COASTAL ENVIRONMENTS

THE COAST AS A NATURAL SYSTEM AND ITS PROCESSES: MARINE (WAVE ACTION, EROSION, DEPOSITION, LONGSHORE DRIFT); SUB-AERIAL (WEATHERING, MASS MOVEMENT).

1. EXPLAIN EROSION AND DEPOSITION

Erosion

Coastal erosion is the wearing away and breaking up of rock along the coast. **Destructive waves** erode the coastline in a number of ways:

Match up the definition.

Hydraulic action	Acids contained in sea water will dissolve some types of rock such as chalk or limestone.
Abrasion	.Air may become trapped in joints and cracks on a cliff face. When a wave breaks, the trapped air is compressed which weakens the cliff.
Attrition	Waves smash rocks and pebbles on the shore into each other, and they break and become smoother.
Solution	Bits of rock and sand in waves grind down cliff surfaces like sandpaper

Deposition

When the sea loses energy, it drops the sand, rock particles and pebbles it has been carrying. This is called deposition. Deposition happens when the swash is stronger than the backwash and is associated with constructive waves.

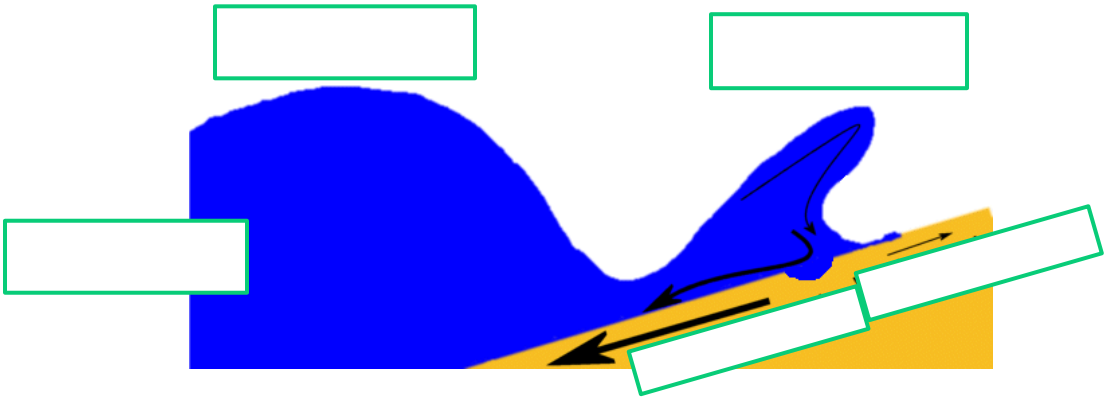
Deposition is likely to occur when: Place a  next to the correct statement.

waves enter an area of deep water.	
waves enter a sheltered area, e.g. a cove or bay.	
there is little wind.	
there is very little supply of material.	
waves enter an area of shallow water.	
waves enter an exposed area, e.g. a headland.	
there is a strong wind.	
there is a good supply of material.	

2. EXPLAIN WAVE ACTION (CONSTRUCTIVE/ DESTRUCTIVE).

Constructive Waves

Destructive Waves



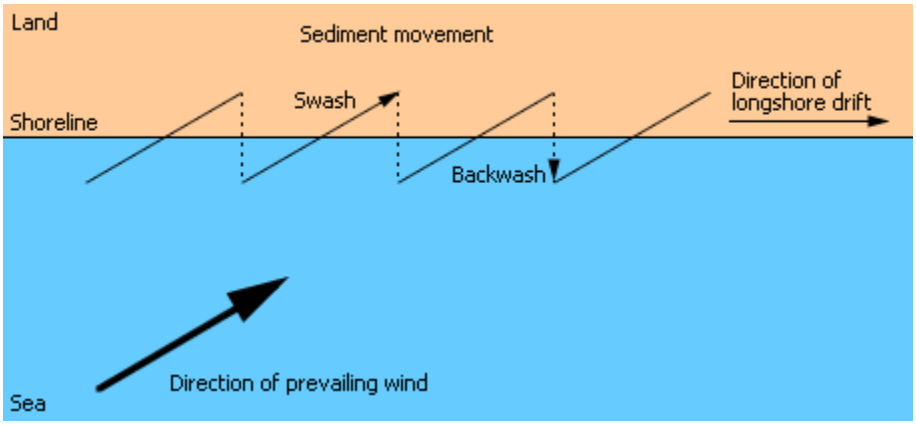
Strong swash	Weak swash	Strong backwash	Weak backwash
High waves	Low waves	Breaking waves	Rolling waves
Long wavelength	Short wavelength		

Constructive waves _____ the beach by _____.

Destructive waves _____ the beach by _____.

Erode
Deposition
Build
Erosion

3. EXPLAIN LONGSHORE DRIFT.



Longshore ..... is the zigzag movement of ..... . The ..... wind causes the ..... of waves to break at the same angle as the prevailing wind. ..... then causes the backwash to drag sediment down the shoreline at a right angle to the coastline. The sediment is ..... moved along the beach causing landforms like spits, ... and tombolos.

Drift Prevailing Gravity Bars

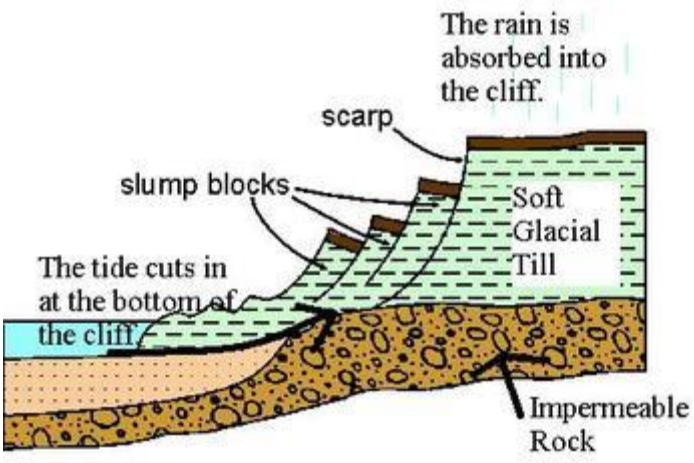
Sediment Swash Gradually

4. EXPLAIN THE SUB–AERIAL PROCESS OF MASS MOVEMENT.

The rate of erosion on coasts is assisted by **sub-aerial processes**. Sub-aerial processes refer to the processes of weathering and mass movement.

Mass Movement: When material moves down a slope due to the pull of gravity, for example, ***rotational slumping***

- **Common especially on clay cliffs**
- **Involves large area of land moving down a slope**
- **Leaves a curved surface behind**
- **During dry weather the clay contracts and cracks**
- **When it rains the water runs into the cracks and is absorbed until saturated (full of water)**
- **This weakens the rock and due to the pull of gravity it slips down the slope of its slip plane**



5. EXPLAIN SUB–AERIAL PROCESS OF WEATHERING.

All 3 types of weathering act on the cliff tops; these act alongside the mass movement and the erosion from the waves to further change the shape of the coastline.

Physical Weathering

- Freeze-thaw
- Water gets into cracks in rocks
- When temp falls this turns to ice and expands
- Expansion puts pressure on rock and fragments can break off

Chemical Weathering

- Rainwater contains weak acid which react with certain rock types

e.g. Carbonates in limestone are dissolved by weak acids and rock breaks up

Biological Weathering

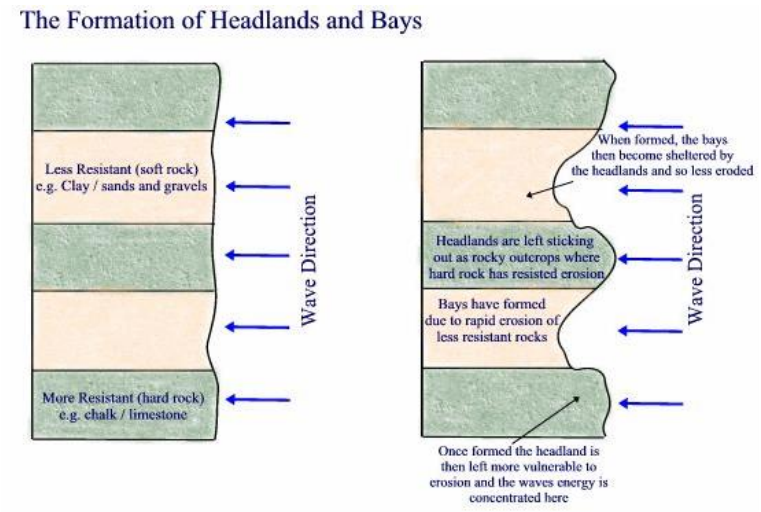
- Action of plants and animals on the land
- Seeds fall into cracks of rocks and start to grow
- Roots force their way into cracks and break up rock
- Burrowing animals can also be responsible for rock break-up

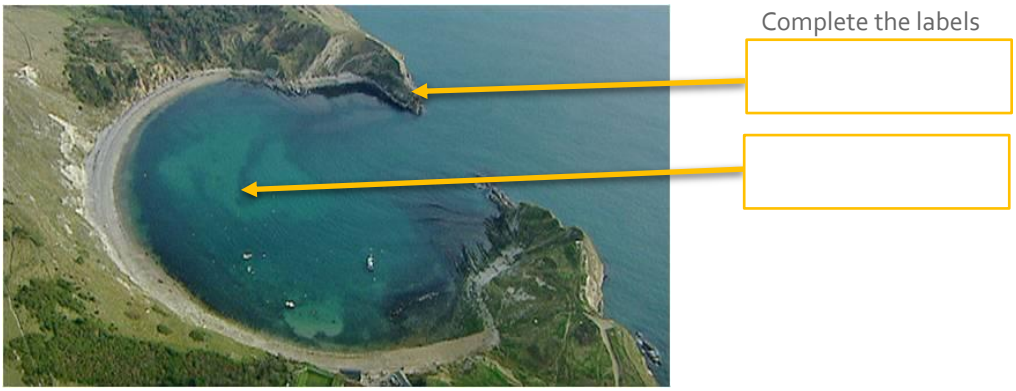
LANDFORMS: EROSIONAL (HEADLANDS AND BAYS; CLIFFS; WAVE-CUT PLATFORMS; CAVES; ARCHES, STACKS AND STUMPS); DEPOSITIONAL (BEACHES, SPITS, BARS).

6. EXPLAIN THE FORMATION OF HEADLANDS AND BAYS.

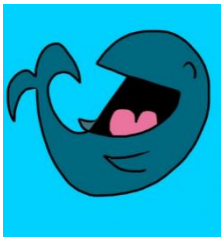
Headlands are **formed** when the _____ attacks a section of coast with _____ bands of hard and soft rock. The bands of _____ rock, such as sand and clay, erode _____ quickly than those of _____ rock, such as chalk. This leaves a section of land jutting out into the sea called a _____.

soft	alternating	headland
more	harder	sea





Complete the labels

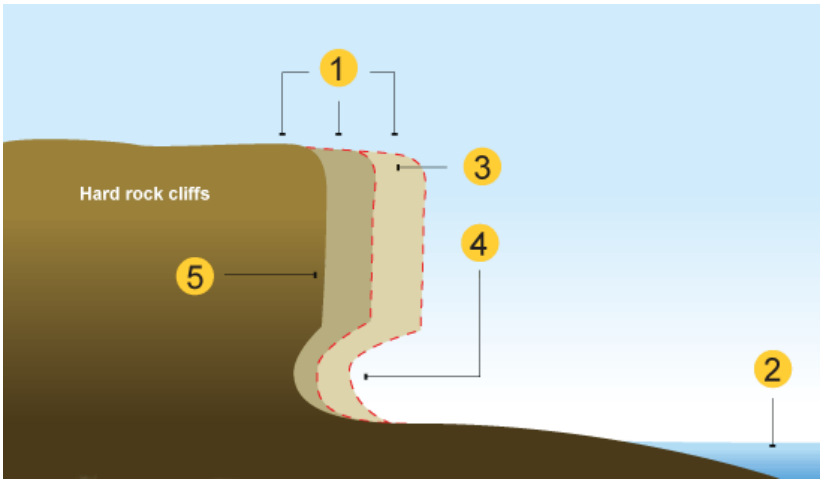


Why don't oysters give to charity?... Because they're shellfish

What did the Pacific Ocean say to the Atlantic Ocean?... Nothing, it just waved

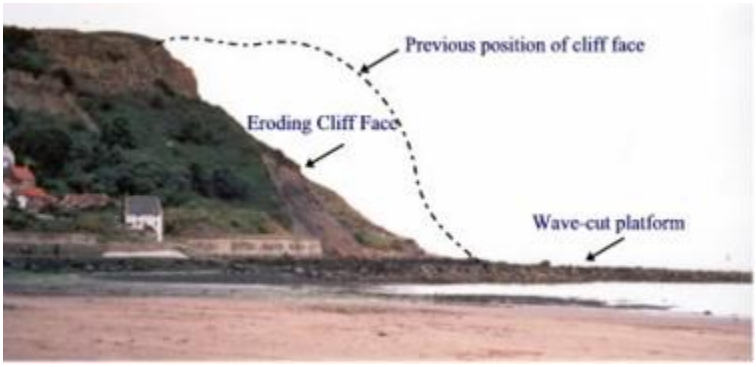
Why does it take pirates so long to learn the alphabet?... Because they spend years at C!

7. EXPLAIN THE FORMATION OF CLIFFS AND WAVE CUT PLATFORMS



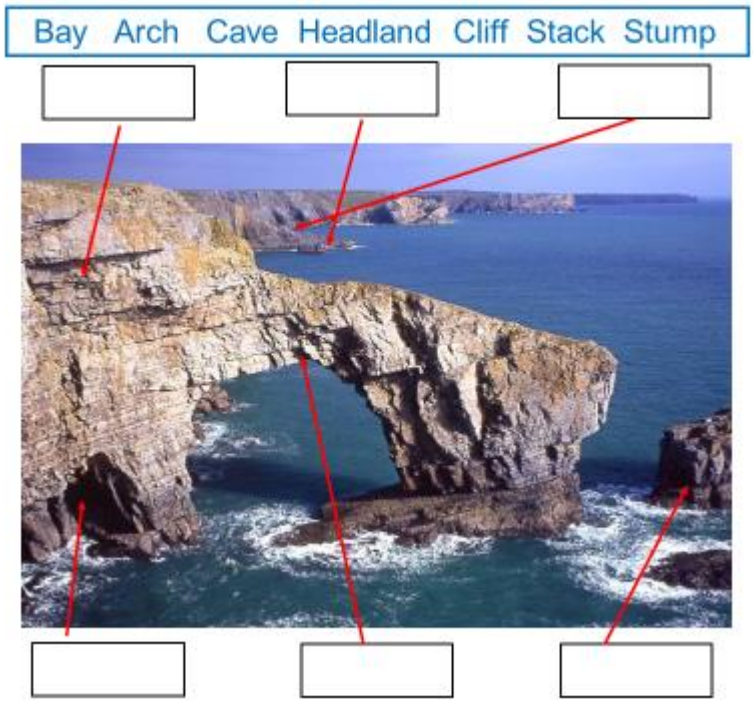
Use the numbers in the diagram above, and match them with the correct action.

Number	Action
	The sea erodes the base of the cliff forming a wave-cut notch through abrasion, hydraulic action and solution.
	Weathering weakens the top of the cliff.
	The backwash transports the rubble towards the sea forming a wave-cut platform.
	The process repeats and the cliff continues to retreat.
	The notch increases in size causing the cliff to collapse because it cannot support the weight above.



Flamborough Head (North Yorkshire Coast)

8. EXPLAIN THE FORMATION OF CAVES, ARCHES, STACKS AND STUMPS.



Caves, arches, stacks and stumps form on the sides of _____as a result of constant erosion on the rocks of the headlands by _____ waves. Any points if weakness in the headlands rocks, such as _____ or joints are attacked particularly by hydraulic action and _____. This is likely to lead to the opening up of a_____. If the cave is enlarged and extends back through to the other side of the headland, possibly meeting another cave, an _____ is formed. Continued erosion by the sea widens the arch. As the sea undercuts the pillars of the arch the roof is weakened and eventually_____. This leaves a _____separated from the headland. Further erosion at the base of the stack may eventually cause it too to collapse. This will leave a small, flat portion of the original stack as a _____. It may only be visible at low tide. An excellent example of this is _____ _____ rocks.

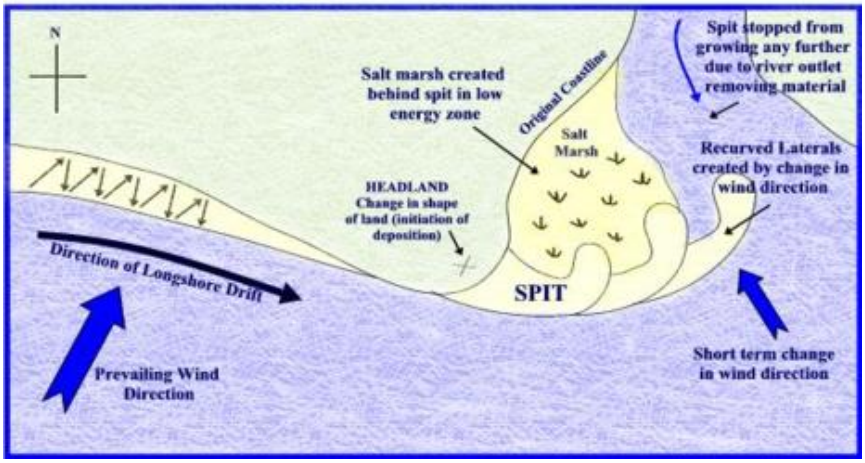
abrasion	collapses	faults	destructive	Old Harry
arch	headlands	cave	stump	stack

Old Harry Rocks, Dorset

9. EXPLAIN THE FORMATION OF THE DEPOSITIONAL LANDFORMS OF BEACHES, SPITS AND BARS.

Beaches are made up of eroded material that has been **transported** from elsewhere and **deposited** by the sea. **Constructive** waves help to build up beaches (strong swash, weak backwash). The material found on a beach (i.e. sand or shingle) depends on the geology of the area and wave energy.

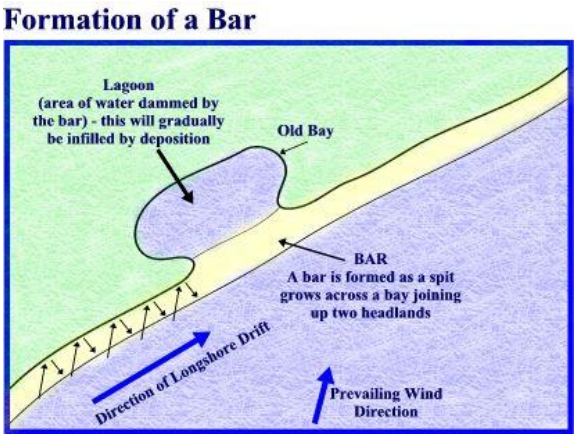
The Formation of a Spit



Put the following statements in the correct order to explain how a spit forms.

This moves sediment along in a zigzag motion.	
Where there is a dramatic change in the shape of the coastline, sediment is deposited in the sea as wave energy drops.	
A spit is a long, narrow piece of sand or shingle that has one end joined to the mainland and projects out into the sea.	**1**
It returns down the beach (backwash) at right angles under the influence of gravity.	
Sediment continues to be transported along the coastline and further out to sea.	
Sediment is transported along the coastline by the process of longshore drift.	
Behind the spit, in sheltered waters, a saltmarsh may develop as finer sediments are deposited.	
Sediment moves up the beach (swash) in the direction of the prevailing wind.	

Spurn Head (Yorkshire Coast)

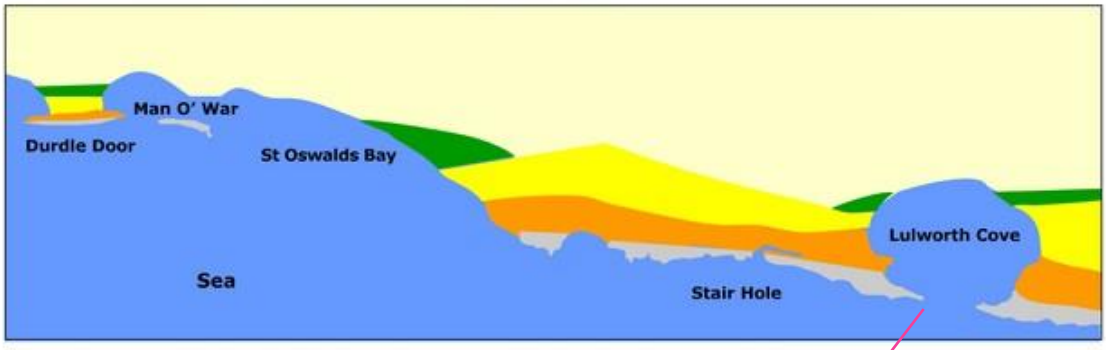


10. **CASE STUDY**: TWO GEOLOGICALLY CONTRASTING COASTLINES

This means that you need to know the features of two coastlines with different types of rock.

This case study will compare the concordant and discordant coastlines in Dorset

COASTAL EROSION – EXAMPLE LULWORTH COVE DORSET

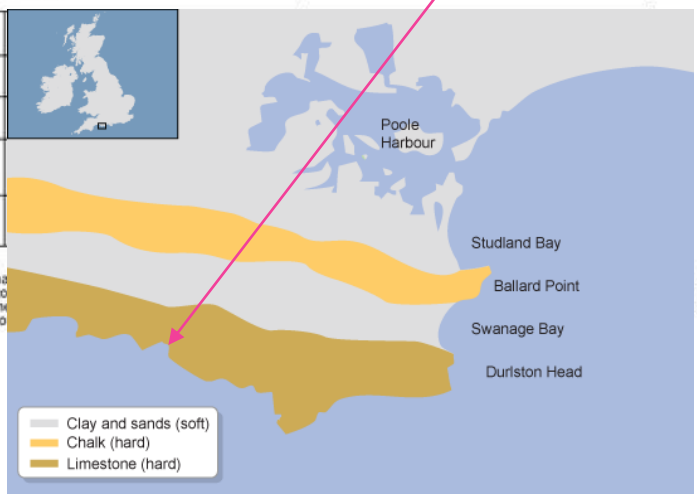


In the southern section of the Isles of Purbeck the beds of rock run parallel to the sea (i.e. they are concordant).

The exposed rocks at Lulworth Cove consist of five different types of sedimentary rock. (That is rocks formed from the accumulated debris of older rocks and marine organisms. As the sediments are deposited they build up layers or strata. These become compressed and cemented to form new rocks). The following table gives details of the rocks and their formation:

	Chalk limestone (marine organisms)
	Greensand –sandstone (sand grains)
	Wealden Beds –sandstone clay (sand grains and clay)
	Purbeck Beds –limestone mud (shells, clay, mud)
	Portland stone – limestone (shells)

Along much of the coastline the Portland limestone, the ha
Cove and Stair Hole the sea has breached the Portland sto
to be more easily eroded. Beyond the Purbeck Beds are th
stair hole is forming. Further west along the coast most o
original coastline.



The geology of the coast is a really important factor that influences the rates of erosion. The more resistant the rock the slower the rates of erosion. As we can see in Swanage, along the Dorset coast. Two headlands, Ballard Point (chalk) and Durlston Head (limestone) of harder rock types are more resistant to erosion. As result they jut out to sea, forming headlands. The softer clays of Swanage have eroded much faster to form the bay. Coastlines, where the geology alternates between strata (or bands) of hard rock and soft rock are called discordant coastlines.

Ballard Point, near Old Harry Rocks in Dorset (a resistant headland made of chalk).

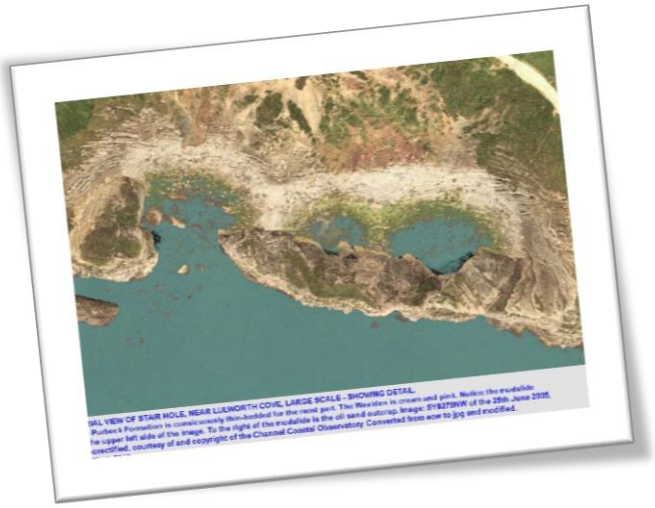
Durlston Head (a headland made of a more resistant, harder rock called limestone)

Swanage Bay is found between the two bands of hard rock. The soft clays here are easily eroded to form a bay between the two headlands of Ballard Point and Durlston Head (above).

A concordant coastline dominated by limestone in the map (above – page 9) has the same type of rock along its length. Concordant coastlines tend to have fewer bays and headlands. However, a close up of Lulworth Cove in the map (above – page 9) shows that bays and coves can form at concordant coasts, once gaps in the resistant rock become breached. In this case, the Portland limestone has been breached at several points. Once broken through, the sandstone clay can be easily eroded to form a cove.

Lulworth Cove is formed due to the initial erosion of the harder, Portland limestone. Then, the faster erosion of the softer sandstone clay behind it.

Durdle Door is an arch found along the south Dorset coastline, which highlights the more resistant rock withstanding the erosion.



Stair Hole (above) and the Man o War Bay (left) again highlights more resistant rock (Purbeck limestone) being breached and the softer rock (sands and clays) behind being eroded.

11. DEFINE THE TERMS 'ECOSYSTEM' AND 'BIODIVERSITY'.

Define ecosystem .....
.....

Define biodiversity .....
.....

12. DESCRIBE AND EXPLAIN THE CHARACTERISTICS, DISTRIBUTION AND BIODIVERSITY OF COASTAL ECOSYSTEMS: **CORAL REEFS, MANGROVES, SAND DUNES AND SALT MARSHES**

13. DESCRIBE THE VALUE OF COASTAL ECOSYSTEMS TO HUMANS.

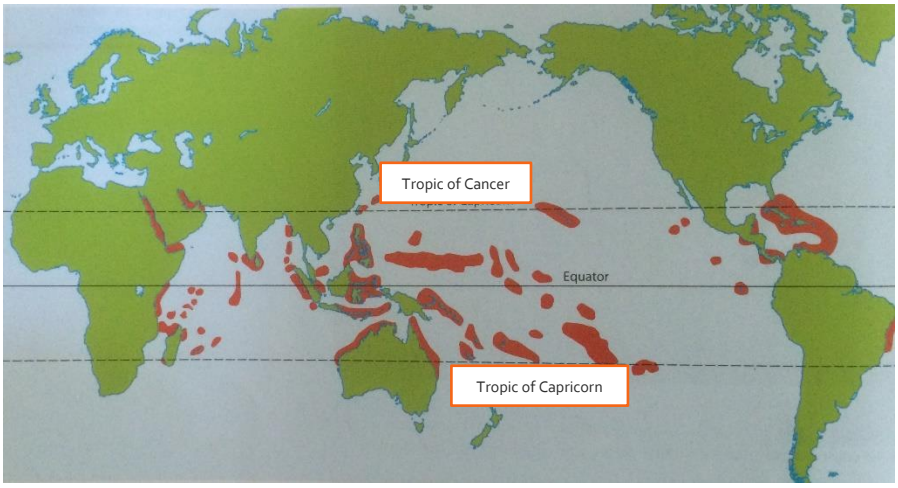
14. EXPLAIN THE THREATS TO THE SURVIVAL OF COASTAL ECOSYSTEMS FROM TOURISM AND OTHER FACTORS (INDUSTRIALISATION, AGRICULTURE AND DEFORESTATION).

CORAL REEFS

CHARACTERISTICS

Coral is created by polyps - a small anemone-like animal. The corals that build reefs are colonies of thousands of polyps held together by soft tissue and the calcareous (calcium carbonate) skeleton they secrete.

DISTRIBUTION



Describe the distribution of coral reefs (3 marks)

PATTERN: Coral reefs are found mostly between the Tropic of Cancer and Capricorn.

DATA/PLACES: Off the coasts of countries such as Australia and Madagascar.

ANOMALY: They are not found in Europe.

Explain the distribution of coral reefs (4 marks). *Use because, so, therefore to ensure you are explaining*!

Coral are found in-between the tropics **because** waters are warmer, between 23°C – 25°C. Corals grow best in shallow water, around 25 metres deep, **because** it still needs light for photosynthesis. Coral

grows close to the coastline **because** that is where there is greatest wave action, **so** corals get the well oxygenated water it needs to survive. Coral is only found in sea water **because** it only survives in salt water.

BIODIVERSITY

Coral reefs with the highest biodiversity occur in South-east Asia and northern Australia. The Great Barrier Reef is in Australia and is renowned not just for its great biodiversity, but also its extent and excellent condition.

- They occupy less than 0.1% of the world's ocean surface, about half the area of France, yet they provide a home for at least 25% of all marine species.
- Over 4,000 species of fish inhabit coral reefs.

TASK: Using the information below, draw a pie chart to show the distribution of world coral reefs by region.

Region	% of world's coral reefs
Indian Ocean	60
Pacific	25
Caribbean	15

VALUE

Draw an arrow to match the value with its explanation.

Fisheries	Coral reefs are vital to the world's fisheries. They form the nurseries for about a quarter of the ocean's fish with around 1500 species of fish, and thus provide revenue for local communities of many LIC as well as national and international fishing fleets.
Tourism	We can also expect coral reef species to contribute to future medical advances. Already coral reef organisms are being used in treatments for diseases like cancer and HIV. Just so long as they are alive and healthy.
Medicine	For many coastal societies around the world, coral reefs and their inhabitants are intricately woven into cultural traditions. For these people – as well as for those who have floated with a mask and snorkel, immersed themselves in the three dimensional wonderland of a scuba dive, or experienced these habitats through media and books – a world without coral reefs would be an infinitely poorer place
Coastal Protection	Revenues generated by coral reefs are also significant. For example, according to a report by the Key West chamber of commerce, tourists visiting Australia's Great Barrier Reef generates well over US$1 billion per year.
Intrinsic Value	Coral reefs break the power of the waves during storms, hurricanes, typhoons, and even tsunamis. By helping to prevent coastal erosion, flooding, and loss of property on the shore, the reefs save many of lives and lots of money each year.

(c) For a named coastal ecosystem, explain the ways in which it is valuable to people.

(6)

Name of coastal ecosystem .....

THREATS

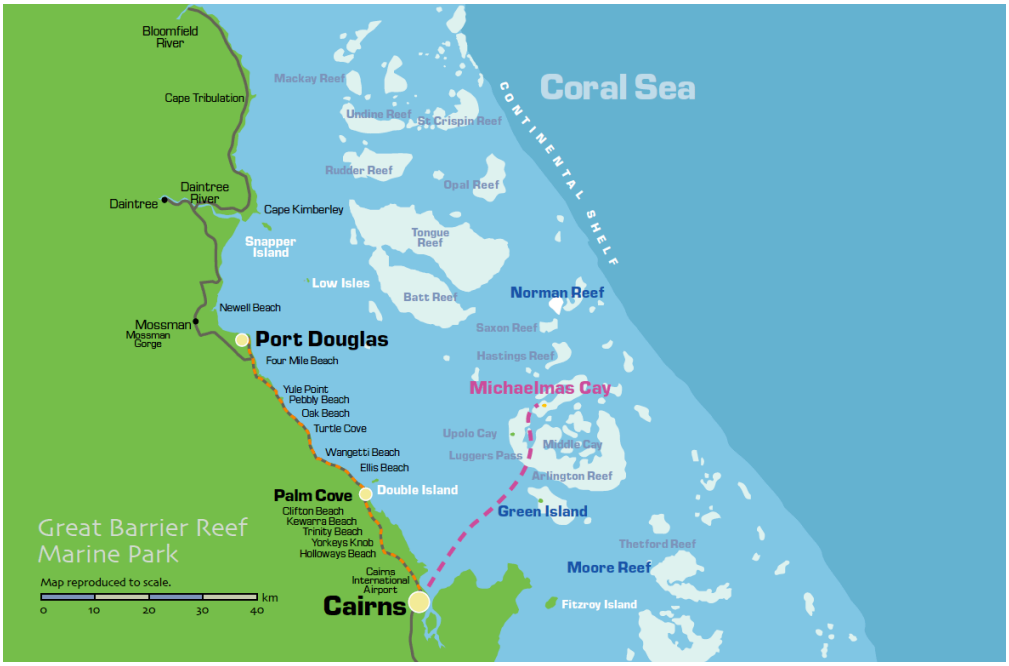
Match the threat, picture and explanation of some of the threats to coral.

Destructive Fishing Practices		The destruction of mangroves results in the depositing of sediment that clouds the water around coral reefs and killing coral.
Destruction of Mangroves		With certain fish removed the ecological balance and food web is disrupted
Tourism		Things such as dynamite and cyanide fishing destroys coral.
Over Fishing		Careless boating, diving and snorkeling causes damage such as anchors dropping on coral.

Case Study: The Great Barrier Reef, Australia

The Great Barrier Reef is the world's largest coral reef system composed of over 2,900 individual reefs and 900 islands stretching for over 2,300 kilometres. The reef is located in the Coral Sea, off the coast of Queensland, Australia.

The Great Barrier Reef can be seen from outer space and is the world's biggest single structure made by living organisms. This reef structure is composed of and built by billions of tiny organisms, known as coral polyps. It supports a wide diversity of life and was selected as a World Heritage Site in 1981. CNN labelled it one of the seven natural wonders of the world. The Queensland National Trust named it a state icon of Queensland.



A large part of the reef is protected by the Great Barrier Reef Marine Park, which helps to limit the impact of human use, such as fishing and tourism. Other environmental pressures on the reef and its ecosystem include runoff, climate change accompanied by mass coral bleaching, and cyclic population outbreaks of the crown-of-thorns starfish. According to a study published in October 2012 by the Proceedings of the National Academy of Sciences, the reef has lost more than half its coral cover since 1985.

The Great Barrier Reef has long been known to and used by the Aboriginal Australian and Torres Strait Islander peoples, and is an important part of local groups' cultures and spirituality. The reef is a very popular destination for tourists, especially in the Whitsunday Islands and Cairns regions. Tourism is an important economic activity for the region, generating over $3 billion per year.

Management of the GBR:

Zoning: The Zoning Plan defines in broad terms a set of management objectives for each zone and describes the activities that are allowed, including those, such as tourism operations, that need a permit.

Permits: Permits are jointly issued by the Great Barrier Reef Marine Park Authority and Queensland Parks and Wildlife Service and are required for all commercial tourism activities. Permits usually contain some conditions that further ensure that tourism operations are sustainable.

Education and training: is also extremely important in management of the Marine Park. The Great Barrier Reef Marine Park Authority communicates information about the special values of the Marine Park, management requirements for tourism operations, and how operators can work in partnership through a range of quality information products and training programmes.

Fishing: Management arrangements for commercial fisheries include:

Limits on the amount of fish that can be taken. Limits on the number of fishing licences. Spatial and seasonal closures. Restrictions on fishing vessel size. Restrictions on the length, mesh size and number

of nets used. Limits on the number of hooks. Restrictions on the take of some fish species. Restrictions on the minimum and maximum size of fish retained.

(d) Explain how a named area of coral reef or mangrove is being managed.

(9)

Name of area: .....

Question Number		Indicative content
2 (d) **Type 1 item**		This is a case-study item seeking knowledge and understanding of a named coral reef and/or mangrove stand management scheme. Good responses will address not only practice and policy in detail but also refer to the ecosystem threats (e.g. pollution; tourism; anchorages...) that they are intended to minimise. Expect naming to be either organisational (e.g. Soufriere Marine Management Area, St. Lucia; South West Tobago Marine Reserve ...) or reef (e.g. Great Barrier...) or mangrove stand (e.g. Port Douglas, Queensland...). MPAs (Marine Protection Areas) and reef management traditionally focuses on zoning, fisheries management and research/education (e.g. Bahamas Reef Environmental Education Foundation). No named area maximum 6.
Level	Mark	Descriptor
Level 1	1-3	Expect shortlist of simple, generic statements e.g. protect from tourists; create MPA; have rules and regulations; police the area; educate people to conserve area...
Level 2	4-6	Expect either long-list of simple generic statements or some development of limited range of management actions e.g. rule banning coral exports by tourists... Outline explanation of work of an MPA.
Level 3	7-9	Expect either a number of developed management actions generic to reefs/stands (L3-/7 marks) or for better reward a case-study style response based on the work of a named MPA agency. Top responses will also refer to the environmental threats management aims to mitigate.

MANGROVES

CHARACTERISTICS

Mangroves are a tree which grows in, inter-tidal and mainly tropical areas with tangled roots that grow above ground. Because they grow in the intertidal zone, they live in a constantly changing environment.

DISTRIBUTION

Describe the distribution of mangroves (3 marks) .....
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.....
.....
.....
.....

Explain the distribution

Temperatures – Most mangroves grow only 30 degrees latitude of the equator.
Salinity – The water around mangroves has to be of a certain salt content if not the mangrove will suffer, so if fresh water is added to salty water this would be harmful.
Exposure to Air – Air is too rich in oxygen will harm to mangrove if the mangrove is exposed for too long.

Use the points above to explain why Mangroves grow where they do. *Make sure you use connectives to explain, like the example on page 12/13*

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BIODIVERSITY

Mangroves support thousands of insects, ants, spiders, moths, termites, and scorpions, which feed and nest in hollowed twigs. Snakes and lizards crawl along tree limbs. Frogs cling to bark and leaves. **Crocodiles** laze in the salt water. There are about 70 species of mangroves, ranging from shrubs to trees that stand 60 metres.

VALUE

- **Contain Natural Resources** – Charcoal, firewood, fish, medicines and other substances can be extracted form mangroves.
- **Foraging and Living Place for Wildlife** – Without mangroves there would be no habitat for animals so there would be no animals.
- **Reducing Water Pollution** – The root systems of mangrove species absorb inorganic substances and reduce water pollution.
- **Protecting the Coastline** – Because the roots of a mangroves can stabilise the coastlines of the river shores and river mouths. They also protect the coastline from wave erosion.
- **Flood Prevention** – Mangroves can stabilise water capacity of the substratum and on the soil surface, hence steady and retain water to prevent flooding.
- **Ornamental Value** – A mangrove forest is a beautiful environment with a diversity of life that in some people's eyes is with saving.

Sketch 6 images to represent the value of the mangroves described above.

THREATS

- **Clearing** – Mangrove forests have often been seen as unproductive and smelly, and so cleared to make room for agricultural land, human settlements and infrastructure, and industrial areas.
- **Overharvesting** – While harvesting has taken place for centuries, harvesting of mangroves become unsustainable and threaten their future.
- **River Changes** – Dams and irrigation reduce the amount of water reaching mangrove forests, changing the salinity of water in the forest.
- **Overfishing** – The global overfishing crisis facing the world's oceans has effects far beyond the directly overfished population. The ecological balance of food chains and mangrove fish communities can also be affected.
- **Destruction of Coral Reefs** – Coral reefs provide the first barrier against currents and strong waves. When they are destroyed, the stronger-than-normal waves and currents reaching the coast can undermine the fine sediment in which the mangroves grow. This can prevent seedlings from taking root and wash away nutrients essential.
- **Pollution** – Fertilizers, pesticides, and other toxic man-made chemicals carried by river systems from sources upstream can kill animals living in mangrove forests.
- **Climate Change** – Mangrove forests require stable sea levels for long-term survival

Explain the threats that put it a coastal ecosystem at risk of destruction (4 marks)

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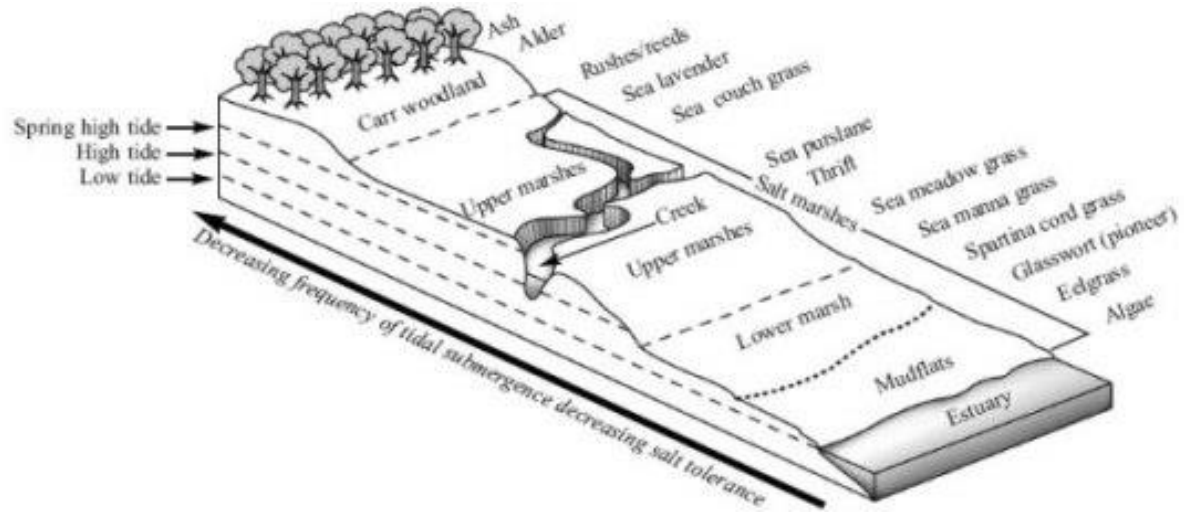
SALT MARSHES

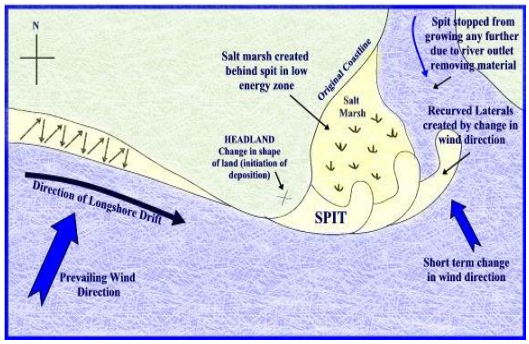
Salt marshes are coastal wetlands that are flooded and drained by salt water brought in by the tides. We have studied them as the areas that form behind a spit because they are protected from waves and so deposition occurs.

CHARACTERISTICS



A number of conditions are needed for salt marsh to develop:

• **A sea shore with very little wave action.** Fine particulate material like muds, silts and clays cannot fall out of suspension (sedimentation) and stick together (flocculate) in sea water during calm conditions. This will help the build-up of a muddy shore in an estuary. Various algae can also help mud particles to aggregate.



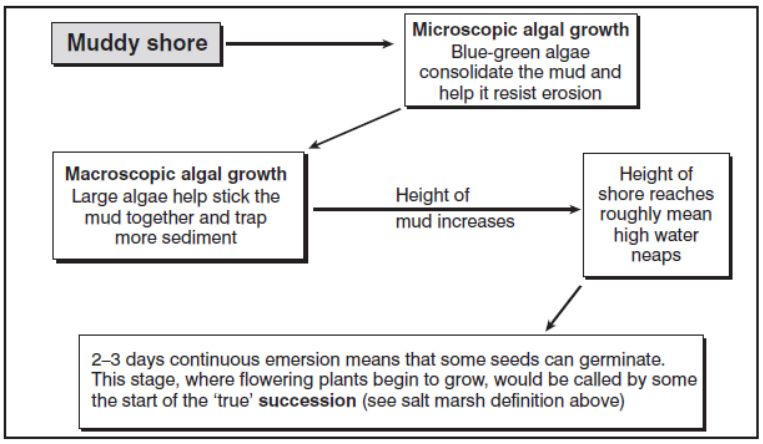
• **Shelter from exposure (wave action).** Such places are found on coasts protected by shingle or sand bars or spits or in large bays with narrow entrances.

• **A source of mud**. This can be from the sea or rivers or both.

Formation: The height of the mud increases as time goes by and consequently it experiences longer periods of emersion (being out of the water). Eventually, the height of the muddy shore reaches a point that equates roughly to the height of an average high water tide. This is a critical point in the development of a salt marsh, because at this height there are several times in the year when the shore is emersed for two or three days continuously.

If a flowering plant seed is to grow, it needs sufficient undisturbed time to germinate and get a grip in the ground. A few days of emersion is just enough time for some seeds to germinate and attach.

Figure 2: Ongoing development of salt marsh



The first flowering plants that begin to grow are pioneer species like *glasswort* and *cord grass*. If plant seeds are sufficiently undisturbed (i.e. if the mud has built up high enough) they will germinate and grow successfully.

The roots of pioneer plants will help consolidate the mud that has already built up by binding it together. Their upper parts will help trap more sediment. When individuals die their roots will remain in the mud helping to hold it together.

With species like *cord grass* growing and trapping sediment the mud height increases. Consequently the muddy shore spends more time emersed (out of the water). Conditions become suitable for more species and they migrate to the area and begin to grow. Examples of species that may appear at this time are *salt marsh grass* and *sea aster*. All species (including the pioneers) start to do better. They will grow bigger and they will exist in greater abundance.

The vegetation is becoming "closed", forming a continuous carpet over the ground and there is much less bare ground available. The community has entered the next stage of succession – establishment.

At the back and drier side of a salt marsh there are species like *rush* and *sedge* in the damper bits and *red fescue grass* in the drier bits.

<u>Explain their distribution.</u> They develop best where…
<u>Biodiversity (list the types of plants and animals)</u>

Value: There are a number of important functions to the coastal zone; these both now and in the past put pressures on the salt marsh environment.

Agriculture: This fertile and flat land allows for large amounts of arable crops to be grown.

Fisheries and aquaculture: fisheries are one of the key economic activities on the coast.

Tourism and recreation: The coastline provides areas for holidays.

Ships and ports: Sheltered estuaries for commercial and leisure ports. Oil refineries and other heavy industries are often located here because of the large areas of flat ground with easy access to exporting and importing bulky raw materials.

Nature conservation: Salt marshes provide a unique area for wildlife, for migrating birds, such as, *curlews, egrets, oyster-catchers* and *snipes*.

SAND DUNES

Formation

A dune is a mound of sand formed by the wind, usually along the beach or in a desert. Dunes form when wind blows sand into a sheltered area behind an obstacle. Dunes grow as grains of sand are deposited and accumulate.

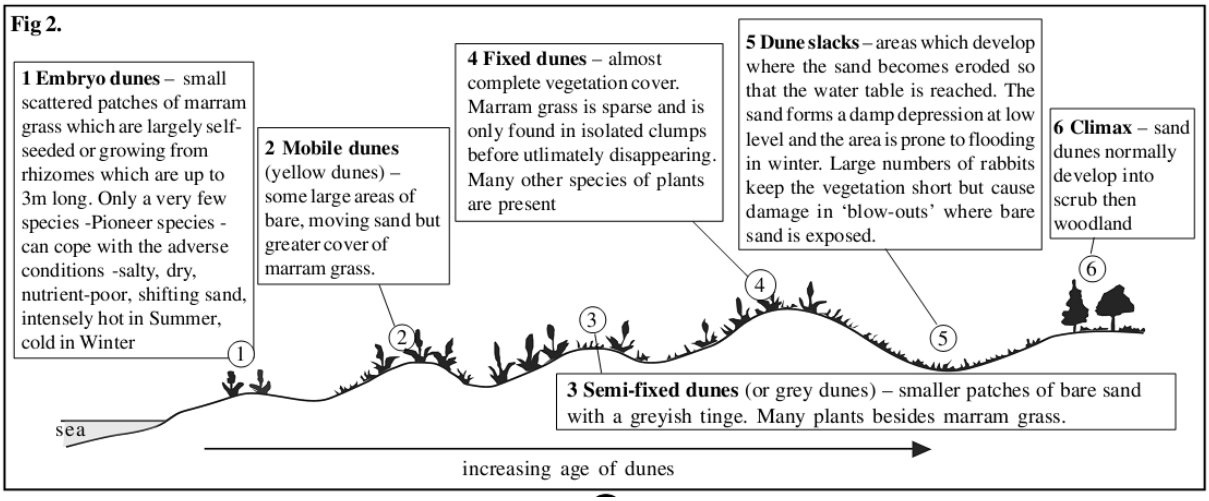
Distribution

They can be found anywhere where the following are found.

- Sand
- Beach
- Coast
- Wind

Sand dune succession

Various zones can be recognised in a set of sand dunes which may represent different stages of succession (Fig 2)



The 3 picture below show an; **embryo dune,** a **yellow dune** and a **fixed dune**. Label each one and justify your answer (use because).

Values

- **Coastal Protection** – Sand dunes act as barriers protecting the land behind from storms.
- **Habitat** – Sand dunes are home to a small amount of life such as vegetation and nests of insects and birds.

Threats

- **Humans** – Humans are the only real threat to sand dunes as they destroy them for land or paths but this can lead to exposure to storms.

15. OUTLINE A RANGE OF CONFLICTS BETWEEN DIFFERENT USERS OF THE COAST.

There are various other conflicts not just between development and conservation but also between conflict over who will have and exploit the land. In many respects, these users are competing with each other because of their special needs.

The main users and there reason for the development of coastal areas are as follows:

- **Local Residents** – good choices of housing; clean environment.
- **Employers** – access to labour; space for shops, offices and factories.
- **Farmer** – well-drained land; shelter from strong onshore winds.
- **Fishermen** – harbours; unpolluted waters.
- **Port Authorities** – harbours and space for port-side services and terminals such as ports and airports.
- **Transport Companies** – good roads and terminals such as ports and airports.
- **Tourists** – beaches, hotels, recreational amenities, heritage sites.
- **Developers** – greenfield sites.

The photograph (below) of Benidorm in Spain shows how it has developed since the 1960s.

What conflicts would there have been while this change was taking place?

Fisherman	V	Developers
	V	
	V	

	V	
	V	
	V	

(iii) The owners of the golf course want to build a large hotel on the sea front

Suggest **one** conflict that might arise from this proposal.

(2)

Question Number	Answer	Mark
2(a)(iii)	Credit valid outline conflict eg • development v. conservation (1) • eyesore on natural coastline (1) … with 1 mark 2nd mark requires a brief argument about nature of conflict of interest eg hotel attract tourists who will disturb natural environment/disrupt bird-watchers … (2)	**2(1+1)**

(iii) Suggest **two** conflicts which might occur between developers and conservationists in coastal areas

(4)

1 .....

2 .....

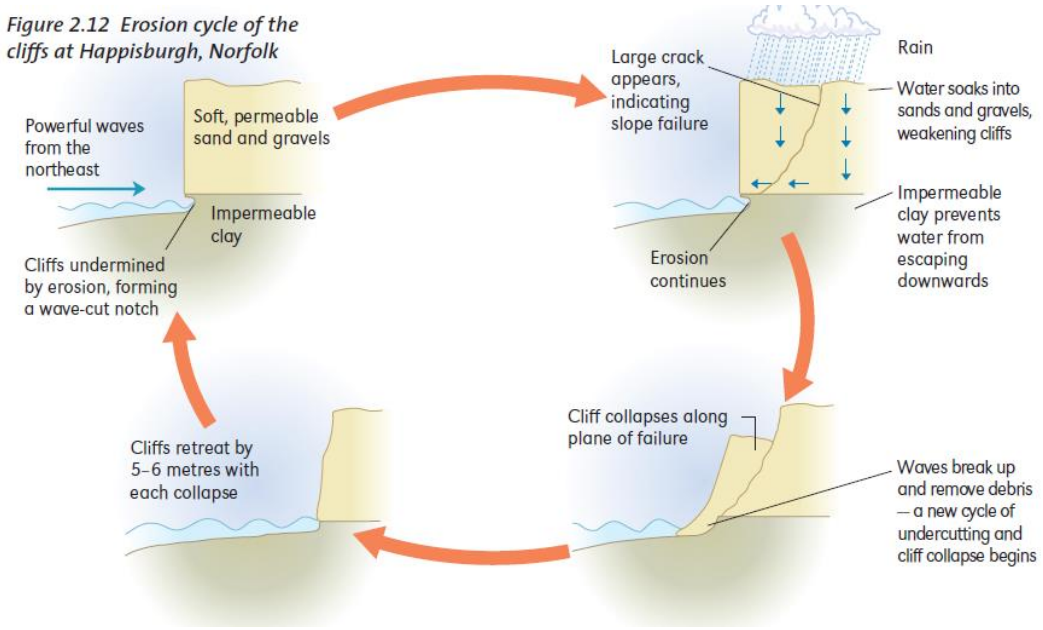
Question Number	Answer	Mark
2(b)(iii). Type 1 item	For each valid and distinctive source of conflict identified award 1 mark i.e. hotel-building versus not building (1); development on the headland versus no building (1); high-rise building versus low-rise (1); four-lane highways versus smaller roads (1) … 2nd mark in each case where nature of conflict developed so that what developers do (i.e. create jobs, wealth .. motivated by economic reasons …) and what conservationists stand for (i.e. conserve areas for plants and animals; ensure access to natural landscape ..) explicit and conflicting.	**4 (2+2)**

16. EXPLAIN COASTAL RETREAT AND THE NEED FOR MANAGEMENT.

The repeated cycle below means that the coasts retreats (moves inland), as a result the users (mentioned above) lose property, land and money. Consequently, the coastline is managed to reduce the impact on these users.

Coastal management is about resolving the conflicts between human benefits and the well-being of coastal ecosystem and protecting the coast e.g. long stretches of beaches.

Figure 2.12 Erosion cycle of the cliffs at Happisburgh, Norfolk



17. **CASE STUDY:** KNOW 1 RETREATING COASTLINE AND ITS CAUSES, IMPACTS AND MANAGEMENT.

Coastal Protection Case Study: Holderness Coast

Location: The Holderness Coast is located on the east coast of England and is the coastal margin with the North Sea. It extends 61km from Flamborough in the north to Spurn Point in the south.

Characteristics: The Holderness Coast is a great case study to use when examining coastal processes and the features associated with them. The area contains 'text book' examples of coastal erosion and deposition. The exposed chalk of **Flamborough** provides examples of erosion, features **such as caves, arches and stacks**. The soft boulder clay underlying **Hornsea** provides clear evidence of the erosional power of the sea. **Mappleton** is an excellent case study of an attempt at coastal management. **Spurn Point** provides evidence of **longshore drift** on the Holderness Coast. It is an excellent example of a **spit.** Around 3% of the material eroded from the Holderness Coast is deposited here each year.

Coastal Retreat: The Holderness Coast is one of Europe's fastest eroding coastlines. The average annual rate of erosion is around 2 metres per year. This is around 2 million tons of material every year. Under lying the Holderness Coast is bedrock made up of Cretaceous Chalk. However, in most places this is covered by glacial till deposited over 18,000 years ago. It is this soft boulder clay that is being rapidly eroded

Reasons for rapid retreat: The fastest eroding stretches of coastline are made up of soft boulder clay, which is a form of glacial till. It is loose and fragmented and easily eroded. The coastline is subject to dominant north easterly prevailing winds with a sizeable fetch creating large waves. The North Sea is also subject to storms with frequent depression in the winter which creates even larger waves. The coast line is subject to longshore drift which moves sediment in southerly direction. A lot of sediment is removed and transported away to sea. In

addition, in places such as Mappleton coastal management has attempted to halt LSD to prevent cliff retreat. Whilst this has prevented cliff retreat at Mappleton it has only speeded up cliff retreat further down the coast as it starves the coast from vital sediment which would protect it.

Coastal Management:

Flamborough Head

Steep Vertical cliffs of resistant Chalk, Contains headland features (Stump, stack, geos etc). Erosion rate of about 2mm a year. Currently no coastal protection due to resistant Chalk

Bridlington

Small coastal Town sits on chalk base has harbour and leisure facilities. Erosion rates around 2mm a year. Used by tourists and fisherman. Little or no protection apart from promenade

Hornsea

Tourist destination Suffers from erosion of weak boulder clay and loss of beach due to LSD. Complaints about loss of livelihoods lead to some hard engineering. Building of sea wall (picture right) and groynes. Beach has grown and acts as a defence. Issues have been created further down the coast at Mappleton due to removal of sediment.

Mappleton

The sea defences at Hornsea have starved area of sand and beaches being washed away due to LSD. This led to a campaign by residents. Boulder Clay under cliff foot marine erosion (Hydraulic Action and Attrition)

2 boulder Groynes (picture right) built, and boulder revetments for £2m (Part funded by EU) More deposition and less LSD.

This has worked but caused major issues at Great Cowden further south

Great Cowden

Erosion of boulder clay and glacial till has been very rapid 1 – 2m per year. Properties and farms at risk. High winter tides cut notches at the foot of cliffs and focuses marine energy leads to partial collapse (Rotational Slump). Becomes worse when saturated through rainwater. These sub-aerial processes do a great deal of damage. Retreat can be up to 20m a year. Fastest erosion rates in the world.

Easlington

2 miles North of Spurn Head. Easington Gas Terminal owned by British Gas and BP Built 1968 – 50m from shore with expected lifespan of 25yrs. More gas found therefore now needs protecting to avoid falling into the sea.

New defences built including. Cliff drainage to avoid slumps and rotational slides. Cliff regarding and rock revetments.

Spurn Head

Long history of settlement. Used during WW1 as a look out post, connected to the mainland by railway. This has been reduced to only a lifeboat station and the families attached to it by a single track road. Also used by the Pilot boat men of the Humber Estuary. On the Point there is a wildlife reserve. Spit is moving westwards and may become an island.. Eventually families will have to move, currently under review as to whether it should be protected or not. Removing the lifeboat station will result in their not being a station in the area

Managed Retreat – strategic realignment

This allows the cliff to retreat in selective places such as Cowden. There no additional external problems created and so environmental problems are reduced. There are cost involved in terms of loss of farmland and acquiring new land for caravan sites and selective functions. Some people will lose out as individual homes will not be compensated.

(d) Discuss why people hold different views about the management of retreating coastlines.

Reference to examples may help your answer.

(9)

Question Number	Indicative content
2 (d)	The management of retreating coastlines is contentious and a suitable topic for discussion e.g. consideration of conflicting viewpoints, analysis of argument ... Candidates should be aware that some people believe that along retreating coastlines there should be: • nothing done • maintenance of existing defences to hold the line • improvement of the defences, perhaps to advance the line • retreat allowed, perhaps managed • or a combination of these. Answers may legitimately stray into the "fors and against" soft engineering (eg. beach nourishment ..) versus hard engineering (eg. concrete sea walls ..) where the view that lines should be held or advanced are presented. Those exploring whether to protect or not and advocating managed retreat should refer to management of coastal environment. The question is as much about coastal management as merely coastal protection. The main thrust of the answer about the holding of different views should revolve around ideas of expense, cost-benefit analysis, conservation, sustainability and land value. Spatial context is important e.g. coastal towns viz-a-viz unpopulated stretches of coastline; highland viz-a-viz lowland coastlines.... Sound answers may offer relevant examples, including from fieldwork, of coastlines and even case-study detail related to one specific coastline. Generic answers also give access to the top level.

Level	Mark	Descriptor
1	1-3	Expect a limited response to the question. Candidates may offer basic points for or against protection or offer sketchy statements from case studies. May offer a brief list of coastal engineering types or of options for managing the coast. Expect simplistic points, imbalance in the answer and a generally very superficial treatment of the topic.
2	4-6	Expect a partial/one-sided/unbalanced attempt at discussion of the subject of whether or not to protect/manage retreating coastlines. The main types of protection e.g. holding the line; hard and soft engineering ... may be offered or the case for or against protection outlined. There may be some use of appropriate examples. Top of level responses will show some recognition that there may be conflict of views.
3	7-9	Expect a sound and balanced discussion in which the key aspects of whether or not to protect and the main advantages and disadvantages of the different management options are addressed. Expect reference to stakeholders and peoples' preferences to be clear. There may be some attempt at a consideration of cost-benefit analysis. The response will put forward and build up an argument about the management conflicts faced along retreating coastlines. Focus to be on managing a coastal area rather than mere protection. Strong answers will offer assessment/evaluation, evidence and/or exemplification, perhaps from fieldwork experience and case study material.

18. DESCRIBE A RANGE OF COASTAL PROTECTION MEASURES BOTH HARD AND SOFT ENGINEERING.

EXPLAIN HOW THESE PROTECT THE COAST

EVALUATE THEIR COSTS AND BENEFITS.

Hard-engineering Management – Hard engineering involves building some type of sea defence, usually from rocks or concrete. It aims to protect the coast from the coastal threats.

Groyne – a wall usually made of wood (can be rocks) built out into the sea from a beach that interrupts water flow and limits the movement of sediment and therefore prevents erosion and longshore drift.

Advantages

- Prevents the movement of beach material along the coast by longshore drift.
- Allows the buildup of a beach. Beaches are a natural defence against erosion and an attraction for tourists.

Disadvantages

- Can be seen as unattractive.
- Costly to build and maintain.

Sea Wall – a wall or embankment erected to prevent the sea encroaching on or eroding an area of land behind.

Advantages **–** Protects the base of cliffs, land and buildings against erosion. Can prevent coastal flooding in some areas.
Disadvantages **–** Expensive to build. Curved sea walls reflect the energy of the waves back to the sea. This means that the waves remain powerful. Over time the wall may begin to erode. The cost of maintenance is high, they are also considered ugly.

Revetment – a retaining wall or facing of masonry or other material, supporting or protecting a rampart, wall.
Advantages – are strong and provide good protection by absorbing the waves energy.
Disadvantages – are that they have a relatively short life span (30-50 years) and are quite expensive, and block the sea of from the public.

Gabion – a cylindrical container made from strong wire filled with earth, stones, or other material.
Advantages

- Absorb the energy of waves.
- Allows the build up of a beach.

Disadvantages **–** Can be expensive to obtain and transport the boulders.

Overall Disadvantages of Hard-engineering

- **Expense** – Most Structures are expensive to build, maintain and repair.
- **Rising Sea Levels –** These structures will be ineffective after sea levels rise.
- **Aesthetics** – Structures can spoil the natural Beauty of coastlines.

Soft-engineering Management

Soft-engineering is just things such as using diggers to deposited sand, offshore underwater bars, changing the angle of a cliff and using fencing, hedging and replanting vegetation.

Soft engineering options are often less expensive than hard engineering options. They are usually more long-term and sustainable, with less impact on the environment. There are two main types of soft engineering:

Beach Replenishment

- This replaces beach or cliff material that has been removed by erosion or longshore drift.
- The main advantage is that beaches are a natural defence against erosion and coastal flooding. Beaches also attract tourists and have ornamental value.
- It is a relatively inexpensive option but requires constant maintenance to replace the beach material as it is washed away.

Overall Coast Management

- **Do Nothing** – this means that along these stretches there are few if any risks. The coast is safe and secure.
- **Hold the Line** – this means the use of hard-engineering to prevent damage to the coastline because of the useful land behind.
- **Managed Retreat** – this means the strategic giving away of the coastline.

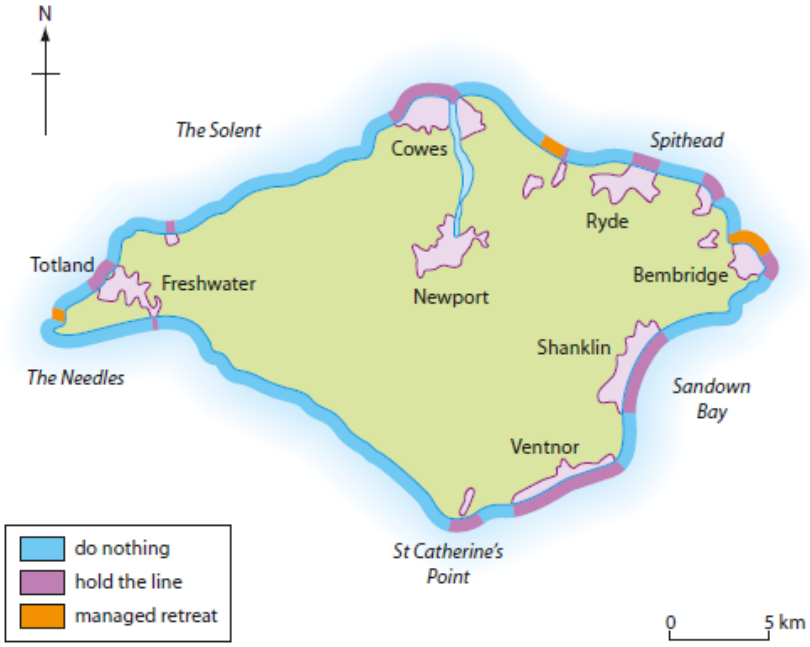


Figure 2.40: *Coastal management of the Isle of Wight*

Describe the distribution of strategies to reduce the impact of coastal retreat on the Isle of Wight (3 marks)

(Use pattern (direction), data (scale) and place names)

.....

.....

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5 WRITTEN QUESTIONS

1. protecting the coast by working with nature
2. tropical and sub-tropical coastal forests
3. a smaller, lower stack
4. coastal sand hills above the high tide mark, covered with grasses and shrubs
5. a rocky, level area at or around sea level representing the base of land and now retreated cliffs

5 MATCHING QUESTIONS

1. ☐ Sea level change
2. ☐ Cave
3. ☐ Salt marsh
4. ☐ Hard engineering
5. ☐ Longshore drift

A. a tidal ecosystem in estuaries and deltas consisting of mud flats with salt tolerant grasses and flowers

B. a hollow eroded by the sea into the base of a cliff

C. protecting the coast by building such structures as sea walls and groynes

D. the movement of sediments along the coast by wave action

E. the rise or fall in the average level of the sea over long periods of time

5 MULTIPLE CHOICE QUESTIONS

1. a ridge of water formed by the circular movement of water near the surface of the sea

○ Bar ○ Wave ○ Cave ○ Stack

2. an organic community of plants

◉ Stump ○ Deposition ○ Cave ○ Ecosystem

3. the number and variety of species in an ecosystem

   Deposition Sub-aerial Spit Biodiversity

4. the dropping of material (sediment) that was being carried by a moving force, such as the waves

   Wave action Deposition Ecosystem Spit

5. a coastal feature formed by the meeting of two caves cut into either side of a headland

   Stack Arch Wave

5 TRUE/FALSE QUESTIONS

1. a linear depositional beach-like landform, formed when a spit joins two headlands → Arch

   True False

2. erosion, transport and deposition caused by waves on the coast → Wave action

   True False

3. occurring on land, as opposed to underwater or underground → Sub-aerial

   True False

4. the protection of aspects of the environment for the future benefit of people → Conservation

   True False

5. an area of land jutting out into the sea → Headland

   True False

MODEL ANSWERS WRITTEN BY STUDENTS

For a named coastal ecosystem, explain the ways in which it is valuable to the people? (6)

The Great Barrier Reef is in Australia and it not just known for its great biodiversity, but also its excellent condition. This coral is a huge benefit to the people of Australia, it can be valuable in a number of ways, for example, Tourism generates millions of people a year just to come and see, and experience the coral reefs, according to a report by the Key West chamber of commerce, tourists visiting The Great Barrier Reef generates well over US$1 billion per year. Another value it has is coastal protection, Coral reefs break the power of the waves during storms, hurricanes, typhoons, and even tsunamis, by helping to prevent coastal erosion, flooding, and loss of property on the shore, the reefs save many lives and lots of money each year. Also it's a source of medical advances, we can also expect coral reef species to contribute to future medical advances. Already coral reef organisms are being used in treatments for diseases like cancer and HIV. Just so long as they are alive and healthy. All these factors come with a coral reef and with that a lot of benefits. LW

Suggest two conflicts that might occur between developers and conservationist in coastal areas? (4)

Each interest group may have a different view about what should be done to protect and manage coastal areas. A difference of opinion can cause conflict between interest groups. For example:

1. *Erosion may be threatening beaches or coastal settlements.*
2. *People may want to develop tourism in the area or existing tourism could be declining.*
3. *There is a danger of flooding if sea levels rise, damaging homes and businesses.*
4. *There could be a problem with sewage and/or pollution damaging its reputation for tourism. LW*