DAWOOD PUBLIC SCHOOL

Course Outline for the year 2011-2012

Physics

Class-X

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, that 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.

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.

Monthly Syllabus:

August 2011	● Thermal Properties of Matter Heat Capacity ● Transfer of Thermal Energy
September 2011	● Transfer of Thermal Energy ● General Wave Properties
October 2011	● Light (Reflection and Refraction) ● Light (Converging Lens)
November 2011	● Revision for Mid Term Examination
December 2011	● Mid Terms Examination
January 2012	● Electromagnetic Spectrum ● Sound
February 2012	● Sound ● Current Electricity
March 2012	● Revision for Mock Examination ● Mock Examination

Syllabus Content:

1. Transfer of Thermal Energy:

GCE O Level Physics by Charles Chew, Unit 12, Pg No.(172-188)
Explaining Physics by Stephen Pople, Unit 4.8- 4.9, 5.12, Pg No. (140 -143, 208-209)

Content:

1.1 Conduction
1.2 Convection
1.3 Radiation
1.4 Total transfer

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Learning Objectives:
Students should be able to:

(a) Describe how to distinguish between good and bad conductors of heat.
(b) Describe, in terms of the movement of molecules or free electrons, how heat transfer occurs in solids.
(c) Describe convection in fluids in terms of density changes.
(d) Describe the process of heat transfer by radiation.
(e) Describe how to distinguish between good and bad emitters and good and bad absorbers of infra-red radiation.
(f) Describe how heat is transferred to or from buildings and to or from a room.
(g) State and explain the use of the important practical methods of thermal insulation for buildings.

2. Thermal Properties of Matter:

GCE O Level Physics by Charles Chew, Unit 10, 11, Pg No.(141-149) & (151-170)
Explaining Physics by Stephen Pople, Unit 4.10 – 4.13, Pg No. (144 -159)

Content:
2.1 Specific heat capacity
2.2 Melting and boiling
2.3 Thermal expansion of solids, liquids and gases

Learning Objectives:
Students should be able to:

a) Describe a rise in temperature of a body in terms of an increase in its internal energy (random thermal energy).
b) Define the terms heat capacity and specific heat capacity.
c) Calculate heat transferred using the formula thermal energy = mass × specific heat capacity × change in temperature.
d) Describe melting/solidification and boiling/condensation in terms of energy transfer without a change in temperature.
e) State the meaning of melting point and boiling point.
f) Explain the difference between boiling and evaporation.
g) Define the terms latent heat and specific latent heat.
h) Explain latent heat in terms of molecular behavior.
i) Calculate heat transferred in a change of state using the formula thermal energy = mass × specific latent heat.
j) Describe qualitatively the thermal expansion of solids, liquids and gases.
k) Describe the relative order of magnitude of the expansion of solids, liquids and gases.
l) List and explain some of the everyday applications and consequences of thermal expansion.
m) Describe qualitatively the effect of a change of temperature on the volume of a gas at constant pressure.

3. General Wave Properties:

GCE O Level Physics by Charles Chew, Unit 13, Pg No.(190-204)
Explaining Physics by Stephen Pople, Unit 5.9, Pg No. (195 -199)

Content:
3.1 Describing wave motion
3.2 Wave terms
3.3 Wave behaviour

Learning Outcomes
Students should be able to:

(a) Describe what is meant by wave motion as illustrated by vibrations in ropes and springs and by experiments using a ripple tank.
(b) State what is meant by the term wave front.
(c) Define the terms speed, frequency, wavelength and amplitude and do calculations using velocity = frequency × wavelength.
(d) Describe transverse and longitudinal waves in such a way as to illustrate the differences between them.
(e) Describe the use of a ripple tank to show
(1) Reflection at a plane surface,
(2) Refraction due to a change of speed at constant frequency.
(f) Describe simple experiments to show the reflection and refraction of sound waves.

4. Light:

GCE O Level Physics by Charles Chew, Unit 14 & 15, Pg No.(206-226) & (228-238)
Explaining Physics by Stephen Pople, Unit 5.1- 5.7, Pg No. (166 -190)

Content:

4.1 Reflection of light
4.2 Refraction of light
4.3 Thin converging and diverging lenses

Learning Objectives:

Students should be able to:

a) Define the terms used in reflection including normal, angle of incidence and angle of reflection.
b) Describe an experiment to illustrate the law of reflection.
c) Describe an experiment to find the position and characteristics of an optical image formed by a plane mirror.
d) State that for reflection, the angle of incidence is equal to the angle of reflection and use this in constructions, measurements and calculations.
e) Define the terms used in refraction including angle of incidence, angle of refraction and refractive index.
f) Describe experiments to show refraction of light through glass blocks.
g) Do calculations using the equation sin i /sin r = constant.
h) Define the terms critical angle and total internal reflection.
i) Describe experiments to show total internal reflection.
j) Describe the use of optical fibres in telecommunications and state the advantages of their use.
k) Describe the action of thin lenses (both converging and diverging) on a beam of light.
l) Define the term focal length.
m) *draw ray diagrams to illustrate the formation of real and virtual images of an object by a lens.
n) Define the term linear magnification and *draw scale diagrams to determine the focal length needed for particular values of magnification (converging lens only).
o) Describe the use of a single lens as a magnifying glass and in a camera, projector and photographic enlarger and draw ray diagrams to show how each forms an image.
p) Draw ray diagrams to show the formation of images in the normal eye, a short-sighted eye and a long-sighted eye.
q) Describe the correction of short-sight and long-sight.

5. Electromagnetic Spectrum:

GCE O Level Physics by Charles Chew, Unit13, Pg No.(199-201)
Explaining Physics by Stephen Pople, Unit 5.8, 5.10 -5.11, Pg No. (191 – 194, 200 - 209)

Content:

5.1 Dispersion of light
5.2 Properties of electromagnetic waves
5.3 Applications of electromagnetic waves

Learning Objectives:

Students should be able to:

a) Describe the dispersion of light as illustrated by the action on light of a glass prism.
b) State the colors of the spectrum and explain how the colors are related to frequency/wavelength.
c) State that all electromagnetic waves travel with the same high speed in air and state the magnitude of that speed.
d) Describe the main components of the electromagnetic spectrum.
e) Discuss the role of the following components in the stated applications:
(1) Radio waves – radio and television communications,
(2) Microwaves – satellite television and telephone,
(3) Infra-red – household electrical appliances, television controllers and intruder alarms,
(4) Light – optical fibres in medical uses and telephone,
(5) Ultra-violet – sunbeds, fluorescent tubes and sterilization,
(6) X-rays – hospital use in medical imaging and killing cancerous cells, and engineering applications such as detecting cracks in metal,
(7) Gamma rays – medical treatment in killing cancerous cells, and engineering applications such as detecting cracks in metal.

6. Sound

GCE O Level Physics by Charles Chew, Unit 16, Pg No.(240-257)
Explaining Physics by Stephen Pople, Unit 5.13-5.14, Pg No. (210 - 216)

Content:

6.1 Sound waves
6.2 Speed of sound
6.3 Ultrasound

Learning Objectives:

Students should be able to:

a) Describe the production of sound by vibrating sources.
b) Describe the longitudinal nature of sound waves and describe compression and rarefaction.
c) State the approximate range of audible frequencies.
d) Explain why a medium is required in order to transmit sound waves and describe an experiment to demonstrate this.
e) Describe a direct method for the determination of the speed of sound in air and make the necessary calculation.
f) State the order of magnitude of the speeds of sound in air, liquids and solids.
g) Explain how the loudness and pitch of sound waves relate to amplitude and frequency.
h) Describe how the reflection of sound may produce an echo.
i) Describe the factors which influence the quality (timbre) of sound waves and how these factors may be demonstrated using a CRO.
j) Define ultrasound.
k) Describe the uses of ultrasound in cleaning, quality control and pre-natal scanning.

7. 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:

7.1 Current
7.2 Electromotive force
7.3 Potential difference
7.4 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. State that the potential difference (p.d.) across a circuit component is measured in volts.
i) 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.
j) Describe the use of a voltmeter with different ranges.
k) State that resistance = p.d./current and use the equation resistance = voltage/current in calculations. Describe an experiment to measure the resistance of a metallic conductor using a voltmeter and an ammeter and make the necessary calculations.
l) Discuss the temperature limitation on Ohm's Law.
m) *use quantitatively the proportionality between resistance and the length and the cross-sectional area of a wire. Calculate the net effect of a number of resistors in series and in parallel.
n) 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.

o) Describe the operation of a light-dependent resistor.

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 y2 = kx3 then plot y2 against x3 and the slope is k
If y = kxn then plot log10(y) or ln(y) against log10(x) or ln(x) slope is n.
On tables and graphs the label is log10(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 ± 0.06

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

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.

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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