CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the October/November 2014 series

9696 GEOGRAPHY

9696/22 Paper 2 (Advanced Physical Options), maximum raw mark 50

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CAMBRIDGE
International Examinations

Tropical environments

Only one question may be answered from this topic.

1 (a) For one tropical ecosystem, describe its climax vegetation and explain how it may be replaced by a plagioclimax or secondary vegetation. [10]

The first demand should be straightforward. For TRF we will get and accept both structure (emergents, canopy and shrub layers) as well as nature (evergreen deciduous trees, buttress roots, drip tips, epiphytes). The climax for savanna may prove more difficult as there may be debate regarding its true nature, i.e. some form of seasonal forest or open woodland with acacia, baobob or eucalyptus. There is also the problem of it being less well defined as it changes from the TRF borders to the semi-arid/desert margins; parkland to scrub. Accept some combination of deciduous trees and grasses as the dominant vegetation. Replacement in the TRF could be from the traditional slash and burn with the growth of secondary forest or from abandoned commercial forest clearance and mining/construction activities. For the savanna, there should be mention of the effects of grazing and fire, both natural and managed. Credit well those who show genuine understanding of the nature of some initial 'natural' vegetation and what has replaced it by human activities.

(b) Describe the different weathering processes operating under humid and seasonally humid tropical conditions. Assess the role of weathering and other factors in the development of deep weathering profiles and basal surfaces of weathering. [15]

Humid and seasonally humid covers a wide range of processes from extreme chemical to all types of physical bar freeze thaw but which will no doubt feature in some answers. Many will merely list processes but others for humid tropics will emphasize such aspects as the need for water for chemical reactions and that processes will be accelerated by high temperatures (Van't Hoff's rule). Good answers should also detail chemical processes such as hydrolysis, oxidation and carbonation and that lithology and rock structure will also determine effectiveness. Physical weathering such as salt crystallisation, exfoliation, block and granular disintegration could feature in the seasonally humid and good answers will recognise that such processes are generally slower and that in fact it is a combination of chemical and physical processes that are often the most effective.
Aspects of the second demand may have been covered in the first part and credited but essentially this is restricted to the humid tropical environments. The key elements which should be included are the prevailing high temperatures and abundant ground water promoting intense chemical weathering. The contribution of tropical vegetation with its rapid breakdown to litter with humic acids and chelation important in developing depths of 30–60 m. Also important is the dense vegetation hindering removal of weathered material as does low relief in reducing effective regolith removal. Rock type and jointing will aid the ingress of chemical weathering and the pattern of jointing will determine the form of the basal surface.

Level 3
Will show very good knowledge of weathering processes in both humid and seasonally humid tropical environments. Will also show comprehensive understanding of how deep weathering profiles develop and the form of the basal surface. **[12–15]**

Level 2
Sound knowledge and understanding but less comprehensive or accurate in some of the detail. Some limitation of relevant factors in the second part but essential coverage at the higher end of this level. **[7–11]**

Level 1
Limited in coverage and lacking in detail but with some knowledge of weathering processes at the higher end of the level. No appropriate understanding of how deep weathering or the basal surface develop. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

2 (a) Fig. 1 shows stages in the development of karst landforms in an area of tropical limestone.

Explain how the processes of weathering and erosion lead to the development of tropical karst landforms such as those shown in Fig. 1. [10]

The process of acidulated water leading to solution of limestone should be explained and for basic responses there should also be an understanding of the role of joints, i.e. the permeability of limestone. In responding to the stages in the diagram there should be some key points to credit:
(a) Initial surface where opening up of joints leads to sinkholes developing and sub-surface streams with cave development.
(b) Coalescing of sinks/dolines with collapse into caverns.
(c) Final stage where there has been massive removal (erosion) leaving towers where there was more massive (less close jointed) limestone.
Top responses may make reference to the impermeable shale, that perhaps there had been some continuing uplift of the block during denudation (one theory) or that tower karst areas are stable blocks of considerable age.

(b) Outline the main characteristics of soil profiles in one tropical ecosystem. Describe the impact of human activities on soils in one tropical ecosystem and suggest how soils may be sustainably managed. [15]

Climate is the key factor in the development of zonal soils from initial weathering of parent rock to the processes of laterisation or calcification according to the movement of water through horizons. In the humid tropics, high temperatures, with abundant mildly acid soil moisture, speed up chemical reactions leading to the solution of silica. Hence, in the humid tropics, deep profiles with ill-defined horizons of red and orange Fe and Al sesquioxides. The role of rapid breakdown of luxuriant TRF vegetation, due to the nature of the climate, is also relevant in contributing litter and humus horizons as well as humic acids in the ground water. In the seasonal savanna less active laterisation, less deep soils (2–4 m) and calcification in the dry season are a result of lower rainfall (500–750 mm) which, with mainly grass and shrub vegetation, have a thin dark humus horizon. However the hot wet season leads to laterisation and loss of silica but capillary action in the dry season leads to cemented laterite crusts over many areas.
Human impact may be in terms of exploitation, clear felling of trees and agricultural practices such as slash and burn, plantation and nomadic pastoralism. A scheme of sustainable management would be one employing crop rotation, selective logging, paddocking of livestock, controlled irrigation and so on.
In the humid tropics, expect mostly removal of forest leading to soil erosion but better answers should reveal understanding of the nature of the soils and their role in nutrient cycling. In seasonally humid ecosystems, over grazing/over cultivation may mainly figure leading to loss of top soil with maybe desertification.
Soil conservation and improvements are possibly the most valuable elements in achieving sustainable development and hence management of any agricultural scheme should embrace them. As ever reward well specific and realistic examples with appropriate detail.

Level 3
Will reveal genuine understanding of soil forming factors and processes with accurate exemplification of characteristics for one tropical ecosystem. Has a balanced knowledge of human impact and an appropriate scheme of sustainable management. **[12–15]**

Level 2
Will show some good knowledge of soils in one tropical ecosystem and some understanding of the role of climate at the higher end of the level. Human impact will be more in terms of soil erosion and management will be limited at the lower level. **[7–11]**

Level 1
Very weak knowledge and understanding of soil forming processes and factors. Human impact will be essentially destructive and management will be limited in terms of soil conservation. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

Coastal environments

Only one question may be answered from this topic.

3 (a) With the aid of diagrams, describe three types of cliff profile (cross section form). Explain the factors and processes that have led to their development. [10]

This should be straightforward but there must be identifiable profiles, often not clearly understood in past examinations. Accept the cave, arch, stack, stump, sequence as one type but the factor of a need for a headland or coastal protrusion as well as rock structure are needed for full credit. Otherwise vertical cliffs, seaward sloping and slope over wall provide basic models. Simple diagrams showing dip of strata and different lithology should be linked to marine erosion and removal to maintain, say, vertical cliffs or uniform slope. Other profiles are developed by slope decline as cliff foot processes reduce or stepped forms from landslides. Credit well those who show understanding of the processes, both marine and sub-aerial, and factors, with examples of actual geology a bonus.

(b) Explain why beaches and coastal sand dunes are fragile and changeable coastal landforms. Evaluate methods of achieving sustainable management of dunes and beaches. [15]

Mainly because they are of unconsolidated materials and located in a dynamic zone with active processes operating. Also many human activities are concentrated in such areas and impact on these landforms. However, there could be a range of approaches to this first demand but included should be reference to material, marine and sub-aerial processes. There could be full credit given to this part without reference to human impacts being considered but most will be keen to build sea walls and groynes even at this first stage. Better approaches will include the constantly changing beach profiles due to constructive and destructive waves and the impact of episodic storm events. Sand dunes are subject to blowouts as wind speeds increase through funnelling between dune ridges. Human impact is relevant as dredging and structures expose their fragility.

The need for sustainable management is that beaches absorb wave energy and thus reduce cliff erosion or protect low lying areas and coastal settlements from inundation. Sand dunes may serve a similar function and are important wild life habitats. Both beaches and dunes are of economic importance as part of the coastal tourist industry. Achieving sustainable management will feature groynes, revetments, gabion cages and breakwaters in the case of beaches and fencing, board walks and marram grass planting in the case of dunes. Evaluation will be the impact of measures such as knock on effects, effectiveness of the measures and costs.

Level 3
Materials, processes and changing form will be clearly understood for both beaches and dunes. Will demonstrate relevant and detailed knowledge of the need for sustainable management and suggest appropriate measures coupled with evaluation. **[12–15]**

Level 2
Will have appropriate knowledge of beaches and dunes and their fragility but less balanced and/or lacking some factors or processes. Will present a range of measures for both beaches and dunes with valid evaluation at the top end of the level. **[7–11]**

Level 1
Will lack a clear structure but will include basic knowledge of wave types and dunes at the top end of the level. Basic hard engineering structures will be included but with limited evaluation and in some cases the definition of the term beach will not be fully appreciated. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

4 (a) Explain the causes of sea level change and the results of such changes on coral reefs. [10]

This wording is straight from the syllabus and it gives candidates an open invitation to write all they know about the topic. It should test their knowledge and understanding as well as their ability to present a coherent account of both causes and results. Causes are both eustatic and regionally isostatic. The former should be linked to glacial episodes, withdrawal from ocean waters and addition to it. The latter will be mainly linked to volcanic island subsidence although major crustal deformation and sedimentation can have a eustatic effect. Many may take this as an opportunity to cite global warming linked to the greenhouse effect which is acceptable in moderation and for which there is current evidence.
The results of sea level changes may be answered in terms of theories by Darwin and Daly, i.e. to explain coral barrier reefs and atolls. Credit those who recognise the rate of change on the ability of coral to keep pace in order to maintain sufficient light for photosynthesis. Allow some credit for the effect of temperature change, either negative or positive, associated with glacial episodes, and some may even consider salinity.

(b) Fig. 2 is a coastal sediment cell subject to shoreline management.

Describe the sediment sources, transportation and deposition within the cell. Explain possible causes for the need for management from A to C and how this need is being met. [15]

The first demand should be straightforward with inputs from rivers, long shore transport and off shore supply. There is also input from maintenance dredging. Description should involve stream transport, long shore drift and constructive waves. Deposition occurs in the form of beaches, spits and bar and at groynes. The need for management from A to C could be that the harbour construction has interrupted the littoral drift from the north and the reservoir has reduced sediment input from the river. This led to starvation of input to the area exposing both the settlement and bar to direct wave erosion. Groynes have been constructed to reduce drift and to accumulate beach sediments and dredged sediment has been fed into the system. A few may suggest that the wild life refuge at C could be threatened by starvation of sediment input to the spit and its eventual erosion unless the sediment supply is maintained.

Level 3
Comprehensive coverage and clear understanding of the processes operating in a coastal sediment cell. Provides both appropriate explanations and feasible solutions. Suggestions for future sustainability of C reveals sound understanding. **[12–15]**

Level 2
Less comprehensive input of sources but reasonable understanding of processes operating. Explanation of solutions limited and unrealistic at the lower end of the level. **[7–11]**

Level 1
Little or no valid understanding of a coastal sediment cell; bits and pieces of hard engineering and input sources. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

Hazardous environments

Only one question may be answered from this topic.

5 (a) Fig. 3 shows the development of a landslide on a cliff or river bluff.

Explain the factors and processes which cause such a landslide. What measures might be taken to limit the hazardous impact of such mass movements? [10]

Geology (rock types and structures) will be a factor as will climate; e.g. permeable strata overlying impermeable, faults or joints allowing ingress of water, humid or seasonally humid climate and so on. Processes will be physical and human; undermining the cliff/bluff by marine or river erosion, heavy rainfall which overwhelms normal through flow, building which increases weight and deforestation which increases infiltration, removal of the foot slope, i.e. allow a stable slope to develop. There should be understanding of the mechanism which leads to slumping/rotational sliding such as shown for top credit with appropriate detail of two examples for causes and measures. A range of measures possible which might include; drainage schemes, sea walls or river embankments, restriction of building, changed land use.

(b) Describe the hazards associated with tropical storms (hurricanes and cyclones) and evaluate their impact on the areas which they affect.
Explain which measures have proved effective in reducing the hazardous impact of tropical storms. **[15]**

Vast quantities of rain (up to 125 mm in one hour have been recorded) which usually last for six hours each side of the storm centre. The resultant hazards are extreme flood events and land/mud slides so that the impact can be massive where river levees are breached and slope settlements are destroyed (plenty of examples; Hong Kong, Rio). Winds of over 250 km/hr denote a category five storm on the Safir-Simpson index. The impact is structural damage and a contribution to the development of storm surges by whipping up waves and driving them on shore. Storm surges develop minimally from the low pressure causing a rise in sea level and mainly by the wave generation from high winds being driven on shore. They will be especially hazardous when combined with a period of high tide. The impact is coastal inundation of low lying coastal areas (Bangladesh) and river estuaries (New Orleans). Combined with river floods from high rainfall has a multiplied effect.
Expect the standard responses but credit both accurate detail and specific reference to hazards arising from tropical storms. Prediction is probably more possible than for many other hazards but forecasting track and landfall pose problems. Planning for evacuation following prediction/forecasting, provision of shelters, sea wall and levee construction, stabilizing slopes and a host of others, some relevant some less so.

Level 3
Displays accurate and comprehensive knowledge of the physical hazards and their impact with appropriate evaluation and exemplification. Good range of measures clearly relevant to tropical storms. **[12–15]**

Level 2
Good knowledge of the hazards but with some lack of detail of impacts and in using examples. Appropriate measures but not developed or lacking assessment. **[7–11]**

Level 1
Weak to limited understanding of the hazards and the scale of their impact. Measures lack accurate detail and assessment as to their effectiveness. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

6 (a) Explain the occurrence and characteristics of volcanoes associated with:

(i) an oceanic plate converging with a continental plate,

(ii) hot spots. [10]

Could well be answered by effective diagrams with some explanatory text on the nature of the volcanoes. At the converging plates there should be reference to the nature of the plates and subduction. Good answers may use an example such as the oceanic Nazca plate subducting below the continental S American plate and detail the inclusion of water and sediments drawn down into a magma chamber. Weaknesses in the highly folded and faulted Andes provide channels for the volcanic activity. The nature of volcanoes at such margins are mostly andesitic from the incorporation of continental rock with oceanic plate basalt. Eruptions are explosive due to the water content with ash and lava flows.

Hot spots are located mainly away from plate margins where magma plumes occur beneath both continental and oceanic plates. In continental plates the eruptions through the plate are often rhyolitic (acid) lavas due to the incorporation of granitic crust material. They are initially explosive but followed by outpourings of basaltic lavas once the rhyolite has been exhausted. In ocean plate examples, such as the Hawaiian chain, the eruptions are of basalt and less explosive. Being a more mobile lava the basaltic cones are less steep. As the ocean plates move over such areas a line of extinct volcanoes are left on, and travel with, the plate. One type of example of hot spot volcanoes is sufficient.

(b) Explain the factors that determine how hazardous an earthquake event might be. Evaluate measures that have been taken to reduce the hazardous impact of earthquakes. [15]

Magnitude and location should be the first two essential factors, with some reference to the Richter scale, depth of focus and location of the epicentre with respect to population centres. Other physical factors might include the nature of geology and relief (liquefaction, landslides) and ocean floor disruption (tsunamis). Human factors are also important: density of settlements and infrastructure linked to MEDCs/LEDCs, preparedness, time of day and many minor elements. Some of these may be developed in answering the second demand. Evaluation and a focus on earthquakes should be the key elements in awarding credit. Prediction is often poorly understood both in terms of methods as well as its effectiveness, i.e. low. The question states ‘have been taken’ so that examples are implied and good answers will draw on them such as hazard zone mapping and thus land use zoning, building and infrastructure design, and a range of preparedness measures.

Level 3
Comprehensive and accurately detailed explanation of factors, both physical and human. Well exemplified measures that have been taken with fully discussed evaluation. **[12–15]**

Level 2
Some lack of coverage of factors and/or accurate detail. Appropriate measures but with minimal exemplification and/or evaluation. **[7–11]**

Level 1
Limited in range and detail of factors. Poor or no evaluation and limited range of measures only loosely linked to earthquakes. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

Arid and semi-arid environments

Only one question may be answered from this topic.

7 (a) Photograph A is of vegetation in an area of a hot and dry climate.

Describe and explain how vegetation, such as that shown in Photograph A, has adapted to extreme temperatures and drought. [10]

The cactus and deciduous trees should provide a helpful start with in one case fleshy (succulent) form and thorns and trees that are spindly and of modest height that shed leaves seasonally. Root characteristics: phreatophytes with long roots to tap deep ground water or roots with a wide areal extent to harvest occasional rain showers. Low density of vegetation is achieved by competition for the meagre soil nutrients. Dormancy is another characteristic where plants and seeds can survive long periods of drought. Some adaptive characteristics have developed to protect against herbivores. Baobabs and grasses strictly belong to the semi-arid or the dry seasonally humid, but accept relevant adaptive characteristics.

(b) Outline the evidence for climatic change in hot arid environments. Examine to what extent the landforms of hot deserts are a result of past pluvial climates. [15]

Apart from geomorphological evidence such as dry valley systems, vast sand seas and Lake Chad, there are botanical remains which indicate parts of the Sahara were once occupied by savanna woodland and steppe grassland. There are signs of former human occupation of the deserts by people who fished lakes and rivers that no longer exist and hunted animals such as elephants and giraffes (e.g. cave art). The great quantities of fossil groundwater that exist hundreds of metres beneath the surface of limestone and sandstone areas could not accumulate in present conditions in hot deserts where evaporation greatly exceeds rainfall. There is other relevant evidence of both cooler wetter past Pleistocene periods as well as earlier humid and semi humid tropical ones. A few well-argued pieces of evidence are sufficient for full credit.
Although present day landforms may have been used as evidence in the first demand, this is about evaluation. A selection of present day land forms might include erosional ones such as wadis, mesas and buttes, pediments, inselbergs, and depositional ones such as dunes, sand seas, playas, alluvial fans and bahadas. Wadis and integrated valley systems are no doubt relic features carved out by earlier rivers but present day flash floods can be intensive and their role may be purely transportation of the thick accumulation of debris in valleys and then depositing it on a pediment to develop alluvial fans and bahadas. Dunes might be regarded by some as solely due to present day processes but are likely to be the reworking of vast sand seas, the result of alluvial deposition in an earlier wetter climate. It will be the relevant selection of landforms and quality of the discussion and evaluation which should be rewarded. Credit anything relevant in the first demand as this is all part of one question.

Level 3
Will demonstrate good and relevant knowledge of past climates and provide a range of apposite evidence. Will display a mature ability of to argue from well-chosen examples of landforms. **[12–15]**

Level 2
Shows some knowledge and understanding of at least one past climatic episode with appropriate evidence. Coverage of some appropriate landforms but with limited evaluation, the degree of which will determine the place on the level. **[7–11]**

Level 1
Reveals little understanding of past climates, maybe pluvials at the top end but with little or weak evidence. Lack of evaluation with limited knowledge of the genesis of landforms. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]

8 (a) Describe the processes of erosion, transport and deposition by wind in deserts and explain how they lead to the development of one erosional landform and one depositional landform. [10]

Erosion is abrasion through 'sand blasting' and most effective within the first metre above ground. Above that, particles are essentially dust. Allow deflation as it lowers the surface even though strictly a transport process. Fine particles can be transported by suspension and taken up to provide condensation nuclei but most sand is transported by saltation and traction is limited. Deposition occurs where wind carrying particles are forced to rise over some obstruction such as rocks with accumulation on the lee side. Sand may also be trapped by vegetation and accumulate. Erosional landforms could be deflation hollows, zeugens, yardangs or mushroom rocks, and allow dreikanter. Barchans will be the most favoured depositional feature but any well-defined dune or dune system acceptable. Diagrams should be most helpful but accurate detail of form, factors and processes needed for good credit.

(b) Explain how the nature of climate and soils pose problems for the sustainable management of either semi-arid or arid environments. Evaluate any attempted or possible solutions to such problems. [15]

Sound knowledge of the nature of the climate and soils should be evident and applied to how they pose problems. Average annual rainfall is low (250–500 mm) and seasonal, winter in the higher latitudes and summer in the lower ones i.e. which margin of the hot arid. Reliability may pose the greater problems as do the irregular and prolonged periods of drought. The nature of the rainfall can also be a problem, i.e. heavy downpours in the lower latitude areas like the Sahel, producing high run off over baked surfaces rather than infiltration to provide soil moisture. Soils will reflect the low precipitation with limited biomass to provide humus and nutrients, but accumulation of organic matter is sufficient to colour the top 25 cm and help in moisture retention. They are generally alkaline, shallow and lacking clear horizons. High evaporation rates will bring salts to the near surface and may pose problems with some forms of irrigation. Because of fragility of the soils they are prone to erosion with removal of vegetation and from over grazing and over cropping which may lead to desertification. Solutions to sustainable management will no doubt range from a list of improbable or unfeasible schemes to well evaluated case studies. Such might include highly sophisticated irrigation farming as practiced in Israel, paddocking of grazing animals and schemes for dry farming techniques involving drought resistant crops and crop rotation and so on. Improved technology coupled with economic development, or aid, may allow for boreholes to tap deep water tables and provision of electric power may reduce dependence on foraging for firewood. Tourism will no doubt be advanced, but will it allow for sustainable management? Many schemes are exploitative and although providing some local employment may lead to displacement of pastoral groups such as the Masai and income generated leaving the area to boost profits of MEDC companies. The thrust of the question is essentially sustainable management of the ecosystem but no doubt many will suggest mineral extraction and other industrial enterprises. These could be made relevant but need evaluation of specific examples.

Level 3
Shows depth of knowledge and understanding of both soils and climate and how they pose problems for development. Uses well detailed and relevant specific solutions with balanced evaluation. **[12–15]**

Level 2
Some limitations in understanding the nature of soils in particular and of the problems posed in detail/relevance. Appropriate solutions but either lacking some specific detail or evaluation. **[7–11]**

Level 1
Limited accurate knowledge of soils and climate and the specific problems they pose. A list of marginally relevant solutions with simple or no evaluation. **[1–6]**

For no response or for no creditable response, 0.

[Total: 25]