English International School
Moscow

# Year 13 Yearly overview 2022-2023

| | Autumn Term | Spring Term | Summer Term |
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| **English** | Theme: Romantic poetry and unseen poetry | | |
| **Maths** | Theme: Mechanics<br><br>Skills: use horizontal and vertical equations of motion to solve problems on the motion of projectiles, including finding the magnitude and direction of the velocity at a given time or position, the range on a horizontal plane and the greatest height reached. Use the principle that if a rigid body is in equilibrium under the action of coplanar forces, then the vector sum of the forces is zero and the sum of the moments of the forces about any point is zero, and the converse of this. Use conservation of linear momentum and/or Newton's experimental law to solve problems that may be modelled as the direct or oblique impact of two smooth spheres, or the direct or oblique impact of a smooth sphere with a fixed surface. | Theme: Statistics<br><br>Skills: Understand and use the relationship between the probability density function (PDF) and the cumulative distribution function (CDF), and use either to evaluate probabilities or percentiles. Formulate hypotheses and apply a hypothesis test concerning the population mean using a small sample drawn from a normal population of unknown variance, using a t-test. Understand the idea of a non-parametric test and appreciate situations in which such a test might be useful. | Theme: Statistics<br><br>Skills: Use formulae for the mean and variance of a discrete random variable in terms of its PGF, and use these formulae to calculate the mean and variance of a given probability distribution. Use the result that the PGF of the sum of independent random variables is the product of the PGFs of those random variables.<br><br>Theme: Exam Preparation |

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| **Biology** | **Topic 5: Energy flow, ecosystems and the environment**<br><br>5.1 understand the overall reaction of photosynthesis as requiring energy from light to split apart the strong bonds in water molecules, storing the hydrogen in a fuel (glucose) by combining it with carbon dioxide and releasing oxygen into the atmosphere<br>5.2 understand how photophosphorylation of ADP requires energy and that hydrolysis of ATP provides an immediatesupply of energy for biological processes<br>5.3 understand the light-dependent reactions of photosynthesis, including how light energy is trapped byexciting electrons in chlorophyll and the role of these electrons in generating ATP, reducing NADP in cyclic andnon-cyclic photophosphorylation and producing oxygen through photolysis of water<br>5.4 understand the light-independent reactions as reduction of carbon dioxide using the products of the light-dependent | **Topic 7 – Respiration, Muscles and the InternalEnvironment**<br><br>7.1 (i)understand the overall reaction of aerobic respiration as splitting of the respiratory substrate to release carbon dioxide as a waste product and reunitinghydrogen with atmospheric oxygen with the release of large amounts of energy<br>(i) understand that respiration is a many-stepped process, with each stepcontrolled and catalysed by a specific intracellular enzyme<br>*Names of specific enzymes are not required.*<br><br>7.2 understand the roles of glycolysis in aerobic and anaerobic respiration, including the | 8.11 understand how phytochrome, auxin (IAA) and gibberellins bring about responses inplants, including their effects on transcription<br><br>8.12 **CORE PRACTICAL 18**<br>**Investigate the production of amylase in germinating cereal grains.**<br><br>8.13 understand how coordination in animals is brought about through nervous andhormonal control<br><br>8.14 know the location and main functions of the cerebral hemispheres, hypothalamus, pituitary gland, cerebellum and medulla oblongata of the human brain<br>**Topic 8 – Coordination, Response and Gene Technology** |

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| | reactions (carbon fixation in the Calvincycle, the role of GP, GALP, RuBP and RUBISCO) and know that the products are simple sugars that are used by plants, animals and other organisms in respiration and the synthesis of new biological molecules(polysaccharides, amino acids, proteins, lipids andnucleic acids)<br>5.5 understand the structure of chloroplasts in relation totheir role in photosynthesis<br>5.6 understand what is meant by the terms absorptionspectrum and action spectrum<br>5.7 understand that chloroplast pigments can be separated using chromatography and the pigments identified usingRf values<br>5.9 understand the relationship between gross primaryproductivity (GPP), net primary productivity (NPP) andplant respiration (R) be able to calculate net primary productivity | phosphorylation of hexoses, the production of ATP by substrate level phosphorylation, reduced coenzyme, pyruvate and lactate<br>*Details of intermediate stages and compounds are not required.*<br><br>7.3 understand the role of the link reaction and the Krebs cycle in the complete oxidation of glucose and formation of carbon dioxide ($CO_2$) by decarboxylation, ATP by substrate level phosphorylation, reduced NAD and reduced FAD by dehydrogenation (names of other compounds are not required) and that these stepstake place in mitochondria, unlike glycolysis which occurs in the cytoplasm<br><br>7.4 understand how ATP is synthesised by oxidative phosphorylation associated with the electron transport chain in mitochondria, including the role of chemiosmosis and ATPsynthase | 8.15 understand how magnetic resonance imaging (MRI), functional magnetic resonance imaging (fMRI), positron emission tomography (PET) and computed tomography (CT) are used in medical diagnosis and the investigation of brain structure and function<br><br>8.16 understand how imbalances in certain naturally occurring brain chemicals can contribute to ill health, including dopamine in Parkinson's disease and serotonin indepression, and to the development of new drugs<br><br>8.17 know how drugs can be produced using genetically modified organisms (plants, animals and microorganisms)<br><br>8.18 understand how recombinant DNA can be produced, including the roles of restrictionendonucleases and DNA ligase |

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| | 5.10 know how to calculate the efficiency of biomass andenergy transfers between trophic levels<br>5.11 understand what is meant by the terms population,community, habitat and ecosystem<br>5.12 understand that the numbers and distribution of organisms in a habitat are controlled by biotic and<br>abiotic factors<br>5.13 understand how the concept of niche accounts for thedistribution and abundance of organisms in a habitat<br>5.15 understand the stages of succession from colonisation tothe formation of a climax community<br>5.16 understand the different types of evidence for climate change and its causes, including records of carbon dioxide levels, temperature records, pollen in peat bogs<br>and dendrochronology, recognising correlations andcausal relationships<br>5.17 understand the causes of anthropogenic climate change, | 7.5 understand what happens to lactate after a period of anaerobic respiration in animals<br><br>7.6 understand what is meant by the term *respiratory quotient* (*RQ*)<br><br>**7.7 CORE PRACTICAL 15**<br>**Use an artificial hydrogen carrier (redox indicator) to investigate respiration in yeast**<br><br>**7.8 CORE PRACTICAL 16**<br>**Use a simple respirometer to determine the rate of respiration and RQ of asuitable material (such as germinating seeds or small invertebrates).**<br><br>7.9 know the way in which muscles, tendons, the skeleton and ligaments interact toenable movement, including antagonistic muscle pairs, extensors and flexors<br><br>7.10 know the structure of a mammalian skeletal muscle fibre | 8.19 understand how recombinant DNA can be inserted into other cells<br><br>8.20 know how microarrays can be used to identify active genes<br><br>8.21 understand what is meant by the term *bioinformatics*<br><br>8.22 understand the risks and benefits associated with the use of genetically modifiedorganisms<br><br>Revision for Exams<br>Practicals |

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| | including the role of greenhouse gases in thegreenhouse effect<br>5.18 understand how knowledge of the carbon cycle can be<br>applied to methods to reduce atmospheric levels ofcarbon dioxide<br>5.19 understand that data can be extrapolated to make predictions and that these are used in models of futureclimate change and understand that models for climate change havelimitations<br>5.20 understand the effects of climate change (changingrainfall patterns and changes in seasonal cycles) on plants and animals (distribution of species, developmentand lifecycles)<br>5.21 understand the effect of temperature on the rate of enzyme activity and its impact on plants, animals and<br>microorganisms, to include Q10<br>5.23 understand how evolution (a change in allele frequency)<br>can come about through gene mutation and naturalselection<br>5.24 understand how isolation reduces gene flow between populations, | understand the structural and physiological differences between fast and slowtwitch muscle fibres<br><br>7.11 understand the process of contraction of skeletal muscle in terms of the sliding filament theory, including the role of actin, myosin, troponin, tropomyosin, calciumions ($Ca^{2+}$), ATP and ATPase<br><br>7.12 know the myogenic nature of cardiac muscle<br>understand how the normal electrical activity of the heart coordinates the heartbeat, including the roles of the sinoatrial node (SAN), the atrioventricularnode (AVN), the bundle of His and the Purkyne fibres<br>understand how the use of electrocardiograms (ECGs) can aid in the diagnosisof abnormal heart rhythms | |

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| | leading to allopatric or sympatric speciation<br>5.25 understand the way in which scientific conclusions about controversial issues, such as what actions should be taken to reduce climate change, or the degree to which humans are affecting climate change, can sometimes<br>depend on who is reaching the conclusions<br>5.26 understand how reforestation and the use of sustainableresources, including biofuels, are examples of the effective management of the conflict between humanneeds and conservation<br><br>**<u>Topic 6: Microbiology, immunity and forensics</u>**<br><br>6.1 understand the principles and techniques involved inculturing microorganisms, using aseptic technique<br>6.2 understand the different methods of measuring the | 7.13 be able to calculate cardiac output<br>understand how variations in ventilation and cardiac output enable rapid delivery of oxygen to tissues and the removal of carbon dioxide from them, including how the heart rate and ventilation rate are controlled and the roles ofthe cardiovascular control centre and the ventilation centre in the medulla oblongata<br><br>7.14 understand the role of adrenaline in the fight or flight response<br><br>**7.15 CORE PRACTICAL 17**<br>**Investigate the effects of exercise on tidal volume, breathing rate, respiratory minute ventilation, and oxygen consumption using data fromspirometer traces.**<br><br>7.16 understand what is meant by the terms *negative feedback* and | |

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| | growth of microorganisms, as illustrated by cell counts,dilution plating, mass and optical methods (turbidity)<br>6.3 understand the different phases of a bacterial growth curve (lag phase, exponential phase, stationary phaseand death phase) and be able to calculate exponential<br>growth rate constants<br>6.5 be able to compare the structure of bacteria and viruses (nucleic acid, capsid structure and envelope) with reference to Ebola virus, tobacco mosaic virus (TMV), human immunodeficiency virus (HIV) and lambdaphage (λ phage) and understand what is meant by the terms lytic andlatency<br>6.6 understand how *Mycobacterium tuberculosis* and human immunodeficiency virus (HIV) infect human cells, causing symptoms that may result in death<br>6.7 know the major routes pathogens may take when entering the body and | *positive feedbackcontrol*<br>understand the principle of negative feedback in maintaining systems withinnarrow limits<br>7.17 understand what is meant by the term *homeostasis* and its importance in maintaining the body in a state of dynamic equilibrium during exercise, including therole of the hypothalamus in thermoregulation<br>7.18 know the gross and microscopic structure of the mammalian kidney<br>7.19 understand how urea is produced in the liver from excess amino acids<br>(*details of the ornithine cycle are not required*) and how it is removed from thebloodstream by ultrafiltration<br>7.20 understand how solutes are selectively reabsorbed in the proximal tubule and howthe loop of | |

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| | understand the role of barriers in protecting the body from infection, including skin, stomach acid, and gut andskin flora<br>6.8 understand the non-specific responses of the body to infection, including inflammation, lysozyme action,<br>interferon and phagocytosis<br>6.9 understand the roles of antigens and antibodies in the<br>body's immune response including the involvement of plasma cells, macrophages and antigen-presenting cells<br>6.10 understand the differences between the roles of B cells (B memory and B effector cells), and T cells (T helper, Tkiller and T memory cells) in the host's immune<br>response<br>6.11 understand how individuals may develop immunity(natural, artificial, active and passive)<br>6.12 understand how the theory of an 'evolutionary race'between pathogens | Henle acts as a countercurrent multiplier to increase the reabsorption of water<br><br>7.21 understand how the pituitary gland and osmoreceptors in the hypothalamus, combined with the action of antidiuretic hormone (ADH), bring about negativefeedback control of mammalian plasma concentration and blood volume<br><br>7.22 understand how genes can be switched on and off by DNA transcription factors, including the role of peptide hormones acting extracellularly and steroid hormones acting intracellularly<br><br>**Topic 8 – Coordination, Response and Gene Technology**<br><br>8.1 know the structure and function of sensory, relay and motor neurons, includingSchwann cells and myelination | |

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| | and their hosts is supported byevasion mechanisms shown by pathogens<br>6.13 understand the difference between bacteriostatic andbactericidal antibiotics<br>6.15 know how an understanding of the contributory causesof hospital-acquired infections has led to codes of practice regarding antibiotic prescription and hospital practice that relate to infection prevention and control<br>6.16 know the role of microorganisms in the decomposition oforganic matter and the recycling of carbon<br>6.17 know how DNA can be amplified using the polymerasechain reaction (PCR)<br>6.18 know how gel electrophoresis can be used to separateDNA fragments of different length<br>6.19 understand how DNA profiling is used for identification and determining genetic relationships between organisms (plants and animals)<br>6.20 understand how to determine the time of death of amammal by examining the | 8.2 understand how the nervous system of organisms can cause effectors to respond toa stimulus<br>8.3 know the structure and function of a spinal reflex arc, including grey matter andwhite matter of the spinal cord<br>8.4 understand how a nerve impulse (action potential) is conducted along an axon,including changes in membrane permeability to sodium and potassium ions<br>8.5 understand the role of myelination in saltatory conduction<br>8.6 know the structure and function of synapses in nerve impulse transmission, including the role of neurotransmitters and acetylcholine<br>understand how the pupil dilates and contracts | |

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| | extent of decomposition,stage of succession, forensic entomology, body temperature and degree of muscle contraction | 8.7 understand how the effects of drugs can be caused by their influence on nerve impulse transmission, illustrated by nicotine, lidocaine and cobra venom alpha toxin,the use of L-DOPA in the treatment of Parkinson's disease and the action of MDMA (ecstasy)<br><br>8.8 understand how the nervous systems of organisms can detect stimuli with referenceto rods in the retina of mammals, the roles of rhodopsin, opsin, retinal, sodium ions,cation channels and hyperpolarisation of rod cells in forming action potentials in the optic neurones<br><br>8.9 understand what is meant by the term *habituation*<br><br>8.10 know that the mammalian nervous system consists of the central and peripheralnervous systems | |

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| **Chemistry** | Chemistry:<br>1. Kinetics<br>Measuring the rate of reaction<br>Rate equations<br>Determining order of reaction<br>Activation energy and catalysts<br>2. Entropy and lattice energy<br>Introducing entropy<br>Calculating total entropy<br>Entropy change<br>Experimental and theoretical lattice energy<br>Enthalpy change of solution and hydration<br>3. Acid-base equilibria:<br>PH scale, ionic product of water<br>Acid-base titrations<br>Indicators<br>Buffer solutions<br>4. Organic chemistry and instrumental techniques<br>Chiral compounds and optical activity<br>Aldehydes and ketones<br>Carboxylic acids<br>Acyl chlorides and esters, polyesters<br>Chromatography and nuclear magnetic resonance | Chemistry:<br>1. Redox equilibria<br>Standard electrode potential<br>Electrochemical cells<br>Thermodynamic feasibility<br>Fuel cells<br>Redox titrations<br>2. Transition metals<br>Transition metals and lectronic configurations<br>Ligands and complexes<br>Common shapes of complexes<br>Transition metals reactions<br>Catalysts<br>3. Organic Chemistry<br>Arenes: reactions of benzene<br>Electrophilic substitution mechanisms<br>Phenol<br>4. Organic nitrogen compounds<br>Amines<br>Amides<br>Amino acids and proteins<br>Chemical reactions of organic nitrogen compounds | Chemistry:<br>1. Organic synthesis<br>Organic analysis and organic synthesis<br>Hazards, risks and control measures<br>Practical techniques in organic Chemistry<br>2. Exam practice |

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| **Physics** | <u>Further Mechanics</u><br>-understand how to use the equation impulse = FΔt =Δp (Newton's second law of motion)<br>- Investigate the relationship between the force exerted on an object and its change of momentum<br>-understand how to apply conservation of linear momentum to problems in two dimensions- Use -ICT to analyse collisions between small spheres,<br>e.g. ball bearings on a table top understand how to determine whether a collision is elastic or inelastic<br>-be able to derive and use the equation Ek  2m for the kinetic energy of a non-<br>relativistic particle<br>-be able to express angular displacement in radians and in degrees, and convert between these units<br>-understand what is meant by angular velocity and be able to use the equations.<br><u>Electric and Magnetic Field</u><br>-understand that an electric field (force field) is defined as a region | <u>Thermodynamics</u><br>- be able to use the equations Δ*E* = *mc*Δ and Δ*E* = *L*Δ*m*<br>-understand the concept of internal energy as the random distribution of potential and kinetic energy amongst molecules<br>-understand the concept of absolute zero and how the average kinetic energy of molecules is related to the absolute temperature<br>-be able to use the equation pV = NkT for an ideal gas<br><u>Nuclear Decay</u><br>-understand the concept of nuclear binding energy and be able to use the equation<br>ΔE = c2Δm in calculations of nuclear mass (including mass deficit) and energy<br>-use the atomic mass unit (u) to express small masses and convert between this and SI units<br>-understand the processes of nuclear fusion and fission with reference to the binding energy per nucleon curve<br>-understand the mechanism of nuclear fusion and the need for very | <u>Practical Skills in Physics II</u><br><u>Plan an experiment</u><br>• identify the most appropriate apparatus, giving details. These may include the range and resolution of instruments and/or relevant dimensions of apparatus (e.g. the length of string usedfor a pendulum)<br>• discuss calibration of instruments, e.g. whether a meter reads zero before measurements are made<br>• describe how to measure relevant variables using the mostappropriate instrument(s) and techniques<br>• identify and state how to control all other relevant variables to |

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| | where a charged particle -experiences a force<br>-understand that electric field strength is defined as E = F and be able to use<br>-be able to use the equation E =<br>for the electric field due to a point charge<br>-know and understand the relation between electric field and electric potential<br>-be able to use the equation E = V for an electric field between parallel plate<br><u>Nuclear and Particle Physics</u><br>-understand what is meant by nucleon number (mass number) and proton number (atomic number)<br>-understand how large-angle alpha particle scattering gives evidence for a nuclear model of the atom and how our understanding of atomic structure has changed over time<br>-understand that electrons are released in the process of thermionic emission and how they can be accelerated by electric and magnetic fields<br>-understand the role of electric and magnetic fields in particle accelerators (linac and cyclotron) and detectors | high densities of matter and very high temperatures to bring about and maintain nuclear fusion<br>-understand that there is background radiation and how to take appropriate account of it in calculations<br>-understand the relationships between the nature, penetration, ionising ability and range in different materials of nuclear radiations (alpha, beta and gamma)<br>-be able to write and interpret nuclear equations given the relevant particle symbols<br><u>Oscillations</u><br>-understand that the condition for simple harmonic motion is F = kx, and hence understand how to --identify situations in which simple harmonic motion will occur<br>-be able to use equations for a simple harmonic oscillator<br>Astrophysics and Cosmology<br>-understand that a gravitational field (force field) is defined as a region where a mass experiences a force<br>-understand that gravitational field strength is defined as g = F and be | make it a fair test<br><u>Implementation and measurements</u><br>• comment on how the experiment could have been improved, possibly by using additional apparatus (e.g. to reduce errors) – examples may include using set squares to measure the diameter of a cylinder and using a marker for timing oscillations<br>• comment on the number of readings taken<br>• comment on the range of measurements taken<br>• comment on significant figures – students may be required toidentify and/or round up any incorrect figures in a table of results<br>• identify and/or amend units that are incorrect |

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| | (general principles of ionisation and deflection only)<br>-be able to derive and use the equation r ∝ p for a charged particle<br>-be able to apply conservation of charge, energy and momentum to interactions between particles and interpret particle tracks<br>-understand why high energies are required to investigate the structure of nucleons<br>-be able to use the equation ΔE = c2Δm in situations involving the creation and annihilation of matter and antimatter particles | -be able to use the equation F = Gm1m2 (Newton's law of universal gravitation)<br>r 2<br>-be able to derive and use the equation g = Gm for the gravitational field due to a<br>r 2<br>-be able to use the equation V = −Gm for a radial gravitational field<br>r<br>grav<br>-be able to compare electric fields with gravitational fields<br>-be able to apply Newton's laws of motion and universal gravitation to orbital motion | <u>Analyse data</u><br>• perform calculations, using the correct number of significantfigures<br>• plot results on a graph using an appropriate scale and units –the graph could be logarithmic in nature<br>• use the correct units throughout<br>• comment on the trend/pattern obtained<br>• determine the relationship between two variables or determinea constant with the aid of the graph, e.g. by determining the gradient using a large triangle |

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| | | | • use the terms precision, accuracy and sensitivity appropriately<br>• suggest realistic modifications to reduce errors<br>• suggest realistic modifications to improve the experiment |
| **Geography** | **1. Coastal Environment**<br>Demonstrate an understanding of:<br>Coastal processes<br>Wave generation and characteristics: fetch, energy, refraction, breaking waves, high and low energy waves, swash, and backwash and marine erosion:<br><br>**Characteristics and formation of coastal landforms**<br>Demonstrate an understanding of:<br>Erosional landforms: cliffs and wave-cut platforms, caves, arches and stacks. Depositional landforms: beaches in cross section (profile) and plan, swash and drift aligned beaches, | **1. Tropical environments**<br>Demonstrate an understanding of:<br>Tropical climates Global distribution and climatic characteristics of humid tropical and seasonally humid tropical environments: the roles of the intertropical convergence zone (ITCZ), subtropical anticyclones, and monsoons.<br><br>**Landforms of tropical environments**<br>Demonstrate an understanding of:<br>The formation of characteristic landforms: granite: (deep weathering profiles) tors, inselbergs, and bornhardts limestone: tropical | **1. Geographical Skills**<br>Through studying the syllabus content, candidates will be expected to have used and developed the following geographical skills:<br>• An understanding of the nature and use of different types of geographical information, both quantitative and qualitative, and understanding of their limitations. • An ability to use and interpret a variety of geographical information in order to identify, describe and explain geographical trends and patterns. |

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| | simple and compound spits, tombolos, offshore bars.<br><br>**Coral reefs Characteristics,**<br>Demonstrate an understanding of: distribution and formation of fringing reefs, barrier reefs, and atolls. Conditions required for coral growth. Threats to coral reefs<br><br>**Sustainable management of coasts**<br>Case study: candidates must study some of the problems of sustainably managing a stretch or stretches of coastline, and evaluate attempted solutions (including hard engineering and soft engineering).<br><br>**2. Production, location and change**<br>Demonstrate an understanding of:<br>• Agricultural systems and food production.<br>• The concept of an agricultural system with inputs, throughputs, subsystems and output.<br>• The management of agricultural change. | karst (cone karst, tower karst, and cockpit karst).<br><br>**Humid tropical (rainforest)**<br>Demonstrate an understanding of: Ecosystems and seasonally humid tropical (savanna) ecosystems Plant communities: development of climax, subclimax and plagioclimax. Vegetation characteristics. Nutrient cycling: diagrams, soil fertility, energy flows, and trophic levels.<br><br>**Sustainable management of tropical environments**<br>Case study: candidates must study some of the threats to (exploitation) and problems of sustainable management of areas within either the rainforest ecosystem or the savanna ecosystem and evaluate attempted solutions.<br><br>2. **Environmental management**<br>Demonstrate an understanding of:<br>• Sustainable energy supplies Renewable and non-renewable energy resources. | • An ability to interpret and evaluate information and produce reasoned conclusions.<br>**2. Revision**<br><br>**3. Final Exams** |

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| | Case study: candidates must study the need for, and some of the difficulties in, the management of agricultural change in one country, at the local scale | • The management of energy supply.<br><br>Case study: candidates must study one country's overall electrical energy strategy showing some of the issues of changes in demand for and supply of electricity, in power production and its location | |