CAMBRIDGE INTERNATIONAL EXAMINATIONS

Cambridge International Advanced Subsidiary and Advanced Level

MARK SCHEME for the May/June 2015 series

9696 GEOGRAPHY

9696/21 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) Explain the similarities and differences between the climate of the humid tropics and the climate of the seasonally humid tropics. [10]

Both have year round warm temperatures, all months having a mean average above 18 °C. In both cases the diurnal temperature range is greater than the annual range. In the humid tropics, because the sun is always high the weather tends to follow a similar daily pattern with high humidity and convectional showers in the late afternoon. In the seasonally humid tropics there is a cooler season in winter where clear skies allow for rapid radiation cooling at night. The main differences are in rainfall amounts and frequency. In the humid tropical climates all months have at least 6 cm rainfall whereas the seasonally humid have a winter dry season. The rainfall is also less reliable. The rainfall in humid tropics is mostly produced by convection associated with insolation and convergence. Polewards of the humid tropical climates, rainfall is dependent upon the movement of the ITCZ and the dry season is the result of sub-tropical highs.

(b) Using an example or examples, describe the problems that may limit the human exploitation of <u>either</u> the tropical rainforest ecosystem <u>or</u> the savanna ecosystem. To what extent have these problems been overcome? [15]

In the case of the TRF, the problems mostly reside in the nature of the nutrient cycle and the sensitivity of the environment. Most nutrients are contained in the biomass and are derived from climatic inputs. The cycle is also a rapid one such that any disturbance, usually by human action, will lead to nutrient loss, soil deterioration and a degenerated vegetation with great loss of biodiversity. Ways to overcome this should be expressed in terms of particular projects such as selective logging, restricted agricultural developments and specific conservation measures, all of which help to maintain a more biodiverse environment.

In savanna areas the main problems are the seasonal drought, unreliability of rainfall, fire and the nature of the mostly lateritic soils. As a result of problems, agriculture is difficult without irrigation, especially in the dry season. The lateritic soils are naturally lacking in nutrients and therefore need soil enrichment such as the application of fertilisers. Such soils are also prone to water and wind erosion and therefore need careful management. Grazing is a possibility but numbers will need to be very carefully controlled. The crops grown should be adapted to the climatic conditions. Other activities could include safari tourism and game reserves.

Level 3
A detailed, thorough and accurate appreciation of the issues with a clear explanation of the problems. Clear evidence of relative success of the solutions to the problems. [12–15]

Level 2
Sound discussion of the problems associated with the exploitation of either ecosystem but limited in the detail provided. Some clear assessment of the relative success of solutions to the problems mentioned but lacking a sustained argument. [7–11]

Level 1
Basic observation of the disturbance or destruction of either ecosystem. Provides a few very general solutions to the problems discussed but with little or no valid assessment of those suggested solutions. [1–6]

For no response, or no creditable response, 0.

2 (a) Fig. 1 shows vegetation structure, soil profile and biomass of the tropical rainforest.

Using Fig. 1, explain the relationships between the vegetation structure, soil profile and biomass. [10]

There should be a general description of the link between vegetation structure, soil profile characteristics and biomass level. Although not shown in the figure, there is a relationship between climate and all three components which needs to be part of the explanation. The level of biomass is high and related to the dense vegetation structure of emergents, canopies and vegetation at a lower level. However, because of limited light penetration due to the dense canopy, ground level vegetation is absent or limited and is not shown in the figure.

The high level of nutrients is derived from the rapid turnover of vegetation as a result of high temperatures and high precipitation. This means that the litter layer is quite thick but the rapid decomposition as a result of the climatic conditions results in a thin humus layer as shown in the figure. The soils are intensely weathered, hence the great depth of weathered material (regolith), but they supply relatively few nutrients to the vegetation.

The high levels of precipitation mean that soil water movement is predominantly downward creating intense leaching which explains the red colour of the soil and high aluminium content. Leaching also leads to nutrient loss which is not replaced as few nutrients are gained from parental material. The coarse texture is also the result of the intense leaching as the finer particles are removed. The system remains in equilibrium but can easily be disturbed by changes to the vegetation.

(b) Describe the limestone landforms that are developed in tropical areas. Explain the extent to which the development of these landforms has been influenced by climate and vegetation. [15]

Tower karst and cockpit karst define the group of landforms that are especially developed on limestone in the tropics, although the features more generally associated with temperate climates (such as caverns, swallow holes, sinks, dolines) can occur. Tower karst comprise steep-sided towers separated by generally level terrain, whereas cockpit karst is composed of more rounded hills and depressions. The landforms are those related to the role of water, often slightly acidic, in weathering the limestone by carbonation. The high temperatures and abundant precipitation encourage the rapid and effective chemical weathering by carbonation. Limestone is mostly composed of calcium carbonate and the jointed nature of the rock allows the ingress of water for the process of carbonation to occur. The highly fissured nature of much limestone in the tropics allows the development of both cockpit country and tower karst. Vegetation can protect to some extent the rounded summits of tower karst and the hill tops in cockpit areas. Vegetation also supplies humic acids which can aid the weathering processes in the lower lying areas.

Level 3
A detailed, thorough and accurate appreciation of karst landforms particularly as they apply to the tropics. There needs to be a reasoned assessment of climate and vegetation in relation to other factors, such as rock structure, in the development of the landforms. [12–15]

Level 2
Sound description of landforms with some appreciation of tropical karst and the factors influencing it will lead to marks at the upper end of the level. A clear understanding of the process of carbonation at the lower end of the level, usually related to temperate limestone landforms. [7–11]

Level 1
Basic descriptive statements often limited to caverns and stalactites, with little that is specific to the tropics. Very limited assessment of the role of factors other than vegetation and climate. [1–6]

For no response, or no creditable response, 0.

Coastal environments

Only one question may be answered from this topic.

3 (a) Explain how waves are generated and describe the different types of wave that are produced. [10]

Waves are a deformation of the sea surface in the form of an oscillatory movement which manifests itself as an alternating rise and fall. This is generated by wind pressure and the wave magnitude is proportional to the strength and duration of the wind and the length of fetch. They can be classified by height between crest and trough (amplitude), length between crests (wave length), velocity, steepness, its period and energy. Terminology used for breaking waves may vary, such as constructive/destructive, low energy/high energy, spilling/plunging breakers.

(b) Explain how coastal sediment cells operate. To what extent can the disruption of sediment cells affect coastal landforms? [15]

Sediment cells are well defined coastal areas where sediment is gained, transported and deposited. There is little transfer of sediment across the boundaries of these cells. Sediment is derived from erosion of cliffs and (mostly) from estuarine river sediments. These are transported by longshore currents and drift. Where velocity is lost, deposition occurs (sinks) such as beaches and spits. This can be illustrated by simple diagrams. Disruption to sediment cells involves changes to both the supply of sediment and its transport which can have important impacts upon the erosion and deposition of sediment. This can be illustrated by reference to examples such as increased cliff erosion due to beach removal, spits and beaches starved of sediment. The disruption can be the result of both natural processes and human action (such as entrapment in groynes, dredging, etc.).

Level 3
A thorough, detailed and accurate explanation of the operation of sediment cells. An effective illustration of the nature and impact of the disruption with a reasoned use of exemplification. Clear identification of the extent of the disruption. [12–15]

Level 2
Sound and clear awareness of the operation of the cell as a system. More emphasis on the effects of disruption with possible reference to exemplars. [7–11]

Level 1
Basic description of coastal processes and a weak understanding of how sediment cells operate. General and weak assessment of the level of disruption caused. [1–6]

For no response, or no creditable response, 0.

4 (a) Photograph A shows some landforms along a stretch of coastline.

Using a labelled diagram, describe the landforms shown in Photograph A and explain how they developed. [10]

Accept any relevant labelled diagram. The photograph shows a distinctively stepped cliff profile and stack with a small wave cut platform. Better answers will identify the profile and comment on the lithology of the cliff such as slope over wall and the accumulation of weathered material half way down the cliff. Explanation will be largely in terms of marine erosion (such as hydraulic action, abrasion, cavitation) on horizontally bedded rocks leading to undercutting and cliff retreat with the formation of headlands and bays. The headland area will be seen to have progressed from cave to arch to stack. Better answers will see evidence of sub aerial processes.

If no diagram: max 6 marks.

(b) Using an example or examples, explain the problems of management of a stretch of coastline. Evaluate attempts to solve these management problems. [15]

An opportunity to develop a good quality example of a management scheme and/or case study of a specific coastal area. The problems should not simply be described but clearly explained in order to access higher marks. Better responses will not just assume that they are derived from coastal erosion and retreat. Solutions may be seen in terms of hard and soft engineering, although some may adopt the hold the line, managed retreat, do nothing type of approach.

Level 3
A detailed, thorough and accurate explanation of the problems and a clear evaluation of the possible solutions. Analysis contains a range of issues, not simply a consideration of cost, and provides continuous reference to the chosen examples. [12–15]

Level 2
Sound and clear explanation of the problems and solutions. Analysis contains a more limited range of issues at the lower level. At the higher level there is a good integration of the case studies with the issues. [7–11]

Level 1
Basic explanation of the problems with little detail of the chosen examples. Generic rather than specific with vague analysis of possible solutions. [1–6]

For no response, or no creditable response, 0.

Hazardous environments

Only one question may be answered from this topic.

5 (a) Explain how avalanches and landslides occur and describe their hazardous effects. [10]

Both occur when shear stress overcomes shear strength on a slope and both movements can engulf settlements, damage infrastructure and cause injury and loss of life.
Snow avalanches are either slab or powder and are of differing depths and widths. Both types of avalanches can be hazardous depending on their size and location. Slab avalanches tend to occur in spring when partial melt occurs at depth leading to instability at a well defined failure surface. Powder avalanches can occur at any time following a heavy snowfall over a partially frozen snow surface. Both types can be triggered by human activities.

Landslides develop along defined slide planes often at the junction of geological unconformity. They may be triggered by water input, tectonic activity or human actions which mobilise failure along the slide plane.

(b) To what extent can the hazardous effects of tropical storm surges be restricted and managed as compared to the hazardous effects of avalanches? [15]

Storm surges are due to high winds and passage of low pressure as a result of the passage of tropical storms and cyclones. The winds drive the waves onto the coastal areas and the extreme low pressure causes the raising of water levels. Storm surges are by far the greatest cause of fatalities and damage. The hazardous effects of both may be limited by prediction and evacuation, but in both cases this is problematic. Avalanches have a colour code system based on levels of danger suggested by the stability of the snowpack. Tropical storms can be tracked and monitored but precise landfall is often difficult to assess in advance. The tropical storms can also be categorised by their potential strength. Engineering and preparation can limit impact with flood defences for tropical storm surges and wind baffles and snow fences for avalanches. All have limitations when faced with large scale events.

Level 3
A detailed, thorough and accurate understanding of the hazardous nature and effects of both tropical storm surges and avalanches. Clear relative assessment of the ways that both hazards might be restricted and managed. [12–15]

Level 2
Sound and clear knowledge of the two hazards with incomplete comparison of the ways that both hazards might be restricted and managed. [7–11]

Level 1
Basic understanding of the hazardous nature of the two hazards with little attempt to differentiate the management of the hazards. [1–6]

For no response, or no creditable response, 0.

6 (a) Fig. 2 shows materials that are erupted from a volcano.

Describe the nature of the erupted materials and explain how they might be hazardous. [10]

Each of the materials should be described and their hazardous impact assessed. Thus pyroclastic flows are the most hazardous due to speed and temperatures, whilst lava flows are less hazardous depending on the composition of the lava. The hazardous nature of the materials will also depend on scale and travel distances.

(b) Explain the similarities and differences in the locations of hazardous earthquakes and volcanoes. To what extent are these hazards predictable? [15]

As both are tectonic in origin they are mostly related to plate boundaries. In both cases they are most hazardous at destructive plate margins where subduction provides the friction for earthquakes and the molten magma for volcanoes. Both do occur at divergent margins but these are more remote from centres of population. Earthquakes can occur at some distance from plate margins as they develop along fault lines such as the Anatolian fault. Earthquakes also occur at collision plate margins and conservative margins whereas volcanoes do not. However, volcanoes may be found at hot spots but not earthquakes. Volcanoes with a known location are more predictable through an array of signs and tests. Similar tests can be used for earthquakes but successful prediction is more difficult and has proved elusive.

Level 3
A detailed, thorough and accurate understanding of the precise similarities and differences in the locations of earthquakes and volcanoes. A comprehensive assessment of the degree to which both can be predicted. [12–15]

Level 2
Sound and clear understanding of several similarities and differences in the locations of earthquakes and volcanoes. A solid assessment of the degree to which both can be predicted. [7–11]

Level 1
A basic description of some similarities and differences in the locations of earthquakes and volcanoes. A simple outline of predictive methods with little or no comparison or assessment. [1–6]

For no response, or no creditable response, 0.

Arid and semi-arid environments

Only one question may be answered from this topic.

7 (a) Explain the operation of weathering in hot arid environments and describe its effects upon rocks. [10]

In the absence of water, mechanical weathering is often seen as the predominant type. Insolation weathering leading to thermal fracture and exfoliation and salt crystal weathering is most prominent. Under certain specific conditions freeze-thaw weathering might be appropriate. But water is often present even if only in the form of dew and this can allow the operation of some limited chemical weathering. This can lead to the breakdown of rock surfaces by granular and block disintegration.

(b) Explain the extent to which wind and water are responsible for the shaping of desert landforms. [15]

A broad question which allows a comparison of landforms shaped by past and present erosional and depositional processes by wind and water. Landforms shaped by wind action might include dune systems, deflation hollows, yardangs and zeugens. Landforms shaped by water action might include the desert piedmont with its mountain front, mesas, wadi systems, pediments and playa lakes. The precise balance between wind and water in shaping many landforms is the subject of some recent controversy, although much water action is still ascribed to past activities.

Level 3
A detailed, thorough and accurate explanation of the landforms shaped by both wind and water action. A comprehensive assessment of the relative importance of wind and water in shaping desert landforms. [12–15]

Level 2
A sound and clear explanation of the landforms shaped by both wind and water action. There may be some imbalance between the two agents of erosion and deposition. Solid but incomplete assessment of the relative importance of wind and water action in shaping desert landforms. [7–11]

Level 1
A basic description with little explanation of some landforms shaped by wind and water. Little correlation between the process involved and the shaping of the landforms. [1–6]

For no response, or no creditable response, 0.

8 (a) **Fig. 3 shows the distribution of semi-arid climates in the tropics.**

Describe the distribution of semi-arid climates shown in Fig. 3 and explain the nature of semi-arid climates. [10]

All semi-arid climates shown in Fig. 3 are located between the Tropic of Cancer and the Tropic of Capricorn. They tend to occur in latitudinal belts. They are widely distributed across several continents and candidates may refer to specific locations within those continents. They are generally characterised by the high temperatures of arid areas, although there can be a seasonality to both temperatures and to the rainfall which is typically higher than arid areas at around 250–500 mm per annum. Rainfall is unreliable as many of these areas are on the periphery of influence from ITCZ movement. The dryness is mostly the result of the influence of the descending air of the sub-tropical high pressure systems, rain shadow effects, proximity to continental interiors and in some cases to cold offshore currents. Climatic conditions are more variable for semi-arid than hot arid areas.

(b) **Explain why many semi-arid areas are subject to desertification. Using an example or examples, evaluate attempts to overcome the effects of desertification. [15]**

As they are peripheral to desert areas, semi-arid areas are highly sensitive to periods of drought or overexploitation which may lead to soil erosion, and vegetation and land degradation. Human activities in terms of population increase, lowering of water tables and overgrazing are often seen as prime causes, although the often temporary impact of drought can be significant. There are many schemes that have been advanced for semi-arid areas, subjected to desertification, which can be described and evaluated. A range of solutions could be evaluated including irrigation schemes, afforestation and re-afforestation of degraded areas, the management of pastoral activities and development of cropping systems appropriate to semi-arid areas.

Level 3
A detailed, thorough and accurate explanation of the causes of desertification in semi-arid areas. A comprehensive assessment of attempts to overcome the effects of desertification using relevant and detailed examples. [12–15]

Level 2
A sound and clear explanation of the factors responsible for desertification. A solid but incomplete assessment of attempts to overcome desertification. [7–11]

Level 1
A basic description of the causes of desertification with little explanation. Assessment of the attempts to overcome the effects of desertification will be poorly developed and possibly inaccurate. [1–6]

For no response, or no creditable response, 0.