

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

## MARK SCHEME for the May/June 2007 question paper

### 9696 GEOGRAPHY

9696/02

Paper 2 (Physical Geography), maximum raw mark 50

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## Tropical environments

- 1 (a) Describe the ITCZ (Inter Tropical Convergence Zone). Why is it important in understanding tropical climates?

ITCZ is the thermal equator that is subject to seasonal movement with the overhead sun. Many will see it as the convergence of surface air forming the bottom parts of the two parts of the Hadley cell. In other words, the product of surface heating and convection and the returning cooler air. Thus the movement of the ITCZ can be seen as the locations of the Hadley cells, the rising branch of the cell being to the north of the equator in June, and in December to the south. Convergence is provided by the ascending parts of the Hadley cell. Its significance comes in the provision of rainfall due to the convective rise that marks many seasonally humid climates in the tropics. A failure of the movement of the ITCZ in such climates can have serious consequences in terms of drought (e.g. Zimbabwe).

[10]

- (b) Describe the vegetation structure and soils that are found in the savanna ecosystem. To what extent have human activities contributed to the development of this ecosystem?

Savannas are seasonally humid and as such can vary from the semi-arid through to the reasonable well watered. In circumstances of relative water abundance they are characterised by the development of low woodland such as Acacia trees which develop along water courses and may have been more widespread in the past. Most savanna areas are associated with extensive grasslands, which can vary in height and scale. These die off in the dry season and exhibit various water retention qualities. Soils will probably be seen as dominated by lateritic soils although the amount of leaching is inhibited by the dry season. Chestnut brown soils are evident in drier areas where there is an accumulation of organic material in the upper horizons. Salts can accumulate due to capillary action in the dry season where precipitation is less than evaporation. It is postulated that human activities have contributed to the development of savanna by the use of fires to encourage the more extensive development of grazing land which has been achieved at the expense of woodland species. Overgrazing can lead to the development of thorn scrub, soil erosion and the process of desertification. The case of the dust bowl may be seen in this context.

[15]

### Level 3

Good description of the nature and structure of savanna vegetation and its variations. Soils will be described in this context and some assessment made of the extent of the human impact.

(12–15)

### Level 2

Seen in general terms as grassland with occasional trees. Some idea of adaptations if not of structures. Soils will be more simplistically described as red or ferrallitic. Human influence will loom large as fire and environmental destroyer.

(7–11)

### Level 1

Vague descriptions of grasslands, with little/no reference made to soils. Some awareness of human influence but poorly expressed in terms of the ecosystem.

(0–6)

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- 2 (a) Fig. 1 shows the soil nutrient levels in a shifting cultivation (slash and burn) system within the tropical rainforest.

**Describe and explain how nutrient levels within the soil change over time.**

Initially nutrient levels within the soil rise above those of the adjacent forest but after three years cultivation decline to a level where abandonment of the clearing is required. Over the subsequent three years nutrient levels slowly return to that of the adjacent forest. These changes can be explained by the addition of nutrients to the soil produced by the burning of the woodland and additions from the decay of woody debris. Thus the nutrients from the biomass store have been transferred to the soil. With the destruction of the TRF biomass and its replacement by crops, little nutrient is fed from litter or fallow periods. This results in the leaching out of nutrients, such that, eventually, crop production is reduced and abandonment occurs. The recovery of secondary forest growth begins to restore the original nutrient flows and stores to levels of that of the adjacent rain forest.

[10]

- (b) Describe the main forms of chemical weathering that occur in tropical environments. Explain how they contribute to the formation of landforms in either granite or limestone areas.

The main forms of chemical weathering should be described i.e. hydrolysis, carbonation, oxidation, chelation etc. The prominence of their activities in humid environments with high temperatures should be emphasised. The presence of deep regoliths and the subsequent significance of deep weathering and basal weathering surfaces could also be developed. The nature of granite and the importance of jointing and hydrolysis in the development of landforms can be emphasised (inselbergs, tors etc.). In the case of limestone, the importance of carbonation and rock structure can be explained in the development of karst features (e.g. tower karst and cockpit country).

[15]

Level 3

Good description of chemical processes with some appreciation of their operation in the tropics. Landforms will be related both to weathering process and rock properties and structure, with well selected examples. (12–15)

Level 2

A rather uneven coverage of chemical weathering, but some appreciation of tropical conditions. Landforms will be described with only passing reference to weathering or to rock properties and structures. (7–11)

Level 1

Only partial grasp of weathering processes which will be expressed in only general terms. A random selection of landforms little related to weathering or rock. (0–6)

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## Coastal environments

- 3 (a) Describe the nature of a coastal sediment cell. How do these cells contribute to the formation of coastal landforms?**

A coastal sediment cell is a system by which sediments are sourced, transported and deposited within a part of a coast and offshore area. They appear as a coastal system, thus sediments are derived from estuaries and coastal erosion, transported by such features as lsd and deposited in the form of beaches, bars, spits etc. The nature of the landform thus depends upon the nature of the cell, as well as the configuration of the coast.

[10]

- (b) To what extent do rock type and structure influence the development of landforms along cliffed coasts?**

Rock type and structure have a major role in shaping cliffed coastlines. This can be demonstrated by reference to different types of cliff profile, plan of coastal form as well as the landforms of stump, stacks, arches etc. Thus the type of rock, its dip, bedding planes, vulnerability to erosion can all be developed. Of course, rock type is not the only influence and high energy environments with active marine and sub-aerial weathering all have a contribution to make.

[15]

### Level 3

Good appreciation of the influence of geology with exemplification from cliff profiles, coastal plans etc. The contribution of marine processes will be considered and the answer marked by appropriate exemplification.

(12–15)

### Level 2

Some awareness of the influence of geology, although this may be limited to relatively few landforms. Marine erosion may well be described in some detail, if not always related to cliffed coastlines.

(7–11)

### Level 1

Some vague references to cliffs, probably restricted to stacks and arches etc. Little development of the role of structure and its role along with marine processes will be poorly developed.

(0–6)

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4 (a) Fig. 2 shows a coastal zone with its tide and wave environments.

**Describe the wave activities occurring in the breaker surf and swash zones. What impact do these activities have upon the shape of backshore and nearshore zones?**

A somewhat different context in which candidates can develop wave action that they normally associate with constructive, destructive, plunging waves. Breaking waves send pulses of water shorewards until they run out of momentum and gravity draws the water back to the sea. The surf zone is between the breaking waves and the point of maximum run up and is thus an area of turbulent activity as the backwash meets the forward spilling waves (swash). The swash zone will be associated with the forward movement of constructive waves, whilst the breaker zone may be associated with plunging waves. Candidates will see the swash zone as one of accumulation of beach sediments whilst the other zones may be associated with the development of a bar at the edge of the breaker zone and the combing down of materials into the trough area. [10]

**(b) What are the principal threats to the continued existence of coral coasts? To what extent can these threats be overcome?**

Coral coasts are predominantly threatened by human activities, which disturb the required conditions for growth and development. Hence, pollution can affect the light sources and the requirement for clear water with no sediment. Also the oxygen content of the water could be affected. Tourism can produce erosion as well as pollution and fishing and other activities can be harmful. Quarrying and souvenir hunting are equally destructive. Global warming and sea level rise could lead to long term destruction as the growth of coral would not be fast enough to compensate for the relatively rapid rise in sea levels. Rising temperatures and carbon emissions may also affect the chemical balance of the oceans again acting as threat. Some natural processes such as storms can also erode reefs, as can long term changes such as uplift. Any coral exposed above sea level for long periods becomes blanched. Some assessment can be made of attempts to overcome these threats although these will be most effectively achieved by use of examples or a case study. [15]

Level 3

A good appreciation of the operation of the threats by reference to the conditions required for coral growth. Good use of a case study and/or examples. Evaluation of efforts to overcome threats will be set within the case study or exemplars. (12–15)

Level 2

A concentration upon particular human activities that threaten coral probably set in some examples or case study. These will be only partially linked to the requirements of coral and the evaluation will be limited. (7–11)

Level 1

Human activities, viz. tourism, the use of dynamite etc. with little relationship to the existence of coral. Evaluation, if any at all, will be of the good/bad variety. (0–6)

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## Hazardous environments

- 5 (a) Explain how and why avalanches occur. Under what conditions do they become hazardous?

Avalanches are mass movements of snow under gravity usually on slopes of over 35 degrees. Candidates could refer to debris avalanches and rock avalanches, but most will restrict themselves to snow, which is acceptable. They occur when the shear stresses exceed the shear strength in the same plane. This could be related to fresh accumulations of snow, melting and refreezing or the disturbance produced by noise, seismic movement or even off-piste skiing. There are classifications of different types of avalanche e.g. slab, loose snow, wet and dry avalanches as well as ice sliding surfaces each of which occur under different circumstances. They are hazardous to people on or below them and to valley settlements such as those in the Alps.

[10]

- (b) For one natural hazard, describe the methods used to predict the occurrence of the hazard and assess the success of these prediction methods.

Earthquakes will probably be most popular with a range of methodologies available. Seismographs to pick up P and S waves, tiltmeters etc. Longer term prediction can be attempted by study of frequency of movement and earthquakes along particular faults and the search for seismic gaps and earthquake storms. Whilst these can often accurately predict area of occurrence, they are not so successful with timing. Volcanoes have similar measuring devices to pick up earth movement as well as analysis of temperatures in lakes and chemical analysis of gases. Photographic evidence can be employed for volcano bulging. Frequency of eruption can also be calculated and in recent times there has been some success in short term prediction. Hurricanes can be monitored and forecast more easily than predicted, particularly as to their landfall. Satellite tracking and meteorological data can assist with short term warnings of likely impact as in the cases of Katrina and Rita. Others may choose tornadoes or avalanches. Mass wasting poses more problems and is unlikely to see many attempts. No doubt animal behaviour will feature strongly in many accounts.

[15]

### Level 3

Good coverage of methodologies of prediction for chosen hazard, may be set within context of a particular event or place. This can then be employed to assess the effectiveness of the predictions.

(12–15)

### Level 2

Rather a catalogue of methodologies, but not particularly well explained as to how they work. Effectiveness will be similarly vague.

(7–11)

### Level 1

Such things as animal behaviour will loom large with a scattering of other mentions of methods. A tendency to drift into effects of hazards rather than prediction.

(0–6)

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- 6 (a) Fig. 3 shows the impact of Cyclone Eline on Mozambique in February 2000. Describe the nature of tropical cyclones and using Fig. 3 explain how their effects may become hazardous.

Cyclones are intense forms of tropical storms and have the same characteristics as hurricanes, in that they are large rotating systems around an area of intense low pressure. They require warm moist air derived from tropical oceans to power them. They produce high rotating wind speeds, rapid uplift giving rise to intense and often prolonged rainfall. In the case of Mozambique the main hazard produced was less that of high winds or even storm surges but as a result of the intense rainfall. This meant that the rivers flowing into the area were swollen and debouched into an already flooded area. Some general comments regarding wind and storm surges is acceptable, although flooding is the most obvious effect.

[10]

- (b) Explain why the occurrence of many natural hazards is associated with tectonic plate margins.

Because this is the location of most seismic and volcanic activity. Different types of plate margin should be described and their association with earthquakes and volcanoes explained. In the latter case it is the collision margins, particularly the Pacific Ring of Fire, that provide the locale of the most dangerous volcanoes. Volcanoes associated with divergent margins tend to be in the middle of oceans and more isolated from densely populated human environments. Earthquakes are associated with plate movements, particularly subduction, or, in the case of California, with a transform boundary. Movement is generated by crustal movement but often transmitted along fault lines. Occasionally such movements and consequent slides of ocean floors can produce hazards such as tsunami that start at points distant from where the hazard is felt.

[15]

Level 3

Good understanding of the nature and processes occurring at plate margins that make them hazardous environments when associated with human populations. Effective use of diagrams and exemplification.

(12–15)

Level 2

Distinguishes between plate margins and associates them with relevant hazards. May concentrate more on volcanoes in explanation than earthquakes. A generalised and often unspecific approach.

(7–11)

Level 1

Plate margins are distinguished but poorly described, particularly as to processes. Hazards will have a general although largely unexplained association with these margins.

(0–6)

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## Arid and semi-arid environments

### 7 (a) Describe and explain the effects of wind erosion upon desert landforms.

Wind can be an effective agent due to high pressure gradients, lack of vegetation and the aridity of the surface. Thus much material can be moved by the wind. Suspension allows the formation of large dust clouds and may well have an impact in removing material from deflation and other hollows many of which can be of considerable size. Saltation is probably a more important mechanism in terms of the abrasion of landforms, but is unlikely to occur at heights above 2 m. Surface creep will also contribute to deflation. Desert (stone) pavements are associated with deflation although fluvial erosion in the past may well have contributed. Sculptured landforms including zeugens and yardangs demonstrate aeolian erosion. Yardangs are ridges showing aerodynamic shaping and can extend over considerable distances (100 km in Tibesti). Zeugens are more rare and form isolated table – like masses of resistant rock when weaker underlying rock has been eroded. Ventifacts are surface stones shaped by the abrasive action of winds.

[10]

### (b) To what extent is irrigation the best way to bring about sustainable management in arid and semi-arid areas?

The key to sustaining larger populations in arid areas is to increase food supply. In the past irrigation has sustained large populations in arid areas – the hydraulic civilisations of the Nile, Mesopotamia etc. The supply of water to make up the water deficit can be difficult and degrading to the environment. Two main sources of water are provided by surface water e.g. by bringing in water either by exotic rivers or by canal or by abstracting water from ground water supplies. Irrigation schemes can be analysed by the candidate, for example those of California. The original private schemes giving way to major state schemes diverting water from the Colorado and transfers of water from Northern to Southern California. The construction of the Aswan Dam in Egypt and schemes in Israel might also be cited. In the short term, irrigation can radically change the flora and fauna but a larger problem is that of salinisation which can render such schemes redundant in 20 years. Irrigation also affects the source area of the water as well as drastically lowering the water table where groundwater abstraction has been employed.

[15]

#### Level 3

Good understanding of irrigation methods and their attendant advantages and problems. Good use of a case study or of exemplification to demonstrate the limitations in terms of sustainability.

(12–15)

#### Level 2

A rather generalised view of irrigation rather than different types. Some awareness of the problems and some exemplification with some limited assessment.

(7–11)

#### Level 1

Pedestrian view of irrigation (shaduf etc.) with little concept of larger scale activities. Vague references only to examples and little more than a realisation that it is not always successful.

(0–6)



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**8 (a) Describe and explain the characteristics of soils in arid and semi-arid environments.**

In desert conditions soils are characterised by a lack of organic material, shallow regolith, a scarcity of micro-organic action and lack of water. There is little sorting of surface material and in character, colour and mineral content they reflect parent material rather than any soil-forming processes. As precipitation is less than PET (potential evapotranspiration) the dominant movement is upwards, which can increase salt in the upper layers, giving very alkaline soils.

Soils in semi-arid environments are also alkaline, shallow and lacking in clear horizons sometimes referred to as chestnut-brown. Organic material is usually only in the top 25 cms and is developed under discontinuous vegetation cover with salts often concentrated in the upper horizons.

[10]

**(b) Fig. 4 shows the process of desertification as a system.**

**To what extent does this system represent the development of desertification in an area or areas you have studied?**

An invitation to develop their case study or case studies of the process of desertification. The diagram is detailed, so candidates should be able to follow it through, applying it to and exemplifying with regard to an area of study. Both human causes and physical effects are evident. No mention is made of drought cycles, which the sharp-eyed may pick up. Not all outcomes will be appropriate to all areas. Thus the development of badlands or a full-blown desert environment may not be appropriate and the progress towards desertification may only be part of the way or may have been interrupted. Plenty to go at, so not all points need be developed.

[15]

**Level 3**

Adapts diagram well to the chosen example (Sahel likely) and the boxed points exemplified and the effects illustrated in terms of the physical environment. A judgement as to the extent to which their case study fits the model.

(12–15)

**Level 2**

A more slavish following of the diagram with general acceptance of its findings. Even so, there must be some application of the points to a particular area or selection of areas.

(7–11)

**Level 1**

Little more than a regurgitation of the diagram with occasional, e.g. as in the Sahel type, illustrations.

(0–6)