

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

9696/21

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

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Page 2	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

Tropical Environments

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

- 1 (a) State and explain the similarities and differences between monsoon and seasonally humid tropical climates. [10]

The similarities are that both climates are seasonal and tropical. As tropical climates they experience high temperatures and seasonal rainfall. Generally the annual temperature range is less than the diurnal, but there is a cool season in winter. In the case of the seasonally humid the rainfall is not always reliable as it is due to the movement of the ITCZ. The monsoon circulation is due in part to the differential heating between land masses and ocean, but good candidates will note that they are also partially dependent upon the movement of the ITCZ.

- (b) Describe and explain the development of landforms that are found in areas of tropical karst (limestone). [15]

As with all karst, the basic process is that of carbonation, i.e. the action of acidulated rainwater on calcium carbonate. In the humid tropics, due to high temperatures and abundant precipitation, the process is considerably enhanced leading to large scale karst features. These can include all the generally found landforms of caves, pavements, dolines, poljes, etc. The tropics are noted, however, for tower karst and cockpit country. The towers are the result of differential weathering and erosion along lines of structural weakness aided by sheetwash in the steep, unvegetated areas.

Candidates will probably:

- Level 3 Display a good understanding of carbonation under tropical conditions and an appreciation of the resultant landforms with impact of rock structure. Tower karst (and/or cockpit country) will be accurately described and some knowledge of its formation shown. [12–15]
- Level 2 Carbonation successfully explained with some range of karstic landforms. Rather generic but some reference to particularly tropical features such as tower karst, etc. Description of landforms will be more successful than explanation. [7–11]
- Level 1 An 'all purpose' limestone response. Carbonation will be described in outline terms and any references made to landforms will concentrate more on smaller scale features, such as stalactites, etc. Little that is specific to the tropics. [0–6]

Page 3	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

2 (a) Describe the types and structure of the vegetation found in tropical savanna areas. [10]

The savanna is distinguished by high temperatures but a dry season in which trees (such as TRF) would find it difficult to flourish. This encourages drought resistant grasses that are coarse and long rooted and the development of deciduous trees that are resistant to drought. Thus tall elephant grass and trees such as the acacia are seen as the typical type of vegetation. This will vary according to the length of the dry season with shorter grasses and trees such as the baobab dominating in the more arid areas. Here the ability to survive the dry season and germinate when the rains arrive is crucial to many of the ground cover plants. The role of fire (either human or natural) is also seen as influencing the types of plants characterising the taller grassland areas.

(b) Fig. 1 shows some human activities in areas of tropical rainforest in South East Asia. Explain the likely impact of these activities upon the tropical rainforest ecosystem. [15]

The purpose for forest clearance are varied, from commercial logging, plantation and smaller scale farming and vegetable production. Although the end result may well be degradation of the ecosystem due to its interdependence and fragility (nutrient cycle) the manner and speed at which it is achieved will be variable. Soil leaching and degradation will occur faster where there has been the greatest loss of biomass (clear felling). Similarly there will be the most immediate impact upon trophic levels and hence animal populations. Burning, however, may lead to short term increases in soil nutrients and the longer term impact will depend upon subsequent use, input of fertilizers, nature of ground cover and any secondary re-growth of forest cover. There is an opportunity here to develop different scenarios based upon the diagram.

Candidates will probably:

- Level 3 Make good use of the information provided, in developing different impacts upon the TRF ecosystem. This will be approached in terms of nutrient cycling and the significance of the biomass store for both vegetation and animal occupation. [12–15]
- Level 2 A more generalized account of the degeneration of the TRF ecosystem, but with some appreciation of the nature of the ecosystem and its interdependence. Emphasis will be on loss of soil fertility and biomass diversity. [7–11]
- Level 1 General account of TRF destruction. The use of the diagram (if any) will be to regurgitate the methods of destruction rather than the effects. Such effects that are described will be seen in cataclysmic terms, often of a global nature. [0–6]

Page 4	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

Coastal environments

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

- 3 (a) Using diagrams, describe different types of coral reef and atoll. Explain the conditions required for their existence. [10]

Coral are marine organisms that live in colonies and secrete external skeletons of calcium carbonate. The types of reef (fringing and barrier) and atoll can be effectively shown diagrammatically with some indication of scale being given. The conditions required for their existence are:-

Warmth – minimum 18 °C optimum 25–30 °C
 Light – photosynthesis restricts most to c25m depth.
 Salinity – tolerance 32 – 42 ppt
 Some turbulence for oxygen and nutrient supply
 Firm base from which to grow
 Clear water
 Below sea level – exposure leads to polyp death
 Sea level rise – only accommodate slow rises.

- (b) What are the main physical factors that influence the erosion of coasts? How far can these physical factors be controlled? [15]

The erosion of coasts are a function of weathering, marine erosion and rock type and structure. The sub-aerial weathering processes contribute to slope instability which can be further aided by marine action in removing and transporting material. The nature of the erosion processes should be outlined as should their erosive effects (high and low energy coasts). The geology of the coasts clearly has a strong influence both in terms of the type (consolidated/unconsolidated resistance, etc) as well as the structure (joints, bedding planes, dip, etc). The extent to which these physical factors can be resisted is limited in both space and time. Some limited protection can be afforded by hard engineering, but this is limited by both cost and effectiveness.

Candidate will probably:

- Level 3 Display good understanding of weathering and erosive process and be able to apply it to coasts constructed of different geologies. An overall assessment of success in controlling physical factors, rather than a litany of examples of hard engineering. [12–15]
- Level 2 An account of physical factors that concentrates on marine erosion, with only limited appreciation of weathering and geology. Exemplification of coastal protection rather than an assessment of control of physical factors. [7–11]
- Level 1 Only marine erosion will be described in a partial manner. Emphasis given to coastal protection against erosion with generic hard engineering structures. [0–6]

Page 5	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

- 4 (a) Fig. 2 shows some features of a sand and shingle beach.
 Explain the formation of the beach features shown on Fig. 2. [10]

Beaches are a product of the materials that form them and wave action. Shingle has greater percolation than sand but requires more energy to move. Wave action will be seen largely in terms of constructive and destructive waves which move material up and down the beach (also beach drift) and sorts the material. The beach profile displays a drop in height towards the sea with the coarser material accumulated at the storm beach and berms, where strong swash has pushed material up the beach. The rest of the features are the product of material being sorted and moved down the beach by swash moving material up and backwash combing material down. This can produce cusps and runnels. An understanding of the process is more important than the detail of all the minor beach forms.

- (b) Explain the extent to which human activities might affect the deposition of sediment along coasts. [15]

Sediment is eroded and moved and deposited along coasts through the operation of natural processes within a sediment cell. The result can be depositional forms such as beaches, spits, dunes, salt marshes and bars. Human activities can interfere (rather than stop) these processes by action within the sediment cell that disturbs the supply of material or interrupts its transport and deposition. As depositional landforms are often fragile (spits, dunes), human activities for recreation can lead to their destruction. Similarly positive measures can be taken to protect fragile environments such as spits or salt marshes. Natural forces, such as the power of storms or the extent of large scale processes (e.g. LSD) are always likely to limit human activities.

Candidates will probably:

- Level 3 Show a good understanding of the sources, transport and sinks of sediment cells and the resultant landforms. Thus human intervention will be viewed as affecting all of these elements to a greater or lesser degree. Some evaluation will be made as to the extent to which such activities have affected coastal deposition in comparison to natural processes. [12–15]
- Level 2 An awareness of the role of human activities within coastal deposition that may be expressed as a series of examples rather than an estimate of overall process. Evaluation will be limited if present at all. [7–11]
- Level 1 A few examples of destructive or constructive human activities with little reference to the processes involved. Reference limited to such things as basic hard engineering, e.g. groynes. [0–6]

Page 6	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

Hazardous environments

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

5 (a) Describe the methods used to predict volcanic eruptions. [10]

Many volcanoes, such as Mt St Helens and Vesuvius are closely monitored and attempts are quite widely made to predict eruptions. The methods involve the use of seismographs to indicate earthquake activity, the monitoring of temperature both at the surface and subsurface as well as that of water and the analysis of gases released from fumaroles. Satellite photographs can be employed to look for bulging and any eruptive material analysed. Eruption frequencies can be calculated.

(b) Outline the methods used to predict earthquakes and explain whether you think these have been more or less successful in limiting the impact of their hazardous effects than in the case of volcanic eruptions. [15]

Seismic activity can be detected by use of seismographs and tilt meters, but in themselves these are not predictive measures. It is possible to monitor movement along known earthquake fault areas. By studying the frequency of past earthquakes it is possible to calculate the possibility of their future occurrence. This study of seismic gaps has had some success (e.g. Bakersfield, California) and has allowed the preparation of hazard maps. Generally the prediction of volcanic eruptions has been more successful, but often the amount of warning has been limited to days. There is still some uncertainty about the timing of volcanic eruptions (e.g. Mt St Helens) but in recent years there has been more success in evacuating populations due to sufficient warnings. This has not been the case with earthquakes, which require prediction of both location and of timing. Earthquakes often take a greater toll of human life (e.g. 2008 Sichuan). Effective action in this case is usually longer term, i.e. building regulations, evacuation education, etc.

Candidates will probably:

- Level 3 Show an understanding of the methods and difficulties of earthquake prediction and illustrate the comparison with volcanic hazards by effective exemplification and evaluation. [12–15]
- Level 2 More methods of monitoring (seismographs, Richter scales, etc) than of prediction. Some comparative estimate of hazardous effects of both earthquakes and volcanoes which will be only partially linked to prediction. [7–11]
- Level 1 Little in the way of prediction apart from animal behaviour and most of the account concentrated upon the effects of both earthquakes and volcanoes often through a particular occurrence of each. [0–6]

Page 7	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

- 6 (a) Fig. 3 shows the development of a tornado within a thunderstorm. Describe the nature of tornadoes and explain how they develop. [10]

Tornadoes are rapidly rotating winds that blow around an area of intense low pressure. It appears as a funnel shaped cloud or as a swirling cloud of debris and dust. They extend from 100m to 600m and can have wind speeds in excess of 70 knots although most are between 20 and 40. Most rotate counter clockwise and last only a few minutes. They form ahead of an advancing cold front and are associated with severe thunderstorms and vast atmospheric instability. This occurs in the USA when warm moist air from the Gulf of Mexico is moving north and meets cold air from the north. Atmospheric instability is enhanced by cold dry air overlying the warm moist airstream. For a tornado to develop the rushing air must rotate causing the funnel cloud.

- (b) Explain the extent to which the hazardous effects of tornadoes are different from those of a tropical cyclone (hurricane). [15]

The hazardous effects of a tornado are caused by its rotating winds and intense low pressure. The winds destroy buildings, uproot trees and hurl lethal missiles into the air. Walls of buildings buckle and as the winds blast over the roof they cause lower pressure above the roof allowing the winds to carry it away. The lower pressure outside a structure can cause it to explode. Hurricanes on the other hand are larger systems that pose threats over greater areas and are not restricted to those of wind speed. They also include storm surges, intense rainfall leading to floods and landslips.

Candidates will probably:

- Level 3 Display some balance and understanding of the hazards posed by both tornadoes and hurricanes and make some evaluative estimate of their respective hazardous nature perhaps backed up by examples. [12–15]
- Level 2 Lacks balance with a concentration upon one or other of the hazards. A tendency to produce cataclysmic accounts rather than realistic assessments of hazards. [7–11]
- Level 1 Little developed in terms of hazards beyond high winds and the hurling of all kinds of material into the air. [0–6]

Page 8	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

Arid and semi-arid environments.

Only one question may be answered from this topic.

- 7 (a) Using one or more examples, describe the causes and environmental consequences of desertification. [10]**

Desertification is the encroachment of desert conditions into areas considered as semi-arid. Many will see it, however, as soil deterioration and erosion on desert margins. The causes are either climatic shifts leading to drought (possible global warming) or human activities. In the latter case, semi-arid environments are fragile with vegetation playing a crucial role in maintaining equilibrium. If vegetation is removed, through population increase or over grazing then the surface becomes mobile leading to deflation and dunes. Examples could be drawn from Asia, Africa or North and South America. No doubt the Sahel will feature, but we can accept the Dust Bowl.

- (b) Describe and evaluate measures that might be employed to restore areas that have suffered desertification. [15]**

Generally, desertification is not seen as an inevitable process and can therefore be avoided. Agricultural techniques such as avoiding bare surfaces and the use of belts of cultivation and embankments to avoid wind erosion. Grazing control. Supplying food and construction material to control tree loss. Education. Bringing back the degraded land into production is more difficult and costly and involves the stabilisation of the surface and the control of run off and the possible introduction of irrigation.

Candidates will probably:

- Level 3 Give a good range of preventative and restorative techniques and well chosen examples. It is possible to base the answer around a single example such as the Sahel. There should be some attempt to evaluate the effectiveness and costs of such schemes. [12–15]
- Level 2 A more patchy coverage of actions but with some exemplification. There may well be a concentration on the negative rather than positive actions, i.e. the restriction of population and animal numbers. Limited evaluation. [7–11]
- Level 1 Little beyond wind breaks and the banning of grazing. Exemplification will be vague and unspecific. No evaluation [0–6]

Page 9	Mark Scheme: Teachers' version	Syllabus	Paper
	GCE AS/A LEVEL – May/June 2010	9696	21

8 Fig. 4 shows some landforms of part of the southern Sahara.

- (a) Briefly describe and explain the landforms in Fig. 4 that have been produced by wind action. [10]

The landforms produced by wind action are the linear and crescentic dunes as well as yardangs. These could be shown diagrammatically as annotation could be used to explain, show wind direction, and the manner in which dunes are formed. We would expect, however, some indication of scale and composition as well as a recognition that dunes are the result of wind transportation and deposition whilst the yardangs are the result of abrasion. Better candidates will note the division between moving dunes and those that are vegetated.

- (b) Describe and explain those landforms that have been produced by water action. Explain what evidence on Fig. 4 might suggest that they may have been produced in a wetter past. [15]

The water formed features are those of the internal drainage basin of Lake Chad fed by seasonal and permanent streams and the wadis that extend over much of the north and east of the area. Both should be described and their formation explained. Lake Chad will be seen as a Playa lake with salt flats fed by seasonal and exotic streams. The steep sided wadis are the result of occasional intense stream flow and are deeply etched into highland areas as well as being choked by sediment. The most prominent evidence for past pluvial activity is the massive reduction in the size of Lake Chad, formerly extending even beyond some of the wadis. The intricate pattern and developed nature of the wadi system also argues for a wetter period of formation. Few, I suspect, will see the redistribution of sand deposits into dunes as evidence of past water action in a huge drainage basin.

Candidates will probably:

- Level 3 Demonstrate good observation of the diagram and a sound knowledge of the landforms. They will be able to identify features of the map that indicate a past pluvial period and its impact. [12–15]
- Level 2 A knowledge of the landforms although the internal drainage into Lake Chad may well be described rather than explained. A tendency to give a past pluvial account of landforms rather than an assessment of the evidence of the diagram. [7–11]
- Level 2 Little attention to the diagram and a rather outline account of both dune formation and the nature and development of wadis. Process largely lacking in explanation as will be evidence of activities in a pluvial past. [0–6]