## Scheme of Work 2024/25

## Geology A Level Yr 12

| Week | Specification reference | Content | Comments | Practical sessions and *Maths Skills* | Resources and homework |
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| **9th Sept** | Topic F1: **ELEMENTS, MINERALS AND ROCKS** Key Idea 1: **The Earth is composed of rocks which have distinctive mineralogies and textures** | a. The Earth's elements may be classified according to the **Goldschmidt system** (lithophile, siderophile, chalcophile, atmophile) which aids subdivision of the Earth on the basis of geochemistry (atmosphere, hydrosphere, crust, mantle and core). | Candidates should be aware of the four-fold classification and its delineation and be able to name at least one element from each group.<br>lithophile: elements that combine well with oxygen and are concentrated in the crust; siderophile: 'iron loving' elements typical of the core; chalcophile: 'ore loving' elements which combine well with sulfur near the Earth's surface;<br>atmophile: volatile elements within liquids and gases on or above the Earth's surface. | | Summer work in F1 Workbook<br>Goldschmidt Ppt.<br>Three online quizzes on minerals<br>*(1) Pro-study on Decimal and Standard Form* |
| | | b. The bulk composition of the Earth is comparable with that of undifferentiated meteorites (chondrites). | Candidates should know that evidence for the internal composition of the Earth partly comes from chondrite meteorites. | | Meteorite Ppt. |
| | | c. The Earth's crust is composed of eight main elements. | Candidates should know that 99% of the Earth's crust (by weight) is made up of just 8 elements and their relative order of abundance. | Recognition of the relative abundance of O, Si, Al, Fe, Ca, Na, K and Mg in the crust and the role of the silicates as rock-forming minerals. | Elements Ppt.<br>Bingo cards |

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| | | d. Silicates are the commonest rock-forming minerals and are built from silicon-oxygen tetrahedra (single, chain, sheet and framework silicates). | Candidates should know the chemical structure of silicates as it relates to the physical properties of minerals (e.g. crystal shape, hardness and cleavage) rather than details of the chemical variations between minerals. As exemplified by olivine (single tetrahedra), augite/pyroxene (single chain), hornblende/amphibole (double chain), micas (sheet) and quartz/feldspar (framework). | Simple analysis of silicate mineral structures from models and diagrams. | Silicates Ppt<br>Silicate minerals<br>Molymods |
| **16th Sept** | | e. Minerals are naturally occurring inorganic chemical compounds or elements with compositions that may be expressed as chemical formulae. Minerals have distinct chemical compositions, atomic structures and physical properties by which they may be identified. | Candidates should be able to investigate the physical/chemical properties of minerals (including unfamiliar minerals) in the laboratory and field.<br><br>Candidates should be able to measure the density of minerals using an appropriate technique and evaluate the accuracy of such calculations.<br><br>Candidates will be required to use a mineral data sheet of diagnostic mineral properties in their identification of the stated minerals. | **SP1:** Investigation of diagnostic properties of minerals: colour, crystal shape, cleavage, fracture, hardness, relative density, streak, lustre, reaction with cold dilute (0.5 mol dm-3) hydrochloric acid.<br><br>**SP2:** Measurement of the density of minerals.<br><br>Recognition, using appropriate tests, of the following rock-forming minerals (as specified on the mineral data sheet available for use in the examination) from their diagnostic properties: quartz, calcite, feldspars (orthoclase, plagioclase), augite, hornblende, olivine, micas (biotite, muscovite), haematite, galena, pyrite, chalcopyrite, | Minerals Ppt.<br><br>F1 Project work<br><br>*(2) Pro-study on significant figures and estimation*<br><br>Minerals: Quartz, fluorite, gypsum, pyrite<br><br>Minerals for SP1: A = Plagioclase felspar, B = Gypsum, C = Haematite, D = Quartz, E = Calcite<br><br>Minerals for SP2: A = Pyrite, B = Galena, C = Baryte D = Quartz, E = Hornblende, F = Calcite<br><br>Minerals for SP3: A = Pyrite, B = Quartz, C = Haematite, D = Halite, E = Biotite Mica, F = Sphalerite, G = Gypsum, H = Galena, I = Calcite, J = Plagioclase feldspar |

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| | | | Candidates should be able to use flow charts to classify minerals (including unfamiliar minerals) from their observed physical/chemical properties. | fluorite, barite, halite, gypsum, garnet, chiastolite/andalusite.<br><br>**SP3:** Application of classification systems using distinguishing characteristics to identify unknown minerals. | |
| **23rd Sept** | | f. Rocks are composed of aggregates of minerals, pre-existing rocks or fossils.<br><br>g. Igneous, sedimentary and metamorphic rocks display differences of composition and texture that reflect their mode of origin. | Candidates should be able to determine the origin of igneous, sedimentary and metamorphic rocks from their differing textures and mineralogies (including unfamiliar rocks) in the laboratory and field.<br><br>Scientific drawings to include samples in the laboratory and the field using appropriate scales. | Observation and investigation of hand specimens of a variety of rocks (including sampling in the field) in order to:<br>□□identify and interpret component composition<br>□□interpret colour and textures (crystalline/clastic; crystal or grain size/shape; sorting; foliation; mineral alignment/bedding/crystalline banding) and hence<br>□□deduce the mode of origin of the rock as igneous, metamorphic or sedimentary.<br><br>**SP4:** Production of scaled annotated scientific drawings of rock samples from hand samples using a light microscope, or hand lens observation.<br><br>*Use and manipulation of the magnification formula*<br><br>*magnification = size of image*<br>*size of real object* | Two online quizzes on sedimentary rocks<br><br>(3) *Pro-study on Order of magnitude calculations*<br><br>Starter: A = Granite, B = Sandstone, C = Gneiss, D = Quartz<br><br>Rocks: E = Schist, F = Conglomerate, G = Pink Granite<br><br>Rock descriptions: Basalt, Coarse Sandstone, Andalusite Shale, Shelly Limestone, Gneiss, Conglomerate, Pink Granite<br><br>SP 4: large specimens including Basalt with xenolith<br><br>Assessment 1 (minerals) |

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| **$30^{th}$ Sept** | Topic F2: **SURFACE AND INTERNAL PROCESSES OF THE ROCK CYCLE**<br>Key Idea 1: **The mineralogy and texture of sedimentary rocks are the result of the surface process part of the rock cycle, driven by external energy sources** | a. External energy: solar heating of the Earth's surface drives the water cycle and influences weathering and erosional processes. | | | Sedimentary Rocks Workbook<br><br>Sed Project work 1<br><br>*(4) Pro-study on Uncertainties*<br><br>Starter: Granite |
| | | b. Physical and chemical weathering of rocks occurs at the Earth's surface and provides the raw materials for new sedimentary rocks:<br>• physical weathering, (insolation, freeze/thaw) breaks rock down into smaller fragments<br>• chemical weathering of silicate and carbonate rocks (hydrolysis, carbonation, solution and oxidation) produces a range of new minerals and solutions together with residual, resistant minerals<br>• biological weathering involves physical and chemical changes. | Candidates should know that the products of weathering are rock fragments, unreactive grains (e.g. quartz), clay minerals (e.g. kaolinite) and ions in solution.<br><br>Candidates need only know the processes outlined. | | |
| | | c. Surface materials are transported by a range of erosional agents and are deposited as sediments:<br>• erosion (abrasion, attrition)<br>• transport (traction, saltation, suspension, solution)<br>• deposition selectively concentrates products in particular environments - grain size related to energy of depositional environment; dominance of quartz and | The surface processes part of the rock cycle facilitates, (though not exclusively) training in, and assessment of, some mathematical skills.<br><br>*For exemplification of mathematical skills see* ***Mathematical Guidance for A level Geology***. | *Recognition and use of appropriate units in calculations (MPS1).*<br><br>*Construction and interpretation of frequency tables and diagrams, bar charts and histograms (MPS10).*<br><br>*Finding of arithmetic means (MPS10).*<br>*Understanding of the principles of sampling as applied to scientific data (MPS8).* | Erosion practical: A = mudstone, B = Conglomerate, C = Sandstone, D = Breccia, E = Coarse Sandstone |

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| | | muscovite in coarse fraction and clay minerals in fine fraction; flocculation; precipitation. | | *Understanding of the measures of dispersion, including standard deviation and interquartile range (MPS10).*<br><br>*Selection and use of a statistical test (MPS 17-19).* | |
| **7th Oct** | | d. Different sedimentary environments may be identified by diagnostic sedimentary structures, rock textures, mineralogy and fossil content.<br><br>e. A study of fluvial, marine, and aeolian sediments demonstrates these differences. | Candidates should be aware of the link between process and product in their studies of the stated sedimentary environments:<br>• fluvial (rivers, deltas, alluvial fans and playa lakes)<br>• aeolian (wind dominated e.g. desert dunes)<br>• marine (shallow water – lagoon/reef/beach systems)<br>• marine (deep water – submarine fan turbidites) | Description of sedimentary rocks in hand specimen, rock exposures and diagrams/photographs from observation of their colour, texture (use of sediment comparators to determine grain size, shape and sphericity), (coarse >2 mm, fine <1/16 mm), reaction with 0.5 mol dm-3 hydrochloric acid, mineralogy and other diagnostic features.<br><br>Investigation of textures of sediments from different depositional environments.<br><br>**SP5:** Production of full rock description of macro and micro features from hand specimens and unfamiliar field exposures of sedimentary rocks in order to interpret component composition, colour and textures, to identify rock types and to deduce their environment of deposition. | Sed Project work 2<br><br>(5) *Pro-study on Ratio, fractions and percentages*<br><br>Starter for Desert: Desert Environment<br><br>Starter for Marine sediments: Coral limestone, beach conglomerate, greywacke |
| **14th Oct** | | | Candidates should be able to explain the formation of the stated sedimentary structures. | Interpretation of maps, **photographs** and graphic logs showing the following sedimentary features: bedding, | Sedimentary structure Ppt<br>Sed Project work 3 |

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| | | | Candidates need only have knowledge of the sedimentary rocks indicated.<br><br>Candidates should be able to identify the stated sedimentary rocks in hand specimen and the field. It is understood that it might not be possible to investigate the full range of rocks in the field or that this list is exclusive. | crossbedding, graded bedding, laminations, desiccation features, ripple marks (symmetrical and asymmetrical), sole structures (load/flame, flute cast).<br><br>Identification in hand specimen of the following sedimentary rocks from their composition, texture and other diagnostic features: sandstones (orthoquartzite, arkose, greywacke), shale/mudstone, limestones (shelly, oolitic, chalk), conglomerate, breccia. Investigation of contrasts between fluvial, marine and aeolian sediments. | *(6) Pro-study on Calculating circumference, surface area and volumes of regular shapes* |
| **21st Oct** | | | *For exemplification of mathematical skills see* ***Mathematical Guidance for A level Geology****.*<br><br>*The mathematical skills identified are not exclusive to this section of the specification.* | *Use of logarithms in relation to quantities that range over several orders of magnitude (MPS7).*<br><br>*Construction and interpretation of frequency tables and diagrams, bar charts and histograms (MPS12).*<br><br>*Knowledge of the characteristics of normal and skewed distribution (MPS11)*.<br><br>*Plotting of variables from experimental or other circular data (MPS14).*<br><br>*Understanding of the terms mean, median and mode (MPS10).* | |

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| | | | | *Selection and use of a statistical test (MPS17-19).*<br><br>*Plotting of two variables from experimental or other linear data (MPS16).* | |
| *Half term* | | | | | |
| **4th Nov** | | f. Sedimentary rocks may result from the accumulation of organic material (limestone, coal) or by precipitation of solid material from solution (evaporites).<br><br>g. Sedimentary rocks exhibit differences in texture which influences porosity and permeability: grain angularity, sphericity, size, sorting, which reflects:<br>the nature of rocks from which they were derived<br>conditions of climate, weathering, erosion and deposition operating during their formation<br>post-depositional factors as sediments are formed into sedimentary rocks: diagenesis and lithification (compaction, recrystallisation, cementation, pressure solution). | Candidates should be able to describe the order of precipitation of evaporate minerals from seawater in terms of their relative solubilities – low  high. (calcite/dolomite gypsum/anhydrite  halite  potassium/magnesium salts).<br><br>Candidates should be aware of the range of texture in descriptive terms (as used on a grain size comparator):<br>• angularity – very angular to well rounded<br>• sphericity – high to low sphericity<br>• size – reference to the Wentworth scale<br>• sorting – very well to poorly sorted<br><br>*For exemplification of mathematical skills see* ***Mathematical Guidance for*** | Analysis of biogenic components in sedimentary rocks.<br><br>Investigation of the concept of 'sediment maturity'. Immature sedimentary rocks characterised by a wide range of mineral compositions and/or lithic clasts; mature sedimentary rocks with restricted mineralogies dominated by mineral species resistant to weathering and erosional processes. | Rocks for starter: Coral limestone, gypsum, conglomerate<br><br>Sedimentary graphs homework<br><br>*(7) Pro-study on manipulating algebraic equations* |

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| | | | ***A level Geology***.<br><br>*The mathematical skills identified are not exclusive to this section of the specification.* | *Understanding that y = mx + c represents a linear relationship (MPS16).* | |
| **11th Nov** | Key Idea 3: **Sedimentary processes can be understood using scientific modelling** | a. Sedimentary processes which are infrequent and/or difficult to observe (e.g. turbidity currents) can be understood and explained using scientific models.<br><br>b. The distribution of environments represented by rocks in a vertical stratigraphic column is related to the distribution of those environments laterally (Walther's Law); marine transgressions and regressions, diachronous | Application of the Hjulstrom graph.<br><br>*Determination of the slope and intercept of a linear graph*<br><br>Application of Walther's Law to extend interpretation from two-dimensional data (borehole logs, cliff sections, graphic logs) to three-dimensions. | Candidates are expected to relate vertical sequences (e.g. outcrop of borehole) with the lateral changes in facies identified in modern sedimentary environments (e.g. a delta) and understand that lithofacies are not necessarily time-dependent.<br><br>http://www.earth-science-activities.co.uk/facies%20diachronism.htm | Three online quizzes on igneous rocks<br><br>(8) *Pro-study on Data and statistical analysis: sampling methods*<br><br>Assessment on sedimentary rocks |
| **18th Nov** | Topic F2: **SURFACE AND INTERNAL PROCESSES OF THE ROCK CYCLE**<br>Key Idea 2: **The formation and alteration of igneous and metamorphic rocks result from the Earth's internal energy** | a. Internal energy: The Earth's internal geological processes result from the transfer of energy derived from radiogenic and primordial heat sources. Heat is transferred from the mantle to the surface by conduction and convection, with temperatures of rocks remaining below melting point (except locally).<br><br>b. Igneous rocks are the products of cooling of magma | Candidates should be able to interpret pressure (depth) temperature graphs and use them to calculate geothermal gradients.<br><br>*For exemplification of mathematical skills see* ***Mathematical Guidance for A level Geology***.<br><br>*The mathematical skills identified are not exclusive to this section of the specification.* | Interpretation of evidence for surface heat flow and temperature variation with depth through simple analysis of the geothermal gradient (geotherm).<br><br>*Solving of algebraic equations (MPS7).*<br><br>*Calculation of the rate of change from a graph showing a linear relationship (MPS16).*<br><br>The recognition of plutons, dykes, sills, lava flows and | Igneous Rocks workbooks<br><br>IG 1 Project work<br><br>(9) *Pro-study on Data and statistical analysis: data analysis; univariate data analysis* |

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| | | in bodies of various sizes and shapes and pyroclastic events. | | pyroclastic deposits by interpretation of maps, sections and photographs.<br>Observation and investigation of igneous rocks to deduce the cooling history:<br>□□crystal size: coarse (>3 mm), medium (1-3 mm), fine (<1 mm)<br>□□crystal shape: euhedral, subhedral, anhedral<br>□□texture: equicrystalline, porphyritic, vesicular, glassy, fragmental (tuff)<br>□□structure: pillow structure, aa/pahoehoe surfaces, columnar joints. | |
| **25th Nov** | | | Candidates need only have knowledge of the igneous rocks indicated.<br><br>Candidates should be able to identify the stated igneous rocks in hand specimen and the field. It is understood that it might not be possible to investigate the full range of rocks in the field or that this list is exclusive. | **SP8:** Production of full rock description of macro and micro features from hand specimens and/or unfamiliar field exposures of igneous rocks in order to interpret component composition, colour and textures, to identify rock type and to deduce their cooling history.<br><br>Identification in hand specimen of the following igneous rocks from their composition, texture and other diagnostic features:<br>□□Silicic: granite<br>□□Mafic: gabbro, dolerite, basalt<br>□□Ultramafic: peridotite. | IG 2 Project work<br><br>*(10) Pro-study on Data and statistical analysis: data analysis; Measures of central tendency* |
| **2nd Dec** | | | *For exemplification of mathematical skills see* | *Use of ratios, fractions and percentages (MPS5).* | IG 3 Project work |

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| | | | ***Mathematical Guidance for A level Geology***.<br><br>*The mathematical skills identified are not exclusive to this section of the specification.* | *Calculation of the circumferences, surface areas and volumes of regular shapes (MPS6).*<br><br>*Construction and interpretation of frequency tables and diagrams, bar charts and histogram.*<br><br>*Knowledge of the characteristics of normal and skewed distributions (MPS12).* | *(11) Pro-study on Data and statistical analysis: data analysis; Measures of dispersion*<br><br>Igneous rocks assessment |
| **9th Dec** | | c. Partial melting of rock at depth to form magma occurs in a number of different interplate and intraplate tectonic settings:<br>beneath divergent plate margins - partial melting of mantle rocks generates basaltic magma<br>near to convergent plate margins - partial melting of subducted oceanic lithosphere and overlying lithospheric wedge generates andesitic magma<br>in mantle plumes (hotspots) – partial melting of mantle rocks generates basaltic magma<br>in deeply buried lower continental crust during orogeny – melting and assimilation of crustal material generates granitic magma. | | Investigation of the role of rising convection cells in decompression melting.<br><br>Investigation of global distribution of mantle plumes from maps. | IG 4 Project work<br><br>*(12) Pro-study on Data and statistical analysis: data analysis; Measures of shape* |

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| **16th Dec** | | d. Volcanic hazards result from:<br>□□blast/explosion<br>□□ash fall, pyroclastic flows (nuées ardentes) and gases<br>□□lava flows<br>□□debris flows and mudflows (lahars).<br><br>e. The nature of the volcanic hazard is linked to the composition, viscosity and gas content of the magma. | Candidates are expected to have studied specific examples of the stated hazards and monitoring techniques but will not be required to recall details of these examples in an assessment.<br><br>Candidates are expected to have studied the hazards associated with explosive and effusive activity and their links to silica and gas content that affects viscosity. | Investigation, using geological data from a wide variety of volcanic monitoring techniques (including ground deformation, gravity and thermal anomalies, gas emissions and seismic activity), of the risk of volcanic hazards and the extent to which they can be managed and controlled in order to reduce risk. | *(13) Pro-study on Data and statistical analysis: data analysis; Probability* |
| *Christmas* | | | | | |
| **6th Jan** | Topic G1 : **rock forming processes**<br>Key Idea 1:**The generation and evolution of magma involves different processes** | a. Igneous rock composition at interplate and intraplate settings depends on:<br>• origin of the parent magma (mantle or crust)<br>• magma evolution: Differentiation and fractionation (continuous and discontinuous reaction series – Bowen); gravity settling to give cumulates<br>magma contamination: incorporation of rock material (xenoliths); magma mixing, during | Candidates should be able to use a scientific calculator to establish time from given decay rate equations e.g. $t = (T_{½}/\ln 2)\ \ln(N_d/N_p + 1)$.<br><br>*For exemplification of the mathematical skills associated with the decay rate equation see* ***Mathematical Guidance for A level Geology***. | Evaluation of the role of temperature, pressure and water content in determining the melting points of rocks.<br><br>Simple calculation of depth of formation of granite magma by crustal melting through interpretation of graphs showing continental geotherm and melting temperatures of wet and dry lower crustal material.<br><br>Calculation of the age of a mineral sample using the decay rate equation<br>$N = N_0 e^{-\lambda t}$<br><br>*(MPS7)* | *(14) Pro-study on Data and statistical analysis: data analysis; circular data* |

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| | | rise and emplacement, leading to change of composition and physical properties (enclaves). | | *Use of logarithms in relation to quantities that range over several orders of magnitude.*<br><br>*Interpretation of logarithmic plots.*<br><br>*Calculation of percentage error in radiometric dating results (MPS7)* | |
| | | b. The substitution of one element for another in the crystal structure of a mineral depends upon atomic radius and valency; solid solution as exemplified by olivine and plagioclase feldspar | Candidates should be able to interpret phase diagrams between solid solution end members from:<br>• Ca-rich plagioclase (Albite) to Na rich (Anorthite)<br>Mg-rich olivine (Fosterite) to Fe-rich (Fayalite). | Investigation of magma crystallisation and differentiation processes using phase diagrams (plagioclase feldspar, olivine). | |
| | | c. The formation of magma chambers under ocean ridges and rises can be interpreted from models. | Candidates should be familiar with new models of ocean ridge formation (using data from seismic tomography and de ep ocean drilling) involving<br>• symmetrical and asymmetrical spreading<br>• ocean core complexes (OCC)<br>• the | Analysis of ocean survey data to investigate current models of how oceanic ridges (particularly mid ocean ridges-MORs) are formed (e.g. RRS James Cook – 2016). | (7) Models of seafloor spreading |

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| | | | significance of serpentinite.<br><br>[https://teacheratseablog.wordpress.com/tag/science/](https://teacheratseablog.wordpress.com/tag/science/)<br><br>[https://www.cardiff.ac.uk/earth-ocean-sciences/about-us/supporting-education](https://www.cardiff.ac.uk/earth-ocean-sciences/about-us/supporting-education) | | |
| **13th Jan** | Key Idea 2:**The mineralogy and texture of metamorphic rocks are determined by the composition of the parent rock and the conditions of metamorphism** | f. Metamorphism involves mineralogical and/or textural change of pre-existing rocks in response to changes in temperature and/or pressure.<br><br>g. Contact (thermal) and regional metamorphism produce distinctive mineralogical and textural changes:<br>non-foliated in contact metamorphism<br>foliation (slaty cleavage, schistosity and gneissose banding) in regional metamorphism. | Candidates should be aware of the concept of metamorphic grade.<br><br>*For exemplification of mathematical skills see **Mathematical Guidance for A level Geology***.<br><br>*The mathematical skills identified are not exclusive to this section of the specification.*<br><br>Candidates should be aware of the metamorphic changes in chemically varied clay-rich rocks (e.g. shale) compared to those dominated by quartz and calcite (sandstones and limestone).<br><br>Candidates need only have knowledge of the metamorphic rocks indicated. | Interpretation of the following metamorphic features using simplified geological maps and photographs: contact aureoles, metamorphic foliations.<br><br>*Understanding that $y = mx + c$ represents a linear relationship (MPS16)*.<br><br>**SP10:** Production of full rock description of macro and micro features from hand specimens and/or unfamiliar field exposures of metamorphic rocks in order to interpret component composition, colour and textures, to identify rock type and to deduce the temperature and pressure conditions of their formation.<br><br>Identification in hand specimen of the following metamorphic rocks from their composition, texture and other diagnostic features: marble, metaquartzite, spotted rock, hornfels, slate, schist, gneiss. | Metamorphic Rocks Workbook<br><br>*(15) Pro-study on Data and statistical analysis: data analysis; Polar equal area "stereonets"* |

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| | | | Candidates should be able to identify the stated metamorphic rocks in hand specimen and the field. It is understood that it might not be possible to investigate the full range of rocks in the field or that this list is exclusive. | | |
| **20th Jan** | | a. Igneous and sedimentary rocks contain minerals that are stable or metastable at the temperature and pressure of their formation. Changes in temperature and/or directed stress over time lead to the growth of new minerals with different stability fields.<br><br>b. Mineralogical changes during metamorphism depend on the composition of the parent rock and the temperature/pressure field.<br><br>c. Contact and regional metamorphism of mudstone/shale lead to the growth of new minerals indicative of the type and grade of metamorphism: low to high grade metamorphism. | Analysis of simple pressure- temperature- time paths involved in contact and regional metamorphism.<br><br>Simple analysis of phase diagrams showing stability fields of selected metamorphic minerals: kyanite/sillimanite/ andalusite<br><br>**SP20: Investigation of contact metamorphism using the 'Metamorphic Aureole' simulation experiment.** | Candidates should appreciate that prograde metamorphic effects result from increases in temperature and (usually) pressure. Retrograde metamorphism (though uncommon) allows prograde mineral assemblages to revert to those more stable at less extreme temperature and pressure.<br>Detailed knowledge of metamorphic facies is not required.<br><br>Candidates are expected to use evidence from index minerals to arrange clay- rich rocks in order of their increasing grade | Convergent Plate Boundary Project work<br><br>*(16) Pro-study on Data and statistical analysis: data analysis; Bivariate data analysis; Scatter diagrams*<br><br>Mid-Year Test |

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| **27th Jan** | | d. Contact, regional and dynamic metamorphism result from different pressure/temperature conditions and produce characteristic textural changes associated with recrystallization, ductile flow and shear | Study of diagrams/photomicrographs to identify and analyse the following metamorphic textures: granoblastic; porphyroblastic; mylonitic. | | *(17) Pro-study on Data and statistical analysis: data analysis; Bivariate data analysis; Spearman's Rank Correlation Coefficient ($r_s$)* |
| **3rd Feb** | Topic F2: **SURFACE AND INTERNAL PROCESSES OF THE ROCK CYCLE**<br>Key Idea 3: **Deformation results when rocks undergo permanent strain in response to applied tectonic stresses and can be interpreted using geological maps**<br>Topic F2: **SURFACE AND INTERNAL PROCESSES OF THE ROCK CYCLE**<br>Key Idea 3: **Deformation results when rocks undergo permanent strain in response to** | a. Rock deformation can be interpreted by reference to Hooke's Law: Simple stress - strain curves showing elastic/brittle and ductile/plastic behaviour; elastic limit, permanent strain and fracture point.<br>a. The nature of rock deformation is determined by the competence of the parent rock and conditions during deformation (temperature, confining pressure, strain rate).<br><br>b. Evidence of rock deformation includes dipping beds, folding, faulting and unconformities. | Candidates should be able to draw and interpret stress-strain curves.<br>Candidates are expected to predict the effects of deformation (brittle fracture and ductile flow) on rocks of different competences.<br><br>*Candidates should be able to use trigonometry (sin, cos, and tan) in determining map or cross section parameters (e.g. true thickness, vertical thickness width of outcrop, angle of dip).* | Measurement and description of evidence obtained by sampling of rock deformation in the field (or from photographs). Use of simple calculations to establish the amount of deformation (percentage of crustal shortening).<br><br>Recognition of the differences in deformation of competent and incompetent rocks.<br><br>*Use of sin, cos and tan in physical problems. (MPS7)*<br><br>Recognition and interpretation of structural features through study of photographs, diagrams, sections, geological maps and in the field. | Structural Geology Workbook<br><br>*(18) Pro-study on Data and statistical analysis: data analysis; Chi-squared ($X^2$) test* |

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| | **applied tectonic stresses and can be interpreted using geological maps** | | *Candidates should be aware of random, systematic and stratified sampling techniques relevant to an investigation. The sampling skills identified are not exclusive to this section of the specification (MPS8).* | | |

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| **10th Feb** | Topic G2: **ROCK DEFORMATION**<br>Key Idea 1: **Geological structures are formed when rock material undergoes deformation** | c. Dipping beds are the results of tectonic/gravity induced stresses, caused by plate movement, that distort beds from the horizontal.<br><br>d. Folding results when compressional stresses exceed the yield strength of a rock.<br>b. Fold characteristics; amplitude, wavelength, interlimb angle (open, tight, isoclinal), axial plane attitude (upright, inclined, overturned, recumbent), plunging folds.<br><br>e. Faulting results when applied compressional, tensional or shear tectonic stresses, caused by plate movement, exceed the fracture strength of a rock.<br>c. Fault type is determined by the orientation of the principal stresses. Technical terms to describe fault elements: slickensides, fault gouge, fault breccia. | Candidates should be aware that fold symmetry is a function of the length of the fold limbs rather than the dip of opposing limbs. Symmetric folds have limbs of equal length; asymmetric folds have limbs of different lengths.<br><br>Candidates are not required to have knowledge of other fault elements.<br><br>Candidates will be expected to interpret the effect of dip-slip or strike- slip relative movement, but not oblique fault movement. | Recognition of fold elements: limb, hinge, axis, axial plane trace, fold symmetry (as a function of limb length), antiform, synform, anticline, syncline.<br><br>Identification of plunge direction (of axis) and axial planar cleavage.<br><br>*Represent limb dip and strike data on a polar equal area stereonet (polar plots only not projections or great circles) (MPS15).*<br><br>*Plotting of variables from experimental or other circular data.*<br><br>Recognition of fault characteristics:<br>dip-slip: normal, reverse, thrust; throw - amount, relative movement of footwall/hanging wall<br>strike-slip: left/ sinistral, right/dextral | *(19) Pro-study on Data and statistical analysis: data analysis; Mann-Whitney U-test* |

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| | | f. Unconformities represent a hiatus in the geological record resulting from a combination of Earth movements, erosion and sea level changes. | | fault displacement (= net slip).<br>Analysis of the relationship between fault type (normal, reverse/thrust, strike-slip) and the orientation of the principal stress components ($\sigma$ max, $\sigma$ int, $\sigma$ min).<br><br>Recognition of unconformities and their use in relative dating. | |

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| *Half term* | | | | | |
| **24th Feb** | | g. The nature of outcrop patterns formed by the intersection of geological structures with a topographic surface are displayed on geological maps. | | Use of geological maps, block diagrams, boreholes, cross-sections and photographs to interpret the geology of an area.<br><br>Construction of geological cross-sections from simplified geological maps.<br><br>Ordering the geological sequence of events in an area from the study of a simplified geological map and/or section. | *(20) Pro-study on Data and statistical analysis: data analysis; Multivariate data analysis;Triangular plots* |
| **3rd Mar** | | | | | *Pro-study 2002 cross section* |
| **10th Mar** | | d. Structural reactivation: earlier-formed faults can be reactivated during later tectonism; folds may be refolded. Structural inversion: reactivation of normal faults in compression or reverse faults/thrusts in extension.<br><br>e. The nature of outcrop patterns formed by the intersection of geological structures with a topographic surface are displayed on geological maps. | *For exemplification of mathematical skills see* ***Mathematical Guidance for A level Geology***.<br><br>*The mathematical skills identified are not exclusive to this section of the specification.* | Recognition of evidence for fault reactivation on geological maps, cross- sections, diagrams and photographs.<br><br>Calculations involving measurements of:<br>• true bed thickness<br>• vertical bed thickness<br>• width of outcrop<br>• angle of dip. | *Pro-study 2003 cross section* |

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| | | | | *Use of sin, cos and tan in physical problems (MPS7).* | |
| **17th Mar** | Topic F3: **TIME AND CHANGE**<br>Key Idea 1: **Study of present day processes and organisms enables understanding of changes in the geological past** | a. Much of the rock record can be interpreted in terms of geological processes that are operating today by applying the Principle of Uniformitarianism: the present is the key to the past.<br><br>b. The study of modern environments enables an interpretation of the sedimentary rock record within the rock cycle model.<br><br>c. The basic unit of sedimentary geology is the *facies* which reflects the depositional environment: lithofacies, biofacies. | Candidates should be able to apply the Principle of Uniformitarianism to evidence of rock cycle processes through Deep Time. A simple understanding of the contributions made by James Hutton (unconformity, Deep Time) and William Smith (principle of faunal succession, first geological map).<br><br>Candidates should be aware that facies relates to the sum total of all the characteristics of a rock (composition, texture, fossil content) of a given age that change laterally. Lithofacies: a mappable unit based on petrological characters (e.g. texture and mineralogy) Biofacies: a mappable unit based on fossil content. | Investigation of the development of *uniformitarianism* and the *rock cycle model* over time and the contributions of James Hutton and William Smith. | Palaeontology Workbook<br><br>Uniformitarianism Project work<br>*Pro-study 2004 cross section* |
| **24th Mar** | | d. Fossils are evidence of former life preserved in rocks. They provide information on the nature of ancient organisms and palaeoenvironmental conditions.<br><br>e. Fossil morphology is used to interpret function/mode of life:<br>bivalves (burrowers/non burrowers) | Candidates are only required to have knowledge of those morphological features stated that are used to identify the group. | Appreciation of the basic distinctions between the following fossil groups based on their hard parts:<br>**brachiopods (marine)**: shell shape and symmetry, pedicle and brachial valves, foramen, hinge line, muscle scars<br>**bivalves (marine/freshwater)**: shape and symmetry of valves, number and size of muscle scars, hinge line, teeth and | Fossil Project work 1<br>*Pro-study 2005 cross section* |

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| | | | | sockets, gape, pallial line and sinus, umbones | |
| **31st Mar** | | c. Fossils are used in relative dating.<br><br>d. The factors contributing to good zone fossils for relative dating/correlation are: wide and plentiful distribution, ready preservation, rapid evolutionary change, a high degree of facies independence, easy identification of index fossils.<br>• the utility of cephalopods as zone fossils assessed in relation to the above factors. | | • **cephalopods (marine)**: suture line, coiled and chambered shell<br>• **corals (marine)**: colonial, solitary, septa | Fossil Project work 2<br>*Pro-study 2006 cross section* |
| Easter | | | | | |
| **22nd Apr** | | e. Fossil morphology is used to interpret function/mode of life:<br>• trilobites (benthonic/pelagic).<br><br>d. The factors contributing to good zone fossils for relative dating/correlation are: wide and plentiful distribution, ready preservation, rapid evolutionary change, a high degree of facies independence, easy identification of index fossils.<br>• the utility of graptolites as zone fossils assessed in relation to the above factors. | | • **trilobites (marine)**: cephalon, glabella, genal spines, eyes, thorax, number of thoracic segments, pygidium<br>• **graptolites (marine)**: stipes, thecae | Fossil Project work 3<br>*Pro-study 2007 cross section* |
| **28th April** | | | | • **plants (terrestrial)**: leaf, stem, root<br>• **trace fossils** (tracks and trails, burrows, coprolites). | Fossil Project work 4<br>*Pro-study 2008 cross section* |

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| | | | | **SP16:** Application of classification systems using distinguishing characteristics to identify unknown fossils.<br><br>**SP17:** Production of scaled, annotated scientific drawings of fossils, using a light microscope, or hand lens observation. | |
| **5th May** | | f. Preservation can give rise to a wide range of fossil materials: actual remains, hard parts, petrification by mineral replacement (calcification, silicification, pyritisation), carbonisation, moulds/casts.<br><br>g. Fossils accumulations may be preserved without appreciable transportation (life assemblages) or preserved after transportation (death assemblages), or as derived fossils re-deposited in later sediment.<br><br>h. The fossil record is:<br>□□biased, in favour of marine organisms, with body parts resistant to decay, that lived in low energy environments, and suffered rapid burial<br>□□incomplete, as natural processes can distort or destroy fossil evidence (predation, scavenging, diagenesis, bacterial decay, weathering, erosion, metamorphism) | Candidates should be able to determine transport history based on the degree of fragmentation, sorting or alignment of specimens within a fossil assemblage.<br><br>Candidates should be aware of the importance and limitations of a *Lagerstätte* in providing exceptional preservation e.g. Ediacaran (Precambrian), Burgess Shale (Cambrian), Wenlock Series (Silurian), Solnhofen (Jurassic). | Analysis of modern and fossil assemblages to interpret the degree of transportation prior to burial. | Exceptional preservation<br>Project work<br>*Pro-study 2009 cross section* |

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| *Transfer Exams, half term, WEX week* | | | | | |
| **9th June** | Topic F3: **TIME AND CHANGE**<br>Key Idea 2:<br>**Geological events can be placed in relative and absolute time scales** | a. Geological events can be placed in relative time scales using criteria of relative age: evolutionary change in fossils, superposition of strata, unconformities, cross-cutting relationships, included fragments, 'way-up' criteria.<br><br>b. Some rocks and minerals can be dated radiometrically to give an absolute age. This involves radioactive decay and the principles of radiometric dating; radioactive series and radioactive half-life; radiometric dating as exemplified by Potassium – Argon (40K– 40Ar), Samarium – Neodymium (147Sm – 143Nd). | Candidates will need to know that differences between the K – Ar and Sm – Nd methods and understand the principle of using the gradient of an isochron to establish relative age in the latter. Candidates will not be expected to plot isochrones or calculate age from isochrons but simply interpret relative age. | Interpretation of age relations of rocks and rock sequences using maps, cross-sections and in the field.<br><br>Simple use of the principles of radiometric dating (decay rates and the half-life concept) to calculate the absolute age of a sample.<br><br>Evaluation of the assumptions, accuracy and limitations inherent in the radiometric dating method. | *Pro-study 2010 cross section*<br><br>Transfer Exam |
| **16th June** | | e. The geological column provides a means of:<br>□□placing geological events in their correct time sequence<br>□□defining the absolute age of some events.<br><br>f. The rock record indicates changing conditions and rates of processes with long periods of slow change interrupted by | Candidates need to be aware of the classification and relative order of the geological column (based on the International Chronostratigraphic chart) – eons, eras, periods.<br><br>Candidates should be aware that the Precambrian predates the Phanerozoic era, but knowledge of subdivisions of the Precambrian is not required. | Interpretation of the ages of geological events using the geological column. | Mass Extinction Project work<br>*Pro-study 2011 cross section* |

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| | | sudden catastrophism causing mass extinctions through geological time. | | | |
| **23rd June** | Topic G3: **PAST LIFE AND PAST CLIMATES**<br>Key Idea 1: **Fossils provide evidence for the increasing diversity of life through geological time** | a. The fossil record provides evidence of changes in floras and faunas through geological time and the development of higher life forms:<br>• Precambrian life: life possibly evolved early in Earth history (3.8 billion years ago). The Ediacaran fauna represents the oldest diverse set of multicellular, soft bodied organisms (565 Ma)<br>• The Cambrian Explosion: the development of mineralised skeletons led to a wide variety of advanced marine invertebrates by the early Cambrian<br>Life in the ocean diversified in stages identified by separate fauna: a basic understanding of the difference between Cambrian, Palaeozoic and modern faunas | Candidates should be familiar with the use of cladograms in showing the relationships amongst organisms and in the development of evolutionary trees.<br><br>Candidates should be able to evaluate a range of hypotheses (environmental, developmental and ecological) that have been proposed for the sudden faunal diversification at the Precambrian-Cambrian boundary.<br><br>http://www.nature.com/news/ what-sparked-the-cambrian- explosion-1.19379<br><br>Candidates will be expected to interpret modes of life from an analysis of vertebrate morphologies including: size, shape, dentition (carnivore v herbivore), pelvis, vertebrae, limbs, ornamentation (horns, plates, feathers). | **SP7:** Use of photomicrographs to identify minerals and rock textures of sedimentary rocks in order to identify rock types and to deduce their environment of deposition.<br><br>**SP9:** Use of photomicrographs to identify minerals and rock textures of igneous rocks to identify rock type and to deduce their cooling history.<br><br>**SP11:** Use of photomicrographs to identify minerals and rock textures of metamorphic rocks to identify rock type and to deduce the temperature and pressure conditions of their formation.<br><br>Interpretation of evolutionary diagrams.<br><br>Analysis of the possible causes of faunal diversification at the Precambrian-Cambrian boundary.<br><br>Interpretation of simple diversity curves (Sepkoski's curves). | *Pro-study 2012 cross section* |

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| **30th June** | | The Phanerozoic was marked by the migration of organisms onto the land during the Palaeozoic. Vertebrate development of amphibians from fish, reptiles from amphibians and mammals and birds from reptiles. Colonisation of the land by plants. | Candidates should be aware of fossil evidence in vertebrate development (as exemplified by *Ichthyostega*, *Archaeopteryx*). | Analysis of the morphology of fossil vertebrates (including dinosaurs) to interpret function/mode of life. | *Pro-study 2013 cross section* |
| **7th July** | | c. Mass extinctions are exemplified by the end-Permian (P-T) and Cretaceous-Paleogene (K-Pg) boundary events.<br><br>d. There are alternative interpretations of evolutionary patterns based on the fossil record. Gradual change (gradualism) vs stability interrupted by sudden change (punctuated equilibrium). | | Evaluation of alternative interpretations of evolutionary patterns.<br><br>Field trips to Stone Farm Rocks/RSPB Pulborough/ Sussex coast before and after the summer<br><br>**SP12:** Location of geological features onto a base map.<br><br>**SP13:** Identification of the location of geological features in the field using six figure grid references on maps.<br><br>**SP14:** Production of scaled, annotated field sketches at unfamiliar field exposures to record data relevant to an investigation.<br><br>**SP15:** Measurement of dip | Mass Extinction Project work<br>*Pro-study 2014 cross section* |

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| | | | | and strike elements: dip angle, dip and strike directions of planar surfaces, including valid sampling, relevant to an investigation. | |