UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 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.

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Tropical environments

1 (a) Photograph A is a granite landform in South Africa.

Draw an annotated diagram identifying and describing the main features of the landforms and explain their formation. [10]

The landform is an inselberg (bornhardt). The rounded shape should be shown on the diagram with its relatively steep sides. The surface shows signs of curvilinear jointing (dilatation) as well as the surrounding collection of rounded boulders. The shape is determined by massive sheet jointing of the rock brought about by the release of the pressure of the overlying burden. The influence of the basal surface of weathering is evident not only in the shape but also the rounded nature of some of the surface boulders. Episodes of deep chemical weathering (hydrolysis) have alternated with periods of stripping, giving rise to etchplanation. Some may advance a case for pediplanation as rivers cut into the surrounding landscape. In either case there is a requirement for climate change.

(b) Describe the nature of savanna vegetation. To what extent does such vegetation represent a response to climate and soils and how much to human interference? [15]

Tropical savannas are characterised by a lower level of perennial grassland often 1-2 m tall at maturity and a distinct upper layer of woody plants. This can exist as an open shrub layer and/or of drought resistant trees. All the vegetation has to be able to withstand periods of drought which prevents the upper layer from dominating. The vegetation also has to be resistant to fire. The shrub-tree layer varies from 1–20m in height. The adaption to drought is shown by such trees as the baobab in terms of water storage in its broad trunk (the upside down tree) or thorny xeorphytic adaptions such as the acacia tree. Grasses have long roots and die back during the dry periods. Soils are lateritic and when baked hard can inhibit tree and shrub growth. Fires occur naturally and are initiated by humans. The vegetation is thus fire resistant and indeed often relies on fire to spread their seed. Savannas are often regarded as sub-climaxes and those in SE Asia are considered to be man made. Overgrazing produces patches bare of grass which can encourage soil loss, desertification, etc. In more humid areas overgrazing could induce shrub and tree growth (acacia savanna). The introduction of non-indigenous species (grasses in Australia) and acacias in parts of Africa has also impacted upon vegetation.

Level 3
Good description of the balance between grass land and shrub/trees with an appreciation of their environmental adaption. Some assessment of the role of humans in terms of fire and grazing impacts. [12–15]

Level 2
Basic split between grasses and such trees as acacia and baobab and some drought adaptions. The role of fire seen as essentially human and destructive. [7–11]

Level 1
Grasses and baobab with little estimate of structure or adaption. Man and fire as the main influence. [0–6]

2 (a) Describe and explain the characteristics of monsoon and seasonally humid climates in tropical areas. [10]

Both climates are seasonal and tropical, i.e. they are hot and have a marked seasonality to their rainfall. Generally the annual temperature range is less than the diurnal, but there is a cooler season in winter. Good answers should provide some examples of figures for temperature and precipitation range. In the case of the seasonally humid climates the rainfall is not always reliable, being dependent upon the movement of the ITCZ and its production of rainfall through convergence and uplift. The monsoon circulation is due in part to the differential heating of land and sea, although the ITCZ also plays some part as well.

(b) Explain how the nature of the vegetation in the tropical rainforest has been influenced by climate and human activities. [15]

TRF vegetation is clearly highly dependent upon climate, which supplies most of inputs to the nutrient cycle. Trees grow all year round due to constant high temperatures and ppt. Nature is affected by exposure to sunlight leading to emergents, canopy, shrubs, forest floor flora, epiphytes, etc. Other climatic adaptations are drip tip leaves, broad leaves lower in the canopy, etc. Human interference is not all merely destructive. Selected felling of emergents and upper canopy trees can lead to greater sunlight penetration to lower and shrub levels. Secondary forest growth is not as tall or as diverse as the original but is now widespread.

Level 3
Climatic influence on TRF understood and illustrated by reference to vegetation types. Human interference seen as more subtle than mere destruction in producing forms of secondary growth. [12–15]

Level 2
Climatic influences described with reference to the usual TRF structure. Less well developed in terms of vegetation types and more subtle adaptations. Human activities largely viewed as destructive leading to crop/grass replacement. [7–11]

Level 1
Hot and wet climate leads to diverse vegetation which is then destroyed by human clearance activity. No balance and little detail. [0–6]

Coastal environments

3 (a) Fig. 1 shows three types of cliff profile (i.e. cross section form).

Using Fig. 1, explain the three cliff profiles in terms of possible rock types, structure and erosional and weathering processes. [10]

A (slope over wall) – either a cliff of uniformly resistant rock where marine and sub aerial erosion has led to a half way stage of cliff retreat or there are weaker rocks overlying more resistant e.g. till over chalk etc.
B (rectilinear slope) – structure is the key factor with seaward dipping strata plus the processes of cliff foot erosion and removal and mass movement along bedding planes.
C (vertical cliff) – horizontal (or vertical) strata with again appropriate processes.

Nominally equal weighting, good candidates will be able to combine the profiles to avoid unnecessary repetition of processes, etc. Good answers will reveal detailed knowledge and use of appropriate terminology with respect to geology and processes.

(b) With reference to examples, describe and explain how human activities have impacted on landforms along coastlines. [15]

There is wide scope here, depending on examples chosen. Candidates may consider impacts on either or both depositional and erosional landforms and the effects of either or both activities and structures.

Good candidates will use case studies effectively with appropriate maps and or diagrams, whereas weaker ones will merely quote places and write in generalities of the effect of groynes, sea walls and so on. Accretion of beaches by groynes, leading to the reduction in cliff foot processes and, hence, cliff decline but with resultant starving of beaches along the coast having the opposite effect, would be one relevant approach. However other scenarios may include the effects of river dam construction, harbour building, coastal quarrying, dredging off shore, cliff top development, pollution and/or destruction of corals. Impact on landforms should be the focus in all answers. Explanation should be in terms of the processes operating and the sequencing of impacts.

Level 3
Good use of an example of a stretch of coast with realistic description and effective explanation. These will apply to both the human aspects and the resultant impact on landforms. A relevant and accurate map and/or diagram will be almost a requirement. Although named examples reflecting study of a specific stretch of coast will probably mark these answers, good answers could be in terms of well worked models of a stretch of coast. [12–15]

Level 2
A lack of detail and precision in both description and explanation. Examples will be less specific and reveal limited knowledge of processes and how landforms are affected. Some input of relevant ideas of the interaction and appropriate diagrams will mark the higher part of this level. [7–11]

Level 1
May be almost wholly descriptive with little relevant explanation and superficial treatment of how there have been impacts on landforms. Realistic exemplification will be lacking. [0–6]

4 (a) Explain how sediment is transported and deposited along coastal areas. Illustrate your answer with reference to the formation of two coastal landforms. [10]

Sediment is transported in suspended form by waves and currents. Heavier material, pebbles and cobbles can be rolled along the sea floor by storms and in high energy environments. The most common means is by long shore currents giving rise to beach and long shore drift. Deposition occurs where the current slackens and the load can no longer be suspended. This occurs at changes in coastal alignment or where the current slackens due to estuaries or shelving. These features can be illustrated by reference to the formation of spits, beaches, bars, etc. some may deal with salt marshes which is acceptable.

Much can be achieved through well annotated diagrams.

(b) Using examples, describe and explain the major threats to the continued existence of coral reefs. [15]

Corals require specific conditions for their survival and hence any significant alteration to these conditions can result in their demise. The main threats include coral bleaching and climate change from acidification and sea level rise, diseases of reef organisms, predators (crown of thorns starfish), invasive species, pollution, from land based human activities, overfishing, coastal modification (ports, groynes, etc.) coral mining, boating, snorkelling and tourism. Not all of these need to be developed but there should be some more general threats and not just reference to localised activities. Damage to coral reefs was particularly extensive in the Caribbean in 1998 due to extensive bleaching down to a depth of 40 m due to increases in sea temperatures and acidification. It is estimated that at least 16% of the global coral reefs have been severely damaged in this way.

Level 3
Good understanding of the conditions for coral growth and how threats appear at a global and local level. A range of threats (not exhaustive) but those selected well explained and illustrated. [12–15]

Level 2
Some concept of global threats to the conditions for coral growth but with limited explanation. More localised and specific threats. [7–11]

Level 1
Concentration upon more localised and minor threats (e.g. tying up boats to reefs or tourist thefts of coral). Little appreciation of threats to the fragile coral environmental conditions.[0–6]

Hazardous environments

5 (a) Fig. 2 shows the global distribution of volcanic hot spots.

Explain the nature of volcanic hot spots and describe how their distribution differs from that of other types of volcano. [10]

Hot spots are located above permanent and deep seated sources of magma plumes. Faults in the earth's crust allow magma to erupt at the surface to produce basaltic types of volcanoes such as Hawaii and La Reunion. As the plates are moving so the volcanoes will move with age thus producing extinct volcanic cones, craters, etc. many of which are located under the ocean. The distribution of hot spots tends to be in the central parts of plates away from the margins. Other volcanic activity in general is particularly associated with subduction and hence destructive boundaries such as is apparent in the Pacific ring of fire.

(b) To what extent and why are earthquakes more hazardous to human life than volcanoes? [15]

Although volcanoes can generate huge amounts of energy and are very destructive, they are more predictable than earthquakes. Explosive volcanoes (Plinian) can lead to loss of life due to the speed of pyroclastic flows, etc. but the monitoring of volcanic activity through tilt meters, bulging, gas emissions, temperature, etc. allows at least 4 days warning of a major eruption. This is generally time enough for evacuation plans to be put in place. Recent experience has shown the success of these methods e.g. Montserrat, Mount St Helens and others. This contrast with the past (Krakatoa, Vesuvius). Earthquakes remain stubbornly unpredictable and many attempts at prediction research have now been abandoned. Seismic gaps etc. may allow likely fault areas to be identified but not the timing of the actual earthquake. The effects of the quakes and after shocks are devastating in crowded areas of poor building quality (e.g. Haiti 2010) Also the disruption to services makes the provision of aid difficult thus exacerbating the death toll.

Level 3
Good account of the hazardous nature of both volcanoes and earth quakes with an assessment of their predictability and justification for conclusion. [12–15]

Level 2
A greater concentration on the nature of the hazards associated with volcanoes and earthquakes with limited account of prediction methods but little assessment. [7–11]

Level 1
Accounts of the hazards and their impact rather than any assessment of their respective impact upon human life. [0–6]

6 (a) Explain how hazardous mass movements occur. [10]

Mass movements are due to slope failure and become hazardous when there is a threat to human life and property. Reasons for slope failure should be given – geological, water content, angle of slopes, etc. and triggers such as tectonic, volcanic and climatic events and possibly human activities. Some may deal with snow avalanches, but other forms of mass movement should be included.

(b) To what extent can such mass movement events be prevented from occurring and their hazardous effects limited? [15]

The hazardous effects of mass movements are the destruction of human settlements and communications through the impact of landslides, and mud and earth flows. Recent example is the massive mud flows in China with devastating consequences. Human activities might be illustrated through Aberfan or Italian dam bursts.

It is possible to identify areas of potential mass movement events but their timing, scale and extent can rarely be forecast accurately. Longer term identification based on geology and hydrology of area, but shorter term will depend on recent weather and changes to environment, such as cut and fill new road through mountains, excavations at foot of slopes for new buildings, etc.

Prevention may take the form of reducing pressure on the slope, controlling slope face processes e.g. using sheet piles, draining the slope, reducing slope foot processes e.g. gabions, changing the angle of the slope so it is nearer the stability angle and planting vegetation to bind the slope surface. These attempts at prevention may only limit effects.

Higher level responses would look at the causes – reduction in shear strength and increase in shear stress to see how these can be prevented. Some may conclude they can't be prevented but their impact can be moderated e.g. hazard mapping or the operation of land zoning.

Level 3
Balanced attempt at evaluation of whether mass movements can be prevented. Knowledge and understanding of ways of preventing mass movements are good. Clear recognition that their success may vary over time, location and with the nature of area/mass movement and its causes. A range of appropriate examples. [12–15]

Level 2
Sound or unbalanced attempt at evaluation of whether mass movements can be prevented. Some limited recognition that success may vary. Knowledge and understanding of ways of preventing mass movements are sound. A range of appropriate examples. [7–11]

Level 1
Little, if any, attempt at evaluation of the ways mass movements can be prevented. Knowledge and understanding of mass movement and prevention methods are limited. Few, if any, appropriate examples. [0–6]

Arid and semi-arid environments

7 (a) Fig. 3 shows the location of some coastal deserts.

Outline the characteristics of hot arid climates and explain how pressure systems and ocean currents play a part in the distribution of the deserts shown in Fig. 3. [10]

There should be data to back up statements of low annual rainfall, high temperatures, seasonal and diurnal temperature ranges. Relative humidity, nocturnal dew and high winds are other characteristics that can be developed but only an 'outline' is required. The Hadley cell should feature in the second part together with the trade wind belt and cold ocean currents along western coasts e.g. Benguelan and the Namib, Peruvian and the Atacama.

Better candidates will give accurate detail in all cases such as adiabatic warming of the descending limb of the Hadley cell; trade wind systems from the north/south east across continental land masses; off shore cooling of air over cold currents hence moisture deficient then warmed when moving over coastal land areas.

(b) Explain the factors that can lead to desertification in semi-arid areas. Evaluate the attempted or possible solutions to the problem of desertification for the sustainability of such areas. [15]

Natural and human factors should be addressed. Natural causes include climatic change, giving extended periods of drought or fire destroying vegetation. Destroyed or reduced vegetation cover in a dry environment leads to soil degradation and wind erosion. Human factors have been perhaps the major contributor: over grazing, depletion of any tree cover for building and fuel, inappropriate cultivation and irrigation and all exacerbated by increasing population pressure.

Case studies, or examples, with realistic and appropriate detail required in evaluating measures to combat or overcome desertification. Addressing the problem should be recognised as a monumental task with no simple solutions. Expect wind breaks or structures to reduce the advance of sands, drought resistant crops, such as sorghums, in place of exhausting cash crops. Controlled drip irrigation systems in place of field ditches and the control of grazing. Input of fertilizers and mulching. But realisation of the poverty of most such areas and that all 'solutions' require knowledge and capital. Understanding of the work of NGOs as well as government agencies.

Level 3
Balanced knowledge and good understanding of causes. Good knowledge of the physical environment with a realistic understanding of the difficulties of applying any effective solutions. Appropriate detail and ability to weigh up their likely and long term success. Exemplification in all parts of the answer. [12–15]

Level 2
Both parts of the question addressed but somewhat lacking in accurate detail and limited in examples. Some appropriate solutions with limited evaluation but not well developed or detailed. At the lower end of the level the solutions are unrealistic and an awareness of the true nature of the environment lacking. [7–11]

Level 1
Weak in coverage and appropriate accurate knowledge of the nature of the environment. A confused mix of solutions with little on no evaluation. [0–6]

8 (a) Explain the operation of weathering and wind erosion in deserts. What impact do they have upon desert landforms? [10]

Weathering in deserts will mainly be associated with thermal fracture due to the high temperature ranges. Better answers will realise that there is a role for chemical weathering due to the occasional incidence of rain, but more the impact of dew and condensation on the underside of rocks. The form of chemical weathering will depend on rock type, but some may be aware that some coastal deserts have drizzle and fog. Wind erosion will be more familiar territory and will involve the process of abrasion to produce features such as yardangs, zeugens and driekantors. Weathering impact on landforms is less marked being generally a slow process, but can result in sheeting and granular disintegration.

(b) To what extent do climate, biodiversity, nutrient cycling and soils in hot arid areas limit the possibilities for their development? [15]

The harsh climate of aridity with high temperatures and winds is not conducive to biodiversity which remains very low. Plants have to exhibit specialist adaptions (xerophytic, phreatic) in order to survive. Densities remain very low which means a lack of litter stores and very limited biomass. Soils are structureless, lacking humus and characterized by upward capillarity and salt accumulation. This does not provide fertile ground for development. The one commodity in abundance is solar radiation which could be used to provide energy for desalination and greenhouse cultivation to create an artificial environment for plant growth. Generally little has as yet been achieved save in more favoured locations with nearby water supplies.

Level 3
Good appreciation of the links between the elements in the question with aridity providing the key. The limitations will be seen in terms of the ecosystem and the need to provide circumstances whereby it can be ameliorated. Use of appropriate examples. [12 –15]

Level 2
Description of the nature of desert climate vegetation and soils with only a very limited linking through nutrient cycling. Development will be suggested in terms of irrigation, etc with little appreciation of its feasibility. [7–11]

Level 1
Hot and dry conditions that produce little more than the cactus. All can be solved by the damming of unspecified rivers and the use of water to irrigate. [0–6]