OXFORD

# Successful

# Technology

## TEACHER'S GUIDE

GRADE 8

WITH EXAM INFO AND EXEMPLAR PAPERS

T. Barnard
T. C. E. Barnard
N. Murtough
R. Wood

Review Copy

It is illegal to photocopy any pages from this book without the written permission of the Publisher.

OXFORD
UNIVERSITY PRESS
SOUTHERN AFRICA

OXFORD
UNIVERSITY PRESS
SOUTHERN AFRICA

Oxford University Press Southern Africa (Pty) Ltd

Vasco Boulevard, Goodwood, Cape Town, Republic of South Africa

P O Box 12119, N1 City, 7463, Cape Town, Republic of South Africa

Oxford University Press Southern Africa (Pty) Ltd is a subsidiary of Oxford University Press, Great Clarendon Street, Oxford OX2 6DP.

The Press, a department of the University of Oxford, furthers the University's objective of excellence in research, scholarship, and education by publishing worldwide in Oxford New York Auckland Cape Town Dar es Salaam Hong Kong Karachi Kuala Lumpur Madrid Melbourne Mexico City Nairobi New Delhi Shanghai Taipei Toronto

With offices in Argentina Austria Brazil Chile Czech Republic France Greece Guatemala Hungary Italy Japan Poland Portugal Singapore South Korea Switzerland Turkey Ukraine Vietnam

Oxford is a registered trade mark of Oxford University Press in the UK and in certain other countries

Published in South Africa by Oxford University Press Southern Africa (Pty) Ltd, Cape Town

**Oxford Successful Technology Grade 8 Teacher's Guide**

ISBN PROM 199059683

© Oxford University Press Southern Africa (Pty) Ltd 2013

The moral rights of the author have been asserted

Database right Oxford University Press Southern Africa (Pty) Ltd (maker)

First published 2013

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, without the prior permission in writing of Oxford University Press Southern Africa (Pty) Ltd, or as expressly permitted by law, or under terms agreed with the appropriate designated reprographics rights organization. Enquiries concerning reproduction outside the scope of the above should be sent to the Rights Department, Oxford University Press Southern Africa (Pty) Ltd, at the address above.

You must not circulate this book in any other binding or cover and you must impose this same condition on any acquirer.

Review Copy

Publisher / Commissioning editor: Brenda van der Poel
Editor: Tammin Barker
Illustrators: Michael Cleghorn, Karen Hermans, Gabriel Metcalfe and Clifford Kriel

**Acknowledgements**

The authors and publisher gratefully acknowledge permission to reproduce copyright material in this book. Every effort has been made to trace copyright holders, but if any copyright infringements have been made, the publisher would be grateful for information that would enable any omissions or errors to be corrected in subsequent impressions.

# Contents

## Section A Orientation

How this Teacher's Guide should be used ..... 5
How the course works ..... 5
Curriculum and Assessment Policy Statement (CAPS) ..... 6

## Section B Planning and assessment

A teaching plan for Technology Grade 8 ..... 13
Sample lesson plan for Grade 8 ..... 20
What is assessment in the Senior Phase? ..... 20
Types of formal assessment for Technology ..... 22
Formal Programme of Assessment (POA) for Technology ..... 23
Inclusive assessment ..... 24
Recording and reporting assessment ..... 25

## Section C Teaching and learning Technology

Teaching Technology in the Senior Phase ..... 26
Grade 8 specific skills for Technology ..... 29
Inclusive teaching ..... 29

Review Copy

## Section D Cognitive levels

Cognitive levels and abilities for Technology in the Senior Phase ..... 32
Meta-cognitive strategies ..... 32

## Section E Guidelines for teaching Technology

**Topic 1 ..... 35**

**Unit 1** Shell and frame structures ..... 36
**Unit 2** Structural members that span a space ..... 42
**Unit 3** Structural failure ..... 46

**Topic 2 ..... 50**

**Unit 1** Graphic conventions ..... 51
**Unit 2** Working drawings ..... 52
**Unit 3** Artistic drawings ..... 54

**Topic 3** ..... **56**

**Unit 1** Mechanical advantage ..... 57
**Unit 2** Simple machines ..... 59
**Unit 3** Complex machines ..... 61
**Unit 4** Gears ..... 63
**Unit 5** Cams and cranks ..... 65
**Term 1** Mini-Practical Assessment Task ..... 69
**Term 1** Exemplar test memorandum ..... 73

**Topic 4** ..... **79**

**Unit 1** Positive impact of technology: Biodegradability ..... 80
**Unit 2** Technology with a positive impact: Recycling ..... 81
**Unit 3** Design a container ..... 82
**Unit 4** Negative impact on technology ..... 83
**Term 2** Mini-Practical Assessment Task ..... 84
**Term 2** Exemplar test memorandum ..... 87

**Topic 5** ..... **88**

**Unit 1** Revise levers and gear ..... 89
**Unit 2** Mechanical advantage calculations ..... 95
**Unit 3** Representing gears graphically ..... 97
**Unit 4** Investigation skills ..... 104
**Term 3** Mini-Practical Assessment Task ..... 105
**Term 3** Exemplar test memorandum ..... 110

**Topic 6** ..... **112**

**Unit 1** Simple electrical circuits ..... 113
**Unit 2** Using energy ..... 114
**Unit 3** Electrochemical and photovoltaic cells ..... 116
**Unit 4** Generating electricity ..... 117
**Term 4** Mini-Practical Assessment Task ..... 118
**Term 4** Exemplar exam memorandum ..... 121
**Resources** ..... 124

Review Copy

# This Teacher's Guide consist of five easy-to-navigate sections

## Sections 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 8

## 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

Review Copy

# How this Teacher's Guide should be used

*Technology Grade 8 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

Review Copy

# How this course works

This series meets the requirements of the CAPS for the Senior Phase.

In Grade 8, 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 (CAPS)

## 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.

Review Copy

## Instructional time allocation

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

Review Copy

| | | | |
|---|---|---|---|
| | Chooses and uses appropriate tools and materials to make products by measuring/marking, cutting/separating, shaping/forming, joining/combining and finishing, with some accuracy.<br>Uses safe working practices and uses correct tools for the job appropriately.<br>**Evaluate**: evaluates the product or system in terms of the design brief.<br>Evaluates the process followed and suggests improvements or modifications to the solution in terms of fitness for purpose.<br>**Communicate**: 3D sketches, plans using oblique projection, circuit diagrams with standard electrical component symbols, systems diagrams and simple flow charts.<br>Plans include scale, thick, thin and dashed lines, dimensions and quantities.<br>Artistic drawings in single VP perspective should be enhanced using colour, texture and shading. | 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.<br>Changes and adapts design ideas where appropriate.<br>Uses safe working practices and uses correct tools for the job appropriately.<br>**Evaluate**: evaluates the product or system objectively in terms of the design brief.<br>Evaluates the process followed and suggests sensible improvements or modifications to the solution in terms of fitness for purpose.<br>**Communicate**: 3D sketches, plans using isometric projection, circuit diagrams with standard electrical component symbols, systems diagrams and simple flow charts.<br>Plans include scale, thick, thin, dashed and chain lines, dimensions and quantities.<br>Artistic drawings in double VP perspective should be enhanced using colour, texture, shading and shadows. | 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.<br>**Evaluate**: evaluates the product or system in terms of the design brief.<br>Evaluates the process followed and suggests sensible improvements or modifications to the solution in terms of fitness for purpose.<br>**Communicate**: 3D and 2D sketches, plans using first angle orthographic projection, circuit diagrams with standard electrical and electronic component symbols, systems diagrams and simple flow charts.<br>Plans include scale, thick, thin, dashed and chain lines, dimensions and quantities.<br>Artistic drawings in either single or double VP perspective should be enhanced using colour, texture, shading and shadows. |
| ***DRAWING SKILLS*** | | | |

Review Copy

| | | | |
|---|---|---|---|
| ***Term 1-4*** | **Technology drawing: sketches and working drawings:**<br>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.<br><br>**Artistic drawing: Sketches and Presentation Graphics**<br>Single vanishing point perspective; texture rendering; colour. | **Technology drawing: sketches and working drawings:**<br>Free-hand sketching.<br>2D view of one face drawn to scale with correct line types and dimensions according to conventions.<br>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.<br><br>**Artistic drawing: Sketches and Presentation Graphics**<br>Double vanishing point perspective; texture rendering; colour; shading. | **Technology drawing: sketches and working drawings**:<br>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<br><br>**Artistic drawing**: Sketches and Presentation Graphics<br>Single and double vanishing point perspective; texture rendering; shading; colour; shadows. |
| ***KNOWLEDGE FOCUS*** | | | |
| ***Term 1*** | **Mechanical systems and control:**<br>Simple mechanisms; first-, second- and third-class levers.<br>• Mechanical advantage/disadvantage using levers (elementary qualitative treatment).<br>• Levers and linkages.<br>• 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. |

Review Copy

| | | | |
|---|---|---|---|
| ***Term 2*** | **Structures:**<br>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.<br>**Task**: cell phone tower (link: electronic communications). Frame structures: cranes. | **Processing:**<br>Positive and negative impacts of technological products on the environment and/or society.<br>Improving properties of materials to adapt them to suit particular purposes:<br>• Withstand forces – tension/compression/bending/torsion/shear<br>• Recycling: paper.<br>• 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:**<br>Interacting mechanical systems and sub-systems.<br>• Hydraulic principles: incompressibility of liquids, pressure in liquids, force transfer.<br>• Hydraulic/pneumatic systems that use restrictors, one-way valves: hydraulic press/jack.<br>• Gear systems – spur, bevel, rack and pinion, worm.<br>• Mechanical control mechanisms – ratchet and pawl; cleats; bicycle brakes; disc brakes.<br>• Belt-drive systems with more than one stage.<br>• Pulley systems – fixed pulley, moveable pulley, and multiple pulleys (block and tackle).<br>• Systems where mechanical, electrical or pneumatic systems are combined.<br>**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**:<br>More simple mechanisms – wedge, gear ratios, cams.<br>• Mechanical systems that change the magnitude of forces involved: gear ratios.<br>• Mechanical systems that change the | **Mechanical systems and control:**<br>Simple mechanisms as components of more complex machines designed to provide users with a mechanical advantage:<br>• Linked lever systems.<br>• Gears (link to term 1: spur, bevel, rack and pinion, worm). | **Electrical systems and control:**<br>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 |

Review Copy

| | | | |
|---|---|---|---|
| | rotary to linear motion: crank, cam.<br><br>**Electrical systems and control:**<br>**Electrical circuit basics:**<br>• Basic circuit components: cell(s), conductor, switch, resistor, lamp.<br>• Simple circuit diagrams showing various component arrangements. Magnetism and magnetic metals: iron and steel, nickel, cobalt.<br>• Introduction to electromagnetism: the electromagnet.<br>• Recycling metals.<br>**Task:** design and make a crane to carry an electromagnet to sort scrap metals for recycling.<br><br>**Processing:**<br>Recycling scrap metals – sorting ferrous and non-ferrous metals. Improving properties of materials.<br>• Improving the properties of wood: waterproofing.<br>• Improving the properties of textiles: waterproofing, fire-resistance.<br>**Task:** emergency shelter for refugees. | • Gears – driver, idler, driven; velocity ratio/force multiplication.<br>• Belt drive and chain drive systems – chain block, bicycle or motor cycle gear cogs.<br>• Hydraulic/pneumatic systems.<br>• Mechanical advantage – including simple calculations.<br>• Systems diagrams.<br>**Task:** mine shaft headgear. | working circuit.<br>• Input components: electrochemical cells, photovoltaic cells.<br>• Storage components: electrochemical cells, capacitors.<br>• Control components: switches, resistors, diodes, light emitting diodes (LED), transistors.<br>• Sensor components: thermistors, light dependent resistors (LDR).<br>• Output components: lamp, buzzer/bell, light emitting diodes (LED).<br>• Resistor codes.<br>• Ohm's Law: quantitative treatment with graphs and calculations.<br>**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:**<br>Simple mechanisms; first-, second- and third-class levers.<br>• Mechanical advantage/disadvantage using levers (elementary qualitative treatment).<br>• Levers and linkages. | **Electrical systems and control:** Electrical circuit basics:<br>• Circuit diagrams, conventions and component symbols.<br>• Input devices, control devices, output devices.<br>• Circuit design (simple) and circuit interpretation.<br>• Circuits with more than one input or control | **Processing:** Extending lifespan:<br>• Metal – paint, galvanise, and electroplate:<br>• Practical – preserving metal by electroplating.<br>• Food – freeze, pickle, dry, salt:<br>• Practical – preserving food by |

Review Copy

| | | | |
|---|---|---|---|
| | • Pneumatics and hydraulics used to increase human strength.<br>**Task:** hydraulic powered rescue equipment. More simple mechanisms – wheel and axle, cranks and pulleys, gears. More simple mechanisms – wedge, gear ratios, cams.<br>• Mechanical systems that change the magnitude of forces involved: gear ratios.<br>• Mechanical systems that change the rotary to linear motion: crank, cam.<br>• Processing:<br>• Recycling scrap metals – sorting ferrous and non-ferrous metals. Improving properties of materials.<br>• Improving the properties of wood: waterproofing.<br>• Improving the properties of textiles: waterproofing, fire-resistance.<br>**Task**: emergency shelter for refugees. | device. Electrical energy sources (including illegal connections):<br>• Sources of direct current: electrochemical cells; photovoltaic cells.<br>• Sources of alternating current: generating (thermal and alternate).<br>• Distributing AC electricity: the national grid, transformers (an application of electromagnetism). Ohm's Law: qualitative treatment. Logic conditions:<br>• **AND** logic (series); truth table.<br>• **OR** logic (parallel); truth table.<br>**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. | drying/salting. Types of plastics and their uses. Recycling plastics to provide raw material for manufacture of new plastic products.<br>**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. |
| ***VALUES AND ATTITUDES*** | | | |
| ***Term 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. | | |

Review Copy

# Teaching plan for Technology Grade 8

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 allocation Hours |
|---|---|---|---|
| | **Term 1** | | |
| **Unit** | | | |
| 1 | **Frame structures**<br>• Definition of ***frame*** structures. - Purpose of structural members (components) in wood and steel roof trusses (king andqueen post, strut, tie, rafter, tie beam).- Learners identify structural members and type of force (shear, torsion, tension, compression) acting on them in given frame structures.<br>• Case study: Electrical pylons – use pictures of a range of pylon designs noting: -The variety of designs that solve the same problem effectively. -The use of internal cross-bracing and triangulation to provide stiffness.<br>• Structural members under tension/compression (worksheet). | **Activities**<br><br>Informal assessment | 2 |
| 2 | **Structural members**<br>• Structures that span over space:- Beams: steel I-beams (girders), concrete lintels; beam and column bridge. - Alternative bridge supports: suspension bridges; cable-stayed bridges. -Arches: arches in buildings, bridges, dam walls. - Cantilevers: simple cantilever, cable-stayed cantilever. Structural failure – the three most likely ways structures fail are:<br>• **-Fracture** of a member – due to lack of strength.<br>• - Bending (flexing, buckling) – due to lack of stiffness (rigidity).<br>• - Toppling over – due to lack of stability (top heavy, narrow base). | **Activities**<br><br>Informal assessment | 2 |
| 3 | • **Purpose of graphics**: develop and communicate ideas. • **Conventions**: outlines (thick/dark); construction lines (thin/feint); hidden detail (dashed);centre lines (chain dash-dot); scaling up and scaling down; dimensioning (in mm).<br>• working drawing techniques for planning:<br>- Single view flat 2D drawing with dimensions, line types and scale. | **Activities**<br><br>Informal assessment | 4 |

Review Copy

| | | | |
|---|---|---|---|
| | - Isometric – using underlying isometric grid (term 1) and simple instruments (term 3).<br>• **artistic drawing:** Double vanishing point perspective with colour, texture and shading.<br>• - Sketching – using pencil, ruler and blank paper. -Enhancing drawing to promote realism using colour, texture, shading and shadows. | | |
| 4 | • revision: mechanical advantage. Well-designed machines give "***mechanical advantage***".<br>• All complex machinery consists of combinations of simple mechanisms.<br>-**the wedge:** e.g. inclined plane or ramp, door wedge, knife blade, etc.<br>-**the wheel and axle**: e.g. from bicycle to shopping trolley.<br>• Gears: (wheels with wedges for teeth)<br>- Show how meshing of two spur gears causes counter-rotation.<br>- Show how introducing an **idler** gear between two spur gears synchronises rotation of the driver and driven gears.<br>**Note**: Since a small idler will rotate more times than the larger gears, it should be made of harder material.<br>- Gear ratios: Show how different sized gears result in a change in the velocity ratio as well as an 'opposite' change in the force ratio – if force increases, speed decreases, and vice versa. | **Activities**<br><br>Informal assessment | 2 |
| 5 | Mechanisms that change the direction of movement:<br>- The cam: show how a cam converts rotary motion into reciprocating motion. Compare an eccentric wheel and a snail cam.<br>- The crank: an adaptation of a second-class lever. Show how a crank converts rotary motion into reciprocating motion.<br>• **Graphic skills**: learners draw an artist's impression of one of each of the above mechanisms in their books using colour, shading and texture. | **Activities**<br><br>Informal assessment | 2 |
| 6 | Learners work in teams to design and make a structure utilising required structural components and mechanisms to suit the context provided.<br>• **Evaluate:** learners examine information on several complex structures and list advantages and disadvantages in the designs.<br>• **Design:** initial idea sketches.<br>• **Design:** design brief with specifications and constraints. | **Mini- PAT**<br><br>Formal assessment | 3 |
| 7 | • **Make:** a 3D isometric projection of the idea with dimensions and drawn to scale.<br>• **Make:** a working drawing in 2D showing one view with dimensions and line types.<br>• **Make:** teams build their structure housing mechanisms using safe working practices. • Communicate: teams present their plans and model.<br>• Communicate: a sketch in double VP perspective enhanced using two of colour, texture or shading. | **Mini- PAT**<br><br>Formal assessment | 4 |
| | Formal Assessment task: Test | Formal assessment | 1 |

Review Copy

| | | | |
|---|---|---|---|
| | | | 20 |
| | **Term 2** | | |
| **Unit** | | | |
| 1 | • **The positive impact of technology:** many natural materials have been replaced in modern times by new or improved materials. Some new materials are environmentally friendly by being bio-degradable.<br>• **Case study 1:** investigate the impact of plastic shopping bags on the environment.<br>• **Report:** learners write a report evaluating the effectiveness of using thicker, bio-degradable plastic shopping bags which shoppers must buy. | **Activities**<br><br>Informal assessment | 2 |
| 2 | • **Case study 2:** technology with a positive impact on society.<br>- Investigate how waste paper and cardboard are recycled to produce new products for the packaging industry.<br>• **Development**: draw a development of an opened container. | **Activities**<br><br>Informal assessment | 2 |
| | • **Practical activity**: a product requires packaging. Design and make packaging for a purpose. The nature of the product determines the design and properties of the packaging material.<br>• Learners work safely to make and assemble the above packaging product. | **Activities**<br><br>Informal assessment | 2 |
| 3 | • **Case study 3**: technological products can have a negative impact.<br>• Investigate a technological product that can have a negative impact on society.<br>• **Class discussion**: facilitate a class discussion on possible solutions that can counteract or compensate for the negative impact of the technology identified. | **Mini- PAT**<br><br>Formal assessment | 2 |
| 4 | • **Revise**: forces that act on material – tension; compression; bending; torsion; shear.<br>• Adapting materials to withstand forces – reinforcing concrete, plywood.<br>• Selecting metal sections (I-beam, angle iron, T-bar, etc.) to withstand forces and to save material. | **Mini- PAT**<br><br>Formal assessment | 2 |
| 5 | • **Design**: learners adapt a material or design a product that will solve the problem or reduce the impact or negative effects of the technology identified.<br>• **Design**: learners sketch free-hand sketches showing two possible solutions.<br>• **Make**: learners draw their chosen solution in 3D using isometric projection.<br>• **Make**: learners make the model/prototype/product they have designed safely.<br>• **Make** (cont.): Learners make the model/prototype/product they have designed safely. | **Mini- PAT**<br><br>Formal assessment | 2 |
| 6 | • **Evaluate**: learners evaluate their solution in terms of its effectiveness in solving or reducing the negative impact of the technology identified. Their evaluation will be assessed in terms of its objectivity, fairness, accuracy and scope (depth). | **Mini- PAT**<br><br>Formal | 2 |

Review Copy

| | | | |
|---|---|---|---|
| | • **Communicate**: Teams present their plans, model and evaluation. | assessment | |
| | Formal Assessment task: Test | Formal assessment | 1 |
| | | | 20 |
| | **Term 3** | | |
| **Unit** | | | |
| 1 | **Revise: levers** – single levers and levers linked in pairs.<br>Single first-class lever – mechanical advantage depends on the position of the fulcrum.<br>Linked first-class levers – consider various samples, e.g.:<br>- Paper scissors (if equal length blade and handle) – no mechanical advantage.<br>- Secateurs (long handle and short, strong blades) – mechanical advantage > 1.<br>- Single second-class lever – always gives some mechanical advantage.<br>- Linked second-lass levers – consider various samples, e.g.:<br>- Office punch – mechanical advantage > 1.<br>- Heavy duty stapler – mechanical advantage > 1.<br>- Single third-class lever – never gives any mechanical advantage.<br>- Linked third-class levers – consider various samples, e.g.:<br>- Office light-duty stapler – mechanical advantage < 1.<br>- Pair of tweezers – mechanical advantage < 1.<br>- **Gear systems** – concepts (counter rotation, idler, velocity ratio, force multiplication).<br>- Two spur gears of unequal size – note counter rotation and velocity ratio.<br>- Two spur gears of unequal size – note velocity ratio and force ratio (mechanical advantage < or > 1).<br>- Two spur gears connected via an idler – note synchronised rotational direction.<br>- Suitable materials – the idler needs to be of a harder material than the other gears.<br>- Two bevel gears linked to transfer the axis of rotation through 90°. | Activities<br><br>Informal assessment | 2 |
| 2 | **Calculate mechanical advantage (ma)** levers: mechanical advantage calculations for levers using ratios. •Calculations using LOAD/EFFORT; load ARM/effort ARM; etc. • Do NOT *use the method of "taking moments about a point"*. • **Gears**: mechanical advantage calculations for gears using ratios. Calculations using tooth ratios; gear wheel diameters; velocity ratios. | Activities<br><br>Informal assessment | 2 |
| 3 | **Represent gear systems graphically**: use circular templates and/or pair of compasses to draw gear systems with:<br>• The driven gear rotating in the ***opposite*** direction to the driver (counter rotation).<br>• The driven gear rotating in the ***same*** direction to the driver (include an idler gear).<br>• The driven gear rotating ***faster*** than the driver (with and without an idler).<br>• The driven gear rotating ***slower*** than the driver (with and without an idler). | Activities<br><br>Informal assessment | 2 |

Review Copy

| | | | |
|---|---|---|---|
| | **Design brief**: learners write a design brief with specifications for a device that will use a combination of gears to achieve:<br>• A mechanical advantage with force multiplication of three times. • An increase in output velocity of four times.<br>**Draw**: use an isometric projection using simple instruments (as in Maths Set) to draw sketches showing gear systems that meet each of the two above specifications. | | |
| 4 | **Sketches (2D)** showing gear systems that:<br>Provide an output force four times greater than the input force (MA = 4:1).<br>Provide double the rotation rate on a driven axle at 90o to the driver axle.<br>**System analysis – bicycle gear system**<br>Analysis of the gears used on modern bicycles – terminology: master/slave or driver/driven; chain wheel; cogs.<br>**Systems diagrams analyse** a mechanical system by breaking it into input-process-output. Draw a Systems Diagram for a gear system with a mechanical advantage of 4:1.<br>**Plan** a mechanical system to produce a specific output. Systems diagram for a gear train with the driven gear rotating faster than the driver. | Activities<br><br>Informal assessment | 2 |
| 5 | **Learners working in teams investigate and report on one of the following**: *Distribute the investigations so all are covered and reported in each class*. **Investigate**: The **impact** on the environment as a result of mining of: Acid mine drainage .....<br>OR **investigate**: The **impact** on the environment as a result of mining of:<br>Dust pollution from mine dumps on residential areas. .....<br>OR **investigate**: Iron age technology: Indigenous mining of iron in South Africa before the modern era ..... OR **investigate**: Bias in technology:<br>Gender bias in career choice / opportunities related to mining. | Activities<br><br>Informal assessment | 2 |
| 6 | **Scenario**: *A commercially viable ore body containing platinum group metals has been found on land belonging to a tribe in rural South Africa. Drill samples have proved that the reef lies at a relatively shallow depth only 500m below surface.*<br>*A decision has been taken to sink a shaft to this depth to conduct bulk sampling on a small scale before deciding on a mining method best suited for the size and value of the resource.*<br>*Your mechanical engineering company decides to submit a tender for the construction of shaft head-gear suitable to transport miners to and from the work level, and for raising ore and waste in loads not exceeding 10 tons at a time.*<br>**Investigate**: Lifting mechanisms (wire rope-driven mine head-gear) in use at South African mines for raising people and ore.<br>**Sketch**: initial idea sketches to meet the requirements given in the scenario.<br>**Design brief** with specifications and constraints. | Mini- PAT<br><br>Formal assessment | 2 |
| 7 | **Simulation**: teams form mechanical engineering companies. They **evaluate** sketches of individuals and select the best idea for the team tender bid. **Drawings for the shaft head-gear** – each learner draws a: 3D isometric drawing of the selected design giving dimensions and drawn to scale. 2D working drawing showing one or more views with dimensions and lines. **Budget**: teams prepare a realistic budget detailing expected costs of constructing a real mine shaft headgear, | Mini- PAT<br><br>Formal assessment | 4 |

Review Copy

| | | | |
|---|---|---|---|
| | detailing valid prices of materials and labour costs of the range of workers who would be involved in designing and building such a device. **Make**: teams build their working scale model using safe working practices. | | |
| 8 | **Communicate**: teams present their tender proposal for the mine shaft headgear (research, plans, flow chart, model and budget) to the "Tender Board". | Mini- PAT<br><br>Formal assessment | 2 |
| | Formal Assessment task: Test | Formal Assessment | 1 |
| | | | 20 |
| | **Term 4** | | |
| **Unit** | | | |
| 1 | • **Revise:** simple circuit components; input devices (electrochemical cell; generator: solar panel), output devices (resistor; lamp; heater; buzzer; motor); control device (switches). Note: Some devices can serve as input, output, process or control device.<br>• Correct connections, short circuits. Electrical components and their accepted symbols.<br>• Drawing electrical circuits using accepted symbols (as in Grade 12 see Addendum C).<br>• Set up circuits using a range of components. Draw the circuits using symbols. | **Activities**<br><br>Informal assessment | 2 |
| 2 | • Energy for heating, lighting and cooking in rural and informal settlements.<br>• Energy from illegal connections; ethical issues; safety considerations.<br>• Class discussion: equitable sharing of resources – industry needs reliable power for job creation; schools need power for lighting and computing.<br>• Written report: Learners write a balanced report on these issues. | **Activities**<br><br>Informal assessment | 2 |
| 3 | • Electrochemical cells.<br>• Practical: make your own batteries – fruit, vegetable and salt water batteries.<br>• Advantages and disadvantages of series and parallel batteries.<br>• Photovoltaic cells - advantages and disadvantages of solar cells. | **Activities**<br><br>Informal assessment | 2 |
| 4 | • Generate electricity for the nation – advantages and disadvantages of: Thermal power stations (steam turbines – sources of heat: coal, gas, nuclear, sun). Hydroelectric power stations (including pumped storage schemes). Wind-driven turbines.<br>• Alternating current; step-up and step down transformers; distributing electric power across the country: the national grid. | **Activities**<br><br>Informal assessment | 2 |

Review Copy

| | | | |
|---|---|---|---|
| 5 | • **Practical:** learners draw circuit diagrams AND connect circuits showing the effect of circuits with resistors connected in series and parallel.<br>• **Investigation**: introduce Ohm's Law (qualitatively – no calculations). Learners use one cell, then two cells, and then three cells connected in series and note the effect on the brightness of a lamp. They must conclude that more cells in series (more voltage) will cause the current strength to increase, if the resistance does not change. | **Mini- PAT**<br><br>Formal assessment | 2 |
| 6 | • **Investigation**: AND logic gate and simple cases where it is used.<br>• **Investigation**: OR logic gate and simple cases where it is used.<br>• **Lesson**: truth tables for AND & OR logic conditions. | **Mini- PAT**<br><br>Formal assessment | 2 |
| 7 | • Design brief: learners write a design brief giving specifications for a suitable panic button system OR scenario given by the textbook.<br>• Circuit diagram: draw the circuit diagram using correct symbol conventions.<br>• **Make**: connect the components specified to form a circuit suitable for at least two switches.<br>• **Communicate**: learners draw the truth table for the device.<br>• **Communicate**: learners prepare an advertising poster for their device. | **Mini- PAT**<br><br>Formal assessment | 2 |
| | Formal Assessment task: End-of-year Examination | Formal assessment | 1 ½ |
| | | | 20 |

Review Copy

## Sample lesson plan for Grade 8

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: 8** | **Term: 1** |
|---|---|---|
| **Unit:** | **Unit title:** | **Contact time:** |
| **Content/concept:**<br>**(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:<br>(Teacher to complete) | | |

Review Copy

## 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. For example, Activity 2 in Unit 2 Term1 (testing the strength of beams) and Activity 1 in Unit 5 Term 3 (issues in mining) are suitable for informal assessment. 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's Book 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. This is why we have provided activities such as Activity 3 on Unit 1, Term 2 (recycling and the impact of plastic bags) and Activity 1 in Unit 7, Term 4 (the role of technology in reducing the impact of crime). 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.

Review Copy

## 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<br><br>**Design Process skills:** | Structures, Processing, mechanical and Electrical/Electronic Systems and Control<br><br>**Knowledge:** | (Technology, Society and the Environment)<br>Indigenous / Impact / Bias<br><br>**Values and attitudes:** |
| **50%** | **30%** | **20%** |

Review Copy

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<br>Understanding<br>Diagnostic<br>Strategic | 40 |
| Higher order | Analyse<br>Interpret<br>Synthesise of skills and knowledge<br>Create<br>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.

Review Copy

## 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:

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

| | | | | |
|---|---|---|---|---|
| | Term 3 + Term 4 | | | |
| | 10 + 10 + 10 + 10 | 5+5+5+5 | | |

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 |
|---|---|
| Term 1 | Mini-PAT |
| | Test |
| Term 2 | Mini-PAT |
| | Test |
| Term 3 | Mini-PAT |
| | Test |
| Term 4 | Mini-PAT |
| | Examination |

Review Copy

## 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.

Review Copy

| 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.

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.

Review Copy

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:

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

Review Copy

## 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:

Learners 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).

Review Copy

## 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<br>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 |

Review Copy

## 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.

Review Copy

**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. Promote self-management skills and responsibility through group roles and the types of tasks you set.
- 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, presentations 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.

Review Copy

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

Review Copy

## 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 in 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:

## 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?

Review Copy

## 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, icons and labels.

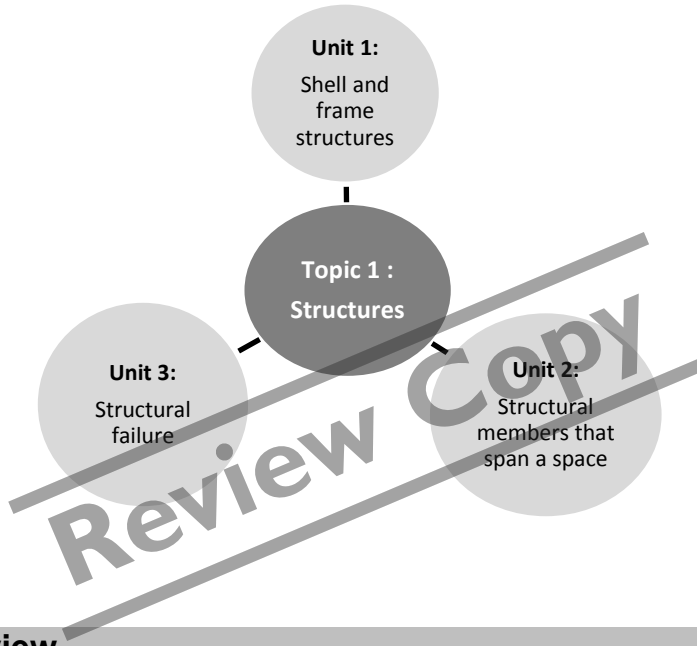
## When looking at, analysing and evaluating products

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?.

Review Copy

# Topic 1 Structures

## Core concepts covered




## Topic overview

In this topic learners will learn to identify different structures according to their functions and design. They will study types of bridges and the advantages and disadvantages of each. The learners will be introduced to structural failure and how it can be prevented.

## Content

| Unit | Content | Pacing (time allocation) | LB page |
|---|---|---|---|
| 1 | Shell and frame structures | 1 hour | 10–20 |
| 2 | Structural members that span a space | 1 hour | 21–28 |
| 3 | Structural failure | 2 hours | 29–35 |
| | | | |

# Unit 1 Shell and frame structures

Learner's Book page10

## Unit overview

In this unit the students will:

- Learn how to identify different types of structures.
- Learn about the structural components of two different roof trusses.
- Learn about forces and their effect on structures.
- Learn how to strengthen structures by triangular bracing.

## Teaching guidelines

- Rather than listing all the different structures ask the learners to tell you about what types of structures they know.
- List these on the chalk board as they give you different words. Help them to see the many and different types of structures which exist.
- Circle all the natural structures with a coloured chalk.
- From the list on the chalk board identify which group each one falls into. Is it a shell, a frame or a combination of the two?
- The next stage is to familiarise the learners with some of the materials used to build structures. Without going into too much detail try to identify why certain materials are used for certain structures. Is it because they are strong or because they are readily available?

Review Copy

### Background knowledge

Structures can also be divided into two main categories. Shell structures and frame structures but some are a combination of both. Animals like the snail and the tortoise have shell structures which protect their bodies. Human beings have a skeletal structure of bones which is a frame to support the other organs in our bodies. When you look at man-made structures it is easy to see that the Electric Pylon is a frame structure but other structures such as buildings are shell structures which provide shelter. However, to support it there is often a framework clad with other material.

**TIP!** Take your learners along to any building at the school which has an open ceiling so that they can see the roof trusses used. They may not be exactly the same as the ones mentioned here but you should be able to point out some of the main structural components.

## Remedial

Learners need to do corrections including complete calculations with notes. If time allows, give the learners additional mechanical advantage calculations to complete. Peer assessment and assistance is another good remediation technique that can be used.

## Activity 1 Identify structures

Learner's Book page 11

### Guidelines to implement this activity

This is an individual activity.

- Learners need to copy and complete the table by identifying the structure as a shell or frame.

### Suggested answers

| Object | Shell | Frame |
|---|---|---|
| bus | x | |
| pylon | | x |
| table | | x |
| tortoise | x | |
| rondavel | x | |
| bicycle | | x |

### 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 6 and give them feedback on their performance to prepare them for formal assessment.

Review Copy

## Remediation/Remedial activity

- Do corrections.

## Activity 2 Identify and sketch some structures

Learner's Book page 13

### Guidelines to implement this activity

This is an individual activity.

- Learners need to make freehand sketches and label their sketches.

### Assessment guidelines

- Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Made at least 2 sketches of frame structures? | | | |
| Made at least 2 sketches of frame structures? | | | |
| Added headings and labels to sketches? | | | |

| Activity 3 | Identify forces | Learner's Book page 16 |
|---|---|---|

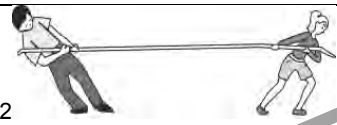
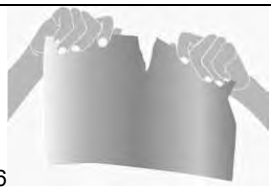
## Guidelines to implement this activity

- This is an individual activity.
- Learners copy and complete the table.

## Background knowledge

- Tension is the exact opposite of compression, it pulls things apart.
- Compression is a force which squeezes something together.
- A twisting force is known as a torsion force.

## Suggested answers

| | Force | Effect |
|---|---|---|
| 1 | Compression | Push |
|  2 | Tension | Pull |
| 3 | Bending | Bend |
| 4 | Torsion | Twist |
| 5 | Tension/pull | Pull |
|  6 | Shear | Tear or cut |

Review Copy

## 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 12 and give them feedback on their performance to prepare them for formal assessment.

| **Activity 4** | **How much force is too much?** | Learner's Book page 17 |
|---|---|---|

## Guidelines to implement this activity

This is group activity.

- Divide learners into groups of 3-4
- Ensure that each group has:
  - 2 bulldog paper clips
  - 4 sheets of A4 paper
  - a pair of scissors
  - a weight (1kg) or stone to act as a weight
  - 1m string
  - a stapler
  - 2 drinking straws
- Follow the steps carefully to demonstrate to the learners.

Review Copy

## Background knowledge

1 Cut the A4 paper lengthways into 70mm wide strips.
2 Fold about 20mm of each strip over a straw and secure this with staples.
3 Attach a bulldog clip to each end.
4 Hang the top clip from a nail fixed into a vertical post.
5 Hang the weight from the bottom clip. This arrangement should be able to carry the weight without tearing the paper.
6 Cut a strip from each side of the paper as indicated by the first broken line in the sketch.
7 Test to see if it still supports the weight.
8 Keep cutting sections away from each side to see how thin the strip in the middle can be before the paper tears.

## Assessment guidelines

- This activity is intended for informal assessment.
- Observe the groups as they are busy with the activity.

| Activity 5 | Examine electricity pylons | Learner's Book page 18 |
|---|---|---|

## Guidelines to implement this activity

This is a group activity.

- Divide the learners into groups of 3-4.
- Explain the three pictures.

## Background knowledge

Picture A – shows a tower with horizontal cross bracing and triangulation to strengthen the structure.
Picture B – shows another tower with horizontal cross bracing and triangulation.
Picture C – show a tower where the whole structure will be in compression.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Can recognise the different ways of strengthening a tower structure? | | | |
| Can recognise the different forces that are affecting different types of structures? | | | |

Review Copy

| Activity 6 | Test 2D shapes for stability | Learner's Book page 18 |
|---|---|---|

## Guidelines to implement this activity

This is a group activity.

- The learners are to use the straws to build the shapes illustrated in their books.
- If you can't get hold of plasticine or modelling clay use sticky tape to join the straws at the corners.

## Background knowledge

When designers create corner joints in a structure they need to strengthen them. The bicycle frame is an excellent example of triangulation. It is strong because it is made out of steel tubing formed into a triangular shape. How are the different tubes joined together? In modern bicycles they are welded together but on older bikes you will notice that the joints have a special thicker piece to strengthen them. These are metal sleeves slightly larger than the diameter of the tubes of the frame. They are called lugs and they slide over the steel

tubes. The two parts are joined together by a process called brazing which is slightly different to welding in that the gap between the tube and the lug is filled with molten brass.

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Can recognise ways of strengthening a structure? | | | |
| Can explain what is meant by triangulation? | | | |
| | | | |

## Extension/Extension activity

The diagram in the textbook shows a method for strengthening corner joints by cutting, folding and gluing a piece of card. Using this method it is possible to make a simple picture frame. The frame itself can be made out of pieces of wood with a 15mm square cross section. Use strong card to make the corner joint and then paint the frame to give it a bright appearance. If you use corrugated card for the corner joints it will also give it an interesting texture.
Can the learners follow instructions in order to make the corner strengthening pieces?
Can the learners recognise similar applications of this process?

Review Copy

## Activity 7 Test 3D shapes for strength

Learner's Book page 19

## Guidelines to implement this activity

This is a group activity.

- Divide the learners into groups of 3-4.
- Make sure that the learners have the following:
  - 24 drinking straws about 100 mm long
  - 4 drinking straws about 140 mm long
  - modelling clay
  - a piece of cardboard 110 x 110 mm
  - weights or books to act as a load.

## Background knowledge

1 Make two cubes using the 100 mm straws.
2 Stand the cubes on a table and place a piece of card on top of them.

3 Place the weights or the books on top of the card. Add them one at a time and see how many can be supported before the cubes collapse.
4 Think about how you can use the four 140 mm straws to strengthen your cube.

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Made 2 cubes? | | | |
| Successfully strengthened the structure? | | | |

# Unit 2 Structural members that span a space

Learner's Book page 21

## Unit overview

Learn about various types of bridges, study how to make material stronger and build models of bridges.

Review Copy

## Teaching guidelines

- Use pictures to help identify different types of bridges.
- Explain that all bridges are built for a specific reason.
- Discuss the types of materials needed to build different types of bridges.

## Background knowledge

Some parts of a bridge are under compression and some will be under tension. This enables the bridge to withstand the forces applied on them. There will be other forces such as torsion and bending at work as well but these will vary according to the type of structure.

## Activity 1 Make structures stronger

Learner's Book page 22

## Guidelines to implement this activity

This is a group activity.

- There are three suggested shapes shown in the book to fold the paper but your learners may come up with some other ideas. Encourage them to do this and to test their ideas.

## Background knowledge

Folding the corrugated paper can be achieved by placing a line of pencils parallel to each other with a slight space between each pencil. The place the paper on top of the pencil and using another pencil press the paper down into the gaps between your line of pencils.

## Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can work together to complete this activity? | | | |
| Can identify different ways of strengthening the paper? | | | |
| Can give examples of where they might have seen this process being used in other situations? | | | |

**Activity 2** **Build an arch bridge** Learner's Book page 24

## Guidelines to implement this activity

This is a group activity.

- Divide learners into groups of 2-3.
- This is similar to the previous activity but uses the arch to support the load.

Review Copy

## Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can work together to build the bridge? | | | |
| Can identify the direction of the forces through the arch to the abutments? | | | |
| Can name different parts of the structure? | | | |

**Activity 3** **Build a suspension bridge** Learner's Book page 25

## Guidelines to implement this activity

This is a group activity.

- Divide learners into groups of 5-6.
- This activity is going to take some time to construct.

- The road is placed in position and the vertical strings pass under it and are then tied to the suspended cable on the other side.

## Background knowledge

The suspension bridge uses the same principle as the arch bridge but turns it upside down. The curve is created by the cables which are firmly anchored to each side of the river embankment. The cable passes over the top of one of the tall towers and drops downwards to the middle of the bridge before passing over the other tower to the embankment on the other side. The roadway is supported by cables hanging vertically from the long suspended cables on each side of the road.

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can work together to build the bridge? | | | |
| Can identify the direction of the forces through the cables to the towers and anchor points of the structure? | | | |
| Can name different parts of the structure? | | | |

Review Copy

**Activity 4** **Human cable stay** Learner's Book page 27

## Guidelines to implement this activity

- This is a group activity.
- Divide learners into groups of 2-3.
- This activity is different from the other activities in that the learners are not building a bridge but are learning how the cables in the cable-stayed structure support the roadway.
- As they try to move their arms down they feel the pressure on the top of their heads.

## Background knowledge

Discuss with the class why cable-stayed bridges have become so popular since they were introduced just over 50 years ago. Reasons:

- They require less material to make than other bridges
- They are quicker to build.
- They look slender and less bulky than other bridges.

- Because only one supporting tower is needed they don't disrupt activity below the bridge. The Nelson Mandela Bridge is built over the main railway lines leading into Johannesburg station.

## Assessment guidelines

This activity is intended for informal assessment.
Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can see the relationship between this exercise and the cable stayed bridge structure? | | | |
| Can identify the direction of the forces through the cables to the tower? | | | |
| Can name different parts of the structure? | | | |

## Activity 5 Model a cantilever bridge

Learner's Book page 28

Review Copy

## Guidelines to implement this activity

- This is a whole class activity but with just three people demonstrating it.
- I suggest that you choose reliable learners to demonstrate this principle.
- Follow the picture in order to position the different people taking part.
- The centre span in the middle will then support a lighter child.
- When you have demonstrated it once, give others an opportunity to try it for themselves.

## Background knowledge

- Use the demonstration given in the textbook to introduce this concept. A ruler can be balanced on a finger providing there is another finger acting as a counterweight on the shorter side.
- If you live in a rural area your learners may not have seen a diving board at a swimming pool. However, they may have seen them on the television for big events such as the Olympic Games. The board itself is acting as a cantilever supporting the weight of the child who is preparing to dive.
- The main boom of the tower crane works on this same principle. There is a large counterweight on the shorter side of the boom with the longer arm stretching out over the construction site.

- Cantilever bridges are heavy steel structures. The Forth Rail Bridge in Scotland is a prime example of this. It takes four years to paint all the steel girders in this bridge. By the time they finish it is time to start again.

## Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can see the relationship between this exercise and the cantilever bridge structure? | | | |
| Can identify how the load carried by the beam is supported by the cantilever? | | | |
| Can name different parts of the structure? | | | |

# Unit 3 Structural failure

Learner's Book page 29

## Unit overview

In this unit learners will learn how forces can affect and damage structures. Their effects can cause the structure to be damaged in one or more of the following ways:

- fracture or break
- bend
- twist
- topple over

Review Copy

## Teaching guidelines

- Show the learners an X-ray photo of a broken bone and ask if any of them have ever broken a bone. Ask them to tell the class what happened and how it affected what they were able to do while the bone was healing. When a bone breaks we say that it has been fractured. The same term is used when a structural member breaks.
- Begin to talk about members breaking in a structure.
- How is that likely to affect the structure as a whole? It will depend on how important a function that member has in the structure.
- For example: If an arm breaks on a chair, it does not mean that the chair cannot be sat on. If the leg breaks on the chair then it is of no further use for the task it was designed for.

## Background knowledge

In large structures, when parts break the effects can be dramatic. Here are some examples. On the 2nd April 2011 a Boeing 737 was forced to make an emergency landing at an airport in the United States of America. The reason was due to the fact that the roof of the plane was ripped open whilst the plane was in flight. The cause of this was probably a structural member breaking due to the torsion forces on the plane's structure. In this case the plane was able to land and no lives were lost.

In 1998 the Injaka Bridge in Mpumalanga collapsed during construction killing fourteen workers and injuring nineteen others. The cause of the collapse was the failure of the temporary structural members used during construction.

The textbook refers to two other dramatic failures: the Tay River Bridge disaster in Scotland and the collapse of the World Trade Centre Twin Towers.

All of these disasters have different causes. It is impossible for designers and engineers to foresee all that might happen to a structure but they do need to consider the choice of materials and the type of construction in order to design structures which can withstand the normal forces applied to them.

| **Activity 1** | **Test the strength of materials** | Learner's Book page 30 |
|---|---|---|

Review Copy

## Guidelines to implement this activity

This is a group activity.

- Divide the learners into groups of 3-4.
- In this activity the learners are going to test the strength of different materials by dropping a heavy steel ball such as a shotput used in athletics onto them.
- If you can't get a shotput, then use a heavy sledgehammer head.
- I've suggested that the sample is placed in a box to prevent accidents from small pieces that break off.
- Another safety measure is to make sure that the learners stand clear until after the ball has been dropped.
- It is important that learners begin to learn that they need to record the results of tests.
- They should write a report in which they describe what materials they tested, how they tested them and what the results of the test were.

## Assessment guidelines

This activity is intended for informal assessment.

Use the checklist below to assess learners.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Can predict what will happen to the material before the ball is | | | |

| | | | |
|---|---|---|---|
| dropped? | | | |
| Can recognise why the different materials have specific uses? | | | |
| Can recognise the need to take safety precautions? | | | |

## Activity 2 Bending and strengthening

Learner's Book page 32

### Guidelines to implement this activity

This is a group activity.

- Divide the learners into groups of 3-4.
- You have already done an activity similar to this where the learners learnt to strengthen material by folding it.
- The difference here is that they are strengthening it by increasing support and using thicker material.
- The thicker strip on its edge should prove to be the strongest. Note the similar principle to the I-beam.

### Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Can recognise ways of strengthening material other than the method used earlier where paper was folded to give it greater strength? | | | |

Review Copy

## Activity 3 Find the centre of gravity

Learner's Book page 34

### Guidelines to implement this activity

This is a group activity

- Divide the learners into groups of 3-4.
- The purpose of this activity is to show that making the base of the structure wider actually lowers the centre of gravity.

### Background knowledge

The centre of gravity is the point around which an object will rotate and eventually fall over. The strength, rigidity and stability of the structure will ultimately depend on a number of factors. These include:

- Correct choice of material

- Correct method of construction
- Strengthening where possible to resist tension, torsion and bending forces.
- Testing of ideas and learning from mistakes.

## Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can recognise methods for making structures more stable? | | | |
| Can recognise the importance of keeping the centre of gravity in the lower portion of the structure's shape? | | | |
| Can give some practical examples of where they have seen these principles in operation? | | | |

**Additional fun activity**

Build a protective cage to protect an egg from breaking as it falls from a height of 3 metres.
Each group will need: 24 straws; some sticky tape; scissors; eight rubber bands; one hardboiled egg.
Build a supporting cage for the egg using the materials given.
Test it by dropping it from a height (3 metres).
Observe which structure was the most effective and try to determine why some structures failed.

**What can you assess?**

Can learners identify reasons as to why some of the structures worked?
Can the learners recognise why some of the structures failed?

Review Copy

## Activity 4 Design a bottle that won't topple

Learner's Book page 35

## Guidelines to implement this activity

This is an individual activity.

- The learners need to make at least two sketches for a solution to make a gas bottle more stable.

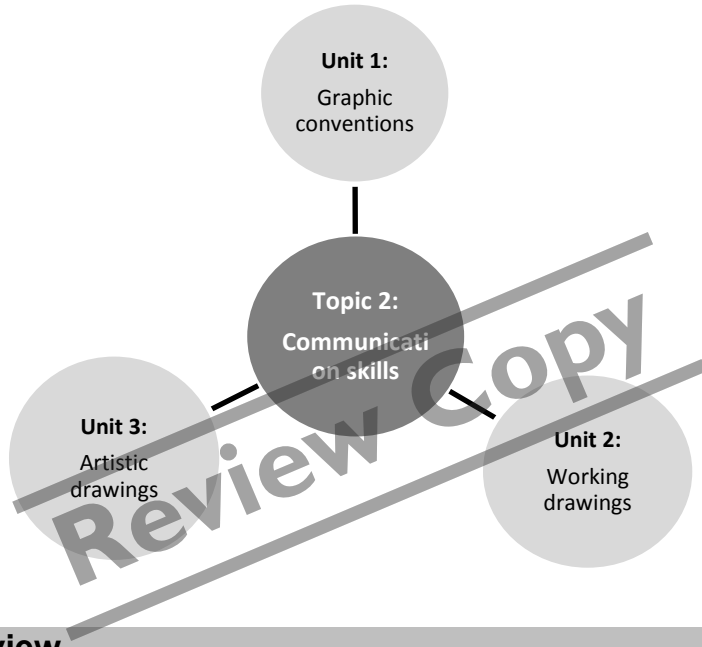
## Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Sketched at least two ideas? | | | |
| Made working sketches? | | | |

# Topic 2 Communication skills

## Core concepts covered




## Topic overview

Topic 2 describes the various forms of graphic communication and their importance in the design and making process. The learners will be introduced to various forms of conventions and drawing styles, each with its own purpose.

## Content

| Unit | Content | Pacing (time allocation) | LB page |
|---|---|---|---|
| 1 | Graphic conventions | 1 hour | 38–43 |
| 2 | Working drawings | 1 hour | 44–48 |
| 3 | Artistic drawings | 2 hours | 49–53 |

# Unit 1 Graphic conventions

Learner's Book page 38

## Unit overview

- Drawing can stimulate imagination and help the learners develop more ideas.
- As they draw, the learners will learn to improve their ideas. The learners will notice that drawing will help them to plan their work and they will discover the importance of this convention.

## Teaching guidelines

- Learners want to see examples. Show them as many examples of the different conventions as possible.
- Draw examples step-by-step for all the learners to see.
- If time allows, give the learners additional drawing exercises.
- Explain to the learners that everyone can draw designs, they just need to practise.

Review Copy

| Activity 1 | Practising using scale | Learner's Book page 43 |
|---|---|---|

### Guidelines to implement this activity

- This is an individual activity.

### Assessment guidelines

- This activity is intended for informal assessment.
- Assess learners informally. Allocate learners a mark out of 8 and give them feedback on their performance to prepare them for formal assessment.

| Activity 2 | Practise accuracy and dimensions | Learner's Book page 43 |
|---|---|---|

### Guidelines to implement this activity

- This is an individual activity.

### Assessment guidelines

- This activity is intended for informal assessment.
- See examples of shapes with dimension line on page 43 of the learner's Book

- give them feedback on their performance to prepare them for formal assessment
- For each shape, give learners one mark for accuracy and one for correct positioning of dimensions
- Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner: | | | |
| Measured the shapes correctly | | | |
| Re-drew the shapes | | | |
| Made accurate drawings | | | |
| Made neat drawings | | | |

# Unit 2 Working drawings

Learner's Book page 44

## Unit overview

Learners will be taught to use routine techniques by using drawing instruments. Learners will be drawing different views and types of working drawings.

Review Copy

## Teaching guidelines

- Make sure that each learner has a basic set of drawing instruments.
- Explain the purpose of each instrument and how to use it.
- Demonstrate to the learners how they should draw a grid and what the purpose of the grid is.
- The learners need to be able to draw accurately according to dimensions. Give them additional drawing practises if possible.

### Activity 1 Identify different types of 3D drawings

Learner's Book page 47

### Guidelines to implement this activity

- This is an individual activity.
- Show learners examples of oblique drawing and tell them to look carefully at page 16 of the learner's book before they start activity

## Assessment guidelines

This activity is intended for informal assessment.
Assess the answers informally. Allocate learners a mark and give them feedback on their performance to prepare them for formal assessment.

| Activity 2 | Practise using drawing instruments<br>Learner's Book page 48 |
|---|---|

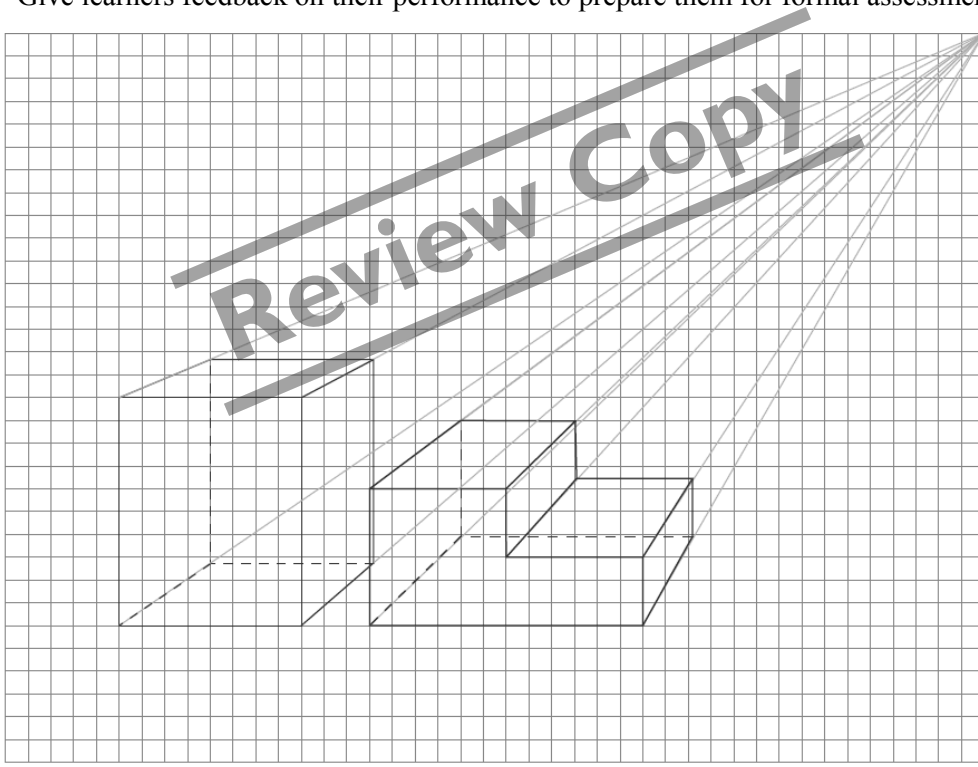
## Guidelines to implement this activity

This is an individual activity.

## Assessment guidelines

This activity is intended for informal assessment.

- Assess learners informally. Allocate learners a mark and give them feedback on their performance to prepare them for formal assessment.
- Give learners feedback on their performance to prepare them for formal assessment.



# Unit 3 Artistic drawings

Learner's Book page 49

## Unit overview

Learners will learn about and practise how to make 3D oblique and 3D artistic drawings. They will learn and practise techniques on how to make artistic drawings look real by using enhancements like shading, colour and texture. The learners will be introduced to different types of perspective drawings and how to apply them.

## Teaching guidelines

- Learners need to draw an accurate grid. Demonstrate drawing grids. Do this step-by-step.
- Try and obtain concrete examples so that learners can feel the texture and see how light falls onto those objects when drawing shadows and texture.
- Drawings take a lot of practice. The more the learners draw, the more skilled they will become. If time allows, give learners additional drawing opportunities.
- Spend more time on the perspective drawings as this is a new concept.

Review Copy

### Activity 1 Do a two-point perspective drawing

Learner's Book page 51

### Guidelines to implement this activity

- This is an individual activity.
- Explain each step very carefully. This is new to the learners.
- Demonstrate how to draw two-point perspectives before the time.

### Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist below to assess learners. Two point perspective drawings are dealt with on pages 49 and 50 of the Learner's book.
- Learner's drawing will depend on the shape of the dimensions of the blocks they start one with.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner: | | | |
| Drew a line to represent the horizon and a height | | | |
| Drew lines from the right vanishing points through the top and bottom of the height line | | | |
| Drew lines from the vanishing points through the intersection of the right hand lines and height lines | | | |

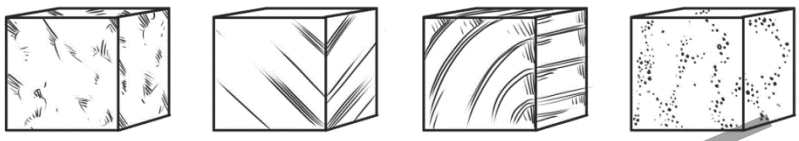
| | | | |
|---|---|---|---|
| Erased all line extensions, construction lines | | | |
| Made a neat drawing | | | |

## Activity 2 Look and draw

Learner's Book page 53

### Guidelines to implement this activity

- This is an individual activity.
- Explain the activity to the learners.
- Revise the different enhancement techniques that can be used to make a drawing more realistic.



### Background knowledge

- Enhancement: Shading, visual texture and colour.

Review Copy

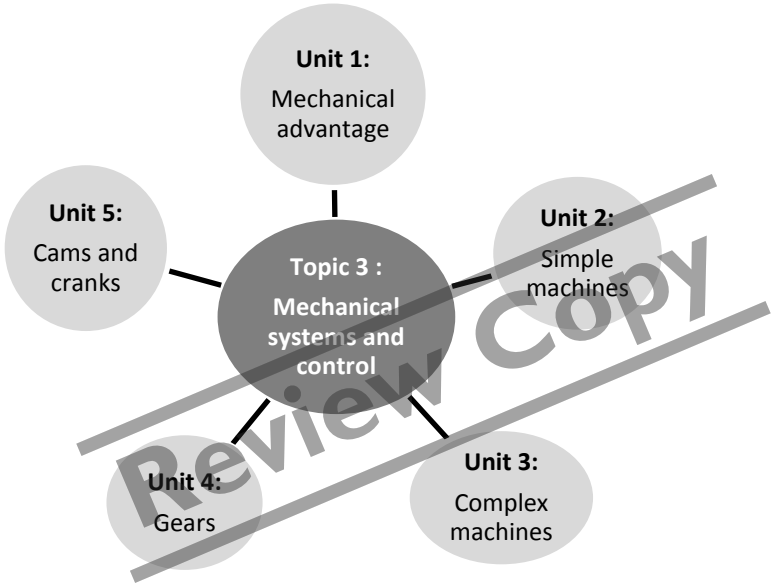
### Assessment guidelines

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

| Criteria<br>The learner: | Yes | Partly | No |
|---|---|---|---|
| Made a list of the types of lines used in the drawing? | | | |
| Made a list of the materials used? | | | |
| Drew four blocks of different sizes using two-point perspective drawings? | | | |
| Enhanced each drawing and made them look like one of the materials listed? | | | |
| Made blocks as realistic as possible using artistic techniques? | | | |

# Topic 3 Mechanical systems and control

## Core concepts covered




Review Copy

## Topic overview

In this topic learners will be using basic calculations to calculate mechanical advantage. The learners will investigate simple as well as complex machines. They will be introduced to gears and the various systems that use gears and their purpose. The learners will also be introduced to cam and follower systems. There is a Mini-PAT at the end of this topic that will give learners the opportunity to design a mechanism that will be used to lift and move heavy loads.

# Content


| Unit | Content | Pacing (time allocation) | LB page |
|---|---|---|---|
| 1 | Mechanical advantage | 30 minutes | 56–58 |
| 2 | Simple machines | 30 minutes | 59–62 |
| 3 | Complex machines | 1 hour | 63–66 |
| 4 | Gears | 1 hour | 67–72 |
| 5 | Cams and cranks | 1 hour | 73–76 |
| | Mini-PAT | 7 hours | 78–82 |


# Unit 1 Mechanical advantage

Learner's Book page 56

## Unit overview

In this unit the students will learn what is meant by the term 'mechanical advantage' and how to calculate the mechanical advantage of a system. They will learn the relationship between the force applied and the distance over which it is applied.

Review Copy

### Teaching guidelines

- This unit introduces the learners to some of the basic principles of machines.
- Machine assist us to perform tasks by using scientific principles which gives us the term 'mechanical advantage'.
- The amount of mechanical advantage is determined by comparing the effort or input force put in to the load or output force produced by the machine.
- It is therefore important that we understand these two terms.
- The example used in the textbook shows a bottle opener removing the top from a cool drink. It would be ideal if you demonstrated this as part of the lesson.
- It is likely that learners do not associate calculations and mathematics with their Technology course.
- In the real world of technology, mathematics plays a very important role and it is important that learners understand the mathematic calculations in this course.

## Background knowledge

- If the MA > 1, it means that the output force or load is greater than the input force or effort.
- If the MA < 1, it means that the output force or load is less than the input force or effort.

The formula used to measure mechanical advantage is:

Mechanical advantage (MA) = $\frac{\text{load}}{\text{effort}}$ or $\frac{\text{output force}}{\text{input force}}$

| Activity 1 | Calculate mechanical advantage | Learner's Book page 58 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- Explain the formula to the learners and demonstrate a few calculations before they do their own.

## Suggested answers

$\frac{96N}{12\ N} = \frac{8}{1}$ MA > 1 = 8✓✓

$\frac{120N}{X} = \frac{3}{1}$ Therefore X $= \frac{120}{3} = 40N$ ✓✓

$\frac{X}{800} = \frac{6}{1}$ Therefore X = 880 x 6 = 4800mm ✓✓

[6]

**Total: 6 marks**

Review Copy

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the answers supplied above to assess learners informally. Allocate learners a mark out of 6 and give them feedback on their performance to prepare them for formal assessment.

## Remediation/Remedial activity

Learners do corrections where necessary.

| Activity 2 | Research machines | Learner's Book page 58 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- The main purpose of this activity is to help the learners realise that machines are not always big heavy pieces of machinery.
- They can be simple machines such as the stapler, the bicycle or the can opener in mum's kitchen.

- Once the learners have drawn up a list, discuss the examples by asking each of them to give what they consider their best example of a machine.

## Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can do the basic calculations for calculating mechanical advantage? | | | |
| Can identify how machines use basic mechanical principles? | | | |
| Can tabulate their results? | | | |
| Can see any design faults in the items they have identified? | | | |

# Unit 2 Simple machines

Learner's Book page 59

Review Copy

## Unit overview

In this unit the students will learn about the inclined plane and investigate various applications of the inclined plane. They will also calculate the mechanical advantage of a screw.

## Teaching guidelines

- The basic principle of the inclined plane is the fact that the input effort can be reduced if the lower effort is sustained over a longer period of time. The example of riding a bicycle up an incline should be one to which most of your learners relate.
- Some of your learners may feel that we can get something for nothing. This is not true. Work and energy are interchangeable terms and are both measured in joules. A machine cannot do more work than the work or energy that goes into it.
- We calculate work (w) by multiplying force (f) by the distance (s) that the force moves.
- Here is an example: An input force of 20N that moves 2 m does 40 (20 x 2) joules (J) of work. This means that if no energy is lost and the output force is 80N, then the load will only move 0.5 m (40N ÷ 80N).
- The balanced equation will be: 20N x 2 = 80N x 0.5

- If the machine is really efficient there will be no loss of energy and the output of the machine will be the same. However, the reality is that, because of factors such as friction some energy is lost to heat and therefore they will not be the same.
- Demonstrate that we use the same principle to raise a load using a plank and a wheelbarrow. Place the end of the plank on a chair and push the wheelbarrow up the slope. In a parking garage a sloping road winds around from floor to floor to get the cars up to the next level. It is simply an inclined plane.

| **TIP!** | Use simple examples of the use of the inclined plane to show the learners that the principle applies to basic structures as well as to big buildings. |
|---|---|

## Background knowledge

- Look back in history to some of the huge structures built by people who did not have access to modern construction tools.
- We can see that they must have made use of mechanisms such as the inclined plane, to build the pyramids in Egypt or Stonehenge in England. In order to build them, large stones would have been pulled up gentle slopes to raise them to the required levels.

| **Activity 1** | **Investigate examples of wedges** | Learner's Book page 62 |
|---|---|---|

Review Copy

## Guidelines to implement this activity

- This is an individual activity.
- You may need to help the learners identify where the input forces are applied and where the output forces overcome the load.
- Keep referring back to the wedge splitting the log as this gives the clue.

## Assessment guidelines

- This activity is intended for investigational purposes.

| Activity 2 | Calculate mechanical advantage | Learner's Book page 62 |
|---|---|---|

## Guidelines to implement this activity

This is an individual activity.

- Demonstrate and revise how to calculate mechanical advantage.
- The steps given in the textbook can be followed to calculate the mechanical advantage of a screw

## Suggested answers

Distance around the head of the screw is 35mm. This is the distance of the input force.
Distance between four threads =10 mm. Therefore distance between one thread = 2.5 mm (10÷4). This is the distance of the output force as it moves the screw into the wood.
Mechanical advantage = distance around the head ÷ the pitch of the screw
= 35 ÷ 2.5
= 4

## Assessment guidelines

- This activity is intended for informal assessment do not allocate marks.
- Watch learner's as they measure the screws. Make sure they understand what a revolution is
- As them to compare their calculators and have class discussions about what the crews with a high mechanical advantage looks like.

Review Copy

# Unit 3 Complex machines

Learner's Book page 63

## Unit overview

In this unit the learners will learn about the wheel and axle and the mechanical advantage of the wheel and the axle. They will discover various examples of the rotational force of the wheel being used to give a mechanical advantage. The learners will also be combining mechanisms to make complicated machines.

## Teaching guidelines

This could be your starting introduction to this unit:

- A wheel and axle can increase the force applied to a load and can change the distance through which a load moves. The wheel is in fact a rotating lever. The hub is the fulcrum.

- Use realistic examples like a bicycle and other mechanisms that contain wheel and axle systems.
- Any machine that is made of different types of mechanisms is a complex machine.
- Learners could have class discussion about complex machines, naming various examples.

## Background knowledge

A wheel and axle can be used to increase the force (MA > 1) when the wheel turns the axle or to increase the output distance (MA < 1) when the axle turns the wheel.

**Examples:**

MA > 1 screwdriver, bicycle handlebar.
MA < 1 cog turning the back wheel of a bicycle.

| Activity 1 | Examine a wheel and axle mechanism | Learner's Book page 66 |
|---|---|---|

### Guidelines to implement this activity

This is a pair activity.

- Having a shopping trolley to illustrate this section would be helpful.
- You can easily turn this into a demonstration lesson.
- The learners should investigate and discuss the questions in the Learners' Book.

Review Copy

### Background knowledge

A swivel castor incorporates a wheel mounted to a fork, but an additional swivel joint above the fork allows the fork to freely rotate about 360°, thus enabling the wheel to roll in any direction. This makes it possible to easily move in any direction without changing its orientation.

### Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can understand how the castor wheel works?<br>Can explain what is happening using their own words? | | | |

| Activity 2 | Draw a two pulley system | Learner's Book page 66 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- Learners need to make a sketch of a two pulley system.

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the checklist on the next page to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Drew a neat free-hand sketch? | | | |
| Drew a functional twopulley system? | | | |
| Added labels/ | | | |

# Unit 4 Gears

Learner's Book page 67

Review Copy

## Unit overview

In this unit the students will learn about spur gears. They will learn how gears change the direction of rotation and they will be introduced to the idler gear and how it enables gears to turn in the same direction.

## Teaching guidelines

- Study the drawings in the Learner's Book to ensure that the learners understand that gears meshed together turn in opposite directions.
- Explain how by using a small idler gear between two gears you can cause the drive to turn in the same direction.
- The idler gear is driven by the driver gear; it is not connected to the motor or driving force directly.

## Background knowledge

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 are 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 one with the larger radius (more teeth) experiences a larger torque than the smaller one.

| **Activity 1** | **Make and test cardboard gears** | Learner's Book page 69 |
|---|---|---|

## Guidelines to implement this activity

- This is a pair activity.
- If you have access to plastic gear kits these are ideal to enable learners to assemble large chains of gears and play with combinations which increase or decrease speed.
- However, making cardboard gears out of corrugated cardboard is just as effective and less costly.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Can follow instructions to make the gear wheels? | | | |
| Can demonstrate an understanding of gear rotation? | | | |

Review Copy

| **Activity 2** | **Sketch gears** | Learner's Book page 70 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- The learners need to make freehand sketches of a simple gear and idler system with a heading and labels.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Made a neat sketch with the correct symbols? | | | |
| Added labels and a heading? | | | |

## Activity 3 Understand input and output speeds

Learner's Book page 72

### Guidelines to implement this activity

- This is an individual activity.
- Demonstrate the calculations.
- Make sure learners understand how to calculate the ratios and output speeds.
- Learners copy and complete the table.

### Background knowledge

Calculate the gear ratio:

input $\frac{90}{30} = \frac{3}{1} \rightarrow 3:1$

output

If the RPM of the larger input gear is 120 RPM, we multiply this by 3 which means the output gear is turning at 360 RPM. If, however, the input gear is smaller than the output gear, we divide the RPM by the ratio number.

### Suggested answers

| Input (effort) | Output (load) | Input RPM | Ratio | Output RPM |
|---|---|---|---|---|
| 25 | 75 | 120 | 1:3 | 40 |
| 20 | 120 | 120 | 1:6 | 20 |
| 80 | 20 | 200 | 4:1 | 800 |
| 40 | 200 | 150 | 1:5 | 30 |
| 75 | 25 | 180 | 3:1 | 520 |

**[10 marks]**

Review Copy

### 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.

## Remediation/Remedial activity

Learners need to do corrections where necessary.

# Unit 5 Cams and cranks

Learner's Book page 73

## Unit overview

In this unit the learners will learn about the cam. They will learn about the snail cam and the eccentric wheel.

## Teaching guidelines

- Cams are useful devices in that they change the rotational speed produced by the electric motor driving a geared system into a reciprocating or linear movement which is able to give a pull-push movement.
- The engineer or designer designs the cam to give a specific amount of rise and fall of the follower. The follower is the part which is resting on the surface of the cam. They can design the cam to give specific actions to the follower. For example:
- It can give a steady rise as the cam turn and a quicker fall once it has reached its specific height.
- It can give a quick rise and a slow fall.
- It can give a steady rise and a steady fall.
- It can give a steady rise and stay stationary at the maximum height for a short time before falling. This stationary position is known as dwell.
- In the case of the snail cam it rises steadily to a specific height and then drops suddenly before starting to rise again.

Review Copy

**TIP!** Remind the learners that in the section where we talked about structures, we mentioned that the human body is itself a frame structure. Therefore parts of the body can be equated with links in a structure.

### Background knowledge

**The eccentric wheel**

The eccentric wheel is usually used in combination with a crank to give a pull-push movement. The pin is fixed near the outer edge of the wheel so that as the wheel rotates the crank link is pulled or pushed backwards and forwards. In old-fashioned steam trains this mechanism could be clearly seen driving the wheels of the train. In most machines this mechanism would be enclosed and therefore not easily seen. The backwards and forwards movement of the windscreen wipers on a car is produced by a link mechanism driven by an eccentric wheel.

## Activity 1 Make a model of a power saw

Learner's Book page 75

### Guidelines to implement this activity

- This is an individual activity.
- Learners use corrugated cardboard to draw shapes and cut them out.
- They have to mount the parts on another piece of cardboard.

### Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Can follow instructions from a picture? | | | |
| Can demonstrate how their mechanism works? | | | |
| Can show clearly the difference between the cam and the snail cam? | | | |

Review Copy

## Activity 2 Draw a freehand sketch

Learner's Book page 75

### Guidelines to implement this activity

- This is an individual activity.
- The learners need to make freehand sketches with headings and labels.
- There should be a distinct difference between the two cams.

### Assessment guidelines

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

| Criteria<br>The learner(s): | Yes | Partly | No |
|---|---|---|---|
| Drew neat freehand sketches? | | | |
| Distinguished between the two different cams? | | | |
| Added headings and labels? | | | |

## Activity 3 Make a child's toy

Learner's Book page 76

### Guidelines to implement this activity

- This is an individual activity.
- The flying pig in the picture was made using a crank to provide an up-and-down movement.
  - Supply the learners with:
  - thick wire for the crank
  - string
  - piece of cork
  - corrugated cardboard
- The learners need to plan first by sketching and then make it as neatly as they can.
- Make a similar toy using a different animal or shape.

### Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Made a neat sketch with labels for their ideas? | | | |
| Used the available materials to make a working model? | | | |
| Made an additional toy using different pictures? | | | |

Review Copy

## Activity 4 Draw a freehand sketch

Learner's Book page 76

### Guidelines to implement this activity

- This is an individual activity.
- The learners need to make freehand sketches with headings and labels.
- The drawings should be enhanced to make them more realistic.

### Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Drew neat freehand sketches? | | | |
| Added labels? | | | |
| Enhanced the sketches? | | | |

# Term 1 Mini-Practical Assessment Task

Learner's Book page 78

## Overview

The learners are going to work as a team to solve the problem of lifting a bag of cement or other heavy object onto the back of a bakkie. The size of the teams will depend on the numbers in your group but I suggest that four members in each team is best. Stress that although they are working as a group,each person must make a contribution to the work. It is not just a matter of letting one person do all the work whilst the others watch.
The solution to the problem could be as simple as a plank of wood and a wheelbarrow but in the scenario it states that they can use gears, pulleys, cranks and cams. They don't have to use all of these but they need to include one or more into their solution.

## Resources

Glue, various types of cardboard, string, thin dowel rod, elastic bands, sellotape, basic tools for cutting cardboard.

## Teaching guidelines

- Although the Mini-PAT is an assessment project you should not expect learners to be able to design and arrive at solutions or to be able to make models without guidance.
- You will need to spend time discussing each aspect of the project and helping them to come to practical solutions.
- Before they start this activity you will need to have done a lot of planning and collecting of material.

Review Copy

### Evaluation skills

| Activity 1 | Evaluate complex structures | Learner's Book page 78 |
|---|---|---|

### Guidelines to implement this activity

- This is an individual activity.
- Learners read and answer the questions.

### Suggested answers

1 The low coffee table is the strongest✓. It has a wider base and a low centre of gravity✓.
2 Advantages: Low centre of gravity✓, very stable,✓ wide base, big surface.
Disadvantages: Very low.✓

3 Learners' own discretion.✓
4 It does not have a very wide base✓ and the stand is quite high. (Does not have a low centre of gravity.)
5 Wider base,✓ shorter stand.✓Heavier base.✓ Own discretion needed.

[10 marks]

Design skills

| Activity 2 | Sketch initial ideas and evaluate them<br>Learner's Book page 80 |
|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- Learners have to develop their own ideas.
- Make sketches of two ideas.
- Learners discuss their initial ideas in a group.
- Learners choose one of these designs to make.

## Assessment guidelines

- Use the rubric below to assess the learners.

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Sketched two ideas? | | | |
| Added headings and labels? | | | |
| Made a list of all possible improvements and advantages? | | | |
| Made sketches that are neat and complete? | | | |

[20 marks]

Review Copy

# Making skills

| Activity 3 | Draw up a design brief | Learner's Book page 80 |
|---|---|---|

## Guidelines to implement this activity

- Learners need to write a detailed design brief complete with specifications and constraints.

## Suggested answers

As a team, design a mechanism✓ that will help a person lift 50kg✓ bags of cement onto the back of a bakkie.✓ The designs should include gears, pulleys, cranks and cams.✓ The designs need to have a frame structure to contain and support the mechanism.✓

[5 marks]

| Activity 4 | Make a 3D isometric projection, a 2D working drawing and a model | Learner's Book page 81 |
|---|---|---|

## Guidelines to implement this activity

Before starting to make the model, discuss the safety aspects. Some are listed in the Learner's Book but other issues which could be included are neatness and tidiness in the workroom.

## Suggested answers

- Returning equipment to the correct storage area after use.
- Putting lids back on glue containers so that they don't dry out.
- Tidying up waste material and putting it in the bin.
- Concentrating on their project and not on what others are doing.
- Discussing things in an orderly manner and not shouting each other down.
- Asking for help when things are not working properly.

**Making the model - practical work**

- Once again it is important to stress that they are a team and whilst they might make just one model each person must participate.
- Each person must make a 2D drawing which includes dimensions.
- The model should clearly demonstrate how their system works. Note, it does not have to be a full-size model and it can be made out of scrap material to represent the metal which would be used in the manufactured design.

Review Copy

# Communication skills

| Activity 5 | Presenting your ideas to the class | Learner's Book page 82 |
|---|---|---|

## Guidelines to implement this activity

Each group needs to make a presentation of their solution to the whole class. The presentation should involve each member of the team explaining one aspect of their work.

- This activity is not intended for assessment
- This allows learners to advertise and discuss their product with the rest of the class.

## Suggested answers

- One could explain their initial thinking and some of the solutions.
- Another could explain the drawings.

- Another member could explain some of the difficulties they had and how they solved them.
- The fourth member can explain and demonstrate the model.

**What can you assess?**

The best way to assess this type of group project is to use a chart. The one below is a guide but can be added to where you feel there are other aspects which need to be assessed.

| Scoring | | | | | Learners in the group | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5 – Very high standard of work | | | | | | | | | |
| 4 – Good solution to the problem | | | | | | | | | |
| 3 – Solution but needs more development | | | | | | | | | |
| 2 – Attempt made but shows lack of effort | | | | | | | | | |
| 1 – Poor standard | | | | | | | | | |
| 0 – No work produced | | | | | | | | | |
| | | | | | | | | | |
| Assessment categories | | | | | | | | | |
| Group co-operation | | | | | | | | | |
| Initial ideas | | | | | | | | | |
| Development of ideas | | | | | | | | | |
| Use of mechanical systems | | | | | | | | | |
| Sketches | | | | | | | | | |
| Working drawings | | | | | | | | | |
| Model | | | | | | | | | |
| Presentation – communication | | | | | | | | | |

**[40 marks]**

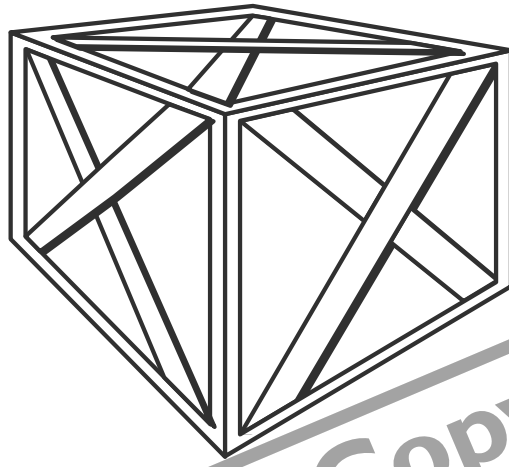
Review Copy

# Term 1 Exemplar test memorandum

Learner's Book page 83

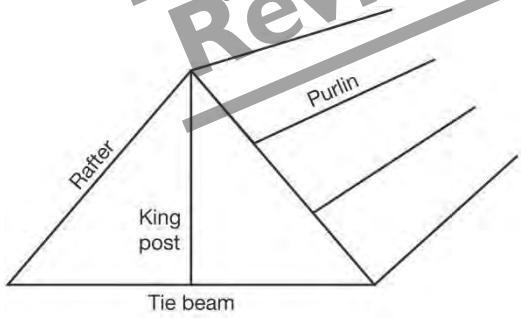
**Structures-+**

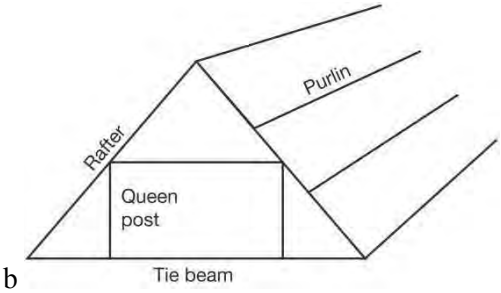
1 Frame construction.✓✓
2 Stronger, harder materials that last for a long time.✓✓
3 Materials that bend easily.✓✓
4 Cross bracing or triangulation.✓✓



5 Riveting and welding.✓✓
6 A lintel is a reinforced concrete beam used to support brickwork above a door or window in a building.✓✓

Review Copy



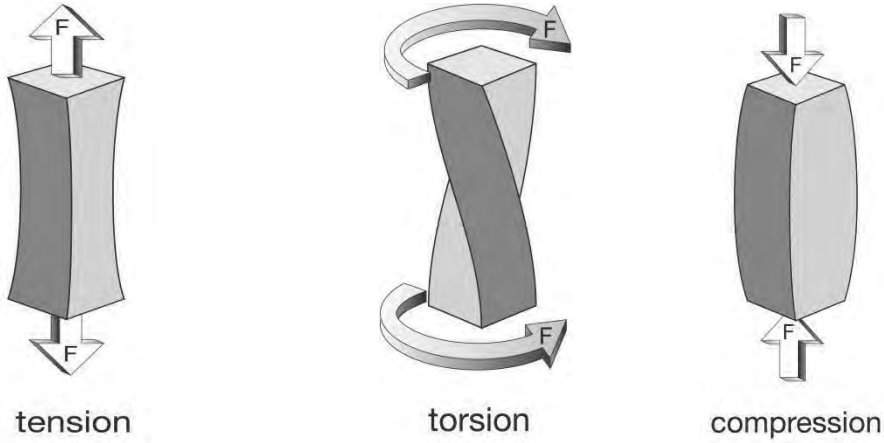

7 a b

King post tie beam strut purlin rafter (7 marks)

Answer - See the diagram in the textbook.

8

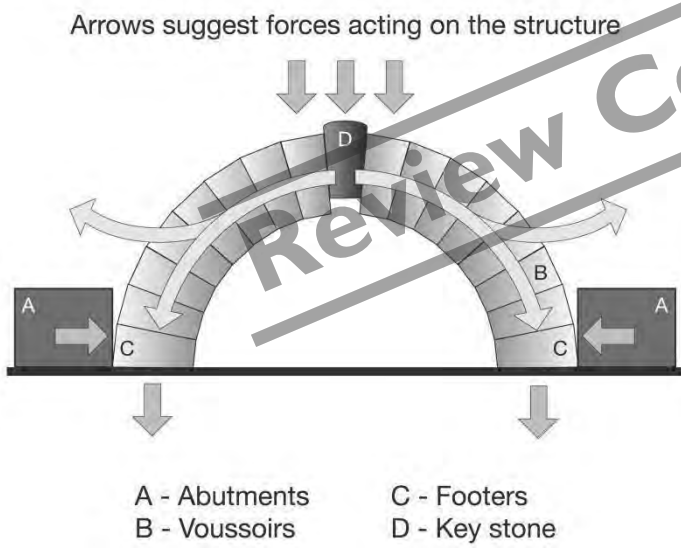
a. b. c.




(6 marks)

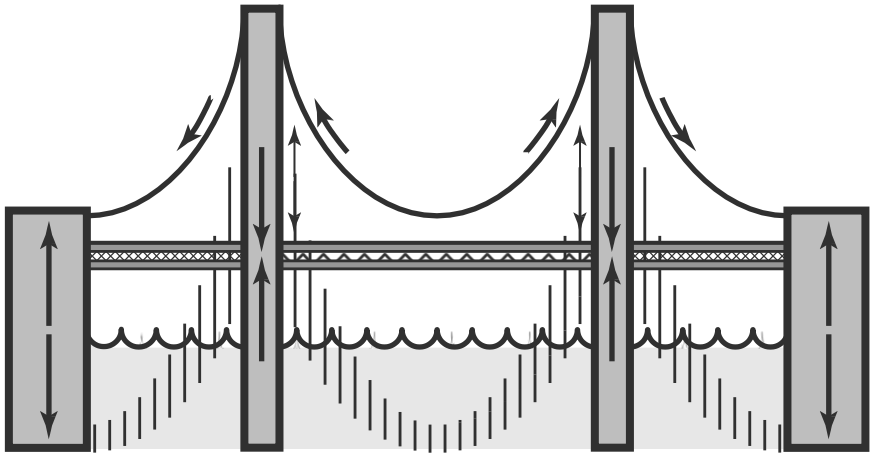
9 a.

Forces carried by arch bridge




Review Copy

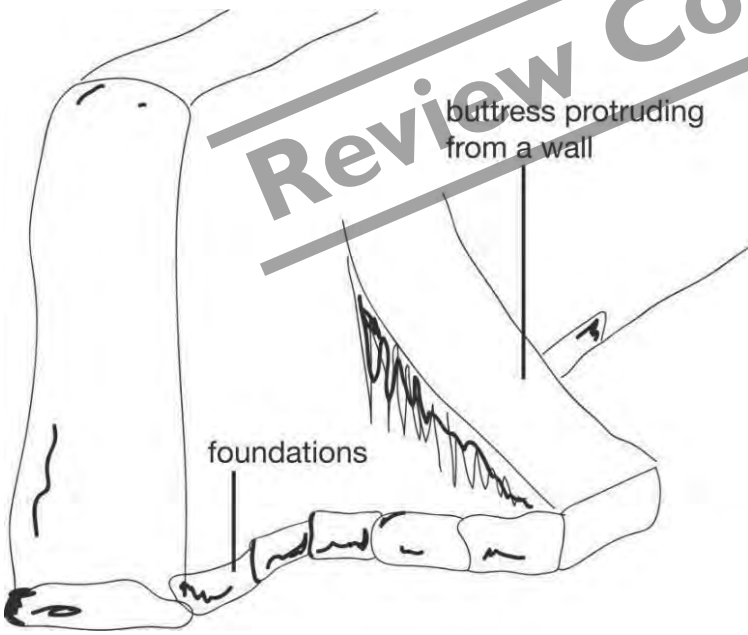
b. Forces carried by suspension bridge



(4 marks)

10 Two of the following:
They require less material to make them than other bridges.
They are quicker to build.
They look slender and less bulky than other bridges.
Because only one supporting tower is needed they don't disrupt activity below the bridge. (2 marks)

11




Review Copy

(2 marks)

**Mechanical systems and control**

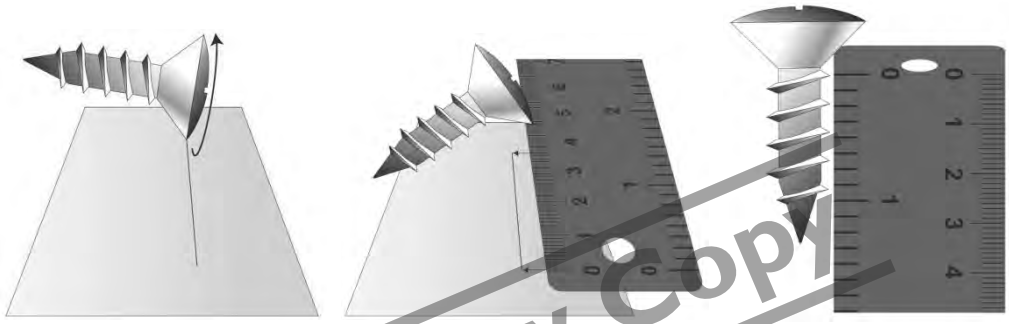
1 Mechanical advantage (MA) = $\frac{\text{load}}{\text{effort}}$ or $\frac{\text{output force}}{\text{input force}}$

2 135 ÷ 5 = 27N

3 A wedge or inclined plane.

4 (4 marks)

5



Review Copy

(4 marks)

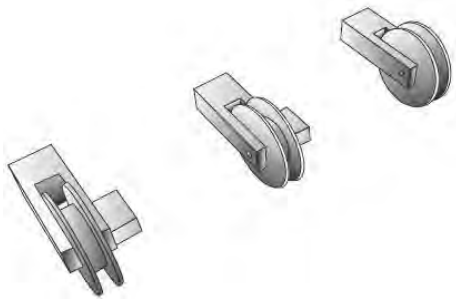
Measure the distance around the head of the screw. You can do this by rolling it over a piece of paper. Mark the starting point and the finishing point after one revolution and use a ruler to measure the distance between the marks.

Measure the distance between the threads. This distance is known as the pitch.

Divide the first number by the second – this gives you the mechanical advantage.

Repeat the experiment with different size screws and see which gives the greatest mechanical advantage.

6



(2 marks)

7 Brass (1 mark)

8 Clockwise direction at 30 RPM.(2 marks

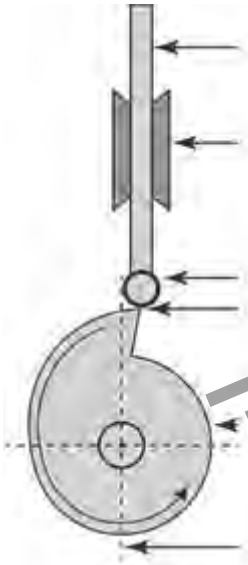
9 Make a sketch to show two gears connected by an idler gear. Explain the advantage of this system. (3 marks)

Answer – See diagram in the textbook on page 69.

10 Copy and complete this table: (4 marks)

| Input (effort) | Output (load) | Input RPM | Ratio | Output RPM |
|---|---|---|---|---|
| 20 | 60 | 120 | 1:3 | 40 |
| 80 | 40 | 50 | 2:1 | 100 |
| 40 | 80 | 160 | 1:2 | 80 |
| 40 | 200 | 150 | 1:5 | 30 |

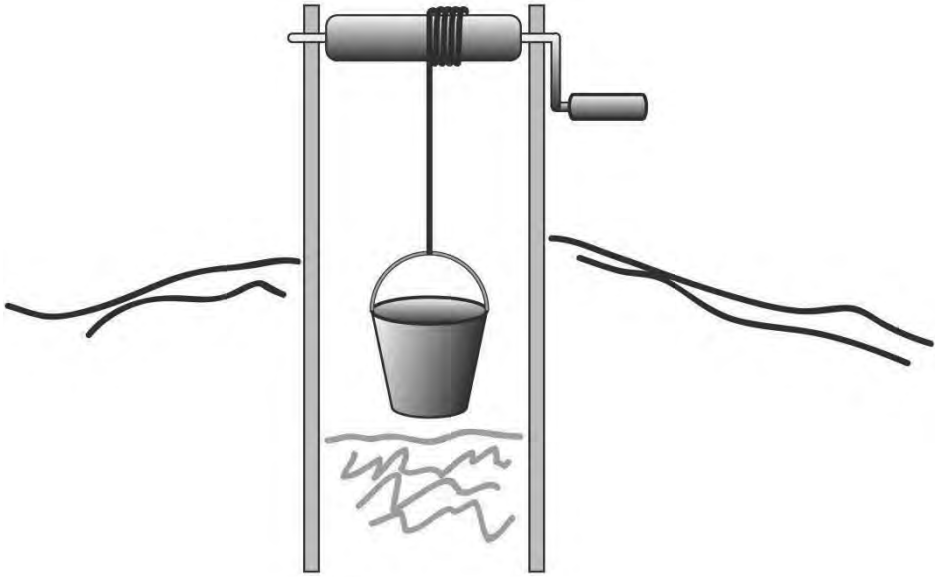
11



Review Copy

(3 marks)

12



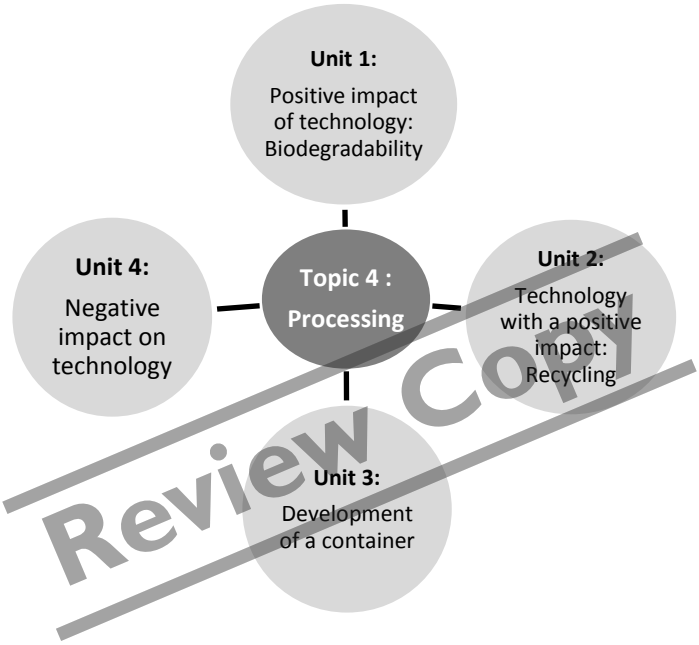
(3 marks)

Total marks 60÷ 2 = 30%

Review Copy

# Topic 4 Processing

## Core concepts covered




Review Copy

## Topic overview

- The learners will engage with the idea of biodegradability and the impact of using plastic products that are not biodegradable. They will engage with the idea of recycling cellulose materials into paper and record the process in a flow chart.
- Finally, this topic covers the considerations when selecting materials to build a recycling container.
- Learners will design, draw, make and evaluate their own recycling container for a chosen category of waste product.

## Content

| Unit | Content | Pacing (time allocation) | LB page |
|---|---|---|---|
| 1 | Positive impact of technology: Biodegradability | 2 hours | 86–87 |
| 2 | Technology with a positive impact: recycling | 2 hours | 88–89 |
| 3 | Design a container | 2 hours | 90–93 |
| 4 | Negative impact on technology | 2 hours | 94 |
| | Mini-PAT | 10 hours | 97 |

# Unit 1 Positive impact of technology: Biodegradability

Learner's Book page86

## Unit overview

In this unit learners engage with the idea of biodegradability and the impact of using plastic products that are not biodegradable. It then explains how plastics pollution can be reduced through recycling.

Review Copy

### Teaching guidelines

- Learning in this unit is based on photos and text supplied and learners' own experience.
- Use examples that the learners can relate to.
- Let the learners discuss certain aspects and then convey their findings to the rest of the class.

### Activity 1 Investigate the impact of plastic and write a report

Learner's Book page 87

#### Guidelines to implement this activity

- This is a group and an individual activity.
- Sections 1 and 2 are group discussion based. The teacher could organise learners into groups of 4.
- In Section 3 each learner must write a report for homework, which can be formally marked.

#### Assessment guidelines

This activity is intended for formal assessment.

Use the rubric below to assess learners.

| Criteria | 1-2 | 3-4 | 5 |
|---|---|---|---|
| Criteria: | | | |
| Recording of research on use of plastic bags | | | |
| Recording of research on use of fibre bags | | | |
| Suitable reasons for use of plastic over fibre | | | |
| Structure of written report | | | |

[20 marks]

# Unit 2 Technology with a positive impact: Recycling

Learner's Book page 88

## Unit overview

In this unit learners engage with the idea of recycling cellulose materials into paper and record the process in a flow chart. They then learn how cardboard packaging is designed as a 'development'.

## Teaching guidelines

- Learning in this unit is based on photos and text supplied.
- Teacher needs to arrange for some matchboxes, tomato boxes and thick paper or thin cardboard for the packaging activity.
- Class discussions are one of the best tools for learning in this unit.

Review Copy

### Activity 1 Investigate recycling waste paper and cardboard

Learner's Book page 89

### Guidelines to implement this activity

- This is a group and individual activity.
- In part 1, learners work in groups of 4 to read and discuss the case study about making paper out of elephant dung.
- Give them 20 minutes in class to do this and then organise a class discussion.
- Parts 2 and 3 are suitable for individual homework to be assessed.

### Suggested answers

See assessment rubric.

### Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Researched and explained the main stages of processing scrap paper and cardboard into new products? | | | |
| Drew a neat manufacturing flow chart? | | | |
| Added suitable labels and headings? | | | |
| Included relevant content? | | | |

# Unit 3 Design a container

Learner's Book page 90

## Unit overview

In this unit the learners will study the basic steps to the development of a suitable container. The learners will understand why packaging needs to be designed for a specific purpose. The different forces that act on materials will also be discussed.

## Teaching guidelines

- In this unit there is no practical activity since it acts as a resource for the mini-PAT.
- A teacher led class discussion about the information covered will be important.
- Take cardboard containers and "reverse-engineer" them so that the learners can see the different components that make up the packaging.
- The learners should be allowed to investigate the materials used for the packaging and relate them to the purpose of that specific packaging.
- Use the packaging of products that the learners can relate to as this will make the learning process easier.

Review Copy

## Activity 1 Design packaging

Learner's Book page 91

### Guidelines to implement this activity

- This is an individual activity.
- Learners will use a matchbox and copy the development and design.
- The learners will design and make packaging for various objects using cardboard and glue.

### Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Made a neat sketch of the matchbox design? | | | |
| Made a list of the properties of a chosen product? | | | |
| Wrote a complete design brief? | | | |
| Made neat and effective packaging for their product? | | | |

# Unit 4 Negative impact on technology

Learner's Book pages 94

## Unit overview

In this unit the students will discuss batteries and the various ways of recycling toxic and chemical materials.

## Teaching guidelines

Everyone knows what batteries are. We have all used batteries at some stage, but not many know of the correct ways of disposing of used batteries.
Use concrete examples when explaining this concept to the learners.
You could even start a battery recycling project at your school if time allows.

Review Copy

### Activity 1 Discuss batteries

Learner's Book page 94

#### Guidelines to implement this activity

- This is an individual activity
- Learners need to set up a table to record the data that they gather.
- The learners need to read the instructions in the learners book in order to complete the activity.

#### Assessment guidelines

This activity is intended for informal assessment.

### Activity 2 Research project

Learner's Book page 95

#### Guidelines to implement this activity

- This is a pair activity
- Learners will need access to a library or the internet.
- They need to look for ways to reduce the environmental impact of used batteries.
- They will make notes and write a report.

- A class discussion could be held so that learners can share their ideas with one another.
- The aim of this activity is to discuss various solutions.

### Assessment guidelines

This activity is intended for informal assessment.
The learners observe one another as they present their ideas to the rest of the class.

## Term 2 Mini Practical Assessment Task

Learner's Book page 97

## Overview

Learners need to follow the technological process of designing, making, evaluating and communication to complete this Mini-PAT. They will need to investigate, design and come up with solutions on how to dispose of and recycle used batteries.

## Teaching guidelines

- Explain each activity to the learners to make sure they understand what is expected of them.
- Assist learners only if it is really necessary.

Review Copy

**Activity 1** **Reduce the impact** Learner's Book page 97

### Guidelines to implement this activity

- This is an investigation activity. Learners investigate different methods of reducing the impact of used batteries
- Learners need to make notes on various solutions.
- This activity is not intended for assessment.

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Chose a relevant product that has an impact on the environment? | | | |
| Made a working design? | | | |

[10 marks]

Learners design✓, draw✓, make✓ and evaluate✓ their own recycling container for a chosen category of waste products. ✓

[5 marks]

Learners brainstorm about strengthening techniques. Not intended for assessment.

## Assessment guidelines

Use the rubric below to assess learners.

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Drew neat free-hand sketches of two possible solutions? | | | |
| Added labels and headings? | | | |

[10 marks]

**Activity 2** **Make accurate drawings and build your container**

Learner's Book page 97

## Guidelines to implement this activity

- This is an individual activity.
- Learners make a neat isometric drawing of their design.
- Learners must make their container.

## Assessment guidelines

Use the rubric below to assess learners.

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Chose a design and make a neat 3D isometric drawing of it | | | |
| Their drawing showed measurements, labels, logos and decorations | | | |
| Made the container, either full size or as a smaller, scale model | | | |
| Made the drawing according to a given scale? | | | |

[20 Marks]

Review Copy

**Activity 3** **Evaluate and communicate** Learner's Book page 97

## Guidelines to implement this activity

- Learners will need to evaluate their product and drawings using the questions in the Learners' Book.

## Assessment guidelines

Use the rubric below to assess the learners.

| Criteria | 1 | 2 | 3-5 |
|---|---|---|---|
| **The learner(s):** | | | |
| Made neat and complete drawings? | | | |
| Made a product that resembles the final design? | | | |
| Is the product a functional recycling container? | | | |
| Made notes on possible improvements? | | | |
| Presented their product using drawings and the product? | | | |

[25 marks]

Mini–PAT total: 70 marks

Review Copy

# Term 2 Exemplar test memorandum

Learner's Book page 98

**Question 1**

jute✓, calico✓, hessian✓, linen✓ and paper✓ (5)

**Question 2**

**Biodegradable:** can be broken down by natural processes✓ such as sunlight, water, bacteria and fungi. Natural materials break down quickly, plastic usually takes years. ✓**Recycling:** To melt, break down ✓and create another product from the existing materials✓ (2)

**Question 3**

| Advantages | Disadvantages |
|---|---|
| Cheap ✓ | Non-biodegradable ✓ |
| Easy to mould ✓ | Pollutes oceans ✓ |
| Can be recycled ✓ | A lot is wasted ✓ |

Use own discretion. Any good answers (6)

**Question 4**

The problem comes when we throw it away. ✓ The wind blows plastic bags into the veld and rain washes them into our rivers and oceans. ✓ In water, plastic bags are not biodegradable; ✓ they break into small pieces and last for years.✓ Sea turtles are especially harmed by plastic pollution. Many turtles are found dead with plastic bags in their stomachs. They think these floating bags are jellyfish and eat them.✓ (5)

Review Copy

**Question 5**

Firstly biodegradable plastic bags✓ can be made from natural materials like starch. ✓ These bags turn into compost in the ground and leave no poisons behind. If they are swallowed by animals they digest quickly. ✓

Secondly by law, all supermarket bags must now be made thicker✓ so that it is worthwhile reusing or recycling ✓them instead of just throwing them away. Recycling plastic not only reduces pollution, it also creates thousands of new jobs. ✓

(6)

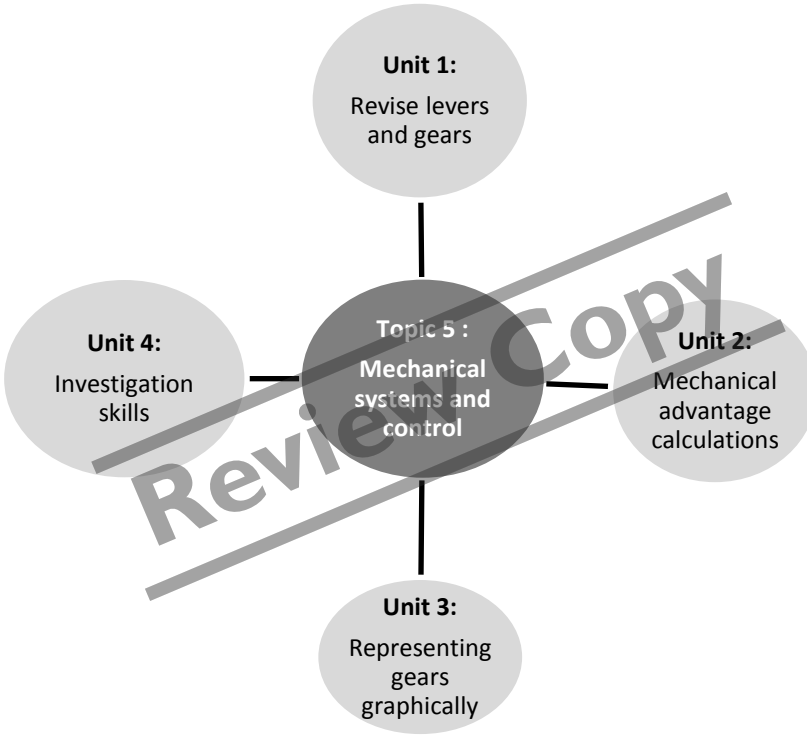
**Question 6**

tension✓, compression, ✓ shear✓, bending✓, torsion (any four correct answers) (4)

**Total: 30 marks**

# Topic 5 Mechanical systems and control

## Core concepts covered




Review Copy

## Topic overview

In this topic the learners will revise levers and gears as well as do more extensive calculations on determining mechanical advantage. They will be introduced to drawing gears using the correct symbols and conventions and finally investigate solutions for a mining issue. The topic ends off with a mini-PAT.

## Content

| Unit | Content | Pacing (time allocation) | LB page |
|---|---|---|---|
| 1 | Revise levers and gears | 2 hours | 100–107 |
| 2 | Mechanical advantage calculations | 2 hours | 108–112 |
| 3 | Representing gears graphically | 2 hours | 113–117 |
| 4 | Investigation skills | 2 hours | 118–122 |
| | Mini-PAT | 8 hours | 124–128 |

# Unit 1 Revise levers and gears

Learner's Book page 100

## Unit overview

- Learners will revise the three classes of levers and calculate the mechanical advantage given or not given for various scenarios.
- The learners will draw lever diagrams to represent different objects.
- Gear systems will be revised as well as calculating gear ratios and RPM speeds.

## Teaching guidelines

- Briefly revise the difference between the three classes of levers. Spend more time on the calculations of mechanical advantage.
- Make sure that learners use the correct symbols when drawing the lever diagrams.
- This unit is mainly revision. Self-study can be implemented.
- Try and obtain concrete examples when revising the different levers and show what is meant by mechanical advantage for each object.
- Learners need to use a compass to draw the gears as they are represented by circles.

Review Copy

### Background knowledge

Machines come in all shapes and sizes. Some are used in factories, some in our homes and if you look around your school, you will find examples there too. All machines have one thing in common: the fact that they all do work. Machines make our work easier, because they give us a mechanical advantage (MA). Perhaps one of the simplest and earliest examples of a machine is the lever.

| Activity 1 | Draw a first-class lever | Learner's Book page 102 |
|---|---|---|

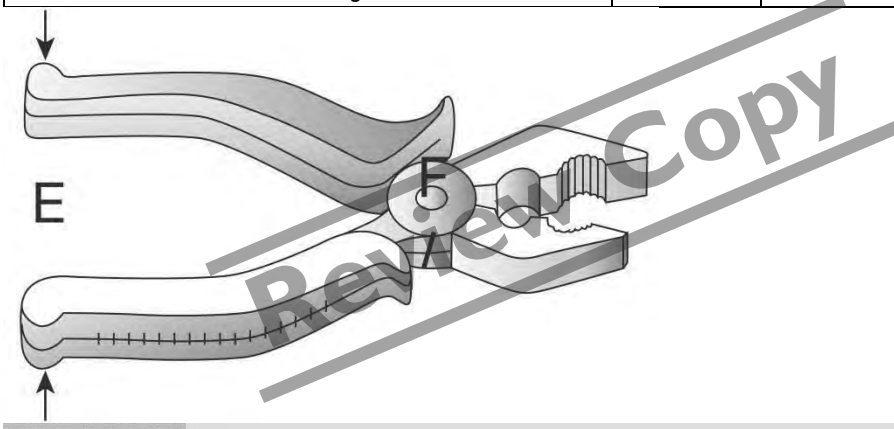
## Guidelines to implement this activity

- This is an individual activity.
- Learners have to draw neat freehand sketches of a pair of pliers, not a diagram, but a realistic sketch.
- They have to add labels and a heading.

## 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 neat freehand sketch of the pliers | | | |
| Labelled the sketch | | | |
| Enhanced the sketch with shading and colour | | | |




Review Copy

| Activity 2 | Compare the mechanical advantage in scissors and secateurs | Learner's Book page 102 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- Learners calculate and compare the mechanical advantage between the two objects.
- Explain each step to the learners to ensure that they know what is expected of them.

## Assessment guidelines

- This activity is intended for informal assessment.
- Assess learners informally. Allocate learners a mark and give them feedback on their performance to prepare them for formal assessment.

| Activity 3 | Draw and sketch levers | Learner's Book page 103 |
|---|---|---|

## Guidelines to implement this activity

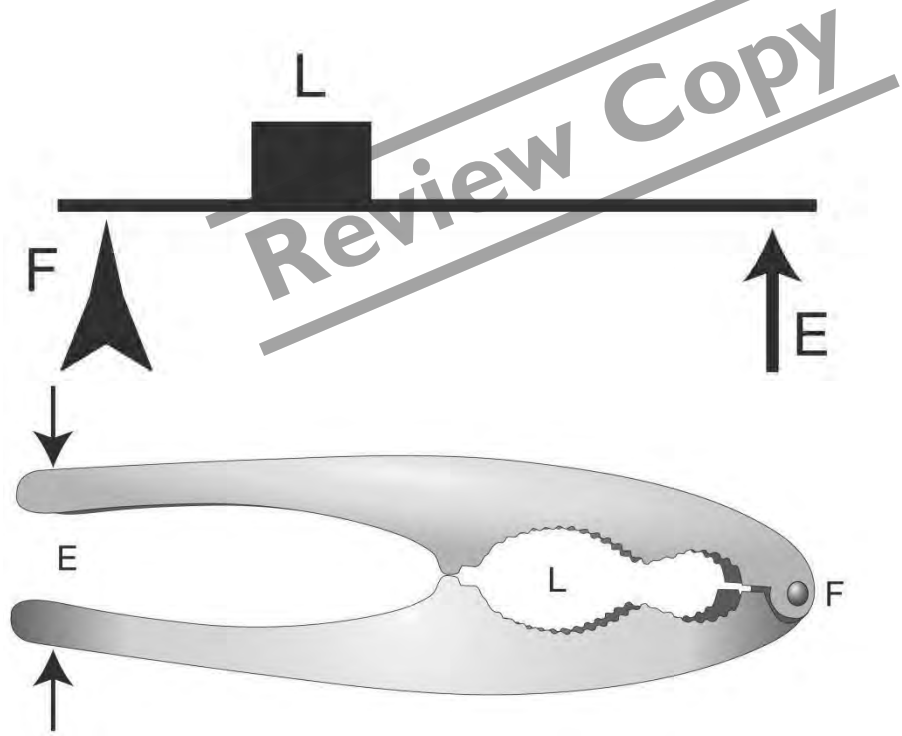
This is an individual activity.

- Learners have to draw a line diagram of a second-class lever.
- They have to add labels and a heading.
- Learners then draw a neat sketch of the nutcracker.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Made a neat line drawing of the class 2 lever | | | |
| Drew a neat freehand sketch of the nutcracker | | | |
| Labelled the sketch | | | |
| Enhanced the sketch with shading and colour | | | |




Review Copy

## Remedial

Give the learners concrete examples of levers (the type of lever does not matter). Allow the learners the learners to make sketches of these mechanisms and let them draw the diagrams that represent each mechanism.

| Activity 4 | Examine a pair of nail clippers | Learner's Book page 105 |
|---|---|---|

### Guidelines to implement this activity

This is a pair activity.

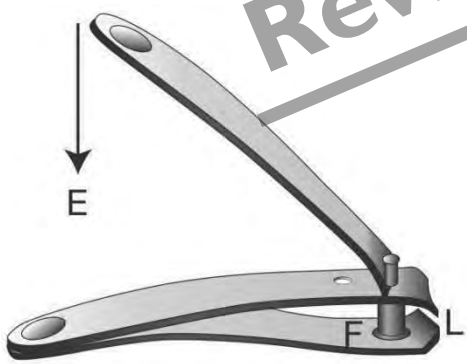
- Learners will draw and investigate the picture of a pair of nail clippers.
- The pairs will discussed the lever found in the nail clippers and label their drawings.

### Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Made a neat drawing of the nail clippers | | | |
| Labelled the sketch | | | |
| Wrote a detailed description on how the nail clippers work | | | |

Review Copy




| Activity 5 | Complete this crossword puzzle | Learner's Book page 105 |
|---|---|---|

### Guidelines to implement this activity

- This is an individual activity.
- Learners read through the information in the Learner's Book to complete the puzzle.
- Copy the crossword puzzle and complete. Follow the clues for the correct answers.

## Suggested answers

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 1m | | | 2s | | |
| | | 3e | | | e | | | a | | |
| | | 4 f | u | l | c | r | u | m | | |
| | | f | | | h | | | e | | |
| 5c | r | o | w | b | A | r | | | | |
| O | | r | | | N | | | | | 6l |
| M | | t | | 7p | l | v | o | t | | E |
| P | | | | | C | | | | | V |
| O | | 8a | d | v | A | n | t | a | g | E |
| U | | | | | L | | | | | R |
| n | | | | | | | | | | |
| 9d | i | s | t | a | n | c | e | | | |

[10]

Total: 10 marks

Review Copy

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the memorandum 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 6 Calculate RPM

Learner's Book page 107

### Guidelines to implement this activity

- This is an individual activity.
- Demonstrate the calculations.
- Make sure learners understand how to calculate the ratios and output speeds.
- Learners copy and complete the table.

### Background knowledge

Calculate the gear ratio:

$$\frac{\text{input}}{\text{output}} \quad \frac{90}{30} = \frac{3}{1} \rightarrow 3:1$$

If the RPM of the larger input gear is 120 RPM, we multiply this by 3 which means the output gear is turning at 360 RPM. If, however, the input gear is smaller than the output gear, we divide the RPM by the ratio number.

### Suggested answers

| Input (effort) | Output (load) | Input RPM | Ratio | Output RPM |
|---|---|---|---|---|
| 25 | 75 | 120 | 1:3 | 40 |
| 20 | 120 | 120 | 1:6 | 20 |
| 80 | 20 | 200 | 4:1 | 800 |
| 40 | 200 | 150 | 1:5 | 30 |
| 75 | 25 | 180 | 3:1 | 520 |

[10 marks]

Review Copy

### 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.

## Remediation/Remedial activity

Learners need to do corrections where necessary.

# Unit 2 Mechanical advantage calculations

Learner's Book page 108

## Unit overview

This unit focuses on mechanical advantage, what it means and how we calculate it for levers as well as gears. It explains that mechanical advantage is the amplification of the input into the output force.

## Teaching guidelines

- Demonstrate the methods in calculating the mechanical advantage in each activity.
- Learners need to understand why these methods are used as it is important for the final assessments.
- Ask learners to demonstrate the calculations to the rest of the class.

### Background knowledge

$$\text{Mechanical advantage (MA)} = \frac{\text{load}}{\text{effort}} = \frac{\text{output force}}{\text{input force}}$$

Review Copy

## Activity 1 Calculate mechanical advantage

Learner's Book page 110

### Guidelines to implement this activity

- This is an individual activity.
- Learners should read the text, identify the lever used, look at the examples and calculate the mechanical advantage given by each lever

### Background knowledge

In the see-saw, the fulcrum or pivot point is in the centre and in order to balance it the weight of each child times the distance from the fulcrum must be equal.

$$\frac{\text{output force}}{\text{input force}} = \frac{30 \times 3}{25 \times 3.6} = \frac{90}{90} \qquad \text{MA} = 1$$

### Suggested answers

1 $\frac{\text{output force}}{\text{input force}} = \frac{1800 \times 0.6}{200 \times 3.3}$ ✓ $= \frac{1080}{660}$ ✓ ✓ MA > 1✓

2 The car is the load at one end of the lever ✓

3 Class 1 lever✓ [7 marks]

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the suggested answers supplied to assess learners informally. Allocate learners a mark out of 7 and give them feedback on their performance to prepare them for formal assessment.

## Remediation/Remedial activity

Do corrections where needed.

| **Activity 2** | **Calculate ratios** | Learner's Book page 112 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- Demonstrate the method to the learners.
- Learners copy and complete the table.

## Background knowledge

The gear ratio is $\frac{\text{input}30}{\text{Output } 60} = \frac{1}{2} = 1:2$

The force ratio is $\frac{\text{load}180}{\text{effort } 90} = \frac{2}{1} = 2:1$

Review Copy

## Suggested answers

| Number of teeth on output gear | Number of teeth on input gear | Velocity Ratio |
|---|---|---|
| 30 | 20 | 3:2 |
| 40 | 10 | 4 |
| 20 | 30 | 2:3 |
| 40 | 20 | 4:2 |
| 40 | 10 | 4:1 |
| 10 | 20 | 1:2 |

## Assessment guidelines

- This activity is intended for informal assessment.
- Use the memorandum supplied above to assess learners informally. Allocate learners a mark out of 6 and give them feedback on their performance to prepare them for formal assessment.

# Unit 3 Representing gears graphically

Learner's Book page 113

## Unit overview

In this unit learners will be taught to represent gears graphically. They will learn about the convention used for drawing gears. The learners will be given opportunity to investigate the gear system of bicycles.

## Teaching guidelines

- Get a bicycle in the class and demonstrate how the gears work so that the learners can see.
- If time allows give them additional drawing exercises.
- Demonstrate how to draw gear diagrams from ratios.
- Each learners needs to have his/her own compass to draw circles.
- This is a fairly new concept for the learners so spend some more time on this unit and assist where necessary.

Review Copy

## Background knowledge

Gear teeth on a gear wheel are repetitive features. Drawing each individual tooth would take too long and so a convention is used. The details for the type of gear and the number of teeth required would be included in a parts list on the drawing.

**Activity 1** **Representing gears** Learner's Book page 113

## Guidelines to implement this activity

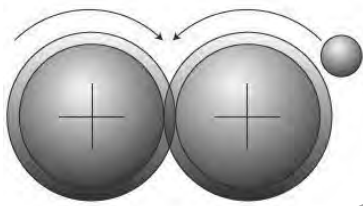
- This is an individual activity.
- There are six drawings that the learners need to make.
- Assist them with the first one and let them do the rest by themselves.

## Assessment guidelines

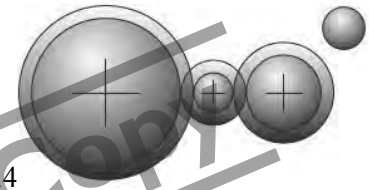
- This activity is intended for informal assessment.

- Use the checklist below to assess learners. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria | 1-2 | 3 | 4-5 |
|---|---|---|---|
| **The learner(s) drew:** | | | |
| Gears with the output gear rotating in the opposite direction to the input gear. (counter rotation)? | | | |
| Gears with the output gear rotating in the same direction to the input. (use an idler gear)? | | | |
| The driven gear rotating faster than the input? | | | |
| The driven gear rotating faster than the input and using an idler gear? | | | |
| The driven gear rotating slower than the input? | | | |
| The driven gear rotating slower than the input and using an idler gear? | | | |

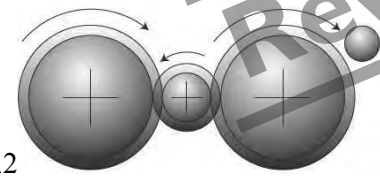


1.1

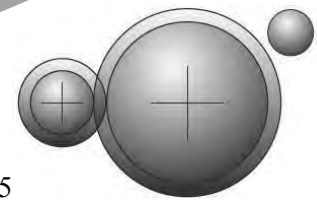


1.4

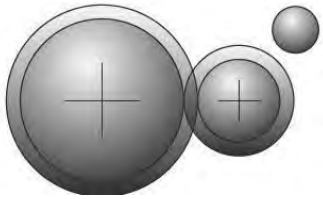
Review Copy



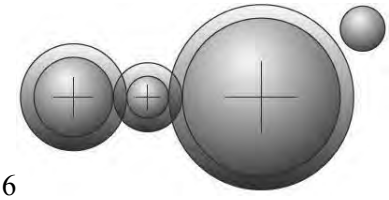
1.2



1.5



1.3



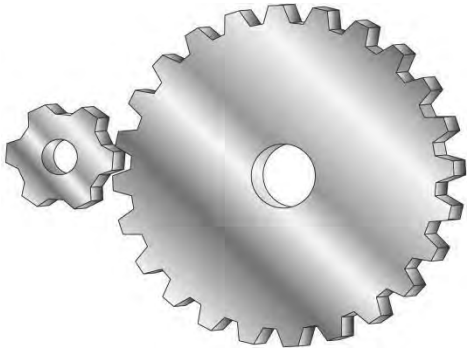
1.6

| Activity 2 | Write a design brief and draw sketches |
|---|---|

Learner's Book page 114

## Guidelines to implement this activity

- This is an individual activity.
- Learners have to write two design briefs for devices which will use a combination of gears to achieve the following:
- A mechanical advantage with force multiplication of three times.



- An increase in output velocity of four times.

Review Copy

## Assessment guidelines

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

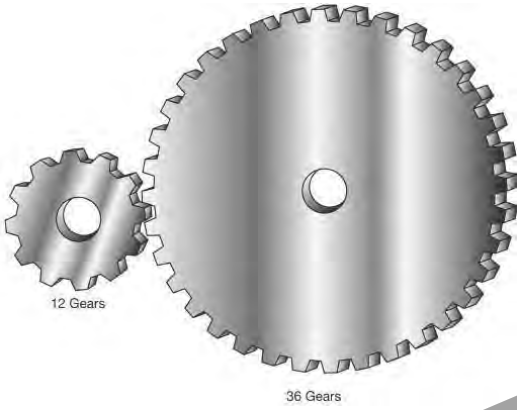
| Criteria | Yes | Partly | No |
|---|---|---|---|
| The learner(s): | | | |
| Identified a mechanism with a force multiplication of 3 times? | | | |
| Identified a mechanism with an increase in output velocity of 4 times? | | | |
| Wrote two complete design briefs? | | | |

| Activity 3 | Sketches of gear systems | Learner's Book page 114 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- Learners need to make sketches of given gear systems:

  A 2D sketch to show a gear system where the output force is four times greater than the input force ( MA = 4 : 1).




  A 2D sketch to show a gear system which provides the rotation on the output gear (driven gear) at 90° to the input gear (driver axle).

Review Copy

## Assessment guidelines

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

| Criteria<br>The learner(s): | 1-2 | 3-4 | 5 |
|---|---|---|---|
| Made a 2D sketch to show a gear system where the output force is four times greater than the input force ( MA = 4 : 1)? | | | |
| Made a 2D sketch to show a gear system which provides the rotation on the output gear (driven gear) at 90° to the input gear (driver axle)? | | | |
| Sketches are neat? | | | |

## Activity 4 Analyse bicycle gears

Learner's Book page 115

## Guidelines to implement this activity

- This is a group activity. (demonstration)
- Divide learners into groups of 4-5.
- The learners will need:
- pencil and paper
- measuring tape
- Learners will need to investigate the gears on the bicycle and perform various calculations and come with conclusions and reasons for their comparisons.

Review Copy

## Assessment guidelines

- This activity is not intended for assessment.

## Activity 5 Calculate the difference between high and low gears

Learner's Book page 116

## Guidelines to implement this activity

- This is a group activity.
- Learners will calculate the differences between the high and low gears by counting the amount of teeth on each gear and using the correct method to calculate the ratios.

## Background knowledge

circumference of wheel = diameter of wheel x pi (pi is 3.14)

## Suggested answers

Answers will be different depending on the bicycle used.

## Assessment guidelines

- This activity is intended for informal assessment.
- Make sure that each learner has completed the investigation and calculations.

| **Activity 6** | **Draw systems diagram** | Learner's Book page 116 |
|---|---|---|

## Guidelines to implement this activity

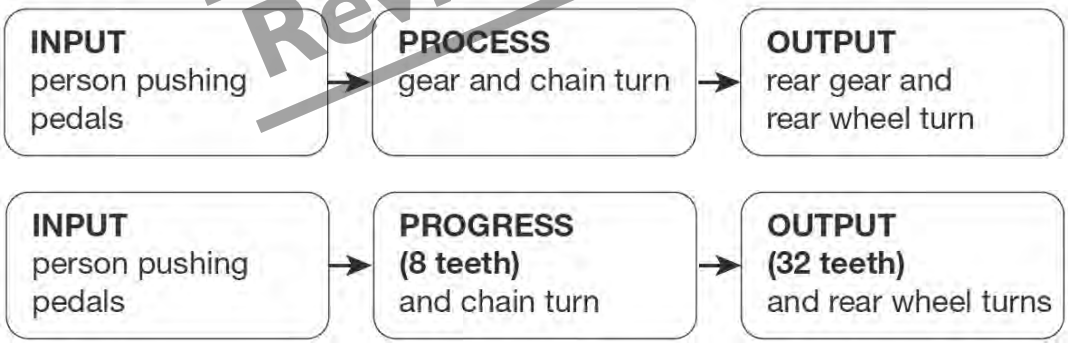
- This is an individual activity.
- Learners will draw a systems diagram for a bicycle. They have to use the three headings and underneath them draw a picture with a brief explanation of what is happening.
- They will draw the system diagram for this gear system where the ratio is 4 : 1.
- Learners need to use a compass when drawing the gear diagram.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Drew a systems diagram of the bicycle? | | | |
| Placed notes under the three headings with explanations? | | | |
| Drew diagrams of the gears with labels? | | | |

Review Copy



## Activity 7 Plan a mechanical system

Learner's Book page 117

### Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 3-4.
- Using their knowledge of gears and systems diagrams, the learners have to plan a mechanical system to help fishermen pull their boat onto a slipway to protect it from the storm.
- Learners need to add drawings and illustrations to explain any additional suggestions or improvements.
- Draw a clear systems diagram for this process.
- Give some three examples of other situations where you could use a ratchet winch.

### 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** | | | |
| Plan a mechanical system to help fishermen pull their boat onto a slipway to protect it from the storm. | | | |
| Drawings and illustrations to explain any additional suggestions or improvements. | | | |
| Draw a clear systems diagram for this process | | | |
| Give three examples of other situations where you could use a ratchet winch. | | | |

Review Copy

## Activity 8 Draw a diagram

Learner's Book page 118

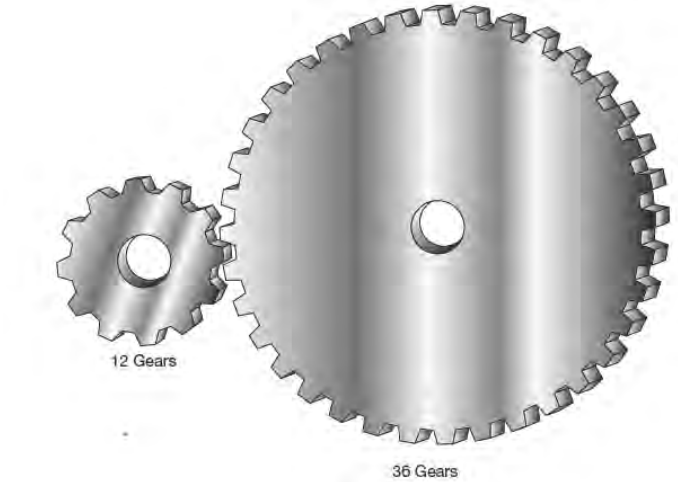
### Guidelines to implement this activity

This is an individual activity.

- Learners have to draw a diagram of the gears using simplified conventions.
- The driven gear has to turn four times faster than the driver gear.
- Learners have to indicate the amount of teeth per gear.

## Assessment guidelines

This activity is intended for informal assessment.




| Mark allocations | 1-2 | 3-4 | 5 |
|---|---|---|---|
| **Assessment criteria** | | | |
| Diagram with simplified conventions | | | |
| Driven gear turns four times faster than driver gear | | | |
| clear systems diagram for this process | | | |
| Labeled the diagram indicating the amount of teeth. | | | |

[20 marks]

Review Copy

# Unit 4 Investigation skills

Learner's Book page 119

## Unit overview

Learners will investigate mines in South Africa regarding their operations and impact on the environment and people. Learners will be given a chance to investigate solutions to certain issues that occur in the mining industry.

## Teaching guidelines

- Read through the investigations with the learners.
- Explain difficult words and concepts that the learners might struggle to understand.
- Give the learners the opportunity to discuss the various issues and raise their opinions with the rest of the class.
- Learners will conduct research on one of four topics.

# Term 3 Mini-Practical Assessment Task

Learner's Book page
124

## Overview

Learners need to follow the technological process of designing, making, evaluating and communicating to complete this Mini-PAT. They will need to investigate, design and come up with solutions on how to construct the shaft head-gear which would be suitable to transport miners up and down the shaft and to lift the ore samples to the surface.

## Teaching guidelines

- Explain each activity to the learners to make sure they understand what is expected of them.
- Assist learners only if it is really necessary.

The learners have to work in teams of four members. They will need:

- A designer
- A quantity surveyor
- A planner
- An environmentalist

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

Review Copy

**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 later 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 there is no delay in construction and they need to indicate exactly when the project is to be complete. 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. Your presentation will need to explain how your proposal is going to limit these effects. In all outdoor engineering projects it is a requirement to submit an Environmental Impact Assessment (EIA).

**Before they start**

- The first task for the team is to decide which role each person should take.
- They must also decide on a name for their company and a logo which will be included on all design drawings, models and any letter heads.
- They are now ready to begin the investigation task.

Review Copy

## Activity 1 Investigate lifting mechanisms

Learner's Book page 126

### Guidelines to implement this activity

- This is an investigation activity.
- Learners have to investigate the pictures and answer the questions.
- Learners are asked to write up an environmental impact assessment
- Use the rubric below to assess learners.

| Mark allocations | 1 | 2 | 3-5 |
|---|---|---|---|
| **Assessment criteria for report** | | | |
| Explanation of environmental impact | | | |
| Specifications mentioned to limit environmental impact | | | |
| Well-structured report | | | |
| Report stays on topic | | | |

[10 marks]

## Activity 2 Draft a report

Learner's Book page 126

### Guidelines to implement this activity

- In all outdoor engineering projects it is a requirement to submit an Environmental Impact Assessment (EIA).
- The learners will need to explain how their proposals will effect the environment.

- they will also need to list the specifications and the way in which they addressed these environmental impacts

## Assessment guidelines

- list of negative impacts on environment
- specifications of structure/product
- improvements to reduce the environmental impact
- can this product have a positive effect to the environment and how?

[10 marks]

| Activity 3 | Sketch initial ideas and evaluate | Learner's Book page 127 |
|---|---|---|

## Guidelines to implement this activity

- Learners use the information they have gathered to sketch various possible solutions.
- Each learner must develop an idea.
- The learners have to evaluate these ideas and select which one they wish to develop further.
- Remind the learners to consider the following questions:
- Does the solution meet the requirements as stated in the scenario?
- Is this solution reasonably easy to manufacture?
- Can it be simplified in any way and if so will it still be effective?
- Is your solution going to be safe to use?

Review Copy

| Mark allocations | 1 | 2 | 3-5 |
|---|---|---|---|
| **Assessment criteria** | | | |
| Did the solution meet the requirements as stated in the scenario? | | | |
| Is this solution reasonably easy to manufacture? | | | |
| Is your solution going to be safe to use? | | | |
| Can it be simplified in any way and if so will it still be effective? | | | |

[10 marks]

| Activity 4 | Create a design brief | Learner's Book page 127 |
|---|---|---|

## Guidelines to implement this activity

- Learners draw up a design brief with specific detail. Could include more detailed sketches.
- The design brief must contain specifications and constraints.
- The learners need to consider the costs involved.

**Design Brief**

Your mechanical engineering company decides to submit a tender for the construction✓ of the shaft head-gear✓ which would be suitable to transport miners ✓up and down the shaft and to lift the ore samples to the surface. ✓ The loads on the system are not to exceed 10 tons (about 1000 kgs) at any one time✓. You will need to research, plan, design, cost evaluate and communicate a ✓solution in order to submit a tender for this project. ✓

[5 marks]

## Activity 5 Draw the shaft head gear

Learner's Book page 127

### Guidelines to implement this activity

- Each learner must draw their own ideas and designs.
- Draw a 3D isometric drawing of the selected design.
- The drawing must be drawn to scale and give the dimensions of the design.
- Make an orthographic (2D drawing) of two views of the design.
- This 2D drawing should also be drawn to scale and should contain major dimensions.

| Mark allocations | 1 | 2 | 3-5 |
|---|---|---|---|
| **Assessment criteria** | | | |
| 3D isometric drawing of the selected design | | | |
| Drawn to scale and give the dimensions of the design | | | |
| Orthographic (2D drawing) of two views of the design | | | |
| 2D drawing should also be drawn to scale and should contain major dimensions | | | |

Review Copy

[15 marks]

## Activity 6 Prepare a budget

Learner's Book page 128

### Guidelines to implement this activity

Learners need to draw up budgets that contain the following:

- expected costs of construction ✓
- costs of materials ✓
- labour costs ✓

Allocate one mark per aspect of the budget [5 marks]

## Activity 7 Build a working scale model

Learner's Book page 128

### Guidelines to implement this activity

- Learners work as a team to make a model of their chosen idea.
- They have to use readily available material such as drinking straws, cardboard, string, plastic and modeling clay.
- Their models should be built neatly, to scale and be the same type of construction as shown in their working drawings.
- Learners do not need to make a full size model but it should be made to scale.

| Mark allocations<br>Assessment criteria | 1 | 2 | 3-5 |
|---|---|---|---|
| Used readily available material? | | | |
| Neat models to scale? | | | |
| Is the solution a viable option? | | | |

[15 marks]

## Activity 8 Present your project

Learner's Book page 128

Review Copy

### Guidelines to implement this activity

- This activity is not intended for assessment.
- Once the learners have compiled their reports, budget, posters, working drawings and models, they will present their proposals to the Tender Board.
- All team members must participate in the presentation.
- Each team member is responsible to present their aspect of the project.
- The rest of the class will evaluate each presentation.
- Each team is requested to make their own rubric to assess the presentations of the other teams.

**Mini–PAT total: 70 marks**

# Term 3 Exemplar test memorandum

Learner's Book page 129

1 A lever is a bar which rests on a point called a fulcrum✓ (1)

2 First class lever: fulcrum in the middle✓
Second class lever: load in the middle✓
Third class lever: effort in the middle✓ (3)

3 Any three correct examples✓✓✓ (3)

4 Circles representing gears✓
Idler gear✓ (2)

5 If an input gear has an RPM of 150 what will be the RPM on the output gear for the following ratios?

4 : 1 - 600✓
1 : 3 - 50✓
1 : 2 - 75✓
2 : 1 - 300✓ (4x½=2)

6 Correct symbols✓
Correct labels for gear teeth. ✓ (2)

7 Bevel gear✓
Neatness✓
2 intermeshing gears✓✓ (4)

8 What material would be suitable to make gears for the following:
Plastic✓
Plastic/metal✓
Brass✓
Plastic✓ (4)

9 Calculate the mechanical advantage for a nutcracker given the following details:
Input = 120 x 3 = Output = 36 x X
360 = 36X
X = 360 = 10N ✓✓
36

(2)

10 A bicycle chain wheel has 58 teeth and the rear wheel cogs have 20, 22, 24 and 26.
Which of the gears on the rear wheel would be best to use for the following situations?

1 20✓
1 20✓
1 26✓

Review Copy

(3)

11 Explain each of the following terms:

11.1 movable arm below the gears on the rear wheel of a bicycle✓

11.2 The gears at the rear wheel✓

11.3a mechanism for shifting gears on a bicycle that operates by moving the chain from one set of exposed gears to another✓

11.4 the driver or master gear wheel which is connected to the pedals by the crank✓

(4)

12 24 ✓✓

(2)

13 story for a school magazine ✓✓

preparing a soccer team for a big game ✓✓ (4)

14 Creates jobs, improves financial markets, Makes resources available. ✓✓

(2)

15 Gender bias in mining, Pollution, depletion of resources. ✓✓

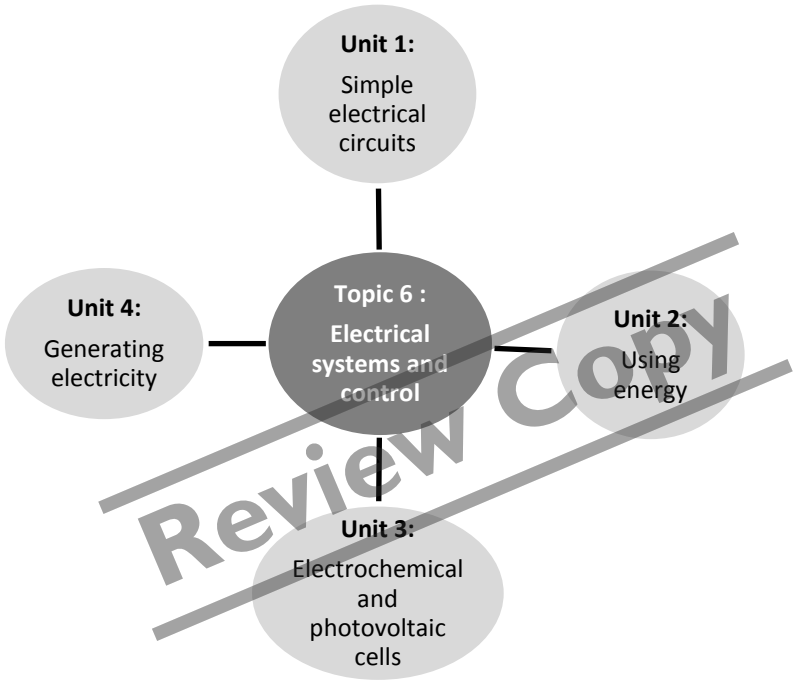
(2)

Review Copy

Total marks 40

# Topic 6 Electrical systems and control

## Core concepts covered




Review Copy

## 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 to them. This topic will explain different ways of generating electricity and includes safety precautions when working with electricity. Ohm's law is introduced and the learners will apply the law in building circuits to test the strength of the current. The Mini-PAT at the end will enable learners to design a simple electrical circuit that consists of various components for a specific function.

## Content

| Unit | Content | Pacing (time allocation) | LB page |
|---|---|---|---|
| 1 | Simple electrical circuits | 2 hours | 132–135 |
| 2 | Using energy | 2 hours | 136–140 |
| 3 | Electrochemical and photovoltaic cells | 2 hours | 141–143 |
| 4 | Generating electricity | 2 hours | 144–148 |
| | Mini-PAT | 8 hours | 150–153 |

# Unit 1 Simple electrical circuits

Learner's Book page132

## Unit overview

This unit revises the symbols for drawing circuit diagrams and explains that components can be divided into input, process and output devices. They will learn the importance of connecting devices correctly and the dangers that can occur when incorrect methods are used.

Review Copy

### Teaching guidelines

- Safety first! Make learners aware of the precautions when working with electricity. Be very diligent.
- Obtain examples of the different components discussed in this unit and describe various applications for the components.
- Demonstrate building circuits before you let learners build their own.
- If not enough resources are available, turn the activities into class demonstrations.

**TIP!** Demonstrate the circuits and the diagrams.

### Activity 1 Build a simple circuit

Learner's Book page 135

#### Guidelines to implement this activity

- This is a pair activity.
- Demonstrate how to build a simple circuit before you let the learners build their own.
- Explain the steps carefully to the learners.
- Explain each electrical component to the learners. Cells, conductor, output device, resistor, switch.

## Assessment guidelines

- This activity is intended for informal observation.
- Demonstrate and observe learners as they build simple circuits.

**Activity 2** **Draw a circuit diagram** Learner's Book page 135

## Guidelines to implement this activity

- This is an individual activity.
- Learners have to draw a diagram using the correct symbols for the circuits that they built in Activity 1.

## Assessment guidelines

Use the checklist below to assess learners informally. Give learners feedback on their performance to prepare them for formal assessment.

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner(s):** | | | |
| Made neat circuit diagrams? | | | |
| Used the correct symbols for each component? | | | |
| Connected each component correctly to the conductor wire? | | | |

Review Copy

## Remedial

The more exposure the learners receive to the correct drawing conventions for circuit diagrams, the better. If you have time available, give the learners additional circuits to draw. You could also use computer software that will allow you to draw the diagrams digitally. This software can be found freely on the internet for educational purposes.

# Unit 2 Using energy

Learner's Book page136

# Unit overview

- This unit covers aspects of electricity usage. Illegal usage of electricity and the risks involved are presented. Learners will conduct a case study about energy innovations using solar power.

## Teaching guidelines

- Spend more time on the safety precautions around electricity and explain all the dangers involved.

- Have a class discussion about illegal energy usage and why it is illegal. Ask the learners to mention examples that they have seen.

| Activity 1 | Using solar power | Learner's Book page 139 |
|---|---|---|

## Guidelines to implement this activity

- This is an individual activity.
- The learners should read through the case study by themselves and think about the questions asked.
- Explain that they should think carefully about all possible answers for the questions.

## Suggested answers

1 They did not have electricity ✓ had to collect wood and buy paraffin for light. ✓
2 There was no wood ✓ to collect so Mr Dramasi needed to buy paraffin ✓for cooking as well as light. The smoke from the stoves in the nearby houses makes it difficult to keep their informal shelter clean. The smoke also causes health problems✓
3 Solar power does not give off any emissions✓. It's clean energy✓. Does not pollute.
4 It saves money✓ [8]

Total: 8 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 8.

Review Copy

## Remediation/Remedial activity

Learners need to do corrections.

| Activity 2 | Introducing nuclear power | Learner's Book page 140 |
|---|---|---|

## Guidelines to implement this activity

- This is a group and an individual activity.
- Divide learners into groups of 3-4.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The group:** | | | |
| Discussed their concerns about building nuclear power plants and made a list? | | | |
| Presented good, valid reasons? | | | |
| Wrote a balanced report? | | | |

# Unit 3 Electrochemical and photovoltaic cells

Learner's Book page141

## Unit overview

In this unit learners will understand that energy can be stored and/or converted from one form to another in cells. They will investigate primitive home-made batteries as well as conventional chemical cells and light absorbing photovoltaic cells.

Review Copy

## Teaching guidelines

- Describe the concepts in relation to what the learners understand. Use examples within their frame of reference.
- Demonstrate how to build your own batteries if you do not want the learners to do it or if you do not have enough resources available.
- Revise series and parallel and explain the advantages and disadvantages of both ways to connect cells.

**TIP!** Use concrete examples. Don't just theorise, learners need to discover.

**Activity 1** **Make your own batteries** Learner's Book page 142

### Guidelines to implement this activity

- This is a group activity.
- Divide the learners into groups of 4-5.
- Demonstrate each step before the learners work in their groups.

## Assessment guidelines

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

| Criteria | Yes | Partly | No |
|---|---|---|---|
| **The learner (s)?:** | | | |
| Followed each step carefully | | | |
| Made a working battery? | | | |
| Recorded which cells and batteries worked best? | | | |
| Made a drawing of each battery made? | | | |
| Made a list of the apparatus used for each battery? | | | |

# Unit 4 Generating electricity

Learner's Book page 144

## Unit overview

This unit explains the need for electricity. Different ways of generating electricity are discussed; those that use heat, and those that don't. The learners will be familiarised with the concept of alternating current and why it is useful.

## Teaching guidelines

- Show the learners lots of pictures and diagrams.
- Explain each method of generating electricity and discuss the advantages and disadvantages of each.
- Have a class discussion about the various methods of generating electricity. Let the learners raise their opinions.

Review Copy

# Term 4 Mini-Practical Assessment Task

Learner's Book pages 150

## 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 panic button.

## Teaching guidelines

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

| Activity 1 | Investigating potential difference, current and resistance Learner's Book page 150 |
|---|---|

### Guidelines to implement this activity

### Assessment guidelines

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

Review Copy

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Built 4 working circuits? | | | |
| Recorded how the brightness of the light changed in each circuit? | | | |
| Drew a circuit diagram for each circuit using the correct symbols? | | | |
| Wrote a statement about the relationship between potential difference, current and resistance? | | | |

[15 marks]

| Activity 2 | Test the strength of electrical current Learner's Book page 151 |
|---|---|

### Assessment guidelines

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

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Built a series of working circuits adding one more cell every time? | | | |
| Recorded what was observed? | | | |

[15 marks]

## Activity 3 Investigating logic

Learner's Book page 151

### Suggested answers

AND Gate – Both✓ switches need to be on to complete the circuit ✓ example ✓
OR gate – Either one of the switches need to be on to complete the circuit. ✓example✓

[5 marks]

## Activity 4 Write your own design brief

Learner's Book page 153

### Guidelines to implement this activity

1 Design and make✓ a personal panic button✓ that will signal ✓an alarm when either of the buttons are pushed. ✓ The components of the panic button should be easy to remove and replace. ✓

[5 marks]

Review Copy

## Activity 5 Draw a circuit diagram for your circuit

Learner's Book page 153

### Assessment guidelines

Use the rubric below to assess learners.

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Used the correct symbols? | | | |
| Added labels and a heading? | | | |
| Added resistors in series and parallel? | | | |

15 marks

| Activity 6 | Make and test your system | Learner's Book page 153 |
|---|---|---|

## Assessment guidelines

Use the rubric below to assess learners.

| Criteria<br>The learner(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Made the panic button with the available equipment? | | | |
| Made switches using scrap metal? | | | |
| Made notes to improve the system? | | | |

15 marks

| Activity 7 | Draw up a truth table for your device<br>Learner's Book page 153 |
|---|---|

## Assessment guidelines

Use the rubric below to assess learners.

| Criteria<br>The learne(s): | 1 | 2 | 3-5 |
|---|---|---|---|
| Drew a truth table indicating the logic gate switches? | | | |
| Completed the truth table correctly (using binary numbers)? | | | |

[10 marks]

| Activity 8 | Make a poster to advertise your system<br>Learner's Book page 153 |
|---|---|

## 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.

Mini-PAT total: 80 marks

Review Copy

# Term 4 Exemplar exam memorandum

Learner's Book pages 154

**Question 1**

1.1 Bridge✓ (1)
1.2 Able to last for a long time without breaking or getting weaker✓✓ (2)
1.3 Able to be drawn out into a thin wire. ✓✓ (2)
1.4 The advantage of this type of bridge is that it requires less steel cable and is faster to construct✓ which means the cost of the bridge is less. ✓ (2)
1.5 Sketch✓, buttress✓, wall✓ (3)
[10]

**Question 2**

2.1 Mechanical advantage (MA) = $\frac{\text{input}}{\text{output}}$✓✓ (2)

2.2 MA = $\frac{\text{input}}{\text{output}}$

5 = $\frac{\text{input}}{135}$✓

input = 135 x 5✓

= 675 N ✓ (3)

2.3 Lever✓ (1)

2.4 Measure the distance around the head of the screw. You can do this by rolling it over a piece of paper. ✓

Mark the starting point and the finishing point after one revolution and use a ruler to measure the distance between the marks. ✓

Measure the distance between the threads. This distance is known as the pitch. ✓

Divide the first number by the second – this gives you the mechanical advantage✓ (4)

2.5 Brass ✓ (1)

2.6 Copy and complete this table: (8)

| Input (effort) | Output (load) | Input RPM | Ratio | Output RPM |
|---|---|---|---|---|
| 20 | 60 | 120 | 1:3✓ | 360✓ |
| 80 | 40 | 50 | 2:1✓ | 25✓ |
| 40 | 80 | 160 | 1:2✓ | 320✓ |
| 40 | 200 | 150 | 1:5✓ | 750✓ |

[19]

**Question 3**

3.1 jute✓, calico✓, hessian✓, linen✓ and paper✓ (5)

Review Copy

3.2

| Advantages | Disadvantages |
|---|---|
| Cheap ✓ | Non-biodegradable ✓ |
| Easy to mould ✓ | Pollutes oceans ✓ |
| Can be recycled ✓ | A lot is wasted ✓ |

(6)

3.3 Firstly biodegradable plastic bags✓ can be made from natural materials like starch. ✓ These bags turn into compost in the ground and leave no poisons behind. If they are swallowed by animals they digest quickly. ✓
Secondly by law, all supermarket bags must now be made thicker✓ so that it is worthwhile reusing or recycling ✓them instead of just throwing them away. Recycling plastic not only reduces pollution, it also creates thousands of new jobs. ✓ (6)

3.4 Tension✓, compression, ✓ shear✓, bending✓, torsion (any four correct answers)

(4)

3.5 Biodegradable: can be broken down by natural processes✓ such as sunlight, water, bacteria and fungi. Natural materials break down quickly, plastic usually takes years. ✓

(2)

[23]

Review Copy

**Question 4**

Explain each of the following terms:

4.1 Movable arm below the gears on the rear wheel of a bicycle✓✓

4.2 The gears at the rear wheel✓✓

4.3 A mechanism for shifting gears on a bicycle that operates by moving the chain from one set of exposed gears to another✓✓

4.4 The driver or master gear wheel which is connected to the pedals by the crank✓✓

(4 x 2 = 8)

**Question 5**

5.1 Input = 120 x 3 = Output = 36 x X

360 = 36X ✓

$X = \frac{360}{36} = 10N$ ✓✓

(3)

5.2.120✓

5.2.220✓

5.2.326✓ (3)

5.3 Creates jobs, improves financial markets, makes resources available. ✓✓✓ (3)

5.4 Gender bias in mining, pollution, depletion of resources. ✓✓✓ (3)

[12]

**Question 6**

Describe the following 3 terms:

6.1 Input devices in electrical systems provide potential electrical energy✓✓ (2)

6.2 Switches and resistors are used to control or direct current. In systems, this would be regarded as "processing", as they change the inputs to alter the outputs. ✓✓ (2)

6.3 Output devices convert electrical potential energy into other forms of energy. These other forms include light, sound, movement and heat energy. ✓✓ (2)

[6]

**Question 7**

Write a term for each of the following definitions:

7.1 Potential✓

7.2 Current✓

7.3 Potential difference✓

7.4 Generator ✓

7.5 Solar panels✓ (5)

**Question 8**

An electrochemical cell is a device that generates✓ a potential difference ✓between the electrodes found inside of the cell. ✓This potential difference is created by chemical reactions✓. A normal "penlite" 1.5 V battery is the most common example of an electrochemical cell. ✓

Photovoltaic cells convert light into electricity. ✓ Sunlight is composed of photons ✓which are particles of solar energy✓. (8)

Review Copy

**Question 9**

9.1 With heat: Thermal power generations, ✓ when we use heat to generate electricity. ✓Burning fossils fuels, nuclear power. ✓

Without heat: Generate electricity where heat is not required to turn a turbine. ✓Hydro-electricity, wind power, solar power.✓ (5)

9.2

| | With heat | Without heat |
|---|---|---|
| Advantages | More power is generated ✓ | Less power generated ✓ |
| Disadvantages | Releases pollutants, greenhouse gases ✓ | Low/no impact on environment ✓ |

(4)

**Total: 100 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 just looking at the pictures in the textbook.

If you have access to a computer linked to the internet, visit the sites listed below:

- http://www.smashinglists.com/longest-bridges-around-the-world/
- http://wiki.answers.com/Q/What_is_the_longest_bridge_in_South_Africa
- http://www.southafrica.info/mandela/mandelabridge.htm#ixzz2CGl4hynH

Watch a film showing the collapse of the Tacoma Narrows Bridge.

- www.youtube.com/watch?v=3mclp9QmCGs
- www.ska.ac.za
- You can search for drawing lessons on: www.youtube.com
- www.technologystudent.com

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 could include:

Review Copy

- Matchboxes, tomato boxes, thick paper or thin cardboard paint, brushes, glue, twine, tape, wire and an X-ray photo of a broken bone.
- Other useful equipment for demonstrating principles should include string, wire, scrap card empty tins and containers.
- Useful equipment for demonstrating forces would be: cool drink cans, guitar, elastic bands, bucket of water and a wet cloth, garden shears and a paper guillotine.
- Your class will need lots of A4 sheets of paper, rulers, pencils, small yoghurt containers or empty tins. A bucket full of small stones of the type used as drainage stones on a building site. Some strong rope, four broom handles and 20 bricks.
- For the unit based on electricity you will need various electrical components which are all listed in the activities of the Learners' Book.
- For graphic communication learners will need the different types of drawing instruments discussed in the Learner's Book.