Area of study 1: Dynamic Landscapes

Topic 1: Tectonic Processes and Hazards

Enquiry question 1: Why are some locations more at risk from tectonic hazards?	
Key idea	**Detailed content**
1.1 The global distribution of tectonic hazards can be explained by plate boundary and other tectonic processes.	a. The global distribution and causes of earthquakes, volcanic eruptions and tsunamis. (1)
	b. The distribution of plate boundaries resulting from divergent, convergent and conservative plate movements (oceanic, continental and combined situations).
	c. The causes of intra-plate earthquakes, and volcanoes associated with hot spots from mantle plumes.
1.2 There are theoretical frameworks that attempt to explain plate movements.	a. The theory of plate tectonics and its key elements (the earth's internal structure, mantle convection, palaeomagnetism and sea floor spreading, subduction and slab pull).
	b. The operation of these processes at different plate margins (destructive, constructive, collision and transform). (2)
	c. Physical processes impact on the magnitude and type of volcanic eruption, and earthquake magnitude and focal depth (Benioff zone).
1.3 Physical processes explain the causes of tectonic hazards.	a. Earthquake waves (P, S and L waves) cause crustal fracturing, ground shaking and secondary hazards (liquefaction and landslides).
	b. Volcanoes cause lava flows, pyroclastic flows, ash falls, gas eruptions, and secondary hazards (lahars, jökulhlaups).
	c. Tsunamis can be caused by sub-marine earthquakes at subduction zones as a result of sea-bed and water column displacement. (3)

Enquiry question 2: Why do some tectonic hazards develop into disasters?	
Key idea	**Detailed content**
1.4 Disaster occurrence can be explained by the relationship between hazards, vulnerability, resilience and disaster.	a. Definition of a natural hazard and a disaster, the importance of vulnerability and a community's threshold for resilience, the hazard risk equation.
	b. The Pressure and Release model (PAR) and the complex inter-relationships between the hazard and its wider context.
	c. The social and economic impacts of tectonic hazards (volcanic eruptions, earthquakes and tsunamis) on the people, economy and environment of contrasting locations in the developed, emerging and developing world.
1.5 Tectonic hazard profiles are important to an understanding of contrasting hazard impacts, vulnerability and resilience.	a. The magnitude and intensity of tectonic hazards is measured using different scales (Mercalli, Moment Magnitude Scale (MMS) and Volcanic Explosivity Index (VEI)).
	b. Comparing the characteristics of earthquakes, volcanoes and tsunamis (magnitude, speed of onset and areal extent, duration, frequency, spatial predictability) through hazard profiles.
	c. Profiles of earthquake, volcano and tsunami events showing the severity of social and economic impact in developed, emerging and developing countries. (4)
1.6 Development and governance are important in understanding disaster impact and vulnerability and resilience.	a. Inequality of access to education, housing, healthcare and income opportunities can influence vulnerability and resilience.
	b. Governance (***P: local and national government***) and geographical factors (population density, isolation/accessibility, degree of urbanisation) influence vulnerability and a community's resilience.
	c. Contrasting hazard events in developed, emerging and developing countries to show the interaction of physical factors and the significance of context in influencing the scale of disaster. (5)

Enquiry question 3: How successful is the management of tectonic hazards and disasters?	
Key idea	**Detailed content**
1.7 Understanding the complex trends and patterns for tectonic disasters helps explain differential impacts.	a. Tectonic disaster trends since 1960 (number of deaths, numbers affected, level of economic damage) in the context of overall disaster trends. (6); research into the accuracy and reliability of the data to interpret complex trends.
	b. Tectonic mega-disasters can have regional or even global significance in terms of economic and human impacts. (🌍 2004 Asian tsunami, 2010 Eyafjallajokull eruption in Iceland (global interdependence) and 2011 Japanese tsunami (energy policy))
	c. The concept of a multiple-hazard zone and how linked hydrometeorological hazards sometimes contribute to a tectonic disaster (🌍 the Philippines).
1.8 Theoretical frameworks can be used to understand the predication, impact and management of tectonic hazards.	a. Prediction and forecasting (***P: role of scientists***) accuracy depend on the type and location of the tectonic hazard.
	b. The importance of different stages in the hazard management cycle (response, recovery, mitigation, preparedness). (***P: role of emergency planners***)
	c. Use of Park's Model to compare the response curve of hazard events, comparing areas at different stages of development.
1.9 Tectonic hazard impacts can be managed by a variety of mitigation and adaptation strategies, which vary in their effectiveness.	a. Strategies to modify the event include land-use zoning, hazard – resistant design and engineering defences as well as diversion of lava flows. (***P: role of planners, engineers***) (7)
	b. Strategies to modify vulnerability and resilience include hi-tech monitoring, prediction, education, community preparedness and adaptation. (**F: models forecasting disaster impacts with and without modification**)
	c. Strategies to modify loss include emergency, short and longer term aid and insurance (***P: role of NGOs and insurers)*** and the actions of affected communities themselves.

Topic 2: Landscape Systems, Processes and Change

Option 2B: Coastal Landscapes and Change

Enquiry question 1: Why are coastal landscapes different and what processes cause these differences?			
Key idea		**Detailed content**	
2B.1	The coast, and wider littoral zone, has distinctive features and landscapes.	a.	The littoral zone consists of backshore, nearshore and offshore zones, includes a wide variety of coastal types and is a dynamic zone of rapid change.
		b.	Coasts can be classified by using longer term criteria such as geology and changes of sea level or shorter term processes such as inputs from rivers, waves and tides.
		c.	Rocky coasts (high and low relief) result from resistant geology (to the erosive forces of sea, rain and wind), often in a high-energy environment, whereas coastal plain landscapes (sandy and estuarine coasts) are found near areas of low relief and result from supply of sediment from different terrestrial and offshore sources, often in a low-energy environment.
2B.2	Geological structure influences the development of coastal landscapes at a variety of scales.	a.	Geological structure is responsible for the formation of concordant and discordant coasts.
		b.	Geological structure influences coastal morphology: Dalmatian and Haff type concordant coasts and headlands and bays on discordant coasts.
		c.	Geological structure (jointing, dip, faulting, folding) is an important influence on coastal morphology and erosion rates, and also on the formation of cliff profiles and the occurrence of micro-features, e.g. caves (🌍 Glamorgan Heritage Coast). (2)
2B.3	Rates of coastal recession and stability depend on lithology and other factors.	a.	Bedrock lithology (igneous, sedimentary, metamorphic) and unconsolidated material geology are important in understanding rates of coastal recession.
		b.	Differential erosion of alternating strata in cliffs (permeable/impermeable, resistant/less resistant) produces complex cliff profiles and influences recession rates. (3)
		c.	Vegetation is important in stabilising sandy coastlines through dune successional development on sandy coastlines and salt marsh successional development in estuarine areas.

Enquiry question 2: How do characteristic coastal landforms contribute to coastal landscapes?			
Key idea		**Detailed content**	
2B.4	Marine erosion creates distinctive coastal landforms and contributes to coastal landscapes.	a.	Different wave types (constructive/destructive) influence beach morphology and beach sediment profiles, which vary at a variety of temporal scales from short term (daily) through to longer periods (4)
		b.	The importance of erosion processes (hydraulic action, corrosion, abrasion, attrition) and how they are influenced by wave type, size and lithology.
		c.	Erosion creates distinctive coastal landforms (wave cut notches, wave cut platforms, cliffs, the cave-arch-stack-stump sequence).
2B.5	Sediment transport and deposition create distinctive landforms and contribute to coastal landscapes.	a.	Sediment transportation is influenced by the angle of wave attack, tides and currents and the process of longshore drift. (5)
		b.	Transportation and deposition processes produce distinctive coastal landforms (beaches, recurved and double spits, offshore bars, barrier beaches and bars, tombolos and cuspate forelands), which can be stabilised by plant succession.
		c.	The Sediment Cell concept (sources, transfers and sinks) is important in understanding the coast as a system with both negative and positive feedback, it is an example of dynamic equilibrium (🌍 Portland Bill to Selsey Bill).
2B.6	Subaerial processes of mass movement and weathering influence coastal landforms and contribute to coastal landscapes.	a.	Weathering (mechanical, chemical, biological) is important in sediment production and influences rates of recession.
		b.	Mass movement (blockfall, rotational slumping, landslides) is important on some coasts with weak and/or complex geology.
		c.	Mass movement creates distinctive landforms (rotational scars, talus scree slopes, terraced cliff profiles).

Enquiry question 3: How do coastal erosion and sea level change alter the physical characteristics of coastlines and increase risks?	
Key idea	**Detailed content**
2B.7 Sea level change influences coasts on different timescales.	a. Longer-term sea level changes result from a complex interplay of factors both eustatic (ice formation/melting, thermal changes) and isostatic (post glacial adjustment, subsidence, accretion) and tectonics.
	b. Sea level change has produced emergent coastlines (raised beaches with fossil cliffs) and submergent coastlines (rias, fjords and Dalmatian). (6)
	c. Contemporary sea level change from global warming or tectonic activity is a risk to some coastlines.
2B.8 Rapid coastal retreat causes threats to people at the coast.	a. Rapid coastal recession is caused by physical factors (geological and marine) but can be influenced by human actions (dredging or coastal management) (🌍 the Nile Delta or Guinea coastline or Californian coastline). ***(A: actions of different players may alter natural systems)***
	b. Subaerial processes (weather and mass movement) work together to influence rates of coastal recession.
	c. Rates of recession are not constant and are influenced by different factors both short- and longer term (wind direction/fetch, tides, seasons, weather systems and occurrence of storms). (7)
2B.9 Coastal flooding is a significant and increasing risk for some coastlines.	a. Local factors increase flood risk on some low-lying and estuarine coasts (height, degree of subsidence, vegetation removal); global sea level rise further increases risk (🌍 Bangladesh or the Maldives).
	b. Storm surge events can cause severe coastal flooding with dramatic short-term impacts (depressions, tropical cyclones) can cause severe coastal flooding.
	c. Climate change may increase coastal flood risk (frequency and magnitude of storms, sea level rise) but the pace and magnitude of this threat is uncertain. ***(F: this risk is creating an uncertain future and needs mitigation and adaptation)***

Enquiry question 4: How can coastlines be managed to meet the needs of all players?	
Key idea	**Detailed content**
2B.10 Increasing risks of coastal recession and coastal flooding have serious consequences for affected communities.	a. Economic losses (housing, businesses, agricultural land, infrastructure) and social losses (relocation, loss of livelihood, amenity value) from coastal recession can be significant, especially in areas of dense coastal developments.
	b. Coastal flooding and storm surge events can have serious economic and social consequences for coastal communities in both developing and developed countries.
	c. Climate change may create environmental refugees in coastal areas.
2B.11 There are different approaches to managing the risks associated with coastal recession and flooding.	a. Hard engineering approaches (groynes, sea walls, rip rap, revetments, offshore breakwaters) are economically costly and directly alter physical processes and systems. (8) ***(A: actions by different players may have unforeseen consequences)***
	b. Soft engineering approaches (beach nourishment, cliff re-grading and drainage, dune stabilisation) attempt to work with physical systems and processes to protect coasts (9) and manage changes in sea level.
	c. Sustainable management is designed to cope with future threats (increased storm events, rising sea levels) but its implementation can lead to local conflicts in many countries. ***(F: mitigation and adaptation will both be needed for future stability)***
2B.12 Coastlines are now increasingly managed by holistic integrated coastal zone management (ICZM).	a. Coastal management increasingly uses the concept of littoral cells to manage extended areas of coastline. Throughout the world, countries are developing schemes that are sustainable and use holistic ICZM strategies.
	b. Policy decisions (No Active Intervention, Strategic Realignment and Hold The Line Advance The Line) are based on complex judgements (engineering feasibility, environmental sensitivity, land value, political and social reasons) (7); Cost Benefit Analysis (CBA) and Environmental Impact Assessment (EIA) are used as part of the decision-making process.
	c. Policy decisions can lead to conflicts between different players (homeowners, local authorities, environmental pressure groups) with perceived winners and losers in countries at different levels of development (developed and developing or emerging countries) (🌍 Happisburgh **and** Chittagong). ***(A: attitudes of differing players may vary)***