(To be filled by the Candidate)

Name of Examination: Agricultural Engineering

Medium of the Exam: English.

Agricultural Engineering (Mock Test II)

Paper I

Time allowed: Three Hours **Maximum Marks: 200**

General Instructions

This Question-Cum-Answer (QCA) Booklet contains 76+3 pages. Immediately on receipt of the Booklet, please check that this QCA Booklet does not have any misprint or torn or missing pages or items, etc. If so, get it replaced by a fresh QCA Booklet.

Candidates must read the instructions on this page and the following pages carefully before attempting the paper.

Candidates should attempts all questions strictly in accordance with the specified instructions and in the space prescribed under each question in the Booklet. Any answer written outside the space allotted may not be given credit.

Question Paper in detachable form is available at the end of the QCA Booklet and can be removed and taken by the candidates after conclusion of the exam.

(To be filled by the Candidate)

Roll No. .....

Name of Examination .....

Question-Cum-Answer Booklet Serial No.

[Above Serial No. should not be written in the Table or anywhere else in the Question-Cum-Answer Booklet]

(To be filled by Supervisor)

Attendance No.	**Invigilator's Signature**

Do's:

1. Read the instructions on the cover page and the specific instructions to this Question Paper mentioned on the next page of this Booklet carefully and strictly follow them.
2. Write your Roll number and other particulars, in the space provided on the cover page of the Question-Cum-Answer-Booklet.
3. Write legibly and neatly in ink. Pencil may be used for drawing diagrams, sketches, etc.
4. For rough work, blank pages provided at the end of this booklet should be used. The rough work should be crossed through afterwards.
5. If you wish to cancel any work, draw your pen through it or write "Cancelled" across it, otherwise it may be valued.
6. Hand over your Question-Cum-Answer-Booklet personally to the invigilator before leaving the examination hall.

(To be filled by Examiners only)

	Question No.	Starting Page No.	Marks	Section Total	Signature of Examiner
	1	5	21		
	2	15	24		
	3	23			
	4	31	24		
	5	39	21		
	6	49	19		
	7	57			
	8	65			
		Grand Total	109		

109/200

Do only 5 (you have done six)

8th question will be not evaluated

SECTION A

Q.1- Write critical notes, within 150 words each, on the following: 8×5=40

Q1(a) Compute the peak runoff rate of 15 years return period from a watershed area of 150 ha to design the field diversion. The sub-watersheds of 50 ha, 75 ha and 25 ha are kept under cultivation (c = 0.5), forest cover (c = 0.3) and grassland (c = 0.3), respectively. The other details are as follows: 8

(i) The maximum length of watercourse = 2500 m

(ii) Relief = 50 m

(iii) Slope of watershed = 2.5%

(iv) Watershed soil is clay; values of a, b, k and n are 0.1483, 0.50, 7.176 and 0.9459, respectively.

3

$A = 150\,ha$

$A_1 = 50\,ha \Rightarrow C_1 = 0.5$

$A_2 = 75\,ha \Rightarrow C_2 = 0.3$

$A_3 = 25\,ha \Rightarrow C_3 = 0.3$

$$C = \frac{A_1C_1 + A_2C_2 + A_3C_3}{A}$$

$$= \frac{(50 \times 0.5) + (75 \times 0.3) + (25 \times 0.3)}{150}$$

$$= 0.366$$

$$T = 0.0195\, L^{0.77} S^{-0.385}$$

$DH = 50$

$L = 2500$

$$S = \frac{DH}{L} = \frac{50}{2500}$$

$$T = 0.0195\,(2500)^{0.77} \left(\frac{2.5}{100}\right)^{-0.385}$$

min

$$T = 2.178$$

$$t_c = 36.298 \text{ min}$$

$Q = \frac{CIA}{360}$ rational equation for runoff.

$$i = \frac{k T^q}{(D+b)^n}$$

$$Q = CiA$$

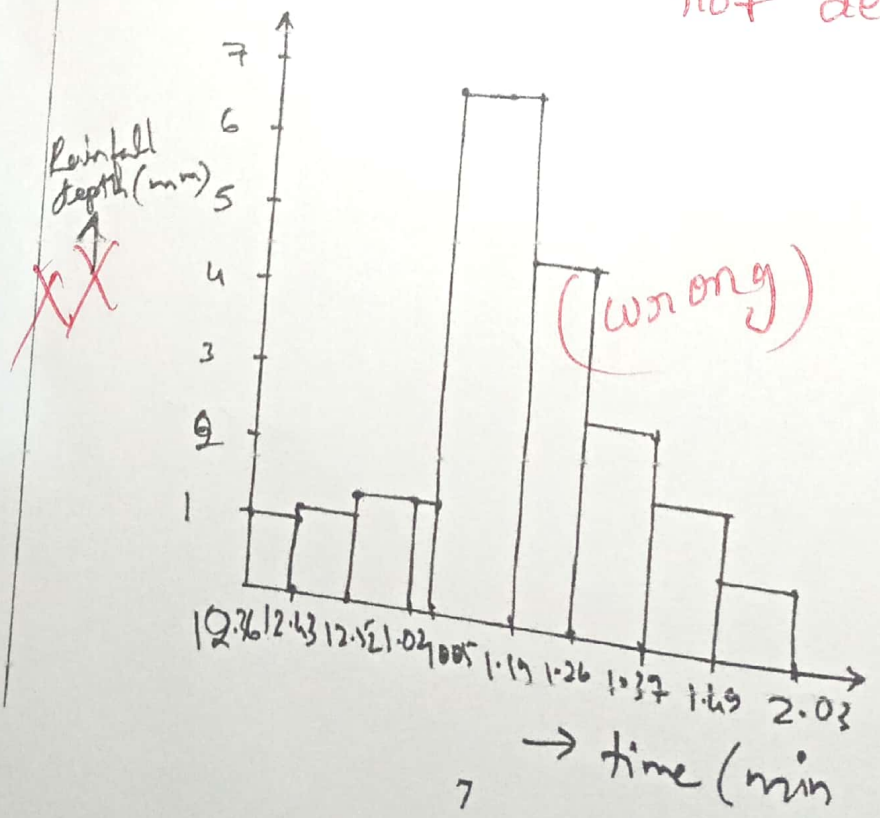
Q.1(b) Construct a hyetograph from the rainfall data provided in the table: [8]

Time (h)	Time interval (min)	Rainfall depth received in time interval (mm)
12:43 p.m.	7	1.0
12:52 p.m.	9	1.2
1:02 p.m.	10	1.5
1:05 p.m.	3	1.5
1:19 p.m.	14	6.5
1:26 p.m.	7	4.6
1:37 p.m.	11	2.6
1:49 p.m.	12	1.8
2:03 p.m.	14	1.2
Rain stopped at 2 : 03 p.m.		

(2)

hyeto → intensity Vs time

not depth



(wrong)

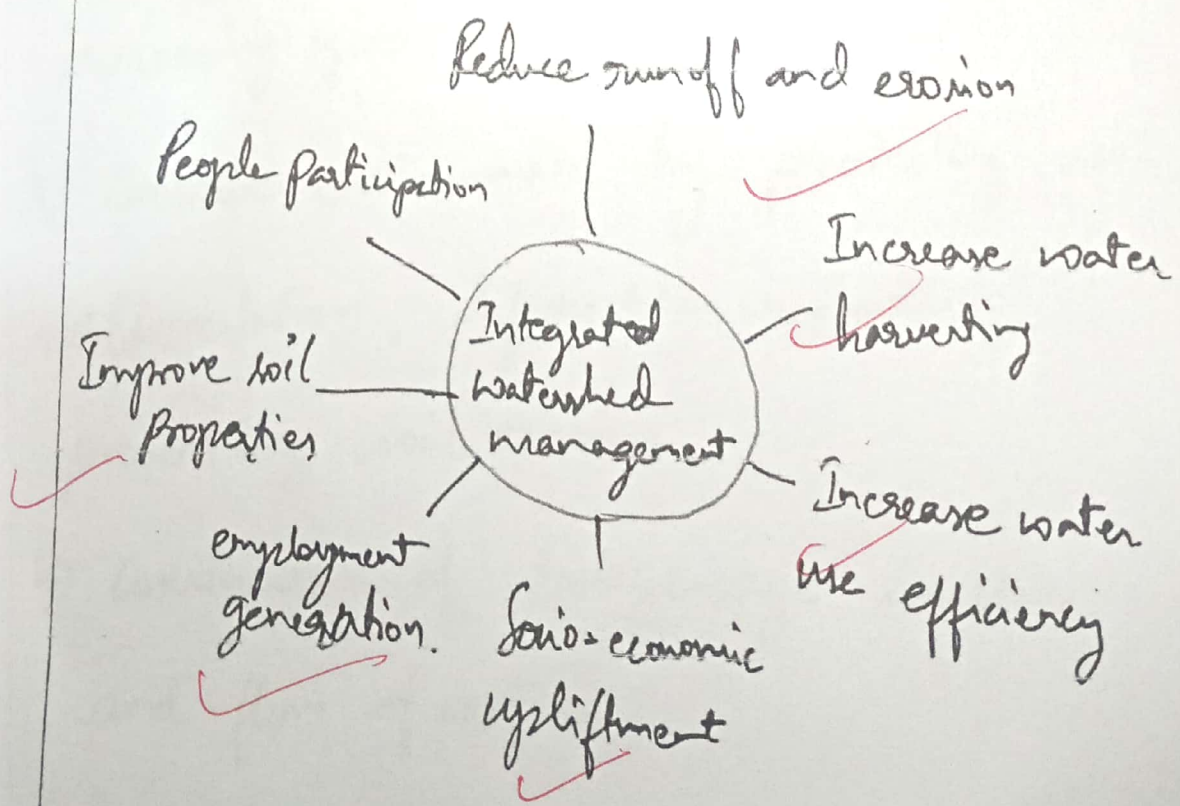
Hyetograph is a graphical representation of the amount of rainfall in a given time in a given watershed.

intensity Vs time

- It helps to compute run off hydrograph by providing data of the storm and its intensity.

Q.1(c) What is integrated watershed management approach? Explain its different objectives 8

(6) Integrated watershed management involves judicious use of all resources in the watershed area which includes soil, forest, vegetation, biodiversity.



Objectives of Integrated water shed management

1) Create employment → Use of MGNREGS scheme to construct water harvesting structures.

2) Socio-economic upliftment → Increase the per capita income of the people by increasing yield.

3) Conserve environment by protecting soil, afforestation, deforestation reduction, preventing soil erosion.

4) Construction of storage structure and flow of water.

) Explain a procedure for checking rainfall data of a station for consistency 8

6

Rainfall data of a station is measured by rain gauges. These are kept in ~~watershed~~ checking different locations and measured.

Double Mass curve

Procedure of measuring

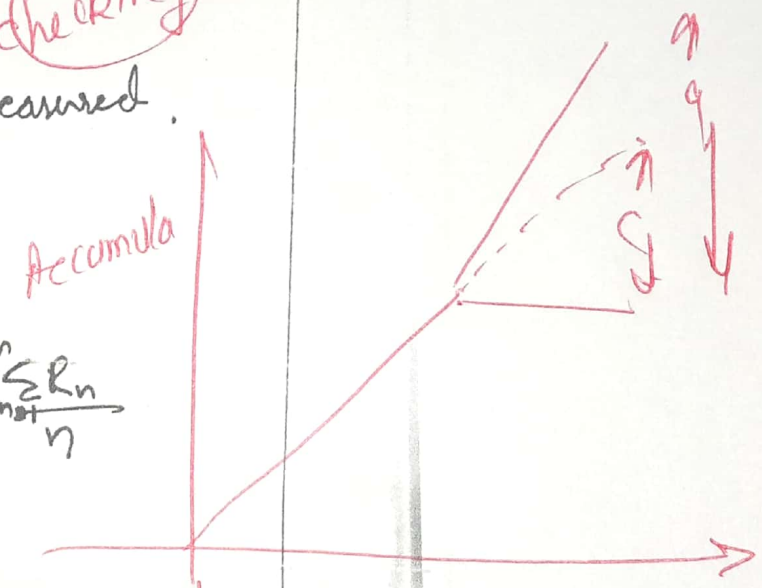
1) Arithematic method. $= \frac{\sum_{n=1}^{n} R_n}{n}$

2) Thessian polygon method.

$$Q = \frac{\sum_{n=1}^{n} R_n A_n}{\text{Area}}$$

3) Isohytal method

$$Q_2 = \frac{\frac{P_1+P_2}{A_1} + \frac{P_2+P_3}{A_2} + \dots}{\text{total Area}}$$



$$\frac{P_{cx}}{P_x} = \frac{M_c}{M_a}$$

Procedure to check consistency :-

Double mass curve method. (good)

$$\frac{P_x}{P_x} = \frac{M_c}{m_a}$$

⇒ The water station rain gauges surrounding the problem station is taken. Around 5 to 7 stations are selected.

⇒ Average of the stations are plotted any deviation of the rain gauge can be found out and rectified.

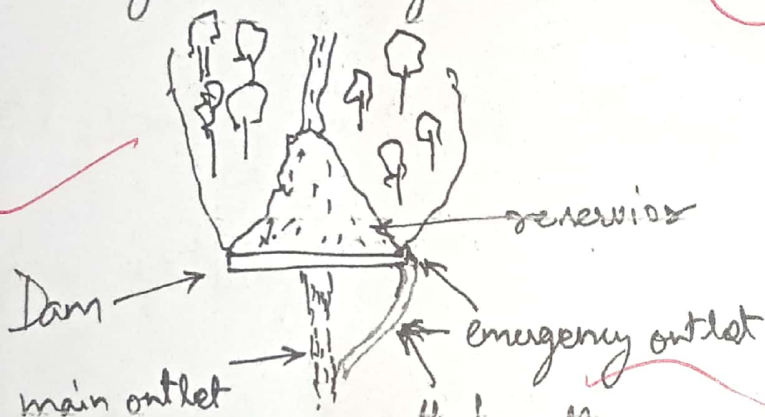
1(e) Define flood routing. Discuss the basic elements of flood routing. 8

to predict the out flow hydrograph

Flood routing is a method of diverting the flow of water away from the dam to protect its structural or hydraulic design.

4

Musking



inflow

outflow

a) The flow of the water, storage capacity of the dam and the dead storage should always be constant

» If there is a storm of high intensity in a duration which is not constant. Flood routing is done to avoid and loss of lives, property and protect the structure of the dam.

» Flood routing is done through emergency spillways.

» The construction of dam is done using data of 25 to 50 years rainfall but as the siltation increases the carrying capacity of the dam reduces.

Answer the following questions in about 250 words each:

a) Discuss the issues and challenges related to watershed management. What is the role of peoples' participation in watershed development **15**

Water shed management is the (10)

Judicious use of all water sources of a given water shed area efficiently and economically.

Issues of watershed management

1) Lack of data → Data for the rainfall intensity, rainfall pattern are not available.

2) Population increase → The demand of water and land for agriculture and industry has risen sharply which puts stress on 15 water sources.

3) deforestation → Deforestation of fdistarshed area and conversion into agrialture land.

4) Non scientific irrigation and agrialture practises.

5) Siltation of water storage area.

6) Ground water exploitation.

Challenges

1) lack of peoples participation.

2) Political activities of free electricity and low charges of water.

3) lack of conjuctive use of all water sources both surface and subsurface water

4) Expensive construction of canals which are not lined to avoid seepage and leaching.

Role of peoples participation

1) Planning of watershed management.

2) Proper useage of all sources both ground water and surface water.

3) Useage of water in night time as seen in warabandi in Utharpradesh

4) Growth of agro forestry.

5) women participation in cleaning of water sources.

Q2(b) The ordinates of the 2-h unit hydrograph of a watershed are given below:

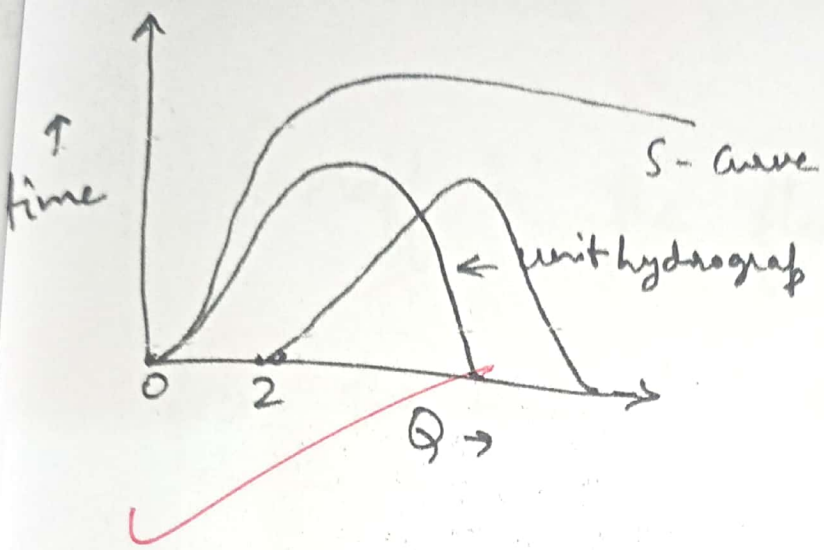
Time, h	0	2	4	6	8	10	12	14	16	18	20	22
2-h UH ordinates, m^3/s	0	20	90	150	180	160	100	60	25	15	5	0

Determine the ordinates of S-curve hydrograph and using S-curve determine the ordinates of the 4-h unit hydrograph of watershed

15

(4)

Time	2h UH	2h UH lagged 2 hours	S curve	S curve
0	0	—	0	0
2	20	0	20	20
4	90	20	110	110
6	150	90 =110	260	260
8	180	150 =260	330	440
10	160	180	340	660
12	100	160	260	700
14	60	100	160	840 X760
16	25	60	85	865 X785
18	15	25	40	880 X800
20	5	15	20	885 X805
22	0	5	5	885 X805
24		0	0	

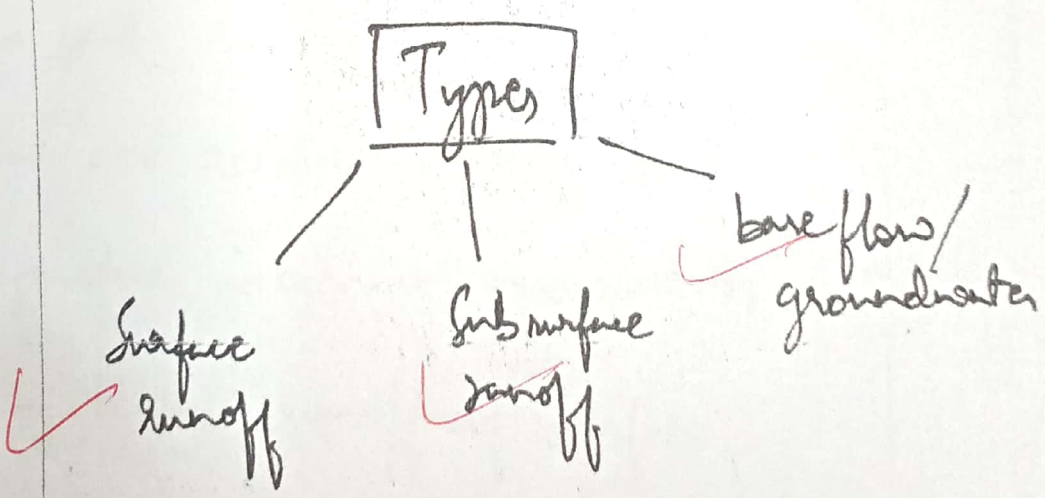


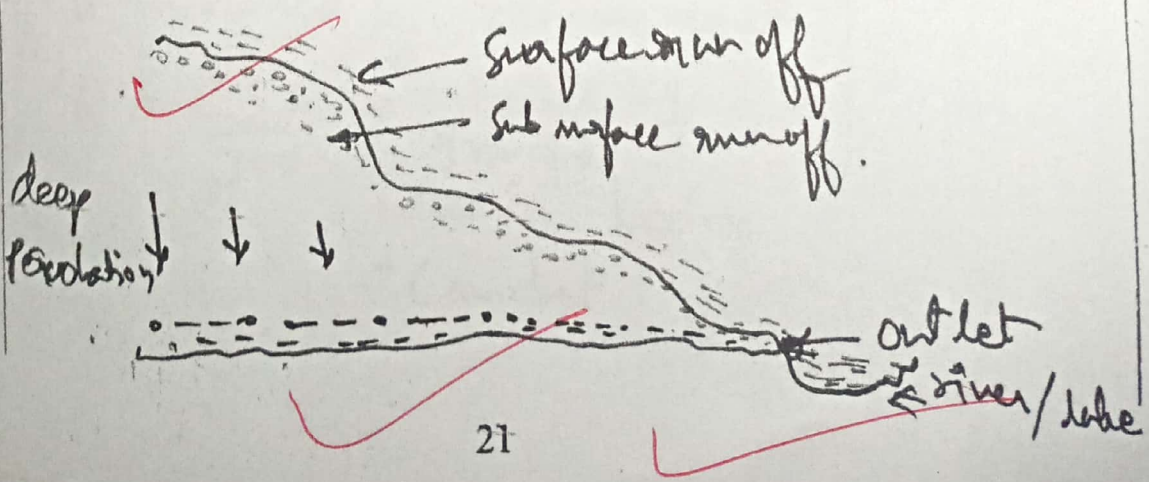
Q2(c) What are the different types of runoff? Explain the factors that affect the runoff in a watershed

10

6

Runoff is the flow of excess water from the watershed to the outlet after the initial losses, interception losses, depression storage are met.





Factors affecting runoff

1) Interception → Interception losses of rain due to canopy cover

2) Vegetation → trees and deep rooted plants facilitate deep percolation.

3) Soil texture, soil profile, soil compactness soil structure plays an important role

Ex:- clay has more rainfall runoff than sand.

4) Wind and relative humidity and temperature increases evaporation leading to less runoff of rainfall.

runoff is measured by ramsar equation

of $Q = \frac{CIA}{360}$ → intensity of rainfall - I

$\frac{22}{7}$

→ area in hectres

→ C constant.

shape of water

slope

Drainage Density

Area of L

4- **Answer the following questions in about 250 words each:**

(a) Differentiate between the following: 15

(i) Specific capacity of well and Specific yield of aquifer

(ii) Pumping test and Recuperation test of a well

(iii) Confined and Unconfined aquifers

10

i)

-) Specific capacity of well is the amount of water that can be stored in the aquifer. measured by drawdown volume

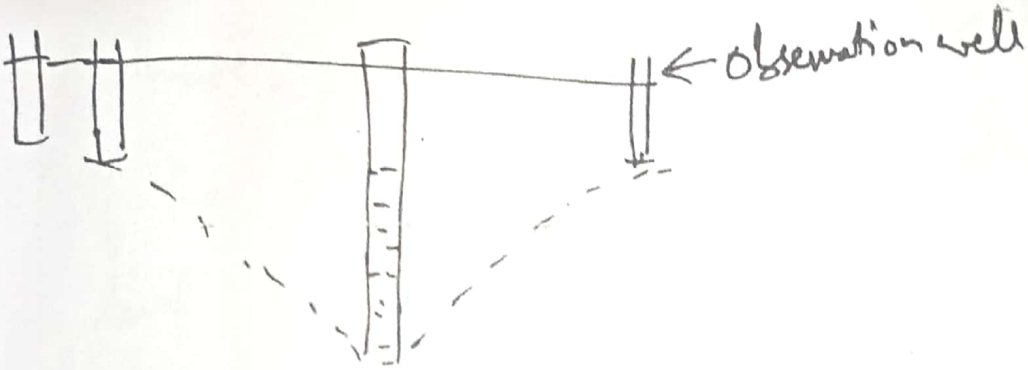
-) Specific yield of aquifer is the amount of water that can be extracted without harming the aquifer.

It can be measured by the quantity of water output using weirs, orifice flumes.

$$Sy = \frac{Vd}{V}$$

Pumping test → to obtain hydraulic properties

The amount of water that can be obtained. The yield and the drawdown relationship.



Recuperation test

test hydraulic conductivity, porosity of the aquifer. The amount of time required to recharge the well after the drawdown to its original state.

Confined aquifers → The water is under pressure trapped under non permeable layer such as clay or granite. The pressure is more than atmospheric pressure (Deep below 30m)

These aquifers create artisan wells.

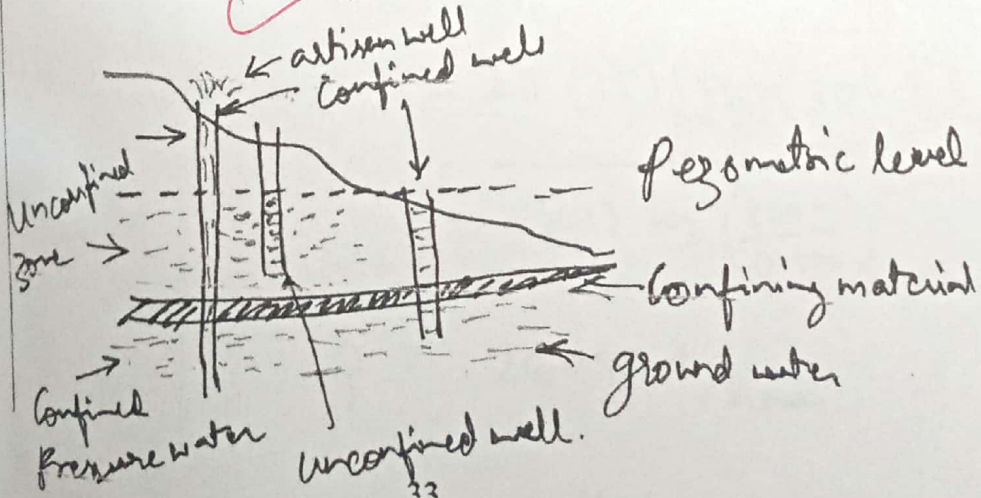
if the outlet is below the piezometric level.

Unconfined aquifers → Upper layer of free underground water

water in subsurface area.

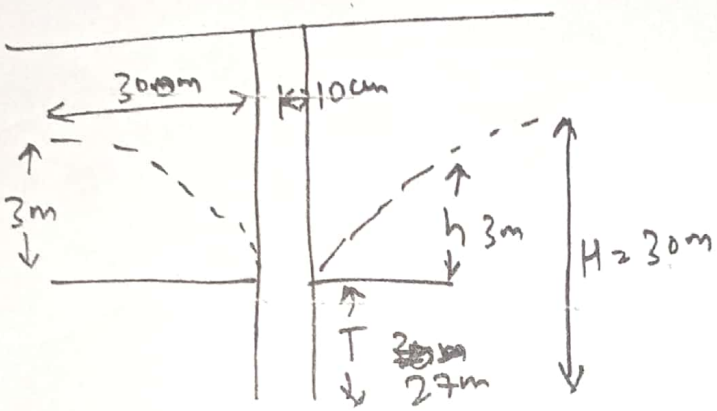
Pressure less than atmospheric pressure

→ Soil is sandy, sandy loam.



Q4(b) A tubewell is established in an artesian aquifer. Find its yield in litres per hour for a drawdown of 3 m when the diameter of the well is 20 cm and the thickness of the aquifer is 30 m. Assume the coefficient of permeability to be 35 m/day. If the diameter of the well is doubled, find the increase in the yield, the other conditions remaining the same. Assume the radius of influence as 300 m in both cases.. 15

6



$k = 35$ m/day

$$Q = \frac{2\pi k b (H-h)}{2.3 \log (R/r)} = \frac{2\pi k b s_w}{\ln (R/r_w)}$$

$$= \frac{2\pi (35)(27)(30-3)}{2.3 \log \left(\frac{300\,m}{0.1\,m}\right)}$$

$b = 30$

$s_w = 3$

$= 193000$ lit/hr

$Q = 20,054$ l/hour

If diameter doubled

$$= \frac{2\pi k T (H-h)}{2.3 \log(R/2r)}$$

$$= \frac{2\pi k T (\cdot}{}$$

$$\frac{2\pi (35 \times 2)(30-3)}{2.3 \log\left(\frac{300}{0.2}\right)}$$

b = 30

$$Q = 2154.8 \text{ l/hour.}$$

$$\frac{Q_2}{Q_1} = 1.0947$$

$$\left(\frac{Q_2 - Q_1}{Q_1}\right) \times 100 = 9.42\%$$

Increase

Q4(c) What discharge can be expected from an unconfined well having diameter as 3.0 meters? The drawdown in the well is 8.0 m and the aquifer is saturated to a depth of 15.0 meters. The coefficient of permeability of the aquifer material is 5 meter per day and the radius of influence is 150 meters

10

8

$d = 3m \quad r = 1.5m$

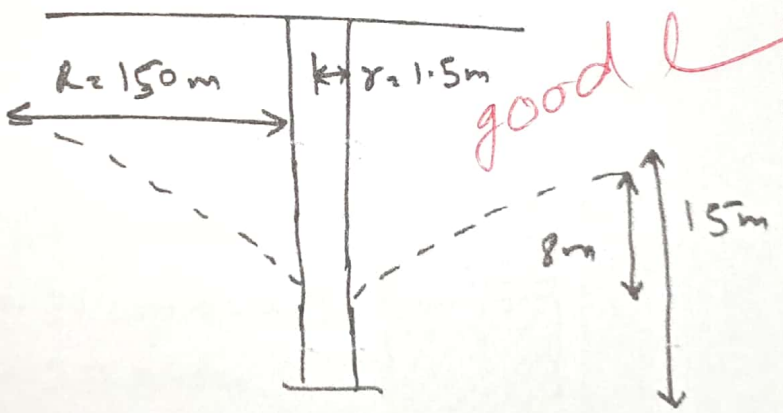
$h = 8m$

$H = 15m$

$r_{radius} = 150m$

$K = 5m/day$

Q 2



good

Unconfined well

$$Q = \frac{\pi K (H^2 - h^2)}{2.3 \log(R/r)}$$

good

$$= \frac{\pi (5)(15^2 - 8^2)}{2.3 \log\left(\frac{150}{1.5}\right)}$$

$Q = 550 m^3/sec$

SECTION B

Write critical notes, within 150 words each, on the following:

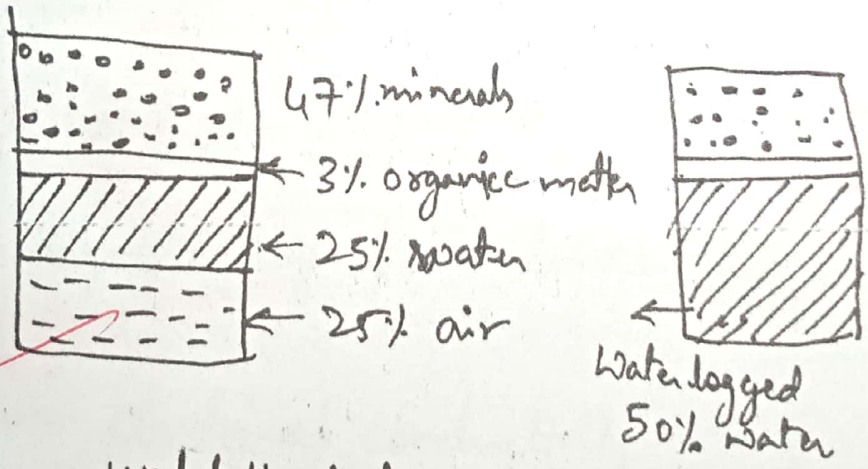
8×5=40

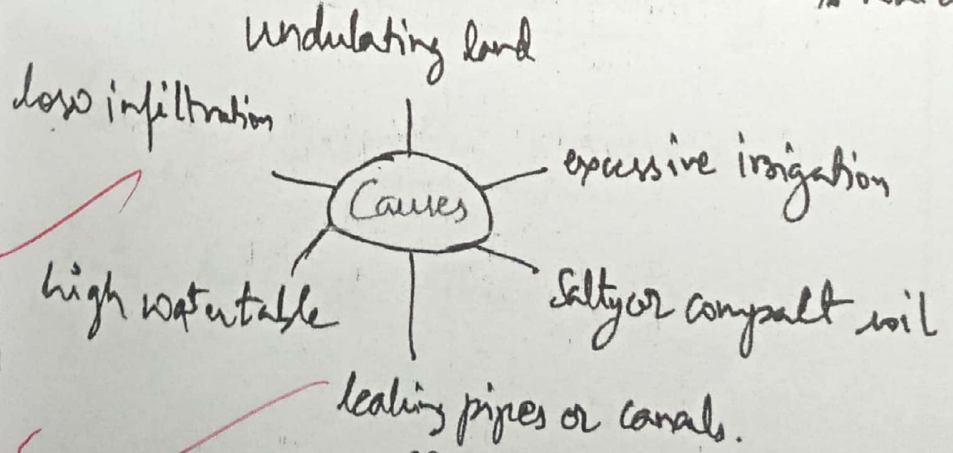
a) What are the causes of water logging and soil salinity in an irrigated agriculture/agricultural field

8

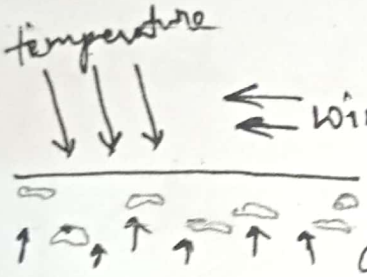
(4)

Water logging is a phenomenon where water is saturated in the soil and root zone. The water is filled in air voids reducing areation of soil





Salinity is the presence of excessive salt minerals due to capillary action or parent rock erosion.



capillary movement of salt.

Salt from lower parent material is pulled up due to capillary action due to high wind or temperature.

The salt is brought up from lower area

This increases electrical conductivity and reducing Osmotic pressure for plants to use the water.

Salt: Na, Mg, Ca, SO_4^{2-}, Cl

Causes of salinity
(High Rainfall
topography
poor quality/wa

Q5(b) Differentiate between ESP and SAR. Derive the relationship between these two indices. What are salt affected soils? Explain different reclamation measures to manage salt affected soils? 8

(3)

Exchangeable sodium percentage

» ESP stands for ~~exchangeable salt~~ particals which is the exchange of cation by plants during transpiration to suck in nutrients and water.

$$ESP = \frac{Na}{CEC} \times 100$$

·It is a measurement of alkaline soil

» SAR stands for ~~salinity~~ sodium adsorption ratio. It is a measurement of ~~saline~~ ~~soil~~.

$$SAR = \frac{Na^+}{\sqrt{\frac{Ca^{+2} + Mg^{+2}}{2}}}$$

Salt affected soil

» Soils which have high salt contents reducing the fertility and yield of the soil.

» There have white deposit on the soil layer

→ The electric conductivity is very high. above 25 measure.

Reclamation method

1) Addition of water and dissolving it and flushing it out.

2) leaching the water and soil mixture to ground level.

3) Addition of gypsum, sulphur, magnesium to remove alkaline soil through flocculation.

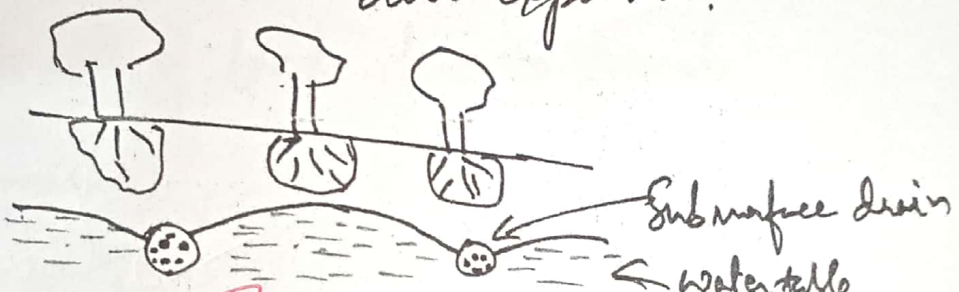
4) Deep ploughing.

5) Drainage of excessive ground water by vertical drainage or biological drainage. Construction of drains mole drain or tile drain

Q5(c) What is sub-surface drainage? What are the factors that cause increase in the ground water level? What are the advantages of sub-surface drainage over surface drainage ? 8

5

Sub surface drainage is the removal of water from subsurface zone of the soil. It reduces water logging at root zone and increases root expansion.



Factors for increase in groundwater

1) Heavy unseasonal rain in short duration.

2) loss of canopy cover.

3) leaking of pipes or canals

4) Excessive irrigation

5) lack of land leveling and land grading.

6) Soil compaction and presence of impervious substrata.

7) Blockage of drains by dirt or burrowing animals.

Advantage of Subsurface Drainage

1) No loss of land due to trench formation.

2) The root zone expansion.

3) Correct irrigation and water usage

4) No slumping or erosion of soil

5) low maintainence compared to surface drainage.

Disadvantage

1) Borrowing animals causes damage to the drains.

Q5(d) Discuss in brief the causes and reclamation of Saline and Alkaline soils

2

Saline and alkaline soils reduces the productivity and yield of the crop. They are due to presence of salts and bicarbonates. 8

Causes

- Excessive irrigation
- Climatic factor → temperature, wind relative humidity, rainfall.
- Parent rock → If parent rock is saline or alkaline the soil will have the same properties.
- Unplanned, non technical irrigation canals and drainage system.

Explain Leaching (Saline) and Gypsum (Alkali)

- leaking pipes and leaching canals.

Reclamation

(Manhon Reclohon method of saline and Alkali seperately

1) Physical method — hand picking of salt blocks
   — Deep ploughing.

Main Method
Saline — Leaching Requires
Alkali - Gypsum Requires

2) Structural — Drainage, surface, subsurface
   — Canal lining, pipe fixing

3) lowering water table — Biological (Poplar, Eucalyptus)
   — Vertical drainage by tubewell.

4) Chemical — Gypsum, Sulphur, sulphuric acid
   — leaching by solution added draining the solution either deep underground or outlet.

25(e) What is leaching requirement of a land? How is it determined 8

5

Leaching requirement is the amount of water that needs to be irrigated to form solution and remove salts from the land.

It is determined by electrical conductivity

$$L_R = \frac{EC_i}{EC_d} = \frac{\text{Electrical conductivity of irrigated water}}{\text{Electrical conductivity of drained water with salt solution.}}$$

$$L_R = \frac{D_i}{D_d} = \frac{\text{Salt in irrigated water}}{\text{Salt in drained water}}$$

$$LR = \frac{Dd}{Di}$$

47

This determines the amount of water required to remove salts.

» When both irrigation water and drained water come to equilibrium or acceptable range the watering is stopped.

$$D_i = W + D_d$$

$$D_i = W + D_i \times LR$$

$$D_i = \frac{W}{1 - LR}$$

Q-6 **Answer the following questions in about 250 words each:**

Q6(a) Runoff water from a watershed enters into a drainage area for 8 hours at the rate of 3 m^3/s. The total rainfall during 24-hour period is 12 cm and the total infiltration during the period is 4 cm. If the total drainage area is 200 ha and the crop can tolerate a ponding of 10 cm, calculate the drainage coefficient of the land

15

(2)

Q_2 3 m^3/s

I_2 12cm / 24 hours $= \frac{12}{100} \times \frac{200 \times 100 \times 100}{24 \times 60 \times 60}$

$= 2.78$ mm

Infiltration = 4cm

A = 200 ha

$input = \frac{V}{A} = \frac{8 \times 3 \times 3600}{200 \times 10^4}$

$= 4.32$ cm

input = 12 + 4.32

output = 4

Net = 12 + 4.32 − 4 = 12.32 cm

C = 12.32 − 10 = 2.32 cm

Q6(b) Discuss the following in brief: 15

(i) Mole drain

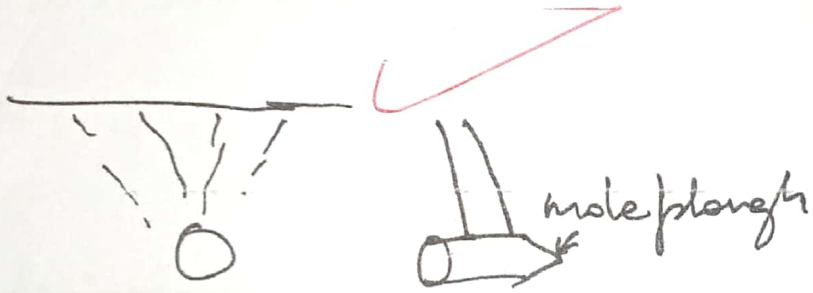
(ii) Interceptor drain

(iii) Bio-drainage

(iv) Channel lining

10

i) Mole drain is the drainage mechanism of using a Mole plough to create a hole inside the sub surface to drain excessive water.



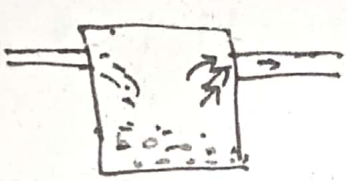
-> It is used in clay soil.

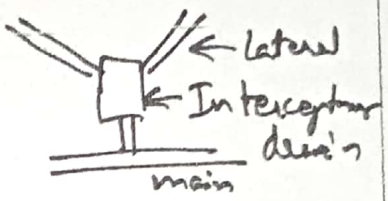
-> Need to be redone every 5 years.

-> Inexpensive than other sub surface drainage as it doesnot have tiles.

Interceptor drain

Intercept drain water from different location coming from lateral drains and divert it into main drain.

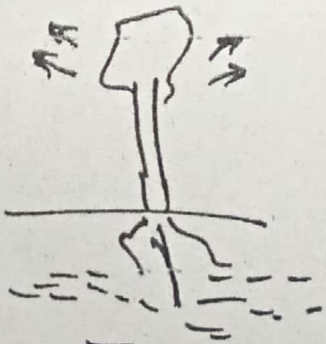




It also stores soil and silt from channel drain

Bio drainage

Use of plants which use more water for evapotranspiration. Example Eucalyptus and popular to drain water from the long water table areas.



Channel lining

Covering of channel using non permiable material to avoid seepage and leaching of the water to adjacent fields.

Material used are concrete, rocks, wooden poles, gibbion, plastic sheets.

Q6(c) Design an open Drainage to drain 550 hectares of land having drainage co-efficient of 2.5 cm. The soil is silt-loam and maximum permissible slope of the channel bed is 0.1 percent and side slopes 1.5:1. Assuming d = 1.2 m, considering the requirements of Free board. Decide the suitable section. Take roughness co-efficient as 0.04. 10

$A = 550 h$

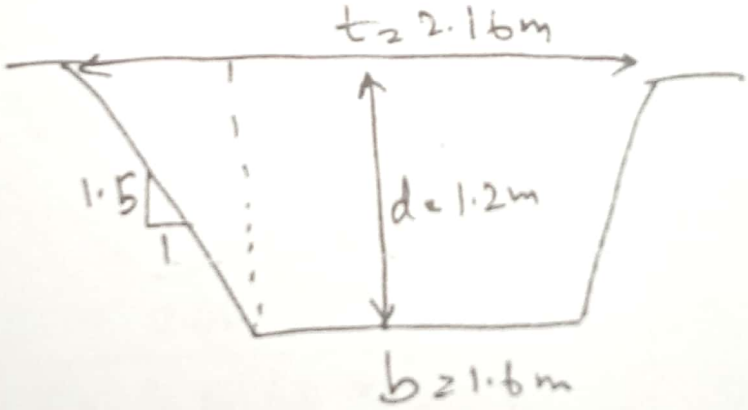
$d_c = 2.5 cm = \frac{2.5}{100} = 0.025 m$

$S = 0.1\% = \frac{0.1}{100} = 0.001$

Side Slope = 1.5 : 1

$d = 1.2 m$

$n = 0.04$



$b = 2d \tan \theta/2$

$= 2(1.2) \tan\left(\frac{33.69}{2}\right)$

$b = 1.6 m$

$\tan \theta = 1/1.5$

$\theta = \tan^{-1}\left(\frac{1}{1.5}\right)$

$\theta = 33.69$

$$Q = \frac{2.5}{100} \times \frac{550 \times 100 \times 100}{24 \times 60 \times 60}$$

good

$$\boxed{Q = 1.59\ m^3/sec}$$

Perimeter of drain $= b + 2d\sqrt{z^2+1}$

$$= 1.6 + 2(1.2)\sqrt{(1.5)^2+1}$$

$$\boxed{P = 5.92m}$$

$$\text{Area} = bd + zd^2$$

$$= (1.6)(1.2) + (1.5)(1.2)^2$$

$$\boxed{A = 4.08\ m^2}$$

$$R = \frac{A}{P} = \frac{4.08}{5.92} = 0.689$$

$$V = \frac{1}{n} R^{2/3} S^{1/2}$$

$$= \frac{1}{0.04} (0.689)^{2/3} (0.001)^{1/2}$$

$$\boxed{V = 0.6168\ m/sec}$$

Top width $= 1.5d$

$= 1.8m +$

Total $= 1.8 +$ free board 20%. $= \boxed{2.16\ m}$

-8 **Answer the following questions in about 250 words each:**

)8(a) Distinguish between a shallow tube well and a deep tube well. 15

7

Tubewell are a narrow well of diameter less than a meter which is sunk into the surface of the ground to extract water from underground.

types - shallow tube well → PwL ≤ 6

deep tube well. → PwL > 6

Shallow tube well.

- Constructed in shallow groundwater area.
- The soil is clay or sandy loam.
- Depth is between ~~to~~ 3 to 10 meter.

8 **Answer the following questions in about 250 words each:**

8(a) Distinguish between a shallow tube well and a deep tube well. 15

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Tubewell are a narrow well of diameter less than a meter which is sunk into the surface of the ground to extract water from underground.

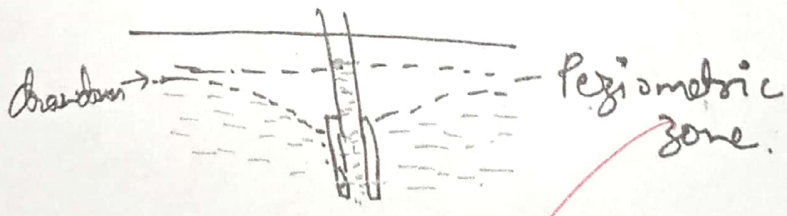
types - shallow tube well
deep tube well.

PWL ≤ 6
PWL > 6

Shallow tube well.

- Constructed in shallow groundwater area.
- The soil is clay or sandy loam.
- Depth is between ~~10~~ 3 to 10 meter.

- Equipment used are auger drill, hammer drill, precussion drill.
- The wells have a filter and water extracted using pumps.
- Some of the wells are ~~artisan~~ below pezometric level which is having atmospheric pressure more than above ground level.

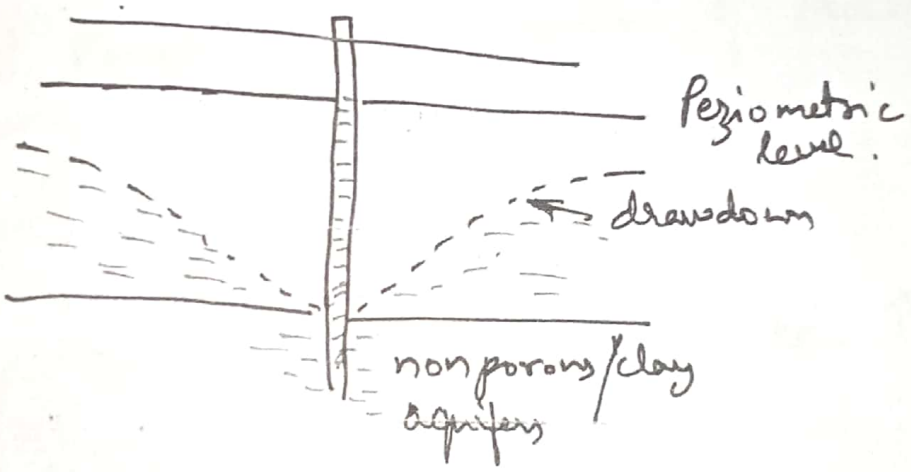


Deep tube well

- The depth is more than 6 meter.
- It is constructed to obtain water from deep aquifer

The well construction is done using driven equipments.

⇒ The water is obtained after entering non porous confined aquifers.



⇒ The water comes out to peziometric level due to pressure difference.

⇒ The difference in pressure is due to forces exerted on the water from confined layer which is more than atmospheric pressure.

Q8(b) What are the sources of drainage problems? What are the ill-effects of drainage? 15

10

Sources of drainage problems.

1) Deforestation on impervious forming

2) Burrowing animals which damages low infiltration

3) Blocks the drainage. Heavy rainfall

4) Sloughing and erosion of sides of drainage

5) excessive rain good which exceeds the capacity of drainage.

6) Calcifer and bacterial blockage of drains.

7) Blockage of drains due to dirt, silt and organic matter

6) Undulated land. good

7) low canopy cover and vegetation.

8) land compaction due to movement of farm machinary.

Ill effects of drainge

1) Increase in salt and alkaline in the land.

2) Reduction in soil temperature.

3) Reduction in anerobic bacteria and increase in harmful pest and deseases

4) Reduction in ability of plant to transpire due to root water saturation.

5) Root transpiration is low leading to root rot, as carbon dioxide increases and reduce Oxygen.

6) Reduction in yield of the crops.

7) It carries away the fertilizer and pesticides of the field.

8) Removes the seeds of the crop which is planted.

8(c) Name five points to be considered for selection of site for pumping tests. 10

1) Collect data about pumping area

2) The soil profile, soil texture, soil structure

3) The site should be selected after careful consideration of disposal of pumped water to a safe location.

4) The pumped water should not enter the soil again.

5) The drawdown should not affect the socio-economy of the area.

6) It should not reduce the yield of the adjacent crops or have any affect on them.

7) It should not have adverse affect on water region by excessive drawdown and should not hinder the ability to recharge.

8) The region of water pump test should not be hydraulically connected to other region and other aquifers

9) Should have enough space to implement testing or observation well to check drawdown.

10) The testing should be economically feasible.