BOTSWANA
EXAMINATIONS
COUNCIL

BOTSWANA SENIOR SECONDARY EDUCATION

ASSESSMENT SYLLABUS

PHYSICS

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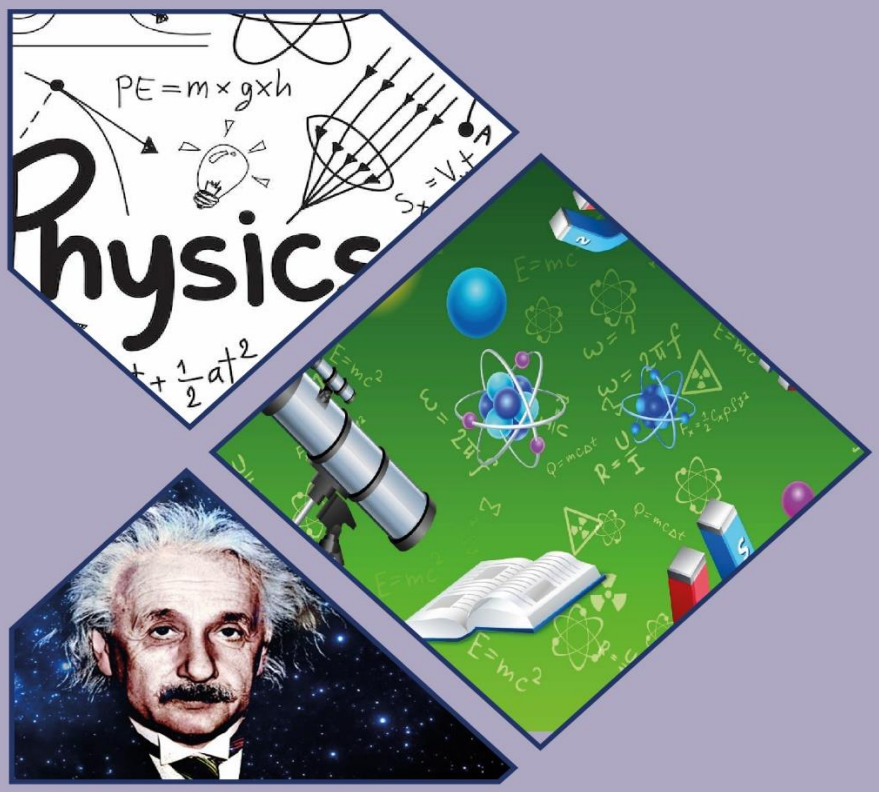

2024 - 2029

FOREWORD

The Botswana Examinations Council (BEC) is pleased to authorise the publication of the Outcome Based Assessment (OBA) syllabus for Physics in the senior secondary education programme. The assessment syllabus forms part of the Botswana General Certificate of Secondary Education (BGCSE) suite of syllabuses available to candidates who have followed the senior secondary programme. The BGCSE is designed for a wide range of learner ability in line with the aspirations of the Revised National Policy on Education of 1994, and its standards are based on Cambridge GCSE and IGCSE.

Our mission as Botswana Examinations Council is 'a globally recognised assessment and awarding body of excellence'. In the quest for responsiveness, the BEC has aligned the assessment to Outcome Based Education (OBE) that recognises the need to impart 21st century skills on learners. As such, ProviderBased Assessment (PBA) forms a component of the final assessment. Furthermore, periodic reviews are promoted for the assessment syllabuses to reflect the aims of the national curriculum and international best practice. Customer feedback forms an integral part of such reviews.

This assessment syllabus document is the outcome of a great deal of professional consultation and collaboration, and I wish to extend my thanks to all those who contributed towards its development. On behalf of the Botswana Examinations Council, I wish to record my appreciation for the part played by Cambridge as part of the accreditation agreement between them and the Council.

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Dr Moreetsi Thobega

Chief Executive Officer Botswana Examinations Council

ACKNOWLEDGEMENT

The Botswana Examinations Council wishes to acknowledge the diligent contribution of all the stakeholders who played a pivotal role in the development of the Physics Assessment syllabus for the Botswana Senior Secondary Education (BSSE). A task such as this one requires mental focus, commitment, dedication, a high level of accountability and responsibility, as such all of them were equal to this task and are much appreciated.

The Assessment Syllabus Development Task Team (ASDTT) comprised of the following:

Dr Moikothai Moidaki	University of Botswana
Dr Anthony Koosimile	University of Botswana
Mr Keamogetswe Khimbile	Molepolole College of Education
Ms Makwa Palesa Olerato	Francistown Senior Secondary School
Mr Buti Fani	Selebi Phikwe Senior Secondary School (Chairperson)
Ms Precious Madibela	Kgari Sechele Senior Secondary School (Secretary)
Mr Mothusi Kelobang	Goodhope Senior Secondary School
Mr Titoga Mnindwa	Department of Curriculum Development and Evaluation
Mr Leonard Puso	Department of Curriculum Development and Evaluation

The members of the Syllabus Advisory Committee (SAC) comprised of the following:

Mr Mooketsi Lanka	University of Botswana
Mr Titoga Mnindwa	Department of Curriculum Development and Evaluation
Mr Tiro Serero	Ledumang Senior Secondary School
Mr Ratshipa Ramatlhakola	Serowe College of Education
Mr Lucky Sitayelo	St Joseph's College
Mr Buti Fani	Selebi Phikwe Senior Secondary School (Chairperson)
Ms Precious Madibela	Kgari Sechele Senior Secondary School (Secretary)

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1.0 INTRODUCTION

The Physics Assessment Syllabus is designed to outline how candidates who have completed a two-year course based on the Botswana Senior Secondary Education (BSSE) Physics teaching syllabus are to be assessed.

The syllabus aims to assess positive achievement at all levels of ability. Candidates will be assessed in ways that encourage them to demonstrate what they know, understand and can do. Provider Based Assessment (PBA) will contribute to the final grade of assessment.

The syllabus will be assessed through one written paper, a practical examination and a Provider Based Assessment the details of which are outlined in the Scheme of Assessment. This Physics Assessment Syllabus should be read in conjunction with:

(a) the Botswana Senior Secondary Education Physics teaching syllabus

(b) the specimen question papers and mark schemes

Prior Learning

The Physics assessment syllabus is designed for candidates who have completed a two-year BSSE Physics programme.

Progression

The Botswana General Certificate of Secondary Education (BGCSE) is a general qualification that enables candidates to progress either directly to the world of employment or to proceed to further qualifications.

2.0 FACILITATOR SUPPORT

A number of support structures are available for facilitators handling the Physics assessment syllabus.

2.1 Support Documents

To ensure uniformity of standards across the Centres, the Botswana Examinations Council will provide the Education and Training Providers (ETPs) with documents and materials that will guide them on how to conduct valid and reliable assessments. These will include guidelines for Outcome Based Assessments, practical test manuals, specimen papers with corresponding mark schemes, annual Principal Moderator and Principal Examiners' reports.

2.2 Training

BEC will offer periodic training to personnel conducting Provider Based Assessment to equip them with requisite knowledge and skills to deliver credible, valid and reliable assessments.

3.0 SYLLABUS OUTCOMES

According to the BSSE Physics teaching syllabus, candidates following the syllabus should upon completion be able to:

3.1 Apply process skills to investigate cause and effect and the interrelatedness of phenomena on earth and the universe.

3.2 Apply scientific concepts and knowledge in addressing health, social, economic and environmental issues.

3.3 Use scientific knowledge to develop technology for sustainable development.

3.4 Demonstrate understanding of natural and artificial processes affecting all forms of life to ensure sustainability.

4.0 ASSESSMENT OBJECTIVES

The main Assessment Objectives are:

AO 1 Knowledge and Understanding AO 2 Application and Problem Solving AO 3 Experimental and Inquiry Skills

A description of each Assessment Objective is:

AO 1 Knowledge and Understanding

Candidates should be able to demonstrate knowledge and understanding of:

1 the concepts, laws, theories and principles of Science

2 the vocabulary, terminology and conventions of Science, including symbols, quantities and units

3 natural and artificial processes affecting health, social, economic and environmental issues

4 scientific concepts in addressing health, social, economic and environmental issues

Questions assessing these objectives will often begin with words such as *define, state, describe, outline, etc.*

AO 2 Application and Problem Solving Candidates should be able to:

1 use information to identify patterns, report trends, draw inferences, make predictions and propose hypotheses

2 apply scientific concepts and knowledge in addressing health, social, economic and environmental issues

3 manipulate data and translate information from one form to another

Questions assessing these objectives may contain information which is unfamiliar to candidates. In answering such questions, candidates are required to take principles and concepts in the syllabus and apply them to the situations described in the questions.

Questions assessing these objectives will often begin with words such as *discuss*, *predict*, *suggest*, *calculate*, *determine, etc*.

AO 3 Experimental and Inquiry Skills Candidates should be able to:

1 follow a sequence of instructions

2 use appropriate techniques, instruments, apparatus and materials safely

3 make and record observations, measurements and estimates

4 interpret and evaluate observations and data

5 plan investigations and / or evaluate methods and suggest possible improvements

6 apply knowledge and draw conclusions in real-life situations

5.0 SCHEME OF ASSESSMENT

5.1 The Components

The candidates are to be assessed by **three** papers:

1 Theory – paper 1
2 Practical Test – either paper 2 or paper 3
3 Provider Based Assessment – either paper 4 or paper 5.

The papers are described in the table.

Paper 1	1 hour 30 minutes	70 marks	50%
Written Theory The paper will consist of short answer and structured questions. The questions will be from the whole syllabus and will test skills from Assessment Objectives 1 and 2. The paper will be of difficulty appropriate to grades **A** to **G**.			
EITHER		**OR**	
Paper 2	2 h 15 min 50 marks 30%	Paper 3	1 h 15 min 50 marks 30 %
Practical Test A laboratory-based paper consisting of questions that will test experimental and observational skills. The questions will be from the whole syllabus and will test skills from Assessment Objectives 3, 2 and 1. The paper will be of difficulty appropriate to grades **A** to **G**.		**Alternative to Practical Test** Questions will test the familiarity with laboratory equipment and procedures. The questions will be from the whole syllabus and will test skills in Assessment Objectives 3, 2 and 1. The paper will be of difficulty appropriate to grades **A** to **G**.	
EITHER		**OR**	
Paper 4	4 terms 40 marks 20%	Paper 5	1 h 30 min 40 marks 20%
Provider Based Assessment. A school-based project selected randomly from the projects collected as evidence in learner portfolios. The projects will be from the whole syllabus and will test skills in Assessment Objective 3, 2 and 1. The paper will be of difficulty appropriate to grades **A** to **G**.		**Alternative to Provider Based Assessment**. A paper consisting of questions based on the experimental skills. The questions will be from the whole syllabus and will test skills in Assessment Objective 3, 2 and 1. The paper will be of difficulty appropriate to grades **A** to **G**.	

Paper 3 and paper 5 are **not** available to candidates in Government Schools unless permission has been sought by the school to administer them.

5.2 Weightings of Assessment Objectives

5.2.1 The weightings of the assessment objectives are shown the table.

Assessment Objective	Weight
AO 1 Knowledge and Understanding	30%
AO 2 Application and Problem Solving	35%
AO 3 Experimental and Inquiry Skills	35%
Total	100%

5.2.2 The distribution of the assessment objectives in each of the papers

Assessment Objectives	Skill and Components Weightings		
	Paper 1	Paper 2 and 3	Paper 4 and 5
AO 1 Knowledge and Understanding	46%	10%	20%
AO 2 Application and Problem Solving	54%	10%	25%
AO 3 Experimental and Inquiry Skills	0	80%	55%
Total	**100%**	**100%**	**100%**
Paper Weighting	**50%**	**30%**	**20%**

5.2.3 The distribution of the assessment objectives in each of the papers

Assessment Objectives	Skill and Components Marks		
	Paper 1	Paper 2 and 3	Paper 4 and 5
AO 1 Knowledge and Understanding	32 ± 2	5 ± 1	8 ± 1
AO 2 Application and Problem Solving	38 ± 2	5 ± 1	10 ± 1
AO 3 Experimental and Inquiry Skills	0	40 ± 2	22 ± 2
Total Marks	**70**	**50**	**40**
Weighted Marks	**100**	**60**	**40**

5.3 Grade Descriptions

A **Grade A** candidate should be able to:

- recall a wide range of scientific vocabulary, terminology and conversions including symbols, quantities and units
- recall a wide range of scientific laws, concepts, principles and theories and use complex scientific knowledge
- demonstrate an understanding of complex scientific concepts of natural and artificial processes affecting health, social, economic and environmental issues
- use a wide range of information to identify complex patterns, and report trends, draw inferences, make predictions and propose hypotheses

- apply a wide range of scientific concepts and knowledge to novel situations in addressing and making recommendations for health, social, economic and environmental issues
- manipulate complex data and translate abstract information from one form to another: e.g. process information from graphs, tables and charts; represent information in the form of graphs, tables and charts
- make concise and complete experimental procedures (plan); critically discuss the plan; generate hypotheses to solve a scientific problem, identify and deal with a wide range of variables
- apply a wide range of knowledge and skills for creativity and innovation in real-life situations
- use appropriate apparatus and a wide range of techniques safely and correctly; follow all given instructions to perform an experiment
- make accurate observations; decide the level of precision needed in measurements and record detailed experimental data; process data, identify and explain anomalous observation make appropriate conclusions and generalisations

A **Grade C** candidate should be able to:

- recall a range of scientific vocabulary, terminology and conversions including symbols, quantities and units
- recall a range of Physics laws, concepts, principles and theories and use complex scientific knowledge
- demonstrate an understanding of Physics concepts of natural and artificial processes affecting health, social, economic and environmental issues
- use a range of information to identify complex patterns, and report trends, draw inferences, make predictions and propose hypotheses
- apply a range of Physics concepts and knowledge to novel situations in addressing and making recommendations for health, social, economic and environmental issues
- manipulate data and translate information from one form to another: e.g. process information from graphs, tables and charts; represent information in the form of graphs, tables and charts
- make concise and complete experimental procedures (plan); discuss the plan; generate hypotheses to solve a scientific problem, identify and deal with variables
- apply knowledge and skills for creativity and innovation in real-life situations
- use appropriate apparatus and techniques safely and correctly; follow most given instructions to perform an experiment
- make accurate observations; decide the level of precision needed in measurements and record experimental data; process data, identify anomalous observation make appropriate conclusions and generalisations

A **Grade E** candidate should be able to:

- recall simple scientific vocabulary, terminology and conversions including symbols, quantities and units
- recall simple Physics laws, concepts, principles and theories and use scientific knowledge
- demonstrate an understanding of simple Physics concepts of natural and artificial processes affecting health, social, economic and environmental issues
- use information to identify simple patterns, and report trends
- apply simple Physics concepts and knowledge to common situations in addressing health, social, economic and environmental issues
- translate simple information from one form to another: e.g. process information from graphs, tables and charts; represent information in the form of graphs, tables and charts
- make simple experimental procedures (plan); discuss the plan; generate hypotheses to solve a scientific problem, identify and deal with simple variables
- apply basic knowledge and skills for creativity and innovation in real-life situations
- use common apparatus and techniques safely and correctly; follow a few given instructions to perform an experiment
- make simple observations and measurements; record experimental data; process data, make conclusions

A **Grade G** candidate should be able to:

- recall basic scientific vocabulary, terminology and conversions e.g. symbols and units
- recall basic Physics laws, concepts, principles and theories
- demonstrate an understanding of basic Physics concepts of natural and artificial processes affecting health, social, economic and environmental issues
- use information to identify basic patterns, and report simple trends
- apply basic Physics concepts and knowledge to common situations in addressing health, social, economic and environmental issues
- translate basic information from one form to another: e.g. process information from graphs, tables and charts; represent information in the form of graphs, tables and charts
- make simple experimental procedures (plan) and identify some variables
- apply basic knowledge and skills for creativity and innovation in real-life situations
- use common apparatus; follow a few given instructions to perform an experiment
- make basic observations and measurements; record experimental data

5.4 Availability of the Syllabus

This syllabus is available to both school going and private candidates.

5.5 Combining the Syllabus with Other Syllabuses

Candidates may not combine this syllabus in an examination series with the following Botswana Senior Secondary Education assessment syllabus:

1430 General Science

6.0 CONTENT

The table shows the Modules and Learning Outcomes that must be covered by the candidates. The details of the Performance Criteria and the Learning Outcomes are covered in the Botswana Senior Secondary Education Physics teaching syllabus.

Module 1	
PHYSL 1	APPLY PRINCIPLES OF MEASUREMENTS AND SCIENTIFIC PROCESSES
PHYSL 1.1: Apply the scientific method PHYSL 1.2: Use scientific conventions PHYSL 1.3: Use fundamental and derived quantities and their units PHYSL 1.4: Perform accurate measurement of different physical quantities	
Module 2	
PHYSL 2	EXPLORE PRINCIPLES OF MECHANICS
PHYSL 2.1: Apply properties of scalars and vectors in real life situations PHYSL 2.2: Demonstrate understanding of motion PHYSL 2.3: Explore effects of forces on shape and size of materials PHYSL 2.4: Explore principles, effects and applications of pressure	
Module 3	
PHYSL 3	DEMONSTARTE UNDERSTAN DING OF ENERGY AND WAVES
PHYSL 3.1: Apply principles of energy, work and power PHYSL 3.2: Apply principles of thermal energy PHYSL 3.3: Demonstrate understanding of general properties of waves	
Module 4	
PHYSL 4	EXPLORE MAGNETISM, ELECTRICITY AND ELECTRONICS

PHYSL 4.1: Apply concepts of magnetism PHYSL 4.2: Demonstrate understanding of electricity PHYSL 4.3: Investigate applications of electromagnetic effects PHYSL 4.4: Demonstrate understanding of basic electronics	
Module 5	
PHYSL 5	INVESTIGATE CONTEMPORARY EFFECTS OF SCIENTIFIC EXPLORATIONS, ATOMIC AND NUCLEAR PHYSICS
PHYSL 5.1: Explore the concepts of radioactivity PHYSL 5.2 Demonstrate understanding of Space Science	

7.0 PROVIDER BASED ASSESSMENT

Provider Based Assessment in Physics entails a continuous assessment of the candidate's work throughout the teaching and learning process. This will establish the extent of mastery of the learning outcomes (LO). The Education and Training Provider shall assess the candidate and keep evidence of assessment for every performance criterion as stipulated in the BSSE Physics teaching syllabus. The Botswana Examinations Council shall select the tasks from the different Provider Based Assessments to be included in the final assessment of the candidate. A portfolio of assessment evidence shall be kept in the centre for every candidate for authentication of the scores awarded to each candidate.

7.1 Structure of Provider Based Assessment

Provider Based Assessment may be through, but not limited to the following LOs:

- Apply the scientific method
- Explore effects of forces on shape and size of materials
- Apply principles of energy, work and power
- Apply concepts of magnetism
- Demonstrate understanding of electricity
- Investigate applications of electromagnetic effects
- Demonstrate understanding of basic electronics

The Provider Based Assessment shall be presented as a report and/or a model whose topics follow the steps of scientific method. The learners shall be provided with a Learning Outcome from which each learner should come up with their own research topic from which they are to carry out an investigation or to design a model.

The report and/or the model should on a minimum cover the topics listed, the details of which are covered in the marking criteria.

1.0 Title, aims and objectives

2.0 Theoretical Background including hypothesis

3.0 Methodology

4.0 Data Presentation and Analysis

5.0 Discussion

6.0 Conclusion

7.0 References

The contribution of Provider Based Assessment in the syllabus is 20% and is subject to review based on the reliability and validity of the scores provided by the ETPs. The Botswana Examinations Council shall subject Provider Based Assessment to external moderation.

7.2 Moderation of Provider Based Assessment

Moderation will be done to ensure that all ETPs have adhered to the standard laid out for Provider Based Assessments. There shall be both internal moderation and external moderation. The internally moderated scores will then be subjected to external moderation.

7.2.1 Internal Moderation

Internal Moderation is an ETP based quality assurance process which ensures that assessment of outcomes is fair, valid, reliable and consistent. The purpose of internal moderation is to standardise the application of the marking criteria and ensure that teachers' judgements within an ETP are consistent.

Internal Moderation should be done as a two-stage process by the ETP

(a) Critiquing: This is done to ensure that assessment tasks are benchmarked against the outcomes in the BSSE Physics teaching syllabus

(b) Verification: This is done to ensure consistency of judgements from assessors within an ETP

7.2.2 External Moderation

External Moderation shall be carried out by trained moderators engaged by the Botswana Examinations Council. The BEC shall provide the ETPs with an external moderation schedule in advance of the moderation exercise. The assessments identified for inclusion into the summative assessment shall include the practical and research projects identified in 7.1.

8.0 OTHER INFORMATION

8.1 Equality and Inclusion

Botswana Examinations Council has taken care in the preparation of this assessment syllabus and accompanying assessment materials to avoid bias of any kind. To comply with the accreditation standards this assessment was designed with the aim of avoiding direct and indirect discrimination.

The standard assessment arrangements may present unnecessary barriers for candidates with special learning needs. Access arrangements will be put in place to enable such candidates to be assessed and to be given a fair recognition of their attainment. Access arrangements that give a candidate an unfair advantage over the others or that compromise the standards being assessed will not be permitted.

Candidates who are unable to access the assessments of any component may be eligible to receive an award based on the parts of the assessment they have taken.

Modifications made to assessments will be in line with the Special Education Needs guidelines of BEC. It is recommended when registering the candidates for entry into the syllabus, centres should specify the special learning requirements for such candidates.

8.2 Grading and Reporting

The grading for BGCSE is at syllabus level with no aggregation of the results. The BGCSE results are reported on a scale of A* – G, A* being the highest and G the lowest. Ungraded (U) indicates that the candidate's performance fell short of the standard required for grade G. Ungraded (U) will be reported on the statement of results but not on the certificate. The letters Q (result pending) and X (no result) may also appear on the statement of results.

9.0 APPENDICES

A Glossary of Terms

Performance criteria in the content section of the syllabus are expressed in terms of what candidates who have completed the BSSE Physics syllabus **know**, **understand** and **can do**. The words used on the examination papers in connection with the assessment of these learning outcomes are contained in this glossary. This is neither exhaustive nor definitive but is meant to provide some useful guidance.

The command word used should consider the skills and the assessment objectives that are being tested by the question. The command word should be clear and prompt the answer expected from the candidates.

command word	meaning

calculate	work out a numerical answer from given facts, figures or information
compare	identify/comment on similarities and/or differences
define	give a precise meaning
demonstrate	show how or give an example
describe	state the points of a topic / give characteristics and main features
determine	work out a numerical answer for a quantity that cannot be measured directly
discuss	write about issue(s) or topic(s) in depth in a structure way
estimate	write a reasoned order of magnitude statement
explain	set out purposes or reasons / make the relationships between things evident / provide why and/or how and support with relevant evidence
give	produce an answer from a given source or recall/remember
identify	name/select/recognise
justify	support a case with evidence/ argument
measure	obtain a quantity from an instrument
outline	set out main points
predict	suggest what may happen based on available information
record	write down the information or facts
sketch	make a simple freehand drawing showing the key features, taking care over proportions
state	express in clear terms
suggest	apply knowledge and understanding to situations where there are a range of valid responses in order to make proposals/put forward considerations

B Mathematical Skills

Candidates will be required to perform quantitative work, including calculations. They should be able to use scientific calculators and mathematical instruments.

The mathematical requirements, which form part of this syllabus, are listed below.

- add, subtract, multiply and divide numbers
- recognise and use expression in decimal form
- use simple formulae
- understand and use averages
- read, interpret and draw simple inferences from tables and statistical diagrams
- find fractions or percentages of quantities
- calculate with fractions, decimals, percentage or ratios
- manipulate and solve simple equations
- substitute numbers in simple equations
- recognise and use expressions in standard form
- interpret and use graphs
- choose by simple inspection and then draw the best smooth curve through a set of points on a graph

- select appropriate axes and scales for plotting a graph
- determine the intercept of a linear graph
- understand and use direct and indirect proportion

C Physical Quantities, Symbols and Units

Candidates are required to demonstrate an understanding of the physical quantities, both base and derived and their corresponding SI units. They will be required to use them in quantitative work and calculations.

base quantity	symbol	SI unit	symbol
length	l	metre	m
mass	m	kilogram	kg
time	t	second	s
temperature	θ, T	Kelvin	K
current	I	ampere	A
luminous intensity	I_v	candela	cd
amount of substance	n	mole	mol

Derived Quantities

physical quantity	symbols	unit(s)
area	A	cm^2; m^2
volume	V	cm^3; m^3
density	□	kg/m^3; g/cm^3
force	F	newton (N)
pressure	P	pascal (Pa); N/m^2; N/cm^2
speed	u, v	m/s; km/h
acceleration	a	m/s^2
energy	E	joule (J); kilojoule (kJ); megajoule (MJ)
power	P	watt (W); kilowatt (kW); megawatt(MW)
frequency	f	hertz (Hz); kilohertz (kHz)
electrical charge	Q, q	coulomb (C)
potential difference	V	volt (V)
resistance	R	ohm (□)
weight	W	newton (N)
acceleration of free fall	g	m/s^2, N/kg
work	W	joule (J)
specific heat capacity	c	J/(g °C), J/(kg °C)
specific latent heat	l	J/kg, J/g

wavelength	□	m, cm
electromotive force	*E*	V

D Scientific Notation

prefix	symbol	factor
pico	p	10^{-12}
nano	n	10^{-9}
micro	□	10^{-6}
milli	m	10^{-3}
centi	c	10^{-2}
deci	d	10^{-1}
deca / deka	da	10^{1}
hecto	h	10^{2}
kilo	k	10^{3}
mega	M	10^{6}
giga	G	10^{9}
tera	T	10^{12}

Units, significant figures. Candidates would be advised in each question on the number of significant figures or decimal places they have to express their answers to. If there is no advice on such, answers can be given to any number of significant figures. Candidates should be aware that misuse of units that is, failure to code units where necessary or the inclusion of units in quantities defined as ratios is liable to be penalised.

E Presentation of Data

Tables

- Each column of a table should be headed with the physical quantity and the appropriate SI units, e.g., time / s, rather than time (s). There are two acceptable methods of stating units, e.g., m / s or ms^{-1}.
- Candidates should use the number of significant figures appropriate to the precision of the measuring instrument.
- The column headings of the table can then be directly transferred to the axes of a constructed graph.

Graphs

- The independent variable will be plotted on the x-axis (horizontal axis) and the dependent variable plotted on the y-axis (vertical axis).
- The graph is the whole diagrammatic presentation. It may have one or several curves / lines plotted on it.
- Points on the curve / line should be clearly marked as crosses (×) or encircled dot (⊙).
- If a further curve / line is included, vertical crosses (**+**) may be used to mark the points.
- Plots of points should have an accuracy of better than 1 mm and all read offs.
- Plots should be made with a sharp pencil.