

**MARK SCHEME for the May/June 2014 series**

**9696 GEOGRAPHY**

**9696/21**

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

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## Tropical environments

- 1 (a) Fig.1 shows the position of the Inter Tropical Convergence Zone (ITCZ) and the mean pattern of winds in January and July.

**Explain how the position of the ITCZ and the pattern of winds are important in tropical climates. [10]**

The ITCZ is an area of low pressure produced by the uplift of air at a convergence zone. This represents the thermal equator and will migrate with the overhead sun as shown in the two diagrams. Uplift occurs along the convergence zone and can produce convective rainfall. Its position is thus important for tropical climates, particularly in the continental interior of Africa, where it provides most of the seasonal rainfall. All tropical climates exhibit high amounts of insolation so temperatures remain uniformly high. Rainfall however is more variable and outside of equatorial areas becomes seasonal. Thus the movement of the ITCZ is vital and can bring onshore moist winds to central Africa in July with the northward shift of the ITCZ. One of the most obvious seasonal impacts is in SE Asia in the operation of the monsoon.

- (b) **Explain how vegetation in tropical rainforest and savanna areas has adapted to climate. To what extent does climate affect sustainable development in one tropical environment? [15]**

Vegetation in TRF areas demonstrates adaption to the high temperatures and ppt by the luxuriance of its growth (height, structure, number of species) as well as more micro adaptations such as drip tip leaves, buttress roots etc. Savannas show great variety partly depending upon the length of the drought season (e.g. Parkland with acacias, baobabs, different species of grasses). Plants display adaption in that they die back in dry seasons (grasses) or store water (baobabs). Similar adaptations can be found in seed dispersal etc. Much can be achieved with diagrams.

Climate inevitably plays a major role in any type of sustainable development. In the case of the TRF, any clearance of vegetation will expose the soil to intense precipitation and hence leaching and erosion. In the savanna, account must always be taken of dry seasons and rainfall variability. Excessive clearance or use of fires could expose the soil to wind erosion and degeneration. It is acceptable for responses to deal with climatic influences in general terms or to use a particular development example.

### Level 3

Good understanding of both micro and macro climatic adaptations with some balance between TRF and savanna. A sensible assessment of the role of climate within sustainable development. [12 – 15]

### Level 2

Concentration on the more micro adaptations found in the TRF with less attention to savanna beyond baobabs and grasses. Tendency to dwell upon developments in the TRF with limited attention to climate. [7 – 11]

### Level 1

Outline only of climatic adaptation, heavily biased towards the TRF. Development mainly the catastrophic effects of TRF clearance. [1 – 6]

For no response or no creditable response, 0.

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**2 (a) Describe the factors that affect the fertility of tropical soils. [10]**

Soil fertility is usually defined in terms of the nutrients available for plant growth, pH, structure, texture minerals and moisture. Generally tropical soils such as oxisols/latosols, tropical red and brown earths are not regarded as fertile. This is often due to the effect of climatic conditions once the nutrient cycle has been broken. Thus clearance of the TRF can bring about the rapid leaching of minerals when exposed to intense rainfall. However, the widespread use of cleared areas for soya and other cultivation does suggest some degree of fertility even if it may not be sustained long term without the input of fertilisers etc.

**(b) Describe the weathering processes that act upon granite in tropical areas and explain their impact upon the development of granite landforms. [15]**

The weathering processes should be those of rapid chemical weathering under humid tropical conditions accelerated by the high temperatures and ppt together with humic acids. Hydrolysis should be explained as well as the impact of jointing pseudo-bedding planes etc. Some may develop exfoliation in the rounding of boulders.

The impact upon landforms will probably be best achieved by the use of diagrams showing stages in the development of landforms such as rurares, inselbergs and tors/castle kopies etc. Initially a surface with deep regolith extending down to an undulating BSW determined by the joint pattern of the granite mass. The impact of weathering will attack the granite along joints and cracks to produce core stones and detached blocks as well as rounding the surface along curvilinear joints. Uplift and erosional stripping will allow the emergence of the landforms to be exposed to the attack of sub aerial processes.

**Level 3**

Good understanding of the chemical weathering processes and its impact upon granite. The stages of landform development explained with apposite diagrams and an appreciation of the impact of the BSW. **[12 – 15]**

**Level 2**

Some description of hydrolysis and its impact upon granite. Landform development not well sequenced with a rather direct emergence of granite landforms more or less fully formed. Little appreciation of the role of such things as BSW, erosion of regolith etc. **[7 – 11]**

**Level 1**

Weak understanding of the nature of chemical weathering particular when conducted at depth. Landforms tend to be limited to inselbergs, with little concept of their evolution. **[1 – 6]**

For no response or no creditable response, **0**.

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## Coastal environments

- 3 (a) Fig. 2 shows a cross section of a beach – dune – salt marsh complex. Describe the landforms shown on Fig. 2 and explain how they have been formed. [10]**

The beach is the product of wave action and the production of beach drift. The dunes are wind transported sand from the beach area when onshore winds are common. This accumulates around objects and vegetation. Buried vegetation such as marram grass is stimulated by burial and results in rapid growth and further accumulation of sand. Dunes on Fig. 2 show a succession with the youngest dunes closest to the shore (yellow dunes) and then more vegetated older dunes further inland. The height increases as long as the sediment supply is maintained and diminishes as it decreases inland. This forms a series of ridges parallel to the coastline with steep windward sides and less steep lee slopes. The salt marsh develop where wave action is weak and currents slack. They are often found where large tidal ranges deposit a lot of mud that encourages colonisation by salt tolerant vegetation (halosere).

- (b) Describe the marine and sub-aerial processes that affect coastal erosion. To what extent have these processes contributed to the landforms on a stretch of coastline you have studied? [15]**

Most should be able to describe the marine processes that are consequent upon wave action i.e. hydraulic action, wave quarrying, wave corrosion. Sub-aerial processes lead to weathering and can result in mass movements. The more demanding task is to apply these processes to landforms, particularly in the context of actual examples. Some answers will tend to deal with generic types of landform such as headlands, bays, wave cut platforms and cliff profiles. This is acceptable if they are explained well. Some will employ realistic examples of the landforms of coastal stretches and will realise that there are other factors at play in coastal erosion and landform development, notably that of rock type and structure.

### **Level 3**

Accurate description of erosional processes. These will be applied to an actual coastal example with a balance between the processes and the influence of geology. **[12 – 15]**

### **Level 2**

Accurate description of marine processes and some appreciation of sub-aerial processes. Rather a generic application to landforms, but some range in terms of wave cut platforms, cliff profiles etc. **[7 – 11]**

### **Level 1**

Outline account of processes with few landforms beyond arches, stacks and stumps. **[1 – 6]**

For no response or no creditable response, **0**.

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- 4 (a) Explain why sea level change is important in the development of coral reefs and atolls. [10]**

Depth is vital for the existence of coral. Too deep and it will not receive sufficient sunlight for photosynthesis, too shallow and coral bleaching may occur. Sea level has thus played a vital part in coral reef evolution. All theories rely upon the upward growth of coral to keep pace with changes in sea level. Thus sea level change has to occur at a rate that can be tolerated by the coral. This can be illustrated by Darwin's atoll formation theory and/or by reference to the development of the Great Barrier Reef. Some may develop the impact of rapid sea level rise consequent upon global warming.

- (b) Explain the factors that can make coastlines at risk from erosion. Using an example or examples, assess the extent to which these factors can be overcome. [15]**

The factors can be divided into: exposure to marine and sub aerial processes; geology and coastal alignment; human activities. Thus coasts that are exposed to high energy environments, long fetch, frequent storms, strong tidal scours etc are likely to be vulnerable. Geology plays a role in rock type and structure as well as its alignment vis a vis marine processes such as wave action. Human activities, such as interference with sediment cells, inappropriate coastal defence strategies or coastal developments in settlement leisure and agriculture can all play a role. Ideally attempts at overcoming these will be described in terms of a particular example of a coastal area. Many, however, will go through various hard and soft engineering methods of coastal protection.

**Level 3**

Good appreciation of the factors of vulnerability, although these may be described in terms of separate examples rather than generically. Good use of a case study or examples to assess the success of protection strategies. **[12 – 15]**

**Level 2**

A less well organised account of vulnerability, but some general coverage. A tendency to describe individual types of strategy with only simplistic assessment. **[7 – 11]**

**Level 1**

Hit and miss regarding vulnerability but the emphasis on powerful waves and storms. Only hard engineering methods considered. **[1 – 6]**

For no response or no creditable response, **0**.

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## Hazardous environments

- 5 (a) Table 1 shows a classification of tsunamis in the Pacific Ocean. Explain how tsunami are caused and why their intensities and hazardous effects vary in the Pacific Ocean. [10]**

Tsunami are caused by violent displacement of the sea bed either by earthquakes, submarine volcanic eruptions or landslides. This produces powerful waves that increase in height as they approach shallow shoreline. They are frequent in the Pacific due to the Pacific Ring of Fire and the circum Pacific belt where 80% of the world's earthquakes occur. They can travel over huge distances and have devastating effects as shown by the recent Tsunami in Japan. The huge waves of over 16m as shown in the table can destroy all coastal installations and carry debris far inland where there are shallow coasts. This clearly poses great hazard to human life through building collapse, drowning or radiation poisoning as in the recent case of Japan.

- (b) Explain why some volcanoes are more hazardous than others. [15]**

Due to the nature of the eruption, the types of erupted material and the action that had been taken to predict the occurrence of the eruption. Some volcanoes are in areas that are little settled but even here the effects can be widespread (e.g. Iceland and disruption to air travel or stratospheric dust affecting weather patterns). Types of volcanic eruption can be seen as effusive or explosive or divided by named type i.e. Hawaiian, Strombolian or Plinian. Their location can be on plate margins or at hot spots. The latter tending to be more effusive (e.g. Hawaii or Reunion). The materials ejected will also vary in their hazardous effects. Lava generally being less of a problem than Pyroclastic flows or lahars. The monitoring of volcanic activity and the ability to predict an eruption through the mechanisms of satellites, seismographs, gas detectors, temperature etc. will also have an impact in the ability to evacuate populations in time.

### **Level 3**

Good understanding of different types of volcano and their eruptive qualities. The hazardous nature of the materials will be described and assessed as well as levels of predictability.

**[12 – 15]**

### **Level 2**

Concentrates on types of ejected materials but some assessment of their relative hazardous nature. Some appreciation of prediction.

**[7 – 11]**

### **Level 1**

Size of eruption most important with emphasis on lava and ash. All volcanoes viewed as similarly hazardous.

**[1 – 6]**

For no response or no creditable response, **0**.

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- 6 (a) Describe one type of hazardous mass movement and explain how it is caused. Describe the nature of its hazardous effects. [10]

Despite the choice most, I suspect, will choose snow avalanches with a few opting for land slides or mud flows. The nature of snow avalanches (powder, slab) should be described as well as their causes (climatic and slope as well as human induced). Landslides and mud flows should be described in terms of slope instability and the processes of sliding or flowing. Causes can be given in terms of tectonic activity, intense rainfall as well as human activities. Attempts to limit the impact is to prevent building in prone areas although some stabilisation activities can be undertaken or in the case of avalanches, diversion barriers erected.

- (b) How are tornadoes formed? Explain the hazards that result from tornadoes and assess the extent to which their effects can be minimised. [15]

Tornadoes are produced by violent updraughts and down draughts of air associated with thunderstorms. At some point a funnel shaped violently rotating vortex descends downwards from the cumulo-nimbus cloud. They occur when warm moist air (e.g. from the Gulf of Mexico) meets cold dry air (e.g. from The Rockies). An upper air inversion develops with a wind shear effect inducing the rotating vortex. They occur quite widely often at sea. In this sense their hazardous effects are often limited. They result from the violent winds and rapid changes in pressure that can destroy buildings and lift materials into the air. The band over which they affect areas is limited but can be devastating on a local scale. As violent storms they are accompanied by intense rainfall but this is usually neither extensive nor long lasting. Conditions under which Tornadoes form can be predicted, but the path of the 'twister' is very difficult to gauge. Warnings are given in Tornado Alley and evacuations do take place. Strengthened tornado shelters can be built and are sometimes incorporated into buildings in areas at risk. Effective use of course depends on the timing of the warnings.

### Level 3

Good understanding of the nature and causes of tornadoes. An explanation of the atmospheric processes as well as the climatic location. Realistic assessment of the hazards and attempts to mitigate effects through prediction and early warnings. [12 – 15]

### Level 2

Climatic circumstances given but atmospheric processes limited and vague. Emphasis on effects with limited appreciation of prediction/forecasts. [7 – 11]

### Level 1

Little explanation of the tornado with emphasis upon the impact of the violent vortex winds. Effects overstated and little on amelioration. [1 – 6]

For no response or no creditable response, 0.

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## Arid and semi-arid environments

### 7 (a) Photograph A shows some landforms in a hot arid area.

**Using a diagram, identify and describe the landforms in Photograph A and explain how they have developed. [10]**

The main landform that is identified is a butte. The more resistant rock forms the vertical core with some almost detached pillars. The sloping slopes are characterised by horizontal bands of more resistant rock which is covered in detritus. The slope angles are very even and give rise to a prominent knick between it and the surrounding gentle sloping pediment or broad alluvial plain. The butte represents a residual feature that has been produced from the lateral erosion of streams cutting into the interfluves. Eventually the interfluves coalesce to leave isolated features. Such extensive fluvial activity took place in previous pluvial periods. In the foreground is a rock that can be defined as exhibiting signs of exfoliation. Current weathering is limited to episodic rain, wind and thermal fracture which may be attributed to the foreground feature.

### (b) Explain how plants and animals in hot arid areas are adapted to extreme temperatures and physical and physiological drought. [15]

Plants have adapted to drought and the loss of water through evapotranspiration (physiological drought) by xerophytic or phreatophytic adaptations. These should be explained and examples given. Other adaptations to seed dispersal etc. allow germination in periods of infrequent rain. Animals show many adaptations to drought and have mechanisms to reduce water loss. They are frequently nocturnal to avoid high day time temperatures. Examples should be cited.

#### **Level 3**

Consideration given of both temperatures as well as drought to plants and animals. [12 – 15]

#### **Level 2**

Plants the best developed although limited attention to temperature and drought. Animals partially described. [7 – 11]

#### **Level 1**

Plants little developed beyond cacti. Animals poorly expressed. Physiological drought not understood. [1 – 6]

For no response or no creditable response, 0.

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- 8 (a) Describe and explain the similarities and differences between the climatic characteristics of arid and semi-arid areas. [10]

Both exhibit high temperatures and low overall rainfall. In arid areas the rainfall tends to be below 250mm whereas in semi-arid the rainfall is higher but usually seasonal and unreliable. Temperatures in arid areas are high with a mean in the mid-upper 20s they are often seasonal with a range of about 10 C. Diurnal range can also be large with night time cooling sometimes to freezing. The range is generally less in semi-arid areas, although the seasonal rainfall can be unreliable and dependent upon the movement of the ITCZ. Arid areas are characterised by clear skies, high wind energy environments and episodic downpours produced by intense convection. As most semi-arid areas are peripheral to deserts the causes (continentality, high pressure, ocean currents etc.) are similar. Semi-arid climates tend to be more associated with continental interiors (e.g. Australia) or protected by mountain barriers (USA).

- (b) Using an example, explain the extent to which climate affects the sustainable development of either an arid or a semi-arid area. [15]

The greatest inhibitor of development is the lack of rainfall and its unreliability. This has often resulted in expensive and ultimately unsuccessful attempts at irrigation. This is not the only climatic control. The high levels of wind and low humidity encourage rapid rates of Pet in both arid and semi-arid areas. Most, I suspect, will deal with development schemes in semi-arid areas where the search for water supplies (bore holes, damming of rivers) has often exacerbated the climatic conditions (e.g. Sahel or Aral Sea). The high temperatures and intense solar radiation require the provision of shelter and clearly affect working hours. Clear atmospheres and long hours of sunshine do, however, offer some possibilities in terms of the development of solar power. Much will depend on the quality of the example(s) used, but answers should not lose sight of the climatic element.

**Level 3**

Good use of a case study or examples to illustrate the constraints imposed by climate. The impact of climate will be assessed within the overall sustainability of the development.

[12 – 15]

**Level 2**

Some reasonable use of an example or examples, but the nature and progress of the development overtakes the aspects of climatic constraints. More narrative than assessment.

[7 – 11]

**Level 1**

Simplistic assumptions about climate. Any example of development limited to such things as the Aswan dam with little description of its impact.

[1 – 6]

For no response or no creditable response, 0.