

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

**MARK SCHEME for the October/November 2011 question paper  
for the guidance of teachers**

**9696 GEOGRAPHY**

**9696/23**

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.

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## Tropical environments

**1 Fig 1 shows the distribution of the main areas of tropical rainforest.**

**(a) Describe and explain the distribution of tropical rainforest shown on Fig.1. [10]**

The distribution is centred on the equator and contained within a fairly narrow latitudinal band of 20° N and S. The distribution extends into the continental interiors of S. America and Africa but otherwise is closer to coastal locations. Clearly this distribution is climatically controlled. It persists in areas of equatorial uplift due to intense solar radiation and convergence at the earth's surface. This leads to high temperatures and year round precipitation. Proximity to oceans adds maritime humidity. Some may point to the fact that tropical rain forest (TRF) does not exist throughout areas dominated by this climate, which could be due to mountains, continentality or clearance. Observant candidates may note the contrast of eastern Madagascar with its arid west.

**(b) Using examples, explain the extent to which the continued existence of tropical rainforest is threatened by human activities. [15]**

Most will argue that the continued existence of TRF hangs in the balance due to clearance for timber, plantations, agriculture, ranching, gold mining and general exploitation of the TRF as a resource to be exported in countries that possess little other resource. These can be exemplified and will no doubt be viewed in an apocalyptic manner. The rate of clearance will no doubt feature. Some answers may look at efforts at conservation (e.g. Queensland) or at methods of exploitation that are not entirely destructive. Better answers may realise that a considerable and growing proportion of the TRF vegetation is in fact secondary forest growth.

### Level 3

An appreciation of the TRF as an ecosystem and hence its frailties due to its nutrient flows which means that much of the human activity is ultimately destructive. Some balance in the exemplification of different types of exploitation and attempts at conservation. [12–15]

### Level 2

Threats to continued existence will be appreciated to some extent through the nature of the ecosystem. Mainly concentrated upon examples of destructive clearance activity. [7–11]

### Level 1

A catalogue of the ways in which TRF vegetation is being or can be destroyed. Little exemplification and no attempt at assessment of the impact upon the ecosystem. [0–6]

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**2 (a) Describe and explain the formation of features associated with tropical karst. [10]**

There are two major landform features associated with tropical karst. Cockpit karst is a landscape pitted with smooth-sided soil-covered depressions and cone-like hills. Tower karst is a landscape characterised by upstanding rounded blocks set in a region of low relief. Although water is less able to dissolve CO<sub>2</sub> in tropical areas owing to higher temperatures, the presence of large amounts of organic matter produces high amounts of CO<sub>2</sub> in the soil water.

Cockpit karst is characterised by groups of hills, fairly uniform in height. They develop mainly as a result of solution.

Tower karst is much more variable in size than the conical hills of cockpit karst, and ranges from just a few metres to over 150 m in height in Sarawak. They are characterised by steep sides, with cliffs and overhangs, and with caves and solution notches at their base. The steepest towers are found on massive, gently tilted limestone.

In wet monsoonal areas rivers will be able to maintain their flow over limestone, erode the surface and leave residual blocks set in a river plain.

**(b) Describe and account for variations in the climates of the humid and seasonally humid tropics. [15]**

Tropical humid climates and seasonally humid climates have a maximum temperature of >20 °C and a minimum monthly temperature of >13 °C. Tropical humid climates have a mean monthly rainfall of over 50 mm for between 8 and 12 months. In contrast, seasonally humid climates have a mean monthly rainfall of over 50 mm for between 1 and 7 months. Tropical humid climates are generally located within 5–10° of the Equator.

The midday sun is always high in the sky – but high humidity and cloud cover keep temperatures from soaring. Some months such as April and October may be wetter due to movements of the ITCZ.

In contrast, seasonally humid climates have a dry season, which generally increases with latitude. Rainfall varies from the moist low latitudes to semi-desert margins. As the midday sun reaches its highest point (zenith), temperatures increase, air pressure falls, and strong convection causes thundery storms. However, as the angle of the noon sun decreases, the rains gradually cease and drier air is re-established.

**Level 3**

Balanced account of humid and seasonally humid climates with description and explanation. Might also include the monsoon. [12–15]

**Level 2**

A more generalised account of both or an imbalanced account which focuses mainly on just one climate. Partial explanation. [7–11]

**Level 1**

Basic descriptive account but lacking in detail or accuracy. Unbalanced account. [0–6]

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## Coastal environments

### 3 (a) Describe the formation of two of the named coastal landforms shown in Fig 2. [10]

Candidates need to choose 2 of the features shown in the diagram and describe their formation. Credit can be given for annotated diagrams. They may write about any 2 of the following:

1. Beach
2. Spit
3. Saltmarsh
4. Headland

**Beach** Beaches consist of sand, shingle and cobbles that build up between the high and low tide mark. Sources of beach material include rivers, estuaries and cliff erosion. Sediment transported by wave action and by longshore drift is re-deposited to form beaches. As constructive waves build up beaches, they often form ridges in the beach known as berms. An important process in the formation of a beach is longshore drift. Not all waves approach parallel to the beach but instead break obliquely. These waves carry sand and pebbles obliquely up the beach, while the backwash runs directly down the beach. This results in the sand and pebbles being gradually moved sideways along the shore.

**Spits** are long narrow ridges of sand and shingle which project from the coastline into the sea, sometimes with a hooked end. They are formed when sand and sediment is transported by the process of longshore drift which transports sediment along the coast. Where there is a break in the coastline and a slight drop in energy, longshore drift will deposit material at a faster rate than it can be removed and gradually a ridge is built up, projecting outwards into the sea – this continues to grow in the direction of the longshore drift by the processes of deposition. A change in prevailing wind direction often causes the end of spits to become hooked. Spits continue to grow until deposition can no longer occur, due to increased water depth or a lack of available sediment.

**Saltmarsh** Where wave energy is reduced behind a spit, silt and fine sand from the river is deposited at each tidal cycle to form mudflats and eventually a salt marsh. Saltwater grasses slowly take hold and spread, stabilizing the land through the growth of root systems. As the plants decay and sediment builds up, a drier Upper Marsh area develops where plants that tolerate lower salt concentrations can colonise.

**Headlands** are resistant outcrops of bedrock projecting into the sea. Headlands form along coastlines in which bands of soft and hard rock outcrop at an angle to the coastline. Differential erosion occurs, with the soft, less resistant rock (e.g. shale or mudrock) eroding more rapidly than the hard, resistant rock (e.g. chalk or limestone). Where the erosion of the soft rock is rapid, bays are formed. Where there is more resistant rock, erosion is slower and the hard rock is left sticking out into the sea as a headland. The exposed headland now becomes vulnerable to the force of destructive waves but shelters the adjacent bays from further erosion.

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- (b) Using examples, explain the extent to which coastal landforms are influenced by human intervention.** [15]

Coastal landforms develop as a result of natural processes of erosion and deposition. However, both the landforms themselves and the processes that form them can be strongly influenced by human intervention. Key factors that impact on landform development include the supply and transportation of sediment and the rate and magnitude of erosion. Candidates should provide examples to support their argument such as: cliff erosion may be modified by armouring the base to prevent undercutting; the knock-on effect of this is to preserve the cliff but to limit the supply of sediment that is required to build other features such as spits and beaches. Other examples might include the use of beach groynes to reduce the movement of sediment by longshore drift, thereby preserving the sand in its current location for a while but creating beach morphology that is in fact man-made. Candidates may well refer to coastal defence structures that modify landforms in order to protect or conserve farmland, conservation areas such as dunes and coastal wetlands. Other factors might include the impacts of development (buildings, transport networks, etc.), pressures from tourism and effects of quarrying and dredging.

### **Level 3**

Shows an appreciation that humans can modify landforms directly and indirectly by modifying the rates of processes that influence sediment deposition, erosion and transportation. Uses well chosen examples to justify an answer that shows balance and recognises that some coastal areas are more heavily influenced by human intervention than others. The best answers may cite impacts in river basins having knock-on effects at the coast or even climate change influencing sea-level rise or increased storminess. [12–15]

### **Level 2**

Uses well chosen examples to explain how processes of landform formation can be modified by coastal management and other human interventions. Gives some detail of the modifications and at the top end uses specific examples. [7–11]

### **Level 1**

Able to associate landforms with erosion and deposition but little detail of processes involved and no appreciation of the effect of human intervention. [0–6]

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**4 (a) Describe the characteristics and distribution of coral reefs. [10]**

Fringing reefs, barrier reefs and atolls should all be described emphasising their essential characteristics. Good marks could be obtained by annotated diagrams. Distribution should be described both globally with reference to specific locations and with reference to water conditions necessary for their formation.

**(b) To what extent do attempts to manage coastlines often cause more problems than they solve? [15]**

There needs to be some information on the issues facing coastal management. These would include coastal erosion, coastal flooding, human impact such as the trampling of sand dunes and inappropriate use of saltmarshes. Inappropriate land use and building would also be relevant as would sea level rise by melting ice caps, global warming, etc. The interference with sediment circulation within coastal sediment cells will generally dominate answers. There needs to be assessment and a genuine attempt to answer the question to achieve high marks.

**Level 3**

The key to this level lies with relevant and detailed examples. Specific instances of good management and mis-management are required with detailed knowledge and understanding of the processes and principles to be able to successfully evaluate coastal management and reach a conclusion. [12–15]

**Level 2**

There will be general reference to relevant issues, but will lack the range of examples necessary for level 3. Knowledge and understanding of processes will be limited as will any attempt at evaluation. [7–11]

**Level 1**

Will lack convincing detail, and examples will be missing or largely inappropriate or misunderstood. Insufficient material for assessment of management. [0–6]

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## Hazardous environments

5 Fig. 3 shows some causes of the Galtur Avalanche in 1999.

- (a) Using Fig. 3, describe and explain the causes of avalanches, and suggest other factors which also might affect the occurrence of an avalanche. [10]

A snow avalanche is a sudden and rapid movement of snow downhill, occurring when the weight of the snow exceeds the friction.

The key causes of avalanches include steep slopes, heavy snowfall, strong wind leading to snow drifts and snow that melts and refreezes. All of these causes are mentioned in Figure 3 and so good answers will use this information to trigger further discussions. An explanation is needed – for instance, the steeper slopes mean that stability is reduced and the friction is more easily overcome.

In addition to the factors mentioned above, credit needs to be given to an awareness of other causes, for example, a rise in temperature, or a long dry winter followed by fresh snowfalls. This leads to the older snow forming a slip plane on which the newer snow can slide. They may also have a trigger, such as an earthquake or human activity (skiing off piste is a common example in Alpine areas). Good candidates will discuss a range of causes, including references to Figure 3 alongside other examples.

- (b) Using examples, discuss why the prediction and monitoring of hazards is not always successful. [15]

Many factors affect the success of prediction. The type of hazard is one factor. Earthquakes are very hard to predict with any degree of accuracy. Tropical storms, however, can be seen in the early stages of storm development leading to more successful predictions and tracking of the potential hazard. More recent advances in technology have meant that hazard prediction and issuing subsequent warnings have become more important. Different hazardous environments lend themselves to various types of prediction. For example, early prediction for volcanoes includes monitoring the gas output and local seismic activity. Ice and snow may melt and the shape of the volcano may change. The path of a hurricane can be tracked. However, the prediction can sometimes be wrong or over/under estimated. The prediction may also not be able to be reliable enough to narrow down into a timeframe which is useful for any response to occur. An event may also be accurately predicted, but this does not prevent the hazard occurring. The economic and technological background may influence the success of the prediction given. The use of examples is key here, and stronger candidates will relate the success or otherwise of prediction and monitoring against actual case studies. These examples may be drawn from the range of environments which they have studied – mass movements, atmospheric and crustal.

### Level 3

A clear discussion of the variety of ways prediction and monitoring can take place. Explicit links to examples are given, and the success of the prediction and monitoring is examined in detail. [12–15]

### Level 2

The ways hazards can be predicted and monitored are described, with some reference to case studies. The success of the prediction is discussed in more basic terms. [7–11]

### Level 1

There is limited or no discussion on the success of the hazard prediction and monitoring. Reference to actual examples is limited. [0–6]

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**6 (a) Describe the factors that determine the nature of volcanic eruptions. [10]**

The key is the major difference between basaltic and acidic lava. The former is more effusive with quieter eruptions and mostly lava flows, the temperature of the lava being quite high (c.1000 °C). It is usually associated with spreading centres and hot spots. Acidic lava is generally more explosive with ash clouds, pyroclastic flows nuées ardentes, volcanic bombs, etc. The lava is cooler (c.700–800 °C) and is mostly associated with subduction zones. Other factors such as the ingress of water, volcanic plugs, etc. could also be considered.

**(b) Using examples, discuss the extent to which the hazardous impact of an earthquake is related to its strength. [15]**

There should be some indication of the measurement of earthquake strength or energy using the Richter scale. Better answers will know that it is a log scale. There needs to be recognition that impact is related to many other factors, the nature of the bedrock, nearness to the epicentre, the depth of the earthquake, density of population, the level of preparedness related to economic development, the nature of the landscape and therefore the liability of landslides, even the time of day. Expect mention of undersea earthquakes and relation to tsunami.

**Level 3**

Answers will demonstrate a thorough understanding of the nature of earthquakes, possibly differentiating the various types of shock waves, together with impact of location and bedrock, illustrated through accurate examples. Understanding of the Richter scale will be clear – probably demonstrated through examples. The impact will take account of and balance a number of other factors and contrast different outcomes of earthquake events of similar intensity. [12–15]

**Level 2**

Answers will demonstrate good knowledge of earthquakes, but will answer with a limited range of factors and may well concentrate on the human aspects rather than the physical. Examples will be used but may lack accuracy and possibly relevance to the question. Limited assessment. [7–11]

**Level 1**

Only vague ideas on relative strength of earthquakes with little understanding of Richter scale. Examples will be lacking or short on detail/accuracy. Limited exploration of factors beyond earthquake strength. [0–6]

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## Arid and semi-arid environments

7 (a) Table 1 shows the general locations of deserts and gives some examples.

**Why is rainfall in the desert areas shown in Table 1 scarce and unpredictable? [10]**

Rainfall is scarce (less than 250 mm) due to the existence of sub-tropical highs producing sinking stable air with very low RH. Continentality can affect some large deserts as can cold offshore currents. Other deserts are in rain shadow. The more discriminating part of the question is rainfall unpredictability. Most ppt in deserts comes from very localised convectional heating producing sudden downpours. These are infrequent and difficult to predict as to both timing and location. In many cases areas can go without rainfall for 8 or more years.

(b) Explain the processes of erosion and transportation in hot deserts. To what extent do these processes influence the development of landforms in the present day? [15]

Erosion and transportation can take place through the agency of both wind and water. In the case of wind, the loose friable surfaces can be removed by the strong desert winds. Lighter material is transported as dust storms, whilst heavier material is pushed along the surface by saltation, rolling or creep. Material that is airborne can be used as an abrasive agent upon rock surfaces, although usually only at lower levels. Water erosion will occur after sudden downpours and is more effective in enclosed channels such as wadis where rock debris and sediment is transported in violent flash floods. Erosion can be significant, if short-lived, as the materials abraid the sides and bottom of the channel. Where wadis emerge onto the desert plain, the flow spreads out in a series of anastomosing channels where the velocity is checked and only the lightest material travels furthest.

It can be argued that wind erosion and transportation will be evident in the present day due to the high winds in so many deserts. Water, however, may be a powerful agent; its infrequency makes it less of a landform-altering agent as compared to past pluvial periods.

### Level 3

Good balance between wind and water as agents of erosion and transportation as well as some assessment of present day roles. [12–15]

### Level 2

A realisation that both wind and water are involved, although a concentration on the former. Reference made, rather vaguely, to past pluvial activity. [7–11]

### Level 1

Exclusively (or almost) wind action, with emphasis on the products (depressions, dunes, yardangs, etc.) rather than the processes. Little evaluation of present day activities. [0–6]

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**8 (a) Describe and explain the ways in which vegetation and animals have adapted to survive in arid conditions. [10]**

Plants have adapted to aridity by conserving water through various adaptions that are classified as either xerophytic (thick skins, limited stomata, needle leaves, etc.) or phreatic (long root systems, widely spaced, etc.). Examples should be given for good marks. Description could take the form of annotated diagrams but the emphasis is on explaining how these features adapt the plant to the arid conditions. In the case of animals, some candidates may take animal properties feature by feature – eyes, skin, size, etc., e.g. a tough stomach that can extract moisture from thorn vegetation – whilst others may go through the arid conditions – scarcity of water, strong winds, heat, etc. and show how various animals have adaptations that enable them to survive, e.g. they are nocturnal. Either approach is valid but the key is the cause-effect linkage, i.e. why adaptation leads to better survival prospects for plants and animals.

**(b) Evaluate the role of human activities in the process of desertification. [15]**

Desertification is the conversion of marginal semi-arid land to a desert. Human activities are largely held responsible for this – chiefly deforestation, overgrazing and excessive monoculture. Evaluation should look at the relative importance of these activities in causing the processes of desertification. Cause and effect need clearly linking, e.g. loss of ground cover due to overgrazing results in the soil being exposed to wind erosion.

Higher level responses may go on to contrast these activities with either those human activities that are trying to reduce desertification, e.g. irrigation, or the role of non-human factors. Sometimes desertification is a natural process as rainfall decreases or wind directions change – much emphasis has been put on the impact of global warming on west Africa.

**Level 3**

Balanced attempt at evaluation of the relative role of human activities in desertification. Knowledge and understanding of the process of desertification are good. Clear recognition that their role may vary over time, location and with the nature of area/activity. A range of appropriate examples. [12–15]

**Level 2**

Sound or unbalanced attempt at evaluation of the relative role of human activities in desertification. Some limited recognition that the role may vary. Knowledge and understanding of processes of desertification are sound. A range of appropriate examples.

[7–11]

**Level 1**

Little, if any, attempt at evaluation of the relative role. Knowledge and understanding of desertification are limited. Few, if any, appropriate examples. [0–6]