Iqra National University

Department of Civil Engineering

Final-Term Assessment

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Course Title: Water Demand Supply and Distribution
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Q1) Define desalination and briefly describe various desalination methods? which method is more effective. Please elaborate briefly?

Ans) Desalination :-

It can be defined as any process which removes excess salts and minerals from water (or) the chemical process of changing seawater into portable water are called desalination.

→ Methods of desalination :-

There are various methods of desalination which is used to remove salts and other minerals.

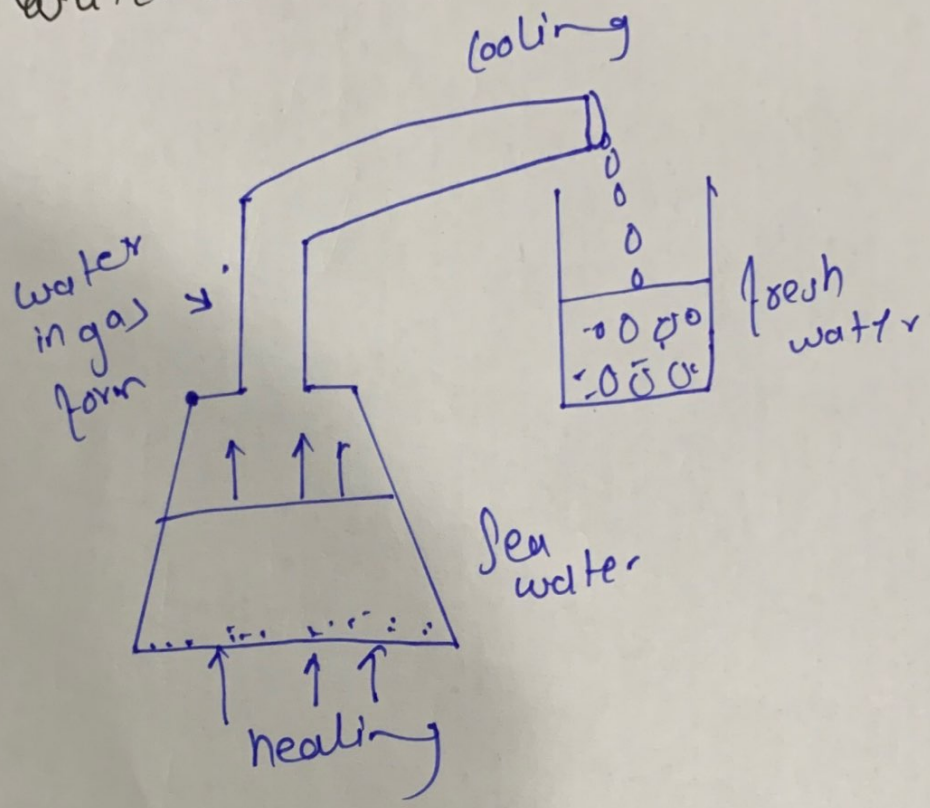
1) Distillation
2) electrodialysis
3) freezing
4) Reverse osmosis.

① Distillation:

Distillation is the oldest ~~method~~ and most commonly used method of distillation. distillation is a phase separation method where by saline water

heated to produce water vapours which is than condensed to produce fresh water. which is best for drinking purposes

→ The major drawback of distillation is high fuel cost to convert Sea water into vapours.

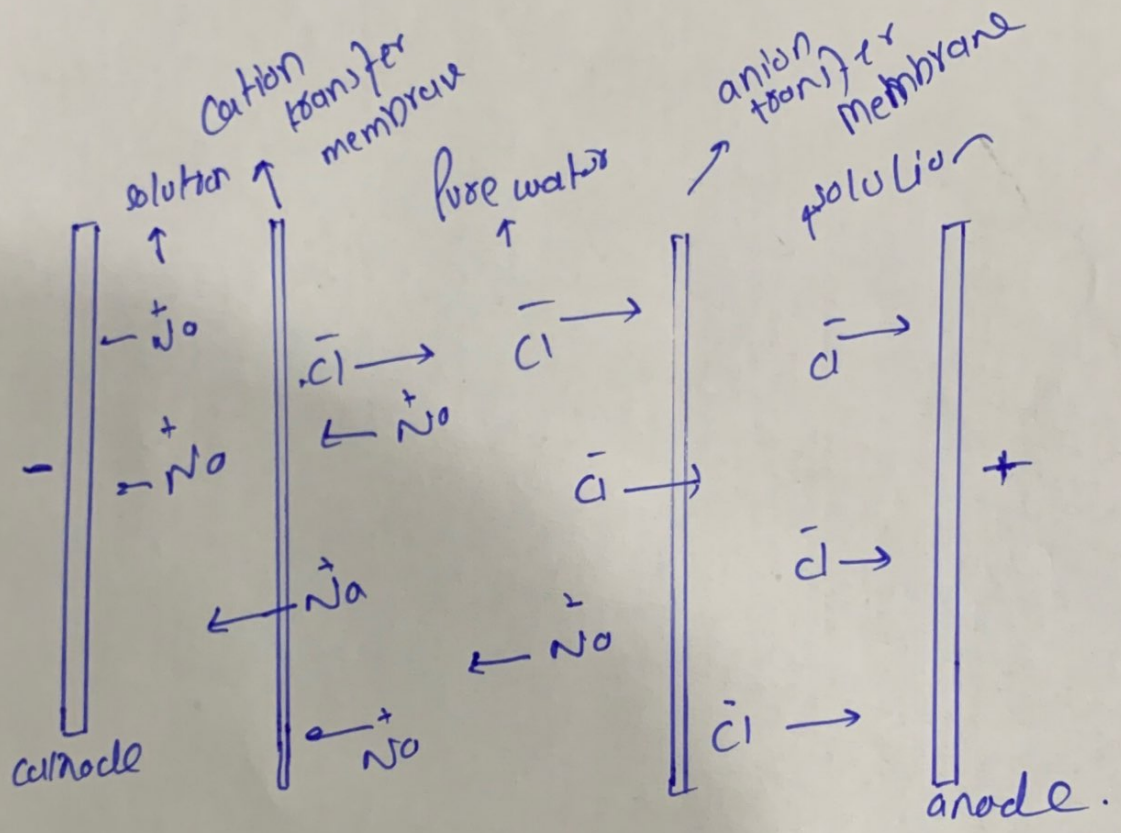


② Electrodialysis :-

a voltage driver electodialysis method is uses electric potential to removes salts using a membrane, leaving fresh water behind

→ water contain dissolved salts in the form of ions and these ions get

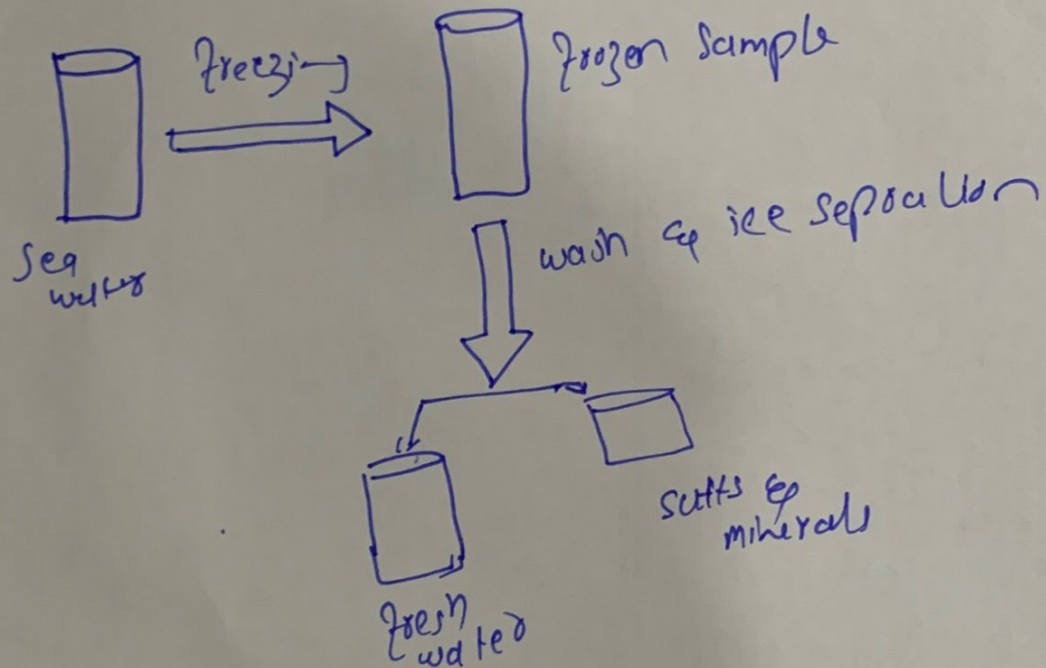
attracted towards oppositly charged electrodes. Electrodialysis can be used to seprate salts and fresh water. this method uses suitable membrane to permit passage of selective ions either cations or anions.



3) Freezing Method :-

The principle involved in freezing distillation is that, the dissolved salts present in the sea water are separated during the formation of ice crystal. Sea water can be desalined

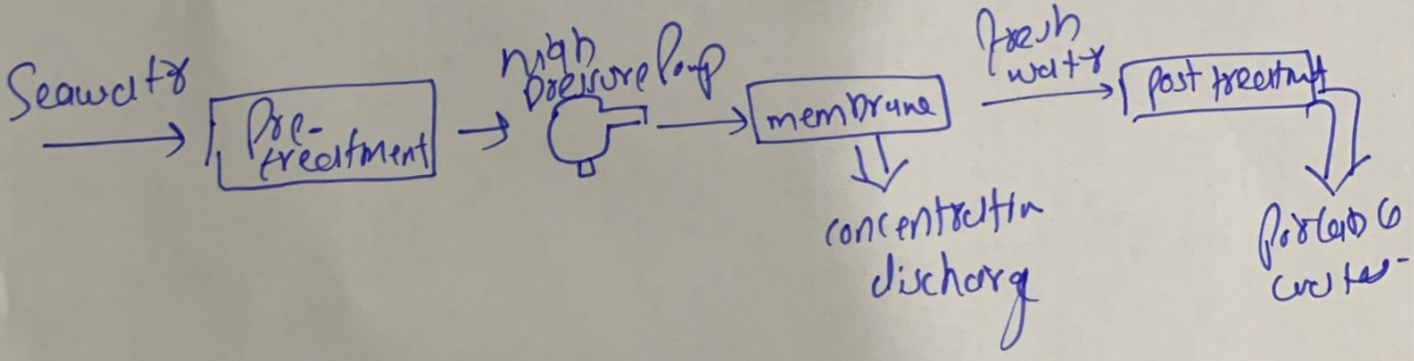
by cooling the water to form crystals Before the total amount of seawater has been frozen. the mixture is washed to removed the salts present in the remaing water or that is sticking to the ice crystals. The ice is than melted to produce fresh water



④ Reverse Osmosis (RO):

In reverse osmosis distillation water is taken from the sea and recieves a first treatment to eliminate impurities, oil, rubish etc. once free of organic substances, the salt water can be

subjected to reverse osmosis. After the filteri we have two streams. one brine and other is freshwater. The brine solution is diluted before being returned to the sea. avoiding high concentration of salts which could harm the ecosystem. The fresh water passes through a remineralization and chlorination process after which it is stored in tanks and than sent to the distribution network for consumption.



⇒ effective method of desalination:

Thermal distillation is the most effective method to convert sea water into fresh water. Thermal distillation removes an average of 99.8%. of the salt and recovered 37%. of the initial water.

on the base of cost, time & energy. Freezing desalination is most efficient but will not completely desalinate the water.

Q2) Briefly describe merits & demerits of 4 types of distribution layouts? which layout will you recommend for newly proposed township in hilly area?

Ans) There are four different types of distribution system.

1) dead end system.
2) Grid-iron-System
3) Ring System
4) Radial System

1) Dead-end-Systems:

It is also known as tree-System. It consist of one main supply from which Sub-main has to be taken. Each Submain - then divided into branch pipes known as Laterals from Laterals house connection has to be taken.

Advantage.

① The distribution network can be solved easily & accurately.
② The calculation of discharge and pressure at any points in the system is easy.
③ Lesser number of valves required to control & regulate the flow of water.
④ The length of pipes needed are less.
⑤ it is cheap & simple.

Disadvantages

① As the water is reached through one route any damage in pipe will complety stop the water.
② This system have anumber of dead-ends that prevent a free circulation of water.
③ As the flow is from one direction during emergency water cannot be diverted from other sicle..

① Grid-iron-System:-

An this system the mains, submains & branches are interconnected with each other. This system is hence more suitable for well planned city.

advantage:

① As the flow of water is more than one route, the discharge to be carried by each pipe, the friction loss & the size of pipe is therefore reduced.

② In case of repair, very small area will be deprived of supply.

③ During emergency more water can be diverted towards the affected point.

④ Due to interlinked connection, the dead ends are completely eliminated.

dis-advantages.

① This system requires more length of pipes and accessories.

② → construction is costly.

③ experts are needed to design the system.

③ Ring System:-

in this syten a closed ring, either circular or rectangular, of the main pipes formed around the area to be served. The distributed

area is divided into rectangular & circular blocks. This System is suitable for well planned road.

advantages:

1. No stagnation of water
2. Repair work can be done without affecting larger network.
3. Large quantity of water is available for fire fighting.

Dis-advantages:

1. Longer length & larger diameter pipes are required.
2. More number of cutt off valves are necessary.
3. Skilled workers are necessary while laying pipes.

(4) Radial distribution System:-

In this System whole area is divided into small distribution districts or zones and an individual distribution reservior is provided for each distribution zone.

Advantage.

① → The water distributed with high velocity & high pressure.

② → head loss is very small because of quick discharge

dis-advantages

① Cost of project is more because of number of individual distribution reservior.

⇒ for newly proposed toonship in hilly areas. in my opinion radial system is more efficient rather than other distribution layouts. whole area is divided into zones of districts. reservoir can be constructed in each zone. due to gravity difference water will be collected into the reservoir and than distributed into the zones.

Q3) what are the different type of reservidors used in water supply system? Breifly describe its importance & how its storage capacity be calculated?

Ans) Reservior:- A water supply scheme drawing water directly from a river or a stream may fail to satisfy the consumer demand during extremely low flows it may difficult to carry out its operation due to devasting floods a barrier in the form of dam, is therefore constructed across the river, so as to form a pool of water. is known as reservoir.

Types of reservoir:-

depending on the purpose served. there are following types of reservoir.

1) Storage reservoir.
2) flood control reservoir.
3) multi purpose reservoir.
4) distribution reservoir.

→ Storage reservoir :-
A storage reservoir can retain such excess supplies during periods of peak flows and can release them gradually during low flows and when the need arises

→ Flood control reservoir :-
A flood control reservoir, generally called a flood mitigation reservoir, stores a portion of the floods. flows in such away as to minimize the flood peaks at the area to be protected downstream

There are two basic types of flood mitigation reservoir.

① → storage reservoir.
② → Retarding reservoir

→ Multi-Purpose reservoir :-
A reservoir planned and constructed to serve not only one purpose but various purpose together is called a multi-purpose reservoir

→ distribution reservoir :-
distribution reservoir connected with the conduits of a primary water supply used to supply water to consumer accordly to

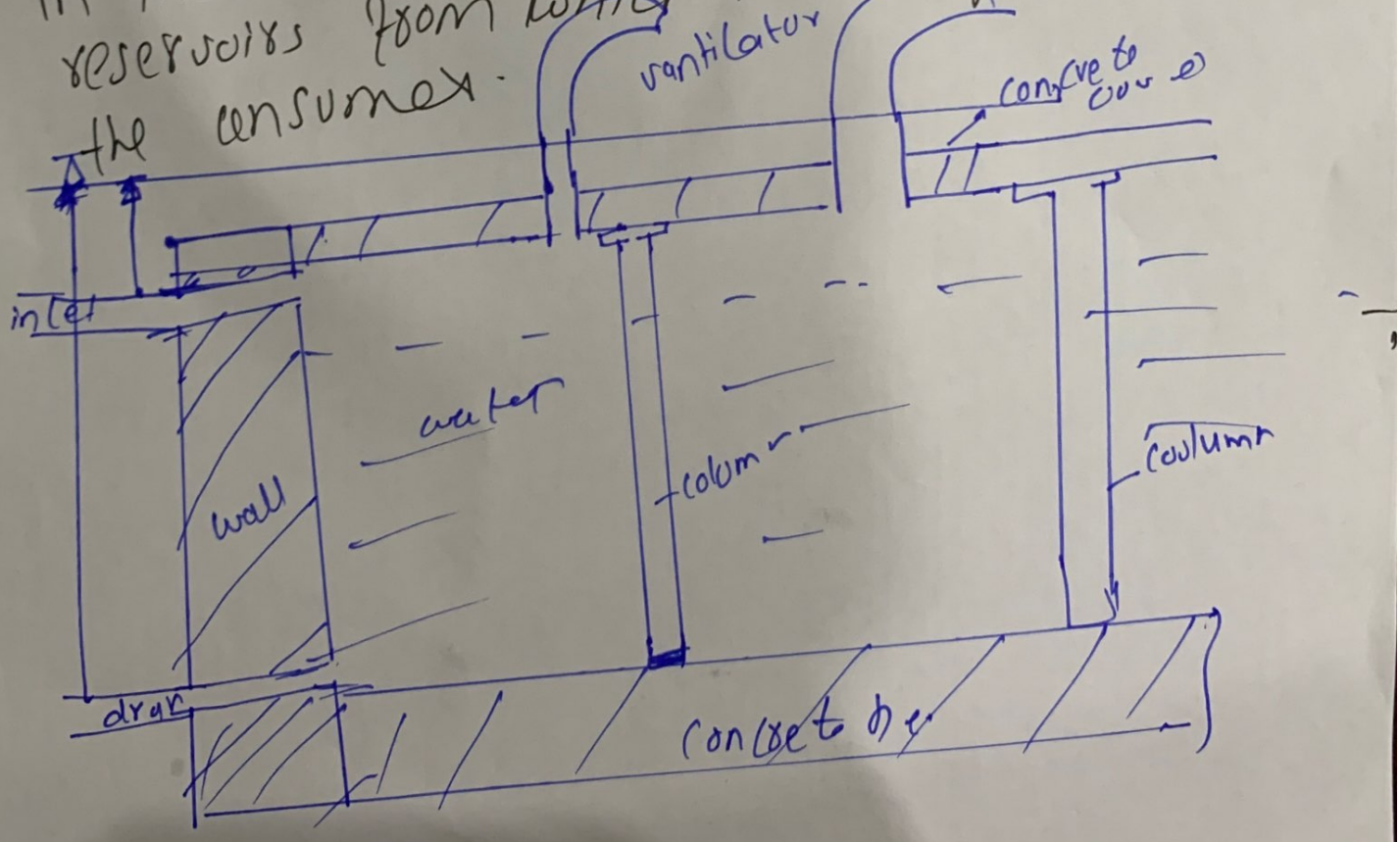
fluctuation in demand over short time periods and serves for local storage in case of emergency.

⇒ Depending upon their elevation w.r.t ground. two type of reservoir.

→1) Surface reservoir.
→2 Elevated reservoir.

Surface Reservoir:

Surface reservoirs are circular or rectangular in shape - These reservoir are constructed at ground level hence these are also called ground reservoir. The treated water stored in these reservoirs is pumped to elevated reservoirs from which it is supplied to the consumer.



Elevated reservoir:

→ elevated reservoir are constructed at an elevation from ground level. These reservoirs are also known as overhead tanks. These reservoirs may be rectangular circular in shape. however, with the advancement in structural analysis. it is possible to construct the elevated reservoir in any shape to suit the architectural requirment.

→ water is pumped to elevated reservoir from surface reservoirs and then supplied to the consumers.

→ Storage capacity of distribution Reservoirs:-

The storage capacity of a distribution reservoir to be provided is based on the following requirment

① Balancing storage.
   a→ hydrograph method
   b→ mass curve method
② Break down storage
③ fire storage.

① Balancing storage:-

The main function of a distribution reservoir is to provide storage

to meet the fluctuating demand of water with a constant rate of pumping of water into the reservoir. The quantity of water required being stored in the reservoir for balancing or equalising this variable demand of water against the constant rate of pumping is known as balancing storage or balancing reserve

The balancing storage of a distribution reservoir can be determined by the following two method.

→ Hydrograph method:-

→ Mass curve method.

$$S = \Sigma p + \Sigma d$$

⇒ Breakdown storage..

The break down storage are often called emergency storage is the storage preserved in order to tide over the emergencies posed by the failure of pump

→ A value of about 25% of the total storage capacity of reservoir or 1.5 – 2 times of the average hourly supply may be

considered as enough provision for counting this storage.

3) Fire storage:-

A provision of fire storage in a distribution reservoir is required to be made to provide water for fire fighting purpose. The fire fighting requirements are based on the recommendations indicated there the fire storage for a distribution reservoir may be provided.

$$Q_f = 65\sqrt{P}(1 - 0.01\sqrt{P})$$

$$Q_f = 53\sqrt{P}$$

$$Q_F = 320(\sqrt{A})$$

Q4) why Pumps are used in water supply schemes and how to calculate Pump Curve to meet water demand?

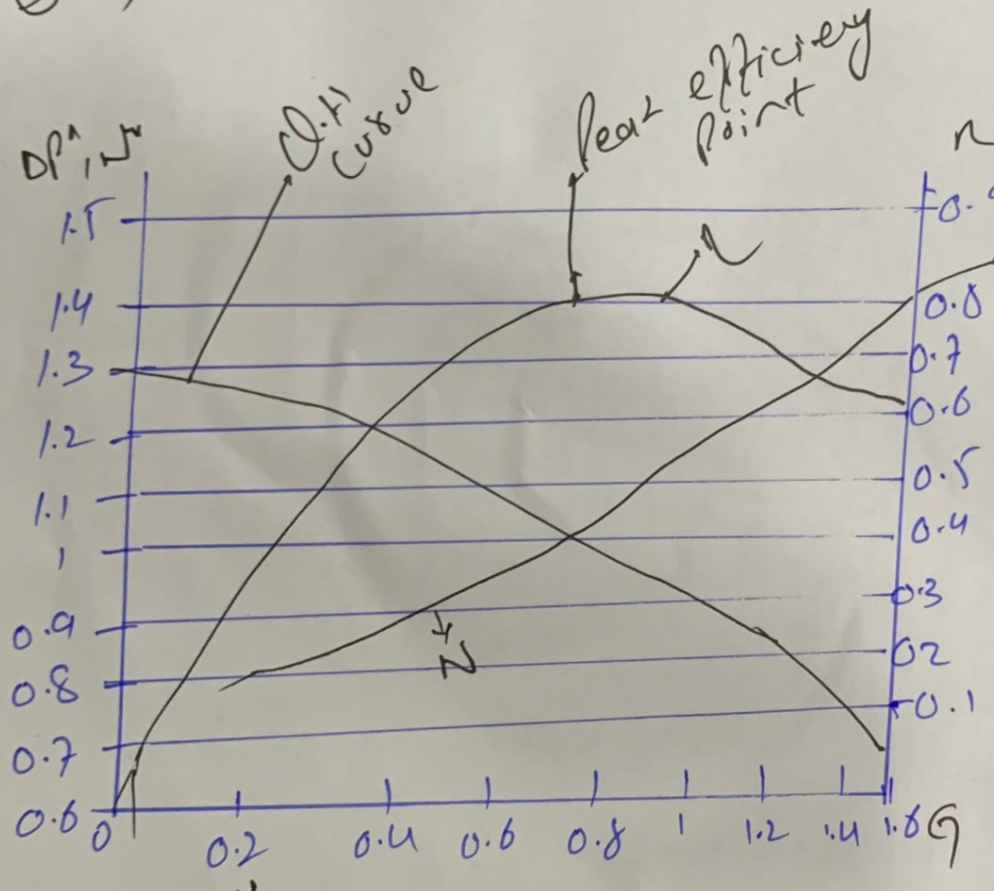
Ans) Pumps are used in distribution systems. Pumps that lifts surface water and move it to a nearby treatment plant are called Low Lifts - Pumps. These moves large volume of water at a relatively low discharge pressures. Pumps that discharge treated water into arterial mains are called high Lift Pumps. These operate under higher pressure. Pumps that increases the pressure within the distribution system or raise water into an elevated storage tanks are called booster Pumps. well Pumps lift water from underground and discharge directly into a distributi System.

⇒ Pump Curve:-

The performance of any type of a pump curve can be shown graphically which can be based on either the tests conducted by the manufacturer or the simulations done by the designer.

These plots are presented as pump-characteristic curve. The hydraulic properties of any pump (e.g) centrifugal pump can be described by the following characteristics.

① → Q-H curve.
② → efficiency curve.
③ → Net Positive Suction head (NPSH) curve



$$NPSH_{available} = H_a + h_o - h_v$$

h_a = Suction head at impeller
h_o = atmospheric pressure
h_v = vapour pressure.

$$h_a = h + v^2/2g$$

h = Pressure at impeller entran
v = velocity of water at impeller entrance.