CAMBRIDGE INTERNATIONAL EXAMINATIONS

GCE Advanced Subsidiary Level and GCE Advanced Level

MARK SCHEME for the May/June 2013 series

9696 GEOGRAPHY

9696/23 Paper 2 (Advanced Physical Options), maximum raw mark 50

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CAMBRIDGE
International Examinations

Tropical environments

1 (a) Explain the role of the ITCZ (inter tropical convergence zone) in determining the distribution of temperatures and rainfall totals in the humid and seasonally humid tropics. [10]

It would be logical to start on the equator at an equinox (i.e. position of the ITCZ) with overhead sun, maximum insolation, L.P., convergence of trades, strong convectional uplift and heavy afternoon rainfall. Although the ITCZ migrates seasonally away from the equator, its effect continues, say 5º N and S. This leads to an equatorial climate with the 2,000 mm all year rainfall but with a double, often slight, maxima at the equinoxes. The relatively slight change in insolation throughout the year gives the small range in temperature (2º–3º) either side of a 26ºC mean. Movement of the sun polewards takes the zone of maximum insolation to over the tropics; the ITCZ following with a seasonal summer maximum rainfall away from the equatorial belt. Good candidates may state that the ITCZ boundary is irregular, mainly due to the effect of the configuration of the continental land masses. However the seasonal effect should be emphasised, with a maximum period of rainfall, usually in July in the northern hemisphere, January in the southern. Appropriate data could be e.g. Kayes (Mali) 14ºN, 12ºW. May 35ºC – Jan 25ºC. Rainfall total 725 mm with 652 mm of that between Jun. and Sep. However figures which show the pattern (obviously reversed in the southern hemisphere) should be credited although some candidates may provide a station set and, in some cases, graphs. Top credit for those who add the variations which might be due to altitude, coastal location and some may bring in monsoon climates. Others may refer to humidity and wind, obviously credit worthy in the overall assessment of the quality of the answer.

(b) To what extent do the processes of weathering and erosion influence the types of landforms found in humid and seasonally humid tropical environments? [15]

To a great extent the processes of weathering and erosion are very important in the development of landforms in the humid tropics. Chemical weathering will be at a maximum under conditions of high amounts of acidulated water and high temperatures. Candidates should develop this with the importance of humic acids from the rotting of lush vegetation added to CO_2 and acceleration of chemical processes with higher temperatures. Erosion will only be fluvial but slopes may suffer from mass movement although this will be limited by a dense vegetation cover. The crux of the question is the role of geology, i.e. the lithology and structure of the rocks. Granite and limestone are named in the syllabus so there should be scope for a range of landforms. In both cases the structure is important, i.e. the joints allowing ingress of solutions for active chemical weathering into the minerals, mainly the felspars in granite and calcium carbonate in limestone (hydrolysis and carbonation). Areas of close jointing will lead to collapse of the rocks, depressions in the basal surface of weathering in granite; dolines in limestone etc. Areas of massive structures (widely spaced jointing) will eventually lead to bornhardts or tower karst. There is scope for the role of erosional processes in revealing landforms after stripping of regolith; ruwares, tors etc.
N.B. Full credit can be gained from consideration of one example of rock type.
In seasonally humid (savanna) areas, weathering will be much less active, but patterns change from the more humid regions to the less but many will see such areas as dominated by physical weathering. Plateau surfaces with steep escarpments may have developed by river incision and valley widening with weathering more active on side slopes. Insolation (thermal fracturing) weathering may be active but many will over play its role, i.e. exfoliation, granular and block disintegration. No doubt freeze thaw will feature in answers but this must be conditioned by altitude and water availability. Because of extensive laterite (ferrocrete) and calcrete crusts, there will be little deep infiltration of water. Wind abrasion may occur to modify existing landforms.

Level 3
Good knowledge of appropriate weathering and erosion processes and understanding of their effectiveness in the different climates. These will be illustrated with accurate and detailed stages of how selected landforms may develop with reference to a particular rock type (or rock types). [12–15]

Level 2
Knowledge of appropriate processes but less accurate understanding of their effectiveness. Aware of the role of lithology and structure of rocks but less precise in the development of specific landforms. [7–11]

Level 1
Lacking in accurate detail of weathering processes or any relevant role of erosion. Some named landforms but limited understanding of the stages of their development. [0–6]

2 (a) Photographs A and B show areas of tropical rainforest and savanna vegetation.

Describe and explain the differences between the two types of tropical vegetation shown. [10]

Candidates may attempt to describe the differences with sole reference to the photographs. Others may describe solely from their knowledge of the two types. Either approach is acceptable. Area A is one of luxuriant vegetation, the buttress roots supporting tall trees in an area of dense growth of smaller trees, climbers, shrubs; large leaves but no grass, in fact a ground cover of mainly litter. In contrast the area B is one of open grassland with scattered trees. There is no dense foliage and the trees are spindly with small leaves. (Some may recognise the baobabs in the middle distance.)
The factors that explain the differences are the contrasts in climate. In one case all year rainfall totalling 2,000 mm combined with high temperatures led to maximum all year growth, low light inhibits growth at ground level, evergreen forest due to continual leave fall combined with new growth. The other area is a response to contrasting seasons of rain and drought; widely spaced acacia trees reflecting scarcity of soil moisture and grasses dying off as the dry season approaches. Approximate equal credit for the two demands but could be a 4/6 split either way.

(b) Describe and evaluate a scheme, or schemes, for sustainable management in <u>either</u> a tropical rainforest <u>or</u> a savanna ecosystem. [15]

Hopefully candidates will have a well prepared case study illustrating the problems of the sustainable management of an area in one of the ecosystems. In practice we may well get a selection of different schemes none of which are developed in depth. Some understanding of what is required for sustainable management should be outlined, i.e. that the ecosystem should not be irrecoverably damaged/destroyed by any developments. In the case of the TRF; managed logging under strict supervision such as selective extraction, agricultural development in restricted areas within the ecosystem, ecotourism will be popular but even mineral extraction can be accomplished without wholesale destruction of the ecosystem. In savanna areas there may be schemes such as controlled management of grazing over designated range areas, tourism with creation of national parks/game reserves.

Level 3
Clear understanding of sustainable management and a selected scheme, or schemes, described with accurate detail(s). Evaluation focused on the conservation of the ecosystem. [12–15]

Level 2
Less precise understanding of the demand, and any scheme, or schemes, lacking full and/or detailed description. Tendency to list without sufficient regard to impact on the ecosystem at the lower end of this level. [7–11]

Level 1
Exploitation rather than sustainable management. Listing of activities from slash and burn to logging. Management in terms of government controls. [0–6]

Coastal environments

3 (a) **Explain how the profile and plan form of beaches are affected by the action of constructive and destructive waves. [10]**

The emphasis should be on the action of the types of wave. Constructive waves break gradually across a gentle beach profile and the forward surging swash builds and steepens the profile with berm ridges at the higher areas. Destructive waves break onto a steeper profile with a plunging action and backwash which combs material back to develop a more gentle beach profile. Many will add the creation of storm beaches and off shore and break point bars. Plan form may be ignored but drift aligned and swash aligned beaches should receive some attention for full credit, e.g. constructive waves breaking obliquely linked to long shore drift, spits and so on, or asymmetrical bay head beaches. Destructive waves breaking normally may create beach cusps.

(b) **To what extent are rock type and structure important in the development of landforms along cliffed coasts? [15]**

To a large extent they are, but marine erosion and sub-aerial processes operate to shape and sculpt the geology into distinct morphological features. Good responses will be based on specific types of rocks and their structure, such as well jointed and blocky as in limestone and granite, inclination of strata and the presence of major and minor faults. No doubt many answers will not get much beyond headlands and bays as processes of wave erosion remove the ‘soft’ rock and leave protruding headlands in ‘hard’, this followed by the inevitable cave, arch, stack, stump sequence and possibly wave cut platforms. Better answers will include accordant and discordant coasts with reference to specific examples. The profile form of cliffs depends very much on lithology and structure coupled with the balance between cliff foot active erosion and removal and sub-aerial mass movement and weathering, i.e. cliff retreat and cliff decline.

Level 3
Clear understanding of the importance of rock type and structure well exemplified with specific examples. Evaluation focused on the role of processes and how both factors and processes are reflected in selected landforms. [12–15]

Level 2
Less well structured but good coverage at the upper end of the level of both factors and processes. Evaluation limited and in more general terms. Relevant examples but lacking appropriate detail at the lower end. [7–11]

Level 1
Limited discussion of 'to what extent?' and little beyond headlands and bays in hard and soft rocks followed by caves, arches etc. Limited use of examples beyond, say, Flamborough Head. [0–6]

4 (a) Fig. 1 shows some threats to coral reefs.

Explain how any <u>three</u> of the threats shown in Fig. 1 can affect the conditions necessary for the growth of coral and the survival of coral reefs. [10]

There is a wide choice: pollution (oil spill, effluent, run off of farm chemicals), structural damage (storms, fishing, construction) and impact of rising temperatures, increased fresh water and sediment input, tourism as well as 'natural' hazards from such as the crown of thorns starfish. What is required is some detail of the nature of three of the threats and how they can affect the conditions which corals thrive in, i.e.:

Warm temperatures; ideally 23–29ºC.
Clear oxygenated water, i.e. away from river mouths but wave movement to oxygenate.
Coral polyps are sensitive requiring salt water 35–38 ppt.
$CaCO_3$ skeletons are tough but will be damaged by severe storms and by fishing and tourist activities.
Increased input of farm pesticides and other chemicals could kill coral polyps.
Increased algal blooms from nutrient-laden sewage can block sunlight, stunting growth and interfering with reproduction.

There may be others, allow those that make sense.

The survival of coral reefs may be implied but some assessment needed for full credit, e.g. the long term survival of the Great Barrier Reef has been documented.

(b) Assess the advantages and disadvantages of soft engineering and hard engineering approaches to the sustainable management of coasts. [15]

Hard engineering approaches tend to be expensive, temporary and generally intrusive visually and unsustainable. They often lead to knock on effects down coast requiring further coastal management, e.g. Hastings, Fairlight, Pett level and so on. Groynes, sea walls, revetments, rock armour, gabions – some assessment of their effectiveness, cost, maintenance and knock on effects can be expected.
Soft engineering approaches are less expensive and more long term. They are generally a more attractive alternative and sustainable as they work with natural processes. Beach nourishment; cheap and retains natural appearance but off shore dredging may interfere with the sediment cell leading to erosion elsewhere. Storms may make frequent replenishment necessary. Managed retreat retains natural balance of the coastal system but loss of land, housing or productive farmland could be expensive in terms of compensation.

Level 3
Balanced coverage with good knowledge and understanding, Effective and accurate exemplification with genuine assessment. [12–15]

Level 2
Cover both aspects with some relevant, if not fully detailed, examples. Has pros and cons but exaggerated or limited assessment at the lower end. [7–11]

Level 1
Essentially a listing of structures, unbalanced coverage with too much emphasis on civil engineering. [0–6]

Hazardous environments

5 (a) Explain why tectonic hazards associated with convergent plate margins are usually more devastating than those at other types of plate margin. [10]

The hazards associated are major earthquakes, tsunamis and volcanoes which occur more regularly and at a larger scale at converging plates, both subduction and collision, than at the other margins; for example Japan March 2011, Indian ocean December 2004, Pakistan 2005. However there have been major hazardous events such as the Laki eruption in 1783; Haiti in 2010; quasi conservative and of course San Francisco 1906; conservative. The explanation is best achieved with diagrams and text, e.g. the difference in the nature of volcanic eruptions, magnitude of earthquakes. Divergent ones, mainly sea floor spreading, do not affect centres of population whereas convergent ones, such as many of the Pacific rim and through the Mediterranean etc. do.

(b) To what extent is the prediction of volcanic eruptions more successful than the prediction of some other types of hazard? In what ways may the hazardous impact of volcanic eruptions be reduced? [15]

Generally true because volcanoes have a fixed location (they can be seen) and because there are many positive pre eruption indicators which can be monitored; visual, chemical, morphological, temperature, seismic. Examples of successful predictions; Mt St Helens and Pinatubo should support the case. In some other types of hazard such as earthquakes, tsunamis and mass movements, the indicators are much less positive both in terms of location and timing of an event. However in the case of tropical storms, a case can be made for accurate and reliable prediction via satellite images and hourly tracking although such storms may change track and hit coasts at unpredicted locations.
The second demand should elicit ways specific to volcanic hazards and not merely a catch all response to hazards in general. Cooling lava with water (Iceland and Hawaii), digging diverting channels and bombing flows (Etna) have been practised. Building design to combat ash fall and monitoring ash clouds for aviation might also figure. Apart from physical measures there are wide ranging and varied measures which governmental bodies and individuals can undertake. These might include; preparedness and education, warning systems and evacuation procedures, stand by services and so on.

Level 3
Balanced but comprehensive coverage showing good knowledge and understanding in line with the above and using accurate supporting detail and relevant selected examples. [12–15]

Level 2
Less in coverage, or balance, but generally good understanding. Limited accurate detail, or examples, at the lower part of the level. [7–11]

Level 1
Limited examples and lacking accurate detail. Response to the second demand in general terms. [0–6]

6 (a) Fig. 2 shows the percentage of deaths from different impacts of tropical storms (cyclones) in Bangladesh. Fig. 3 shows the location of Bangladesh.

Suggest reasons for the variations in the numbers of deaths from tropical storms occurring in Bangladesh. [10]

Fig. 2 shows maximum deaths (89%) from storm surges which suggests a lowland coast heavily populated, with a maximum tidal wave height; e.g. allow the narrowing width of the Bay of Bengal, i.e. its funnelling effect even though dubious. However the large narrowing river estuaries could be very relevant. Some may suggest extreme low pressures at the centre of the tropical storms raise sea level, which is again minimal but would show some thinking. Deaths from wind could be explained by its high velocity (Cat. 5 >250 kph) in tropical storms which could cause trees and structures to fall or project loose objects. Capsising of craft off shore and in the surf zone leads to drowning, steepening wave heights and high winds. Credit to those who show good knowledge and understanding of the weather associated with tropical storms and can extract valid information from Fig. 3.

(b) Explain the nature and causes of hazardous mass movements on slopes and evaluate their effects on lives and property. [15]

From the range of types of mass movements we should expect three or four to be mentioned but two are enough for full credit. Candidates most likely to select from landslides, rock falls, debris flows and avalanches and mudflows (including lahars). Nature and causes will no doubt be combined into a general account covering both description and explanation. They are hazardous when they occur unexpectedly (sudden mass movement), and when they affect people and property. In all such cases there is a 'tipping point' when shearing resistance of rock or soil is overcome by saturation/lubrication following heavy rain or human interference (deforestation, cultivation and building on slopes or excavation) and earthquake triggering and volcanic activity.

Effect on lives and property will be best achieved with well detailed examples. Avalanches can travel at great speed (40 to 300 kph) triggered by a sudden rise in temperature or earth tremor (less likely from yodelling) and have engulfed whole settlements, e.g. Galtur 1999. Mud flows can move up to 3 metres per second often in surges, buildings may be undermined or moved en masse and extreme events from tropical storm or monsoon rainfall have caused major loss of lives, e.g. Nepal 2002 (500), Rio 2010 (>200), Hong Kong 1972. Lahars can be particularly hazardous often melting ice and snow providing vast quantities of water to mix with volcanic debris travelling up to 75 kph, e.g. Nevado del Ruiz eruption in 1985 demolishing Armero with nearly 23,000 deaths. Coastal landslides caused by continual cliff foot erosion and removal affect cliff top settlement and coastal infrastructure.

Level 3
At least three described and explained with accurate detail showing good understanding of materials, processes and scale. Effects of at least two circumstances well evaluated with appropriate examples. [12–15]

Level 2
At least two well described and explained effectively showing reasonable understanding of materials and processes. Less well balanced answers especially at the lower level. Some lack of accurate detail in exemplification. [7–11]

Level 1
Limited understanding of both materials and processes and lacking accurate detail in addressing both demands of the question. [0–6]

Arid and semi-arid environments

7 (a) Describe the processes of erosion, transport and deposition by wind and explain their contribution to the development of <u>one</u> type of desert landform. [10]

Erosion: abrasion due to 'sand blasting' effect by sand grains but only effective at low level in desert sand storms. Deflation more effective in affecting surface form but only by the removal of loose material, mainly sand or products of weathering, more strictly a transport process but allow here.
Transport: fine material deflated and carried in suspension by the wind in dust storms, larger grains moved by saltation or surface creep.
Deposition: occurs when wind velocity drops, as when impeded by obstacles or dust is washed down by rain.
Yardangs, zeugens, gours (mushroom rocks), deflation hollows, barchans, seifs and allow dreikanter even though hardly a landform. Credit well those who demonstrate 'their effect', e.g. wind abrasion only effective near the ground to cause undercutting, or more effective on soft rocks or polishing harder ones. Hence the importance of the geology of yardangs and zeugens. Similarly wind constancy and direction is important in the development of dunes, i.e. transport and deposition involved. As only one landform is required, there should be accurate detail and a well executed diagram/sketch.

(b) Evaluate the contribution of water, both present and past, in the development of desert landforms. [15]

Some may outline the importance of water in chemical weathering; limited today but much more operative in the past, including possibly deep weathering profiles providing vast amounts of regolith. Evidence is chemically rotted crystalline rocks and laterite capped hills and alluvial deposits comprising sediments from old regolith being reworked, even at present in desert flash floods.
Most answers will focus purely on the operation of fluvial processes and some may use evidence other than geomorphological (cave paintings and alligators etc.), allowable in moderation. However evaluation should be in terms of the scale and morphology of landforms and the low rainfall and limited episodic run off of the present.
Contribution in the past would be the development of deeply carved valleys, extensive weathering on slopes with effective removal thus creating wadis, dissected plateaux, pediments and alluvial plains.
A change to more arid conditions left debris-choked wadis added to by continued accumulations from the products of mainly physical weathering with limited removal. Alluvial fans and bahadas may be produced by present flash floods deposited where wadis open out on to a pediment. Playas develop in internal basins from present intermittent streams carrying fine suspension and solution loads. In total then, limited present development of landforms.

Level 3
Well balanced and fully covered answer showing breadth and depth of knowledge and understanding throughout. Appropriate detail in relevantly selected examples. May include well executed diagrams although not essential for this level. [12–15]

Level 2
Covers the demands of the question but with less depth of understanding. Some lack of detail or coverage of appropriate landforms. May be heavily weighted to reproducing the landforms of the desert piedmont rather than a wider perspective. [7–11]

Level 1
Limited appreciation of the full demands of the question with a lack of understanding of what constitutes 'past' and 'present'. Description of landforms without effective discussion and poorly executed diagrams. [0–6]

8 (a) **Fig. 4 gives climate data for A, a hot arid environment and B, a semi-arid environment.**

Describe and explain the differences between the two types of climate as represented by the data shown in Fig. 4. [10]

Descriptions of differences should be straight forward; the contrast in totals of rainfall and range and values of temperature both seasonal and diurnal. Explanation for A should be based on the location re the descending part of the Hadley cell H.P. zone at 25ºN; little to no rainfall in the summer months and high temperatures. Some may give continentality, effect of rain shadow or even of ocean currents.
Explanation for B should identify higher rainfall but below the quoted 500/600 mm maximum in semi-arid definitions. However rainfall is in the summer months and related to the movement of the ITCZ bringing L.P. convectional rain, often in severe thunder storms. Temperatures are high throughout the year reflecting latitude of 12ºN. Summer maximum lower than the hot desert; cloud cover, more vegetation. Comparison between the two areas is not asked for but some may sensibly use the approach.

(b) **Describe the characteristics of soils in hot arid and semi-arid environments. Explain how plants and animals have adapted successfully to <u>aridity</u>. [15]**

The principal characteristics of aridisols are soil moisture deficiency, extreme in arid areas and less in semi-arid, high levels of calcium carbonates and salts in the upper horizons (solonchaks), limited or no organic content. There will probably be a range of textures; stony, sandy and frequently a hard surface crust. Generally grey with ill defined horizons. In the less semi-arid areas, increased organic matter from higher soil moisture (more rainfall and cooler temperature) gives a thin humus layer and soils can be agriculturally productive with irrigation. Expect less exhaustive treatment of soils than response to second demands, especially plants.
Adaptations to combat the environment include: expire (but leave seeds or eggs), store water (succulent plants or fatty storage in animals), conserve water (small leaves or dry fæces), tolerate dehydration (prickly pear cactus and desert toads), reduce heat input (shiny leaves and orientation or stay in shade/become nocturnal), dissipate heat (long appendages, e.g. limbs, ears or small bodies or leaves), endure, which principally applies to plants which have developed long roots to reach down towards the water table or wide spreading ones to gather the limited soil moisture from a wide area. Credit well reference to specific species from cactus and creosote bush in deserts and allow reference to baobabs, acacias and grasses in semi-arid.

Level 3
Well balanced answer with genuine knowledge and understanding of soils (something often rare) using appropriate terminology and clear on the processes for explanation. Covers both plants and animals with a range of adaptations and examples. [12–15]

Level 2
Less well balanced with more generalised understanding of soils and lack of clear distinction between arid and semi-arid at the lower end of the level. Covers plants effectively but limited with respect to animals. [7–11]

Level 1
Weak knowledge and understanding of soils; 'sandy and dry'. Knowledge of basic plant adaptations but little beyond cactus and limited knowledge of animal physiology to cope. [0–6]