

GEOGRAPHY

Time Allowed: 3 hr.

Max. Marks: 250

Instructions to Candidate

- There are EIGHT question divided in Two Sections.
- Candidate has to attempt FIVE questions in all
- Question No. 1 and 5 are compulsory and out of the remaining, three are to be attempted choosing at least one question from each section.
- The number of marks carried by a question/part is indicated against it.
- Answers must be written in the medium authorized in the Admission Certificate which must be stated clearly on the cover of this Question-cum-Answer (QCA) Booklet in the space provided. No marks will be given for answers written in medium other than the authorized one.
- Word limit in questions, wherever specified, should be adhered to.
- Attempts of questions shall be counted in chronological order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in the Question-Cum-Answer booklet must be clearly struck off.

93
400

1. Invigilator's Signature _____

2. Invigilator's Signature _____

Name Vaibhav

Mobile No. _____

Date _____

Signature [Signature]

- ① Structure your answers properly
- ② Add spatial aspects
- ③ Draw maps & diagrams -

ATB //

SECTION-A

Attempt all questions:

1. Answer the following questions in about 150 words each:

(10 × 5 = 50)

- (a) Write a short note on the contribution of Ancient period historians and philosophers in the evolution of geomorphological thought.
- (b) Write a short note on Bowen's Reaction Series.
- (c) Describe the terms in detail,
1. Podzolization
 2. Gleying
- (d) Discuss the continental drift theory of Taylor.
- (e) Write a short note on Misfit meandering.

1a) Ancient geographers, historians and philosophers had a great role in identifying and developing geography as a subject of study as well as in the development of geographical thought. Some of the contributions are: →

Copernicus was the first person to state that earth was round in shape. This idea grew with time and led to various geographical discoveries by the way of sea voyages.

Emmanuel Kant considered geography as a subject to describe the features of the landforms of a region and not a scientific subject. He called geographical studies as "chorology".

Remarks

Can use
subheads

GREEKS
ROMANS
ARABS

Veranius who was a young explorer wanted geography to be a study of not just description but scientific description. He believed that physical geography was the core of geographical studies.

Humboldt was the first geographer to study the subject on scientific lines. Humboldt however believed that the purpose of geography as a subject was to "scientifically describe" the landscapes and it should not venture into theory and model making.

Ritter on the other hand was from the German school believed that geography is a scientific subject and that it should have theory & model making within its scope.

Vidal de la blache tried to establish the man - environment relationship and he believed that man's activities and behaviour are influenced by the environment.

All these ancient philosophers and historians consistently debated and worked towards the development & evolution of Geography as a subject of study.

Remarks

1) b)

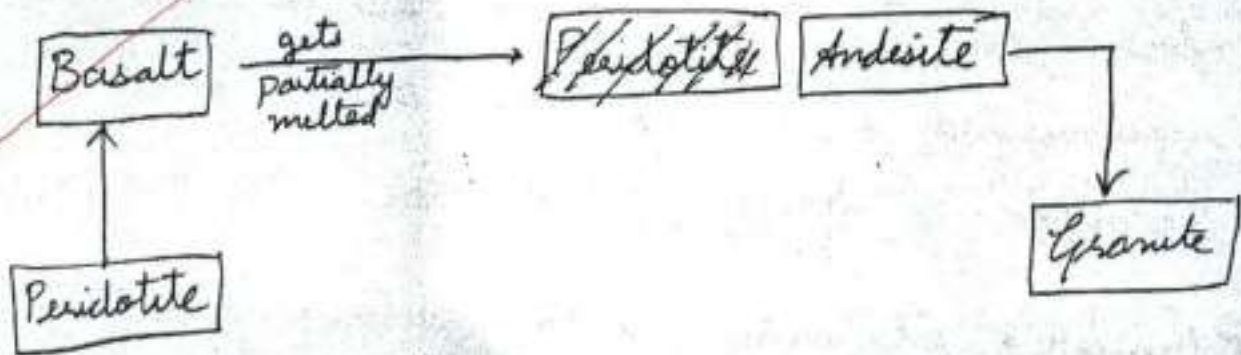
Bowen, a Canadian geologist, gave the theory of partial melting and reaction series.

According to Bowen, rocks are mixtures with minerals of different melting points segregated in it.

When a rock is melted & cooled while rising up inside the earth's surface, the minerals with higher melting point get solidified earlier and the resultant lava from the volcano has less ferrous magnesium silicates.

improve your content

For example: →



Hence ultra mafic Peridotite gets converted into felsic granite.

Refer Model Answer

Remarks

4) Podzolisation and gleying are the processes

witnessed in the periglacial & taiga regions.

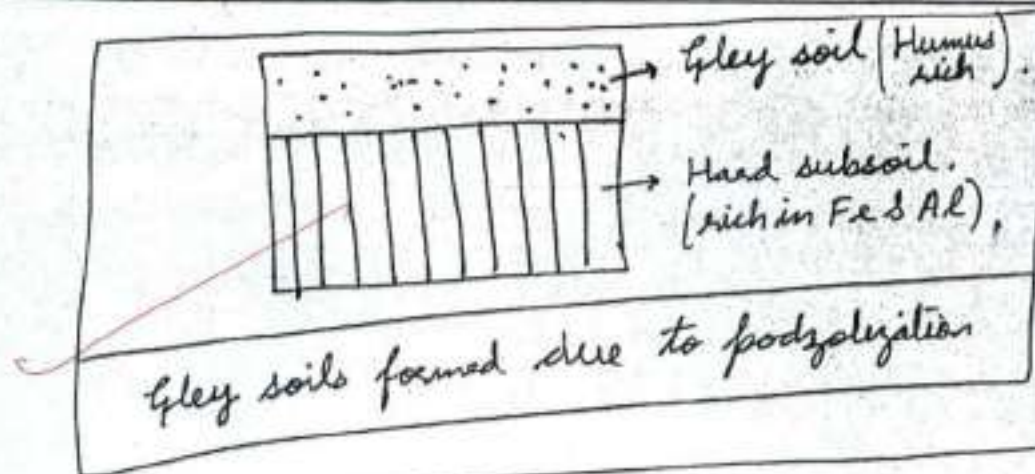
Podzolisation :- Podzolisation as a process takes place in areas in high latitudes. The process of chelation ~~and~~ takes place when chelating agents dropped by conifers, bind with the iron and aluminium present in the soil and leaches them into the subsoil through the process of elluviation. As a result, the subsoil gets rich in iron and aluminium and hence becomes hard and impermeable. This impermeable & hard subsoil prevent the ~~formation~~ percolation of water downwards. Hence, the water gets accumulated in the top layer leading to the formation of swamps and marshes.

Gleying :- Gleification is the resultant of podzolisation.

As the result of formation of swamps and marshes, the soil in these areas become rich in humus and carbon. Anaerobic decomposition of humus in such conditions leads to the formation of red, blue, green gley patches. The soil is highly acidic and has a crumb structure.

Remarks

Shaded map
of podzol
areas



- 4) d) Taylor like Alfred Wegener was of the opinion that mountain ranges are formed at the leading edge of the continents which are moving on the earth's surface. Taylor gave examples of Andes, Rockies and Atlas to emphasise on his point of moving continents.
- He also gave the evidences of coal fields found in temperate regions which indicate the movement of continents.

Refer Model Answer

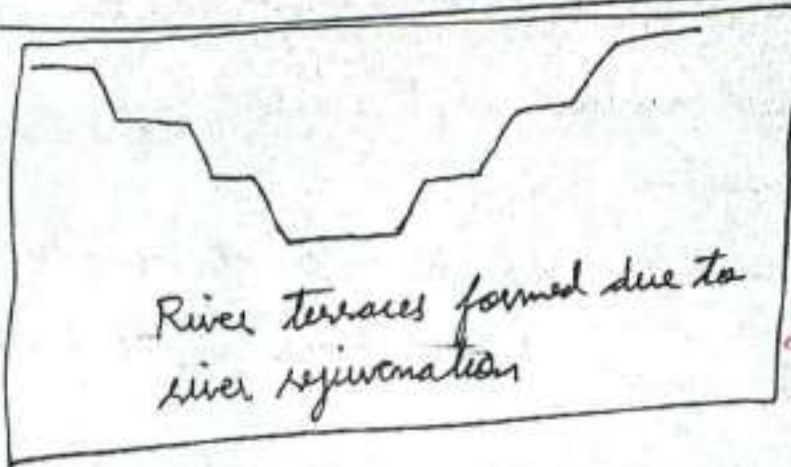
Remarks

A) Meandering is the sinuous course followed by the river in mature and senile stages of its cycle of erosion.

Misfit meanders are a type of meanders formed due to the rejuvenation of the cycle of erosion of the river. Due to rejuvenation, the river displays the features of a young river in the senile stage. Rejuvenation leads to increase in the energy of the river. This increase in energy is spent by the river in enhanced erosion in the mature and senile stages.

Rejuvenated Erosion of river produces various features which are called in geological discordance with the stage of the river. Misfit meanders is an example of geological discordance with the river due to its enhanced capacity to erode, erodes the river bed vertically in the meandering section. This leads to the formation of valley in valley topography due to the formation of river terraces.

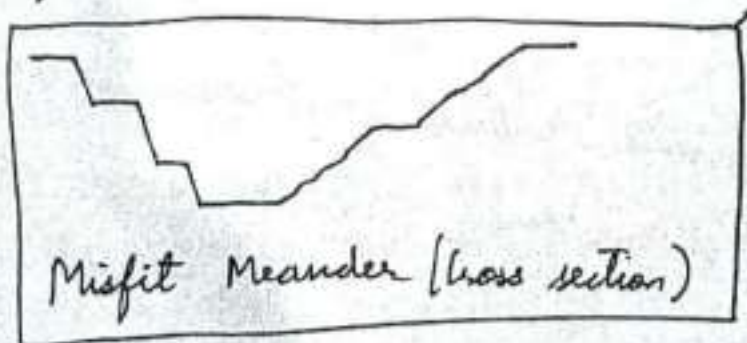
Remarks



it is terracing

The main difference between incised meanders and misfit meanders is that the steps of the river terrace on the opposite sides of the river are not symmetric in misfit meanders. The reason behind this is the topography and the structural factors of the region.

③



Remarks

4. Answer the following questions:

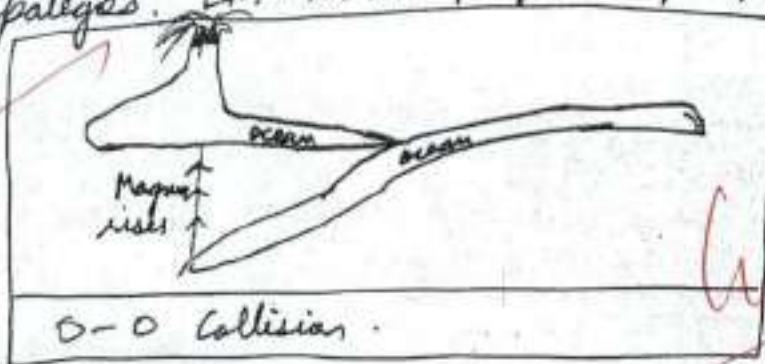
- (a) Interactions between various plates form the most important reason behind the formation of various landforms according to Plate Tectonic theory. Illustrate. (250 Words) (20)
- (b) Among all the factors, changes in the channel gradient is the most important factor for creating disturbance in graded profile. Explain with the process of rejuvenation. (200 Words) (15)
- (c) The channel morphology of bedrock channels is largely determined by structural and lithological controls. Elaborate. (200 Words) (15)

4) a) Plate tectonics theory was laid down in the 1960s and is the most comprehensive and scientific theory related to landform formation. It explains the mechanism behind the plate movements as the convection currents arising from the mantle plume. The interactions between various plates form the most important reason behind the formation of various landforms according to the plate tectonics theory as explained below: →

- The D-D convergence between plates lead to the subsidence of the heavier plate below the comparatively lighter plate. As the plate subsides, it gets melted and due to partial melting process, the basaltic magma gets converted to peridotite.

Remarks

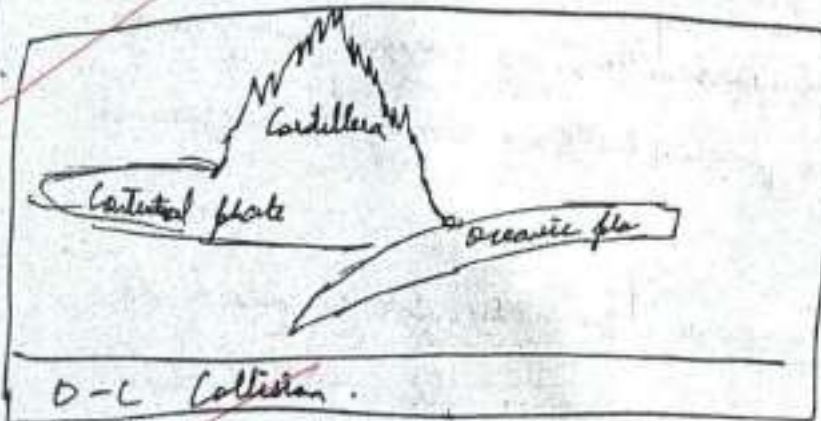
This periodotite rises up and causes volcanic eruptions in the forearc region leading to the formation of archipelagos. Ex: → the archipelagos in Philippines, Indonesia etc



Good

- O-C Collision leads to the formation of cordilleras which also have certain volcanic mountains in between. Ex: → Mount Cotopaxi in Andes

(7)

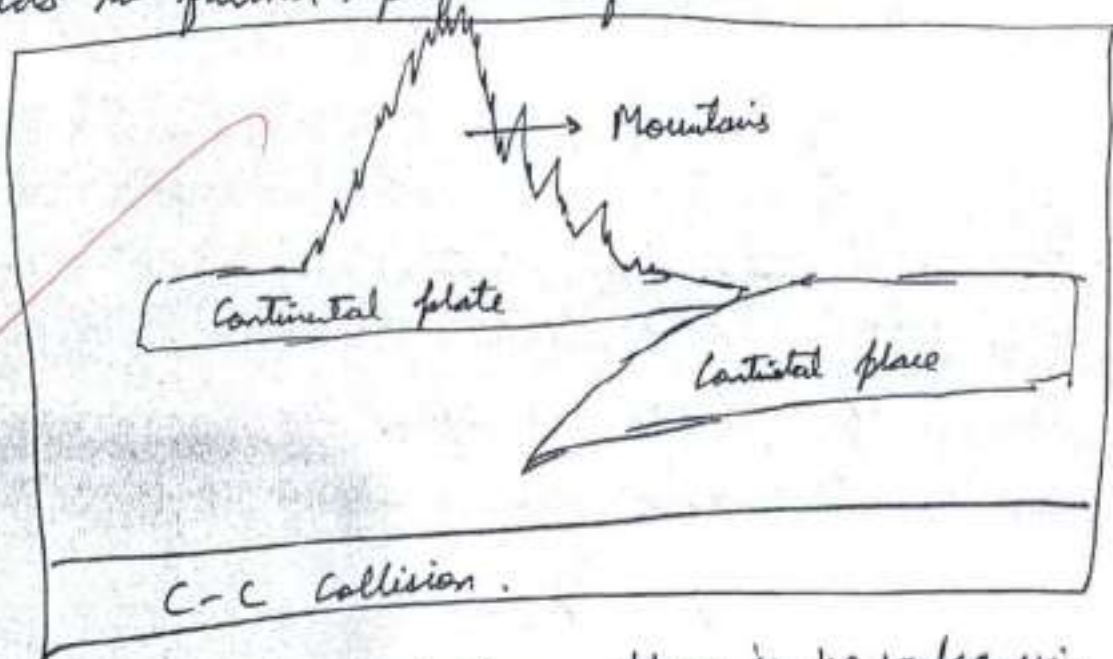


Add world map showing various plates & boundaries

- C-C Collision leads to formation of ultra high mountains like Himalayas. Due to great compressive forces, reverse faults and recumbent folds with nappe structures are found in Himalayas.

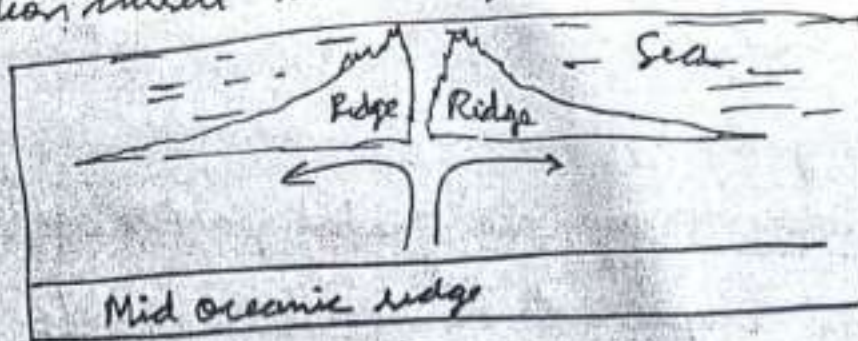
Remarks

Doubling of crust mechanism takes place which leads to further upliftment of mountains.



Since there is no subsidence, there is no volcanism in C-C collision.

- Divergent plate boundaries lead to the formation of mid ^{oceanic} ~~atlantic~~ ridges (MOR) which are the regions of crust formation. Basaltic magma oozes out of long fissure cracks. Rising & diverging convection current leads to formation of MORs.



Remarks

• Transverse boundaries slip past one another hence neither creation nor destruction of crust takes place.
Ex: → San Andreas fault in the USA.

Hence, various plate interactions produce diverse landforms.

4) b). Graded profile is the profile of equilibrium, where the energy of a stream is equal to the load carried by it. Hence, when a stream is in a graded state, it efficiently transports its load without deposition & erosion. The concept of grade was first used by G.K. Gilbert and later by W.M. Davis. S.A. Schumm gave a theory of episodic erosion where he uses the concept of grade & graded profile.

Changes in channel gradient is the most important factor for creating disturbances in graded profile. This can be understood by the following analysis: →

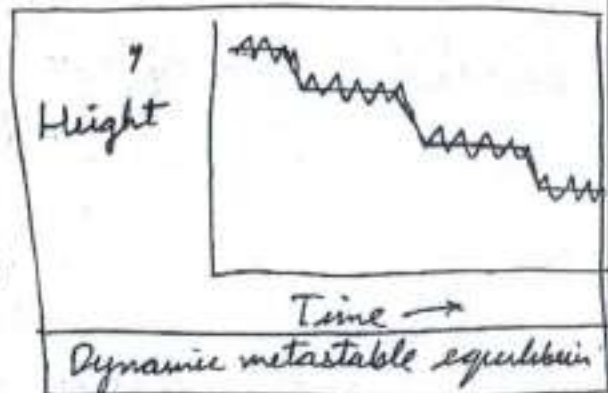
• According to S.A. Schumm's dynamic metastable equilibrium theory, the graded profile is not a gradual slope but it oscillates around a mean

Remarks

average. There are long periods of deposition which leads to increase in channel gradient. When the geomorphic threshold is breached, episodic erosion takes place which is again followed by deposition.

Hence, changes in channel gradient due to continuous alternate deposition & erosion create a disturbance in the graded profile.

- **Rejuvenation** due to tectonic or climatic factors also impacts channel gradient.



In case of positive change in cycle, the base level rises, hence the gradient gets impacted by it which further impacts the graded profile as the river will have to work again to establish a graded profile.

In case of negative change, the base level falls which leads to rejuvenation and reinvigorated erosion by river to establish a new graded profile.

- Rejuvenation due to tectonic upliftment of the source regions (mountains) leads to reinvigoration of the stream and hence it erodes faster to achieve grade.

Remarks

From the above discussion, it can be established that gradient of a stream determines its graded level.

If there is a change in gradient due to rejuvenation (external) or by internal factors (S.A. Schumm's theory), the river will have to work again to attain its new graded level.

4)c) Channel morphology is the quantitative study of various parameters related to streams and establishing relationships between them. The factors & parameters include :-

- Fluid dynamics.
- Hydraulic geometry
- Load.
- Channel structure
- Bed and Bank structure etc.

Draw diagram related to it.

• Bedrock channels are a type of channels which flow through a region of harder rocks and hence are straight, less sinuous, less eroding and less braiding than the alluvial channels.

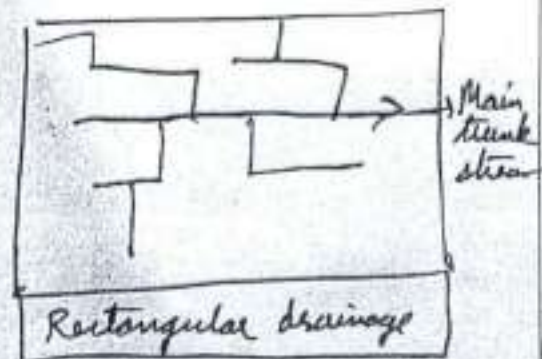
Bedrock channels are directly influenced by the structure & lithological aspects of the

eg: 1) Thalweg
- sinosity of river etc.

Remarks

underlying bedrocks.

- In hard rock regions, rivers perform vertical erosion rather than lateral erosion. Hence there is a formation of canyons and gorges.
- Due to less erosion, the load in the river is less. Hence the velocity of river will be higher than that of alluvial channels.
- The width to depth ratio of the bedload channels will be less due to vertical downcutting.
- The drainage pattern in bedrock channels is most likely to be trellis or rectangular because the influence of structure on the channel flow.
- The drainage system comprises of consequent, subsequent; obsequent & resequent streams according to the structure & lithology of bedrock.



Remarks

Channel morphology of a bedrock channel whether it is stream velocity, drainage, hydraulic etc is determined by the structure of the underlying rock.

The examples of such streams is :- Peninsular rivers, Himalayan rivers in the mountainous regions etc.

8

Remarks

SECTION-B

Attempt all questions:

5. Comment on the following into 150 words:

(10 × 5 = 50)

- Explain various theories put forward by various geomorphologists regarding the formation of limestone caves.
- Explain the process of Nivation and Frost Heaving.
- Write a short note on the tectonic-geomorphic model of M. Morisawa
- Write a short note on Cymatogenic Movements suggested by L.C. King.
- Why Continental Drift theory is also called as an impossible hypothesis?

5a) Limestone caves are formed in regions of carbonate rocks where the processes of chemical weathering/solution is dominant. Various theories have been put forward by various geomorphologists regarding the formation of limestone caves, some of them are discussed below:

W.M. Davis :→ Davis considered limestone cave formation as a part of two cycle process. Initially, the limestone bed is placed in the phreatic zone where the phreatic water, through the solution process, dissolves the rock and forms caves and caverns.

After this process, the limestone bed gets uplifted due to geological reasons into the vadose zone where the depositional features

Remarks

of the karst topography like stalactite, stalagmites, cave pillars etc are formed because in vadose zone water is not in saturation but there is only partial availability of water.

C. A. Malott :-> gave his theory for the formation of limestone caves. According to him, the limestone bed is located in the vadose zone with a subaerial stream flowing through the region.

This stream forms sink holes and swallow holes in the limestone bed which eventually gets converted to blind valley. The stream then erodes the limestone bed downwards & horizontally with time leading to the formation of caves & caverns.

Hence, it is evident that the debate regarding the formation of limestone caves was mainly on the issue of the location of the limestone bed and whether upliftment was a part of the process or not.

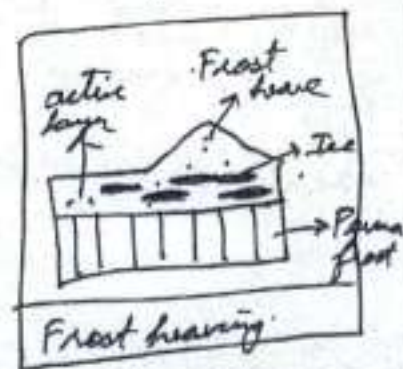
Remarks

Can draw some diagrams related to KARST topography

5b) Processes of Nivation & frost heaving are the features of periglacial regions. The basic mechanism behind both of them is the expansion of the active layer due to the freezing of water present in it.

Frost heaving :- In frost heaving, the water present in the active layer gets frozen during the night. This leads to the expansion of the layer. This expansion and the resultant pressure exerted by the frozen ice on the coarse regolith in the active layer hears up the coarse particles in the active layer towards the surface. This leads to swelling of land & formation of mounds. Sometimes, it seems as if the land is vomiting stones. This process is called frost heaving.

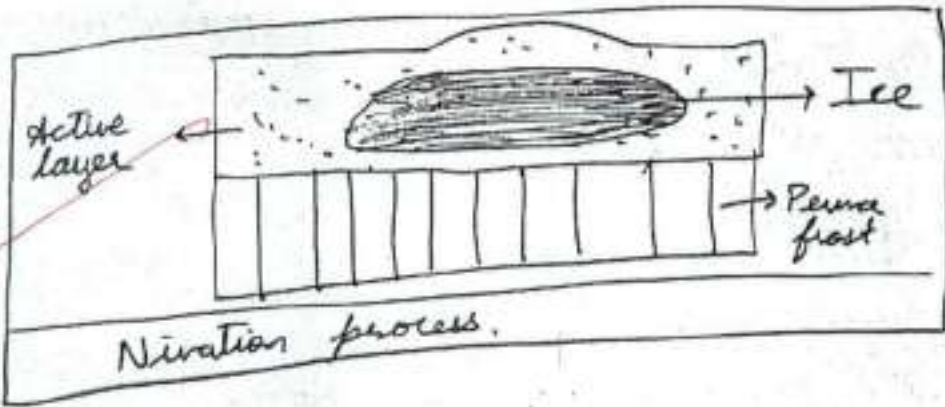
Frost heaving can also take place due to lateral heaving by the frozen ice.



Remarks

Nivation: → In the nivation process, the region of active layer gets frozen during the night. This frozen part of active layer of soil exerts pressure in its surrounding soil material. The erosion in the beneath layer and the surrounding parts of the frozen part of active layer is called Nivation.

6



Good

Frost heaving and nivation pose serious problem of structure stability in cold countries in high latitudes. Due to frost heaving & nivation, the foundations of buildings get distorted which might lead to a hazard. Hence proper modifications to the structural engineering in these areas is required.

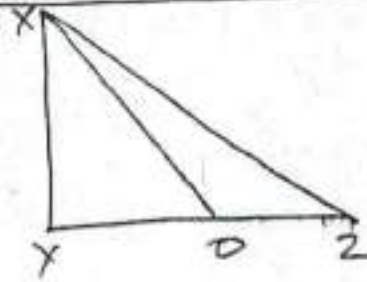
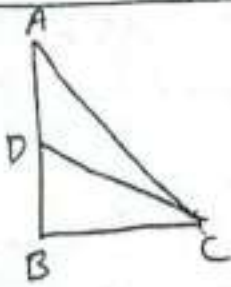
Remarks

5c) The techno-geomorphic model is a landform development model given by M. Morisawa. It is a comprehensive model which was based on the tectonic factors and their role in landform development.

The chief features of techno-geomorphic model are:

- It includes tectonic movements which were largely ignored in earlier theories.
- Morisawa also gave emphasis on isostatic adjustments and their role in landform development.
- Her model was oriented towards structure and process rather than time which was the most important factor in the cycle of erosion by W.M. Davis.
- Morisawa also explained the role of exogenetic forces in the sculpting of landforms.
- She established a relationship between the slope and the erosion potential of a stream.

Remarks



According to Morisawa, the stream flowing through the slope (XD) will have greater erosion potential than the one following (XZ), although both had the same potential energy initially.

Similarly, (AC) has more erosion potential than DC because of higher initial potential energy.

The tectonic-geomorphic model of M. Morisawa had fair bit of quantification. It also had theories and relationships b/w various aspects.

Moreover the model incorporated almost all the process and forces at work in the development of a landform. Hence, her model was much more holistic and quantitative than the models prior to it.

Remarks

5) d) Cyanotogenic movements are the parallel retreat movements as envisaged by L.C. King in his theory of pediplanation. Under this, all the segment length remains equal and they all retreat parallelly except the basal square segment which is replaced by lower slope and longer segment. The ultimate product of these movements is the formation of pediplains with occasional inselbergs in otherwise flat undulating plain.

Add more

5) e) "Continental drift" was the theory given by Alfred Wegener to explain the features present on the earth surface and their evolution with time. It was one of the best explanations of the features and the reasons of their formation during its time. It rightly hypothesised that the earth crust is not stable but it drifts. Due to this drifting

Remarks

of SiAl₂ layer of SiMa, the theory explained the formation of mountain ranges, islands, location of coal fields etc.

However, there were certain weaknesses in the theory which led to its ultimate rejection. It was even called an impossible hypothesis. Some of the reasons are: →

- The theory failed to explain the mechanism behind the movement of SiAl over SiMa. Wegener initially said that the attraction of Sun & Moon were responsible. This was outrightly rejected by Harold Jeffery. Later he said that a buoyant force was the driving mechanism behind continental drift. These explanations were rejected.
- He could not explain the intra continental location of mountain ranges like Appalachians, Urals, Himalayas etc.
- The structure of rocks of islands did not match the continents nearby. For instance, Rocks of Japan are different from rocks of Asia.
- The notion of SiAl & SiMa layer was rejected by the plate tectonics theory.

Hence his theory was called an "impossible hypothesis".

Add map / diagram

Remarks

7. Answer the following questions:

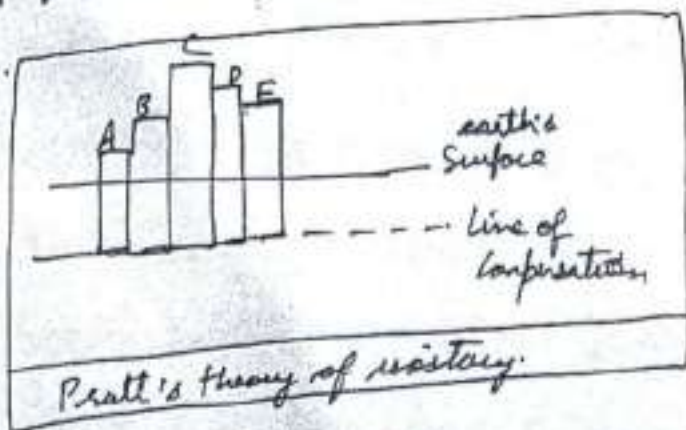
- (a) Discuss the view of Airy and Pratt regarding the concept of Isostasy. Also, give the interpretation of the theory of plate tectonics. (250 Words) (20)
- (b) What is a Zoogeographic region? Provide a classification of major Faunal regions of the world and discuss Ethiopian Faunal Region and Oriental Faunal Region in detail. (200 Words) (15)
- (c) Write a short note on various factors causing rejuvenation in landforms and thus describe the consequent landforms. (200 Words) (15)

7) a) Isostasy is the mechanical balance due to which landforms remain stable mechanically. Various theories have been given regarding Isostasy as explained below: →

• Archdeacon Pratt : → According to ~~Pratt~~ Pratt,

- Equal area underly equal mass
- The density of landforms are different.
- There is a line of compensation upto which the density is variable. Below the line, there is same density.

• Hence according to Pratt, the higher a landform, lower will be its density. Hence "C" has lowest density in the figure.



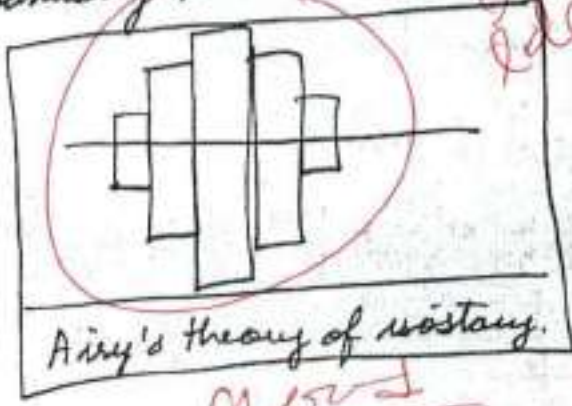
Remarks

Airy :-> Airy's theory is called "roots theory".

- Density of all landforms is the same.
- Landforms float over SiMa layer and they have roots below the surface which provide them buoyant thrust which keeps the landform mechanically stable.

put some ideas into it

- According to Airy, the roots of the landform are 8 to 9 times deep inside the surface of earth.



Airy's theory of isostasy.

9

- Hence, according to Airy, higher a landform, deeper roots it will have.

Plate tectonics theory :->

Plate tectonics theory states that lithospheric plates as a whole float over asthenosphere which is semifluid in nature. When the isostatic balance of a place is disturbed due to loading or unloading, the pliving mineral

Remarks

flows accordingly inside the asthenosphere and consequently, there will be isostatic adjustment somewhere else. Hence according to plate tectonic theory, isostatic balance is maintained at a regional or global level.

Ex: → Scandinavian countries witnessed unloading because of melting of pleistocene & pliocene ice. This led to upliftment of their coasts but it must have been compensated by isostatic subsidence somewhere else.

7) c) Rejuvenation means that the channel gets reinvigorated and its erosive ability increases. Hence it displayed symptoms of youth stage in mature & senile stage.

Various factors causing rejuvenation are: →

Dynamic
Static factors : →

- Tectonic upliftment or subsidence may lead to rejuvenation of the stream
- Tilting of a landscape can lead to rejuvenation
- Subsidence of ocean floor can decrease the base level and cause rejuvenation

Remarks

• Enstatic factors :->

- Isostatic upliftment or subsidence can cause rejuvenation.
- Change in basin topography may lead to rejuvenation.

Isostatic??

• Static factors :->

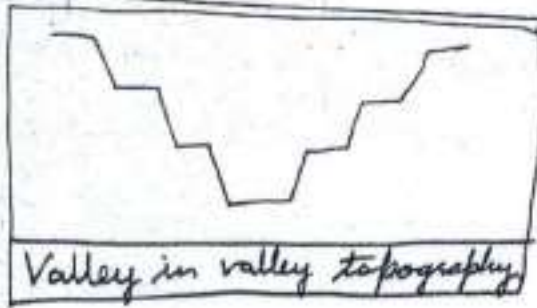
- Climate change can increase discharge and cause rejuvenation.
- Increased precipitation in the catchment area.
- Decrease/increase in load in the river.
- Anthropogenic activities like dam construction can change river morphology and cause rejuvenation.

8

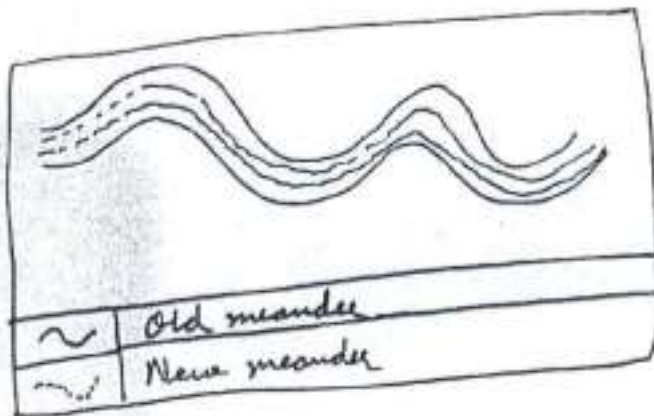
Various landforms are formed due to rejuvenation.

- Topographic discordance is witnessed due to rejuvenation. Here the features of youth stage are witnessed below mature stage.

- Valley in Valley topography is formed due to rejuvenation which leads to enhanced vertical erosion & formation of river terraces.

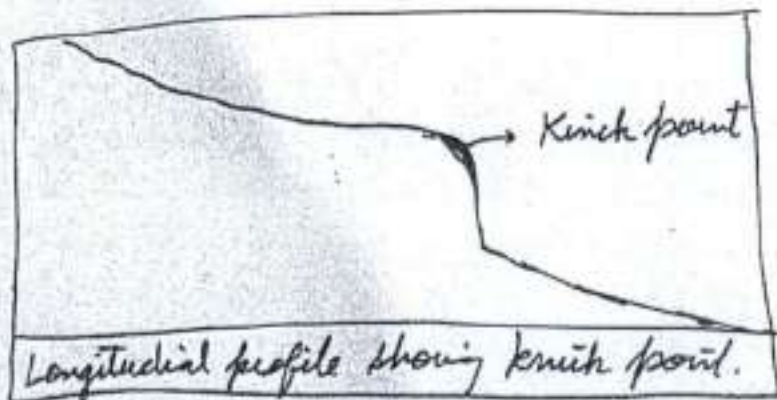


- Incised meanders due to enhanced vertical erosion hence deeper meanders are cut within older meanders



Very good

- Knick point falls are formed at the point from where the rejuvenated stream starts eroding headwards



Remarks

All these are the causes of rejuvenation and related landforms. Various examples of rejuvenation can be seen in India. For instance:

Knick point falls → Gautamdhara (Subarnarekha rd)

Hunder falls [Near Ranchi]

Dhuandhar falls [Near Jabalpur]

Most Delta
of Sundarbans

8. Answer the following questions:

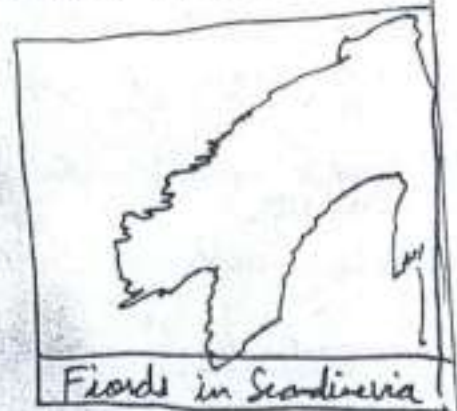
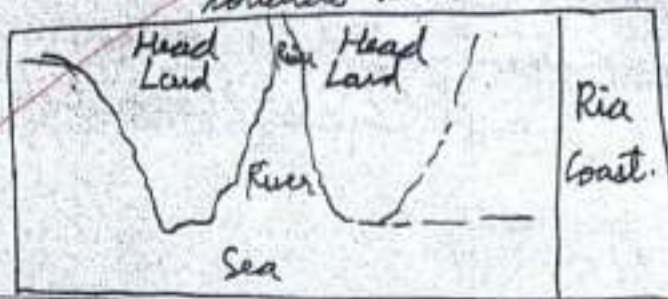
- (a) Write a short note on Johnson's Classification of Shorelines (250 Words) (20)
- (b) Write a short note on climatic interruptions in the cycle of erosion. (200 Words) (15)
- (c) Write a short note on intrazonal Soils. (200 Words) (15)

8a)

D.W. Johnson gave a genetic classification of shorelines. His classification has been praised to be simple and easily interpretable. The chief features of his classification are:→

- Shorelines of emergence :→ These were the shorelines where there were evidences of emergence due to tectonic factors or climate change.
- Shorelines of submergence :→ In these shorelines there were evidences of submergence due to tectonic factors or climate change. He further divided submergent shorelines into

(i) Ria shorelines which included submergent mouths of rivers are of funnel shape as they are wide towards ocean & narrow towards sea.



Remarks

(ii) Fjord :→ These are the submerged glacial valleys which have a mound towards the sea which is the eretuhile terminal moraine.

Neutral Shorelines :→ These coastlines neither show the evidence of submergence nor of emergence.

Various types of shorelines are a part of this :→

- Delta shorelines
- Alluvial shorelines
- Coral reef shorelines
- Volcanic shorelines.
- Fault shorelines.

Draw a world map showing these

• Compound shorelines :→ These shorelines display the evidences of both emergence and submergence. For example, the coastline of Norwegian coast.

Although, the classification is quite simplistic, it has been criticized by Shepherd because according to shepherd, all the coasts have witnessed submergence and emergence at some point of time, hence they all must be compound shorelines. He also ignored the eustatic processes.

Remarks

8b)

Climate plays a very significant role in the process of landform development because it influences the processes operating both directly and indirectly.

Climatic interruptions in the cycle of erosion can be analysed through the following points: →

- Climate influences the discharge in a river, hence it influences the cycle. If the discharge is greater, due to precipitation or melting of ice, the erosion capability of river increases. Thus it shortens the cycle of erosion as the river will erode faster to achieve the base level.
- Climate change leads to rise or fall in the base level. This rise and fall in base level has positive and negative impact on the cycle of erosion respectively.
- Climate change also leads to isostatic adjustments (eg: → in Scandinavian countries) which leads to changes in base level.

Remarks

• Climate influences the vegetation and soil of a region. Vegetation density and type impacts the erosion process and hence influences the cycle of erosion.

• Climate plays an important role in the periglacial cycle as given by L.C. Peltier. Temperature controls the freeze & thaw mechanism and hence the periglacial cycle.

• Climate influences the Karst cycle because hot and humid climate readily erodes limestone while in dry climate, limestone is resistant to erosion.

• Glacial cycle of erosion and its rate is also controlled by climate.

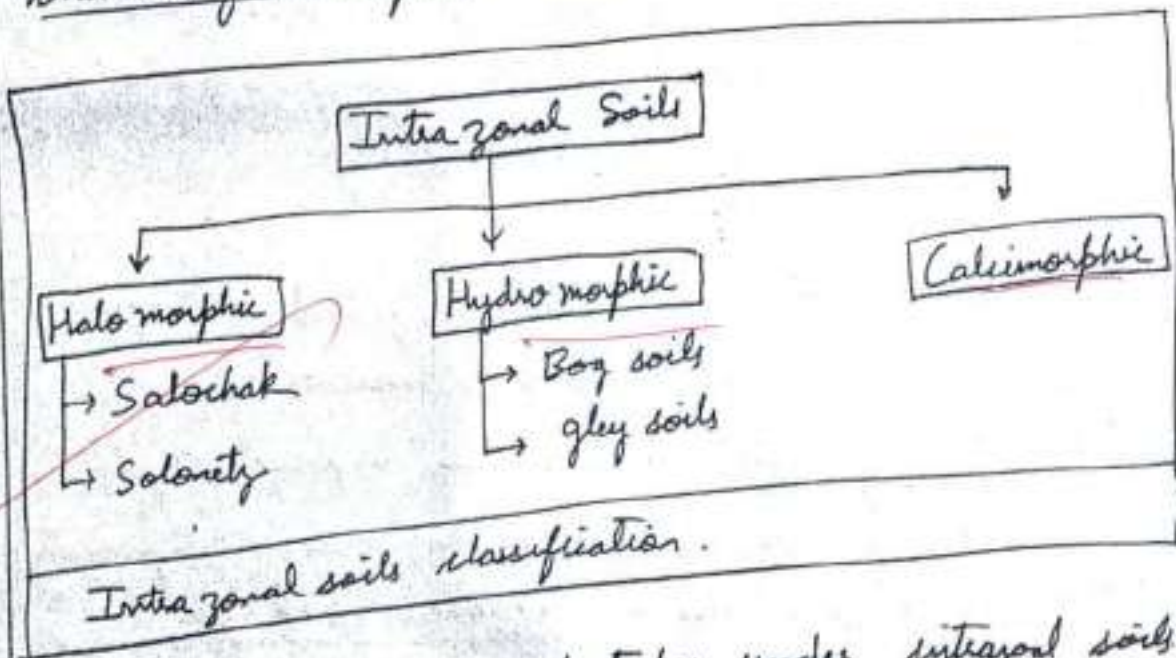
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Considering the above points, it can be concluded that climate interruptions in the cycle of erosion are widespread and multi regional.

Case Categories
 et al
 ↳ Role of Windy
 ↳ Role of water
 ↳ Role of Temperature
 ↳ Humidity

8c) Intrazonal soils have been classified in the Marbut scheme which is a fine combination of genetic as well as morphological classification of soils.

Intrazonal soils are the soils which has been chemically modified due to certain processes.



Discussion of various soil types under intrazonal soils

- **Halomorphie**: → These soils are rich in salts and hence are rendered as waste soils. They are not suitable for cultivation and hence should be directed to **grassland**. However, certain measures like adding gypsum can be done to increase fertility & reduce salinity

Remarks

- Salochar : → These soils are rich in salt content. These are found in wastelands of UP, Punjab, Haryana & Rajasthan and are called Usar / Kalai in local areas.
- Solonchak : → These soils are called alkaline soil or sodic soil. The alkaline salts swell when in contact with moisture which prevents the percolation of water. *Good clarity*
- Hydromorphic : → These soils are found in water covered areas like swamps and marshes.
 - Gley soils are found in Temperate regions where due to gleification, there is no percolation of water, hence blue/green/black gley patches are formed due to anaerobic decomposition of humus. *(7)*
 - Bog Soils are found in marshes of tropical areas. They are also called peaty soils. Highly acidic in nature. Example are Kasseri soils in Kerala.

Remarks

- Calcimorphie :→ These soils are rich in calcium due to the gypsum present in these areas. It has black color and highly fertile. High humus content, hence this soil has crumb structure. This soil is good for production of wheat, barley, maize, sorghum etc. It is found in steppes and Prarie areas. These areas are also called "the bread basket of the world".

Remarks