BPSC Main Exam 2019 | CIVIL ENGINEERING | Test 6
ASSISTANT ENGINEER | Objective Paper-II

ANSWER KEY

1.	(c)	11.	(d)	21.	(b)	31.	(b)	41.	(c)
2.	(c)	12.	(b)	22.	(a)	32.	(b)	42.	(b)
3.	(d)	13.	(c)	23.	(a)	33.	(c)	43.	(b)
4.	(a)	14.	(c)	24.	(b)	34.	(a)	44.	(d)
5.	(c)	15.	(b)	25.	(c)	35.	(a)	45.	(b)
6.	(c)	16.	(d)	26.	(d)	36.	(d)	46.	(a)
7.	(c)	17.	(d)	27.	(c)	37.	(b)	47.	(c)
8.	(c)	18.	(b)	28.	(b)	38.	(a)	48.	(c)
9.	(b)	19.	(a)	29.	(c)	39.	(d)	49.	(a)
10.	(b)	20.	(b)	30.	(b)	40.	(d)	50.	(b)

DETAILED EXPLANATIONS

2. (c)

Leaching requirement in %

$$= \frac{D_i - C_u}{D_i} \times 100$$

Where,

D_i = Total irrigation water depth to be applied

C_u = consumptive use

$$10 = \frac{D_i - 90}{D_i} \times 100$$

$$D_i = 100 \text{ mm}$$

4. (a)

An aqueduct and syphon aqueduct are cross drainage works in which the canal is taken over the natural drain, such that the drainage water runs below the canal either freely or under syphoning pressure. Super passage and syphon are cross drainage works in which the drain is taken over the canal such that the canal water runs below the drain either freely or under syphoning pressure.

Level crossing is a cross drainage work in which the canal water and drain water are allowed to intermingle with each other. A level crossing is generally provided when a large canal and a huge drainage (such as a stream or a river) approach each other practically at the same level.

5. (c)

According to Lacey's theory the dimensions of bed width, depth and slope of canal attain a state of equilibrium with time which is called true regime state. Lacey defined a regime channel as a stable channel transporting a minimum bed load consistent with fully active bed.

6. (c)

Lacey's silt factor

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

$$\therefore \quad d_m = \left(\frac{f}{1.76}\right)^2 = 1.3$$

7. (c)

$$\text{Perimeter, } P = 4.75\sqrt{Q} = 4.75 \times \sqrt{100} = 47.5 \text{ m}$$

8. (c)

A lined canal can be designed smaller in cross-section and also in length. The steeper gradients can be provided because higher velocities are permissible. It can, therefore, help to bring high areas under command.

9. (b)

Meander ratio is the ratio of meander belt to meander length i.e., $\dfrac{M_B}{M_L}$.

10. (b)

Groynes are embankment type structures, constructed transverse to the river flow, extending from the bank into the river. They are constructed to protect the bank from which they are extended, by deflecting the current away from the bank. These are called repelling groynes. On the upstream side of a repelling groyne, a still water pocket is formed, where the suspended sediments carried by the river, gets deposited. For low water training or training for depth groynes can be used. Herein they contract the width of the channel to provide sufficient depth for navigation during low water periods.

In order to train the flow along a certain course guide banks are most commonly used. However groynes can also be used to deflect the flow or attract the flow.

11. (d)

Rigid modules or modular outlets are those through which the discharge is constant and fixed within limits irrespective of the fluctuations of the water levels of either the distributary or of the water course or of both $\therefore$ sensitivity = 0, and flexibility = 0.

12. (b)

If f_c represents the allowable stress of the dam material, then the maximum height (H_{max}) which can be obtained, without exceeding the allowable compressive stresses is given as:

$$f = \gamma_w H(s_c - C + 1)$$

or

$$H = \frac{f}{\gamma_w (S_c - C + 1)}$$

When uplift is neglected i.e., $C = 0$

$$H_{max} = \frac{f}{\gamma_w (S_c + 1)}$$

13. (c)

Rockfill dams are very useful in seismic regions, as they provide high resistance to seismic forces because of their flexible character

14. (c)

15. (b)

An ogee spillway is mostly suitable for concrete gravity dams especially when the spillway is located within the dam body in the same valley. The trough spillway or chute spillway is the simplest type of a spillway which can be easily provided independently and at low costs. It is lighter and adaptable to any type of foundations and hence provided easily on earth and rockfill dams.

16. (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 infact 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.

17. (d)

A cyclone is a large low pressure region with circular wind motion. Two types of cyclones are recognized viz., tropical cyclones and extratropical cyclones. A tropical cyclone is a wind system with an intensely strong depression. The normal areal extent of a cyclone is about 100-200 km in diameter. The isobars are closely spaced and the winds are anticlockwise in the Northern hemisphere.

18. (b)

The Tipping-bucket type gauge gives data on the intensity of rainfall.

21. (b)

With the reduction of unit hydrograph duration, 1 cm excess rainfall will occur in reduced period. So peak ordinate of UH will increase and time base will decrease. Thus the peak ordinate of 2 hr UH will be greater than 80 m^3/s.

22. (a)

A U-tube manometer can also be used to measure negative or vacuum pressure. For measurement of small negative pressure, a U-tube manometer without any manometric liquid may be used.

23. (a)

The time period of oscillation,

$$T = 2\pi\sqrt{\frac{K^2}{g \cdot (GM)}}$$

$\Rightarrow$

$$T = 2\pi\sqrt{\frac{9 \times 9}{10 \times 0.9}} = 2\pi \times \frac{9}{3} = 6\pi$$

24. (b)

Distorted model can have vertical scale exaggeration or slope exaggeration. Therefore they are not geometrically similar. It may have either geometrical distortion, or material distortion or distortion of hydraulic quantities or a combination of these.

25. (c)

The thrust on a stationary flat plate is given as

$$F = \rho a V^2$$

$$F = 1000 \times \frac{\pi}{4} \times \left(\frac{50}{1000}\right)^2 \times 20^2 = 785.4 \text{ N}$$

26. (d)

$$\text{Specific speed of turbine, } N_s \;=\; \frac{N\sqrt{P}}{H^{5/4}} = \frac{90\sqrt{900}}{(30)^{5/4}} = 38.455$$

If N_s = 30 to 51, the type of turbine will be Pelton with multi jet.

27. (c)

Using, $\qquad\qquad\qquad h_1 s_1 \;=\; h_2 s_2$

(i) For kerosene, $\qquad 100 \times 1 \;=\; h_2 \times 0.8$

$\qquad\qquad\qquad\qquad\quad h_2 \;=\; 125 \text{ m}$

(ii) For carbon tetrachloride,

$\qquad\qquad\qquad 100 \times 1 \;=\; h_2 \times 1.6$

$\qquad\qquad\qquad\qquad h_2 \;=\; 62.5 \text{ m}$

28. (b)

An approximate analysis for TDS is often made by determining the electrical conductivity of the water. The ability of water to conduct electricity is called specific conductance and it is a function of its ionic strength. Unfortunately, specific conductance and concentration of TDS are not related on a one to one basis. Only ionized substances contribute to specific conductance. Organic molecules and compounds that dissolve without ionizing are not measured. Additionally, the magnitude of specific conductance is influenced by the valence of the ions in the solution, their mobility and their relative numbers. The temperature also has an important effect with specific conductance increasing as the water temperature increases. The ions usually accounting for majority of TDS in natural waters are Na, Ca, Mg, HCO_3^-, SO_4^{2-}, Cl^-, etc. Hence their presence increases the electrical conductivity of water.

29. (c)

Ion exchange process is used for zero hardness water.

A variety of dissolved solids can be removed by ion exchange. For hardness removal zeolite (a naturally occurring sodium alumino-silicate material sometime called green sand) and synthetic resins are used. The removal process is based on high adsorption capacity of calcium and magnesium ions compared to sodium ions. In this process exchange sites are utilized to remove hardness. When all the exchange sites are utilized, hardness begins to appear in the effluent. This is called break through and it necessitates the regeneration of the medium by contacting it with a strong sodium-chloride solution.

30. (b)

For mixing basins Gt should be 30,000 to 60,000 where t is the detention period or mixing periods (usually 60 to 120 sec). For flocculator the G value ranges between 20 to 80 s^{-1} and detention period 20 to 60 minutes.

31. **(b)**

Bangalore method: This method of composting is an anaerobic method and was developed at Bangalore in India in 1939. It is recommended where night soil and refuse are used for preparing the compost. The method overcomes many of the disadvantages of the Indore method, such as the problem of heap protection from adverse weather, nutrient losses from high winds and strong sun, frequent turning requirements, and fly nuisance. However, the time required for the production of finished compost is much longer. The method is suitable for areas with scanty rainfall.

Indore method: This method of composting is an aerobic method through passive aeration and was made at Indore in India in mid 1920s.

32. **(b)**

Total domestic water consumption usually amounts to 50 – 60% of the total water consumption.

33. **(c)**

If diameter > Economical dia
• Less cost of Pumping
• High cost of pipe material
If diameter < economical dia
• Less cost of pipe material
• High cost of pumping

34. **(a)**

BOD_5 = Loss of oxygen in mg/l × Dilution ratio
BOD_5 = (7 – 0) × 100 = 700 mg/l

35. **(a)**

Length of tank = flow velocity × detention time

= 0.25 × 60 = 15 m

36. **(d)**

The volume of sludge at the time of cleaning
$$= 0.5 \times 7 = 3.5 \text{ m}^3 = 3500 \text{ litres}$$
$$\text{Rate of accumulation of sludge} = 5 \times 70 = 350 \text{ litre/year}$$
$$\text{Cleaning interval} = \frac{3500}{350} = 10 \text{ years}$$

37. **(b)**

The main objective of prime coat is to plug in the capillary voids of the porous surface and to bind the loose mineral particles on the existing surface.

42. **(b)**

Traffic flow equation:

$$u = 80 - 0.7k$$

Since flow
$$q = u \cdot k = 80\,k - 0.7\,k^2$$

For maximum flow $\dfrac{dq}{dk} = 0$

For an equation $u = a - b\,k$

$$q_{max} = \frac{a^2}{4b} = \frac{(80)^2}{4 \times 0.7} \simeq 2286\,\text{vph}$$

43. **(b)**

The PCU may be considered as a measure of the relative space requirement of a vehicle class compared to that of a passenger car under a specified set of roadway, traffic and other conditions. If the addition of one vehicle of a particular class in the traffic stream produces the same effect as that due to the addition of one passenger car, then that vehicle class is considered equivalent to the passenger car with a PCU value equal to 1.0.

44. **(d)**

Flexible progressive system (most efficient method of signalling)

46. **(a)**

As per IRC, in designing the length of valley transition curve the rate of change of centrifugal acceleration is taken as 0.6 m/s^3.

49. **(a)**

As per Indian Standards the ruling design speed is 80 kmph.

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