basic education

Department:
Basic Education
REPUBLIC OF SOUTH AFRICA

TECHNICAL MATHEMATICS

GUIDELINES FOR PRACTICAL ASSESSMENT TASKS

GRADE 12

2024

These guidelines consist of 30 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 Mathematics Grade 12 consists of three tasks (one task per term) which should be completed by end of Term 3. The tasks are COMPULSORY for ALL candidates offering **Technical Mathematics 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 acquired and it applies the science of Mathematics to the technical field where the emphasis is on application. 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 differ from subject to subject.

The tasks should be administered under supervised conditions. Moderation may be done onsite, at the school.

2. TEACHER GUIDELINES

2.1 How to administer the PATs

- The following documents must be available for all formal tasks:
  - Task instructions explaining the procedures to be followed
  - The worksheets which include questions to be answered under examination conditions
  - The teacher guidelines with task instructions, worksheets and marking guidelines (The teacher guidelines MUST NOT be released to the learners.)
  - Teachers should compile marking guidelines (memoranda) for the real results of the task conducted (Teachers should do the tasks themselves FIRST.)
- The tasks must be done individually. 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 examination conditions.
- Only once all the learners are ready to do the task and they are seated, ready to answer the questions, may teachers hand out a worksheet to each learner. Examination conditions have to be applied.
- If it is not possible to do the task and complete the worksheet on the same day, the teacher must collect the learners' tasks. These tasks must be kept at the school.

2.2 Moderation of the PATs

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

- Index indicating all tasks with raw and weighted marks
- All task instructions
- Marking guidelines for all tasks, with ticks and totals
- Composite working mark sheet for all learners showing raw and weighted marks
- Evidence of internal moderation
- Evidence of administration of tasks, including registers

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 tasks

3. LEARNER GUIDELINES

3.1 The PAT for Grade 12 consists of THREE tasks.

3.2 The PAT contributes 25% towards your final promotion mark for Grade 12.

3.3 Group work is allowed as per the instructions. However, the work presented in the PAT must be your own.

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

4. EVIDENCE OF MODERATION

Learner's name:	
School:	

MARK ALLOCATION

TASK	MAX. MARK	WEIGHTING	LEARNER'S MARK (TEACHER)	MODERATED MARK (SCHOOL)	MODERATED MARK (DISTRICT)	MODERATED MARK (PROVINCE)
1	40	10				
2	30	7,5				
3	30	7,5				
TOTAL	100	25				
NAME						
SIGNATURES						
DATE						

DECLARATION OF AUTHENTICITY

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

_____ _____
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/her own.

_____ _____
SIGNATURE OF TEACHER DATE

SCHOOL STAMP

5. CONCLUSION

On completion of the practical assessment task learners should be able to demonstrate their understanding of the subject, 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.

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TECHNICAL MATHEMATICS

PRACTICAL ASSESSMENT TASK 1

GRADE 12

2024

MARKS: **40**

TIME: **2 hours**

SURNAME AND NAME	

SCHOOL	

This task consists of 8 pages (including the cover page).

TECHNICAL MATHEMATICS TASK 1

TOPIC: COMPLEX NUMBERS

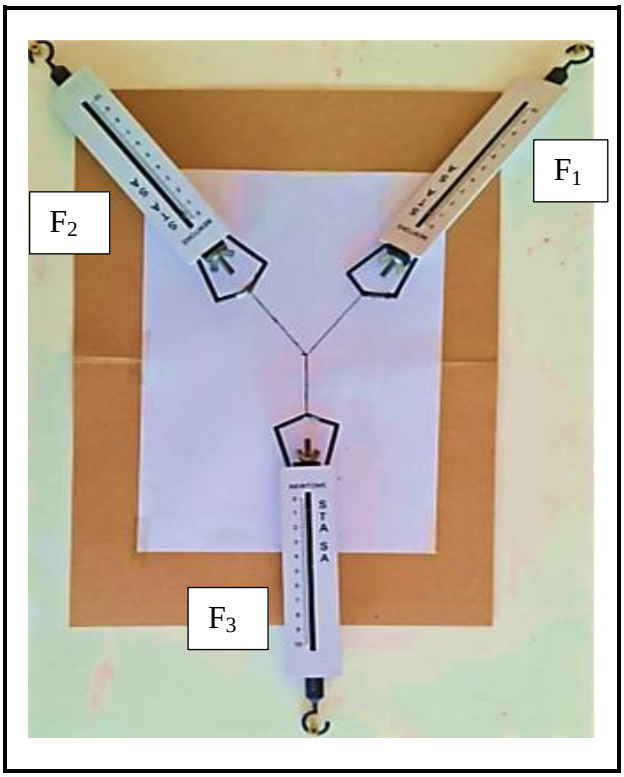
AIM:

- **To apply complex numbers to determine the resultant of two forces**

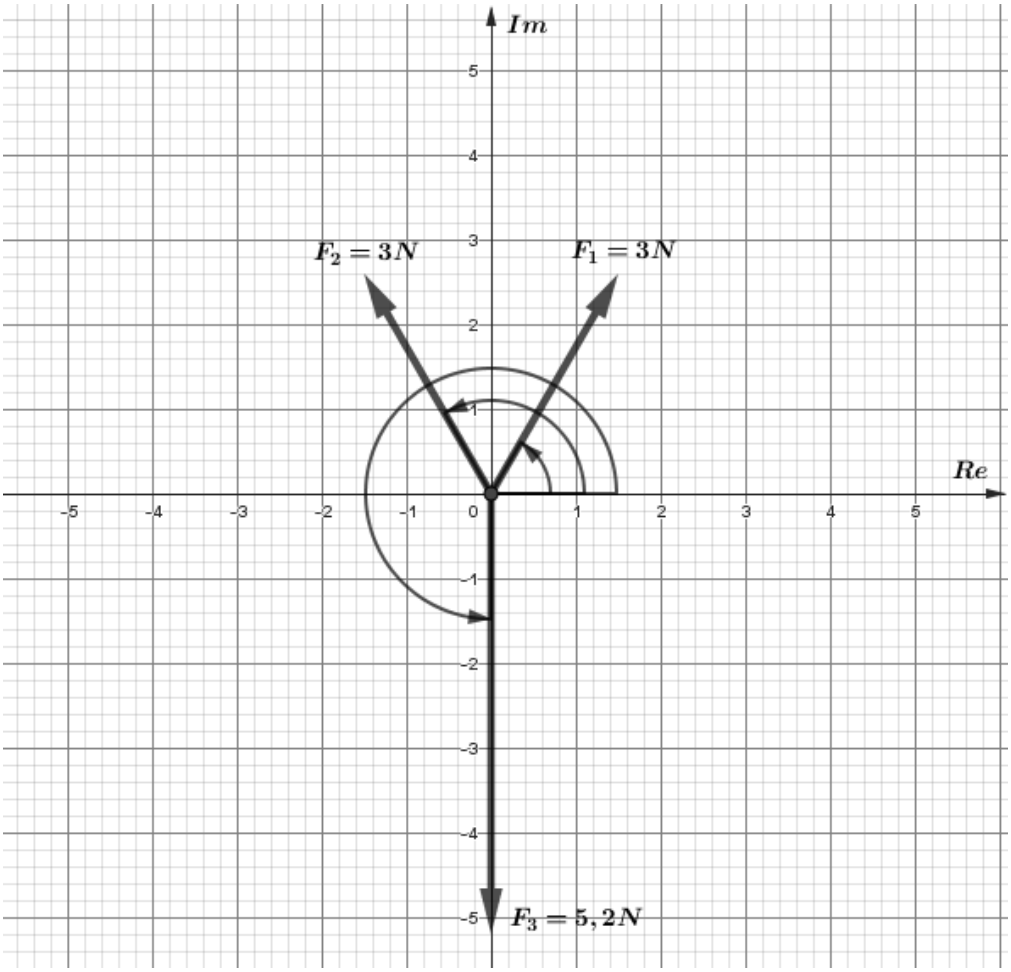
INTRODUCTION

A **force** is a vector quantity that has ~~a~~ magnitude and direction.
A **resultant** force is equal to the sum of the forces acting on an object.
Equilibrium forces are a set of forces whose resultant is zero.
The **equilibrant** force is a force that is equal in magnitude to the resultant force, but acts in the opposite direction.

The picture below is an illustration of THREE forces which are in equilibrium.



The diagram below models the THREE forces in equilibrium as shown in the picture on page 8.



INSTRUCTIONS

- Learners must work individually to complete this activity.
- Learners will be required to:
    - Use a protractor to accurately measure the argument of each force in the diagram provided and record readings in the table provided.
    - Express each force in the polar form, $z = Fcis\,\theta$, where F (modulus r) is a magnitude of a force and θ (argument) is the direction of a force.

MATERIALS REQUIRED

- Pen
- Pencils
- Ruler and maths set
- Scientific calculator

1. Complete the table below.

Force	Magnitude of each force in Newton (F)	Argument of force (θ)	Complex polar form of force Z = (F *cis* θ)
Force 1	3 N		
Force 2	3 N		
Force 3	5,2 N		

(6)

2. Use the table above to answer the following questions:

2.1 Convert F_1, F_2 and F_3 to rectangular form.

	Solution	Marks
		(4)

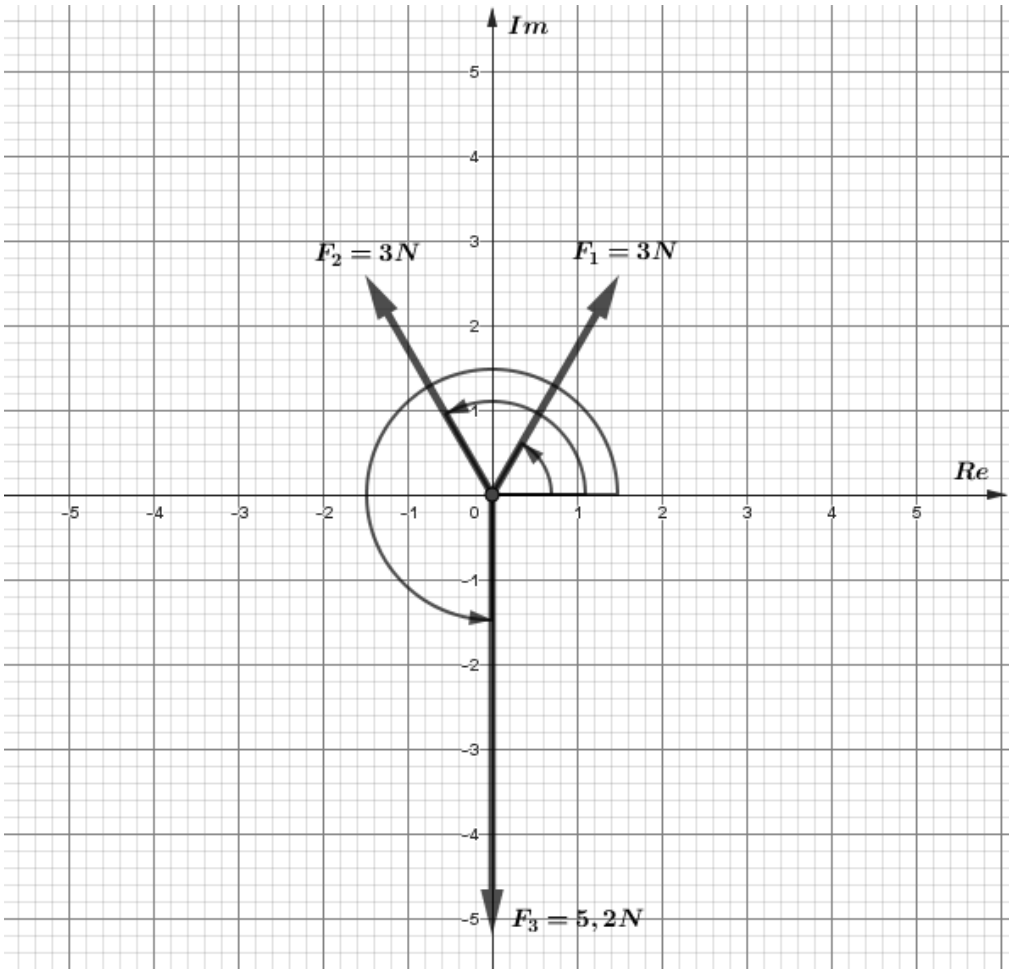
2.2 Determine the resultant force (F_R), the sum of F_1 and F_2, in rectangular form.

	Solution	Marks
		(2)

2.3 Hence, express $F_{R,}$ determined in QUESTION 2.2, in polar form. (Show all working.)

	Solution	Marks
		(5)

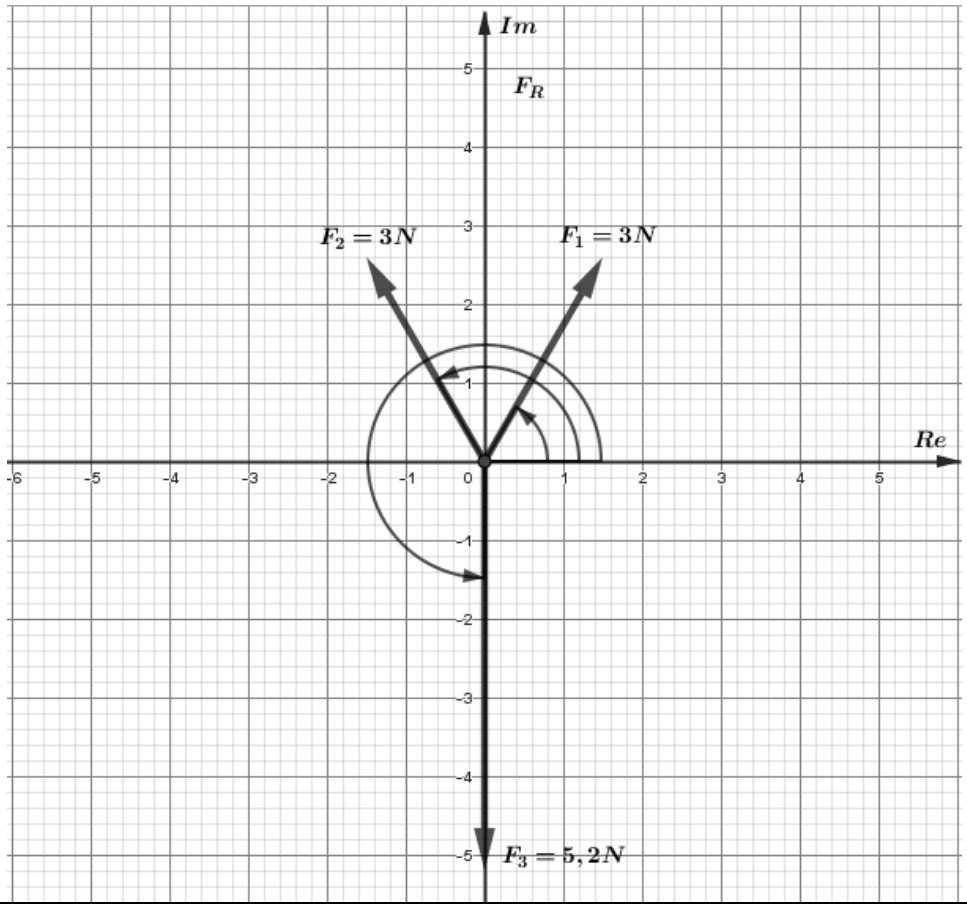
2.4 Draw and label F_R on the Argand diagram below.

	Solution	Marks
		(1)

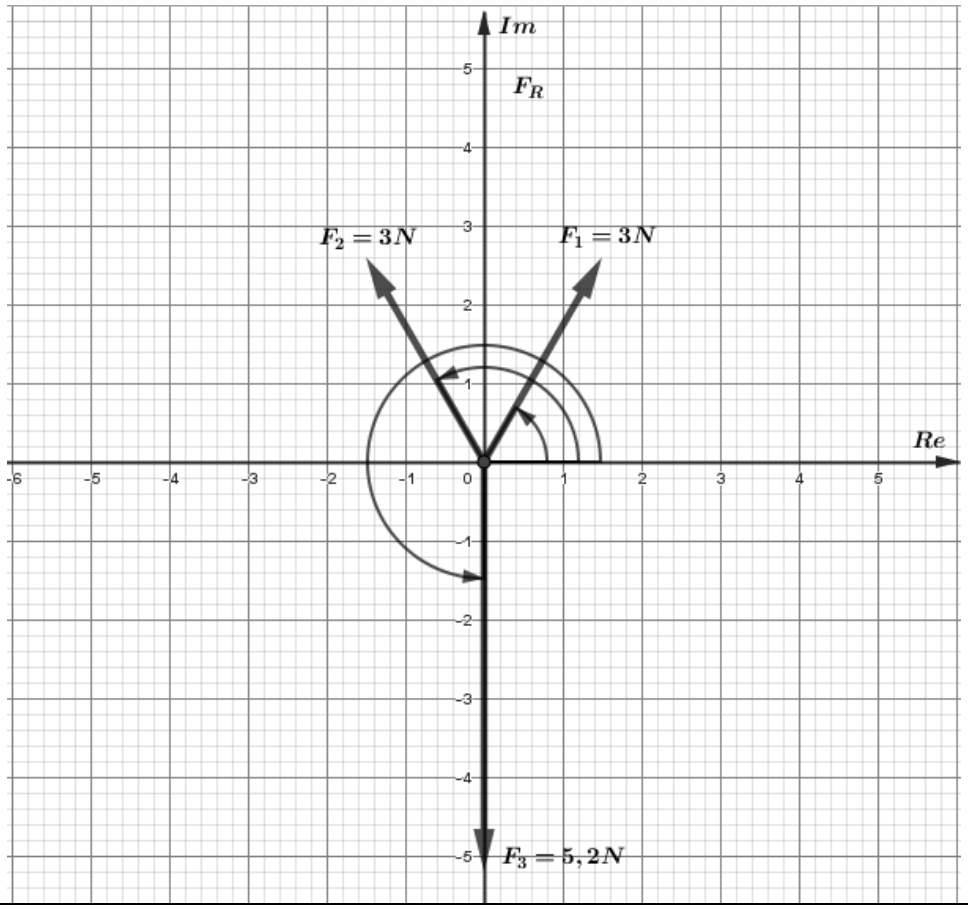
2.5 Compare F_R with F_3 (the equilibrant).

	Solution	**Marks**
		(2)

2.6 Use the same method as in QUESTIONS 2.2–2.5 to determine whether F_1 is an equilibrant of F_2 and F_3.

	Solution	Marks
		
		(10)

2.7 Use the same method as in QUESTIONS 2.2–2.5 to determine whether F_2 is an equilibrant of F_1 and F_3.

	Solution	**Marks**
		
		(10)

TOTAL: 40

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TECHNICAL MATHEMATICS

PRACTICAL ASSESSMENT TASK 2

GRADE 12

2024

MARKS: **30**

TIME: **8 hours**

SURNAME AND NAME	

SCHOOL	

This task consists of 9 pages (including the cover page).

TECHNICAL MATHEMATICS TASK 2

TOPIC: FUNCTIONS AND INTEGRATION

AIMS:

- **To apply functions to the design and making of a 3-D model of a parabolic arch bridge**
- **To apply integration to calculate the side area of an arch bridge**

INTRODUCTION

A bridge is a structure that is built to span a physical obstacle without blocking the way underneath. It is constructed for the purpose of providing passage over the obstacle, which is usually difficult or impossible to cross.

INSTRUCTIONS

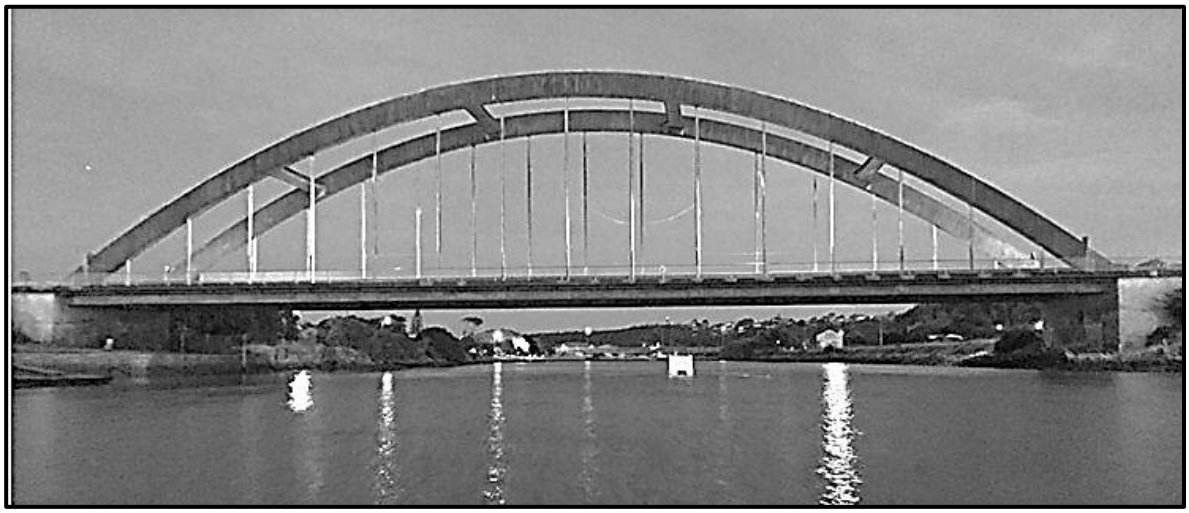
- The PAT task 2 should be done within a total of 8 hours.
- This task consists of two activities.
- A calculator is required to do the task.

ACTIVITY 1

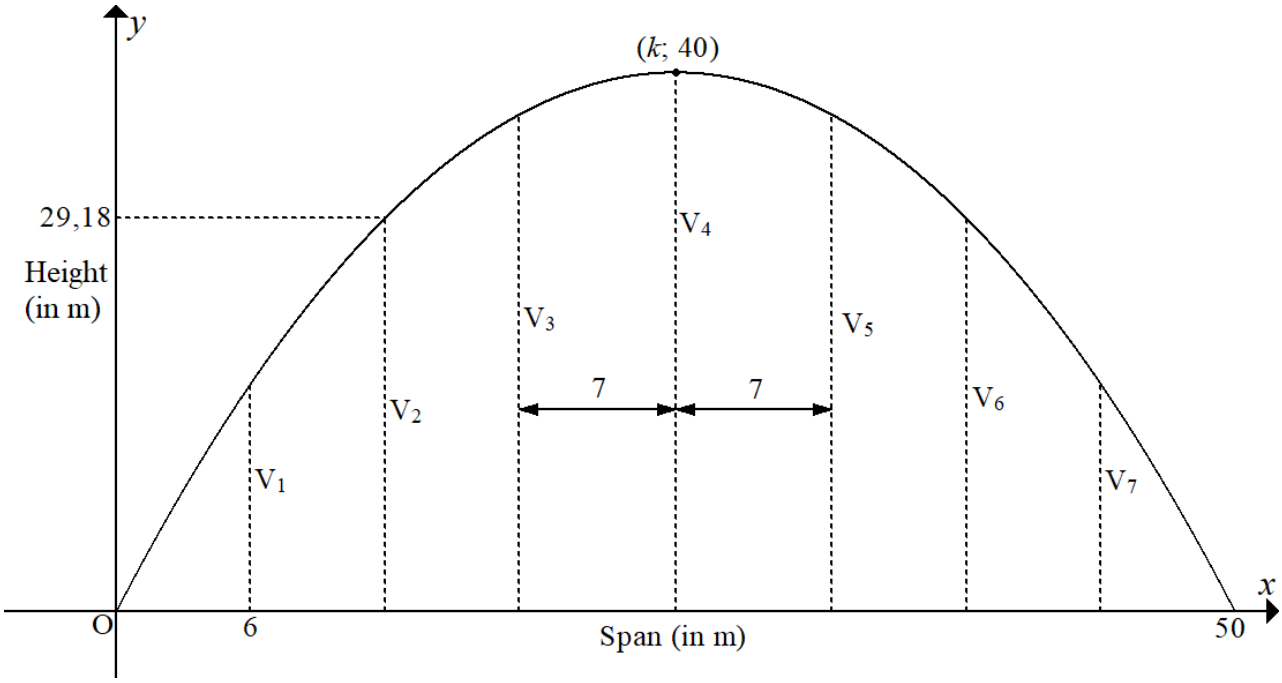
AIM:

- **To determine the equation of a parabolic arch bridge and perform various calculations**

The pictures on the next page, taken from different angles, show a parabolic arch bridge.



The diagram below models a parabolic arch bridge which spans 50 metres. The maximum height of the bridge is 40 metres. Seven vertical hangers, V_1 to V_7, are mounted to the bridge as shown in the diagram below. The distance between V_3 and V_4 is equal to the distance between V_4 and V_5 – each equal to 7 metres. The distance between the other hangers is 6 metres each.



1.1 Calculate the numerical value of k, the distance of V_4 from the origin.

_____

_____ (1)

1.2 Write down two formulae used to determine the equation of a parabola.

_____

_____

_____

_____

_____

_____ (2)

1.3 Hence, determine the equation defining the parabolic arch bridge in the given diagram in standard form, $y = ax^2 + bx + c$.

(4)

1.4 The first vertical hanger (V_1) is mounted 6 metres away from the origin. Determine the height of V_1.

(2)

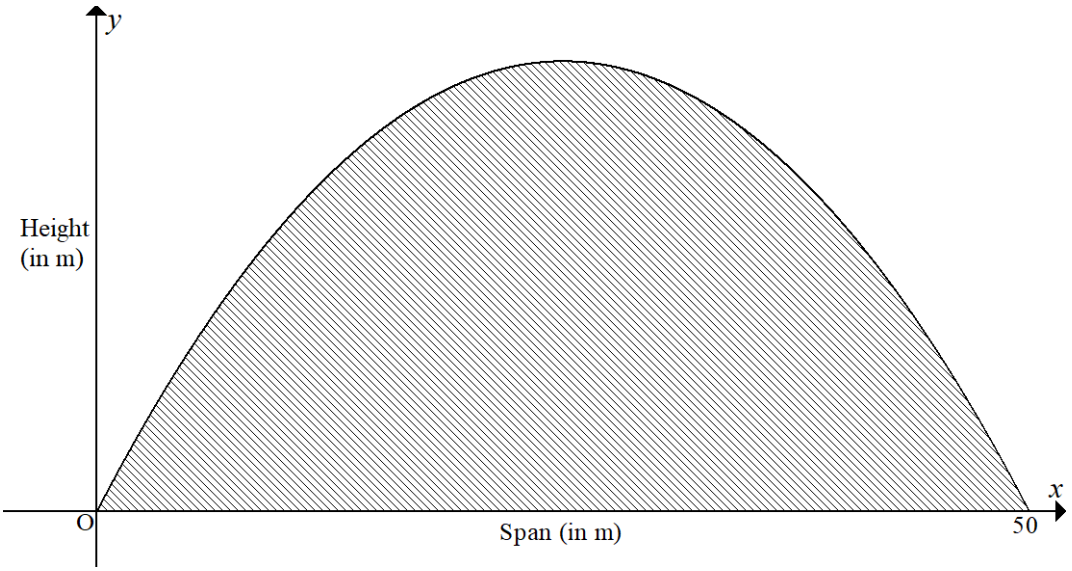
1.5 The height of hangers V_1 and V_6 is 29,18 metres. Determine how many metres from the origin these two hangers are mounted.

(5)

1.6 Write down the distance between hangers V_1 and V_3.

(1)

1.7 The diagram below models the side view of the parabolic arch bridge. Determine the size of the shaded area.



(5)
[20]

ACTIVITY 2

AIM:

- **To make a 3-D model of an arch bridge by applying the information acquired in ACTIVITY 1**

INSTRUCTIONS

Learners will work in groups of four.

1. This activity will be assessed using the rubric on the next page.
2. Make a three-dimensional model of the arch bridge.
3. The width of the bridge is 20 metres, the height is 40 metres and the length is 50 metres.
4. The bridge must have seven vertical hangers positioned and with heights as calculated in ACTIVITY 1 above.
5. The scale of the 3-D model should be 1 cm = 1 m.
6. You may use any appropriate material to build a 3-D model of the bridge.
7. Only one model of a bridge should be presented by the group of four learners and the names of the group members must be on the model.

LEARNER NAME AND SURNAME:				
No	**Assessment Criteria**	**1**	**2**	**Marks**
1	**Attitude**	Lack of motivation; constant support needed to carry out instructions	Good motivation; no support needed to carry out instructions	
2	**Values**	The bridge was not submitted on time	The bridge was submitted on time	
3	**Skills**	The model is not a presentation of the 3-D arch bridge	The model is a presentation of the 3-D arch bridge	
		One or two dimensions are not accurate	All three dimensions are accurate	
		Some positions and heights of hangers are not accurate	All positions and heights of hangers are accurate	
			SUBTOTAL:	**10**

TOTAL: 30

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TECHNICAL MATHEMATICS

PRACTICAL ASSESSMENT TASK 3

GRADE 12

2024

MARKS: **30**

TIME: **2 hours**

SURNAME AND NAME	

SCHOOL	

This task consists of 7 pages (including the cover page).

TECHNICAL MATHEMATICS TASK 3

TOPIC: TRIGONOMETRY

AIM:

- **To investigate and apply the sine and area rules**

INSTRUCTIONS AND INFORMATION

1. The PAT task 3 consists of TWO activities.

2. Answer ALL the questions.

3. Materials required:

    - Calculators
    - Mathematical sets

4. Clearly show ALL calculations, diagrams, etc. that you have used in determining your answers.

5. Learners should submit this task individually.

ACTIVITY 1

AIM:

- **To investigate the sine and area rules**

1.1 Draw, in the space provided below, THREE different shaped triangles and name all of them PQR (e.g. right-angled, scalene and isosceles triangle).

Label the sides of the three triangles in terms of p, q and r.

Use a protractor to measure each angle and the ruler to measure the magnitude of each side of each triangle PQR.

	Solution	**Marks**
	Triangle 1: Scalene triangle Triangle3: Isosceles triangle Triangle 2: Right-angled triangle	
		(3)

1.2 Use the triangles drawn in QUESTION 1.1 to answer the questions below.

1.2.1 Complete the following tables.

	Solution	**Marks**

Triangle 1:

Size of each angle in degrees	Magnitude of each side in mm	Each ratio rounded off to ONE decimal place
$\widehat{\mathrm{Q}} =$	$q =$	$\frac{q}{\sin\widehat{\mathrm{Q}}} =$
$\widehat{\mathrm{P}} =$	$p =$	$\frac{p}{\sin\widehat{\mathrm{P}}} =$
$\widehat{\mathrm{R}} =$	$r =$	$\frac{r}{\sin\widehat{\mathrm{R}}} =$

(3)

Triangle 2:

Size of each angle in degrees	Magnitude of each side in mm	Each ratio rounded off to ONE decimal place
$\widehat{\mathrm{Q}} =$	$q =$	$\frac{q}{\sin\widehat{\mathrm{Q}}} =$
$\widehat{\mathrm{P}} =$	$p =$	$\frac{p}{\sin\widehat{\mathrm{P}}} =$
$\widehat{\mathrm{R}} =$	$r =$	$\frac{r}{\sin\widehat{\mathrm{R}}} =$

(3)

Triangle 3

Size of each angle in degrees	Magnitude of each side in mm	Each ratio rounded off to ONE decimal place
$\widehat{\mathrm{Q}} =$	$q =$	$\frac{q}{\sin\widehat{\mathrm{Q}}} =$
$\widehat{\mathrm{P}} =$	$p =$	$\frac{p}{\sin\widehat{\mathrm{P}}} =$
$\widehat{\mathrm{R}} =$	$r =$	$\frac{r}{\sin\widehat{\mathrm{R}}} =$

(3)

1.2.2 Use the tables on the previous page to draw a conclusion on the relationship of the ratios $\frac{q}{\sin \widehat{Q}}$; $\frac{p}{\sin \widehat{P}}$ and $\frac{r}{\sin \widehat{R}}$ of triangle PQR.

	Solution	**Marks**
		(1)

1.3 Show that the area of Δ PQR $= \frac{1}{2} pq\ Sin\ \widehat{R} = \frac{1}{2} pr\ Sin\ \widehat{Q} = \frac{1}{2} rq\ Sin\ \widehat{P}$

	Solution	**Marks**
	Triangle 1: Triangle 2: Triangle 3:	(6)
		[19]

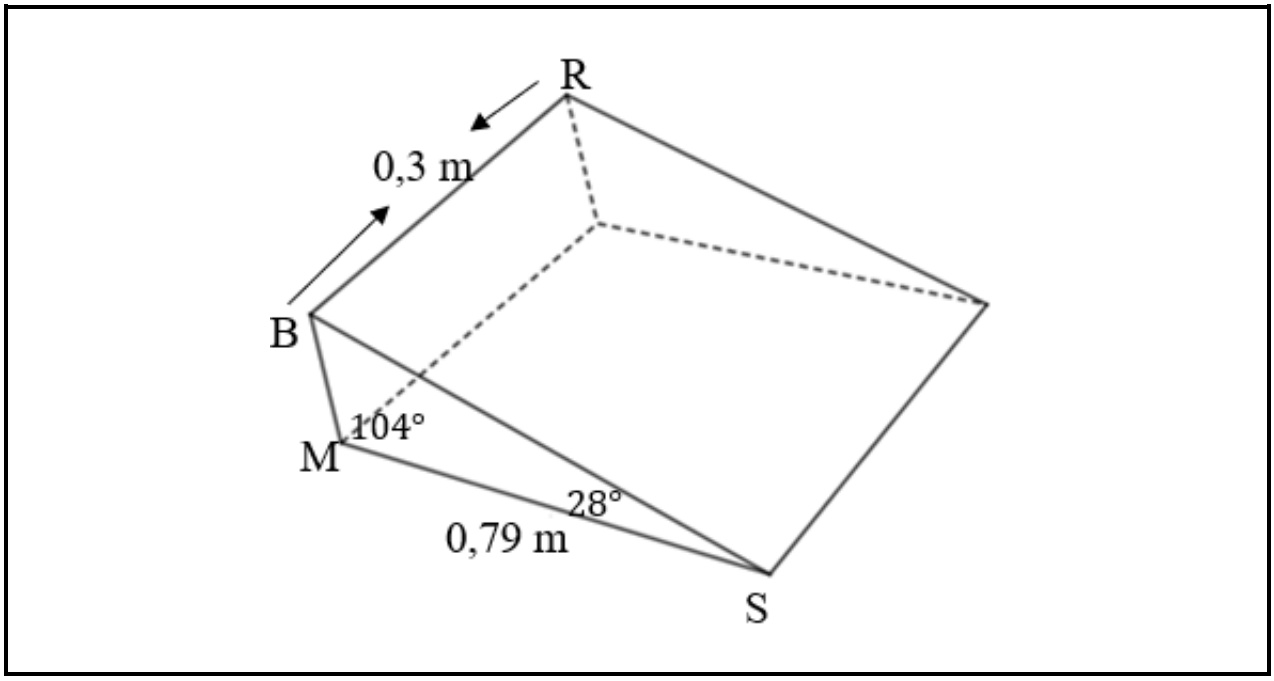
ACTIVITY 2

A company is planning to manufacture tyre stoppers in the shape of a triangular prism.

The tyre stoppers will be made of steel material.

The side view of a wheel stopper forms a triangle as shown below.

Side MS = 0,79 m and side BR = 0,3 m. $B\hat{M}S = 104°$ and $B\hat{S}M = 28°$



2.1 Use the sine rule to determine, in metres, the lengths BS and MB.

	Solution	**Marks**
		(4)

2.2 The tyre stoppers must be rubberised. The rubberising costs R280 per square metre. Determine how much it will cost to rubberise a stopper.

	Solution	**Marks**
		(7)
		[11]

TOTAL: 30