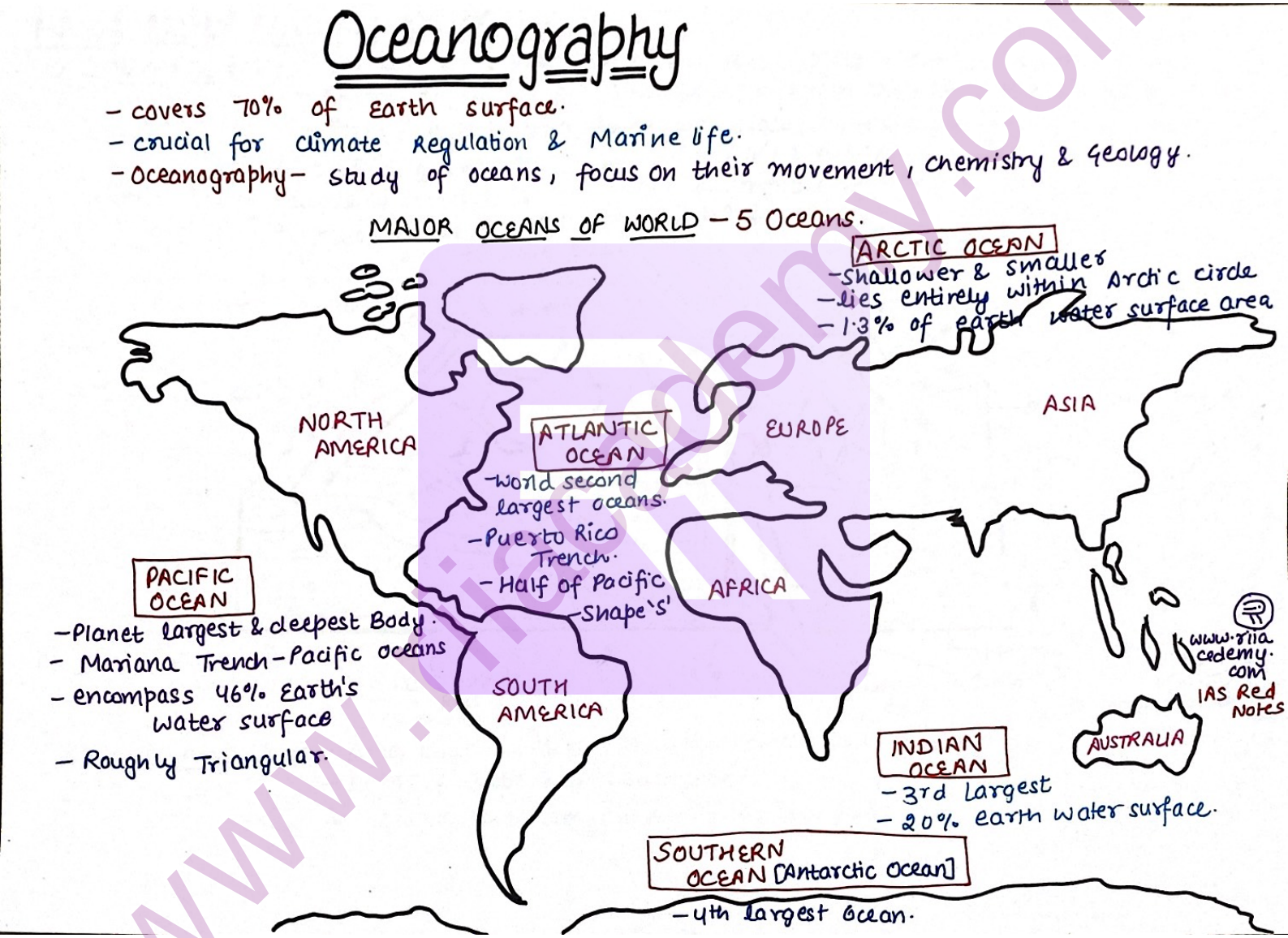
Oceanography

- covers 70% of Earth surface.
- crucial for climate Regulation & Marine life.
- Oceanography - study of oceans, focus on their movement, chemistry & Geology.

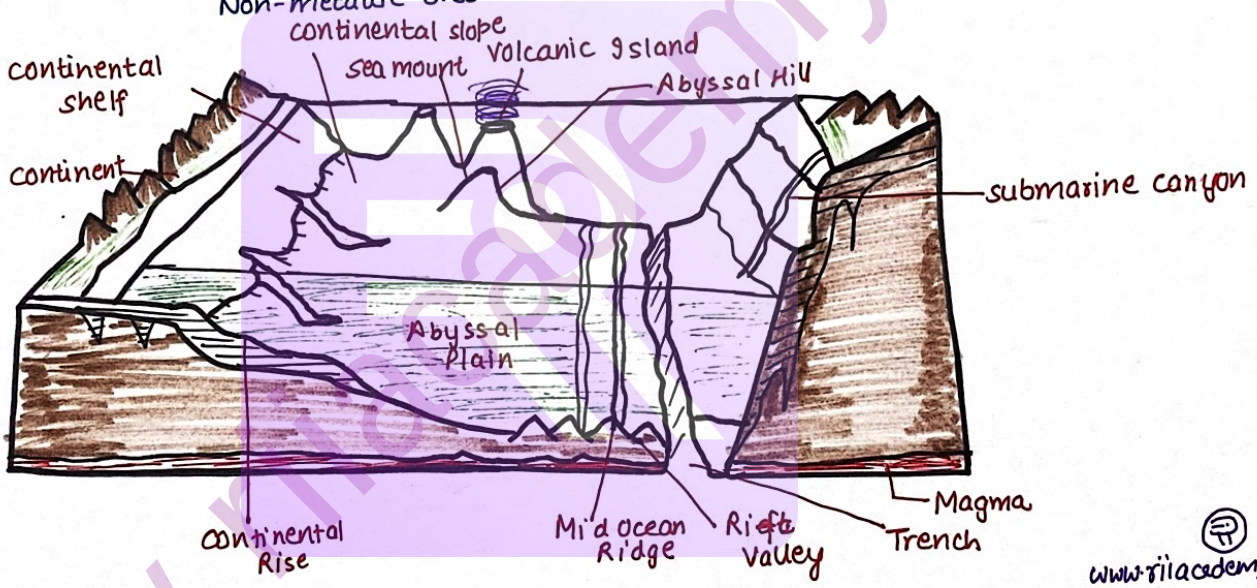
MAJOR OCEANS OF WORLD - 5 Oceans.



MAJOR RELIEF FEATURES OF OCEAN

1> Continental Shelf – gently sloping extension of continental plate – stretch into sea.
- shelves typically 70-80 km wide, siberian shelf – 1500 km.
- form due to factors like submerged continent ports, sea level Rise, sediment deposits wave erosion.

significance – → Rich fishing area
→ source of fossil fuels
→ Deposits of Metallic & Non-metallic ores.



2> Continental Slope – Area that connects continental shelf to ocean Basins.
- Depth of slope b/w 200 – 3000m
- features like canyon & Trench found here.

③ Continental Rise – when slope Reaches a level b/w 0·5° & 1°
– with Increasing depth, Rise – flat & Merges with abyssal plain.

④ Deep Ocean plains – Flatlest & smoothest Regions of world.
– depth vary b/w 3000m – 6000m
– plains – covered with fine grained sediments → silt, clay.

⑤ Oceanic Ridge – composed of 2 chains of Mountains
↳ separated by large depression [Divergent Boundary]
– Iceland – part of Mid Atlantic Ridge

OCEAN DEPOSITS ON BASIS OF DEPTH

- Deep sea deposit [Below 100 fathoms]
  - Pelagic Deposit
    - ooze – soft, Mud like substance made from Microscopic shells.
    - Deep sea clay – extremely fine particles that settle from water column.
  - Terrigenous deposits
    - Land derived sediments Transported by Rivers, Winds & Glaciers.
- Shallow sea deposit
- Littoral deposit
  - Gravels
  - sands
  - Mud

Isthmus, Strait, Bay, Gulf

- **Isthmus** – Narrow strip of land connecting two larger land areas & separates two bodies of water

significance →
- Strategic Military & economic Routes (e.g:- Panama canal.)
- Facilitates land Based Transportation
- Influence ocean circulation.

- **Strait** – Narrow Body of water connecting two larger bodies of water & separating two land mass

significance →
- Development of Ports & Harbour – Suez canal.
- Strategic military Chokepoints e.g:- Strait of Malacca
- Biodiversity Hotspots
  e.g:- Coral Triangle – southeast Asia

- **Bay** – Large Body of water partially enclosed by land, but with a wide Mouth, providing access to sea
  e.g:- Bay of Bengal.
  - Formed due to → erosion of coastlines
    → subsidence of Land.
  - Significance → excellent harbours & fishing grounds
    → safe anchorage.

- **Gulf** – Large Body of sea or land, partially enclosed by land, typically enclosed by land.
  - Narrow opening than Bay. Persian Gulf
  - Formed by Tectonic activity

significance →
- International shipping Routes
- Rich marine diversity
- oil Reserves.

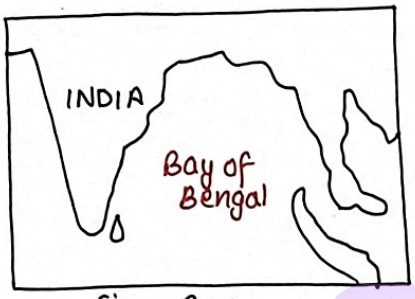


Fig:- Bay.

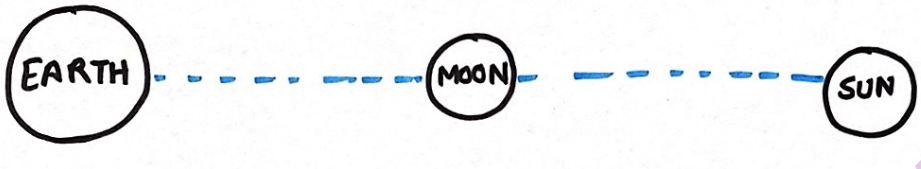
Fig:- Gulf

MOVEMENT OF OCEAN WATER

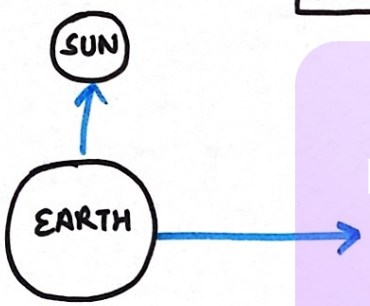
1) **Waves** - oscillating movements of water caused → Wind Blowing across surface of sea
- key factor influence wave formation → wind speed, wind duration, distance over which wind blows.

2) **TIDES** - Rhythmic Rise & Fall of entire sea level
- occurs roughly once or twice daily - gravitational pull of moon
- Influenced by sun & Earth Rotation
- categorised in 2 ways

- **FREQUENCY**
  - **SEMI-DIURNAL** - Two High Tides & two low Tides → occur in 24-Hour period.
  - **DIURNAL** - only one high tide & one low tide occur in a day
- **SUN-MOON ALIGNMENT**
  - **SPRING TIDES** - Sun, Moon & Earth aligned, combined gravity creates High & low Tide.
  - **NEAP TIDES** - Sun & Moon Right angle to Earth, opposing forces produce less dramatic changes



SPRING TIDES → Twice a Month
- → one on full Moon period
- → another during New Moon period.



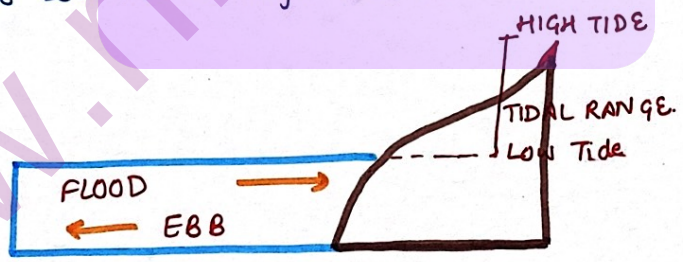
NEAP TIDES → Twice a Month.

Factors controlling Magnitude of Tide.

a) Movement of moon in relation to earth.
b) Uneven distribution of water
c) Irregularities in configuration of ocean.
d) Changes in position of sun & Moon

Ebb & Flood

- Ebb - Time b/w High tide & Low Tide, when water level is falling.
- Flood - Time b/w Low tide & High Tide, when water level is Rising.



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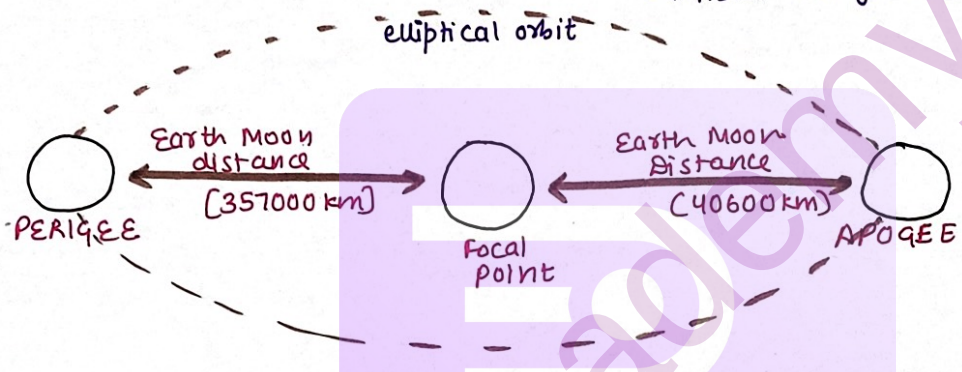
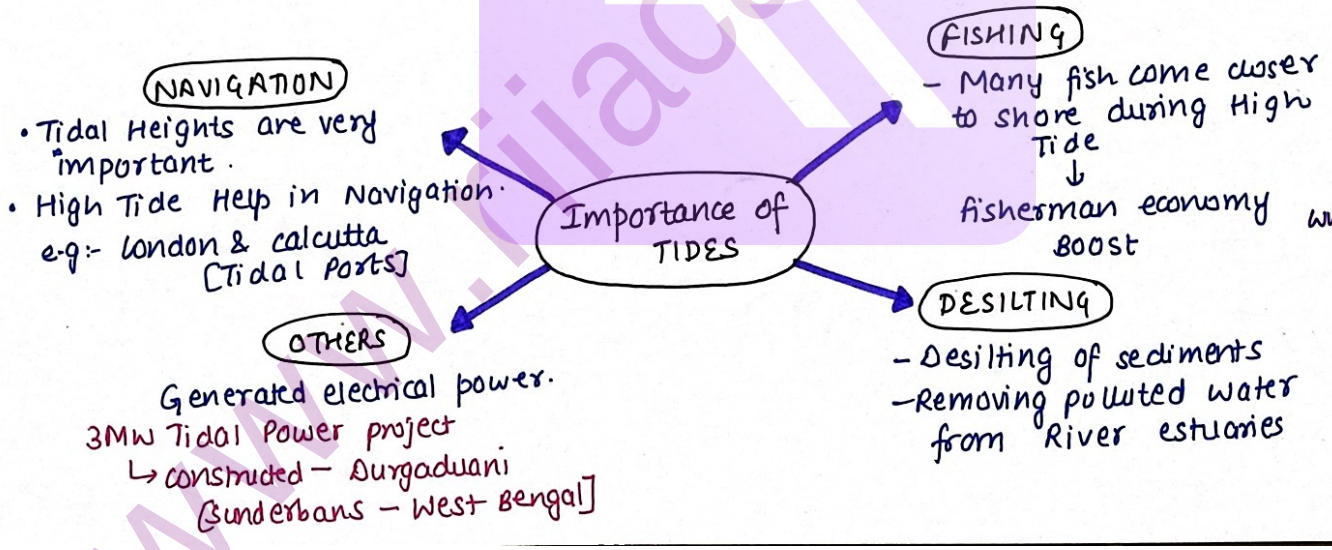
- Magnitude of Tides - Perigee & Apogee of Earth.
  - Earth closest to sun - Perihelion [3rd January]
    ↳ Tidal Range much greater, unusually High & low Tides.
  - Earth farthest from sun - Aphelion [4th July]
    ↳ Tidal Range less than Avg.



- Apogee - Moon closet to the earth
- Perigee - Moon farthest from earth



3> Ocean Currents

- Large, continuous movement of seawater - flow through world oceans.
- Driven by factors → Earth Rotation
  → Temp. difference
  → Salinity Levels.

FACTORS INFLUENCING OCEAN CURRENTS

PRIMARY FORCES

① Heating by solar energy → cause water to Expand.

② Wind - push ocean surface - water to move

③ Gravity - pulls the water down.

④ Coriolis force - causes water to move
- Right [North Hemisphere]
- Left [South Hemisphere].

- large accumulations of water & flow around them - GYRES.

SECONDARY FORCES

① Difference in water density - affects vertical Mobility of ocean currents
- Water - High salinity - denser than water with low salinity & same way cold water denser than warm water.

② Temp. of Oceans -
Cold Ocean currents - cold water pole sinks
Warm Ocean currents - warm water Travel out of equator

Types of Ocean currents

BASED ON DEPTH
- Surface water current
- Deep water current

BASED ON TEMP.
- COLD CURRENT
- WARM CURRENT.

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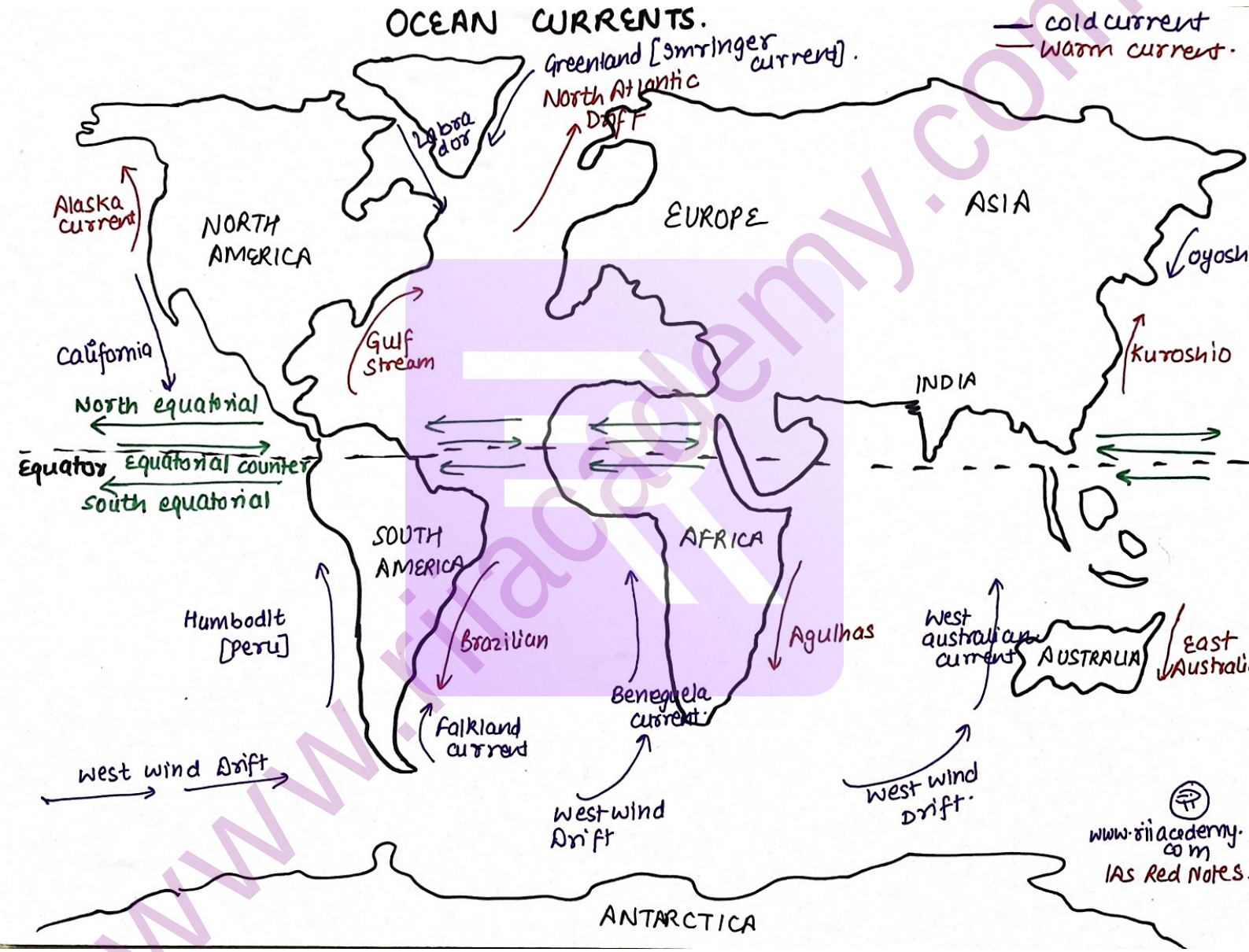
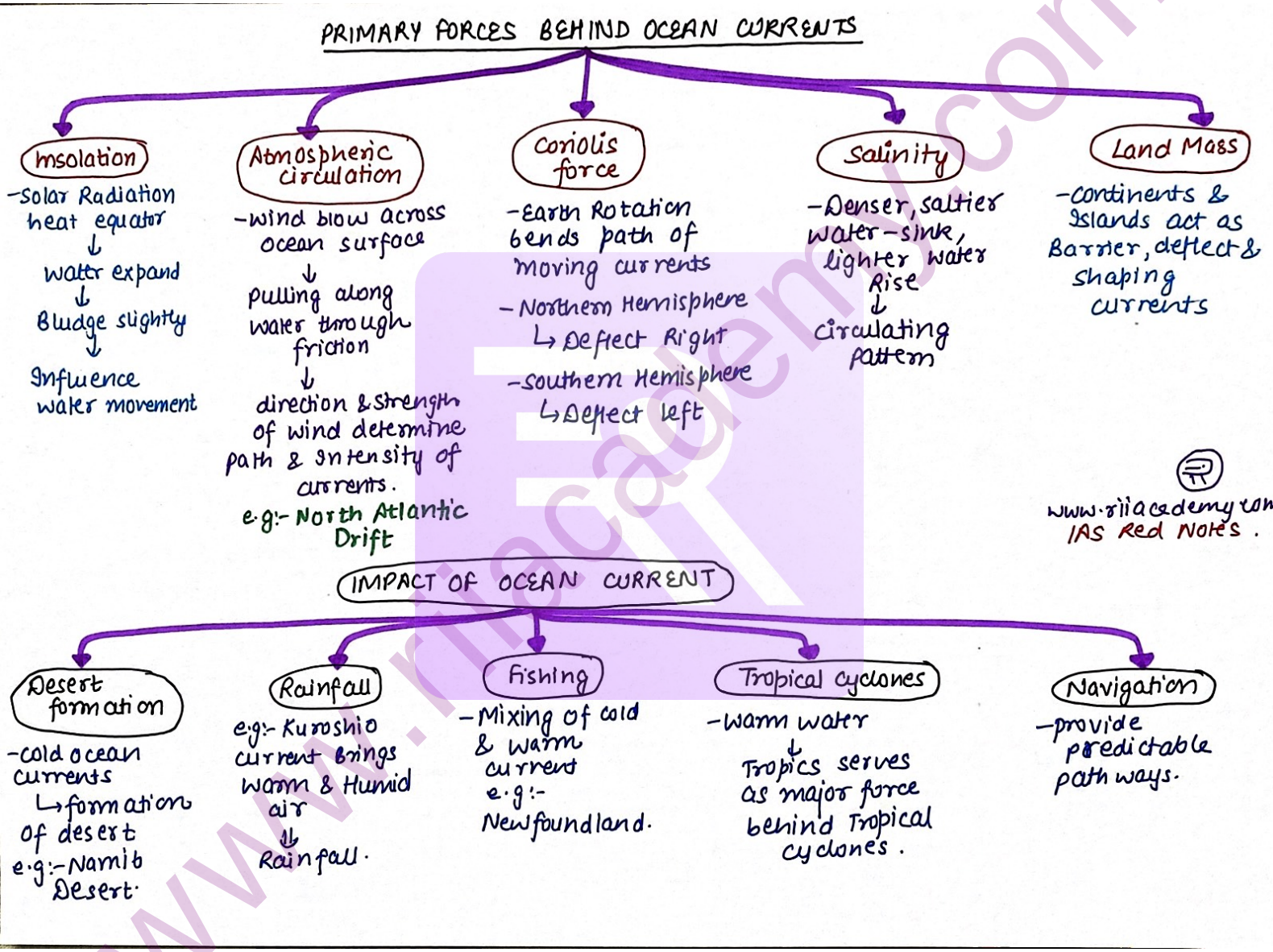
- **Based on Depth -**
  - A> **Surface currents** - upper 400m of ocean.
    - constitute 10% of all water in Ocean.
  - B> **Deep water currents** - 90% of ocean water.
    - Move around ocean Basin - variations → density, gravity.
    - Deep water sink into deep ocean basins
      - ↳ At high latitude, where Temp. are cold enough to cause density to increase

- **Based on Temperature -**
  - A> **cold currents** - carry cold water from higher latitude → lower latitude
    - cools coastal climate & impact local climates
    - Generally found → west coast - continents - low & Mid latitudes
      - → east coast - Higher latitudes.
    - Example - California Current
      Benguela current etc.
  - B> **Warm currents** - Transport warm water
    - ↳ low latitude to Higher latitude
    - Increase Temp. along coastline
    - Influence Regional weather patterns
    - Generally found → east coast - low & Mid latitudes
      - → West coast - Higher latitudes
    - Example - Gulf stream
      Kuroshio current
      Agulhas current etc.





Ocean Salinity

- **Salinity** → Total amount of dissolved salts in sea water
  - calculated as amount of salt (gm) dissolved in 1000gm of seawater.
  - usually expressed parts per thousand or ppt.
  - salinity - 24.7 → upper limit to demarcate – Brackish water.

- ROLE OF OCEAN SALINITY
  - Salinity determines –
    a) Compressibility
    b) Thermal Expansion
    c) Temperature
    d) Density
    e) Evaporation
    f) Humidity
    g) Composition & Movement of sea.

Dissolved salts in sea water
[gm of salt per kg of water]

Chlorine	18.97
Sodium	10.47
Sulphate	2.65
Magnesium	1.28
Calcium	0.41
Potassium	0.38
Bicarbonate	0.14
Bromine	0.06
Borate	0.02
Strontium	0.01

Highest salinity in Water Bodies.

- Lake Van [Turkey] [330‰]
- Dead sea [238‰]
- Great sea Lake [220‰]

- Factors affecting Ocean salinity
  1) Depends on evaporation & precipitation.
  2) Wind – Influence salinity – Transferring water to other areas.

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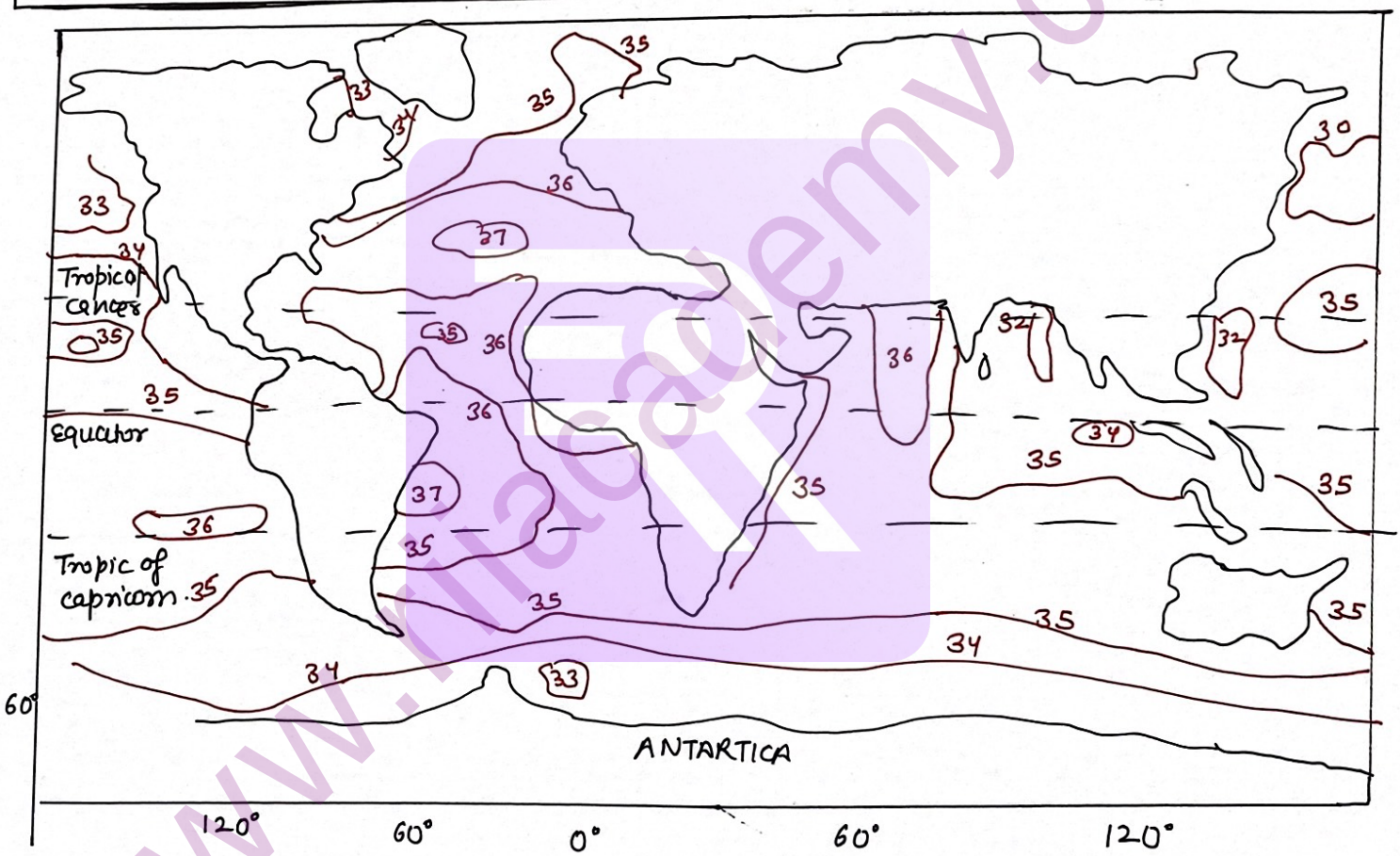
3> Ocean currents - salinity variation.

4> surface salinity - influenced by fresh water flow from Rivers.

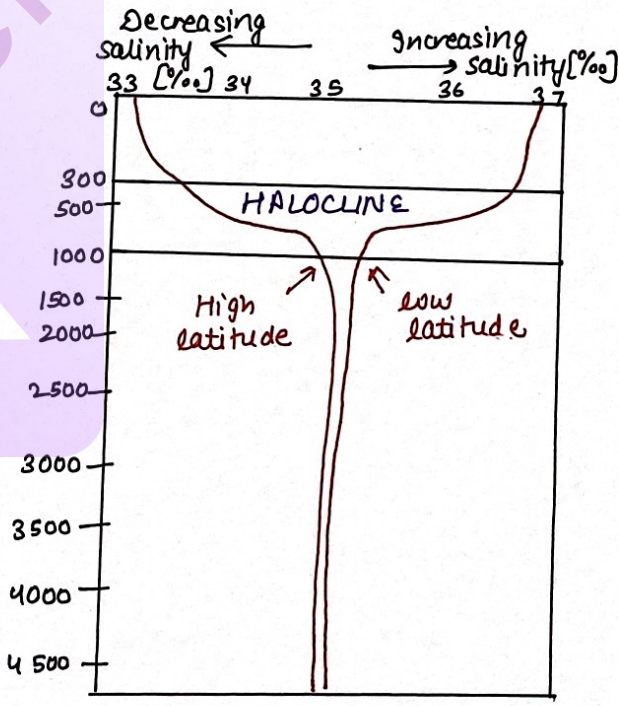
Horizontal Distribution of salinity



- On an Avg, salinity decrease from equator ⟶ poles.
- Highest salinity – Near equator – High Temp. & evaporation
  ⇓ ↳ But High Rainfall Reduce Relative proportion of salt
  Salinity – only 35‰
- Highest salinity – 20°N – 40°N – 36‰ → High Temp & evaporation but Relatively low Rainfall.
- zone 40° to 60° [N|S] → Low salinity → North – 31‰ / South – 33‰
- salinity dec. polar zone → Influx of Glacial Melt water.

VERTICAL DISTRIBUTION – SALINITY

- Both Trends of Increase & decrease of salinity with increasing depth – observed.
- salinity increase with increasing depth
  ↳ 300 m – 1000 m [Higher latitudes]
  ie.. positive Relationship
  ↳ Denser water below but salinity becomes constant Beyond 1000m.
- salinity dec – 300 – 1000m – lower latitudes.
- Rapid Rate of change in salinity [300m – 1000m]
  ↳ Zone of steep gradient [Halocline].



Temperature - Ocean Waters

- ocean water gets Heated up by solar energy just as Land.
- Process of Heating & cooling of oceanic water - slower than land.

Factors affecting Temp. distribution

Latitude
- Temp. of surface water dec. from equator towards poles
⇓
Amount of Insolation dec. polewards

Unequal distribution of land & water
- Ocean - North Hemisphere
↓
Receive more heat due to their contact with larger extent of land than Oceans
↓
South Hemisphere.

Prevailing winds
- winds blow from land towards oceans
↳ drive warm surface water away from coast
↓
upwelling of cold water from below
↓
Longitudinal variation in Temperature.

Ocean currents
- warm ocean currents - Raise the Temp. in cold areas.
- cold ocean currents - dec. Temp in warm ocean areas.

NOTE:- Enclosed seas in low latitudes → Records Relatively Higher Temp. than Open seas

Enclosed seas in High latitude → lower Temp. than open seas.

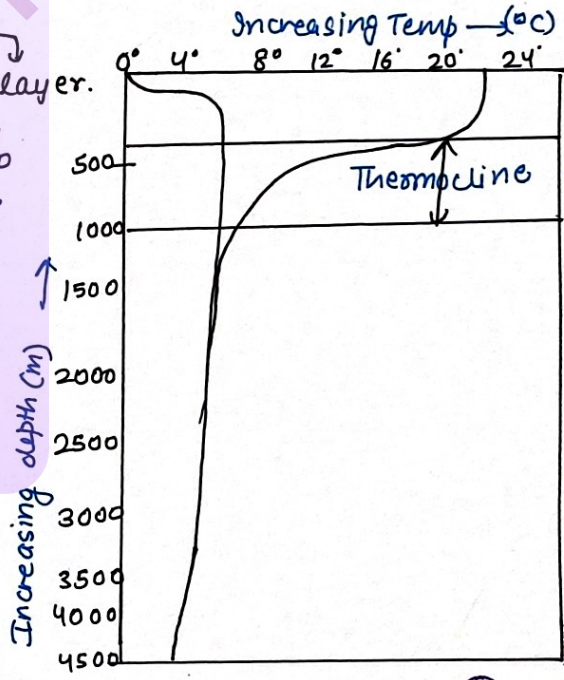
HORIZONTAL & VERTICAL DISTRIBUTION OF TEMP.

- Temperature decreases with Increasing depth.
- Profile - shows boundary Region b/w surface water of ocean & deeper layers.
  - ↳ Begins around 100-400m below sea surface & extend several Hundred of metres downwards.
- This boundary Region → where there is Rapid dec. of Temperature [THERMOCLINE]
- About 90% Total volume of water - found below thermocline. ↳ Temp. approach 0°C.
- Middle & Low latitude - 3 layer system

Ist layer
↓
Top layer of warm oceanic water
- about 500m thick with Temp. Ranging b/w 20° & 25°C.
- within Tropical Region ↓ Present throughout the year
- Mid latitudes ↓ only during summer.

second layer
[Thermocline]
↳ lies below first layer
- Rapid decrease in Temp. with Increasing depth
- 500 - 1000m thick.

third layer.
- very cold & extends upto deep ocean floor
- Arctic & Antartic circle ↓ Surface Temp. close to 0°C & Temp. change with depth is very slight ↓ Only one layer of cold water exist.



HORIZONTAL DISTRIBUTION OF TEMP.

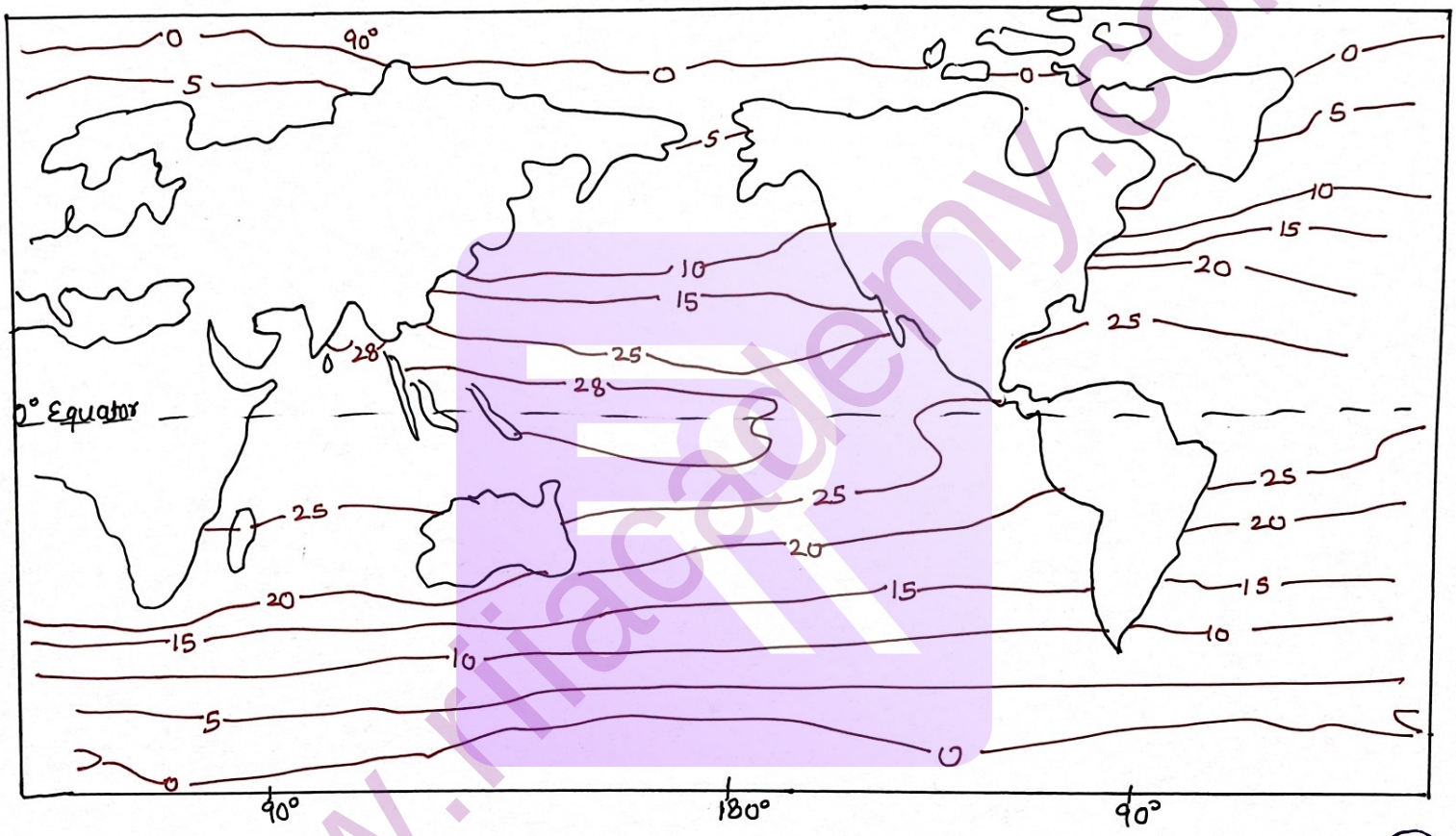


Fig:- Spatial Distribution of surface Temp (°C) of Oceans.

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