UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2012 question paper

for the guidance of teachers

9696 GEOGRAPHY

9696/21 Paper 2 (Advanced Physical Options), maximum raw mark 50

This mark scheme is published as an aid to teachers and candidates, to indicate the requirements of the examination. It shows the basis on which Examiners were instructed to award marks. It does not indicate the details of the discussions that took place at an Examiners' meeting before marking began, which would have considered the acceptability of alternative answers.

Mark schemes must be read in conjunction with the question papers and the report on the examination.

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Tropical Environments

1 (a) Describe how, and explain why, the soil profile characteristics of savanna soils differ from those of tropical rainforest soils. [10]

Diagrams would seem most appropriate and if fully annotated could get full credit. Implied are basic zonal soils but accept any pairs that reflect soil processes relevant to the two ecosystems. The syllabus lists oxisols/latosols, tropical red and brown earths. It would seem sensible to start with TRF latosols and a soil profile showing a thin humus layer, under a thicker litter one (intense bacterial activity), upper A horizon, red from hydrated oxides of Fe and A*l*, deep soil (30 m) lower red/yellow horizon. Indication on diagram, or in text, of the role of climate in weathering and soil 'water' movement; promoting latosolisation/leaching (downward movement of soil constituents, leaching of silica, etc.)
In savanna areas there is perhaps a wider variation in soils related to the length of dry season. Upward water movement may lead to a calcium rich upper layer and higher pH, seasonally alternating upward and downward movements may give upper cemented layers such as laterite, merging horizons but generally red as in TRF. The grassland vegetation yields a thin dark brown humus layer of tropical brown earths. Soil depth (1 to 2 m) much less than TRF. Explanation in terms of climate, vegetation and soil 'water' movements.

(b) For one tropical ecosystem, explain the extent to which soil fertility can be affected by:
(i) exploitation of the ecosystem;
(ii) sustainable management of the ecosystem. [15]

This should follow on naturally from **(a)** and be helpful for candidates, although there may be repetition of material. Soil fertility should be in terms of nutrients, structure, texture, pH, minerals, moisture; i.e. the constituents and conditions necessary for plant growth. Apart from the basic knowledge of TRF soils being of low fertility once the nutrient cycle has been broken, some may recognise that there can be more fertile azonal soils and soils related to location along a soil catena. In savanna areas, tropical brown earths may be more fertile with the upward movement of calcium but cemented layers may inhibit plant growth as may a high pH in some areas.

(i) will probably be seen in terms of loss of fertility and only in terms of soil erosion in some cases. Better answers should reveal an understanding of fertility and that in some types of exploitation, maintaining fertility is significant.

(ii) some will refer to case studies with sustainability central to such schemes. Most will opt for TRF examples but maintaining, or improving fertility, should be central to all cases.

Level 3
Good knowledge and understanding of soil fertility in one of the ecosystems and how it is affected. A balanced response to the two parts and appropriate examples and/or detail. [12–15]

Level 2
Sound but limited knowledge of soil fertility but with some relevant detail of examples in each demand. Less well balanced response than Level 3 especially at the lower end. [7–11]

Level 1
Weak understanding of soil fertility apposite to the ecosystems. Exploitation mainly resulting in soil erosion in **(i)**. Limited response and in general terms in **(ii)**. [0–6]

2 (a) **Fig. 1 is a cross section diagram of a granite inselberg in a tropical region. Explain how processes of weathering and erosion have operated in stages to produce a granite inselberg in a tropical area, such as that shown in Fig. 1.**

Best achieved with diagrams of stages preceding the final one given in Fig. 1. Some initial surface with deep regolith extending down to an undulating basal surface of weathering determined by the joint pattern of the granite mass. Tropical humid weathering processes should be detailed, i.e. chemical (principally hydrolysis) accelerated by the high temperatures, humic acids and so on. Then following stage(s) to show/explain possible uplift and erosional stripping until the granite landform emerges first as a ruware, then the domed inselberg. Better answers will refer to the pseudo bedding joints from dilatation leading to exfoliation and accentuating the domed morphology.

(b) **Describe the changes in the structure of vegetation in moving across areas from tropical rain forest to dry savanna. For one tropical ecosystem, explain the extent to which the nature of the vegetation is a response to the climate. [15]**

Many may provide a sketch showing change from the layered vegetation with emergents of the TRF through the seasonally more open forest and then open parkland savanna to areas of dry scrub. Different terminology may be used but the key elements of the structure of vegetation should relate to the change from year round rainfall to increasingly longer dry seasons to eventual semi-arid conditions. Many may detail the nature of the vegetation in this part of the answer which can be credited for one of the ecosystems, as that is the requirement of the second demand.
The second demand allows them to expound in the TRF on drip tips, buttress roots, epiphytes, evergreen deciduous forest. In savanna ecosystems; perennial grasses 1 to 2 m. tall, open canopies of drought-resistant, fire-resistant or browse-resistant trees with acacias and baobabs as examples. Whichever is chosen, the question requires 'the extent to which vegetation is a response to the climate', i.e. soils, such as related to geology, slopes, flood plains. Some may relevantly suggest human and animal influences especially in the savanna.

Level 3
Accurate knowledge showing clear changes in structure through at least three stages and related to lengths of dry season. Good detail of the nature of vegetation in one area with examples and reference to other factors. [12–15]

Level 2
Good to basic knowledge of structure and coverage and with clearly identified changes related to climate. Reasonable knowledge of the nature but mainly only linked to climate. [7–11]

Level 1
Confuses structure and nature with weak descriptions, very general link to the seasonal changes. Repetition in second part and lack of relevant other factors. [0–6]

Coastal environments

3 (a) With the aid of diagrams, explain how rock type, structure and marine and sub-a processes can account for different types of cliff profile (cross section form). [1

What is hoped for are vertical, inclined, slope over wall, slumped profiles, etc. and the lithology, structures and processes to explain them. Credit well those that show realistic understanding of the interaction of geology and process with a minimum of three examples, e.g. horizontal bedding with active wave erosion and removal to give vertical cliffs, seaward dip with sliding and removal to maintain a sloping cliff, slope over wall from either wave erosion into resistant rock and cliff retreat with incomplete replacement of a slope profile or less resistant strata overlying more resistant. Then there are declining cliffs where active cliff foot erosion has ceased, blocky profiles in well jointed granite or limestone, etc. Sea level change is not in the syllabus and therefore not expected but it could be very relevant in some cases.

(b) Explain how physical processes and human activities can lead to rapid changes in beaches and coastal sand dunes. How and with what success can management strategies limit those changes which threaten the coastal environment? [15]

Both features are essentially temporary in size and form. Seasonal wave types and episodic storm events can change beach profiles and form dramatically and the physical processes can be exacerbated by human activities. Beach structures, dredging/quarrying and nourishment could also be relevant.
Coastal dunes can be subjected to erosion due to storm events/blow outs or accumulation from a prolonged period of on shore winds. Humans can damage dune systems by trampling and excavation. Interference with long shore drift may starve dunes from replenishment. There is plenty to provide material but look for balance between the features as well as the input of physical and human effects.
Management strategies will include the usual groynes, revetments, gabion cages, etc. Controlled access to dune systems and stabilising with marram grass planting and so on.

Level 3
Well balanced with good and realistic understanding of processes and activities. Apposite examples but L3 could be achieved without specifically named or located ones. Accuracy in detailing constructive and destructive waves and some understanding of the dynamic nature of the coastal system. Realistic grasp of management strategies and evaluated. [12–15]

Level 2
Less complete coverage but some good detail in parts, routine management schemes and less well evaluated. [7–11]

Level 1
Unbalanced and simplistic understanding. Weak management with no evaluation. [0–6]

4 (a) **Photographs A and B show two types of coral reef.**

Outline the conditions necessary for the growth of coral reefs and, with reference to one theory, explain how a coral atoll may develop from fringing and barrier reefs such as those shown in photographs A and B. **[10]**

The conditions will probably have been well rehearsed, temperature (16–33°C but optimum 23°–26°), light/depth (<70 m), clear water (away from river mouths to avoid silt), also salt water necessary 35–38 ppt (parts per thousand) and well oxygenated. Some may elaborate on plankton, photosynthesis, etc.
Coral atoll best explained with a sequence of diagrams and reference to Darwin or Daly but we may get Murray and others. Credit well, as ever, genuine/realistic understanding e.g. ability for rate of coral growth to keep pace with sea level rise.

(b) **With reference to a stretch, or stretches of coast, explain how management of one area may create more problems than are solved. How may such problems be managed?** **[15]**

This is a variation on the usual theme with the hint that, say, arresting erosion in one stretch with groynes, etc. will starve beach replacement along the coast with inevitable consequences. Expect the well used examples such as Hastings and Fairlight, Pett levels or the Holderness coast. However, more local relevant examples are appearing. Whatever the source, it is the accurate detailing, with hopefully a sketch map, that deserves the credit.
Addressing such problems may be to introduce more hard engineering or consider soft engineering such as beach replenishment or consider managed retreat etc.

Level 3
Accurate detailing of a stretch or stretches of coast with realistic understanding and sense of scale revealed. Feasible solutions advanced. [12–15]

Level 2
Examples less well defined or unconnected, with some lack of accurate detailing. 'Routine' approach lacking genuine understanding. Sensible solutions at the higher end but unrealistic at the lower. [7–11]

Level 1
Lack of appropriate example(s) or any accurate detailing. Lists of engineering structures but weakly linked to either the first or second demand. [0–6]

Hazardous environments

5 (a) Explain how and where tornadoes may develop and describe the extent to which tornadoes are hazardous. [15]

Tornadoes are spawned by violent uplift associated with thunderstorms, usually where there is an inversion such as humid air from the Gulf of Mexico streaming north meeting cold air from Canada or Rocky Mountains. A vortex develops from the shearing effect of air streams meeting. Tornado alley will no doubt be mentioned but tornadoes are universal if normally less violent elsewhere.

Tornadoes are not hazardous to the extent of other hazards studied, there have been extreme events notably in middle USA, (deaths of 689 in 1925), but generally low numbers and damage localised (although costly if cities affected) due to the short and narrow path of the average tornado. Hazards are the high winds and extreme low pressure at the centre (outbursting of buildings) and uplift of vehicles, etc.

(b) Explain the nature and causes of two types of hazardous mass movements on slopes. How effective are measures which may be taken to reduce the hazardous impact of one of them? [15]

Their nature should be straightforward but there could be a range of triggers as the events develop from some critical point of balance between shearing strength and strain; over saturation of soil from an extreme rainfall event or lubrication of a slip plane, earthquake shaking and human induced disturbances. The key force is gravity, so critical slope angle e.g. of debris also important and then there are the numerous forms of human activity from deforestation to skiing, overloading and quarrying etc. There is plenty to go at.

Measures will depend on the example chosen but could be reducing or avoiding the human interference, regrading slopes, pinning, afforestation, even prediction in some cases and so on.

Level 3

Accurate knowledge of both the nature and causes with good understanding of scale for both types. Appropriate examples and realistic appraisal of measures. Uses appropriate terminology throughout. [12–15]

Level 2

Less well balanced coverage of two types but sound to good knowledge in parts. Some lack of understanding of the mechanics/processes. Measures more limited, or unrealistic, in addressing the hazards. [7–11]

Level 1

Lacking in fine detail of the nature in both types chosen and very limited understanding of causes. Measures either inappropriate or unrealistic. [0–6]

6 (a) **Fig. 2 shows the potential hazards from an eruption of a volcano.**

Describe the nature of three of the hazards shown and explain the extent to which each may prove to be hazardous. **[1**

Should be straightforward and therefore some accurate descriptions needed for valid credit. Pyroclastic flows will be extremely hazardous because of their nature (high speeds up to 100 km/h of hot ash, rock fragments and gas 600–900°C). Lava flows much less hazardous in terms of loss of life as generally slow flowing. Lahars can be highly hazardous e.g. Nevado del Ruiz 1985 and so on.

Nominally five marks total for each demand or three marks per example with a bonus available.

(b) **Describe the types of hazard that can result from a major earthquake event. Evaluate the effectiveness of measures to reduce the hazardous impact of earthquakes.** **[15]**

Ground shaking from seismic waves leading to buildings collapsing, roads and rails buckled and fractured, gas, water and electricity supplies cut. Earthquakes may trigger landslides and cause liquefaction. Then there are tsunamis. Allow 'knock on' effects such as diseases and trauma.
The measures should be specific to earthquakes and not the frequent catchall list applicable to any and all types of hazard. Prediction can be virtually written off! even though there will be changes in animal behaviour (pigs chasing tails and leaping fish), i.e. a realistic assessment of its effectiveness is needed. A realistic appraisal is also needed in presenting building and infrastructure design, hazard mapping, preparedness measures such as response units and education, etc.
Nominally equal weighting for the two demands but the first one must be covered adequately.

Level 3
Good coverage of at least three types of hazard backed up with specific examples and revealing both knowledge and mature understanding. Genuine evaluation of measures with relevant cases cited. [12–15]

Level 2
More limited coverage but with sound to good knowledge and understanding. Second demand less well focused on earthquakes and lacking in evaluation. [7–11]

Level 1
Lacks detail to substantiate the types of hazard. Overweighted response to second demand with considerable irrelevance and/or lacking in accurate detail. [0–6]

Arid and semi-arid environments

7 (a) Outline the distribution of the large areas of hot deserts in the world and expla[illegible] factors that account for that distribution. **[1[illegible]**

Basically western sides of all continents between latitudes 20° and 30° but extents varied, e.g. Atacama and Sahara/Arabian. The crux of the question is the explanation which should include the descending limb of the Hadley cell with adiabatic warming/drying, desiccating trade winds from across land masses/rain shadow, continentality and cold ocean currents. It is the degree of accurate understanding that is needed and not just the listing.

Nominally mark up to 3 and 7 but distribution could be up to 4 or explanation up to 8.

(b) Explain the environmental factors restricting sustainable management in either an arid or a semi-arid area and evaluate any attempted solutions. **[15]**

Essentially insufficient and/or unreliable rainfall, extended drought followed on occasions by excessive rainfall. Sparse vegetation cover for grazing and soils lacking structure and low in nutrients for agriculture. Desertification from a history of overgrazing and deforestation for fuel and salt encrusted soils resulting from inappropriate widespread irrigation methods. Some detail, ideally with examples and data for full credit.
The syllabus advises 'A case study illustrating the problems…' and there have been well argued and evaluated answers in the past. The weaker answers will list improbable and/or unfeasible solutions.

Level 3
Succinct but accurate coverage of the environmental factors, i.e. the focus of the demand. Well presented and evaluated attempted solutions with appropriate detail of at least one example. [12–15]

Level 2
Covers principal environmental factors but with some lack of fine detail and less specific solutions or fully realistic ones. [7–11]

Level 1
Limited and imprecise detailing of factors and no specific cases of solutions; 'develop tourism', 'dig wells', 'irrigate', 'develop industries', etc. [0–6]

8 (a) Fig. 3 shows landforms of a mountainous hot desert landscape.

Identify three of the landforms indicated by letters and explain their formation.

A – wadi – carved out by erosion from running water (river) in a wetter past and/or stream flood episodes, steep sides from lateral erosion and lack of weathering to develop 'normal' valley side slope profile.
B – alluvial fan – deposited as a fan-shaped mass where a rapidly flowing stream leaves a steep and narrow valley and enters an area of gentle gradient. Reduction in gradient, and thus stream velocity, occurs, causing overloading and deposition.
C – butte – a flat topped feature which has become separated from the adjacent plateau by stream erosion into probable faulted lines of weakness. Accumulation of weathered rock gives a boulder controlled slope of uniform angle.
D – pediment – could prove the most difficult for a clear explanation but it is essentially an erosion surface even though maybe covered with a veneer of deposition. Could be an active basal slope left by recession of the mountain front or result from lateral planation. Action of stream floods, a local base level, accept an explanation that fits relevant and realistic processes.
E – playa – a lake developed in an internal drainage basin from intermittent streams from the occasional rainfall. However, the lake that forms is rapidly evaporated and its site occupied by a saline or alkaline crust or mud flat.

(b) Explain the low biomass productivity of arid and semi-arid environments and describe nutrient cycling in one of the environments. How have plants and animals adapted to the harsh conditions of such environments? [15]

Scarcity of water and alkalinity give hostile conditions. Lack of water main barrier as the environments have a high potential for photosynthesis. In deserts the rate of nutrient cycling is low with an NPP of < 0.003 kilos/square m/annum (TRF = 2.2) – higher in semi-arid up to 0.2 in more favourable areas. Top answers may include a Gersmehl diagram of one environment; in deserts the soil is the largest nutrient store with slow decomposition of dead organic matter and lack of leaching plus dry minerals but unavailable to plants. In semi-arid; biomass is the largest nutrient store with sufficient seasonal water for growth of vegetation and overall the stores and nutrient flows are much larger than in deserts.
No doubt there will be many scant responses to the first demand and long accounts of how plants have adapted with less on animals. The vegetation will have been well rehearsed but should not dominate assessment. Expect good range well linked to conditions with examples, not just cactus.

Nominally up to 7 for first demand but could be higher where there is genuine and detailed knowledge and understanding. Maximum of 10 for second part.

Level 3
Good knowledge and understanding of productivity and nutrient cycling in both environments. Balanced account of adaptations with appropriate examples. [12–15]

Level 2
Limited response to first demand but elements of understanding. Sound to good knowledge of adaptations of both plants and animals. [7–11]

Level 1
Very little understanding of the first demand, all negatives and lack of distinction between the two biomes. Second demand dominated by plants with limited examples. [0–6]