CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2013 series

9696 GEOGRAPHY

9696/23 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 should be read in conjunction with the question paper and the Principal Examiner Report for Teachers.

Cambridge will not enter into discussions about these mark schemes.

Cambridge is publishing the mark schemes for the October/November 2013 series for most IGCSE, GCE Advanced Level and Advanced Subsidiary Level components and some Ordinary Level components.

CAMBRIDGE
International Examinations

Tropical environments

1 (a) Describe the nature of the Inter Tropical Convergence Zone (ITCZ) and explain how the seasonal movement of the ITCZ and air masses can influence tropical climates. [10]

The ITCZ is a zone of the convergence of air, produced by convection from the heating of the earth's surface by the overhead sun. This produces uplift and an area of low pressure to which surface winds blow. In this case the North-east and South-east trade winds. The ITCZ forms the thermal equator and will move with the overhead sun due to the earth's tilt. Thus in July the ITCZ will migrate northward when the sun is overhead at the tropic of Cancer and in January south of the equator when the sun is overhead at the tropic of Capricorn. This will affect the pressure belts weakening the sub tropical highs and moving equatorial low pressure belts north and south of the equator. As the low pressure belts are areas of convectional uplift, rain is possible although but not always certain. This has a vital impact upon seasonally humid tropical climates and can also affect the tropical monsoons.

(b) Fig. 1 shows nutrient cycling in tropical rainforests.

Briefly describe the ways in which nutrients are cycled in Fig. 1. Explain the changes that would occur in the nutrient cycle after shifting cultivation has taken place. [15]

A diagrammatic representation of the nutrient cycle rather than the gerschmel flow diagram. The principles remain the same with inputs through climate and soil minerals and outputs through leaching and any vegetation losses. The climate ensures very rapid uptake of nutrients from the soil and litter into a very extensive biomass. The biomass thus is by far the largest nutrient store with soil and litter retaining few nutrients. The system is self perpetuating whilst undisturbed, but intervention in the form of shifting cultivation can have dramatic impacts. The replacement of trees by crops means that a proportion of the nutrient stores will be lost to cropping and hence will affect the flow between litter and biomass. Similarly the exposure of the soil to climatic elements can result in increased leaching and nutrient loss. Even after abandonment the nutrients available may only be sufficient for the development of secondary forest.

Level 3
Interprets the diagram in terms of nutrient cycles. Is aware of the interruptions to the system produced by clearance and cultivation and able to express this in terms of the nutrient cycle. **[12–15]**

Level 2
More descriptive of the diagram, but does attempt some organised progression through the flows of nutrients and the main elements of vegetation (biomass) soil and litter. More emphasis on vegetation losses and soil depletion in consequent clearance. **[7–11]**

Level 1
Repeats the diagram with little attempt at organisation. Clearance will result in soil erosion, loss of plant diversity etc. **[0–6]**

2 (a) Explain how deep weathering profiles develop in humid tropical areas. How can these deep weathering profiles influence the development of granite landforms? [10]

Deep weathering profiles are produced in the humid tropics because the climate (temperature and precipitation) promote rapid rates of chemical weathering. The abundant vegetation also prevents some erosional loss of regolith as well as adding humic acids to the weathering profiles. This allows the development of a basal surface of weathering. Granite is a resistant igneous rock but is vulnerable to chemical weathering (hydrolysis) through both its mineral content and more importantly its jointed structure. Diagrams could be used to show the break up of granitic structures into blocks and core stones and the influence of sheet jointing on the development of inselbergs. When regolith is stripped these structures are revealed at the surface as tors and inselbergs.

(b) Describe the main characteristics of the savanna ecosystem. To what extent are savanna ecosystems the result of human interference? [15]

The savanna areas are located in seasonally humid tropical areas and reflect some variety in the nature of their ecosystems. All, however, show some adaption to the existence of a dry season. Plants have to adapt to this and the most common species is that of various grasses which have long root systems and die back in the dry period. There is often an open canopy of drought resistant or browse resistant trees in slightly wetter areas or an open shrub layer. Thus there is variation between, tree or woodland savanna, park savanna, shrub savanna and grass savanna. In the drier areas plants display more xerophytic adaptions whereas others display resistance to animals or fire. Soils also vary according to bedrock and edaphic conditions. Laterisation is a common feature. The fauna has the greatest diversity of hoofed mammals (ungulates) as well as a diverse set of carnivores although these will vary according to the type of savanna.
Savannas are not thought to be a climatic climax but a sub-climax of what would have been a seasonal woodland climax. The sub-climax could have been induced by regular burning. Other savannas may represent grazing sub-climaxes.

Level 3
Good understanding of the climatic influences on the development of savanna with ecological description extending beyond vegetation. An awareness of the sub-climax status and some of the causes. **[12–15]**

Level 2
Description largely limited to vegetation that encompasses some variation i.e. grasses, acacia trees and baobabs. Fire seen as the main element in the production of savanna areas. **[7–11]**

Level 1
Grasses and baobabs are the limit to description. Some influences of fire may be recorded. **[0–6]**

Coastal environments

3 (a) Describe the characteristics of coral and explain how coral reefs and atolls were formed. [10]

Coral reefs are biologically very diverse ecosystems comprised of marine animals. The coral polyps attach themselves to hard surfaces in shallow seas. As they grow they exude calcium carbonate which forms their skeleton. As they grow and die these colonies of polyps create reefs. Formation will largely be in terms of the Darwin thesis of a sinking volcanic island being surrounded progressively, by fringing, then barrier reefs and finally an atoll. Alternatives might be given, such as Daly or Murray but will still depend upon changing sea levels.

(b) Photograph A shows some coastal landforms.

Using a sketch diagram, identify the landforms and explain their formation. To what extent are such depositional landforms fragile environments that can be rapidly altered by physical processes and human interference? [15]

The main feature is a spit. Sketch diagrams should show its main shape and the existence of dunes in the central part of the spit. The more sharp eyed might note the bar developed on the seaward side and the sand deposition inside the spit. Formation should be couched in the usual terms of accumulation of sediment transported by longshore drift at points where the current changes, such as an estuary. The dunes represent the accumulation of the sand deposits by the wind, which are then anchored by vegetation. These are very fragile landforms easily prey to changes in sediment supply or winter storms. The more observant may notice the thinness of the spit which can easily be breached. Human activities can stabilise (through vegetation coastal protection schemes) or destabilise these environments by interference with sediment supply or inappropriate uses for leisure etc.

NB If no diagram, limit to Level 2.

Level 3
Sketch that shows the correct shape and identifies main features which can be employed in the explanation of formation. Justification of fragility with some appropriate examples of the effects of both physical and human activities. **[12–15]**

Level 2
Diagram becoming more text book model but with identification of significant features. Formation largely restricted to LSD in the form of beach drift and fragility largely due to human activities. **[7–11]**

Level 1
Crude diagram with little more than a spit identified. Formation simplistic and destruction largely due to human occupation. **[0–6]**

4 (a) Explain the processes that lead to the development of a wave-cut platform. [10]

The main marine erosion processes should be described, i.e. hydraulic action, wave quarrying and corrosion. These should be put into the context of the erosion of a cliff and its retreat, leaving the existence of a wave cut platform from which much of the eroded cliff material has been removed. The retreat of the cliff may have been aided by mass movement consequent upon sub-aerial weathering. Much can be achieved through a well annotated diagram(s).

(b) Describe the nature of a coastal sediment cell. Explain how studying sediment cells can give an understanding of the processes operating along a coastline and can help plan its management. [15]

A sediment cell comprises part of a coast and its immediate off shore sea in which sediment is cycled in the form of sources, transport and sinks. Thus each cell is powered principally by waves which obtain sediment through erosion, transport it by currents and longshore drift and deposit it in sinks such as coastal depositional landforms of beaches, spits and bars. These systems are not completely closed systems but they do not appear to overlap very much. They do provide a means of organising studies and can be illustrated by reference to particular examples of coastal stretches. As such they can help in management by demonstrating the inter-related nature of coastal processes such that an alteration to one element will have consequences elsewhere. For example entrapment of sediment in one place could remove sediment from elsewhere, allowing enhanced coastal erosion. That is the system has to reflect some sort of balance.

Level 3
Good understanding of the nature of a sediment cell and good exemplification. Role in coastal management explained and illustrated. **[12–15]**

Level 2
A more simplistic description of sediment cells but an awareness that they deal with the erosion, transport and deposition of sediment. Little appreciation of their role in planning beyond the possible knock-on effects of action. **[7–11]**

Level 1
Sediment cells seen largely as depositional landforms or landform. Planning restricted to hard engineering. **[0–6]**

Hazardous environments

5 (a) Describe the main types of volcanic eruption and explain where they occur. [10]

There are many ways in which volcanic eruptions are classified, but most distinguish between the quieter, effusive type of eruption and the violent explosive eruptions.
The effusive types of eruption are associated with the Hawaiian eruptions which are located on hot spots. Lava flows emerge from the flanks of central vent volcanoes. Icelandic fissure eruptions (divergent plate boundaries) are often classified in this type of eruption. The violent explosive eruptions are Plinian. Here enormous ash clouds which descend to form pyroclastic flows that pour down the flanks of the volcano with often side explosions as at Mt St Helens. These form on destructive (convergent) plate margins often where an oceanic plate is subducted below a continental plate. In between are a number of types of eruption of increasing violence (Strombolian – with incandescent lava; Peléan – with nuées-ardentes; Vulcanian with gases that blast apart congealed crust). All however are located on convergent plate boundaries.

(b) Fig. 2 shows some methods of prediction of volcanic eruptions.

Explain how these methods can be employed for predicting eruptions. Describe the types of volcanic hazard that are important to predict in order to minimise deaths. [15]

The fig shows a number of ways by which volcanoes are monitored and predictions of eruptions made. Thus tiltmeters, seismographs, satellite observation temperature and gas measurements are all shown. Candidates should then explain how these are used in prediction. Thus a number of small earthquakes occur as the magma chamber fills, ground swelling as the magma approaches the surface, temperature and radon gas emissions occur with the movement of magma closer to the surface. All types of volcanic hazard are to some extent dangerous, but explosive events and pyroclastic flows are more lethal and therefore more important to predict. Evacuation is possible with sufficient warning and prediction now can often be made several days ahead of an eruption. Some hazards can spread considerable distances (ash, tephra) whilst other very dangerous secondary hazards can be triggered such as lahars.

Level 3
Good association of monitoring with volcanic activity and hence prediction. An awareness of the nature of hazards and their relative importance in terms of prediction. **[12–15]**

Level 2
Longer on methods and shorter on the volcanic activity they are testing and hence prediction. Rather a list of volcanic hazards than any assessment. **[7–11]**

Level 1
Repeats the material from the diagram with little additional material. Disorganised account of volcanic hazards and/or eruption. **[0–6]**

6 (a) Explain the causes of hazardous mass movements. [10]

Hazardous mass movements are large scale and fast. They can be the result of normal slope processes leading to failure. Thus shear stress overcoming shear strength, pore pressure by increased rainfall or a sudden thaw creating snow melt. Many can be the result of other hazardous activity such as tectonic activities associated with earthquakes and volcanic activity. Earthquakes can destabilise slopes, volcanoes produce snow melt and engender lahars. Intense storms can also bring about slope instability. Human activities can also contribute although their influence is more limited. Deforestation, undercutting, and overloading can all affect slope stability as can off-piste skiing.

(b) Using examples, describe the types of hazard that result from mass movements and explain how far it is possible to manage the risks to human life. [15]

The main types of hazard are those produced by landslides, mudflows, rock and snow avalanches. They occur suddenly and engulf settlements often with considerable loss of life. Descriptions could be made of:
Mudflows consequent upon hurricanes in the Caribbean and volcanic eruption in Colombia (lahars).
Landslides after earthquakes.
Rock falls.
Snow avalanches.
The management of risk is largely one of avoidance i.e. not to build in areas prone to such hazards. Some of the human causes can be avoided (e.g. deforestation, slag heaps, quarrying and mining, undercutting of slopes).
In the case of snow and ice avalanches, they can sometimes be triggered in advance, before they become dangerous, or snow fences can be erected or barriers protecting settlements. In many cases however, both prediction and ameliorative measures are few and far between.

Level 3
Good range of mass movements and an understanding of their nature and hence the risks that they pose. A realistic assessment of risk limitation with good exemplification. **[12–15]**

Level 2
Some range of mass movements although a more limited explanation of their hazardous character. A tendency to focus on one type of hazard (e.g. avalanches) in describing risk abatement. **[7–11]**

Level 1
Vague descriptions, often limited to one or two types of mass movement. Little/no realistic assessment of the risks posed. **[0–6]**

Arid and semi-arid environments

7 (a) **Explain the causes of aridity. Describe the characteristics of a hot arid climate in terms of precipitation, temperature and wind. [10]**

The arid areas of the world (under 250mm rainfall) are caused by the existence of sub tropical high pressure, continentality, rain shadows and cold ocean currents. Each should be explained. Deserts are high wind environments due to the high temperatures and lack of barriers. The unconsolidated and dry nature of the surface can produce frequent dust storms. Precipitation is scarce but not completely absent from most deserts. High levels of convection can bring about violent storms but these are usually short lived and very episodic. Temperatures can reach very high readings during the daytime due to cloudless skies, but at night time can fall to freezing as rapid radiation cooling will occur. Thus diurnal temperature range is greater than seasonal.

(b) **Photograph B shows some landforms found in hot arid areas.**

Draw a sketch diagram to identify the landforms. Explain how the landforms were formed and to what extent they are the result of weathering and erosional processes operating today. [15]

The photograph shows a dissected mountain front in the background separated by a sharp knick from a pediment area. In the foreground the pediment has become covered by dunes that are anchored by vegetation. A case could be made for barchan (crescentric) and linear dunes.
The formation of these features can be approached by the weathering and erosion of the mountain front by both stream flow in the wadis or arroyos, water debouching onto the pediment that is eroded by sheet floods. Material that has been accumulated by these activities is then redistributed into the dune shapes which can be explained by wind direction and vegetation obstacles. The amount of geomorphic work undertaken is clearly beyond the scope of current processes. Hence the assumption that these are relict features which are the result of past pluvial periods and in some cases many past pluvial periods. The sand dunes are clearly being reworked by current wind processes but the origins of the sand are also the result of past erosional processes.

Level 3
Sketch diagram that is adequate to identify the main features of a dissected mountain front, knick, pediment and dunes. Formation explained and good assessment of past/present processes. **[12–15]**

Level 2
Sketch concentrates on the dunes with only limited identification of the mountain front features. Explanation follows the same pattern and a distinction made between dunes (present wind processes and past fluvial erosion). **[7–11]**

Level 1
Only the dunes identified and explained in terms of wind and obstacles. Mostly assigned to present day processes. **[0–6]**

8 (a) **Describe what is meant by biomass productivity, physical drought and physiological drought in hot arid environments. Explain how these factors affect soil characteristics in these environments. [10]**

Biomass productivity (sometimes called net primary productivity) is a measure of the amount of biomass produced per square metre a year. In hot arid areas this is very low i.e. about 0.003 kilos per square metre. Physical drought is the lack of rainfall less than 250mm per year) whilst physiological drought is that produced where potential evapotranspiration rates are greater than the input of precipitation or other water. The significance for soils is that they lack organic material as the regolith is shallow with sparse vegetation. In terms of drought this inhibits micro-organism activity and there is little sorting of surface material. With physiological drought, groundwater is drawn to the surface by capillary action and leads to concentrations of salts in the upper horizons. Hence solonchak and solonetz soils.

(b) **Explain how desertification has occurred in semi-arid areas. To what extent is it possible to stop desertification and reverse its effects? [15]**

Desertification is the encroachment into semi-arid areas of desert conditions of both aridity and dune development. Its causes are drought that is possible part of normal climatic cycles, global warming inducing climatic change or human intervention. It is the last that will gain most attention and is related to overgrazing, over population, destruction of vegetation and the draining of fossil water supplies. The effects are the deterioration of soils, the loss of vegetation leading to deflation and the development of dunes and the general increase in surface run off when rain does occur. Examples can be cited as the Sahel, Dust Bowl etc.
Attempts have been made to remedy these situations but generally only in limited areas. They rely on reducing grazing, lowering populations and providing alternative more sustainable occupations (e.g. bee keeping). Large scale irrigation has generally proved unfeasible or ineffective.

Level 3
Good understanding of desertification, its causes and effects. Use of good examples or case studies of attempts to reverse the processes with an assessment of level of success. **[12–15]**

Level 2
Desertification seen more in terms of general deterioration and the causes mostly human. Effects are largely soil deterioration. Rather generalised schemes with little assessment made. **[7–11]**

Level 1
No definition of desertification and weak appreciation of any causes and few if any effects. Schemes for reconstitution will be limited to large scale irrigation (e.g. The Nile). **[0–6]**