basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

TECHNICAL SCIENCES

GUIDELINES FOR PRACTICAL ASSESSMENT TASKS

GRADE 12

2018

These guidelines consist of 27 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
- TECHNOLOGY: Civil Technology, Electrical Technology, Mechanical Technology, Engineering Graphics and Design and Technical Sciences

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 PAT is implemented during the first three terms of the school year. The PAT allows 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.

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.

2. TEACHER GUIDELINES

2.1 How to administer the PATs

- The following documents must be available for all formal experiments:
  - Experiment instructions explaining the procedures to be followed for the experiments
  - The worksheets which include questions to be answered under examination conditions
  - The teacher's guidelines with experiment instructions, worksheets and marking guidelines (the teacher's guidelines MUST NOT be released to the learners)
  - Teachers should compile marking guidelines (memoranda) for the real results of the experiments conducted (teachers should do the experiments themselves FIRST)
- Experiments must be performed individually or in pairs. However, if sufficient apparatus is not available, experiments can be performed in groups. Each learner must record his/her OWN INDIVIDUAL data and observations.
- Each learner must have his/her OWN worksheet and answer the questions INDIVIDUALLY under exam conditions.
- Only once all the learners have performed the experiments and they are all seated and ready to answer questions may teachers hand out a worksheet to each learner. Examination conditions have to be applied.
- If it is not possible to perform the experiment and answer the worksheet on the same day, the teacher must collect the learners' data after a part of the experiment has been done. This data must be kept at school. Only when learners finalise the experiment may the data be returned to them.

2.2 Moderation of the PATs

For moderation the following are required either in a separate class or in a laboratory:
- Names of learners chosen for district moderation
- Equipment/Apparatus/Chemicals placed ready at workstations
- Experiment instructions and worksheets (blank) for chosen learners to answer questions

For moderation the following documents are required in the teacher's file:
- Index indicating all tasks with raw and weighted marks
- All experiment instructions, formal tests and examinations
- Marking guidelines for all experiments, with ticks and totals
- 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 indicating all tasks with raw and weighted marks
- Answer sheets for all experiments, formal tests and examinations

3. LEARNER GUIDELINES

3.1 This practical assessment task for Grade 12 consists of THREE experiments.

3.2 This practical assessment task contributes 25% towards your final promotion mark for Grade 12.

3.3 All work in the practical assessment task must be your own. Group work will NOT be allowed.

3.4 Show ALL calculations clearly and include units. Round off answers to TWO decimal places. Use correct SI units.

4. EVIDENCE OF MODERATION

Learner's name:	
School:	

EVIDENCE OF MODERATION

MODERATION	SIGNATURE OF TEACHER	DATE	SIGNATURE OF HOD	DATE
School-based				

5. MARK ALLOCATION

EXPERIMENT	MAXIMUM MARK	WEIGHTING	LEARNER'S MARK (TEACHER)	MODERATED MARK (SCHOOL)	MODERATED MARK (DISTRICT)	MODERATED MARK (PROVINCE)
1	35	40				
2	35	30				
3	35	30				
TOTAL	105	100				

SCHOOL STAMP

6. DECLARATION OF AUTHENTICITY

NAME OF THE SCHOOL: ……..

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

CLASS: …….

NAME OF TEACHER: ……

SCHOOL STAMP

I hereby declare that the project submitted for assessment is my own, original work and has not been previously submitted for moderation.

_____ _____
SIGNATURE OF LEARNER DATE

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

_____ _____
SIGNATURE OF TEACHER DATE

7. FORMAL EXPERIMENTS

EXPERIMENT 1: DETERMINE THE RELATIONSHIP BETWEEN ACCELERATION AND FORCE FOR A CONSTANT MASS

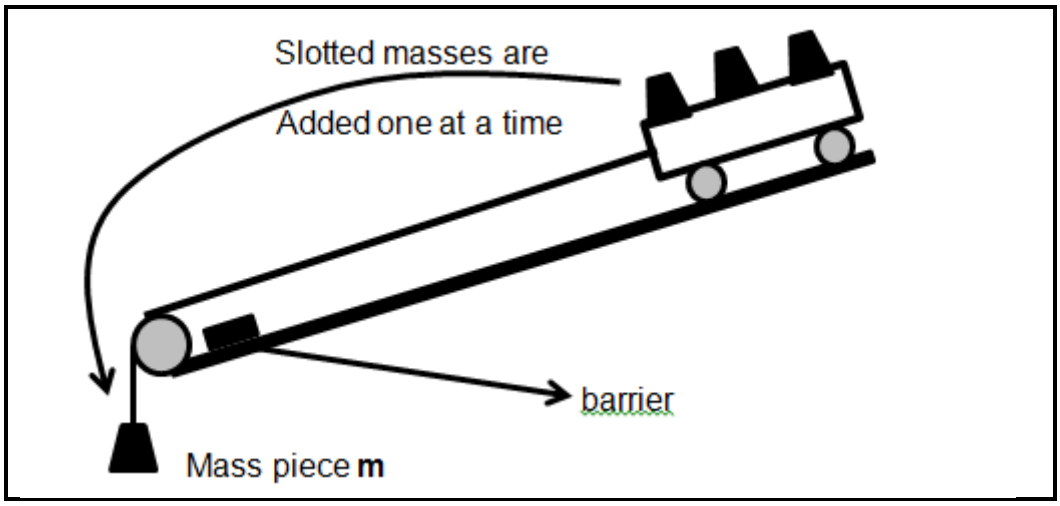
EXPERIMENT INSTRUCTIONS FOR NEWTON'S SECOND LAW: OPTION 1

AIM: To determine the relationship between the resultant force acting on an object and the acceleration produced

APPARATUS:

- Dynamics trolley kit
- 4 slotted mass pieces of equal mass
- Runway
- Inextensible string
- Stopwatch

METHOD: Set up a runway with a trolley as shown below.



1. Without any mass pieces, raise one end of the runway just enough so that the trolley rolls down the incline at constant velocity.
2. Measure the length of the runway that the trolley is going to move through.
3. Pass a piece of string, with a mass piece **m** hanging on one end, over a pulley. Attach the other end of the string to the trolley so that when the mass is released, it causes the trolley to accelerate. Attach 3 similar mass pieces to the trolley.
4. Use a stopwatch and measure the time from the moment the trolley is released up to the time it strikes the barrier. Repeat this action at least 3 times per mass so that the average of the 3 times may be used.
5. Use the readings to calculate the average velocity.
6. The force is conveniently increased when slotted masses of **m** are added. Place the unused slotted masses on the trolley. Transfer them to the slotted mass holder each time the accelerating force is increased. This ensures that the total mass experiencing acceleration remains constant throughout the experiment.
7. Repeat steps 1 to 6 with 2, 3 and then 4 mass pieces.
8. Record results.

DATA REPRESENTATION:

	Δx	**Mass (kg)**	Δt **(s)**	Δv
1				
2				
3				

When learners have completed the experiment they have to answer the questions on the worksheet under controlled conditions.

WORKSHEET FOR NEWTON'S SECOND LAW: OPTION 1

35

PRACTICAL SKILLS

1. Following instructions and manipulation

Criteria		Marks
Accurately following a sequence of written/verbal instructions	Following a sequence of instructions including branched instructions	1
Manipulative skills include correct and safe handling of apparatus and materials	Able to use all apparatus and material correctly and safely	1

2. For this experiment write down the following:

2.1 The dependent variable: (1)
2.2 The independent variable: (1)
2.3 The controlled variable: (1)

3. In point 1 of the METHOD of the experiment, you were asked to raise the runway. Draw a fully labelled free-body diagram showing ALL forces acting on the trolley placed on the raised runway and use it to explain why the runway was raised. (4)

4. What is the reason for raising the runway at one end? (2)

5. Why were the mass pieces placed on the trolley first and then transferred to the hook? (2)

6. **Data representation and interpretation of results**

Using the data collected, complete TABLE 1 below.

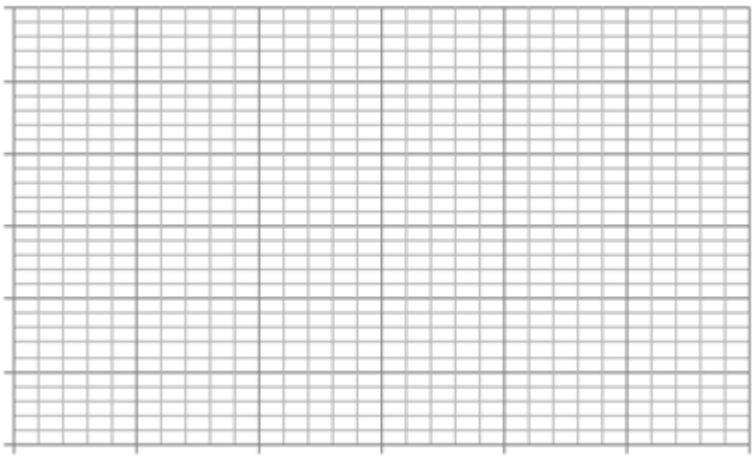
TABLE 1

	Δx	Mass (kg)	Time (s)	$\Delta v = v_f - v_i$	$a = \frac{v_f - v_i}{\Delta t}$	$F_{net}=ma$
1						
2						
3						

NOTE: 1 mark for the whole column of Δx, highlighted in light grey, then 1 mark for each subsequent reading. (18)

7. **Data analysis**

Plot a graph of acceleration versus F_{net}.



(4)

8. **Conclusion**

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

TOTAL: ____ / **35**

Total mark converted = $\frac{learners\ mark}{35} \times 40 =$ ____ / **40**

THE RELATIONSHIP BETWEEN RESULTANT FORCE AND ACCELERATION (NEWTON'S SECOND LAW)

EXPERIMENT INSTRUCTIONS FOR NEWTON'S SECOND LAW: OPTION 2

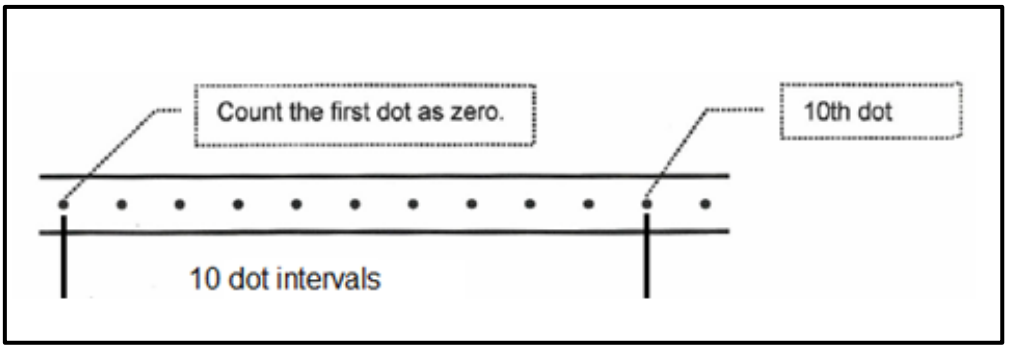
AIM: To determine the relationship between the resultant force acting on an object and the acceleration produced.

APPARATUS:

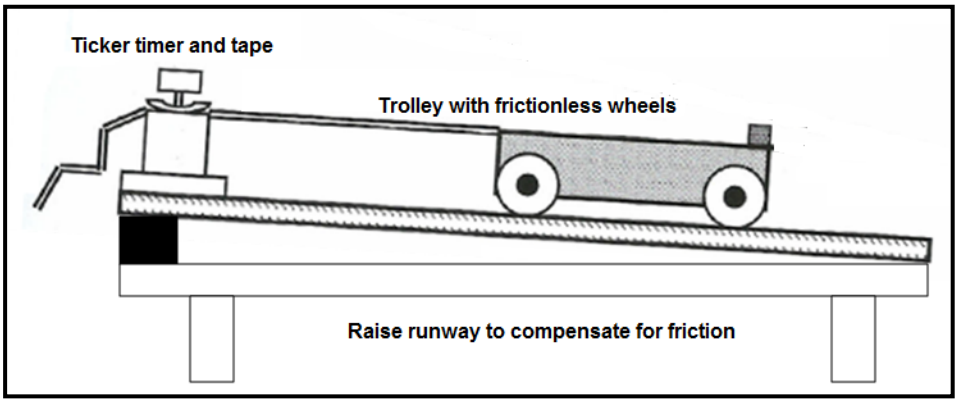
- Trolley with frictionless wheels which run on a smooth runway
- Ticker-timer and tape
- Batteries or transformer for the ticker-timer
- 3 or 4 elastic bands of the same length
- A meter ruler

METHOD:

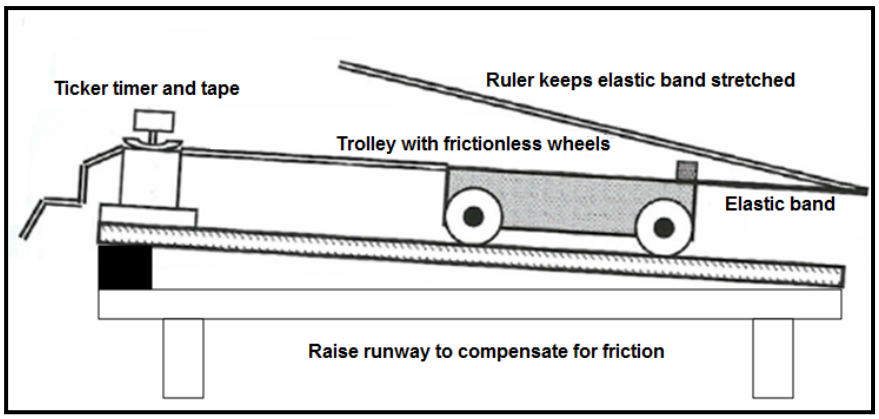
1. Select a frequency of 25 Hz or 50 Hz in the ticker-timer. Determine the period (T) of the ticker-timer.
2. Determine the time needed to make 11 dots (10 ticker-timer intervals) (t = n x T) where **n** is the number of ticks or intervals. Example:



3. Place a trolley on a runway and adjust the runway to compensate for friction on the trolley wheels (incline the runway until the trolley runs with constant velocity). See the figure below.

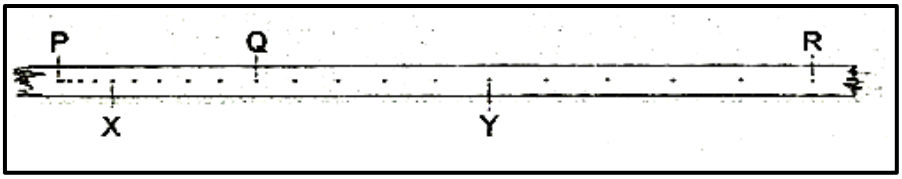


4. Attach one end of an elastic band to the trolley and the other end of the elastic band to the end of the ruler. Let a partner hold onto the trolley while you stretch the elastic band until the 800 mm mark on the ruler is in line with the front of the trolley. Signal your partner to release the trolley and move forward with the trolley keeping the elastic band stretched by the same amount. Practise this a few times.



5. Pass the tape through the timer and attach it to the end of the trolley. Make sure that the tape has no slack between the trolley and the timer. Start the timer, stretch the elastic as before (800 mm) and move forward keeping the elastic band stretched by the same amount to apply a constant force.
6. At the end of the motion remove the tape from the trolley and timer. Note the frequency of the timer and mark 10 dot intervals on the tape starting close to the beginning of the tape where the dots are clearly visible.
7. Repeat steps 5 and 6 using TWO and THREE elastics bands.
8. Analyse the tape for each case (trial) to determine the acceleration and record your results in the table below.

Trial number	**Resultant force, F (number of elastic bands)**	**PQ (m)**	**v_x ($m \cdot s^{-1}$)**	**QR (m)**	**v_y ($m \cdot s^{-1}$)**	**a ($m \cdot s^{-2}$)**	$\frac{F}{a}$
1							
2							
3							



When learners have completed the experiment they have to answer the questions on the worksheet under controlled conditions.

WORKSHEET FOR NEWTON'S SECOND LAW: OPTION 2

35

PRACTICAL SKILLS.

1. Following instructions and manipulation

Criteria		Marks
Accurately following a sequence of written/verbal instructions	Following a sequence of instructions including branched instructions	1
Manipulative skills include correct and safe handling of apparatus and materials	Able to use all apparatus and material correctly and safely	1

2. Write down the following for this experiment:

2.1 The dependent variable (1)
2.2 The independent variable (1)
2.3 The control variable (1)

3. Determine the period of the ticker timer. (2)

4. Using readings from the ticker tape, calculate the time taken for the interval. (2)

5. What is the ONE possible significant error in this experiment? (1)

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

7. Using data collected, complete TABLE 1 below.

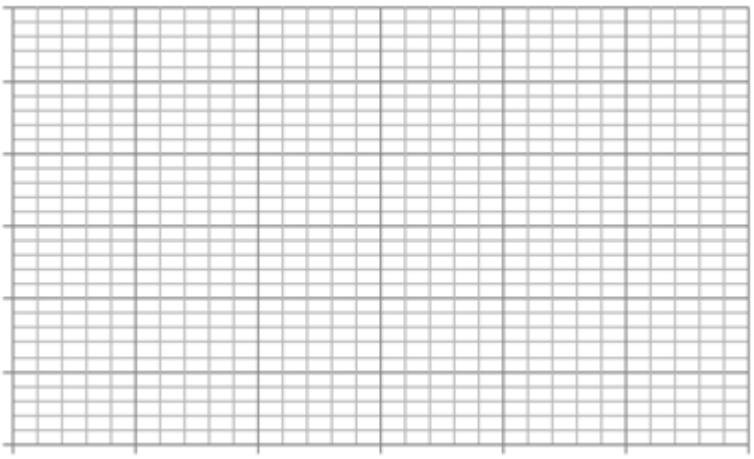
TABLE 1

Trial number	Resultant force, F (number of elastic bands)	PQ (m)	v_x ($m \cdot s^{-1}$)	QR (m)	v_y ($m \cdot s^{-1}$)	a ($m \cdot s^{-2}$)	F/a
1							
2							
3							

(18)

8. **Data analysis**

Plot a graph of acceleration versus F_{net}.



(4)

9. **Conclusion**

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

TOTAL: ____/35

Total mark converted = $\frac{learners\ mark}{35} \times 40 =$ ____/40

THE RELATIONSHIP BETWEEN RESULTANT FORCE AND ACCELERATION (NEWTON'S SECOND LAW)

EXPERIMENT INSTRUCTIONS FOR NEWTON'S SECOND LAW: OPTION 3

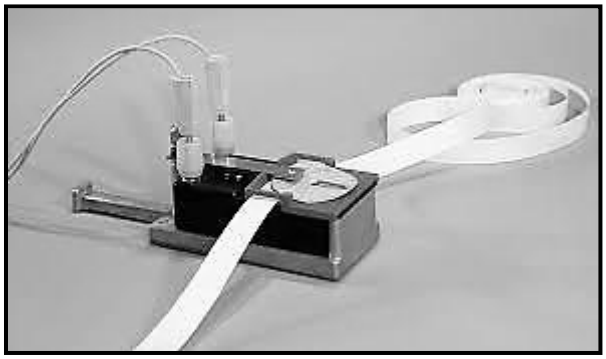
AIM: To determine the relationship between the resultant force acting on an object and the acceleration produced.

APPARATUS:

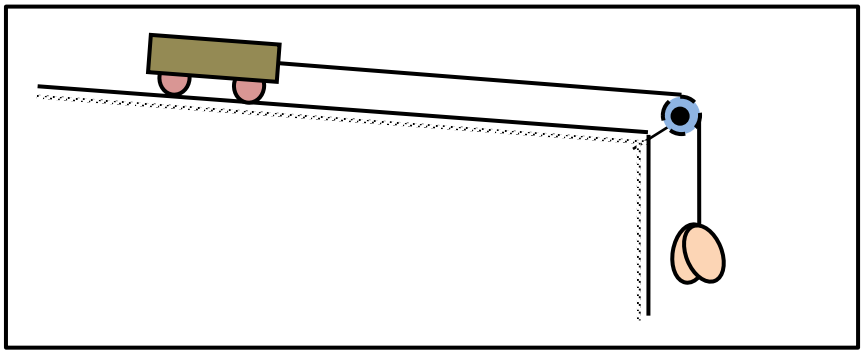
- Trolley
- Runway/Rail/Track
- Ticker-timer and tape
- Batteries or transformer for the ticker-timer
- Inextensible string
- Pulley
- Thread
- Mass pieces, 6 x 10 g or 3 x 20 g

METHOD:

1. Mount the ticker timer on the track (runway/rail).
2. Attach a carbon disc to the ticker-timer.
3. Connect the ticker-timer to a 6 V power supply.

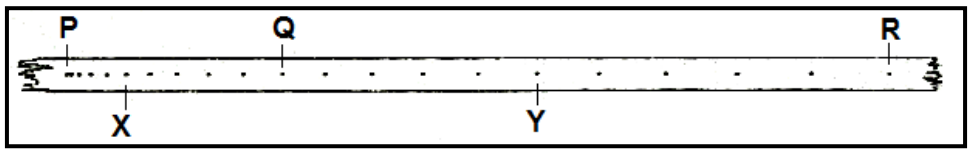


4. Select the frequency (number of dots in 1 second) 40 Hz or 50 Hz in the ticker timer.
5. Place a trolley on the runway (track/rail) and adjust the runway (track/rail) to compensate for friction on the trolley wheels (incline the runway until the trolley runs at a constant velocity).
6. Pass a string with a 20 g mass piece hanging on one end over the pulley (figure below). Attach the other end of the string to the trolley so that when the mass piece is released, it causes the trolley to accelerate. Choose a length of string such that the mass piece does not touch the ground until the trolley nearly reaches the pulley.



7. Place the unused mass pieces provided on the trolley. You are going to transfer them to the mass holder each time the accelerating force is increased. This ensures that the total mass experiencing acceleration remains constant throughout the experiment.

8. Start the timer and release the system leaving it free to move with acceleration.
9. Remove the tape and select two displacements of 10 intervals each (**PQ** and **QR**) from the starting point and measure the distance covered in each case (study the diagram below).



10. Count 5 dots for the first displacement **PQ** and mark with an **X**. Count 5 dots for the second displacement **QR** and mark with a **Y**. See diagram above.
11. Repeat steps 6 to 10 but hang masses of 40 g and 60 g respectively over the pulley transferring them from the trolley.
12. Record the data collected from the experiment in a table like the one below.

Trial number	**Resultant force, F (Fg = mg) (N)**	**Distance PQ (m)**	**v_x ($m \cdot s^{-1}$)**	**Distance QR (m)**	**v_y ($m \cdot s^{-1}$)**	**a ($m \cdot s^{-2}$)**
1						
2						
3						

When learners have completed the experiment they have to answer the questions on the worksheet under controlled conditions.

WORKSHEET FOR NEWTON'S SECOND LAW: OPTION 3

35

PRACTICAL SKILLS

1. Following instructions and manipulation

Criteria		Marks
Accurately following a sequence of written/verbal instructions	Following a sequence of instructions including branched instructions	(1)
Manipulative skills include correct and safe handling of apparatus and materials	Able to use all apparatus and material correctly and safely	(1)

2. Write down the following for this experiment:

2.1 The dependent variable (1)
2.2 The independent variable (1)
2.3 The controlled variable (1)

3. Determine the period of the ticker timer. (2)

4. Calculate the time taken between the 10 dots ($\Delta t = n \times T$). (2)

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

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

7. Using data collected, complete TABLE 1 below.

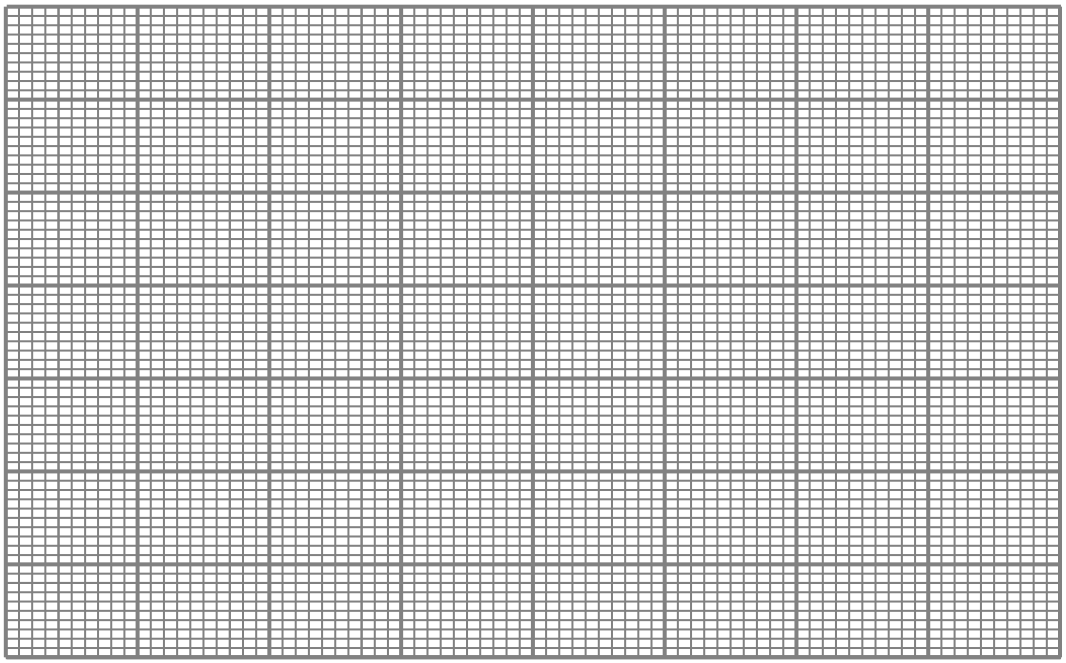
TABLE 1

Trial number	Resultant force, F (Fg = mg) (□)	Distance PQ (m)	v_x ($m \cdot s^{-1}$)	Distance QR (m)	v_y ($m \cdot s^{-1}$)	a ($m \cdot s^{-2}$)
1						
2						
3						

(18)

8. **Data analysis**

With the results recorded in TABLE 1, plot a graph of acceleration vs. resultant force and draw the line of best fit.



(4)

9. **Conclusion**

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

TOTAL: ____ / **35**

Total mark converted = $\frac{learners\ mark}{35} \times 40 =$ ____ / **40**

EXPERIMENT 2: DETERMINE THE PATH OF A RAY OF LIGHT THROUGH A GLASS SLAB FOR DIFFERENT ANGLES OFINCIDENCE

EXPERIMENT INSTRUCTIONS FOR EXPERIMENT 2

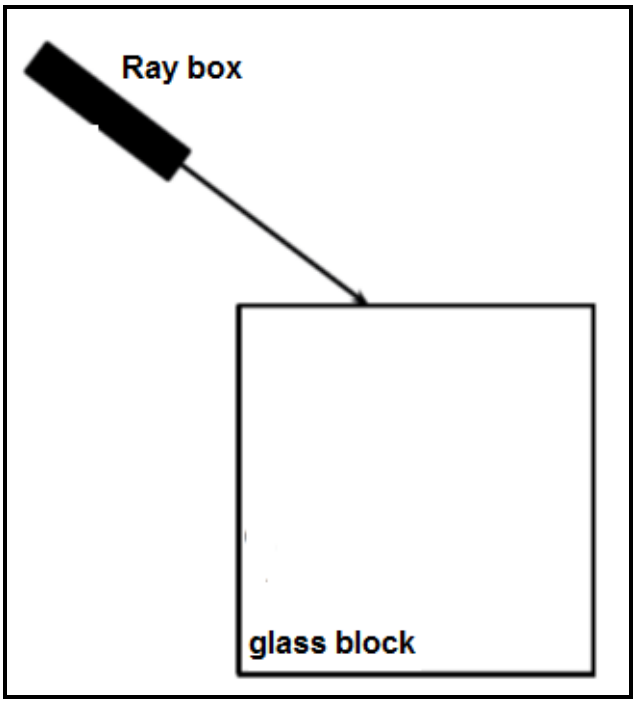
AIM: To determine the path of a ray through a glass block at different angles of incidence by drawing a ray diagram.

APPARATUS:

- Sheet of white paper
- Pins
- Rectangular glass block
- Ray box
- Pencil
- Ruler
- Protractor

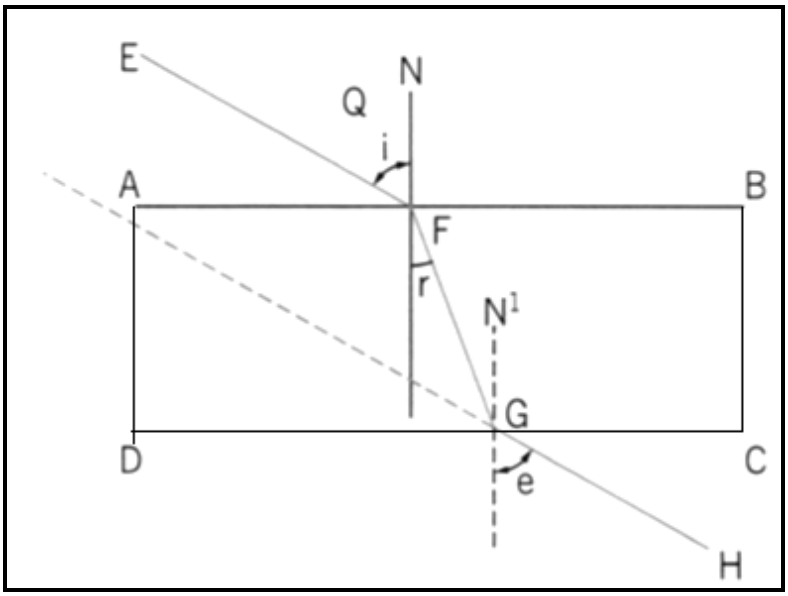
METHOD:

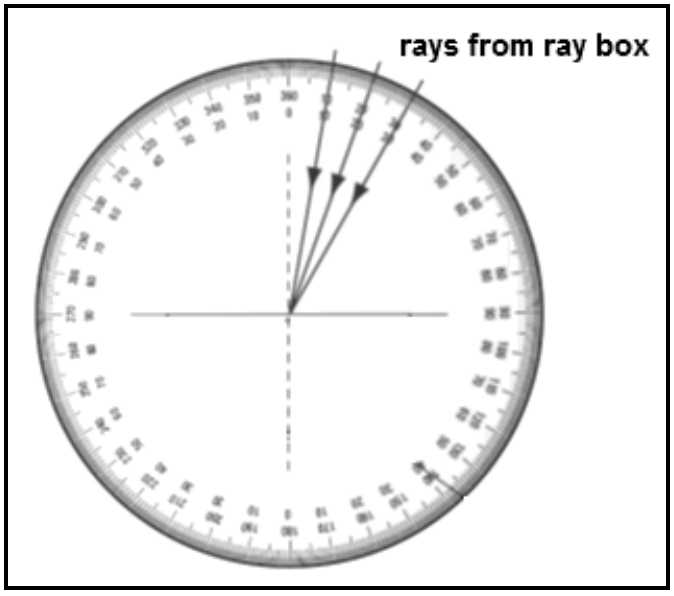
1. Secure a sheet of white paper to a board with some pins.
2. Place the glass block on the sheet of paper and trace the outline of the block with a sharp pencil. Remove the glass block and label the boundary points A, B, C and D. Replace the glass block on the rectangle on the paper.
3. Turn the ray box on and aim the light through the side of the glass block, as illustrated in the diagram below.



4. Use your pencil to make a dot somewhere on the incident light ray, E, and another dot at the point where it enters the glass block. Label this point F.
5. Use your pencil to make a dot at the point where the light ray exits the glass block. Label this point G. Also make dots along the emergent ray H.
6. Turn off the ray box and remove the glass block from the paper. Use the ruler to join the dots so that you have drawn a picture that looks like the figure at 8 below.
7. Draw the normal to the surfaces where the light ray enters and leaves the block and mark the angle of incidence and the angle of refraction on the top surface and the bottom surface.

8. Measure the angle between EF and the normal with a protractor. Note in a table.





9. Replace the glass block on the rectangle ABCD.
10. Repeat the experiment but allow the incident ray to fall onto the glass block at different angles. It must always enter the block at point F.
11. Note all the angles of incidence.
12. Measure the angles of refraction, as well as the angle between the emergent ray and the normal at point G, for every different angle of incidence. Note in a table similar to the table below.

Examples of angles of incidence are: 15°, 25°, 35°, 45°, 55°, 65°, 75° 85°, etc.

Experiment	Angle of incidence (degrees)	Angle of refraction (degrees)	Angle of emergence (degrees)
1			
2			
3			
4			

When learners have completed the experiment they have to answer the questions on the worksheet under controlled conditions.

WORKSHEET FOR EXPERIMENT 2: DETERMINE THE PATH OF A RAY OF LIGHT THROUGH A GLASS SLAB FOR DIFFERENT ANGLES OF INCIDENCE

35

PRACTICAL SKILLS

1. Following instructions and manipulation

Criteria		Marks
Accurately following a sequence of written/verbal instructions	Following a sequence of instructions including branched instructions	1
Manipulative skills include correct and safe handling of apparatus and materials	Able to use all apparatus and material correctly and safely	1

2. Write down the following for this experiment:

2.1 The dependent variable (1)
2.2 The independent variable (1)
2.3 The controlled variable (1)

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

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

5. Using the data collected, complete TABLE 1 below.

TABLE 1

Experiment	Angle of incidence (degrees)	Angle of refraction (degrees)	Angle of emergence (degrees)
1			
2			
3			
4			

(12)

6. **Data analysis and interpretation**

6.1 Draw a labelled ray diagram for this experiment. (5)

6.2 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)

6.3 Study the surface where the light exits the glass block. Compare the angle of incidence and the angle of refraction here. (2)

6.4 How do the optical densities and indices of refraction for air and glass compare? (2)

6.5 Discuss the path the light ray follows through the rectangular block. (2)

6.6 Clearly indicate the direction of the light ray. (1)

7. **Conclusion**

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

TOTAL: ____ / **35**

Total mark converted = $\frac{learners\ mark}{35} \times 40 =$ ____ / **40**

EXPERIMENT 3: DETERMINE THE ELECTRODE POTENTIAL OF A Cu-Zn ELECTROCHEMICAL CELL

EXPERIMENT INSTRUCTIONS FOR EXPERIMENT 3

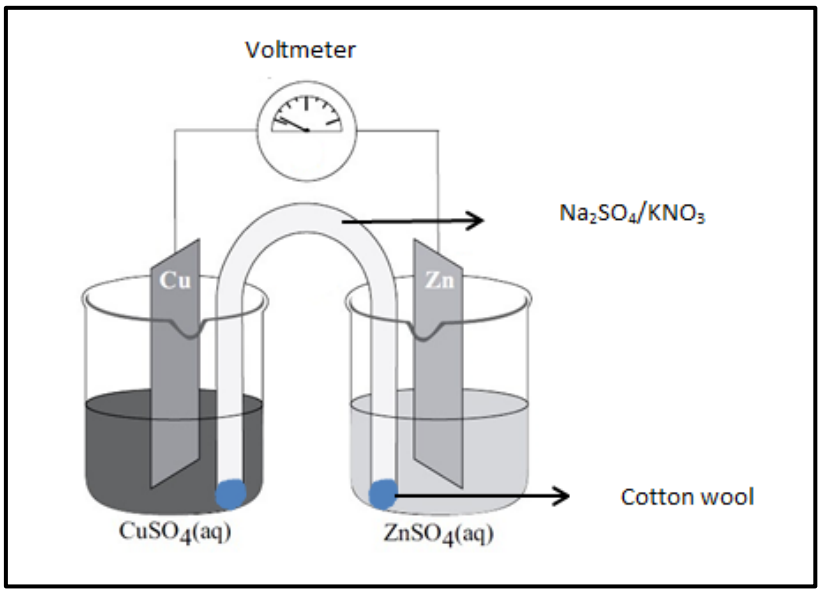
AIM: To determine the electrode potential of a Cu-Zn cell.

APPARATUS:

- 200 mℓ zinc sulphate solution
- 200 mℓ copper sulphate solution
- Na_2SO_4 or KNO_3 solution or NaCℓ paste
- 2 glass beakers
- Clear rubber tube/filter paper (U-tube)
- Voltmeter
- Connecting wires with crocodile clips
- Cotton wool
- Zinc and copper plates/rods

METHOD:

1. Pour about 200 mℓ of the zinc sulphate solution into one glass beaker and place the zinc plate in it.
2. Pour about 200 mℓ of the copper sulphate solution into the second beaker and place the copper plate in it.
3. Connect the zinc and copper plates to the voltmeter using the connecting wires.
4. Note the reading on the voltmeter and record in a table.
5. Fill the U-tube with the Na_2SO_4 or KNO_3 solution or NaCℓ paste and seal the openings of the tube with the cotton wool.
6. Place the U-tube so that one end is in the copper sulphate solution and the other end is in the zinc sulphate solution. Do this very quickly.
7. Note the reading on the voltmeter.
8. Repeat taking readings 5 times at different time intervals.



Mass of Electrodes					
Plate/Electrode	Initial Mass		Final Mass		
Copper					
Zinc					
Voltmeter readings					
Before placing the U-tube filled with a salt solution/paste in the beakers		After placing the U-tube filled with a salt solution/paste in the beakers			
Colours of the electrodes					
	At the beginning of the experiment		Between 10 to 20 minutes during the reaction		
Copper electrode					
Zinc Electrode					
Colours of the solutions in the beakers					
	At the beginning of the reaction		A few hours after the reaction occurred		
$CuSO_4$					
$ZnSO_4$					

When learners have completed the experiment they have to answer the questions on the worksheet under controlled conditions.

WORKSHEET FOR EXPERIMENT 3: DETERMINE THE ELECTRODE POTENTIAL OF A Cu-Zn ELECTROCHEMICAL CELL

35

PRACTICAL SKILLS

1. Following instructions and manipulation

Criteria		Marks
Accurately following a sequence of written/verbal instructions	Following a sequence of instructions including branched instructions	1
Manipulative skills include correct and safe handling of apparatus and materials	Able to use all apparatus and material correctly and safely	1

2. Write down the following for this experiment:

2.1 The dependent variable (1)
2.2 The independent variable (1)
2.3 The controlled variable (1)

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

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

5. Using data collected, complete TABLE 1 below.

TABLE 1

Mass of Electrodes					
Plate/Electrode	Initial Mass		Final Mass		
Copper					
Zinc					
Voltmeter readings					
Before placing the U-tube filled with a salt solution/paste in the beakers		After placing the U-tube filled with a salt solution/paste in the beakers			
Colours of the electrodes					
	At the beginning of the experiment		Between 10 to 20 minutes during the reaction		
Copper electrode					
Zinc Electrode					
Colours of the solutions in the beakers					
	At the beginning of the reaction		A few hours after the reaction occurred		
$CuSO_4$					
$ZnSO_4$					

(12)

6 **Data analysis and interpretation**

6.1 Why was cotton wool placed in each opening of the U-tube? (2)

6.2 Based on what you know of oxidation and reduction, why did those mass changes take place? (2)

6.3 Explain the colour change in the solutions. (2)

6.4 Which electrode is the anode and which is the cathode? (2)

6.5 Write down the reaction that takes place at the copper electrode. (2)

6.6 Write down the reaction that takes place at the zinc electrode. (2)

6.7 What is the impedance of the U-tube filled with a salt solution that was placed between the $CuSO_4$ and $ZnSO_4$ electrolytes? (2)

7. **Conclusion**

What conclusions can be drawn from this experiment?

(2)

TOTAL: ____ **35**

Total mark converted = $\frac{learners\ mark}{35} \times 40 =$ ____ **40**

8. 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.