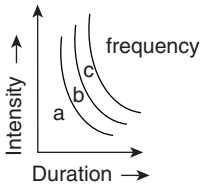
Hydrology Test 1

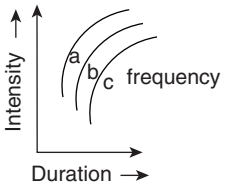
Number of Questions: 25 **Time: 60 min.**

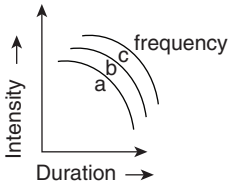
Directions for questions 1 to 25: Select the correct alternative from the given choices.

1. The region where air coming from the pole (cooler and denser) and the air of the middle cell (warmer and lighter) meet is called _____.
(A) Cold front
(B) Warm front
(C) Polar front
(D) Occluded front

2. The intensity – duration – frequency Curve from the following is
(Where $a < b < c$)

(A) 

(B) 

(C) 

(D) None

3. The rate of evaporation from a water body increases directly with increase in
1. Radiation
2. Wind upto a critical value
3. Atmospheric pressure
4. Quality of water
(A) Only 2, 3, 4 are correct
(B) Both 1 and 2 are correct
(C) Both 2 and 3 are correct
(D) Only 1, 2, 4 are correct

4. The infiltration capacity curves which are developed from infiltrometer tests or the hydrograph analysis methods are used to estimate _____ from a given storm.
(A) Infiltration
(B) Rainfall
(C) Runoff
(D) All the above

5. _____ hydrograph is independent of rainfall duration.
(A) Instantaneous unit hydrograph
(B) Synthetic unit hydrograph
(C) Direct runoff hydrograph
(D) Unit hydrograph

6. When the seepage takes place from the stream into the ground, it is called _____ stream.
(A) Perennial stream
(B) Influent stream
(C) Effluent stream
(D) Ephemeral stream

7. A structure with a useful life period of 100 years is designed for a 50-year flood. Then the risk in the design is given by _____.
(A) 0.68 (B) 0.71
(C) 0.87 (D) 0.99

8. The peak flow in outflow hydrographs in a channel routing occurs at _____.
(A) Intersection point of inflow and outflow hydrographs
(B) Before intersection
(C) After intersection
(D) Any of the above

9. For unconfined aquifers, the storage coefficient
(A) is essentially the same as the specific yield.
(B) does not exist
(C) is essentially the same as the specific retention.
(D) is essentially the same as the porosity.

10. In surface float method, the actual velocity of flow (V_a) is equal to _____ times of surface velocity (V_s).
(A) 0.2 (B) 0.4
(C) 0.8 (D) 0.85

11. In a river flow which has shallow depth velocity at different depths at a c/s $0.2d$, $0.4d$ and $0.8d$ from the bottom are 0.1, 0.2, 0.5 m/s respectively. Find the mean velocity at that cross-section.
(A) 0.3 m/s (B) 0.2 m/s
(C) 0.4 m/s (D) 0.35 m/s

12. A sample has a hydraulic conductivity of 12 m/day. What would be its intrinsic permeability? (indarcys)
(A) 12.68 (B) 13.12
(C) 14.35 (D) 16.89

13. During a recuperation test conducted on a open well in a region, the water level in the well was depressed by 4 m and it was observed to rise by 2 m in 90 minutes. What would be the yield from that well having a diameter of 6 m under a depression head of 3 m?
(A) 35.1 m^2/h (B) 39.19 m^3/h
(C) 48.32 m^3/h (D) 51.6 m^3/h

14. Calculate the peak of the outflow hydrograph in a river reach using Muskingham method given the following inflow hydrograph. Take $Co = 0.032$, $C_1 = 0.53$ and the starting value of outflow hydrograph as 10^3/s.

Time (hrs)	0	1	2	3	4	5	6	7
Inflow (m^3/s)	10	20	30	40	50	40	30	20

(A) 30.2 m^3/s (B) 42.4 m^3/s
(C) 51.6 m^3/s (D) 20.8 m^3/s

15. An urban area has a runoff coefficient of 0.35 and an area of 0.8 km^2. The maximum depth of rainfall with a 30 – year return period is as below:

Duration (min)	3	5	10	20	30	40
Depth of rainfall (mm)	10	15	20	25	30	35

If a culvert for drainage at the outlet of this area is to be designed for a time period of 30 years, estimate the peak flow rate. Take the time of concentration for the drainage area as 20 minutes.
(A) 5.83 m^3/s
(B) 15.55 m^3/s
(C) 2.78 m^3/s
(D) 10.13 m^3/s

Common Data for Questions 16 and 17:
The drainage area of water shed is 60 km^2. The Φ – index is 0.4 cm/hr. Base flow at outlet 12 m^3/s, 1 hour – UHG of water shed is triangular in shape with a time base of 10 hour. Peak ordinate occurs at 5 hours.

16. Peak ordinate of UHG in (m^3/s) is _____.
(A) 13.33 (B) 23.33
(C) 33.33 (D) 43.33

17. For a storm of depth of 6.4 cm and duration of 1 hr, the peak ordinate in m^3/s of hydrograph is _____.
(A) 153 (B) 181
(C) 212 (D) 240

18. A storm of 3-hour duration occurred over a basin of area 555.2 km^2. The resulting flow measurement is as follows:

Time (hr)	0	2	4	6	8	12	15
Q (m^3/s)	10	210	310	360	260	60	10

If Base flow = 10 m^3/s, find the depth of runoff over a catchment.
(A) 2.53 cm
(B) 0.81 cm
(C) 3.14 cm
(D) 1.43 cm

19. The total observed runoff volume during a 7-hour storm with a uniform intensity of 2 cm/h is $25 \times 10^6 m^3$. If the area of the basic is 300 km^2, find the average infiltration rate for the basin in (mm/hr).
(A) 2.18 (B) 3.63
(C) 5.72 (D) 8.14

20. The infiltration rate for excess rain on a small area was observed to be 5 cm/hr at the beginning of rain and decreased exponentially toward an equilibrium of 0.6 cm/hr. A total of 35 cm of water infiltrated during 10 hours interval. Determine *k* of the Horton's equation.
(A) 0.05/hr
(B) 0.11/hr
(C) 0.15/hr
(D) 0.2/hr

21. Match the following in Group – A with Group – B.

	Group – A		Group – B
P.	Transpiration	1.	Phytometer
Q.	Evapotranspiration	2.	Rainfall simultator
R.	Evaporation	3.	Lysimeter
S.	Infiltration	4.	Water balance method

P Q R S P Q R S
(A) 2 4 3 1 (B) 1 3 4 2
(C) 3 2 1 4 (D) 4 1 2 3

22. If 9.2 liters of water is added to an evaporation pan of 1.3m diameter to bring the water surface to the stipulated level and if a nearby rainguage measured a rainfall of 8.8 mm. what is the evaporation recorded for the day?
(A) 0.6 mm
(B) 1.87 mm
(C) 2.3 mm
(D) 3.2 mm

Common Data for Questions 23 and 24:
A one-day rainfall of 16 cm in Hyderabad is found to have a return period of 100 years.
Calculate the probability that one-day rainfall of this magnitude or larger magnitude

23. Will not occur in Hyderabad during the next 50 years.
(A) 0.01 (B) 0.99
(C) 0.605 (D) 0.53

24. Will occur in next year.
(A) 0.01 (B) 0.99
(C) 0.605 (D) 0.53

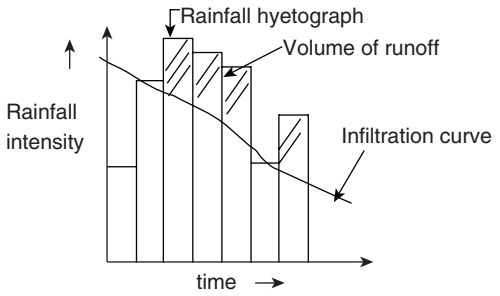
25. Find out the mean precipitation of a catchment which is in a triangular shape of side 10 km. Rainguages installed at each corner recorded 10 cm, 15 cm, 20 cm respectively.
(A) 15 cm (B) 12 cm
(C) 17 cm (D) 14 cm

Answer Keys

1. C	**2.** A	**3.** D	**4.** C	**5.** A	**6.** B	**7.** C	**8.** D	**9.** A	**10.** D
11. B	**12.** C	**13.** B	**14.** B	**15.** A	**16.** C	**17.** C	**18.** D	**19.** D	**20.** C
21. B	**22.** B	**23.** C	**24.** A	**25.** A					

Hints and Explanations

4.



Choice (C)

7. Risk = $1 - q^n$

$P = \frac{1}{T_r} = \frac{1}{50} = 0.02$

$q = 0.98$

$\therefore$ Risk = $1 - (0.98)^{100}$

$= 0.867 \cong 0.87$ Choice (C)

8. In reservoir routing, the peak of outflow hydrograph is at the intersection of inflow and outflow, but not for channel routing. Choice (D)

9. **Storage coefficient:**
The volume of water that an aquifer releases per unit surface area of the aquifer per unit change in component of head normal to that surface.
In an unconfined aquifer it is equal to specific yield. (water extracted by force of gravity). Choice (A)

10. $V_a = 0.85\ V_s$ Choice (D)

11. For shallow depth, one point method is used
$V_m = V_{0.4} = 0.2$ m/s. Choice (B)

12. Permeability $k = \frac{K\mu}{\rho g}$

$k = 12$ m/day
$\mu = 0.01$ gm–cm/s
$\rho = 1$ gm/cc
$g = 981$ cm/s^2

$k = \frac{12 \times 100 \times 0.01}{24 \times 60 \times 60 \times 1 \times 981}$

$= 1.416 \times 10^{-7}$cm^2
$= 1.416 \times 10^{-11}$m^2
1 Darcy $= 0.987 \times 10^{-12}$m^2

$\therefore \quad k = \frac{1.416 \times 10^{-11}}{0.987 \times 10^{-12}} = 14.35$ Darcy's. Choice (C)

13. $h_1 = 4$ m
$h_2 = 4 - 2 = 2$m
$T = 90$ minutes $= 1.5$ h

$C = \frac{k}{A} = \frac{2.303}{T} \log\left(\frac{h_1}{h_2}\right)$

$= \frac{2.303}{1.5} \log\left(\frac{4}{2}\right)$

$= 0.462$ h^{-1}

$Q = CAH$

$= 0.462 \times \left(\frac{\pi}{4} \times 6^2\right) \times 3$

$= 39.19$ m^3/h. Choice (B)

14. $C_0 = 0.032$, $C_1 = 0.53$
$C_2 = 1 - C_0 - C_1 = 0.438$
Outflow $Q_2 = C_0 I_2 + C_1 I_1 + C_2 Q_1$
$= (0.032 \times 20) + (0.53 \times 10) + (0.438 \times 10)$
$= 10.32$ m^3/s

Similarly

Inflow (m^3/s)	Outflow (m^3/s)
10	10
20	10.32
30	16.08
40	24.22
50	33.41
40	**42.41**
30	40.74
20	34.38

$\therefore$ Peak discharge = 42.41 m^3/s. Choice (B)

15. Area = 0.8 km^2 = 80 ha

$Q = \frac{AIR}{360}$

Duration to be taken = time of concentration = 20 minutes

Depth of rainfall = $\frac{25}{20} \times 60 = 75$ mm/h

$Q = \frac{80 \times 0.35 \times 75}{360}$

$= 5.83$ m^3/s. Choice (A)

16. Volume = $A \times$ depth
$= 60 \times 10^6 \times 0.01$
$= 6 \times 10^5$m^2

From UHG

$\frac{1}{2} \times 10 \times 60 \times 60 \times Q = 6 \times 10^5$

$Q = 33.33$ m^3/s. Choice (C)

17. $\Phi = 0.4$ cm/hr $= \frac{6.4 - R}{1}$

Runoff $R = 6$ cm
Peak $DRH = 33.33 \times 6 = 200$ m^3/s
Peak $SHG = DRH +$ Base flow
$= 200 + 12 = 212$ m^3/s. Choice (C)

18. **Base flow** = B

Let O_{s1}, O_{s2}, are storm hydrograph ordinates

Let OD_1, OD_2. OD_3 ….. are direct runoff hydrograph ordinates

$OD_1 = O_{s1} - B$

$OD_2 = O_{s2} - B$

OD	0	200	300	350	250	50	0

By Trapezoidal formula:-

Volume

$$= \Delta t\left[\frac{OD_1 + OD_7}{2} + \Sigma(\text{remaining ordinates})\right]$$

$$V = 2 \times 60 \times 60\left[\frac{0+0}{2} + (200+300+350+200+50)\right]$$

$V = 7.92 \times 10^6 \text{m}^3$

$$\text{Depth} = \frac{V}{A} = \frac{7.92\times10^6}{555.2\times10^6}$$

$= 0.01426$ m

$= 1.43$ cm. Choice (D)

19. Total rainfall = Intensity of rainfall × duration

$= 2 \times 7 = 14$ cm

Volume of runoff $= 25 \times 10^6 \text{m}^3$

Area of the basin $= 300 \text{ km}^2 = 300 \times 10^6 \text{m}^2$

$$\text{Depth of runoff} = \frac{\text{Volume of runoff}}{\text{Area of runoff}}$$

$$= \frac{25\times10^6}{300\times10^6} = 0.083 \text{ m}$$

$= 8.3$ cm

Total infiltration = rainfall – runoff = 14 – 8.3 = 5.7 cm

$$\text{Average infiltration rate} = \frac{5.7}{7} = 0.814 \text{ cm/h}$$

$= 8.14$ mm/h. Choice (D)

20. $$35 = \int_0^{10} \left(0.6 + (5-0.6)e^{-kt}\right)dt$$

$$35 = 0.6t - \frac{4.4}{k}e^{-kt}\Big]_0^{10}$$

$$35 = 6 - \frac{4.4}{k}e^{-k\times10} + \frac{4.4}{k}e^{o}$$

$$\frac{4.4}{k}[1 - e^{-10k}] = 29$$

$e^{-10k} \simeq 0$

$\therefore \quad k = 0.152$/hr Choice (C)

22. Evaporation recorded $= 8.8 - \dfrac{(9.2\times10^{-3})\times1000}{\frac{\pi}{4}\times1.3^2}$

$= 1.87$ mm ($1\text{m}^3 = 1000$ liters). Choice (B)

23. $$p = \frac{1}{T} = \frac{1}{100} = 0.01$$

$q = 0.99$

Probability for not occurring in next 50 years.

$P = {}^{50}C_0\, p^0\, q^{50}$

$= 1 \times 1 \times (0.99)^{50}$

$= 0.605$. Choice (C)

24. Will occur next year:

$\Rightarrow$ at least once in 1 year

$P = {}^{1}C_1\, p^1\, q^0 = 0.01$. Choice (A)

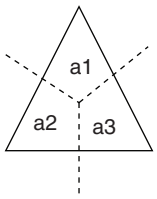
25. $a_1 = a_2 = a_3$ = areas represented by rain gauges = $\dfrac{A}{3}$

Mean precipitation

$$\overline{P} = \frac{P_1a_1 + P_2a_2 + P_3a_3}{A} \downarrow$$

$$= \frac{\left(10\times\frac{A}{3}\right) + \left(15\times\frac{A}{3}\right) + \left(20\times\frac{A}{3}\right)}{A}$$

$= 15$ cm.



Choice (A)