education

Department:
Education
REPUBLIC OF SOUTH AFRICA

NATIONAL CURRICULUM STATEMENT GRADES 10-12 (GENERAL)

SUBJECT ASSESSMENT GUIDELINES

ENGINEERING GRAPHICS AND DESIGN

JANUARY 2008

PREFACE TO SUBJECT ASSESSMENT GUIDELINES

The Department of Education has developed and published Subject Assessment Guidelines for all 29 subjects of the National Curriculum Statement (NCS). These Assessment Guidelines should be read in conjunction with the relevant Subject Statements and Learning Programme Guidelines.

Writing Teams established from nominees of the nine provincial education departments and the teacher unions formulated the Subject Assessment Guidelines. The draft copies of the Subject Assessment Guidelines developed by the Writing Teams were sent to a wide range of readers, whose advice and suggestions were considered in refining these Guidelines. In addition, the Department of Education field-tested the Subject Assessment Guidelines in 2006 and asked for the comments and advice of teachers and subject specialists.

The Subject Assessment Guidelines are intended to provide clear guidance on assessment in Grades 10 to 12 from 2008.

The Department of Education wishes you success in the teaching of the National Curriculum Statement.

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1. PURPOSE OF THE SUBJECT ASSESSMENT GUIDELINES

This document provides guidelines for assessment in the National Curriculum Statement Grades 10 - 12 (General). The guidelines must be read in conjunction with *The National Senior Certificate: A Qualification at Level 4 on the National Qualifications Framework (NQF)* and the relevant Subject Statements. The Subject Assessment Guidelines will be applicable for Grades 10 to 12 from 2008.

The Department of Education encourages teachers to use these guidelines as they prepare to teach the National Curriculum Statement. Teachers should also use every available opportunity to hone their assessment skills. These skills relate both to the setting and marking of assessment tasks.

2. ASSESSMENT IN THE NATIONAL CURRICULUM STATEMENT

2.1 Introduction

Assessment in the National Curriculum Statement is an integral part of teaching and learning. For this reason, assessment should be part of every lesson and teachers should plan assessment activities to complement learning activities. In addition, teachers should plan a formal year-long Programme of Assessment. Together the informal daily assessment and the formal Programme of Assessment should be used to monitor learner progress through the school year.

Continuous assessment through informal daily assessment and the formal Programme of Assessment should be used to:

- develop learners' knowledge, skills and values
- assess learners' strengths and weaknesses
- provide additional support to learners
- revisit or revise certain sections of the curriculum and
- motivate and encourage learners.

In Grades 10 and 11 all assessment of the National Curriculum Statement is internal. In Grade 12 the formal Programme of Assessment which counts 25% is internally set and marked and externally moderated. The remaining 75% of the final mark for certification in Grade 12 is externally set, marked and moderated. In Life Orientation however, all assessment is internal and makes up 100% of the final mark for promotion and certification.

2.2 Continuous assessment

Continuous assessment involves assessment activities that are undertaken throughout the year, using various assessment forms, methods and tools. In Grades 10-12 continuous assessment comprises two different but related activities: informal daily assessment and a formal Programme of Assessment.

2.2.1 Daily assessment

The daily assessment tasks are the planned teaching and learning activities that take place in the subject classroom. Learner progress should be monitored during learning activities. This informal daily monitoring of progress can be done through question and answer sessions; short assessment tasks completed during the lesson by individuals, pairs or groups or homework exercises.

Individual learners, groups of learners or teachers can mark these assessment tasks. Self-assessment, peer assessment and group assessment actively involves learners in assessment. This is important as it allows learners to learn from and reflect on their own performance.

The results of the informal daily assessment tasks are not formally recorded unless the teacher wishes to do so. In such instances, a simple checklist may be used to record this assessment. However, teachers may use the learners' performance in these assessment tasks to provide verbal or written feedback to learners, the School Management Team and parents. This is particularly important if barriers to learning or poor levels of participation are encountered.

The results of these assessment tasks are not taken into account for promotion and certification purposes.

2.2.2 Programme of Assessment

In addition to daily assessment, teachers should develop a year-long formal Programme of Assessment for each subject and grade. In Grades 10 and 11 the Programme of Assessment consists of tasks undertaken during the school year and an end-of-year examination. The marks allocated to assessment tasks completed during the school year will be 25%, and the end-of-year examination mark will be 75% of the total mark. This excludes Life Orientation.

In Grade 12, the Programme of Assessment consists of tasks undertaken during the school year and counts 25% of the final Grade 12 mark. The other 75% is made up of externally set assessment tasks. This excludes Life Orientation where the internal assessment component counts 100% of the final assessment mark.

The marks achieved in each assessment task in the formal Programme of Assessment must be recorded and included in formal reports to parents and School Management Teams. These marks will determine if the learners in Grades 10 and 11 are promoted. In Grade 12, these marks will be submitted as the internal continuous assessment mark. Section 3 of this document provides details on the weighting of the tasks for promotion purposes.

2.2.2.1 Number and forms of assessment required for Programmes of Assessment in Grades 10 and 11

The requirements for the formal Programme of Assessment for Grades 10 and 11 are summarised in Table 2.1. The teacher must provide the Programme of Assessment to the subject head and School Management Team before the start of the school year. This will be used to draw up a school assessment plan for each of the subjects in each grade. The proposed school assessment plan should be provided to learners and parents in the first week of the first term.

Table 2.1: Number of assessment tasks which make up the Programme of Assessment by subject in Grades 10 and 11

SUBJECTS		TERM 1	TERM 2	TERM 3	TERM 4	TOTAL
Language 1: Home Language		4	4*	4	4*	16
Language 2: Choice of HL or FAL	HL	4	4*	4	4*	16
	FAL	4	4*	4	4*	16
Life Orientation		1	1*	1	2*	5
Mathematics or Maths Literacy		2	2*	2	2*	8
Subject choice 1**		2	2*	2	1*	7
Subject choice 2**		2	2*	2	1*	7
Subject choice 3		2	2*	2	1*	7

Note:

* One of these tasks must be an examination

** If one or two of the subjects chosen for subject choices 1, 2 or 3 include a Language, the number of tasks indicated for Languages 1 and 2 at Home Language (HL) and First Additional Language (FAL) are still applicable. Learners who opt for a Second Additional Language are required to complete 13 tasks in total: 4 tasks in term 1 and 3 tasks in each of terms 2, 3 and 4.

Two of the assessment tasks for each subject must be examinations. In Grades 10 and 11 these examinations should be administered in mid-year and November. These examinations should take account of the requirements set out in Section 3 of this document. They should be carefully designed and weighted to cover all the Learning Outcomes of the subject.

Two of the assessment tasks for all subjects, excluding Life Orientation, should be tests written under controlled conditions at a specified time. The tests should be written in the first and third terms of the year.

The remainder of the assessment tasks should not be tests or examinations. They should be carefully designed tasks, which give learners opportunities to research and explore the subject in exciting and varied ways. Examples of assessment forms are debates, presentations, projects, simulations, written reports, practical tasks, performances, exhibitions and research projects. The most appropriate forms of assessment for each subject are set out in Section 3. Care should be taken to ensure that learners cover a variety of assessment forms in the three grades.

The weighting of the tasks for each subject is set out in Section 3.

2.2.2.2 Number and forms of assessment required for Programme of Assessment in Grade 12

In Grade 12 all subjects include an internal assessment component, which is 25% of the final assessment mark. The requirements of the internal Programme of Assessment for Grade 12 are summarised in Table 2.2. The teacher must provide the Programme of Assessment to the subject head and School Management Team before the start of the school year. This will be used to draw up a school assessment plan for each of the subjects in each grade. The proposed school assessment plan should be provided to learners and parents in the first week of the first term.

Table 2.2: Number of assessment tasks which make up the Programme of Assessment by subject in Grade 12

SUBJECTS		TERM 1	TERM 2	TERM 3	TERM 4	TOTAL
Language 1: Home Language		5	5*	4*		14
Language 2: Choice of HL or FAL	HL	5	5*	4*		14
	FAL	5	5*	4*		14
Life Orientation		1	2*	2*		5
Mathematics or Maths Literacy		3	2*	2*		7
Subject choice 1**		2	2*	(2*) 3*		(6[#]) 7
Subject choice 2**		2	2*	(2*) 3*		(6[#]) 7
Subject choice 3		2	2*	(2*) 3*		(6[#]) 7

Note:

* One of these tasks in Term 2 and/or Term 3 must be an examination

** If one or two of the subjects chosen for subject choices 1, 2 or 3 include a Language, the number of tasks indicated for Languages 1 and 2 at Home Language (HL) and First Additional Language (FAL) are still applicable. Learners who opt for a Second Additional Language are required to complete 12 tasks in total: 5 tasks in term 1, 4 tasks in term 2 and 3 tasks in term 3.

[#] The number of internal tasks per subject differs from 6 to 7 as specified in Section 3 of this document.

Schools can choose to write one or two internal examinations in Grade 12. Should a school choose to write only one internal examination in Grade 12, a scheduled test should be written at the end of the term to replace the other examination. Internal examinations should conform to the requirements set out in Section 3 of this document. They should be carefully designed and weighted to cover all the Learning Outcomes of the subject.

Two of the assessment tasks for all subjects, excluding Life Orientation, should be tests written under controlled conditions at a specified time.

The remainder of the assessment tasks should not be tests or examinations. They should be carefully designed tasks, which give learners opportunities to research and explore the subject in exciting and focused ways. Examples of assessment forms are debates, presentations, projects, simulations, assignments, case studies, essays, practical tasks, performances, exhibitions and research projects. The most appropriate forms of assessment for each subject are set out in Section 3.

2.3 External assessment in Grade 12

External assessment is only applicable to Grade 12 and applies to the final end-of-year examination. This makes up 75% of the final mark for Grade 12. This excludes Life Orientation which is not externally examined.

The external examinations are set externally, administered at schools under conditions specified in the *National policy on the conduct, administration and management of the assessment of the National Senior Certificate: A qualification at Level 4 on the National Qualifications Framework (NQF)* and marked externally.

In some subjects the external assessment includes practical or performance tasks that are externally set, internally assessed and externally moderated. These performance tasks account for one third of the end-of-year external examination mark in Grade 12 (that is 25% of the final mark). Details of these tasks are provided in Section 3.

Guidelines for the external examinations are provided in Section 3.

2.4 Recording and reporting on the Programme of Assessment

The Programme of Assessment should be recorded in the teacher's portfolio of assessment. The following should be included in the teacher's portfolio:

- a contents page;
- the formal Programme of Assessment;
- the requirements of each of the assessment tasks;
- the tools used for assessment for each task; and
- record sheets for each class.

Teachers must report regularly and timeously to learners and parents on the progress of learners. Schools will determine the reporting mechanism but it could include written reports, parent-teacher interviews and parents' days. Schools are required to provide written reports to parents once per term on the Programme of Assessment using a formal reporting tool. This report must indicate the percentage achieved per subject and include the following seven-point scale.

RATING CODE	RATING	MARKS %
7	Outstanding achievement	80 – 100
6	Meritorious achievement	70 –79
5	Substantial achievement	60 – 69
4	Adequate achievement	50 – 59
3	Moderate achievement	40 – 49
2	Elementary achievement	30 – 39
1	Not achieved	0 – 29

2.5 Moderation of the assessment tasks in the Programme of Assessment

Moderation of the assessment tasks should take place at three levels.

LEVEL	MODERATION REQUIREMENTS
School	The Programme of Assessment should be submitted to the subject head and School Management Team before the start of the academic year for moderation purposes. Each task which is to be used as part of the Programme of Assessment should be submitted to the subject head for moderation before learners attempt the task. Teacher portfolios and evidence of learner performance should be moderated twice a year by the head of the subject or her/his delegate.
Cluster/ district/ region	Teacher portfolios and a sample of evidence of learner performance must be moderated twice during the first three terms.
Provincial/ national	Teacher portfolios and a sample of evidence of learner performance must be moderated once a year.

3. ASSESSMENT OF ENGINEERING GRAPHICS AND DESIGN IN GRADES 10 – 12

3.1 Introduction

Engineering Graphics and Design integrates cognitive and manipulative skills and uses lines, symbols and technologies to design and communicate graphically. The four Learning Outcomes of Engineering Graphics and Design encompass the knowledge, skills and values that will be developed through this subject.

The focus of assessment in Engineering Graphics and Design falls on the measurement of learner performance in:

- demonstrating an awareness and understanding of the interrelationship between Engineering Graphics and Design, society and the environment;
- understanding and applying the design process;
- demonstrating knowledge and understanding of the principles and concepts of graphic communications within the contexts of civil, electrical and mechanical technologies; and
- demonstrating the application of engineering graphical skills and techniques across a range of disciplines effectively and responsibly.

The following table suggests the weighting of the Learning Outcomes for Engineering Graphics and Design:

LEARNING OUTCOME	WEIGHTING
LO1: Technology, society and the environment	5%
LO2: Technological process	20%
LO3: Knowledge and understanding	35%
LO4: Application of knowledge	40%

To fully assess all the knowledge, skills and values of Engineering Graphics and Design in an authentic manner, a Practical Assessment Task is necessary. The Practical Assessment Task showcases the learner's ability to apply in authentic and relevant tasks a broad range of knowledge, skills and values acquired during the learning process and provides learners with the opportunity to express their creativity and innovativeness.

3.2 Daily assessment in Grades 10, 11 and 12

Daily assessment in Engineering Graphics and Design provides learners with multiple opportunities to improve and master the knowledge, skills and values related to the subject.

The following are examples of daily assessment tasks to develop learners' knowledge, skills and values:

- Instrument drawings
- Scale drawing
- Interpretation of symbols
- Pictorial drawings

- Multi-view drawings
- Sectional and assembly drawings
- CAD tasks
- Freehand drawings
- Develop a design to solve a minor civil, electrical or mechanical problem
- Compare codes of practice and theory across civil, electrical and mechanical contexts

3.3 Assessment in Grades 10 and 11

3.3.1 Programme of Assessment in Grades 10 and 11

The Programme of Assessment for Engineering Graphics and Design in Grades 10 and 11 comprises seven tasks which are internally assessed. The six tasks which are completed during the school year make up 25% of the total mark for Engineering Graphics and Design. The seventh task is the end-of-year assessment which includes a Practical Assessment Task (PAT) and two written theory papers. Together the Practical Assessment Task and the theory papers make up the remaining 75%.

<table>
<tr><th colspan="4">PROGRAMME OF ASSESSMENT (400 marks)</th></tr>
<tr><td>ASSESSMENT TASKS</td><td colspan="3">END-OF-YEAR ASSESSMENT</td></tr>
<tr><td>25% (100 marks)</td><td colspan="3">75% (300 marks)</td></tr>
<tr><td rowspan="3">2 tests
1 exam (mid-year)
3 practical assignments</td><td colspan="2">PAT</td><td>THEORY EXAM PAPERS</td></tr>
<tr><td colspan="2">25% (100 marks)</td><td>50% (200 marks)</td></tr>
<tr><td>PAT: Part 1
Design project
(50 marks)</td><td>PAT: Part 2
CAD drawing task
(50 marks)</td><td>• Paper 1 (100 marks)
• Paper 2 (100 marks)</td></tr>
</table>

The Programme of Assessment comprises:

- Two tests (first and third term)
- One midyear examination (written)
- Three practical assignments (one per term in terms 1-3)
- The end-of-year assessment task (which includes a Practical Assessment Task and two written examinations)

Example of an annual Programme of Assessment for Grades 10 and 11:

ASSESSMENT TASKS		TERM ONE	TERM TWO	TERM THREE	TERM FOUR	% OF FINAL PROMOTION MARK
Tests		1		1		7.5
Midyear examination (written)			1			10
Practical assignments: Case studies/ Investigation/ Application of drawing skills		1	1	1		7.5
End-of-year assessment	Written examination: Paper 1 Paper 2				1	50
	PAT: Part 1 – Design project Part 2 – CAD drawing				1	25

3.3.2 Examples of assessment tasks in Engineering Graphics and Design

Tests

The tests in Engineering Graphics and Design must be substantive in terms of time and marks. For example, a test should last at least 60 minutes and count a minimum of 50 marks. Tests should include theory on graphical communication and presentation, codes of practice, computer hardware and the impact of EGD on resources and values along with the formulation and application of design briefs.

Practical assignments

In Engineering Graphics and Design a practical assignment comprises a series of practical activities and could involve case studies, design questions and application exercises. From the three required practical assignments, one should be based on civil technology context and one based on mechanical technology context. A practical assignment is shorter and of lower cognitive demand compared to a Practical Assessment Task (PAT). Practical assignments require of learners to apply their knowledge to carry out a given task in a given situation.

See Appendix 1 for examples of Grade 10 practical assignment tasks and tools.

Practical Assessment Task (100 marks)

A Practical Assessment Task allows the teacher to directly and systematically observe learner applied competence. The assessment of performance is based on the demonstration of specific technological skills. Practical Assessment Tasks allow the learner to illustrate complex learning where knowledge, skills, and values are integrated in a performance. The Practical Assessment Task runs through the first three terms and should be handed in at the end of the third term.

The Practical Assessment Task in Grades 10 and 11 is **internally** set, assessed and moderated. The design project is completed under controlled conditions and is assessed by means of a rubric. The learners should know the assessment criteria before they start with the task. The task should have utilitarian value and must be based on real-life situations.

In Engineering Graphics and Design, the Practical Assessment Task makes up 25% of the total promotion mark and includes two separate tasks, namely:

- a complete design project (PAT Part 1) and
- a CAD drawing (PAT Part 2).

PAT Part 1 – Design project (50 marks)

Learners are expected to produce and present designs. The design project could be set in either a civil or mechanical context. The design should require the use of instruments, freehand or CAD for the drawings. All work done for this task is presented in a design portfolio.

The design project counts 50 marks and consists of a design portfolio (25%) and the final design (75%).

The design portfolio should include evidence of how the development of the design project was approached, that is:

- The planning process
- The knowledge and skills accumulated in the process
- The technological process followed
- The safety and environmental aspects considered
- The calculations used – if applicable, sketches or diagrams
- The starting time and ending time – how long it took to complete from start to finish
- The investigations or research undertaken, and
- Any other information that is relevant to the design project.

The final design developed in the design project is the culmination of problem solving and development through the design process expounded in Learning Outcome 2 (Investigate / research – concept ideas / sketches – final drawings – evaluate).

This design project has the following characteristics:

- Higher order thinking processes and problem-solving skills are required.
- Provides opportunities for learners to present and explain their work.
- Opportunities for creativity, innovation, invention and ingenuity are created.

The design project for EGD will be undertaken in three phases:

Phase 1: Learners produce the relevant information and drawings or sketches and modelling and trial material which will lead to the making of the product or artefact. The evidence of this phase will be located in the design portfolio and this phase will be undertaken during term 1 and the start of term 2.

Phase 2: Learners develop the actual product or artefact at the start of the second term and finalise it by the end of term 3.

Phase 3: Learners submit the product or artefact for assessment by the end of the third term. The accompanying planning done in phase 1 (design portfolio) must also be submitted for assessment at this time.

See Appendix 2 for an example of the two rubrics with which to assess this project.

PAT Part 2 – CAD drawing (50 marks)

In a CAD practical drawing task learners are provided with a drawing and asked to reproduce it using CAD and show certain features such as dimensions, layers, notes, annotations, etc according to predetermined criteria.

NOTE:

Where schools do not have CAD facilities the interim suggestion is that a second design project of the same cognitive level be set that must be completed using instruments.

As CAD is a compulsory component of the EGD curriculum, all schools must ensure that they start acquiring the necessary computer hardware and software and phase this component in as soon as possible.

Examinations

The mid-year and end-of-year examinations for Grades 10 and 11 should each consist of two papers counting 100 marks each. The suggested duration of each paper is 2 hours. All the questions are compulsory. The questions should be set in such a way that they assess the knowledge and skills covered in all the EGD Learning Outcomes. See Appendix 3 for guidance on the weighting of the cognitive levels in examination papers.

The format must be similar to that outlined for Grade 12.

Grades 10 and 11*:*

- Two papers
- 100 marks each = 200 marks
- Paper 1 = 2 hours
- Paper 2 = 2 hours

Suggested outline for the Grade 10 examination papers:

PAPER	FOCUS	MARKS
Paper 1	Emphasis on 1st angle orthographic projection • Civil drawings • Electrical circuits • Descriptive geometry • Perspective (1-point) The paper can address the design process and include analytical type questions.	100
Paper 2	Emphasis on 3rd angle orthographic projection • Mechanical drawings • Solid geometry • Isometric and/or oblique The paper can address the design process and include analytical type questions.	100
	TOTAL	200

Suggested outline for the Grade 11 examination papers:

PAPER	FOCUS	MARKS
Paper 1	Emphasis on 1st angle orthographic projection • Civil drawings • Electrical circuits • Perspective (2-point) • Interpenetration and development The paper can address the design process and include analytical type questions.	100
Paper 2	Emphasis on 3rd angle orthographic projection • Mechanical drawings • Solid geometry • Isometric • Loci The paper can address the design process and include analytical type questions.	100
	TOTAL	200

3.4 Assessment in Grade 12

In Grade 12, assessment consists of two components: a Programme of Assessment which makes up 25% of the total mark for Engineering Graphics and Design and external assessment which makes up the remaining 75%. The Programme of Assessment for Engineering Graphics and Design comprises six tasks which are internally assessed. The external assessment component includes a Practical Assessment Task and two written theory papers. Together the Practical Assessment Task and the theory papers make up the remaining 75%. The external assessment tasks are externally set and moderated.

PROGRAMME OF ASSESSMENT (100 marks)	EXTERNAL ASSESSMENT (300 marks)		
INTERNAL ASSESSMENT TASKS	**EXTERNAL ASSESSMENT TASKS**		
25% (100 marks)	**75% (300 marks)**		
	PAT		**THEORY EXAM PAPERS**
	25% (100 marks)		**50% (200 marks)**
2 tests 2 exams (midyear and trial) 2 practical assignments	PAT: Part 1 Design project (50 marks)	PAT: Part 2 CAD drawing task (50 marks)	• Paper 1 (100 marks) • Paper 2 (100 marks)

Together the Programme of Assessment and the external assessment component make up the annual assessment plan for Grade 12.

The annual assessment plan comprises:

- Two tests (first and third term)
- Two written examinations (midyear and trial)
- Two practical tasks (one per term in terms 1 and 2)
- The external assessment task (which includes a Practical Assessment Task and two written examinations)

Example of an annual assessment plan for Grade 12:

ASSESSMENT TASKS		TERM ONE	TERM TWO	TERM THREE	TERM FOUR	% OF FINAL PROMOTION MARK
Tests		1		1		7.5
Examination (midyear and trial)			1	1		10
Practical assignments: Case studies/ Investigation/ Application of drawing skills		1	1			7.5
External assessment	Written examination: Paper 1 Paper 2				1	50
	PAT: Part 1 – Design project Part 2 – CAD drawing				1	25

In Grade 12 one of the tasks in Term 2 and/or Term 3 must be an internal examination. In instances where only one of the two internal examinations is written in Grade 12, the other examination should be replaced by a test at the end of the term.

3.4.1 Programme of Assessment in Grade 12

Tests

The tests in Engineering Graphics and Design must be substantive in terms of time and marks. For example, a test should last at least 60 minutes and count a minimum of 50 marks. Tests should include theory on graphical communication and presentation, codes of practice, computer hardware and the impact of EGD on resources and values along with the formulation and application of design briefs.

Practical assignments

In Engineering Graphics and Design a practical assignment comprises a series of practical activities and could involve case studies, design questions and application exercises. From the two required practical assignments, one should be based on civil technology context and one based on mechanical technology context. A practical assignment is shorter and of lower cognitive demand compared to a Practical Assessment Task (PAT). Practical assignments require of learners to apply their knowledge to carry out a given task in a given situation.

Examinations

The mid-year and trial examinations for Grade 12 should each consist of two papers counting 100 marks each. The duration of Paper 1 and Paper 2 is 3 hours. All the questions are compulsory. The questions should be set in such a way that they assess the knowledge and skills covered in all the EGD Learning Outcomes.

See Appendix 3 for guidance on the weighting of the cognitive levels in examination papers.

The trial examination needs to be closely related to the final examination in terms of time allocation, layout of paper and subject requirements. See Section 3.4.2.2 for an outline of the Grade 12 examination paper.

3.4.2 External assessment in Grade 12

The external assessment component in Grade 12 consists of an externally written examination (50%) and the Practical Assessment Task (25%).

3.4.2.1 Practical Assessment Task

Schools will be informed of the task at the beginning of the first term of each academic year. Schools will choose one option from given scenarios.

A Practical Assessment Task allows the teacher to directly and systematically observe learner applied competence. The assessment of performance is based on the demonstration of specific technological skills. Practical Assessment Tasks allow the learner to illustrate complex learning where knowledge, skills, and values are integrated in a performance. The task should have utilitarian value and must be based on real-life situations. The Practical Assessment Task runs through the first three terms and should be handed in at the end of the third term.

The Practical Assessment Task in Grade 12 is **externally** set and moderated, but internally assessed. The design project is completed under controlled conditions and is assessed by means of a rubric. The learners should know the assessment criteria before they start with the task.

In Engineering Graphics and Design, the Practical Assessment Task makes up 25% of the total promotion mark and includes two separate tasks, namely:

- a design project (PAT Part 1) and
- a CAD drawing (PAT Part 2).

PAT Part 1 – Design project (50 marks)

Learners are expected to produce and present designs. The design project could be set in either a civil or mechanical context. The design should require the use of instruments, freehand or CAD for the drawings. All work done for this task is presented in a Design Portfolio.

The design project counts 50 marks and consists of a design portfolio (25%) and the final design (75%).

The design portfolio should include evidence of how the development of the project was approached, that is the:

- The planning process
- The knowledge and skills accumulated in the process
- The technological process followed
- The safety and environmental aspects considered
- The calculations used – if applicable, sketches or diagrams
- The starting time and ending time – how long it took to complete from start to finish
- The investigations or research undertaken, and
- Any other information that is relevant to the project.

The final design developed in the design project is the culmination of problem solving and development through the design process expounded in Learning Outcome 2 (Investigate / research – concept ideas / sketches – final drawings – evaluate).

The design project for EGD will be undertaken in three phases:

Phase 1: Learners produce the relevant information and drawings or sketches and modelling and trial material which will lead to the making of the product or artefact. The evidence of this phase will be located in the design portfolio and this phase will be undertaken during term 1 and the start of term 2.

Phase 2: Learners develop the actual product or artefact at the start of the second term and finalise it by the end of term 3.

Phase 3: Learners submit the product or artefact for assessment by the end of the third term. The accompanying planning done in phase 1 (design portfolio) must also be submitted for assessment at this time.

PAT Part 2 – CAD drawing

In a CAD practical drawing task learners are provided with a drawing and asked to reproduce it using CAD and show certain features such as dimensions, layers, notes, annotations, etc according to predetermined criteria.

NOTE:

Where schools do not have CAD facilities the interim suggestion is that a second design project of the same cognitive level be set that must be completed using instruments.

As CAD is a compulsory component of the EGD curriculum, all schools must ensure that they start acquiring the necessary computer hardware and software and phase this component in as soon as possible.

See Appendix 2 for an example of the two rubrics with which to assess this project.

3.4.2.2 External examination

The external end-of-year examination papers should test the knowledge and skills covered in all the Engineering Graphics and Design Learning Outcomes. The following table suggests the outline for examinations in Grade 12.

Grade 12:

- Two papers
- 100 marks each = 200 marks
- Paper 1 = 3 hours
- Paper 2 = 3 hours

Suggested outline for the Grade 12 examination papers:

PAPER	FOCUS	MARKS
Paper 1	Emphasis on 1st angle orthographic projection • Civil drawings • Electrical diagrams • Perspective (2-point) • Interpenetration and development The paper can address the design process and include analytical type questions.	100
Paper 2	Emphasis on 3rd angle orthographic projection • Mechanical drawings • Isometric • Loci The paper can address the design process and include analytical type questions.	100
	TOTAL	200

3.5 Promotion

For promotion and certification purposes learners should achieve at least a level 2 rating (Elementary achievement: 30-39%) in Engineering Graphics and Design.

3.6 Moderation

All Grade 10 and 11 tasks are internally moderated, while all Grade 12 tasks need to be externally moderated. The subject head or head of department for Engineering Graphics and Design at a school will generally manage this process.

APPENDIX 1: DETAILS OF THE MOST APPROPRIATE GRADE 10 ASSESSMENT TASKS AND TOOLS

1. TASKS

Case studies
Case studies can be given to learners as assignments – a case study focuses on a specific aspect related to Engineering Graphics and Design, for example drawing office practice, industry standards in a specific engineering field, study of staircases, mechanisms in a machine or modern electronic devices. This assessment task should be approximately two to three hours in duration and should result in a graphic(s) related to the case study. It could be a redesign, a storyboard, a poster, etc. Appropriate text may at times be included to accompany the graphic(s).

Research tasks
Research tasks are focused on finding out something, in other words the task requires the learners to find data, information, etc. about a topic. An example may be the development of drawing instruments over time, gathering data related to specifications in the electrical, engineering drawing and graphics or mechanical field, the change in use of mechanisms in the mining industry, etc. The main difference between a case study and a research task is that a case study is about known aspects, whilst a research topic may entail unknown aspects and may result in a new design, theory or process. Therefore, a research question must be formulated so that the result will be a finding of some sort.

Assignments
Assignments are tasks that require learners to do more than interpret questions and drawings, copy or reproduce information or drawings, do drawings that require knowledge from past examination papers, etc. They should focus on adding value to the skills and knowledge in Engineering Graphics and Design. Assignments provide an excellent opportunity for research into different aspects of Engineering Graphics and Design and also provide opportunities for designing. They should, where possible, concentrate on a specific context, such as the engineering drawing and graphics, mechanical or electrical field and should ideally focus on more than one concept and include design, for example redesign a cam to produce specific movements, design the wiring layout for a small house or design the plumbing layout for a two-storey building. These tasks should require that a variety of skills and knowledge are applied, for example an engineering drawing and graphics task could ask for a complete floor plan, a perspective drawing, freehand drawing and an indication of the electrical fixtures. Assignments should be between two to four hour duration and should incorporate two or more of the Learning Outcomes of which Learning Outcome 2 should be one.

Tests
Tests should focus on testing a specific skill or knowledge or a combination of both. They should not be cluttered with a range of concepts in one question. Tests must be administered under controlled conditions. Tests could target specific concepts, such as completing the loci of a point on a mechanism, completing drawings with respect to hatching or dimensions, determining the true lengths and angles of lines, changing a drawing from first to third angle, completing circuit diagrams from given data or inserting plumbing and electrical fixtures into a given floor plan. All tests must assess the learners' ability to apply understanding of concepts in authentic problem-solving or design situations. The minimum duration of a test should be 30 minutes. Tests should be set and assessed with a quality set of criteria and memoranda.

Examinations
Examinations are culmination or capability tasks; they are like extended tests and should cover all Learning Outcomes. All examinations must be administered under controlled conditions.

2. TOOLS

Checklist of criteria
Criteria are the specific things that are looked for in a graphic or piece of work, for example use of conventions, use of space, correctness, interpretation, accuracy, quality of line work and innovativeness.

Rubrics or level descriptors for criteria:
Rubrics are explanations of what is expected for each of the criteria that are chosen – rubrics usually describe what is required on a scale.

Marking memorandum
Marking memoranda usually contain the model or expected answer (where possible). They also state how many marks are to be awarded for each aspect (criteria) and describe in detail how and where marks or credits should be awarded.

Assessment of all pieces is carried out by first determining the specific **criteria** to be targeted in the piece of work. Criteria stipulate what is to be assessed, for example the use of conventions, the layout or line work. For each of these criteria there should be a description stating what is expected, so that when the evidence is presented a balanced judgment can be made.

Model answers provide a useful indicator of what the solution should look like. These should ideally provide for alternative solutions as well, for example a different method of determining a true length or different orientation. In Engineering Graphics and Design there will also be instances where a model answer is not possible, for example when a design for the interior of a dwelling is required. A **marking memorandum** should always accompany any task for assessment purposes. Depending on the

task the marking memorandum will indicate the allocation of marks for the individual aspects that will be assessed, and should in all instances tie up with the criteria. For example, if one of the criteria for a question of electrical drawings is 'the use of conventions' the mark allocation could be ten. The marking memorandum will further clarify how these ten marks should be distributed for the drawing, such as two marks each for five correct circuit symbols used. This could be further specified as one mark for the correct symbol and 1 mark for the correct orientation of the symbol in the completed circuit.

APPENDIX 2: EXAMPLES OF ASSESSMENT TOOLS

Design projects should be assessed using two rubrics: one for assessing the final design and the other for assessing the design portfolio.

A. RUBRIC FOR ASSESSMENT OF FINAL DESIGN

LEVELS OF PERFORMANCE							
CRITERIA	**7**	**6**	**5**	**4**	**3**	**2**	**1**
	80 –100%	**70 - 79%**	**60 - 69%**	**50 - 59%**	**40 - 49%**	**30 - 39%**	**0 - 29%**
Proportion (Freehand, designing)	A very high level of skills evident in drawing. Drawings are perfect according to size and shape. Drawing are accurate according to angles (isometric, oblique, orthographic) Drawing reflects effectively ergonomic considerations.	A high level of skill is evident in drawing. Drawings satisfy size and shape. Drawings show very little deviations in accuracy. Drawings fulfil the ergonomic considerations.	An adequate level of skill is evident in drawing: Drawings satisfy size and shape. Drawings show minor deviations in accuracy. Drawings fulfil the ergonomic considerations.	A satisfactory level of skill is evident in drawing: Drawings satisfy size and shape. Drawings show some deviations in accuracy. Drawings reflect some ergonomic considerations.	A limited level of skill is evident in drawing: Drawings satisfy limited size and/or shape requirements. Drawings show deviations in accuracy. Drawings reflect a few ergonomic considerations.	A low level of skill is evident in drawing. Drawings barely fulfil size and shape requirements. Drawings are not accurate according to angles. Drawings show no ergonomic considerations.	A very low level of skill is evident in drawings: Drawings are incomplete and show little attention to size, shape, accuracy or ergonomics.
Assembly (Assemblies, exploded views, sequence diagrams…)	A very high level of insight in drawing assemblies is demonstrated. Assemblies show clearly how parts fit together in sectional or outside views. Assemblies show	A high level of insight in drawing assemblies is demonstrated. Assemblies show clearly how most parts fit together in all sectional or outside views.	An adequate level of insight in drawing assemblies is demonstrated. Assemblies show how most parts fit together in most sectional or outside views.	A fair level of insight in drawing assemblies is demonstrated. Assemblies show how some parts fit together in some sectional or outside views.	A limited level of insight in drawing assemblies is demonstrated. Assemblies show a limited understanding of how parts fit together in sectional	Some insight in drawing assemblies is demonstrated. Assemblies show a limited understanding of how parts fit together in some sectional or outside	A lack of insight in drawing assemblies is demonstrated. Assemblies are incomplete and show little attention to how parts fit together, the correct sequence of

LEVELS OF PERFORMANCE							
CRITERIA	**7**	**6**	**5**	**4**	**3**	**2**	**1**
	80 –100%	**70 - 79%**	**60 - 69%**	**50 - 59%**	**40 - 49%**	**30 - 39%**	**0 - 29%**
	unambiguously the sequence of putting together parts. Assemblies show clearly the positions of all parts for assembly.	Assemblies show clearly the sequence of putting together parts. Assemblies show clearly the positions of most parts for assembly.	Assemblies show the sequence of putting together parts. Assemblies show the positions of most parts for assembly.	Assemblies show acceptably the sequence of putting together parts. Assemblies show the positions of some parts for assembly.	or outside views. Assemblies show acceptably the sequence of putting together parts. Assemblies show the positions of a few parts for assembly.	views. Assemblies show little understanding of how to sequence the putting together of parts. Assemblies show a limited understanding of positioning parts for assembly.	assembly or the position of parts for assembly.
Correctness	A very high degree of competency, knowledge and skill in interpreting questions and executing drawings is shown: in accuracy of all dimensions; in correctness of all visible and hidden details; and in accuracy of all calculations and constructions.	A high degree of competency, knowledge and skill in interpreting questions and executing drawings is shown: in accuracy of most dimensions; in correctness of most visible and hidden details; and in accuracy of most calculations and constructions.	An adequate degree of competency, knowledge and skill in interpreting questions and executing drawings is shown: in accuracy of most dimensions; in correctness of most visible and hidden details; and in acceptable accuracy of most calculations and constructions.	A satisfactory level of competency, knowledge and skill in interpreting questions and executing drawings is shown: in accuracy of some dimensions; in correctness of some visible and/or hidden details; and in accuracy of some calculations and/or constructions.	A limited degree of competency, knowledge and skill in interpreting questions and executing drawings is shown: in accuracy of some dimensions; in correctness of a few visible and/or hidden details; and in accuracy of some calculations and/or constructions.	A low level of competency, knowledge and skill in interpreting questions and executing drawings that shows up as major faults: in accuracy of a few dimensions; in correctness of most visible and hidden details; and in accuracy of most calculations and constructions.	A lack of competency, knowledge and skill in interpreting questions and executing drawings is shown: in drawings that are incomplete and in which accuracy, correct application of lines and constructions receive little attention.
Conventions (Dimensions, sectioning, lines, symbols)	A very high level of knowledge and application of "SANS" drawing conventions is evident in all	A high level of knowledge and application of "SANS" drawing conventions is evident in most	An adequate level of knowledge and application of "SANS" drawing conventions is evident in most	A satisfactory level of knowledge and application of "SANS" drawing conventions is evident in some	A limited level of knowledge and application of "SANS" drawing conventions is evident in some	A low level of knowledge and application of "SANS" drawing conventions is evident in most	A very low level of knowledge and application of "SANS" drawing conventions is evident in:

LEVELS OF PERFORMANCE							
CRITERIA	**7**	**6**	**5**	**4**	**3**	**2**	**1**
	80 –100%	**70 - 79%**	**60 - 69%**	**50 - 59%**	**40 - 49%**	**30 - 39%**	**0 - 29%**
	drawings in terms of the consistent correct use of: Line types Dimensioning techniques Naming or labelling techniques Sectioning techniques	drawings in terms of the correct use of: Line types Dimensioning techniques Naming or labelling techniques Sectioning techniques	drawings in terms of the correct use of: Line types Dimensioning techniques Naming or labelling techniques Sectioning techniques	drawings in terms of the correct use of: Line types Dimensioning techniques Sectioning techniques	drawings in terms of the correct use of: Line types Dimensioning techniques Sectioning techniques	drawings in terms of the incorrect use of: Line types Dimensioning techniques Sectioning techniques	Incomplete work that shows little attention to the use of acceptable line types and the techniques of dimensioning, sectioning and naming or labelling.
Layout and presentation	A very high level of ability shows understanding of positioning of views, the use of positive and negative space and aesthetic considerations in presentations.	A high level of ability shows understanding of acceptable positioning of views, and a range of aesthetic considerations in presentations.	An adequate level of ability shows understanding of acceptable positioning of views and a range of considerations in presentations.	A satisfactory level of ability shows understanding of acceptable positioning of views and a limited range of considerations in presentations.	A limited level of ability shows limited understanding of positioning of views and a limited range of considerations in presentations.	A low level of ability shows a little understanding of positioning of views and aspects to be considered in presentations.	A very low level of ability is evident in work that is incomplete and does not show understanding of positioning views and/or aspects to be considered in presentations.

B. RUBRIC FOR ASSESSMENT OF DESIGN PORTFOLIO

LEVELS OF PERFORMANCE							
CRITERIA	**7**	**6**	**5**	**4**	**3**	**2**	**1**
	80 –100%	**70 - 79%**	**60 - 69%**	**50 - 59%**	**40 - 49%**	**30 - 39%**	**0 - 29%**
10.2.1 Interprets a situation or given design brief	Shows an in-depth and comprehensive understanding of the situation or given design brief.	Shows a thorough understanding of the situation or the given design brief.	Shows a good understanding of the situation or given design brief.	Shows a satisfactory understanding of the situation or given design brief.	Shows adequate understanding of the situation or given design brief.	Shows a partial understanding of the situation or given design brief.	Shows little to no understanding of the situation or given design brief.
10.2.2 Researches possible solutions	Shows evidence of in-depth research resulting in resulting in a wide range of possible solutions, which are clearly, logically and comprehensively recorded.	Shows evidence of thorough research resulting in a range of possible solutions, which are, logically and comprehensively recorded.	Shows evidence of sound research resulting in a number of possible solutions, which are clearly and comprehensively recorded.	Shows evidence of adequate research resulting in a number of possible solutions, which are clearly recorded.	Shows evidence of adequate research resulting in limited possible solutions, which are recorded.	Shows evidence of limited research resulting in a possible solution, which is not fully recorded	Shows little to no evidence of any research or research is irrelevant to the solution.
10.2.3 Selects, analyses and synthesises information and selects a final solution	Shows thorough, independent and creative ways in analysing, synthesising and selecting a final solution.	Shows independent and creative ways in analysing, synthesising and selecting a final solution.	Shows high level of evidence in analysing, synthesising and selecting a final solution.	Shows satisfactory evidence of analysing, synthesising and selecting a final solution.	Shows adequate evidence of analysing, synthesising and selecting a final solution.	Shows limited evidence of analysing, synthesising and selecting a final solution.	Shows little to no evidence of any analysis or synthesis in selecting a final solution.
10.2.4 Presents the final solution	The final solution is of an exceptional quality. A variety of presentation methods are used. The presentation is of exceptional	The final solution is of an outstanding quality. A range of presentation methods are used. The presentation is	The final solution is of a very high standard. The presentation is tidy, correct, accurate and complete.	The final solution is satisfactorily completed. The presentation is tidy, accurate and complete. The solution	The final solution is adequately complete. The presentation is tidy and accurate.	The final solution is partially complete. The presentation is tidy and reasonably accurate.	The final solution is incomplete, disjointed or not submitted. The presentation is untidy and inaccurate.

LEVELS OF PERFORMANCE							
CRITERIA	**7**	**6**	**5**	**4**	**3**	**2**	**1**
	80 –100%	**70 - 79%**	**60 - 69%**	**50 - 59%**	**40 - 49%**	**30 - 39%**	**0 - 29%**
	quality. The solutions comply fully with the design brief.	of high quality. The solution complies fully with the design brief.	The solution complies fully with the design brief.	complies with the design brief.			
10.2.5 Evaluation	Shows evidence of comprehensive evaluation at all stages of the design process.	Shows evidence of thorough evaluation at all stages of the design process.	Shows evidence of acceptable evaluation at all stages of the design process.	Shows evidence of satisfactory evaluation of most stages of the design process.	Shows evidence of adequate evaluation at some stages of the design process.	Shows evidence of limited evaluation at some stages of the design process.	Little or no evidence of any evaluation.

APPENDIX 3: TAXONOMY FOR ENGINEERING GRAPHICS AND DESIGN

CATEGORIES OF COMPLEXITY	DESCRIPTION OF CATEGORIES	SOME EXAMPLES	WEIGHTING
Basic cognitive skills	Recall of basic knowledge	give labels; list; name; state or identify functions; recognise; use given data, information or symbols; etc.	± 10%
Comprehension	More than recall of facts includes understanding and insight into routine and familiar content or situations	describe or explain concepts; classify; choose from given data, information, conventions or symbols; make direct decisions or deductions from data given; do calculations; etc.	± 30%
Application	Application of components and systems to familiar and unfamiliar situations	interpret data; decide on the appropriate symbols, scales, conventions, processes and time management; draw flow charts or mind maps; produce graphics using mechanical or CAD skills; draw tables and graphs to organise and present data; draw sketches to communicate ideas and possible solutions; etc.	± 40%
Higher intellectual abilities	Application of design principles, analysis, synthesis and evaluation of data.	solve the problem; formulate a hypothesis; design a solution; analyse data; predict; argue; evaluate; etc.	±20%