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# **KPWD-AE** 2021

## **CIVIL ENGINEERING**

## **QUESTIONS WITH DETAILED SOLUTIONS**

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## **KPWD - 2021 (AE)** CIVIL ENGINEERING

### **QUESTIONS WITH DETAILED SOLUTIONS**

01. The carry-over factor for a prismatic beam element is

(a) 1 (b) 1/2 (c) 3/4 (d) 1/4

#### 01. Ans: (b)

#### Sol:

- If far end is fixed COF = 1/2
- If far end is hinged COF = 0
- For cantilever beam COF = -1
- 02. The equation of a symmetric parabolic arch of span 'L' and rise 'h' is (origin at left support)

(a) 
$$y = 4hx^{2}(L - x^{2})L^{2}$$
  
(b)  $y = 4hx (L - x)^{2}/L^{2}$   
(c)  $y = 4hx^{2} (L - x)/L$   
(d)  $y = 4hx (L - x)/L^{2}$ 

**02.** Ans: (d) Sol:  $y = \frac{4hx}{L^2}(L-x)$ 

03. The shape of influence diagram for the maximum bending moment in a simply support beam is
(a) rectangular
(b) parabolic
(c) triangular
(d) trapezoidal

#### 03. Ans: (b)

Sol:

- The shape of ILD for BM at a section is triangle.
- The shape of ILD for BM with respect of simply supported beam is parabola.

- 04. In connection with theories of failure, which of the following statement is wrong?
  - (a) In the case of brittle materials maximum principal stress theory should be used.

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- (b) For ductile materials, the maximum shear stress theory give a good approximation
- (c) Shear strain energy theory is preferred, when the mean principle stress in Tensile
- (d) For ductile material, strain energy theory gives a good approximation

#### 04. Ans: (d)

- **Sol:** For ductile material, shear strain energy theory gives a good approximation
- 05. The ratio of deflection at centre of fixed beam and simply supported beam under a uniformly distributed load is

(a) 0.1 (b) 0.25 (c) 0.2 (d) 0.5

Since

Sol:  

$$y_{SSB} = \frac{5\omega L^4}{384 EI}$$

$$y_{fixed} = \frac{\omega L^4}{384 EI}$$

$$\frac{y_{fixed}}{y_{SSB}} = \frac{\frac{\omega L^4}{384 EI}}{\frac{5\omega L^4}{384 EI}} = \frac{1}{5} = 0.2$$

06. The slope of a simply supported beam at the end under a moment M at that end is

(a) ML/2EI	(b) ML/3EI
(c) ML/4EI	(d) ML/6EI



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#### 07. Ans: (a) Sol:



$$y_{c} = (y_{c})_{P} + (y_{c})_{M}$$

$$= \frac{P(\frac{L}{2})^{3}}{3EI} + \frac{M(\frac{L}{2})^{2}}{2EI}$$

$$= \frac{PL^{3}}{24EI} + \frac{(\frac{PL}{2})(\frac{L}{2})^{2}}{2EI}$$

$$= \frac{PL^{3}}{24EI} + \frac{(\frac{PL}{2})(\frac{L}{2})^{2}}{2EI}$$

$$= \frac{PL^{3}}{24EI} + \frac{PL^{3}}{16EI} = \frac{5PL^{3}}{48EI}$$

- 08. For a given material is Poisson's ratio is 0.25 the ratio of Young's modulus and Modulus of rigidity is (a) 2.5 (b) 0.4 (c) 2.75 (d) 3.0
- **08.** Ans: (a) Sol:  $\mu = 0.25$ ,  $\frac{E}{G} = ?$  $E = 2G(1+\mu)$   $\frac{E}{G} = 2 (1+\mu) = 2 (1+0.25) = 2.5$
- 09. A mild steel flat of width 200 mm and thickness 10 mm is bent into a arc circle of radius 10 m by applying the moment M, if the Young's modulus E = 200 GPa then magnitude of M in N-m is (a) 288 (b) 333 (c) 292 (d) 229

09. Ans: (b)

b = 200 mm

 $R = 10m = 10 \times 10^3 mm$  $E = 200 \times 10^3 MPa$ From bending equation  $\frac{M}{I_{NA}} = \frac{E}{R}$  $M = \frac{E}{R} \times I_{NA} = \frac{E}{R} \times \frac{bt^3}{12}$  $=\frac{200\times10^{3}}{10\times10^{3}}\times\frac{200\times10^{3}}{12}$  $= 333.33 \times 10^3$  N-mm = 333.33 N-m





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bar of 80 mm diameter and 800 mm in length	с <sub>Г</sub> 1	12. Ans: (c)
biected to an avial load of 200kN. It elongates by	, (	ol. In buildi

subjected to an axial load of 200kN. It elongates by 0.30 mm and diameter decreases by 0.01 mm. What is the Poisson's ratio of material of bar?

(a) 0.25 (b) 0.33 (c) 0.50 (d) 0.75

#### 10. Ans: (b)

10.

**Sol:** d = 80mm L = 800mm P = 200 kN

 $9 \ \Delta L = 0.30 \ mm \quad \ \ \downarrow \Delta d = 0.01 \ mm \quad \mu = ? \label{eq:L}$ 

$$\left| (-) \cdot \frac{\varepsilon_{\text{lat}}}{\varepsilon_{\text{long}}} \right| = \left| (-) \cdot \frac{\left(\frac{\delta d}{d}\right)}{\frac{\delta L}{L}} \right|$$
$$\left| \frac{(-)\left(\frac{-0.01}{80}\right)}{\frac{0.30}{800}} \right| = \frac{0.000123}{0.000373}$$
$$u = 0.333$$

11. The relation between Young's modulus (E), Shear modulus (C) and bulk modulus (K) is given by

(a) 
$$E = \frac{9K.C}{3K+C}$$
 (b)  $E = \frac{6K.C}{3K+C}$   
(c)  $E = \frac{3K.C}{3K+C}$  (d)  $E = \frac{12K.C}{3K+C}$ 

**11. Ans: (a) Sol:**  $E = \frac{9KC}{3K+C}$ 

- 12. Consider the following activities in a building construction
  - 1. Concreting of roof slabs
  - 2. Brick line concrete terracing
  - 3. Erection of formwork for slab
  - 4. Construction of parapet wall in terrace

The correct sequence of thee activities is

(a) 1, 3, 2, 4	(b) 3, 1, 4, 2
(c) 3, 1, 2, 4	(d) 1, 3, 4, 2

**Sol:** In building construction, the correct sequence of activity

**Civil Engineering** 

- 3. Erection of formwork for slab
- 1. Concreting of roof slabs
- 2. Brick lime concrete terracing
- 4. Construction of parapet wall in terrace
- 13. The road connecting a city to highway is called(a) arterial street(b) sub-arterial street(c) collector street(d) local street

13. Ans: (a)

14. Crossing angles at grade intersections should not be in any case less than
(a) 30°
(b) 45°
(c) 60°
(d) 75°

#### 14. Ans: (a)

15. The order in which a road is laid(a) sub soil, base, sub grade, sub base(b) base, sub soil, sub grade, sub base(c) sub base, base, sub grade, sub soil(d) sub soil, sub grade, sub base, base

#### 15. Ans: (d)

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- 16. In simple tension or compression
  - (a) Maximum shear stress is equal to the applied stress and acts on planes at 45° to it.
  - (b) Maximum shear stress is equal to one-half the applied stress and acts on planes at 45° to it.
  - (c) Maximum shear stress is equal to the applied stress and acts on planes at 90° to it.
  - (d) Maximum shear stress is equal to one-half the applied stress and acts on planes at 90° to it.

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# 21. Ans: (c) Sol: $A \xrightarrow{6EI\delta} L^2 \xrightarrow{L} B \xrightarrow{S=1} M_A = \frac{6EI}{L^2}$

22. In a office building, one washbasin should be provided for every \_\_\_\_\_ number of persons.
(a) 5 (b) 25 (c) 15 (d) 10

#### 22. Ans: (b)

23. Flotation is a method of water purification by(a) gas transfer(b) ion transfer(c) solute stabilization(d) solid transfer

#### 23. Ans: (a)

- **Sol:** Flotation by applying compressed air from bottom.
- 24. Which one of the following is not a method of preventing fly nuisance at filter sites of sewage?
  - (a) Sprinkle alum
  - (b) Chlorinating the sewage
  - (c) Add insecticide in the sewage
  - (d) Sprinkle lime

#### 24. Ans: (b)

**Sol:** Chlorinating sewage to control bacterial growth.

25. One of the grades of bitumen recommended by IRC for grade macadam is

(a) 85/100	(b) 60/70		
(c) 120/50	(d) 180/200		

#### 25. Ans: (a)

26. If design speed is 'V' kmph and reaction time 't' is 2.5 seconds, lag distance, in metres, is calculated as (a) 0.278 Vt
(b) 0.35 Vt
(c) 0.36 Vt
(d) 0.4 Vt

#### 26. Ans: (a)

5

**Sol:** Lag distance =  $S_l = vt$ =  $\frac{5}{18}vt$ 

Where v = Design speed in m/s

V = Design speed in kmph

- 27. To exclude the floating debris from sewage, screens are used and fixed
  - (a) parallel to the direction of flow
  - (b) perpendicular to the direction of flow
  - (c) at an angle  $30^{\circ}$   $60^{\circ}$  to the direction of flow
  - (d) orientation is immaterial

#### 27. Ans: (c)

Sol: Screen is provided at an angle 30 to 60° to horizontal.

28. The population of a city is 10 lakhs and average water consumption is 200 lpcd. The fire demand is 200 MLD. Then the distribution system is to be199 designed for

(a) 540 MLD	(b) 360 MLD
(c) 740 MLD	(d) 560 MLD

#### 28. Ans: (d)

Since

**Sol:** Distribution system is designed for total demand i.e. coincidental draft or maximum hourly demand, which ever is greater.

Average demand,  $Q = 10,00,000 \times 200 l/day$ 

= 200 MLD

Maximum daily demand = 1.8 Q

 $=1.8 \times 200 = 360$  MLD

Coincidental draft = Maximum daily demand + Fire demand

= 360 + 200 = 560 MLD



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#### 6

Maximum hourly demand =  $2.7 \times Q$ =  $2.7 \times 200 = 540$  MLD  $\therefore$  Total demand = 560 MLD

29. If T-alkalinity in water is 350 mg/l as CaCO<sub>3</sub> and P-alkalinity is 200 mg/l as CaCO<sub>3</sub>. The find the concentration of OH<sup>-</sup>, carbonates and bicarbonates in water in mg/l

(a) 50, 300, 0	(b) 0, 50, 300
(c) 0, 300, 50	(d) 50, 0, 300

#### 29. Ans: (a)

- **Sol:** P = 200
  - T = 350 T/2 = 175 P > T/2 OH = 2 P - T = 50  $CO_3 = 2T - 2P = 300$ HCO<sub>3</sub> = 0
- 30. A sand filter bed is 60 cm depth having a porosity of 0.48 and specific gravity of 2.60 for the filter material. If the settling velocity of the filter particle is 10 cm/sec, then the back wash rate required to wash the filter hydraulic so as to have expansion of 50% is

(b) 1.13 cm/sec

(d) 2.85 cm/sec

- (a) 0.37 cm/sec (c) 1.47 cm/sec
- 30. Ans: (c)
- **Sol:**  $\frac{Z_{e}}{Z} = \frac{1-n}{1-n}$ 
  - $\frac{1.5z}{z} = \frac{1-0.48}{1-n}$

$$1.5 (1 - n_{e}) = 0.52$$
$$n_{e} = \frac{1.5 - 0.52}{1.5} = 0.653$$

 $=10 \times (0.653)^{4.5} = 1.472 \text{ cm/sec}$ 

31. Detention time for a sedimentation tank (continuous flow type, is given for a tank, passing a discharge = Q Length = L, Width = B and Depth = H, as

(a) 
$$\frac{BLH}{Q}$$
 (b)  $\frac{Q}{BLH}$   
(c)  $\frac{Q}{BL}$  (d)  $\frac{Q}{BH}$ 

#### 31. Ans: (a)

**Sol:** Detention time =  $\frac{BLH}{Q}$ 

- 32. The suitable layout of distribution system for a city with roads of rectangular pattern is
  - (a) Grid iron system(b) Dead end system(c) Ring system(d) Radial system

#### 32. Ans: (a)

 The Chezy's coefficient C is related to Darcy-Weisbach fiction factor is

(a) C = 
$$\sqrt{\frac{g}{8f}}$$
  
(c) C =  $\sqrt{\frac{8g}{f}}$ 

(b) C = 
$$\sqrt{\frac{8g}{f^{1/4}}}$$
  
(d) C =  $\sqrt{\frac{f}{8g}}$ 

### 33. Ans: (c)

Sol: Relation between Chezy's constant and Darcy-Weisbach fiction factor

Proof: 
$$h_f = \frac{f.\ell.V^2}{2g.d}$$
 (Darcy Weisbach equation)

For non-circular pipe  $d=4R=4 \times Hydraulic$  radius (or) mean depth.

$$h_{f} = \frac{f\ell V^{2}}{2g(4R)} = \frac{f\ell V^{2}}{8gR}$$
  

$$\therefore V^{2} = \frac{h_{f}}{\ell} \cdot \frac{8g}{f} \cdot R \qquad \left[\frac{h_{f}}{\ell} = \text{Slope} = S\right]$$
  

$$\therefore V^{2} = \frac{8g}{f} \cdot S \cdot R$$



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$$\therefore V = \sqrt{\frac{8g}{f} \cdot R \cdot S} = \sqrt{\frac{8g}{f}} \cdot \sqrt{R \cdot S}$$

 $V = C.\sqrt{R}.S....(1)$ 

Also Chezy's equation

$$V = C.\sqrt{R.S} = \frac{1}{n}R^{2/3}S^{1/2}$$

from equation (1) and (2)

 $C = \frac{1}{n} (R)^{1/6} = \sqrt{\frac{8g}{f}}$ 

comparing C =  $\sqrt{\frac{8g}{f}}$ 

Chezy's coefficient =  $\sqrt{\frac{8g}{\text{Darcy's friction factor}}}$ 

- 34. In water treatment, slow sand filters, when compared to rapid gravity filters, produce
  - (a) less contaminated effluent
  - (b) more contaminated effluent
  - (c) equally contaminated effluent

(d) none of these

#### 34. Ans: (a)

- **Sol:** Slow Sand filters produce high quality water compared to rapid sand filter.
- 35. Under which of the following activity a negative float can occur?
  - (a) Sub-critical activity (b) Critical activity
  - (c) Normal activity (d) Super critical activity

#### 35. Ans: (d)

**Sol:** A negative float can occur in case of Sub-critical activity only.

**Explanation:** Negative float is the amount of time that must be saved to bring the project to completion on time.

**Ex:** An activity start date is set earlier than the end date for a preceding activity in the critical path of the given project.

Sub-Critical Activity denotes more than enough resources.

Supercritical activity has a negative float which results when activity duration is more than the available. It is the indication of abnormal situation how to reduce the activity duration.

- 36. A document which fully describes the materials, proportions and workmanships and accurately represent the work to be executed is
  - (a) Rate analysis(c) Bill of quantities
- (b) Schedule of rates
- (d) Al the above

#### 36. Ans: (\*)

Sol: Actual answer supposed to be SPECIFICATIONS. Specifications are precisely written documents that go with the construction documents and describe materials as installation methods, describe the project to be constructed, supplementing drawings and forming part of the contract, and describe qualities of materials, their methods of manufacture and their installation, and workmanship and mode of construction.

 Graphical representation of activities consisting of nodes and arrows are known as

- (a) Bar charts
- (b) Gantt charts
- (c) Networks
- (d) Linked Gantt Charts

#### 37. Ans: (c)

**Sol:** Graphical representation of activities consisting of nodes and arrows are known as Networks.



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- 38. Amount of time by which the start of an activity may be delayed without causing a delay in the completion of a project is known as
  - (a) Total Float (b) Free Float
  - (c) Independent Float (d) Interference Float

#### 38. Ans: (a)

**Sol:** In project management, float is corresponding to activity in CPM.

Total Float: It is the amount of time by which an activity can be delayed without delaying the project duration. Extra time available for an activity without delaying the project schedule.

Total Float = L.S.T - E.S.T

- 39. Interference Float is described as
  - (a) Free Float-Total Float
  - (b) Total Float-Independent Float
  - (c) Total Float-Free Float
  - (d) Free Float-Independent Float

#### 39. Ans: (c)

**Sol:** Interference Float is described as the difference between total float and free float.

Interference Float = Total Float – Free Float Interference float is the amount of time that a schedule activity can be delayed (or) extended from its early start date without delaying the project finish date.

- 40. If the average water consumption of a city is 300 Lpcd and its population is 4,00,000, the maximum hourly discharge of the maximum day will be
  - (a) 120 MLD
  - (b) 324 MLD
  - (c) 216 MLD
  - (d) None of the above

#### 40. Ans: (b)

Sol: Average demand Q = 4,00,000  $\times$ 300 *l*/day = 120 MLD Maximum hourly Q = 2.7  $\times$  average demand = 2.7  $\times$  120 = 324 MLD

- 41. A primary settling basin with a diameter of 26 m and 2.1 m side water depth has to treat water with a discharge of 0.15 m<sup>3</sup>/s. The detention period of the basin is 2.41 hr. Surface overflow rate and weir loading rate of the tank is
  - (a) 24.4  $m^3/day.m^2$  and 317.33  $m^3/day.m$
  - (b) 21.5 m<sup>3</sup>/day.m<sup>2</sup> and 339 m<sup>3</sup>/day.m
  - (c) 20.9 m<sup>3</sup>/day.m<sup>2</sup> and 159.23 m<sup>3</sup>/day.m
  - (d) 26.8  $m^3/day.m^2$  and 120  $m^3/day.m$

#### 41. Ans: (\*) (No option)

**Sol:**  $Q = 0.15 \text{ m}^3/\text{sec} = 12960 \text{ m}^3/\text{day}$ 

SOR 
$$v_o = \frac{Q}{A_g} = \frac{12960}{\frac{\pi}{4}(26)^2} = 24.41 \text{ m}^3/\text{day/m}^2$$

WLR = 
$$\frac{Q}{\pi D} = \frac{12960}{\pi (26)} = 158.66 \text{ m}^3/\text{day/m}$$
  
\$\approx 159 \text{ m}^3/\text{day/m}\$

- 42. The maximum velocity in a partially filled circular sewer section (roughness of surface not considered) is obtained when the sewer is running at
  - (a) 0.81 times the full depth
  - (b) Full depth
  - (c) 0.5 times the full depth
  - (d) 0.75 times the full depth

#### 42. Ans: (a)

1995

**Sol:** Velocity of flow in sewer is maximum at depth of flow 0.81 times diameter.



Engineering Publications		9		Civil Engineering
<ul> <li>43. For a Grit channel, if the velocity is 0.25 m/s and the minute, then the length of the (a) 20 m (b) 30 m (c) 15 m (d) 60 m</li> </ul>	recommended flow detention period is 1 channel is	4	.7.	The domestic sewage of a town was tested for total solids and following results were obtained Weight of sample of sewage = 100 gm Weight of solids after evaporation of liquid = 0.862 m Weight of dry residue after ignition = 0.506 gm
43. Ans: (c) Sol: Length of grit chamber = $v_H$ > = 0.2: = 15 t	$\times DT$ 5 × 1× 60 m		7 -	What is the value of volatile solids?(a) 826 ppm(b) 726 ppm(c) 356 ppm(d) 436 ppm
<ul> <li>44. The shallow wells constructed of a river to collect river w their bottoms are called</li> <li>(a) Infiltration galleries (b)</li> <li>(c) Springs (d)</li> </ul>	d in series along banks vater seeping through ) Infiltration wells ) Tubewell	RIA	iol:	Volume of sample = $\frac{\text{Mass}}{\rho} = \frac{100}{1} = 100 \text{ cc}$ Volatile solids = $\frac{W_2 - W_s}{V}$ = $\frac{0.862 - 0.506}{100} \times 10^6 \text{ppm}$ = 3560 ppm
<ul> <li>44. Ans: (b)</li> <li>Sol: Shallow well at river bank is</li> <li>45. Coagulants used in water treat when the raw water is <ul> <li>(a) Acidic</li> <li>(b) Alkalin</li> <li>(c) Neutral</li> <li>(d) Turbid</li> </ul> </li> </ul>	infiltration well. atment function better	4	.8.	Answer not matching may be (c) Zeolite used in zeolite softening process for the treatment of hard water gets exhausted after certain time of usage but can be regenerated by flushing it with (a) 10% calcium chloride solution (b) 10% magnesium surface solution
<ul><li>45. Ans: (d)</li><li>Sol: Coagulants are used for treating by colloidal particles.</li></ul>	ng turbid water caused	e 19	99 8.	<ul><li>(c) 10% magnesium chloride solution</li><li>(d) 10% sodium chloride solution</li><li>Ans: (d)</li></ul>
<ul> <li>46. Rapid gravity filters are used</li> <li>(a) Industrial plants</li> <li>(b) Swimming pools</li> <li>(c) Large municipal supplies</li> <li>(d) Small scale industries</li> </ul>	for	4	9.	Zeolite is regenerated by soaking in Nacl solution. Empirical Freeman formula to calculate the quantity of water required for the fire fighting is (a) $Q = 4640\sqrt{p}(1-0.01\sqrt{p})$
<ul><li>46. Ans: (c)</li><li>Sol: Rapid sand filters are used supplies.</li></ul>	for large municipal	4	9.	(b) $Q = 1135.5\left(\frac{p}{10} + 10\right)$ (c) $Q = 3182\sqrt{p}$ (d) $Q = 5663\sqrt{p}$ Ans: (b)

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50.	Sludge thickening is co following methods 1. Gravity thickening 2. Air flotation 3. Leaching Which of the above meth (a) 2 and 3 (b) 1 (c) 1 and 2 (d) 1	monly achieved by the hods are correct? and 3 , 2 and 3		53.	<ul> <li>If EC-Electrical Conductivity TDS - Total Dissolve Solids then</li> <li>(a) EC decreases with increase in TDS</li> <li>(b) EC increases with increase in TDS</li> <li>(c) EC decrease initially and then increase with increase in TDS</li> <li>(d) EC increase initially and then decrease with increase in TDS</li> </ul>		
50. Sol:	Ans: (c) Sludge is thickened by flotation.	gravity thickener or air		<b>53.</b> Sol: 54.	Ans: (b) EC and TDS are linearly related The minimum and maximum diameter of sewers,		
51.	Find the pH of a mixtu following two solutionsSolution A: Volume 300Solution B: Volume 700(a) 6.234(b) 7(c) 5.153(d) 3	ure formed by mixing the ml:pH = 7 ml: pH = 5 .03 .23	R IA	V G 54.	generally adopted in the designs may be (a) 150 mm and 1000 mm (b) 150 mm and 3000 mm (c) 250 mm and 4500 mm (d) 600 mm and 900 mm Ans: (b)		
51.	Ans: (c)		5	Sol:	Minimum 150 mm and maximum 3000 mm		
Sol:	$(H^{+})_{mix} = \frac{300 \times 10^{-7} + 70}{300 + 70}$ $= 7.03 \times 10^{-7} \text{ mo}$ $(pH)_{mix} = \log_{10} \frac{1}{(H^{+})_{mix}}$ $= \log_{10} \frac{1}{7.03 \times 10}$	$\frac{00 \times 10^{-5}}{1/1}$ $\frac{1}{-7} = 5.153$	:e 1	55. <b>99</b>	If the depletion of oxygen is found be $2 \text{ mg/}l$ after incubating 3 ml of sewage diluted to 300 ml at 20°C for 5 days, then the BOD of sewage would be (a) 200 mg/l (b) 300 mg/l (c) 600 mg/l (d) 250 mg/l		
52.	A city has a populati Kuichling's formula, the (a) 33,000 lit/min (c) 31,820 lit/min	ion of 1,00,000. As per fire demand for the city is (b) 25,000 lit/min (d) 21,820 lit/min		55. Sol:	Ans: (a) DO consumed = DO depleted BOD = DO consumed × Dilution factor $= 2 \times \frac{300}{3} = 200 \text{ mg/l}$		
52. Sol:	Ans: (c) P = 1,00,000 = 100 thous $Q = 3182\sqrt{P} = 3182\sqrt{10}$ = 31820 lit/min	sand 0		56. 56. Sol:	Self-Cleaning velocity of sewage flowing in pipelines is usually (a) 0.25 m/sec (b) 0.40 m/sec (c) 0.80 m/sec (d) 1.00 m/sec Ans: (c) Self-cleansing velocity usually range between 0.6 to 0.9 m/sec.		
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- 60. What will be fixed end moment for the given beam 61. Ans: (d) of span L = 6 m, when subjected to concentrate load Sol: 8 kN/m P = 20 kN?Р 12 m L/2L/2 Η -H 30 m L/4 L/4 L/2 Horizontal Thrust (H) =  $\frac{\omega L^2}{8h}$ В А (a) 12.97 kNm (b) 22.04 kNm  $=\frac{8\times 30^2}{8\times 12}=75$  kN (c) 12.50 kNm (d) 10.00 kNm A propped cantilever of span 5 m carries a uniformly 62. 60. Ans: (b) distributed load of 2.5 kN/m run over its entire Sol: span. The value of prop reaction to keep the beam Μ L/2 L/2 horizontal is Α (a) 4.16 kN (b) 4.98 kN L/4L/4 (d) 7.81 kN (c) 6.25 kN L/2P=20K N 3m 3m 62. Ans: (b) Prismatic beam Sol: W=2.5 kN/mL= 5 m For prismatic Beam, fixed end moment is  $\frac{PL}{8}$ For Non-primatic Beam, fixed end moment is Prop reaction  $(R_{\rm B}) = \frac{3 {\rm wL}}{8}$ greaterthan  $\frac{PL}{8}$ 1995 Since  $=\frac{3 \times 2.5 \times 5}{8} = 4.68 \text{ kN}$  $> \frac{20 \times 6}{8}$ Answer not matching, may be (b) > 15 kN-m 63. The world's first suspension bridge is 22.04 >15 kN-m (a) Akashi Kaikyo bridge (b) George Washington bridge 61. If a two hinged parabolic arch is subjected to (c) Wheeling suspension bridge uniformly distributed load 8 kN/m over entire (d) East bridge horizontal beam of span 30 m and maximum sag of cable as 12 m, then what will be the horizontal 63. Ans: (c) thrust? **Sol:** Akashi Bridge (1998) (a) 200 kN (b) 150 kN George washington bridge (1927)
  - (c) 100 kN (d) 75 kN
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Wheeling suspension bridge (1847)

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**Civil Engineering** 

- 64. Reaction locus for a two hinged semi-circular arch is
  - (a) A straight line parallel to line joining the abutments and at height  $\pi R/2$  above it
  - (b) A curved line parallel to the arch and at height  $\pi R/2$  above
  - (c) A straight line parallel to line joining abutments and at height  $\pi R$  above it
  - (d) A curve whose equation is y = PE

#### 64. Ans: (a)

- Sol: For a two hinged semi-circular arch, the reaction locus is a straight line at a distance  $\frac{\pi R}{2}$  from the abutments.
- 65. For a simply supported beam, the greatest left end reaction is
  - (a) Maximum positive shear
  - (b) Maximum negative shear
  - (c) Support reaction
  - (d) None of the above

#### 65. Ans: (a)

66. A beam AB of 10 m span is hinged supported at A and roller supported at B. The influence line for reaction  $R_B = mx$  where m is

(a) 
$$\frac{1}{2.5}$$
 (b)  $\frac{1}{5}$  (c)  $\frac{1}{7.5}$  (d)  $\frac{1}{10}$ 

#### 66. Ans: (d)





67. Two loads of an electrical crane, 50 kN each, spaced at 4 m centre to centre cross a girder of 8 m span. Find the absolute maximum bending moment in the beam

(a) 112.5 kNm	(b) 122.5 kNm
(c) 132.5 kNm	(d) 142.5 kNm

#### 67. Ans: (a)



Absolute maximum bending moment =  $50 \times \frac{3}{8} + 500 \times \frac{15}{8}$ = 18.75 + 93.75= 112.5 kN-m

68. Three new roads A, B and C are to be completed in a five-year plan in Maharashtra. Which of the following is the order of priority based on maximum utility principle (with top priority first)? Road Length (km) No.of villages served

	А	30	600	
	В	40	750	
	С	50	450	
(a) B, C and A	(b) B, A and C			
(c) C, B and A	(	d) A, B	and C	

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#### 68. Ans: (d)

- **Sol:** Priority = Population/length
  - Priority = 600/30 = 20Road: A
  - Road: B Priority = 750/40 = 18.75
  - Road: C Priority = 450/50 = 9
  - The order of Priority A,B & C
- 69. Which of the following statement is incorrect?
  - (a) Geometric design of High ways deals with cross selection elements
  - (b) Geometric design of Highways deals with horizontal and vertical alignment details.
  - (c) In the geometric design of Highways, design speed will not be considered
  - (d) In the geometric design of Highways environmental factors will be considered.

#### 69. Ans: (b)

- Sol: Geometric Design deals with horizontal alignment (horizontal curves), vertical alignment (sag and summit curves)
- 70. The following rational formula is widely used to estimate the peak run-off water for highway drainage (b)  $Q = \frac{Ci}{A_d}$ 
  - (a)  $Q = Ci A_d$ (c) Q =  $\frac{C}{iA_{d}}$
- 70. Ans: (a)
- 71. For design of road side drain the following data is not required
  - (a) Rain fall data
  - (b) Type of soil of the side drain
  - (c) Paved and shoulder area
  - (d) Design speed of Vehicle

#### 71. Ans: (d)

Sol: Design speed is not required for the design of side drains.



72. According BIS recommendation, the cement concrete paver blocks use in Highway construction for medium traffic roads shall have a compressive strength of

(a) 40 MPa (b) 20 MPa (c) 25 MPa (d) 50 MPa

#### 72. Ans: (a)

- **Sol:** Compressive strength of power blocks  $\lt 40$  Mpa as per BIS.
- 73. What is the rating value, if in the opinion of the road users a particular road stretch is "Very good"?
  - (a) 5 to 6 (b) 3 to 4 (c) 2 to 3 (d) 4 to 5

#### 73. Ans: (d)

- Sol: As per present serviceability index (PSI)
  - 0-1; Very poor
  - 1-2 : Poor
  - 2-3 : Fair
  - 3-4 : Good
  - 4-5; Very good
- If mean deflection is 1.449 mm for a flexible 74. pavement and standard deviation is 0.107 mm, the characteristic deflection for highway with heavy traffic is

a) 1.66 mm	(b) 1.56 mm
c) 1.34 mm	(d) 1.24 mm

#### 74. Ans: (a)

Since

(d)  $Q = C^{2/3} i A_d$ 

**Sol:** Mean deflection,  $\delta = 1.449$ Stadard deviation,  $\sigma = 0.107$ Characteristic deflection as per Benklemna's beam Deflection text for high ways =  $\delta + 2\sigma$ 

= 1.449 + 2(0.107)

= 1.663 mm

Engineering Publications	1	5	Civil Engineering
<ul> <li>75. An alluvial river has a maximum flow discharg 95 m<sup>3</sup>/sec. What is the linear waterway of the brias per Lacey's equation?</li> <li>(a) 92.2 m</li> <li>(b) 23.4 m</li> <li>(c) 46.8 m</li> <li>(d) 56.</li> </ul>	ge of idge .2 m	78	<ul> <li>Minimum depth of foundation below the scour line in a arch bridge for piers should not be less than</li> <li>(a) 1.2 m</li> <li>(b) 1.8 m</li> <li>(c) 2.4 m</li> <li>(d) 3.0 m</li> </ul>
75 Ans: (c)		78	B. Ans: (b)
Sol: Maximum flow discharge = $95m^3/sec$ Linear waterway of a bridge as per Lacey's equa is $L = C\sqrt{Q}$	ition	So	<b>D:</b> Minimum depth of foundation below scour line in arch bridges will be 1.8 for other bridges it is 1.2 m (as per IRC).
$L = 4.8\sqrt{Q} = 4.8\sqrt{95}$		79	<ol> <li>The worth of an asset at the end of its useful life is given by</li> </ol>
L = 40.78  m [As per Lacey's eqn C = 4.8] Lacey's eqn is used in IPC: 6			<ul><li>(a) Present worth</li><li>(b) Salvage value</li><li>(c) Sunk cost</li><li>(d) Marginal cost</li></ul>
Lacey's equi is used in fixe, o.	EER	IN	G
76. As per IRC class A loading, which of the follow statement is correct in connection with design bridge decks?	ving n of	79 So	<ul> <li>Ans: (b)</li> <li>Salvage value is the estimated resale value of an asset at the end of its useful life.</li> </ul>
<ul><li>(a) Impact factor is directly proportional to w of bridge deck</li></ul>	ridth		• Salvage value is subtracted from the cost of an asset to determines the depreciated cost.
<ul> <li>(b) Impact factor is inversely proportional width of bridge deck.</li> <li>(a) Impact factor is inversely proportional sector.</li> </ul>	l to	80	). The point at which total costs equal to total revenue is called
length	span		(a) Break even (b) Profit
(d) Impact factor is directly proportional to s length	span	180	(c) Worth (d) Annuity
76. Ans: (b)		Sc	<b>bl:</b> The point at which total costs equal to total revenue
Sol: Impact factor decreases with increase in width bridge deck.	h of		is called "Break-Even" point
77. If a rocker and roller bearing is provided at one of a bridge girder, then the other end will be	end		B.E.P.
(a) fixed end (b) simple support			
(c) free end (d) rocker bearing			output Qty
77. Ans: (d)			At BEP Total Revenue = Total Cost
<b>Sol:</b> All the bridge girders are simply supported @ one			A DEI, Iotai Revenue – Iotai Cost.
end rocker and roller bearing acts like a roller	and		
at the other end there will be only rocker bear which acts like a hinge support.	ring,		
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16

#### KPWD - AE 202

- 81. In the time Cost Optimisation using CPM method for network analysis, the crashing of activities along the critical path is done starting with activity having(a) Longest duration(b) Highest cost slope
  - (c) Least cost slope (d) Shortest duration

#### 81. Ans: (c)

**Sol:** In time-cost optimisation using CPM method for Network Analysis, the crashing of activities along the critical path is done starting with an activity having least-cost slope.



- 82. If the optimistic time, most likely time and pessimistic time for activity A are 4, 6 and 8 respectively and activity B are 5, 5.5 and 9 respectively, then
  - (a) Expected time of activity A is greater than the expected of activity B
  - (b) Expected time of activity B is greater than the expected of activity A
  - (c) Expected time of both activity A and B are same
  - (d) None of the above

#### 82. Ans: (c)





Expected time of an activity  $A = = \frac{t_o + 4t_m + t_p}{6}$ 

$$(E_{A}) = \frac{4 + 4 \times 6 + 8}{6}$$

$$=\frac{4+24+8}{6}=6$$
 days

Expected time of an activity  $B = = \frac{5+4 \times 5.5+9}{6}$ 

$$(E_{\rm B}) = \frac{36}{6} = 6$$
 days

- 83. Security deposit deducted at 5% from contractor's bill is
  - (a) Refunded when the contractor has completed the work
  - (b) Refunded even before the completion of the work
  - (c) Refunded after 5 years defect liability
  - (d) Refunded when the defect liability period of six months or one monsoon whichever is later is over

#### 83. Ans: (d)

**Sol:** Security deposit deducted at 5% from contractors bill is refunded when the defect liability period of six months (or) one monsoon which ever is later is over



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			17		Civil
84.	Which of the following i	s not primary dismantling	5	87.	Ans: (d)
	method?			Sol	: The simplest relation and the most
	(a) Splitters	(b) Thermal lancing			equation for the mean velocity calc
	(c) Hand held chippers	(d) Diamond sawing			"Manning equation" by analyzing the
					data obtained. The equation is
84.	Ans: (d)				$V = \frac{1}{2} (R)^{2/3} (S)^{1/2}$
Sol:	Diamond sawing is not a primary dismantling		5		n (n) . (5)
method. It is a r	method. It is a method us	ed for separation.			R = Hydraulic radius
				where,	
			1		

- 85. Person 'A' sells, by auction to person 'B' a house which 'A' knows it to be unsound. 'A' does not say anything to 'B' about the house being unsoundness. The act of person 'A' is
  - (a) misrepresentation (b) fraud (c) not fraud
    - (d) undue influence

#### 85. Ans: (c)

- Sol: Person 'A' sells, by auction to person B, a house which 'A' knows to be unsound. A does not say anything to B about the house being unsoundness. The act of person 'A' is "Not fraud".
- 86. The maximum permissible size of stone aggregate used for the construction of subgrade is
  - (a) 25 mm (b) 50 mm
  - (d) 10 mm (c) 12.5 mm

#### 86. Ans: (b)

- Sol: As per IRC, maximum size of coarse used in the preparation of sub grade is 50 mm.
- 87. The longitudinal slope of a known cross-section and develop flow for designed values of roughness coefficient and hydraulic radius is found from
  - (a) Hazen Williams Equation
  - (b) Darcy Weisbach Equation
  - (c) Hagen Poiseuille Equation
  - (d) Manning's Formula

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n = Manning's roughness coefficient

Factors effecting 'n' are below

- 1. Surface roughness
- 2. Channel alignment
- 3. Channel irregularities
  - 4. Channel velocity flow area and channel slope.

88. As per IRC guidelines, a bituminous concrete surface of a highway is considered good (resurfacing layer is justified) if the value of unevenness index is less than (a) 200 mm/km (b) 2000 mm/km

(d) 2 mm/km

#### 88. Ans: (b)

Since

(c) 20 mm/km

- Sol: As per IRC guidelines for good pavement surface, 199 uneven index should not be more than 2000 mm per one km length.
- 89. Expansion bearings which are used in modern urban bridges which permit sliding movement and rotation in all directions is
  - (a) Sliding Plate Bearing
  - (b) R.C Rocker Expansion Bearing
  - (c) Steel Roller-cum-Rocker Bearing
  - (d) Sliding cum Rocker Bearing

#### 89. Ans: (a)

**Sol:** The bearings which are used in urban bridges which permits horizontal movement and rotation are sliding plate bearings.



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Engineering Publications	
90. If $t_o$ is the optimistic time estimate, $t_p$ is the	92. Ans: (c)
pessimistic time estimate and $t_m$ is the most likely	Sol:
time estimate, then the average or expected time, $t_e$	• Vibratory rollers are used for compacting
of completion of an activity is given by	granular soils and pavement layers with
(a) $(t_0 + 6t_m + t_p)/4$ (b) $(t_0 + t_m + t_p)/6$	granular materials.
(c) $(t_{a} + 4t_{m} + t_{m})/6$ (d) $(4t_{a} + t_{m} + t_{m})/6$	• In vibrators rollers, compaction is effected due
	to dynamic effect of vibrator and also due to
90. Ans: (c)	static weight of the roller
Sol: Expected time (t) = $\frac{(t_o + 4t_m + t_p)}{4}$	
· · · · · 0	93. The technique of pressure injection of grouts for
where,	the purpose of raising or stabilizing faulty concrete
t = optimistic time	pavement floors and other slab on grade surface is
t = pessimistic time	termed as'
t = most likely time	IN G (a) Slab Jacking technique
	(b) Polymer grouting technique
91. The most common type of precedence relationship	(c) Resin injection technique
used in PERT, CPM and ladder network is the	(d) Dry packing technique
(a) Start-to-start relationship	
(b)Finish-to-start relationship	<b>93.</b> Ans: (a)
(c) Finish-to-finish relationship	<b>Sol:</b> Slab Jacking Technique is a method of raising (or)
(d) Start-to-finish relationship	stabilizing faulty concrete pavements and slab on
	grade surface that has sunk (or) is uneven. A pattern
91. Ans: (b)	of holes are drilled, then a mixture is pumped
<b>Sol:</b> A logical connection in which a successor venture	beneath the slab to raise provides a stable base, thus
can not start until a predecessor activity has finished.	strengthening the slab.
FINISH-TO-START relationship is the most	1995
commonly used logical relationship.	94. Arrange the steps involved in rehabilitation of
	distressed concrete structure
92. Select the correct statement about vibratory rollers	1. Remove all cracked, spalled and look concrete
1. Vibratory rollers are used to compact silty soil	2. Clean the exposed concrete surface and steel
2. Vibratory rollers are used for compacting	reinforcement
granular soils	3. Support structural members properly as
3. Compaction in vibratory rollers is effected due	required
to dynamic effect of vibrator and also due to	4. Apply protective coating over the exposed or
static weight of the roller	repaired surface
(a) 1 and 3	5. Provide additional reinforcing bars is low in
(b) 1 and 2	reinforcement is more than 10%
(c) 2 and 3	6. Shotcreting/polymer concrete for patch repair
(d) All the above	work of grouting for porous/honev combed
( )	concrete

18

KPWD - AE 2021

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Engineering Publications	19 Civil Engineering
(a) 3, 1, 2, 5, 6, 4 (b) 2, 1, 3, 5, 6, 4 (c) 3, 1, 2, 5, 4, 6 (d) 2, 1, 3, 5, 4, 6 <b>94.</b> Ans: (c)	97. Building and other construction workers act became effective in India during to extend social security of the workers (a) 1956 (b) 1971 (c) 1996 (d) 2015
<ul> <li>Sol: Steps involved in rehabilitation of distressed concrete structure:</li> <li>Support structural members properly as required</li> <li>Remove all cracked, spalled and look concrete</li> <li>Clean the exposed concrete surface and stee reinforcement</li> <li>Provide additional reinforcing bars is low in reinforcement is more than 10%</li> <li>Apply protective coating over the exposed or repaired surface</li> <li>Shotcreting/polymer concrete for patch repaired work of grouting for porous/honey combed concrete</li> </ul>	<ul> <li>97. Ans: (c)</li> <li>Sol: Building and other construction workers act become effective in India in 1996.</li> <li>98. The concrete obtained by adding soluble or emulsified polymer into ordinary Portland cement concrete is concrete <ul> <li>(a) Polymer impregnated</li> <li>(b) Polymer modified cement</li> <li>(c) Polymer</li> <li>(d) High density</li> </ul> </li> </ul>
<ul> <li>95. What is meant by sunk cost?</li> <li>(a) It is what the asset is worth of at the end of it useful life</li> <li>(b) It is the cost which has already been incurred and cannot be recovered</li> <li>(c) It is the incremental revenue of selling product</li> <li>(d) It is the present worth of the project</li> </ul>	<ul> <li>98. Ans: (a)</li> <li>Sol: The concrete obtained by adding soluble or emulsified polymer into ordinary Portland cement concrete is called as Polymer impregnated concrete.</li> <li>99. The third phase of a construction project life cycle is <ul> <li>(a) Construction</li> <li>(b) Conceptual design</li> </ul> </li> <li>(c) Preliminary design</li> <li>(d) Detailed design</li> </ul>
<ul><li>95. Ans: (b)</li><li>Sol: Sunk Cost is a cost that has already been incurred and that cannot be recovered.</li></ul>	<ul> <li>99. Ans: (a)</li> <li>Sol: Construction is the third phase of a construction project.</li> </ul>
<ul> <li>96. Total float can be calculated using</li> <li>(a) Total float = Late finish – Early finish</li> <li>(b) Total float = Late start – Early start</li> <li>(c) None of the above</li> <li>(d) Both (a) and (b)</li> </ul>	<ul> <li>100. Payment of Wages Act of 1936 was amended int he year</li> <li>(a) 1980</li> <li>(b) 1981</li> <li>(c) 1982</li> <li>(d) 1984</li> </ul>
<ul> <li>96. Ans: (d)</li> <li>Sol: Total Float = Late Finish –Early Finish (or) Late Start – Early Start T.F = L.F – E.F (or) LS – ES</li> </ul>	<ul> <li>100. Ans: (c)</li> <li>Sol: Payment of Wages act of 1936 was amended in the year 1982.</li> </ul>
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