# Switching AQA GCSE (9-1) Physics to OCR GCSE (9-1) Gateway Physics A

## Introduction

Are you currently teaching the AQA GCSE sciences? Are you thinking of switching? We are here to help.

We will provide you with all the support you could need to switch from the AQA GCSE Physics qualification to our OCR GCSE Physics A, including:

* Mapping of AQA’s specification to OCR’s specification
* An overview of the differences in assessment
* Mapping of the AQA textbook to OCR’s specification

## Our offer

* Our GCSE (9-1) Gateway Physics A qualification has been created by our subject specialist team working with a number of stakeholders including: OCR Science Consultative Forum, teachers, assessors, Higher Education Institutions and learned societies. It has been created to be a qualification which engages students so they achieve their full potential.
* Our GCSE team are passionate about both science and education. With industry, teaching and assessment experience, they are fully committed to supporting centres’ delivery of our GCSE qualifications.
* We have produced a wide range of support materials, such as handbooks (including maths skills), delivery guides, practical activities and end of topic quizzes. We have a selection of practice papers which can be used as mock papers in preparation for the exams and we have a free and user-friendly tool - ExamBuilder - that you can use to create customised papers for students.
* Within this document as well as mapping the specifications, we also provide textbook mapping – illustrating how you can use your existing AQA textbooks to teach the OCR specification; making it easier for you to use the resources you already have.
* Join our conversations on the OCR Community and @ocr\_science on Twitter to discuss and share good practice.

## Key differences

|  |  |
| --- | --- |
| **OCR GCSE (9-1) Gateway Physics A** | **AQA GCSE (9-1) Physics** |
| **8 flexible practical** activities - select from our suggested activities or use your own preferred practical activities. | 8 required practical activities you have to deliver. |
| In each assessment students have 1 hour and 45 minutes to complete **90** marks worth of questions | In each assessment learners have 1 hour and 45 minute to complete **100** marks worth of questions. |
| 15 marks of multiple choice questions at the start of each paper. | Some multiple choice questions scattered throughout papers. |
| One6 mark level of response question per paper. | Not a set number, but **more than one** 6 mark level of response question on all sample assessment material. |

## Content mapping

The content within the OCR GCSE (9-1) in Physics A (Gateway) covers the key concepts of physics and will be very familiar. We’ve laid it out in a logical progression to support teaching the GCSE in a linear way.

Below is a table to show where AQA Physics content is cover in the OCR Gateway physics specification.

| **AQA Physics (8463)** | **OCR Physics A (Gateway Science) (J249)** | **Surplus Content In AQA Physics** |
| --- | --- | --- |
| 4.1.1 Energy changes in a system, and the ways energy is stored before and after such changes | P1.2 Changes of state (part)P2 Forces (part)P7.1 Work done  | Required practical activity 1.Students should be able to give examples that illustrate the definition of power e.g. comparing two electric motors that both lift the same weight through the same height but one does it faster than the other. |
| 4.1.2 Conservation and dissipation of energy | P7.2 Power and efficiency  | Required practical activity 2 (physics only) |
| 4.1.3 National and global energy resources | P8.2 Powering Earth (part) |  |
| 4.2.1 Current, potential difference and resistance | P3.1 Static and charge (part)P3.2 Simple circuits | Required practical activity 3Required practical activity 4 |
| 4.2.2 Series and parallel circuits | P3.2 Simple circuits |  |
| 4.2.3 Domestic uses and safety | P8.2 Powering Earth |  |
| 4.2.4 Energy transfers | P7.1 Work done (part)P7.2 Power and efficiency (part) |  |
| 4.2.5 Static electricity | P3.1 Static and charge |  |
| 4.3.1 Changes of state and the particle model | P1.2 Changes of state | Required practical activity 5 |
| 4.3.2 Internal energy and energy transfers | P1.2 Changes of state |  |
| 4.3.3 Particle model and pressure | P1.3 Pressure |  |
| 4.4.1 Atoms and isotopes | P6.1 Radioactive emissions |  |
| 4.4.2 Atoms and nuclear radiation | P6.1 Radioactive emissions |  |
| 4.4.3 Hazards and uses of radioactive emissions and of background radiation (physics only) | P6.2 Uses and hazards |  |
| 4.4.4 Nuclear fusion and fission (physics only) | P6.2 Uses and hazards |  |
| 4.5.1 Forces and their interactions | P2.2 Newton’s lawsP2.3 Forces in action |  |
| 4.5.2 Work done and energy transfer | P2.3 Forces in action |  |
| 4.5.3 Forces and elasticity | P2.3 Forces in action | Required practical activity 6 |
| 4.5.4 Moments, levers and gears (physics only) | P2.3 Forces in action |  |
| 4.5.5 Pressure differences in fluids (physics only) | P1.3 Pressure |  |
| 4.5.6 Forces and motion (incl. 4.5.6.1 Describing motion along a line; 4.5.6.2 Forces, acceleration and Newton’s Laws of motion; 4.5.6.3 Forces and braking) | P2.1 Motion (part)P2.2 Newton’s laws (part)P2.3 Forces in action (part)P8.1 Physics on the move (part - braking) | Required practical activity 7 |
| 4.5.7 Momentum (HT only) | P2.2 Newton’s laws |  |
| 4.6.1 Waves in air, fluids and solids | P5.1 Wave behaviour (part)P5.3 Wave interactions (part) | Required practical activity 8Required practical activity 9 |
| 4.6.2 Electromagnetic waves | P5.2 The electromagnetic spectrum (part)P5.3 Wave interactions (part) | Required practical activity 10 |
| 4.6.3 Black body radiation (physics only) | P8.3 Beyond Earth |  |
| 4.7.1 Magnetism and electromagnetism | P4.1 Magnets and magnetic fieldsP4.2 Uses of magnetism |  |
| 4.7.2 The motor effect | P4.2 Uses of magnetism |  |
| 4.7.3 Induced potential, transformers and the National Grid (physics only) (HT only) | P4.2 Uses of magnetismP8.2 Powering Earth |  |
| 4.8.1 Solar system; stability of orbital motions; satellites (physics only) | P8.3 Beyond earth |  |
| 4.8.2 Red-shift (physics only) | P8.3 Beyond Earth |  |

## Assessment

A comparison of the differences in assessment models is below:

|  |  |
| --- | --- |
| **OCR GCSE (9-1) Gateway Physics A** | **AQA GCSE (9-1) Physics** |
| **Paper 1** (Foundation) or **Paper 3** (Higher)Assessed: Topic 1-4 and 9Time allowed: 1 hour 45 minutesFoundation and Higher tier availableMarks 90 marksWeighting 50% of GCSEQuestion types: Section A: 15 x Multiple choiceSection B: structured, closed short answer and 1x 6 mark level of response | **Paper 1** Assessed: Topics 1-4Time allowed: 1 hour 45 minutesFoundation and Higher tier availableMarks: 100 marksWeighting: 50% of GCSEQuestion types: Multiple choice, structured, closed short answer and open response  |
| **Paper 2** (Foundation) or **Paper 4** (Higher)Assessed: Topic 5-8 and 9(may draw on knowledge from topics 1-4)Foundation and Higher tier availableMarks 90 marksWeighting 50% of GCSEQuestion types: Section A: 15 x Multiple choiceSection B: structured, closed short answer and 1 x 6 mark level of response | **Paper 2** Assessed: Topics 5-8 (may draw on knowledge from topics 1-4)Time allowed: 1 hour 45 minutesFoundation and Higher tier availableMarks: 100 marksWeighting: 50% of GCSEQuestion types: Multiple choice, structured, closed short answer and open response. |

## Using the AQA textbook

Below you will find all the information you need to start teaching OCR GCSE (9-1) Gateway Physics A while still using the new AQA textbooks. We have mapped our specification to the AQA OUP, Hodder and Collins textbooks to save you having to buy another set of textbooks. We also have endorsed textbooks for use with our specification and details of these textbooks can be found on the qualification page on the OCR website.

## AQA OUP textbook mapping

 indicates content is for separate science physics only

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** |
| --- | --- | --- | --- |
| **Topic P1 Matter** |
| **P1.1 The Particle model** |
| P1.1a describe how and why the atomic model has changed over time | 7.1, 7.2 | 92-95 |   |
| P1.1b describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus | 7.2 | 94 |   |
| P1.1c recall the typical size (order of magnitude) of atoms and small molecules | 7.2 | 94 | A typical size for an atom is given, but no more. |
| P1.1d define density | 6.1 | 76 |   |
| P1.1e explain the differences in density between the different states of matter in terms of the arrangements of the atoms and molecules | 6.2 | 79 |   |
| P1.1f apply the relationship between density, mass and volume to changes where mass is conserved | 6.7 | 89 |   |
| PM1.1i recall and apply: density (kg/m3) = mass (kg)/volume (m3) | 6.7 | 89 |   |
| **P1.2 Changes of state** |
| P1.2a describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed | 6.2 | 78 | Chemical changes are not mentioned. |
| P1.2b describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed | 6.2 | .78 |  Chemical changes are not mentioned |
| P1.2c describe how heating a system will change the energy stored within the system and raise its temperature or produce changes of state | 6.2 | 78-79 |   |
| P1.2d define the term specific heat capacity and distinguish between it and the term specific latent heat | 2.4, 6.5 | 30-31, 84-85 | These two topics are in chapters that are some distance apart. |
| P1.2e apply the relationship between change in internal energy of a material and its mass, specific heat capacity and temperature change to calculate the energy change involved | 2.4 | 30 |   |
| P1.2f apply the relationship between specific latent heat and mass to calculate the energy change involved in a change of state | 6.5 | 84-85 |   |
| PM1.2i apply: change in thermal energy (J) = mass (kg) x specific heat capacity (J/kg°C) x change in temperature (°C) | 2.4 | 30 |   |
| PM1.2ii apply: thermal energy for a change in state (J) = mass (kg) x specific latent heat (J/kg) | 6.5 | 84-85 |   |
| **P1.3 Pressure** |
| P1.3a explain how the motion of the molecules in a gas is related both to its temperature and its pressure | 6.6 | 86-87 |   |
| P1.3b explain the relationship between the temperature of a gas and its pressure at constant volume (qualitative only) | 6.6 | 86 |   |
| P1.3c  recall that gases can be compressed or expanded by pressure changes and that the pressure produces a net force at right angles to any surface | 6.7 | 88 |   |
| P1.3d  explain how increasing the volume in which a gas is contained, at constant temperature can lead to a decrease in pressure | 6.7 | 88 |   |
| **P1.3e explain how doing work on a gas can increase its temperature** | 6.7 | 88 |   |
| P1.3f  describe a simple model of the Earth’s atmosphere and of atmospheric pressure | 11.3 | 167 |   |
| P1.3g  explain why atmospheric pressure varies with height above the surface of the planet | 11.3 | 166-167 |   |
| **P1.3h ** **describe the factors which influence floating and sinking** | 11.4 | 168-169 |   |
| **P1.3i  explain why pressure in a liquid varies with depth and density and how this leads to an upwards force on a partially submerged object** | 11.4 | 168 |   |
| **P1.3j ** **calculate the differences in pressure at different depths in a liquid** | 11.2 | 165 |   |
| PM1.3i  apply: for gases: pressure (Pa) x volume (m3) = constant (for a given mass of gas and at a constant temperature) | 6.7 | 89 |   |
| **PM1.3ii  apply: pressure due to a column of liquid (Pa) = height of column (m) x density of liquid (kg/m3) x g (N/kg)** | 11.2 | 165 |   |
| **Topic P2 Forces** |
| **P2.1 Motion** |
| P2.1a describe how to measure distance and time in a range of scenarios | 9.1 | 134 |   |
| P2.1b describe how to measure distance and time and use these to calculate speed | 9.1 | 134-135 |   |
| P2.1c make calculations using ratios and proportional reasoning to convert units and to compute rates | 9.1 | 135 |   |
| P2.1d explain the vector–scalar distinction as it applies to displacement and distance, velocity and speed | 9.2 | 136-137 |   |
| P2.1e relate changes and differences in motion to appropriate distance-time, and velocity-time graphs; interpret lines and slopes | 9.4 | 140-141 |   |
| **P2.1f interpret enclosed area in velocity-time graphs** | 9.4 | 140-141 |   |
| P2.1g calculate average speed for non-uniform motion | 9.1 | 134-135 |   |
| P2.1h apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration | 9.1-9.2 | 134-136 |   |
| PM2.1i recall and apply: distance travelled (m) = speed (m/s) x time (s) | 9.1 | 134 |   |
| PM2.1ii recall and apply: acceleration (m/s2) = change in velocity (m/s) / time (s) | 9.2 | 136-137 |   |
| PM2.1iii apply: (final velocity (m/s))2 - (initial velocity (m/s))2 = 2 x acceleration (m/s2) x distance (m) | 9.2 | 137 |   |
| PM2.1iv recall and apply: kinetic energy (J) = 0.5 x mass (kg) x (speed (m/s))2 | 1.5 | 13 |   |
| **P2.2 Newton's laws** |
| P2.2a recall examples of ways in which objects interact | 8.2 | 116 |   |
| P2.2b describe how such examples involve interactions between pairs of objects which produce a force on each object | 8.2 | 116-117 |   |
| P2.2c represent such forces as vectors | 8.3 | 118-119 |   |
| P2.2d apply Newton’s First Law to explain the motion of an object moving with uniform velocity and also an object where the speed and/or direction change | 8.3 | 118 |   |
| **P2.2e use vector diagrams to illustrate resolution of forces, a net force (resultant force), and equilibrium situations** | 8.9 | 130-131 |   |
| **P2.2f describe examples of the forces acting on an isolated solid object or system** | 8.9 | 130-131 |   |
| **P2.2g describe, using free body diagrams, examples where two or more forces lead to a resultant force on an object** | 8.3 | 118-119 |   |
| **P2.2h describe, using free body diagrams, examples of the special case where forces balance to produce a resultant force of zero (qualitative only)** | 8.3, 8.9 | 118, 131 |   |
| P2.2i apply Newton’s second law in calculations relating forces, masses and accelerations | 10.1 | 144-145 |   |
| **P2.2j explain that inertia is a measure of how difficult it is to change the velocity of an object and that the mass is defined as the ratio of force over acceleration** | 10.1 | 145 |   |
| **P2.2k define momentum and describe examples of momentum in collisions** | 10.4 | 150-151 |   |
| P2.2l  apply formulae relating force, mass, velocity and acceleration to explain how the changes involved are inter-related  | 10.6 | 154-155 |   |
| P2.2m use the relationship between work done, force, and distance moved along the line of action of the force and describe the energy transfer involved | 1.3 | 8 |   |
| P2.2n calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules | 1.3-1.5 | 8 to 13 |  |
| P2.2o explain, with reference to examples, the definition of power as the rate at which energy is transferred | 1.9 | 20 |   |
| P2.2p recall and apply Newton’s third law | 8.2 | 116-117 |   |
| **P2.2q explain why an object moving in a circle with a constant speed has a changing velocity (qualitative only)** | 9.2 | 136 |   |
| PM2.2i recall and apply: force (N) = mass (kg) x acceleration (m/s2) | 10.1 | 144-145 |   |
| **PM2.2ii recall and apply: momentum (kg m/s) = mass (kg) x velocity (m/s)**  | 10.4 | 150-151 |   |
| PM2.2iii recall and apply: work done (J) = force (N) x distance (m) (along the line of action of the force) | 1.3 | 8 |   |
| PM2.2iv recall and apply: power (W) = work done (J) / time (s) | 1.9 | 20 |   |
| **P2.3 Forces in action** |
| P2.3a explain that to stretch, bend or compress an object, more than one force has to be applied |   |   | Not covered. |
| P2.3b describe the difference between elastic and plastic deformation (distortions) caused by stretching forces | 10.8 | 158 | The term "plastic" is not used; "inelastic" is used instead. |
| P2.3c describe the relationship between force and extension for a spring and other simple systems | 10.8 | 159 |   |
| P2.3d describe the difference between linear and non-linear relationships between force and extension | 10.8 | 159 |   |
| P2.3e calculate a spring constant in linear cases | 10.8 | 159 |   |
| P2.3f calculate the work done in stretching | 1.5 | 13 | This is covered separately from the rest of the spring constant information, in chapter 1 - Energy. |
| P2.3g describe that all matter has a gravitational field that causes attraction, and the field strength is much greater for massive objects | 1.4, 10.2 | 11, 146 | It is not explicitly stated that all matter is gravitationally attracted to all other matter, although it can be inferred. |
| P2.3h define weight, describe how it is measured and describe the relationship between the weight of an object and the gravitational field strength (g) (and) has a value of 10N/kg at the Earth’s surface | 10.2 | 146 |   |
| P2.3i recall the acceleration in free fall | 10.2 | 146-147 |   |
| P2.3j apply formulae relating force, mass and relevant physical constants, including gravitational field strength (g), to explore how changes in these are inter-related | 10.1-10.2 | 144-147 |   |
| P2.3k  describe examples in which forces cause rotation | 8.4 | 120 |   |
| P2.3l define and calculate the moment of the force in such examples | 8.4 | 120-121 |   |
| P2.3m  explain how levers and gears transmit the rotational effects of forces | 8.4-8.5 | 120-123 |   |
| P2.3n recall that the pressure in fluids (gases and liquids) causes a net force at right angles to any surface | 6.7 | 88 |   |
| P2.3o use the relationship between the force, the pressure and the area in contact | 11.1 | 162 |   |
| PM2.3i recall and apply: force exerted by a spring (N) = extension (m) x spring constant (N/m) | 10.8 | 159 |   |
| PM2.3ii apply: energy transferred in stretching (J) = 0.5 x spring constant (N/m) x (extension (m))2 | 1.5 | 13 |   |
| PM2.3iii recall and apply: gravity force (N) = mass (kg) x gravitational field strength, g (N/kg) | 10.2 | 146 |   |
| PM2.3iv recall and apply: (in a gravity field) potential energy (J) = mass (kg) x height (m) x gravitational field strength, g (N/kg) | 1.4 | 10 |   |
| PM2.3v  recall and apply: pressure (Pa) = force normal to a surface (N) / area of that surface (m2) | 11.1 | 162 |   |
| PM2.3vi  recall and apply: moment of a force (Nm) = force (N) x distance (m) (normal to direction of the force) | 8.4 | 121 |   |
| **Topic P3 Electricity** |
| **P3.1 Static and charge** |
| P3.1a describe that charge is a property of all matter and that there are positive and negative charges. The effects of the charges are not normally seen on bodies containing equal amounts of positive and negative charge, as their effects cancel each other out | 4.1 | 50-51 | It is not explicitly stated that the charges usually balance; just assumed. The emphasis is on the fact that there are occasions where there is an imbalance. |
| P3.1b describe the production of static electricity, and sparking, by rubbing surfaces, and evidence that charged objects exert forces of attraction or repulsion on one another when not in contact | 4.1 | 50-51 |   |
| P3.1c explain how transfer of electrons between objects can explain the phenomena of static electricity | 4.1 | 50-51 |   |
| P3.1d  explain the concept of an electric field and how it helps to explain the phenomena of static electricity | 4.1 | 51 |   |
| P3.1e recall that current is a rate of flow of charge (electrons) and the conditions needed for charge to flow | 4.2 | 52 |   |
| P3.1f recall that current has the same value at any point in a single closed loop | 4.2 | 53 |   |
| P3.1g recall and use the relationship between quantity of charge, current and time | 4.2 | 53 |   |
| PM3.1i recall and apply: charge flow (C) = current (A) x time (s) | 4.2 | 53 |   |
| **P3.2 Simple circuits** |
| P3.2a describe the differences between series and parallel circuits | 4.5-4.6 | 58-61 |   |
| P3.2b represent d.c. circuits with the conventions of positive and negative terminals, and the symbols that represent common circuit elements | 4.2 | 52 |   |
| P3.2c recall that current (I) depends on both resistance (R) and potential difference (V) and the units in which these are measured | 4.3 | 54 |   |
| P3.2d recall and apply the relationship between I, R and V, and that for some resistors the value of R remains constant but that in others it can change as the current changes | 4.3 | 54-55 |   |
| P3.2e explain that for some resistors the value of R remains constant but that in others it can change as the current changes | 4.3-4.4 | 56-57 |   |
| P3.2f explain the design and use of circuits to explore such effects | 4.4 | 56-57 |   |
| P3.2g use graphs to explore whether circuit elements are linear or non-linear | 4.4 | 56-57 |   |
| P3.2h use graphs and relate the curves produced to the function and properties of circuit elements | 4.4 | 56-57 |   |
| P3.2i explain why, if two resistors are in series the net resistance is increased, whereas with two in parallel the net resistance is decreased (qualitative explanation only) | 4.5 | 58-59 |   |
| P3.2j calculate the currents, potential differences and resistances in d.c. series and parallel circuits | 4.5-4.6 | 58-61 |   |
| P3.2k explain the design and use of such circuits for measurement and testing purposes | 4.4 | 56 |   |
| P3.2l explain how the power transfer in any circuit device is related to the potential difference across it and the current, and to the energy changes over a given time | 5.3 | 68 |   |
| P3.2m apply the equations relating potential difference, current, quantity of charge, resistance, power, energy, and time, and solve problems for circuits which include resistors in series, using the concept of equivalent resistance | 5.3-5.4 | 68-71 |   |
| PM3.2i recall and apply: potential difference (V) = current (A) x resistance (Ω) | 4.3 | 54 |   |
| PM3.2ii recall and apply: energy transferred (J) = charge (C) x potential difference (V) | 5.4 | 70 |   |
| PM3.2iii recall and apply: power (W) = potential difference (V) x current (A) = (current (A))2 x resistance (Ω) | 5.3 | 69 |   |
| PM3.2iv recall and apply: energy transferred (J, kWh) = power (W, kW) x time (s, h) = charge (C) x potential difference (V) | 5.4 | 70 |   |
| **Topic P4 Magnetism and magnetic fields** |
| **P4.1 Magnets and magnetic fields** |
| P4.1a describe the attraction and repulsion between unlike and like poles for permanent magnets | 15.1 | 214-215 |   |
| P4.1b describe the difference between permanent and induced magnets | 15.1 | 214-215 |   |
| P4.1c describe the characteristics of the magnetic field of a magnet, showing how strength and direction change from one point to another | 15.1 | 214-215 |   |
| P4.1d explain how the behaviour of a magnetic (dipping) compass is related to evidence that the core of the Earth must be magnetic | 15.1 | 214-215 | The Earth's magnetic field is described, but the fact that the behaviour of compasses is evidence for it is not explicitly stated. |
| P4.1e describe how to show that a current can create a magnetic effect and describe the directions of the magnetic field around a conducting wire | 15.2 | 216 |   |
| P4.1f recall that the strength of the field depends on the current and the distance from the conductor | 15.2 | 216 |   |
| P4.1g explain how solenoid arrangements can enhance the magnetic effect | 15.2 | 217 |   |
| **P4.2 Uses of magnetism** |
| **P4.2a describe how a magnet and a current-carrying conductor exert a force on one another** | 15.4 | 220 |   |
| **P4.2b show that Fleming’s left-hand rule represents the relative orientations of the force, the current and the magnetic field** | 15.4 | 220 |   |
| **P4.2c apply the equation that links the force on a conductor to the magnetic flux density, the current and the length of conductor to calculate the forces involved** | 15.4 | 220-221 |   |
| **P4.2d explain how the force exerted from a magnet and a current-carrying conductor is used to cause rotation in electric motors** | 15.4 | 221 |   |
| **P4.2e**  **recall that a change in the magnetic field around a conductor can give rise to an induced potential difference across its ends, which could drive a current, generating a magnetic field that would oppose the original change** | 15.5 | 222-223 |   |
| **P4.2f**  **explain how this effect is used in an alternator to generate a.c., and in a dynamo to generate d.c** | 15.6 | 224-225 |   |
| **P4.2g**  **explain how the effect of an alternating current in one circuit, in inducing a current in another, is used in transformers** | 15.7 | 226-227 |   |
| **P4.2h**  **explain how the ratio of the potential differences across the two depends on the ratio of the numbers of turns in each** | 15.8 | 228 |   |
| **P4.2i**  **apply the equations linking the potential differences and numbers of turns in the two coils of a transformer** | 25.8 | 228-229 |   |
| **P4.2j**  **explain the action of the microphone in converting the pressure variations in sound waves into variations in current in electrical circuits, and the reverse effect as used in loudspeakers and headphones** | 15.6 | 225 |   |
| **PM4.2i apply: force on a conductor (at right angles to a magnetic field) carrying a current (N) = magnetic flux density (T) x current (A) x length (m)** | 15.4 | 221 |   |
| **PM4.2ii**  **apply: potential difference across primary coil (V)/potential difference across secondary coil (V) = number of turns in primary coil / number of turns in secondary coil**  | 15.8 | 228-229 |   |
| **Topic P5 Waves in matter** |
| **P5.1 Wave behaviour** |
| P5.1a describe wave motion in terms of amplitude, wavelength, frequency and period | 12.2 | 176 |   |
| P5.1b define wavelength and frequency | 12.2 | 176 |   |
| P5.1c describe and apply the relationship between these and the wave velocity | 12.2 | 177 |   |
| P5.1d apply formulae relating velocity, frequency and wavelength | 12.2 | 177 |   |
| P5.1e describe differences between transverse and longitudinal waves | 12.1 | 175 |   |
| P5.1f  show how changes, in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related | 12.3 | 178-179 |   |
| P5.1g  describe the effects of reflection, transmission, and absorption of waves at material interface | 12.3 | 178-179 |   |
| **P5.1h**  **describe, with examples, processes which convert wave disturbances between sound waves and vibrations in solids** | 12.5 | 182 |   |
| **P5.1i**  **explain why such processes only work over a limited frequency range, and the relevance of this to human hearing**  | 12.5 | 182 |   |
| P5.1j describe how ripples on water surfaces are used to model transverse waves while sound waves in air are longitudinal waves, and how the speed of each may be measured | 12.1-12.2 | 174-177 |   |
| P5.1k describe evidence that in both cases it is the wave and not the water or air itself that travels | 12.1 | 174-175 |   |
| PM5.1i recall and apply: wave speed (m/s) = frequency (Hz) x wavelength (m) | 12.2,12.4 | 177, 181 |   |
| **P5.2 The electromagnetic spectrum** |
| P5.2a recall that electromagnetic waves are transverse and are transmitted through space where all have the same velocity | 12.1, 13.1 | 175 190 |   |
| P5.2b explain that electromagnetic waves transfer energy from source to absorber | 13.1 | 190 |   |
| P5.2c apply the relationships between frequency and wavelength across the electromagnetic spectrum | 13.1 | 191 |   |
| P5.2d describe the main groupings of the electromagnetic spectrum and that these groupings range from long to short wavelengths and from low to high frequencies | 13.1 | 190 |   |
| P5.2e describe that our eyes can only detect a limited range of the electromagnetic spectrum | 13.1 | 190 |   |
| P5.2f recall that light is an electromagnetic wave | 13.2 | 192 |   |
| P5.2g give examples of some practical uses of electromagnetic waves in the radio, micro-wave, infra-red, visible, ultra-violet, X-ray and gamma-ray regions | 13.2-13.4 | 192-197 |   |
| P5.2h describe how ultra-violet waves, X-rays and gamma-rays can have hazardous effects, notably on human bodily tissues | 13.4 | 196-197 |   |
| **P5.2i** **explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in our bodies** | 12.5-12.7, 13.5 | 183-187, 198-199 |   |
| **P5.2j recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits** | 13.3 | 195 |   |
| **P5.3 Wave interactions** |
| **P5.3a recall that different substances may absorb, transmit, refract, or reflect electromagnetic waves in ways that vary with wavelength** | 12.3, 13 | 179, 190 |  |
| **P5.3b explain how some effects are related to differences in the velocity of electromagnetic waves in different substances** | 14.2 | 204-205 |   |
| P5.3c  use ray diagrams to illustrate reflection, refraction and the similarities and differences between convex and concave lenses (qualitative only) | 14.1-14.2, 14.4 | 202-205, 208-209 |   |
| P5.3d construct two-dimensional ray diagrams to illustrate reflection and refraction (qualitative only –equations not needed) | 14.1-14.2 | 202-205 |   |
| P5.3e explain how colour is related to differential absorption, transmission and reflection | 14.3 | 206-207 |   |
| **Topic P6 Radioactivity** |
| **P6.1 Radioactive emissions** |
| P6.1a recall that atomic nuclei are composed of both protons and neutrons, that the nucleus of each element has a characteristic positive charge | 7.2 | 94-95 |   |
| P6.1b recall that atoms of the same elements can differ in nuclear mass by having different numbers of neutrons | 7.3 | 96 |   |
| P6.1c Use the conventional representation for nuclei to relate the differences between isotopes | 7.3 | 96-97 |   |
| P6.1d recall that some nuclei are unstable and may emit alpha-particles, beta-particles, or neutrons, and electromagnetic radiation as gamma-rays | 7.3 | 96-97 |   |
| P6.1e relate these emissions to possible changes in the mass or the charge of the nucleus, or both | 7.3 | 96-97 |   |
| P6.1f use names and symbols of common nuclei and particles to write balanced equations that represent radioactive decay | 7.3 | 97 |   |
| P6.1g balance equations representing the emission of alpha-, beta- or gamma-radiation in terms of the masses, and charges of the atoms involved | 7.3 | 97 |   |
| P6.1h recall that in each atom its electrons are arranged at different distances from the nucleus, that such arrangements may change with absorption or emission of electromagnetic radiation and that atoms can become ions by loss of outer electrons | 7.2 | 95 |   |
| P6.1i recall that changes in atoms and nuclei can also generate and absorb radiations over a wide frequency range | 7.2-7.3 | 95-97 | This is not explicitly stated as such, but can be inferred from the information given. |
| P6.1j explain the concept of half-life and how this is related to the random nature of radioactive decay | 7.5 | 100-101 |   |
| **P6.1k calculate the net decline, expressed as a ratio, during radioactive emission after a given (integral) number of half-lives**  | 7.5 | 101 |   |
| P6.1l recall the differences in the penetration properties of alpha-particles, beta-particles and gamma-rays | 7.4 | 98-99 |   |
| **P6.2 Uses and hazards** |
| P6.2a recall the differences between contamination and irradiation effects and compare the hazards associated with these two | 7.4, 7.9 | 98-99, 108-109 |   |
| P6.2b  explain why the hazards associated with radioactive material differ according to the half-life involved | 7.9 | 108-109 |   |
| P6.2c  describe the different uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue | 7.6 | 102-103 |   |
| P6.2d  recall that some nuclei are unstable and may split, and relate such effects to radiation which might emerge, to transfer of energy to other particles and to the possibility of chain reactions | 7.7 | 104-105 |   |
| P6.2e  describe the process of nuclear fusion | 7.8 | 106-107 |   |
| **Topic P7 Energy** |
| **P7.1 Work done** |
| P7.1a describe for situations where there are energy transfers in a system, that there is no net change to the total energy of a closed system (qualitative only) | 1.2 | 6 to 7 | The term "closed system" is defined. |
| P7.1b describe all the changes involved in the way energy is stored when a system changes for common situations | 1.2 | 6 |   |
| P7.1c describe the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces, and by work done when a current flows | 1.1 | 4 to 5 |   |
| P7.1d make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system |  |  | Not covered. |
| P7.1e calculate the amounts of energy associated with a moving body, a stretched spring and an object raised above ground level | 1.4-1.5 | 10 to 13 |   |
| **P7.2 Power and efficiency** |
| P7.2a describe, with examples, the process by which energy is dissipated, so that it is stored in less useful ways | 1.6 | 14-15 |   |
| P7.2b describe how, in different domestic devices, energy is transferred from batteries or the a.c. from the mains | 1.8 | 18-19 |   |
| P7.2c describe, with examples, the relationship between the power ratings for domestic electrical appliances and how this is linked to the changes in stored energy when they are in use | 1.9, 5.5 | 20-21, 72-73 |   |
| P7.2d calculate energy efficiency for any energy transfer | 1.7 | 16-17 |   |
| **P7.2e describe ways to increase efficiency** | 1.7 | 17 |   |
| P7.2f explain ways of reducing unwanted energy transfer | 1.7 | 17 |   |
| P7.2g describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls (qualitative only) | 2.5 | 32-33 |   |
| PM7.2i recall and apply: efficiency = useful output energy transfer (J) / input energy transfer (J) | 1.9 | 21 |   |
| **Topic P8 Global challenges** |
| **P8.1 Physics on the move** |
| P8.1a recall typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems |  |  | Not covered |
| P8.1b estimate the magnitudes of everyday accelerations | 9.2, 9.4 | 136-141 |  |
| P8.1c make calculations using ratios and proportional reasoning to convert units and to compute rates | 9.3 | 139 |   |
| P8.1d explain methods of measuring human reaction times and recall typical results | 10.7 | 157 | No methods of measuring reaction times are given. "Thinking distance" is given in the case of braking, but no other details are given. |
| P8.1e explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety | 10.7 | 157 |   |
| P8.1f  estimate how the distances required for road vehicles to stop in an emergency, varies over a range of typical speeds | 10.7 | 157 |   |
| P8.1g explain the dangers caused by large decelerations | 10.6-10.7 | 154-157 |   |
| **P8.1h**  **estimate the forces involved in typical situations on a public road**  | 10.6 | 154-155 |   |
| P8.1i  estimate, for everyday road transport, the speed, accelerations and forces involved in large accelerations | 10.6 | 154-155 |   |
| **P8.2 Powering Earth** |
| P8.2a describe the main energy sources available for use on Earth, compare the ways in which they are used and distinguish between renewable and non-renewable sources | 3.1-3.3 | 36-41 |   |
| P8.2b explain patterns and trends in the use of energy resources |  |  | Not explicit. |
| P8.2c recall that, in the national grid, electrical power is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic use | 15.8 | 228-229 |   |
| P8.2d recall that step-up and step-down transformers are used to change the potential difference as power is transferred from power stations | 15.8 | 228-229 |   |
| P8.2e explain how the national grid is an efficient way to transfer energy | 15.8 | 228-229 |   |
| **P8.2f**  **link the potential differences and numbers of turns of a transformer to the power transfer involved; relate this to the advantages of power transmission at high voltages** | 15.8 | 228-229 |   |
| P8.2g recall that the domestic supply in the UK is a.c. at 50Hz and about 230 volts | 5.1 | 64 |   |
| P8.2h explain the difference between direct and alternating voltage | 5.1 | 64 |   |
| P8.2i recall the differences in function between the live, neutral and earth mains wires, and the potential differences between these wires | 5.2 | 66-67 |   |
| P8.2j explain that a live wire may be dangerous even when a switch in a mains circuit is open, and explain the dangers of providing any connection between the live wire and earth | 5.2 | 67 |   |
| PM8.2i apply: potential difference across primary coil (V) x current in primary coil (A) = potential difference across secondary coil (V) x current in secondary coil (A) | 15.8 | 228 |   |
| **P8.3 Beyond Earth** |
| P8.3a  explain the red-shift of light as seen from galaxies which are receding (qualitative only). The change with distance of each galaxy’s speed is evidence of an expanding universe | 16.4 | 238-239 |   |
| P8.3b  explain how red-shift and other evidence can be linked to the Big-Bang model | 16.4 | 238-239 |   |
| P8.3c  recall that our Sun was formed from dust and gas drawn together by gravity and explain how this caused fusion reactions, leading to equilibrium between gravitational collapse and expansion due to the energy released during fusion | 16.1 | 232-233 |   |
| P8.3d  explain that all bodies emit radiation, and that the intensity and wavelength distribution of any emission depends on their temperatures | 2.3 | 28-29 |   |
| P8.3e  recall the main features of our solar system, including the similarities and distinctions between the planets, their moons, and artificial satellites | 16.1, 16.3 | 233, 236-237 |   |
| **P8.3f**  **explain for circular orbits, how the force of gravity can lead to changing velocity of a planet but unchanged speed (qualitative only)** | 16.3 | 236 |   |
| **P8.3g**  **explain how, for a stable orbit, the radius must change if this speed changes (qualitative only)** | 16.3 | 237 |   |
| **P8.3h**  **explain how the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted; illustrate this balance using everyday examples and the example of the factors which determine the temperature of the Earth** | 2.3 | 28-29 |   |
| **P8.3i**  **explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in the Earth’s core and in deep water** | 12.5, 12.7 | 183, 186-187 |   |

## AQA Collins textbook mapping

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** |
| --- | --- | --- | --- |
| **Topic P1 Matter** |
| **P1.1 The Particle model** |
| P1.1a describe how and why the atomic model has changed over time | 4.12 | 132-133 |   |
| P1.1b describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus | 4.1 | 110 |   |
| P1.1c recall the typical size (order of magnitude) of atoms and small molecules | 4.1 | 110 | Only one approximate value for the atomic radius is given. |
| P1.1d define density | 3.1 | 84-85 |   |
| P1.1e explain the differences in density between the different states of matter in terms of the arrangements of the atoms and molecules | 31., 3.3 | 84,89 |   |
| P1.1f apply the relationship between density, mass and volume to changes where mass is conserved | 3.3 | 88 |   |
| PM1.1i recall and apply: density (kg/m3) = mass (kg)/volume (m3) | 3.2 | 86-87 |   |
| **P1.2 Changes of state** |
| P1.2a describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed | 3.3 | 88 |   |
| P1.2b describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed | 3.3 | 88 |   |
| P1.2c describe how heating a system will change the energy stored within the system and raise its temperature or produce changes of state | 3.3-3.4 | 89-91 |   |
| P1.2d define the term specific heat capacity and distinguish between it and the term specific latent heat | 3.5-3.6 | 92.95 |   |
| P1.2e apply the relationship between change in internal energy of a material and its mass, specific heat capacity and temperature change to calculate the energy change involved | 3.5 | 93 |   |
| P1.2f apply the relationship between specific latent heat and mass to calculate the energy change involved in a change of state | 3.6 | 94-95 |   |
| PM1.2i apply: change in thermal energy (J) = mass (kg) x specific heat capacity (J/kg°C) x change in temperature (°C) | 3.5 | 92-93 |   |
| PM1.2ii apply: thermal energy for a change in state (J) = mass (kg) x specific latent heat (J/kg) | 3.6 | 94.95 |   |
| **P1.3 Pressure** |
| P1.3a explain how the motion of the molecules in a gas is related both to its temperature and its pressure | 3.7 | 96-97 |   |
| P1.3b explain the relationship between the temperature of a gas and its pressure at constant volume (qualitative only) | 3.7 | 96-97 |   |
| P1.3c  recall that gases can be compressed or expanded by pressure changes and that the pressure produces a net force at right angles to any surface | 3.7 | 97 |   |
| P1.3d  explain how increasing the volume in which a gas is contained, at constant temperature can lead to a decrease in pressure | 3.7 | 97 |   |
| **P1.3e**  **explain how doing work on a gas can increase its temperature** | 3.8 | 99 |   |
| P1.3f  describe a simple model of the Earth’s atmosphere and of atmospheric pressure | 5.17 | 175 |   |
| P1.3g  explain why atmospheric pressure varies with height above the surface of the planet | 5.17 | 175 |   |
| **P1.3h**  **describe the factors which influence floating and sinking** | 5.16 | 173 |   |
| **P1.3i**  **explain why pressure in a liquid varies with depth and density and how this leads to an upwards force on a partially submerged object** | 5.16 | 173 |   |
| **P1.3j**  **calculate the differences in pressure at different depths in a liquid** | 5.16 | 173 |   |
| PM1.3i  apply: for gases: pressure (Pa) x volume (m3) = constant (for a given mass of gas and at a constant temperature) | 3.8 | 98 |   |
| **PM1.3ii**  **apply: pressure due to a column of liquid (Pa) = height of column (m) x density of liquid (kg/m3) x g (N/kg)** | 5.16 | 173 |   |
| **Topic P2 Forces** |
| **P2.1 Motion** |
| P2.1a describe how to measure distance and time in a range of scenarios | 5.2 | 144 |   |
| P2.1b describe how to measure distance and time and use these to calculate speed | 5.2 | 144 |   |
| P2.1c make calculations using ratios and proportional reasoning to convert units and to compute rates | 5.2 | 144 |   |
| P2.1d explain the vector–scalar distinction as it applies to displacement and distance, velocity and speed | 5.1 | 143 |   |
| P2.1e relate changes and differences in motion to appropriate distance-time, and velocity-time graphs; interpret lines and slopes | 5.4 | 148-149 |   |
| **P2.1f interpret enclosed area in velocity-time graphs** | 5.4 | 148-149 |   |
| P2.1g calculate average speed for non-uniform motion | 5.2 | 144 |   |
| P2.1h apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration | 5.2 | 145 |   |
| PM2.1i recall and apply: distance travelled (m) = speed (m/s) x time (s) | 5.2 | 144-145 |   |
| PM2.1ii recall and apply: acceleration (m/s2) = change in velocity (m/s) / time (s) | 5.3 | 146-147 |   |
| PM2.1iii apply: (final velocity (m/s))2 - (initial velocity (m/s))2 = 2 x acceleration (m/s2) x distance (m) | 5.5 | 150-151 |   |
| PM2.1iv recall and apply: kinetic energy (J) = 0.5 x mass (kg) x (speed (m/s))2 | 1.2 | 16-17 |   |
| **P2.2 Newton's laws** |
| P2.2a recall examples of ways in which objects interact | 5.1 | 142 |   |
| P2.2b describe how such examples involve interactions between pairs of objects which produce a force on each object | 5.11 | 162-163 |   |
| P2.2c represent such forces as vectors | 5.7-5.8 | 154-157 |   |
| P2.2d apply Newton’s First Law to explain the motion of an object moving with uniform velocity and also an object where the speed and/or direction change | 5.7 | 154-155 |   |
| **P2.2e use vector diagrams to illustrate resolution of forces, a net force (resultant force), and equilibrium situations** | 5.8 | 156 |   |
| **P2.2f describe examples of the forces acting on an isolated solid object or system** | 5.7 onwards | 154 onwards |   |
| **P2.2g describe, using free body diagrams, examples where two or more forces lead to a resultant force on an object** | 5.7-5.8 | 154-156 |   |
| **P2.2h describe, using free body diagrams, examples of the special case where forces balance to produce a resultant force of zero (qualitative only)** | 5.7-5.8 | 154-156 |   |
| P2.2i apply Newton’s second law in calculations relating forces, masses and accelerations | 5.9 | 158-159 |   |
| **P2.2j explain that inertia is a measure of how difficult it is to change the velocity of an object and that the mass is defined as the ratio of force over acceleration** | 5.9 | 159 |   |
| **P2.2k define momentum and describe examples of momentum in collisions** | 5.12 | 164 |   |
| P2.2l  apply formulae relating force, mass, velocity and acceleration to explain how the changes involved are inter-related  | 5.12 | 164-165 |   |
| P2.2m use the relationship between work done, force, and distance moved along the line of action of the force and describe the energy transfer involved | 1.3 | 18 |   |
| P2.2n calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules | 1.3 | 18-19 |   |
| P2.2o explain, with reference to examples, the definition of power as the rate at which energy is transferred | 1.4 | 20 |   |
| P2.2p recall and apply Newton’s third law | 5.11 | 162-163 |   |
| **P2.2q explain why an object moving in a circle with a constant speed has a changing velocity (qualitative only)** | 5.3 | 147 |   |
| PM2.2i recall and apply: force (N) = mass (kg) x acceleration (m/s2) | 5.9 | 158-159 |   |
| **PM2.2ii recall and apply: momentum (kg m/s) = mass (kg) x velocity (m/s)**  | 5.12 | 164-165 |   |
| PM2.2iii recall and apply: work done (J) = force (N) x distance (m) (along the line of action of the force) | 1.3 | 18 |   |
| PM2.2iv recall and apply: power (W) = work done (J) / time (s) | 1.4 | 20 |   |
| **P2.3 Forces in action** |
| P2.3a explain that to stretch, bend or compress an object, more than one force has to be applied | 5.18 | 176 | This is only made clear in the case of extension of a spring. |
| P2.3b describe the difference between elastic and plastic deformation (distortions) caused by stretching forces | 5.18 | 176 | The term "plastic" is not used; "inelastic" is used instead. |
| P2.3c describe the relationship between force and extension for a spring and other simple systems | 5.18 | 177 |   |
| P2.3d describe the difference between linear and non-linear relationships between force and extension | 5.18 | 177 |   |
| P2.3e calculate a spring constant in linear cases | 5.18 | 177 |   |
| P2.3f calculate the work done in stretching | 5.18 | 177 |   |
| P2.3g describe that all matter has a gravitational field that causes attraction, and the field strength is much greater for massive objects | 5.6 | 152 |   |
| P2.3h define weight, describe how it is measured and describe the relationship between the weight of an object and the gravitational field strength (g) (and) has a value of 10N/kg at the Earth’s surface | 5.6 | 152-153 |   |
| P2.3i recall the acceleration in free fall | 5.6 | 153 |   |
| P2.3j  apply formulae relating force, mass and relevant physical constants, including gravitational field strength (g), to explore how changes in these are inter-related | 5.9 | 158-159 |   |
| P2.3k  describe examples in which forces cause rotation | 5.14 | 168 |   |
| P2.3l  define and calculate the moment of the force in such examples | 5.14 | 169 |   |
| P2.3m  explain how levers and gears transmit the rotational effects of forces | 5.15 | 170-171 |   |
| P2.3n  recall that the pressure in fluids (gases and liquids) causes a net force at right angles to any surface | 5.16 | 172 |   |
| P2.3o  use the relationship between the force, the pressure and the area in contact | 5.16 | 172 |   |
| PM2.3i recall and apply: force exerted by a spring (N) = extension (m) x spring constant (N/m) | 5.18 | 177 |   |
| PM2.3ii apply: energy transferred in stretching (J) = 0.5 x spring constant (N/m) x (extension (m))2 | 5.18 | 177 |   |
| PM2.3iii recall and apply: gravity force (N) = mass (kg) x gravitational field strength, g (N/kg) | 5.6 | 153 |   |
| PM2.3iv recall and apply: (in a gravity field) potential energy (J) = mass (kg) x height (m) x gravitational field strength, g (N/kg) | 1.1 | 14-15 |   |
| PM2.3v  recall and apply: pressure (Pa) = force normal to a surface (N) / area of that surface (m2) | 5.16 | 172-173 |   |
| PM2.3vi  recall and apply: moment of a force (Nm) = force (N) x distance (m) (normal to direction of the force) | 5.14 | 168-169 |   |
| **Topic P3 Electricity** |
| **P3.1 Static and charge** |
| P3.1a describe that charge is a property of all matter and that there are positive and negative charges. The effects of the charges are not normally seen on bodies containing equal amounts of positive and negative charge, as their effects cancel each other out | 2.1 | 48-49 | It is not explicitly stated, but assumed, that charges are balanced in most cases. |
| P3.1b describe the production of static electricity, and sparking, by rubbing surfaces, and evidence that charged objects exert forces of attraction or repulsion on one another when not in contact | 2.1, 2.2 | 48-49, 51 |   |
| P3.1c explain how transfer of electrons between objects can explain the phenomena of static electricity | 2.1-2.2 | 48-51 |   |
| P3.1d  explain the concept of an electric field and how it helps to explain the phenomena of static electricity | 2.2 | 50-51 |   |
| P3.1e recall that current is a rate of flow of charge (electrons) and the conditions needed for charge to flow | 2.3 | 52-53 |   |
| P3.1f recall that current has the same value at any point in a single closed loop |  |  | It is not explicitly stated that the current is the same at all points in a closed loop. |
| P3.1g recall and use the relationship between quantity of charge, current and time | 2.3 | 52 |   |
| PM3.1i recall and apply: charge flow (C) = current (A) x time (s) | 2.3 | 52 |   |
| **P3.2 Simple circuits** |
| P3.2a describe the differences between series and parallel circuits | 2.4 | 54-55 |   |
| P3.2b represent d.c. circuits with the conventions of positive and negative terminals, and the symbols that represent common circuit elements | 2.3 | 52-53 |   |
| P3.2c recall that current (I) depends on both resistance (R) and potential difference (V) and the units in which these are measured | 2.3 | 53 |   |
| P3.2d recall and apply the relationship between I, R and V, and that for some resistors the value of R remains constant but that in others it can change as the current changes | 2.6 | 58-59 |   |
| P3.2e explain that for some resistors the value of R remains constant but that in others it can change as the current changes | 2.6-2.8 | 58-63 |   |
| P3.2f explain the design and use of circuits to explore such effects | 2.7-2.8 | 60-63 |   |
| P3.2g use graphs to explore whether circuit elements are linear or non-linear | 2.7-2.9 | 60-65 |   |
| P3.2h use graphs and relate the curves produced to the function and properties of circuit elements | 2.7-2.9 | 60-65 |   |
| P3.2i explain why, if two resistors are in series the net resistance is increased, whereas with two in parallel the net resistance is decreased (qualitative explanation only) | 2.4 | 54-55 |   |
| P3.2j calculate the currents, potential differences and resistances in d.c. series and parallel circuits | 2.4-2.5 | 54-57 |   |
| P3.2k explain the design and use of such circuits for measurement and testing purposes | 2.5-2.9 | 56-65 |   |
| P3.2l explain how the power transfer in any circuit device is related to the potential difference across it and the current, and to the energy changes over a given time | 2.12 | 70-71 |   |
| P3.2m apply the equations relating potential difference, current, quantity of charge, resistance, power, energy, and time, and solve problems for circuits which include resistors in series, using the concept of equivalent resistance | 2.13 | 72-73 |   |
| PM3.2i recall and apply: potential difference (V) = current (A) x resistance (Ω) | 2.13 | 72 |   |
| PM3.2ii recall and apply: energy transferred (J) = charge (C) x potential difference (V) | 2.12 | 71 |   |
| PM3.2iii recall and apply: power (W) = potential difference (V) x current (A) = (current (A))2 x resistance (Ω) | 2.13 | 72 |   |
| PM3.2iv recall and apply: energy transferred (J, kWh) = power (W, kW) x time (s, h) = charge (C) x potential difference (V) | 2.12 | 70-71 |   |
| **Topic P4 Magnetism and magnetic fields** |
| **P4.1 Magnets and magnetic fields** |
| P4.1a describe the attraction and repulsion between unlike and like poles for permanent magnets | 7.1 | 244 |   |
| P4.1b describe the difference between permanent and induced magnets | 7.1 | 245 |   |
| P4.1c describe the characteristics of the magnetic field of a magnet, showing how strength and direction change from one point to another | 7.1 | 245 |   |
| P4.1d explain how the behaviour of a magnetic (dipping) compass is related to evidence that the core of the Earth must be magnetic | 7.2 | 246 |   |
| P4.1e describe how to show that a current can create a magnetic effect and describe the directions of the magnetic field around a conducting wire | 7.2, 7.3 | 247-249 |   |
| P4.1f recall that the strength of the field depends on the current and the distance from the conductor | 7.2 | 247 |   |
| P4.1g explain how solenoid arrangements can enhance the magnetic effect | 7.3 | 248 |   |
| **P4.2 Uses of magnetism** |
| **P4.2a describe how a magnet and a current-carrying conductor exert a force on one another** | 7.3 | 249 |   |
| **P4.2b show that Fleming’s left-hand rule represents the relative orientations of the force, the current and the magnetic field** | 7.3 | 249 |   |
| **P4.2c apply the equation that links the force on a conductor to the magnetic flux density, the current and the length of conductor to calculate the forces involved** | 7.5 | 252-253 |   |
| **P4.2d explain how the force exerted from a magnet and a current-carrying conductor is used to cause rotation in electric motors** | 7.6 | 254 |   |
| **P4.2e**  **recall that a change in the magnetic field around a conductor can give rise to an induced potential difference across its ends, which could drive a current, generating a magnetic field that would oppose the original change** | 7.8 | 258-259 |   |
| **P4.2f**  **explain how this effect is used in an alternator to generate a.c., and in a dynamo to generate d.c** | 7,10 | 263 |   |
| **P4.2g**  **explain how the effect of an alternating current in one circuit, in inducing a current in another, is used in transformers** | 7.11 | 264-265 |   |
| **P4.2h**  **explain how the ratio of the potential differences across the two depends on the ratio of the numbers of turns in each** | 7.11 | 264 |   |
| **P4.2i**  **apply the equations linking the potential differences and numbers of turns in the two coils of a transformer** | 7.22 | 264-265 |   |
| **P4.2j**  **explain the action of the microphone in converting the pressure variations in sound waves into variations in current in electrical circuits, and the reverse effect as used in loudspeakers and headphones** | 7,10 | 262 |   |
| **PM4.2i apply: force on a conductor (at right angles to a magnetic field) carrying a current (N) = magnetic flux density (T) x current (A) x length (m)** | 7.5 | 252-253 |   |
| **PM4.2ii**  **apply: potential difference across primary coil (V)/potential difference across secondary coil (V) = number of turns in primary coil / number of turns in secondary coil**  | 7.11 | 264-265 |   |
| **Topic P5 Waves in matter** |
| **P5.1 Wave behaviour** |
| P5.1a describe wave motion in terms of amplitude, wavelength, frequency and period | 6.1 | 192 |   |
| P5.1b define wavelength and frequency | 6.1 | 192 |   |
| P5.1c describe and apply the relationship between these and the wave velocity | 6.1 | 193 |   |
| P5.1d apply formulae relating velocity, frequency and wavelength | 6.1 | 193 |   |
| P5.1e describe differences between transverse and longitudinal waves | 6.2 | 194 |   |
| P5.1f  show how changes, in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related | 6.2 | 195 |   |
| P5.1g  describe the effects of reflection, transmission, and absorption of waves at material interface | 6.6 | 202-203 |   |
| **P5.1h**  **describe, with examples, processes which convert wave disturbances between sound waves and vibrations in solids** | 6.8 | 206-207 |   |
| **P5.1i**  **explain why such processes only work over a limited frequency range, and the relevance of this to human hearing**  | 6.8 | 206-207 |   |
| P5.1j describe how ripples on water surfaces are used to model transverse waves while sound waves in air are longitudinal waves, and how the speed of each may be measured | 6.2, 6.5 | 194, 200 |   |
| P5.1k describe evidence that in both cases it is the wave and not the water or air itself that travels | 6.2 | 194 |   |
| PM5.1i recall and apply: wave speed (m/s) = frequency (Hz) x wavelength (m) | 6.5 | 200 |   |
| **P5.2 The electromagnetic spectrum** |
| P5.2a recall that electromagnetic waves are transverse and are transmitted through space where all have the same velocity | 6.11 | 212-213 |   |
| P5.2b explain that electromagnetic waves transfer energy from source to absorber | 6.11 | 212 |   |
| P5.2c apply the relationships between frequency and wavelength across the electromagnetic spectrum | 6.11 | 213 |   |
| P5.2d describe the main groupings of the electromagnetic spectrum and that these groupings range from long to short wavelengths and from low to high frequencies | 6.11 | 213 |   |
| P5.2e describe that our eyes can only detect a limited range of the electromagnetic spectrum | 6.11 | 212-213 |   |
| P5.2f recall that light is an electromagnetic wave | 6.11 | 212 |   |
| P5.2g give examples of some practical uses of electromagnetic waves in the radio, micro-wave, infra-red, visible, ultra-violet, X-ray and gamma-ray regions | 6.13-6.17 | 216- 225 |  |
| P5.2h describe how ultra-violet waves, X-rays and gamma-rays can have hazardous effects, notably on human bodily tissues | 6.13-6.14 | 216-218 |   |
| **P5.2i**  **explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in our bodies** | 6.9, 6.13 | 208-209, 216-217 |   |
| **P5.2j recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits** | 6.17 | 224 |   |
| **P5.3 Wave interactions** |
| **P5.3a recall that different substances may absorb, transmit, refract, or reflect electromagnetic waves in ways that vary with wavelength** | 6.2, 6.4, 6.6, 6.7, 6.8, 6.12 | 195, 199, 203, 204, 207, 215 |   |
| **P5.3b explain how some effects are related to differences in the velocity of electromagnetic waves in different substances** | 6.12 | 214-215 |   |
| P5.3c  use ray diagrams to illustrate reflection, refraction and the similarities and differences between convex and concave lenses (qualitative only) | 6,20-6.21 | 230-233 |   |
| P5.3d  construct two-dimensional ray diagrams to illustrate reflection and refraction (qualitative only –equations not needed) | 6.7 | 204-205 |   |
| P5.3e  explain how colour is related to differential absorption, transmission and reflection | 6.18 | 226-227 |   |
| **Topic P6 Radioactivity** |
| **P6.1 Radioactive emissions** |
| P6.1a recall that atomic nuclei are composed of both protons and neutrons, that the nucleus of each element has a characteristic positive charge | 4.1 | 110 |   |
| P6.1b recall that atoms of the same elements can differ in nuclear mass by having different numbers of neutrons | 4 | 109 |   |
| P6.1c Use the conventional representation for nuclei to relate the differences between isotopes | 4.1 | 111 |   |
| P6.1d recall that some nuclei are unstable and may emit alpha-particles, beta-particles, or neutrons, and electromagnetic radiation as gamma-rays | 4.2 | 113 |   |
| P6.1e relate these emissions to possible changes in the mass or the charge of the nucleus, or both | 4.2 | 113 |   |
| P6.1f use names and symbols of common nuclei and particles to write balanced equations that represent radioactive decay | 4.4 | 116-117 |   |
| P6.1g balance equations representing the emission of alpha-, beta- or gamma-radiation in terms of the masses, and charges of the atoms involved | 4.4 | 116-117 |   |
| P6.1h recall that in each atom its electrons are arranged at different distances from the nucleus, that such arrangements may change with absorption or emission of electromagnetic radiation and that atoms can become ions by loss of outer electrons | 4.1 | 111 |   |
| P6.1i recall that changes in atoms and nuclei can also generate and absorb radiations over a wide frequency range | 4.1 | 111 |   |
| P6.1j explain the concept of half-life and how this is related to the random nature of radioactive decay | 4.5 | 118-119 |   |
| **P6.1k calculate the net decline, expressed as a ratio, during radioactive emission after a given (integral) number of half-lives**  | 4.5 | 118-119 | Ratios are not used. |
| P6.1l recall the differences in the penetration properties of alpha-particles, beta-particles and gamma-rays | 4.3 | 115 |   |
| **P6.2 Uses and hazards** |
| P6.2a recall the differences between contamination and irradiation effects and compare the hazards associated with these two | 4.3 | 115 |   |
| P6.2b  explain why the hazards associated with radioactive material differ according to the half-life involved | 4.4 | 120 |   |
| P6.2c  describe the different uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue | 4.6,4.8-4.9 | 121, 124-125 |   |
| P6.2d  recall that some nuclei are unstable and may split, and relate such effects to radiation which might emerge, to transfer of energy to other particles and to the possibility of chain reactions | 4,10 | 128 |   |
| P6.2e  describe the process of nuclear fusion | 4.11 | 130-131 |   |
| **Topic P7 Energy** |
| **P7.1 Work done** |
| P7.1a describe for situations where there are energy transfers in a system, that there is no net change to the total energy of a closed system (qualitative only) | 1.12 | 37 |   |
| P7.1b describe all the changes involved in the way energy is stored when a system changes for common situations | 1.12 | 37 |   |
| P7.1c describe the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces, and by work done when a current flows | 1.12 | 36-37 |   |
| P7.1d make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system |  |  | Not covered |
| P7.1e calculate the amounts of energy associated with a moving body, a stretched spring and an object raised above ground level | 1.1-1.2 | 14-17 |   |
| **P7.2 Power and efficiency** |
| P7.2a describe, with examples, the process by which energy is dissipated, so that it is stored in less useful ways | 1.7 | 26-27 |   |
| P7.2b describe how, in different domestic devices, energy is transferred from batteries or the a.c. from the mains | 2,10 | 66-67 |   |
| P7.2c describe, with examples, the relationship between the power ratings for domestic electrical appliances and how this is linked to the changes in stored energy when they are in use | 2.12-2.13 | 70-73 |   |
| P7.2d calculate energy efficiency for any energy transfer | 1.8 | 28-29 |   |
| **P7.2e describe ways to increase efficiency** | 1.8-1.9 | 28-31 |   |
| P7.2f explain ways of reducing unwanted energy transfer | 1.9 | 30-31 |   |
| P7.2g describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls (qualitative only) | 1.7 | 26-27 |   |
| PM7.2i recall and apply: efficiency = useful output energy transfer (J) / input energy transfer (J) | 1.8 | 28-29 |   |
| **Topic P8 Global challenges** |
| **P8.1 Physics on the move** |
| P8.1a recall typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems | 5.2 | 145 | Only walking, running and cycling are given here, though the speed of sound in air is given more than once elsewhere. |
| P8.1b estimate the magnitudes of everyday accelerations | 5.5 | 150-151 |   |
| P8.1c make calculations using ratios and proportional reasoning to convert units and to compute rates | 5.2 | 144 |   |
| P8.1d explain methods of measuring human reaction times and recall typical results | 5.13 | 166 | Reaction times are mentioned and examples of typical times are given, but only one method of measurement - the popular ruler-dropping one - is given. |
| P8.1e explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety | 5.13 | 166-167 |   |
| P8.1f  estimate how the distances required for road vehicles to stop in an emergency, varies over a range of typical speeds | 5.13 | 166-167 |   |
| P8.1g explain the dangers caused by large decelerations | 5.13 | 167 |   |
| **P8.1h**  **estimate the forces involved in typical situations on a public road**  | 5.13 | 167 |   |
| P8.1i  estimate, for everyday road transport, the speed, accelerations and forces involved in large accelerations | 5.13 | 167 |   |
| **P8.2 Powering Earth** |
| P8.2a describe the main energy sources available for use on Earth, compare the ways in which they are used and distinguish between renewable and non-renewable sources | 1.10-1.11 | 32-35 |   |
| P8.2b explain patterns and trends in the use of energy resources | 1.11 | 34-35 |   |
| P8.2c recall that, in the national grid, electrical power is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic use | 2.11 | 68-69 |   |
| P8.2d recall that step-up and step-down transformers are used to change the potential difference as power is transferred from power stations | 2.11 | 69 |   |
| P8.2e explain how the national grid is an efficient way to transfer energy | 2.11 | 68-69 |   |
| **P8.2f**  **link the potential differences and numbers of turns of a transformer to the power transfer involved; relate this to the advantages of power transmission at high voltages** | 7.11 | 265 |   |
| P8.2g recall that the domestic supply in the UK is a.c. at 50Hz and about 230 volts | 2,10 | 66 |   |
| P8.2h explain the difference between direct and alternating voltage | 2,10 | 66 |   |
| P8.2i recall the differences in function between the live, neutral and earth mains wires, and the potential differences between these wires | 2,10 | 66-67 |   |
| P8.2j explain that a live wire may be dangerous even when a switch in a mains circuit is open, and explain the dangers of providing any connection between the live wire and earth | 2,10 | 67 |   |
| PM8.2i apply: potential difference across primary coil (V) x current in primary coil (A) = potential difference across secondary coil (V) x current in secondary coil (A) | 7.11 | 264-265 |   |
| **P8.3 Beyond Earth** |
| P8.3a  explain the red-shift of light as seen from galaxies which are receding (qualitative only). The change with distance of each galaxy’s speed is evidence of an expanding universe | 8.7 | 288-289 |   |
| P8.3b  explain how red-shift and other evidence can be linked to the Big-Bang model | 8.7 | 289 |   |
| P8.3c  recall that our Sun was formed from dust and gas drawn together by gravity and explain how this caused fusion reactions, leading to equilibrium between gravitational collapse and expansion due to the energy released during fusion | 8.3 | 280 |   |
| P8.3d  explain that all bodies emit radiation, and that the intensity and wavelength distribution of any emission depends on their temperatures | 8.7 | 288 |   |
| P8.3e  recall the main features of our solar system, including the similarities and distinctions between the planets, their moons, and artificial satellites | 8.1-8.2 | 276-279 |   |
| **P8.3f**  **explain for circular orbits, how the force of gravity can lead to changing velocity of a planet but unchanged speed (qualitative only)** | 8.2 | 279 |   |
| **P8.3g**  **explain how, for a stable orbit, the radius must change if this speed changes (qualitative only)** | 8.2 | 279 |   |
| **P8.3h**  **explain how the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted; illustrate this balance using everyday examples and the example of the factors which determine the temperature of the Earth** | 6.22 | 234-235 |   |
| **P8.3i**  **explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in the Earth’s core and in deep water** | 6.4, 6,10 | 199, 210-211 |   |

## AQA Hodder textbook mapping

| **Specification statement** | **Chapter covering specification statement** | **Page number** | **Comments** |
| --- | --- | --- | --- |
| **Topic P1 Matter** |
| **P1.1 The Particle model** |
| P1.1a describe how and why the atomic model has changed over time | 4 | 91-93 |   |
| P1.1b describe the atom as a positively charged nucleus surrounded by negatively charged electrons, with the nuclear radius much smaller than that of the atom and with almost all of the mass in the nucleus | 4 | 88 |   |
| P1.1c recall the typical size (order of magnitude) of atoms and small molecules | 4 | 88 |   |
| P1.1d define density | 3 | 67 |   |
| P1.1e explain the differences in density between the different states of matter in terms of the arrangements of the atoms and molecules | 3 | 71 |   |
| P1.1f apply the relationship between density, mass and volume to changes where mass is conserved | 3 | 79 |   |
| PM1.1i recall and apply: density (kg/m3) = mass (kg)/volume (m3) | 3 | 67 |   |
| **P1.2 Changes of state** |
| P1.2a describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed | 3 | 73 |   |
| P1.2b describe that these physical changes differ from chemical changes because the material recovers its original properties if the change is reversed | 3 | 73 |   |
| P1.2c describe how heating a system will change the energy stored within the system and raise its temperature or produce changes of state | 3 | 72 |   |
| P1.2d define the term specific heat capacity and distinguish between it and the term specific latent heat | 3 | 73-76 | The two terms are introduced consecutively and defined separately. |
| P1.2e apply the relationship between change in internal energy of a material and its mass, specific heat capacity and temperature change to calculate the energy change involved | 3 | 74 |   |
| P1.2f apply the relationship between specific latent heat and mass to calculate the energy change involved in a change of state | 3 | 78 |   |
| PM1.2i apply: change in thermal energy (J) = mass (kg) x specific heat capacity (J/kg°C) x change in temperature (°C) | 3 | 75 |   |
| PM1.2ii apply: thermal energy for a change in state (J) = mass (kg) x specific latent heat (J/kg) | 3 | 76 |   |
| **P1.3 Pressure** |
| P1.3a explain how the motion of the molecules in a gas is related both to its temperature and its pressure | 3 | 78-79 |   |
| P1.3b explain the relationship between the temperature of a gas and its pressure at constant volume (qualitative only) | 3 | 79 |   |
| P1.3c  recall that gases can be compressed or expanded by pressure changes and that the pressure produces a net force at right angles to any surface | 3 | 78-79 |   |
| P1.3d  explain how increasing the volume in which a gas is contained, at constant temperature can lead to a decrease in pressure | 3 | 79 | In fact, the example given involves measuring an increase in pressure with a decrease in volume, but it also points out that the two quantities are inversely proportional. |
| **P1.3e**  **explain how doing work on a gas can increase its temperature** | 3 | 81 |   |
| P1.3f  describe a simple model of the Earth’s atmosphere and of atmospheric pressure | 5A | 139 |   |
| P1.3g  explain why atmospheric pressure varies with height above the surface of the planet | 5A | 139 |  |
| **P1.3h**  **describe the factors which influence floating and sinking** | 5A | 137 |   |
| **P1.3i**  **explain why pressure in a liquid varies with depth and density and how this leads to an upwards force on a partially submerged object** | 5A | 136 |   |
| **P1.3j**  **calculate the differences in pressure at different depths in a liquid** | 5A | 137 |   |
| PM1.3i  apply: for gases: pressure (Pa) x volume (m3) = constant (for a given mass of gas and at a constant temperature) | 3 | 79 |   |
| **PM1.3ii**  **apply: pressure due to a column of liquid (Pa) = height of column (m) x density of liquid (kg/m3) x g (N/kg)** | 3 | 136-137 |   |
| **Topic P2 Forces** |
| **P2.1 Motion** |
| P2.1a describe how to measure distance and time in a range of scenarios | 5B | 148 |   |
| P2.1b describe how to measure distance and time and use these to calculate speed | 5B | 148 |   |
| P2.1c make calculations using ratios and proportional reasoning to convert units and to compute rates | 5B | 148 |   |
| P2.1d explain the vector–scalar distinction as it applies to displacement and distance, velocity and speed | 5A, 5B | 117, 148 | A fuller explanation of vectors and scalars is given in 5A, and the distinction is referred to again in 5B, when velocity/speed and acceleration equations are introduced. |
| P2.1e relate changes and differences in motion to appropriate distance-time, and velocity-time graphs; interpret lines and slopes | 5B | 149 |   |
| **P2.1f interpret enclosed area in velocity-time graphs** | 5B | 152, 153 |   |
| P2.1g calculate average speed for non-uniform motion | 5B | 148-151 |   |
| P2.1h apply formulae relating distance, time and speed, for uniform motion, and for motion with uniform acceleration | 5B | 148, 153 |   |
| PM2.1i recall and apply: distance travelled (m) = speed (m/s) x time (s) | 5B | 148 |   |
| PM2.1ii recall and apply: acceleration (m/s2) = change in velocity (m/s) / time (s) | 5B | 152 |   |
| PM2.1iii apply: (final velocity (m/s))2 - (initial velocity (m/s))2 = 2 x acceleration (m/s2) x distance (m) | 5B | 153 |   |
| PM2.1iv recall and apply: kinetic energy (J) = 0.5 x mass (kg) x (speed (m/s))2 | 1 | 5 | This is not recalled in the motion chapter. |
| **P2.2 Newton's laws** |
| P2.2a recall examples of ways in which objects interact | 5A | 118-119 |   |
| P2.2b describe how such examples involve interactions between pairs of objects which produce a force on each object | 5A | 120-121 |   |
| P2.2c represent such forces as vectors | 5A | 120-121 |   |
| P2.2d apply Newton’s First Law to explain the motion of an object moving with uniform velocity and also an object where the speed and/or direction change | 5B | 158 |   |
| **P2.2e use vector diagrams to illustrate resolution of forces, a net force (resultant force), and equilibrium situations** | 5A | 120-121 |   |
| **P2.2f describe examples of the forces acting on an isolated solid object or system** | 5A | 122 |   |
| **P2.2g describe, using free body diagrams, examples where two or more forces lead to a resultant force on an object** | 5A | 122 |   |
| **P2.2h describe, using free body diagrams, examples of the special case where forces balance to produce a resultant force of zero (qualitative only)** | 5B | 158 |   |
| P2.2i apply Newton’s second law in calculations relating forces, masses and accelerations | 5B | 159 |   |
| **P2.2j explain that inertia is a measure of how difficult it is to change the velocity of an object and that the mass is defined as the ratio of force over acceleration** | 5B | 161 |   |
| **P2.2k define momentum and describe examples of momentum in collisions** | 5B | 166-168 |   |
| P2.2l apply formulae relating force, mass, velocity and acceleration to explain how the changes involved are inter-related  | 5B | 167 |   |
| P2.2m use the relationship between work done, force, and distance moved along the line of action of the force and describe the energy transfer involved | 5A | 125 |   |
| P2.2n calculate relevant values of stored energy and energy transfers; convert between newton-metres and joules | 5A | 124-125 |   |
| P2.2o explain, with reference to examples, the definition of power as the rate at which energy is transferred | 1 | 10 |   |
| P2.2p recall and apply Newton’s third law | 5B | 162-163 |   |
| **P2.2q explain why an object moving in a circle with a constant speed has a changing velocity (qualitative only)** | 5B | 149 |   |
| PM2.2i recall and apply: force (N) = mass (kg) x acceleration (m/s2) | 5B | 159 |   |
| **PM2.2ii recall and apply: momentum (kg m/s) = mass (kg) x velocity (m/s)**  | 5B | 170 |   |
| PM2.2iii recall and apply: work done (J) = force (N) x distance (m) (along the line of action of the force) | 5A | 124 |   |
| PM2.2iv recall and apply: power (W) = work done (J) / time (s) | 1 | 10 | This is not recalled in the forces or motion chapters. |
| **P2.3 Forces in action** |
| P2.3a explain that to stretch, bend or compress an object, more than one force has to be applied | 5A | 125 |   |
| P2.3b describe the difference between elastic and plastic deformation (distortions) caused by stretching forces | 5A | 126 | The term used is "inelastic" instead of "plastic". |
| P2.3c describe the relationship between force and extension for a spring and other simple systems | 5A | 126 |   |
| P2.3d describe the difference between linear and non-linear relationships between force and extension | 5A | 128 | The terms "linear" and "non-linear" are not used. |
| P2.3e calculate a spring constant in linear cases | 5A | 127 |   |
| P2.3f calculate the work done in stretching | 5A | 126 |   |
| P2.3g describe that all matter has a gravitational field that causes attraction, and the field strength is much greater for massive objects | 5A | 120 |   |
| P2.3h define weight, describe how it is measured and describe the relationship between the weight of an object and the gravitational field strength (g) (and) has a value of 10N/kg at the Earth’s surface | 5A | 120 |   |
| P2.3i recall the acceleration in free fall | 5A | 156 |   |
| P2.3j  apply formulae relating force, mass and relevant physical constants, including gravitational field strength (g), to explore how changes in these are inter-related | 5A | 120 |   |
| P2.3k  describe examples in which forces cause rotation | 5A | 129-130 |   |
| P2.3l  define and calculate the moment of the force in such examples | 5A | 129-130 |   |
| P2.3m  explain how levers and gears transmit the rotational effects of forces | 5A | 130-134 |   |
| P2.3n  recall that the pressure in fluids (gases and liquids) causes a net force at right angles to any surface | 5A | 135 |   |
| P2.3o  use the relationship between the force, the pressure and the area in contact | 5A | 135 |   |
| PM2.3i recall and apply: force exerted by a spring (N) = extension (m) x spring constant (N/m) | 5A | 126 |   |
| PM2.3ii apply: energy transferred in stretching (J) = 0.5 x spring constant (N/m) x (extension (m))2 | 5A | 126 |   |
| PM2.3iii recall and apply: gravity force (N) = mass (kg) x gravitational field strength, g (N/kg) | 5A | 120 |   |
| PM2.3iv recall and apply: (in a gravity field) potential energy (J) = mass (kg) x height (m) x gravitational field strength, g (N/kg) | 1 | 6 to 8 |   |
| PM2.3v  recall and apply: pressure (Pa) = force normal to a surface (N) / area of that surface (m2) | 5A | 135 |   |
| PM2.3vi  recall and apply: moment of a force (Nm) = force (N) x distance (m) (normal to direction of the force) | 5A | 129 |   |
| **Topic P3 Electricity** |
| **P3.1 Static and charge** |
| P3.1a describe that charge is a property of all matter and that there are positive and negative charges. The effects of the charges are not normally seen on bodies containing equal amounts of positive and negative charge, as their effects cancel each other out | 2 | 57 | It is not explicitly stated that the charges usually balance; just assumed. The emphasis is on the fact that there are occasions where there is an imbalance. |
| P3.1b describe the production of static electricity, and sparking, by rubbing surfaces, and evidence that charged objects exert forces of attraction or repulsion on one another when not in contact | 2 | 56-57 |   |
| P3.1c explain how transfer of electrons between objects can explain the phenomena of static electricity | 2 | 56 |   |
| P3.1d  explain the concept of an electric field and how it helps to explain the phenomena of static electricity | 2 | 57 |   |
| P3.1e recall that current is a rate of flow of charge (electrons) and the conditions needed for charge to flow | 2 | 39 |   |
| P3.1f recall that current has the same value at any point in a single closed loop | 2 | 40 |   |
| P3.1g recall and use the relationship between quantity of charge, current and time | 2 | 39-40 |   |
| PM3.1i recall and apply: charge flow (C) = current (A) x time (s) | 2 | 39-40 |   |
| **P3.2 Simple circuits** |
| P3.2a describe the differences between series and parallel circuits | 2 | 46-47 |   |
| P3.2b represent d.c. circuits with the conventions of positive and negative terminals, and the symbols that represent common circuit elements | 2 | 38-39 |   |
| P3.2c recall that current (I) depends on both resistance (R) and potential difference (V) and the units in which these are measured | 2 | 41 |   |
| P3.2d recall and apply the relationship between I, R and V, and that for some resistors the value of R remains constant but that in others it can change as the current changes | 2 | 42-43 |   |
| P3.2e explain that for some resistors the value of R remains constant but that in others it can change as the current changes | 2 | 42-43 |   |
| P3.2f explain the design and use of circuits to explore such effects | 2 | 42-43 |   |
| P3.2g use graphs to explore whether circuit elements are linear or non-linear | 2 | 43-45 |   |
| P3.2h use graphs and relate the curves produced to the function and properties of circuit elements | 2 | 43-46 |   |
| P3.2i explain why, if two resistors are in series the net resistance is increased, whereas with two in parallel the net resistance is decreased (qualitative explanation only) | 2 | 46-47 |   |
| P3.2j calculate the currents, potential differences and resistances in d.c. series and parallel circuits | 2 | 48-49 |   |
| P3.2k explain the design and use of such circuits for measurement and testing purposes | 2 | 45-50 | More detail on safety from p. 50 onwards, under "Domestic use and safety". |
| P3.2l explain how the power transfer in any circuit device is related to the potential difference across it and the current, and to the energy changes over a given time | 2 | 53 |   |
| P3.2m apply the equations relating potential difference, current, quantity of charge, resistance, power, energy, and time, and solve problems for circuits which include resistors in series, using the concept of equivalent resistance | 2 | 48-49,53-54 | The phrase "equivalent resistance" is not used; the rule for adding the resistance of resistors in series is. |
| PM3.2i recall and apply: potential difference (V) = current (A) x resistance (Ω) | 2 | 53 |   |
| PM3.2ii recall and apply: energy transferred (J) = charge (C) x potential difference (V) | 2 | 53 |   |
| PM3.2iii recall and apply: power (W) = potential difference (V) x current (A) = (current (A))2 x resistance (Ω) | 2 | 53 |   |
| PM3.2iv recall and apply: energy transferred (J, kWh) = power (W, kW) x time (s, h) = charge (C) x potential difference (V) | 2 | 53 |   |
| **Topic P4 Magnetism and magnetic fields** |
| **P4.1 Magnets and magnetic fields** |
| P4.1a describe the attraction and repulsion between unlike and like poles for permanent magnets | 7 | 221 |   |
| P4.1b describe the difference between permanent and induced magnets | 7 | 223 |   |
| P4.1c describe the characteristics of the magnetic field of a magnet, showing how strength and direction change from one point to another | 7 | 222 |   |
| P4.1d explain how the behaviour of a magnetic (dipping) compass is related to evidence that the core of the Earth must be magnetic | 7 | 222-223 |   |
| P4.1e describe how to show that a current can create a magnetic effect and describe the directions of the magnetic field around a conducting wire | 7 | 224 |   |
| P4.1f recall that the strength of the field depends on the current and the distance from the conductor | 7 | 224 |   |
| P4.1g explain how solenoid arrangements can enhance the magnetic effect | 7 | 225 |   |
| **P4.2 Uses of magnetism** |
| **P4.2a describe how a magnet and a current-carrying conductor exert a force on one another** | 7 | 227 |   |
| **P4.2b show that Fleming’s left-hand rule represents the relative orientations of the force, the current and the magnetic field** | 7 | 229 |   |
| **P4.2c apply the equation that links the force on a conductor to the magnetic flux density, the current and the length of conductor to calculate the forces involved** | 7 | 227 |   |
| **P4.2d explain how the force exerted from a magnet and a current-carrying conductor is used to cause rotation in electric motors** | 7 | 230 |   |
| **P4.2e**  **recall that a change in the magnetic field around a conductor can give rise to an induced potential difference across its ends, which could drive a current, generating a magnetic field that would oppose the original change** | 7 | 232-233 |   |
| **P4.2f**  **explain how this effect is used in an alternator to generate a.c., and in a dynamo to generate d.c** | 7 | 234-235 |   |
| **P4.2g**  **explain how the effect of an alternating current in one circuit, in inducing a current in another, is used in transformers** | 7 | 236 |   |
| **P4.2h**  **explain how the ratio of the potential differences across the two depends on the ratio of the numbers of turns in each** | 7 | 236-237 |   |
| **P4.2i**  **apply the equations linking the potential differences and numbers of turns in the two coils of a transformer** | 7 | 237 |   |
| **P4.2j**  **explain the action of the microphone in converting the pressure variations in sound waves into variations in current in electrical circuits, and the reverse effect as used in loudspeakers and headphones** | 7 | 235 |   |
| **PM4.2i apply: force on a conductor (at right angles to a magnetic field) carrying a current (N) = magnetic flux density (T) x current (A) x length (m)** | 7 | 227 |   |
| **PM4.2ii**  **apply: potential difference across primary coil (V)/potential difference across secondary coil (V) = number of turns in primary coil / number of turns in secondary coil**  | 7 | 237-241 |   |
| **Topic P5 Waves in matter** |
| **P5.1 Wave behaviour** |
| P5.1a describe wave motion in terms of amplitude, wavelength, frequency and period | 6 | 183 |   |
| P5.1b define wavelength and frequency | 6 | 183 |   |
| P5.1c describe and apply the relationship between these and the wave velocity | 6 | 184 |   |
| P5.1d apply formulae relating velocity, frequency and wavelength | 6 | 184 |   |
| P5.1e describe differences between transverse and longitudinal waves | 6 | 181-182 |   |
| P5.1f show how changes, in velocity, frequency and wavelength, in transmission of sound waves from one medium to another, are inter-related | 6 | 188 |   |
| P5.1g  describe the effects of reflection, transmission, and absorption of waves at material interface | 6 | 188-190 |   |
| **P5.1h**  **describe, with examples, processes which convert wave disturbances between sound waves and vibrations in solids** | 6 | 191 |   |
| **P5.1i**  **explain why such processes only work over a limited frequency range, and the relevance of this to human hearing**  | 6 | 191 |   |
| P5.1j describe how ripples on water surfaces are used to model transverse waves while sound waves in air are longitudinal waves, and how the speed of each may be measured | 6 | 181-182, 185-186 |   |
| P5.1k describe evidence that in both cases it is the wave and not the water or air itself that travels | 6 | 181-182 |   |
| PM5.1i recall and apply: wave speed (m/s) = frequency (Hz) x wavelength (m) | 6 | 187 onwards |   |
| **P5.2 The electromagnetic spectrum** |
| P5.2a recall that electromagnetic waves are transverse and are transmitted through space where all have the same velocity | 6 | 194 |   |
| P5.2b explain that electromagnetic waves transfer energy from source to absorber | 6 | 194 |   |
| P5.2c apply the relationships between frequency and wavelength across the electromagnetic spectrum | 6 | 194 |   |
| P5.2d describe the main groupings of the electromagnetic spectrum and that these groupings range from long to short wavelengths and from low to high frequencies | 6 | 194 |   |
| P5.2e describe that our eyes can only detect a limited range of the electromagnetic spectrum | 6 | 194 |   |
| P5.2f recall that light is an electromagnetic wave | 6 | 194 |   |
| P5.2g give examples of some practical uses of electromagnetic waves in the radio, micro-wave, infra-red, visible, ultra-violet, X-ray and gamma-ray regions | 6 | 200-201 |   |
| P5.2h describe how ultra-violet waves, X-rays and gamma-rays can have hazardous effects, notably on human bodily tissues | 6 | 199, 201 |   |
| **P5.2i**  **explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in our bodies** | 6 | 191-192 |   |
| **P5.2j recall that radio waves can be produced by, or can themselves induce, oscillations in electrical circuits** | 6 | 198-199 |   |
| **P5.3 Wave interactions** |
| **P5.3a recall that different substances may absorb, transmit, refract, or reflect electromagnetic waves in ways that vary with wavelength** | 6 | 195 | This is not made clear in the case of all waves; only specifically with light. |
| **P5.3b explain how some effects are related to differences in the velocity of electromagnetic waves in different substances** | 6 | 196 |   |
| P5.3c  use ray diagrams to illustrate reflection, refraction and the similarities and differences between convex and concave lenses (qualitative only) | 6 | 196, 203 |   |
| P5.3d  construct two-dimensional ray diagrams to illustrate reflection and refraction (qualitative only –equations not needed) | 6 | 189, 196 |   |
| P5.3e  explain how colour is related to differential absorption, transmission and reflection | 6 | 208-209 |   |
| **Topic P6 Radioactivity** |
| **P6.1 Radioactive emissions** |
| P6.1a recall that atomic nuclei are composed of both protons and neutrons, that the nucleus of each element has a characteristic positive charge | 4 | 88 |   |
| P6.1b recall that atoms of the same elements can differ in nuclear mass by having different numbers of neutrons | 4 | 89-90 |   |
| P6.1c use the conventional representation for nuclei to relate the differences between isotopes | 4 | 89-90 |   |
| P6.1d recall that some nuclei are unstable and may emit alpha-particles, beta-particles, or neutrons, and electromagnetic radiation as gamma-rays | 4 | 93-94 |   |
| P6.1e relate these emissions to possible changes in the mass or the charge of the nucleus, or both | 4 | 94 |   |
| P6.1f use names and symbols of common nuclei and particles to write balanced equations that represent radioactive decay | 4 | 94,96 |   |
| P6.1g balance equations representing the emission of alpha-, beta- or gamma-radiation in terms of the masses, and charges of the atoms involved | 4 | 96 |   |
| P6.1h recall that in each atom its electrons are arranged at different distances from the nucleus, that such arrangements may change with absorption or emission of electromagnetic radiation and that atoms can become ions by loss of outer electrons | 4 | 89 ,92 |   |
| P6.1i recall that changes in atoms and nuclei can also generate and absorb radiations over a wide frequency range | 4 | 199 |   |
| P6.1j explain the concept of half-life and how this is related to the random nature of radioactive decay | 4 | 98-99 |   |
| **P6.1k calculate the net decline, expressed as a ratio, during radioactive emission after a given (integral) number of half-lives**  | 4 | 101 | No examples involve ratios; only absolute quantities are used. |
| P6.1l recall the differences in the penetration properties of alpha-particles, beta-particles and gamma-rays | 4 | 97 |   |
| **P6.2 Uses and hazards** |
| P6.2a recall the differences between contamination and irradiation effects and compare the hazards associated with these two | 4 | 105 |   |
| P6.2b  explain why the hazards associated with radioactive material differ according to the half-life involved | 4 | 97,102-103, 105 |   |
| P6.2c  describe the different uses of nuclear radiations for exploration of internal organs, and for control or destruction of unwanted tissue | 4 | 104-105 |   |
| P6.2d  recall that some nuclei are unstable and may split, and relate such effects to radiation which might emerge, to transfer of energy to other particles and to the possibility of chain reactions | 4 | 106 |   |
| P6.2e  describe the process of nuclear fusion | 4 | 108 |   |
| **Topic P7 Energy** |
| **P7.1 Work done** |
| P7.1a describe for situations where there are energy transfers in a system, that there is no net change to the total energy of a closed system (qualitative only) | 1 | 4 | The term "closed system" is never used; instead the principle of conservation of energy is stated broadly, i.e. energy can only be converted, not created or destroyed. |
| P7.1b describe all the changes involved in the way energy is stored when a system changes for common situations | 1 | 5 to 7 |   |
| P7.1c describe the changes in energy involved when a system is changed by heating (in terms of temperature change and specific heat capacity), by work done by forces, and by work done when a current flows | 3 | 72, 75 |   |
| P7.1d make calculations of the energy changes associated with changes in a system, recalling or selecting the relevant equations for mechanical, electrical, and thermal processes; thereby express in quantitative form and on a common scale the overall redistribution of energy in the system | 1, 2 | 9,10, 54 |   |
| P7.1e calculate the amounts of energy associated with a moving body, a stretched spring and an object raised above ground level | 1 | 06-Sep |   |
| **P7.2 Power and efficiency** |
| P7.2a describe, with examples, the process by which energy is dissipated, so that it is stored in less useful ways | 1 | 15 |   |
| P7.2b describe how, in different domestic devices, energy is transferred from batteries or the a.c. from the mains | 2 | 50-51 |   |
| P7.2c describe, with examples, the relationship between the power ratings for domestic electrical appliances and how this is linked to the changes in stored energy when they are in use | 2 | 53-54 |   |
| P7.2d calculate energy efficiency for any energy transfer | 1 | 18-19 |   |
| **P7.2e describe ways to increase efficiency** | 1 | 19-20 |   |
| P7.2f explain ways of reducing unwanted energy transfer | 1 | 15-17 |   |
| P7.2g describe how the rate of cooling of a building is affected by the thickness and thermal conductivity of its walls (qualitative only) | 1 | 16-17 |   |
| PM7.2i recall and apply: efficiency = useful output energy transfer (J) / input energy transfer (J) | 1 | 18 |   |
| **Topic P8 Global challenges** |
| **P8.1 Physics on the move** |
| P8.1a recall typical speeds encountered in everyday experience for wind and sound, and for walking, running, cycling and other transportation systems | 5B | 147 | Wind and sound speeds are not given in the chapter on motion, but the speed of sound is given in chapter 6, pages 185 and 187. |
| P8.1b estimate the magnitudes of everyday accelerations | 5B | 152-154 |   |
| P8.1c make calculations using ratios and proportional reasoning to convert units and to compute rates | 5B | 148 |   |
| P8.1d explain methods of measuring human reaction times and recall typical results | 5B | 164-165 | Only the ruler-dropping technique is given as an example, although it is suggested that the experiment be tried with distractions in order to test the potential effect on stopping distance in vehicles. |
| P8.1e explain the factors which affect the distance required for road transport vehicles to come to rest in emergencies and the implications for safety | 5B | 163-166 |   |
| P8.1f  estimate how the distances required for road vehicles to stop in an emergency, varies over a range of typical speeds | 5B | 164-166 |   |
| P8.1g explain the dangers caused by large decelerations | 5B | 167-171 |   |
| **P8.1h**  **estimate the forces involved in typical situations on a public road**  | 5B | 171 |   |
| P8.1i  estimate, for everyday road transport, the speed, accelerations and forces involved in large accelerations | 5B | 171 | Forces are not calculated in these examples. |
| **P8.2 Powering Earth** |
| P8.2a describe the main energy sources available for use on Earth, compare the ways in which they are used and distinguish between renewable and non-renewable sources | 1 | 21-25 |   |
| P8.2b explain patterns and trends in the use of energy resources | 1 | 21-25 |   |
| P8.2c recall that, in the national grid, electrical power is transferred at high voltages from power stations, and then transferred at lower voltages in each locality for domestic use | 1 | 55 |   |
| P8.2d recall that step-up and step-down transformers are used to change the potential difference as power is transferred from power stations | 1, 7 | 55, 236-238 | Only step-up transformers are mentioned in chapter 1; transformers are expanded on in chapter 7. |
| P8.2e explain how the national grid is an efficient way to transfer energy | 1 | 55 |   |
| **P8.2f**  **link the potential differences and numbers of turns of a transformer to the power transfer involved; relate this to the advantages of power transmission at high voltages** | 7 | 237-238 |   |
| P8.2g recall that the domestic supply in the UK is a.c. at 50Hz and about 230 volts | 2 | 50-51 |   |
| P8.2h explain the difference between direct and alternating voltage | 2 | 50 |   |
| P8.2i recall the differences in function between the live, neutral and earth mains wires, and the potential differences between these wires | 2 | 51 |   |
| P8.2j explain that a live wire may be dangerous even when a switch in a mains circuit is open, and explain the dangers of providing any connection between the live wire and earth | 2 | 51 |   |
| PM8.2i apply: potential difference across primary coil (V) x current in primary coil (A) = potential difference across secondary coil (V) x current in secondary coil (A) | 7 | 239 |   |
| **P8.3 Beyond Earth** |
| P8.3a  explain the red-shift of light as seen from galaxies which are receding (qualitative only). The change with distance of each galaxy’s speed is evidence of an expanding universe | 8 | 256 |   |
| P8.3b  explain how red-shift and other evidence can be linked to the Big-Bang model | 8 | 257 |   |
| P8.3c  recall that our Sun was formed from dust and gas drawn together by gravity and explain how this caused fusion reactions, leading to equilibrium between gravitational collapse and expansion due to the energy released during fusion | 8 | 252 |   |
| P8.3d  explain that all bodies emit radiation, and that the intensity and wavelength distribution of any emission depends on their temperatures | 6 | 210 |   |
| P8.3e  recall the main features of our solar system, including the similarities and distinctions between the planets, their moons, and artificial satellites | 8 | 248-249 | Nothing about artificial satellites. |
| **P8.3f**  **explain for circular orbits, how the force of gravity can lead to changing velocity of a planet but unchanged speed (qualitative only)** | 8 | 253-254 |   |
| **P8.3g**  **explain how, for a stable orbit, the radius must change if this speed changes (qualitative only)** | 8 | 254-255 |   |
| **P8.3h**  **explain how the temperature of a body is related to the balance between incoming radiation absorbed and radiation emitted; illustrate this balance using everyday examples and the example of the factors which determine the temperature of the Earth** | 6 | 211-212 | Only a very simplified account is given. |
| **P8.3i**  **explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in the Earth’s core and in deep water** | 6 | 192 |   |

## Want to switch to OCR?

If you’re an OCR-approved centre, all you need to do is download the specification and start teaching. Your exams officer can complete an intention to teach form which enables us to provide appropriate support. When you’re ready to enter your students, you just need to speak to your exams officer to:

1. Make estimated entries by 10 October so we can prepare the question papers and ensure we’ve got enough examiners.
2. Make final entries by 21 February. If you are not already an OCR-approved centre please refer your exams officer to the centre approval section of our admin guide.

## Next steps

1. Familiarise yourself with the specification, sample assessment materials and teaching resources on the OCR Biology A qualification page of the OCR website.

<http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-physics-a-j249-from-2016/>

1. Browse the online delivery guides for teaching ideas and use the Scheme of Work builder to create your personal scheme of work.
<http://www.ocr.org.uk/qualifications/gcse-gateway-science-suite-physics-a-j249-from-2016/planning-and-teaching/>
2. Get a login for our secure extranet, Interchange – this allows you to access the latest past/practice papers and use our results analysis service, Active Results.

<https://interchange.ocr.org.uk>

1. Sign up to receive subject updates by email.
<http://www.ocr.org.uk/i-want-to/email-updates>
2. Sign up to attend a training event or take part in webinars on specific topics running throughout the year and our Q&A webinar sessions every half term.
<https://www.cpdhub.ocr.org.uk>
3. Attend one of our free teacher network events that are run in each region every term. These are hosted at the end of the school day in a school or college near you, with teachers sharing best practice and subject specialists on hand to lead discussion and answer questions.
<http://ocr.org.uk/qualifications/professional-development/teacher-networks/>