GCSE
ADDITIONAL SCIENCE, PHYSICS
UNIT P2 – Example 2
4463, 4451

Scheme of Work

Introduction

This Outline Scheme of Work is one of a number of schemes prepared by practising teachers for the new AQA GCSE Sciences suite. It is hoped that other teachers will find them helpful as the basis for the fully detailed schemes prepared for teaching from September 2006. Each outline scheme covers one unit (B1, B2, B3, C1, C2, C3, P1, P2, P3) and for some units more than one outline scheme is available. This is because there are different, equally valid ways of approaching the teaching of the specifications and a single scheme would not show the range of possible approaches.

The AQA specifications are designed to be used with a wide range of resources, so this scheme does not assume the availability of any particular printed or electronic publications, or any special equipment. Teachers are enabled to use existing resources, including their own, together with resources specially purchased for the new specifications.

The outline scheme is arranged under the section headings of the relevant specification, for example, *13.1/12.1 How can we describe the way things movet?* The content in the section is further subdivided with a brief statement given of the coverage of each subdivision, together with activities that relate to that content and an indication of the number of hours it is suggested are needed to deliver that part of the content.

Opportunities to deliver 'How Science Works' and to use ICT are highlighted using the same icons as used in the specifications.

This identifies parts of the content which lend themselves to extended investigative work of the type needed to explore Sections 10.3–10.7 of the specifications. These sections are about obtaining valid and reliable scientific evidence.

This identifies parts of the content which lend themselves to activities which allow Sections 10.2 and 10.8–10.9 to be considered. These sections are about using scientific evidence, for example, how scientific evidence can contribute to decision making and how scientific evidence is limited.

This identifies where there are opportunities to use ICT sources and tools in teaching the specifications.

UNIT P2

Total hours: 4 | **12.1/13.1 How can we describe the way things move?**

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Construct graphs of constant motion		• Construct ticker tape charts of distance moved in set time of constant speed. Appreciate that this is a distance moved in a unit time – constant speed graph. Calculation of distance travelled. Slope of graph = speed. Calculation of speed from the graph (HT only)	Use of friction style car and ticker tape timers. Also use of data loggers. Understand the shape of the graph. Change experiments to measure speed of objects present in data. PSA
Construct graphs of changeable motion		• Construct ticker tape charts of distance moved in set time of changeable speed. Appreciate that this is a distance moved in a unit time – velocity graph. Calculation area under graph = distance travelled. Slope = acceleration. Calculate the acceleration from the graph.	Understand the shape of the graph. Difference in variables: • of car weight • speed of motor PSA

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
The difference between speed and velocity Calculation of acceleration		• Discussion of differences – examples. Velocity = speed in a known direction. • Numerical examples to exemplify	Keep examples in ms^{-1} or kms^{-1}. Conversion of ms^{-1} to kms^{-1} to appropriate level. Keep examples in ms^{-2} (or kms^{-2}) Know the equation for acceleration: a = change in velocity / time taken for change [m/s / s = m/s^2] Use of prepared graphs from practical work. PSA

Total hours: 11	13.2/12.2 How do we make things speed up or slow down?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Terminal velocity		• Appreciate that an unbalanced force must act as an object. Revise: examples such as submarines, squashing: stretching an eraser • Use of above graph to identify data • To draw and interpret velocity time graphs for bodies that reach terminal velocity • Parachute practical. Further work – helicopter practical – variables of sail area/mass trapped height • Practical issues of terminal velocity: parachutes	Use ball bearings in long glass tube ~ 2.5m, filled with bubble bath / washing up liquid. Ensure that ball bearings are small enough to go through fluid at a reasonable rate (circa ¼ diameter of tube maximum). Use of ICT in plotting graphs. Explain diagram/results. Time for marked distance – calculate velocity, plot graph, find terminal velocity. Variables to change: density of fluid / length of drop / size of ball bearing / marble. (PSA)
To be able to calculate the weight of an object		• Knowledge and calculations using: weight (N) = mass (kg) × gravitational field strength (m/s^2)	Use of gravitational field strengths different to $10m/s^2$. Should be able to find mass / weight / acceleration constant supplied with other pair.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Whenever there are two forces acting on each other, the sum of the forces will be zero		• Moments experiment, using levers and weights. Calculation of turning moment. Balanced moments are equal. Therefore the number of forces acting on a specified body can be resolved into: thrust, drag, weight and upthrust. If T=D and W=U, there is no resultant force acting on the body and therefore it is stationary. If any force appears in T, D, W or U, there is a resultant force and the object will move. It will accelerate in the direction of this force.	This should include multiloads on one side – to give some complexity to the situation. Submarines / ships Use preloaded containers to float / sink to demonstrate Neutral buoyancy + load will sink.
If there is a resultant force and the object will accelerate in the direction of this force		• Knowledge and use of the equation: resultant force (N) = mass (kg) x acceleration (m/s^2) • The frictional forces (drag) are balanced by the driving force of a lorry • There are greater forces when a body travels at a higher speed	Use of highway code Societal aspects. Limitations.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Vehicles and their stopping distances		• Analysis of the stopping distances of cars / motorcycles. Plotting graphs of data from the Highway Code • Predictive work at specified distances. The reason for speed limits in city limits / 20 mph zones	Data analysis work, using data obtained from the Highway Code $$105. Also http://www.thinkroadsafety.gov.uk/
The effect of the driver in stopping his vehicle if he is under the influence of drink/drugs/tiredness		• Appreciate that drink/drugs/tiredness can affect the integrity of the driver	Liaison with the local Police Community Officer to hear first hand of the effects of the factors given
The difference between a well maintained vehicle and a poorly maintained one, in terms of road safety		• Look at the tyres, inflation/tread; road surfaces; vision; road weather conditions	This could link in with above lesson. Life skills session. Police community ? could be a useful content.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Design a better sports shoe		• Investigate the friction of a surface (road) with the sole of a shoe (tyre) • Presentation of data	Practical comparing the different tread patterns of shoes to friction effect on surfaces. Area of shoe can be determined by inking shoe and rolling onto paper. Need to place a constant load into shoe to remain constant. Many variables available- ideal PSA open ended investigative piece of work.
Suggest a couple of lessons left open here to allow catch up work/space for a mid-unit test etc			

Total hours: 4	13.3/12.3 What happens to the movement energy when things speed up or slow down?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Changing kinetic energy into other energy forms		• Seven circle plan – transmutation of KE into.. Mostly transferred into heat	PE, stress, strain, heat, elastic etc. Give suitable examples
Calculation of kinetic energy		• Be able to calculate and use the equation: kinetic energy, KE, (J) = mass, m (kg) $\times$ speed, $(m/s^2)^2$, v^2 • Take common examples, person running down corridor; car travelling at speed, v, then doubled to 2v, then doubled again to 4v; compare energy values • KE proportional to $speed^2$	Suggest energy converters for: Numerical appreciation of KE = mv^2. [Care with **s** and **v** – these are not defined in specification]. Useful to do calculation with a typical car (in kg) t show them energy contained in a moving car at say 20 (8.94), 30 (13.41) & 70(31.29) mph Conversion factor: mph x $0.44704ms^{-1}$
Work done = energy transferred		• Students to lift a brick/object a set height. Use Work (J) = force (N) $\times$ distance moved (m)	Different objects to rise. Calculation using kg, tonne, and gramme masses – conversion of units as per Mathematics specification. Also calculation of force using F = ma equation. Assume g = 10N/kg

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Changing shape		• Stretching a spring/rubber band, to show that PE is transferred into internal elastic energy in changing the shape of the elastic band	Can repeat this with supermarket carrier bags to show permanent deformation when they are stretched past their design parameters.

Total hours: 5	12.4/13.4 What is momentum?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
What is momentum?		• Use m = m x v, to establish that the faster an object is moving the ore energy it contains • Use to explain safety features of a car	Linear air track collisions with plasticine/materials to show destructive power. Use of ICT software.
Momentum has magnitude and direction		• Addition of momentum in a single linear direction only • If force acts on a body that is moving, it can cause it to stop, accelerate or decelerate	Use linear air rack for collisions. Can go qualitative or quantitative dependent on the set of students / ability.
Momentum is conserved in collisions		• Standard air track/quantitative experiments	Use linear air rack for collisions. Can go qualitative or quantitative dependent on the set of students / ability. Consider a circular object that explodes and the path of particles.
Momentum is conserved in collisions and that these take place in a discrete mount of time.(1) (HT only)		• Link between force = change in momentum/time	Numerical methods to develop.
Suggest a lesson for review / consolidation here			

Total hours: 4	12.5/13.5 What is static electricity, how is it used and what is the connection between static electricity and electrical currents?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
What is static electricity?		• Charging of insulative strips. Charging by friction. Knowledge that electrons are removed and transferred • Two electrostatically charged materials will repel each other, if charged similarly, and attract if oppositely charged	Standard demonstration of static electricity.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Explain why static electricity is dangerous		• Experiments with a Van der Graf • The greater the charge the higher the potential difference required to jump across the gap • Discharging of charged materials	Van der Graff generator – lighting a Bunsen flame. Alcohol gun. Practical implications including: loading aeroplanes with fuel, lightning conductors; etc
Uses of electrostatics		• Photocopiers and smoke precipitators. Basic operation and function of these devices.	Other examples where static electricity is useful. Also a nuisance; eg: lightning conductors.
Electric charges can flow through materials called metals		• Concept of electrons flowing, taking charge with them; called a current • Charged bodies loose their charge by discharging their charge by connecting a conductor between it and earth	Demonstration of Van der Graf connecting it to earth by use of suitable cables, via a sensitive uA meter.

Total hours: 6	13.6/12.6 What does the current through an electrical circuit depend on?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Circuit symbols		• Know the circuit symbols in the specification • Know that a diode allows current flow in one direction only • LDR resistance varies with light intensity • Thermistor resistance decreases as temperature rises	Be able to connect up circuit symbols in a series and parallel circuit. Be able to place a voltmeter in the circuit to measure the potential difference. Be able to place an ammeter in the circuit to measure the current in the circuit / parts of circuit. Demonstrations of … Use of digital resistance multimeter and LDR. Use of digital resistance multimeter and thermistor.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Current potential voltage graphs		• Of resistance at constant temperature; filament lamp, diode. Use Ohms Law equipment - resistance/lamp results can be taken. Appreciate V = I / R • The greater the resistance,the smaller the current for a given resistance • The potential difference of the cells is the sum of the cells in series – taking into account the sign of their delivery • Cells and batteries supply current that always passes in the same direction d.c.	PSA for resistance & lamp. Diode – specimen results. Note: I (up) v potential difference (across) on graph.
Calculations using previous graph		• Calculation of R from graph • Analysis of graphs • Using V = I/R; be able to find V; I or R	
Resistances in series		• The total resistance is the sum of each component • There is the same current through each device • The total potential difference is shared between the components (proportionally)	Be able to calculate series resistance Be able to find the series current in the circuit Be able to calculate the potential difference across a component

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
Resistances in parallel		• The potential difference across each component is the same • The total current through the whole circuit is the sum of the separate currents	Be able to find the parallel potential difference in the circuit. Know how to calculate the current in separate components, and sum them to find the total current.
Total hours: 2	**13.7/12.7 What is mains electricity and how can it be used safely?**		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Wiring a mains plug		• To know how to correctly wire and calculate the fuse value in a mains plug for a domestic use • Recognize dangers in its use • Know that mains electricity is a.c., operates at 230V and in the UK that this has a frequency of 50Hz • Know that the earth & fuse protect the user • Know that the neutral terminal stays at 0 V • Know that the live terminal alternates between a positive and negative potential, with respect to the neutral terminal	HSE dangers. Know the structure of: the electrical cable. a 13A plug. Know the correct wiring of a plug. action of a fuse. Know why a metal cased appliance is earthed.

Total hours: 2	13.8/12.8 Why do we need to know the power of electrical appliances?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Electric current is a flow of charge		• When current flows, it is the rate of flow of charge • Revisit V = IR circuit, which when transferred is called the power. Power (W) = energy transferred (J)/time (s). This can be transferred into heat.	Could use small electrical heaters and shc equation (given) to find heat capacity of fluid. PSA { Power = VIt & Heat gained = mcΘ } Know the electrical energy equations and be able to demonstrate their use: Power (W) = current (A) x potential difference (V) Energy transformed (J) = potential difference (V) x charge (C) Charge flow (C) = current (A) x time (t)
Suggest a lesson for review/consolidation here			

Total hours: 4	13.9/12.9 What happens to radioactive substances when they decay?		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Our modern concept of the modern-day atom		• To review the modern concept of the atom model. Develop from the Thomson plum pudding model to the Rutherford satellite nuclear model.	Diagrams; start to put into place protons, neutrons and electrons. What the masses of these particles are ….. Include data from next row.
Basic knowledge about the atom, its composition and make-up		To know: • the relative electric charges of the proton, neutron and electron • their relative position in the atom • the composition of a neutral atom • the composition of an ion • elements of the same type have the same number of protons (electrons) • different elements have different numbers of protons (electrons) • isotopes of elements • the mass number (being the number of protons and neutrons)	Use of a periodic table and determine the proton, neutron and electron counts of various elements. Include dot and cross diagrams of some elements.

Topic outline		Teaching approach including possible experiments/investigation opportunities	Additional notes
The effect of alpha and beta decay on radioactive nuclei		• The effect of alpha and beta breakdown on radioactive elemental decay	There is no need to learn any radioactive decay chains
Total hours: 4	**13.10/12.10 What are nuclear fission and nuclear fusion?**		
Topic outline		**Teaching approach including possible experiments/investigation opportunities**	**Additional notes**
Nuclear fission		• Fission is splitting of large nuclei in order to release energy. This is seen when a neutron is absorbed into a uranium 235 and plutonium 239 atom. A chain reaction may occur if excess neutrons are then absorbed by additional nuclei. • Sketches of the process required illustrating fission and leading to a chain reaction	Limited to (apparently) U235 and Pu239. The fission is limited to split into two daughter products and three neutrons - which are available for further fission reactions. No numerical calculations to state how much energy is released.
Nuclear fusion		• Joining of two light weight nuclei together, forming a single larger nuclei and in doing so releasing energy	There are no numerical calculations (apparently) to give the amount of energy released.
Revision/Module Test			