

MARK SCHEME for the October/November 2012 series

9696 GEOGRAPHY

9696/23

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

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Tropical environments

- 1 (a) Describe and explain the differences between the humid and monsoon climates in the tropics. [10]**

Humid tropical climates have no distinct dry season; all months have at least 60mm of rain, whereas the monsoon climate exhibits a marked dry season. In both cases temperatures are high although more consistently so in the humid climates where average daily temps can be as high as 27°C. The monsoon climates display greater seasonal variation in both temperature and ppt. Reasons are that the humid climates are found within the equatorial low pressure driven by intense heating and hence convectional rainfall. Monsoon climates are most commonly found in S. Asia where they are subject to seasonal changes in wind direction. In Asia, during the summer, the high land temperatures produce onshore winds bringing moisture laden winds. High pressure in winter brings NE winds that are dry.

- (b) Table 1 shows some factors that affect the ecology of tropical rainforest. Explain the extent to which these factors might affect the management of areas that have been cleared of forest. [15]**

The table shows aspects of the nutrient cycling within the TRF, which will clearly affect the results of forest clearance and cultivation. Deforestation for logging will permanently remove nutrients as the nutrient cycle is broken. The effects can be reduced if trees are selectively felled and the trees debranched on site. With deforestation rainfall interception will be reduced with consequent impact upon the soils of cleared areas leading to both leaching and erosion. Again selective logging may reduce this impact, as would a permanent crop or shrub cultivation. Rainforest soils lack fertility when clearance has been undertaken leading to a rapid deterioration in any cultivation that can only be maintained by high inputs of fertilisers. Agro-forestry, where crops and woodland are intertwined could reduce the need for fertilisers. As germination is close to the surface the soils are not robust in terms of any mechanisation or the progress of heavy clearance equipment. This will require low levels of mechanized harvesting or planting.

Level 3

Good understanding of the implications of the nutrient cycling for clearance and subsequent usage of TRF. Some suggestions for impact of these factors upon management of TRF and cleared areas. [12–15]

Level 2

Some appreciation of the implications of the nutrient cycle for clearance but very little in terms of the management of TRF apart from retention of the canopy. [7–11]

Level 1

Repeats material in the table and generally gives the global problems associated with TRF clearance. [0–6]

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- 2 (a) Describe the characteristics of soils found in the humid tropics (tropical rainforest). Explain how soil forming processes have produced these types of soil. [10]**

The most common soil in the TRF is classed as an oxisol (red soil). These have high aluminum and iron oxide contents giving them their characteristic red or yellow coloration. They have low fertility due to the rapid decomposition of organic material and rapid uptake by trees. This leaves the soils deficient of both humus and nutrients. Many soils are old and derive little nutrients from the parent material. As there is high rainfall the main movement is downward leading to leaching and to further nutrient depletion. Under drier conditions the oxides can form impermeable layers of laterite.

- (b) Explain the nature of weathering processes in humid tropical areas and describe their influence on the development of granite landforms. [15]**

Chemical weathering is dominant in the humid tropics due to the high temperatures and ready supply of water. The high temperatures increase the rate and the water allows the introduction of the weathering agents into rocks. It is inhibited to some degree by the luxuriance of the vegetation such that much chemical weathering is most effective at depth giving rise to a basal surface of weathering. Rotting vegetation contributes humic acids. Mechanical weathering is less dominant due to vegetation and climate and is limited to biological weathering, dilatation (where surface is removed) and possibly some limited thermal fracture. Granite landforms are generally the result of deep weathering (hydrolysis) along a basal surface of weathering. This exploits joints and cracks within the granite to bring about block disintegration. Periods of climatic change may bring about the stripping of regolith allowing the production of features such as inselbergs, castle kopjes, spheroidal blocks, etc.

Level 3

Good understanding of the weathering processes related to tropical humid climates and the impact upon the production of granite landforms. [12–15]

Level 2

Rather a generic weathering account although the importance of chemical weathering will be recognised. Granite landforms will be described with a rather imprecise link to the weathering processes. [7–11]

Level 1

Mainly mechanical weathering including freeze thaw. Little appreciation of granite landforms or their formation. [0–6]

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Coastal environments

3. (a) **Explain how weathering, rock type and rock structure influence the erosion and form of coastal landforms.** [10]

An attempt to emphasise the importance of geology to coastal development. Clearly the nature of the rock and its resistance will affect the coast in both plan and profile. More easily eroded rocks will retreat to form bays whilst more resistant rocks will produce head lands and steep cliffs. The structure of the rocks and the dip of the strata will have an effect on cliff profiles, whilst joints and bedding planes can be exploited in the production of caves, stacks, etc. Weathering, particularly sub aerial weathering, will impact upon the profiles of cliffs. Detail on the precise nature of the landforms is not required; it is more the impact of the factors in the question.

- (b) **Fig.1 shows managed natural retreat as a form of coastal management. Describe the operation of this type of management and assess its effectiveness compared to other forms of coastal management.** [15]

The idea behind managed retreat as shown here is that the costly maintenance of the sea wall is allowed to lapse such that the protected reclaimed farmland is sacrificed and the natural coastal processes allowed to reassert themselves. The original salt marsh had been lost to erosion consequent upon the construction of the sea wall. The sediment cell allows for the regeneration of the salt marsh which now acts as a buffer to further coastal erosion. This is achieved at the loss of farmland in this instance and it might be argued that hard engineering coastal defences (walls, rip raps, gabions, off shore reefs, etc.) can be more cost effective where valuable property or farmland is being protected. The methods can be viewed as part of a management strategy.

Level 3

Understanding of the nature of the retreat and an attempt to assess the various options available in terms of coastal management. This may well be illustrated by appropriate exemplification. [12–15]

Level 2

More of a general account of coastal protection but at least some attempt at comparison of different methodologies. [7–11]

Level 1

Repeat of material in diagram together with a description of some hard engineering methods of coastal defence. [0–6]

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4. (a) **Describe constructive and destructive waves and explain their effects upon the shape of beaches.** [10]

Most will see beaches solely as the result of constructive and destructive waves although the accumulation of beach material is due to long shore drift. Constructive waves are long low waves with a period of 8–12 seconds producing a powerful swash and a much weaker backwash. Destructive waves are shorter with a period of 3–6 seconds and have a steep plunging break and a relatively feeble swash. Constructive waves with their stronger swash will push material up the beach increasing the profile/slope whilst destructive waves with their stronger back wash comb materials down lowering the slope. Coarser material is deposited on the upper parts of beaches and is usually only affected by winter storm waves. Minor changes to beaches, such as berms and runnels are the response to wave action.

- (b) **Describe and explain the formation of tombolos, offshore bars, barrier beaches and coastal dunes. To what extent can these coastal landforms be changed by physical processes and human activities?** [15]

Apart from dunes all of these features are related to the movement of sediment along coasts, usually by longshore drift. Tombolos are spit like features that join an island to the coast and are produced where the sea bed is shallow allowing an accumulation of sediment. Offshore bars are accumulations of beach material parallel to the coastline often lying some distance off shore. Initially bars are often submerged at high tide but in time grow upwards as a result of further wave sedimentation. They are characteristic of shallow coasts with gentle gradients. Waves thus break well offshore, eroding the sea bed and throwing forward the sediment. On some coastlines these bars develop across the mouths of a series of bays and inlets forming barrier beaches (e.g. Martha's Vineyard or southern Baltic). Sand dunes are common features at the landward edge of extensive sand beaches or spits and bars. They are formed by onshore winds which transport sand exposed and dried at low tide, The accumulation is aided by grasses such as sea couch or marram. All of these sediment features are subject to change by natural events such as storms or by the interruption to their sediment supply which could occur naturally or by human activities. They can thus be seen as rather fragile features that frequently change form over time.

Level 3

Good understanding of the landforms probably illustrated by appropriate diagrams. An awareness of the factors that can bring about changes in shape and orientation. [12–15]

Level 2

Rather a patchy appreciation of the landforms and an emphasis on human activities in inducing change. [7–11]

Level 1

Little comprehension of landforms beyond possibly dunes and only leisure activities as elements of change. [0–6]

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Hazardous environments

- 5 (a) Fig 2 is an excerpt from a newspaper report on one means of predicting volcanic eruptions. Explain how other methods, as well as satellites, can be used for the prediction of volcanic eruptions. [10]

Satellites can be used as heat sensitive probes as in the newspaper article to indicate rising magma, although this may only give limited amount of time before an eruption. They can also be used to detect bulging, as can tilt meters. Seismographs can indicate series of minor earthquakes that are known to precede many eruptions. Radon gas emissions can indicate disturbance to rock minerals and the existence of other gases can indicate the filling of the magma chamber. Temperature of the ground and ground water as well as the level of groundwater can also indicate imminent volcanic activity. The study of volcanic periodicity from historic records can also allow some estimate of the probability of an eruption.

- (b) Describe and explain where and how volcanic eruptions occur. Explain why the materials ejected by volcanoes may be hazardous. [15]

Most volcanic eruptions occur along plate margins. Divergent (mid ocean) margins allow the extrusion of magma as part of sea floor spreading (e.g. Iceland). Convergent (destructive) and collision margins give rise to volcanoes as the magma from crustal melting in the benioff zones proceeds through cracks, faults in the crust to the surface. Hot spots (e.g. Hawaii, Reunion) allow magma to rise to the surface through faults etc. as the plates pass over the hot spot. The materials extruded can all pose some form of hazard. Tephra (ash) can affect breathing and cause the collapse of buildings. Lava flows (acidic or basic) can affect lives and property but are usually slow moving enough to be avoided. Explosive volcanoes are most hazardous as they can produce pyroclastic flows which are mixtures of toxic gas, ash, volcanic bombs, all at very high temperatures and very fast moving. Example the fate of Pompeii. Secondary hazards can be caused by the sudden rainfall resultant upon the eruptions causing lahars and landslips.

Level 3

Good understanding of the location and causes of volcanic activity. The nature of the eruptive products will be explained and their hazardous potential assessed. [12–15]

Level 2

An association of volcanoes with plate boundaries and some indication of how they are formed. More attention paid to nature of eruption but more descriptive than explanatory in terms of hazards. [7–11]

Level 1

Vague association with Pacific ring of fire but no explanation. Products limited to lavas and possibly ash. [0–6]

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6. (a) Explain where and how tropical storms (cyclones) occur. [10]

These occur in low latitudes in the northern hemisphere (July–October) and southern hemisphere (Jan–Feb) when sea temperatures are at their highest. They are usually not found 6 degrees N and S of the equator as there is insufficient coriolis force to impart spin. Sea temperatures should be 27°C or more to provide sufficient moisture. They comprise bands of thunderstorms that spiral around a calm cloud free eye of very low pressure. Very high winds occur at the edge of the eye where extremely deep and vigorous cumulo-nimbus clouds generate great updrafts, high winds and intense rainfall. They are very large systems.

(b) Using examples, describe the hazards associated with tropical storms and evaluate the methods that can be used to prevent damage and loss of life. [15]

Category 5 storms have wind speeds in excess of 250 km/h and a storm surge of more than 5.5 m. This can lead to extensive damage to roofs, windows and doors and give rise to deaths and injuries from flying objects. The storm surge is probably the greatest threat as it can lead to extensive and very sudden coastal inundation which will swamp many coastal defences. This can be illustrated by the experiences of New Orleans, where the levées and coastal protection was completely overwhelmed. The intense rainfall can destabilise slopes, bringing about mud flows and landslides. These are particularly hazardous in LEDCs where shanty towns are located on steep, unstable slopes. The best way to reduce the hazards is through forecasting and early warning to allow evacuation of threatened areas. The course of storms and hence their landfall are difficult and expensive to predict and beyond the means and capabilities of many LEDCs (eg low lying and populous Bangladesh). Clearly the development of sufficiently robust coastal protection schemes and the development of buildings which allow wind and water to pass beneath the main structures can afford some degree of protection, but are expensive and may not be deemed cost effective.

Level 3

Evaluation and explanation of the nature and impacts of the hazards, particularly storm surges. Good exemplification and assessment of prediction and amelioration. [12–15]

Level 2

Some sensible use of examples to illustrate the nature of the hazards although limited assessment of forecasting and hard engineering. [7–11]

Level 1

Most damage seen as at result of high wind speeds with little to no exemplification or action to limit impacts. [0–6]

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Arid and semi arid environments

7 (a) Describe and explain the characteristics of semi-arid climates. [10]

Semi-arid climates are defined as having rainfall of 300–600 mm. Rainfall patterns are unpredictable and subject to great fluctuations. Temperatures are generally high throughout the year with a mean annual temperature above 18°C. As these climates tend to be located around the hot arid climatic areas, the basic causes of their aridity are similar, i.e. sub-tropical highs, continental interiors, rain shadow effects. Rainfall is often convectional and thus unpredictable as to where it will fall. Some areas, such as the Sahel can be affected by the movement of the ITCZ. All areas are subject to periodic drought.

(b) Fig 3 shows the contribution of overgrazing to global desertification by region. How does overgrazing affect desertification? Using examples, explain the extent to which other factors can also influence desertification. [15]

Overgrazing is seen as a significant contributor to desertification but is only the main cause in Oceania, which has the lowest amount of desertification in terms of hectares.

It is also above world averages in Africa. The argument is that the fragile balance of vegetation and environment is easily disturbed by the introduction of too many grazing animals. The vegetation is destroyed leading to a loss of humus and nutrients and the lack of precipitation means that the soil is easily transported by the wind, giving rise to desertification. Another linked cause is increase in population leading to deforestation and the sinking of boreholes depleting ground water supplies. Drought is increasingly thought to be an equally significant contributor to permanent deterioration of soils. It has been argued, however, that in semi-arid conditions vegetation can quickly recover from droughts as long as there are not excessive strains put upon the ecosystem by human occupation. Most semi-arid areas are unsuitable for any degree of cultivation.

Level 3

Good understanding of the impact of overgrazing on soil deterioration as well as other causes including the role of droughts. Appropriate exemplification perhaps from the Sahel, Australia or N. America. [12–15]

Level 2

Grazing impact explained but causes of desertification largely ascribed to human activities with only generalised exemplification. [7–11]

Level 1

Little more than vegetation destruction by animals and humans. Little explanation or exemplification. [0–6]

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- 8 (a) Explain the processes of weathering in hot arid areas and describe their effects upon rocks. [10]**

The considerable diurnal range of temperatures in deserts of up to 30°C is thought to lead to powerful thermal fracturing resulting in angular rock fragments due to the breakdown of the rock by continuous expansion and contraction. Many fragments appear too large to be derived from thermal fracture and it is suggested that chemical weathering does exist. This could be possible through the action of dew collecting on the undersides of rocks but chemical weathering was likely to have been more active in a wetter past. Platy fragments litter many rock surfaces which suggest chemical processes are still in operation as is salt weathering and hydration.

- (b) Using examples, discuss the extent to which landforms in hot arid areas are the product of past erosional and depositional processes. [15]**

The existence of large scale drainage networks, wadis, alluvial fans, as well as former lake sites all argue for a degree of water erosion that is well beyond that experienced today. Episodic activity takes place with sudden downpours where a lot of erosional activity may take place in limited locations such as wadis, but this would not be sufficient to create the range of water eroded features. Thus pluvial periods in the Pleistocene and beyond are seen as the likely period of most landform formation. Some may argue that wind erosion and deposition are still active giving rise to depressions, yardangs, zeugans and dune systems. Even here the scale suggests that water action and past weathering may have been a significant factor.

Level 3

Good appreciation of the relict nature of desert landforms and a realistic assessment of past as against present processes with good exemplification. [12–15]

Level 2

Some understanding of the effects of water activity, illustrated by reference to some landforms. This will generally be ascribed to the past, whilst wind and weathering will be seen only as current activities in landforms. [7–11]

Level 1

Descriptions of a few landforms that will be ascribed to either wind action (dunes) or water (wadis). No attempt to argue a case. [0–6]