ESE 2024 Prelims Solutions

Civil Engineering

Set-C

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Civil Engineering Paper Analysis of ESE 2024 Preliminary Examination		
Sl.	**Subjects**	**No. of Questions**
1	Building Materials	17
2	Strength of Materials	21
3	Structural Analysis	04
4	Design of Steel Structures	12
5	RCC & Prestress Concrete	10
6	Construction Practice, Planning & Management	08
7	Fluid & Hydraulic Machines + OCF	13
8	Engineering Hydrology	04
9	Irrigation Engineering	04
10	Environmental Engineering	16
11	Geo-technical Engineering	17
12	Surveying and Geology	13
13	Transportation Engineering (Highway, Tunnel, Railway Engg.)	11

UPSC ESE Prelims 2024

CIVIL ENGINEERING analysis

by MADE EASY faculties

1. What is the proportion of acid and alkalis permitted in the water used in construction?
   (a) A 100 ml sample of water should be neutralized by not more than 2 ml of 0.1 normal NaOH of 10 ml of 0.1 normal HCl
   (b) A 200 ml sample of water should be neutralized by not more than 2 ml of 0.1 normal NaOH of 10 ml of 0.1 normal HCl
   (c) A 300 ml sample of water should be neutralized by not more than 2 ml of 0.1 normal NaOH of 10 ml of 0.1 normal HCl.
   (d) A 50 ml sample of water should be neutralized by not more than 2 ml of 0.1 normal NaOH of 10 ml of 0.1 normal HCl.

Ans. (*)

As per IS 456 : 2000, the following concentration represent the maximum permissible values.

(a) To neutralise 100 ml sample of water, using phenolphthalein as an indicator, it should not require more than 5 ml of 0.02 normal NaOH.

(b) To neutralise 100 ml sample of water, using mixed indicator, it should not require more than 25 ml of 0.02 normal H_2SO_4. Here, no option is matching.

End of Solution

2. Match the following lists regarding different types of bricks with their applications:

List-I	List-II
P. Sand lime bricks	1. Tough, durable
Q. Face bricks	2. Edges and curves to suit the shape
R. Paving bricks	3. Cheaper and used only for backup
S. Sewer bricks	4. Where distinct brick work finish is intended

Select the correct answer usng the code given below:

	P	Q	R	S
(a)	1	2	3	4
(b)	2	3	4	1
(c)	3	4	1	2
(d)	4	1	2	3

Ans. (c)

- Sewer brick can be shaped like bullnose to facilitate drainage easily.
- Facing brick should have good appearance, colour and texture.
- Paving brick has more resistance against abrasion and has comparatively more iron which cause vitrification of brick even at lower temperature.
- Sand lime brick used for fire resistance, acoustic insulation, also impact less efflorosence.

End of Solution

3. What are the two main categories of embankment slopes?

(a) Flat and Steep
(b) Recoverable and Non-recoverable
(c) Desirable and Undesirable
(d) Hazardous and Non-hazardous

Ans. (a)

End of Solution

4. Match the following lists:

List-I (Median widths at intersections)

P. Four feet or wider
Q. Twentyeight feet or wider
R. Sixteen feet or wider
S. Twenty feet or wider

List-II (Key features)

1. Provides a pedestrian refuge and room for a dual left-turn bay
2. Provides a pedestrian refuge and room for a left-turn bay
3. Provides a pedestrian refuge.
4. Provides refuge for a crossing passenger car.

Select the correct answer using the codes given below.

	P	Q	R	S
(a)	4	1	2	3
(b)	3	1	2	4
(c)	3	4	2	1
(d)	2	3	4	1

Ans. (c)

End of Solution

5. If V_d is design speed (mph), t_{p-r} is perception-reaction time (sec), a is deceleration rate (ft/sec^2) and G is longitudinal grade of the road (%/100). What is the expression for stopping sight distance?

(a) $SSD = 1.468V_d t_{p-r} + \dfrac{V_d^2}{30\left(\left(\dfrac{a}{32.2}\right) \pm G\right)}$

(b) $SSD = 1.468V_d t_{p-r} + \dfrac{V_d^2}{\left(\dfrac{a}{32.2}\right) \pm G}$

(c) $SSD = 1.468V_d t_{p-r} - \dfrac{V_d^2}{30\left(\left(\dfrac{a}{32.2}\right) \pm G\right)}$

(d) $SSD = 1.468V_d t_{p-r} - \dfrac{V_d^2}{\left(\dfrac{a}{32.2}\right) \pm G}$

Ans. (a)

As we know,

$$SSD = V_d t_r + \frac{V_d^2}{2g(f \pm G)}$$

Where V_d is in m/s, t_r in seconds, g is in ms^{-2}.

Now, Vd (in ft/sec) = 1.468 × V_d (in miles/hr)

Now,Deaceleration, a (in ft/sec^2) = μg

$$= \frac{a}{g}$$

Now, $g = 32.2$ ft/sec^2

So, $f = \dfrac{a}{32.2}$

Hence, SSD (in feet) $= \left[(1.468V_d)t_{p-r}\right] + \left[\dfrac{(1.468V_d)^2}{2g(f \pm G)}\right]$

$$= 1.468V_d t_{p-r} + \frac{V_d^2}{\frac{2 \times 32.2}{1.468^2}\left(\frac{a}{32.2} \pm G\right)}$$

$$= 1.468V_d t_{p-r} + \frac{V_d^2}{30\left(\frac{a}{32.2} \pm G\right)}$$

End of Solution

6. If V_d is design speed (mph), e_{max} is maximum rate of superelevation, f_{max} is coefficient of side friction. What is the expression for minimum radius of curvature (R_{min})?

(a) $R_{min} = \dfrac{V_d^2}{(0.01e_{min} - f_{max})}$

(b) $R_{min} = \dfrac{V_d^2}{15(e_{min} + f_{max})}$

(c) $R_{min} = \dfrac{V_d^2}{15(e_{min} - f_{max})}$

(d) $R_{min} = \dfrac{V_d^2}{15(0.01e_{min} + f_{max})}$

Ans. (d)

Minimum radius of curvature (R_{min}) is given as

$$R_{min} = \frac{V_d^2}{15[0.01e_{max} + f_{max}]}$$

where, V_d is design speed in miles/hour.

End of Solution

7. What is the major difficulty in establishing human surveillance in freeway management systems?

(a) Difficulty in integrating electronic detection with human surveillance.
(b) Infrastructure for providing video providing video to the location of the human operator.
(c) Human operators have superior judgment, but they may lose attention.
(d) Lack of qualified human operators.

Ans. (a)

In freeway management systems, the major difficulty is establishing human surveillance with integrated electronic detection.

End of Solution

8. The weighted average of the damages caused by the individual axle load group with respect to the corresponding volume of the traffic of each group is known as

(a) Lane distribution factor
(b) Load Safety factor
(c) Vehicle damage factor
(d) Heavy-vehicle adjustment factor

Ans. (c)

Vehicle damage factor (VDF) is a multiple to convert the number of commercial vehicles of different axle loads and axle configurations to the number of standard axle load repetitions.

End of Solution

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9. Which one of the following is a factor that is to be multiplied by the total traffic repetitions in a lane to convert it to equivalent repetitions along the maximum distressed path?
(a) Lane distribution factor
(b) Load Safety factor
(c) Vehicle damage factor
(d) Lateral distribution factor

Ans. (d)

End of Solution

10. Consider the following statements regarding tunnel:
1. In hills with soft rocks, a tunnel is cheaper than a cutting.
2. The maintenance cost of a tunnel is considerably higher than that of a bridge.
3. The construction of a tunnel is costly as it requires special construction.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (d)

End of Solution

11. Match the following lists:

List I (Size of the tunnel)	List II (Purpose of the tunnel)
P. Circular	1. Water and sewage mains
Q. Elliptical	2. Roads and Railways
R. Horseshoe	3. Water and sewage

Select the correct code given below: answer using the

	P	Q	R
(a)	2	1	3
(b)	3	1	2
(c)	3	2	1
(d)	2	3	1

Ans. (b)

End of Solution

12. Consider the following statements regarding full face method for tunneling in hard rocks:
1. An entire section of the tunnel is tackled at one time.
2. Mucking tracks can be laid on the tunnel floor and extended as the work progresses.
3. It is suitable for unstable rocks.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (a)
This method is not suitable for unstable rocks.

End of Solution

13. Match the following lists:

List-I (Type of soil)

P. Silt
Q. Clay
R. Sand

List-II (Method of tunneling)

1. One or two ports are opened and the material flows continuously into the tunnel.
2. One or two port doors are opened. The material is excavated and deposited at the bottom of the tunnel.
3. Tunneling is of the open type. The material settles on the floor of the shield and it should be continuously removed.

Select the correct answer using the code given below:

	P	Q	R
(a)	2	1	3
(b)	3	1	2
(c)	3	2	1
(d)	2	3	1

Ans. (a)

End of Solution

14. Which one of the following methods is achieved by drilling a drift through the tunnel from portal to portal?

(a) Blow-in method
(b) Exhaust method
(c) Blow-out method
(d) Natural method

Ans. (a)

End of Solution

15. Which one of the following types of soils will usually shrink if drained or if subjected to repeated loading?

(a) Non-cohesive soils
(b) Cohesive soils
(c) Peat
(d) Silts

Ans. (b)

If cohesive soil is drained then it will show the property of swelling and shrinkage.

End of Solution

16. Consider the following statements regarding aerial photogrammetry:

1. Aerial photogrammetry has the ease with which topography of inaccessible areas can be detailed.
2. In aerial photogrammetry, there is possibility of omitting of few field data.

Which of the above statements is/are correct?

(a) 1 only
(b) 2 only
(c) both 1 and 2
(d) Neither 1 nor 2

Ans. (c)

- If aerial photogrammetry is done at some height then there is a chance to omitting of few field data.
- Aerial photogrammetry has the ease with which topography of inaccessible areas can be detailed.

Hence both the statements are correct.

End of Solution

17. Match the following lists:

List-I (Region)	List-II (Wavelentgh)
P. Reflected IR band	1. Less than 0.03 nm
Q. X-ray	2. 0.1 – 30 cm
R. Gamma ray	3. 0.7 – 3.0 μm
S. Microwave	4. 0.03 – 3.0 nm

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	3	1	4
(b)	3	4	1	2
(c)	4	1	3	2
(d)	4	1	2	3

Ans. (b)

End of Solution

18. Accurate transfer of surface alignment down a vertical shaft using two plumbwires can be achieved by

(a) Rise and fall method
(b) Collimation method
(c) Bowditch's method
(d) Weisbach triangle method

Ans. (d)

Weisbach triangle method of surface alignment down through a vertical shaft in tunnel is the most accurate and widely excepted method.

End of Solution

19. If R is the radius of the circle and Δ is deflection angle, what is the formula for external distance (E) in circular curve for use in design and setting out?

(a) $E = R\left(\sec\frac{\Delta}{2} - 1\right)$

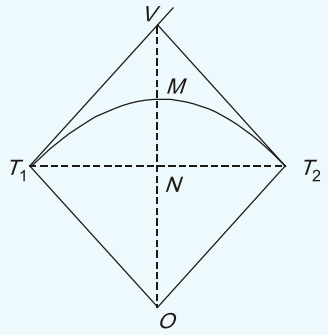
(b) $E = R\left(1 - \sec\frac{\Delta}{2}\right)$

(c) $E = R\left(\cos\frac{\Delta}{2} - 1\right)$

(d) $E = R\left(1 - \cos\frac{\Delta}{2}\right)$

Ans. (a)

External /apex distance(E) is given as



$E = VM$

$= R\left(\sec\frac{\Delta}{2} - 1\right)$

End of Solution

20. Which one of the following situations is NOT at all suitable for tunneling?

(a) If the beds are parallel to horizontal or have approximately zero degree inclination

(b) If the beds are vertically dipping and the axis of the tunnel is perpendicular to the strike.

(c) If the strike of involved beds is parallel to the axis of the tunnel.

(d) If the dip of involved beds is parallel to the axis of the tunnel.

Ans. (c)

End of Solution

21. Which one of the following is NOT a necessity of specifications for construction?

(a) Specification of a work is required to specify the quality and quantity of different materials required for a construction work and is one of the essential contract documents

(b) Specification is necessary to specify the equipment, tools and plans to be engaged for a work and thus enables to procure them beforehand

(c) Specification is an essential contract document and is required for Arbitration
(d) Specification has no impact on changes of cost of materials and tools i.e. the tender rate

Ans. (d)

End of Solution

22. What is the capital value of a premises consisting of land and a well-built house, let out for ₹800/- per month inclusive of all taxes. The house is in good condition. The rent by comparison with other premises is fair and is likely to be maintained. Assume the following data:
Outgoings: 18% of the gross rent, expected rate of return: 8%, future life of the building: 60 years.

(a) ₹98,400/-
(b) ₹141,687.50/-
(c) ₹110,687.50/-
(d) ₹88,400/-

Ans. (a)

$$\text{Capitalized value (C.V.)} = \frac{\text{Net income}}{i}$$

$$= \frac{800 \times 12 \times 0.82^2}{0.08}$$

$$= \text{Rs. } 98400$$

End of Solution

23. Which one of the following is the advantage of lump sum contract?

(a) In case of unforeseen hazards during construction, the contractor is put to unlimited hardship
(b) There may not be any hazard which could not be visualized beforehand
(c) It becomes intricate to accommodate additions, alterations of design and specifications
(d) Lump sum contract works better in civil engineering construction than for mechanical and electrical installations

Ans. (a)

End of Solution

24. Consider the following statements regarding the right of the contractor to terminate:

1. If the work is stopped by a court order for three months or more for any reasons.
2. If the architect fails to issue the certificate of payment in the stipulated period.
3. If the owner fails to pay the contractor after the stipulated period or certification for the payment from the consultant or the arbitrator.

Which of the above statements is/are correct?

(a) 1 and 2
(b) 2 and 3
(c) 1 and 3
(d) 2 only

Ans. (c)

End of Solution

25. How many number of bricks are required in 10 m^3 of brick work?

(a) 3000 numbers (b) 5000 numbers

(c) 2000 numbers (d) 4000 numbers

Ans. (b)

$$\text{Number of bricks} = \frac{10\text{m}^3}{20\times10\times10\times10^{-6}\,\text{m}^3}$$

$$= 5000 \text{ numbers}$$

End of Solution

26. Consider the following statements regarding the essential insurance record to be maintained:

1. Workmen's compensation and employer's accountability insurance in accordance with applicable laws should be maintained.
2. Comprehensive general liability insurance to cover any solitary whichever body or the property should be maintained.
3. Comprehensive automobile liability insurance to cover any solitary whichever body or the property damage should be maintained.

Which of the above statements is/are correct?

(a) 1 only (b) 1 and 2 only

(c) 3 only (d) 2 and 3 only

Ans. (b)

End of Solution

27. A supplier sends steel plates in a huge quantity to a contractor. The first batch was exhaustively examined for thickness and gave a standard deviation of 1.80. The contractor feels that the knowledge of mean within a range of 0-5 to its true value for a probability of 95% would be satisfactory. What is the size of sample?

(a) 40 numbers (b) 30 numbers

(c) 60 numbers (d) 50 numbers

Ans. (d)

Standard deviation, $\sigma = 1.8$

$$\text{Sample size, } n = \frac{Z^2\cdot\sigma^2}{e^2}$$

Z is probability factor and e is error. [for 95% probability, $Z = 1.96$]

So,
$$n = \frac{(1.96)^2\times(1.8)^2}{0.5^2}$$

$$= 49.78 \simeq 50$$

End of Solution

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28. A preliminary survey indicates that 20% of the time of a gang of workers is spent ideally. What is the total number of observations required to determine the proportion of idle time within ±5% with 95% confidence limit?

(a) 216 observations (b) 226 observations
(c) 246 observations (d) 236 observations

Ans. (c)

$$\text{Sample size, } n = \frac{z^2 p(1-p)}{e^2}$$

where z is probability factor [For p = 95% z is 1.96]
p is probability.
e is permissible error.

So, $$n = \frac{(1.96)^2 (0.2)(1-0.02)}{(0.05)^2}$$

$$n = 245.86 \simeq 246$$

End of Solution

29. Consider the following statements regarding the dependency of crane load capacity:

1. The size of the crawlers is not a factor due to diminutive mounting which decreases the stability of any footing.
2. The strength of the boom is also one of the major governing factors in establishing load ratings, and any extension of the boom reduces the rating. Lowering the boom also increases the clearance radius and thus reduces the rated capacity.
3. The counterweight is added to the after-end of the machine. Manufacturer's specifications provided standard and maximum counter- weights and also the crane ratings. Counter weights may be increased to a specified maximum, but the operating radius must not exceed that given by the manufacturer.

Which of the above statements is/are correct?

(a) 1 and 2 (b) 1 and 3
(c) 1 only (d) 2 and 3

Ans. (b)

Statements I and III are correct, however statement II is ambiguous.

End of Solution

30. Match the following lists regarding the physical properties of cement:

List-I	List-II
P. Loss on ignition	1. Causes expansion
Q. Insoluble residues	2. Due to evaporation of moisture and carbondioxide
R. Lime and alumina content	3. Due to inactive materials like gypsum
S. Sulphur content	4. Causes unsoundness

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	3	4	1
(b)	3	4	1	2
(c)	4	1	2	3
(d)	2	4	1	3

Ans. (a)

- Attack of sulphur cause increment in volume i.e. expansion.
- Loss in ignition shows presence of moisture.
- In soluble residue signify impurity in cement.

Alternate:

Loss on ignition : Due to evaporation of moisture and carbondioxide
Insoluble residues : Due to inactive materials like gypsum
Lime and alumina content : Causes unsoundness
Sulphur content : Sulphur expansion

End of Solution

31. In the conveying of most building concrete from the mixer or truck to the form is done in bottom-dump buckets, then the chief danger during conveying is that of

(a) Transferring
(b) Moisture and temperature
(c) Segregation
(d) Vibrations

Ans. (c)

As per IS-456 : 2000, the maximum permissible free fall of concrete to avoid segregation is 1.5 m. Bottom-dump buckets are used to avoid this free fall.

End of Solution

32. Which one of the following is NOT a property of an admixture?

(a) Improve workability
(b) Increase strength
(c) Improve durability
(d) Increase permeability

Ans. (d)

- Water reducing admixtures increases strength at same workability or increases workability at same strength.
- Air entraining admixture increases durability and resist frost action.

End of Solution

33. Which one of the following is the creep coefficient at any time? (Where C_{ct} is the creep coefficient at any time and C_{cu} is the ultimate creep coefficient and t is the time in days after loading)

(a) $C_{ct} = \dfrac{t^{0.60}}{10 + t^{0.60}} C_{cu}$

(b) $C_{ct} = \dfrac{t^{0.50}}{10 + t^{0.50}} C_{cu}$

(c) $C_{ct} = \dfrac{t^{0.40}}{10 + t^{0.40}} C_{cu}$

(d) $C_{ct} = \dfrac{t^{0.70}}{10 + t^{0.70}} C_{cu}$

Ans. **(a)**

The creep coefficient at any time C_{ct} can be related to the ultimate creep coefficient C_{cu} as per Bransion's equation.

$$C_{ct} = \frac{t^{0.60}}{10 + t^{0.60}} C_c$$

End of Solution

34. Consider the following statements regarding the design of T-beams:

1. To establish flange thickness h_f based on flexural requirements of the slab, which normally spans transversely between perpendicular T beams.
2. Determine the effective flange width b_f according to ACI limits.
3. Choose web dimensions b_w and d based on either negative bending requirements at the supports or shear requirements by setting a reasonable upper limit on the nominal unit shear stress V_u in the beam web.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. **(d)**

End of Solution

35. What is the minimum thickness 'h' of non prestressed one-way slabs of length 'L' for simply supported?

(a) L/24
(b) L/10
(c) L/20
(d) L/28

Ans. **(c)**

As per IS 456 : 2000

For one way slabs, $d = \dfrac{\text{Eff. span}}{20 \times MF_t \times MF_c}$

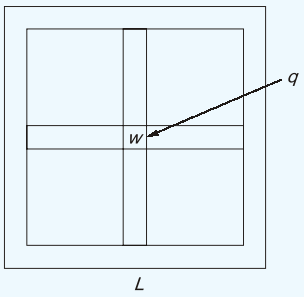
End of Solution

36. What is the maximum bending moment of elastic plates in a square slab where q is the load shared on length l?

(a) $0.625\ ql^2$ (b) $0.00625\ ql^2$

(c) $0.0625\ ql^2$ (d) $0.000625\ ql^2$

Ans. (c)



Dead load in each direction, $w = \frac{q}{2}$

Maximum bending moment $= \frac{wL^2}{8} = \frac{\frac{q}{2} \times l^2}{8}$

$= 0.0625\ ql^2$

End of Solution

37. What is the load factor for stem in the design procedure for cantilever retaining walls with safety?

(a) 1.2 (b) 1.6

(c) 2 (d) 2.5

Ans. (b)

$$\frac{0.9 \times M_{balancing}}{M_{overturning}} \geq 1.4$$

$$\geq \frac{1.40}{0.9}$$

$$\geq 1.55$$

End of Solution

38. Which one of the following types of equipment is used in topographic surveys and also for recording the shapes of buildings?

(a) Electromagnetic distance measurement devices

(b) GPS

(c) Satellite camera

(d) Aerial camera

Ans. (d)

Aerial camera is the most appropriate option.

End of Solution

39. Match the following lists:

List-I (Correction)	List-II (Formula)
P. Absolute length (c_a)	1. $\frac{1}{24}\left(\frac{W}{P}\right)^2 L$
Q. Sag (c_g)	2. $\frac{h^2}{2L}$
R. Alignment (c_m)	3. $\frac{c}{l}L$

Select the correct answer using the code given below:

	P	Q	R
(a)	2	1	3
(b)	3	2	1
(c)	3	1	2
(d)	2	3	1

Ans. **(c)**

$$\text{Absolute length } (C_c) \rightarrow \frac{C}{l}L$$

$$\text{Sag } (C_g) \rightarrow \frac{1}{24}\left(\frac{W}{P}\right)^2 L$$

$$\text{Alignment } (C_m) \rightarrow \frac{h^2}{2L}$$

End of Solution

40. If sensitivity of a bubble tube is 30" per 2 mm division what would be the error in staff reading on a vertically held staff at a distance of 200 m, when the bubble is out of centre by 2.5 divisions?

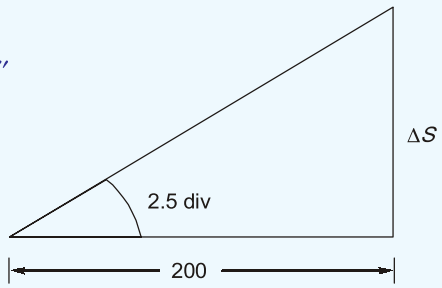
(a) 0.073 m (b) 0.73 m
(c) 0.0073 m (d) 7.3 m

Ans. **(a)**

$\alpha = 30''$ $\quad \theta = 2.5 \times 30''$
$l = 2$ mm
$\Delta = 200$

$$\tan(2.5 \times 30'') = \frac{\Delta s}{200}$$

$$\Rightarrow \quad \Delta s = 0.07272 \simeq 0.073$$



End of Solution

41. When a celestial body crosses the observer's meridian, it is said to be
(a) culminate
(b) vernal equinox
(c) obliquity
(d) celestial pole

Ans. (a)

End of Solution

42. Why the observations of field astronomy do not involve the measurement of declination and right ascension?
(a) Because the altitude and azimuth are constantly changed to the motion of the celestial body
(b) Because the stars do not occupy fixed positions on the celestial sphere
(c) Because the distance of the sun from the earth is variable
(d) Because of the obliquity of the ecliptic

Ans. (b)

End of Solution

43. If the equality of back sight distance and foresight cannot be maintained, under such condition, which one of the following levelling types is most important part of geodetic surveying?
(a) Spirit levelling
(b) Reciprocal levelling
(c) Trigonometric levelling
(d) Ordinary levelling

Ans. (b)
Reciprocal levelling eliminates all the errors hence is suitable in geodetic surveying.

End of Solution

44. Consider the following statements regarding global positioning system (GPS):
1. GPS cannot be used in all weather conditions.
2. In GPS surveying inter visibility between stations or points surveyed is not necessary.
3. High cost of GPS surveying has restricted the realization of the full potential of GPS.
Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (d)
All the statements are correct.

End of Solution

45. Consider the following statements regarding remote sensing surveys:
1. Different types of land use are distinguishable on images.
2. Most images lack the horizontal perspective.
3. For surveys of small areas, the cost of mobilizing a remote sensing mission may be uneconomical

Which of the above statements is/are correct?

(a) 1 and 2 (b) 2 and 3

(c) 2 only (d) 3 only

Ans. (b)

Different types of land use are not distringustable very rearly on the images.

End of Solution

46. If γ_s = unit weight of the material of falling sphere in g/cm^3, γ_t = unit weight of the liquid medium in g/cm^3, μ_t = viscosity of the liquid medium in g sec/cm^2, and D = diameter of the spherical particle in cm. According to Stokes' law, what is the formula for the terminal velocity (ν) of the spherical particle?

(a) $\nu = \frac{1}{18}\left[\frac{(\gamma_s - \gamma_t)}{\mu_t}\right]D^2$ (b) $\nu = \frac{1}{8}\left[\frac{(\gamma_s + \gamma_t)}{\mu_t}\right]D^2$

(c) $\nu = \frac{1}{12}\left[\frac{(\gamma_s - \gamma_t)}{\mu_t}\right]D^2$ (d) $\nu = \frac{1}{2}\left[\frac{(\gamma_s + \gamma_t)}{\mu_t}\right]D^2$

Ans. (a)

End of Solution

47. Consider the following statements regarding sedimentation analysis of soil particles based on Stokes' law:

1. The finer soil particles are never perfectly spherical.
2. All the soil grains may have the same specific gravity.
3. Particles constituting to fine soil fraction may carry surface electric charges.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only

(c) 2 and 3 only (d) 1, 2 and 3 only

Ans. (b)

End of Solution

48. What is meant by Thixotropy?

(a) Property of a material which is manifested by its resistance to flow

(b) The ratio of the unconfined compression strength in the natural or undisturbed state to that in the remoulded state

(c) The compressive stress at failure, giving due allowance to the reduction in area of cross-section

(d) Phenomenon of strength loss- strength gain, with no change in volume or water content

Ans. (d)

Thixotropy is the phenomenon of strength loss-strength gain with no change in volume or water content.

End of Solution

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49. Consider the following statements regarding energy heads:
1. The velocity head in soils is negligible.
2. Direction of flow is determined by the difference in total head.
3. Negative pore pressure cannot exist.

Which of the above statements are correct?
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

Ans. (a)
Negative pore pressure can exist in soil in case of capillary pores.

End of Solution

50. What is the value of coefficient of permeability for coarse gravel?
(a) Greater than 100 mm/s
(b) Greater than 10 mm/s
(c) Greater than 1 mm/s
(d) Less than 0.1 mm/s

Ans. (a)

End of Solution

51. A reinforced concrete foundation, of dimensions 18 m × 36 m exerts a uniform pressure of 180 kN/m^2 on a soil mass, with E-value 45 MN/m^2. What is the value of immediate settlement under the foundation?
(a) 1 m (b) 1.54 m
(c) 18 mm (d) 54 mm

Ans. (d)

$$S_i = \frac{qB\left(1-\mu^2\right)I_f}{Es} = \frac{180\times 18\times\left(1-\mu^2\right)\times\left(I_f\right)}{45\times 10^3}$$

$I_f = 1.2,\ \mu = 0.5 = 64.5$ mm

Closest answer is (d).

End of Solution

52. Which one of the following terms is defined as "Maximum pressure which a foundation can withstand without the occurrence of shear failure of the foundation"?
(a) Gross bearing capacity (b) Bearing capacity
(c) Ultimate bearing capacity (d) Safe bearing capacity

Ans. (c)
Maximum pressure which a foundation can withstand without the occurrence of shear failure of the foundation is the definition of ultimate bearing capacity.

End of Solution

53. If S_i = immediate settlement at a corner of a rectangular flexible foundation of size L × B, B = Width of the foundation, q = Uniform pressure on the foundation, E_S = Modulus of elasticity of the soil beneath the foundation, ν = Poisson's ratio of the soil, and I_t = Influence value, which is dependent on L/B. What is the immediate settlement of a flexible foundation?

(a) $S_i = q.B\left(\frac{1+\nu^2}{E_S}\right)\cdot I_t$

(b) $S_i = q.B\left(\frac{1-\nu}{E_S}\right)\cdot I_t$

(c) $S_i = q\left(\frac{1+\nu^2}{BE_S}\right)\cdot I_t$

(d) $S_i = q.B\left(\frac{1-\nu^2}{E_S}\right)\cdot I_t$

Ans. (d)

End of Solution

54. Consider the following statements regarding bearing capacity values specified in building codes:

1. The codes tacitly assume that the allowable bearing capacity is dependent only on the soil type.
2. The codes assume that the bearing capacity is dependent of the size, shape and depth of foundation.
3. Building codes are usually not up-to-date

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

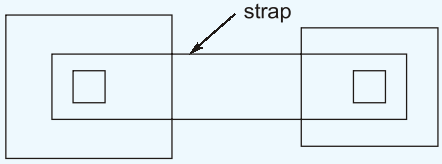
Ans. (d)
All the statements are correct

End of Solution

55. Which one of the following comprises two or more footings connected by a beam called strap?

(a) Continuous footing
(b) Spread footing
(c) Combined footing
(d) Cantilever footing

Ans. (b)



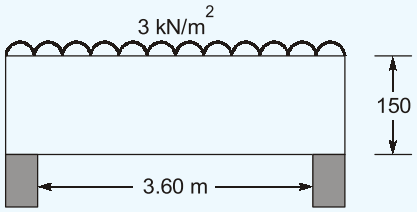
Spread footing

End of Solution

56. A one way slab has effective span 3.6 m and is 150 mm thick. The live load expected on it is 3 kN/m^2. What are the design shear and loads for checking serviceability respectively?

(a) 18.225 kN, 6.75 kN
(b) 16.225 kN, 5.75 kN
(c) 18.225 kN, 7.75 kN
(d) 15.225 kN, 8.75 kN

Ans. (a)



$$DL = 0.15 \times 1 \times 1 \times 25$$
$$= 3.75 \text{ kN/m}^2$$
$$L.L. = 3.00$$
$$W_{working} = 6.75$$
$$W_{factored} = 10.125$$

$$V = \frac{WL}{2} = \frac{6.75 \times 3.6}{2} = 12.15$$

$$V_v = 1.5V = 1.5 \times 12.15 = 18.225$$

End of Solution

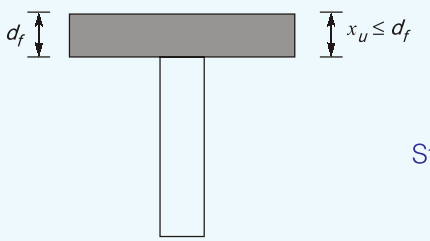
57. Consider the following statements regarding the strength of flanged sections in flexure where the moment of resisting capacity of the flanged sections depends upon the depth of neutral axis x_u:

1. If $x_u \le D_f$, compressive force is in the flange only.
2. If $\frac{3}{7}x_u > D_f$, compressive stress in the flange is uniform.
3. If $x_u > D_f$ and $\frac{3}{7}x_u > D_f$, compressive stress in flange in non uniform.

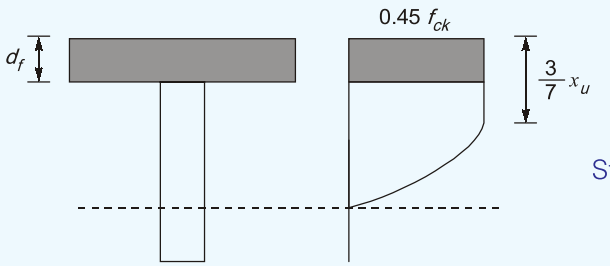
Which of the above statements is/are correct?

(a) 1 and 3
(b) 2 and 3
(c) 1 and 2
(d) 1 only

Ans. (c)



Statement I is correct



Statement II is correct

End of Solution

58. What is the maximum deflection for cantilever subjected to udl throughout? (Where E is the modulus of elasticity of concrete, I is the moment of inertia, L is length of the span, P is the point load)

(a) $\frac{5\omega L^3}{384EI}$ (b) $\frac{PL^3}{3EI}$

(c) $\frac{\omega L^4}{8EI}$ (d) $\frac{PL^3}{84EI}$

Ans. **(c)**

Deflection in cantilever beam due to uniformly distributed load is $\frac{\omega L^4}{8EI}$.

End of Solution

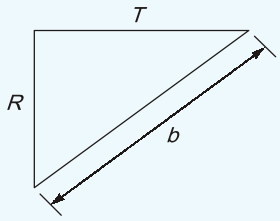
59. Which one of the following is the equation for width of the step in a staircase, consider R being the rise, T being tread, D/2 being the depth and b is the width ?

(a) $b = \sqrt{\frac{R^2}{T^2}}$ (b) $b = \sqrt{R^2 + T^2}$

(c) $b = \sqrt{R^2 \cdot T^2}$ (d) $b = \sqrt{R^2 - T^2}$

Ans. **(b)**

From figure, $\beta = \sqrt{R^2 + T^2}$



End of Solution

60. Which one of the following statements is correct under safety provisions of the ACI code?
(a) Design strength is greater than required strength and design moment is greater than required moment
(b) Design strength is greater than required strength and design moment is less than required moment
(c) Design strength is less than required strength and design moment is greater than required moment
(d) Design strength is less than required strength and design moment is less than required moment

Ans. (a)
As per safety provisions of the ACI CODE
Statement I is correct.

End of Solution

61. Which of the following is not a factor in the design of tension members ?
(a) Length of the connection
(b) Type of fabrication
(c) Connection eccentricity
(d) Gross area of the cross section

Ans. (d)
Net area of the cross section is a factor in the design of tension members. But gross area of the cross section is not a factor.

End of Solution

62. Match the following lists:
List-I (Members)
P. A tension member in which a reversal of direct stress occurs due to loads other than wind or seismic forces
Q. A member subjected to compressive forces resulting only from a combination of wind actions
R. A member normally acting as a tie in a roof truss which is not considered effective when subject to reversal of stress resulting from the earthquake
S. Members always in tension
List-II (Maximum effective slenderness ratio)
1. 350
2. 400
3. 180
4. 250
Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	3	4	1
(b)	3	4	1	2
(c)	3	4	2	1
(d)	2	4	1	3

Ans. (b)

Refer table-3 IS 800 : 2007.

End of Solution

63. Which one of the following is NOT a parameter for determining the strength of the column?

(a) Material of the column
(b) Cross-sectional configuration
(c) Width of the column
(d) Residual stress

Ans. (c)

End of Solution

64. Consider the following modes regarding the failure of an axially loaded column:

1. Local buckling
2. Squashing
3. Joint buckling

Which of the above modes are correct?

(a) 2 and 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (b)

Various types of failure of axially loaded columns are–

(i) Squashing
(ii) Local buckling
(iii) Flexural buckling
(iv) Lateral Torsional buckling
(v) Flexural torsional buckling

End of Solution

65. Match the following lists:

List-I (Sections)	List-II (Limiting width to thickness ratio)
P. Rolled section	1. $88\varepsilon^2$
Q. Welded section	2. 42ε
R. Circular hollow section	3. 15.7ε
S. Hot rolled RHS	4. 13.6ε

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	3	4	1
(b)	3	1	4	2
(c)	3	4	1	2
(d)	2	4	3	1

Ans. (c)

Refer IS 900:2007 Table-2.

End of Solution

66. Match the following lists:

List-I (Types of beams with)

P. Angles
Q. Rolled I-sections
R. Castellated beams
S. Plate girders

List-II (Applications)

1. Long spans and heavy loads
2. Roof purlin and sheeting rail
3. Most frequently used as a beam
4. Long spans and light loads

Select the correct answer using the code given below:

	P	Q	R	S
(a)	3	4	1	2
(b)	3	1	4	2
(c)	2	3	4	1
(d)	2	4	1	3

Ans. (c)

End of Solution

67. Consider the following statements regarding the lateral torsional buckling of symmetric sections:

1. The beam has no initial imperfections and its behavior is elastic.
2. It is loaded by unequal and opposite end moments in the plane of the web.
3. The beam have residual stresses and its ends are simply supported vertically and laterally.

Which of the above statements is/are correct?

(a) 2 and 3 (b) 3 only
(c) 1 and 2 (d) 1 only

Ans. (d)

- Column should be loaded by equal and opposite end moment.
- Residual stresses are not considered.

End of Solution

68. Which of the following is NOT a functional requirement of a girder?

(a) Strength to carry bending moment
(b) Vertical stiffness to satisfy any deflection limitation
(c) Strength to carry shear i.e. adequate web area
(d) Stiffness to reduce the buckling or post-buckling strength of the web

Ans. (d)

As the stiffeners can be provided to reduce the buckling, so it is not a functional requirement for a girder.

End of Solution

69. Which one of the following is NOT a difference between the behavior of the beam-columns subject to the bending moment about minor axis to major axis?

(a) In the case of slender members under small axial load, there is very little reduction of moment capacity below M_p, since lateral torsional buckling is not a problem in weak axis bending

(b) The moment of magnification is larger in the case of beam- columns bending about their weak axis

(c) As the slenderness decreases, the failure curves in the P/P_n, y-y axis plane change from convex to concave, showing decreasing dominance of minor axis bucking

(d) The failure of short/stocky members is either due to section strength being reached at the ends or at the section of larger magnified moment

Ans. (c)

End of Solution

70. In practical design of steel structures, on the vertical walls, external pressure coefficient on windward wall is

(a) 0.8 (b) 0.5

(c) –0.5 (d) –0.8

Ans. (a)

End of Solution

71. Consider the following statements regarding the behavior of a column under a compression load:

1. The stress-strain properties do not remain constant throughout the section.
2. Residual stresses due to cooling after rolling the steel section and those imposed by welding during construction exist in the section before loading.
3. Due to construction details, the load is perfectly concentric and the end conditions will not vary from case to case.

Which of the above statements is/are correct?

(a) 1 and 2 (b) 1 only

(c) 2 only (d) 1 and 3

Ans. (c)

- Stress strain properties remains constant throughout the section.
- Load is not perfectly concentric and end conditions vary from case to case.

End of Solution

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72. What is the minimum load factor for dead load as per IS 800:1984?
(a) 1.3 (b) 1.7
(c) 2.3 (d) 2.7

Ans. (b)

End of Solution

73. What is the grain specific gravity for humus type soil?
(a) 2.37 (b) 1.37
(c) 4.37 (d) 3.37

Ans. (b)
As the humus soil is organic soil and specific gravity of organic soil is less than 2, So its specific gravity is 1.37.

End of Solution

74. When the specific gravity of solids is known, which one of the following types of methods is used to determine the water content?
(a) Pycnometer method
(b) Rapid moisture tester method
(c) Oven-drying method
(d) Sand-replacement method

Ans. (a)

$$\text{Water content, } w = \left\{\frac{W_2 - W_1}{W_3 - W_4}\left(\frac{G-1}{G}\right) - 1\right\}$$

Where G is specific gravity. So if 'G' is known, then this method can be used.

End of Solution

75. Which one of the following soils are transported by wind?
(a) Alluvial soils (b) Lacustrine soils
(c) Aeolian soils (d) Marine soils

Ans. (c)

End of Solution

76. Match the following lists:

List I (components)	List II (working)
P. Trusses	1. Carry compressive force
Q. Cables	2. Located at the crown and supports elevations
R. Arches	3. Support their loads hinged in tension arches
S. Three	4. Prevent collapse

Select the correct answer using the code given below :

	P	Q	R	S
(a)	4	3	1	2
(b)	3	2	4	1
(c)	4	1	2	3
(d)	2	3	4	1

Ans. (a)

- Arches generally carries compressive forces and cables caries loads in tension.

End of Solution

77. Which one of the following is the condition for maximum shear in a cantilever?

(a) It occurs when a series of concentrated loads are not placed at the farthest point away from the fixed support

(b) It occurs when a series of distributed loads are placed at the farthest point away from the fixed support

(c) It occurs when a series of concentrated loads are placed at the nearest point away from the fixed support

(d) It occurs when a series of concentrated loads are placed at the farthest point away from the fixed support.

Ans. (*)

End of Solution

78. Match the following lists:

List I (Type of commercial building/institution)	List II (Water demand in Litres per day)
P. Restaurants	1. 45 per capita
Q. Nurses homes and medical quarters	2. 70 per seat
R. Cinemas, concert halls and theatre	3. 135 per capita.
S. Factories	4. 15 per seat

Select the correct answer using the code given below:

	P	Q	R	S
(a)	4	1	2	3
(b)	2	1	4	3
(c)	4	3	2	1
(d)	2	3	4	1

Ans. (d)

End of Solution

79. Consider the following statements regarding quality difference of ground water and surface water:

1. The Turbidity of ground water is high, whereas surface water is little.
2. Total dissolved solids of ground water is lower than surface water.
3. Concentration of inorganic compounds or ions of ground water is higher than surface water.

Which of the above statements is/are correct?

(a) 1 and 2 (b) 2 only
(c) 3 only (d) 1 and 3

Ans. (c)

- Turbidity of ground water is lower in comparison to surface water.
- TDS of ground water is high than surface water due to presence of minerals.

End of Solution

80. If P is population of town/city, Q is total quantity of water required during one year for a town/city; what is the formula for maximum daily per capita demand for a town/city?

(a) $1.8 \times \frac{Q}{P \times 365}$ (b) $1.8 \times \frac{Q}{P \times 24}$
(c) $1.5 \times \frac{Q}{P \times 365}$ (d) $1.5 \times \frac{Q}{P \times 24}$

Ans. (a)

End of Solution

81. If P_n = Population at the end of n decade, P_o = Present population, P_{av} = Average arithmetic increase in the population (decadal), P_I = Average incremental increase in population, n = Number of decades; what is the mathematical representation of Incremental Increase Method?

(a) $P_n = P_I \times n + (P_{av} + P_o)$
(b) $P_n = P_I + (P_{av} + P_o) \times n$
(c) $P_n = P_o + (P_{av} + P_I) \times n$
(d) $P_n = P_o \times n + (P_{av} + P_I)$

Ans. (c)

End of Solution

82. The impurities in water which are extremely small size particles and cannot be removed by settling and filtration are known as

(a) Suspended impurities
(b) Colloidal impurities
(c) Dissolved impurities
(d) Picked up impurities

Ans. (c)

- Colloidal impurities can be removed by filtration.
- Suspended impurities and picked up impurities can be removed by sedimentation

End of Solution

83. What is the function of flocculator in the typical water treatment scheme for surface water?

(a) To rapid dispersion of chemical coagulant(s) to encourage destabilization of colloids
(b) To permit the settlement of chemical 'flocs' along with colloidal particles
(c) To provide for gentle mixing of the destabilized colloids to promote agglomeration of colloids into large easily settleable flocs
(d) To remove the flocs and colloids which escape from the settlement in the secondary sedimentation tank

Ans. (c)

After coagulation, filtration is adopted which induces slow mixing in water and destabilized the colloids.

End of Solution

84. What is the function of rapid mixing in the typical water treatment flow scheme for ground water with high hardness?

(a) To drive out the objectionable dissolved gas such as H_2S and CO_2
(b) To permit the settlement of chemical precipitates under gravity
(c) To reform the calcium and magnesium bicarbonates to prevent settlement of $CaCO_3$ under $Mg(OH)_2$ precipitates in the distribution lines
(d) To disperse the lime and soda ash to form the chemical precipitates

Ans. (d)

Lime and soda process is used to remove hardness of water. These chemicals are added in coagulation tank.

End of Solution

85. If Q is the water requirement in L/min and P is population in thousands, what is Buston's formula to determine fire demand?

(a) $Q = 5663\sqrt{P}$ (b) $Q = 3182\sqrt{P}$

(c) $Q = 4637\left(1 - 0.01\sqrt{P}\right)$ (d) $Q = 100\sqrt{P}$

Ans. (a)

End of Solution

86. What is meant by soffit?

(a) The system of pipes which conveys discharges in separate pipes to the drainage system

(b) A pipe or conduit which is owned by a local authority for conveyance of the sewage

(c) The highest point of the interior of a sewer pipe at any cross section

(d) The horizontal pipe lay below the floor level or below basement to receive the discharge of soil or waste water

Ans. (c)

End of Solution

87. What is the logical extension of the pit privy?

(a) Septic tank and tile field (b) Composting toilet

(c) Seepage pits (d) Plastic pipe with holes

Ans. (a)

End of Solution

88. Consider the following statements regarding a good building/house drainage system:

1. The pipes should be of non- absorbent materials.
2. The system should have traps at all necessary points.
3. The branch drains should be as long as possible.

Which of the above statements are correct?

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

Ans. (a)

Branch drains should not be very long.

End of Solution

89. What is a drawback of aerobically digested sludges?
(a) Odor reduction
(b) Enhanced putrescible
(c) Degraded of organic acids
(d) Difficulty in dewatering

Ans. (d)

End of Solution

90. What needs to be maintained to avoid the odour problem in tannery effluent treatment?
(a) Low pH
(b) pH between 7 – 8
(c) pH between 9.5 – 10
(d) High pH

Ans. (d)

End of Solution

91. The water remaining in the soil after the removal of gravitational water is called
(a) Capillary water
(b) Gravity water
(c) Hygroscopic water
(d) Field capacity

Ans. (a)

Capillary water: The water that is stored in the soil after the gravitational water is drained out is called capillary water. They are stored in the capillary spaced around the soil granules against the force of gravity by the capillary force in them.They are available to the plant root absorption.

Field capacity: The maximum amount of capillary water remaining in the soil after the removal of gravitational water (is called its field capacity). In general it represents the water held at a tension of 1/3 atmosphere.

NOTE: The colsest answer is capillary water (a).

End of Solution

92. The field capacity and permanent wilting point for a given 0.8 m root zone soil are 35 and 10 per cent, respectively. At a given time, the soil moisture in the given soil is 20 per cent when a farmer irrigates the soil with 250 mm depth of water. Assuming bulk specific gravity of the soil as 1.6, what is the amount of water wasted from the consideration of irrigation?
(a) 23.2%
(b) 58%
(c) 5.8%
(d) 19.2%

Ans. (a)

Field capacity, $FC = 35\%$

Permanent wilting point, $PWP = 10\%$

Depth of root zone, $d = 0.8$ m

Moisture content, $M_0 = 20\%$

Now, Depth of water provided, $d_w = \frac{\gamma}{\gamma_w} \times d \times (FC - M_0)$

$= 1.6 \times 0.8 \times (0.35 - 0.20)$

$= 0.192 \text{ m} = 192 \text{ mm}$

So, Percentage of water wasted $= \dfrac{(250 - 192) \times 100}{250} = 23.2\%$

End of Solution

93. Match the following lists:

List-I (Soil texture)	List-II (Field capacity(%))
P. Sand	1. 5 – 10
Q. Loam	2. 27 – 35
R. Silty clay	3. 18 – 25
S. Clay	4. 32 – 40

Select the correct answer using the code given below:

	P	Q	R	S
(a)	4	3	2	1
(b)	1	3	2	4
(c)	3	1	2	4
(d)	4	2	1	3

Ans. **(b)**

End of Solution

94. If V is the wind velocity and F is the fetch, F < 32 km, what is the formula for wave height (h_w) in gravity dams?

(a) $h_w = 1.032\sqrt{VF} + 0.76 + 0.27F^{\frac{1}{4}}$

(b) $h_w = 0.032\sqrt{VF} - 0.76 - 0.27F^{\frac{1}{4}}$

(c) $h_w = 1.032\sqrt{VF} - 0.76 + 0.27F^{\frac{1}{4}}$

(d) $h_w = 0.032\sqrt{VF} + 0.76 - 0.27F^{\frac{1}{4}}$

Ans. **(d)**

When F < 32 km,

height of wave, $h_w = 0.032\sqrt{VF} + 0.76 - 0.27F^{\frac{1}{4}}$

When $F > 32$ km

$h_w = 0.032\sqrt{VF}$

End of Solution

95. If c_1 = a dimensionless pressure coefficient, α_h = horizontal acceleration factor, ρ= mass density of water, g = acceleration due to gravity, h = depth of the reservoir, what is the formula for the variation of horizontal hydrodynamic earthquake pressure with depth (P_e) in gravity dams?

(a) $P_e = C_1\alpha_h \frac{g}{h}$ (b) $P_e = \frac{C_1\alpha_h}{gh}$

(c) $P_e = C_1\alpha_h gh$ (d) $P_e = C_1 g(h+\alpha_h)$

Ans. **(c)**

As per Zanger method for calculating hydrodynamic pressure, P_e

$$P_e = C_1 \times k_h \times \rho_w g \times h$$

$$= C_1 \times \frac{\alpha_h}{g} \times \rho_w g \times h$$

$$= C_1 \times \alpha_h \times \rho_w \times h$$

NOTE: No option are correct but (c) is closest.

End of Solution

96. Consider the following statements regarding the distribution shear stress assumptions:

1. For all values of y, q is uniform across the width of the cross- section, irrespective of its shape.
2. 'F = (dM/dx)' is derived from the assumption that bending stress- varies non-linearly across the section and is not zero at the centroid.
3. The material is homogenous and isotropic and the value of E is the same for tension as well as compression.

Which of the above statements is/are correct?

(a) 1 and 2 only (b) 2 and 3 only

(c) 1 and 3 only (d) 1, 2 and 3

Ans. **(c)**

Bending stresses are assumed linear and stresses are zero at neutral axis.

End of Solution

97. Which one of the following statements is NOT a property of the curves?

(a) Both the systems of the curves cross each other at 45°

(b) Each system crosses the N.A at 45°

(c) At any point of a curve the tangent and normal give the directions of the two principal stresses.

(d) The intensity of stress along each curve is the greatest when it is parallel to the length of the beam and diminishes along the curve to zero, where it cuts a face of beam at right angles.

Ans. **(b)**

End of Solution

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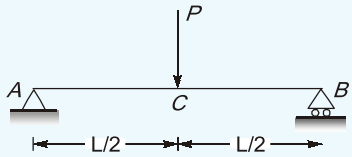
98. A rod of circular section is subjected to a shearing force on a plane perpendicular to its axis. What is the maximum shearing stress in terms of shearing force and rod diameter, if the rod is used as a beam with free ends and a central concentrated load, express the free length in terms of diameter for which the maximum shearing stress, due to shearing force is half the maximum direct stress ?

(a) L = (3/2)D (b) L = (1/2)D

(c) L = (5/2) D (d) L = (2/3)D

Ans. (d)



Now, Maximum shear stress, $\tau_{max} = \frac{4}{3} \times \frac{V_{max}}{\frac{\pi}{4}D^2}$

where $V_{max} = \frac{P}{2}$

So, $\tau_{max} = \frac{4}{3} \times \frac{P}{2 \times \frac{\pi}{4}} \times D^2$

$= \frac{8P}{3\pi D^3}$

Now, Maximum bending stress, $\sigma_b = \frac{M_{max} \times y}{I}$

Where $M_{max} = \frac{PL}{4}$

So, $\sigma_b = \frac{PLX(D/2)}{4 \times \frac{\pi}{64} \times D^4}$

$= \frac{8PL}{\pi D^3}$

Now, $\tau_{max} = \frac{1}{2}\sigma_b$

$\Rightarrow \frac{8}{3}\left(\frac{P}{\pi D^3}\right) = \frac{1}{2} \times \left(\frac{8PL}{\pi D^3}\right)$

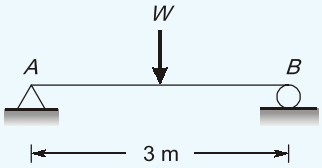
$\Rightarrow \frac{L}{D} = \frac{2}{3}$

End of Solution

99. A beam 3 m long, simply supported at its ends is carrying a point load IW at its mid-span. If the slope at the ends of the beam does not exceed 1°, what is the deflection at the mid-span?

(a) 17.45 mm (b) 17.45 cm
(c) 19.45 mm (d) 19.45 cm

99. (a)



For the given loading,

$$\text{Slope at ends, } \theta = \frac{WL^2}{16EI}$$

$$\text{Defection of centre} = \frac{WL^3}{48EI} = \theta \cdot \frac{L}{3}$$

$$\text{Slope, } \theta = \frac{WL^2}{16EI} = 1° \times \frac{\pi}{180°}\text{ rad} = \frac{\pi}{180°}\text{ rad}$$

$$\therefore \quad \text{Deflection} = \frac{\pi}{180} \times \frac{L}{3}$$

$$= \frac{\pi}{180} \times \frac{3000}{3}\text{ mm} \simeq 17.45\text{ mm}$$

End of Solution

100. Consider the following statements regarding the end conditions and internal conditions of a conjugate beam:

1. A stable and statically determinate real beam will have a conjugate beam which is also stable and statically determinate.
2. An unstable real beam will have statically indeterminate conjugate beam. Hence if a conjugate beam is found to be statically in determinate, it is concluded that the real beam is unstable and further analysis is not appropriate.
3. A statically indeterminate real beam will have stable conjugate beam. Hence its conjugate load must be such that it maintains equilibrium.

Which of the above statements is/are correct?

(a) 1 and 3 (b) 2 and 3
(c) 1 and 2 (d) 1 only

100. (c)

A statically indeterminate real beam will have unstable conjugate beam. Therefore, statement 3 is wrong.

End of Solution

101. Which one of the following is NOT an assumption of impact loading on a beam?
(a) The falling weight sticks to the beam and moves/vibrates with it
(b) No energy loss takes place
(c) The beam is linearly non elastic
(d) The deflected shape of the beam is the same under a dynamic load as under the static load

101. (c)
Material of the beam is assumed to be linearly elastic.

End of Solution

102. Which one of the following is NOT an effect of wind on a structure?
(a) The effect of wind on a structure depends upon the density and velocity of the air
(b) It depends upon the angle of incidence of the wind
(c) It depends upon the shape and stiffness of the structure
(d) It depends upon the smoothness of the structure surface.

102. (d)
Effect of wind does not depend upon the smoothness of the structure surface.

End of Solution

103. Match the following lists:

List I (Basic structural elements)	List II (Applications)
P. Tin rods	1. Carry tensile and compressive loads
Q. Beams	2. Members that resist axial compressive force
R. Columns	3. Bracing
S. Trusses	4. Reinforced concrete

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	3	4	1
(b)	3	4	2	1
(c)	4	1	2	3
(d)	1	2	3	4

Ans. (b)

End of Solution

104. Consider the following statements regarding the principle of super position:
1. The total displacement of the stress at a point in a structure subjected to several external loadings can be determined by adding together the displacements caused by each of the external loads acting together.
2. The material must behave in a nonlinear elastic manner.
3. The geometry of the structure must not undergo significant change when the loads applied.

Which of the above statements is/are correct?

(a) 1 and 2 (b) 2 only

(c) 3 only (d) 1 and 3

104. (d)

Material is assumed to behave in a linear elastic manner.

End of Solution

105. What is the condition for stability of truss with b number of bars, r number of external support reactions with j number of joints?

(a) $b + r = 2j$ (b) $b + r > 2j$

(c) $b + r < 2j$ (d) $b + r < j$

105. (a)

For stability of truss,

$$b + r = 2j$$

End of Solution

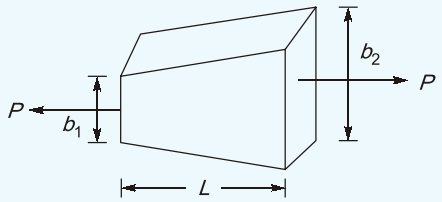
106. Which one of the following is the equation for extension of whole length of a uniformly tapering rectangular bars where b_1 and b_2 are the limits of widths ($b_2 > b_1$), length L, thickness t and the bar is subjected to an axial force P and elastic module E?

(a) $\Delta = \dfrac{PL}{(b_2 - b_1)tE}\log_e \dfrac{b_2}{b_1}$ (b) $\Delta = \dfrac{PL}{(b_2 - b_1)tE}\log_{10} \dfrac{b_1}{b_2}$

(c) $\Delta = \dfrac{PL}{(b_1 - b_2)tE}\log_{10} \dfrac{b_2}{b_1}$ (d) $\Delta = \dfrac{PLt}{(b_2 - b_1)E}\log_e \dfrac{b_2}{b_1}$

106. (a)

For tapered bar,



Extension, $\Delta L = \dfrac{PL}{(b_2 - b_1) + E}\log_e\left(\dfrac{b_2}{b_1}\right)$

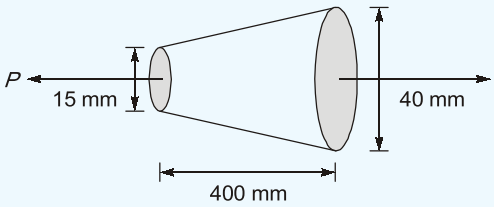
End of Solution

107. A conical bar tapers uniformly from a diameter of 15 mm to a diameter of 40 mm in a length of 400 mm. What is the elongation of the bar under an axial tensile force of 100 kN? (Take $E = 2 \times 10^5$ N/mm^2)

(a) 0.242 mm (b) 0.121 mm

(c) 0.424 mm (d) 0.212 mm

107. (c)



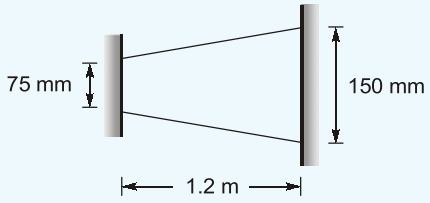
Elongation, $\delta = \dfrac{PL}{\left(\dfrac{\pi D_1 D_2}{4}\right)E}$

$$= \frac{100\times10^3\times100}{\left(\frac{\pi\times15\times40}{4}\right)\times2\times10^5} = 0.424 \text{ mm}$$

End of Solution

108. A circular section tapering bar is rigidly fixed at both the ends. The diameter changes from 75 mm at one end to 150 mm at the other end, in a length of 1.2 m. What is the maximum stress in the bar if the temperature is raised by 32°C?
(Take $E = 2 \times 10^5$ N/mm^2 and $\alpha = 12 \times 10^{-6}$ per 1°C)
(a) 123.6 N/mm^2 (b) 143.6 N/mm^2
(c) 163.6 N/mm^2 (d) 153.6 N/mm^2

108. (d)



$\Delta L = L\alpha\Delta T$
$= 1.2 \times 10^3 \times 12 \times 10^{-6} \times 32 = 0.46$ mm

Also, $\Delta L = \dfrac{PL}{\left(\dfrac{\pi D_1 D_2}{4}\right)E} = 0.46$

Maximum stress,

$\Rightarrow$ $P = \dfrac{0.46\times\pi\times75\times150\times2\times10^5}{4\times1.2\times10^3} = 677.4$ kN

$\sigma_{max} = \dfrac{P}{\frac{\pi}{4}(75)^2} = \dfrac{677.4\times10^3}{\frac{\pi}{4}\times75^2} = 153.33$ N/mm^2

End of Solution

109. A thin type of steel is to be shrunk on to a rigid wheel of 900 mm diameter. What is the internal diameter of the tyre if the hoop stress is limited to 120 N/mm^2? (For the tyre take $\alpha = 12 \times 10^{-6}$ per ^{o}C and $E = 2 \times 10^5$ N/mm^2)

(a) 899.46 mm (b) 819.46 mm

(c) 900.54 mm (d) 800.54 mm

109. (a)

Hoop strain, $\varepsilon_n = \dfrac{\pi D - \pi d}{\pi d} = \dfrac{D-d}{d}$

Hoop strain, $\sigma_n = \varepsilon_n \times E$

$= \dfrac{900-d}{d} \times 2 \times 10^5 = 120$

$d = 899.46$ mm

End of Solution

110. Consider the following statements regarding the effective stress and effective strain :

1. $\bar{\sigma}$ and $\bar{\varepsilon}$ will reduce to σ_x and ε_x in an x-direction tension test.
2. The incremental work per volume done in deforming a material plastically is $d\omega = \bar{\varepsilon}\, d\bar{\sigma}$.
3. It is usually assumed that the $\bar{\sigma}$ vs $\bar{\varepsilon}$ curve describes the strain hardening for loading under a constant stress ratio α, regardless of α^*.

Which of the above statements is/are correct?

(a) 2 and 3 (b) 3 only

(c) 1 and 3 (d) 2 only

Ans. (c)

The incremental work per volume done in deforming a material plastically is given by

$dw = dw = \bar{\sigma}\, d\,\bar{\in}$

Hence statement II is incorrect.

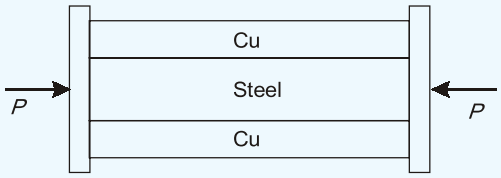
End of Solution

111. A solid cylinder of steel is placed inside a copper tube. The assembly is compressed between rigid plates by forces P. What is the value of increase in temperature so that all the load is carried by the copper tube? (Let the parameters with suffix *c* represent copper and suffix *s* represent steel)

(a) $t = \dfrac{4P}{A_s E_s (\alpha_c - \alpha_s)}$ (b) $t = \dfrac{2P}{A_c E_c (\alpha_s - \alpha_c)}$

(c) $t = \dfrac{P(\alpha_c - \alpha_s)}{A_c E_c}$ (d) $t = \dfrac{P}{A_c E_c (\alpha_c - \alpha_s)}$

Ans. (d)



Net elongation due to temperature rise and P force,

$$\underbrace{(L\alpha_{cu}\Delta T) - \frac{P_1 L}{A_c E_c}}_{\text{Copper tube}} = \underbrace{(L\alpha_S \Delta T) - \frac{P_2 L}{A_s E_s}}_{\text{Steel}}$$

where P_1 and P_2 are the forces in copper tube and steel respectively

Here, $P_2 = 0$ and $P_1 = P$ $[P_1 + P_2 = P]$

$$L\alpha_c \Delta T - L_s \Delta T = \frac{PL}{A_c E_c}$$

$$\Rightarrow \quad \Delta T = \frac{P}{A_c E_c (\alpha_c - \alpha_S)}$$

End of Solution

112. Match the following lists:

List I (Materials)	List II (Modulus of elasticity)
P. Aluminium alloys	1. 190
Q. Cast iron	2. 190 - 210
R. Copper	3. 70 - 79
S. Steel	4. 110 - 120
T. Wrought iron	5. 83 - 170

Select the correct answer using the code given below :

	P	Q	R	S	T
(a)	2	3	4	5	1
(b)	3	4	5	1	2
(c)	4	5	1	2	3
(d)	3	5	4	2	1

Ans. (d)

End of Solution

113. Which one of the following precipitations results from ocean air streams passing over land and being deflected upward by coastal mountains, thus cooling below saturation temperature and spilling moisture?

(a) Convective precipitation
(b) Frontal precipitation
(c) Orographic precipitation
(d) Cyclonic precipitation

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Ans. (c)

Precipitin caused by hills or mountain ranges deflecting the moisture laden air masses upward, causing them to cool and precipitate their moisture is called orographic precipitin.

End of Solution

114. Which one of the following terms refers to the time between the end of the net rainfall and the end of the direct runoff hydrograph?

(a) Recession time
(b) Time-to-peak
(c) Lag time
(d) Concentration time

Ans. (d)

Concentration time starts from end of rainfall to end of recession limb.

End of Solution

115. Match the following lists :

List I (Soil and vegetation)	List II (Infiltration rate (mm/hr))
P. Forested loam	1. 10 – 70
Q. Loam pasture	2. 0 – 4
R. Sand	3. 3 – 15
S. Bare clay	4. 100 – 200

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	1	4
(b)	3	1	2	4
(c)	4	1	3	2
(d)	4	1	2	3

Ans. (c)

End of Solution

116. Match the following lists :

List I (Type of surface)	List II (Value of coefficient of runoff)
P. Wooded areas	1. 0.70 – 0.95
Q. Gravel roads and walks	2. 0.15 – 0.30
R. Macadamized Roads	3. 0.01– 0.20
S. Watertight roof surfaces	4. 0.25 – 0.60

Select the correct answer using the code given below:

	P	Q	R	S
(a)	2	3	1	4
(b)	3	2	4	1
(c)	3	1	2	4
(d)	4	1	2	3

Ans. (b)

$$\text{Coefficient of runoff} = \frac{\text{Runoff}}{\text{Precipition}}$$

Water tight roof surfaces will have lowest infiltration rate, therefore having highest runoff.

End of Solution

117. Consider the following statements regarding ground water :

1. Ground water is exhaustible and is evenly available.
2. Natural replenishment of the ground water resource is a very fast process.
3. Ground water is generally better than surface water in respect of biological characteristics.

Which of the above statements is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

Ans. (c)

- Ground water is not exhaustable.
- Natural repensishment of ground water resource is a slow process.

End of Solution

118. Match the following lists:

List I (Material)	List II (Specific yield %)
P. Clay	1. 5 – 15
Q. Sand and gravel	2. 15 – 25
R. Sandstone	3. 0.5 – 5
S. Limestone	4. 1 – 10

Select the correct answer using the code given below :

	P	Q	R	S
(a)	2	3	1	4
(b)	1	2	4	3
(c)	3	1	2	4
(d)	4	2	1	3

Ans. (c)

Clay will have lowest yield among given materials.

End of Solution

119. A fully penetrating artesian well is pumped at a rate $Q = 1500\ m^3$/ day from an aquifer whose storage coefficient and transmissivity are 4×10^{-4} and $0.145\ m^2$/min, respectively. Considering $\omega(u) = 8.62$, what is the drawdowns at a distance 3 m from the production well after one hour of pumping?

(a) 8.62 m
(b) 14.53 m
(c) 4.93 m
(d) 2.38 m

Ans. (c)

$$\text{Drawdown, } S_w = \frac{Q}{4\pi T} \times \omega(u)$$

where $\omega(u)$ is the well function,

$$\Rightarrow \quad S_w = \frac{1500 \times m^3/d \times 8.62}{4\pi \times 0.15 m^2/min \times 24 \times 60 min/d}$$

$$= 4.927 \simeq 4.93 \text{ m}$$

End of Solution

120. Water attached to soil particles through loose chemical bonds is termed as

(a) Capillary water
(b) Gravity water
(c) Hygroscopic water
(d) Field capacity

Ans. (c)

End of Solution

121. Consider the following statements regarding flow measurement through pipes :

1. The reduction in constriction diameter causes velocity to increase.
2. High velocities in constriction cause low pressures in the system.
3. The reduction in constriction diameter enables lesser accuracy in its measurement.

Which of the above statements is/are correct :

(a) 1 and 2
(b) 2 and 3
(c) 2 only
(d) 1 and 3

Ans. (a)

For a constant discharge, reduction in area increase velocity and thereby, causing low pressure in the system.

End of Solution

122. Consider the following statements regarding ultrasonic flowmeters :

1. There are no moving parts.
2. They cannot measure flow quantities in reverse flow.
3. There is no direct contact with the fluid, there is no danger of corrosion or clogging.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

Ans. (b)

End of Solution

123. When the average flow is steady, which one of the following causes significant fluctuations in velocity, temperature and pressure?

(a) Streamlines in turbulent flow
(b) Molecular diffusion in turbulent flow
(c) Eddy motion in turbulent flow
(d) Orderly flow in turbulent flow

Ans. **(c)**
Eddy motion in turbulent flow.

End of Solution

124. Consider the following statements regarding uniform flow in channel :

1. The depth of flow and wetted area are constant at every section along the channel reach.
2. The velocity of flow and discharge are varying along the channel reach.
3. The total energy line, water surface and the channel bottom are all parallel.

Which of the above statements is/are correct?

(a) 1 and 2
(b) 2 and 3
(c) 3 only
(d) 1 and 3

Ans. **(d)**
The velocity and discharge should remain constant along the channel reach.
Statement 1 and 3 are correct.

End of Solution

125. If Q = discharge into the channel, a = Cross sectional area at the entrance, and D_n is depth at the channel entrance, what is the equation for depth of the reservoir (D_r) when the flow in the channel is subcritical?

(a) $D_r = D_n - \frac{Q}{2ga^2}$
(b) $D_r = D_n - \frac{Q^2}{2ga^2}$
(c) $D_r = D_n + \frac{Q}{2ga^2}$
(d) $D_r = D_n + \frac{Q^2}{2ga^2}$

Ans. **(d)**
For reservoir,

$$y_1 + \frac{v_1^2}{2g} = y_2 + \frac{v_2^2}{2g}$$

$$D_n + \frac{Q^2}{2ga^2} = Dr + 0 \qquad [v_2 = 0]$$

$$Dr = D_n + \frac{Q^2}{2ga^2}$$

End of Solution

126. Which one of the following heads is defined as "the head against which a centrifugal pump has to work"?

(a) Suction head
(b) Delivery head
(c) Static head
(d) Manometric head

126. (d)

Manometric head

End of Solution

127. Consider the following statements regarding positive-displacement pumps :

1. Positive-displacement pump is better able to handle shear sensitive liquids.
2. A well-sealed positive-displacement pump can create a significant vacuum pressure at its inlet, even when dry.
3. The rotor(s) of a positive displacement pump run at higher speeds than the rotor (impeller) of a dynamic pump at similar loads.

Which of the above statements are correct?

(a) 1 and 2 only
(b) 1 and 3 only
(c) 2 and 3 only
(d) 1, 2 and 3

127. (a)

End of Solution

128. Consider the following statements regarding draft tube of Francis turbine :

1. It permits a suction head to be established at the runner exit.
2. It makes possible to install the turbine above the tail race level without loss of head.
3. It converts a large proportion of velocity energy rejected from the runner into useful pressure energy.

Which of the above statements is/are correct?

(a) 1 and 2 only
(b) 2 and 3 only
(c) 3 only
(d) 1, 2 and 3

128. (d)

All three statements are correct.

End of Solution

129. Consider the following statements regarding Kaplan turbine:

1. The runner blades of Kaplan turbine runner are warped.
2. The blade angle is being greater at the hub than at the outer tip.
3. The peripheral velocity of the blades is being directly proportional to radius.

Which of the above statements is/are correct?

(a) 1 and 3 only
(b) 2 and 3 only
(c) 3 only
(d) 1,2 and 3

129. (a)

- Peripheral velocity, $u = \frac{\pi DN}{60}$

$$u \propto D$$

- Blade angle is lesser at hub than at the outer tip.

$\therefore$ Statement 1 and 3 are correct.

End of Solution

130. Match the following lists:

List I (Specific speed (rpm))	List II (Type of turbine)
P. 8.5 to 30	1. Francis turbine
Q. 50 to 340	2. Kaplan turbine
R. 255 to 860	3. Pelton wheel turbine with single jet

Select the correct answer using the code given below :

	P	Q	R
(a)	2	3	1
(b)	3	1	2
(c)	2	1	3
(d)	1	2	3

130. (b)

End of Solution

131. Consider the following statements regarding the difference between true strains and engineering strains :

1. True strains for equivalent amounts of deformation in tension and compression are equal including for sign.
2. True strains are additive. For a deformation consisting of several steps the overall strain is the sum of the strains in each step.
3. The volume change is related to the sum of the three normal strains. For constant volume, $\varepsilon_z + \varepsilon_y + \varepsilon_z = 0$.

Which of the above statements are correct?

(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3

131. (c)

True strains for equivalent amounts of deformation in tension and compression including for sign are not equal.

End of Solution

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132. Consider the following statements regarding the properties of materials :

1. A material in plastic state is temporarily deformed by the application of load and it has tendency to recover.
2. Ductility is the characteristic of a material to be drawn out longitudinally to a reduced section under the action of tensile force.
3. Malleability is a property of a material which permits the materials to be partially extended in all directions without rupture.

Which of the above statements is/are correct?

(a) 1 and 2 (b) 2 only
(c) 3 only (d) 1 and 3

132. (b)

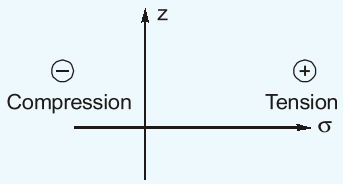
Both the statement, I and III are incorrect.

End of Solution

133. Which one of the following statements is correct regarding the Mohr's circle of a plane Tensor?

(a) σ is positive in tension and is plotted to the right of the origin. Compression is negative to the left
(b) τ is plotted negatively if it rotates the stress block clockwise
(c) Angles θ from one axis to another around the origin are in different direction
(d) Any orthogonal set of axes are 90° to one another on Mohr's circle

133. (a)



End of Solution

134. Consider the following regarding the general situations in linear elasticity:

1. The stress field is a function of only the boundary conditions, geometric shape and loading which are constant.
2. The stress field is a function of material properties like volume and deviatoric stiffness as well.
3. The loads are time independent.

Which of the above statements are correct?

(a) 1, 2 and 3 (b) 1 and 3 only
(c) 1 and 2 only (d) 2 and 3 only

134. (b)

The stress field is a function of material properties like volume but not deviatoric stiffness.

End of Solution

135. Consider the following statements regarding two dimensional stress formulations :
1. In a plane stresses are identical for any given geometry, loading.
2. The in-plane stresses are different for plane strain or plane stress.
3. Linear viscoelastic stress fields are different for constant load and change with time.
Which of the above statements is/are correct?
(a) 1 only (b) 1 and 2
(c) 3 only (d) 2 and 3

135. (a)
In a plane, stress can carry for different geometry and loading.

End of Solution

136. What is the temperature of the tensile strength of the stone in water for 3 days?
(a) 40°C to 50°C (b) 10°C to 15°C
(c) 20°C to 30°C (d) 5°C to 15°C

Ans. (c)
As per is **IS 1121 Part 3: 2012** The test specimen shall be saturated by vacuum saturation by immersing in water maintained at 20°C to 30°C in evacuation vessel under a vacuum of 50 to 100 mm of Hg.

End of Solution

137. The decomposition of felspar is represented as
(a) $K_2AlO_3.6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$K_2CO_3 +$
(Alkaline carbonate)
$AlO_3.2SiO_2.2H_2O+$
(Kaolinite)
$4SiO_2.nH_2O$
(Hydrated silicate)
(b) $K_2Al_2O_3.6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$K_2CO_3 +$
(Alkaline carbonate)
$Al_2O_3.2SiO_2.2H_2O+$
(Kaolinite)
$4SiO_2.nH_2O$
(Hydrated silicate)

(c) $K_2Al_2O.6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$K_2CO +$
(Alkaline carbonate)
$Al_2O_3.2SiO_2.2H_2O +$
(Kaolinite)
$4SiO_2.nH_2O$
(Hydrated silicate)

(d) $KAl_2O_3.6H_2O + CO_2 + nH_2O =$
(Orthoclase)
$KCO_3 +$
(Alkaline carbonate)
$Al_2O_3.2SiO_2.2H_2O +$
(Kaolinite)
$4SiO_2.nH_2O$
(Hydrated silicate)

Ans. (b)

Felspar is mineral that has the composition of alumina silicate with potash (orthoclase) $K_2O.Al_2O_3.6SiO_2$ and also Alumino silicate with soda $(Na_2O.Al_2O_3.6SiO_2)$

Decomposition of felspar can be represented as

$$K_2Al_2O_3.6H_2O + CO_2 + nH_2O \rightarrow \underset{\text{alkaline carbonate}}{K_2CO_3} + \underset{\text{kaolinite}}{Al_2O_3.2SiO_2.2H_2O} + \underset{\text{hydrated silicate}}{4SiO_2.nH_2O}$$

End of Solution

138. Match the following lists:

List I	List II
P. Trap and Basalt	1. Damp proofing and partitions
Q. Sandstone	2. Rough stone for masonry work
R. Laterite	3. Tile stone for roofing
S. Slate	4. Road metal and concrete aggregate

Select the correct answer using the code given below :

	P	Q	R	S
(a)	1	3	2	4
(b)	4	2	3	1
(c)	3	4	2	1
(d)	4	3	2	1

Ans. (d)

- Trap and Basalt are igneous rock used for road metal, aggregates and decorative feature.

- Sandstone is sedimentary rock used for paving, tile stone, roofing, ornamental and grit work.
- Laterite is metamorphic rock suitable for rough store masonry.
- Slate is metamorphic rock suitable for not covering, flooring, damp proofing and partition.

End of Solution

139. Consider the following statements regarding the characteristics of poor lime :
1. It requires less slaking time and hydrates very fast.
2. Setting and hardening is very fast.
3. The color varies from yellow to grey.

Which of the above statements is/are correct?

(a) 1 only (b) 1 and 2
(c) 3 only (d) 1 and 3

Ans. (c)
- Poor lime require more time and hydrates slowly.
- It makes thin paste with water setting and hardening is very slow.
- As it contain clay > 30%, so colour is muddy white i.e. yellow to grey.

End of Solution

140. Consider the following statements regarding the advantages of plywood :
1. It has good strength both along as well as across the grains.
2. It will not shrink or swell across the grains.
3. It can be curved into desired shapes.

Which of the above statements is/are correct?

(a) 1 and 3 (b) 1 and 2
(c) 2 and 3 (d) 2 only

Ans. (a)
- As ply wood prepared by giving odd number of veener perperelicular to each other hence it has good strength both along and across the grain.
- It can be curved into desired shape.
- It shrinks or swell more across me grain but in general less tendency to shrink or swell.

End of Solution

141. Match the following lists:

List-I	List-II
P. Bridges	1. Gamhar, haritaki
Q. Scientific Instruments	2. Red cedar, satin, sissoo
R. Railway carriage	3. Gauva
S. Shuttering	4. Black wood, iron wood

Select the correct answer using the code given below:

	P	Q	R	S
(a)	1	2	3	4
(b)	2	3	4	1
(c)	3	2	4	1
(d)	4	2	1	3

Ans. (b)

- For bridges Babul, Red cedar, iron wood, Jarul, Sal, Satin, Sissoo, Nageshwar Tree cam be suitable.
- For scientific instrument Guava is suitable.
- For Railway carriage Black wood, Teak iron wood, Red wood are suitable.
- For shuttering Nageshwar, Gamhar, haritaki are suitable.

End of Solution

142. Consider the following statements regarding calcined clay:

1. Its chief function is to impart strength and hydraulic properties of mortar.
2. It is dense, compact and impermeable concrete.
3. It increases the temperature of hydration and sets the concrete quickly.

Which of the above statements are correct?

(a) 2 and 3 only
(b) 1 and 2 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (b)

Surkhi (Calcinated clay) impart strength hydraulicity and makes the concrete impermeable, dense and compact.

End of Solution

143. What are the concrete stages production order respectively ?

(a) Batching, mixing, transporting, placing, curing, compacting, finishing
(b) Batching, transporting, mixing, placing, compacting, curing, finishing
(c) Batching, mixing, transporting, compacting, placing, curing, finishing
(d) Batching, mixing, transporting, placing, compacting, curing, finishing

Ans. (d)

Production of concrete stages:

- Batching
- Mixing
- Transporting
- Placing
- Compacting
- Curing
- Finishing

End of Solution

144. Consider the following statements regarding the functions of admixtures:
1. It is to speed up the rate of development of strength at early ages.
2. It increases the strength of concrete.
3. It increases the heat of evolution and decreases the durability of concrete.

Which of the above statements is/are correct?
(a) 2 and 3 only (b) 1 and 3 only
(c) 1 and 2 only (d) 1, 2 and 3

Ans. (c)
- Accelerators are used to increase rate of gain in strength.
- Water reducer admixture increases strength at same workability.

End of Solution

145. Consider the following statements regarding the concrete mix design:
1. It is to be compressive with strength of standard test specimens.
2. It is to be compiled with the durability requirements to accept the environment.
3. It is to be capable of mixed, transported, and compacted as efficiently as possible.

Which of the above statements are correct?
(a) 1 and 3 only (b) 1, 2 and 3
(c) 2 and 3 only (d) 1 and 2 only

Ans. (b)
- Concrete mix design is done to achieve desired compressive strength of concrete.
- W/C Ratio should be taken as per exposure condition of site.
- Concrete mix design also take care for mode of transportation (clause for pumping) compaction requirement (clause for slump) and mixing (clause for amount of water, coarse aggregate to be added).

End of Solution

146. Consider the following statements regarding the design requirements of concrete mix:
1. Grade of concrete: M20, M25 connotes the characteristic strength of 30 N/mm^2 to 35 N/mm^2.
2. Type of cement: The grade of OPC such as of 33, 43 or 53 grade.
3. Type of mixing and curing water: Whether fresh potable water, seawater, ground water is to be used.

Which of the above statements are correct ?
(a) 1, 2 and 3 (b) 2 and 3 only
(c) 1 and 2 only (d) 1 and 3 only

Ans. (b)
M20 and M25 connotes the characteristic strength of 20 N/mm^2 and 25 N/mm^2.

End of Solution

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147. Consider the following statements regarding the characteristics of good mortar:
1. The density and strength of mortars made of the same class of aggregate decrease as the proportion of fine aggregate is increased.
2. It requires about twice as much cement to produce a mortar of given strength when fine sand is used as it does with coarse sand.
3. Even small percentage of mica if present considerably increases the tensile strength and adversely affects the compressive strength.

Which of the above statements are correct?
(a) 1 and 2 only
(b) 2 and 3 only
(c) 1 and 3 only
(d) 1, 2 and 3

Ans. (a)
- Increment in fine aggregates makes the mix poor.
- Mica reduces tensile strength and adversely affect compressive strength.

End of Solution

148. How does the bulk modulus of elasticity of a fluid change with increasing pressure?
(a) It remains constant
(b) It decreases with increase in pressure
(c) It increases with increase in pressure
(d) It becomes zero

148. (c)

Bulk modulus, $k = \dfrac{\dfrac{\Delta p}{\Delta V}}{V}$

$k \propto \Delta P$

$\Rightarrow$ Bulk modulus increase with increase in pressure.

End of Solution

149. Consider the following statements regarding stability of floating bodies:
1. If metacentre (M) lies above centroid (G), then the body is said to be in unstable equilibrium.
2. If metacentre (M) lies below centroid (G), then the body is said to be in unstable equilibrium.
3. If metacentre (M) coincides with centroid (G), then the body is said to be in stable equilibrium.

Which of the above statements is/are correct?
(a) 1 and 3
(b) 2 and 3
(c) 2 only
(d) 1 only

149. (c)

- If matecentre (M) lies above centroid (G), then the body is said to be in stable equilibrium.
- If metacentre (M) coincides with centroid (G), then the body is said to be in neutral equilibrium.

Therefore only statement 2 is correct.

End of Solution

150. If V_s is the velocity of the vector, r is the radius of cuvature and $\frac{\partial V_n}{\partial_t}$ is the local normal acceleration; what is the expression for total normal acceleration of fluid particles?

(a) $\frac{dV_n}{dt} = V_s^2 + r\frac{\partial V_n}{\partial t}$

(b) $\frac{dV_n}{dt} = \frac{V_s^2}{r} + \frac{\partial V_n}{\partial t}$

(c) $\frac{dV_n}{dt} = r + V_S^2\frac{\partial V_n}{\partial t}$

(d) $\frac{dV_n}{dt} = \frac{r}{V_S^2} + \frac{\partial V_n}{\partial t}$

150. (b)

Total normal acceleration,

$$\frac{dV_n}{dt} = \underbrace{\frac{V_s^2}{r}}_{\text{convective}} + \underbrace{\frac{\partial V_n}{rt}}_{\text{local}}$$

End of Solution