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Successful

Technology

TEACHER'S GUIDE

GRADE 9

WITH EXAM INFO AND EXEMPLAR PAPERS

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Contents

Introduction

Section A Orientation

How this Teacher's Guide should be used 6
How the course works 6
Curriculum and Assessment Policy Statement (CAPS) 7
The CAPS for Technology 8

Section B Planning and assessment

Teaching plan for Technology Grade 9 16
Sample lesson plan for Grade 9 25
What is assessment in the Senior Phase? 25
Types of formal assessment for Technology 27
Formal Programme of Assessment for Technology 29
Inclusive assessment 30
Recording and reporting assessment 31

Section C Teaching and learning Technology

Teaching Technology in the Senior Phase 32
Requirements for teaching Technology 34
Inclusive teaching 35

Section D Cognitive levels

Cognitive levels and abilities for Technology in the Senior Phase 38
Metacognitive strategies 39

Section E Teaching Technology

Topic 1 Design skills 41
Unit 1 First-angle orthographic projection 42
Unit 2 Drawing complex 3D objects 44
Topic 2 Structures 47
Unit 1 Forces and loads 48
Unit 2 Strength of materials under the action of forces 51
Unit 3 Properties of construction materials 53
Term 1 Mini Practical Assessment Task 57
Term 1 Exemplar Test – Memorandum 63

Topic 3 Mechanical systems and control 64
Unit 1 Syringe mechanisms 65
Unit 2 Hydraulic systems 68
Unit 3 Pulley systems 69
Unit 4 Mechanical control systems 71
Unit 5 Interaction of gears 74
Unit 6 Design skills 75
Mini Practical Assessment Task 76
Term 3 Exemplar Test - Memorandum 78

Topic 4 Electrical systems and control 80
Unit 1 Simple electrical systems 81
Unit 2 Resistor colour codes 83
Unit 3 Switches 85
Unit 4 Sensors 86
Mini Practical Assessment Task 89
Exemplar Test memorandum 91

Topic 5 Processing 92
Unit 1 Preserving metal 93
Unit 2 Preserving food 94
Unit 3 Types of plastics and their uses 96
Mini-Practical Assessment Task 99
Term 4 Exemplar Exam and memorandum 101

Five easy-to-navigate sections

Section A: Orientation

- How this Teacher's Guide should be used
- How the course works
- Curriculum and Assessment Policy Statement (CAPS): an overview, instructional time allocation, CAPS for Technology: Overview for Grade 9

Section B: Planning and assessment

- A teaching plan that follows the CAPS time allocations
- Sample lesson plans
- What is assessment in the Senior Phase?
- The four types of assessment
- Types of formal assessment for Technology
- Formal assessment requirements for Technology
- Formal Programme of Assessment (POA) for Technology
- Inclusive assessment
- Recording and reporting assessment

Section C: Teaching and learning Technology

- What is Technology?
- Lesson plans for the teaching of Technology
- Inclusive teaching
- Learners with barriers to learning

Section D: Cognitive levels

- Cognitive levels and abilities for Technology in the Senior Phase
- Meta-cognitive strategies
- Progression in skills in Technology

Section E: Guidelines for teaching Technology

How this Teacher's Guide should be used

Technology Grade 9 Teacher's Guide is a course that provides rich resources to ensure complete curriculum coverage and the successful development of Technology concepts and skills.
The teacher's Guide supports you by:

- Defining subject, National Curriculum and Assessment Policy Statement (CAPS) and teaching terminology
- indicating pacing, and content in unit overviews,
- providing background information (prior knowledge and skills covered in previous grades and/or interesting subject/topic background)
- providing remediation and extension activities
- providing suggested answers for every activity
- providing Formal Assessment Tasks and marking guidelines and rubrics as required by the CAPS
- including unseen tests and end-year exams, alternatives to those offered in the Learner's Book
- providing easy referencing between components

How this course works

This series meets the requirements of the CAPS for the Senior Phase.
In Grade 9, Technology consists of two core components: a Teacher's Guide and a Learner's Book.

The Learner's Book

The full-colour Learner's Book provides content knowledge, core concepts and skills development. It includes activities for learners to develop, practise and consolidate their knowledge and skills. Teachers receive guidance on how to teach important concepts. Written texts are supported by illustrations that help to explain content. All examples, activities and illustrations are representative of all cultural groups. Activities steadily become more challenging so that learners progressively develop their understanding of concepts and their practical skills.

The Teacher's Guide

The Teacher's Guide provides all the planning, teaching and assessment tools needed to teach Technology successfully.

Curriculum and Assessment Policy Statement

An overview of CAPS

This series is based on the *National Curriculum Statement Grades R–12* (NCS, January 2012) which is the policy document for learning and teaching in South Africa. The NCS consists of three documents, namely:

- Curriculum and Assessment Policy Statements (CAPS) for all approved subjects for Grades R–12
- National Policy pertaining to the Programme and Promotion Requirements of the National Curriculum Statement Grades R–12
- National Protocol for Assessment Grades R–12 (January 2012).

Each CAPS document has four sections:

- Section 1 – Introduction to the Curriculum and Assessment Policy Statements
- Section 2 – The specific subject's aims, time allocations and requirements
- Section 3 – Overview of topics, teaching plan and content clarification
- Section 4 – Assessment guidelines in the specific subject.

Sections 2, 3 and 4 of the CAPS document, together with the National Policy pertaining to the Programme and Promotion Requirements of the NCS, represent the norms and standards of the *National Curriculum Statement Grades R–12*.

Instructional time allocation

The instructional time in the Senior Phase is as follows:

Subject	Teaching hours per week	Total per term
Home Language	5	50
First Additional Language	4	40
Mathematics	4,5	45
Natural Sciences	3	30
Social Sciences	3	30
Technology	2	20
Economic Management Sciences	2	20
Life Orientation	2	20
Creative Arts	2	20
Total	**27,5**	**275**

The CAPS for Technology

Each CAPS document provides:

- an overview of topics and content areas for its subject (see below)
- the weighting prescribed for each content area (see below)
- a teaching plan for the subject (see Section B – Planning and assessment).

Topic overview

Annexure A in the CAPS for Technology provides a detailed progress map of skills, graphics and knowledge that are covered in each grade and term of Technology. Below is a broad overview of Senior Phase Technology.

	Grade 7	Grade 8	Grade 9
DESIGN PROCESS SKILLS			
Terms 1-4	***Problems set in a locally relevant context***. **Investigate**: background context, nature of the need, environmental situation, people concerned. Identifies technologies and methods. Considers source/resources and copyright laws. Uses search techniques. Extracts relevant data for specific purposes. **Design**: people, purpose, appearance, environment, safety, cost of model. Writes a design brief giving specifications and constraints (with assistance in terms 1 and 2). Generates at least two viable solutions using sketches with	***Problems set in a nationally relevant context***. **Investigate**: background context, nature of the need, environmental situation, people concerned. Identifies technologies and methods. Considers source/resources and copyright laws. Uses search techniques. Extracts relevant data. Makes meaningful summaries and uses the information to justify and support decisions and ideas. **Design**: people, purpose, appearance, environment, safety, cost of real solution. Writes a design brief giving specifications and constraints (without assistance). Generates several alternative solutions using sketches with explanatory notes. Selects the most suitable solution giving valid reasons. **Make:** develops plans for making detailing: resources, dimensions, making steps (such as flow diagrams). Draws simple assembly drawings (exploded diagrams) if needed.	***Learners must identify a problem, need or opportunity from a given real-life context.*** **Investigate**: background context, nature of the need, environmental situation, people concerned. Locates and collects. Compares, sorts, verifies, evaluates (cross-checking different sources or resources) and stores information. **Design**: people, purpose, appearance, environment, safety, real costs, ergonomics, quality, production. Writes a design brief giving specifications and constraints (without assistance). Generates a range of possible solutions using

	explanatory notes. Selects one solution giving reasons. **Make:** develops plans for making detailing: resources, dimensions, making steps (such as simple flow diagrams). Draws simple plans using oblique technique. Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/separating, shaping/forming, joining/combining and finishing, with some accuracy. Uses safe working practices and uses correct tools for the job appropriately. **Evaluate:** evaluates the product or system in terms of the design brief. Evaluates the process followed and suggests improvements or modifications to the solution in terms of fitness for purpose. **Communicate**: 3D sketches, plans using oblique projection, circuit diagrams with standard electrical component symbols, systems diagrams and simple flow charts. Plans include scale, thick, thin and dashed lines, dimensions and	Draws plans using isometric projections. Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/separating, shaping/ forming, joining/combining and finishing with accuracy. Changes and adapts design ideas where appropriate. Uses safe working practices and uses correct tools for the job appropriately. **Evaluate:** evaluates the product or system objectively in terms of the design brief. Evaluates the process followed and suggests sensible improvements or modifications to the solution in terms of fitness for purpose. **Communicate**: 3D sketches, plans using isometric projection, circuit diagrams with standard electrical component symbols, systems diagrams and simple flow charts. Plans include scale, thick, thin, dashed and chain lines, dimensions and quantities. Artistic drawings in double VP perspective should be enhanced using colour, texture, shading and shadows.	sketches with explanatory notes. Selects the most viable solution using well-reasoned argument. **Make:** develops plans for making detailing: resources, dimensions, making steps (such as flow diagrams). Draws simple assembly drawings (exploded diagrams) if needed. Draws working drawings using first angle orthographic projections. Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/ separating, shaping/forming, joining/combining and finishing with accuracy. Changes and adapts design ideas where appropriate. Uses safe working practices and uses correct tools for the job appropriately. **Evaluate:** evaluates the product or system in terms of the design brief. Evaluates the process followed and suggests sensible improvements or modifications to the solution in terms of fitness for purpose. **Communicate**: 3D and 2D sketches, plans using first angle orthographic projection, circuit diagrams with standard electrical

	quantities. Artistic drawings in single VP perspective should be enhanced using colour, texture and shading.		and electronic component symbols, systems diagrams and simple flow charts. Plans include scale, thick, thin, dashed and chain lines, dimensions and quantities. Artistic drawings in either single or double VP perspective should be enhanced using colour, texture, shading and shadows.
DRAWING SKILLS			
Terms 1-4	**Technology drawing: sketches and working drawings:** Free-hand sketching. 2D view of one face drawn to scale with correct line types and dimensions. 3D oblique technique: 45o cabinet projection to scale with correct line types and dimensions. Line types: outlines, construction lines, hidden detail. **Artistic drawing: Sketches and Presentation Graphics** Single vanishing point perspective; texture rendering; colour.	**Technology drawing: sketches and working drawings:** Free-hand sketching. 2D view of one face drawn to scale with correct line types and dimensions according to conventions. 3D isometric projection 30o: drawn using underlying grid to scale with correct line types and dimensions. Line types: outlines, construction lines, hidden detail lines, centre lines, wavy lines. **Artistic drawing: Sketches and Presentation Graphics** Double vanishing point perspective; texture rendering; colour; shading.	**Technology drawing: sketches and working drawings:** Free-hand sketching. 2D working drawings in first angle orthographic projection: elementary use of instruments. 3D isometric projection: 30o drawn using underlying grid to scale, correct line types and dimensions. Line types: outlines, construction lines, hidden detail lines, centre lines, wavy lines. Dimensioning: conventions, arrows. Drawing boards NOT required **Artistic drawing: Sketches and Presentation Graphics** Single and double vanishing point perspective; texture rendering; shading; colour; shadows.
KNOWLEDGE FOCUS			

Term 1	**Mechanical systems and control:** Simple mechanisms; first-, second- and third-class levers. • Mechanical advantage/disadvantage using levers (*elementary qualitative treatment*). • Levers and linkages. • Pneumatics and hydraulics used to increase human strength. **task**: hydraulic powered rescue equipment.	Structures: Reinforcing: struts, ties. Stabilising: base size, base angles, centre of gravity, ground anchors. Strengthening structures using folding, tubing, triangular webs and internal cross-bracing. Pylons (link: electrical systems, the national grid). Components of frame structures: arch, beam, cantilever, column. **task**: frame structure using mechanisms.	Structures: Strength of materials under the action of forces: compression, tension, torsion, and shear. Properties of construction materials: mass, density, hardness, stiffness, flexibility, corrosion. Suitability of materials (fitness-for-purpose) in terms of properties, safety and cost effectiveness. **task**: identify and solve problems related to community on the far side of a river.
Term 2	**Structures:** Purpose of structures: contain, protect, support, span. Natural and man-made structures. Types of structures: shell, frame, solid. Strengthening structures by folding, tubing and triangulation. Frame structures: roof trusses, towers. **Task**: cell phone tower (link: electronic communications). Frame structures: cranes.	**Processing:** Positive and negative impacts of technological products on the environment and/or society. Improving properties of materials to adapt them to suit particular purposes: • Withstand forces – tension/compression/bending/torsion/shear • Recycling: paper. • Adapt material for packaging of a product. **Task**: design a product that will solve or reduce the negative impact of the technology studied earlier.	**Mechanical systems and control:** Interacting mechanical systems and sub-systems. • Hydraulic principles: incompressibility of liquids, pressure in liquids, force transfer. • Hydraulic/pneumatic systems that use restrictors, one-way valves: hydraulic press/jack. • Gear systems – spur, bevel, rack and pinion, worm. • Mechanical control mechanisms – ratchet and pawl; cleats; bicycle brakes; disc brakes. • Belt-drive systems with more than one stage. • Pulley systems – fixed pulley, moveable pulley, and multiple pulleys (block and tackle). • Systems where mechanical,

			electrical or pneumatic systems are combined. **Task**: identify and solve problems that can be solved by mechanical systems integrated with either electrical/ electronic or hydraulic or pneumatic.
Term 3	**Mechanical systems and control:** More simple mechanisms – wedge, gear ratios, cams. • Mechanical systems that change the magnitude of forces involved: gear ratios. • Mechanical systems that change the rotary to linear motion: crank, cam. **Electrical systems and control:** Electrical circuit basics: • Basic circuit components: cell(s), conductor, switch, resistor, lamp. • Simple circuit diagrams showing various component arrangements. Magnetism and magnetic metals: iron and steel, nickel, cobalt. • Introduction to electromagnetism: the electromagnet. • Recycling metals. **Task**: design and make a crane to carry an electromagnet to sort scrap metals for recycling.	**Mechanical systems and control:** Simple mechanisms as components of more complex machines designed to provide users with a mechanical advantage: • Linked lever systems. • Gears (link to term 1: spur, bevel, rack and pinion, worm). • Gears – driver, idler, driven; velocity ratio/force multiplication. • Belt drive and chain drive systems – chain block, bicycle or motor cycle gear cogs. • Hydraulic/pneumatic systems. • Mechanical advantage – including simple calculations. • Systems diagrams. **Task**: mine shaft headgear.	**Electrical systems and control:** Electronic systems and control – how simple electronic circuits and devices are used to make an output respond to an input. Learners should be able to read a ***given*** electronic circuit diagram and assemble the components into a working circuit. • Input components: electrochemical cells, photovoltaic cells. • Storage components: electrochemical cells, capacitors. • Control components: switches, resistors, diodes, light emitting diodes (LED), transistors. • Sensor components: thermistors, light dependent resistors (LDR). • Output components: lamp, buzzer/bell, light emitting diodes (LED). • Resistor codes. • Ohm's Law: *quantitative* treatment with graphs and

	Processing: Recycling scrap metals – sorting ferrous and non-ferrous metals. Improving properties of materials. • Improving the properties of wood: waterproofing. • Improving the properties of textiles: waterproofing, fire-resistance. **Task**: emergency shelter for refugees.		calculations. **Task**: identify a problem that can be solved by an electronic circuit. Assemble a given electronic circuit and design a device which can utilise the circuit to solve the problem.
Term 4	**Mechanical systems and control:** Simple mechanisms; first-, second- and third-class levers. • Mechanical advantage/disadvantage using levers (*elementary qualitative treatment*). • Levers and linkages. • Pneumatics and hydraulics used to increase human strength. **Task**: hydraulic powered rescue equipment. More simple mechanisms – wheel and axle, cranks and pulleys, gears. More simple mechanisms – wedge, gear ratios, cams. • Mechanical systems that change the magnitude of forces involved: gear ratios. • Mechanical systems that change the rotary to linear motion: crank,	**Electrical systems and control:** Electrical circuit basics: • Circuit diagrams, conventions and component symbols. • Input devices, control devices, output devices. • Circuit design (simple) and circuit interpretation. • Circuits with more than one input or control device. Electrical energy sources (including illegal connections): • Sources of direct current: electrochemical cells; photovoltaic cells. • Sources of alternating current: generating (thermal and alternate). • Distributing AC electricity: the national grid, transformers (an application of electromagnetism). Ohm's Law: *qualitative* treatment. Logic conditions: • **AND** logic (series); truth table. • **OR** logic (parallel); truth table. **Task**: dual switch system like an alarm circuit with at least two panic buttons in different rooms, or similar concept using either AND or OR logic conditions.	**Processing:** Extending lifespan: • Metal – paint, galvanise, and electroplate**:** **Practical** – preserving metal by electroplating. • Food – freeze, pickle, dry, salt: **Practical** – preserving food by drying/salting. Types of plastics and their uses. Recycling plastics to provide raw material for manufacture of new plastic products. **task**: identify a problem in a given scenario where cutting, joining, bending or moulding plastics can be used to make a product that will satisfy a need, want or opportunity.

	cam. **Processing:** Recycling scrap metals – sorting ferrous and non-ferrous metals. Improving properties of materials. • Improving the properties of wood: waterproofing. • Improving the properties of textiles: waterproofing, fire-resistance. **Task**: emergency shelter for refugees.		
VALUES AND ATTITUDES			
Terms 1-4	Technology, society and the environment must be addressed throughout the syllabus wherever applicable. Activities provide ample opportunities for dealing with indigenous technologies, the impact of technology, and bias in technology.		

Teaching plan for Technology Grade 9

This table shows the pacing of the topics for the course by term, where to find the content and activities in the Learner's Book, and when Formal Assessment takes place.

Term	Content/topics (as per the CAPS)	Assessment	Time allocationHours
Term 1			
Unit			
1	First angle orthographic projection: three-dimensional objects on flat paper. - Concept of drawing three different views: front, top and side. Simple cubes. - Line types: dark, feint, dashed, wavy, chain. Scale and dimensions.	Activities Informal assessment	2
2	More complex 3D objects drawn in orthographic projection with instruments. **Design problem**: flight of stairs and wheelchair ramp. - Design brief specifying number of steps, height of stair risers, width and gradient of ramp, handrail, etc. - Sketch the stair and ramp in 3D using isometric projection. - Draw a plan for the stair and ramp using first angle orthographic projection to an appropriate scale, using correct views, line types and dimensions according to convention.	Activities Informal assessment	2
3	Forces and loads can be static or dynamic, and loads can be even or uneven. - Strength of materials under the action of forces – metal cross-sections: - Tension (pulling); compression (pushing); bending of beams (compression and tension). - Torsion – using internal cross-bracing to resist twisting. • Properties of various construction materials: mass/density; hardness; stiffness; flexibility, corrosion resistance and prevention of corrosion.	Activities Informal assessment	2
4	**Task 1: simulation: structures (Grade 9 learners must be able to identify a problem from a given context)**	Mini- PAT Formal assessment	2

	This task deals with the design of a structure that will solve a problem facing a community living on the far side of a river from the city. The local authority places an advertisement inviting contractors to submit tenders for a solution. **learners form teams to act as 'Contracting Companies' which will compete for the contract to solve the problem**. **the teams must be structured, with carefully designed roles for every learner.** The tender process (including ethical practices). • **Investigate:** provide the scenario so that learners can investigate the problem situation and various possible structures which could solve the problem(s) they identify. Analysis of existing products relevant to the identified problem in terms of fitness-for-purpose (including suitability of materials), safety for users, costs of materials and costs of construction. Realistic costs of real materials, labour, transport, etc.		
5	• **Sketch** initial ideas: each learner generates two possible ideas. • **Evaluate and adapt**: teams evaluate individual ideas and develop a final idea. • **Design brief**: learners write a design brief with specifications for the final idea. • **Flow chart**: teams discuss how to proceed, then each learner draws a flow chart.	Mini- PAT Formal assessment	2
6	**Working drawings**: each learner draws the plan (or an aspect of the plan) using first angle orthographic projection with suitable scale, correct line types and dimensions. • **Budget:** costing of the "real-life" solution, including correct materials and labour costs.	Mini- PAT Formal assessment	2
7	**Model of a viable solution:** It must be built neatly to scale, showing intelligent use of materials. Learners must use safe working practices.	Mini- PAT Formal assessment	2
8	**Evaluate:** teams collaborate to produce an evaluation instrument. Each learner uses the instrument to evaluate their team's solution and that of another team. This can be done during the other team's presentation. • **Team presentations:** teams present their tender bid to the "Tender Board". Each team member must be responsible for an aspect of the presentation. Tenders consist of sketches, plans, budget, model and artistic impressions.	Mini- PAT Formal assessment	4
	Formal Assessment task: Test	Formal assessment	1

			20
Term 2			
Unit			
1	• **Revise**: syringe mechanics using two equal sized syringes linked by a tube. Force transfer between the syringes filled with: - Compressed air – pneumatic system. - Water – hydraulic system. • **Action research**: learners experiment with two different sizes of syringes linked by a tube and filled with hydraulic fluid (water). Learners ***experience*** force transfer with either force multiplication or force division (depending on which syringe is the driver/master). Gases (like air) are compressible. Liquids (like water, oils) are incompressible. • **Action research**: Pascal's principle – *pressure exerted on one part of a hydraulic system will be transferred equally, without any loss, in all directions to other parts of the system*. Note that equal volumes of liquid are moved through the systems, and this results in different extensions (amount of movement) where syringes (cylinders) are of different sizes, so less distance/more force (MA > 1); and more distance/less force (MA < 1).	Activities Informal assessment	2
2	The hydraulic press (including simple calculations). • The hydraulic jack. • **Investigation:** Design considerations ~ fit-for-purpose: - Evaluate the design of the hydraulic jack in terms of: Who is it for? What is it for? Will it do the job? What should it be made of? What should it cost? Is it cost-effective? Does it look good (aesthetics)? Is it safe/easy to use for the end user (ergonomics)? • Draw a systems diagram which describes the way a hydraulic jack works.	Activities Informal assessment	2

3	**Action research**: practical investigations: - Use a single wheel ***fixed*** pulley to change the direction of pull (MA = 0). - Use a single wheel ***moveable*** pulley to change the direction of pull (MA > 0). - Use a pulley block system (block and tackle) to determine the relationship between load- bearing ropes on moveable pulley wheels and M.A (force multiplication). • **Investigate**: learners find out about the following mechanical control systems: - Ratchet and pawl - Disc brake - Bicycle brake - Cleat.	Activities Informal assessment	2
4	Lead learners as they **revise** the interactions of the following: - Spur gears of equal size counter-rotating. - Spur gears of unequal size counter-rotating – note velocity/force relationships. - Spur gears using an idler to synchronise rotation. • Lead learners as they find out about the interactions of the following: - Bevel gears of equal size – axis of rotation 90°. - Bevel gears of unequal size – axis of rotation 90° – note velocity/force relationships. - Rack-and-pinion gear system as found on automatic gates and steering racks. - Worm gear system for large reduction in speed and increase in force.	Activities Informal assessment	2
5	**Evaluate**: learners examine various items using mechanisms found in the modern kitchen and/or home, workshop/garage. Items like can openers, egg beaters, 'strap' spanners for opening bottles, knives for a range of purposes, and vice grip, wire strippers and ratchet spanners should be evaluated in terms of: Who is it for? What is it for? Will it do the job? What material is it made of? Is the material suitable? What should it cost? Does it look good? Is it safe and easy to use? They report on three items. • **Artistic drawing**: single vanishing point perspective. - Learners draw a 3D wooden object using single VP perspective. They enhance the drawing showing the texture of the wood grain, colour and shadows. - Learners use single VP perspective to draw an inside view of the	Activities Informal assessment	2

	classroom.		
6	• **Investigate** the *situation* so that an appropriate machine can be designed to solve the problem, need or want given in the scenario. Investigate the *possible mechanisms and controls* to be used together to make the machine. • **The design brief:** each learner writes his/her suggestion for the design giving specifications and constraints. • **Sketches:** each learner produces two sketches of viable possible designs. Teams meet and examine the individual suggestions and then decide on a final solution.	Mini- PAT Formal assessment	2
7	**Plan: working drawings** The teams collaborate to produce drawings for their model/prototype using first angle orthographic projection. Each team member draws a plan of the design OR, if it is very complex, one or more aspects of the design. Each learner must demonstrate her/his competency in using this drawing technique. • **Make: prototype/working model** Learners use safe working practices. Building: the model must showcase a viable solution to the problem. It should be to scale and neat, and show intelligent use of available materials.	Mini- PAT Formal assessment	3
8	**Team presentations**: Each team is given five minutes to present their solution in the form of sketches, artistic impressions of the solution, working drawings/plans, costing and their model.	Mini- PAT Formal assessment	2
	Formal Assessment task: Test	Formal assessment	1
			20
TERM 3			
Unit			
1	**Revise 1 – component symbols:** • Cells in series and parallel. • Lamps in series and parallel.	Activities Informal assessment	2

	• Switches in series (AND logic) and parallel (OR logic). • Current in the circuit – conventional current flows from positive to negative. **Revise 2 – simple circuits:** • One cell, switch, two lamps in series. • Two cells in series, switch, two lamps in series. **OHM's law quantitatively**: *as voltage increases, current increases if resistance is constant*. **Action research**: testing Ohm's Law practically – measure the voltage (potential difference) and the current strength in each of the following circuits: • One cell connected to a 20W resistor – note the voltmeter and ammeter readings. • Two cells connected to the 20W resistor – note the voltmeter and ammeter readings. • Three cells connected to the 20W resistor – note the voltmeter and ammeter readings • Plot the readings on a graph and determine the relationship between potential difference and current strength while keeping the resistance constant.		
2	**Resistor colour codes:** • Low value resistors often have their resistance value printed on them in numbers. • Higher value resistors are coded using coloured bands. The first three bands give the value of the resistor in ohms. The fourth band is an accuracy rating as a percentage. **Note**: **r** - *represents the resistance of a resistor in ohms* .... [Ω]. **v** - *represents the potential difference in volts* ..... [V]. **i**- *represents the current strength in amperes* ..... [A].	Activities Informal assessment	2
3	**Switches:** Manual switches controlled by the user, e.g. push, SPST, SPDT, DPDT. • **diodes and led (l**ight **e**mitting **d**iode)**:** - A diode is a component that allows current to flow in **one direction only**. - A LED allows current to flow in **one direction only** and also **gives off light** and is often used as an indicator that a circuit is 'ON'. • **transistors:** only npn-type will be used at this level.	Activities Informal assessment	4

	- A transistor is a device that can act as a ***switch*** and it can ***amplify*** a small current (e.g. from a sensor) into a larger current. - Connect a simple transistor circuit. **sensors** – important **input devices**: • **ldr**(**l**ight **d**ependent **r**esistor) – a component whose resistance decreases with light [dark – high resistance; bright light – low resistance]. • **thermistor:** a component whose resistance varies with temperature. Two types exist: - **+ t:** resistance *increases* with increasing temperature. - **- t:** resistance *decreases* with increasing temperature. • **touch or moisture detector**: a component that can be bridged using a 'wet' finger, thus completing the circuit, indicating the touch. • **Capacitors**: a component which can store and then release electrical energy.		
4	**Simple electronic circuits**: Learners **draw**, AND work in groups to assemble these simple electronic circuits: LED, 470Ω resistor, switch, and 4,5V series battery. LDR, buzzer, 3V series battery. NPN transistor, buzzer or bell, thermistor, variable resistor, 1kΩ resistor, 6V series battery (or DC power supply or photovoltaic panel). 6V series battery, LED, 470Ω resistor, 1 000µF capacitor, switch.	Activities Informal assessment	2
5	**Practical task**: **electronic systems setting the scene** *Duration of this lesson is one 30-minute period*. Systems where **electrical and electronic** systems are combined. This may be integrated with other aspects like **structures**, etc. Learners will not be expected to ***design*** an electronic circuit. They will assemble and connect the components of a given circuit and will design a suitable application for that circuit. The electronic circuit may contain sensor devices and/or use transistor(s). **Scenario**: describe a situation where a given electronic circuit can be used to meet a need. Learners are given the task of building a given electronic circuit and finding an appropriate use for this circuit. **Investigate:** the situation and the nature of the need so that an appropriate	Mini- PAT Formal assessment	2

	circuit can be chosen to solve the problem, need or want given in the scenario. • A given circuit must be incorporated into the design of a device that will use the electronics to address the problem, need or want. • **The design brief**: Each learner writes his/her suggestion for the design with specifications & constraints. • **Sketches** Each learner draws the circuit diagram. Each learner produces a sketch in 3D showing the device that will use the electronic circuit. • Teams meet and examine the individual suggestions to decide on a final solution.		
6	**Plans: working drawings** • The learners produce plans for their device/model/prototype using first angle orthographic projection. The plans should include a 3D "assembly" drawing in exploded view showing how the model fits together. • Each team member draws a working drawing of the design OR an aspect of the design. • **Make: device /prototype/working model** • The model must showcase a viable solution to the problem. It should be to scale and neat, and show intelligent use of available materials.	Mini- PAT Formal assessment	2
7	**Team presentations**: Each team is given five minutes to present their solution in the form of sketches, artistic impressions of the solution, working drawings/plans, costing and their model. • Each learner compiles a record of his/her own individual contribution to the task. This should be reflected in each learner's **workbook**.	Mini- PAT Formal assessment	4
	Formal Assessment task: Test	Formal Assessment	1
			20

Term 4			
Unit			
1	Preserving metals (first two methods theoretically, 1.3 practically) 1.1. Painting	Activities Informal assessment	2

	1.2. Galvanising 1.3. Electroplating		
2	Preserving food (first two methods theoretically, 2.3 practically) 2.1. Storing grain 2.2. Pickling 2.3. Drying and/or salting	Activities Informal assessment	2
3	• Types of plastics and their uses • **Investigation:** identification of plastic identifying-codes and sorting for recycling. Properties of plastics Reduce – reuse – recycle	Activities Informal assessment	2
4	• Case study: Remanufacturing waste plastic into pellets for re-use. • Systems diagram: Draw a systems diagram describing a plastics recycling project. • Case study: Moulding recycled plastic pellets into products.	Activities Informal assessment	2
5	**Practical task**: **working with Plastics** Setting the scene *Duration of this lesson is 30 minutes*. **Scenario**: Describe a situation where cutting, joining, bending AND/OR moulding plastics can be used to make a plastic product that will satisfy a need, want or opportunity. **Case study:** plastics used on modern motor cars. • **Case study:** plastics used around the home. • **Problem identification:** learners identify a need or want that can be satisfied by the making of a plastic item of their own design.	Mini- PAT Formal assessment	2
6	**Sketch:** learners sketch their plastic item using isometric projection on grid paper. • **Plan:** learners draw their plastic item using first angle orthographic projection. • **Skills development:** learners practise the skills needed to manufacture their plastic item – measure, mark out, cut, bend and join. Moulding is an optional extra.	Mini- PAT Formal assessment	2
7	Practical sessions: working safely, learners measure, mark out, cut and bend the materials for their plastic item, and then assemble the product. • Each learner compiles a record of his/her term's work including extending the lifespan of metals and food, properties and uses of various plastics, the plastics recycling strategy, the case studies, and the sketches and plans for the plastic item.	Mini- PAT Formal assessment	2
	Formal Assessment task: End-of-year Examination	Formal assessment	2
			20

Sample lesson plan for Grade 9

Some teachers may find daily lesson plans useful, although these are not a formal policy requirement. A sample template of a lesson plan is below.

Date:	**Grade: 9**	**Term: 1**
Unit:	**Unit title:**	**Contact time:**
Content/concept: **(Teacher to complete)**	**Activities:**	**Resources required:** **Learner's Book**
Activity 1:		
Links with previous activity: n/a		
Links with next activity: (Teacher to complete)		
Teaching plan (Teacher to complete; tips provided below)		
Assessment:		
Teacher reflection: (Teacher to complete)		

What is assessment in the Senior Phase?

Assessment is about collecting evidence of the learners' knowledge. It is an integral part of teaching and learning, and should be planned when preparing the lesson content. Assessment helps to identify the needs of the learners. It also provides evidence of progress, enables teachers to reflect on what they are doing and provides for feedback and reporting to all stakeholders. Good assessment practice in Technology includes:

- assessing whether skills and aims are applied to content knowledge
- providing feedback.

Informal or daily assessment

Assessment for learning has the purpose of continuously collecting information on a learner's achievement that can be used to improve their learning.

Informal assessment is a daily monitoring of learners' progress. This is done through observations, discussions, practical demonstrations and investigations, learner-teacher conferences, informal classroom interactions, etc. Informal assessment may be as simple as stopping during the lesson to observe learners or to discuss with learners how learning is progressing. CAPS tells us that informal assessment should be used to provide feedback to the learners and to inform planning for teaching, but need not be recorded or taken into account for promotion. It should not be seen as separate from learning activities taking place in the classroom. Learners or teachers can mark these assessment tasks. In Technology the "enabling" activities that precede the mini-PAT are intended to develop the knowledge, skills and values to the point where the learners are ready to be assessed formally. Assessment for learning must be developmental. Learners or teachers can mark these enabling tasks.

Self-assessment and peer 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. The results of daily assessment tasks are not taken into account for promotion and certification purposes. Preceding and during the min-PAT, learners can be supported through encouraging and developing skills in informal self-and per-assessment.

Learners should be encouraged to *apply* skills, knowledge and values and attitudes that they have develop through classroom practise, to real-life contexts. They also need to develop real-life skills. The Learner Book's and Teacher's Guide provide activities, including support and extension activities, which support learners in developing skills, conceptual knowledge and values and attitudes that form the basis of success as an adult and in the world of work. Other reliable sources of information that draw links between the curriculum and real-life, and may enrich the curriculum are provided in the Teacher Guide.

Formal assessment

All assessment tasks that make up a formal programme of assessment for the year are regarded as formal assessment. Formal assessment tasks are marked and formally recorded by the teacher for progression and certification purposes. All formal assessment tasks are subject to moderation for the purpose of quality assurance and to ensure that appropriate standards are maintained. Formal assessment provides teachers with a systematic way of evaluating how well learners are progressing in a grade and in a particular subject. Examples of formal assessments in technology Senior Phase include mini-Practical Assessment Tasks, tests and examinations. Formal assessment tasks make up a year-long formal programme of assessment in each grade.

The four steps of assessment

1. Generating and collecting evidence of achievement
2. Evaluating the evidence
3. Recording the findings
4. Using the findings to guide future learning and teaching.

Types of formal assessment for Technology

Formal assessment for Technology will consist of:

- Pen and paper tests or examinations.
- the mini-Practical Assessment Tasks

Tests and examinations

Tests and exams for formal assessment should cover a substantial amount of content. Tests and exams must be completed under strictly controlled conditions.

Content weighting for tests and examinations: Grades 7–9		
Investigate, design, make, evaluate and communicate **Design Process skills:**	Structures, Processing, mechanical and Electrical/Electronic Systems and Control **Knowledge:**	(Technology, Society and the Environment) Indigenous / Impact / Bias **Values and attitudes:**
50%	**30%**	**20%**

Each test and examination must cater for a range of cognitive levels. (Refer also to the table in Section D.)

Cognitive level	**Activity**	**Cognitive levels Percentage of task**
Low order	Knowledge recall	30
Middle order	Application of skills Understanding Diagnostic Strategic	40
Higher order	Analyse Interpret Synthesise of skills and knowledge Create Evaluate	30

Mini Practical Assessment Tasks (mini-PATs)

Learners complete a mini-PAT in each term for formal assessment. This is a set of short practical assessment tasks which make up the main formal assessment of a learner's skills and application of knowledge during each term. It may be an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process (IDMEC). It is composed of a variety of forms of assessment suited to the range of activities that make up a mini-PAT.

The purpose of each mini-PAT is to formalise the practical component of Technology contextualised within a knowledge focus. At least 40 out of the 70 mini-Pat marks per term must be attributed to Practical work. Work done "off-campus" outside the direct control of the teacher should normally not form part of the formal assessment record. The combined mini-PAT marks contribute 1/3 to the final exam mark, i.e. 20 out of 60.

A learner must present the full design process once as a mini-Practical Assessment Task in term 3 of each grade. This meets the requirement of one project per subject per annum. The preferred tool to be used to assess learner performance in a mini-Practical Assessment Task is an analytical rubric. Teachers will assess skills and values using analytical rubrics which should have clear descriptors for each level. This means that a descriptor should say why an achievement is deemed to be, say, 'meritorious' or 'elementary'. Schools must take responsibility for providing resources (both tools and materials) needed during the mini-PAT. Learners must complete the mini-PATs for formal assessment under teacher supervision. Teachers will assess the mini-PATs formally.

Formal programme of assessment for Technology

The end of year promotion mark will comprise 40% CASS (10% for each term) and 60% (mini-Pat 20% and examination 40%) end of year examination:
Below is a breakdown of formal assessment in Technology:

<table>
<tr><td colspan="6">Formal assessment in technology – Grades 7, 8 and 9</td></tr>
<tr><td rowspan="3"></td><td>Informal daily assessment</td><td colspan="4">Formal assessment : term marks</td></tr>
<tr><td></td><td colspan="2">Practical tasks and theory test / examination</td><td colspan="2">Total</td></tr>
<tr><td>Enabling tasks</td><td>Mini-PAT</td><td>Term Test/ Examination</td><td colspan="2">Term Mark</td></tr>
<tr><td>Term 1</td><td rowspan="4">0%</td><td rowspan="2">70%</td><td rowspan="2">30%</td><td colspan="2" rowspan="2">100%</td></tr>
<tr><td>Term 2</td></tr>
<tr><td>Term 3</td><td>70%</td><td>30%</td><td colspan="2">100%</td></tr>
<tr><td>Term 4</td><td>70%</td><td>30%</td><td colspan="2">100%</td></tr>
<tr><td rowspan="5">Promotion mark</td><td></td><td>70 marks = 100%</td><td>No test</td><td colspan="2">100%</td></tr>
<tr><td>CASS Component:40%</td><td colspan="3">Final examination component:60%</td><td rowspan="2">Promotion</td></tr>
<tr><td>Continuous assessment: Tests and mini-PATs: 40</td><td>Combined mini-PAT:20</td><td>Examination:40</td><td></td></tr>
<tr><td>Term 1 + Term 2 + Term 3 + Term 4</td><td>T1+T2+T3+T4</td><td rowspan="2">40</td><td rowspan="2">100</td></tr>
<tr><td>10 + 10 + 10 + 10</td><td>5+5+5+5</td></tr>
</table>

We have provided a full Formal Programme of Assessment that includes:

- Tests and memorandum for Terms 1 – 3
- End-of -year examination and memorandum for Term 4
- Mini-PATs and assessment rubrics for each term.

The tests, examination and tasks cater for a range of cognitive levels and abilities. To support learners we have provided exemplary tests and exams which can be used for revision. A memorandum for each test is provided in Section E. In addition unseen exemplary tests and examinations, with memoranda, are provided in Section E to assist you.

Programme of assessment

Term	Type of activity	LB Pages
Term 1	Mini-PAT	Page 34
	Test	Page 38
Term 2	Mini-PAT	Page 63
	Test	Page 66
Term 3	Mini-PAT	Page 82
	Test	Page 85
Term 4	Mini-PAT	Page 108
	Examination	Page 112

Inclusive assessment

Teachers need to develop adaptive and alternative methods to assess learners with barriers to learning, so that learners are given opportunities to demonstrate competence in ways that suit their needs. Here are some examples of how to assess these learners, while still maintaining the validity of the assessment.

- Some learners may need concrete apparatus for a longer time than their peers.
- Assessment tasks, especially written tasks, may have to be broken up into smaller sections for learners who cannot concentrate or work for a long time, or short breaks may be given during the tasks. Learners can also be given extra time to complete tasks.
- Some learners may need to do their assessment tasks in a separate venue to limit distractions.
- A variety of assessment instruments should be used, as a learner may find that a particular assessment instrument does not allow them to show what they can do.
- Learners who cannot read can have tasks read to them and they can orally dictate answers. Assessment can also include a practical component in which learners can demonstrate their competence without having to use language.
- A sign-language interpreter can be used.
- Assessment tasks can be available in Braille or enlarged with bolded text.
- Assessment can include the use of dictaphones or computers with voice synthesisers.
- The forms of assessment used should be appropriate for age and developmental levels. The design of these tasks should cover the content of the subject and include a variety of tasks designed to achieve the objectives of the subject.

Recording and reporting assessment

Recording

Recording is a process in which the teacher documents the level of a learner's performance in a specific assessment task. It indicates learner progress towards the achievement of the knowledge as prescribed in the Curriculum and Assessment Policy Statements. Records of learner performance should provide evidence of the learner's conceptual progression within a grade and her / his readiness to progress or being promoted to the next grade. Records of learner performance should also be used to verify the progress made by teachers and learners in the teaching and learning process.

Reporting

Reporting is a process of communicating learner performance to learners, parents, schools, and other stakeholders. Learner performance can be reported in a number of ways. These include report cards, parents' meetings, school visitation days, parent-teacher conferences, phone calls, letters, class or school newsletters, etc. Teachers in all grades report in percentages against the subject. The various achievement levels and their corresponding percentage bands are as shown in the table below.

Rating code	Description of competence	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	20–29

Teachers will record actual marks against the task by using a record sheet; and report percentages against the subject on the learners' report cards.

Section C Teaching and learning Technology

In the educational context, Technology can be defined as the use of knowledge, skills, values and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration. The Technology curriculum aims to provide opportunities for learners to develop and apply specific design skills to solve technological problems; understand the concepts and knowledge used in Technology education and use them responsibly and purposefully and to appreciate the interaction between people's values and attitudes, technology, society and the environment.

Teaching Technology in the Senior Phase

Key issues to teach are:

1. Problem solving using the design process
2. Practical skills
3. Knowledge and application of knowledge.

The design process: problem solving and skills

Technology develops valuable problem-solving skills that will benefit every learner in many life contexts. As learners progress through a task, they must be **taught** the associated knowledge and the skills needed to **design and create** a solution.

The **design process** (**i**nvestigate, **d**esign, **m**ake, **e**valuate, **C**ommunicate - IDMEC) forms the backbone of the subject and should be used to structure the delivery of all learning aims. Learners should be exposed to a problem, need or opportunity as a starting point. They should then engage in a systematic process that allows them to develop solutions that solve problems, rectify design issues and satisfy needs.

Investigation in this subject involves finding out about contexts and needs, investigating or evaluating existing products in relation to key design aspects and performing practical tests to develop understanding of particular aspects of the content areas or determining a product's fitness-for-purpose. While investigating, learners should be provided with opportunities to explore values and attitudes and develop informed opinions that can help them to make compromises and value judgements. Investigation can happen at any point in the Design Process. It should not be seen as something that must be completed before design begins.

Designing, making and evaluating. These skills should not be seen as separate – they are inter-related. **Evaluation** skills are used to choose design ideas. At this level, learners should be introduced to key aspects of design. These should be used to evaluate both

existing and designed products against predetermined criteria. When **making**, learners should be encouraged to continue to reflect on their progress against these criteria and to modify their solutions based on problems encountered. As learners progress they should be able to demonstrate **increasing accuracy and skill**, **better organisation** and **safer working practices**.

Communication should also be seen as integral to the overall process. Learners should be recording and presenting progress in written and graphical forms on an on-going basis. Their presentations should show increasing use of media, levels of formality and conventions as they progress through the phase. Graphical skills should develop through Grade 7 – 9. Learners should be able to draw:

- Free-hand sketches (design stage)
- Working drawings (planning and making stage) using formal draughting techniques in line with conventions.
- Artistic drawings (communication stage) using artistic techniques including perspective, texture rendering, shading, colours and shadows

Types of drawing covered in Grade 7 – 9 include:

- 2D drawings
- Front, side and top views
- 3D isometric projection
- First angle orthographic projection
- Single vanishing point perspective and double vanishing point perspective

Content areas:

There are four core content areas in Technology in grades 7 – 9. These are:

- Structures
- Processing
- Mechanical systems and control
- Electrical systems and control

These four content areas form the basis of the four strands which must be done each year in every grade. Where possible in the senior phase, the learner should engage in projects that integrate processing, structures and systems and control. The recommended approach will be to introduce the required knowledge followed by practical work in which the knowledge is applied. In all cases, the teaching will be structured using the *Design Process* as the backbone for the methodology. Some of these elements will be assessed formally each term.

Values and attitudes: **L**earners must be made aware of the interrelationship between technology, society and the environment.

Indigenous technology: Wherever applicable, learners should be made aware of different coexisting knowledge systems. They should learn how indigenous cultures have used specific materials and processes to satisfy needs, and become aware of indigenous intellectual property rights.

Impact of technology: Learners must be able to identify and evaluate both the positive and negative impacts of technology on people's lives.

Bias in technology: Learners should be able to identify and express opinions that explain how certain groups within society might be favoured or disadvantaged by products of technology.

Requirements for teaching technology:

1. Each learner must have:
- An approved textbook.
- A 72-page A4 workbook/exercise book. (In secondary schools learners may require two books per year.)
- Stationery including basic mathematical set (drawing instruments): pencil, eraser, ruler and set squares.
2. A designated teaching venue with a Technology teacher.
3. Technology rooms must be secure, with doors that lock, and with burglar-proofing if possible. Enough cupboards should be available to store and lock away all resources.
4. It is the responsibility of the school to provide each learner with the minimum tools and material to meet the needs of the subject (see Annexure B for possible tools and resources) and to develop the teacher's appropriate knowledge and skills.
5. Enabling tasks: Activities used to teach and then practise specific skills in preparation for a more advanced task – sometimes also called resource tasks. These tasks are assessed informally.
6. Mini-Pat: A short Practical Assessment Task which makes up the main formal assessment of a learner's skills and knowledge application during each term. It may be an assignment covering aspects of the design process, or it may be a full capability task covering all aspects of the design process (IDMEC).

Specific features and scope for Technology

These specific skills, values and attitudes should be developed in the Senior Phase.

solve problems in creative ways
combine thinking and doing in a way that links the abstract concepts to concrete understanding
use and engage with knowledge in a purposeful way
deal with inclusivity, human rights, social and environmental issues in tasks
use a variety of like skills, such as decision-making, critical and creative thinking, cooperation, problem solving and needs identification in authentic contexts
develop positive attitudes, perceptions and aspirations towards technology based careers
collect, collate, synthesise and organise information, e.g. from text, visual material, real life examples
use more than one kind of form of communication, e.g. diagrams, charts, plans, texts
distinguish important from less important information (relevance/usefulness to task)
compare information
recognise bias and different points of view
develop own ideas and points of view based on new knowledge
take part in discussions and listen with interest
recognise bias in technology
ask questions and identify issues, needs, wants and problems
use information to describe, explain and answer questions
evaluate existing products and processes and evaluate own products
make links between concepts and knowledge, skills and values and attitudes
acknowledge and appreciate diverse lifestyles and world views
use and draw sketches, tables, working drawings, graphs, and flow charts
cross-reference information using different sources
develop observation, interviewing and recording skills
investigate contexts
process, interpret, present and evaluate information
devise and frame questions use authentic contexts rooted in real situations outside the classroom
do practical investigations to develop knowledge and skills
write in a structured and coherent way
provide reasoned explanations
work co-operatively and independently
work safely
evaluate designs using criteria and make improvements

Inclusive teaching

What is inclusive teaching?

In the Senior Phase, it is crucial that learners find themselves in an environment where they can develop an interest in learning and the belief that they can learn. Inclusive education is defined as a learning environment that promotes the full personal, academic and professional development of all learners irrespective of race, class,

gender, disability, religion, culture, sexual preference, learning styles and language. Inclusion is about acknowledging and respecting that:

- all children have the right to learn
- all children are able to learn
- all learners need support
- all learners are unique and have different, but equally valued, learning needs
- all learners need the opportunity to build on their own unique strengths
- the learner is the centre of the teaching and learning process
- there are differences in learners, for example, age, gender, language, culture, learning styles, disabilities, HIV status and so on.

Inclusion is also about:

- enabling educational structures, systems and learning methodologies to meet the needs of all learners
- more than just formal schooling – it embraces learning that occurs in the home, community and so on
- changing attitudes, behaviour, methodologies and environments to meet the needs of all learners
- ensuring maximum participation of all learners in the culture and curriculum of all educational institutions
- identifying and minimising barriers to learning that can occur at any level of the system.

Some of the learners in your class may already suffer from exclusion or think negatively about education. There is no reason for their exclusion from class activities. It is the responsibility of the teacher to ensure the inclusion of these learners.

This means adapting activities to suit their needs and capabilities. It is equally important that the class is not divided because of this. Rather, learners with these challenges should be accepted and helped where possible by their peers. Learners should at all times be discouraged from teasing, bullying or ignoring learners with special needs. When these attitudes are directed towards a learner, they create a barrier to learning in that learner.

Practical guidelines for inclusive teaching

- Have a true understanding of each learner's background, strengths, unique abilities, needs and barriers. Then use this information to inform your planning and give a clearer focus.
- Remember that the teacher is a facilitator of learning.
- Keep the content and material as relevant as possible.

- Break down learning into small, manageable and logical steps. Keep instructions clear and short (plan beforehand).
- Grade activities according to the different levels and abilities of learners. Try to ensure that learners remain challenged enough without undue stress.
- Develop a balance between individual teaching, peer tutoring, co-operative learning and whole-class teaching.
- Use learners to help one another in the form of group types, peer-assisted learning, buddy systems and so on. Ensure that learners feel included and supported in the classroom by both the teacher and their peers.
- Set up pairs and groups of learners where members can have different tasks according to strengths and abilities.
- Motivate learners and affirm their efforts and individual progress. Build confidence. Encourage questioning, reasoning, experimentation with ideas and risking opinions.
- Spend time on consolidating new learning. Use different ways to do this until all learners understand the concept. Make time to go back to tasks so that learners can learn from their own and others' experiences and methods.
- Use and develop effective language skills (expressive and receptive, verbal and non-verbal).
- Experiment with a variety of teaching methods and strategies to keep learners interested and to cater for and develop different learning styles. Use games, cooperative group work, brainstorming, problem-solving, debates, and so on.

Learners with barriers to learning

A barrier to learning is anything that prevents a learner from participating fully and learning effectively. This includes learners who were formerly disadvantaged and excluded from education because of the historical, political, cultural and health challenges facing South Africans. Some other examples of barriers to learning may be learners who are visually or hearing impaired, or learners who are intellectually challenged. Barriers to learning cover a wide range of possibilities and learners may often experience more than one barrier. Some barriers, therefore, require more than one adaptation in the classroom and varying types and levels of support. These learners may require and should be granted more time for:

- completing tasks
- acquiring thinking skills (own strategies)
- assessment activities.

Teachers need to adapt the number of activities to be completed without interfering with the learners gaining the required language skills.

Cognitive levels and abilities for Technology in the Senior Phase

RECALL ROUTINE	UNDERSTANDING DIAGNOSTIC	APPLICATION STRATEGIC	ANALYSE INTERPRET	SYNTHESISE CREATE	EVALUATE
Low order 30%	**Middle order 40%**		**High order 30%**		
Absorb Count Define Identify Label List Match Memorise Name Outline Point out Quote Recite Recognise Repeat Remember Reproduce Respond Select State Trace	Classify Compare Convert Discuss Distinguish Define Demonstrate Describe Estimate Explain Generalise Give examples Illustrate Infer Interpret Match Paraphrase Restate Rewrite Select Summarise Translate	Change Compute Construct Demonstrate Draw Illustrate Predict Relate Solve Use	Breakdown Differentiate Discriminate Investigate Organise Relate Separate Subdivide	Abstract Arrange Combine Compile Construct Create Design Discuss Formulate Generalise Generate Group Integrate Organise Summarise	Appraise Conclude Contrast Create Critique Criticize Decide Dispute Evaluate Grade Judge Justify Interpret Support Recommend

Meta-cognitive strategies

What are metacognitive strategies and how can I use them?

Metacognition is the process of thinking about how you think. Adults often do this automatically. Before taking on something new, we may ask ourselves: What do I already know about this? What will help me understand it better? How is it structured? As we engage with a text or action, we may ask ourselves: Did I understand that? Why do I think that? How does this connect with what I already know? How could I apply this in my life? Then we evaluate what we have learnt or done by asking questions like: Did I understand that well? What strategies helped and what strategies didn't help? What should I do the next time I take on a task like this?

Learners, however, are often unaware of how they think and engage with learning material. You help learners to learn independently by explicitly guiding them to plan, monitor, and evaluate their reading and learning strategies. This is particularly effective for those learning in English as a second language and for learners who are struggling. It can dramatically improve their performance.

You teach metacognitive skills by asking learners to explain what they are thinking and what strategies they are using to understand material. This is best done is small groups. You can also use 'think aloud' strategies when engaging with texts and images. 'Think-aloud' activities are often effective when reading texts to learners, and during small-group and pair reading exercises. Here is an example of how to teach metacognitive strategies using a 'think aloud':

When reading text:

Read the text title and the table of contents
Look at the images and predict what the text may be about.
Skim-read the text looking for headings, words in bold, and summaries. As you skim read, stop to ask yourself whether you understood the content. If the text has a long or complex sentence, describe how you divided it up to understand it. Find places where you could ask questions such as:

- Why would this...?
- Is this similar to ...
- How can I figure out what this new word means?
- What does the writer want me to know?
- What do I think will happen next? Why do I think that?

- Do I need to re-read this for detailed information?

Asking and answering questions post-reading such as:

- Did I read and understand this well?
- What helped me to understand? What didn't help?
- What should I do next time I read about this topic?
- What will help me remember what I read?

When viewing drawings and visual data

- Read text such as captions and labels and work out their relationship to the image.
- Draw on your prior knowledge. Ask what the image reminds you of or is similar to. As you view the image, think about what you already know about the subject and what more you would like to know.
- Ask yourself: what is the purpose of the image. What information does it intend to convey?
- Look for patterns and conventions
- Try to understand how the parts link to the whole.
- Read the key carefully for symbols and icons. and labels

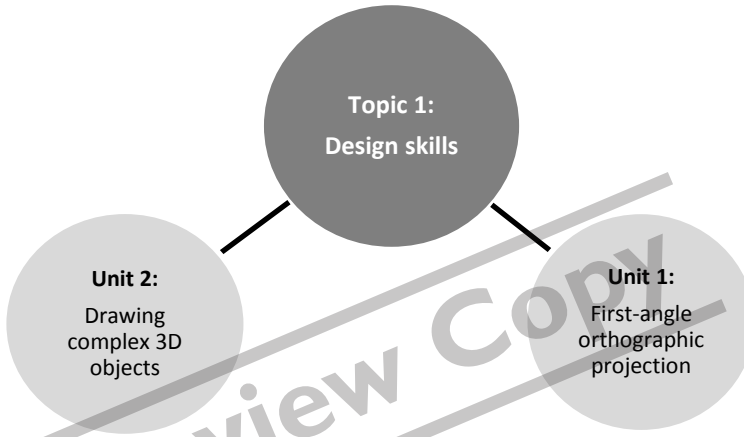
When looking at, analysing and evaluating products

- Draw on prior knowledge. Ask yourself what you already know about the subject and what more you would like to know.
- Analyse the product as a system. What are the input, processes and outputs? What is the underlying structure? How do the parts or components relate to the whole? How does the product meet its function or purpose?

Section E Guidelines to teaching Technology

Topic 1 Design skills

Core concepts covered



Topic overview

Learners will add perspective to make drawings look realistic. Rendering will also be used to make drawings more realistic by adding colour, shadows, shading and visual texture. They will create hard-line drawings to help them communicate and use dimensions accurately. The learners will draw a variety of isometric and orthographic drawings.

Content

Unit	Content	Pacing (time allocation)	LB page
1	First-angle orthographic projection	2 hours	10-15
2	Drawing complex 3D objects	2 hours	16-19

Unit 1 First-angle orthographic projection

Learner's Book pages 10 – 15

Unit overview

Learners will apply the drawing skills they acquired in Grades 7 and 8 to draw first-angle orthographic projections.

Teaching guidelines

- Explain the many purposes of graphic communication.
- Revise the drawing conventions (see pages 10 and 11 of Learner's Book).
- Revise drawing to scale.
- Allow learners to make additional drawings if time allows.
- Demonstrate new drawing styles before introducing the activities to the learners.
- Explain the steps very carefully.

Activity 1 Work with scale and dimensions Learner's Book page 12

Guidelines to implement this activity

This is an individual activity

- Learners investigate the house plan and answer the questions.

Assessment guidelines

- This activity is intended for informal assessment.
- The house is 8 m long: The bedroom is 15 m^2. Drawn at a scale of 1 : 50, the plan will be half the size of the one on page 12 of the Learner's Book.

Activity 2 **Practise orthographic drawings** Learner's Book page 12

Guidelines to implement this activity

This is a pair activity.

- Three-dimensional drawings can be difficult to interpret. Assist learners by showing them how to use a number of two-dimensional drawings of an object to represent it.
- Help learners to calculate the exact measurements.
- Assist where necessary.

Make sure that each pair has:

- unlined paper
- ruler
- scissors
- sticky tape.

Assessment guidelines

This activity is intended for informal assessment.
Use the checklist below to assess learners.

Criteria The learner(s):	Yes	Partly	No
Cut out two rectangles with a length of 60 mm and a height of 30 mm			
Cut out two rectangles with a length of 60 mm and a height of 20 mm			
Cut out two rectangles with a length of 30 mm and a height of 20 mm			
Followed each step to build an accurate box according to measurements.			

Activity 3 **Step-by-step orthographic drawing** Learner's Book page 15

Guidelines to implement this activity

This is an individual activity.

- Demonstrate each step to the learners.
- Assist where necessary.

Assessment guidelines

This activity is intended for informal assessment.
Use the checklist below to assess learners.

Criteria The learner(s):	Yes	Partly	No
Followed each step carefully			
Made a neat orthographic drawing			
Used the correct line conventions			
Drew according to the correct dimensions			

Unit 2 Drawing complex 3D objects

Learner's Book pages 16 - 19

Unit overview

In this unit the learners will work from a scenario. They will write up a design brief and come up with ideas by drawing sketches, isometric drawings and plans.

Teaching guidelines

- Discuss the scenario with the learners.
- Have a class discussion about the specifications and constraints and allow the learners to add to the list if possible.
- Explain each activity thoroughly and demonstrate steps where needed.
- The learners might struggle with drawing accurately according to the measurements.

Activity 1 Write a design brief

Learner's Book page 16

Guidelines to implement this activity

- This is an individual activity.
- Learners need to study the scenario, specifications and constraints and write a complete design brief.

Suggested answers

Design an access ramp for a public library that will make it possible for people in wheelchairs and people using walking aids to enter the building.✓ Your design must include at least one handrail✓ and must be wide enough✓ for four people to walk up or down at a time on either side. The design should have a non-slip surface✓ and must include a flat area outside the door for people to stand.✓

Total: 5 marks

Assessment guidelines

- This activity is intended for informal assessment.
- Use the suggested answers supplied above to assess learners informally. Allocate learners a mark out of 5.

Activity 2 **Make quick sketches of your ideas** Learner's Book page 17

Guidelines to implement this activity

- This is an individual activity
- Learners will need to study the specifications and constraints and sketch two or three design ideas.

Assessment guidelines

This activity is intended for informal assessment.
Use the rubric below to assess learners.

Mark allocations Assessment criteria	1-2	3-4	5
Sketched at least 2 ideas (6 marks)			
Sketches are labelled (2 marks)			
Sketches are drawn according to specifications (6 marks)			
Sketches are neat and have been enhanced (6 marks)			

20 marks

Activity 3 **Make an isometric drawing of your design**
Learner's Book page 18

Guidelines to implement this activity

- This is an individual activity
- Revise the line conventions for isometric drawings.

- Assist learners with the measurements.
- Demonstrate steps only if really necessary.

Assessment guidelines

This activity is intended for informal assessment.
Use the checklist below to assess learners.

Mark allocations	1-2	3-4	5
Assessment criteria			
Dimensions are in proportion (5 marks)			
Design follows the specifications (5 marks)			
Design solves the problem (5 marks)			
Made a neat drawing (5 marks)			
Made a proper, scaled and dimensioned isometric drawing using drawing instruments. (bonus marks)			

[20 marks – 5 bonus]

Activity 4 **Draw a plan view** Learner's Book page 19

Guidelines to implement this activity

- This is an individual activity
- Learners need to draw a plan for the stairs and ramp using first-angle orthographic projection to an appropriate scale.
- The learners have to use correct views, line types and dimensions according to convention.

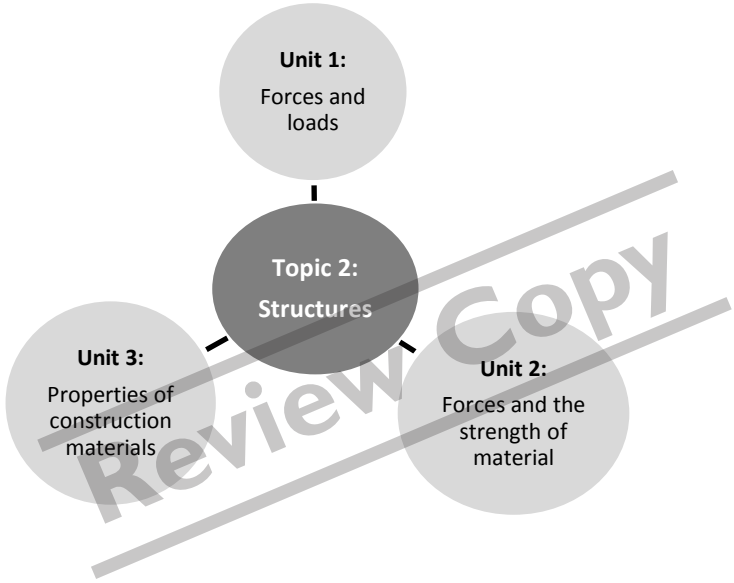
Assessment guidelines

This activity is intended for informal assessment.
Use the checklist below to assess learners.

Criteria	Yes	Partly	No
The learner(s):			
Drew a plan for the stairs and ramp			
Drew the plan to an appropriate scale			
Used the correct conventions			
Drawing is neat			

Topic 2 Structures

Core concepts covered



Topic overview

The learners will learn what is meant by a force. They will learn how compression and tension forces affect a structure. They will learn about the strength of different materials and the methods of testing materials. Learners will engage with the terms mass, density, hardness and stiffness and learn about corrosion and how to prevent it.

Unit	Content	Pacing (time allocation)	LB page
1	Forces and loads	1 hour	22-25
2	Forces and strength of materials	30 minutes	26-29
3	Properties of materials	30 minutes	30-35
	Mini-PAT	12 hours	37-39

Unit 1 Forces and loads

Learner's Book pages 22-25

Unit overview

In this unit the learners will:

- learn what is meant by a force
- learn about static forces
- learn about dynamic forces
- learn how compression and tension forces affect a structure.

Teaching guidelines

- Start by telling the story of Sir Isaac Newton.
- Ask the learners if they think that the story is true.
- Did Isaac Newton discover gravity? Answer no. Gravity has always existed.
- Sir Isaac Newton observed its effect and as a result of watching something fall to the ground he began to think about what caused it to do so.
- Forces cannot be seen. We can see the effect of a force caused by a load being applied to something.
- Here you can refer to the illustration of the washing on the washing line. The weight of the washing is one force pulling on the line.
- The line itself has a weight which is being pulled towards the ground and the wind is another force being applied.

Background knowledge

Static forces don't have movement. So a building has weight but it does not move. The forces are pressing downwards all the time. It is only when a part of the structure fails that the building will collapse.
Dynamic forces result in movement. When a learner kicks a football, the force from the foot is transferred to the ball, which then flies through the air.

Activity 1 **Stretching a spring** Learner's Book page 23

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups.
- Adding the weights causes the spring to stretch.
- Explain to the learners that this is known as Hooke's law.
- In the graph the line will rise in a straight line. At a point where the spring reaches its limit the line will curve.
- Hooke's law of proportionality no longer applies. This point is known as the elastic limit and the spring will not return to its original length.

Assessment guidelines

- This activity is intended for informal assessment.
- What can you assess?
- Can the learners follow instructions?
- Can the learners draw the graph?
- Can the learners see the relationship between the length of the spring and the weight applied to it?

Activity 2 **Test for load** Learner's Book page 25

Guidelines to implement this activity

- This is a group activity.
- This activity can be used as a competition to see whose structure carries the greatest number of books.

Assessment guidelines

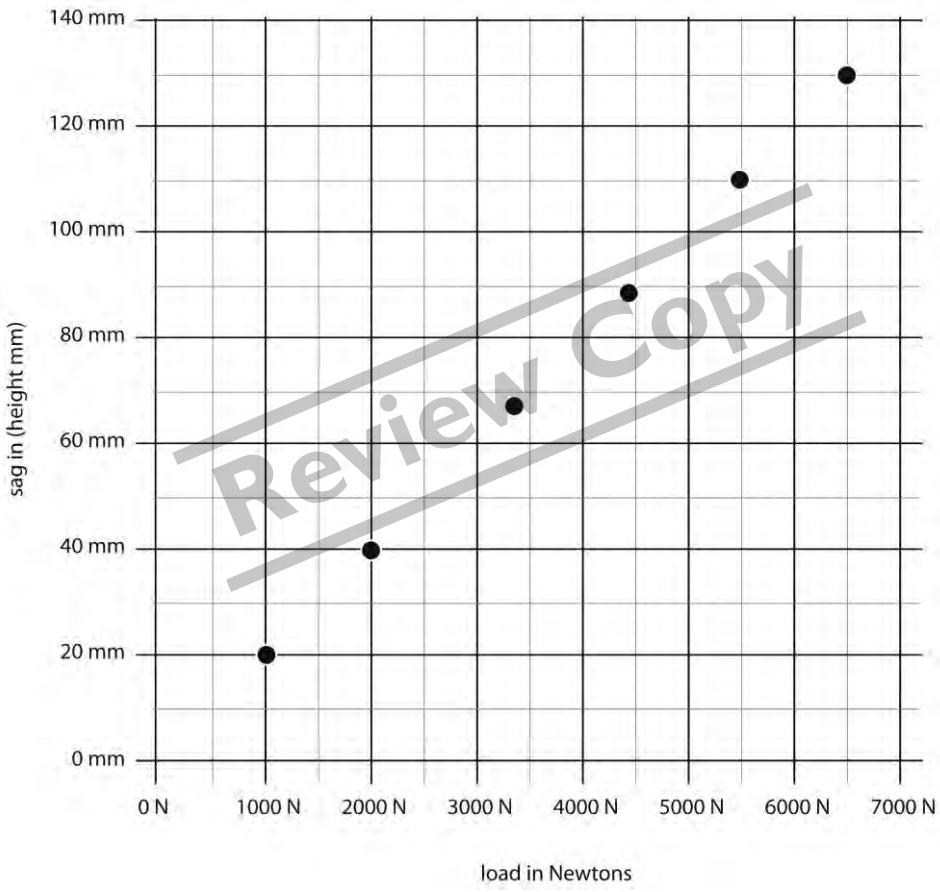
- This activity is intended for informal assessment.
- What can you assess?
- Can the learners follow instructions?
- Can the learners strengthen the structure?
- Can the learners explain why one structure is better than another?

Activity 3	Plot a graph	Learner's Book page 25

Guidelines to implement this activity

- This is an individual activity.
- The learners need to plot the graph in their workbooks and then answer the questions.

Suggested answers



1 In correct column - The sag is directionally proportional to the load. The load divided by the sag is 50. Therefore in the last column 6 500 divided by 50 would be 130 and not 135.

2 A load which would give a sag of 48 mm would be 2 400 N.

3 Sag for a load of 2 500 N would be 50 mm.

4 The longer the beam the greater the sag as the weight of the beam is also causing it to sag. Also, the torque force is load multiplied by distance from the supporting point. You can demonstrate this with a piece of paper supported at two points. As the supports move outwards the paper sags more.

Assessment guidelines

- This activity is intended for informal assessment.
- Use the suggested answers above to assess the learners.

Unit 2 Forces and the strength of materials

Learner's Book pages 26 - 29

Unit overview

In this unit the learners will:

- learn about torsion forces
- learn about shear forces
- learn about bending forces
- learn about the strength of different materials
- learn about different methods of testing materials.

Teaching guidelines

- Review the work covered in Grade 8 on forces causing failure in structures.
- As part of that work the learners tested various materials by bending them or by dropping objects onto them or by loading them until they broke.
- Engineers try to design things in such a way that they do not break. In many ways they have learnt from past experience and have therefore been able to produce strong materials which are able to withstand greater forces.
- The example at the start of this unit talks about the early railway bridges which broke because of the vibrations caused by the movement of the trains crossing them.
- George Stephenson solved this problem by looking to nature and developing a tubular bridge.
- The train travelled through the centre of the tube and the first bridge he built using this system lasted for 120 years.

Background knowledge

Torsion forces are forces which cause a structure to twist. One way to demonstrate this is to squeeze the water out of a wet cloth. Hold it between two hands and twist it in opposite directions. The fabric twists on itself, squeezing out the water. Constant twisting on a structure can cause cracks to develop which will lead to the structure breaking. You can demonstrate this using a piece of chalk. Hold the ends of the chalk in two hands and twist it in opposite directions. The chalk will break.

TIP!	If you use this demonstration make sure your box of chalk is locked safely away afterwards as the learners will want to try this for themselves and all you will be left with is a box of small pieces of chalk!

Activity 1	**Test for fatigue**	Learner's Book page 29

Guidelines to implement this activity

- This is a class demonstration.
- This test involves bending the material backwards and forwards. This is what you demonstrated when you broke the wire paper clip.

Assessment guidelines

This activity is not intended for assessment.

Activity 2	**Do an impact test**	Learner's Book page 29

Guidelines to implement this activity

- This is a demonstration.
- Use the test rig to test the different materials.
- Be aware of the safety aspect in this test. Wear safety goggles and be very careful picking up broken pieces with sharp edges.

Assessment guidelines

- This activity is intended for informal assessment.
- What can you assess?
- Can the learners describe what happened with the different materials?

- Can they determine which materials are strong or stiff, which are ductile and which are brittle?

Activity 3	Sketch solutions	Learner's Book page 29

Guidelines to implement this activity

- This is an individual activity
- Sketch some ideas for a device which could be used to crush (compressive force) a cool drink can for recycling.
- Crushing cans means that they take up less space and are therefore easier to transport. Think about whether it is better to apply the force to the side of the can or to the ends.

Assessment guidelines

- This activity is not intended for assessment.

Unit 3 Properties of construction materials

Learner's Book pages 30 – 34
Time allocation: 30 minutes

Unit overview

In this unit the learners will:

- learn about the properties and uses of wood
- learn about the properties and uses of steel
- learn about the properties and uses of concrete
- learn about the properties and uses of plastic
- learn about the terms mass, density, hardness and stiffness
- learn about corrosion and how to prevent it.

Teaching guidelines

- Read through the first section of this unit and then ask the following question:
  What types of materials are used to build the homes in your area?
- This would be a good starting point for this unit. What are the disadvantages of the materials being used? For example:
  Do they protect against the rain or the heat?
  Do they look good?
  Are they easy to build with?

Are they expensive?
Will they last a long time?
Do they need a lot of maintenance?

- Cover the basic properties of the materials listed in the unit.
- Show examples of each material and discuss where it would be used.
- Write a list on the chalkboard of the many uses for each material.
- Ask the learners for their suggestions and write up their answers.

Background knowledge

Wood – The type of wood most commonly used in the construction industry is pine. This is because it is readily available, grows quickly and is cheaper than hardwoods.
Steel – There are many different types of steel. The quality, strength and properties of the different steels depend on the different elements which are added to the iron ore in the smelting process. In this production process the molten metal can be formed into different shape and sizes.
Concrete – Mixing cement, sand, and small stones is the basic mixture for concrete. When water is added a chemical reaction takes place which causes the cement to bond the sand and stone together. A common mixture for concrete is one part of cement, three parts of sand and three parts of stones.
Plastic – Plastics are used widely in the construction industry for items such as drain pipes, gutters, and window frames. Polystyrene is an excellent insulation material for keeping out the heat.
Composites - These are more modern materials made by combining resins with glass fibres. They are light and strong and can be easily moulded. The most common composite that learners may have heard about is fibreglass, used to build boats and repair damaged car bodies.

Activity 1 **Conduct a materials survey** Learner's Book page 34

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 4 – 5.
- This is an activity that the learners can do during break time or after school.
- It is important that they begin to recognise common materials and to see where they are used.
- Some learners will discover more materials than others, so once the activity has finished share the lists during the next lesson.

Assessment guidelines

- This activity is intended for informal assessment.
- What can the learners assess?
- Can the learners work effectively by themselves?
- Can the learners recognise the different materials?

Activity 2 **Complete a word search** Learner's Book page 35

Guidelines to implement this activity

- This is an individual activity.
- Learners read through the text on page 32 to complete the word search.

Suggested answers

- A measurement of mass is measured in units known as Newtons.
- Load relates to the weight of an object on a structure.
- The weight of an object pushing down on the earth is a static force.
- Forces which result in movement are dynamic forces.
- The force which causes an object to fall to the ground is gravity.
- A force which stretches a structural member is known as tension.
- A force which causes movement backwards and forwards is called a bending force.
- Cars crashing into a solid object are an example of impact.
- Another term for corrosion in metal is rust.
- Galvanised steel has been coated with zinc.
- A dynamic test moves and twists the structural member in order to test for fatigue.
- The point where a material begins to change its shape is known as the yield point.
- Density refers to the relationship between weight and volume.

D	Y	N	A	M	I	C				F
Y			B							A
I		D	E	N	S	I	T	Y		T
E			N	E	W	T	O	N	S	I
L	O	A	D							G
D			I	M	P	A	C	T		U
			N							E
			G	R	A	V	I	T	Y	Z
			H	U						I
	T	E	N	S	I	O	N			N
				T	S	T	A	T	I	C

Assessment guidelines

- This activity is intended for informal assessment
- Use the suggested answer above and give the learners marks out of 13.

Term 1 Mini Practical Assessment Task

Learner's Book pages 37 -- 39

Overview

The scenario set for this practical assessment task states that the learners are to design a structure that will solve a problem facing a community living on the other side of a river from the city. The local authority places an advertisement inviting contractors to submit tenders for a solution. The learners are to act as 'Contracting Companies' which will compete for the contract to solve the problem.

Teaching guidelines

Teams must be selected with carefully designed roles for every learner. It is therefore suggested that you divide the class into groups of four with each learner taking one of the following roles:

- a designer
- a quantity surveyor
- a planner
- an environmentalist

Although each member of the group has a specific role they must all be involved in the process of designing solutions and compiling the final report and posters.

The Designer's role

The designer is responsible for drawing up the final sketches and any drawings for presentation to the public and to the tender board. These drawing will latter become the working drawings for the construction team.

The Quantity Surveyor's role

The quantity surveyor is responsible for the initial costing of the project which includes the provision of materials, labour and any machinery which may need to be hired. They also need to include the amount of profit which the company wants to make. Once a project has started a quantity surveyor keeps a close check on the cost to make sure that they are not exceeding the budget.

The Planner's role

The project planner looks at the daily progress that needs to be made in order to complete a project. They need to predict how long each stage will take. They need to

consider when different materials need to be ordered so that there is no delay in construction and they need to indicate exactly when the project is to be completed. The time factor will be affected by the time of year, weather patterns and any possibility of flooding. They should draw up a flow chart to include all these details.

The Environmentalist's role

Many people today are concerned about the environment. People are concerned about pollution of rivers, the destruction of existing trees and the visual damage caused by buildings and structures on the rural landscape. The presentation will need to explain how the proposal is going to limit these effects. In all outdoor engineering projects it is a requirement to submit an Environmental Impact Assessment (EIA).

Introducing the project

The newspaper article is a genuine story published in the *Times* newspaper dated 26 March 2012. Many similar stories are regularly published and you may know of similar situations in your area. Read through the account with your learners and discuss the issues with them. You might even touch on the historical background to communities being separated by distance from access to even small towns. Are these situations being corrected in the new South Africa? Whose responsibility is it? Are there simple solutions?

TIP!

If you want to get a good standard of work from your students you need to keep checking on their progress as a group. Are all participating? Are they working through each stage as laid out in the textbook? Learners are often tempted to skip what they consider non - essential and put all their efforts into making a model. The reports and evaluation of ideas are important stages, so ask to see each group's work as the project progresses. In this way you can give them any guidance which they may need.

Activity 1 **Investigate possible solutions** Learner's Book page 36

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 4 - 5.
- The first task for the team is to decide which role reach person should take.
- Decide on a name for the company and a logo which will be included on the design drawings, models and any letterheads.
- Brainstorm possible solutions and draw up a list of possibilities.

Investigation

- Investigation is part of the initial planning stage. There are a number of questions listed in the textbook to guide their thinking.
- It will also involve looking at the map and you may need to help your learners interpret some of the details on the map.

Assessment guidelines

This activity is not intended for assessment; it just gives learners the opportunity to generate ideas.

Activity 2 **Sketch, evaluate and adapt** Learner's Book page 36

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 4 - 5.
- Make sketches of two ideas.
- Learners discuss their initial ideas in a group.
- Learners choose one of these designs to make.
- Free-hand sketching is the best way to develop design solutions.
- Learners are often tempted to come up with just one idea and then feel that they have the solution.
- You should encourage them to develop many ideas.
- If each learner in the group sketches two ideas they can then discuss these and evaluate the best solutions.
- Their final solution may well be a combination of two or three ideas.

Assessment guidelines

- Use the rubric below to assess the learners' sketches.

Mark allocation Assessment criteria	1	2	3-5
Sketched two ideas (6 marks)			
Added headings and labels (2 marks)			
Made a list of all possible improvements and advantages (6 marks)			
Sketches are neat and complete (2 marks)			

[20 marks]

Evaluate

Before they develop solutions learners must discuss how they will be evaluated. Each group must draw up a list of criteria such as:

- Does the solution meet the requirements as stated in the scenario?
- Is the solution reasonably easy to build?
- Is the solution safe to use?

Activity 3 A design brief, a flow chart and working drawings

Learner's Book page 37

Guidelines to implement this activity

- Learners need to write a detailed design brief complete with specifications and constraints.
- The details for the design brief are given in the textbook. Draw the learners' attention to these and guide the groups where necessary.
- Environmental Impact Assessment report. It is important that learners realise that any development has an effect on the world we live in. In all big construction projects the EIA report plays an important role as to whether the project will be developed further.
- Learners must show how their solution will be manufactured in a flow chart.
- Learners must provide working drawings for their design including a first-angle orthographic drawing (see Learner's Book page 14).

[5 marks]

Activity 4 Cost your solution and make a model

Learner's Book page 37

Costing

It is difficult to give specific cost guidelines as these will vary from area to area. The following is an indication of the minimum hourly rate paid in the construction industry and updated in December 2012.

Quantity Surveyor	R100.00
Construction Labourer	R22.00
Safety Officer	R60.00
Bricklayer	R26.00
Construction Foreman	R31.25
Construction Manager	R250.00
Carpenter	R28.65

The costing of the materials required to build their solution will depend on the materials being used. Are they building using wood, steel, steel cables, brickwork, concrete, concrete pipes, etc. Learners could phone a local supplier to get an indication of the costs of the materials they intend to use.
In order to present a final tender the group should consider:

- The cost of materials needed.
- The cost of labour to manufacture the equipment.
- The profit required by the company carrying out the work.

Model making

- Before learners start to make their models they should complete any drawings required. They should be of a good standard and use the correct type of line work and projections.
- Once the drawings are completed the model can be built. This is a team project and only one model needs to be built. The model is built to the same scale as used for the drawings.
- You will need to make sure that the teams have a supply of materials such as: drinking straws, cardboard, string, glue, wire, empty containers, plastic and modelling clay.

Assessment guidelines

- Use the rubric below to assess the learners.
- Because amounts and contractors will differ, use your own discretion when assessing the work.

Mark allocation Assessment criteria	1	2	3-5
Neatly presented budget (5 marks)			
Budget includes contractors (5 marks)			
Budget includes costs and totals (5 marks)			
Model is built neatly (5 marks)			
Model is built according to the scale of the working drawings (5 marks)			

[25 marks]

Activity 5 Presenting your ideas to the class

Learner's Book page 150

Guidelines to implement this activity

- This activity is not intended for assessment.
- This allows learners to advertise and discuss their product with the rest of the class.
- All team members have to take part in the presentation. If you assigned a role to each person in the group then they can take on that role for their presentation.
- The Designer presents the working drawings, indicating how the team came to choose their particular solution. The designer therefore points out the merits of their design.
- The Quantity Surveyor will present an estimate of the cost involved. This is based on the cost of material and the cost of labour to build the system. It also includes the profit required from the project.
- The Planners should present an input, process, output diagram. This diagram can be expanded into a flow diagram to show the timeline for the construction process.
- The Environmentalist should present the EIA report and be open to answer any questions on their findings.

Mini-PAT total: 70 marks

Term 1 Exemplar test – memorandum

Learner's Book page 40

Question 1

A static test does not involve movement. Subjecting a beam to a load would be a static test.

A dynamic test involves bending material backwards and forwards. Breaking a paper clip by bending it is a dynamic test. (5)

Question 2

Answers in **bold:**

2.1 Weight is the force of **gravity** on an object.

2.2 Wooden beams made from strips of wood glued together are called **laminated** beams.

2.3 Compression in a structure **squeezes** the parts together.

2.4 The ability of a structural member to remain the same shape without bending refers to its **stiffness.**

2.5 Another name for rust is **corrosion.** (5)

Question 3

3.1 **50 mm**

3.2 In a spring experiment, the results were:

Load (Newtons)	0	1	2	3	4	5	6	7
Length (mm)	50	58	70	74	82	90	102	125
Extension (mm)	0	8	20	24	32	40	52	73

3.3 **The 70 mm length is incorrect; it should be 66 mm (proportionality is 8)**

3.4 **3,75 N**

3.5 **86 mm** (8)

Question 4

Write a letter to the local paper stating why you feel it is important that the construction company building the new bridge at Hope's Drift consider the environmental issues. **The teacher will need to use his or her judgement as to the points made in the letter**. (6)

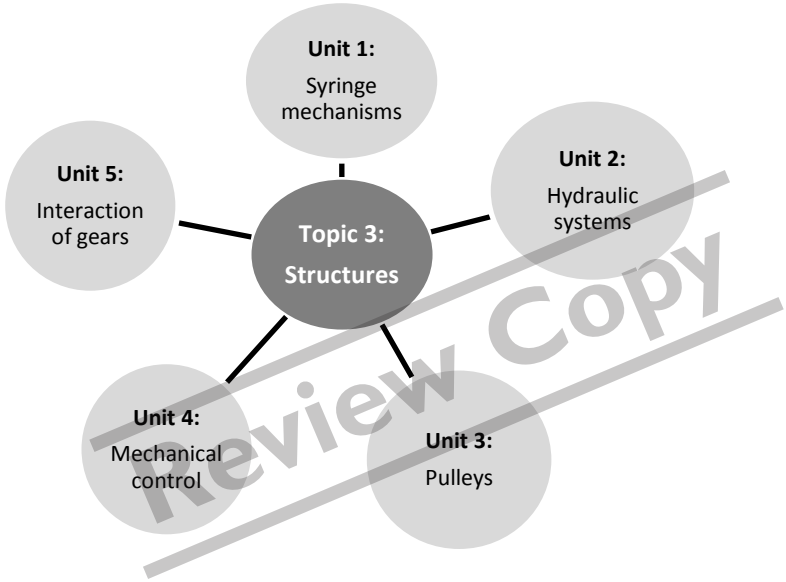
Question 5

Make sure learners' designs include forms of structural strengthening and support like triangulators, struts and ties. (6)

Total: 30 marks

Topic 3 Mechanical systems and control

Core concepts covered



Topic overview

- In this topic learners will learn about pneumatic and hydraulic systems. They will be introduced to Pascal's principle and how to calculate the mechanical advantage of pneumatic and hydraulic systems.
- The learners will discover what pulley systems are and learn about the different types.
- They will be introduced to the braking systems of vehicles and finally discuss the interaction of gears. This topic ends with a formal Mini-PAT.

Content

Unit	Content	Pacing (time allocation)	LB page
1	Syringe mechanisms	2 hours	42-45
2	Hydraulic systems	2 hours	46-49
3	Pulleys	1 hour	50-53
4	Mechanical control systems	1 hour	54-59
5	Interaction of gears	2 hours	60-63
6	Design skills	2 hours	64-68
	Mini-PAT	7 hours	70-71

Unit 1 Syringe mechanisms

Learner's Book pages 42- 45

Unit overview

In this unit the learners will:

- learn about pneumatic systems
- learn about hydraulic systems
- learn about Pascal's principle
- learn how to calculate the mechanical advantage of pneumatic and hydraulic systems.

Teaching guidelines

- Introduce this topic by asking how many of the learners are keen on weight lifting.
- Ask one of them to demonstrate their strength by lifting a heavy load from the floor to the table.
- If group activities are not able to occur, you can turn the activities into demonstration lessons.

Activity 1 Compare a pneumatic and a hydraulic system

Learner's Book page 42

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 - 4.
- Demonstrate the pneumatic system to your class so that they can see how to connect the equipment correctly.

- Explain how the pressure applied to the end of one syringe pushes out the piston on the other syringe.
- Also mention how this is not an immediate reaction, there is a 'spongy' feel to the system as the pressure builds up before the piston starts to move.
- Even though you have demonstrated the system the learners should assemble the pneumatic system for themselves so that they feel how the system works.
- Once they have completed the first part they can fill the system with water to test the hydraulic system.
- Once the groups have tried out the two systems, discuss what they discovered. Stress the technical terms of Master cylinder or Master piston and the Slave cylinder or piston.

Safety aspect

You will need to be very firm about learners not using the syringes to squirt water at each other. Remind them of the safety aspect of all the practical work. Point out that although they may feel that their actions might be fun, there is a danger of others slipping and being hurt.

Assessment guidelines

- This activity is not intended for assessment.
- This is a demonstration/group investigation.

Activity 2 **Compare a hydraulic system with syringes of different sizes** Learner's Book page 43

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 - 4.
- The process is very similar to the first activity but the sizes of the Master cylinder and Slave cylinder are different.
- Once again, once the groups have finished, discuss what they have discovered from this activity.

Background knowledge

Pascal's principle

The formula force = pressure × area is important for understanding how to calculate the mechanical advantage of this type of system. It is also important that the learners

understand that the pressure in the system is the same throughout the system. It is the surface area of the pistons that affects the amount of force transferred.

Therefore the mechanical advantage = $\frac{\text{area of output piston}}{\text{area of input piston}}$

Assessment guidelines

- This activity is intended for informal assessment.
- What can you assess?
- Can the learners work well together as a group?
- Can they explain what they have learnt?
- Can they identify where this type of system might be used?

Challenge: Make a useful system

Learner's Book page 45

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 - 4.
- The picture on page 45 of the Learner's Book gives an idea for making a mechanical arm using syringes and tubing. The learners could make this model or if they are really creative they could try to design a model themselves.
- The design is for a hydraulically operated "Poop Scoop" to pick up dog droppings from the school field before the soccer game or at the local park.
- Using the principles learnt in this unit the learners could build a model.
- The model built will depend on the skill of the learners.

Assessment guidelines

- This activity is not intended for assessment.
- What can you assess?
- Can the learners demonstrate this principle at work in their model?

Unit 2 Hydraulic systems

Learner's Book pages 46 - 49

Unit overview

In this unit the learners will:

- learn about hydraulic systems
- learn about the hydraulic car jack
- learn how to calculate the loads lifted by hydraulic systems.

Teaching guidelines

- Start by reviewing what the learners found out in Unit 1.
- Explain again the difference between the two systems.
- The pneumatic drill is an excellent example of the use of compressed air to drive a tool.
- The spongy effect of the system absorbs the shock to the hands and arms of the operator.

Background knowledge

The car braking system uses the hydraulic system, as pressure is needed immediately the foot is put on the pedal. If a car's brakes appear to be spongy it is because air has got into the system and this needs to be corrected by a mechanic. Some learners may pick up on the fact that in Unit 1 it was mentioned that some brake systems are pneumatic systems. This is true, but the air pressure is used to hold back powerful springs, which are released when the brake is applied, and this action causes the brake pads to be applied.

TIP! While talking about the pneumatic drill it is an excellent opportunity to stress safety aspects of the work environment. All operators of noisy equipment should wear ear protection, otherwise the constant noise will damage their hearing.

Activity 1 **Investigate the hydraulic jack** Learner's Book page 48

Guidelines to implement this activity

- This is an individual activity.
- Discuss each investigation step with the learners.

Suggested answers

The answers of the learners will differ as they are asked to investigate and give their own opinions.

The input, process, output system would be:

Input – pressure applied to the fluid in the master cylinder.
Process fluid flows into the slave cylinder pushing up the slave piston.
Output – car lifted off the ground.

What type of lever is AC? – second-class lever.
How much force does lever X exert on the master cylinder?

$$10\ N \times 330 = 30 \times X \quad \rightarrow \quad 3\ 300\ N = 30\ X \quad \rightarrow \quad X = \frac{3\ 300}{30}$$

Force at X = 110 N

What is the load that can be lifted by this system?
The slave piston is 7 times the area of the master piston therefore it will lift 7 times the force applied to the master cylinder.
110 N x 7 = 770 N

Assessment guidelines

- This activity is intended for informal assessment.
- Use the suggested answers above to assess learners.

Unit 3 Pulley systems

Learner's Book pages 50 - 53

Unit overview

In this unit the learners will:

- learn about a single-pulley system.
- learn about a two-pulley system.

- learn about a three-pulley system.
- learn about a chain hoist system.

Teaching guidelines

- You can obtain pulleys commercially either from a supplier of science equipment or from a hardware store which will supply pulleys used for window blinds.
- However, you can make your own using empty cotton reels.
- For the single-pulley system you can simply use a broom handle.

Background knowledge

- The single-pulley system gives no mechanical advantage. The effort put in will be the same as the load which is lifted.
- It is easier to lift a load when a rope goes round two pulleys. Because two ropes are pulling the load, the effort needed is only about half as much as the load.
- The more pulleys we use the easier it is to lift the load.
- Large cranes use multiple pulleys and can therefore lift extremely heavy loads.

Activity 1 **Test an idea** Learner's Book page 51

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 - 4.
- Each group will need: a bucket half-filled with sand, a rope and a broom handle
- Half fill the bucket with sand.
- Explain each step to the groups.

Assessment guidelines

- This activity is not intended for assessment.
- Observe learners as they test the one-pulley system.

Activity 2 **Test a two-pulley system** Learner's Book page 52

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 - 4.

- Each group will need: 2 cotton reels, 4 dowels rods about 100 mm long, some string, a small empty tin or plastic container, some corrugated cardboard.
- Explain each step to the groups.

Assessment guidelines

- This activity is not intended for assessment.
- Observe learners as they test the two-pulley system.
- Can the learners work well together in a group?
- Can the learners follow the visual instruction in order to make the model?
- Can the learners explain how the system works and why it gives a mechanical advantage?
- Can learners give other examples where pulleys are used?

Unit 4 Mechanical control systems

Learner's Book pages 54 - 59

Unit overview

In this unit the learners will:

- learn about the ratchet and pawl and its various applications
- learn about the braking system for a car
- learn about the braking system for a bicycle
- learn about three different types of cleats.

Teaching guidelines

- We have looked at various mechanisms that help increase the speed or decrease it, or systems to increase the lifting power, and mechanisms that help to give a mechanical advantage.
- Now we turn our attention to methods of stopping or restricting the movement.

Background knowledge

Ratchet and pawl

This mechanism stops movement in one direction only. It is extremely simple but because it is often enclosed inside a casing it is not easily seen. It is used in various tools such as the carpenter's brace and the socket spanner wrench. It is used in many different applications. Here are some examples: turnstile mechanisms, tension control units for car seat-belts, brake levers on cars, fishing reels and winch machines.

Challenge: Discover how a handbrake works

Learner's Book page 55

Guidelines to implement this activity

- This is an individual activity.
- Leaners have to view the website and draw a basic sketch of the parking handbrake system (http://4mechanical.com/important-to-use-parking-brake.html)
- If possible, try and get hold of and old car handbrake.

Assessment guidelines

- This activity is not intended for assessment.
- Observe learners as they investigate the handbrake system.

Activity 1 Test the effectiveness of a bicycle braking system

Learner's Book page 57

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 4 - 5.
- The learners will need to do a number of runs to get an accurate assessment of the effectiveness of their bicycle brakes.
- The reason for this is the speed will not always be constant and they may be tempted to apply the brake before the line.
- Be aware of safety aspects and insist that those riding the bicycles wear a helmet.

Assessment guidelines

- This activity is intended for informal assessment.
- What can you assess?
- Can the learners carry out this test in an orderly manner?
- Can the learners tabulate results correctly?
- Can the learners evaluate the results they obtained?

Activity 2 Write a report

Learner's Book page 58

Guidelines to implement this activity

- This is an individual activity.

- The learners must write a report explaining how the brake system works and where it is applied.

Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess learners informally.

Criteria The learner:	Yes	Partly	No
Wrote a good report on how the braking system works			
Understands where the braking system is applied			
Is familiar with the new vocabulary			

Activity 3 **Design a broom rack** Learner's Book page 59

Guidelines to implement this activity

- This is an individual activity.
- Each learner needs to design his or her own product.
- A neat sketch must be drawn with labels and a heading.

Suggested answers

- The teacher will need to assess each learners answer as there will be different solutions to this problem.

Assessment guidelines

- This activity is intended for informal assessment.

Use the checklist below to assess learners informally.

Criteria The learner:	No	Partly	Yes
Came up with a working design			
Drew neat sketches of the design			
Drew different views of the design			
Added a heading and labels			

Unit 5 Interaction of gears

Learner's Book pages 60 - 63

Unit overview

In this unit the learners will:

- learn about the spur gear
- learn about bevel gears
- learn about the rack and pinion gear
- learn about worm gears.

Teaching guidelines

- Gears are very useful and are used in many types of machines. They are like wheels in contact with each other. However, because the teeth are meshed together, they do not slip as wheels would be likely to do.
- Another advantage is that it is easy to reduce friction between gears with grease or oil.
- The secret of understanding how gears work is that they are like two separate levers in contact with each other.
- Where the gears make contact the force that they exert on each other is the same.
- This means that the gear with the larger radius (more teeth) experiences a larger torque than the smaller one.
- The drawings in the textbook show that gears meshed together turn in opposite directions.
- Explain how by using a small idler gear between two gears you can make them turn in the same direction.
- The idler gear is driven by the driver gear; it is not directly connected to the motor or driving force.

Background knowledge

- Torque = force x shortest distance of force from the pivot.
- If the force is the same, then the gear that has teeth furthest from the pivot has more torque. This means that for different sized gears in contact with others, the input torque (on the driver gear) and the output torque (on the driven gear) are not the same.

Unit 6 Design skills

Learner's Book pages 64 - 68

Unit overview

In this unit the learners will:

- investigate and evaluate the design of household item
- practise artistic drawings

Activity 1 Evaluate mechanical systems

Learner's Book page 64

Guidelines to implement this activity

- This is an individual activity.
- Ask learners to look around their kitchens at home and the workshop at school to find items which use the mechanical systems we have been talking about. They might find items that use levers such as pliers, cutters, wire strippers, vice grips or scissors. Then there are tools which use gears, such as egg-beaters, can openers and electric two-speed drills.
- Learners find as many items as they can and compile a list under the following headings:

Tool	What's it for?	Who's it for?	What material is it made of?	Is it safe to use?	Does it work well?	Does it look good?
Can opener	Opening tin food cans.	Anyone who cooks food.	Chromed steel.	Yes	Not always.	No. The design could be improved.

Assessment guidelines

- This activity is not intended for assessment.

Activity 2 Communicate your findings

Learner's Book page 58

Guidelines to implement this activity

- This is an individual activity.

- Each learner chooses three of the tools in his/her table and writes a report based on the details under the headings of the table.
- Learners who feel that the design can be improved, can make a sketch of some of their ideas.

Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess learners informally.

Criteria The learner:	No	Partly	Yes
Chose three tools			
Wrote a detailed report on the three chosen tools			
Made suggestions for possible improvements			
Made neat, labelled sketches of their suggestions			

Mini Practical Assessment Task

Learner's Book pages 70-71

Overview

Learners need to follow the technological process of investigating, designing, making, evaluating and communicating to complete this mini-PAT. They will need to design and build a prototype of an automated ferris wheel or merry-go-round.

Teaching guidelines

- Explain each activity to the learners to make sure they understand what is expected of them.
- Do not give too much information and examples as the learners are in Grade 9 and have completed many mini-PATs before.

Activity 1 Investigate the situation

Learner's Book page 70

- This activity is not intended for assessment.
- The learners need to investigate the situation and the nature of the need so that they can come up with ideas to develop an appropriate device.

Activity 2 Write a design brief

Learner's Book page 70

1 Design and create ✓a prototype of an automated ferris wheel, or a merry-go-round. ✓Your design must be cost-effective and must have a built-in safety feature. ✓The prototype and designs will be used in a presentation ✓to convince the government to contract your team. ✓

[5 marks]

Activity 3 Draw sketches

Learner's Book page 71

Use the rubric below to assess the learners' sketches:

Mark allocations	1	2	3-5
Assessment criteria			
2 sketches of possible ideas (6 marks)			
Added labels and a heading (5 marks)			
Ideas are viable solutions (6 marks)			
Sketches are neat (4 marks)			
Safety feature is included (4 marks)			

[25 marks]

- The members of each team now gather to discuss their designs and ideas.
- They will need to decide on the best solution and develop that idea as their final solution.

Activity 4 Draw a plan

Learner's Book page 71

Use the rubric below to assess the learners.

Mark allocation	1	2	3-5
Assessment criteria			
Device plan drawn in first-angle orthographic projection (6 marks)			
3D assembly drawing (6 marks)			
Labels and heading included (4 marks)			
Team created a final working drawing (4 marks)			

[20 marks]

Activity 5 Make a working prototype

Learner's Book page 71

Use the rubric below to assess the learners.

Mark allocation	1	2	3-5
Assessment criteria			

Prototype is according to final design (6 marks)			
Prototype is neat and attractive (3 marks)			
Prototype is fully functional and according to scale (6 marks)			

[15 marks]

Activity 6 **Present your solution** Learner's Book page 71

Use the rubric below to assess learners.

Mark allocations	1	2	3-5
Assessment criteria			
Presentation includes all necessary materials and drawings and is presented well			

[5 marks]

Total mini-PAT: 70 marks

Term 2 Exemplar Test - Memorandum

Learner's Book pages 72

Question 1

1.1 A pulley is just a wheel✓ with a groove ✓cut in its edge. A pulley system consists of a pulley wheel or wheels with a rope passing over them. ✓ When the rope is pulled the direction of the pull is changed from a downward pull to a lifting action. A combination of two or more pulleys working together reduces the force needed to lift the load. ✓ Pulleys are used on cranes that lift heavy loads. They are also used to raise and lower a flag on a flagpole, by mechanics to lift engines out of cars, and in elevator systems to raise the lift. ✓ (5)

1.2 A system that uses more than two pulleys is known as a block and tackle system. ✓ We know we use half the effort if we use two pulleys. Using more pulleys will reduce the amount of effort needed even more. ✓ A block and tackle pulley system is commonly used at the lifting end of the cable on a crane to enable the crane to lift very heavy loads. ✓ (3)

[8]

Question 2

2.1 The chain hoist consists of an endless chain looped over sprocket wheels. ✓The two top wheels are different sizes - effectively, they are a gearing system. The different ratio of these gears will reduce the effort needed to lift the load. ✓ When someone pulls down on the chain the smaller gear will turn. The larger

wheel pulls more chain over it than the smaller wheel. One advantage of this system is that the load remains still unless the chain is moved. ✓ (3)

Question 3

3.1 A ratchet is a wheel with saw-shaped teeth round its rim. ✓ The pawl is a tooth-shaped lever which is pivoted✓ so that it slides over the saw-shaped teeth when they turn in one ✓direction but drops into the slot between the teeth when it is turned in the other ✓direction. (4)

3.2 A hand-operated winch used to pull a boat out of the sea. ✓ The gearing system winds a strong cable around a drum and to prevent ✓the boat from sliding back, a pawl engages in the ratchet so that the drum cannot rotate in the opposite direction.✓ By releasing the pawl the boat can be slowly returned to the sea. ✓(4)

[8]

Question 4

A calliper is the frame around the edge of the disk brake that includes the brake pads and the hydraulic pistons. ✓✓

(2)

Question 5

Bevel gears✓ are sometimes known as crown and pinion gears. The two gears intermesh at an angle and are useful when the direction of a shaft's rotation needs to be changed. ✓They are usually mounted on shafts that are at 90° angles to each other. ✓

Rack and pinion gears✓ are used to convert a rotational movement into linear motion. They are the type of gears used to open and close sliding security gates. ✓ The rack is a straight steel bar with teeth cut along one edge. ✓This bar is fixed to the frame of the gate.

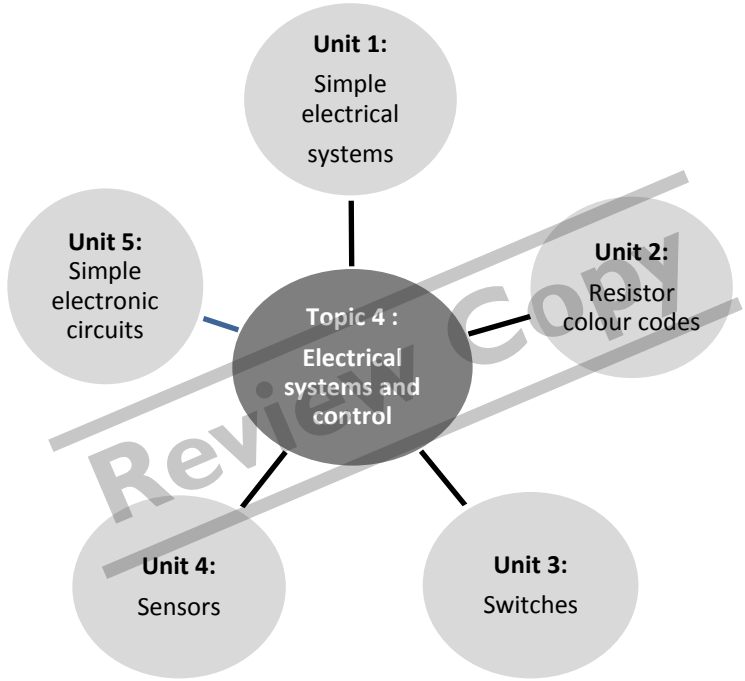
Worm gears ✓are used when large gear reductions are needed. This means that the input speed may be high but the output speed is low. The worm gear is cut on a rotating shaft and engages with a spur gear. ✓As the shaft rotates the spur gear turns with less speed because of its large diameter but with greater force. ✓

(3x3=9)

Total: 30 marks

Topic 4 Electrical systems and control

Core concepts covered



Topic overview

Learners will build circuits and draw diagrams using components that are known to them as well as new components that will be introduced. This topic will explain components such as switches, sensors and LEDs. The mini-PAT at the end will enable learners to design and make a working product using various electrical components for a specific function.

Content

Unit	Content	Pacing (time allocation)	LB page
1	Simple electrical systems	2 hours	74-80
2	Resistor colour codes	2 hours	81-82
3	Switches	2 hours	83-84
4	Sensors	2 hours	85-87
	Mini-PAT	8 hours	92-90

Unit 1 Simple electrical systems

Learner's Book pages 74 - 80

Unit overview

Learners will revise component symbols used in simple electrical systems. They will revise components connected in series and in parallel. The learners will do Ohm's law quantitatively and apply it in an action research.

Teaching guidelines

- Do not spend too much time on revision as learners should know this by now.
- Do not go into too much detail for Ohm's law, only do the necessary for the action research.
- Use concrete examples and supply learners with the needed components in the practical activities.

Activity 1 **Build a simple circuit** Learner's Book page 77

Guidelines to implement this activity

- This is a paired activity.
- Make sure you have enough components for each pair of learners.
- Have a class discussion about the difference between parallel and series circuits before they start.

Assessment guidelines

- This activity is not intended for assessment.

- Learners need to draw their circuit diagrams using the correct symbols. Remind them that there is a table of symbols at the back of the Learner's Book.

Activity 2 **Investigate logic** Learner's Book page 78

Guidelines to implement this activity

- This is an individual activity.
- Learners read through the information on logic gates in the Learner's Book.
- Learners are required to write their own definitions for the two logic gates and give their own examples.

Background knowledge

Truth tables

Truth tables help us to summarise systems that use logic. We deal with two inputs in the simplest of these systems. Each input could be ON or OFF. There are four states the circuit can be in. Look at Tables 1 and 2.

Table 1 Truth table for AND gate circuit

	input		output
	Switch 1	Switch 2	Lamp is:
1	off	off	Off
2	on	off	Off
3	off	on	Off
4	on	on	On

Table 2 Truth table for OR gate circuit

	input		output
	Switch 1	Switch 2	Lamp is:
1	off	off	Off
2	on	off	On
3	off	on	On
4	on	on	On

Suggested answers

OR switches: When two switches are in parallel, if either switch is on the circuit is completed. ✓✓

AND switches: To get an output, all switches need to be closed in the circuit. ✓✓

Allocate 1 mark for every good example given.

Assessment guidelines

- This activity is intended for informal assessment.
- Use the suggested answers supplied above to assess learners informally. Allocate learners a mark out of 10 and give them feedback on their performance to prepare them for formal assessment.

Activity 3 **Test Ohm's law** Learner's Book page 79

Guidelines to implement this activity

- This is a pair activity.
- Supply each pair with: cells, lamp, conductors, voltmeter, ammeter.
- If you do not have enough resources, demonstrate the activity to the class or ask a few learners to come forward and demonstrate it.

Assessment guidelines

- This activity is not intended for assessment.
- Learners need to copy and complete the table by writing in the data they obtain from testing the different circuits they have built.

Unit 2 Resistor colour codes

Learner's Book pages 81 - 82

Unit overview

In this unit the learners will investigate potential difference, current and resistance. They will learn about resistor codes and tolerances and use this knowledge to calculate value ranges of resistors.

Teaching guidelines

- Discuss why the values on resistors are important and why they use colour codes to identify the values.
- Obtain working examples of resistors and demonstrate to the learners how they should be connected in an electrical circuit.
- Assist the learners if necessary while they are building circuits and incorporating different types of resistors.

Activity 1 Investigate potential difference, current and resistance

Learner's Book page 81

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 - 4.
- The learners need to build each of the required circuits using the available resources and they should each write a short conclusion on what they have discovered.
- Supply the learners with: cells, lamp, conductors, steel wool.

Assessment guidelines

- This activity is intended for informal assessment.
- Use the rubric below to assess learners and give them feedback to prepare them for the final exam.

Mark allocations	1-2	3-4	5
Assessment criteria			
Built each one of the circuits (5 marks)			
Wrote a well-structured statement (5 marks)			
Conclusion on the relationship between potential difference, current and resistance (5 marks)			

[15 marks]

Activity 2 Use the resistance code and the tolerances to calculate value range

Learner's Book page 82

Guidelines to implement this activity

- This is an individual activity
- Learners should use the table of the colour codes to work out the value ranges of each of the given resistors.

Suggested answers

1	grey green blue gold	= 85 000 000 Ω	✓	5% tolerance ✓
2	red black red silver	= 2 000 Ω	✓	10% tolerance ✓
3	orange yellow brown silver	= 340 Ω	✓	10% tolerance ✓
4	brown black green red	= 1 000 000 Ω	✓	2% tolerance ✓
5	red red red silver	= 2 200 Ω	✓	10% tolerance✓

[10 marks]

Assessment guidelines

- This activity is intended for informal assessment.
- Use the memorandum above and give the learners a mark out of 10.
- Learners should do all corrections where needed.

Unit 3 Switches

Learner's Book pages 83 - 84

Unit overview

In this unit learners will investigate logic, learn about LEDs and transistors, connect a simple LED circuit and connect a simple transistor circuit.

Teaching guidelines

- Do not spend much time on the revision as learners should know this by now.
- Do not go into too much detail, the learners only need to build and investigate simple circuits using the new components.
- Use concrete examples and supply learners with the needed components in the practical activities.

Activity 1 Connect a simple LED circuit

Learner's Book page 84

Guidelines to implement this activity

- This is a pair activity.
- Learners have to build a simple series circuit using the given components and conductors.
- After building a working LED circuit, they will have to draw a diagram of their circuit using the correct conventions and symbols.

Assessment guidelines

- This activity is not intended for assessment.
- Make sure that each learner drew a circuit diagram.

Activity 2 **Connect a simple transistor circuit** Learner's Book page 84

Guidelines to implement this activity

- This is a pair activity.
- Learners have to add a transistor to the circuit they built in Activity 1.
- After building a working transistor circuit, they will have to draw a diagram of their circuit using the correct conventions and symbols.

Assessment guidelines

- This activity is not intended for assessment.
- Make sure that each learner drew a circuit diagram and that they have come up with a reason for the changes in the brightness of the LED.

Unit 4 Sensors

Learner's Book pages 85 - 87

Unit overview

In this unit the learners will discover different kinds of sensors and summarise the many uses of sensors

Teaching guidelines

- Briefly discuss the different types of sensors in this unit.
- Use practical examples that the learners can relate to.
- Have a class discussion about the many uses of sensors and let the learners name examples of electronic devices that use sensors.
- Explain each activity thoroughly and demonstrate steps where needed.

Activity 1 **Test a thermistor** Learner's Book page 86

Guidelines to implement this activity

- This is a pair activity.
- The learners have to build a basic LED series circuit like the one they made in Unit 3
- The leaners have to add a thermistor.

- Allow them to use a hair dryer or any other device that can generate heat to heat up the thermistor.
- The learners will need to explain what happens once the thermistor is heated.

Assessment guidelines

- This activity is not intended for assessment.
- Turn the explanation into a class discussion to explain what the effect of the thermistor in the circuit is.

Activity 2 **Classifying sensors** Learner's Book page 87

Guidelines to implement this activity

- This is an individual activity
- Learners will need to study the information on the different types of sensors on pages 78 and 79 in the Learner's Book.
- Learners should draw up a table of comparison showing the different types of sensors, their function and real-life examples of where the sensors can be found.

Suggested answers

Sensor	Function	Example of device
LDR	When light falls on an LDR, the resistance changes dramatically	Own discretion
Thermistor	A thermistor is a component whose resistance varies with temperature	Own discretion
Tactile sensor	They are components that are sensitive to touch	Own discretion

Allocate one mark per cell and one mark for a neat and complete comparative table.

[10 marks]

Assessment guidelines

- This activity is intended for informal assessment.
- Use the suggested answers above to give learners a mark out of 10.
- This activity acts as a good summary for their final exams.

Activity 3	Building simple circuits	Learner's Book page 87

Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3 – 4.
- Learners have to build the requested circuits.
- Only assist if necessary.
- There are four circuits which they will need to build.

Assessment guidelines

- This activity is not intended for assessment.
- Make sure that each learner drew a circuit diagram.

Activity 4	Draw circuit diagrams	Learner's Book page 87

Guidelines to implement this activity

- This is an individual activity.
- Learners draw a diagram using the correct conventions and symbols for each of the four circuits built in Activity 1.

Assessment guidelines

This activity is intended for informal assessment.
Use the rubric below to assess learners informally and give them feedback to prepare them for the final exam.

Mark allocations	1-2	3-4	5
Assessment criteria			
Built each one of the circuits (5 marks)			
Drew a diagram for each one of the circuits (5 marks)			
Neat diagrams using the correct conventions and symbols (5 marks)			

[15 marks]

Term 3 Mini Practical Assessment Task

Learner's Book pages 89 - 90

Overview

Learners need to follow the technological process of designing, making, evaluating and communicating to complete this mini-PAT. They will need to design and build a small and portable LED flashlight.

Teaching guidelines

- Explain each activity to the learners to make sure they understand what is expected of them.

Activity 1 Solve a problem

Learner's Book page 89

- This activity is not intended for assessment.
- The learners need to investigate the situation and the nature of the need so that they can develop an appropriate device to solve the issue of the community.
- The circuit that the learners want to develop must be able to be incorporated into a device that meets the specifications.

Activity 2 Write a design brief and draw a circuit diagram and a sketch

Learner's Book page 89

1 + 2 Design an electronic product that functions as a flashlight ✓and that can also be used as a key ring. ✓ Your product must be small and compact ✓and the structure that holds the circuit must be made out of recycled material like a plastic lip gloss container. ✓Your flashlight must have both an LED and a tactile switch. ✓

[5 marks]

3. Use the rubric below to assess the circuit diagrams.

Mark allocations	1	2	3-5
Assessment criteria			
Used the correct symbols (10 marks)			
Added labels and a heading (2 marks)			
Diagram is neat and contains all necessary components (3 marks)			

[15 marks]

4. Use the rubric below to assess the 3D sketch.

Mark allocations	1	2	3-5
Assessment criteria			
Used the correct conventions (10 marks)			
Added labels and a heading (2 marks)			
Sketch has all the needed components (3 marks)			

[15 marks]

Activity 3 Decide on a final solution

Learner's Book page 90

- This activity is not intended for assessment.
- Each group has to evaluate all the sketches and 3D drawings and choose one that their team will use for the final product.

Activity 4 Make working drawings and a working model

Learner's Book page 90

Use the rubric below to assess the learners.

Mark allocation	1	2	3-5
Assessment criteria			
Device plan drawn in first-angle orthographic projection (6 marks)			
3D assembly drawing (6 marks)			
Labels and heading included (2 marks)			
Used available materials to assemble a working model (6 marks)			
Neat and functional model with correct components (5 marks)			

[25 marks]

Activity 5 Present your product

Learner's Book page 90

Use the rubric below to assess learners.

Mark allocations	1	2	3-5
Assessment criteria			
Presentation includes all necessary materials and drawings (5 marks)			
Product well presented (5 marks)			

[10 marks]

Total mini-PAT: 70 marks

Term 3 Exemplar test – memorandum

Learner's Book pages 91

Question 1

1.1 A switch is the most common circuit control device. ✓ Switches are used to control or direct current.✓ (2)

1.2 Switches are described by the number of poles ✓and throws they have. Pole refers to the number of circuits controlled by the switch.✓ (2)

1.3 SPST✓, SPDT✓, DPDT ✓ (3)

[7]

Question 2

AND: both conditions need to apply before current is allowed to pass. ✓✓

OR : One or the other needs to comply for a current to pass through. ✓✓ (4)

Question 3

Solder is a soft mix of metals which is melted between conductors in a circuit. ✓ Good soldered joints are small. ✓ In most electrical and electronic circuits, connections are made permanent by soldering. ✓ (3)

Question 4

Ohm's Law states that the amount of current passing through a conductor is directly proportional to the voltage across the conductor. ✓✓ For example, if the terminals of an electric battery are connected to an electric lamp and the voltage output of the battery is decreased by 20%, the amount of current flowing through the lamp will also be reduced by 20%.✓✓ (5)

Question 5

5.1 Resistors absorb power from a circuit and convert it into heat. ✓✓ (2)

5.2 The first band stands for the first digit of the value. ✓ The second band stands for the second digit of the value. ✓ The third band stands for the number of zeroes✓ after the first two digits. ✓ (4)

Question 6

LEDs are commonly used as output devices.

LED stands for Light Emitting Diode. ✓ An LED allows current to flow in one direction only ✓and also gives off light. It is often used as an indicator that a circuit is 'ON'. ✓

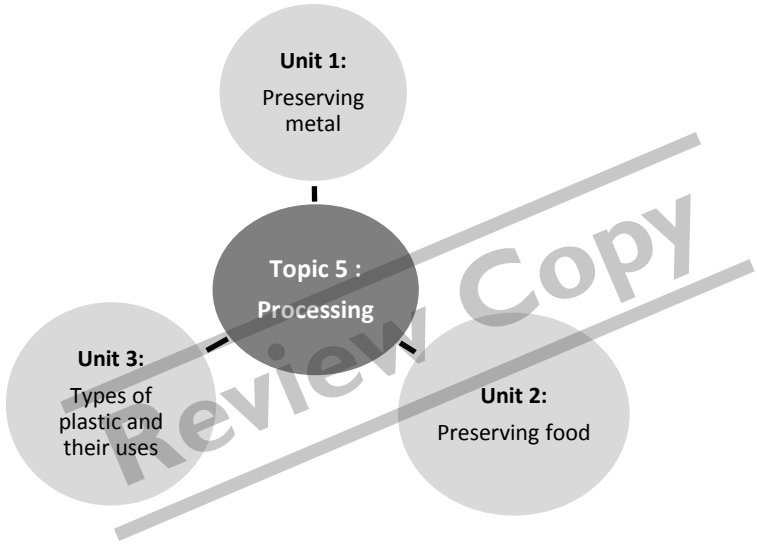
LEDs are used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances. ✓✓ (5)

Total: 30 marks

Section E Guidelines to teaching technology

Topic 5 Processing

Core concepts covered



Topic overview

Learners will engage with the idea of metal corrosion and the various methods used to prevent this damage. The learners will be introduced to different food preservation techniques and why plastics are so popular. They will investigate the environmental impact of plastics and how to reduce this impact. A mini-PAT will be completed at the end of the term.

Content

Unit	Content	Pacing (time allocation)	LB page
1	Preserving metal	2 hours	87-92
2	Preserving food	2 hours	93-97
3	Types of plastics and their uses	4 hours	98-107
	Mini-PAT	6 hours	108-110

The following activities in this strand are suitable for formal assessment:

Unit 1 Preserving metal

Learner's Book pages 93 - 98

Unit overview

- In this unit learners engage with the idea of metal corrosion. It is then explained how painting metal, electroplating and galvanising can control corrosion.
- In the Activity "Electroplate a steel nail" learners gain first-hand experience of the science involved and terminology needed.

Teaching guidelines

- Class teaching and discussion with reference to photos and text.
- Teacher demonstration of electroplating a steel nail.
- Use practical examples when explaining certain concepts and methods of preserving metals.
- Use examples that the learners can relate to.

Activity 1 **Electroplate a steel nail** Learner's Book page 97

Guidelines to implement this activity

- This is a group / demonstration activity.
- Divide the learners into groups of 4 – 5.
- Supply the groups with the following: a small glass container like a jam jar, a piece of heavy copper wire, a large steel nail that is long enough to stick out of the

container, 1 tablespoon of copper sulphate crystals, one or two 1,5 V batteries, 2 x 30 mm pieces of plastic-coated electric wire with an alligator clip at one end, a plastic or wooden stirrer for mixing the solution - not a metal teaspoon.

- Follow the steps very carefully and demonstrate each step before learners do the activity themselves.

Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess the groups.

Criteria	Yes	No
Steps		
Put a spoonful of copper sulphate into the container, add water, and stir until the copper sulphate dissolves		
Connect the +ve terminal of the battery to the nail, using the alligator clip. This will be the cathode (the part to be plated).		
Connect the -ve terminal to the copper wire using the alligator clip. This will be the anode (the metal to be plated on the part).		
Make sure the cathode and anode do not touch each other; ideally keep them about an inch apart.		

Unit 2 Preserving food

Learner's Book pages 99 - 103

Unit overview

- In this unit learners engage with the idea of preserving food by dry storage, pickling and drying.
- In the investigation, learners write a report for a class discussion to explain how different technologies stop the activity of micro-organisms.
- In the activity, learners have an opportunity to make their own simple sun dryer and then use it to produce three different sun-dried fruit or vegetable products. Learners make their own illustrated flow chart of their sun-drying process.

Teaching guidelines

- Class teaching and discussion with reference to photos and text.
- Teacher demonstration of creating a sun dryer.
- Use practical examples when explaining certain concepts and methods of preserving foods.
- Use examples that the learners can relate to.

Activity 1 **Investigate: indigenous knowledge systems**

Learner's Book page 100

Guidelines to implement this activity

- This is a group activity.
- Divide learners into groups of 3 - 4.
- The groups discuss three different modern technologies used to preserve foods.
- The groups write a report for a class discussion to explain how each technology stops the activity of micro-organisms.
- Learners discuss their findings with the other groups.

Assessment guidelines

This activity is intended for an informal class discussion.

Activity 2 **Draw a flow chart** Learner's Book page 101

Guidelines to implement this activity

- This is an individual activity.
- Learners make their own illustrated flow chart to show the sequence of manufacturing fermented pickled cucumbers.
- Refer to the photos and the recipe for brine-pickled cucumbers.

Assessment guidelines

This activity is intended for formal assessment.

Use the rubric below to assess learners.

Mark allocations	1-2	3-4	5
Assessment criteria			
Structure of flow chart (6 marks)			
Manufacturing sequence (6 marks)			
Logical layout (4 marks)			
Neatness (4 marks)			

[20 marks]

Activity 3 **Make your own sun-dried product** Learner's Book page 103

Guidelines to implement this activity

- This is a group activity.
- Divide learners into groups of 3 - 4.
- Learners need to produce an edible product and a flow chart to show the sequence of manufacturing.
- Discuss each step with the class.

Assessment guidelines

- This activity is intended for informal assessment.
- Learners should create a self-assessment rubric and complete it for informal assessment by the teacher.

Unit 3 Types of plastics and their uses

Learner's Book pages 104 - 113

Unit overview

- In this unit learners engage with the historical background of plastics development and a little of how their chemistry makes them so useful. Learners then have an opportunity to make their own plastic item at home. The learners will also engage with the properties of plastics. In the activity, learners use this knowledge to compare the properties of different containers.
- Learners will be introduced to the need to recycle plastic, reduce how much plastic we use and re-use plastic items when possible. They will discuss the technical details of recycling plastic in the specific case of polyethylene, or HDPE, more commonly known as polythene. This is done through a case study and an activity.

Teaching guidelines

- Class teaching and discussion with reference to photos and text.
- Use examples that the learners can relate to.

Activity 1	Work with polymers	Learner's Book page 105

Guidelines to implement this activity

- This is a group activity.
- Divide learners into groups of 3 - 4.
- Learners follow the steps to separate proteins from the milk by adding acid. .

Assessment guidelines

This activity is intended for an informal class activity.

Activity 2	Research recyclable plastics	Learner's Book page 106

Guidelines to implement this activity

- This is an individual activity.
- Learners do research and write a report about which categories of plastic can be recycled in the area. Include the 'recycling symbols' for each category.
- This activity is to increase their knowledge and not for assessment.

Activity 3	Compare the properties of different containers	Learner's Book page 107

Guidelines to implement this activity

- This is a group activity.
- Divide learners into groups of 3-4.
- Learners copy and complete the table and compare the properties of different containers.
- Learners may add additional properties to the table.

Assessment guidelines

This activity is not intended for assessment.

Activity 4	Make candles from old wax crayons	Learner's Book page 110

Guidelines to implement this activity

- This is a group activity
- Divide the learners into groups of 3 - 4.
- Discuss each step carefully.
- Supply learners with: moulds for the candles, old, broken wax crayons with the paper removed, string to make candle wicks.

Assessment guidelines

This activity is not intended for assessment.

Activity 5	Draw a systems diagram	Learner's Book page 113

Guidelines to implement this activity

- This is an individual activity.
- Learners draw a systems diagram describing the sequence of plastics recycling at the Blue Crane Technical School.

Assessment guidelines

- This activity is intended for formal assessment.
- Use the rubric below to assess learners.

Mark allocations	1-2	3-4	5
Assessment criteria			
Structure of systems diagram (6 marks)			
Included all the steps (6 marks)			
Logical layout and labels (4 marks)			
Neatness (4 marks)			

[20 marks]

Term 4 Mini Practical Assessment Task

Learner's Book pages 115-117

Overview

- Two case studies are presented to further learners' design, draw and make activity:
  plastics in modern cars
  plastic household items
- A scenario about Mam Nomakhayisi's problem contextualises the brief that learners must create.

Teaching guidelines

- Although polythene, recycling code 2, does not give off poisonous fumes when melted, other plastics may do.
- From a safety point of view no other types of plastic should be melted in oil. These can safely be softened in hot water.
- Under no circumstances should boiling water be used.
- Some cotton cloths should be available for holding the hot plastic when bending it.
- Learners must use a hacksaw to cut hard plastic because craft knives can easily slip and cut.
- Smooth rough edges of moulded plastic with sandpaper, not a craft knife.
- The melted polythene can be stirred and lifted out with a fork into the mould but never touched with bare hands until cool.
- There are 4 hours available for practical work, so learners should do as much practical work as possible in school.
- The emphasis is on individual work and learners should be encouraged to solve the problem creatively.

Activity 1 Write a brief

Learner's Book page 115

- Learners need to list the specifications and constraints from the scenario.
  Allocate learners a mark out of 10 -- 5 marks for any 5 valid specifications listed and 5 marks for any 5 valid constraints listed.

[10 marks]

Activity 2 Sketch your design

Learner's Book page 117

Mark allocations	1	2	3-5
Assessment criteria			
Chose a design and made a neat 3D isometric drawing (5 marks)			
Drawing showed measurements, labels, logos and decorations (5 marks)			
Drawing according to scale (5 marks)			

[15 marks]

Activity 3 Draw your design in more detail

Learner's Book page 117

Mark allocations	1	2	3-5
Assessment criteria			
First-angle orthographic projection (5 marks)			
2D drawing drawn to scale and contains major dimensions (5 marks)			
Attachment of different parts (5 marks)			
Drawing labelled correctly (5 marks)			

[20 marks]

Activity 4 Assemble your material

Learner's Book page 117

Criteria	1	2	3-5
The learner:			
Prepared materials well (5 marks)			
Joined parts together properly (5 marks)			
Demonstrated effectiveness of product (5 marks)			

[15 marks]

Activity 5 Compile a record

Learner's Book page 117

Learners will need to compile a project portfolio of their designs, research, diagrams and final product. Assess learners using the rubric below

Mark allocations	1	2	3-5
Record includes the following:			
Research on plastics recycling (2 marks)			
Specifications and constraints (2 marks)			
Systems diagram (2 marks)			
Isometric sketches (2 marks)			
Orthographic drawing (2 marks)			

[10 marks]

Mini-PAT total: 70 marks

Term 4 Exemplar exam memo

Learner's book page: 118

Question 1

1.1 A static test does not involve movement. ✓ Subjecting a beam to a load would be a static test. ✓
A dynamic test involves bending material✓ backwards and forwards. ✓ Breaking a paper clip by bending it is a dynamic test. ✓ (5)

1.2 Weight is the force of gravity on an object. ✓
Wooden beams made from strips of wood glue together are called laminated beams. ✓
Compression in a structure squeezes the parts together. ✓
The ability of a structural member to remain the same shape without bending refers to it's stiffness. ✓
Another name for rust is corrosion. ✓ (5)

1.3 The teacher will need to use his or her judgement as to the ideas presented in the learner's solution. (6)

1.4 In a spring experiment, the results were:

Load (Newtons)	0	1	2	3	4	5	6	7
Length (mm)	50	58	70	74	82	90	102	125
Extension (mm)	0✓	8✓	20✓	24✓	32✓	40✓	52✓	73✓

(8)

50 mm✓
The 70 mm length is incorrect; it should be 66 mm (proportionality is 8). ✓✓
3,75 N✓✓
86 mm✓✓ (7)

1.5 The teacher will need to use his or her judgement as to the points made in this letter. (6)

[37]

Question 2

2.1 A pulley is just a wheel✓ with a groove ✓cut in its edge. A pulley system consists of a pulley wheel or wheels with a rope passing over them. ✓ When the rope is pulled the direction of the pull is changed from a downward pull to a lifting action. A combination of two or more pulleys working together reduces the force needed to lift the load. ✓ Pulleys are used on cranes that lift heavy loads. They are also used to raise and lower a flag on a flagpole, by mechanics to lift engines out of cars, and in elevator systems to raise the lift. ✓ (5)

2.2 A system that uses more than two pulleys is known as a block and tackle system. ✓ We know we use half the effort if we use two pulleys. Using more pulleys will reduce the amount of effort needed even more. ✓ A block and tackle pulley system is commonly used at the lifting end of the cable on a crane to enable the crane to lift very heavy loads. ✓ (3)

2.3 The chain hoist consists of an endless chain looped over sprocket wheels. ✓ The two top wheels are different sizes - effectively, they are a gearing system. The different ratio of these gears will reduce the effort needed to lift the load. ✓ When someone pulls down on the chain the smaller gear will turn. The larger wheel pulls more chain over it than the smaller wheel. One advantage of this system is that the load remains still unless the chain is moved. ✓ (3)

2.4 A calliper is the frame around the edge of the disk brake that includes the brake pads and the hydraulic pistons. ✓✓ (2)

[13]

Question 3

3.1 A ratchet is a wheel with saw-shaped teeth round its rim. ✓ The pawl is a tooth-shaped lever which ✓is pivoted so that it slides over the saw-shaped teeth when they turn in one ✓direction but drops into the slot between the teeth when it is turned in the other ✓direction. (4)

3.2 Hand-operated winch used to pull a boat out of the sea. ✓ The gearing system winds a strong cable around a drum, and to prevent ✓the boat from sliding back a

pawl engages in the ratchet so that the drum cannot rotate in the opposite direction. ✓ By releasing the pawl the boat can be slowly returned to the sea. ✓(4)

3.3 Bevel gears✓ are sometimes known as crown and pinion gears. The two gears mesh at an angle and are useful when the direction of a shaft's rotation needs to be changed. ✓They are usually mounted on shafts that are at 90° angles to each other. ✓

Rack and pinion gears✓ are used to convert a rotational movement into linear motion. They are the type of gears used to open and close sliding security gates✓. The rack is a straight steel bar with teeth cut along one edge. ✓This bar is fixed to the frame of the gate.

Worm gears ✓are used when large gear reductions are needed. This means that the input speed may be high but the output speed is low. The worm gear is cut on a rotating shaft and engages with a spur gear. ✓As the shaft rotates the spur gear turns with less speed because of its large diameter but with greater force. ✓

(3x3=9)

[17]

Question 4

4.1 A switch is the most common circuit control device.✓ Switches are used to control or direct current.✓ (2)

4.2 Switches are described by the number of poles ✓and throws they have. Pole refers to the number of circuits controlled by the switch.✓ (2)

4.3 Switches are described by the number of poles ✓and throws they have. Pole refers to the number of circuits controlled by the switch✓ (2)

4.4 AND: both conditions need to apply before current is allowed to pass. ✓✓
OR : one or the other need to comply for a current to pass through. ✓✓ (4)

[11]

Question 5

5.1 Solder is a soft mix of metals which is melted between conductors in a circuit. ✓Good soldered joints are small. ✓ In most electrical and electronic circuits, connections are made permanent by soldering. ✓ (3)

5.2 Ohm's Law states that the amount of current passing through a conductor is directly proportional to the voltage across the conductor. ✓✓ For example, if the terminals of an electric battery are connected to an electric lamp and the voltage output of the battery is decreased by 20%, the amount of current flowing through the lamp will also be reduced by 20%. ✓✓✓ (5)

5.3 Resistors absorb power from a circuit and convert it into heat. ✓✓ (2)

5.4 The first band stands for the first digit of the value. ✓ The second band stands for the second digit of the value. ✓ The third band stands for the number of zeroes✓ after the first two digits. ✓ (4)

[14]

Question 6

LEDs are commonly used as output devices.
LED stands for Light Emitting Diode. ✓ An LED allows current to flow in one direction only ✓and also gives off light. It is often used as an indicator that a circuit is "ON". ✓ LEDs are used in the remote control units of many commercial products including televisions, DVD players, and other domestic appliances. ✓✓

(5)

Question 7

7.1 Even though metals are so strong and useful, they can also degrade. ✓ Most of the metals we see in daily life - copper, zinc, iron, steel, brass, bronze ✓and aluminium - change colour or slowly break into pieces when they are in contact with oxygen and/or water.✓ (3)

7.2 Painting: ✓The key to effectively protecting metal with paint is the strength of the adhesive✓ that is mixed in with the paint. The first protective paint used on metal was bitumen, ✓ the shiny, thick, black liquid that sticks to your shoes when you play in the street on a hot summer day.
Galvanising ✓things made of metal, usually steel, prevents corrosion. ✓ When something is galvanised, it is covered with a thin coat of zinc to form a physical barrier against water and oxygen. Zinc reacts with oxygen, water and carbon dioxide in the air to form a thin skin of zinc carbonate.✓
Electroplating✓ is widely used to preserve and beautify metal items that would otherwise corrode. The process involves using an electric current to deposit a thin layer✓ of non- corroding metal, for example gold, platinum, silver, tin, nickel, chromium and copper on the object that you want to preserve.✓(3x3=9)

7.3 Micro-organisms are living things such as fungi, bacteria and moulds. ✓ They feed on organic material such as meat, vegetables and grains. They are too small to see but their waste products can be poisonous if you eat them. ✓ Because micro-organisms reproduce very fast, we need to preserve food while it is still fresh. Preserving food stops micro-organisms from feeding, breeding and making poisonous waste. ✓ (3)

[15]

Question 8

8.1 A polymer is a very long molecule✓made of smaller molecules joined together✓, usually in long chains of hundreds, or even thousands. (2)

8.2 Any 3 of the following:

Elasticity: the ability to be stretched but return to its original shape like a rubber band
Tensile strength: the ability to resist stretching forces
Compressive strength: the ability to resist squeezing forces
Torsional strength: the ability to resist twisting forces
Stiffness: the ability to resist bending forces
Flexibility: the ability to be bent and still return to its original shape
Ductility: the ability to be stretched without breaking
Hardness: the ability to resist scratching
Toughness: the ability to resist hard knocks without breaking
Accept colour: the ability to accept colouring pigments during manufacture - like when you put food colour in a sponge cake mix.
Printability: the ability to be painted or printed on
Thermal insulation: the ability to stop heat passing through it
Electrical insulation: the ability to stop electricity passing through it
Resistance to corrosion: the ability to resist chemicals and water attack
Washability: the material is easy to clean
Mouldabilty: the ability to easily take the shape of a mould
Thermoplastic: the ability to be reheated and remoulded many times
Thermosetting: the shape of the material is fixed when it is made and it cannot be remoulded
Recyclability: the ability to be converted into new products
Flammability: the ability to burn (3x2=6)

Total: 120 marks

Resources

A lot of the learning in technology is based on photos and text supplied and learners' own experience. Find any pictures of local structures, which you can relate to the various topics, as the learners will tend to remember these illustrations better than by just looking at the pictures in the textbook. Acquire physical examples of various materials so that the learners can see and touch.
Additionally, teachers can supply simple tools to be shared.

If you have access to a computer linked to the Internet, visit the sites listed below:
You can search for drawing lessons on: www.youtube.com
http://www.videojug.com/film/how-to-use-a-ratchet-spanner
http://www.youtube.com/watch?v=dyFg1daXOZI
www.technologystudent.com
Try to download a programme called Crocodile from the Internet. This is free software that enables you to build circuits and test them on the computer.

You will also need various resources for the different activities.

- These are listed where necessary and you will have to work out how much you will require for your class.
- Additional materials/tools could include: matchboxes, tomato boxes, thick paper or thin cardboard, paint, brushes, glue, twine, tape, wire, plastic shopping bags, an empty egg box, a glass jar and a paper guillotine.
- For the unit based on electricity you will need various electrical components which are all listed in the activities of the Learner's Book.
- For graphic communication learners will need the different types of drawing instruments discussed in the Learner's Book.