

**UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS**

**GCE Advanced Subsidiary Level and GCE Advanced Level**

**MARK SCHEME for the May/June 2009 question paper  
for the guidance of teachers**

**9696 GEOGRAPHY**

**9696/02**

Paper 2 (Physical Geography), maximum raw mark 50

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<b>Page 2</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE AS/A LEVEL – May/June 2009</b>	<b>9696</b>	<b>02</b>

*Tropical Environments*

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

- 1 (a) Describe and explain the differences between the climates of the humid tropics and the seasonally humid (sub-humid) tropics. [10]**

Climates of the humid and seasonally humid tropics both exhibit year round high temperatures generally with the coolest month being in excess of 18 C. There is thus little difference in temperature regimes due to the intense solar radiation that occurs throughout the tropics. The only variation is likely to be with altitude. Humid tropical climates (rainforest) will be wet in all seasons with at least 6 cm of rainfall in each month whereas seasonally humid climates have a distinct dry season although annual rainfall usually exceeds 100 cm. The dry months have rainfall less than 6cms. In the case of the humid tropics rainfall occurs almost daily due to high insolation and convection. In the seasonally humid tropics rainfall is associated with the movement of the ITCZ this makes rainfall seasonal but also less reliable. There is no need to introduce monsoon climates, but they are acceptable if covered in terms of seasonal pressure changes and the ITCZ.

- (b) To what extent can the landforms found in the humid and seasonally humid tropics be explained by present-day weathering processes? [15]**

The main processes extant in the tropics is that of chemical weathering induced by the high temperatures and abundant rainfall. This can be illustrated by the operation of hydrolysis (granite) and carbonation (limestone). This has led to the accumulation of deep layers of regolith and the operation of weathering at basal surfaces as well as adding the role of humic acids. All of these can be seen as present processes although the nature of the rock type will have important impacts on the landforms produced. The introduction of etchplanation or even pediplanation into the equation assumes some form of regolith removal that suggest climate change over time and hence the possible impact of past processes.

**Level 3**

Good description of weathering processes that are related to both climatic and rock conditions. The resultant landforms, depths of regolith will be well described. The role of stripping and /or regolith removal will induce some discussion of the role of time and climatic change. [12–15]

**Level 2**

The weathering processes will be described and related to landforms. This will take the form of the deep weathering model as well as some indication of carbonation. There may be a concentration on only one of these. There will be little, if any, appreciation of the role of climate change and only an appreciation of the role of rock structure through such features as the blocky nature of tors, castle koppies etc. [7–11]

**Level 1**

An account of either inselbergs or of tower karst with little explanation in terms of weathering processes or with any appreciation of the role of rock type or climate. [0–6]

**[Total: 25]**

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2009	9696	02

2 (a) Fig. 1 shows the movement of nutrients through the tropical rainforest ecosystem.

**Using the diagram, explain how nutrients are introduced, transferred, stored and lost from the ecosystem. [10]**

The nutrients enter the system through the atmosphere (rainfall) and through the soil in terms of rock weathering to give a mineral component and the nitrogen uptake by tree roots. The inputs are moved largely from the soil (which acts as a nutrient store) having received nutrients from litter and tree decay as well as minerals from parent rock. The transference from both atmosphere and soil occurs via throughfall, uptake by the trees, litter and other falls. The other stores are the litter which is small in this case due to rapid decay and uptake, and the biomass which is the largest recipient of all inputs into the system and hence the largest store. Losses from the system are via the leaching of nutrients from the soil store. This is a change from the usual Gersmehl model, but should be interpreted in a similar manner.

**(b) For either the tropical rainforest or the savanna ecosystem, explain the extent to which soils may affect sustainable development. [15]**

Soils in either system are clearly in balance with the rest of the ecosystem, as long as the system is maintained in its steady state. If sustainable management implies some disturbance to the system, which it usually does, then soils can provide a limiting factor in sustainable strategy. In the case of the TRF, the soil is a relatively small nutrient store and could be subject to major losses through leaching if the major nutrient store (the biomass) is removed. Also biomass removal for cultivation or grazing could expose the soil to problems of erosion due to the climate and its often lateritic nature. Therefore sustainable strategies will have to take soil vulnerability into account and revolve around such things as selective logging, development of secondary forest or devising means of soil conservation and enrichment in any scheme of cultivation. In the case of the savanna, the soils form a relatively larger nutrient store. The existence of dry seasons with unreliable rainfall would however mean that soil nutrients could be vulnerable if major changes in land use were contemplated (i.e. removal of grasslands) Witness the impact in the dust bowl etc.

Level 3

Good appreciation of the role of soil within the selected system as well as the requirements of sustainability. This could be developed by the use of a case study or of selected examples. [12–15]

Level 2

Some appreciation of the vulnerability of soils but a tendency to develop examples of forest clearance or the role of fire with predictable dire consequences for the chosen ecosystem. Little concept of either sustainability or of management. [7–11]

Level 1

Seen as an opportunity to develop an account of either soil erosion or of the predatory activities of humans in the TRF or savannah leading to widespread if not global, destruction. [0–6]

**[Total: 25]**

<b>Page 4</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE AS/A LEVEL – May/June 2009</b>	<b>9696</b>	<b>02</b>

*Coastal Environments*

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

- 3 (a) How might changes in sea level affect the formation and types of coral reefs found today? [10]**

Coral is sensitive to sea depth in terms of the light and temperatures required for its growth and development. Thus sea level change has been important in the past for the development of fringing reefs, barrier reefs and atolls. Darwin's theories regarding sea level change and the development of coral can be cited and good candidates may introduce other theories (e.g. Daly etc). There should be some understanding of why sea level is important for healthy coral reefs and I suspect many will dwell upon the possible consequences of global warming and sea level change.

- (b) To what extent is the building of sea defences (hard engineering) a more effective method of sustainable management than allowing coasts to revert to a natural state (managed retreat)? [15]**

Managed retreat involves the removal of coastal defences and allowing the area to revert to a natural balanced state. It is commonly used in areas of deposition such as salt marsh and creeks where the defences (hard engineered sea walls, groynes etc) are removed allowing the drained land to revert to marsh. Although there is a loss of arable land and indeed settled areas, the result often leads to lower levels of coastal erosion as the marsh is very effective at absorbing storm conditions. There is also a benefit in maintenance costs. It could thus be regarded as sustainable coastal management. It can be argued that it is not suitable in all areas, particularly fast eroding coastlines where expensive infrastructure has been placed. It also could be deemed inappropriate where large areas have been reclaimed for use such as in Holland or Singapore. There is ample opportunity for the use of examples or case studies of sustainable coastal management.

**Level 3**

A clear indication of managed retreat and its implications for coastal management. This is then set against the results of hard engineering and some assessment made of the advantages and limitations of both strategies. Well exemplified. [12–15]

**Level 2**

More an account of the advantages and limitations of hard engineering strategies for coastal management. This will largely be seen as attempts to restrict coastal erosion resulting in 'knock on' effects in nearby coastal locations. Managed retreat will be seen as a 'do nothing' approach and will not feature much in the account. [7–11]

**Level 1**

Simple examples of hard engineering (gabions, groynes) will be described in a general manner and will be seen as better than doing nothing. [0–6]

**[Total: 25]**

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2009	9696	02

4 (a) Fig. 2 shows some factors influencing wave formation.

**Using Fig. 2, describe how wind and fetch affect wave height and suggest other factors which might affect the form of a wave. [10]**

Wave height is seen in the diagram as a function of wind velocity and fetch. Generally the longer the fetch the smaller the velocity required to generate a wave of the same height. Hence a wave of 1m in height requires a wind speed of over 17 at 10 km but at a fetch of 100 km only a velocity of c 8. Good candidates will note the logarithmic scale of fetch. Fetch allows a longer duration for wind to blow as waves are a product of friction produced by the wind. Good answers should use the data shown. Other factors affecting wave form are the depth of water and the shape of the coast. Wave height will increase as depth decreases. The coast can also refract waves.

**(b) How does wave action contribute to both the erosion and deposition on coasts? [15]**

Wave action can be seen as occurring in high energy environments characterized by high and frequent waves due to long fetch and high winds. Here marine erosion will be prominent through claptosis and the other forms of marine erosion. Some might see these as destructive waves. Conversely in low energy environments where there is a lower frequency of waves more swash and less backwash then waves can have constructive functions in building beaches and when associate with LSD can bring about other sedimentary landforms such as spits bars etc.

Level 3.

A well organized answer that relates marine erosion and deposition directly to wave action, providing examples of the types of processes in operation which can be illustrated by landforms produced. [12–15]

Level 2

A tendency to provide lists of the marine processes associated with erosion and those associated with deposition together with, perhaps, some description of landforms (e.g. caves, stacks and spits and beaches). The relationship with wave action will be assumed rather than explained. [7–11]

Level 1

A rather random collection of features of coastal erosion and those of deposition that displays no organization and little association with wave action. [0–6]

**[Total: 25]**

<b>Page 6</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE AS/A LEVEL – May/June 2009</b>	<b>9696</b>	<b>02</b>

*Hazardous Environments*

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

**5 (a) Why may tectonic plate margins produce hazardous environments ? [10]**

Because areas of plate movement are the main locations for earthquakes and volcanic activity. There should be some explanation of how tectonic plate movement (convergent and divergent) are the causes of earthquakes and volcanoes. This could aptly be demonstrated by the judicious use of annotated diagrams. There should also be some mention of the need for the coincidence of well populated areas with plate margins. Examples could be cited from the Sumatra, Java, Japan etc. Clearly mid- oceanic plate margins are less likely to be hazardous to human life.

**(b) To what extent can the effects of hazards associated with tectonic plate margins be managed? [15]**

An opportunity to provide a case study or examples. These however should be linked to attempts at the management of the environment rather than just the effects of a hazardous event. Many will quote the usual development of earthquake buildings or the production of hazard maps. Some may approach the question along the lines of methods of prediction of earthquakes and/or volcanic eruption and subsequent evacuation of population. There should be some attempt to estimate the effectiveness of the methods described and hence the ability to allow the continued occupation of the areas at risk.

**Level 3**

Well chosen case study or examples that illustrate the problems of the occupation of hazardous areas. As little can be done to prevent the hazard it is the effectiveness of the warning and remedial action that is of significance. A cost/benefit balance might be introduced i.e. the advantages of the locale (soils etc) against the risk of destruction. [12–15]

**Level 2**

Often detailed accounts of the actions taken to limit the effects of earthquakes or volcanic eruption. These, however, will not be characterized by any estimate of the effectiveness in managing the environment. [7–11]

**Level 1**

Rather stray and ill organized examples of attempts to deal with the aftermath of hazardous event or to minimize the impact (e.g. buildings on springs or lava deflection barriers) Little or no attempt to evaluate any effectiveness . [0–6]

**[Total: 25]**

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2009	9696	02

- 6 (a) Fig. 3 shows the positions of a hurricane (tropical storm) as it approached the coast of the USA.

**Describe the course taken by the hurricane and suggest reasons why it is difficult to predict where the hurricane would strike the coast. [10]**

Between Aug 22 and 26 the hurricane proceeds along a steady path in a NW direction before making a swing to the south west and finally resuming in a north westerly direction. Both represent 4 days and the distance travelled is about the same but with clear shears and changes in direction. By projecting these forward the landfall of the hurricane is a matter of probabilities with the most likely only 27% probability. The reason for this unpredictability is partly due to the nature of the system and partly the methods used to monitor them. The system is immensely dynamic with high winds that are liable to shift direction of the rotation. Monitoring is achieved by satellite and aircraft observation, which only details past and current progress and only allows a projection forward of the current passage.

- (b) **Explain which areas of the world are most at risk from hurricanes (tropical storms) and the effects such storms can have upon populated areas. [15]**

Tropical storms (hurricanes, typhoons willy willies, cyclones etc) occur most frequently in tropical or sub tropical waters where temperatures are in excess of 26C over wide areas. They require input from the coriolis force to engender rotation so are not found proximate to the equator. In the northern hemisphere they are most frequent between June and November. They tend to affect eastern coastal areas and are most devastating when they strike low lying heavily populated coasts such as New Orleans, Bangladesh etc. The hazardous effects are produced by the high winds and intense rainfall that accompanies them. The winds can cause destruction of buildings, particularly in ELDCs where the structures are flimsy. Services are also disrupted (overhead power cables etc). Very often the greater damage and loss of life is consequent upon flooding and associated slope instability. New Orleans amply illustrates the impact of flooding and the dangers of subsequent disease.

Level 3

Concise summary of the areas most at risk and why. Good use of exemplification/case study to illustrate hazardous effects, which can be compounded by poverty. [12–15]

Level 2

Grasp of conditions favorable to hurricane development but less precise on areas most at risk and why. Concentrates on effects of hurricane but often in an unspecific manner with little distinction between the impact of wind and flooding. [7–11]

Level 1

Only average grasp of the conditions required for hurricane generation and little description of at risk areas. Rather sensationalized accounts of impacts largely centring on high wind speeds. [0–6]

**[Total: 25]**

<b>Page 8</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE AS/A LEVEL – May/June 2009</b>	<b>9696</b>	<b>02</b>

*Arid and semi-arid environments*

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

**7 (a) Explain how wind may erode and transport material in hot deserts. [10]**

Dust and sand is entrained by the wind due to the nature of the surface, high wind speeds and the arid climate. Material carried by the wind depends on the size of particle and the speed of the wind. It can also move material by saltation and rolling. Most material is only carried in the lower parts of the wind system that is close to the surface. Thus erosion by abrasion is usually limited to heights of little more than a meter. Erosion can also occur through deflation of areas, sometimes over large areas of the surface.

**(b) To what extent are the landforms of hot deserts the product of both wind and water action ? [15]**

The two tend to work symbiotically, although most candidates, I suspect will work on the assumption that the landforms are the result of one or the other. Thus yardangs, zeugans dunes and deflation hollows are the result of wind activity whilst the landforms of the desert piedmont and wadi systems are the result of (largely past) water action. Some might see that features such as deflation hollows can be limited by the water table and that the sand for dune systems was derived from vast internal basins in the past. Wind can be viewed as resorting and reshaping material largely derived from past water action. Thus many of the desert landforms are relict and rather slow changing.

Level 3

Will grasp the interlinked nature of the two actions though might still argue that there is a fundamental distinction between water and wind action in some landforms e.g. wadis and the shaping of dunes. [12–15]

Level 2

Will see the two actions as distinctive producing different landforms. A reasonable coverage of both process and resultant landforms if somewhat list like. [7–11]

Level 1

Simplistic descriptions of some wind activity and the resultant landforms and of water activity with a partial coverage of both. [0–6]

**[Total: 25]**



<b>Page 9</b>	<b>Mark Scheme: Teachers' version</b>	<b>Syllabus</b>	<b>Paper</b>
	<b>GCE AS/A LEVEL – May/June 2009</b>	<b>9696</b>	<b>02</b>

**8 (a) Fig. 4 shows the location of arid and semi arid climates.**

**Describe and explain the locational pattern of areas with arid and semi arid climates. [10]**

The locations can be grouped into generalized types of location. The sub-tropical (e.g. Sahara), the continental/rain shadow or coastal. Explanations should be of the sub tropical highs, rain shadow/continentality and the impact of cold ocean currents. For good marks these should be fully explained with appropriate examples.

**(b) Explain how soils are affected by and vegetation is adapted to hot desert conditions. [15]**

Soils respond to aridity in the sense that the lack of water means that they cannot develop true profiles. They tend to lack structure, are loose and friable, have low humus content with the main movement being upward capillarity through the soil which can lead to the accumulation of salts. Vegetation shows a number of adaptations pertinent to particular locations. Thus there are xerophytic adaptations to leaves, trunks etc and those that adapt in terms of root development or are salt tolerant.

Level 3

Some balance between soils and vegetation with useful and appropriate exemplification of each. [12–15]

Level 2

Soils treated in an outline manner but some appreciation of lack of structure and humus. Concentration on vegetation although tending to be dominated by xerophytic adaptations. Limited exemplification. [7–11]

Level 1

Little appreciation of soils beyond their sandy and dry nature. Vegetation adaptations will tend to be a series of examples e.g. cactus water storage or thorn shrubs. Little appreciation of the nature of the adaptation. [0–6]

**[Total: 25]**