UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the October/November 2009 question paper for the guidance of teachers

9696 GEOGRAPHY

9696/22 Paper 22 (Advanced Physical Options), maximum raw mark 50

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UNIVERSITY of CAMBRIDGE International Examinations

Tropical Environments

1 (a) Describe the main characteristics of climax and plagioclimax vegetation in tropical areas. [10]

Climax vegetation can be described as the outcome of a prisere, whereby it has become adapted to environmental conditions e.g. fully developed primary tropical rainforest with its layered structure or semi-humid wooded savanna. A stable vegetation that owes its main characteristics to human activities (such as felling or use of fire) forms a plagioclimax vegetation. Examples could be drawn from secondary tropical rainforest with its smaller trees and limited variety and savannas that are predominantly characterised by long rooted grasses and trees that can withstand the impact of fires

NB Tropical areas in the question need not be taken as all of the tropics, i.e. TRF and savanna need not be covered for maximum marks.

(b) Using examples, describe the different ways in which humans have sought to exploit either tropical rainforests or savannas. How sustainable are these types of exploitation? [15]

An opportunity to develop different uses of TRF, not all of which are equally destructive. Many will contrast slash and burn agriculture with felling, grazing, plantations, mining, etc. The former will be seen as sustainable, in that some cover is preserved and secondary growth allows some forest regeneration. This is sustainable as long as population densities remain low. Contrasted with this are major clearance schemes for timber or mining where the cleared forest is subsequently burnt over. This results in deterioration of the latisols and little subsequent regeneration. Selected felling and replanting is more sustainable as is some planned (and limited) agricultural usage.

In the case of savannas most will probably develop the use of fire in the encouragement of grasslands for extensive grazing. Arable is limited by the dry season and latosols although possible under conditions of irrigation. Sustainability is linked to carrying capacity in terms of livestock and the ability to move herds to areas of pasture available in dry seasons.

Level 3

Produce a balanced account of different usages which are assessed for their relative degree of sustainability. There will be an appropriate use of examples, although these do not need to cover all types of TRF or savanna exploitation. (12–15)

Level 2

A description of different types of TRF clearance with the emphasis on the destruction of the biome. Consequences will usually be seen as catastrophic although there will be some effort to distinguish between the different levels of impact. Similarly with fire and the removal of savannah woodlands. (7–11)

Level 1

The destruction of the rainforest or savanna woodland and its global implications with little or no attention to different types of human exploitation of the ecosystem. (0–6)

[Total: 25]

2 (a) Fig. 1A and Fig. 1B show data for two types of tropical climate. Identify and describe the climates shown in Fig. 1A and Fig.1 B. Explain how vegetation might be affected by each type of climate. [10]

Fig.1A shows a humid tropical (rainforest) climate. The temperatures are uniformly high at over 25°C for most of the year. The average annual range is low (2.2°C) which is smaller than the diurnal range; there is thus little change from day to day and no seasonality. Ppt is high (total 274 cms) and occurs every month and indeed most days. There is greater variation in monthly ppt than in temperature due to movement of ITCZ. The vegetation is abundant due to heat and moisture and grows throughout the year leading to evergreen forest which compete to reach light hence layering and emergents etc. Due to intense ppt there are adaptions such as drip tip leaves.

Fig.1B shows seasonally humid tropics (savanna). Temperatures are high but show some seasonality, but it is the ppt that displays the greatest contrast with 3 months of drought. Vegetation has to adapt to this dry period encouraging grasslands and deciduous trees such as acacia.

Reserve 4 marks for vegetation but with a maximum of 6.

(b) How far has climate influenced the development of landforms in areas of granite rocks within the tropics? [15]

Climate has a vital role in that the abundant moisture and temperatures increases the rate of chemical weathering. It also allows the development of vegetation and the production of humic acids which aid the development of basal surfaces of weathering beneath deep regoliths. Granite exposed at the surface in the drier tropical areas will be subject to thermal fracture. There are, however, many other factors to consider. The nature of granite itself in terms of chemical composition, texture, and structure. All of these affect the processes (hydrolysis) the ingress of weathering at the basal surface and areas of relative resistance which give rise to landforms such as tors, inselbergs, etc. Climatic change also has a role to play, particularly in etchplanation and pediplanation.

Level 3
Produce an account that reviews the impact of climate on granite weathering before going on to consider other factors that produce distinctive landforms. Some balance and assessment in the account. (12–15)

Level 2
A tendency to launch directly into the development of granite landforms with passing references to the roles of climate and to rock structure. There will be some recognition of their relative roles. (7–11)

Level 1
Descriptive accounts of some landforms such as tors or inselbergs with little or no attempt to indicate the role of climate. (0–6)

[Total: 25]

Coastal environments

3 (a) Using diagrams, explain the development of wave cut platforms, caves, arches and stacks. [10]

The processes of marine erosion along rock coast should be explained as should the role rock type and structure in promoting cliff retreat in the case of wave cut platforms. Similarly the development of caves through wave quarrying and the exploitation of lines of weakness. No doubt the impact of cavitation will be dwelt upon in the development of caves and the isolation of arches, stacks and stumps. Much can be achieved through the employment of well annotated diagrams.

(b) Using one or more examples demonstrate the extent to which coasts can be sustainably managed. [15]

There should be some indication as to what sustainable management means in a coastal environment. There is a need to balance the uses to which the coastal area is being put with the needs of long term environmental protection or indeed restoration. There is an opportunity to develop a particular case study or examples which seek to preserve some aspects of the coast whilst allowing for its use as residential, recreational, industrial or other uses. Whilst the human activities can to some extent be controlled through planning laws or price, the physical processes are both difficult and expensive to contain. The difficulty is often in the production of an overarching plan rather than the reliance upon more usual piecemeal responses.

Level 3
Provide a suitable case study or examples that demonstrate the difficulties of sustainable management in coastal contexts. This could review competing interests and pose the difficulties of managing natural processes. (12–15)

Level 2
Example(s) selected to discuss the nature of coastal protection rather than sustainable management. Thus the range of possible or actual solutions in terms of hard engineering, soft engineering, retreat etc. will be posited and to some extent evaluated. (7–11)

Level 1
A collection of coastal protection measures that are generic and trend towards those of hard engineering. No concept of coastal management. (0–6)

[Total: 25]

4 (a) Fig. 2 shows the movement of water in sea waves. Explain how such movement occurs and describe the differences between constructive and destructive waves. [10]

Waves are produced by wind blowing over the surface of the water. They are the means of transmitting energy through the water. The friction of wind on the surface produces orbital movements of water molecules that diminish with depth. This produces troughs and crests of waves where the height is a function of the energy. Waves move forward when they approach shorelines and break. There are two types of wave – the surfing or destructive wave and the surging or constructive waves. Destructive waves have spilling breakers and are high energy waves. They have strong backwash. Constructive waves (surging breakers) are low energy that are shallow and have long wave lengths. They have a strong swash and a weaker backswash.

(b) How do waves affect deposition along coasts? What other factors can affect the development of landforms of coastal deposition? [15]

Waves affect deposition along coasts in that they aid coastal erosion to supply sediment, transport it, deposit it and help to shape the resultant landforms. Probably most sediment is not derived from wave erosion, but more from the input of rivers, etc. The transportation can be explained as beach drift and longshore currents. Deposition occurs where velocity and competence is lost and provides landforms such as beaches, spits, bars, etc. Refraction and constructive and destructive waves help to mould the landforms and in cases of storm waves can destroy them. Other factors affect the supply of sediment (e.g. rivers and the development of salt marshes), wind in the production of dunes, but most importantly coastal alignment and composition. Human activities can affect supply of sediment and seek to protect and destroy some coastal landforms.

Level 3
Demonstrate a clear understanding of the role of waves within coastal deposition with clear accounts of processes such as LSD and refraction. Good examples of landforms and account of the factors that influence their development. (12–15)

Level 2
Some explanation of the processes of transportation and the role of constructive and destructive waves. Landforms will be only partially linked to waves and the other factors will be limited and possibly dominated by human activities. (7–11)

Level 1
Rather vague descriptions of LSD with poor connection to the movement or deposition of sediment. Landforms will be vey limited in terms of wave action or any other factor other than human interference (e.g. groynes). (0–6)

[Total: 25]

Hazardous environments

5 (a) Explain the nature and causes of avalanches and describe their hazardous effects. [10]

Avalanches represent a sudden and rapid movement of ice, snow, earth or rock down a slope. In all cases they occur where shear stresses on a potential sliding surface exceed shear strength. Many will only deal with snow and ice which is acceptable here. Snow avalanches can be characterised by slab or loose snow avalanches, whether they are surface or full depth, wet or dry snow, unconfined or confined channel and airborne or ground flow. Wet snow avalanches are the most powerful and generate the most hazards. They occur in spring with partial snow melt. Airborne snow is also hazardous due to the powerful shock waves which precede it. Rock and debris avalanches are most hazardous when triggered by earthquakes in the location of settlements.

(b) Describe and evaluate the methods used to limit the hazardous effects of avalanches and other forms of mass movement. [15]

Here it is necessary to go beyond snow and ice, although I suspect many will dwell upon the various ways in which snow avalanches are limited. Using explosives to detonate dangerous snow slopes, preventing off piste skiing, erecting diversion barriers above settlements and the training of search and rescue teams have all been tried with varying success. In most cases of hazardous mass movements the main approach is to stop or to limit activities that destabilise slopes. Disafforestation, undercutting, mining, dumping of slag heaps or the placement of reservoirs or buildings on top of unstable slopes. Little can be done to prevent large scale mass movements consequent upon earthquakes.

Level 3
Give a balanced account of the methods employed although there may be some concentration on avalanches. The methods will be assessed in the case of avalanches by cost/effectiveness, but other forms of mass movement will be considered. (12–15)

Level 2
Mostly snow avalanches with only passing reference to the more general problems of maintaining slope stability. Some limited evaluation of the methods outlined. (7–11)

Level 1
Few methods of limiting the impact of mass movements restricted to ideas such as stopping loud noises in snow environments or ploughing along contours in other areas. No evaluation. (0–6)

[Total: 25]

6 (a) Table 1 gives information on some major earthquakes occurring between 2001 and 2008. With the help of Table 1, explain why some earthquakes are more hazardous to human life than others. [10]

The earthquakes are all of a magnitude of 6.6 or over, but have very variable impact regarding fatalities. The largest magnitude does not necessarily mean the greatest fatalities (e.g. Hokkaido). Clearly location proximate to settled areas has an important influence (i.e. Alaska and Hokkaido cf Indonesia or China). Also the level of preparedness or wealth has an influence (California cf Indonesia) and accessibility (Gujarat). Hazards secondary to the effects of shaking may also be significant. Here the tsunami generated off the coast of Indonesia caused the largest number of fatalities. Liquefaction and rock falls can also be significant.

(b) Explain the origins and general location of earthquakes and evaluate the methods used to limit their effects. [15]

Earthquakes are shocks due to sudden movement in crustal rocks. Most occur along fault lines in areas of volcanic activity. The point where the seismic waves reach the surface is known as the epicentre. Thus they are most frequently found along plate margins, particularly the Pacific ring of fire. Methods used to limit their impact include monitoring earth movements (seismographs), prediction (frequency seismic gaps, hazard maps), building regulations and zoning, protection of vital services, education. These tend to be more prevalent and effective in countries that can afford them (e.g. USA and Japan), but even here (as in Kobe) little can be done to prevent major disasters if a powerful earthquake occurs in the centre of densely settled cities.

Level 3
Accurately explain the origin and general global location of earthquakes. The attempts to limit their impact will be well exemplified and their effectiveness assessed. (12–15)

Level 2
A general association of earthquakes with plate margins and tremors from within the earth's mantle. An eclectic and sometimes disorganised list of methodologies employed in earthquake zones with limited appreciation of prediction or of levels of success of the methods. (7–11)

Level 1
Earthquakes seen as earth movements vaguely associated with plate margins. Some random efforts to contain the effects, but more a description of the effects of earthquakes or an earthquake. (0–6)

[Total: 25]

Arid and semi-arid environments

7 (a) Describe the characteristics of soils found in hot arid areas. [10]

Regolith is shallow and the sparse flora does not contribute much organic matter. Aridity inhibits micro-organic activity and there is little sorting of surface material. Azonal in character with colour and mineral content that reflect parent material. Much of the soil process reflects past rather than present conditions. Dominant water movement is upward leading to concentration of salts in upper horizons – salinisation (solanchak) (accumulation of bases with pH less than 8) and solonetz (hard alkaline layer just beneath surface)

(b) How have plants and animals adapted to extreme temperatures and aridity? To what extent can such environments be sustainably managed without harming plants and animals? [15]

The scarcity of water and high temperatures produces a hostile environment for both flora and fauna thus specialisation is necessary. Nutrient cycling is low as is net primary production (NPP). Plants have adapted by:-
deep roots – phreatophytes;
leaves and stems adapted to reduce water loss – xerophytes;
water storage systems in leaves, stems and trunks – cacti and baobab;
seeds that can stand extended periods of dormancy;
leaves protected by thorns or alkaline toxicity – cacti;

Fauna – carrying capacity is limited by food supply. Insects and reptiles dominate as herbivores largely introduced by humans. Adaptions:-
subsurface dwelling;
unusual renal systems to reduce water loss;
nocturnal, insects with hard, waterproof skins, scavengers, migrating species (locusts).

Sustainability largely means being left alone. Any attempt to irrigate, introduce herbivores, etc. will result in deterioration and change to the ecosystem, upsetting the fragile and delicate balance.

Level 3
Demonstrate a good grasp of flora adaptions and some grasp of the relationship of fauna to heat and aridity. An awareness of the fragility of the ecosystem. (12–15)

Level 2
Some understanding of floral adaptions with some exemplification. Faunal adaptions far more limited. Sustainability will be seen in terms of human occupation. (7–11)

Level 1
Flora limited to cacti and water storage, Faunal a list of some animals found in desert areas. Little concept of either sustainability or of ecosystems. (0–6)

[Total: 25]

8 (a) Photograph A shows some landforms in a hot arid area. Using a sketch diagram, identify and describe the landforms shown in Photograph A. [10]

A classic view of 'monumental' desert landforms characteristic of Utah and Arizona. The sketch diagram should identify the mesa and buttes, the mountain front with its vertical slopes as well as indicate the well developed knicks and the slopes of the rock pediment. On the lower slopes of the pediment can be seen horizontal bedding planes and large detritus suggesting a boulder controlled slope. The foreground shows the more gentle slope of the pediment area that has smaller debris and some vegetation. Award 4 for the sketch and 6 for the identification and description of the features.

(b) Explain how landforms such as those shown in Photograph A have developed. To what extent have they been formed by past and present physical processes? [15]

The rocks are sedimentary, horizontally bedded and have been dissected by wadi systems. Valley sides are vertical. When erosion has reached an advanced stage, the interfluves are reduced to mesa and buttes and the valley floors begin to coalesce as broad alluvial plains. Lateral erosion by streams has produced the extensive pediments. Some may argue for parallel retreat of slopes. The better answers may well indicate the probable role of faulting in that mountain fronts are often eroded fault scarps. The amount of erosive and weathering activity required to produce such landscapes all argue for a greater amount of geomorphological activity than is currently evident from the work of wind or episodic rainfall. This all points to a pluvial period in the pliestocene when much of the downcutting, lateral stream planation and slope retreat could have taken place.

Level 3
Show a knowledge of the component landforms and good understanding of the processes involved in their formation. Emphasis will be placed upon both weathering and erosion from a wetter past, with current activity limited to a slow moulding of the landforms. (12–15)

Level 2
An awareness of the role of water in the production of the landforms which might be largely associated with sheet wash (as evidenced by the knick and pediment). Again past pluvial activity will be deemed responsible. May be some references to the desert piedmont zone. (7–11)

Level 1
References made to water and wind activity, but unspecific as to how the processes operate(d) and how they shaped the landform. Seen as past processes, but little suggestion as to when or how. Could be a confused with a generic account of the desert piedmont zone. (0–6)

[Total: 25]