Summer Mid Paper (2020)

I-D :- 7493

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Subject :- Eng Hydrology & water Mangemat

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Date :- THU, 20, Aug, 2020

Answer # 01

Given Data :-

$K = 0.4$, $\rho_a = 1.34\ kg/m^3$

$P = 115.21 \times 10^3\ N/m^2$, $\rho_w = 1000\ kg/m^3$

$V = 2.88\ m/sec$, $e_o = 5690\ N/m^3$

$Z = 3.44\ m$, $e_a = 2540\ N/m^2$

$Z_o = 0.46mm = 0.00046\ m$

Required Data :-

Calculate evaporation = ?

Solution :-

As we know that

$$C = \frac{0.622\ K^2 \rho_a V}{P \rho_w \left[\ln\left(\frac{Z}{Z_o}\right)^2\right]}$$

$$C = \frac{0.622\ (0.4)^2 \times 1.34 \times 2.88}{115.21 \times 10^3 \times 1000 \left[\ln\left(\frac{3.44}{0.00046}\right)^2\right]}$$

$$C = 4.18998 \times 10^{-11}$$

(2)

$$E = C\,(e_o - e_a)$$

$$E = 4.1899 \times 10^{-11}\,(5690 - 2540)$$

$$E = 1.3 \times 10^{-7}\ m/sec$$

$$E = 1.3 \times 10^{-7} \times 1000 \times (1 \times 60 \times 60 \times 24)$$

$$\boxed{E = 11.23\ mm/day}$$ — Ans

Answer # 2 (a)

(1) Hydrologic Equation:-

The quantification of the hydrologic cycle which is an open system can be represented by a mass balance equation

$$I - O = \Delta S = I = O \pm \text{Change in Storage.}$$

where I is in flow into system during a defined period.

"O" is out flow from a system during a defined period and Δs is change in storage in the system during the period.

This equation uses the principle of conservation of mass in a closed system where by any water entering a system must be transfered into either evaporation surface runoff or stored in the ground.

Δs chang in storage may be subdivided into several parts.

- Change of moisture storage in the soil (ΔM)
- Change of lakes and reserviors (ΔL).

- Change in river channels (ΔSc)
- Change in Glaciers (ΔSG)

So $\Delta S = \Delta M + \Delta L + \Delta Sc + \Delta SG$.

(11) **Relative Humidity :-** Relative humidity is the ratio of the partial pressure of water vapor to the equilibrium vapor pressure of water at a given temperature. Relative humidity depends on temp and the pressure of the system of interest. The same amount of water vapor result in higher relative humidity in cool air than warm air.

The relative humidity (RH or ϕ) of an water mixture is defined as the ratio of the partial pressure of water vapor (P_{H_2O}) in the mixture of the equilibrium vapor pressure of water over a flat surface of pure water at a given temperature

$$\phi = \frac{P_{H_2O}}{P^*_{H_2O}}$$

(III) Lapse Rate :-

The lapse rate is defined as the rate of decrease with height for an atmospheric variable. The variable involved is temperature unless specified otherwise. The termonology aries from the word lapse in the sense of a decrease or decline: thus the lape rate is the rate of decrease with height and not simply the rate of Chang. while most often applied on earth atmosphere.

$$\gamma = \frac{dT}{dz}$$

T = Temperature
z = Altitude.

(IV) Meterology :-

Melerology is the science that studies atmospheric phenomina especially those that relate to weather. Meterologistists who forcast the weather rely on thousand of weather station located around the world, both on land and sea.

(v) Precipitation :-

- Precipitation is the discharge of water (in liquid or solid form) out of atmosphere.
- The principal form of precipitation is rain and snow and to a loser extend is hail, steel etc.
- Precipitation is divided from atmospheric water.
- other factor such as wind, temperature, atmospheric pressure and local landscape can influence precipitation.

Answer # 2 (B)

Ans **Uses of Precipitation Data :-**

- Run off Estimation Analysis.
- Amount of infiltration.
- Ground water Analysis.
- water balance studies of catchments.
- Flood Analysis for design of hydraulic structure.
- Real time Flood Forecasting.
- Low Flow studies.
- water logging and Salanity.
- Environmental Effects of water Resources Project.

Types of Precipitation :-

There are three types of Precipitation.

(i) **Convectional Precipitation :-**

Convectional Precipitation result from the heating of the earth's surface. The warm ground heat the air over it. As the air warm the air molecules begin to move further apart with increased distance between molecules the molecules are less density packed. Thus the air become higher and rises

rapidly into the air becomes atmosphere. As the air rises, it cool weather vapour in the air condenses into clouds and precipitation.

Generally this kind of precipitation occur in tropics, where on a hot day, the ground surface get heated unequally. causing the warmer air to lift up.

(2) Orographic Precipitation :-

orographic precipitation result when warm moist air moving across the ocean is forced to rise by large mountains. As the air rises it cools. Cold air cannot hold as much moisture as warm air. As air cools the water vapour in the air condeses and water droplets are form. Clouds form and precipitation occurs on the wind ward side of the mountain. The air is now dry and rises over top the mountain. As the air move back down the mountain it collect moisture from the ground via evaporation. This side of the mountain is called lee ward side. It recives very little precipitation.

(3) Cyclonic Precipitation :-

Cyclonic or frontal precipitation results when the leading edge of a warm, moist air mass meets a cool and dry air mass. The molecules in the cold air are more tightly packed together and thus the cold air is heavier than the warm air.

The warm air mass is forced up over the cool air. As it rises the warm air cool the water vapour in the air condenses and clouds and precipitation results.

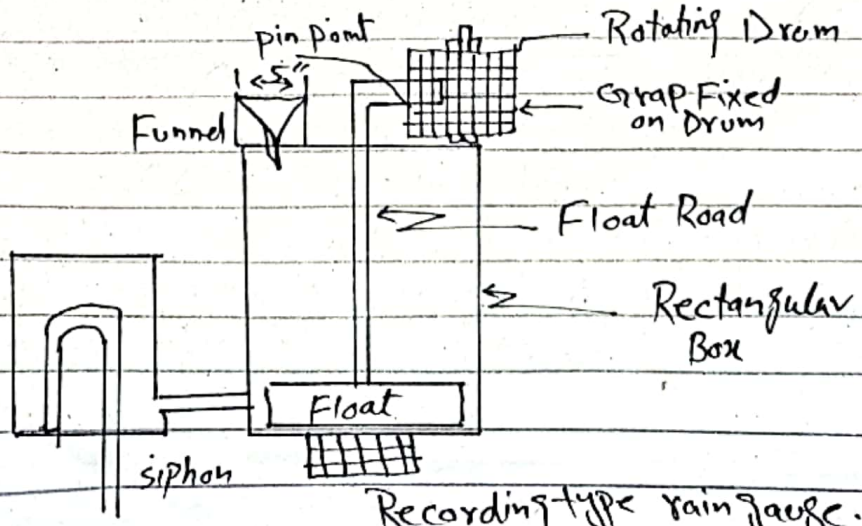
This precipitation is common in Atlantic Canada. This type of system is called frontal precipitation because the moisture tends to occur along the moisture tends to occur along the front of air mass.

Answer # 2 (c)

Ans **Flooting type recording rain gauge:-**

Working is similar to weighing gauge bucket. Funnel recives the rain water which is calleded in rectangular Container. Float is provided at the bottom of container. Float is rassed as the water level rises as the water level rises in the Container. Movement of float is being recorded by a pen moving on recording drum.

When the water level in the container rises so that float touches the top, the siphon comes into operation and release the water thus the water in the box is drain out.



Recording type rain gauge.

Answer # 3(a)

Thiesen Polygon Method.

Rain gauge Station	Polygon Area (Km^2) "A"	Precipitation (mm)	A × P ($km^2 . mm$)
A	12	23.64	283.68
B	71	31.18	2213.78
C	42	18.52	777.84
D	57	21.87	1246.59
E	13	22.35	290.55
F	34	29.18	992.12
G	88	38.22	3363.36
Sum	317		9167.92

$$P_{AV} = \frac{\Sigma (A \times P)}{\Sigma A}$$

$$= \frac{9167.92}{317}$$

$$\boxed{P_{AV} = 28.920 \text{ mm}}$$ — Ans

Answer # 3 (b)

Isohytel Method

Isohytes (cm)	Area b/w Isohytes (km^2)	Average Precipitation $\frac{P1+P2}{2}$	Product $A \times \frac{P1+P2}{2}$
16.25			
	14	19.3	270.2
22.35			
	35	20.48	716.8
18.61			
	92	15.54	1429.68
12.47			
	72	14.295	1029.24
16.12			
	44	16.62	731.28
17.12			
	19	18.15	344.85
19.18			
	52	19.745	1026.74
20.31			
Sum	328		5548.79

$$P = \frac{\Sigma\left(A \times \frac{P1+P2}{2}\right)}{\Sigma A} = \frac{5548.79}{328}$$

$$\boxed{P = 16.9170 \text{ cm}}$$ — Ans