UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2011 question paper

for the guidance of teachers

9696 GEOGRAPHY

9696/21 Paper 2 (Advanced Physical Options), maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

- Cambridge will not enter into discussions or correspondence in connection with these mark schemes.

Cambridge is publishing the mark schemes for the May/June 2011 question papers for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level syllabuses and some Ordinary Level syllabuses.

UNIVERSITY of CAMBRIDGE
International Examinations

1 (a) Using Fig. 1 describe and explain the movement of nutrients in a tropical rainforest ecosystem? [10]

Tropical forests exhibit extremely rapid rates of nutrient transfer, due to high temperatures, rainfall and humidity. Biomass (living vegetation, inc. roots) is the largest store of nutrients. Litter or decaying matter is the smallest store because nutrients are processed very efficiently by abundant decomposers including bacteria, fungi, and termites (fuelled by availability of nutrients and high temperatures). Nutrients are transferred rapidly from litter to the soil and almost immediately absorbed by vegetation. Nutrients are not stored in the soil for long; however they can be lost by leaching if the forest is cleared.

(b) Describe the nature of the vegetation in tropical rainforests. To what extent is this influenced by climate? [15]

Nearly constant high temperatures and high rainfall (2000 mm) allow evergreen trees to grow all year round. Rainforest plants have many adaptations to their environment. Structure is influenced by exposure to sunlight. The upper canopy of 30 m trees allows light to be easily available at the top of this layer. Emergent trees are spaced wide apart, and are 50 m tall with umbrella-shaped canopies that grow above the forest. Because emergent trees are exposed to drying winds, they tend to have small, pointed leaves that are dark green, small and leathery to reduce water loss in the strong sunlight. These giant trees have straight, smooth trunks with few branches. Their root system is very shallow, and to support their size they grow buttresses.

With 2000 mm of rain per year, plants have made adaptations that help them shed water off their leaves quickly; many plants have drip tips that allow rain to run off and some leaves have oily coatings to shed water. This keeps them dry and prevents mould from forming. The lower canopy consists of 20 m trees and is made up of the trunks of canopy trees, shrubs, plants and small trees. There is little air movement. As a result the humidity is constantly high. This level is in constant shade.

The forest floor is usually completely shaded, except where a canopy tree has fallen and created an opening. The forest floor receive so little light that few bushes or herbs can grow there. To absorb as much sunlight as possible leaves are very large. Some trees have leaf stalks that turn with the movement of the sun so they always absorb the maximum amount of light. Some trees will grow large leaves at the lower canopy level and small leaves in the upper canopy. Other plants grow in the upper canopy on larger trees to get sunlight. These are epiphytes such as orchids. Many trees have buttress and stilt roots for extra support in the shallow, wet soil.

The heat and humidity help to break down the litter. A shrub layer receives about 3% of the light that filters in through the canopies.

Level 3
A thorough description of the vegetation nature and structure with an emphasis on the role of climate. Good appreciation of the role of climate in the adaptations made by plants. Reference to climate will include air movement, humidity, sunlight, temperature and rainfall. Structure will include mention of areas of tree fall creating openings. (12–15)

Level 2
The vegetation structure will be described and related to the climate in simple terms. e.g. evergreen trees are able to grow all year round because of nearly constant high temperatures and high rainfall. (7–11)

Level 1
A simple account of vegetation structure in a tropical rainforest, with no assessment of the role of climate. Concentration will be on structure; emergents, upper canopy, lower canopy and shrub layer. (0–6)

2 (a) **Describe the factors that lead to the development of deep weathering profiles on granite in tropical environments. [10]**

The main factors are related to granite as a rock, climate, vegetation, relief, hydrology and time. Rock influence includes the mineralogy and structure of granite with joints being of prime importance. Closer spaced joints will be preferentially weathered by percolating ground water. Vertical joints have a greater influence than horizontal joints. Coarse grained granite, especially with large feldspar crystals, might be weathered faster than fine granite. Water from abundant rainfall powers the weathering process especially hydrolysis. Relief governs the movement of water downwards or laterally down slope as throughflow. Abundant vegetation leads to humic acid formation which aids weathering. Stability is important in allowing sufficient time for deep weathering to occur. Much credit can be obtained from annotated diagrams.

(b) **To what extent do the nature of soils and climate cause problems for development of tropical savanna regions? [15]**

Soils are generally infertile and coarse grained. Seasonality of rainfall causes precipitation of minerals within the upper horizons rendering cultivation difficult. A hard lateritic layer is characteristic of many areas. Soils often lack organic matter and are poorly structured. Soil erosion is rife. Seasonal and variable rainfall also make development difficult with a gradation from the edge of the TRF to semi-arid regions. May mention other factors such as population pressures, overgrazing, etc to indicate the relative importance.

Level 3
Good knowledge of the nature of soils and climate and how they affect development. Some may recognise the gradation across the savanna and relate to sustainability. Other factors expected at this level in discussing extent. Examples will be accurate and relevant. (12–15)

Level 2
Some recognition of the nature of soils and climate but will often treat them as two separate groups of factors and not see them as integrated. Some vagueness in describing soil properties. Evaluation limited and likely to be between soils and climate only. Examples may be lacking or somewhat simplistic. (7–11)

Level 1
Limited grasp of the nature of soils or climate with an inability to relate them to development. Lack of relevant examples. (0–6)

3 Photograph A shows an area of coral reef off the coast of Antigua.

(a) Describe the distribution of coral reefs shown in Photograph A and explain the conditions needed for such coral growth. [10]

The photograph shows discontinuous fringing reefs developed in shallow, tropical waters off the coast of Antigua. Some may describe the coral as a combination of fringing reefs and the discontinuous type of barrier reef. Reward any relevant observation drawn from the photograph.

The main conditions for coral growth include

- Temperatures – tropical coral only lives in water with a temperature over 18 °C but ideally between 23 °C and 25 °C – hence coral is generally restricted to tropical environments. In Bermuda, however, they are found due to the Gulf Stream bringing heat further north. They are generally absent on the west side of tropical continents due to the presence of cold currents.
- Light – coral feed on tiny algae and these need light to photosynthesise. Hence coral tend to form in shallow water where there is more light.
- Clear, oxygenated water – sediment in the water affects coral's ability to feed and decreases the amount of light. Hence reefs are rarely found close to river mouths.
- Coral cannot live for long outside water so they are rarely found above the low tide level.

(b) Using examples, explain the factors that can produce variations in cliff profiles (cross section form). [15]

There are a number of factors – each should be supported with examples.

- Rock type – resistant rocks such as granite and basalt may form steep cliffs. So too can less resistant rocks such as clay.
- The rate of supply of sediment (cliff erosion) and removal is important. If removal equals the rate of supply, a steep cliff is formed. If supply is greater than the rate of removal a gentle cliff profile is produced.
- The orientation of bedding planes can produce steep or gently dipping cliffs.
- Climate and sea level change may produce beveled cliffs or slope-over-wall cliffs.
- A cliff with an extending wave cut platform may be protected from marine erosion and become gentler in profile through sub-aerial weathering.
- Sub-aerial processes may break down rock to produce scree like material at the base of cliffs.
- Mass movements can produce slumping and create complex cliff profiles.
- Human activity can alter cliff profiles, reprofile them or try to preserve them.

Level 3
Balanced account of a range of factors and supporting examples of different types of cliff profile. Likely to emphasise physical rather than human factors. Good levels of explanation. (12–15)

Level 2
A more generalised account of factors that are only partially related to cliff profiles. Support less strong. Description likely to be stronger than explanation. (7–11)

Level 1
Basic descriptive account of coastal erosion lacking in detail or support. Partial account. Of profiles or a misconception of profile. (0–6)

4 (a) Describe the formation and natural characteristics of either a coastal saltmarsh or a coastal sand dune complex. [10]

Coastal saltmarshes are dynamic systems extending from near total submergence at the seaward end to emergence at the landward end. They are saline environments where vegetation succession can be illustrated. Their formation is in more sheltered areas, such as behind spits. The halophytes (plants that tolerate the saline conditions) are able to colonise despite the daily submergence and saline conditions. These plants trap the sediment and thus the inter-tidal mudflats develop further through such processes as flocculation. Further characteristics are a lack of oxygen due to the waterlogging, and a high pH value. The sward zone contains more continuous vegetation, with hollows present containing more saline water (from the evaporation of sea water). The submergence of this zone is less though still present, thus plants such as sea lavender are present which are able to tolerate these conditions.

The coastal sand dune system is one with the youngest dunes on the seaward side, and the mature dunes inland. This is a dynamic system. The location of dunes is usually lowland near coasts of large tidal ranges and a plentiful supply of sand, facing the prevailing wind. The youngest dunes may have limited vegetation, with few plants being able to tolerate the conditions. This leads to features such as blow outs. These embryo and foredunes are more mobile than the mature system of grey dunes behind. The increase in both height and in biodiversity inland is partly due to the decreasing influence of the coastal conditions allowing more plants to colonise and climatic climax to be reached.

High marks should be given to candidates who tackle both the formation and the characteristics. Credit specific examples, including locations and named species.

(b) To what extent are the landforms found along a stretch of coastline the result of the characteristics of the waves present? [15]

The characteristics of the wave help to determine the types of landforms that are found along a stretch of coastline. For instance, in headlands and bays, the headlands receive more wave energy due to wave refraction and thus become more vulnerable to erosion. The bays are more sheltered and the waves found would be more low energy and thus the accumulation of material may happen, forming beaches and a natural protection from erosion.

However in the example above, this does not fully explain the landforms present – headlands and bays are most commonly found in areas of alternating rock type.

Beach morphology again can be determined partly by the characteristics of the wave. This determines whether the shoreline is swash aligned or drift aligned. The presence of a storm beach and a large breakpoint bar is characteristically from a destructive wave. Higher energy waves typically produce shallower profiles. But again, other processes help to explain the landforms present – storms can bring about changes in the landforms, sub-aerial processes provide additional sediment e.g. from cliff slumping. Man also has an influence (e.g. the role of hard engineering).

Expect candidates to use a range of landforms, both erosional and depositional. The better answers will focus on the balance between the characteristics of the wave and other important processes such as sub-aerial processes and rock type and structure. The best answers will focus on a detailed case study on one stretch of coastline.

Level 3
Good understanding of the variety of processes which operate along a stretch of coastline. These are linked well to actual landforms. The appreciation that whilst the characteristics of a wave may play an important role, this is not the only process which determines the resultant landforms. (12–15)

Level 2
The characteristics of waves will be described and linked to some landforms. There may be less consideration of other variables which may affect the stretch of coastline described. (7–11)

Level 1
An account of the characteristics of waves. There may be a simplistic link with erosional and or depositional landforms. (0–6)

5 Fig. 2 shows the distribution of areas affected by hurricane (tropical storm) activity.

(a) Describe and explain the distribution of areas at risk of hurricanes. [10]

Hurricanes are generally found in tropical and sub-tropical areas, mainly on the eastern side of continents. Not found within 5 degrees N & S of the equator due to coriolis effect. Highest frequencies occur off East Asia, the Caribbean and the Indian Oceans, plus eastern Pacific N of equator. Explanation should be in terms of the high sea temperatures generated in these areas supplying sufficient latent heat for the development of these large intense low pressure areas. Movement is predominantly east to west making low lying eastern coasts the most vulnerable.

(b) To what extent is it possible to manage the hazards posed by hurricanes? [15]

The main hazards include high wind speeds, high tides, storm surges and flooding – these are summarised in the Saffir-Simpson scale and how they vary with different categories of hurricane strength.

There are a number of ways in which this could be tackled e.g. how individuals could respond pre-hurricane, during the hurricane and after the hurricane. Alternatively, it could be seen as what a government or planning authority might do. For example,

Government and disaster agencies are likely to be involved in **monitoring** the hurricane and **predicting** where it is likely to make landfall so as to provide warnings. On a longer-term basis they are likely to be involved in **land use planning**. This is designed to control land use so that the least critical facilities are placed in most vulnerable areas. Policies regarding future development may regulate land use and enforce building codes for areas vulnerable to the effects of tropical cyclones.

A master plan for **flood plain management** should be developed to protect critical assets from flash, riverine and coastal flooding.

Reducing Vulnerability of Structures and Infrastructures

- New buildings should be designed to be wind and water resistant. Design standards are usually contained in Building codes.
- Communication and utility lines should be located away from the coastal area or installed underground.
- Improvement of building sites by raising the ground level to protect against flood and storm surges.
- Protective river embankments, levées and coastal dikes should be regularly inspected for breaches and opportunities taken to plant mangroves to reduce breaking wave energy.
- Improved vegetation cover. This helps to reduce the impact of soil erosion and landslides and facilitates the absorption of rainfall to reduce flooding.

Level 3
Balanced account of a range of ways of managing the risk of hurricanes. Likely to include short-term and long-term measures. May recognise the differences between the individual's methods and governments. Support likely to be present. (12–15)

Level 2
A more generalised account of measures. Likely to be unbalanced with a greater focus on either individual or government role. Support less convincing. Description likely to be stronger than explanation. (7–11)

Level 3
Basic descriptive account lacking in detail or support. Partial account. Unbalanced. Descriptive. (0–6)

6 (a) Explain the causes and distribution of earthquakes. [10]

An earthquake is the result of a sudden release of energy in the Earth's crust. The magnitude of an earthquake is measured on the Richter scale (1 = low; 9 = high).

Earthquakes are caused mostly by displacement or movement along faults due to the build up of tension, but also by volcanic activity, large landslides, and large underground explosions. Candidates are likely to use plate tectonics to explain the underlying reasons for movement of the Earth's crust that result in displacements and release of energy. Answers that focus on movement and build up of stress should be credited over those that simply describe plate tectonics.

(b) To what extent do physical factors and human factors influence the hazardous impact of earthquakes? [15]

Candidates must demonstrate an appreciation that earthquakes are only hazardous when they occur close enough to the Earth's surface to cause damage to buildings and people. The question allows candidates the opportunity to use examples or a case study to discuss factors that influence the impact of an earthquake. For example, an earthquake that occurs close to the surface and results in significant earth movement is likely to result in severe damage to infrastructure including roads, railways and buildings. An offshore earthquake may result in a tsunami and the resultant wave can cause very severe damage to infrastructure and loss of life through flooding near the coast.

Earthquakes are difficult to predict and often occur suddenly without warning giving people no time to evacuate or take other avoiding action. Candidates may refer to relatively recent events in Japan, New Zealand, Haiti, Chile or Indonesia to provide examples. The event in Haiti had a large impact because it occurred close to the surface and at night; the shock waves cause large displacement of the sediments on which the capital city Port au Prince was located. Most domestic buildings were poorly constructed and unable to withstand sudden earth movements thereby collapsing immediately and causing very heavy loss of life.

Level 3
Answers show a clear understanding of what constitutes a hazard and the factors associated with earthquakes that raise or reduce the risk to humans. Candidates will use well chosen examples to illustrate their answers and show some appreciation of how risk from earthquakes can be mitigated by appropriate construction techniques (e.g. California and Japan), planning controls & disaster planning (aware of aftershocks). (12–15)

Level 2
Aware of key factors such as location of epicentre and proximity to population centres. Aware of effects of earthquakes in causing damage through building collapse, landslides, tsunami etc. Able to use examples to illustrate answer but may lack detail. (7–11)

Level 1
Candidates show some appreciation that earthquakes can be destructive but answers do not make a clear distinction between the earthquake, the resultant damage and its impact on human populations. No clear understanding of factors that make a natural process hazardous. (0–6)

7 (a) Describe the nature of weathering of rocks in arid and semi-arid environments. [10]

Most will concentrate on the operation of thermal fracture (onion skin weathering) when diurnal heating and cooling can lead variously to sheet and granulalar disintegration. Freeze-thaw is also important in high altitude deserts such as the Colorado Plateau.
There should be recognition that water is important in rock weathering in arid and semi-arid environments. Salt weathering may at times be more important than insolation weathering, and experiments indicate that even that needs some water. Hydration weathering following infrequent rain storms is also relevant. There should be recognition of the role of dew and condensation in effects such as tafoni and chemical weathering.

(b) Fig. 3 shows the formation of a desert piedmont zone.

Assess the roles of weathering and water action in producing the distinctive landforms of the desert piedmont zone shown in Fig. 3. [15]

The main components of the piedmont zone are bahadas, playas, pediments, free faces (rock cliffs, inselbergs). Generally the free faces are affected by weathering processes resulting in rock falls, etc. Water action produces pediments, alluvial fans, bahadas and playas. The integration of the processes and landforms is important in understanding the evolution of features of the piedmont zone. Candidates may assess water and weathering in relation to other processes, notably wind action.

Level 3
Accurate knowledge of the components of the piedmont zone in their correct juxtaposition. A good annotated diagram will suffice in this. All the components will be assessed in equal measure with accurate knowledge of processes. (12–15)

Level 2
Will possibly not describe the piedmont zone in depth and there will be some inaccuracies in relating features to processes. The pediment is likely to be the most misunderstood feature. Diagrams will probably lack detail, especially in annotation. Some assessment of relative role of water action and weathering is likely. (7–11)

Level 1
Some knowledge of the features of the piedmont, but juxtaposition and relation to processes will be weak. Probably no meaningful assessment of the processes. (0–6)

8 (a) Outline the possible causes and consequences of desertification. [10]

There are many potential causes of desertification. Some are natural – such as long-term climate change and prolonged drought – but there are many that are human-related. These include the sedentarisation of nomads, increasing numbers of livestock for subsistence, deforestation for fuelwood and population growth, for example.

The consequences include reduced agricultural productivity, reduction of vegetation cover, soil erosion, soil compaction – in general the spread of desert-like conditions into areas which were previously productive. Candidates may develop consequences in human terms such as malnutrition and even migration.

(b) Using examples, assess the extent to which it is possible to manage an arid or semi-arid environment. [15]

There should be some indication as to how an arid or semi-arid environment can be managed in the long-term. An example could be the use of diguettes or earthen dams in the Sahel, the production of prickly pear in the Eastern Cape region of South Africa or mineral development in Botswana. The use of such areas for tourism and game reserves may provide a better return than farming. There may need to be some control through planning.

Level 3
Provide a suitable case study or case studies/examples that illustrate how it is possible to manage arid and semi-arid environments. They are likely to investigate some problems and potential solutions and deal with general management issues. (12–15)

Level 2
Example(s) selected may refer to mis-use of the environment rather than management. However, there could be some explanation of why the use proved poor. (7–11)

Level 3
A generic answer which does not deal with the management/cause-effect but merely considers human use of arid and semi-arid environments with little regard to the question. (0–6)