CLASS TEST

S.No.: 01DLSKCE_ABC_20092026

MADE EASY
Leading Institute for IES, GATE & PSUs

Delhi | Bhopal | Hyderabad | Jaipur | Pune

Web: www.madeeasy.in | **E-mail:** info@madeeasy.in | **Ph:** 011-45124612

HYDROLOGY

CIVIL ENGINEERING

Date of Test : 20/09/2026

ANSWER KEY

1.	(c)	7.	(d)	13.	(a)	19.	(d)	25.	(a)
2.	(a)	8.	(c)	14.	(b)	20.	(c)	26.	(d)
3.	(d)	9.	(c)	15.	(a)	21.	(b)	27.	(c)
4.	(a)	10.	(a)	16.	(a)	22.	(d)	28.	(b)
5.	(b)	11.	(d)	17.	(b)	23.	(a)	29.	(a)
6.	(b)	12.	(d)	18.	(c)	24.	(d)	30.	(b)

DETAILED EXPLANATIONS

1. (c)

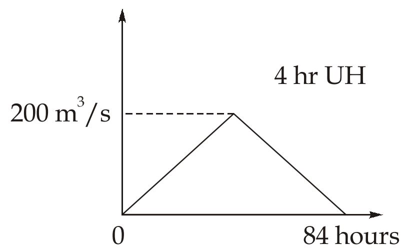
For unit hydrograph,

Area under unit hydrograph = Direct runoff volume due to 1 cm of effective rainfall

$\Rightarrow \quad \frac{1}{2} \times Q_p \times 20 = 1 \times 10^{-2} \times 500 \times 10^4 \quad$ [where Q_p is peak discharge (in m^3/hr)]

$\Rightarrow \quad Q_p = 5000\ m^3/hr$

3. (d)



Area of UH = C.A. × 0.01 (where C.A. is catchment area)

$\Rightarrow \quad \frac{1}{2} \times 84 \times 3600 \times 200 = \text{C.A.} \times 0.01$

$\Rightarrow \quad \text{C.A.} = 3024 \times 10^6\ m^2$

$\Rightarrow \quad \text{C.A.} = 3024\ km^2$

4. (a)

$T = 200$ years

$y_T = \text{Reduced variate} = -\ln.\ln.\left(\frac{T}{T-1}\right) = -\ln.\ln.\left(\frac{200}{200-1}\right)$

$\Rightarrow \quad y_T = 5.296 \simeq 5.3$

5. (b)

Peak of DRH = 135 – 10 = 125 m^3/s

$P = 54$ mm, $\quad \phi = 4$ mm/hr

$\therefore \quad R = P - \phi \times t = 54 - 4 \times 1 = 50$ mm $= 5$ cm

$\therefore \quad$ Peak of 1 hr UH $= \frac{125}{5} = 25\ m^3/s$

6. (b)

7. (d)

State is defined as the water surface elevation measured above a datum:

Manual stage measurements are done using.

(i) Staff gauge

(ii) Wire gauge

Automatic stage measurements are done using

(i) Float gauge recorder

(ii) Bubble gauge

Stage data is presented in the form of plot of stage against chronological time known as stage hydrograph.

8. (c)

Using normal ratio method, missing annual rainfall at station X is given by

$$p = \frac{N_x}{n}\left[\frac{P_A}{N_A} + \frac{P_B}{N_B}\right]$$

where m is total number of neighboring stations,

$$\therefore \quad p = \frac{250}{2}\left[\frac{140}{200} + \frac{270}{300}\right] = 200 \text{ mm}$$

9. (c)

Symon's raingauge is non-recording type raingauge.

10. (a)

The rising limb of a hydrograph is also known as concentration curve and it represents the increase in discharge due to the gradual building up of storage in channels and over the catchment surface.

11. (d)

$$\text{Total rainfall} = 0.6 + 3.0 + 1.8 = 5.4 \text{ cm}$$
$$\text{Excess rainfall} = 5.4 - 3.5 = 1.9 \text{ cm}$$
$$\text{Excess rainfall duration}, t_e = 2 \times 3 = 6 \text{ hrs}$$
$$\phi\text{-index} = 1.9/6 = 0.317 \text{ cm/hr}$$

This value being more than $\frac{0.6}{2} = 0.3 \text{ cm/hr}$, the excess rainfall duration will reduce by 2 hours.

$$\therefore \quad t_e = 4 \text{ hours}$$
$$\text{Excess rainfall} = 3 + 1.8 - 3.5 = 1.3 \text{ cm}$$
$$\therefore \quad \phi\text{-index} = 1.3/4 = 0.325 \text{ cm/hr}$$

12. (d)

As per dilution technique,

$$\text{Discharge in stream,} \quad Q = \frac{Q_1[C_1 - C_2]}{C_2 - C_0}$$

where, $Q_1 = 35 \times 10^{-3} \text{ m}^3/\text{sec.}$

$C_0 = 15 \text{ ppm} = 15 \text{ mg/L}$

$C_1 = 300 \text{ g/l} = 300 \times 10^3 \text{ mg/L}$

$C_2 = 70 \text{ ppm} = 70 \text{ mg/L}$

$$\therefore \quad Q = \frac{35 \times 10^{-3}\left[300 \times 10^3 - 70\right]}{70 - 15} = 190.86 \simeq 191 \text{ m}^3/\text{sec}$$

13. (a)

$$P(\text{at least once}) \text{ in 20 years} = 1 - \left(1 - \frac{1}{T}\right)^n = 1 - \left(1 - \frac{1}{40}\right)^{20} = 0.397 \simeq 40\%$$

15. (a)

On comparison with the Horton's equation in the standard form, f_c = 6 mm/hr, f_o = 22 mm/hr and k = 2/h.

Since the rainfall intensity is more than f_o, the infiltration takes place at the capacity rate throughout the storm. Hence the commutative depth of infiltration for the first 45 minutes is given by,

$$f = \int_0^{3/4} f\,dt = \int_0^{0.75}\left(6+16e^{-2t}\right)dt = \left[6t-8e^{-2t}\right]_0^{0.75} = \left[6\times 0.75-8\times e^{-1.5}\right]-[0-8]$$

$$= 10.715 \text{ mm}$$

16. (a)

$$\text{Direct runoff} = \frac{1}{2}\times 64\times 3600\times 36 = 4147200 \text{ m}^3 = 4.1472\times 10^6 \text{ m}^3$$

$$\text{Effective rainfall} = 1 \text{ cm}$$

$$\therefore \quad \text{Catchment area} = \frac{4.147\times 10^6}{1}\times 10^2 \text{ m}^2 = 414.72 \text{ km}^2$$

$$\therefore \quad \text{Equilibrium discharge} = 2.778\times\frac{A}{D} = 2.778\times\frac{414.72}{6} = 192.02 \text{ m}^3/\text{sec}$$

17. (b)

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

$$\therefore \quad A = \frac{0.36\times\sum \text{Ordinates}\times\Delta t}{h} = \frac{0.36\times 105\times 1}{3} = 12.60 \text{ km}^2 = 1260 \text{ ha}$$

18. (c)

$$P = (10+30+40+50+25+8)\times\frac{30}{60} = 81.5 \text{ mm}$$

$$R = 38 \text{ mm}$$

$$\therefore \quad W_{\text{index}} = \frac{P-R}{t} = \frac{81.5-38}{(180/60)} = 14.5 \text{ mm/hr}$$

$$\therefore \quad \phi_{\text{index}} = \frac{81.5-38-(10+8)0.5}{(180-30-30)/60} = 17.25 \text{ mm/hr}$$

Check:

$$\text{Runoff} = \left[(30-17.25)+(40-17.25)+(50-17.25)+(25-17.25)\right]\frac{30}{60}$$

$$= 38 \text{ mm which is same as given in question}$$

19. (d)

From water budget equation,

$$\text{P + R – G – E – T} = \Delta S$$

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

$\Rightarrow \quad 7.5 - T = 1$

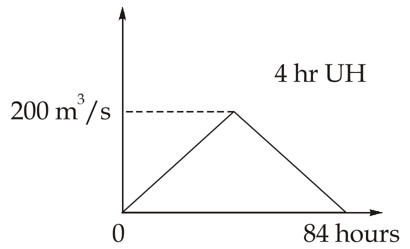
$\Rightarrow \quad T = 6.5$ mm

$\therefore$ Amount of evapotranspiration = 6.5 mm

20. **(c)**

By Inglis formula, $$Q_p = \frac{124A}{\sqrt{A+10.4}} = \frac{124 \times 38.6}{\sqrt{38.6+10.4}} = 683.77 \text{ m}^3/\text{sec}$$

21. **(b)**



$$\text{Area of UH} = \text{C.A.} \times 0.01$$

$$\Rightarrow \quad \frac{1}{2} \times 84 \times 3600 \times 200 = \text{C.A.} \times 0.01$$

$$\Rightarrow \quad \text{C.A.} = 3024 \times 10^6 \text{ m}^2$$

$$\Rightarrow \quad \text{C.A.} = 3024 \text{ km}^2$$

22. **(d)**

The risk involved is 0.20 and n = 2 years

$$\therefore \quad 0.20 = 1 - \left(1 - \frac{1}{T}\right)^2$$

$$\Rightarrow \quad T = 9.47 \text{ years}$$

$$\Rightarrow \quad T \simeq 9.5 \text{ years}$$

23. **(a)**

Total rainfall, $$P = (3.5 + 6.5 + 8.5 + 7.8 + 6.4 + 4.0 + 4.0 + 6.0) \times \frac{30}{60}$$

$$= 23.35 \text{ cm}$$

Total rainfall excess $$= [(6.5-4.5)+(8.5-4.5)+(7.8-4.5)+(6.4-4.5)+(6.0-4.5)] \times \frac{30}{60}$$

$$= 6.35 \text{ cm}$$

$$\therefore \quad W\text{-index} = \frac{23.35 - 6.35}{4} = 4.25 \text{ cm/hour}$$

24. **(d)**

$$\mu = P_{av.} = \frac{800 + 520 + 440 + 420}{4} = 545 \text{ mm}$$

$$\sigma_{n-1}^2 = \frac{\Sigma(P_i - P_{av})^2}{n-1}$$

$$\Rightarrow \quad \sigma_{n-1}^2 = \frac{(800-545)^2 + (520-545)^2 + (440-545)^2 + (420-545)^2}{4-1}$$

$$\Rightarrow \quad \sigma_{n-1} = 175.404 \text{ mm}$$

$$c_v = \frac{\sigma_{n-1}}{\mu} \times 100 = \frac{175.404}{545} \times 100 = 32.18\%$$

Now, No. of rainguages, $N = \left(\frac{c_v}{\varepsilon}\right)^2 = \left(\frac{32.18}{10}\right)^2 = 10.355$

i.e. $N = 11$

$\therefore$ Additional raingauge stations required = 11 – 4 = 7

25. (a)

$$Q = \pi k \frac{\left(H_o^2 - H_w^2\right)}{\ln\left(r_o / r_w\right)}$$

$$= \frac{3.14 \times 25 \times \left(30^2 - 22^2\right)}{\ln(300/0.3)}$$

$$= 4729.84 \text{ m}^3/\text{day}$$

26. (d)

$$Q_u = C_0 I_4 + C_1 I_3 + C_2 Q_3$$
$$= 0.02 \times 30 + 0.5 \times 18 + 0.48 \times 10$$
$$= 14.4 \text{ m}^3/\text{s}$$

27. (c)

For the 1st 6 hr

Rainfall = 3 cm

Effective rainfall = 3 – 0.325 × 6 = 1.05 cm

For the 2nd 6 hr

Rainfall = 4 cm

Effective rainfall = 4 – 0.325 × 6 = 2.05 cm

I Time	*II* Ordinate of UH	*III* DRH due to first 6 hr storm	*IV* DRH due to second 6 hr storm	*III+IV* Final DRH	*VI = V + 10* Final flood hydrograph
0	0	0	–	0	10
3	20	21	–	21	31
6	45	47.25	0	47.25	57.25
9	65	68.25	41	109.25	119.25
12	120	126	92.25	218.25	228.25
15	165	173.25	133.25	306.5	316.5

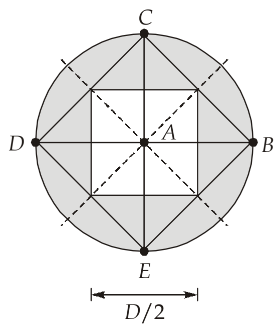
28. (b)

Basin diameter, D = 15 km

Side of square around station $A = \frac{15}{2} = 7.5$ km

Area of station A = 7.5 × 7.5 = 56.25 km^2

Total area of circular basin $= \frac{\pi}{4}(15)^2 = 176.7 \text{ km}^2$



$$\text{Area of station } B = \text{Area of station } C = \text{Area of station } D = \text{Area of station } E$$

$$= \left(\frac{176.7 - 56.25}{4}\right) = 30.11 \text{ km}^2$$

$$\therefore \quad \text{Mean rainfall} = \frac{9 \times 56.25 + 30.11(7 + 10 + 11 + 8)}{176.7}$$

$$= 9 \text{ cm}$$

29. (a)

Storms	Duration (hr)	Intesnsity (cm/hr)	Total runoff depth (cm)
1	4	$\frac{3}{4} = 0.75$	$3 - 4 \times 1 = 0$
2	4	$\frac{7}{4} = 1.75$	$7 - 4 \times 1 = 3$
3	4	$\frac{11}{4} = 2.75$	$11 - 4 \times 1 = 7$
4	6	$\frac{7}{6} = 1.167$	$7 - 6 \times 1 = 1$
5	6	$\frac{8}{6} = 1.33$	$8 - 6 \times 1 = 2$

$$\text{Total runoff depth} = 3 + 7 + 1 + 2 = 13 \text{ cm} = 0.13 \text{ m}$$

$$\text{Total runoff volume} = 0.13 \times 195 \times 10^6 \text{ m}^3$$

$$= 0.13 \times 195 \text{ Mm}^3$$

$$= 25.35 \text{ Mm}^3$$

30. (b)

$$\text{Average depth of rainfall} = \frac{15 \times 30 + \left(\frac{30+40}{2}\right) \times 250 + \left(\frac{40+50}{2}\right) \times 150 + \left(\frac{50+35}{2}\right) \times 180 + \left(\frac{35+60}{2}\right) \times 215 + 60 \times 60}{15 + 250 + 150 + 180 + 215 + 60}$$

$$= \frac{450 + 8750 + 6750 + 7650 + 10212.5 + 3600}{870}$$

$$= 43 \text{ mm}$$

■■■■