

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**  
GCE Advanced Subsidiary Level and GCE Advanced Level

**MARK SCHEME for the May/June 2010 question paper**  
**for the guidance of teachers**

**9696 GEOGRAPHY**

**9696/22**

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

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## Tropical environments

Only *one* question may be answered from this topic.

1 Fig. 1A and Fig. 1B show some weathering in a tropical environment.

- (a) Explain the processes of weathering shown in Figs 1A and 1B and suggest what landforms might be produced. [10]

The weathering process(es) is that of chemical weathering occurring under the regolith. This could be ascribed to either hydrolysis or to carbonation. It is occurring along lines of structural weakness that is jointing within the rock. The weathering plane forms the basal surface of weathering and the acidulated water effecting the weathering could be enhanced by humic acids. The joints are emphasised by the weathering processes leading to the development of core stones. With stripping of the overlying regolith blocks of rock are exposed at the surface forming a tor or Castle Kopje. This is then subject to further surface weathering through rainwater and exfoliation, etc.

- (b) With the use of an example or examples, discuss the extent to which the continued existence of one tropical ecosystem is threatened by human activities. [15]

Either TRF or savannah ecosystems could be selected, although, I suspect the majority will opt for the former. In this case they are likely to argue that the ecosystem is under great threat due to clearance for timber, ranching, agriculture, etc. The ecosystem does include both animals and soils – so the impact of human activities on these should also be assessed. Some may argue that strenuous efforts are being made now to preserve TRF environments (e.g. Queensland) and to find productive use for the ecosystems (i.e. controlled tourism, selected felling, replanting schemes)

Savannah ecosystems, it could be argued, are in part induced by human activity (i.e. fire) as they can be viewed as a plagio-climax. Threats still exist through such things as the introduction of alien grasses which take over the ecosystem (Australia) or over grazing, clearance for agriculture and the subsequent deterioration of the lateritic soils. The extraction of water for irrigation can lead to the destruction of natural woodland and increasing levels of drought which could induce dust bowl type conditions.

- Level 3 An appreciation of the nature of the ecosystem and its full frailties. Not just vegetation but an awareness of the disruption to nutrient flows and its likely impact upon soils and animals. An attempt at some assessment of extent of continued existence. Of an example or examples. [12–15]
- Level 2 Some awareness of the nature of the ecosystem and the threats to its existence, although the latter will dominate. Concentrates on vegetation and its destruction, but some exemplification. [7–11]
- Level 1 Seen as an opportunity to catalogue the ways in which the vegetation is being destroyed globally by a multiplicity of human agencies. Little exemplification. No attempt at impact or at balance. [0–6]

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- 2 (a) Explain the influence of the inter tropical convergence zone (ITCZ) upon the weather experienced in tropical areas. [10]

The ITCZ being a convergence zone leads to uplift, cooling and hence the possibility of convective induced rainfall. The seasonal movement of the ITCZ (i.e. with the thermal equator) is vital in bringing rains to seasonally humid climates in the tropics. Years in which such movement is less pronounced can lead to periods of drought. Better answers may be able to develop the role of the ITCZ in monsoon climates.

- (b) To what extent can the nature of vegetation in the tropics be attributed to climate? [15]

Most will argue that to the greatest extent vegetation is dependent upon climate. They will cite the luxuriant species rich vegetation of the TRF as being dependent upon high inputs of ppt and year round high temperatures which allows the development of a layered structure of vegetation with the richest nutrient store being found in the biosphere. In contrast the seasonality of ppt inputs into the seasonally humid tropics results in a drought period inhibiting growth and restricting the vegetation to long rooted grasses and water storing trees.

Better answers will realise that soils (hence geology), altitude and human activities do have a role to play. Altitude and soils can lead to variations in the TRF (cloud forest, etc.) and variations along soil catenas in both the TRF and savannah. Human activities can be seen as partly responsible for savannah as well as the development of secondary forest in the TRF.

- Level 3 Good description of the climatic parameters and their impact in terms of vegetation. Will realise other factors do come into play which are outlined and then a judgement made as to their relative significance. [12–15]
- Level 2 Establishes some descriptive link between climate and vegetation in the humid and seasonally humid tropics. Reasonable description of vegetation types although only limited appreciation of any other contributory factors or variations. [7–11]
- Level 1 Hot and wet gives TRF and hot and partly dry gives savanna. Outline description of vegetation (particularly savanna) and little awareness of variation beyond human destruction which may be developed to the exclusion of all else. [0–6]

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## Coastal environments

Only *one* question may be answered from this topic.

### 3 Fig.2 shows one theory of the formation of coral reefs.

- (a) Explain the theory shown in Fig. 2 and outline one other theory of coral reef formation. [10]

Darwin's theory postulates the sinking of a volcanic island and the growth of coral to accommodate the sinking island. Thus the original fringing reefs become offshore barrier reefs and finally a coral atoll. Other theories could be that of Daly, where changing sea levels during and after the ice age are accompanied by coral exposure in sea level fall and its subsequent upward growth from eroded marine platforms, keeping pace with the rise in sea levels. Other possibilities would be Murray's theory of upward growth from submarine platforms or the influence of sea floor spreading.

- (b) Describe the processes of marine erosion. To what extent are these processes responsible for the landforms of rocky coastlines? [15]

The main processes should be described in some detail. That is, hydraulic action, wave quarrying, cavitation, abrasion, attrition and solution. Their effectiveness can be illustrated by the landforms produced in high energy environments. Cliffs, wave cut platforms headlands, bays and inevitably caves, stacks and stumps. These processes do not act in isolation, however, as rock type and structure have major roles to play as, to a lesser extent, does such features as sub-aerial erosion and weathering.

- Level 3 Cogent exposition of the processes and their effective illustration by reference to the landforms backed up by useful exemplification. The influence of rock type and structure will be understood and briefly illustrated. [12–15]
- Level 2 An understanding of the erosion processes and their illustration by reference to a range of landforms. Other aspects such as geology will be far more limited in its appreciation, may be extending little beyond a mention. [7–11]
- Level 1 Partial appreciation of processes with illustrations limited to stacks and stumps. The role of any other factors (save human intervention) will be overlooked. [0–6]

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- 4 (a) Describe the sources of coastal sediment and explain how sediment is transported along coasts. [10]**

Coastal sediment is derived from marine erosion (e.g. cliffs), downward movement of beach materials and from estuaries and river mouths. Some might be recycled from off shore bars, etc. It is transported by suspension, saltation and traction and moved along the coast by the offshore currents such as long shore drift as well as beach drift.

- (b) Using diagrams, explain how spits and saltmarshes are formed. To what extent are they threatened by human activities? [15]**

Diagrams should show the development of spits due to the lateral movement of sediment by LSD and its deposition where the current slows (e.g. estuary or change in coastal orientation). The shape of the spit as well as the development of salt marshes should be illustrated and be reasonably accurate (not just a banana type diagram). Salt marshes as areas of accumulation of organic rich estuarine muds and sands should be described within the areas of tidal change. As the spits are fragile landforms prone to natural alteration and destruction they are clearly at risk from human activities. The restriction of sediment supply by coastal features such as groynes or changes to river courses can have significant impacts as can the removal of materials. As the spit protects salt marshes they too become vulnerable with the additional hazard of coastal pollution.

Level 3 Well constructed and annotated diagrams will illustrate the explanation of formation. Human activities will be seen in context and can be argued to be protective from natural destruction as well as destructive in their own right. [12–15]

Level 2 An appreciation of the movement of coastal sediment and the mode of its deposition as a spit. Salt marshes may be less well developed and the impact of humans will be seen as mainly destructive in allowing coastal development and pollution, etc. [7–11]

Level 1 Poor diagrams (coastal banana) and little appreciation of how spits or salt marshes accumulate or what they constitute as a landform. Human activities will be destructive if somewhat unspecific. [0–6]

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## Hazardous environments

Only *one* question may be answered from this topic.

5 Figs 3A and 3B show two types of snow avalanche.

- (a) Explain how such avalanches occur and describe one method employed to limit their hazardous effects. [10]

The two avalanches are that of powder avalanches and slab avalanches. Powder avalanches usually start from a single point and accumulate snow as they descend. Most common following heavy snow on a smooth frosted surface. Snow will ride up on a cushion of air in front of which can be a blast wave.

Slab avalanches are caused by a slab of compact snow slipping forward. Requires wind speeds of 16–50km/h to maintain movement and occurs in very cold periods.

Methods could be reinforcing buildings, placing wind baffles, snow fences, tree planting artificially triggering avalanches. Preventing access to dangerous slopes.

- (b) To what extent are the hazards produced by mass movements on slopes the result of human activities? [15]

This includes all hazardous mass movements and is not limited to snow avalanches. Mass movements are triggered when shear strength is exceeded by shear stress. In hazard terms this is frequently the result of earthquakes, volcanic activity or slope failure through water (pore) pressure as the result of storms. Human activities can produce instability in slopes through activities such as mining, quarrying, undercutting, off-piste skiing, etc. or through inadequately constructed dams. In terms of hazardous outcomes human influence is probably a minor impact.

Level 3 A well argued case that explains and exemplifies the hazards associated with mass movement. The causes will be well explained and a sound case argued. [12–15]

Level 2 Concentrates on the hazardous effects of mass movement but with some balance between natural and human agency. [7–11]

Level 1 Seen as essentially man made hazards with little appreciation of the nature of mass movement. [0–6]

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**6 (a) Explain the hazardous nature of the materials ejected from volcanoes. [10]**

Volcanoes release huge amounts of tephra, which can extend over large distances and include lava bombs and vast ash clouds. These can produce building collapse, respiratory failure, etc. Lava flows can invade settlements and destroy buildings and populations. Pyroclastic flows are the most deadly as they are high speed avalanches of rock, ash and gases with devastating effects (Pompei). Landslides and lahars are secondary effects.

**(b) Describe the methods used to predict volcanic eruptions. How effective are such predictions in saving lives? [15]**

Volcanoes will not erupt without warning signs. Hence the monitoring of volcanoes allows some ability to predict their eruption. The signs take the form of swarms of small earthquakes, ground swelling, gas discharges and rising water temperatures. Studies can be made of electrical and magnetic fields which indicate the ascent of magma. All this requires very expensive kit and considerable expertise that is beyond many LEDCs. Even in the MEDCs the amount of warning may be limited and to be effective relies on well rehearsed plans for evacuation. This could be a daunting prospect, as in the Bay of Naples with its huge population.

Level 3 Good understanding of the nature of volcanic behaviour based upon various methods of monitoring. A realistic assessment of their effectiveness. [12–15]

Level 2 A range of aspects of volcanic prediction methodologies which may not always be well explained in terms of the methodology employed. Success may well be illustrated by reference to successful evacuation (e.g. Pinatabu). [7–11]

Level 3 Descriptive account that concerns more the effects of eruption rather than monitoring pre eruption. Descriptive of a particular eruption and subsequent effects. [0–6]

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## Arid and semi-arid environments

Only *one* question may be answered from this topic.

7 Fig. 4 shows areas at high risk from desertification.

- (a) Describe and explain the distribution of areas at high risk from desertification shown on Fig. 4. [10]

Areas most at risk are those surrounding the world's arid areas and hence are subject to similar lack of rainfall. This is due to sub-tropical high pressure, continentality and cold ocean currents and rain shadow. These at risk regions are prone to a difficult and uncertain climate (semi-arid). Biophysical systems are stressed between relative abundance and drought. Candidates should be able to use the map in the description of at risk areas (e.g. Sahel).

- (b) Using examples, discuss the extent to which desertification results from natural causes or from human activities. [15]

Climatic factors are the creators of arid and semi-arid environments and this makes desert margins very vulnerable to even small changes in climate. A period of drought can quickly lead to a loss of vegetation, soil deterioration and erosion particularly by wind (dust bowl effect) which can then inhibit any powers of recovery. The end result is the spread of desert conditions. However the main contributor to the problems of semi-arid areas is undoubtedly humanity. Overgrazing, unwise irrigation, tree removal have all been consequent upon population growth engendered during good climatic periods. The areas are then in no position to weather the periods of drought and often cannot exist without major environmental deterioration even in times of normal rainfall.

- Level 3 Good use of case study or examples to illustrate the balance between the difficult nature of the climate and environment and the carrying capacity of humanity with the results of environmental deterioration and consequent famine etc. [12–15]
- Level 2 Human activities seen as the main culprit with some exemplification as to how this has been achieved and its consequences in terms of desertification. [7–11]
- Level 1 Human activities bringing about soil erosion and deterioration. Unspecific as to areas or cause and effect. [0–6]



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- 8 (a) Using diagrams, describe the different types of sand dune found in arid environments and explain their development. [10]

A fairly straight forward task of drawing diagrams illustrating crescentic, linear, transverse, parabolic, dome and star shaped dunes with appropriate explanations in terms of the transportation of sand and the impact of wind directions

- (b) To what extent have hot arid areas been shaped by present day processes of erosion? [15]

The present day erosive processes should include both wind and water and should be explained in terms of stream flood and sheet flood as well as wind erosion. The problem lies in the small scale effects of wind erosion and the episodic nature of water action. In neither case is it likely to occur frequently or intensively to produce the sizeable and extensive landforms of the desert piedmont or extensive wadi systems. Current process tend to mould existing landforms although episodic events such as sudden floods can have some impact in moving alluvial materials

The evidence in terms of landforms can be developed from the desert piedmont and the retreat of the mountain front with the development of a pediment by lateral sheet floods. Wadis and their alluvial infill can be assigned to stream floods as can the development of extensive drainage systems and residual playa lakes. Even sand seas can be attributed to the product of vast inland oceans in the past. Clearly much of this activity took place in past pluvial periods and much desert landscape represents relict landforms that are only episodically affected by storm events or the ongoing action of the wind which mainly transports already eroded material around.

- Level 3 Good appreciation of the effects of erosive action upon desert landforms today, well illustrated by reference to examples. An awareness of the balance between past pluvial activity and the present limited erosional activity. [12–15]
- Level 2 Descriptive account of erosion in the deserts with both wind and water featuring. A belated reference to past pluvial periods but little assessment or relation to landforms. [7–11]
- Level 1 A collection of some desert landforms (e.g. dunes, yardangs playas) with a limited attempt at explaining their formation by either wind or water. [0–6]