Topic 3

Coastal systems and landscapes

Coasts as natural systems

Like all systems in physical geography, coastal systems have inputs, processes, flows and outputs. These act together to form a rich variety of component landforms and landscapes.

1 **Complete the following paragraph by filling in the gaps from the list below. (AO1, AO3)** 20 marks

Inputs into a coastal system include:

- **energy from ....., ..., ... and .....**
- **sediment either eroded from the local coastal rocks or transported from either ..... or along the .....**
- **the .... and ..... of the local geology**
- **sea level change**

Erosional processes such as .... and ..... result in erosional coastlines and landscapes as well as eroded material. ..... alters the eroded material by making it ..... and less ..... .

Sediment is transported by either ..... or ..... until it reaches a low ..... environment where it is ..... .

The outputs from the system are in the form of:

- **..... ..... dissipated by breaking along the shoreline**
- **sediment accumulation above ....**
- **sediment moved on to other ....**

finer, hydraulic action, ocean currents, abrasion, water, energy, wave energy, deposited, wind, sediment cells, waves, offshore, high tide level, coast, rock type, wind, structure, angular, tides, attrition

Systems and processes

Sources of energy

Wind is a primary source of energy. Energy transferred from wind to water not only creates waves but also drives the vast oceanic circulation systems called gyres. It also provides the energy to transport fine material along terrestrial surfaces such as beaches and sand dunes. Swell waves are the result of winds generating waves far out to sea. They tend to travel in the direction of the winds that originally formed them.

2 Outline how energy is transferred from wind to sea water. (AO1) 2 marks

.....

.....

.....

3 Table 3.1 gives the percentage wind direction for Newquay, Cornwall.

Table 3.1

Direction	Percentage
N	6.2
NNE	3.7
NE	2.9
ENE	2.4
E	3.9
ESE	5.2
SE	5.2
SSE	6.3

Direction	Percentage
S	6.7
SSW	7
SW	6.8
WSW	10.5
W	9.6
WNW	8.1
NW	8.7
NNW	6.6

Complete Figure 3.1 by constructing a wind rose diagram for Newquay. (AO3) 5 marks

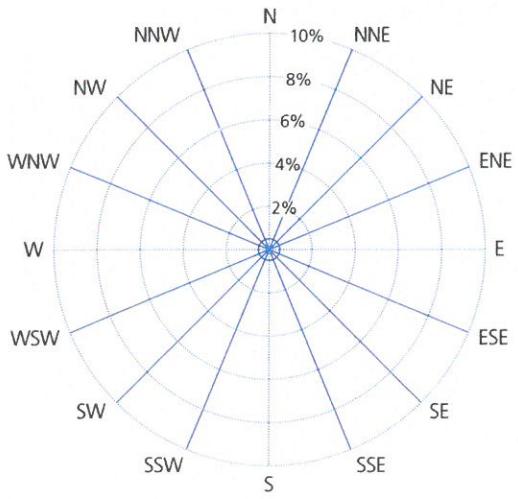


Figure 3.1 A wind rose diagram showing the mean annual percentage of wind direction for Newquay, Cornwall

Waves are expressions in the sea's surface that indicate that energy is being transferred from one place to another. They have little impact on landscapes until they come into contact with land. As the sea shallows, the frictional drag at the base of the wave causes it to shorten, steepen and eventually break. These breaking waves are divided into two broad types, constructive (spilling) waves and destructive (plunging waves).

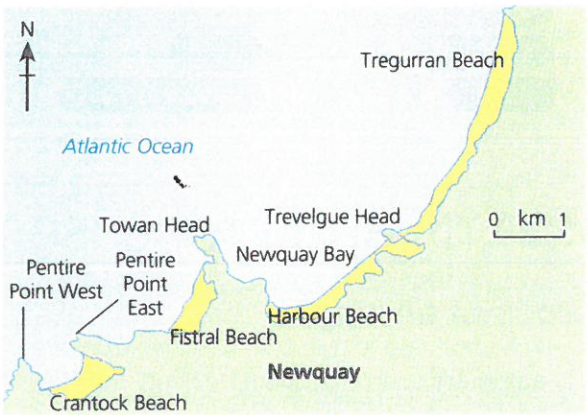


Figure 3.2 A sketch map of the beaches around Newquay, Cornwall

4 Use labelled diagrams to show the difference between a constructive wave and a destructive wave. (AO1, AO2, AO3) 6 marks

5 Describe and explain the different impacts that constructive waves and destructive waves have on a beach. (AO1, AO2) 6 marks

6 Using Figures 3.1 and 3.2, state which of the named beaches around Newquay is likely to be the best for surfing. Give reasons for your choice. (AO1, AO2, AO3) 6 marks

In the sea, a current is the permanent or seasonal movement of water. Ocean currents rarely have any effect on coastal landscapes. Rip currents are strong localised currents that carry water away from the shore. They have a role in the creation of beach cusps.

The main current to affect coastlines is the longshore current. This can give rise to the transport process of longshore drift.

Tides are a periodic rise and fall in the depth of the sea. The amount of rise and fall varies throughout a lunar month depending on the relative positions of the sun and the moon to the Earth.

Similar to all budgets, a coastal sediment budget is the balance between what sediment goes into a stretch of coastline and what sediment comes out.

7 **Use labelled diagram(s) to explain the causes of high and low tides, and spring and neap tides. (AO1, AO3)** 4 marks

Sediment sources

8 **Define the term sediment cell. (AO1)** 2 marks

9 **Describe a sediment cell that you have studied. (AO1)** 3 marks

10 **What are the main sources of sediment along a coastline? (AO1)** 2 marks

Geomorphological processes

Weathering, the physical disintegration and chemical decomposition of rocks in situ at or near the Earth's surface, occurs on coastlines. There are three types of weathering: mechanical/physical, biological and chemical.

Sea water is slightly alkaline and so is not usually able to react with carbonate rocks, though carbonation does occur to coastal limestones.

11 **The main form of mechanical weathering is freeze–thaw action. What causes freeze–thaw action along coastlines and why is it quite rare on British coastlines, especially along the south coast of England? (AO1, AO2)** 4 marks

12 **Apart from freeze–thaw action, name one other type of mechanical weathering process that occurs specifically on coastlines. Describe the process and explain how it affects the coastal landscape. (AO1, AO2)** 4 marks

13 **Under what circumstances does carbonation occur on coastlines? (AO1)** 2 marks

Mass movement, the movement of rocks under the influence of gravity, occurs on coastlines.

One of the most common is rotational slumping.

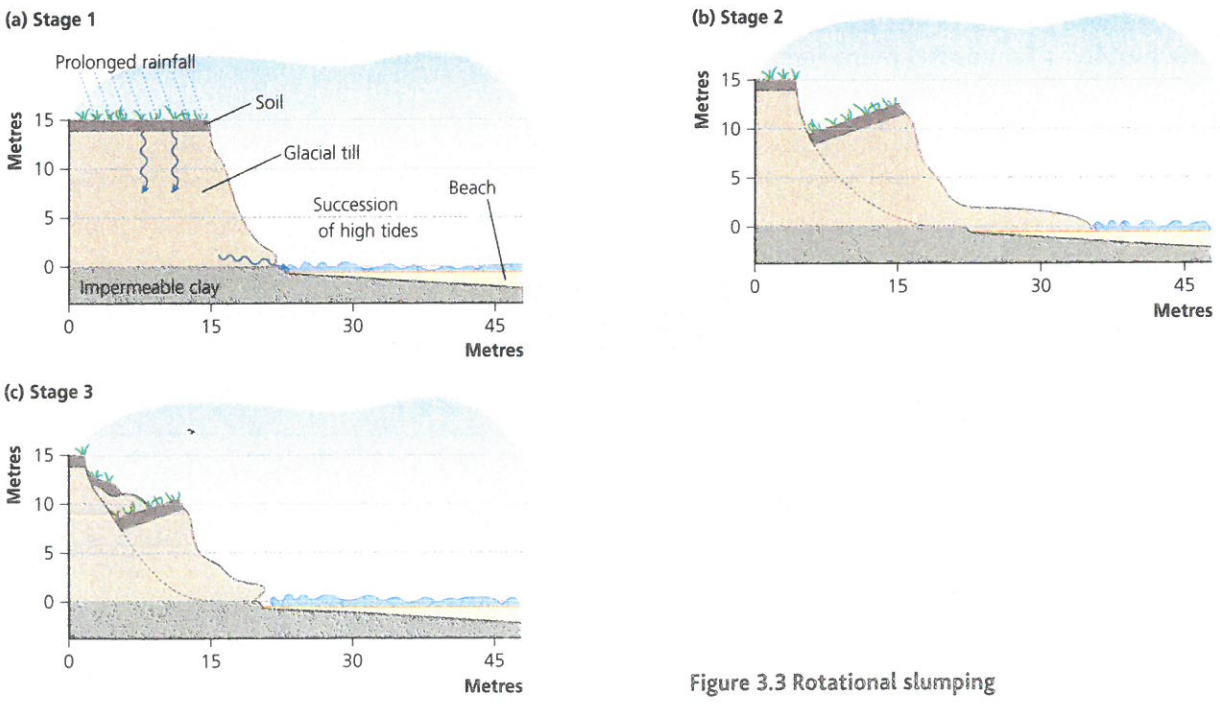


Figure 3.3 Rotational slumping

14 Using Figure 3.3 and an example you have studied, explain the process of rotational slumping for that location. (AO1, AO2, AO3) **6 marks**

15 The most common form of marine sediment transport is longshore drift. Draw an annotated diagram to explain the process of longshore drift. (AO1, AO3) **4 marks**

16 Wind moves lighter material on a beach by the processes of saltation and traction. Describe these processes and explain why onshore winds causing this movement may create problems for coastal managers. (AO1, AO2) **5 marks**

Deposition of coastal material occurs when the medium carrying that sediment (water or air) either loses energy or becomes less turbulent.

Coastal landscape development

Landforms and landscapes of coastal erosion

Figure 3.4 Selwick's Bay, Flamborough Head, Yorkshire

17 Figure 3.4 shows caves, arches and a wave-cut platform on the Yorkshire coast.

a Outline the sequence of events in the evolution of this coastline. (AO1, AO2, AO3) 4 marks

b Although stacks are not present in the photograph, explain how stacks could be formed at Flamborough Head. (AO1, AO2) 4 marks

18 Annotate Figure 3.5 with the following labels: (AO1, AO3)

Ripples | Berms | Beach cusps | Runnel | Ridge | Storm beach

6 marks

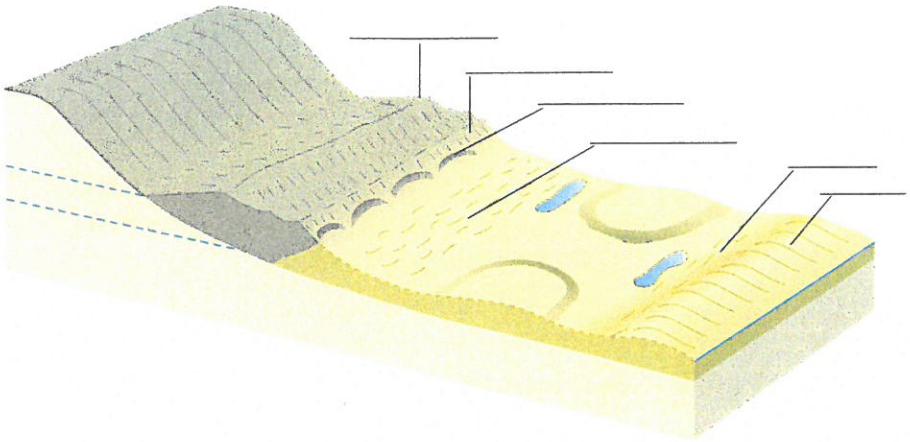


Figure 3.5 The main features of a beach

19 Using an annotated diagram, explain the formation of coastal spits. (AO1, AO3)

4 marks

20 Describe the main features of coastal sand dunes and explain the role of wind and vegetation in their formation. (AO1)

6 marks

Estuarine landscapes

21 **Describe and explain the formation of a saltmarsh and tidal (mud) flats. (AO1, AO3)** 5 marks

Sea-level change

Raised beaches and marine platforms have been caused by falling sea levels whereas rias, fjords and Dalmatian coastlines are formed by rising sea levels.

22 **Draw an annotated sketch of either a ria or a fjord or a Dalmatian coastline describing the main features and explaining the role of changing sea level. (AO1, AO3)** 5 marks

Coastal management

Securing the sustainable use of the coastal zone provides particular challenges. There are often complex issues related to whose responsibility it is to manage the coastline. An estimated 60% of the world's human population live on or close to the coast and the pressures on coastal environments for economic development are particularly high.

Hard engineering

Hard engineering could be defined as controlled disruption of natural processes by using human-made structures. These structures include: sea walls, groynes, breakwaters.

Soft engineering

Soft engineering uses natural systems for coastal defence such as beaches and dunes which can absorb and adjust to wave and tide energy. It involves manipulating and maintaining these systems, without changing their fundamental structures.

23 Describe the hard coastal defences along a stretch of coastline. Analyse the extent to which the defences have achieved the goals set by coastal managers. (AO1) 8 marks

24 Using an example of a scheme of soft engineering you have studied, assess the sustainability of the scheme. (AO1) 8 marks

Exam-style questions (AS)

1 Outline the role of weathering in the development of some coastlines. (AO1) 4 3 marks

2 Study Figure 3.6. Describe the coastline and assess the role played by sea-level change in the formation of this coastline. (AO2, AO3) 7 6 marks

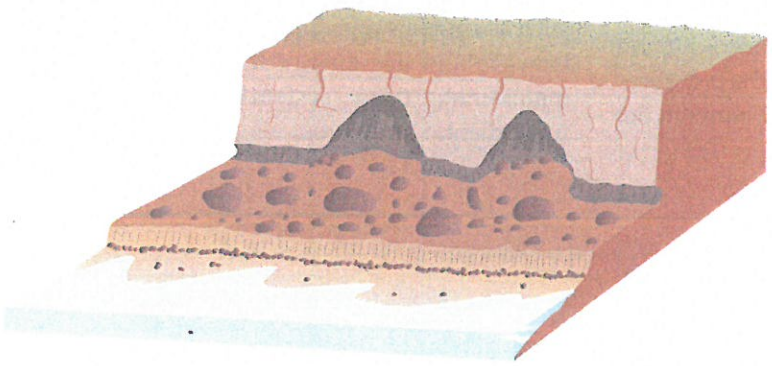


Figure 3.6 A sketch of part of the coastline of the Isle of Arran

3 **To what extent do major changes in sea level in the last 10,000 years contribute to the development of landforms such as raised beaches, marine platforms, rias, fjords and Dalmatian coasts? (AO1, AO2)**

10 9 marks

Write your answer on a separate sheet of paper.

4 **To what extent does climate change present risks and opportunities for human occupation in a named coastal landscape beyond the UK? (AO1, AO2)**

22 20 marks

Write your answer on a separate sheet of paper.

Exam-style questions (A-level)

5 **Explain the concept of eustatic sea-level change. (AO1)**

5 4 marks

6 **Some students carried out fieldwork on the shingle beach and ridge at Porlock in North Devon shown on the sketch map Figure 3.7. One of the characteristics that they measured was the roundness of the pebbles at the western end (Gore Point) and the eastern end (Hurlstone Point) of the beach.**

7 6 marks

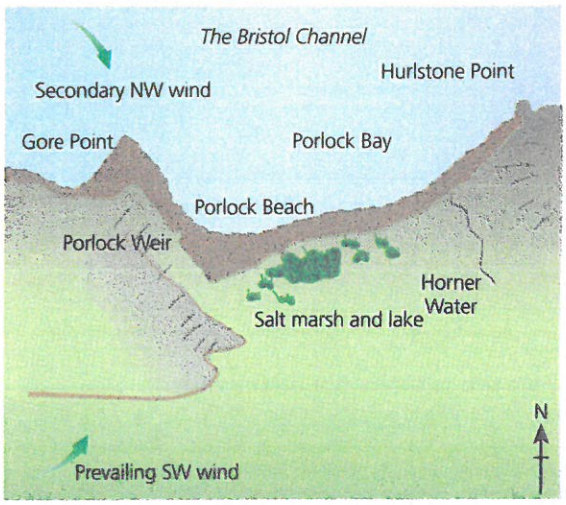


Figure 3.7 A sketch map of Porlock Bay and Beach

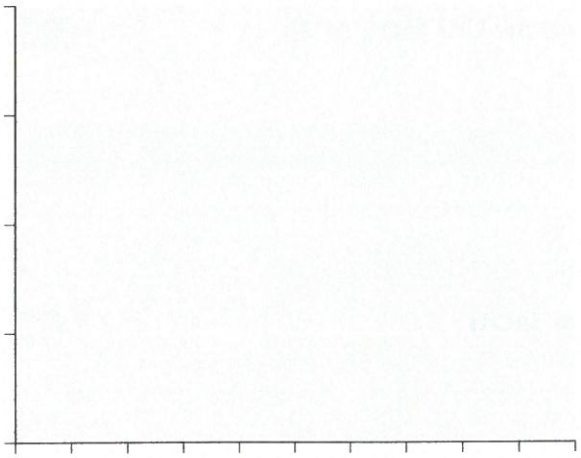
A sample of 150 pebbles was collected at each point and the Cailleux roundness index was measured, where 0 is completely angular and 1,000 is a perfect sphere. The results are shown in Table 3.2.

Table 3.2

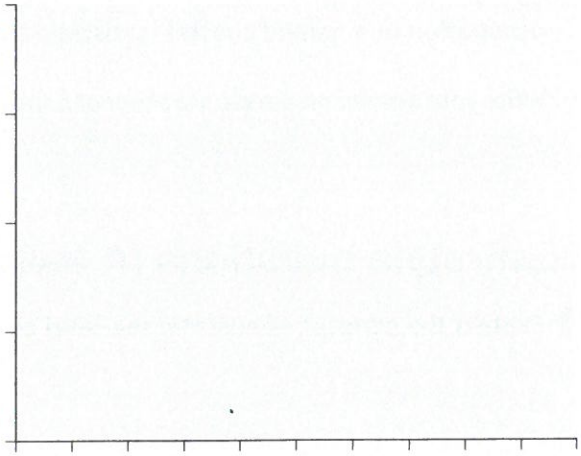
Shape	Gore Point	Rank	Hurlstone Point
0–100	2	10	1
101–200	14	5	2
201–300	28	2	8
301–400	36	1	25
401–500	25	3	23
501–600	19	4	16
601–700	9	6	26
701–800	4	9	27
801–900	8	7	15
901–1000	5	8	7

a Draw two histograms, one for Gore Point and one for Hurlstone Point to show the frequency of different pebble roundness at each end of Porlock Beach. What conclusions can be drawn from your histograms? (AO2, AO3)

Gore Point



Hurlstone Point



b Suggest another statistical technique that could be used to analyse the data in Table 3.2.

7 Assess the role of erosion in the formation of the coastal landscape shown in Figure 3.4. (AO2, AO3)

7 6 marks

8 To what extent does increasing globalisation affect the sustainable management of coastlines? (AO1, AO2)

25 20 marks

Write your answer on a separate sheet of paper.