Cambridge International AS & A Level

**Cambridge International Examinations**
Cambridge International Advanced Subsidiary and Advanced Level

**GEOGRAPHY** **9696/22**

Paper 2 Advanced Physical Options **October/November 2016**

MARK SCHEME

Maximum Mark: 50

**Published**

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.

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**Tropical environments**

**1 (a) Fig. 1 shows climate graphs for two tropical environments.**

**Compare the climates shown in Figs. 1A and 1B. Explain why the amount and seasonal pattern of rainfall varies between the two locations. [10]**

**Comparison**
Descriptive differences are the total amounts and seasonal distribution of rainfall and the values and range of temperatures (Singapore 1 °C, Kolkata 11 °C). Actual data should be used to aid the comparison.

**Explanation**
This should be in terms of the movement of the ITCZ. This will relate to rainfall totals and seasonal distribution. The nature of the rainfall due to low pressure, convergence, instability/uplift. The rainfall will be heavy from afternoon convectional uplift, with thunderstorms possible/probable. The differences should be brought out for top credit to be awarded such as virtually year round low pressure in the equatorial belt (Singapore) as opposed to a short seasonal low pressure during the 'summer' for Kolkata. Some may recognise that Kolkata represents a monsoon climate but full credit can be given without reference to such monsoon effect.

Award marks based on the quality of explanation and breadth of the response.

**(b) Assess the importance of weathering processes in the development of different landforms under humid tropical conditions. [15]**

The assessment will probably be very important, but equally important are lithology, structure and erosional processes. Details of weathering processes are required with hydrolysis and carbonation primarily with respect to granite and limestone but oxidation is also significant. Chelation/humic acids may figure and chemical processes accelerated under the hot humid climate. Some reference to physical and biological weathering could be appropriate. Both limestone and granite should be addressed in evaluating the role of lithology, and in both cases the importance of joint control. The question mentions different landforms, not just landforms, so it is to be expected that the assessment will be in terms of the relative importance of weathering processes with respect to specific landforms in either granite or limestone. Erosion plays a significant part in exposing landforms from deeply weathered regolith for the development of many granite landforms.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3 [12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. Response makes clear the links between weathering and landforms and evaluates the role of other factors noted in the mark scheme. Any examples of landforms and related rock types used are appropriate and integrated effectively into the response.

**Level 2 [7–11]**
Response develops on a largely secure base of knowledge and understanding but is selective with omissions but there is sound understanding of some processes and aware of the role of lithology, structure and erosion. Limited or lack of evaluation at the lower end of the scale. Examples may lack detail or development.

**Level 1** **[1–6]**
Response is mainly descriptive with limited knowledge of weathering processes and landforms and restricted use of landforms, with a lack of understanding of the role of other factors. Examples may be lacking entirely.

No response or no creditable response. **[0]**

**2 (a) With the aid of a diagram, describe the changes in soil characteristics along a tropical soil catena. [10]**

The most well developed catena occurs in seasonally humid (savanna) environments. Catenas are very poorly developed in humid tropical (rainforest) environments.

If a catena from a seasonally humid environment is chosen (the most likely), the diagram should show three elements, an upper plateau surface well drained with oxidised soils, a slope element which will be moderately well drained at the upper parts but poorly drained nearing the foot and finally, the level basal plain very poorly drained. The levelled receiving site will have dark peaty soils while the slope will show gradation from the oxidized plateau surface to the peaty lower one. It may be mottled with blue grey elements where oxidation is restricted. As noted above, there will be differences in detail and soil characteristics between the tropical rainforest and savanna ecosystems. Some credit can be given for a purely generic account for understanding the principle that there are downslope changes in soils with limited detail relating to tropical environments.

If only just a profile and its characteristics – maximum 4 marks.
If only a profile but some indication as to how it might change – maximum 6 marks.

If no diagram, then maximum 6 marks.

Award marks based on the quality of explanation and breadth of the response.

**(b) Describe how and explain why the vegetation structure of a tropical rainforest ecosystem differs from the vegetation structure of a savanna ecosystem. [15]**

**Description**
'How' will be the contrast between luxuriant evergreen and deciduous forest growth with emergents, canopy layers in TRF as against parkland with scattered trees, shrubs and grasses in savanna ecosystems. Credit will be for accurate detail and coverage.

**Explanation**
'Why' will be the climate: the contrast between all year rainfall (2000 mm) and constant warm temperatures against a strong seasonal climate of winter drought and summer rains (600 mm). The influence of animals could be important in the savanna.

Allow for a wider range of interpretations for the savanna as well as for the influence of human activities and fire. The question does not state 'natural or climax vegetation' but this will no doubt be assumed. However, credit fully acceptable definitions if justified by appropriate knowledge and understanding.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3** **[12–15]**

Response is well founded in detailed knowledge and strong conceptual understanding of the topic. Response is comprehensive with relevantly detailed descriptions of both ecosystems. Accurate explanations are backed up with data and any examples used are appropriate and integrated effectively into the response.

Clarifying and explaining the differences will be evident at this level.

**Level 2** **[7–11]**

Response develops on a largely secure base of knowledge and understanding but is selective with omissions. There is sound coverage of one ecosystem, most likely the tropical rainforest, but with some lack of accurate detail for the other ecosystem with a more limited coverage. Limited or lack of evaluation at the lower end of the scale. Examples may lack detail or development.

**Level 1** **[1–6]**

Response is mainly descriptive with limited knowledge of the vegetation in either ecosystem. Examples are in name only or lacking entirely.

No response or no creditable response. **[0]**

**Coastal environments**

**3 (a) Describe how waves are generated and explain how different types of breaking waves develop. [10]**

Most waves are generated by winds blowing over water; the moving air exerts a frictional drag on the surface water particles setting up orbital water movements. At the wave crest, these are forward and in the trough, backward giving rise to oscillations.

Expect many to produce diagrams which could earn full credit if well annotated. Waves break as they approach shallower water as the orbital motion is disrupted. The types of breaking waves that could be discussed are plunging, spilling and surging and will probably be related to wind strength and fetch. However, steeply shelving beaches will lead to more rapid and plunging breakers whereas beaches of intermediate slope angle produce surging waves. Spilling waves occur on gently sloping beaches. Two are sufficient for full credit but some may add wave refraction and waves breaking directly onto vertical surfaces.

Award marks based on the quality of explanation and breadth of the response.

**(b) To what extent does the interaction of marine processes and sub-aerial processes determine the morphology (shape) of coastal landforms? [15]**

To a large extent true but the rock types and structures of the coast are a large determinant of the morphology. Expect an account of wave erosion processes and simple hard and soft rocks to give a headland and bay configuration followed by the development of the geo, cave, arch, stack and stump sequence. However, better answers will use specific rock types and stress the importance of structure, both massive crystalline and the orientation of sedimentary bedding as well as the role of faults and jointing. The interaction of marine and sub-aerial processes is vital as it is the balance between them that determines cliff decline or active retreat. Diagrams should reveal understanding such as with cliff profiles related to dip.

The question does not say cliffs or erosional/depositional landforms, thus better candidates might argue ‘yes’ for cliffs but ‘no’ for depositional landforms, although one could argue that sub-aerial processes help to produce material for depositional landforms.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3 [12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. There will be genuine evaluation based on accurate knowledge and understanding of both the interaction of the processes and the influence of other factors such as rock type and structures. Examples used are appropriate and integrated effectively into the response.

**Level 2 [7–11]**
Response develops on a largely secure base of knowledge and understanding but is selective with omissions. There are elements of understanding of the roles of both processes and factors but it is lacking in a balanced evaluation. Examples may lack detail or development.

**Level 1** **[1–6]**
Response is mainly descriptive with limited knowledge of processes and factors. Does not go beyond hard and soft rocks and cracks in the rocks with very basic headlands and bays and arches and stacks. There is no evaluation and examples are in name only or lacking entirely.

No response or no creditable response. **[0]**

**4 (a) Photograph A shows a coral atoll in the Pacific Ocean.**

**Explain the causes of sea level changes and how they relate to <u>one</u> theory of atoll formation such as shown in Photograph A.** **[10]**

The two main causes are eustatic and isostatic. Eustatic changes are due to the glacial and interglacial periods and no doubt there will be current global warming, which can be credited but only where there is understanding of its scale, i.e. minimal.

Local changes may be subsidence as in Darwin's theory or isostatic and no doubt be a popular choice.

Daly's glacial control theory is a second alternative; any corals existing on coastal shores would have died with the onset and lowering of sea level, coastal erosion to create wave-cut platforms would have been the base for coral reef growth with rising temperatures and sea level. There would be no need for islands to subside; instead they could have been planed off by lower sea levels.

Murray's theory does not involve subsidence but that coral atolls grew on submarine plateaux or islands existing up to 30 m deep.

Award marks based on the quality of explanation and breadth of the response.

**(b) For a stretch or stretches of coastline, explain the need for protection and evaluate <u>one</u> scheme for its sustainable management.** **[15]**

The need could be from exposure to destructive high energy waves, rising sea level, the coastal geology or a combination of these. Some needs may have been activated by human activities including interference with a sediment cell by earlier defence works or dredging. A scheme should be more than listing sea walls, groynes and revetments or beach nourishment. It should embrace the objectives and present an assessment of options and evaluation of actual or possible outcomes.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3** **[12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. Response is comprehensive with a detailed explanation of needs including a clear focus on the physical processes and factors. A relevant scheme detailing problems, objectives and outcomes with valid evaluation.

**Level 2** **[7–11]**

Response develops on a largely secure base of knowledge and understanding, but is selective with omissions. There is a more limited coverage of needs lacking accurate detail of the physical aspects, especially at the lower end of the level. Examples are less well focused on meeting the needs identified with less comprehensive evaluation.

**Level 1** **[1–6]**

Response is mainly descriptive with limited knowledge. There is limited assessment of needs and couched in very general terms. Schemes essentially application of basic hardware or soft engineering with little, inappropriate or no evaluation.

No response or no creditable response. **[0]**

**Hazardous environments**

**5 (a) Fig. 2 shows the global distribution of tropical storms (cyclones).**

**Describe and explain the global distribution of where tropical storms (cyclones) develop and the paths they take. [10]**

Tropical storms develop in a narrow band between 5° and 15° N and S of the equator except in the South Atlantic and eastern Pacific oceans. They do not originate on the equator because of a lack of Coriolis force. They develop in areas where sea temperatures exceed 26 °C and are of sufficient depth to fuel tropical storms which develop from atmospheric disturbance at the meeting of warm and cooler air masses. All tropical storms develop fully where there is no wind shearing. They do not develop on the western coasts of Africa and South America because of the cold offshore currents. Tropical storms track westwards driven by the westerly flowing air streams from the convergence of the NE and SE trades and they veer polewards before dying out. Reference to tropical storms not continuing into land masses is a creditworthy point if explained, but not essential for full credit.

Award marks based on the quality of explanation and breadth of the response.

**(b) Explain the hazardous impacts of tornadoes. To what extent can the hazardous impacts of tornadoes be managed? [15]**

Hazardous impacts can be destruction of property and possible flooding along a narrow belt extending for relatively short distances of a few kilometres. Exceptionally, 'killer tornadoes' (less than 2%) may create swathes hundreds of metres wide and up to 150 km long. With a few exceptions, loss of life is generally low, say, in comparison with tropical storms. Characteristics include extreme high winds drawn into an ascending vortex and heavy downpours of rain with the possibility of massive hailstorms. Movable bodies such as cars and lorries can be uplifted and dumped, and the extreme low pressure can cause some buildings to 'explode'. There is often widespread crop destruction. Implicit understanding of the genesis of tornadoes will feature in the best answers.

Management of the impacts includes prediction and forecasting, building design and construction and education. 'To what extent' is the command and difficulty of prediction and monitoring should be appreciated with some appropriate knowledge of techniques: satellite weather patterns, Doppler radar and ground monitoring of movements. Warning systems, cellar shelters and preparedness should feature but relevantly related to tornadoes.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3 [12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. There is good knowledge and clear understanding of the range and scale of impacts together with accurate explanation. Well balanced discussion of the 'extent to which' impacts can be managed with appropriate detail of techniques and measures. Examples used are appropriate and integrated effectively into the response.

**Level 2** **[7–11]**
Response develops on a largely secure base of knowledge and understanding but is selective with omissions. It might lack some accurate detail of scale and be limited in some aspects of explanation. Appropriate management measures are given but are short in accurate detail and/or appropriateness to tornadoes. Examples are less well focused on meeting the needs identified, with less comprehensive evaluation.

**Level 1** **[1–6]**
Response is mainly descriptive with limited knowledge. There is no clear understanding of the scale or appropriate explanation. Hazards are relevant but not specific to tornadoes in scale and distribution; confusion with tropical storms. A 'catch all list' of management solutions. There is no evaluation and examples are in name only or lacking entirely.

No response or no creditable response. **[0]**

**6 (a) Explain how human activities can contribute to the nature and causes of hazardous mass movements on slopes.** **[10]**

The important word is 'contribute' rather than 'cause'. The cause will always be physical and will affect the balance between shear strength and shear stress. A list of human activities which may contribute might include, in no particular order: deforestation, building on, or on top of, slopes, cutting into the base of slopes, mining/quarrying and no doubt skiing off piste and other marginal factors such as atomic weapons testing, filling of large reservoirs. It will be necessary to explain how these activities affect the shear strength-shear stress balance. There should also be some explanation of the nature of the mass movements caused by human activity.

Award marks based on the quality of explanation and breadth of the response.

**(b) Explain the tectonic hazards that may occur at convergent plate margins. For <u>one</u> type of tectonic hazard, evaluate its impact on lives and property.** **[15]**

Again, two would be sufficient for full credit. The main two to expect are earthquakes and volcanoes. Tsunamis will no doubt be discussed; they do not necessarily occur at the plate margins but are obviously related to what is happening at the margins. Explanations are required and well annotated diagrams could go a long way to providing them. Evaluating the effect on lives and property should be well focused on the particular hazard and not the catch all list that is often the case.

In the use of examples, allow those which have not been generated at a convergent margin such as San Francisco or Icelandic volcanoes.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3** **[12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. There is a detailed and accurate explanation of at least two tectonic hazards, probably with well executed diagrams. Comprehensive, relevant and well evaluated effects on lives and property with apposite examples.

**Level 2** **[7–11]**

Response develops on a largely secure base of knowledge and understanding but is selective with omissions. It is descriptive rather than fully explanatory except possibly about what can be gauged from diagrams but is accurate at the higher end of the level. Has relevant effects but they are less well evaluated and/or covered. Examples are less well focused on meeting the needs identified with less comprehensive evaluation.

**Level 1** **[1–6]**

Response is mainly descriptive with limited knowledge. There will be a superficial attempt at explanation and any diagrams will be limited or inaccurate. There is a tendency to produce a list of effects with minimal, if any, evaluation. Examples are in name only or lacking entirely.

No response or no creditable response. **[0]**

**Arid and semi-arid environments**

**7 (a) Describe and explain the distribution and climatic characteristics of hot arid environments. [10]**

A map, either of the world or of a continent, could earn full credit for the distribution, but more likely will be written descriptions which should include reference to latitude, western and or continental regions. Climatic characteristics should include some accurate data of temperatures and rainfall together with their distribution. The best approach would be the use of one hot desert example.

Explanation should involve the descending limb of the Hadley cell, 'offshore' easterly trade winds, continentality, 'rain shadow', cold ocean currents. Most important is the Hadley cell and an accurate explanation of the effect.

There are four elements to this question; thus award marks based on the quality of explanation and breadth of the response.

**(b) Explain the process of desertification in semi-arid environments. Evaluate the success of a scheme, or schemes, to manage areas of <u>either</u> an arid <u>or</u> a semi-arid environment sustainably. [15]**

The processes are the gradual exposure and deterioration of soils until they become friable and blown by wind to extend desert margins. Explanation is part physical due to the unreliable rainfall with extended periods of drought and, probably mainly, by human activities of deforestation for fuel and building, overgrazing and/or overcropping.

An arid or semi-arid option is provided for any scheme so as to meet the requirements of the syllabus. Expect wind breaks of tree lines or structures to reduce the advance of sands, drought resistant crops and paddocking of livestock. Specific schemes will no doubt be used often with controlled drip irrigation systems, deep wells to source fossil ground or minor dam constructions coupled with input of fertilisers and mulching. Evaluation is important and often a case of feasibility and long term outcome following initial input from government and NGO initiatives.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3 [12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. There is a relevant and accurate explanation of both physical and human input to the processes of desertification. The scheme, or schemes, discussed will be relevant and detailed, showing a realistic understanding with full evaluation.

**Level 2 [7–11]**
Response develops on a largely secure base of knowledge and understanding but is selective with omissions. There is sound explanation of the processes. Some appropriate management initiatives are discussed but are less fully detailed and evaluated.

**Level 1** **[1–6]**
Response is mainly descriptive with limited knowledge. There will probably be a lack of physical processes as well as lacking accurate detail of human activities with no or not relevant examples. There might be no clear location as to arid or semi-arid.

No response or no creditable response. **[0]**

**8 (a) Describe the processes of wind erosion in deserts. Explain the role of wind in the development of desert sand dunes.** **[10]**

Erosion is achieved by abrasion, the sand blasting effect of particles blown by strong winds against rock surfaces and effective up to one metre above the surface. Deflation is the lifting and removal of dry and fine sand particles by wind creating deflation hollows.
Nominally 4 with 2/2 for abrasion and deflation.

The role of wind in developing sand dunes is in transport and deposition; saltation is most important in the early stages but suspension becomes significant as embryo dunes develop. The role of some object such as a shrub or boulder or animal carcass to initiate deposition should be given and better answers will develop dune formation with reference to examples such as barchans and seifs. There should be reference to a plentiful supply of sand.
Mark out of 6 explanation of sand dunes.

**(b) Photograph B shows landforms in a hot desert.**

**With the aid of diagrams, describe the landforms shown in Photograph B and explain their formation. To what extent have past climates been important in the development of these landforms?** **[15]**

Clearly evident is the mountain front of a plateau breached by an emerging wadi/aroya. There is a vast sand sheet covering a pediment with isolated remnants of the plateau including the foreground feature. Explanation should be in terms of pedimentation, the retreat of the front due to weathering and active removal by sheet floods or lateral planation by stream floods. Remnants, or outliers, from the plateau are the isolated outcrops which have been, or are being, subjected to physical weathering. There could be credit for alluvial fans/bahadas.

The explanations should point to processes operating under past pluvial climate conditions with probable present day physical weathering and occasional flash floods in the wadi and issuing onto the pediment. There is no evidence of streams and the nature of the isolated tree would suggest a very arid present day climate.

If there is no diagram, maximum middle of Level 2.

Award marks based on the quality of explanation and breadth of the response using the marking levels below.

**Level 3** **[12–15]**
Response is well founded in detailed knowledge and strong conceptual understanding of the topic. There will be a clear and well illustrated account of at least two landforms. There will be a good understanding of factors and processes leading to the development of the landforms as well as an evaluation the role of past as well as present climate and processes. Diagrams will be accurate and well annotated.

**Level 2** **[7–11]**

Response develops on a largely secure base of knowledge and understanding but is selective with omissions. There will be a less accurate description and somewhat insecure knowledge or understanding in explanations of their development. There will be limited reference to the importance of past climatic conditions, and diagrams will be limited in detail and accuracy.

**Level 1** **[1–6]**

Response is mainly descriptive with limited knowledge. There will be inaccurate explanations. Diagrams will be poor or entirely lacking. There will be limited or no appreciation of the role of past climates.

No response or no creditable response. **[0]**