CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9696 GEOGRAPHY

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

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CAMBRIDGE
International Examinations

Tropical environments

1 (a) Explain the nature of energy flows and trophic levels for one tropical ecosystem. You may answer by means of fully annotated diagrams. [10]

Ecosystems maintain themselves by cycling energy and nutrients from external sources. Plants (primary producers) use energy from the sun and by photosynthesis manufacture their own ‘food’ drawing nutrients from the soil, i.e. level one in both energy and trophic levels. Thus energy passes from the sun to producers to consumers to decomposers to a nutrient pool available to producers. About 10% of net energy production at one trophic level is passed on to the next level.

Much can be presented by diagrams and the question allows full credit for well annotated ones. These will most likely be pyramids for trophic levels and cyclic types to show energy transfers. The question demands reference to **one** tropical ecosystem. In the TRF there is massive plant growth, i.e. the primary producer. Primary consumers are grasshoppers, slugs, many insects and larger herbivores, primates. In the third and fourth trophic levels are the next level of consumers, the former may include frogs, toads, smaller birds with hawks, reptiles and some mammals, in the latter. In savannas tall grasses are the main primary producers; at a lower level are shrubs and sparse trees. Primary consumers are zebras, giraffes etc. Higher order consumers such as jackals, lions, lizards, snakes are secondary but lions can be a third order as they prey on carnivores as well as herbivores. Scavengers and decomposers also play an important role in the trophic system; vultures, hyenas and termites are an integral part of the nutrient cycling system. Decomposers, bacteria, mushrooms, etc. break down plant and animal remains and return nutrients and minerals to the soil.

(b) Outline the problems of sustainable management for <u>one</u> tropical ecosystem. Evaluate a scheme, or schemes, to sustainably manage a tropical ecosystem. [15]

This should logically follow on from some of the thinking that went into answering part (a). The ecosystems function on maintaining the balance of cycling nutrients. Clearance of TRF for mining and timber or commercial (or subsistence) agriculture and overgrazing of savanna can destroy the primary producer, i.e. plants. Thus there will be eventual loss of habitats, energy and food for natural consumers and lack of return of nutrients to the soil and so on. This should be supported by specific examples and some may provide appropriate data.
The syllabus demands a case study illustrating the problems of sustainable management and an evaluation of attempted solutions. For the TRF there may be designated areas excluding development, controlled selective logging with government licensing, limited agriculture within forests. Ecotourism may feature but some sense of reality and scale is needed. In savanna areas, expect game reserves, managed agriculture and tourism again. Evaluation is needed and good answers will address the pros and cons of any scheme and have management of the ecosystem fully incorporated.

Level 3
Good explanation of threats in terms of the functioning of an ecosystem with detailed exemplification. Well presented, appropriate scheme, or schemes, with location and scale clearly expounded and evaluated. Management of the ecosystem being central to the answer. [12–15]

Level 2
Threats understood in general terms with less specific or detailed examples. Appropriate scheme, or schemes, but some lack of detail or data. Limited evaluation and/or less consideration of the ecosystem as such. [7–11]

Level 1
Destruction and soil erosion rather than 'how the ecosystems are threatened'. Limited/inappropriate/unrealistic scheme, or schemes, lacking in detail and/or relationship with the ecosystem. Little or no evaluation. [0–6]

2 (a) Fig. 1 gives climate graphs A and B of data for two tropical climates.

Describe and explain the nature of the two tropical climates shown in Fig. 1. [10]

Descriptive points are the total amounts and seasonal distribution of rainfall and the range of temperatures (Manaus 2 ºC, Kano 8 ºC). The rainfall will be heavy from afternoon convectional uplift, with thunderstorms particularly in the savanna. Explanations should be in terms of the movement of the ITCZ. This will relate to temperature values and annual range as well as rainfall totals and distribution. The nature of the rainfall due to L.P., convergence, instability/uplift and heavy convection rainfall. Some may sensibly add contrasts in diurnal differences in temperatures.

(b) Assess the factors and processes that lead to deep weathering under humid tropical conditions. Explain how granite landforms may develop over time [15]

Factors are the lithology and structure of parent rock, the climate and dense luxuriant vegetation. Chemical weathering is the principal process. Under conditions of high rainfall and temperatures, chemical weathering can be accelerated especially with humic acids from rotting vegetation; it will be particularly effective into well jointed rocks such as granite and limestone. With a lack of surface erosion in such conditions, weathering can penetrate deeply to create a thick regolith above the basal surface of weathering. Physical weathering will be absent or insignificant. Over time the regolith will be stripped by a process of uplift and erosion, some may relate to climate change. Ruwares and inselbergs and tors and koppies develop in relation to jointing; again best explained in stages by diagrams. Pressure release may produce pseudo bedding planes and spalling aided in some cases by physical weathering. However such large domed landforms are strictly less typical of granite.

Level 3
Balanced coverage of both demands revealing genuine understanding of the humid tropical environment. Accurate and detailed knowledge of both factors and processes backed up with data and examples. Clear understanding of the development of landforms in granite with relevant illustration, probably by well executed diagrams. [12–15]

Level 2
Covers both demands but with less depth of knowledge of factors and/or processes. Understanding of stages in the development of landforms but some lack of accuracy or detail or scale. [7–11]

Level 1
Lack of understanding of how processes operate within the factors of the climate and parent rock type. No depth of knowledge of chemical weathering or the role of jointing and lithology. Has some relevant landforms but no valid understanding of their development. [0–6]

Coastal environments

3 (a) Describe the conditions which provide the best environment for the growth of coral and explain how coral may be threatened by changes to those conditions. [10]

The conditions are generally well rehearsed but reward well those who provide accurate detail and data:

- Warm (tropical) seas; ideally 23–29 ºC and some coastal platform on which to develop with a low tidal range to avoid long periods of exposure.

- Clear oxygenated water; light for photosynthesis for plankton and therefore a restriction on depth, up to 70 m. in some cases. Gentle wave movement will keep water oxygenated.

- Coral polyps are sensitive requiring salt water; 35–38 ppt.

- $CaCO_3$ skeletons are tough but can be damaged by severe storms.

There is a wide range of factors that may affect conditions; rising sea temperatures both global and local, pollution from coastal development or agriculture (nitrates encouraging algal blooms), increase sediment from land clearance, physical damage from fishing and tourism. As with description, it is realistic and accurate detail that can be well rewarded plus specific examples.

(b) With reference to a stretch, or stretches of coast, describe some of the problems of sustainable management and evaluate the effectiveness of attempted solutions. [15]

The syllabus demands a case study of 'sustainable management of a stretch or stretches of coastline'. Expect the common examples of Hastings to Pett level or the Holderness coast or Christchurch Bay. These are appropriate but accurate detail and understanding of the problems posed should be forthcoming. Other answers may, generally less successfully, select more random examples. Home based studies from New Zealand (Omaha Beach) and Brunei also provide good bases for answers. The problems may range from coastal erosion threatening settlements to silting up of harbours, loss of beaches, erosion of spits and sand dunes. Whatever they are, they need to be clearly presented.
'Evaluation of effectiveness of attempted solutions' is the crux of the question. Hence arresting longshore drift to protect against cliff recession may be effective by groynes and seawalls but are they sustainable and what are the consequences down coast? Similarly beach replenishment may involve offshore dredging and be unsustainable in the long term. Managed retreat might be evaluated in terms of initial costs of compensation and loss of productive land but be cost effective long term.

Level 3
Well documented stretch of coast with problems detailed and accurate at this level. Genuine evaluation with balanced pros and cons of options and displaying a good understanding of the coastal system and the factors and processes operating. [12–15]

Level 2
Appropriate stretch, or stretches, of coast with a statement of problems. A range of coastal structures assessed but less consideration of measures to meet the specific solutions or a full evaluation. [7–11]

Level 1
Stretch of coast loosely defined or selection of unrelated examples. Groynes, sea walls, revetments etc. described and illustrated but with limited evaluation of their role or effectiveness in solving specific problems. [0–6]

4 (a) Fig. 2 shows an area of tidal sedimentation and coastal salt marsh.

Explain how sedimentation and salt marshes develop in tidal estuaries along a depositional coast such as in Fig. 2. [10]

Estuaries provide the necessary shelter from the direct action of constructive and destructive waves constantly changing beach profiles. Sedimentation is a build up of silt and clays brought down by rivers and combining with sands left by receding tides. Tidal rise has stronger inflowing movement than the fall. The presence of a spit across the estuary mouth may accelerate the process of sedimentation. At the interface between river and marine waters, clay sized particles flocculate, forming larger particles which settle out of suspension. Salt marshes develop in stages from a green algae, then pioneer species (e.g. *Spartina, Salicornia or mangroves*) which tolerate saline conditions and begin to trap sediment. This in turn is colonised in succession leading to the build of a salt marsh. Credit well accurate detail showing good understanding of the stages.

(b) Using examples, explain how marine erosion, subaerial processes, rock type and structure interact to produce different landforms along a cliffed coastline. [15]

This may be attempted from the general to particular examples or from selected landforms and offering explanation. Marine erosion will be most effective into well jointed rocks or less competent ones; the former giving castellated cliffs, arches, stacks and so on while the latter may give steep or slumped profiles depending upon rates of removal and/or subaerial processes. Landslip cliffs could be explained by lubrication of clays underlying porous/permeable sandstones or chalk etc. (heavy rain and wave erosion of the toe maintaining instability). Structural dip combined with cliff foot wave erosion and weathering / mass wasting may determine the form of cliff profiles. At a larger scale, there are headlands and bays along discordant coasts or coves/elongated bays breaking into accordant ones. There is much which can be covered and answers will range from grape shots, with minimal detail, to those with fewer but well worked specific examples explained with appropriate terminology, geological and process detail.

Level 3
Specific examples that embrace all four elements of the question and presented with accurate detail such as types of rock, major and minor structures and good understanding of processes; wave erosion, subaerial weathering and mass movements. [12–15]

Level 2
Less coverage to explain the range of interactions but some good understanding with well presented examples at the higher end of this level. At the lower end more of a catalogue lacking specific/accurate detail. [7–11]

Level 1
Generic examples with unspecific rock types, lack of precision/accuracy in marine and subaerial processes. Limited beyond headlands and bays in hard and soft rocks and the suite of caves, arches, stacks and stumps. [0–6]

Hazardous environments

5 (a) Fig. 3 shows two types of mass movement affecting slopes.

Explain the possible causes of the two types of mass movement shown in Fig. 3 and suggest hazards that might be created by them. [10]

Slump/rotational slide: movement en masse of a large area of land common along coastlines and steep scarp slopes or valley sides. Caused by undermining of the slope by erosion and lubrication of a slip plane, e.g. chalk/porous sandstone overlying clay.
Mudflow: a flowing mixture of water saturated debris moving downslope under the force of gravity. Formed when loose masses of unconsolidated wet debris become unstable. Water may be from heavy rainfall and/or melting snow or ice. Some may link to volcanoes or triggering by earthquakes.
The hazards that might be created should be realistic, the best with examples. Mudflows can overwhelm settlements or disrupt transport infrastructure, often channelled along valleys and may sweep away bridges. Allow lahars for which they may have detailed cases. Slumping / rotational slides may move and destroy buildings on slopes especially where their weight may 'tip the balance' for gravity to overcome shearing resistance. Allow landslides such as often quoted from Rio and Hong Kong.

(b) Describe some of the problems of sustainable management for <u>one</u> particular hazardous environment and evaluate any possible solutions to such problems. [15]

A requirement of the syllabus is ‘a study illustrating some of the problems of sustainable management of a hazardous environment and an evaluation of attempted or possible solutions’. It is important that the problems relate to a named hazardous environment, as should the solutions, and not the ‘catch all’ lists that sometimes have occurred. The problems will be the physical and economic feasibility of sustainable management.
Preparedness for an event will be an important element; technology to monitor and predict volcanic eruptions or hurricanes, with appropriate evacuation plans, are a possible solution but the problems may be the reliability of forecasts or feasibility of evacuation with MEDCs more able than LEDCs. Land use zoning and building codes may be a solution attempted in earthquake prone regions but precise location of a possible event may be a major problem (e.g. Christchurch, June 2011).

Level 3
Well documented and accurate description of a hazardous environment, either a named event or location, or a specific type of hazard. Balanced evaluation of problems and solutions which are clearly relevant to the hazardous environment chosen. [12–15]

Level 2
Good to satisfactory description of a particular hazard with appropriate exemplification if somewhat lacking in detail at the lower end of the level. Evaluation not fully relevant in all aspects to the particular hazard chosen. [7–11]

Level 1
Lacking in focus on the nature of a particular hazard and limited in coverage and detail of the problems. Catch all solutions with little or no evaluation. [0–6]

6 (a) Describe how <u>either</u> tropical storms (cyclones and hurricanes) <u>or</u> tornadoes develop. Outline how a particular area may suffer from the immediate impact of one of these climatic hazards. [10]

The first demand should have been well rehearsed and the former events likely to be more popular than the latter. Tropical storms develop over warm sea areas (> 26 ºC) in a belt c 5º N. and S. of the equator in late summer (when sea temperatures reach their maximum) and where the Coriolis force on converging air is needed to maintain the L.P. and deflect the winds. Undisturbed upper atmosphere allows the development of the massive uplift and generation of elements of the system – diagrams may add detail. Gulf coast/ S.E. United States or Bangladesh or any other area where tropical storms hit islands or a coastline. How it may suffer is from storm surges, wind damage, flooding due to L.P., high wind speeds and torrential rain. Note, secondary effects are not required.

Tornadoes are spawned by violent uplift associated with thunderstorms, usually where there is an inversion such as humid air from the Gulf of Mexico streaming north meeting cold air from Canada or Rocky Mountains. A vortex develops from the shearing effect of air streams meeting. However the reason for the spinning effect is not fully understood and we cannot expect any precise understanding. Tornado alley will no doubt be mentioned but tornadoes are universal if normally less violent elsewhere. Immediate impact can be the destruction of buildings (intense L.P.), uplift and dumping of persons and vehicles etc. heavy rain / hail storms. (> 1,000 deaths in USA in 2011).

(b) Explain and evaluate the methods of prediction of tropical storms and tornadoes. Evaluate other measures that may be taken to reduce their hazardous impact [15]

Prediction of tropical storms has developed with satellite imagery and computer modeling to become reliable in terms of an approaching event but precise determination of which area(s) will be affected may prove more difficult. The weather conditions leading to tornadoes can be forecast but the likely location of such events is less predictable. In U.S.A. there are teams of 'chasers' with sophisticated electronic equipment tracking tornadoes to give advance, if brief, warning. Evaluation of each may include resources available, e.g. MEDCs v LEDCs as well as the reliability of the technology.
Other measures include defensive structures such as sea walls in the case of tropical storms or planting mangroves, building design and land use zoning in coastal areas. River flood control engineering and development/land use on slopes. Additionally to preventative measures are the management of evacuation, provision of shelters and resources to cope with the after effects.

Level 3
Accurate and detailed knowledge of methods of prediction and of their effectiveness and reliability. A range of other measures clearly linked to tropical storms and tornadoes and effectively assessed. Well exemplified throughout. [12–15]

Level 2
Coverage of both parts of the question but either less detailed or less comprehensive. Shows an understanding of techniques of prediction but limited evaluation. Selected examples used in the second demand but with some lack of accurate detail at the lower end of the level [7–11]

Level 1
Limited in coverage and accuracy throughout. Prediction in terms of satellites and computers but no monitoring or imaging. A standard list of other measures not focussed sufficiently on the impact of tropical storms and tornadoes. [0–6]

Arid and semi-arid environments

7 (a) Describe the causes of aridity in arid and semi-arid areas and explain how the climatic characteristics of these environments differ. [10]

For arid areas the causes to expect are descending limb of the hadley cell (H.P. adiabatic warming), continentality / rain shadow, off shore trade wind belt, cold ocean currents. For semi-arid areas we may expect the same but good answers should relate to the movement of the ITCZ and the seasonal nature of rainfall.
The differences between the two should include less rainfall in arid; <250 mm and 250 to 600 mm in semi-arid, higher maximum temperatures in arid; 35 ºC and greater range, both annual and diurnal. Explanation should be in terms of latitude giving a greater range in annual temperatures in arid and surface vegetation and cloud cover affecting diurnal ranges. Rainfall in arid is sporadic but more reliably seasonal in semi arid areas during the summer solstices.

(b) Explain how plants have adapted to <u>either</u> an arid <u>or</u> a semi-arid environment. With reference to an example, or examples, evaluate solutions to managing such an environment sustainably. [15]

They have a choice of area which may help in differentiation. However some adaptations may be common to both environments but e.g. cacti are arid and acacias semi-arid etc. For arid, expect xerophytes such as cactus and other succulents, with means of storing and conserving water; shallow if wide root systems, waxy skin, thorns etc. – phreatophytes with long roots to reach more permanent water supply - dormancy; plants and seeds that can survive long periods of drought. For semi arid we can expect similar types of adaptations but also deciduous trees and grasses and species such as acacias and baobabs. The syllabus demands a study to meet the second demand of the question and we should expect something more than just a listing of irrigation, tourism, sea water desalinisation and other generally unfeasible schemes with little or no reference to the nature of the environment.

Level 3
Accurate and detailed knowledge of plant adaptations with appropriate examples. Well documented and evaluated study of sustainable management in one of the environments showing good understanding of the problems. [12–15]

Level 2
More basic coverage of plant adaptations with limited exemplification, less specific to the area at the lower end of this level. Relevant solutions but limited evaluation and / or detail linked to the nature of the chosen environment. [7–11]

Level 1
Limited specific and/or detailed knowledge of plant adaptations beyond cactus. A catch all list of improbable or unfeasible solutions with little or no reference to the constraints of the chosen environment. [0–6]

8 (a) Photographs A and B show some desert landforms.

Describe the landforms shown and explain the factors and processes that have led to their development. [10]

Photo A of dunes these are crescentic or barchans. Factors are the vast amounts of sand an arid climate and constant wind direction, processes are the transport, some initial arresting feature and build up with gentle up slope and steep lea side with wind eddies etc.
Photo B of zeugens (allow gours / mushroom rocks). Factors are horizontal beds of differing resistance and arid climate, processes of wind abrasion most effective up to a metre above ground. Up to a maximum of 6 marks for either one.

(b) Outline the evidence for climatic change in hot arid and semi-arid environments. Evaluate the role of Pleistocene pluvials in the development of desert landforms. [15]

Evidence should principally be the landforms, vast seas of sand accumulated from past deep weathering, massive wadis and well integrated relic drainage systems, inselbergs. However accept anthropological evidence e.g. cave paintings, historical records and expect fauna such as desert crocodiles for limited credit.
The second demand should elicit an explanation of fluvial processes as well as more active past weathering processes. They have been principally responsible for the scale and variety of desert landforms which should be explained. Present processes of wind erosion, transport and deposition and occasional rainstorms should be considered in terms of modifying landforms.

Level 3
A range of evidence, both accurate and well detailed showing good understanding of past climate(s). Genuine evaluation of the input of past processes in explaining their role in the development of landforms as well as the imprint of present day ones. [12–15]

Level 2
Appropriate evidence but with some lack of detail and/or understanding of the nature of past climates and a restricted range at the lower end of this level. Aware of the role of past climates in the development of landforms but more limited on evaluation and/or coverage. [7–11]

Level 1
Evidence limited and mainly in terms of cave paintings etc. Limited range of landforms to develop any realistic evaluation of the role of past processes. [0–6]