# ANSWERS AND EXPLANATIONS

**1. *Ans. (a)***

Double mass curve is used to check the consistency of rainfall data.

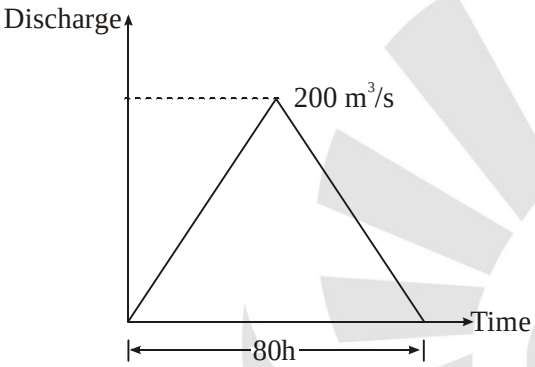
**2. *Ans. (c)***

**3. *Ans. (d)***

Total Runoff = Area of diagram under the curve

$$= \frac{1}{2}\times 200\times 80\times 3600$$

$$= 28.8 \times 10^6 \text{ m}^3$$




Total area of catchment

$$A = 1440 \text{ km}^2 \text{ (given)}$$

So, Effective rain fall:

$$= \frac{\text{Run-off}}{\text{Area of catchment}}$$

$$= \frac{28.8\times 10^6}{1440\times 10^6}$$

$$= 0.02 \text{ m} \simeq 2 \text{ cm}$$

**4. *Ans. (b)***

Probability for 10 year return period

$$P = \frac{1}{10} = 0.1$$

So, Probability of flood occurring at least once in 4 years.

$$= 1 - (1 - P)^4$$

$$= 1 - 0.9^4 = 0.3439$$

$$= 34.39\% \simeq 35\%$$

**5. *Ans. (b)***

Lacey's silt factor

$$= 1.76\sqrt{d_m} = 1.76\sqrt{0.25}$$

$$= 1.76 \times 0.5 = 0.88$$

**6. *Ans. (b)***

$$p = \frac{1}{100} = 0.01$$

Probability of flood occurring at least once in 100 years.

$$\Rightarrow \quad = 1 - (1 - p)^n$$

$$= 1 - (1 - 0.01)^{100}$$

$$= 0.6339 = 63.39\%$$

$$\simeq 64\%$$

**7. *Ans. (b)***

**8. *Ans. (b)***

**9. *Ans. (b)***

**10. *Ans. (b)***

Initial speed of vehicle

$$v = fgt$$

$$s = \frac{v^2}{2fg} = \frac{f^2g^2t^2}{2fg}$$

$$f = \frac{2s}{gt^2} = \frac{2\times 9.8}{9.8\times 2^2} = 0.5$$

**11. *Ans. (c)***

**12. *Ans. (c)***

**13. *Ans. (a)***

$$\text{Jam density} = \frac{100}{\text{Space headway(H)}}$$

$$\frac{1000}{6.25} = 160 \text{ Veh/km}$$

$$\text{Maximum flow} = \frac{\text{Jam density} \times \text{Free speed}}{4}$$

$$= \frac{160\times 65}{4} = 2600 \text{ vph}$$

**14. *Ans. (c)***

**15. *Ans. (d)***

**16. *Ans. (b)***

**17. *Ans. (a)***

**18.** ***Ans. (a)***

Section-22 of Environment (Protection) Act, 1986 has a provision for No right to appeal.

**19.** ***Ans. (a)***

**20.** ***Ans. (c)***

**21.** ***Ans. (c)***

**22.** ***Ans. (b)***

**23.** ***Ans. (c)***

**24.** ***Ans. (b)***

**25.** ***Ans. (a)***

**26.** ***Ans. (b)***

**27.** ***Ans. (a)***

**28.** ***Ans. (d)***

**29.** ***Ans. (a)***

**30.** ***Ans. (d)***

**31.** ***Ans. (a)***

**32.** ***Ans. (a)***

**33.** ***Ans. (c)***

When vertical and horizontal scales are different, the model is called distorted model.

Velocity ratio,

$$V_r = \sqrt{L_{rV}} = \sqrt{\frac{1}{9}} = \frac{1}{3}$$

Area ratio, $A_r = L_{rV}L_{rH} = \frac{1}{9}\times\frac{1}{40}$

Discharge ratio,

$$Q_r = V_rA_r = \frac{Q_m}{Q_p}$$

Discharge in prototype

$$Q_p = \frac{Q_m}{V_rA_r}$$

$$= 1 \times 3 \times 9 \times 40$$

$$= 1080\ l\text{ps}$$

**34.** ***Ans. (c)***

In hydraulic jump, flow changes from super critical to subcritical. The strength of jump is decided by Froude Number corresponding to supercritical flow i.e. upstream flow ($F_1$).

**35.** ***Ans. (c)***

$q = 10\ m^3/s/m$

$V_1 = 20\ m/s$

$$F_1 = \left(\frac{q^2}{gy_1^3}\right)^{1/2} = \left[\frac{100}{9.81\times(0.5)^3}\right]^{1/2}$$

$$= 9.03$$

$$y_1 = \frac{q}{V_1} = \frac{10}{20} = 0.$$

Using $\frac{y_2}{y_1} = \frac{1}{2}\left[-1+\sqrt{1+8F_1^2}\right]$

$$y_2 = \frac{0.5}{2}\left[-1+\sqrt{1+8\times(9.03)^2}\right]$$

$y_2 = 6.14\ m$

**36.** ***Ans. (a)***

$y_0 > y_c$

i.e. NDL should lie above CDL.

**37.** ***Ans. (a)***

$E_1 = 3$ m at upstream section

$E_c = 2.5$ m

Maximum loss of energy

$E_1 = E_c + \Delta z$

$\Delta z = E_1 - E_c$

$\Delta z = 0.5$ m

**38.** ***Ans. (d)***

When flow length becomes equal to mixing length, the flow get fully developed and the thickness of boundary layer mets at the pipe centre line. Beyond this length, the velocity distribution is parabolic which is remain parabolic for remaining length.

**39.** ***Ans. (b)***

| Type | Reynold number $(R_e)_{critical}$ |
|---|---|
| Flow around spherical bodies | $R_e = 1$ |
| Open channel flow | $R_e = 500$ |
| Flow between parallel plates | $R_e = 1000$ |
| Pipe flow | $R_e = 2000$ |
| Flow over flat plate | $R_e = 3 \times 10^5$ |

For open channel

$(Re)_{critical} = 500$

Flow is laminar when

$$Re < 500$$

Flow is turbulent when

$$Re > 500$$

**40.** ***Ans. (c)***

**41.** ***Ans. (a)***

**42.** ***Ans. (c)***

As per Lacey's theory, velocity of flow in channel is given by

$$V = \left[\frac{Qf^2}{140}\right]^{1/6}$$

where Q = Discharge of channel ($m^3/s$)

f = Lacey's silt factor

Here, $Q = 70\ m^3/s$

$$f = \sqrt{2}$$

$$\therefore \quad V = \left[\frac{70\times\left(\sqrt{2}\right)^2}{140}\right]^{1/6}$$

$$V = 1.0\ m/s$$

**43.** ***Ans. (b)***

**44.** ***Ans. (b)***

**45.** ***Ans. (b)***

Volumetric method of assessment leads to lower duty.

**46.** ***Ans. (b)***

**47.** ***Ans. (c)***

In sharda type fall, the rectangular crest can be used for discharge limited upto 14 cumec.

**48.** ***Ans. (b)***

**49.** ***Ans. (b)***

**50.** ***Ans. (b)***

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