Dawood Public School
Course Outline for the year 2011-2012
Physics
Class-XI

Books:

Pople, S. 2001. *Explaining Physics*, GCSE edition, Oxford University Press

Chew, C. et al. 2000. *GCE 'O' Level Physics* (2 ed), Singapore; Marshal Cavendish Education

Cambridge O Level Physics **Syllabus code 5054**

All candidates enter for **three** papers – Papers 1 and 2 and 4.

Paper 1 **Multiple Choice** **1 hour**

40 compulsory multiple choice questions of the direct choice type. The questions involve four response items.
40 marks

Paper 2 **Theory** **1 hour 45 minutes**

This paper has two sections:

Section A has a small number of compulsory, structured questions of variable mark value. 45 marks in total are available for this section.

Section B has three questions. Each question is worth 15 marks. Candidates must answer **two** questions from this section.

There is no compulsory question on Section 25 of the syllabus (Electronics systems). Questions set on topics within Section 25 appear only in Paper 2 and are always set as an alternative within a question. Candidates will answer on the question paper. 75 marks

Paper 4 Alternative to Practical **1 hour**

A written paper of compulsory short-answer and structured questions designed to test familiarity with laboratory practical procedures.

Candidates will answer on the question paper. 30 marks

Syllabus AIMS and Assessment
AIMS

The aims of the science curricula are the same for all students. These are set out below and describe the educational purposes of an O Level/School Certificate course in Physics. They are not listed in order of priority.
The aims are to:

- Acquire a systematic body of scientific knowledge, and the skills needed to apply this in new and changing situations in a range of domestic, industrial and environmental contexts;
- Acquire an understanding of scientific ideas, how they develop, the factors which may affect their development and their power and limitations;
- Plan and carry out a range of investigations, considering and evaluating critically their own data and that obtained from other sources;
- Evaluate in terms of their scientific knowledge and understanding, the benefits and drawbacks of scientific and technological developments, including those related to the environment, personal health and quality of life, considering ethical issues where appropriate;
- Select, organize and present information clearly and logically, using appropriate scientific terms and conventions,
- Stimulate interest in and care for the local and global environment.
- Promote an awareness that:

* The study and practice of science are co-operative and cumulative activities, which are subject to social, economic, technological, ethical and cultural influences and limitations;
* The applications of sciences may be both beneficial and detrimental to the individual, the community and the environment.

Assessment Objective

The skills appropriate to Physics may, for convenience, be broadly categorized as follows:
A description of each of these categories is given below:

Knowledge and understanding

Students must be able to:

- Recognize, recall and show understanding of specific scientific facts, terminology, principles, concepts and practical techniques;
- Demonstrate understanding of the power and limitations of scientific ideas and factors affecting how these ideas develop;
- Draw on existing knowledge to show understanding of the benefits and drawbacks of applications of science;
- Select, organize and present relevant information.

Dawood Public School
Course Outline for the year 2011-2012
Physics
Class-XI

Application of knowledge and understanding, analysis and evaluation
Students must be able to:

- Describe, explain and interpret phenomena, effects and ideas in terms of scientific principles and concepts, presenting arguments and ideas clearly and logically;
- Interpret and translate, from one form into another, data presented as continuous prose or in tables, diagrams and graphs;
- Carry out relevant calculations;
- Apply principles and concepts to unfamiliar situations, including those related to applications of science in a range of domestic, industrial and environmental contexts;
- Evaluate scientific information and make informed judgments from it.

Investigative skills
Students must be able to:

- Devise and plan investigations, drawing on scientific knowledge and understanding in selecting appropriate strategies;
- Demonstrate appropriate investigative methods, including safe and skilful practical techniques, obtaining data which are sufficient and of appropriate precision, recording these methodically;
- Interpret data to draw conclusions which are consistent with the evidence, using scientific knowledge and understanding, whenever possible, in explaining their findings;
- Evaluate data and methods.

Weighting of Assessment Objectives
Theory Papers (Papers 1 and 2)

A Knowledge with understanding, approximately 65% of the marks with approximately 30% allocated to recall.
B Handling information and solving problems, approximately 35% of the marks.

Practical Assessment (Paper 4)

This is designed to test appropriate skills in C Experimental skills and investigations, and will carry 20% of the marks for the subject.

Monthly Syllabus

August 2011	● Static Electricity ● Current Electricity ● D.C. Circuits
September 2011	● Practical Electricity ● Magnetism and Electromagnetism ● Electromagnetism ● ATP
October 2011	● Electromagnetism ● Electromagnetic Induction ● Introductory Electronics ● Electronic Systems ● ATP
November 2011	● REVISION FOR MID TERM EXAMS
December 2011	● MID TERM EXAMS
January 2012	● Radioactivity ● The Nuclear Atom ●ATP ● Past Papers
February 2012	● Past Papers ● ATP
March 2012	● Revision for Mock Examinations

Dawood Public School
Course Outline for the year 2011-2012
Physics
Class-XI

Syllabus Contents
1. Static Electricity

GCE O Level Physics by Charles Chew, Unit 17, Pg No.(259-274)
Explaining Physics by Stephen Pople, Unit 6.1 – 6.3, Pg No. (230 -241)

Content
1.1 Laws of electrostatics
1.2 Principles of electrostatics
1.3 Applications of electrostatics

Learning Objectives
Students should be able to:

a) Describe experiments to show electrostatic charging by friction.
b) Explain that charging of solids involves a movement of electrons.
c) State that there are positive and negative charges and that charge is measured in coulombs.
d) State that unlike charges attract and like charges repel.
e) Describe an electric field as a region in which an electric charge experiences a force.
f) State the direction of lines of force and describe simple field patterns.
g) Describe the separation of charges by induction.
h) Discuss the differences between electrical conductors and insulators and state examples of each.

(i) State what is meant by "earthing" a charged object.
(j) Describe examples where charging could be a problem e.g. lightning
(k) Describe examples where charging is helpful e.g. photocopier and electrostatic precipitator.

2. Current Electricity

GCE O Level Physics by Charles Chew, Unit 18, Pg No.(276-299)
Explaining Physics by Stephen Pople, Unit 6.4 – 6.6, Pg No. (242 -252)

Content
2.1 Current
2.2 Electromotive force
2.3 Potential difference
2.4 Resistance

Learning Objectives
Students should be able to:

(a) State that a current is a flow of charge and that current is measured in amperes.
(b) Do calculations using the equation charge = current x time.
(c) Describe the use of an ammeter with different ranges.
(d) Explain that electromotive force (e.m.f.) is measured by the energy dissipated by a source in driving a unit charge around a complete circuit.
e) State that e.m.f. is work done/charge.
(f) State that the volt is given by J/C.
(g) Calculate the total e.m.f. where several sources are arranged in series and discuss how this is used in the design of batteries.
(h) Discuss the advantage of making a battery from several equal voltage sources of e.m.f. arranged in parallel.
(i) State that the potential difference (p.d.) across a circuit component is measured in volts.
(j) State that the p.d. across a component in a circuit is given by the work done in the component/charge passed through the component.
(k) Describe the use of a voltmeter with different ranges.
(l) State that resistance = p.d./current and use the equation resistance = voltage/current in calculations.
(m) Describe an experiment to measure the resistance of a metallic conductor using a voltmeter and an ammeter and make the necessary calculations.
(n) Discuss the temperature limitation on Ohm's Law.
(o) *use quantitatively the proportionality between resistance and the length and the cross-sectional area of a wire.
(p) Calculate the net effect of a number of resistors in series and in parallel.
(q) Describe the effect of temperature increase on the resistance of a resistor and a filament lamp and draw the respective sketch graphs of current/voltage.

(r) Describe the operation of a light-dependent resistor.

3. D.C. Circuits

GCE O Level Physics by Charles Chew, Unit 19, Pg No.(301-309)
Explaining Physics by Stephen Pople, Unit 6.7 – 6.8, Pg No. (253 -261)

Content
3.1 Current and potential difference in circuits
3.2 Series and parallel circuits

Learning Objectives
Students should be able to:

(a) *draw circuit diagrams with power sources (cell, battery or a.c. mains), switches (closed and open), resistors (fixed and variable), light dependent resistors, lamps, ammeters, voltmeters, magnetising coils, bells, fuses, relays, light-emitting diodes and rectifying diodes.
(b) State that the current at every point in a series circuit is the same, and use this in calculations.
(c) State that the sum of the potential differences in a series circuit is equal to the potential difference across the whole circuit and use this in calculations.
(d) State that the current from the source is the sum of the currents in the separate branches of a parallel circuit.
(e) Do calculations on the whole circuit, recalling and using formulae including R = V/I and those for potential differences in series, resistors in series and resistors in parallel.

4. Practical Electricity

GCE O Level Physics by Charles Chew, Unit 20, Pg No.(311-329)
Explaining Physics by Stephen Pople, Unit 6.9 – 6.11, Pg No. (262 -272)

Content
4.1 Uses of electricity
4.2 Dangers of electricity
4.3 Safe use of electricity in the home

Learning Objectives
Students should be able to:

(a) Describe the use of electricity in heating, lighting and motors.
(b) Do calculations using the equations power = voltage x current, and energy = voltage x current x time.
(c) Calculate the cost of using electrical appliances where the energy unit is the kW h.
(d) State the hazards of damaged insulation, overheating of cables and damp conditions.
(e) Explain the use of fuses and circuit breakers and fuse ratings and circuit breaker settings.
(f) Explain the need for earthing metal cases and for double insulation.
(g) State the meaning of the terms live, neutral and earth.
(h) Describe how to wire a mains plug.
(i) Explain why switches, fuses and circuit breakers are wired into the live conductor.

5. Magnetism and Electromagnetism

GCE O Level Physics by Charles Chew, Unit 21, Pg No.(331-350)
Explaining Physics by Stephen Pople, Unit 7.1 – 7.4, Pg No. (280 -291)

Content
5.1 Laws of magnetism
5.2 Magnetic properties of matter
5.3 Electromagnetism

Learning Objectives

Students should be able to:

(a) State the properties of magnets.
(b) Describe induced magnetism.
(c) State the differences between magnetic, non-magnetic and magnetized materials.
(d) Describe electrical methods of magnetization and demagnetization.

(e) Describe the plotting of magnetic field lines with a compass.
(f) State the differences between the properties of temporary magnets (e.g. iron) and permanent magnets (e.g. steel).
(g) Describe uses of permanent magnets and electromagnets.
(h) Explain the choice of material for, and use of, magnetic screening.
(i) Describe the use of magnetic materials in audio/video tapes.
(j) Describe the pattern of the magnetic field due to currents in straight wires and in solenoids and state the effect on the magnetic field of changing the magnitude and direction of the current.
(k) Describe applications of the magnetic effect of a current in relays, circuit-breakers and loudspeakers.

6. Electromagnetism

GCE O Level Physics by Charles Chew, Unit 22, Pg No.(352-361)
Explaining Physics by Stephen Pople, Unit 7.5 – 7.6, Pg No. (292 -297)

Content
6.1 Force on a current-carrying conductor
6.2 The d.c. motor

Learning Objectives
Students should be able to:

(a) Describe experiments to show the force on a current-carrying conductor, and on a beam of charged particles, in a magnetic field, including the effect of reversing (1) the current, (2) the direction of the field.
(b) State the relative directions of force, field and current.
(c) Describe the field patterns between currents in parallel conductors and relate these to the forces which exist between the conductors (excluding the Earth's field).
(d) Explain how a current-carrying coil in a magnetic field experiences a turning effect and that the effect is increased by increasing (1) the number of turns on the coil (2) the current.
(e) Discuss how this turning effect is used in the action of an electric motor.
(f) Describe the action of a split-ring commutator in a two-pole, single coil motor and the effect of winding the coil onto a soft-iron cylinder.

7. Electromagnetic Induction

GCE O Level Physics by Charles Chew, Unit 23, Pg No.(363-376)
Explaining Physics by Stephen Pople, Unit 7.8 – 7.11, Pg No. (303 -317)

Content
7.1 Principles of electromagnetic induction
7.2 The a.c. generator
7.3 The transformer

Learning Objectives
Students should be able to:

(a) Describe an experiment which shows that a changing magnetic field can induce an e.m.f. in a circuit.
(b) State the factors affecting the magnitude of the induced e.m.f.
(c) State that the direction of a current produced by an induced e.m.f. opposes the change producing it (Lenz's Law) and describe how this law may be demonstrated.
(d) Describe a simple form of a.c. generator (rotating coil or rotating magnet) and the use of slip rings where needed.
(e) *sketch a graph of voltage output against time for a simple a.c. generator.
(f) Describe the structure and principle of operation of a simple iron-cored transformer.
(g) State the advantages of high voltage transmission.
(h) Discuss the environmental and cost implications of underground power transmission compared to overhead lines.

8. Introductory Electronics

GCE O Level Physics by Charles Chew, Unit 24, Pg No.(379-384)
Explaining Physics by Stephen Pople, Unit 8.1 – 8.5, 8.8, Pg No. (324 -340, 349 - 351)

Content
8.1 Thermionic emission
8.2 Simple treatment of cathode-ray oscilloscope
8.3 Action and use of circuit components

Dawood Public School
Course Outline for the year 2011-2012
Physics
Class-XI

Learning Objectives
Students should be able to:

(a) State that electrons are emitted by a hot metal filament.
(b) Explain that to cause a continuous flow of emitted electrons requires (1) high positive potential and (2) very low gas pressure.
(c) Describe the deflection of an electron beam by electric fields and magnetic fields.
(d) State that the flow of electrons (electron current) is from negative to positive and is in the opposite direction to conventional current.
(e) Describe in outline the basic structure and action of a cathode-ray oscilloscope (c.r.o.)
(f) Describe the use of a cathode-ray oscilloscope to display waveforms and to measure p.d.'s and short intervals of time.
(g) Explain how the values of resistors are chosen according to a colour code and why widely different values are needed in different types of circuit.
(h) Discuss the need to choose components with suitable power ratings.
(i) Describe the action of thermistors and light-dependent resistors and explain their use as input sensors.
(j) Describe the action of a variable potential divider (potentiometer).
(k) Describe the action of a capacitor as a charge store and explain its use in time delay circuits.
(l) Describe the action of a reed switch and reed relay.
(m) Explain the use of reed relays in switching circuits.
(n) Describe and explain circuits operating as light-sensitive switches and temperature operated alarms (using a reed relay or other circuits).
(o) State the meaning of the terms processor, output device and feedback.

9. Electronic Systems

GCE O Level Physics by Charles Chew, Unit 24, Pg No.(384-392)
Explaining Physics by Stephen Pople, Unit 8.7, Pg No. (345 -348)

Content
9.1 Switching and logic circuits
9.2 Bistable and astable circuits

Learning Objectives
Students should be able to:

(a) Describe the action of a bipolar npn transistor as an electrically operated switch and explain its use in switching circuits.
(b) State in words and in truth table form, the action of the following logic gates, AND, OR NAND, NOR and NOT(inverter).
(c) State the symbols for the logic gates listed above (American ANSI Y 32.14 symbols will be used).
(d) Describe the use of a bistable circuit.
(e) Discuss the fact that bistable circuits exhibit the property of memory.
(f) Describe the use of an astable circuit (pulse generator).
(g) Describe how the frequency of an astable circuit is related to the values of the resistive and capacitative components.

10. Radioactivity

GCE O Level Physics by Charles Chew , Unit 25, Pg No.(395-404)
Explaining Physics by Stephen Pople, Unit 8.9, 8.11-8.12, Pg No. (352 -356, 361 - 369)

Content
10.1 Detection of radioactivity
10.2 Characteristics of the three types of emission
10.3 Nuclear reactions
10.4 Half-life
10.5 Uses of radioactive isotopes including safety precautions

Learning Objectives
Students s should be able to:

(a) Describe the detection of alpha-particles, beta-particles and gamma-rays by appropriate methods.
(b) State and explain the random emission of radioactivity in direction and time.
(c) State, for radioactive emissions, their nature, relative ionising effects and relative penetrating powers.
(d) Describe the deflection of radioactive emissions in electric fields and magnetic fields.
(e) Explain what is meant by radioactive decay.
(f) Explain the processes of fusion and fission.
(g) Describe with the aid of a block diagram one type of fission reactor for use in a power station.

(h) Discuss theories of star formation and their energy production by fusion.
(i) Explain what is meant by the term half-life.
(j) Make calculations based on half-life which might involve information in tables or shown by decay curves.
(k) Describe how radioactive materials are handled, used and stored in a safe way.
(l) Discuss the way in which the type of radiation emitted and the half-life determine the use for the material.
(m) Discuss the origins and effect of background radiation.
(n) Discuss the dating of objects by the use of C^{14}

11. The Nuclear Atom

GCE O Level Physics by Charles Chew, Unit 25, Pg No.(404-416)
Explaining Physics by Stephen Pople, Unit 8.10, Pg No. (357 -360)

Content

11.1 Atomic model
11.2 Nucleus

Learning Objectives

Students should be able to:

(a) Describe the structure of the atom in terms of nucleus and electrons.
(b) Describe how the Geiger-Marsden alpha-particle scattering experiment provides evidence for the nuclear atom.
(c) Describe the composition of the nucleus in terms of protons and neutrons.
(d) Define the terms proton number (atomic number), Z and nucleon number (mass number), A.
(e) Explain the term nuclide and use the nuclide notation $^{A}Z_{X}$ to construct equations where radioactive decay leads to changes in the composition of the nucleus.
(f) Define the term isotope.
(g) Explain, using nuclide notation, how one element may have a number of isotopes.

Paper 4: Alternative to Practical Paper

This paper is designed for those Centres for whom the preparation and execution of the Practical Test is impracticable. The Alternative to Practical Paper consists of four or five questions relating to practical Physics: candidates answer on the question paper.

The best preparation for this paper is a thorough course in experimental Physics. Candidates are unlikely to demonstrate their full potential on this paper unless they have become fully familiar with the techniques and apparatus involved by doing experiments for themselves. Questions may involve the description of particular techniques, the drawing of diagrams, or the analysis of data. The examiners expect the same degree of detail as for Paper 3 and candidates should be taught to adopt practices which satisfy the same general marking points. In addition, candidates should be able to draw, complete and label diagrams of apparatus and to take readings from diagrams of apparatus given in the question paper. Where facilities permit, demonstration experiments by the teacher can be very useful in the teaching of particular techniques, and can be the source of useful data for candidates to analyse.

Notes on the Alternative to Practical Paper Paper 4

1. This paper is an alternative to a practical exam, not an alternative to a practical course.
2. The preparation for students is a well-designed practical course.
3. The course should teach candidates how to make measurements using many different types of instruments. They should see the instruments, handle them, discuss their scales and the scale units before using the instruments.
4. Students should understand why the choice of range for the measuring scale should match the size of the quantity being measured.
5. Students should be taught how to record measurements in a table. A table should record all the measurements needed to obtain the value of a given physical quantity.
   For example if a length *l i*s derived from $l = l_2 - l_1$ then l_1 and l_2 should appear in the table.
   Columns (or rows) in the table should be headed with the name of symbol of the physical quantity. The unit in which the quantity is measured should be included. The SI method is recommended. Encourage neat work.
6. Ideally, when performing an experiment (and relevant readings are recorded) it is helpful to arrange the experiment so that one variable is increased step by step.
   Candidates should always look for a trend in the recorded results. Some trends are

   - *y* increases as *x* increases
   - Straight line through the origin, if *x* is doubled then *y* is doubled, direct proportionality
   - *y* decreases as *x* increases
   - *x* times *y* = k, inversely proportionality. Inverse proportionality is generally not properly understood
7. A graph is the best way to display the results of an experiment.

   - *y*/unit against *x/*unit should be understood as the label of each axis
   - axes should

- be labelled with quantity, unit and scaled
- As large as possible, but should not use an awkward scale to achieve the size
- Plotting should be neat and as accurate as possible
- Graph lines should be neat, thin and a good fit (if there is scatter of points they should lie either side of the line{in a rough way!! }). Straight lines should FILL the page (even beyond the range of points) so that any gradient calculation can use the largest y and x. Students should understand why! (_y is a measurement.)
- Students should describe what information is obtained from a graph, see note 6.

8. Students should understand the idea of a **fair test** or comparison in which only one variable is altered at a time, eg when investigating how rate of cooling experiment depends on temperature room to be kept constant--room draughts, volume and type of liquid, amount of stirring.

9. Students should be trained to give a conclusion to an experiment.

10. Good procedures: -

- Repeat to spot anomalous errors or to calculate an average
- Avoid making parallax errors, {the line of sight should be perpendicular to the reading on the scale}
- Make a note of the details of any scale that is used eg
- The unit in which the scale is calibrated
- The maximum reading that can be obtained
- The smallest change in value that can be obtained
- Physical quantities
- Aim to use quantities that have magnitudes that are towards the upper values of the scale
- A unit must always be given with the magnitude of a quantity
- In experiments involving the measurement of a length
- Try to use lengths that are at least 100 mm in length
- Measure to the nearest mm, (so the "accuracy" in (a) is 1 in 100)
- When measuring heights ensure that the rule is held perpendicular to the base
- Use a fiducial aid
- Know how to arrange apparatus so that it is parallel or perpendicular to a bench
- In light experiments using objects, lenses and a screen
- Ensure that each item is aligned so that the centre of each item is at the same height and on the same horizontal straight line (ideally use the term optic axis)
- Try to use distances that are at least 100 mm in length
- Use a fiducial aid when measuring a length
- Try to use a translucent screen
- Perform the experiment in a shaded part of the laboratory
- In ray tracing experiments
- When using marker pins space the pins so that they are at least 60 mm apart
- Ensure that the pins are vertical
- Draw neat thin lines
- Use the largest angles available and draw the arms of the angle longer than the radius of any protractor being used, a large radius is desirable
- When using a thermometer
- Position the eye so that the mercury thread appears to touch the scale
- Attempt to interpolate the position of the meniscus on the scale ie read between the marks
- Check whether the thermometer is full or 1/3 immersion
- In heat experiments
- Choose volume/mass values of the quantities that give large changes in the Temperature
- Insulate the container, cover the container, stir, wait for highest temperature
- In electrical experiments
- Check for a zero error
- Tap the meter to avoid sticking
- Initially choose the highest range for the ammeter/voltmeter, then reduce the range for the ammeter so that the deflection is almost full scale
- Always check polarities before closing the switch (completing the circuit)
- Always check that connections are clean.
- Switch off the current when not making a measurement.
- When measuring an interval of time
- Choose a clock or stopwatch that will give 1% accuracy (e.g. 1 sec in 100 sec)
- For oscillations (of a pendulum or vibrating rule), be able to define a complete oscillation; time N oscillations so that the total time is at least 100sec and use the terminology periodic time $T = t/N$; repeat the experiment so as to obtain an average of t; explain how to use a fiducial aid at the centre of the oscillation; explain where the eye should be placed as to as to avoid parallax errors

Your Handy Checklist for the Practical

1. Repeat all readings and average. Show all readings. If timing measure the period of at least 5 oscillations each time. Try for 10 if time allows. Remember timing error is 0.1s with a handheld stopclock.

When taking a set of readings make sure that they cover the whole range of the readings fairly evenly.

2. Try to arrange for a single table which

- shows all readings, even the first, and their averages
- has the correct units and quantities for each column
- has the same precision (ie no. of sig figs) for every reading in a particular column.

Choose a sensible number of sig. figs. (usually 2 or 3)

3. Your graph should

- have each axis labelled with both quantity and unit
- occupy at least 5x7 squares (ie half the paper) with **YOUR** plotted points
- ask yourself whether the origin should be plotted
- not use an awkward scale, ie 1 square = 3, 7 ,9 units
- have points plotted neatly, with NO large blobs, or crosses. Circle your points if you plot them as dots.
- have a clear even thin line plotted

4. In measuring the slope

- use at least half of the drawn straight line
- show the coordinates that you use for the slope or the values of the sides of the triangle that you use.
- give your answer to 1 or 2 sig. figs as appropriate. Don't forget units.

5. Know the straight line formula for a graph, y =mx +c,

- If $y^2 = kx^3$ then plot y^2 against x^3 and the slope is k
- If $y = kx^n$ then plot $\log_{10}(y)$ or ln(y) against $\log_{10}(x)$ or ln(x) slope is n.
  On tables and graphs the label is $\log_{10}(y/m)$ or ln(y/m) to show the unit of y as metres
  Check that you know how to use logs.

Checking Relationships

In each case **state** what should be constant, perform the calculation and then say whether the constant was found and the relationship verified within the error.

- Y proportional to x   Y/x should be constant
- Y proportional to 1/x   Yx should be constant
- Y proportional to e^x Y decreases by same **factor** if x increases by equal amounts

Errors

1. Causes of error in simple measurements **LEARN THESE**
   - **Lengths** rulers have battered ends, or the zero is not actually at the end
     parallax error, you must view any reading from directly above.
     likely error is $\pm$1 mm or perhaps $\pm$ 0.3 mm
   - **Times** stopwatches measure to $\pm$ 0.01s but you can't press them that accurately,
     likely error is $\pm$ 0.1s.
   - **Meters (eg ammeter)** error is the smallest scale reading, or notice any fluctuation.
2. Combining errors
   - There are absolute errors and percentage errors
   - Adding or subtracting quantities add absolute errors
   - Multiplying or dividing quantities add percentage errors to get percentage error in answer

Work through this example then repeat it yourself on paper

If A = 2.34 $\pm$ 0.02 and B = 6.0 $\pm$ 0.1

(notice the values are quoted to the no. of decimal places justified by the error)

A+B = 8.34 $\pm$ 0.12 = 8.3 $\pm$ 0.1
B-A = 3.64 $\pm$ 0.12 = 3.6 $\pm$ 0.1

B/A = 2.56 %error = %error in A +%error in B
= 1 + 1.5
= 2.5%
actual error in B/A = 2.56 * 2.5/100 = 0.06

so B/A = 2.56 $\pm$ 0.06

B.A = 14.04, again to 2.5%, which is 2.5*14.04/100 = 0.4
B.A = 14.0 $\pm$ 0.4

Dawood Public School
Course Outline for the year 2011-2012
Physics
Class-XI

Describing and improving an experiment
State every reading you will take. Do not say "Take the readings as before". Make clear what is kept constant and what is changed. Give sensible values for quantities, particularly those that are changed. Use your common sense. Have at least five sets of readings as a variable changes. Say that you will repeat and average each reading. Say what the axes will be for a straight line graph. Never just say "plot a graph". Set out your account clearly and logically; use their suggested format if you think it helps. Plan your account briefly before you start writing.

Glossory of Terms Used
The glossary (which is relevant only to Science subjects) will prove helpful to candidates as a guide but it is not exhaustive. The glossary has been deliberately kept brief, not only with respect to the numbers of terms included but also to the descriptions of their meanings. Candidates Should appreciate that the meaning of a term must depend, in part, on its context.

1. *Define (the term(s) ...)* is intended literally. Only a formal statement or equivalent paraphrase, such as the defining equation with symbols identified, being required.
2. *Explain/ What is meant by* ... normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.
3. *State* implies a concise answer with little or no supporting argument, e.g. a numerical answer that can be obtained 'by inspection'.
4. *List* requires a number of points with no elaboration. Where a given number of points is specified, this should not be exceeded.
5. *Describe* requires candidates to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena. The amount of description intended should be interpreted in the light of the indicated mark value.
6. *Discuss* requires candidates to give a critical account of the points involved in the topic.
7. *Deduce* implies that candidates are not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.
8. *Suggest* is used in two main contexts. It may either imply that there is no unique answer or that
Candidates are expected to apply their general knowledge to a 'novel' situation, one that formally may not be 'in the syllabus'.
9. *Calculate* is used when a numerical answer is required. In general, working should be shown.
10. *Measure* implies that the quantity concerned can be directly obtained from a suitable measuring instrument, e.g. length, using a rule, or angle, using a protractor.
11. *Determine* often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula, e.g. the Young modulus, relative molecular mass.
12. *Show* is used when an algebraic deduction has to be made to prove a given equation. It is important that the terms being used by candidates are stated explicitly. 13. *Estimate* implies a reasoned order of magnitude statement or calculation of the quantity concerned. Candidates should make such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.
14. *Sketch*, when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct. However, candidates should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having an intercept, asymptote or discontinuity at a particular value. On a sketch graph it is essential that candidates clearly indicate what is being plotted on each axis.
Sketch, when applied to diagrams, implies that a simple, freehand drawing is acceptable: nevertheless, care should be taken over proportions and the clear exposition of important detail.

FORMULAE FOR RELATIONSHIPS BETWEEN PHYSICAL QUANTITIES
The relationship below will not be provided for candidates either in the form given or in rearranged form.

the relationship between speed, distance and time:
speed = dis/time
the relationship between force, mass and acceleration:
force = mass × ***acceleration***
acceleration = change in velocity / time
the relationship between density, mass and volume:
density = mass / volume
the relationship between force, distance and work:
work done = force × ***distance moved in direction of force***
the energy relationships:
energy transferred = work done
kinetic energy = ½ × ***mass*** × ***speed***^{2}
change in potential energy = mass × ***gravitational field strength*** × ***change in height***
the relationship between mass, weight and gravitational field strength:

weight = mass × ***gravitational field strength***
the relationship between an applied force, the area over which it acts and the resulting pressure:
pressure = force / area
the relationship between the moment of a force and its distance from the pivot:
moment = force × ***perpendicular distance from pivot***
the relationships between charge, current, voltage, resistance and electrical power:
charge = current × ***time***
voltage = current × ***resistance***
electrical power = voltage × ***current***
the relationship between speed, frequency and wavelength:
wave speed = frequency × ***wavelength***
the relationship between the voltage across the coils in a transformer and the number of turns in them:

$$\frac{\text{voltage across secondary}}{\text{voltage across primary}} = \frac{\text{number of turns in secondary}}{\text{number of turns in primary}}$$

Resource List

Breithaupt, J Key Science – Physics (Stanley Thornes)
Dobson, K The Physical World (Nelson)
Duncan, T GCSE Physics (Third edition) (John Murray)
Nuffield Co-ordinated Sciences Physics (Longman)
www.focuseducational.com
www.crocodile-clips.com

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