Q1.

To what extent does plate tectonic theory help in understanding the development of landforms associated with plate movement?

[20 marks]

Q2.

Assess the extent to which the nature of plate margins determines the impacts of earthquake events.

[20 marks]

Q4.

Summarise the formation of rift valleys.

[3 marks]

Q5.

Assess the extent to which the frequency and magnitude of volcanic activity is more predictable at some plate margins than others.

[9 marks]

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_____

Q6.

Which of the following summarises the process of slab pull?

[1 mark]

A A driving force of plate movement generated at mid-ocean ridges. Newly formed crust cools, becomes denser and so moves away from the centre of the ridge. ⬭

B A driving force of plate movement generated at a subduction zone as an old, cold dense plate sinks into the mantle beneath. ⬭

C Forces generated at conservative plate margins as one plate drags past another. ⬭

D Warm convection currents within the mantle act like a conveyor belt, driving and carrying the plates of the lithosphere. ⬭

Q7.

Outline processes which lead to the formation of fold mountains.

[4 marks]

_____

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Q11.

Which of the following best describes an island arc?

[1 mark]

A An archipelago formed of a series of volcanoes rising above sea level associated with an ocean trench and destructive plate margin. ⬭

B An underwater mountain range associated with sea-floor spreading at a constructive plate boundary. ⬭

C A linear lowland area between highlands formed as tectonic processes begin to pull tectonic plates apart. ⬭

D Linear mountain ranges formed as two or more tectonic plates are pushed together often causing layers of sedimentary rocks to buckle and warp. ⬭

Q12.

Outline the process of slab pull in relation to plate movement.

[3 marks]

Q13.

How is a rift valley formed?

[1 mark]

A As tectonic plates slide past each other, earthquakes are caused at the point of pressure release, often with a very shallow focus. ⬭

B Tectonic processes lead to the divergence of plates. As the plates pull apart, the land collapses leading to a depression in the land. ⬭

C As plates converge, one plate is forced beneath the other leading to the formation of a subduction zone. Rift valleys are formed in the subduction zone. ⬭

D Molten rock is forced through a moving plate leading to the creation of rift valleys. Chains of islands are formed. ⬭

Mark schemes

Q1.

AO1 – Knowledge and understanding of plate tectonic theory. Knowledge and understanding of landforms associated with seismicity and vulcanicity.

AO2 – Application of knowledge and understanding to assess the extent to which plate tectonics accounts for landforms associated with seismicity and vulcanicity.

Notes for answers

AO1

- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and seafloor spreading.
- Destructive, constructive and conservative plate margins. Characteristic processes: seismicity and vulcanicity. Associated landforms: young fold mountains, rift valleys, ocean ridges, deep sea trenches and island arcs, volcanoes.
- Magma plumes and their relationship to plate movement.

AO2

- Expect to see exploration of the link between plate tectonic theory and its associated landform development. Expect also to see consideration of theories around gravitational sliding (ridge push / slab pull).
- Convection currents and ridge push / slab pull theories are likely to be linked to ridges and rift valleys (such as Mid-Atlantic Ridge or the East African Rift Valley) and trenches such as the Marianas Trench). The theory suggests that upwelling magma is forced through the lithosphere as a result of convection in the mantle and asthenosphere, lead to ridge formation. Some may suggest that ridge push is also suggested to play a part in the sea floor spreading.
- Expect consideration of young fold mountains as an extension to the idea of trench formation and associated with slab pull /gravitational sliding theories. Reference to The Andes and Himalayas may feature. Some may go further and draw connections to different types of plate boundary, expect to see reference to constructive, destructive and collision boundaries.
- Some may refer to evidence to support the theory such as palaeomagnetism or those associated with Wegener's theories (the jigsaw fit, brachiopod fossil remains etc.).
- In terms of vulcanicity the same theories can be used to account for island arcs such as Japan or the Kermadec Arc may feature. The Pacific Ring of Fire may also feature.
- Hot spots caused by magma plumes are also likely to feature and contributing theory to the development of island chains such as the Hawaiian islands. This can be further used to support the idea that the pacific plate is moving in a north westerly direction, as the age of the rock making up the islands increases in the same north westerly direction.
- In terms of the question expect to see most view plate tectonic theory as providing a secure link to process and landform, with further development and support provided by gravitational sliding and hot spots.

Credit any other valid assessment.

Level 4 (16–20 marks)

- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are

comprehensive, sound and coherent (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1).
- Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).

Level 3 (11–15 marks)
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

Level 2 (6–10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1–5 marks)
- Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2).
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes (AO1).
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
- Nothing worthy of credit.

AO1 = 10, AO2 = 10
[Total 20 marks]

Q2.

AO1 – Knowledge and understanding of the nature of plate margins. Knowledge and understanding of the factors affecting the impact of earthquake events.

AO2 – Application of knowledge and understanding to assess the extent to which the nature of plate margins determines the impacts of earthquake events.

Notes for answers

AO1

- Destructive, constructive and conservative plate margins. Characteristic processes: seismicity and vulcanicity. Associated landforms: young fold mountains, rift valleys, ocean ridges, deep sea trenches and island arcs, volcanoes.
- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea-floor spreading.
- The nature of seismicity and its relation to plate tectonics: forms of seismic hazard: earthquakes, shockwaves, tsunamis, liquefaction, landslides. Spatial distribution, randomness, magnitude, frequency, regularity, predictability of hazard events.
- Impacts: primary/secondary; environmental, social, economic, political. Short and long-term responses; risk management designed to reduce the impacts of the hazard through preparedness, mitigation, prevention and adaptation.
- Impacts and human responses as evidenced by a recent seismic event.

AO2

- A number of plate margins (destructive, constructive, conservative) could be the focus of the response and this may affect the direction in which the candidates argue.
- Some responses may assess the extent to which the nature of the different kinds of plate margins affects the impacts, this is a valid approach. This may suggest that the nature of the plate boundaries affects the magnitude, frequency and depth of focus of the earthquakes, which may be very significant in determining the impacts of earthquakes. Expect such responses to be supported with illustrative examples to provide evidence of the primary/secondary, environmental, social, economic and political impacts, with assessment of the extent to which the nature of the plate boundary where the earthquake happened determined these impacts.
- Some responses may seek to assess the extent to which the nature of plate boundaries determines the impacts of earthquakes compared to other factors. These responses may seek to compare the nature of plate boundaries to factors such as the perception of the hazard posed by the earthquake and the level of development of the location. Others may assess the role of the nature of the plate margin in comparison to the nature of the human response to it, which may include: fatalism, prediction, adjustment/adaptation, mitigation, management and risk sharing, and the extent to which these are determinants of the impacts of earthquakes. Equally some may seek to compare the nature of the plate boundaries to factors such as other environmental or physical geographical features, such as location, relief or climate of the area affected.
- In relation to the chosen illustrative examples assessment may come to the view that the nature of the plate boundaries is the most significant factor in determining the impacts of earthquakes, whilst others may conclude that it is other factors that are more important in determining the impacts of earthquakes, whilst others will conclude that it is a combination of factors that determines the impacts of earthquakes.

- Assessment must focus on, and come to a view on, the extent to which the nature of plate boundaries determines the impacts of earthquakes.
- Any view is acceptable, as long as it is supported with reasoned argument and illustrative examples and evidence.

Credit any other valid approach.

Level 4 (16–20 marks)
- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts and processes throughout (AO1).
- Detailed awareness of scale and temporal change which is well-integrated where appropriate (AO1).

Level 3 (11–15 marks)
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts and processes (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

Level 2 (6–10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2).
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1–5 marks)
- Very limited and/or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2).
- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different

contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts and processes.
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
Nothing worthy of credit.

AO1 = 10, AO2 = 10
[Total 20 marks]

Q3.

AO1 − Knowledge and understanding of plate tectonics. Knowledge and understanding of the nature and cause of volcanic events.

AO2 − Application of knowledge and understanding in analysis and evaluation of the extent to which plate tectonic theory can assist in developing understanding of the nature and causes of volcanic activity.

Notes for answers

AO1
- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea-floor spreading.
- Destructive, constructive and conservative plate margins. Characteristic processes: seismicity and vulcanicity. Associated landforms: young fold mountains, rift valleys, ocean ridges, deep sea trenches and island arcs, volcanoes.
- Magma plumes and their relationship to plate movement.
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes.
- Lava flows, mudflows, pyroclastic and ash fallout, gases / acid rain, tephra. Spatial distribution, magnitude, frequency, regularity and predictability of hazard events.

AO2
- Plate tectonic theory provides powerful support in aiding understanding of the causes of vulcanicity. However hot spots and the formation of island chains such as the Hawaiian Island chain provide evidence that plate tectonics is not a complete theory.
- There should be clear links to the established theory around the cause of vulcanicity.
- Expect to see reference to magma plumes and concepts associated with convection currents.
- There should also be reference to diverse types of plate boundary and how these produce different types of volcano. Composite cone and shield volcanoes may feature here.
- In terms of nature, expect to see reference to a range of volcano types and how these relate to diverse types of lava. Rhylolitic and andesitic lava types may feature here.
- Some may consider the types of eruption which relate to the different volcanoes. Whilst the question is not strictly about hazards, provided the response links the eruption to the plate tectonic theory, then this is a valid approach.
- Hot spot theory may also feature. Expect to see this used to explain the formation of the Hawaiian chain but also to challenge the idea that volcanoes only occur on plate

boundaries.
- Whatever the approach there should be some critical engagement with the theory and how it supports understanding of the development of vulcanicity.
- Case study support may feature to show contrasting volcanic activity around the world. Again provided this is used in the context of plate tectonic theory, this is a valid approach.

Level 4 (16−20 marks)
- Detailed evaluative conclusion that is rational and firmly based on knowledge and understanding which is applied to the context of the question. Interpretations are comprehensive, sound and coherent (AO2).
- Detailed, coherent and relevant analysis and evaluation in the application of knowledge and understanding throughout (AO2).
- Full evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Detailed, highly relevant and appropriate knowledge and understanding of place(s) and environments used throughout (AO1).
- Full and accurate knowledge and understanding of key concepts, processes and interactions and change throughout (AO1).
- Detailed awareness of scale and temporal change which is well integrated where appropriate (AO1).

Level 3 (11−15 marks)
- Clear evaluative conclusion that is based on knowledge and understanding which is applied to the context of the question. Interpretations are generally clear and support the response in most aspects (AO2).
- Generally clear, coherent and relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Generally clear evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Generally clear and relevant knowledge and understanding of place(s) and environments (AO1).
- Generally clear and accurate knowledge and understanding of key concepts, processes and interactions and change (AO1).
- Generally clear awareness of scale and temporal change which is integrated where appropriate (AO1).

Level 2 (6−10 marks)
- Some sense of an evaluative conclusion partially based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretations are partial but do support the response in places.
- Some partially relevant analysis and evaluation in the application of knowledge and understanding (AO2).
- Some evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Some relevant knowledge and understanding of place(s) and environments which is partially relevant (AO1).
- Some knowledge and understanding of key concepts, processes and interactions and change. There may be a few inaccuracies (AO1).
- Some awareness of scale and temporal change which is sometimes integrated where appropriate. There may be a few inaccuracies (AO1).

Level 1 (1−5 marks)
- Very limited and / or unsupported evaluative conclusion that is loosely based upon knowledge and understanding which is applied to the context of the question (AO2). Interpretation is basic.

- Very limited analysis and evaluation in the application of knowledge and understanding. This lacks clarity and coherence (AO2).
- Very limited and rarely logical evidence of links between knowledge and understanding to the application of knowledge and understanding in different contexts (AO2).
- Very limited relevant knowledge and understanding of place(s) and environments (AO1).
- Isolated knowledge and understanding of key concepts, processes and interactions and change. There may be a number of inaccuracies (AO1).
- Very limited awareness of scale and temporal change which is rarely integrated where appropriate. There may be a number of inaccuracies (AO1).

Level 0 (0 marks)
- Nothing worthy of credit.

AO1 = 10, AO2 = 10
[Total 20 marks]

Q4.

Point marked
Award 1 mark per valid point with extra mark(s) for developed points (d).
For example:

Notes for answers
AO1
- Rift valleys are formed where continental plates pull apart (1) becoming an emergent plate boundary (1d).
- Hot magma rises in the upper mantle below the crust (1) this causes the crust to dome (1d).
- Parallel linear faults/cracks form in the brittle crust (1).
- As the plate is pulled apart the crust between the faults begins to sink (1) forming the linear flat-bottomed and steep sided rift valley (1d).
- Where the rift is well developed the valley floor can often sink below sea level (1).

The notes for answers are not exhaustive. Credit any valid points.

AO1 = 3
[Total 3 marks]

Q5.

AO1 – Knowledge and understanding of the frequency and magnitude of volcanic activity. Knowledge and understanding of how the nature of plate boundaries affects the frequency and magnitude of volcanic activity.

AO2 – Application of knowledge and understanding to analyse and assess whether the frequency and magnitude of volcanic activity is more or less predictable at different plate boundaries.

Level 3 (7–9 marks)
AO1 – Demonstrates detailed knowledge and understanding of concepts, processes, interactions and change. These underpin the response throughout.
AO2 – Applies knowledge and understanding appropriately with detail. Connections and relationships between different aspects of study are fully developed with complete relevance. Evaluation is detailed and well-supported with appropriate evidence.

Level 2 (4–6 marks)
AO1 – Demonstrates clear knowledge and understanding of concepts, processes, interactions and change. These are mostly relevant, though there may be some minor inaccuracy.
AO2 – Applies clear knowledge and understanding appropriately. Connections and relationships between different aspects of study are evident with some relevance. Evaluation is evident and supported with clear and appropriate evidence.

Level 1 (1–3 marks)
AO1 – Demonstrates basic knowledge and understanding of concepts, processes, interactions and change. This offers limited relevance with inaccuracy.
AO2 – Applies limited knowledge and understanding. Connections and relationships between different aspects of study are basic with limited relevance. Evaluation is basic and supported with limited appropriate evidence.

Notes for answers
AO1

- Earth structure and internal energy sources. Plate tectonic theory of crustal evolution: tectonic plates; plate movement; gravitational sliding; ridge push, slab pull; convection currents and sea-floor spreading.
- Destructive, constructive and conservative plate margins. Characteristic processes: vulcanicity.
- The nature of vulcanicity and its relation to plate tectonics: forms of volcanic hazard: nuées ardentes, lava flows, mudflows, pyroclastic and ash fallout, gases/acid rain, tephra. Spatial distribution, randomness, magnitude, frequency, regularity and predictability of hazard events.

AO2

- Responses should assess the frequency of volcanic activity at different types of plate margins.
- Responses should assess the magnitude of volcanic activity at different types of plate margins.
- Assessment may assess the predictability of frequency and magnitude separately, however it is likely that a judgement will be given about the predictability of both at different plate margins.
- It is expected that volcanic activity is assessed at more than one type of plate margin.
- Assessment may be illustrated and supported with evidence from named plate boundaries or specific volcanoes.

Credit any valid assessment as long as the argument is coherent and feasible.

AO1 = 4, AO2 = 5
[Total 9 marks]

Q6.

B A driving force of plate movement generated at a subduction zone as an old, cold dense plate sinks into the mantle beneath.

AO1 = 1
[Total 1 mark]

Q7.

Allow 1 mark per valid point with extra mark(s) for developed points (d). For example:

AO1

- Fold mountains are product of the convergence of tectonic plates (1).
- Continental and / or ocean plates are forced together (1). This may be as a result of opposing convection currents or as a result of concepts associated with slab pull and ridge push (d).
- Some may refer to continental fold mountain formation which has crust that is less dense, forced together with a crumpling effect (1) whereby continental mass is warped and forced upwards (d).
- Others may consider the relationship between continental and ocean crust whereby the more dense ocean curst is forced into the mantle (1) leading to uplift of the continental crust (d). These fold mountains such as the Andes are also associated with volcanic activity (d).

AO1 = 4

[Total 4 marks]

Q11.

A

AO1 = 1

[Total 1 mark]

Q12.

Point marked

Allow 1 mark for each valid point with additional marks for developed points.

Notes for answers

- Slab pull is associated with destructive plate margins (1) **OR** where one plate is being subducted under another (1).
- The subducting plate is generally more dense and less buoyant than the opposing plate so is forced to sink (1). Gravity acts on the leading edge of the subducting plate (1) this action then helps to 'pull' the rest of the plate with it (1)(d).
- Allow max (1)(d) for support with data regarding rates of plate movement associated with slab pull. E.g. 2 to 8 cm per year.

AO1 = 3

[Total 3 marks]

Q13.

B

AO1 = 1

[Total 1 mark]

Examiner reports

Q4.

This question differentiated responses well. Around a quarter gained all 3 marks or scored zero. The best responses gave a succinct summary of the formation of rift valleys. Many gave a short clear sequence of formation. Surprisingly many students appeared very unfamiliar with rift valleys, some even suggested glaciers were involved in their formation.

Q5.

This question differentiated quite well, with almost 2/3 of students getting into Level 2 or higher, and only about 15% getting in to Level 3. The best responses had clear knowledge and understanding of the tectonic processes operating at different plate margins. These often also evidenced a clear grasp of how the nature of volcanic activity differed at these different boundaries. It was envisaged that most students would take a theoretical approach, and then possibly support points with some specific detail or evidence from a named example. Many did do this, but a significant number also made case studies of volcanoes in different tectonic settings the focus. This was creditworthy. Again, the best answers gave very clear assessment, and came to a clear view of the predictability of volcanic activity in different settings. The weakest answers displayed very little knowledge and understanding of either the nature of different plate margins or volcanic activity.

Q6.

This question was accessible to the majority of students, but it differentiated quite well. Almost 70% correctly identified B as the correct option.

Q11.

71% of students accurately chose A as the correct answer.

Q12.

Many were well prepared for this and gave succinct summaries of the process, with a clear grasp of the role of gravity at destructive plate margins. Others clearly had little or no understanding of the process.

Q13.

It was surprising to note that only 76% of responses showed knowledge of how a rift valley is formed. These are relatively straightforward marks for basic knowledge which some students are missing out on.