Please write clearly, in block capitals.

Centre number

Candidate number

Surname

Forename(s)

Candidate signature

A-level GEOGRAPHY

Paper 1 Physical geography

Additional specimen Morning Time allowed: 2 hours 30 minutes

Materials
For this paper you must have:
• a pencil
• a rubber
• a ruler.
You may use a calculator.

Instructions
• Answer all questions in Section A.
• Answer either Question 2 or Question 3 or Question 4 in Section B.
• Answer either Question 5 or Question 6 in Section C.

Information
• The total number of marks available for this paper is 120.

Advice

For the multiple-choice questions, completely fill in the circle alongside the appropriate answer(s).

CORRECT METHOD   WRONG METHODS

If you want to change your answer you must cross out your original answer as shown.

If you wish to return to an answer previously crossed out, ring the answer you now wish to select as shown.
Section A

Water and carbon cycles

Answer all questions.

01. Explain the concept of carbon sequestration. [4 marks]

Question 1 continues on the next page
Figure 1 shows a climatic water balance using data gathered from a meteorological station in the city of Potsdam, Germany. Data for 2003, 2007 and 2008 are presented along with the 1961–1990 average. The data plotted show the difference between the daily accumulated precipitation and the daily potential evapotranspiration for each period.
Using Figure 1, analyse the water balance data for the city of Potsdam. [6 marks]

Question 1 continues on the next page
Figure 2 shows the impact of different emissions scenarios upon predicted climate change.

Using Figure 2 and your own knowledge, assess the challenges associated with staying within a carbon budget which will limit global average temperature increases to 2°C.

[6 marks]
“Human activity has caused irreversible damage to the fragile inter-relationship between the water cycle and the carbon cycle.”

To what extent do you agree with this view?

[20 marks]
Section B

Answer one question.

Answer either Question 2 or Question 3 or Question 4.

Shade the circle below to indicate which optional question you have answered.

CORRECT METHOD  

WRONG METHODS

Question 2  Hot desert systems and landscapes

Explain the concept of aridity index in relation to desert climatic conditions.  

[4 marks]
Figure 3a shows a model of simulated global precipitation change in summer and winter for 2071–2100 relative to the 1986–2005 averages.
Figure 3b shows the location of the world’s major hot desert areas.

Using Figure 3a and Figure 3b, analyse the simulated precipitation change for the major desert areas of the world.

[6 marks]
Figure 4a shows aspects of climate, soils and vegetation in a typical desert landscape.
**Figure 4b** shows comparative productivity data for a range of biomes.

<table>
<thead>
<tr>
<th>Biome type</th>
<th>Area ($10^6$ km$^2$)</th>
<th>Mean net primary productivity (g/m$^2$/yr)</th>
<th>Mean biomass (kg/m$^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tropical rainforest</td>
<td>17</td>
<td>2200</td>
<td>45</td>
</tr>
<tr>
<td>Temperate deciduous forest</td>
<td>7</td>
<td>1200</td>
<td>30</td>
</tr>
<tr>
<td>Savanna</td>
<td>15</td>
<td>900</td>
<td>4</td>
</tr>
<tr>
<td>Tundra and alpine</td>
<td>8</td>
<td>140</td>
<td>0.6</td>
</tr>
<tr>
<td>Desert and semi-desert</td>
<td>18</td>
<td>90</td>
<td>0.7</td>
</tr>
<tr>
<td>Extreme desert and ice</td>
<td>24</td>
<td>3</td>
<td>0.02</td>
</tr>
</tbody>
</table>

Using **Figure 4a, Figure 4b** and your own knowledge, assess the impact of climate and soils upon productivity in this desert environment.

[6 marks]
The pressures of population expansion, human activities and natural changes will inevitably lead to an increase in the process of desertification and the extent of deserts.

To what extent do you agree with this view? [20 marks]
Question 3  Coastal systems and landscapes

0 3 1 Explain the difference between eustatic, isostatic and tectonic sea level change. [4 marks]
Figure 5, on the insert, shows data about the sediment budget in the estuary of Southampton Water and its tributaries.

Using Figure 5, assess the impact of sediment transport pathways upon the development of this estuary.

[6 marks]
Figure 6 is an aerial photograph of a stretch of the Dorset coastline.

Figure 7 provides additional contextual information about the area, including its geology.
Using **Figure 6, Figure 7** and your own knowledge, account for the development of this area of the Dorset coastal landscape.

[6 marks]
"Flooding and erosion is set to increase to unprecedented levels along coastlines across the world. In response, mitigation and adaptation by coastal managers will ensure that people and places are not affected."

To what extent do you agree with this view?

[20 marks]
Question 4  Glacial systems and landscapes

• Explain the physical characteristics of vegetation in cold environments. [4 marks]

Question 4 continues on the next page
Figure 8a is a remotely sensed image of a solifluction lobe in Alaska, USA. A number of transect lines have been added to the map. These show changes to the long and cross profile of the solifluction lobe relative to the surrounding landscape.

Figure 8b shows the long profile of the solifluction lobe.
Figure 8c shows the cross profile of the solifluction lobe.

Using Figure 8a, Figure 8b and Figure 8c, analyse the characteristics of the solifluction lobe.

[6 marks]
Figure 9 shows data related to a solifluction lobe, in Alaska, USA.
Using Figure 9 and your own knowledge, account for the development of this landscape. [6 marks]

Question 4 continues on the next page
Fluvioglacial landscapes are set to experience more rapid change than any other cold environment, as a direct result of human induced impacts upon the dynamic equilibrium.

To what extent do you agree with this view? [20 marks]
END OF SECTION B
Section C

Answer one question.

Answer either Question 5 or Question 6.

Shade the circle below to indicate which optional question you have answered.

Question 5 Hazards

In the context of plate tectonic theory, what is meant by gravitational sliding?  

[1 mark]

A At major destructive boundaries, friction within the Benioff Zone forces the oceanic lithosphere to return to a molten state. This leads to the formation of andesitic volcanoes.

B At major constructive boundaries, ridges are formed. These produce a gravitational effect (ridge push). Plates to slide away from the ridge towards the earth’s centre of gravity.

C At major conservative boundaries, plates slide past each other, leading to the formation of major landscape features such as the San Andreas Fault.

D On the continental lithosphere, as plates slide apart, a large depression emerges along the fault line leading the formation of a rift valley.
What is the connection between young fold mountains and ocean trenches?

A. At a destructive boundary, oceanic and continental lithosphere collide. The trench is formed on the seaward side and the fold mountains are formed on the landward side.

B. In places such as the Himalayas, converging continental plates lead to the development of fold mountains with ocean trenches formed on the seaward side.

C. As plates diverge and magma is extruded, fold mountains are created. At the base of these long ridges, ocean trenches are formed. They stretch for hundreds of kilometres.

D. As oceanic plates converge, large island chains are formed. At the subduction zone trenches are formed and the island chains emerge as fold mountains.

Question 5 continues on the next page.
Which is an appropriate strategy to mitigate against the impact of volcanoes?

[1 mark]

A. In order to deal with liquefaction, geological surveys can be undertaken to identify areas at risk. Large areas can be cordoned off as part of an exclusion zone strategy.

B. Remote sensing can be used to monitor a number of indicators of the impending eruption. These include thermal imaging, sulphur gas sampling and seismography.

C. By analysing past eruptions and predicting likely eruption patterns, land use planning can be used to restrict development and occupation in areas considered to be most vulnerable.

D. In order to address the threat posed by lava bombs and other tephra, vast quantities of water can be sprayed over the erupting volcano, reducing the capability of damage.
Which is not a method by which wildfire can be brought under control? [1 mark]

A  If the area is judged to be self-contained or low value in terms of ecological value /potential human occupation, it may be left to burn out naturally, particularly when rain is forecast.

B  Specially designed aircraft can be used to control the spread of wild fire in two ways. They can douse the flames with water or soak the vegetation which has not yet caught fire.

C  Selective burning and vegetation clearance along ‘fire lines’ may be used to contain the fire and stop it from jumping across to the area defined as requiring protection.

D  The use of accelerants can be used to clear the vegetation in and around large settlements at risk of wildfire. As the fire approaches, attention is shifted to the settlement not the fire.
Figure 10 shows data related to sea surface temperature (SST) and Power Dissipation Index (PDI) in the main development region (MDR) of hurricanes in the Atlantic Ocean.

Figure 10

![Graph showing SST and PDI](image)

Key
- PDI
- SST

Note: PDI is an aggregate of storm intensity, frequency, and duration and provides a measure of total hurricane power over a hurricane season.
**Figure 11** shows data related to hurricanes that have made landfall in the USA between 1851 and 2010. The hurricanes have been categorised according to the Saffir-Simpson Hurricane Wind Scale, where 1 is the lowest intensity hurricane and 5 is the highest.

<table>
<thead>
<tr>
<th>Decade</th>
<th>All 1, 2, 3, 4, 5</th>
<th>Major 3, 4, 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>1851-1860</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>1861-1870</td>
<td>15</td>
<td>1</td>
</tr>
<tr>
<td>1871-1880</td>
<td>20</td>
<td>7</td>
</tr>
<tr>
<td>1881-1890</td>
<td>22</td>
<td>5</td>
</tr>
<tr>
<td>1891-1900</td>
<td>21</td>
<td>8</td>
</tr>
<tr>
<td>1901-1910</td>
<td>18</td>
<td>4</td>
</tr>
<tr>
<td>1911-1920</td>
<td>21</td>
<td>7</td>
</tr>
<tr>
<td>1921-1930</td>
<td>13</td>
<td>5</td>
</tr>
<tr>
<td>1931-1940</td>
<td>19</td>
<td>8</td>
</tr>
<tr>
<td>1941-1950</td>
<td>24</td>
<td>10</td>
</tr>
<tr>
<td>1951-1960</td>
<td>17</td>
<td>8</td>
</tr>
<tr>
<td>1961-1970</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>1971-1980</td>
<td>12</td>
<td>4</td>
</tr>
<tr>
<td>1981-1990</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>1991-2000</td>
<td>14</td>
<td>5</td>
</tr>
<tr>
<td>2001-2010</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td><strong>Average per decade</strong></td>
<td><strong>17.7</strong></td>
<td><strong>6</strong></td>
</tr>
</tbody>
</table>

Using **Figure 10** and **Figure 11**, analyse the data shown. [6 marks]
**Figure 12** shows data related to the impact of major volcanic eruptions.

**Figure 13** provides information on the Tambora eruption in 1815.

**Figure 13**

Tambora, Indonesia – eruption in 1815

Mixed in with the 30 cubic kilometres or more of rock spewed out from Tambora’s crater, were more than 50m tonnes of sulphur dioxide, a large fraction of which rose up with the ash cloud into the stratosphere. While most of the ash fell back quite quickly, the sulphur dioxide stayed up and spread both around the equator and towards the poles. Over the following months it oxidised to form sulphate ions, which developed into tiny particles that reflected away some of the light coming from the sun. The sulphate particles were small enough to stay aloft for many months.
**Figure 14** shows information related to the short and long-term impacts of volcanoes.

Using **Figure 12**, **Figure 13**, **Figure 14** and your own knowledge, assess the challenges associated with responding to major volcanic eruptions. 

[9 marks]
Evaluate the effectiveness of the hazard management cycle in assisting with the planning for wildfire events.

[9 marks]
Question 5 continues on the next page

DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED
Assess the importance of plate tectonic theory in helping to understand the nature and causes of volcanic activity.

[20 marks]
Question 6  Ecosystems under stress

0 6. 1 What is a sub-climax?

[A] The natural vegetation pattern is disrupted by human activity. This is often planned intervention in order to prevent the vegetation reaching its natural equilibrium.

[B] A stage in the ecological succession of a plant or animal community, often persisting because of the repeated effects of fire, flood, or other conditions.

[C] An ecological community in which populations of plants or animals remain stable and exist in balance with each other and their environment. A sub-climax community is the final stage of succession.

[D] A temporary seral stage in the development of the equilibrium. As a result of decay and weathering, mosses and lichen give way to grasses. A stable, balanced sub-climax is formed.

0 6. 2 What is the soil moisture budget?

[A] The balance between water and carbon in soils. The input of water comes from precipitation and carbon is recycled through photosynthesis, decay and plant transpiration.

[B] The amount of vegetation growing in an area determines the soil moisture budget. If the area is a tropical forest, the soil moisture will be depleted as a result of uptake by trees.

[C] The balance between the water inputs and water outputs. This budget can be represented: Drainage basin discharge = precipitation – evapotranspiration +/- changes in storage.

[D] The soil moisture budget has a direct bearing upon net primary productivity. The single biggest driving factor is the available soil moisture in determining the rate of growth of plant life.
What are the characteristics of temperate deciduous woodland? [1 mark]

A. Large forests form in higher latitudes. There are four distinct layers of vegetation and the trees are highly adapted to the scarce nutrients and colder conditions.

B. Thick forests form in tropical areas. The forest floor is generally clear of vegetation as the area has reached its climatic climax. The trees are deciduous shedding leaves at different times throughout the year.

C. The trees are highly adapted to the inconsistent patterns of rainfall and long dry season. Acacia and baobab trees dominate the landscape, adapted to cope with the short, wet season.

D. Trees are deciduous and well adapted to the seasonal variation in temperature and sunlight. The forest floor usually has little vegetation as the canopy often blocks out the light and the trees themselves take up available soil nutrients.

Why are algae important in the health of coral? [1 mark]

A. This is an ancient symbiotic relationship. Coral provides algae with shelter and nutrients and algae provide coral with a food supply. It allows coral to survive in otherwise nutrient poor waters.

B. The algae thrive in waters which exceed 26°C. In these warm tropical waters, the algae cover the surface of the sea water. These conditions favour the development of the coral ecosystem.

C. The algae are a parasite which feeds off the unwanted detritus from the coral. This in turn allows zooplankton to develop which is the beginning of the food chain in the ecosystem.

D. The coral expels the algae when temperatures exceed 26°C. As the coral temporarily whitens, the algae then becomes a food source for other primary consumers which the coral can then feed off.
Figure 15 shows the average percentage coverage of coral along the Great Barrier Reef, Australia between 1985 and 2012. It also shows whether coral coverage increased or decreased over 214 survey sites.

Figure 16, on the insert, shows change in coral coverage by area and data relating to the cause of coral mortality.
With reference to Figure 15 and Figure 16, assess the changes taking place in the Great Barrier Reef.

[6 marks]
Figure 17 shows data related to Amazonian deforestation between 2004 and 2012.
Figure 18 is a map showing Amazonian deforestation in 2010.

Question 06.6 continues on the next page
Using Figure 17 and Figure 18 and your own knowledge, assess the implications of this data for sustainability and biodiversity. [9 marks]
Analyse factors which lead to the development of a sub-climax vegetation community.

[9 marks]
Assess the extent to which savanna grassland could be considered a fragile environment under threat from both human activity and natural processes. [20 marks]
END OF QUESTIONS
There are no questions printed on this page