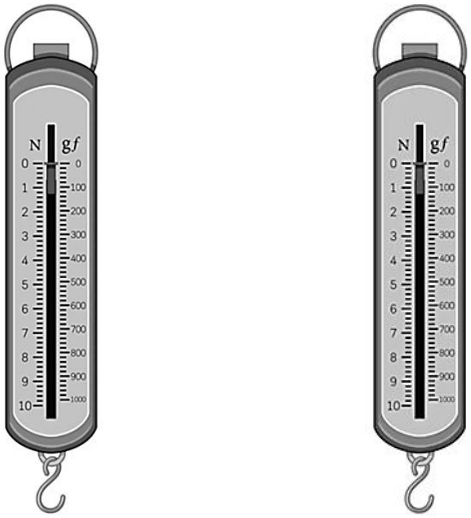
EXPERIMENT 1

THE RELATIONSHIP BETWEEN ACTION AND REACTION FORCES

1. AIM: To determine the relationship between the action and reaction pairs of forces.

2. APPARATUS/EQUIPMENT

- Two spring balances



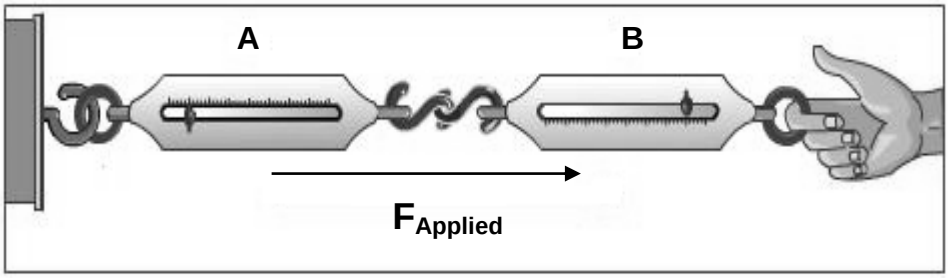
- Wall-fixed hook

3. PRECAUTIONS

- Before making use of the two spring balances, it must be ensured that their pointers are at the zero mark.
- The readings of the spring balances must be noted only when the pointers come to rest.

4. PROCEDURE

Step 1: Attach spring balance **A** to a hook fixed to the wall and attach spring balance **B** to the hook of spring balance **A**, as shown in the figure below.



Step 2: Hold the spring balances exactly horizontally with the floor.

Step 3: Pull the ring of spring balance **B** gently.

Step 4: Take and record readings on spring balances **A** and **B** in the table provided below.

Step 5: Repeat steps **2** to **4** five times by applying different forces.

TABLE OF RESULTS

	Reading on spring balance B in Newton (N)	Reading on spring balance A in Newton (N)	Difference in reading between A and B
1			
2			
3			
4			
5			

WORKSHEET FOR EXPERIMENT 1

THE RELATIONSHIP BETWEEN ACTION AND REACTION FORCES

PRACTICAL SKILLS

CRITERIA	MARKS
Correct setting-up of the apparatus	3
• Both spring balances **A** and **B** are held horizontally with the floor. • Spring balance **B** is pulled gently. • Pointers of both spring balances are at the zeo mark each time before spring balance **B** is pulled.	2 1 2
Precaution is taken so that the readings of the spring balances are recorded only when the pointers come to rest.	2

(10)

TABLE OF RESULTS

	Reading on spring balance B in Newton (N)	Reading on spring balance A in Newton (N)	Difference in reading of A and B
1			
2			
3			
4			
5			

(15)

DATA ANALYSIS AND INTERPRETATION

1. State Newton's Third Law of Motion in words. (2)

2. Write down THREE properties of action-reaction pairs. (3)

3. Give TWO real-life examples that demonstrate Newton's Third Law of Motion. (2)

4. Name the reaction force that works against the force of spring balance **A** on spring balance **B.** (2)

5. Draw a labelled free-body diagram of all the horizontal forces acting on spring balance **B**. (2)

6. If spring balance **B** exerts a force of 10 N on spring balance **A**, what is the magnitude of the force that **A** exerts on **B**? (1)

7. If the force that **B** exerts on **A** is to the right, in which direction does **A** exert a force on **B**? (1)

8. What conclusion can be made from the above experiment? (2)

[40]

EXPERIMENT 2

THE PATH OF A RAY OF LIGHT THROUGH A RECTANGULAR GLASS BLOCK FOR DIFFERENT ANGLES OF INCIDENCE

1. AIM: To determine the path of a ray of light through a glass block at different angles of incidence by drawing a ray diagram

2. APPARATUS/EQUIPMENT

- A4 sheet of white paper
- Pins/Sticky tape
- Board/Table
- Rectangular glass block
- Laser beam
- Pencil
- Ruler
- Protractor

3. PROCEDURE

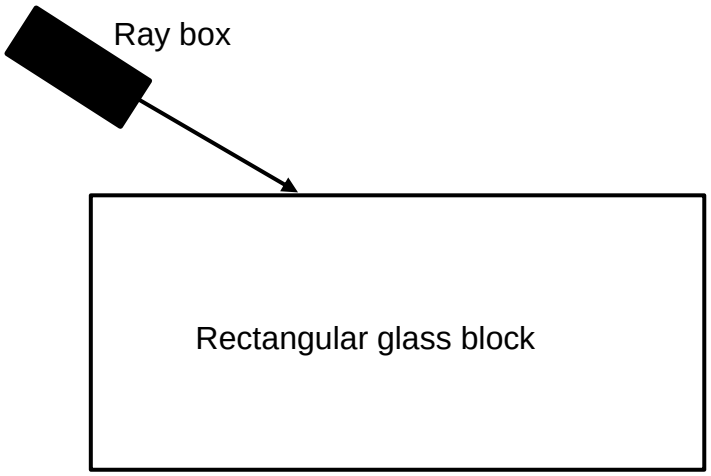
Step 1: Secure the sheet of white paper onto a flat board/ table using pins/ sticky tape.

Step 2: Place the glass block on the sheet of paper and trace the outline of the block with a sharp pencil.

Step 3: Remove the glass block and label the boundary points **A**, **B**, **C** and **D** at each corner.

Step 4: Replace the glass block on the rectangular outline on the paper.

Step 5: Turn on the ray box and aim the light through the side of the glass block, as illustrated in the diagram below.

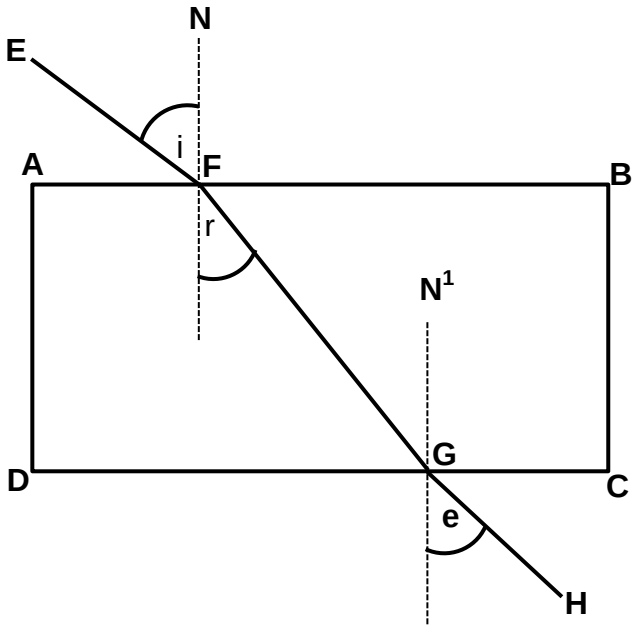


Step 6: Use a pencil to make a dot somewhere along the incident light ray, **E**. Make another dot at the point where the light ray enters the glass block. Label this point **F**.

Step 7: Use a pencil to make a dot at the point where the light ray exits the glass block. Label this point **G**. Make dots along the emergent ray, **H**.

Step 8: Turn off the ray box and remove the glass block from the paper.

Step 9: Use the ruler to join the dots so that a complete ray diagram that looks like the figure below is drawn.



Step 10: Draw the normal to the surface where the light ray enters the block and mark the angle of incidence on the top of the air/glass interface and the angle of refraction beneath it.

Step 11: Measure BOTH angles between ray **EF** and the normal with the protractor. Record the measurements on the table of results below.

Step 12: Draw the normal to the surfaces where the light ray leaves the glass block and mark the angle of refraction on the top glass/air interface and the angle of emergence beneath it.

Step 13: Measure BOTH angles between ray **GH** and the normal with a protractor. Record the measurements on the table of results below.

Step 14: Repeat steps **1** to **13**, but change the angles at which the light from the ray box is aimed through the side of the rectangular glass block, FOUR times. The light must ALWAYS strike the rectangular glass block at point **F**.

DATA REPRESENTATION

TABLE 1

Angles of incidence should be the following: 30°, 45° and 60°

Experiment	Angle of incidence (degrees)	Angle of refraction (degrees)	Angle of emergence (degrees)
1			
2			
3			

WORKSHEET FOR EXPERIMENT 2

THE PATH OF A RAY OF LIGHT THROUGH A RECTANGULAR GLASS BLOCK FOR DIFFERENT ANGLES OF INCIDENCE

PRACTICAL SKILLS

CRITERIA	MARKS
Accurately follows a sequence of verbal/written instructions	1
Has the ability to handle all apparatus safely	1
Correctly handles ray/laser beam	1
Accurately traces the outline of the glass block	1
Measures the incident angles correctly	2

(6)

QUESTIONS

1. Identify the variables in each of the following:

   1.1 Dependent (1)

   1.2 Independent (1)

2. Give ONE possible significant error in this experiment. (1)

3. State ONE safety precaution that should be adhered to. (1)

4. Use the data collected to complete the table below:

Experiment	Angle of incidence (degrees)	Angle of refraction (degrees)	Angle of emergence (degrees)
1			
2			
3			

(6)

5. DATA ANALYSIS AND INTERPRETATION

5.1 Draw a labelled ray diagram for this experiment, showing all the light rays, angles and glass block. (5)

5.2 On the surface where the light enters the glass block, what do you notice about the angle of incidence compared to the angle of refraction? (2)

5.3 Study the surface where the light exits the glass block.

How does the angle of incidence compare with the angle of refraction? (2)

5.4 How do the optical densities of refraction for air and glass compare? (1)

5.5 Discuss the path the light ray follows as it enters the rectangular glass block from the air. In the answer refer to the SPEED OF LIGHT and the DIRECTION. (2)

6. What conclusions can be drawn from this experiment? (2)

[30]

EXPERIMENT 3

DETERMINE THE CELL POTENTIALS OF ALUMINIUM-COPPER AND IRON-COPPER ELECTROCHEMICAL CELLS

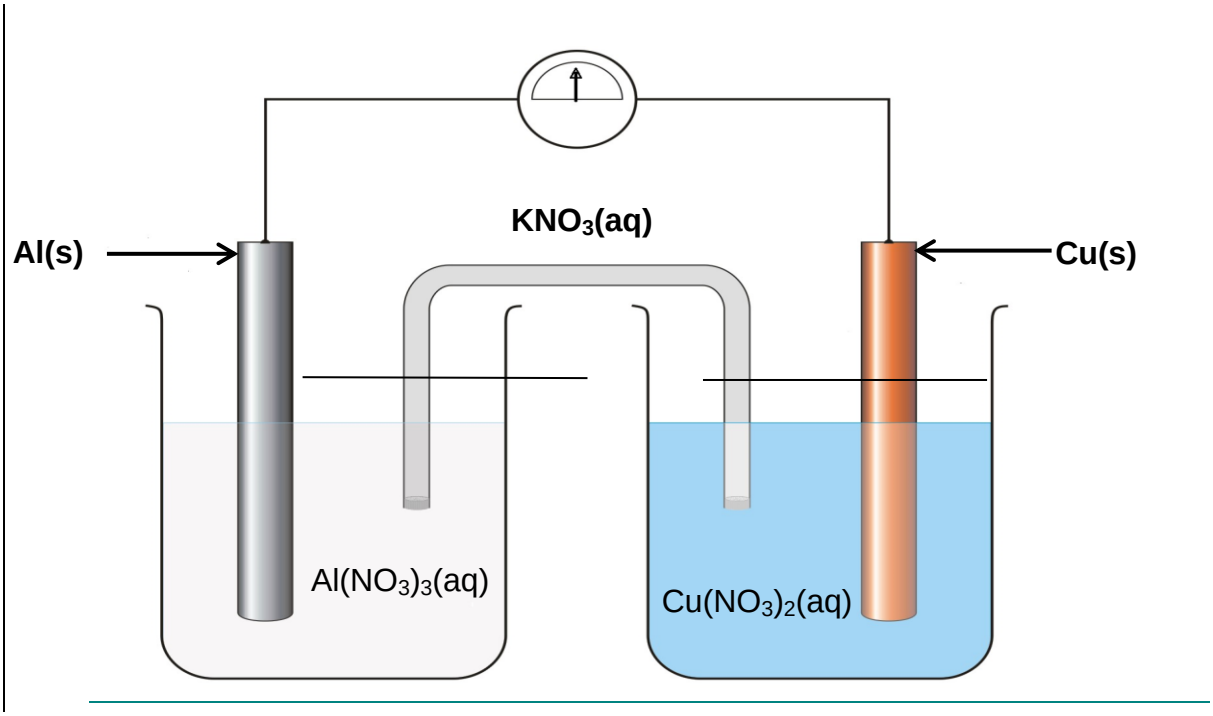
1. AIM: To determine the cell potentials of Al-Cu and Fe-Cu electrochemical cells

2. APPARATUS/EQUIPMENT

- 4 x 250 ml glass beakers
- Electrodes: Cu(s), Al(s) and Fe(s)
- Electrolytes: 1,0 mol·dm^{-3} solutions of $Cu(NO_3)_2$, $Al(NO_3)_3$ and $Fe(NO_3)_3$
- Salt bridge solution: 1,0 mol·dm^{-3} solution KNO_3
- Glass U-tube and cotton wool plugs OR strips of filter paper
- Sand paper/Steel wool
- Connecting wires
- Crocodile clips
- Voltmeter/Multimeter

3. PROCEDURE

Experimental set-up:



Step 1: Pour about 200 ml of $Cu(NO_3)_2$ solution in one of the 250 ml glass beakers and 200 ml of $Al(NO_3)_3$ in another one.

Step 2: Clean each metal electrode thoroughly with steel wool/ sand paper.

Step 3: Immerse each metal electrode in its ionic solution.

Step 4: Fill the U-tube with the KNO_3 solution and plug the cotton wool into each open end, or soak one filter paper strip with the KNO_3 solution until it is entirely wet.

Step 5: Quickly turn over the U-tube and put the one side into the $Al(NO_3)_3$ solution and the other into the $Cu(NO_3)_2$ solution.

OR

Insert one end of the filter paper strip into the $Al(NO_3)_3$ solution and the other end into the $Cu(NO_3)_2$ solution.

Step 6: Using the connecting wires and crocodile clips, connect the Al(s) to the one terminal of the voltmeter/multimeter and the Cu(s) to the other.

Step 7: Take the initial reading on the voltmeter/multimeter and record the result in the table provided below

Step 8: Assemble the Fe-Cu cell by repeating steps **1** to **7** (using $Fe(NO_3)_3$ instead of $Al(NO_3)_3$ and Fe instead of Al electrode).

4. OBSERVATIONS/RESULTS

Complete the table below using the data collected during the investigation and the calculated values.

Galvanic cell	**Standard Cell Potential (V)** $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$	**Experimental value**
Al - Cu		
Fe - Cu		

WORKSHEET FOR EXPERIMENT 3

DETERMINE THE CELL POTENTIALS OF ALUMINIUM-COPPER AND IRON-COPPER ELECTROCHEMICAL CELLS

PRACTICAL SKILLS

CRITERIA	MARKS
Wearing appropriate safety clothing (e.g., coat, goggles, rubber gloves)	1
Safety precautions: • Prevent skin or eye contact with the electrolytes. • Ensure that the room is well ventilated or work in a fume cupboard.	2
Correct and safe handling of glassware (no breakage) and chemicals (no spillage/swallowing)	2
Ensuring that electrodes were cleaned with sand paper	1
Correct assembling and handling of apparatus: • Electrodes dipped into the correct electrolyte • Salt bridge correctly assembled • Electrodes correctly connected to the voltmeter/multimeter	3

(9)

TABLE OF RESULTS

1. Complete the table below using the data collected during the investigation Calculate E^{θ}_{cell} using the Table of Standard Reduction Potential. Show all calculations.

Ga vanic cell	**Standard cell potential (V)** $E^{\theta}_{cell} = E^{\theta}_{cathode} - E^{\theta}_{anode}$	**Expe imental value**
Al - Cu		
Fe - Cu		

(8)

2. Are these electrochemical cell reactions spontaneous or non-spontaneous? Explain the answer. (3)

3. Write down ONE possible reason why the calculated values might differ from the experimental values. (1)

4. What does the plugged U-tube or moist filter paper represent? (1)

5. Is the copper electrode an ANODE or CATHODE in these cells? (1)

6. Explain the meaning of the words *reducing ability* of a substance. (2)

7. Which ONE of the metals used as electrodes in this investigation is the strongest reducing agent? (1)

8. Explain the answer to QUESTION 7 above. (1)

9. Which ONE of the metal-copper electrode combinations produced the highest cell potential? (1)

10. How does the difference in standard reduction potentials of the electrodes affect the initial cell potential of the two cells? (2)
[30]

TOTAL: 100