



HPPSC AE Civil Engineering

Mega Mock Challenge

(September 13th - September 14th 2021)

Questions & Solutions

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- 1. The rain waterholes in the parapet or in edging is called as
 - A. Water proofing B. Weep hole
 - C. Edge hole D. Hole
- Ans. B
- Sol. A **weep hole**, or a **weep**-brick is a small opening that allows water to drain from within an assembly. Weeps are located at the bottom of the object to allow for drainage.

2. In fibre reinforced concrete, if the fibres are not dispersed properly, then the resulting problem is called as -

- A. Segregation B. Balling
- C. Spalling D. Congestion
- Ans. B

Sol. Fibers that are long at higher volume fractions were found to ball up during the mixing process. The process called '**balling**' affects the workabilityand strength characteristics of **concrete**. This has a tendency to influence the **concrete** and strength.

Spalling is break away of *concrete* surface which often extends to the top layers of reinforcing steel, Spalling happens in concrete because of moisture in the concrete.

3. In how many classes fly ash is classified?

A. 2	В. 3
C. 4	D. 5

- Ans. A
- Sol. Fly ash is classified in 2 classes: Class C fly ash and class F fly ash.
- 4. What is the amount of water used to conduct the initial setting time test of cement which has a standard consistency of P.

A. 0.55 P	B. 0.85 P
C. 0.60 P	D. 0.95 P

- Ans. B
- Sol. Initial setting time is defined as the time that is measured from the instant, water is added into the cement up to the time it starts losing its plasticity. In order to perform this test, 50 gms of cement sample is taken and gauged with **.85P** (85% water required to prepare the cement paste of standard consistency is added in it) and the paste prepared is filled in the mould.
- 5. The cement whose strength is a little lower than the ordinary cement during the first three months but attains afterwards the same strength is known as
 - A. low-heated Portland cement B. rapid hardening Portland cement
 - C. Portland blast slag cement D. Portland pozzolana cement
- Ans. A
- Sol. In low heated Portland cement, By reducing the proportion of C₃S & C₃A and increasing the proportion of C₂S.Rate of heat of hydration reduced significantly. Therefore this cement develops strength comparatively at lower rate.



- 6. Which IS code gives specifications about cement plaster?
 - A. IS 1500 B. IS 1221
 - C. IS 1400 D. IS 1661

Ans. D

- Sol. IS code 1661 deals with the code of practice for the application of cement and cement-lime plastering on the buildings.
- 7. Quick setting cement is produced by adding _____.
 - A. less amount of gypsum in very fine powdered form
 - B. more amount of gypsum in very fine powdered form
 - C. aluminium sulphate in very fine powdered form
 - D. pozzolana in very fine powdered form

Ans. C

- Sol. In Quick Setting cement(much finer than OPC), **gypsum content is reduced** to get the quick setting property. Also, small amount of aluminium sulphate is added. Since gypsum is invariably added to almost all types of cement hence for this problem, the more prominent answer would be addition of aluminium sulphate.
- 8. Air entrainment in the concrete increases
 - A. workability B. strength
 - C. the effect of temperature variation D. the unit weight
- Ans. A
- Sol. when air entraining agent mixing with concrete then air bubble is formed in concrete which is used to increase the workability, but it will reduce the strength and unit weight of concrete.

9. In order to have segregation in concrete dropping height should not be more than _____.

- A. 25 cm B. 50 cm
- C. 100 cm D. 250 cm
- Ans. C
- Sol. The concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. The concrete shall be placed and compacted before initial setting of concrete commences and should not be subsequently disturbed. Methods of placing should be such as to **preclude segregation**. Care should be taken to avoid displacement of reinforcement or movement of formwork. As a general guidance, the maximum permissible free fall of concrete may be taken as 1.5 m.

Theoretically for drop placing it should not be more than 1 to 1.5 meter for well cohesively mixed concrete.

B. cambium

- 10. The solution of salts from the soil absorbed by the trees which becomes a viscous solution due to loss of moisture and action of carbon dioxide is knownas:
 - A. pith
 - C. bark D. sap

Ans. D

Sol. Sap in between cambiun layer and heartwood, sap cotains moisture.



 Calculate the quantity (cubic meter) of the cement required for 1 cubic meter of brick work with cement mortar (1 : 4)

A. 0.05	B. 0.06
C. 0.2	D. 0.24

Ans. B

Sol. Volume of 1 brick with mortar = $20 \times 10 \times 10 = 0.002$ Cum Therefore, Number of bricks required for 1 cubic metre = 1/0.002 = 500 Nos Volume of 1 brick without mortar = 0.001539 Cum ($19 \text{ cm} \times 9 \text{ cm} \times 9 \text{ cm}$) Volume of 500 bricks without mortar = 500×0.001539 Cum. Volume of bricks without mortar for 1 cum = 0.7695 Cum Required amount of wet cement mortar = 1 Cum - Volume of bricks without mortar.= 1 - 0.7695 = .2305 Cum Dry volume of a mortar = 0.2305 cum $\times 1.33 = 0.306565$ cum (33% as bulkage of sand) Volume of cement required = $\frac{1}{5} \times .306 = .06$

- 12. How does the seasoning of timber help?
 - A. It increases the weight of timber
 - B. It improves the strength properties of timber
 - A. Only A B. Only B
 - C. Both A and B D. None of these
- Ans. B
- Sol. Seasoning means removal of extra moisture from the timber, as the result of seasoning weight of timber decreases and strength increases
- 13. Which of the following tests compares the dynamic modulus of elasticity of samples of concrete?
 - A. Compression test B. Ultrasonic pulse velocity test
 - C. Split test D. Tension test

Ans. B

Sol. Ultrasonic Pulse Velocity test.

The dynamic modulus of elasticity of sample of concrete tests by ultrasonic pulse velocity test.

- 14. Which of the following is the unit of measurement for the sills of windows?
 - A. Cubic meter B. meter
 - C. Number D. Square meter
- Ans. D
- Sol. A window sill is the surface at the bottom of a window. It is measured in sqm.
- 15. Calculate the cost of the plastering required for a wall of 4 m long, 3.5 m high and 300 mm thick, if the rate of plastering is Rs. 12 per square meter. (Assume both side plastering is done)

A. 101	B. 168
C. 336	D. 423
C	

Ans. C



Sol. Cost of plastering(both sides of wall) = $2 \times (Surface area \times rate of plastering)$

 $= 2 \times (3.5 \times 4 \times 12)$

= Rs.336

16. A portion of an embankment having a uniform up-gradient 1 in 500 is circular with radius 1000 m of the center line. It subtends 180 ° at the center. If the height of the bank is 1 m at lower end, and side slopes 2:1, the earth work involved ______
 A. 26,000 m³
 B. 26,500 m³

C. 27,000 m³ D. 27,500 m³

Ans. D

Sol. For truncated cone, with slope 2:1 top radius will be 500m as the bottom radius is given as 1000m

Therefor volume of truncated cone is

$$= \frac{\pi \times h \times (R^2 + r^2 + (r \times R))}{3}$$
$$= \frac{3.14 \times 1 \times (1000^2 + 500^2 + (1000 \times 500))}{3}$$

= 27500

The maximum shear stress occurs on the outermost fibres of a circular shaft under torsion.
 In a close coiled helical spring, the maximum shear stress occurs on the _____.

A. Outermost fibers B. Fibers at mean diameter

C. Innermost fibers

D. None of these

Ans. C

Sol.

Maximum shear stress occure at the inner end of the spring

 $\tau_{\text{max}} = \tau_{\text{inner}} = \frac{16P R}{\pi d^3} (1 + \frac{d}{4R})$ $\tau_{\text{outer}} = \frac{16P R}{\pi d^3} (1 - \frac{d}{4R})$

Note: d/4R counts for direct shear.

Hence, In case of closed coil helical spring, the maximum shear occurs on the innermost fibres.

- 18. A circular shaft is subjected to a torque `T' which is half of the bending moment applied, then the ratio of maximum bending stress and maximum shear stress is _____.
 - A. 2 B. 4
 - C. 3 D. 1.5
- Ans. B



Sol. torque= Half bending moment

$$\tau = 0.5M ,$$

$$\sigma = \frac{32M}{\pi d^3}$$

$$\tau = \frac{16T}{\pi d^3}$$

So

$$\frac{\sigma}{\tau} = \frac{\frac{32M}{\pi d^3}}{\frac{16T}{\pi d^3}} = \frac{2M}{T} = \frac{2M}{0.5M} = 4$$

- 19. A 30cm diameter circular column is 3m long the slenderness ratio of the column is
 - A. 20 B. 30
 - C. 40 D. 50

Ans. C

Sol.
$$\lambda = \frac{effectivelenth}{radiusofgyration}$$

Radius of gyration = $\sqrt{\frac{I}{A}} = d/4$

$$\lambda = \frac{l}{d/4} = 40$$

20. If standard load, diameter of steel ball, diameter of intent are 10 N, 80 mm, 40 mm, respectively. What will be brinnell hardness number?

Ans. C

Sol. Brinnell hardness number

$$= \frac{P}{\frac{\pi D}{2} \left[D - \sqrt{D^2 - d^2} \right]}$$
$$= \frac{10 \times 10^3}{\frac{\pi}{2} 80 \left[80 - \sqrt{80^2 - 40^2} \right]}$$
$$= \frac{10 \times 10^3}{1347} = 7.42$$

21. Analysis of continuous beam can be done by

- A. All of the options B. Moment Distribution Method
- C. Slope Deflection Method D. Three Moment Theorem

Ans. A

Sol. Analysis of continuous beam can be done by any of the three above method.



- 22. The moment distribution method in structural analysis is also called as
 - A. Flexibility method

B. Displacement method

C. Unit method

D. Force method

- Ans. B
- Sol. Displacement method of analysis (also known as stiffness matrix method). In theforce method of analysis, primary unknown are forces. In this method compatibility equations are written for displacement and rotations (which are calculated by force displacement equations).
- 23. Consider the following statements: Sinking of an intermediate support of a continuous beam(i) reduces the negative moment at support.
 - (ii) increases the negative moment at support.
 - (iii) reduces the positive moment at support.
 - (iv) increases the positive moment at the center of span.
 - Of these statements:
 - A. (i) and (iii) are correct B. (i) and (iv) are correct
 - C. (ii) and (iv) are correct D. (ii) and (iii) are correct
- Ans. B
- Sol. In continuous beams, each support provides vertical and/or horizontal reactions when the beam is subjected to uniformly distributed load(called UDL) or Point load. Beam is subjected to negative bending moments at supports and positive bending moments at mid-span. When one of the intermediate supports is sinking, it results in reduction of negative bending moment at the support but increase in bending moments at mid-span on the either side.
- 24. In a trussed bridge, the maximum limit of span is -

A. 18 to 30 m	B. 50 to 150 m
C. 30 to 80 m	D. 3 to 7.5 m

- Ans. C
- Sol. These are the most commonly used bridges and are found satisfactory for spans 10 m to as large as 300 m. *Bridges of spans 50 m to 60 m are most common*. Cross beams are connected to trusses either at the level of the top chord or at the level of the bottom chord. Accordingly the bridges are deck bridges or through bridges.
- 25. The space between two adjacent trusses is called

A. Span	B. Pitch
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C. Panel D. Bay

Ans. D

Sol. Space between adjacent bents in a roof truss is called a bay. They are economically spread throughout.



26. List I - List II

- A) Moderate condition 1) Concrete in contact with harmful chemicals
- B) Severe condition 2) Concrete continuously under water
- C) Very extreme condition 3) Concrete submerged completely under sea water
- D) Extreme condition 4) Concrete exposed to sea water spray

a b c d	abcd
A. 4 3 1 2	B.2341
C. 3 4 2 1	D. 3 1 2 4

Ans. B

27. What will be the limiting percentage of tension steel for M20 grade concrete and Fe415 steel for design a singly reinforced beam?

A. 0.96%	B. 1.24%
C. 0.75%	D. 1.36%

- Ans. A
- Sol. C=T
 - 0.36fckBxu,lim=0.87fyAst
 - 0.36x20xBx0.48d=0.87x415xAst(Ast/Bd)x100=0.957%

28. A 2 legged 8 mm diameter HYSD bar of Fe-415 grade is used as vertical shear reinforcement for a beam of width of 250 mm and effective depth 300mm. The nearest magnitude of spacing of min shear reinforcement is......mm

A. 363 mm	B. 300 mm
C. 225 mm	D. 400 mm

Ans. C

Sol. $A_{sv,min}/(Bs_v)=0.4/(0.87 f_y)$ or $(2x\pi/4x8^2)/(s_vx250)=0.4/(0.87x415)s_v=363 mm$

But s_v<min(0.75d,300mmS_v=225 mm

- 29. Consider following statements
 - 1) Value of modulus of elasticity of wet specimen is higher than that of dry specimen.
 - 2) Modulus of elasticity of concrete increases with age.

3) Modular of elasticity of concrete having higher cement content is less than that having lower cement content

correct statement(s) is/are.

A. 1, 2 only	B. 2, 3 only
C. 1, 3 only	D. 1, 2 and 3

Ans. A

- Sol. 1. Value of modulus of elasticity of wet specimen is more than that of dry specimen so statement $1 \rightarrow$ correct
 - 2. Modulus of elasticity of concrete increases with age so statement 2 \rightarrow correct

3. Modulus of elasticity of concrete having higher cement content is more than that having lower cement content so statement $3 \rightarrow$ Incorrect



30. Positive bending moment coefficient at the middle of the interior star of a continuous one way slab for dead load and live load respectively as per IS 456 : 2000 are :

A.
$$\frac{1}{12}, \frac{1}{10}$$
B. $\frac{1}{12}, \frac{1}{16}$ C. $\frac{1}{16}, \frac{1}{12}$ D. $\frac{1}{12}, \frac{1}{9}$

Ans. C

Sol. As per Table 12, IS 456:2000, bending moment coefficient

Coefficient of D.L. = $+\frac{1}{16}$ Coefficient of L.L. = $+\frac{1}{12}$

- 31. Shear force coefficient at end support due to dead load as recommended by IS 456 : 2000 is.
 - A. 0.40 B. 0.45 C. 0.50 D. 0.55
- Ans. A
- Sol. As per Table 13 for shear coefficients:

Shear force coefficient for Dead load at end support = 0.40

32. A beam column for non-sway column in a building frame is subjected to a factored axial load of 40 kN, factored moment at bottom of column of 35kNm. For ISHB 200, the values are A = 4750 mm², $y_y = 45.1$, h = 200 mm, b = 200 mm, b_f = 9 mm and the effective length is 0.7 L. Its buckling load will be

Α.	390 kN	в.	380	kΝ
C.	360 kN	D.	400	kΝ

- Ans. A
- Sol. Equivalent axial load (buckling load), $P_e = P + 2M_z / d$ = 40 + 2 ×35 /0.2 = 390 kN
- 33. A steel rod of 20 mm diameter is used as a tie member in a roof bracing system, and may be subjected to possible reversal of stress due to wind load. What is the maximum permissible length of the member?

A. 3000 mm	B. 2500 mm
C. 1750 mm	D. 2000 mm

- Ans. C
- Sol. Slenderness ratio of a tie member in the roof bracing system may be subjected to possible reversal of stress due to wind load is 350.

 $\frac{L}{r_{min.}}$ = Slenderness ratio Where $r_{min.}$ = radius of gyration = $\frac{D}{4}$ (For circular section)

D = 20 mm

Therefore, $r_{min.} = 5 \text{ mm}$

 $L = 350 \times 5 = 1750 \text{ mm}$



34. A simply supported rectangular beam, length 3m. plastic hinge is formed in beam after applying load to the beam. Length of plastic hinge will be-

A. 2m	B. 3m

C. 1m D. 4m

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Ans. C
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Sol. Length of plastic hinge for simply supported beam, $L' = I (1 - 1/k_s)$ Where, $k_s =$ shape factor = 1.5 for rectangular beam

L' = 3 (1 - 1/1.5) = 3X1/3 = 1m

35. If the value of a 20 mm diameter rivet in a lap joint connecting two plates 10 mm and 15 mm thick, then bearing strength of one rivet is

(Take $\tau = 100 \text{ N/mm}^2$ and $\sigma = 200 \text{ N/mm}^2$) A. 21.5 kN B. 32.25 kN C. 43 kN D. 64.5 kN

Ans. C

- Sol. Nominal diameter of rivet = 20 mm Gross diameter of rivet, d = 20 + 1.5 = 21.5 mm Allowable bearing stress in rivet, $\sigma = 200 \text{ N/mm}^2$ Thickness of thinner plate in lap joint, t = 10 mm Bearing strength of one rivet = σd t = 200 x 21
 - Bearing strength of one rivet = σ . d. t = 200 x 21.5 x 10 = 43000 N = 43 kN
- 36. In a truss girder of a bridge, a diagonal consists of mild steel flat 400 I.S.F. and carries a pull of 80 tones. If the gross diameter of the rivet is 26 mm, the number of rivets required in the splice is

A. 6	B. 7
C. 8	D. 9

- Ans. C
- Sol. If power driven rivet is used- 8
 - If field rivet is used- 9
- 37. Co-efficient of wind resistance of a circular surface is?

A. $\frac{3}{2}$	В. <mark>2</mark> з
C. $\frac{1}{2}$	D. 1/3

Ans. C

- Sol. Co-efficient of wind resistance of a circular surface is 1/2
- 38. Foundation plan will show -
 - A. Carpet area B. Height of foundation
 - C. Length of plinth level D. Size and depth of foundation

Ans. D

Sol. The foundation plan is a plan view drawing, in section, showing the location and size of footings, piers, columns, foundation walls, and supporting beams.



39. The old type of Pile Driving Equipment which is banned in most countries due to heavy sound and vibration is called as -

A. Augur Boring Pile Driver

B. Hammer Driven Pile Driver

C. CFA - Continuous Flight Augur

D. Hydraulic Pile Driver

Ans. B

- Sol. Hammer Driven Pile Driver is the old type of Pile Driving Equipment which is banned in most countries due to heavy sound and vibration.
- 40. Effective stress is
 - A. The stress at particles contact
 - B. A physical parameter that can be measured
 - C. Important because it is a function of engineering properties of soil.
 - D. All of the above

Ans. C

- Sol. Effective stress cannot be measured directly. We can only calculate it mathematically as $\sigma = \sigma \mu$. Most of the properties of soil like shear strength, compressive strength of soil are function of the effective stress only.
- 41. On increasing the temperature, viscosity exerts a reduction of 75% and unit weight reduced by 85% of a percolating fluid, and change in coefficient of permeability observed to be
 A. 28.67%
 B. 21.11%
 - C. 16.67%

D. 13.33%

Ans. D

Sol.
$$K \propto \frac{\gamma_w}{\mu}$$

Where K is coefficient of permeability

 $\gamma_{
m w}$ is unit weight of water

 $\boldsymbol{\mu}$ is viscosity of fluid

Let initially coefficient of permeability,

$$K_1 = \frac{\alpha \gamma_w}{\mu}$$

Where a is specific gravity of fluid After increasing the temperature,

$$K_2 = \frac{0.85\alpha\gamma_w}{0.75\mu} = \frac{17}{15}K_1$$

Change in coefficient of permeability = $\frac{\Delta K}{K_1}$

$$\frac{\Delta K}{K_1} = \frac{\frac{17}{15}K_1 - K_1}{K_1} \times 100 = 13.33\%$$



- 42. For a sandy soil, the angle of internal friction is 30° . If the major principal stress is 50 kN/m^2 at failure, then the corresponding minor principal stress (in kN/m²) will be
 - A. 12.2 C. 20.8
- B. 16.66 D. 27.2

Ans. B

Sol.
$$\frac{\sigma_1}{\sigma_3} = \frac{1 + \sin \phi}{1 - \sin \phi}$$

Or, $\sigma_3 = \frac{\sigma_1 (1 - \sin \phi)}{(1 + \sin \phi)} = \frac{50 \times (1 - \sin 30^\circ)}{(1 + \sin 30^\circ)} = 16.66$

43. Which of the following statement is incorrect?

- A. Smectite has largest specific surface among clay mineral.
- B. Halloysite particles are tubular in shape in contrast to platy shape of kaolinite particles.
- C. Kaolinite clay is also used as an intestinal absorbant in anti diarrheal medicine.
- D. There is little or no isomorphous substitution in Illite.

Ans. D

- Sol. There is little or no isomorphous substitution in Kaolinite.Illite has substantial amount of isomorphous substitution in the form of Al in place of Si.Montmorillonite is called Smectite.
- 44. The results of a consolidation test on an undisturbed soil, sampled at a depth of 8 m below the ground level are as follows: Saturated unit weight = 18 kN/m^3 , Pre-consolidation pressure = 80 kPa.

The water table was encountered at the ground level. Assuming the unit weight of water as 10 kN/m^3 . The over-consolidation ratio of the soil is

A. 1.0 B. 1.25 C. 1.5 D. 2.0

Ans. B

Sol.

$$\overline{\sigma} = \gamma_{\text{sub x 8}}$$

$$= (18 - 10) \times 8 = 64 \text{ kN/m}^2$$

$$OCR = \frac{\sigma_c}{\sigma_c} = \frac{100}{\sigma_c} = 1.25$$

64

σ

45. A soil fails under an axial vertical stress of 90 kN/m² in unconfined compression test. The failure plane makes an angle of 55° with the horizontal. The shear parameters 'C' and ' ϕ ' respectively will be

A. 31.51 kN/m ² , 0°	B. 30.9 kN/m ² , 20°
C. 31.51 kN/m ² , 20°	D. 30.9 kN/m², 0°



Ans. C Sol. $\alpha = 55^{\circ} \Rightarrow 45 + \frac{\Phi}{2} = 55^{\circ}$ $\Rightarrow \varphi = 20^{\circ}$ $q_u = \sigma_1 = 90 \text{ kN/m}^2, \sigma_3 = 0$ $\sigma_1 = \sigma_3 \tan^2 \alpha + 2C \tan \alpha$ $\Rightarrow 90 = 2 \times C \tan 55^{\circ}$ $\Rightarrow C = 31.51 \text{ kN/m}^2$ 46. A soil sample tested in a triaxial compression apparatus failed when the total maximum and minimum principal stresses were 80 kPa and 26 kPa, respectively. The pore pressure measured at failure was 8 kPa. The effective principle stress ratio at failure is

Ans. B

Sol. $\overline{\sigma_{1f}} = 80 - 8 = 72$ kPa

 $\overline{\sigma_{3f}} = 26 - 8 = 18 \text{ kPa}$ $\Rightarrow \frac{\overline{\sigma_{1f}}}{\overline{\sigma_{3f}}} = \frac{72}{18} = 4$

47. A soil has discharge velocity of 6×10^{-7} m/s and a void ratio of 0.60. Its seepage velocity will be_____X 10^{-7} m/s

Ans. D

Sol. Seepage velocity
$$= \frac{V}{n} = \frac{V}{\frac{e}{1+e}} = \frac{6 \times 10^{-7}}{\frac{0.6}{1+0.6}} = 16 \times 10^{-7} \text{ m/s}$$

48. The radius of a horizontal circular curve is 100 m. The design speed is 127 kmph and design coefficient of lateral friction is 0.15. Assuming pressure on inner and outer wheel is equal, Superelevation will be

A. 1.12	B. 0.72
C. 1.27	D. 0.57

Ans. C

Sol. R = 100 m

But pressure on each wheel is same so f = 0

$$e = \frac{V^2}{127R} = \frac{127 \times 127}{127 \times 100} = 1.27$$

Calculate the extra widening required for a pavement of 7 m on a horizontal curve of radius
 324 m. If the longest which base of vehicle expected on road is 7 m. Design speed is 495 kmph.

C. 0.55 D. 0



Ans. D

- Sol. As per IRC Radius > 300 m no need to provide extra widening.
- 50. In a district where rainfall is light, road of cement concrete pavement, 7m wide is constructed. What should be height of crown with respect to edges in this case
 - A. 0.07 mt B. 0.117 mt
 - C. 0.106 mt D. 0.058 m

Ans. D

Sol. For cement concrete road having light rainfall; camber rate of 1/60 is provides

Rise of crown with respect to edge = $\frac{1}{60} \times \frac{7}{2} = 0.058$ m

51. Choose the correct option regarding Passenger car unit {PCU}

A. Standard vehicle unit to convert the other vehicle class. This standard unit is called PCU.

B. PCU is used as a measurement of relative space requirement compared to passenger car.

C. PCU is helpful for designing under mixed flow condition.

D. All of above

Ans. D

- Sol. To design for mixed flow Concept of PCU was created. Under this Standard vehicle unit (Passenger Car) is used to convert the other vehicle class. PCU help us to understand the space requirement of all vehicles.
- 52. What will be elongation index based on data given below.

Initial weight of aggregate = 50 kg

weight of aggregate having greatest dimension more than 1.8 times the mean dimension = 35 kg

Α.	142%	В. 3	0%
			• • •

C. 167% D. 70%

Ans. D

Sol. Elongation Index = $\frac{W_2}{W_1} \times 100$

 w_1 = Initial weight of aggregate = 50 kg

 w_2 = weight of aggregate having greatest dimension more than 1.8 times the mean dimension = 35

so elongation index $=\frac{35}{50} \times 100 = 70\%$

53. The minimum super elevation or curves should not be less than:

A. 5% B. 4%	
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C. Camber D. None of these

Ans. C

Sol. The minimum super elevation or curves should not be less than camber.



54. The method used to control the amount of dust where use of water while drilling may be impracticable or undesirable is

A. Dry system

C. Control system

- B. Vacuum hood system
- D. Absorption system

- Ans. B
- Sol. To remove dust, if water can not be used, then we use vacuum to suck out the dust.
- 55. For the construction of a 640 m long B.G. railway track by using a sleeper density of M +
 5, and the length of each rail is 12.8 m, the number of sleepers required will be
 A. 1000 B. 900
 - C. 800 D. 700
- Ans. B
- Sol. Here, M = 13 m for B.G.
 - ∴ Number of sleeper = $\frac{(m + 5)}{12.8} \times L$ ⇒ Number of sleeper = $\frac{(13 + 5)}{12.8} \times 640 = 900$
- 56. What is the true bearing of line AB? If the magnetic bearing for AB is N 25° W and the declination observed at the station is 5° 45' West?

A. N30°45′ W	B. N19° 15′ W
C. N30° 45′ E	D. N 19° 15′ E

Ans. A

Sol. TB (True Bearing) = MB (Magnetic bearing) ± Declination

(Use + ve for eastern and - ve for western declination)



(a) Declination east

(b) Declination west

True bearing of $AB = Magnetic bearing \pm Declination$

True bearing of AB = $(360^{\circ} - 25^{\circ}) - 5^{\circ} 45' = 329^{\circ} 15'$

From the conversion of W.C.B. to Q.B.

The true bearing of AB = $360^{\circ} - 329^{\circ} 15' = 30^{\circ} 45'$

- 57. A section line AB appears to be 10.16 cm on a photograph for which the focal length is 16 cm. The corresponding line measures 2.54 cm on a map, which is to a scale 1/50,000. The terrain has an average elevation of 200 m above mean sea level. The flying altitude of the aircraft above mean sea level during photograph will be
 - A. 1800 m B. 2000 m
 - C. 2200 m D. 2400 m



Ans. C

Sol. Scale = $\frac{f}{H-h}$

 $\frac{10.16 \text{ cm}}{2.54 \times 50000} = \frac{16}{\text{H} - 20000}$ H = 220000 cm H = 2200 m

58. What is the minimum number of satellites required for global coverage in a satellite navigation system?

A. 32	B. 28
C. 24	D. 16

Ans. C

- Sol. A minimum of 24 satellites are required for complete global GPS coverage.
- 59. Assertion (A): Plane table survey might be preferred over theodolite survey for small scale maps.

Reason (R): Plane table survey can be used in areas with magnetic attraction as well.

- A. both A and R and true, and R is the correct explanation of A
- B. both A and R are true, but R is not a correct explanation of A
- C. A is true but R is false
- D. A is false but R is true

Ans. B

- Sol. Plane table survey might be preferred over theodolite survey since for small scale maps since it is simpler and easier to implement and at small scales, high accuracy might not be required.
- 60. In a close loop traverse algebraic sum of latitude is computed to be 3 mm and algebraic sum of departure is computed to be 4 mm. What is the closing error.

A. 5 mm	B. 6 mm
C. 7 mm	D. 8 mm

Ans. A

Sol. Closing error
$$= \sqrt{(\sum L)^2 + (\sum D)^2}$$

$$=\sqrt{(3)^2+(4)^2}$$

```
= 5 mm
```

- 61. Which one of the following Remote Sensing Systems employs only one detector?
 - A. Scanning B. Framing
 - C. Electromagnetic spectrum D. All of the above

Ans. A

Sol. A scanning system employs a single detector with a narrow field of view that is swept across the terrain to produce an image.



62. For a closed traverse ABCDE the closing error was found to be 4.32 mm. What will be relative error of closure if the perimeter of traverse is 864 m.

A. 1 in 200 B. 1 in 2000 C. 1 in 20000

D. 1 in 200000

Ans. D

Sol. Relative Error of closure = $\frac{\text{Magnitude of closing Error}}{\text{Magnitude of closing Error}}$ Perimeter of traverse

$$= \frac{1}{p_{e}}$$

$$= \frac{1}{(864 \times 1000)/4.32}$$

$$= 1 \text{ in } 200000$$

Directions: Each of the next items consists of two statements, one labeled as 63. the 'Statements (I)' and the other as 'Statement (II)'. You are to examine these two statements carefully and select the answers to these items using the codes given below:

Statements (I): Instantaneous unit hydrograph (IUH) is used in theoretical analysis of rainfall excess-runoff characteristics of a catchment.

Statements (II): For a given catchment, IUH, being independent of rainfall characteristics, is indicative of the catchment storage characteristics.

A. Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

B. Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I)

C. Statement (I) is true but Statement (II) is false

D. Statement (I) is false but Statement (II) is true

- Ans. B
- Sol. In order to obtain the runoff hydrograph resulting from a storm of varying intensities, it is preferable to have a unit hydrograph of very short duration, theoretically, the shortest duration in zero. According if duration of effective rainfall approach, zero, the unit hydrograph is called as an instantaneous unit hydrograph, generally abbreviated as IUH. The advantage of IUH over unit hydrograph (Sharman, 1932) is that the IUH overcomes the problem of duration of rainfall and the restriction on uniform distribution of rainfall.
- 64. **Statements (I):**theoretically an infinite number of unit graphs are possible for a given basin.

Statements (II): The rainfall duration and its areal distribution affect the hydrograph.

A. Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

B. Both Statement (I) and Statement (II) are individually true but Statement (II) is NOT the correct explanation of Statement (I)

C. Statement (I) is true but Statement (II) is false

D. Statement (I) is false but Statement (II) is true



Ans. D

Sol. The unit hydrograph (UH) of a basin is defined as the hydrograph resulting from an effective rainfall of 1 unit evenly distributed over the basin during the time D. Theoretically an infinite number of unit hydrograph, are possible for a given basin. The following hypothesis is considered while the linear unit hydrograph is used as a transfer function.1). The unit hydrograph reflects the ensemble of the physical characteristic of the river basin.

2). The effective rainfall is uniformly distributed over the catchment.

3). The shape characteristic of the unit hydrograph are independent of time. Therefore duration of the unit hydrograph is constant regardless the effective rainfall intensity.

- 65. The best method of estimating runoff is
 - A. Unit Hydro graph B. Runoff-Coefficient Method
 - C. Rational formula D. Infiltration index method
- Ans. A
- Sol. Unit hydrograph can be used to draw flood hydrograph of any rainfall and hence is the most convenient tool to estimate runoff.
- 66. The sum of specific yield and specific retention is equal to
 - A. Porosity B. Permeability coefficient
 - C. Storage coefficient D. Saturation percentage
- Ans. A
- Sol. Specific yield specific retention = Porosity

Porosity is the amount of voids present in soil. Now these voids certain water which can either by yielded or will be retained by the soil hence.

- $S_v + S_r = n$
- 67. Auxiliary devices in stilling basins are provided
 - A. to stabilize the flow B. To reduce the length of the basin
 - C. As additional measure to control jump D. All of the above

Ans. D

- Sol. Auxiliary devices in stilling basins are
 - (i) Chute blocks \rightarrow measure to control jump and reduce its length
 - (ii) Sills and dentate sills \rightarrow stabilize the flow.
 - (iii) Baffle walls \rightarrow breaking the flow and dissipate energy.
- 68. In case of gravity dams, the factor of safety against overturning should not be less than
 - A. 1.00 B. 1.10
 - C. 1.25 D. 1.50

Ans. D

Sol. According to IS code FOS against over turing should not be less than 1.5.



- 69. The net irrigation requirement is
 - A. The amount of water used to satisfy evapotranspiration need.
 - B. The consumptive use in excess of effective rainfall
 - C. The amount of water required to satisfy consumptive and leaching requirement
 - D. Total depth of water supplied to the fields.

Ans. C

- Sol. Net irrigation water is the amount of water required to satisfy the evapotranspiration and leaching requirement of the crop.
- 70. Von-Karmon momentum integral equation is :

A.
$$\frac{2\tau_o}{\rho U^2} = \frac{d\theta}{dx}$$

B. $\frac{\tau_o}{2\rho U^2} = \frac{d\theta}{dx}$
C. $\frac{\tau_o}{\rho U^2} = \frac{d\theta}{dx}$
D. $\frac{\tau_o}{3\rho U^2} = \frac{d\theta}{dx}$

Ans. C

Sol. In 2D incompressible and steady flow, pressure gradient in direction of flow is zero :

$$\frac{\tau_o}{\rho U^2} = \frac{d\theta}{dx}$$

- 71. Euler's equation for motion of liquids is based on the assumption that the _____.
 - A. flow acoss streamline
 - B. flow takes place continuously
 - C. flow is homogeneous, non-viscous and incompressible
 - D. flow is turbulent

Ans. C

- Sol. Euler's equation is based on the following assumptions:
 - The fluid is non-viscous (i,e., the frictional losses are zero).
 - The fluid is homogeneous and incompressible (i.e., mass density of the fluid is constant).
 - The flow is continuous, steady and along the streamline.
 - The velocity of the flow is uniform over the section.
 - * No energy or force (except gravity and pressure forces) is involved in the flow.

72. Given $\mu = 0.06$ poise and $\rho = 0.9$ gm/cm³, what is the value of kinematic viscosity in stokes?

A. 0.04	B. 0.054
C. 0.067	D. 0.082

Ans. C

Sol. Kinematic viscosity = $\frac{Dynamic \ viscosity}{Density} = \frac{\mu}{\rho} = \frac{0.06}{0.9} = 0.067$ stokes

73. A sphere of diameter 30 cm is moving with a uniform velocity of 4 m/s. The dynamic viscosity and specific gravity of the liquid is given as 0.8 poises and 0.9 respectively. What is the value of Reynolds number?

A. 135	B. 10000
C. 13500	D. 15000



Ans. C Sol. Reynolds number (R_e) = $\frac{\rho V D}{\mu}$ Here $\rho = .9 \times 1000 = 900$, $\mu = .8 \times 10 \text{ N-s/m}^2$ Hence $R_e = 13500$ 74. A ship's model of scale 1:100 had a wave resistance of 1 N at its design speed. The corresponding wave resistance (in N) in prototype will be _____. A. 100 B. 10000 C. 1000000 D. 1000 Ans. C Sol. The correct wave resistance in prototype $n^3 = 1 \times (100)^3 = 1000000 \text{ N}$ 75. What will be the maximum upper limit of BOD of a glucose solution of concentration 300 mg/l?B. 327 mg/l A. 321 mg/l C. 333 mg/l D. 340 mg/l Ans. A Sol. Water contains only glucose which is oxidised under following equation $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ 180 grams of glucose + 192 grams of oxygen \rightarrow 264 grams of carbondioxide + 108 grams of H2O From this balanced equation of oxidation of glucose, it can be stated that the theoretical 192 oxygen demand of glucose is 180 = 1.07 mg of O₂/mg of glucose Therefore, theoretical oxygen demand of 300 mg/l of glucose solution = $1.07 \times 300 = 321$ mg/l 76. What is the order of BOD_5 removal efficiency of a septic tank for isolated houses? A. 10 to 20% B. 45 to 55% C. 70 to 80% D. Above 90% Ans. B Sol. BODs removal efficiency of a septic tank for isolated houses = 45-55 % 77. The maximum efficiency of BOD removal is achieved in which of the following? A. Oxidation ditch B. Oxidation ponds C. Aerated lagoons D. Trickling filter Ans. A Sol. The main advantage of oxidation ditch is the ability to achieve removal performance objective with low operational requirement and maintenance costs. 78. Activated sludge is the:

- A. Resultant sludge removable from the aeration unit
- B. Sludge settled in the humus tank
- C. Sludge in the secondary tank post aeration, rich in microbial mass
- D. Sludge in the secondary tank post aeration, rich in nutrients



Ans. C

- Sol. Activated sludge contained a large concentration of highly active micro-organism. It gets settled in the secondary sedimentation tank of activated sludge plant.
- 79. The MLSS concentration in the aeration tank of extended aeration activated sludge process is 5000 mg/l. If one litre of sample settled in 30 minutes and the measuring cylinder showed a sludge volume of 200 mg/l, then the sludge volume index would be nearly:
 - A. 200 ml/gm B. 150 ml/gm
 - C. 50 ml/gm D. 40 ml/gm

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Ans. D
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Sol. Sludge volume index (SVI) =
$$\frac{V_{ob}(\frac{ml}{l})}{X_{ob}(\frac{ml}{l})} \times 1000$$

$$SVI = \frac{200}{5000} \ge 1000 = 40 \text{ ml/gm}$$

80. An average operating data for conventional activated sludge treatment plant is as follows: Quantity of waste sludge = 10900 m^3

Wastewater = $35000 \text{ m}^3/\text{d}$

Calculate the aeration period in hours (h)?

A. 7.5 h	B. 6.4 h
C. 5.7 h	D. 2 h

Ans. A

Sol. Aeration period (t) in hr is given by equation as

t =
$$\frac{v}{q} \times 24 = \frac{10900}{35000} \times 24 = 7.47$$
 h approximately equal to 7.5 h

- 81. Of the following, the longest serving Prime Minister of Japan is:
 - A. Yamakaba Hitashi. B. Taro Katsura.
 - C. Shinzo Abe. D. Yoshihide Suga

Ans. C

Sol. Option (c) is correct

The longest serving prime minister of Japan – Shinzo abe.

- 82. Which of the following districts of Himachal Pradesh had the low sex ratio of women against the State average as per the Census- 2011?A. Shimla; Sirmaur; Solan and Kullu.B. Kullu; Una; Chamba and Shimla
 - C. Sirmaur; Una; Solan and Mandi. D. Kullu; Chamba; Kangra and Bilaspur.

Ans. A

Sol. Option (A) correct

 \rightarrow Shimla; sirmaur; solan; and kullu are the districts of Himachal Pradesh which had the low sex ratio of women against the state coverage as per, the census 2011

- 83. Identify the following painter, who has made the painting entitled: "Mother and Child":
 - A. Amrita Sher-Gil.
 - C. M.F. Husain.

B. Jaimini Roy.



Ans. B

Sol. Option (b) is correct

The famous painting "Mother and child" is painted by Jamini Roy

84. Find out the correct match of the following eminent women of India with their respective offices:

(i) Asima Chatterjee	(a) First Woman Chief Justice of Himachal Pradesh High Court	
(ii) Leila Seth	(b) First Woman President,	
(iii) Amrita Pritam	(c) First woman Awardee of Sahitya Academy Award	
(iv) Sucheta Kriplani	(d) First Woman Chief Minister.	
A. (i) – (b); (ii) – (c); (iii) – (a); (iv) – (d).	
B. (ii) – (d); (i) – (b); (iii) – (c); (iv) – (a)		
C. (iv) – (a); (iii) – (d); (ii) – (b); (i) – (c).		
D. (i) – (b); (ii) – (a); (iii) – (c); (iv) – (d).	

Ans. D

Sol. Option (d) is correct

Faisnain	Respective offices.	
women		
i) Asima	(b) First woman President, India	
Chatterjee	science congress.	
ii) Leila Seth	(a) First woman chief justice of	
	Himachal Pradesh high court.	
iii) Amrita	(c) First woman awardee of sahitya	
Pritam	academy award in punjabi literature.	
iv) sucheta	(d) First woman chief minister	
kriplani		

Correct option (d) - (i)-(b), (ii)-(a), (iii) - (c), (iv) - (d)

- 85. Which of the following is correct about the Hali people of Himachal Pradesh?
 - (i) The Halis are mostly in Chamba district and are either farm labourers or tenants.
 - (ii) They are classified as the Scheduled Tribes.
 - (iii) The Polyandry marriage is mostly prevalent among them.
 - (iv) Widow remarriage is known as gadhoj.
 - A. (iii) and (iv). B. (i) and (iv).
 - C. (ii) and (iii). D. (iv) and (ii)

Ans. B

Sol. Option (B) is correct

Correct option about Hali people of Himachal Pradesh.

- i) Halis are mostly in chamba district and are either farm labourers are tenants.
- iv) Widow remarriage is known as gadhoj



- 86. Which of the following districts of Himachal Pradesh has the largest Scheduled Tribes population as per the Census of 2001?
 - A. Kinnaur.
 - C. Chamba.

B. Kullu.

D. Lahaul & Spiti.

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Ans. C
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Sol. Option (c) Chamba

 \rightarrow Chamba districts of Himachal Pradesh has the largest scheduled Tribes population as per the census of 2001.

- 87. Which of the following is the correct option of the places of U.S.A, which were attacked by the terrorists in September, 2001?
 - A. New York City; Pennsylvania; and Washington DC
 - B. New York City; Washington DC; and Ithaca.
 - C. New York City; Los Angles; and Ithaca.
 - D. New York City; California; and Washington DC

Ans. A

Sol. Option (a) is correct.

 \rightarrow New York City; Pennsylvania. Washington DC are the place of U.S.A., which were attacked by terrorists in September, 2001.

- 88. The Noble Prize- 2018 in Physics was awarded to the Scientists for:
 - A. The invention of 'Chipped optical pulses'.
 - B. Discovering LED lighting system.
 - C. Coining the term 'Radioactivity'.
 - D. Making breakthrough in 'Super-Computors'.
- Ans. A
- Sol. Option (A) is correct

 \rightarrow The Noble prize – 2018 in physics was awarded to the scientists for the invention of chipped optical pulses.

- 89. Identify the location of three branches of the Bombay (Mumbai) High Court correctly:
 - A. Nagpur; Aurangabad & Pune. B. Panaji; Nagpur & Aurangabad.
 - C. Pune; Panaji & Nagpur. D. Aurangabad; Pune & Nasik

Ans. B

Sol. Option (B) is correct

 \rightarrow The three branches of Mumbai high court are:

i) Panji,

- ii) Nagpur, and Aurangabad.
- 90. The region of Solah singhi Dhar is in district:
 - A. Kinnaur. B. Kullu.
 - D. Sirmaur. C. Hamirpur.
- Ans. B
- Sol. Option (c) hamirpur is correct.

The region of solah singhi Dhar is in district of Hamirpur.



91.	Of the following,	which is true	about the Jugga	Movement of 1884?
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(i) It was started by the Rajputs in Mahasu area whose surplus lands were confiscated by the State.

(ii) A movement for demanding reforms in Karsog.

(iii) The movement demanded withdrawal of criminal cases against the political leaders in all the Shimla States.

(iv) A brahmana protest against the resumption of their land grants in the State of Bilaspur.

B. (ii) only.

B. New York.

- A. (iii) & (i).
- C. (ii) & (iv). D. (iv) only.

Ans. A

Sol. Option (d) is correct

 \rightarrow about the Jugga movement of 1884 only point (iv) is correct – A brahmana protest against the resumption of their land grants in the state of Bilaspur

- 92. The Headquarters of World Trade Organization (WTO) are in:
 - A. Vienna
 - C. Geneva. D. Washington.

Ans. C

Sol. option (c) is correct

 \rightarrow The headquarter of world trade organisation (WTO) are in Geneva.

- 93. Which of the following Passes are matched correctly with their districts in Himachal Pradesh?
 - (i) Drati Pass
 (a) Lahaul Spiti.
 (ii) Shipkila
 (b) Chamba Pangi.
 (iii) Shakarof
 (c) Lahaul Spiti.
 (iv) Rangchi Galu
 (d) Kullu
 A. (i) (a); (ii) (d); (iii) (c); (iv) (b).

B. (i) – (b); (ii) – (a); (iii) – (c); (iv) – (d)

- C. (iv) (a); (iii) (d); (ii) (b); (i) (c).
- D. (i) (b); (ii) (a); (iii) (c); (iv) (d).
- Ans. B
- Sol. Option (B) is correct

Passes	Districts
Drati Pass	Chamba – Pangi
Shipki La	Lahaul spiti
Shakarof pass	Lahaul spiti
Rangchi Galu	Kullu

(B) i-b, ii-a, iii-c, and iv-d is correct.

94. Identify the correct number of total Panchayat Samitis upto 2019-20 in Himachal Pradesh from the following:

A. 82	B. 73

C. 78 D. 69



Ans.	В		
Sol.	ol. Option (c) – 78 is correct		
	ightarrow The total member of Panchayat samitis	s upto 2019-2020 in Himachal Pradesh is 78.	
95.	Which is true about the largest number of Regional Co-operative Marketing Societies in the		
	following district of Himachal Pradesh in the ye		
	(i) Kangra.		
	(ii) Shimla.		
	(iii) Mandi.		
	A. Mandi only.	B. Shimla only.	
	C. Kangra only.	D. Mandi & Kangra.	
Ans.	D		
Sol.	Option (B) Shimla only is correct		
	ightarrow The largest number of Reginal co-operative Marking societies is present in Shimla district		
	of Himachal Pradesh.		
96. From where did the NASA launch the planet – hunting telescope		net – hunting telescope, Kepler in 2009?	
	A. Bikonur Space Center.	B. Kennedy Space Center.	
	C. Cape Caneveral Air Force Station.	D. Washington Space Center.	
Ans.	C		
Sol.	Option (c) is correct		
	NASA launch the planet – hosting (etc sco	ope kepler in 2009 from "cape canaveral Air Force	
	station".		
97.	7. Which of the following are the three Divisions of Himachal Pradesh?		
	A. Kangra, Shimla and Mandi.	B. Shimla, Kangra and Sirmaur.	
	C. Shimla, Chamba and Kangra.	D. Mandi, Kangra and Sirmaur.	
Ans.	A		
Sol.	Option (A) is correct		
	The there divisions of Himachal Pradesh are		
	i) Kangra		
	ii) Shimla, and		
	iii) Mandi		
98.	Tista and Subansiri are the tributaries of	river;	
	A. The Narmada.	B. The Tungbhadra.	
	C. The Ganga.	D. The Brahmaputra.	
Ans.	D		

Sol. Option (d) is correct

 \rightarrow Tista and Subansiri are the tributaries of the Brahmaputra river.



99. Which of the following are the correct provisional estimates of the 10th Agriculture Census,

2015-16, about the small and marginal land h

- (i) They constitute about 90% of total agricultural land holdings.
- (ii) They constitute nearly 70% of total agricultural land holdings.
- (iii) They constitute over 98.50% of total agricultural land holdings.
- A. (i) only. B. (iii) only
- C. (i) & (iii) D. (ii) only

Ans. A

Sol. \rightarrow according to GOI reports small and marginal holdings (below two heaters) constituted 86.71% of the total land holdings.

The option (i) – They constitute about 90% of total agriculture land holdings is correct.

- 100. Of the following, which crop has the largest area brought under the high Yielding Varieties Programme in Himachal Pradesh in the year 2020
 - A. Paddy. B. Soyabean.
 - C. Wheat D. Maize.

Ans. C

Sol. Wheat crop has the largest area brought under the light yielding varieties programme in Himachal Pradesh
