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POSTAL BOOK PACKAGE 2024

CONTENTS

CIVIL ENGINEERING

Objective Practice Sets

Engineering Hydrology

1 CHAPTER
Introduction and General Aspect of Hydrology

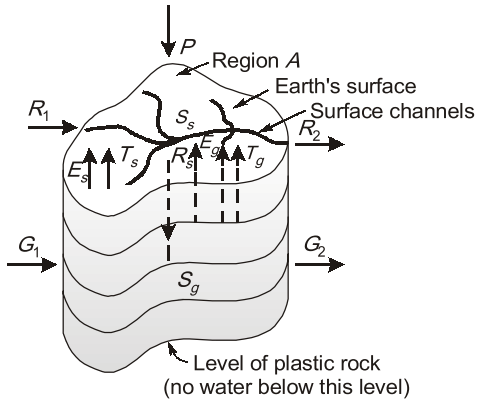
Q.1 Hydrology deals with
(a) process of depletion of water resources of land
(b) process of natural science of water
(c) process of various water phases
(d) All of the above

Q.2 What is 'Hydrological Cycle'?
(a) Processes involved in the transfer of moisture from sea to land
(b) Processes involved in the transfer of moisture from sea back to sea again
(c) Processes involved in the transfer of water from snowmelt in mountains to sea
(d) Processes involved in the transfer of moisture from sea to land and back to sea again

Q.3 In the hydrological cycle the average residence time of water in the global
(a) atmospheric moisture is larger than that in the global rivers
(b) oceans is smaller than that of the global groundwater
(c) rivers is larger than that of the global groundwater
(d) oceans is larger than that of the global groundwater

Q.4 If the average annual rainfall and evaporation over land masses and oceans of the earth are considered it would be found that
(a) over the land mass the annual evaporation is the same as the annual precipitation
(b) about 9% more water evaporates from the oceans than what falls back on them as precipitation
(c) over the ocean about 19% more rain falls than what is evaporated
(d) over the oceans about 19% more water evaporates than what falls back on them as precipitation

Q.5 Regional hydrological cycle is shown in the figure.



The correct hydrologic budget equations
(a) $P + R_1 - R_2 + R_g - E_s - T_s - I = DS_s$
(b) $I + G_1 - G_2 - R_g - E_g - T_g = DS_g$
(c) $P - (R_2 - R_1) - (E_s + E_g) - (T_s + T_g) - (G_2 - G_1) = D(S_s + S_g)$
(d) $P - R - G - E - T = DS_s$

Q.6 The hydrologic equation states that :
(a) Σ Inflow – Σ outflow = constant
(b) Sub-surface inflow = sub-surface outflow
(c) Inflow into the basin = outflow from the basin
(d) Inflow – outflow = change in storage

Q.7 Under identical conditions, the evaporation from sea water is
(a) about 2-3% less than that from fresh water
(b) the same as that from fresh water
(c) about 2-3% more than that from fresh water
(d) 8-9% more than that from fresh water.

Q.8 A watershed has an area of 300 ha. Due to a 10 cm rainfall event over the watershed a stream flow is generated and at the outlet of the watershed it lasts for 10 hours. Assuming a runoff/rainfall ratio of 0.20 for this event, the average stream flow rate at the outlet in this period of 10 hours is

(a) 1.33 m^3/s (b) 16.7 m^3/s
(c) 100 m^3/minute (d) 60000 m^3/h

Q.9 Rainfall of intensity of 20 mm/h occurred over a watershed of area 100 ha for a duration of 6 h. measured direct runoff volume in the stream draining the watershed was found to be 30,000 m^3. The precipitation not available to runoff in this case is
(a) 9 cm (b) 3 cm
(c) 17.5 mm (d) 5 mm

Q.10 A catchment of area 120 km^2 has three distinct zones as below:

Zone	Area (km^2)	Annual runoff (cm)
A	61	52
B	39	42
C	20	32

The annual runoff from the catchment, is
(a) 126.0 cm (b) 42.0 cm
(c) 45.4 cm (d) 47.3 cm

Q.11 The quantitative statement of the balance between water gains and losses in a certain basin during a specified period of time is known as which one of the following?
1. Water budget
2. Hydrologic budget
3. Ground budget
(a) 1 only (b) 2 only
(c) 3 only (d) None of these

Q.12 Which one of the following pairs is not correctly matched?
(a) Water losses — Evaporation
(b) Runoff — Stream flow
(c) Percolation — Soil erosion
(d) Storm — Precipitation

Q.13 The total rainfall precipitated during a storm is 10.0 mm and the antecedent moisture at the root in the soil was 5.0 mm, the loss of water due to seepage was 2.5 mm, losses due to percolation 2.0 mm, surface run-off 3.0 mm and the moisture retained in the soil is 1.0 mm. The amount of evapotranspiration from the area will be _____ mm.

Q.14 A reservoir has average water spread over 4 km^2. During two months period of study, surface inflow = 240 ha-m, surface outflow = 192 ha-m: rainfall = 28 cm; change in storage = (+)72 ha-m. By the hydrologic equation, the estimated reservoir losses are
(a) 160 ha-m (b) 120 ha-m
(c) 88 ha-m (d) 232 ha-m

Q.15 The catchment area of the irrigation tank is 50 km^2. The uniform precipitation in the month of October over the catchment was recorded to be 100 mm. 60% of the precipitation reaches the tank. The irrigation canal discharges at a uniform rate of 1 m^3/s in this month. If seepage loss is 50% of the evaporation loss, then evaporation loss is _____ $\times 10^6$ m^3.
[Assume losses take place due to evaporation and seepage only]
(a) 0.33 (b) 0.21
(c) 0.495 (d) 1.5

Q.16 A reservoir receives 5 ha-m water and the loss due to evaporation from the pan is 11 cm. It receives the rainfall of 5 cm over its plan area of 100 ha. The decrease in the level is observed as 3 cm. Taking the pan factor as 0.7, loss due to seepage will be
(a) 5 ha-m (b) 6 ha-m
(c) 7.3 ha-m (d) 5.3 ha-m

Q.17 Which of the following are pertinent to the realization of hydrological cycle?
1. Latitudinal difference in solar heating of the Earth's surface.
2. Inclination of the Earth's axis.
3. Uneven distribution of land and water.
4. Coriolis effect.
(a) 1, 2 and 3 only (b) 1, 2 and 4 only
(c) 2, 3 and 4 only (d) 1, 2, 3 and 4

Q.18 **Statement (I):** Condensation of water vapour into droplets precedes the precipitation process.
Statement (II): Formation of precipitation droplets is predicted on the presence of condensation nuclei.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I)
(c) Statement (I) is true but Statement (II) is false
(d) Statement (I) is false but Statement (II) is true

Q.19 The average surface area of a reservoir in the month of June is 20 km^2. In the same month, the average rate of inflow is 10 m^3/s, outflow rate is 15 m^3/s, monthly rainfall is 10 cm, monthly seepage loss is 1.8 cm and the storage change is 16 million m^3. The evaporation (in cm) in that month is
(a) 46.8 (b) 136.0
(c) 13.6 (d) 23.4

Q.20 The plan area of a reservoir is 1 km^2. The water level in the reservoir is observed to decline by 20 cm in a certain period. During this period the reservoir receives a surface inflow of 10 hectare-meters, and 20 hectare-meters are abstracted from the reservoir for irrigation and power. The pan evaporation and rainfall recorded during the same period at a nearby meteorological station are 12 cm and 3 cm respectively. The calibrated pan factor is 0.7. The seepage loss from the reservoir during this period in hectare-meters is
(a) 0.0 (b) 1.0
(c) 2.4 (d) 4.6

Q.21 Which of the following components of precipitation constitute direct runoff?
1. Snow melt
2. Through flow
3. Rainfall on the surface of the stream

Select the correct answer using the codes given.
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.22 What would be the evaporation opportunity (E.O.) if actual evaporation from the land is 15 mm in a month and evaporation from an equivalent free surface is 18 mm in a given month?
(a) 83.33% (b) 16.67%
(c) 70% (d) 120%

Q.23 Consider the following statements regarding hydrological cycle:
1. The hydrological cycle is sun driven process.
2. It is existing 1 km in lithosphere and 15 km in troposphere in tropical region.
3. Convenient starting point to describe the cycle is Oceans.

Which of the above statement(s) is/are correct?
(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) 1, 2 and 3

Q.24 The lake have a surface area of 1000 na and having a water surface elevation at 98.5 m. The inflow in a lake is 4 m^3/sec and out flow is 4.02 m^3/s. If evaporation in lake in one week is 4 cm and seepage from the ground is 10 mm in a week. The level of water surface after one week is _____ m.

Q.25 **Statement (I):** Residence time of Ocean is larger than that of global ground water.
Statement (II): Oceans have a large amount of water.
(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I).
(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I).
(c) Statement (I) is true but Statement (II) is false.
(d) Statement (I) is false but Statement (II) is true.

Q.26 A rainfall of 2 cm/hr is occurred in a catchment. Due to catchment divide 30% of the rainfall will be discharge in a stream "*A*". Actual discharge in stream is reached as 0.6 m^3/sec.
If catchment area is 0.864 km^2. Then the area of catchment leakage _____ km^2.
(If runoff coefficient equal to 0.5)

Q.27 An unregulated stream provides the following volumes through each successive 4-day period over a 40 day duration at a possible reservoir site of storage capacity 16 m^3. The average outflow needed in 4 days to ensure maintaining the constant flow over these 40 days is _____ Mm^3. (If the reservoir is full to start with)

(Day)	0	4	8	12	16	20	24	28	32	36	40
Runoff Vol. (Mm^3)	0	9.6	5.4	2.3	3.5	2.3	2.2	1.4	6.4	12.4	10.9

Q.28 If the total rainfall precipitated during a storm is 10.0 mm. Given, the antecedent moisture at the root in the soil was 5.00 mm, the loss of water due to seepage 2.5 mm, losses due to percolation 2.00 mm, surface runoff 3.00 mm, and the moisture retained in the soil is 1.00 mm, then the amount of evapotranspiration from an area is

(a) 6.5 mm (b) 2.9 mm
(c) 8.4 mm (d) 9.2 mm

■■■■

Answers Introduction and General Aspect of Hydrology

1. (d)	2. (d)	3. (d)	4. (b)	5. (c)	6. (d)	7. (a)	8. (c)	9. (a)	10. (c)
11. (a)	12. (c)	13. 6.5	14. (c)	15. (b)	16. (d)	17. (b)	18. (a)	19. (d)	20. (d)
21. (d)	22. (a)	23. (d)	24. 98.44		25. (a)	26. 0.144		27. 5.64	28. (a)

Explanations Introduction and General Aspect of Hydrology

1. (d)

Hydrology is the science which deals with the occurrence, circulation and distribution of water on earth and its atmosphere. The movement of water from one phase (i.e., liquid or gaseous) to another phase is known as hydrological cycle.

Hence option (d) is correct.

2. (d)

Most of the earth's water sources such as rivers, lakes, oceans, ground water, etc. get their supplies from rain, while the rain water in itself is derived from the evaporation from these sources. Water is infect lost to the atmosphere as vapour from the earth, which is then precipitated back in the form of rain, snow, hail, dew, sleet or frost, etc. This evaporation and precipitation continues forever and thereby, a balance is maintained between the two. This process is known as 'Hydrologic Cycle'.

5. (c)

The hydrologic budget consists of inflows, outflows, and storage as shown in the following equation: Inflow = Outflow +/- Changes in Storage. Inflows add water to the different parts of the hydrologic system, while outflows remove water. Storage is the retention of water by parts of the system.

In the Hydrologic Budget Equation:

P – R – E – T – G = ÄS

Where, P - Total Precipitation

R – Net Runoff

E – Total Evaporation

T – Total Transpiration

G – Net Ground Water Flow

ΔS – Total change in storage

6. (d)

The hydrologic equation is based on the law of conservation of mass and it state that

Mass inflow – mass outflow = Change in storage

$$I - O = \Delta_{storage}$$

Hence option (d) is correct.

8. (c)

Given, Area of watershed = 300 ha

Rainfall = 10 cm

Duration = 10 hrs

$$\frac{\text{Run-off}}{\text{Rainfall}} = 0.2$$

$\therefore$ Runoff = 0.2 × 10 = 2 cm

Average stream flow rate

$$= \frac{2\times10^{-2}\times300\times10^{4}}{10\times60}$$

$$= 100\ m^3/\text{minute}$$

9. (a)

Total precipitation

= 20 × 6 = 120 mm = 12 cm

Total runoff

$$= \frac{30000}{100\times10^4} = 3\times10^{-2}\ \text{m}$$

$$= 3\ \text{cm}$$

Precipitation not available to runoff

$$= 12 - 3 = 9\ \text{cm}$$

10. (c)

Annual runoff from the catchment

$$= \frac{\Sigma RA}{\Sigma A}$$

$$= \frac{61\times52 + 39\times42 + 20\times32}{120}$$

$$= 45.42\ \text{cm}$$

11. (a)

For a particular basin or catchment the equation showing the water gains and losses during a specified period of time is called water budget equation.

12. (c)

- Due to evaporation water losses occur.
- As a result of runoff, stream flow is generated.
- Percolation (infiltration) occurs due to vegetation, there is no soil erosion.
- Due to precipitation, storm generates.

13. 6.5 (5.9 to 6.9)

From water budget equation,

$P + R - G - E - T = \Delta S$

Total rainfall, P = 10 mm

Antecedent moisture at root in the soil = 5 mm

Loss of water due to seepage = 2.5 mm

Loss of water due to percolation = 2 mm

Surface runoff = 3 mm

Moisture retained in the soil = 1 mm

So, $10 + 5 - 2.5 - 2 - 3 - T = 1$

$\Rightarrow \quad 7.5 - T = 1$

$\Rightarrow \quad T = 6.5$ mm

$\therefore$ Amount of evapotranspiration = 6.5 mm

14. (c)

Area = 4 km^2

Surface inflow = 240 ha-m

Surface outflow = 192 ha-m

Rainfall = 28 cm

Change in storage

= +72 ha-m

Total mass inflow

= 240 ha-m + rainfall

= 240 ha-m + 0.28 × 400

= 352 ha-m

Let losses are Δ_L,

Using hydrologic equation,

Mass inflow – Mass out flow

= Change in storage

$352 - (192 + \Delta_L) = 72$

$\Delta_L = 352 - 192 - 72$

= 88 ha-m

Hence option (c) is correct.

15. (b)

$$\text{Total inflow} = 50\times10^6\times\frac{100}{1000}\times0.6 = 3\times10^6\,\text{m}^3$$

Outflow from canal = $1 \times 3600 \times 24 \times 31$

= 2.678×10^6 m^3

$\therefore$ Loss of water = $3 \times 10^6 - 2.678 \times 10^6$

= 0.322×10^6 m^3

= Seepage loss + Evaporation loss

Since seepage loss = 50% of evaporation loss

$\therefore$ 1.5 × evaporation loss = 0.322×10^6

$$\text{Evaporation loss} = \frac{0.322\times10^6}{1.5} = 0.21\times10^6\ \text{m}^3$$

16. (d)

$$\text{Evaporation loss} = 100\times\frac{11}{100}\times0.7 = 7.7\ \text{ha-m}$$

$$\text{Rainfall} = 100\times\frac{5}{100} = 5\ \text{ha-m}$$

$$\text{Change in storage} = 100\times\frac{3}{100} = 3\ \text{ha-m}$$

Now, $(I + P) - (E + \text{Seepage loss}) = \Delta S$

$\Rightarrow (5 + 5) - (7.7 + X) = -3$

$\Rightarrow \quad 10 - 7.7 - X = -3$

X = Seepage loss

= 5.3 ha-m

17. (b)

It make no difference whether the distribution of land and water is even or uneven.

18. (a)

When water is saturated locally in the atmosphere, the water condenses and