

# SAOU WEBINAR – OCTOBER 2021

## TECHNICAL MATHEMATICS AND TECHNICAL SCIENCES CHANGES/ STATUS FROM 2021

PRESENTED BY: M. NJOMENI – CES: TECHNICAL MATHEMATICS AND TECHNICAL SCIENCES

DATE: 20 OCTOBER 2021





# PRESENTATION OUTLINE

A. Introduction

B. Technical Mathematics

C. Technical Sciences

D. Introduction of PAT in Technical Mathematics

E. Conclusion



# A. INTRODUCTION

- As per the National Development Plan, South Africa needs to produce 30 000 artisans per year (by 2030), subject to demand. *(National Development Plan, Chapter 9, page 277)*
- Technical Mathematics and Technical Sciences play a major role in increasing learner participation in Technical Subjects as they are enabling subjects.
- The more learners who do and achieve in Technical Subjects, the better.
- Therefore, improved participation and performance in Technical Mathematics and Technical Sciences will ensure more learners achieve in Technical Subjects.



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# B. TECHNICAL MATHEMATICS



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Programme of Assessment for Technical Mathematics Grade 12								
Assessment Tasks		Term 1	Term 2	Term 3	Term 4	% of Final Promotion Mark		Marks
SBA	Test 1 (10% of SBA)	1 paper				10	25	The marks of all three tasks are converted according to the weightings to give a total mark out of <b>100</b>
	Assignment /test (10% of SBA)							
	Investigation (20%)							
	Test (10% of SBA)		2 papers			6,25		
	Test (10% of SBA)			2 papers		8,75		
	Trial examination (25% of SBA)							



Assessment Tasks		Term 1	Term 2	Term 3	Term 4	% of Final Promotion Mark		Marks
PAT	Practical 1 (40% of PAT)	1				10	25	The marks of all three tasks are converted according to the weightings to give a total mark out of <b>100</b>
	Practical 2 (30% of PAT)		1			7.5		
	Practical 3 (30% of PAT)			1		7.5		
External Examination	2 Final Examination papers of equal weight				Paper 1	25	50	2 x 150 marks giving a total of 300 marks for papers 1 and 2. The 300 marks is converted to <b>200</b> marks.
					Paper 2	25		
Final Promotion Mark							100	SBA + PAT + Final Examination = 100 + 100 + 200 = 400



## 2.1 Format of Question Papers for Grade 12

PAPER	TOPICS	Weighting of content areas	DURATION	TOTAL	DATE	MARK-ING
1	<ul style="list-style-type: none"> <li>Number Systems (binary and complex numbers)</li> <li>Algebra (expressions, equations and inequalities including nature of roots, exponents, surds and logarithms)</li> </ul>	$50 \pm 3$	3 hours	150	November	External
	<ul style="list-style-type: none"> <li>Functions and graphs</li> </ul>	$35 \pm 3$				
	<ul style="list-style-type: none"> <li>Finance, growth and decay</li> </ul>	$15 \pm 3$				
	<ul style="list-style-type: none"> <li>Differential calculus and integration</li> </ul>	$50 \pm 3$				
2	<ul style="list-style-type: none"> <li>Analytical Geometry</li> </ul>	$25 \pm 3$	3 hours	150	November	External
	<ul style="list-style-type: none"> <li>Euclidean Geometry</li> </ul>	$40 \pm 3$				
	<ul style="list-style-type: none"> <li>Trigonometry</li> </ul>	$50 \pm 3$				
	<ul style="list-style-type: none"> <li>Mensuration, circles, angles and angular movement</li> </ul>	$35 \pm 3$				

Questions in Papers 1 and 2 will assess performance at different cognitive levels with the emphasis on process skills, critical thinking, scientific reasoning and strategies to investigate and solve problems in a variety of contexts. **INTEGRATION OF CONTENT AREAS IS POSSIBLE.**





## 2.2 Weighting of Cognitive Levels

Papers 1 and 2 will include questions in four cognitive levels. The distribution of cognitive levels in the papers is given below.

**NOTE:** The weighting has been modified relative to the *CAPS* document.

COG-NITIVE LEVEL	DESCRIPTION OF SKILLS TO BE DEMONSTRATED	WEIGHTING (plus, minus)	APPROXIMATE NUMBER OF MARKS IN A 150-MARK PAPER
<b>Knowledge</b>	<ul style="list-style-type: none"> <li>Recall</li> <li>Identification of correct formula on the information sheet (no changing of the subject)</li> <li>Use of mathematical facts</li> <li>Appropriate use of mathematical vocabulary</li> <li>Algorithms</li> <li>Estimation and appropriate rounding of numbers</li> <li>Definitions</li> <li>Properties of functions</li> </ul>	$(25 \pm 2)\%$	34 to 40 marks
<b>Routine procedures</b>	<ul style="list-style-type: none"> <li>Perform well-known procedures</li> <li>Simple applications and calculations which might involve few steps</li> <li>Derivation from given information may be involved</li> <li>Identification and use (after changing the subject) of correct formula</li> <li>Generally similar to those encountered in class</li> </ul>	$(45 \pm 2)\%$	64 to 70 marks



COG- NITIVE LEVEL	DESCRIPTION OF SKILLS TO BE DEMONSTRATED	WEIGHTING (plus, minus)	APPROXIMATE NUMBER OF MARKS IN A 150-MARK PAPER
<b>Complex procedures</b>	<ul style="list-style-type: none"> <li>Problems involve complex calculations and/or higher-order reasoning</li> <li>There is often not an obvious route to the solution</li> <li>Problems need not be based on a real-life context</li> <li>Could involve making significant connections between different representations</li> <li>Require conceptual understanding</li> <li>Learners are expected to solve problems by integrating different topics</li> </ul>	$(20 \pm 2)\%$	27 to 33 marks
<b>Problem solving</b>	<ul style="list-style-type: none"> <li>Non-routine problems (which are not necessarily difficult)</li> <li>Problems are mainly unfamiliar</li> <li>Higher order reasoning and processes are involved</li> <li>Might require the ability to break the problem down into its constituent parts</li> <li>Interpreting and extrapolating from solutions obtained by solving problems based in unfamiliar contexts.</li> </ul>	$(10 \pm 2)\%$	12 to 18 marks





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# C. TECHNICAL SCIENCES



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The core content outlined in the Technical Sciences Curriculum and Assessment Policy Statement (CAPS) is compulsory and will be examined in TWO papers. Note that all the topics in the Grade 12 curriculum as stated in the Technical Sciences CAPS are examinable at the end of year examination.

The question paper could comprise of multiple choice questions (maximum weighting 14%), matching-columns (maximum weighting 5%), one-word answer (maximum weighting 5%) and structured questions. The final end-of-year examination is nationally set, marked and moderated. All the questions will focus on content as stated in the National Curriculum Statement.

Grade 12	Examination	Maximum marks	Duration
	Preparatory examination		
	Paper 1	150	3 hours
	Paper 2	75	1.5 hours
	Final examination		
	Paper 1	150	3 hours
	Paper 2	75	1.5 hours



**Table 5: Weighting of topics for final and preparatory (trial) examination papers in grade 12**

Grade	Content	% Combined Weighting Overall (% weighting in P1+P2)	% Weighting in Paper 1	% Weighting in Paper 2
12	Mechanics	41.33	62	---
	Electricity and Magnetism	14.67	22	---
	Matter and materials	10.67	---	62
	Chemical change	20.67	---	38
	Waves, Sound and Light	12.67	16	---

#### 4.4 COGNITIVE LEVELS

All assessment tasks should comply with the cognitive levels in Table 6.

**Table 6: Weighting and description of cognitive levels**

Cognitive levels	Description	% Weighting for paper 1	% Weighting for paper 2
1	Remembering	25	30
2	Understanding	30	35
3	Analysing and Applying	40	30
4	Creating and Evaluating	5	5



**Programme of Assessment for Technical Sciences Grade 12**

Assessment Tasks		Term 1	Term 2	Term 3	Term 4	% of Final Promotion Mark		Marks
SBA	Control Test 1 (35% of SBA)	1 paper				8.8	25%	The marks of all three tasks are converted according to the weighting to give a total mark out of 100
	Preparatory examination (65% of SBA)			2 papers		16.2		
PAT	Experiment 1 (40% of PAT)	1				10	25%	The marks of all three tasks are converted according to the weighting to give a total mark out of 100.
	Experiment 2 (30% of PAT)		1			7,5		
	Experiment 3 (30% of PAT)			1		7,5		



Assessment Tasks		Term 1	Term 2	Term 3	Term 4	% of Final Promotion Mark		Marks
External Examination	2 Final Examination papers				2 papers	50	50%	<p>2 papers Paper 1 of 150 marks for 3 hours.</p> <p>Paper 2 of 75 marks for 1,5 hours.</p> <p>150 marks + 75 marks give a total of 225 marks overall for Papers 1 and 2.</p> <p>The 225 marks are converted to <b>200</b> marks.</p>
Final Promotion Mark							100%	<p>SBA + PAT + Final Examination = 100 + 100 + 200 = 400</p>



## Weighting for the SBA, PAT and Final Examinations for Grade 12

### Formal assessment marks

Description	Weighting	Maximum Marks (after conversion)
SBA	25%	100 marks
PAT	25%	100 marks
Final Examinations	50%	200 marks
<b>Programme of Assessment</b>	<b>100%</b>	<b>400 marks</b>

The table below shows the compilation of the mark for school-based assessment (SBA).

Description	Time frame	Weighting in terms of final SBA mark	Marks
Control Test 1	Term 1	35%	100 converted to 35
Trial Examinations	Term 3	65%	225 converted to 65
Total SBA mark		100%	100 marks



## 2.4 Weighting and description of cognitive levels

Papers 1 and 2 will include questions across four cognitive levels. The distribution of cognitive levels in Paper 1 and Paper 2 is given below. (Ref: 2021 Grade 12 CAPS Amendments Abridged Section 4.)

All assessment tasks should comply with the cognitive levels given in the table below.

Cognitive levels	Description	% Weighting for Paper 1	% Weighting for Paper 2
1	Remembering	25	30
2	Understanding	30	35
3	Analysing and applying	40	30
4	Creating and evaluating	5	5



## 2.5 Weighting of topics for Final and Preparatory (Trial) Examinations in Grade 12 (Ref.: 2021 Grade 12 CAPS Amendments Abridged Section 4)

Paper 1								
Content	Marks	% Weighting	Total	Duration	Weighting of questions across cognitive levels			
Mechanics	93	62	150 marks	3 hours	25	30	40	5
Electricity and Magnetism	33	22						
Waves, Sound and Light	24	16						

Paper 2								
Content	Marks	% Weighting	Total	Duration	Weighting of questions across cognitive levels			
Matter and Materials	47	62	75 marks	1,5 hours	30	35	30	5
Chemical Change	28	38						



## Marks and duration for examination papers in Grade 12

Examination	Maximum marks	Duration
<b>Mid-year Examinations</b>		
Paper 1	150	3 hours
Paper 2	75	1,5 hours
<b>Preparatory Examinations</b>		
Paper 1	150	3 hours
Paper 2	75	1,5 hours
<b>Final Examinations</b>		
Paper 1	150	3 hours
Paper 2	75	1,5 hours



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# D. PAT IN TECHNICAL MATHEMATICS



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# D.1. INTRODUCTION OF PAT IN TMAT

All the Technical subjects specialisations were introduced with a component of the Practical Assessment Tasks (PAT) including Technical Sciences. Technical Mathematics was introduced without the PAT. Sasol Foundation was at the fore front in developing the Technical Mathematics and Technical Sciences textbooks and training of subject Advisors and teachers. In December 2020, the DBE approved Abridged CAPS Section 4 to be implemented from January 2021. PAT for Technical Mathematics was part of the approved changes/ improvements in Section 4 of the CAPS document. The DBE officially communicated the approved CAPS Section 4 to the system through **CIRCULAR S4 OF 2021**.

In May 2021, Umalusi approved the Practical Assessment Task for Technical Mathematics. **CIRCULAR E11 OF 2021** was issued on 14 May 2021. Training of Provincial Coordinators, Subject Advisors and Teachers had commenced on 10 May in preparing the system on Technical Mathematics PAT and its administration to all Technical Schools and is continuing as per the Management Plan issued together with the circular and the PAT Guidelines.



## D.2. MANAGEMENT PLAN ON ADMINISTRATION OF TECHNICAL MATHEMATICS PAT

DATE(S)	PLAN	RESPONSIBILITY
10 May 2021	Virtual Meeting with Provincial Coordinators (PCs) – PAT 1 Level 1 Mediation	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> </ul>
11 – 14 May 2021	<ul style="list-style-type: none"> <li>PCs in provinces with District Subject Advisors to have a Virtual Meeting with Subject Advisors (SAs) – PAT 1 Level 2 Mediation</li> <li>Provincial Team led by PC is established and responsibilities are distributed among Team Members</li> </ul>	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> <li>Provincial Coordinators</li> </ul>
14 May 2021	<ul style="list-style-type: none"> <li>PAT Guidelines shared with Provincial Coordinators</li> <li>PAT Guidelines shared with Provincial Heads of Exams</li> <li>PAT Guidelines shared with Communication to be uploaded in the Website</li> </ul>	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> <li>CD: NAPE</li> </ul>
12 – 18 May 2021	Provincial Teams have Meeting with teachers – PAT 1 Level 3 Mediation	<ul style="list-style-type: none"> <li>PCs – TMAT</li> <li>District SAs – TMAT</li> </ul>



## D.2. MANAGEMENT PLAN ON ADMINISTRATION OF TECHNICAL MATHEMATICS PAT (cont...)

DATE(S)	PLAN	RESPONSIBILITY
19 – 31 May 2021	<ul style="list-style-type: none"> <li>PAT Task 1 to be administered by all schools</li> <li>Monitoring and Support by PCs and SAs is taking place concurrently</li> <li>31 May is the last day of submission of PAT Task 1 by ALL learners.</li> </ul>	<ul style="list-style-type: none"> <li>District SAs – TMAT</li> <li>Principals &amp; TMAT Teachers</li> <li>PCs and SAs – TMAT</li> <li>Principals &amp; TMAT Teachers</li> </ul>
1 – 4 June 2021	<ul style="list-style-type: none"> <li>Mediation of PAT Task 1 Marking Guidelines to PCs and SAs</li> <li>Mop-up Monitoring and Support – ensuring that ALL schools have administered PAT Task 1 and all learners have submitted.</li> </ul>	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> <li>SAs &amp; PCs – TMAT</li> </ul>
7 – 11 June 2021	<ul style="list-style-type: none"> <li>Mediation and release of PAT Task 1 Marking Guidelines to Teachers so that Marking of Task1 starts.</li> <li>Sharing of PAT Task 1 Marking Guidelines to Provincial Heads of Exams and Communication (to be uploaded in the website)</li> </ul>	<ul style="list-style-type: none"> <li>PCs &amp; SAs – TMAT</li> <li>DBE CES – TMAT</li> <li>CD: NAPE</li> </ul>



## D.2. MANAGEMENT PLAN ON ADMINISTRATION OF TECHNICAL MATHEMATICS PAT (cont...)

DATE(S)	PLAN	RESPONSIBILITY
14 – 18 June 2021	Mediation of Task 2 and 3 to PCs and SAs – If possible: All PCs and SAs to converge to one venue. Successes and challenges (if any) shall be shared by all provinces. If not possible, Virtual Meetings shall be held.	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> </ul>
21 – 25 June 2021	Mediation of Task 2 and 3 to teachers	<ul style="list-style-type: none"> <li>PCs &amp; SAs – TMAT</li> </ul>
28 June to 8 July 2021	Administration of PAT Task 2 by ALL schools with 8 July being the last day of submission by ALL learners	<ul style="list-style-type: none"> <li>Principals &amp; TMAT Teachers</li> </ul>
26 – 30 July 2021	<ul style="list-style-type: none"> <li>Mediation and release of PAT Task 2 Marking Guidelines to Teachers so that Marking of Task 2 starts.</li> <li>Sharing of PAT Task 2 Marking Guidelines to Provincial Heads of Exams and Communication (to be uploaded in the website)</li> </ul>	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> <li>CD: NAPE</li> </ul>



## D.2. MANAGEMENT PLAN ON ADMINISTRATION OF TECHNICAL MATHEMATICS PAT (cont...)

DATE(S)	PLAN	RESPONSIBILITY
2 – 13 August 2021	Administration of PAT Task 3 by ALL schools with 13 August being the last day of submission by ALL learners	<ul style="list-style-type: none"> <li>Principals &amp; TMAT Teachers</li> </ul>
16 – 20 August 2021	<ul style="list-style-type: none"> <li>Mediation and release of PAT Task 3 Marking Guidelines to Teachers so that Marking of Task 3 starts.</li> <li>Sharing of PAT Task 3 Marking Guidelines to Provincial Heads of Exams and Communication (to be uploaded in the website)</li> </ul>	<ul style="list-style-type: none"> <li>DBE CES – TMAT</li> <li>CD: NAPE</li> </ul>
23 – 27 August 2021	<ul style="list-style-type: none"> <li>Mop-up and ensuring that ALL learners have completed ALL PAT Tasks (TASK 1 – 3)</li> <li>PCs and SAs ensuring that PAT Mark Schedules are completed by teachers and NO learner does not have PAT marks.</li> </ul>	<ul style="list-style-type: none"> <li>Principals &amp; TMAT Teachers</li> <li>PCs &amp; SAs– TMAT</li> </ul>
6 – 30 September 2021	On Site Moderation of PAT by SAs, PCs and DBE Coordinator.	<ul style="list-style-type: none"> <li>SAs – TMAT</li> <li>PCs - TMAT</li> <li>DBE CES – TMAT</li> </ul>



# **D.3. MEDIATION OF TECHNICAL MATHEMATICS FIRST PRACTICAL ASSESSMENT TASK (PAT) IN GRADE 12 IN 2021**





# 2021 GRADE 12 TECHNICAL MATHEMATICS FIRST PRACTICAL ASSESSMENT TASK (PAT) MEDIATION

## PAT GUIDELINES PRESENTATION (FOR PCs, SAs AND TEACHERS!)

**MAY 2021**





# PRESENTATION OUTLINE

1. Introduction
2. 2021 Grade 12 PAT Guidelines
3. Conclusion



# 1. INTRODUCTION

Circular S4 of 2021 which was communicated to all stakeholders of the Department of Basic Education brought about changes in many subject in Section 4 of the CAPS Document.

One of the notable changes in TECHNICAL MATHEMATICS is the introduction of Practical Assessment Task in grades 10 – 12 from 2021.

The introduction of PAT in TECHNICAL MATHEMATICS automatically brought about changes in the weighting in resulting. From 2021, the final marks shall be calculated as follows: 25% SBA + 25% PAT + 50% Exams.

The table below further emphasises the weightings in grade 12 in 2021:

<b>Tasks</b>	<b>Administered</b>	<b>Marks</b>	<b>Total</b>	
Paper 1	External	150	<b>300</b>	<b>50%</b>
Paper 2	External	150		
PAT	PAT	100	<b>100</b>	<b>25%</b>
SBA	Internal	100	<b>100</b>	<b>25%</b>



# 1. INTRODUCTION (cont...)

- The setting and moderation of grade 12 PATs has been completed and signed off by Umalusi (Quality Assurer).
- Since PAT is introduced for the first time in TECHNICAL MATHEMATICS in 2021, it is necessary that the PAT Guidelines and Tasks are mediated to all Officials in the space of the subject so as to have uniform implementation across all provinces, districts and schools offering the subject.
- In this presentation, the slides that follow are compiled from the PAT Guidelines.
- There are other 3 presentations compiled from the PAT Guidelines but only focussing at each of the 3 tasks that constitutes TECHNICAL MATHEMATICS PAT in 2021.
- This presentation and the next three, are only focussing on grade 12. Grade 10 and 11 PAT shall be compiled at Provincial, District and/or school levels. PCs and SAs shall inform teachers in due course.
- Grade 10 and 11 PAT Guidelines should be compiled in line with grade 12 PAT Guidelines as far as possible.
- Now, let us look at grade 12 PAT Guidelines:



# 2. 2021 GRADE 12 PAT GUIDELINES

## TABLE OF CONTENTS

1. INTRODUCTION
2. TEACHER GUIDELINES
  - 2.1 How to administer the PATs
  - 2.2 Moderation of the PATs
3. LEARNER GUIDELINES
4. EVIDENCE OF MODERATION, MARK ALLOCATION AND DECLARATION OF AUTHENTICITY
5. CONCLUSION
6. TASKS
  - TASK 1: COMPLEX NUMBERS
  - TASK 2: EUCLIDEAN GEOMETRY
  - TASK 3: CIRCLES, ANGLES AND ANGULAR MOVEMENT





## 2. 2021 GRADE 12 PAT GUIDELINES (cont...)

### 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 and Technical Mathematics
- 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 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**.



## 2. 2021 GRADE 12 PAT GUIDELINES (cont...)

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 apply 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 differs from subject to subject.

The tasks should be administered under supervised conditions. Moderation may be done onsite.



# 2. 2021 GRADE 12 PAT GUIDELINES (cont...)

## 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 controlled conditions
  - The teacher's guidelines with task 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 task conducted (teachers should do the tasks themselves **FIRST**)
- 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 controlled conditions.
- Only once all the learners are ready to do the task and they are all seated and ready to answer questions may teachers hand out a worksheet to each learner. Controlled conditions have to be applied.
- If it is not possible to do the task and answer the worksheet on the same day, the teacher must collect the learners' tasks. These tasks must be kept at school.



## 2. 2021 GRADE 12 PAT GUIDELINES (cont...)

### 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 task, with ticks and totals
- Composite working marksheet 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 sheet for all tasks



## 2. 2021 GRADE 12 PAT GUIDELINES (cont...)

### 3. LEARNER GUIDELINES

- 3.1 This practical assessment task for Grade 12 consists of THREE tasks.
- 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 units where necessary.



## 4. EVIDENCE OF MODERATION

Learner's name:	
School:	

### MARK ALLOCATION

TASK	MAXIMUM MARK	WEIGHTING	LEARNER'S MARK (TEACHER)	MODERATED MARK (SCHOOL)	MODERATED MARK (DISTRICT)	MODERATED MARK (PROVINCE)
1	40	40				
2	30	30				
3	30	30				
TOTAL	100	100				
NAME						
SIGNATURES						
DATE						

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

SCHOOL STAMP



## 2. 2021 GRADE 12 PAT GUIDELINES (cont...)

### 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.



# 3. CONCLUSION

- The success in the administration of TECHNICAL MATHEMATICS PAT depends on all involved.
- Therefore, let us all play our part in ensuring that PAT is administered professionally and that all learners complete all tasks – one task at a time!
- Let us remember to ask where we need to, share when we need to, keeping in mind that 'Together Everyone Achieves More' (TEAM)!





**Thank You**



# 2021 GRADE 12 TECHNICAL MATHEMATICS FIRST PRACTICAL ASSESSMENT TASK (PAT) MEDIATION

## TASK 1 PRESENTATION

MAY 2021







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## TECHNICAL MATHEMATICS

### PRACTICAL ASSESSMENT TASK 1

GRADE 12

2021

SURNAME & NAME	
----------------	--

SCHOOL	
--------	--

TERM: 2

MARKS: 40



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ICA

This task consists of 14 pages  
(including the cover page)



2021 PAT – TASK 1



## TECHNICAL MATHEMATICS TASK 1

### TOPIC: COMPLEX NUMBERS

**AIM:** To apply and develop mathematical skills, reasoning and demonstrate an understanding of complex numbers in real life technical problems.

A **complex number** is any number that can be written in the form  $a + bi$  where  $a$  and  $b$  are real numbers, where  $a$  is a real part,  $b$  is an imaginary part, and  $i$  is an imaginary unit.

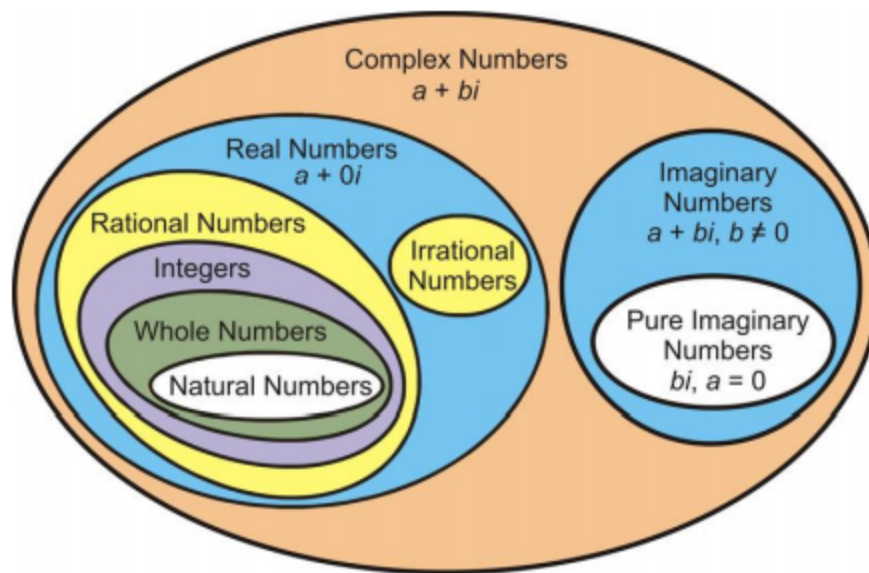
### INSTRUCTIONS AND INFORMATION

1. This PAT Task 1 worksheet consists of FIVE questions.
2. Answer ALL the questions.
3. Resources required are calculators, grids (provided) and mathematical sets.
4. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.



## QUESTION 1

## CLASSIFICATION OF COMPLEX NUMBERS AND INTRODUCTION TO COMPLEX CONJUGATES.



Classify each complex number by placing a value in the appropriate column(s).

Solution						Marks
1	No.	Complex Number	Imaginary Part	Real Part	Complex Conjugate	(3)
	1.	$5 + 2i$				
	2.	$-8 + \frac{1}{2}i$				
	3	$-3i$				
						[3]



## QUESTION 2

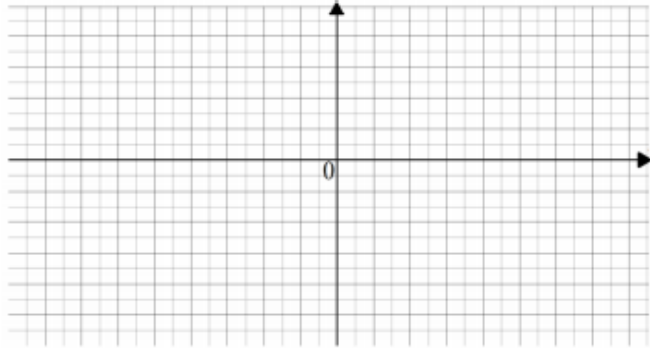
## BASIC OPERATIONS AND GRAPHICAL REPRESENTATION OF COMPLEX NUMBERS

Complex numbers can be represented on a complex plane, the Argand diagram with the horizontal axis as the real part and the vertical axis as the imaginary part.

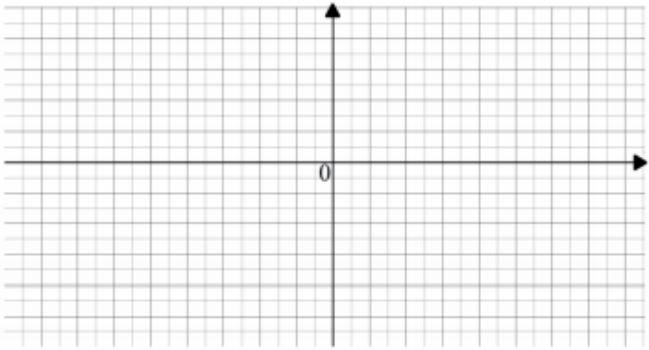
A Complex number  $z = a + bi$  in rectangular form has  $a$  representing the distance along the real axis and  $b$  the distance along the imaginary axis.

2.1 Determine, with the aid of an Argand diagram:

2.1.1 The sum of  $z_1 = -8 + 3i$  and  $z_2 = 3 - 5i$  (3)

	Solution	Marks
2.1.1		

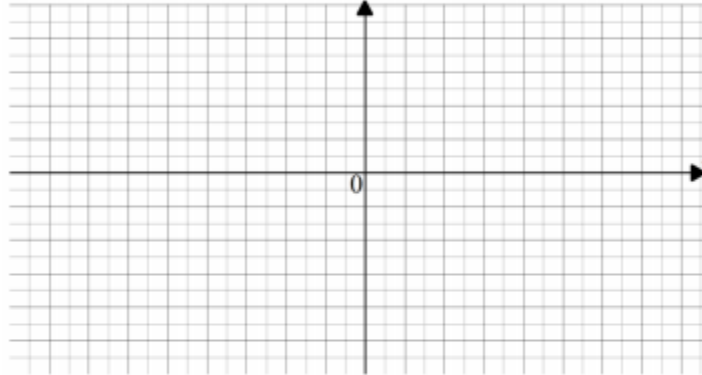
2.1.2 The difference between  $z_3 = 9 - 7i$  and  $z_4 = 6 + i$  (3)

	Solution	Marks
2.1.2		

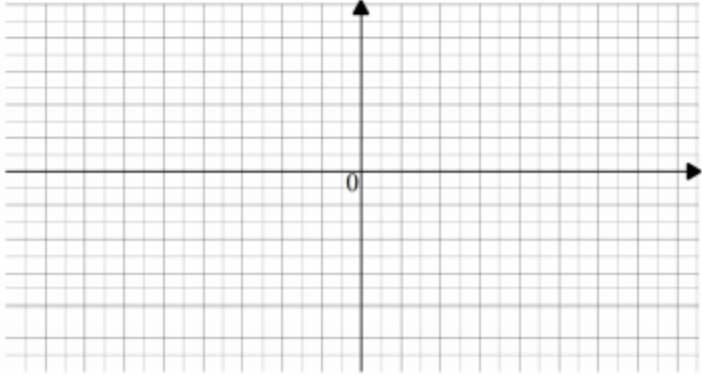


2.2 Sketch the given complex number and its complex conjugate on the grid provided :

2.2.1  $z_3 = 9 - 7i$  (3)

	Solution	Marks
2.2.1		
		

2.2.2  $z_4 = 6 + i$  (2)

	Solution	Marks
2.2.2		



- 2.3 What can you deduce from **QUESTIONS 2.2.1** and **2.2.2** about the complex number and its complex conjugate? (1)

	<b>Solution</b>	<b>Marks</b>
2.3		
		<b>[12]</b>



**POLAR FORM AND GRAPHICAL REPRESENTATION OF COMPLEX NUMBERS**

- A complex number in rectangular form  $a + bi$  has polar coordinates  $r \operatorname{cis} \theta = r(\cos \theta + i \sin \theta) = r \angle \theta$  where:
  - $r = \sqrt{a^2 + b^2}$ ,  $r$  is the modulus
  - $\tan \theta = \frac{b}{a}$ ,  $\theta$  is the argument.
- In a complex plane, by drawing a vector from the origin to the point representing  $z = a + bi$ , an angle  $\theta$  in standard position is formed. The point  $a + bi$  is  $r$  units from the origin.
- When converting a complex number from a rectangular form to a polar form,
  - the quadrant in which the complex number lies should be identified.
  - the required angle is found by using a tangent ratio, the signs of  $a$  and  $b$  indicate the quadrant in which the angle is found.

Convert to polar form and represent on an Argand diagram the following rectangular complex numbers:

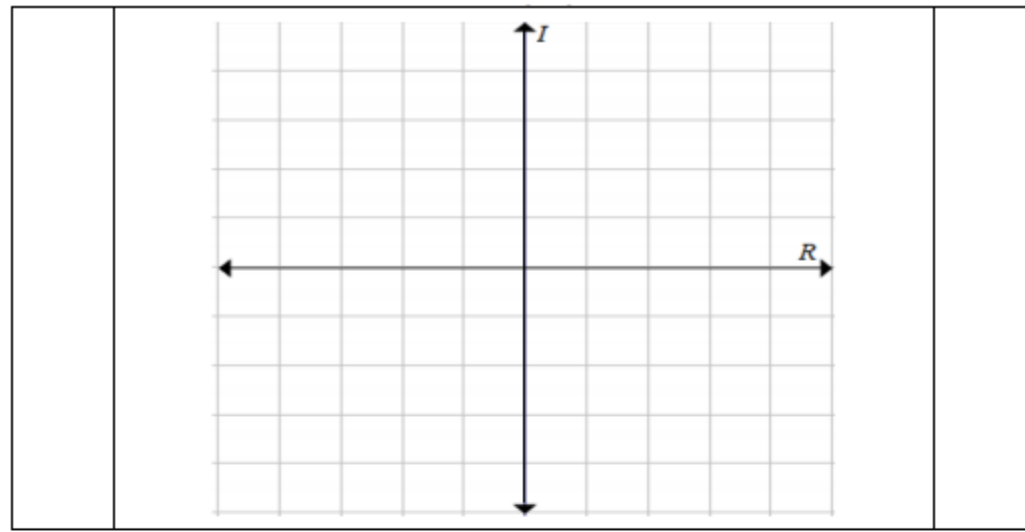
3.1  $z = 4i$

(4)

	Solution	Marks



# 2021 PAT – TASK 1



3.2

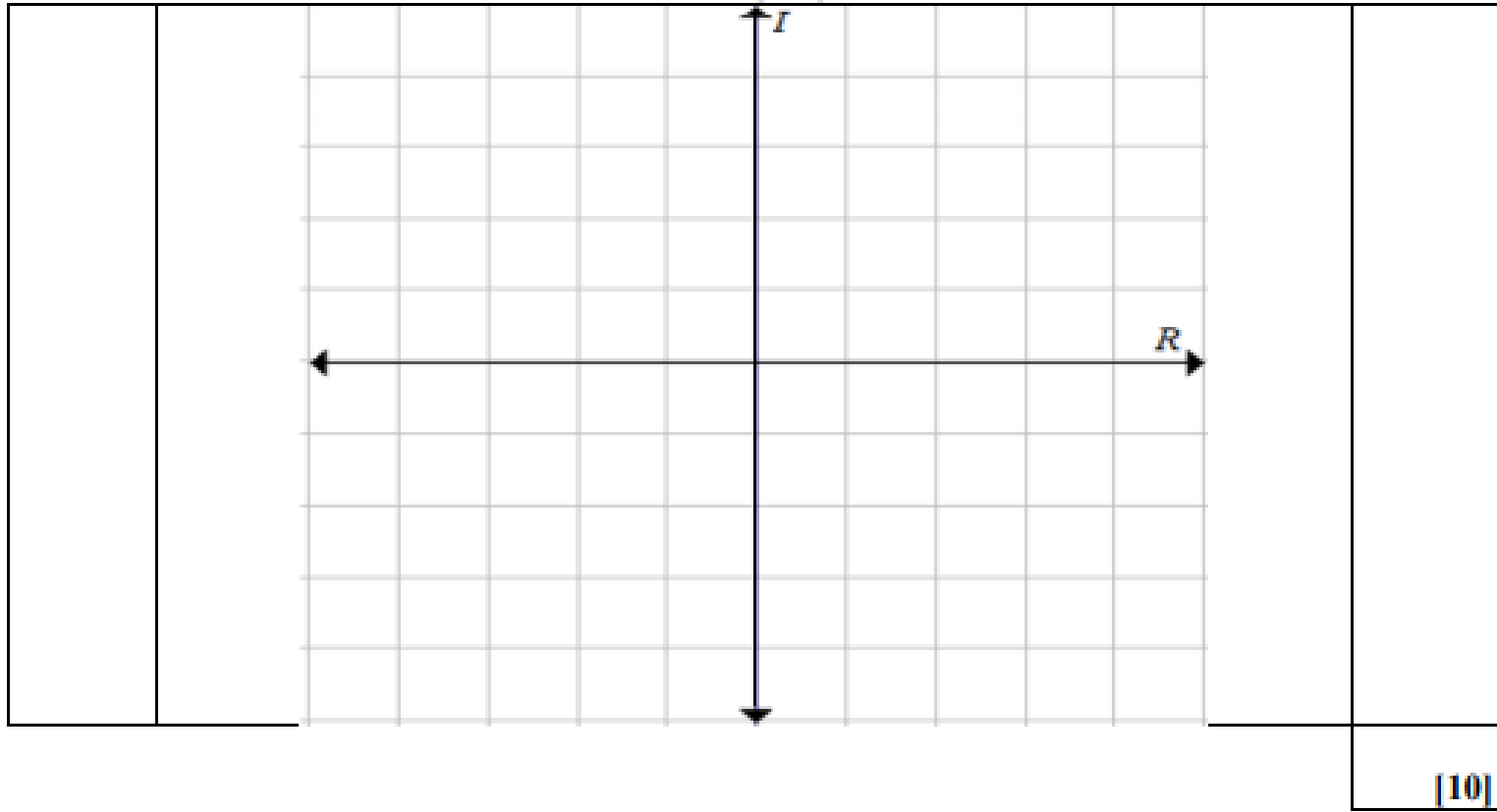
$$z = 2\sqrt{5} + 2i$$

(6)

	Solution	Marks



# 2021 PAT – TASK 1

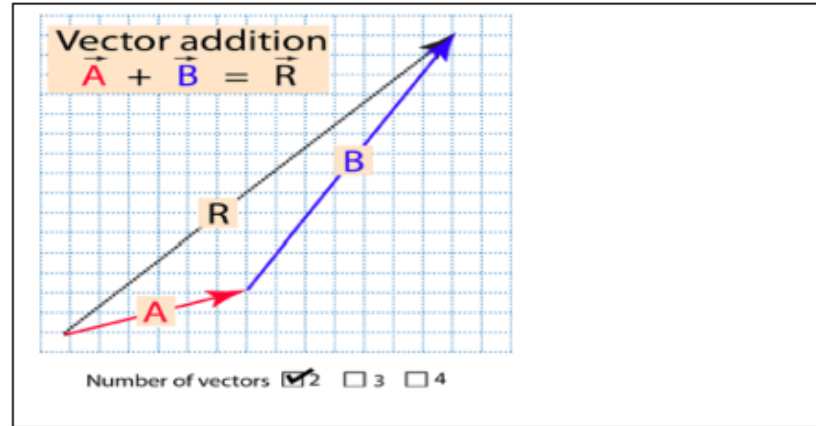




## QUESTION 4

### APPLY COMPLEX NUMBER TO DETERMINE THE RESULTANT FORCE OF TWO VECTORS BY ADDITION

The picture below shows a force diagram of the addition of two vectors



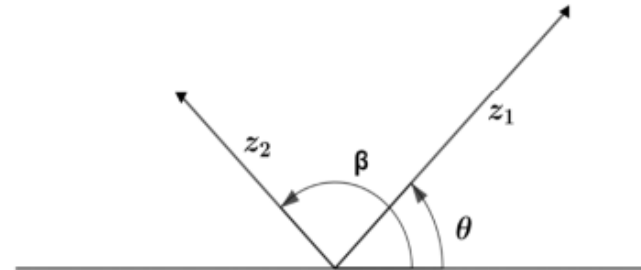
Now use knowledge of complex numbers to add two vectors.

Given in the diagram below:

Force 1:  $z_1 = 4\sqrt{2} \operatorname{cis} \theta$

Force 2:  $z_2 = \frac{6}{\sqrt{2}} \operatorname{cis} \beta$

The diagram below shows the two vectors.



Using a protractor

**Step 1:** Measure  $\theta$  in degrees.

**Step 2:** Measure  $\beta$  in degrees.



4.1 Using a protractor measure angles  $\theta$  and  $\beta$

(2)

	Solution	Marks
	$\theta = \underline{\hspace{2cm}}^\circ$	
	$\beta = \underline{\hspace{2cm}}^\circ$	
		(2)

4.2 Write  $z_1$  and  $z_2$  in polar form

(2)

	Solution	Marks
		(2)

4.3 Determine resultant Force  $z_R$  if  $z_R = z_1 + z_2$

(1)

	Solution	Marks
		(1)

4.4 Express  $z_R$  in polar form  $r \text{ cis } \theta$

(1)

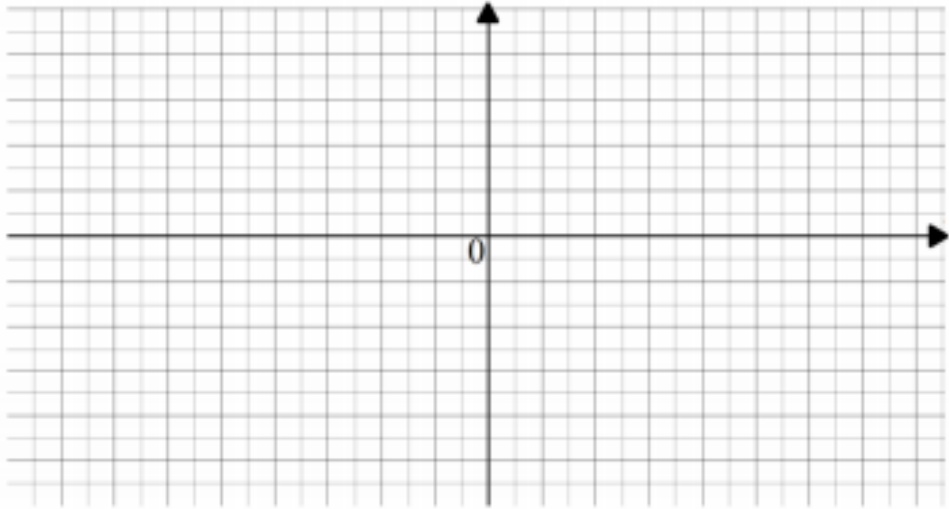
	Solution	Marks
		(1)



4.5 Represent the resultant force in an Argand diagram

(3)

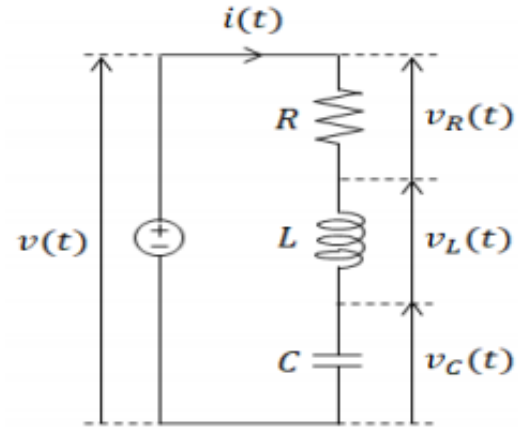
[9]

	Solution	Marks
		



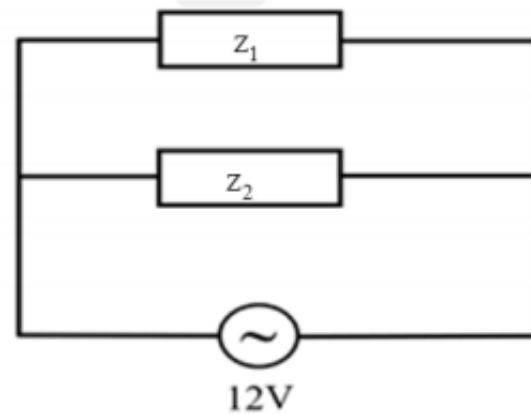
QUESTION 5

APPLICATION OF COMPLEX NUMBERS IN ELECTRONICS (RLC circuits)



The diagram below models an AC circuit with two impedances  $z_1 = (30 + 10i) \Omega$  and  $z_2 = (10 - 30i) \Omega$  connected in parallel.

The total impedance is  $z_T = \frac{z_1 \times z_2}{z_1 + z_2}$



Determine the total impedance,  $z_T = \frac{z_1 \times z_2}{z_1 + z_2}$



# 2021 PAT – TASK 1

	Solution	Marks
5.		
		(6)
		[6]







**Thank You**



# 2021 GRADE 12 TECHNICAL MATHEMATICS FIRST PRACTICAL ASSESSMENT TASK (PAT) MEDIATION

## TASK 1 MARKING GUIDELINES PRESENTATION

JUNE 2021





# 2021 PAT – TASK 1 MARKING GUIDELINES



**basic education**

Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

**TECHNICAL**

**MATHEMATICS**

**MARKING GUIDELINES FOR  
PRACTICAL ASSESSMENT  
TASKS**

**GRADE  
12**

**2021**



**basic education**  
Department:  
Basic Education  
**REPUBLIC OF SOUTH AFRICA**

ICA

These Marking Guidelines consist of 19 pages.





**TECHNICAL MATHEMATICS TASK 1****TOPIC: COMPLEX NUMBERS**

**AIM:** To apply and develop mathematical skills, reasoning and demonstrate an understanding of complex numbers in real life technical problems.

**NOTES:**

A **complex number** is any number that can be written in the form  $a + bi$  where  $a$  and  $b$  are real numbers, where  $a$  is a real part,  $b$  is an imaginary part, and  $i$  is an imaginary unit.

**TECHNICAL MATHEMATICS TASK 1 MARKING GUIDELINES****NOTE 1:**

1. Consistent accuracy to be applied where applicable.
2. If a question is answered TWICE, the FIRST attempt should be marked.
3. Correct scale used by the learner should be considered.

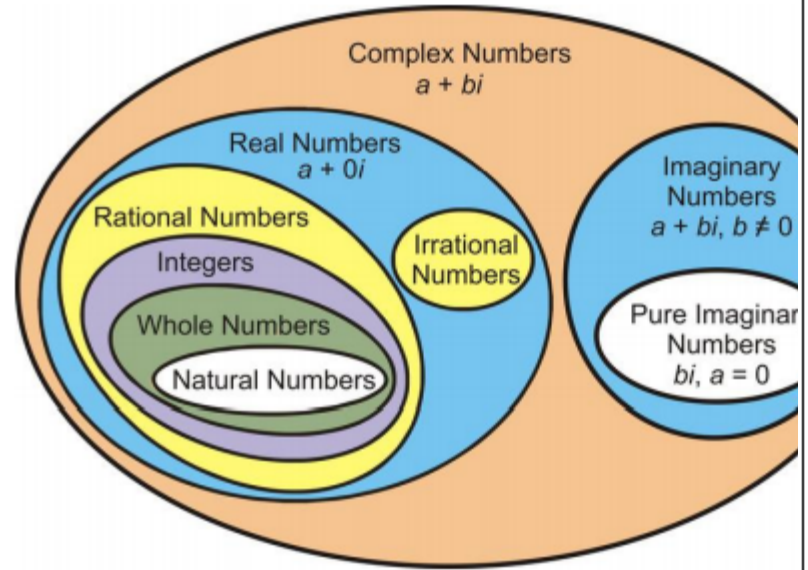
**NOTE 2:** This Task 1 Marking Guidelines consists of 10 pages.





QUESTION 1

CLASSIFICATION OF COMPLEX NUMBERS AND INTRODUCTION TO COMPLEX CONJUGATES.



Classify each complex number by placing a value in the appropriate column(s).

Solution					
1	No.	Complex Number	Imaginary Part	Real Part	Complex Conjugate
	1.	$5 + 2i$			
	2.	$-8 + \frac{1}{2} i$			
	3	$-3i$			

Solution					Marks
No.	Number	Imaginary Number	Real Number	Complex Conjugate	✓✓✓ for all 9 values correct  ✓✓ for 6 values correct  ✓ for 3 values correct  (3)
1.	$5 + 2i$	$2i$	5	$5 - 2i$	
2.	$-8 + \frac{1}{2}i$	$\frac{1}{2}i$	-8	$-8 - \frac{1}{2}i$	
3.	$-3i$	$-3i$	0	$3i$	
					[3]

NOTES: Please replace 'Number' by 'Part' in the 3<sup>rd</sup> and 4<sup>th</sup> column in the table!



QUESTION 2

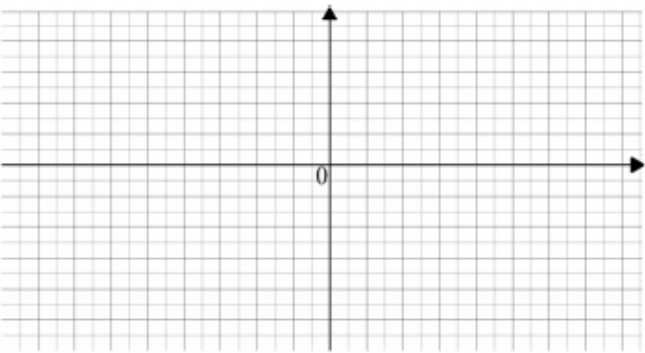
BASIC OPERATIONS AND GRAPHICAL REPRESENTATION OF COMPLEX NUMBERS

Complex numbers can be represented on a complex plane, the Argand diagram with the horizontal axis as the real part and the vertical axis as the imaginary part.

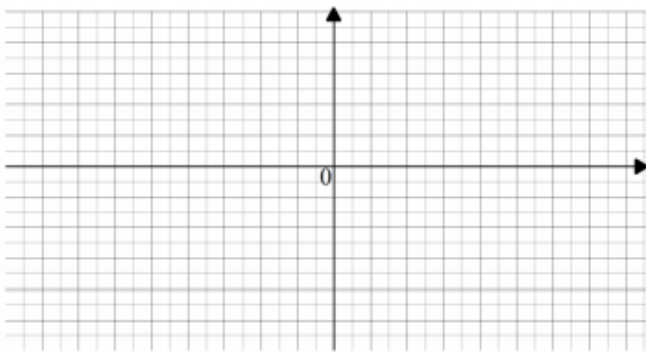
A Complex number  $z = a + bi$  in rectangular form has  $a$  representing the distance along the real axis and  $b$  the distance along the imaginary axis.

2.1 Determine, with the aid of an Argand diagram:

2.1.1 The sum of  $z_1 = -8 + 3i$  and  $z_2 = 3 - 5i$

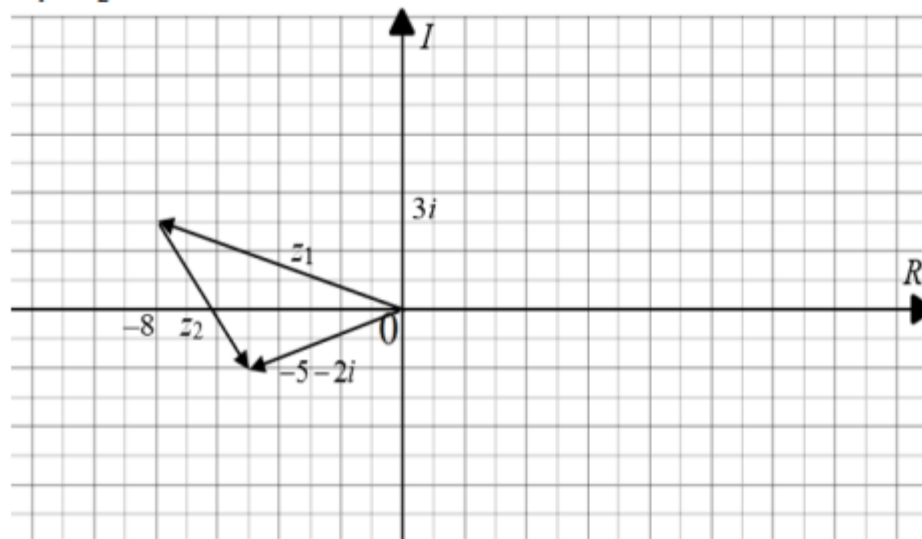
Solution	
2.1.1	

2.1.2 The difference between  $z_3 = 9 - 7i$  and  $z_4 = 6 + i$

Solution	
2.1.2	

2.1.1

$$z_1 + z_2 = -8 + 3i + 3 - 5i = -5 - 2i$$



✓sum

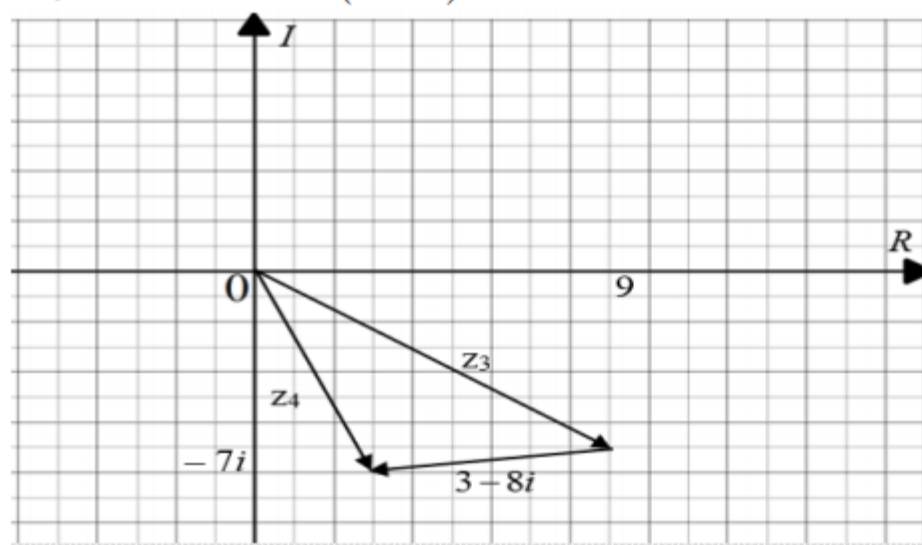
✓plotting  $z_1$  and  $z_2$

✓plotting resultant

(3)

2.1.2

$$z_3 - z_4 = 9 - 7i - (6 + i) = 3 - 8i$$



✓difference

✓plotting  $z_3$  and  $z_4$

✓plotting resultant

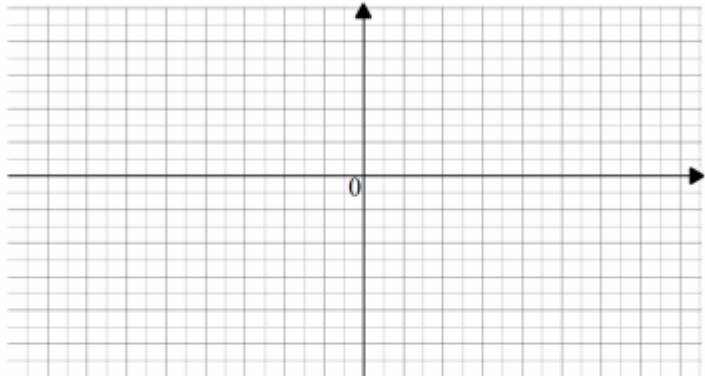
(3)

**NOTES: The sum and difference is implied if the it is correctly plotted!**

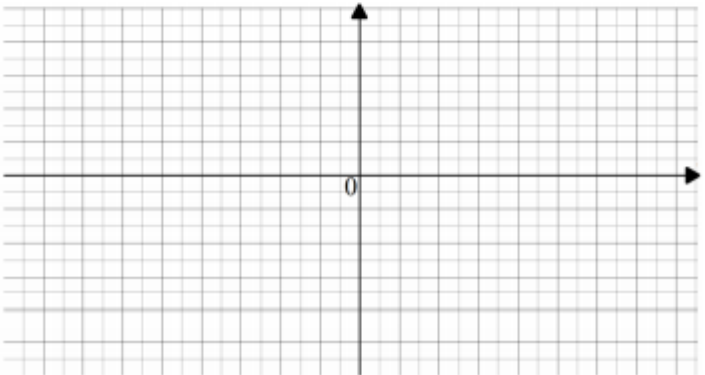


2.2 Sketch the given complex number and its complex conjugate on the grid provided :

2.2.1  $z_3 = 9 - 7i$

Solution	
2.2.1	
	

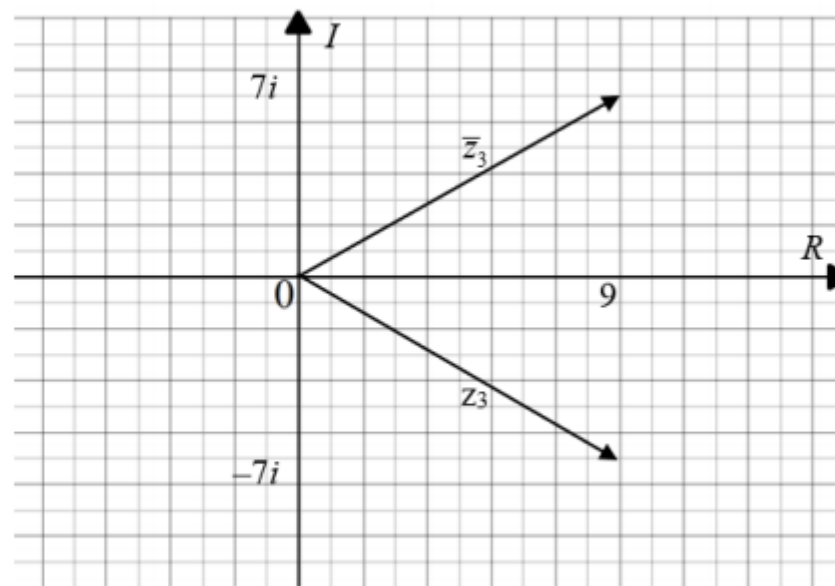
2.2.2  $z_4 = 6 + i$

Solution		Marks
2.2.2		

2.2.1

$$z_3 = 9 - 7i$$

$$\bar{z}_3 = 9 + 7i$$



✓ conjugate

✓ plotting  $z_3$

✓ plotting conjugate

(3)

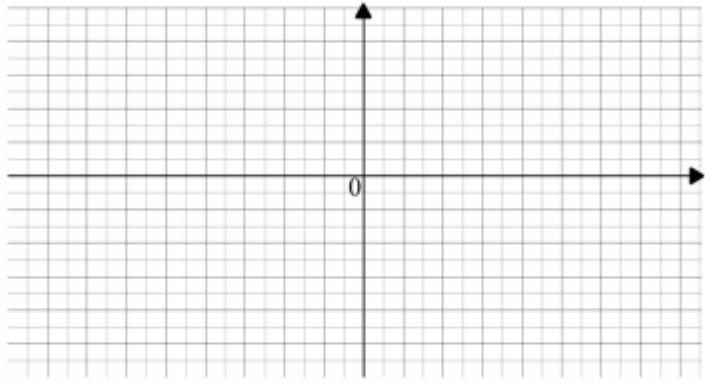
**NOTES: The conjugate is implied if the it is correctly plotted!**



2.2 Sketch the given complex number and its complex conjugate on the grid provided :

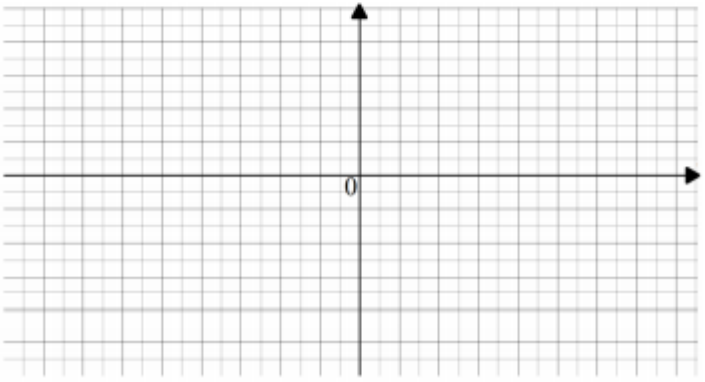
2.2.1  $z_3 = 9 - 7i$

(3)

	Solution	Marks
2.2.1		

**NOTES: The conjugate is implied if the it is correctly plotted!**

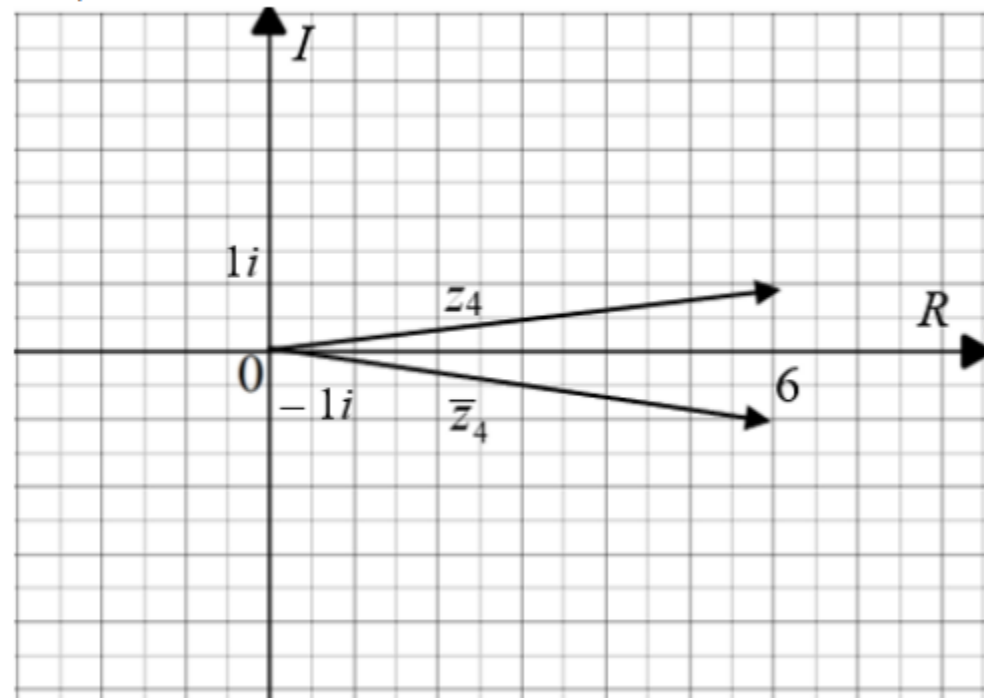
2.2.2  $z_4 = 6 + i$

	Solution
2.2.2	

2.2.2

$z_4 = 6 + i$

$\bar{z}_4 = 6 - i$



✓plotting  $z_4$

✓plotting conjugate

(2)





2.3 What can you deduce from **QUESTIONS 2.2.1** and **2.2.2** about the complex number and its complex conjugate? (1)

	Solution	Marks
2.3		
		[12]

**NOTES:** Accept any deduction which makes sense about the complex number and its conjugate!

2.3	<p>The complex conjugate is a reflection of its complex number about the real axis.</p> <p><b>OR</b></p> <p>The complex conjugate is symmetrical to its complex number about the Real axis</p>	<p>✓Deduction</p> <p>(1)</p> <p>[12]</p>
-----	--	--

**NOTES:**



QUESTION 3

POLAR FORM AND GRAPHICAL REPRESENTATION OF COMPLEX NUMBERS

- A complex number in rectangular form  $a + bi$  has polar coordinates  $r \operatorname{cis} \theta = r(\cos \theta + i \sin \theta) = r \angle \theta$  where:
  - $r = \sqrt{a^2 + b^2}$ ,  $r$  is the modulus
  - $\tan \theta = \frac{b}{a}$ ,  $\theta$  is the argument.
- In a complex plane, by drawing a vector from the origin to the point representing  $z = a + bi$ , an angle  $\theta$  in standard position is formed. The point  $a + bi$  is  $r$  units from the origin.
- When converting a complex number from a rectangular form to a polar form,
  - the quadrant in which the complex number lies should be identified.
  - the required angle is found by using a tangent ratio, the signs of  $a$  and  $b$  indicate the quadrant in which the angle is found.

Convert to polar form and represent on an Argand diagram the following rectangular complex numbers:

3.1  $z = 4i$

Solution

3.1

$$z = 4i$$

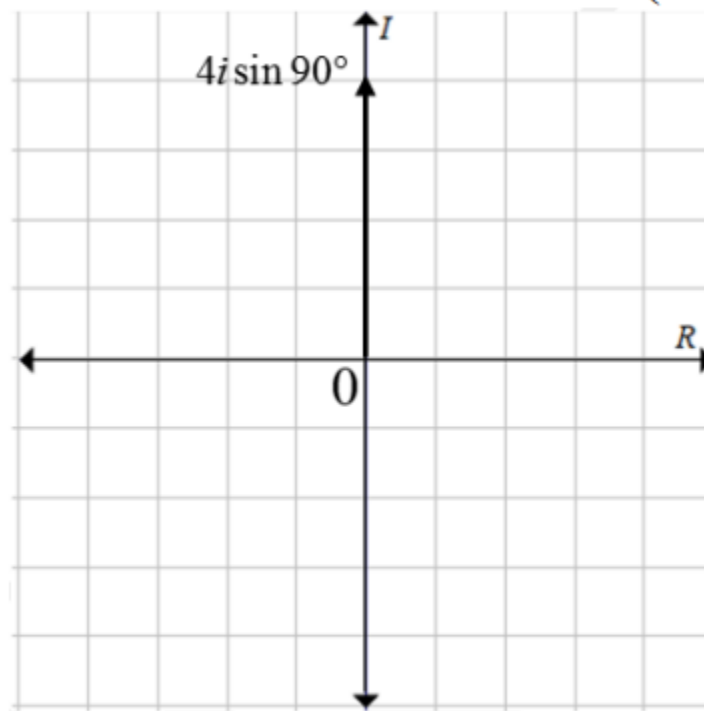
$$r = \sqrt{4^2}$$

$$r = 4$$

$$\theta = 90^\circ \text{ OR } \frac{\pi}{2}$$

$$z = 4 \operatorname{cis}(90^\circ) \text{ OR } 4 \operatorname{cis} \frac{\pi}{2}$$

$$z = 4(\cos 90^\circ + i \sin 90^\circ) \text{ OR } z = 4\left(\cos \frac{\pi}{2} + i \sin \frac{\pi}{2}\right)$$



$$\checkmark r = 4$$

$$\checkmark \theta = 90^\circ \text{ or } \frac{\pi}{2}$$

$$\checkmark z = 4 \operatorname{cis} 90^\circ$$

OR

$$z = 4(\cos 90^\circ + i \sin 90^\circ)$$

OR

$$z = 4 \cos \frac{\pi}{2} + i \sin \frac{\pi}{2}$$

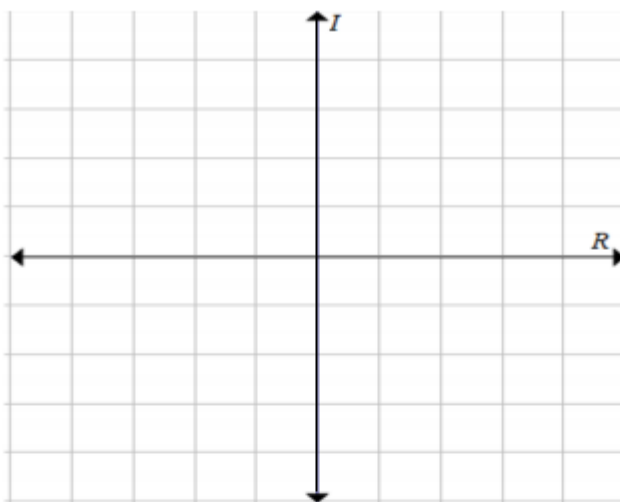
$\checkmark$  correct plotting

(4)

**NOTES: Accept the third polar form notation.**







3.2

$$z = 2\sqrt{5} + 2i$$

Solution

3.2

$$z = 2\sqrt{5} + 2i$$

$$r = \sqrt{(2\sqrt{5})^2 + (2)^2}$$

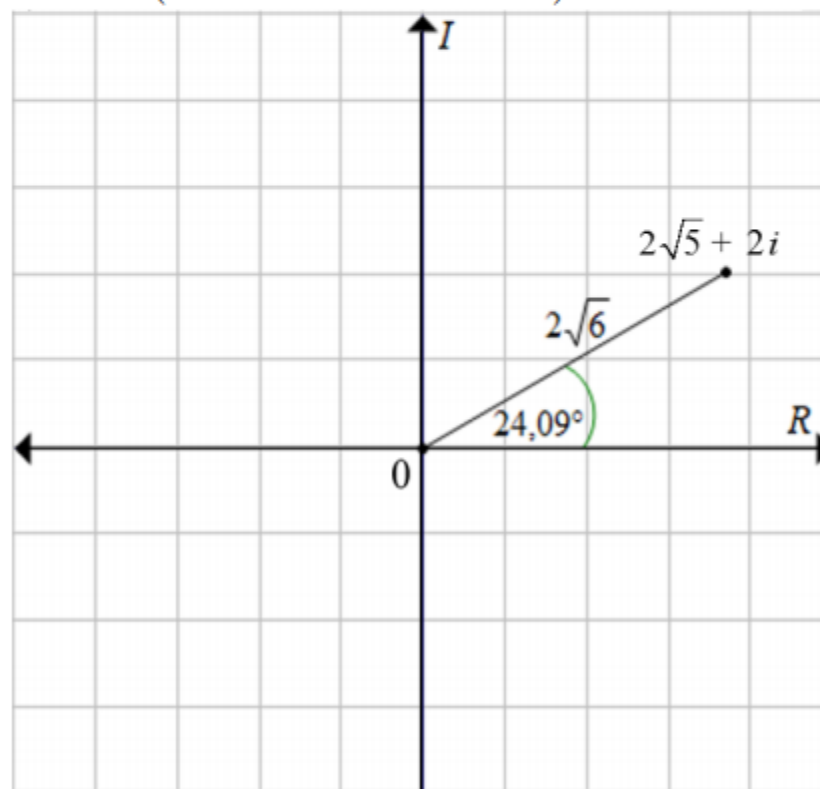
$$r = \sqrt{24} = 2\sqrt{6}$$

$$\tan \theta = \frac{2}{2\sqrt{5}}$$

$$\theta = 24,09$$

$$z = 2\sqrt{6} \operatorname{cis}(24,09^\circ)$$

$$z = 2\sqrt{6} (\cos 24,09^\circ + i \sin 24,09^\circ)$$



**NOTES: Accept the third polar form notation.**

$$\checkmark \sqrt{(2\sqrt{5})^2 + (2)^2}$$

✓ value of  $r$

$$\checkmark \frac{2}{2\sqrt{5}}$$

$$\checkmark \theta = 24,09^\circ$$

$$\checkmark z = 2\sqrt{6} \operatorname{cis} 24,09^\circ$$

**OR**

$$z = 2\sqrt{6} (\cos 24,09^\circ + i \sin 24,09^\circ)$$

✓ plotting

(6)  
[10]



# 2021 PAT – TASK 1

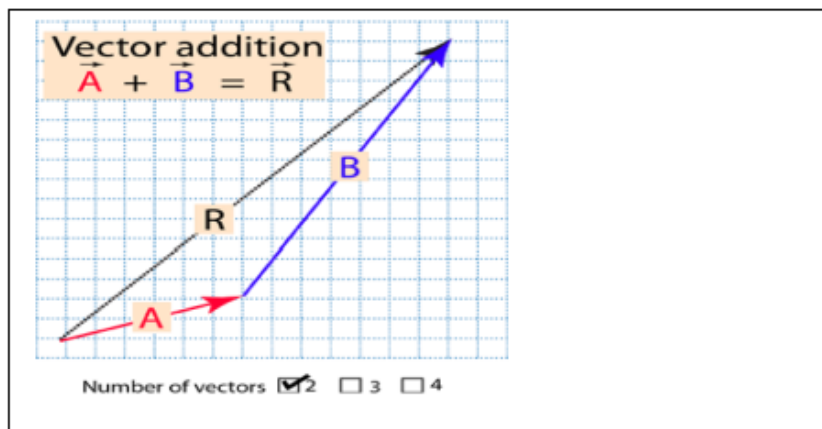
**NOTES:**



## QUESTION 4

APPLY COMPLEX NUMBER TO DETERMINE THE RESULTANT  
FORCE OF TWO VECTORS BY ADDITION

The picture below shows a force diagram of the addition of two vectors



**NOTES:** Please measure the on the learners' script to verify their answers!

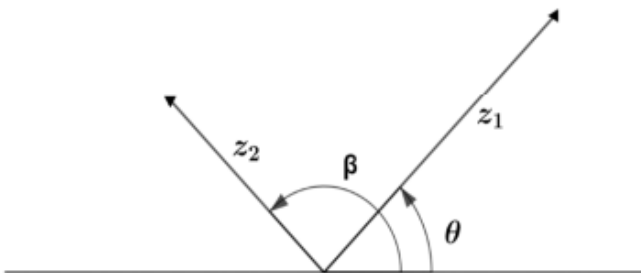
Now use knowledge of complex numbers to add two vectors.

Given in the diagram below:

Force 1:  $z_1 = 4\sqrt{2} \operatorname{cis} \theta$

Force 2:  $z_2 = \frac{6}{\sqrt{2}} \operatorname{cis} \beta$

The diagram below shows the two vectors.



Using a protractor

**Step 1:** Measure  $\theta$  in degrees.

**Step 2:** Measure  $\beta$  in degrees.



4.1 Using a protractor measure angles  $\theta$  and  $\beta$

Solution
$\theta = \underline{\hspace{2cm}}^\circ$
$\beta = \underline{\hspace{2cm}}^\circ$

4.1	$\theta = 45^\circ$ $\beta = 135^\circ$	$\checkmark \theta$ value $\checkmark \beta$ value (2)
-----	--	--

4.2 Write  $z_1$  and  $z_2$  in polar form

Solution

4.2	$z_1 = 4 + 4i$ $z_2 = -3 + 3i$	$\checkmark z_1$ value $\checkmark z_2$ value (2)
-----	-----------------------------------	---

4.3 Determine resultant Force  $z_R$  if  $z_R = z_1 + z_2$

Solution

4.3	$z_R = 1 + 7i$	$\checkmark z_R$ value (1)
-----	----------------	-------------------------------

4.4 Express  $z_R$  in polar form  $r \text{ cis } \theta$

Solution	Marks
	(1)

4.4	$z_R = 5\sqrt{2} \text{ cis } 81,87^\circ$	$\checkmark z_R$ in polar form (1)
-----	--	---------------------------------------

**NOTES: Please measure the on the learners' script to verify their answers! Follow learners' workings!**

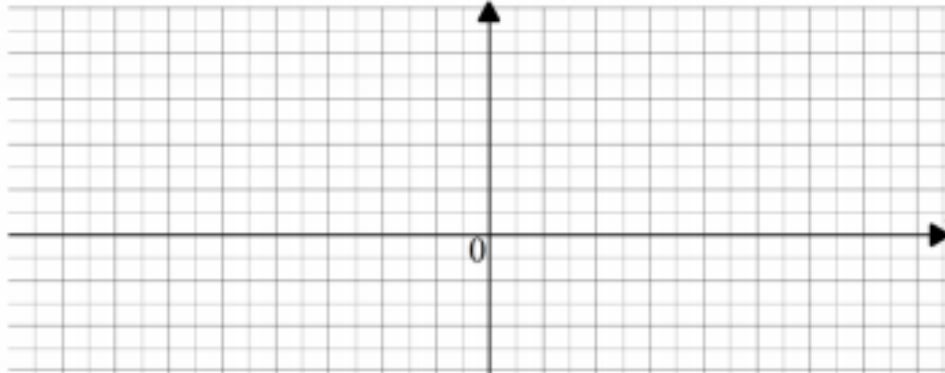




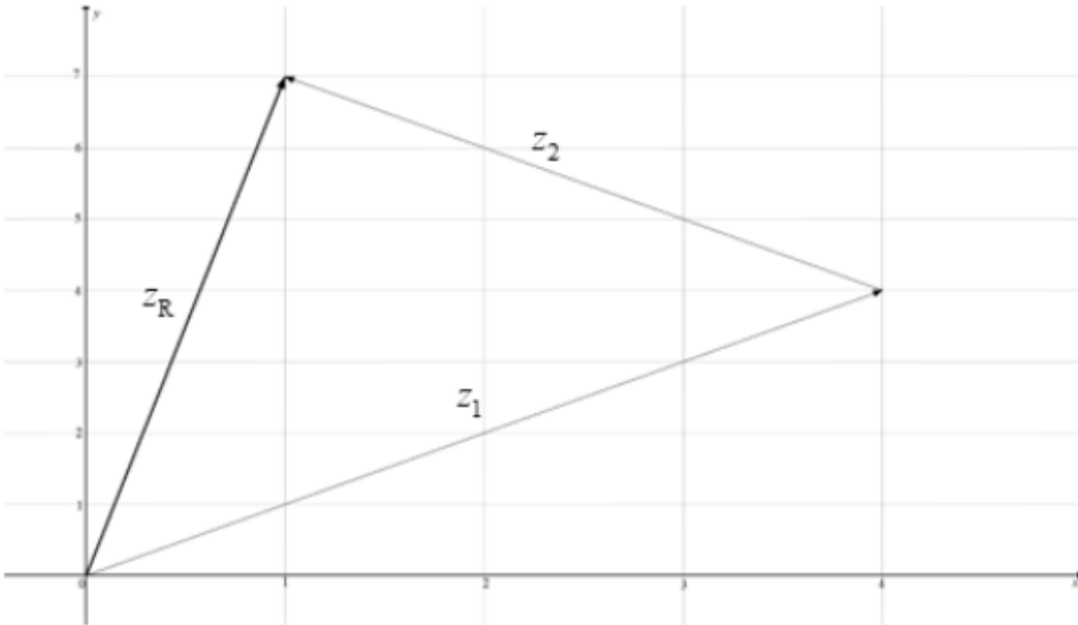
4.5 Represent the resultant force in an Argand diagram

(3)

[9]

Solution	Marks
	

NOTES:

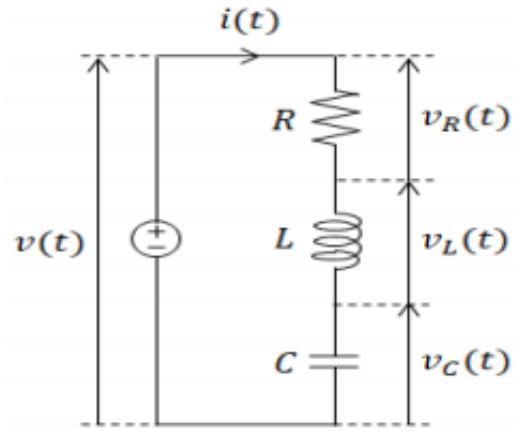
4.5		$\checkmark z_1$ $\checkmark z_2$ $\checkmark z_R$	(3)
-----	---	--	-----





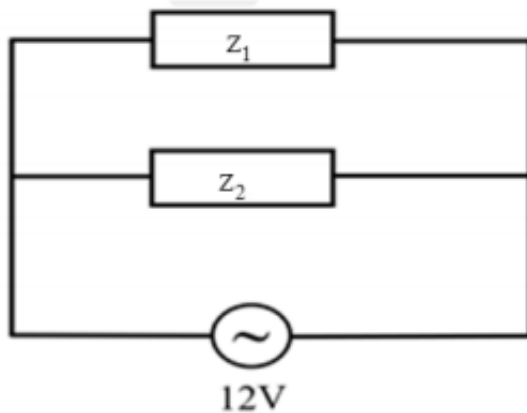
## QUESTION 5

### APPLICATION OF COMPLEX NUMBERS IN ELECTRONICS (RLC circuits)



The diagram below models an AC circuit with two impedances  $z_1 = (30 + 10i) \Omega$  and  $z_2 = (10 - 30i) \Omega$  connected in parallel.

The total impedance is  $z_T = \frac{z_1 \times z_2}{z_1 + z_2}$



Determine the total impedance,  $z_T = \frac{z_1 \times z_2}{z_1 + z_2}$

5.

$$\begin{aligned}
 z_T &= \frac{z_1 \times z_2}{z_1 + z_2} \\
 z_T &= \frac{(30 + 10i) \times (10 - 30i)}{(30 + 10i) + (10 - 30i)} \\
 &= \frac{300 - 900i + 100i - 300i^2}{40 - 20i} \\
 &= \frac{300 - 800i - 300(-1)}{40 - 20i} \\
 &= \frac{600 - 800i}{40 - 20i} \times \frac{40 + 20i}{40 + 20i} \\
 &= \frac{24000 + 12000i - 32000i - 16000i^2}{1600 - 400i^2} \\
 &= \frac{24000 - 20000i - 16000(-1)}{1600 - 400(-1)} \\
 &= \frac{40000 - 20000i}{2000} \\
 &= 20 - 10i
 \end{aligned}$$

✓ substitution

✓ simplification

✓  $i^2 = -1$

✓ multiplying by  
conjugate of the  
denominator

✓ simplification

✓ answer

[6]

**NOTES:**



# 2021 PAT – TASK 1 M.G NOTES

**NOTES:**





**Thank You**



# 2021 GRADE 12 TECHNICAL MATHEMATICS FIRST PRACTICAL ASSESSMENT TASK (PAT) MEDIATION

## TASK 2 PRESENTATION

JUNE 2021







basic education

Department:  
Basic Education  
REPUBLIC OF SOUTH AFRICA

## TECHNICAL MATHEMATICS

### PRACTICAL ASSESSMENT TASK 2

GRADE 12

2021

SURNAME AND NAME	
------------------	--

SCHOOL	
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TERM: 2

MARKS: 30

This task consists of 12 pages.



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2021 PAT – TASK 2



## TECHNICAL MATHEMATICS TASK 2

### TOPIC: EUCLIDEAN GEOMETRY

**AIM:** To verify the midpoint theorem and proportionality theorem and apply the two theorems to solve problems

### INSTRUCTIONS AND INFORMATION

1. This PAT Task 2 worksheet consists of SIX questions.
2. Answer ALL the questions.
3. Clearly show ALL calculations, diagrams, graphs, etc. that you have used in determining your answers.



**ACTIVITY 1****Objective**

- To investigate the relationship between the line joining the mid-points of two sides of a triangle and the third side
- To apply the midpoint theorem to solve problems in a real-life context

**Materials required**

- Mathematical instruments (ruler and protractor are essential)
- Pen
- Pencil
- Cotton/String
- Scissors
- Tracing paper
- Cellophane tape
- Paper glue

**Theory**

**Midpoint theorem:** The line segment joining the midpoints of any two sides of a triangle is parallel to the third side and it is half the length of the third side.

**Procedure**

**Step 1:** Draw any  $\triangle ABC$  in the space provided below.

	Solution	
Step 1		



**Step 2:** Use a ruler to measure the lengths of AB, AC and BC and record them in the space below.

	Solution	
Step 2	AB = _____; AC = _____ and BC = _____	

**Step 3:** Mark the midpoints D and E of the sides AB and AC respectively. Join D and E.

	Solution	
Step 3	$\therefore$ Length of AD = _____ and AE = _____	

- Step 4:**
- Place a piece of cotton/string along the length of BC.
  - Mark off and cut so that the length of the cotton is the same as BC.
  - Fold the piece of cotton/string in half and place that against DE.
  - Use cellophane tape to stick the cotton piece along the length of DE.
  - Does the folded half fit exactly along the length of DE?
  - Use a ruler to measure the length of DE and record the value.

	Solution	
Step 4	<ul style="list-style-type: none"> <li>• Does the folded half fit exactly along the length of DE? _____</li> <li>• Use a ruler to measure the length of DE and record the value:  DE = _____</li> </ul>	

- Step 5:**
- Use a tracing paper, trace and cut out a copy of  $\triangle ADE$ .
  - Clearly label angles  $\hat{A}$ ,  $\hat{D}$  and  $\hat{E}$  at the respective vertices.
  - Place your traced cut-out of  $\triangle ADE$  so that  $\hat{D}$  is placed over  $\hat{B}$  of  $\triangle ABC$ .
  - Use paper glue to stick the cut-out of  $\triangle ADE$  so that  $\hat{D}$  is placed over  $\hat{B}$  of  $\triangle ABC$ .
  - Does  $\hat{D}$  fit exactly over  $\hat{B}$ ?
  - Use a protractor to measure the size of  $\hat{ABC}$  and  $\hat{ADE}$  and record them below.

	Solution	
Step 5	<ul style="list-style-type: none"> <li>• <math>\hat{ABC} = \text{_____}^\circ</math> and <math>\hat{ADE} = \text{_____}^\circ</math></li> </ul>	



**Observations and Conclusion**

1. Answer the following questions:

1.1 Compare the sizes of  $\hat{ABC}$  and  $\hat{ADE}$

	Solution	
1.1		

1.2 Fill in the missing word:

The line segment DE is ..... to BC  
(corresponding  $\angle$ s are =)

	Solution	
1.2		

1.3 Compare the lengths of DE and BC.

	Solution	
1.3		

1.4 Explain the relationship between the lengths of DE and BC,

i.e. length of DE = ... BC

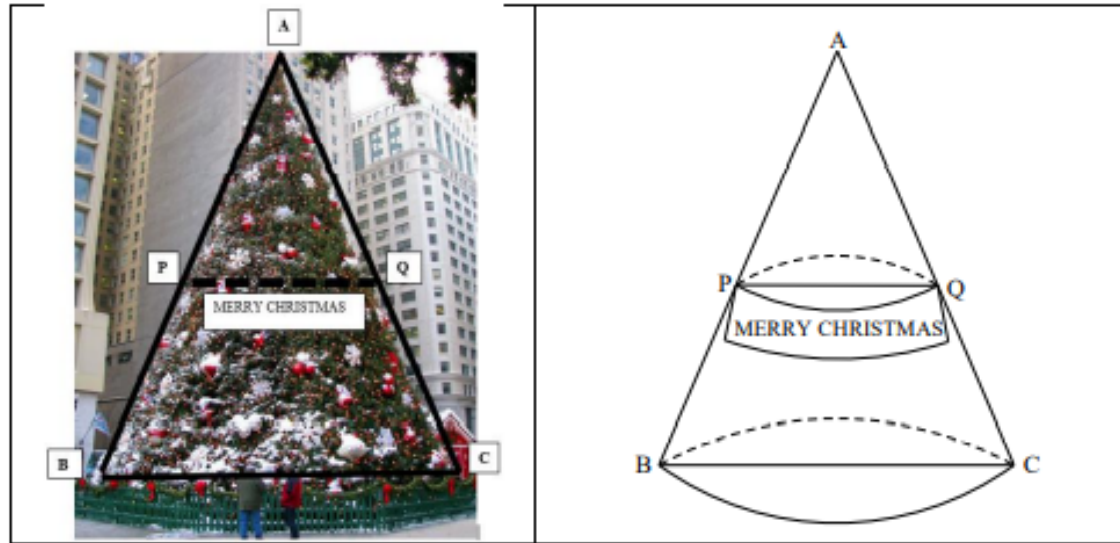
	Solution	
1.4	DE = ... BC	



- 1.5 Explain the relationship that you observe between the line segment joining the midpoints of two sides of a triangle and the third side.

	Solution	
1.5		

2. The picture below shows a large Christmas tree and the diagram alongside models the picture.  
Points P and Q are the midpoints of sides AB and AC respectively of  $\triangle ABC$ .  
The slogan 'MERRY CHRISTMAS' is attached to a steel cable surrounding the Christmas tree from P to Q.





Use the midpoint theorem to determine the length of the slogan from P to Q, by first determining the length of BC (the base diameter) if the circumference of the base circle of the tree is 40,84 m. Show your calculations in the space below.

Use the following formula: Circumference of circle =  $2\pi r$

	Solution	



**ACTIVITY 2****Objective**

- To investigate the basic proportionality theorem

**Materials required**

- Mathematical instruments (ruler and protractor are essential)
- Pen
- Pencil

**Theory**

**Proportionality theorem:** The line drawn parallel to one side of a triangle divides the other two sides proportionally.  
Equal ratios form proportion.

**Procedure**

**Step 1:** Draw  $\triangle KLM$  in the space provided below.

	Solution	
Step 1		

**Step 2:** Measure the lengths of KL, KM and LM. Record them below.

	Solution	
Step 2	KL = _____; KM = _____ and LM = _____	

**Step 3:** Draw line segment NP with N on KL and P on KM such that  $NP \parallel LM$

	Solution	
Step 3	Show in Step 1 above.	



**Step 4:** Measure the lengths of KN, NL, KP, PM and NP. Record them below.

	Solution	
Step 4	<p>KN = _____, NL = _____, KP = _____,</p> <p>PM = _____ and NP = _____</p>	

## Calculations, Observations and Conclusion

1. Answer the following questions:

1.1 Calculate the following:

1.1.1  $\frac{KN}{NL}$  and  $\frac{KP}{PM}$

	Solution	
1.1.1	$\frac{KN}{NL} = \frac{\quad}{\quad}$ and $\frac{KP}{PM} = \frac{\quad}{\quad}$	

1.1.2  $\frac{KN}{KL}$  and  $\frac{KP}{KM}$

	Solution	
1.1.2	$\frac{KN}{KL} = \frac{\quad}{\quad}$ and $\frac{KP}{KM} = \frac{\quad}{\quad}$	

1.1.3  $\frac{NP}{LM}$

	Solution	
1.1.3	$\frac{NP}{LM} = \frac{\quad}{\quad}$	



# 2021 PAT – TASK 2

1.2 Compare the values of the ratios calculated above.

	Solution	
1.2		

1.3 Explain the relationship observed between the line segments that are divided by the line drawn parallel to the 3rd side of a triangle.

	Solution	
1.3		

1.4 Write down the relationship between the lengths of NP and LM, i.e. the length of NP = ... LM

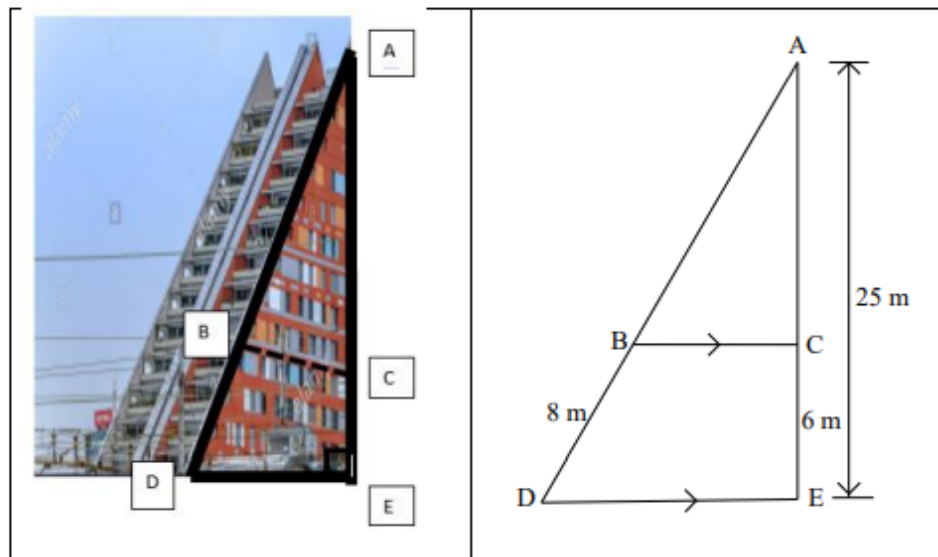
	Solution	
1.4	NP = ... LM	

1.5 Explain the relationship that you observe between the line segment joining the midpoints of two sides of a triangle and the third side.

	Solution	
1.5		



2. A company has been contracted to place metal spikes on a triangular building along the length of side AD to prevent birds from roosting and messing on the building. The cost of the spikes, including labour, is R165 per meter. The diagram below models the side view of the building, as shown.



If the length of  $AE = 25$  m,  $CE = 6$  m,  $BD = 8$  m and  $BC \parallel DE$ , use the proportionality theorem to determine how much will it cost to fit the spikes by first determining the length of AD. Show calculations in the space below.

Solution		

TOTAL: 30





**Thank You**



# 2021 GRADE 12 TECHNICAL MATHEMATICS FIRST PRACTICAL ASSESSMENT TASK (PAT) MEDIATION

## TASK 3 PRESENTATION

JUNE 2021







basic education

Department:  
Basic Education  
REPUBLIC OF SOUTH AFRICA

## TECHNICAL MATHEMATICS

### PRACTICAL ASSESSMENT TASK 3

GRADE 12

2021

SURNAME AND NAME	
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SCHOOL	
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TERM: 3

MARKS: 30



basic education  
Department:  
Basic Education  
REPUBLIC OF SOUTH AFRICA

ICA

This task consists of 7 pages.



2021 PAT – TASK 3



## TOPIC: CIRCLES, ANGLES AND ANGULAR MOVEMENT

### AIMS:

- To apply and develop mathematical skills, reasoning and demonstrate an understanding of radians and degrees
- To convert between degrees and radians
- To calculate area, arc length and height of the segment
- To apply the knowledge gained in circles, angles and angular movement to solve real-life problems

### INSTRUCTIONS AND INFORMATION

1. Answer ALL the questions.
2. Resources required are a wall chart, ruler, compass, pencil and protractor.
3. Clearly show ALL calculations, diagrams etc. that you have used in determining your answers.
4. Make sure your sketch is neat and constructed according to the instructions.



## ACTIVITY 1

Resources required: ruler, protractor, compass and coloured pencils

Step 1: Draw an equilateral triangle PQR with sides of length 6 cm. (1)

	Solution	Marks
Step 1		

Step 2: Draw a circle through points A and B such that R is the centre, where A is the midpoint of PR and B the midpoint of QR. (2)

	Solution	Marks
Step 2	Must be done on the diagram under Step 1.	

Step 3: Shade the area of the minor sector RAB. (1)

	Solution	Marks
Step 3	Must be done on the diagram under Step 1.	

Step 4: Write down the length of side AR and the magnitude of  $\hat{R}$ . (2)

	Solution	Marks
Step 4	AR = _____ $\hat{R}$ = _____	



# 2021 PAT – TASK 3

Step 5: Convert the magnitude of  $\hat{R}$  to radians.

(2)

	Solution	Marks
Step 5		

Step 6: Determine the arc length of the minor sector RAB.

(3)

	Solution	Marks
Step 6		

Step 7: Hence, determine the unshaded area APQB.

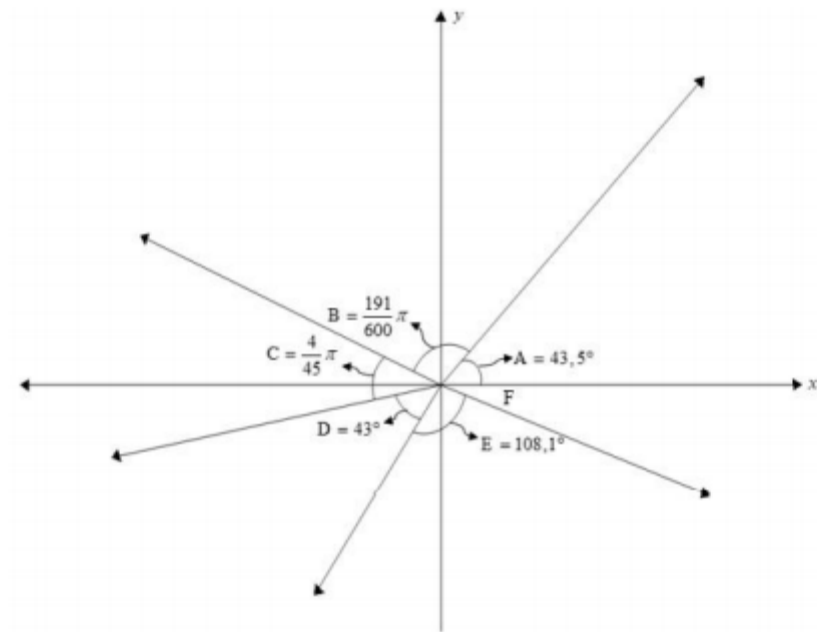
(5)

	Solution	Marks
Step 7		



Step 8: The diagram below shows angles in degrees and radians.

(6)



Complete the following table by converting between degrees and radians measures if:

$$180^\circ = \pi \text{ radians}$$

Solution			Marks
Step 8	ANGLES		
	DEGREES	RADIANS	
	43,5°	$\frac{29}{240} \pi$	
	.....	$\frac{191}{300} \pi$	
	.....	$\frac{4}{25} \pi$	
	43°	.....	
	108,1°	.....	
	$x = \text{.....}^\circ$	.....	
	TOTAL	360°	
			[22]

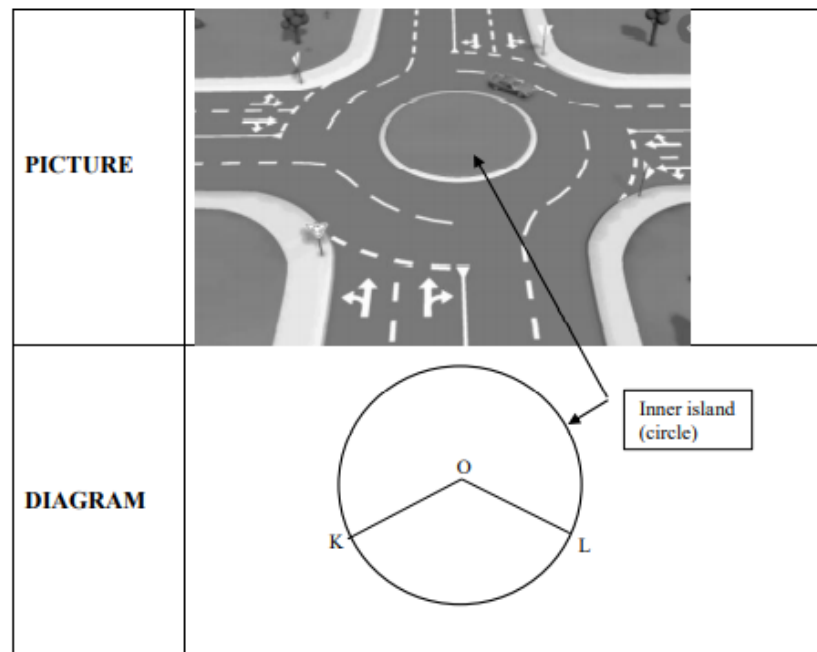


## ACTIVITY 2

The picture below shows a traffic circle at one of the busy intersections in a certain municipality. The municipality wants to pave the inner island of the traffic circle and plans to do so in three consecutive days by paving a third of the island each day. The inner island has a circumference of 18 m. The diagram below the picture models the inner island of the traffic circle.

O is the centre of the circle.

K and L are points on the circle.



2.1 Calculate:

2.1.1 The length of the radius OK correct to ONE decimal place. (1)

	Solution	Marks
		(1)

2.1.2 The magnitude of the obtuse angle  $\hat{KOL}$  (in degrees). (1)

	Solution	Marks
		(1)



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**Thank You**



## 4. MODERATION OF TMAT PAT





# 4. MODERATION OF TMAT PAT

As indicated in the PAT Guidelines, Moderation of PATs shall be done:

## 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 task, with ticks and totals
- Composite working marksheet 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 sheet for all tasks



## 5. CONCLUSION





# 5. CONCLUSION

Once more, let me over-emphasise the following:

- The success in the administration of TECHNICAL MATHEMATICS PAT depends on all involved.
- Therefore, let us all play our part in ensuring that PAT is administered professionally and that all learners complete all tasks – one task at a time!
- Let us remember to ask where we need to, share when we need to, keeping in mind that 'Together Everyone Achieves More' (TEAM)!



## E. CONCLUSION







**Thank You**