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CIVIL ENGINEERING

Objective Practice Sets

Engineering Hydrology

1 CHAPTER
Introduction and General Aspect of Hydrology

Q.1 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.2 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.3 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.4 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.5 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.6 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.7 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.8 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.9 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.10 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.11 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.12 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.13 **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.14 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.15 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.16 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.17 **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.18 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.19 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.20 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. (b)	3. (d)	4. (c)	5. (a)	6. (c)	7. (a)	8. (c)	9. 6.5	10. (c)
11. (b)	12. (d)	13. (a)	14. (d)	15. (d)	16. (d)	17. (a)	18. 0.144	19. 5.64	20. (a)

Explanations Introduction and General Aspect of Hydrology

1. (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'.

3. (d)

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

Mass inflow – mass outflow = Change in storage

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

4. (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/minute

5. (a)

Total precipitation

= 20 × 6 = 120 mm = 12 cm

Total runoff

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

= 3 cm

Precipitation not available to runoff

= 12 – 3 = 9 cm

6. (c)

Annual runoff from the catchment

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

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

= 45.42 cm

7. (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.

8. (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.

9. 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

10. (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.

11. (b)

$$\text{Total inflow} = 50 \times 10^6 \times \frac{100}{1000} \times 0.6 = 3 \times 10^6 \text{ m}^3$$

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

$= 2.678 \times 10^6$ m^3

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

$= 0.322 \times 10^6$ m^3

= Seepage loss + Evaporation loss

Since seepage loss = 50% of evaporation loss

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

$$\text{Evaporation loss} = \frac{0.322 \times 10^6}{1.5} = 0.21 \times 10^6 \text{ m}^3$$

12. (d)

$$\text{Evaporation loss} = 100 \times \frac{11}{100} \times 0.7 = 7.7 \text{ ha-m}$$

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

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

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

13. (a)

When water is saturated locally in the atmosphere, the water condenses and precipitates. Sufficient water nuclei must be present to aid condensation and thus cause precipitation.

14. (d)

Let 'x' cm evaporation takes place in month of June.

Total inflow = I + P

$$= \left(\frac{10 \times 30 \times 24 \times 60 \times 60}{20 \times 10^6} \times 100\right) + 10$$

= 139.6 cm

Total outflow = Q+ S+ E

$$= \left(\frac{15 \times 30 \times 24 \times 60 \times 60}{20 \times 10^6} \times 100\right) + 1.8 + x$$

$= 196.2 + x$ cm

As total outflow is more than total inflow, therefore depression in storage takes place.

Depression in storage

$$= -\frac{16 \times 10^6}{20 \times 10^6} \times 100 = -80 \text{ cm}$$

$\Rightarrow \quad 139.6 - (196.2 + x) = -80$

$-x = -80 + 56.6$

$\therefore \quad x = 23.4$ cm