Natural Sciences

CLASS TEXT & STUDY GUIDE

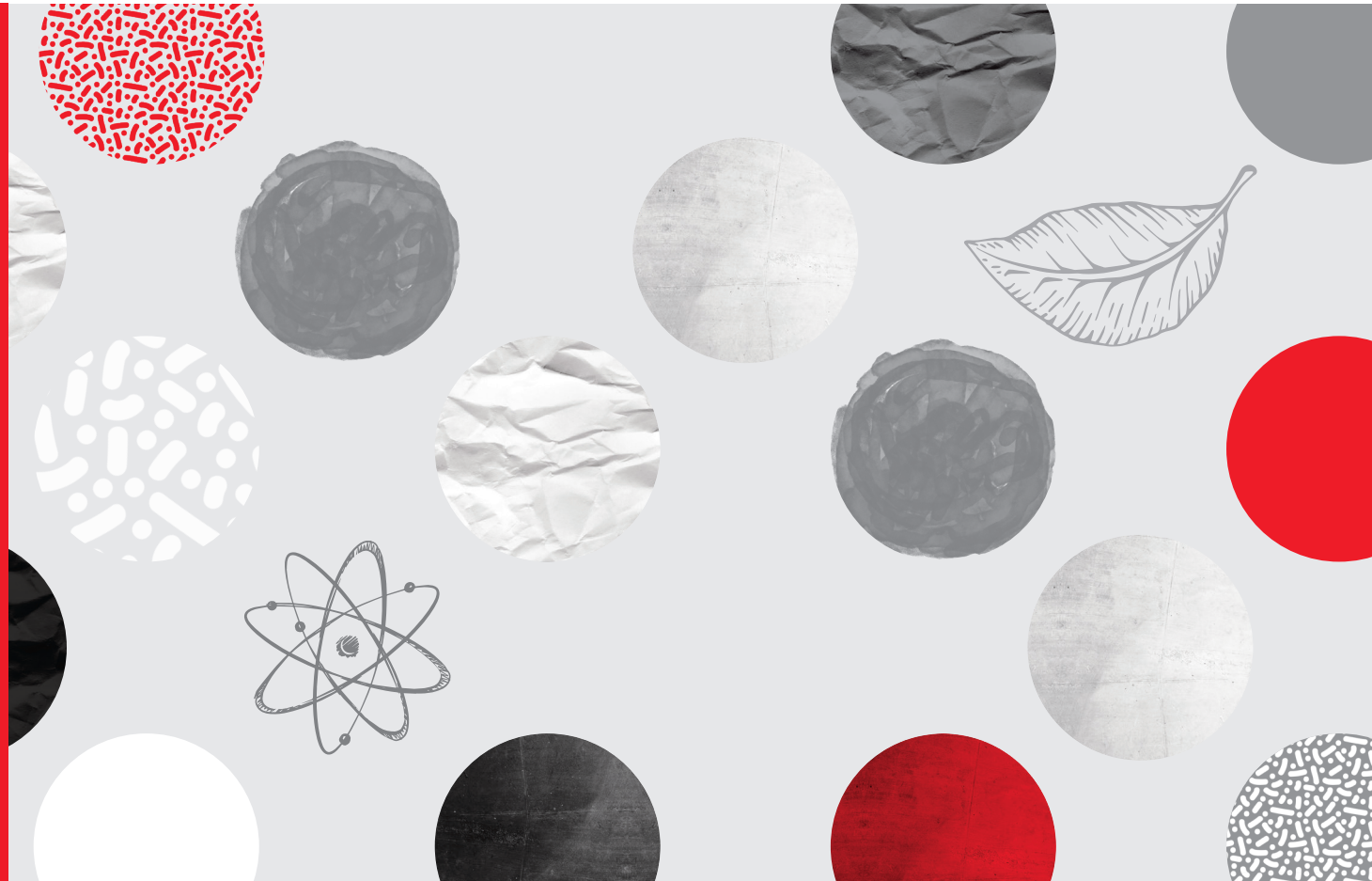
Liesl Sterrenberg, Grace Elliott, Helena Fouché, Retha Louw, Norman Davies & Silvana Scarola

GRADE

9

CAPS

3-in-1



THE ANSWER SERIES *Your Key to Exam Success*

Grade 9 Natural Sciences 3-in-1 CAPS

CLASS TEXT & STUDY GUIDE

This Grade 9 Natural Sciences handbook and study guide is a major newcomer to our Sciences range that will prove invaluable in unpacking a challenging curriculum.

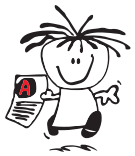
It includes:

- Comprehensive Skills Section
- Topic-based Questions
- Organised, easy-to-follow Notes
- Detailed Answers

Key Features:

- Skills section:
  - step-by-step explanation of scientific investigation
  - illustrated summary of representing data (tables/graphs/diagrams)
  - worked example of a scientific investigation question
  - expanded Action Verbs list to identify the focal point of questions
- clear, self-explanatory diagrams with annotated labels
- enrichment snippets to stimulate discussion
- visual summary flow diagrams
- extensive range of questions with detailed answers
- tips and teacher-talk boxes to provide context and clarity

This study buddy establishes a solid groundwork for success in Life Sciences and Physical Sciences. It motivates independent learning, avoids rooting of common misconceptions and develops confidence in tackling scientific material.



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THIS CLASS TEXT & STUDY GUIDE INCLUDES

1. Notes
   - Life and Living
   - Matter and Materials
   - Energy and Change
   - Planet Earth and Beyond
2. Questions per Module
3. Detailed Answers (in separate booklet)

E-book available

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CONTENTS

Evaluation (discussion)	○ Suggesting reasons for the patterns/trends observed ○ Suggesting reasons for the anomalies (outliers/results that don't 'fit') ○ Evaluating your method: was it fair? reliable? accurate? valid? How could you improve in each of these areas? ○ Discussing the worth of the experiment and what the results could mean for society/school/you
Conclusion	○ Links the results directly to the aim and can either support or refute (disprove) the hypothesis ○ States a new, but linked, hypothesis that may be investigated as a result of your results – this is known as 'further work' *A hypothesis is not* right *or* wrong. *Science is constantly changing, therefore we can only* ***accept*** *or* ***reject*** *a hypothesis.* 

PLANNING AND CONDUCTING AN INVESTIGATION

Differentiate Between the Planning and Conducting Phases of an Investigation

○ Planning requires decision-making. Anything that can be described in a sentence that begins with 'Decide to ...' is a planning step.

○ Conducting means to implement (to do) something.

Planning *involves decisions that are made* ***before the investigation****.*

Conducting *involves decisions that are made* ***after planning*** *and* ***part of the investigative method****.*

Before starting any investigation, we need to **plan** how it will be done. **Planning** steps for a typical investigation include:

○ determining **who/what** the sample will be (age/gender/species/etc. of participants)

○ determining the size of the **sample**

○ determining **when** the investigation will take place (time frame)

○ determining **where** the investigation will take place (location)

○ obtaining **permission** from the participants

○ determining how we will measure and record our **results** (selecting apparatus)

○ determining the **variables** - especially the variables that must be controlled to make it a **valid** investigation

After the planning phase, then decisions can be implemented as part of the investigative method. This is called the **conducting** phase.

ENSURING MEANINGFUL RESULTS

The following aspects must be considered to ensure your results answer the investigative question and are meaningful.

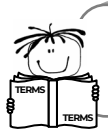
1 validity 2 reliability 3 accuracy

NOTE

Although ***validity*** *and* ***reliability*** *are the most important aspects,* ***accuracy*** *is included with a brief explanation to ensure a comprehensive list of aspects that ensure meaningful results. Fair testing and precision are other aspects that also affect the validity and reliability of results, but they are not discussed in this curriculum.*

1 Validity

Validity refers to **experimental method/scientific process** and if it appropriately addresses the aim of the investigation,
i.e. a test is valid if it measures what it claims to measure.



V*alidity* tests: ***HOW*** *the experiment is performed.*
Remember *the* ***V****:* ***HOW*** *are* ***V****ariables controlled?*

To ensure that results are valid:

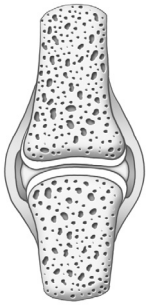
○ test only **one variable** (the independent variable) at a time

○ identify the controlled/fixed variables and keep them constant

○ choose an appropriate design for the experiment

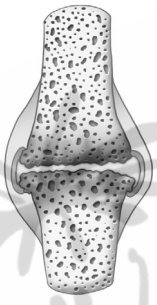
Arthritis

- Condition that occurs when the cartilage between two bones wears down and becomes thin.
- Friction between the two bones causes pain, swelling and inflammation.
- It causes deformity of joints and difficulty in movement.
- It affects mainly older people.



Normal joint

Normal hand

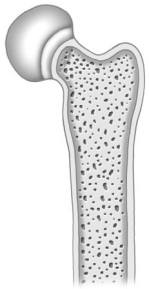


Arthritis joint

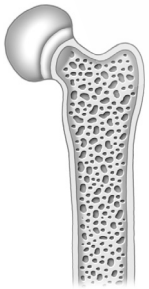
Arthritis hand

Osteoporosis

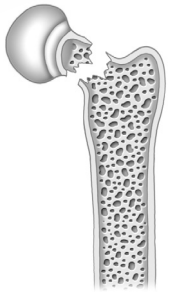
- This condition causes bones to become spongy and fragile, resulting in low bone density.
- These brittle bones increase the risk of fractures.
- It is caused by a lack of calcium and vitamin D in the diet.
- It occurs mainly in older people.



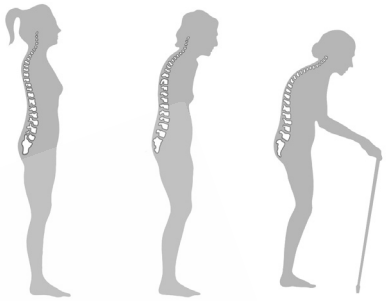
Normal bone



Osteoporosis bone



Broken osteoporosis bone

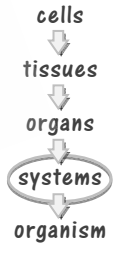


Posture changes due to osteoporosis and ageing

UNIT 6

EXCRETORY SYSTEM: OVERVIEW

- **Excretion** is a process that results in the removal of **metabolic waste** from an organism.



Excretory system
removes waste and regulates water and salts

metabolism: all the chemical reactions in a cell, e.g. respiration, protein synthesis, etc.

- **Metabolic waste** is substances produced by cells that are harmful to the organism if they accumulate.
- The main waste products are CO_2, excess water, salts and urea.
- CO_2 is removed by the lungs.
- Most of the other waste is excreted in urine via the kidneys.

NOTE

Faeces contain some metabolic waste, but is mostly undigested waste. The removal of faeces is known as egestion.

NOTE

Use the diagrams on p. 33 to understand the processes illustrated below. These processes will be discussed in more detail in TOPIC 3 on p. 35.

♂ = male ♀ = female

THE MAIN PROCESSES INVOLVED IN HUMAN REPRODUCTION

♂ *sperm production in testes*

Copulation

The male penis is inserted into the female vagina in sexual intercourse

stimulates

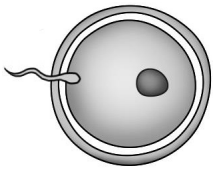
♂ **Ejaculation**

Semen containing sperm cells is released from the urethra of the penis into the vagina

sperm swims to Fallopian tube ♂

♂♀ **Fertilisation**

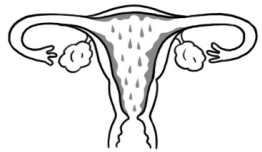
A male sperm fuses with a female ovum in the Fallopian tube to form a zygote



if fertilisation does not occur

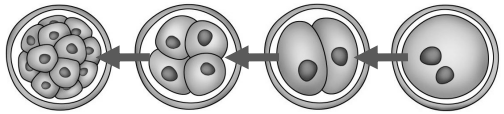
♀ **Menstruation**

Part of the lining of the uterus (including the unfertilised ovum) is discharged via the vagina



in ♀ **Cell division**

The fertilised ovum (zygote) divides repeatedly to form a ball of cells



ball of cells moves along Fallopian tube to the uterus

in ♀ **Implantation**

Ball of cells embeds into the wall of the uterus resulting in pregnancy

pregnancy (gestation)

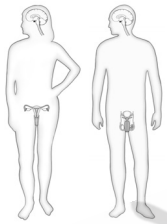
in ♀ **Growth**

Cells continue to divide, and differentiate, causing an increase in size and complexity in the developing embryo

pregnancy (gestation)

♂ OR ♀ **Maturation**

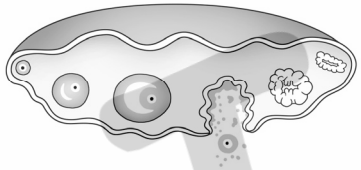
Birth occurs after 40 weeks. Growth continues for 15-20 years through puberty until individuals are sexually mature and able to reproduce



ovum production in ovaries ♀

♀ **Ovulation**

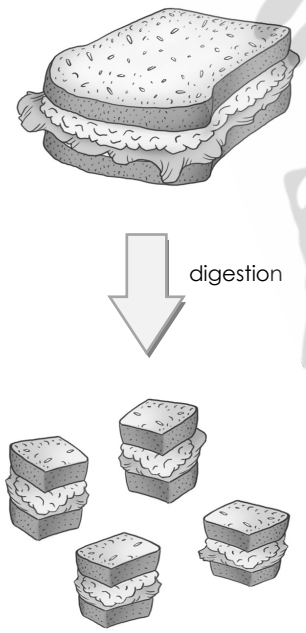
An ovum is released once a month from an ovary into the Fallopian tube

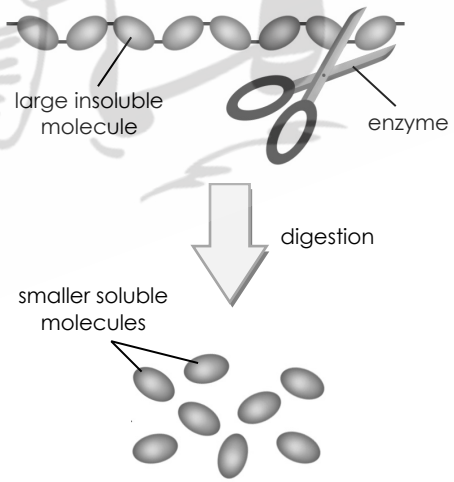


ovum released ♀

Types of Digestion

Mechanical digestion The physical breaking, crushing and mashing of food into smaller particles. This creates a larger surface area for enzyme action.	**Chemical digestion** The mixing of food with digestive enzymes and hydrochloric acid to break food down on the molecular level.
○ **Mouth** (mastication) – food is broken into smaller particles by teeth and tongue ○ **Stomach** (churning) – food mashed by contraction and relaxation of muscle walls and mixed with gastric juice	○ **Mouth** – saliva contains enzymes to break down starch ○ **Stomach** – gastric juice contains hydrochloric acid and enzymes to break down proteins ○ **Small intestine** – bile dissolves fats; pancreatic juice and intestinal juice contain enzymes to break down carbohydrates, proteins and fats





TOPIC 1 CELLS AS THE BASIC UNITS OF LIFE

Question 1

Give **one word** or **term** for each of the following statements:

1.1 The characteristic where an organism responds to a stimulus.

1.2 The organelle that stores cell sap.

1.3 The fluid substance in which all the organelles are suspended.

1.4 The rigid structure that provides shape to the plant cell.

1.5 The structures in the nucleus that carry hereditary characteristics.

1.6 The stain used to prepare onion cells.

1.7 The green pigment found in chloroplasts which facilitates the process of photosynthesis.

1.8 A photograph of a cell as seen through an electron microscope.

1.9 The process whereby cells become specialised in structure and function.

1.10 The process by which water moves across the cell membrane.

1.11 A characteristic of cell membranes that controls the movement of substances into/out of the cell.

1.12 A group of different tissues working together to perform a particular function.

1.13 Focuses light rays and controls the amount of light passing through the specimen on the stage of the microscope.

1.14 Holds microscope objectives with low and high-power lenses.

1.15 Magnifies the specimen under observation.

1.16 Slowly brings microscope lens closer to or further away from specimen.

CARBON DIOXIDE POLLUTION

Too much carbon dioxide in the atmosphere is a likely cause of **global warming**. People burn large amounts of carbon-containing fuels for energy. We need to find other ways of providing energy if we want to limit and reverse global warming.

Coal-burning power station

UNIT 3

REACTION OF SULPHUR WITH OXYGEN

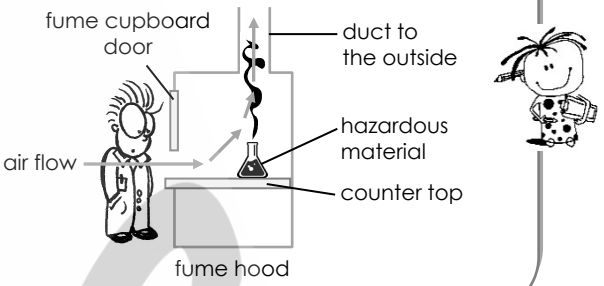
- Sulphur is a bright yellow, strong-smelling element. It is available as a powder or in sticks called roll sulphur.
- Use the powdered form of sulphur or grind a portion of roll sulphur to powder in a pestle and mortar.

Pestle and mortar

- Scoop some powdered sulphur into the deflagrating spoon and heat in the Bunsen burner flame.
- The sulphur will melt to form a brown transparent liquid. This is a physical change, not a chemical change.

NOTE

Inhalation of sulphur dioxide gas causes irritation and breathing difficulties. The experiment must be demonstrated using small quantities of sulphur in a fume cupboard in a chemistry laboratory or outdoors.



- Lower the melted sulphur into the gas jar containing oxygen. The sulphur burns with a beautiful **blue flame**.
- The product is a choking **colourless gas**. The reactant and the product look very different. This difference suggests that a chemical change occurred.

Match burning

- We can write the word equation as:

sulphur + oxygen → sulphur dioxide

- and the chemical equation as:

$$S + O_2 \rightarrow SO_2$$

- The chemical equation is balanced. There is one sulphur atom and two oxygen atoms on each side of the reaction equation. We do not need to add any more atoms to either side.

SULPHUR DIOXIDE POLLUTION

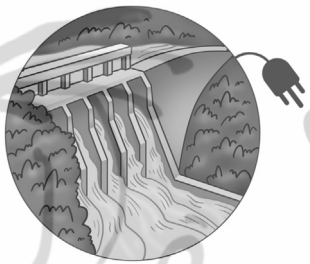
Sulphur dioxide gas reacts with water in the atmosphere to make sulphurous acid. This acid dissolves in water in the clouds and falls as **acid rain**. Acid rain damages plants and buildings.

- About 1 000 wind turbines are needed to generate the same amount of energy as a modern power plant running on coal or other fuel.

> **NOTE**
> *Areas such as the coastal regions in the Western and Southern Cape generally get lots of wind and are ideally suited to the erection of wind farms.*

Hydroelectric power

Functioning and advantages



- The functioning of a hydroelectric power station is based on falling water causing a turbine to spin.
- The turbine in turn spins a generator in order to generate electricity.
- No fuel is required to spin the turbine and no pollution occurs.
- Hydroelectric power is a renewable energy source.

Disadvantages

- South Africa is unfortunately a dry country without many rivers and high-lying water sources for the generation of hydroelectric power.
- Dams are expensive to build. They also have a significant impact on the environment and on local communities.

Tidal and wave power

Functioning and advantages

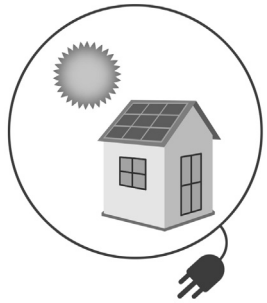
- The ocean tides, i.e. high tide and low tide, are a result of the gravitational pull of the sun and the moon.
- There is an average difference of approximately 8 m between high and low tide. To harness tidal power, a special dam wall is built over a river mouth. This wall lets the ocean water through and dams it up as the tide rises.
- When the tide recedes, the water flows back over a number of turbines causing them to spin.
- The turbines in turn spin a generator to generate electricity.
- The movement of waves can also be used to move large floating turbines (rafts) and thereby generate electricity.
- No fuel is required and no pollution occurs.
- Wave power is a clean, renewable energy source with no waste products.

Disadvantages

- During low tide, there are large areas of exposed mud that are the habitats of many small animals that form a vital part of the food chain. Building a dam disrupts these mudflats and damages the ecosystem.
- The river mouths are no longer available for maritime use.
- The natural environment along the coast is defaced.
- A very large number of rafts is needed to generate a reasonable amount of electricity.

Solar power

Functioning and advantages



- **Sun-heated steam**
  - There are different ways to focus the heat of the sun in order to heat water and produce steam. One method involves using thousands of mirrors.
  - Mirrors are set up to focus the heat of the sun on a tower in which steam is produced.
  - The steam can be used to spin a turbine that, in turn, spins a generator in order to generate electricity.
  - No fuel is required and no pollution occurs.
  - Solar power is a clean, renewable energy source.

- The waste combines with rainwater to form sulphurous acid which then dissolves uranium and other heavy metals as it flows or seeps into local groundwater.
- Mine dumps contain chemicals (heavy metals and radioactive materials) that are toxic to humans, animals, plants and microorganisms.

https://visibleearth.nasa.gov/view.php?id=44264

Mine dumps (slag piles) of waste from gold mining near Soccer City, Johannesburg

Pollution of Water Resources

- Rain washes toxins from exposed rock surfaces and from the air into water supplies.
- Chemicals from mine dumps, abandoned mines and active mines can leach into local water supplies.
- These chemicals change the pH of the water to become highly acidic.
- Organisms living in the water cannot tolerate the pollution, they die out which leads to a loss of biodiversity.
- The water is unsuitable for cooking and cleaning and pose serious health risks to consumers.
- Some toxic, waste material (tailings) from mining is stored in dams. Any leakage from a tailings dam will have serious environmental consequences.

NOTE

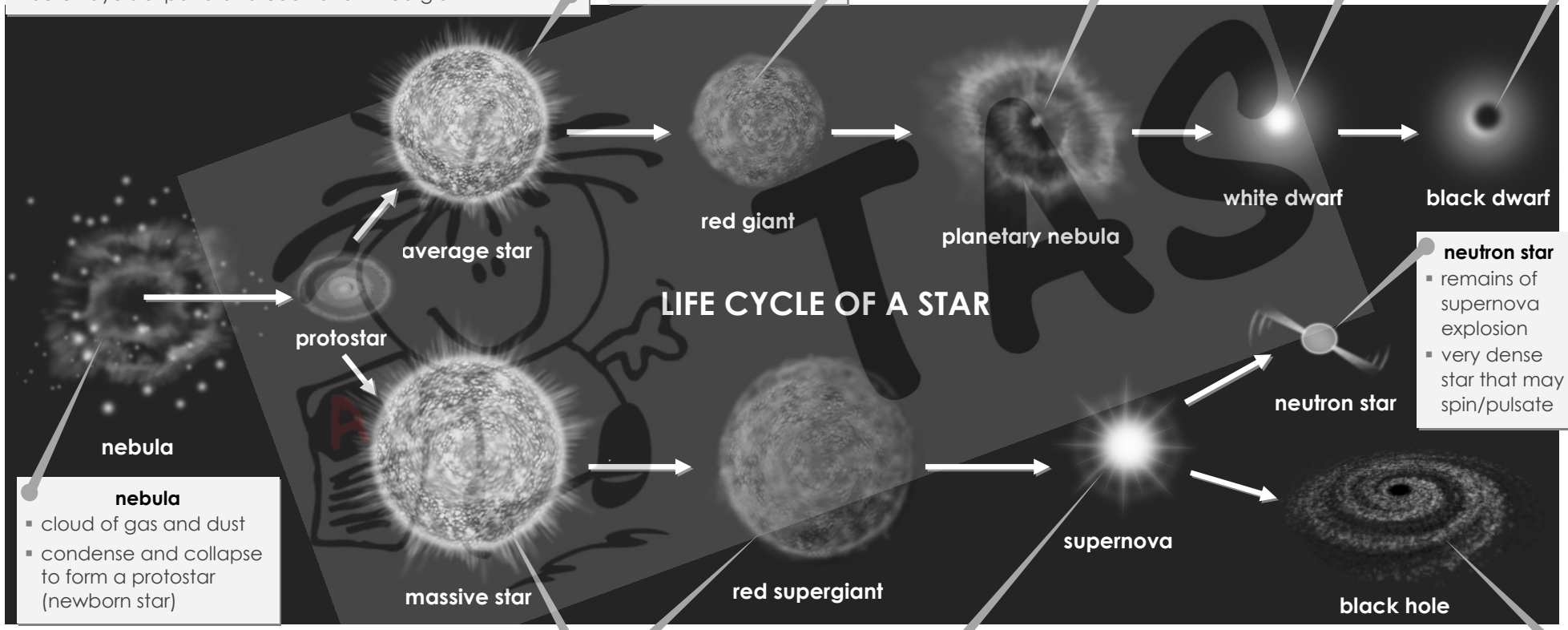
Acid mine drainage (AMD) *is the accumulation of water in abandoned mines. The maze of shafts and tunnels fill up with water which reacts with exposed chemicals in the rocks to form a weak acid. This acid water is hazardous and slowly leaks out into the environment and causes harm to organisms and humans.*

Damage to Places with High Tourist or Cultural Heritage Value

- Mining practices change the landscape of a region.
- It also produces air pollution which discourages tourism and damages buildings, statues and monuments.
- It may displace communities that already live in the area and have a cultural history there.
- The iSimangaliso Wetland Park (Greater St. Lucia Wetland Park) in KwaZulu-Natal and the Wavecrest community in the Eastern Cape have been under threat from mining companies.
- Underground activity of mining destabilises the land surface and makes it unstable for development.
- Opencast mining destroys vast areas of land regardless of archaeological or cultural value.

Destruction of Habitats and Farm Land

- Farming lands and wild life environments are also under threat with large-scale removal of soil and vegetation, leading to soil erosion.
- Pollution of water affects biodiversity as it destroys plant and animal species.
- Contaminated water used for irrigation affects quality of crops and cause accumulation of toxins in food.
- Air pollution can result in acid rain, which damages vegetation or crops.
- Disused mines create a damaged environment with waste material dumps that occupy habitats of indigenous species and open shafts creating a safety hazard for humans and animals.



average star
- small/medium size star formed from a protostar
- lower mass star
- e.g. sun
- main sequence star in its stable phase
- nuclear fusion in the core converts hydrogen fuel to helium
- nuclear fusion produces energy (heat and light)
- core runs out of hydrogen fuel and contracts
- outer layers expand and cool to form red giant

red giant
- very large star
- cooler than main sequence stars
- core uses helium fuel
- core contracts
- outer layers of gas are ejected to form a planetary nebula

planetary nebula
- cloud of gases released by dying red giant star
- hot core forms white dwarf

white dwarf
- very dense, hot, white, shrinking stars
- cools and dims to form black dwarf

black dwarf
- remains of white dwarf
- cold and dark

neutron star
- remains of supernova explosion
- very dense star that may spin/pulsate

nebula
- cloud of gas and dust
- condense and collapse to form a protostar (newborn star)

massive star
- very large size star formed from protostar
- great mass star
- e.g. Rigel
- main sequence star in its stable phase
- nuclear fusion in the core converts hydrogen fuel to helium
- nuclear fusion produces energy (heat and light)
- swells and expands to form red supergiant

red supergiant
- largest stars
- core contracts and collapses
- star undergoes supernova explosion
- sheds outer layers of gas that form nebulae

supernova
- explosion of red supergiant due to loss of fuel
- core contracts to form very dense neutron star or collapses completely to form black hole

black hole
- remains of supernova explosion
- very dense area with strong gravity that draws all matter including light

TOPIC 7 COST OF ELECTRICAL POWER

Question 42

42.1 power

42.2 Power is the rate at which energy is transferred or at which work is done.

42.3 watt (W)

42.4 $\frac{J}{s}$; $J \cdot s^{-1}$

42.5 1 000

42.6.1 100 J energy is used/supplied per second

42.6.2 1 100 J energy is used/supplied per second

42.7 kilowatt hour (kWh)

42.8 number of kWh = power (kW) × number of hours (h)

42.9 cost = number of kWh × tariff per kWh

42.10.1 cost = number of kWh × tariff per kWh
= 2 × 6 × 0,8
= R9,60

power = 2 000 W = 2 kW
t = 6 h
tariff = R0,80

42.10.2 cost = number of kWh × tariff per kWh
= $1{,}1 \times \frac{1}{6} \times 1{,}20$
= R0,22

power = 1 100 W
= 1,1 kW
t = 10 min
= $\frac{10}{60} = \frac{1}{6}$ h
tariff = R1,20

42.10.3 time used during month = (19 - 15) × 28
= 4 × 28
= 112 h

NB: *Feb 2019 had 28 days*

power = 1 800 W
= 1,8 kW
tariff = R2,20

cost = number of kWh × tariff per kWh
= 1,8 × 112 × 2,2
= R443,52

MODULE 4 ANSWERS

TOPIC 1 THE EARTH AS A SYSTEM

Question 1

1.1 biosphere

1.2 hydrosphere

1.3 lithosphere

1.4 atmosphere

1.5 ozone layer/stratosphere

Question 2

2.1.1 A general term to describe something with many smaller parts that are connected and working together.

2.1.2 lithosphere, hydrosphere, atmosphere and biosphere

2.1.3
- lithosphere e.g. rocks, lava
- hydrosphere e.g. water, rain
- atmosphere e.g. air, wind, weather
- biosphere e.g. trees, animals, seeds

2.2

Atmosphere	Lithosphere	Biosphere	Hydrosphere
ozone, oxygen, carbon dioxide, nitrogen, methane, water vapour	rocks, minerals, gold, salt, coal	earthworms, humans, bacteria	glaciers, rivers, snow, oceans, water vapour