

M.Tech. (Highway Engineering) Entrance Test, 2022

1. The value of  $\int_0^4 \sqrt{16-x^2} dx$  is :

- (A)  $\pi$  (B)  $2\pi$   
(C)  $3\pi$  (D)  $4\pi$

2. The value of  $L^{-1} \left\{ \frac{5s^2 + 8s - 1}{(s+3)(s^2+1)} \right\}$  is :

- (A)  $2e^{-3t} + 3\cos t - \sin t$   
(B)  $2e^{-3t} - 3\cos t + \sin t$   
(C)  $3e^{-3t} + 2\cos t - \sin t$   
(D)  $3e^{-3t} - 2\cos t + \sin t$

3. A library has two books each having three copies and three other books each having two copies. In how many ways can all these books be arranged in a shelf so that copies of the same book are not separated ?

- (A) 80 (B) 100  
(C) 120 (D) 140

4. 21 mango trees, 42 apple trees and 56 orange trees have to be planted in rows such that each row contains the same number of trees of one variety only. Minimum number of rows in which the above trees may be planted is :

- (A) 9 (B) 12  
(C) 14 (D) 17

5. By integration the area bounded by the three straight lines  $y = 4 - x$ ;  $y = 3x$  and  $3y = x$  is :
- (A) 2 square units (B) 3 square units  
(C) 4 square units (D) 5 square units
6. The mean value of  $y = 3x^2 + 4x + 1$  between  $x = -1$  and  $x = 2$  is :
- (A) 2 (B) 4  
(C) 6 (D) 8
7. What is the length of the curve  $x = 2\cos^3 \theta$ ;  $y = 2\sin^3 \theta$  between the points corresponding to  $\theta = 0$  and  $\theta = \pi/2$  ?
- (A) 2 units (B) 3 units  
(C) 4 units (D) 5 units
8. What is the shape of the curve represented by  $\frac{x}{5} = \sqrt{1 + \left(\frac{y}{2}\right)^2}$  ?
- (A) Hyperbola (B) Rectangular hyperbola  
(C) Parabola (D) Ellipse
9. Give the order and degree of the ordinary differential equation given below :
- $$\frac{d^3 y}{dx^3} + x \left( \frac{dy}{dx} \right)^{3/2} + x^2 y = 0.$$
- (A) 3 and 2 (B) 3 and 3  
(C) 2 and 3 (D) 3 and 3/2

10. Given that A and B are events such that  $P(A) = 0.6$ ,  $P(B) = 0.3$  and  $P(A \cap B) = 0.2$ , find  $P(A|B)$  and  $P(B|A)$  respectively :
- (A)  $2/3$  and  $1/3$  (B)  $1/3$  and  $2/3$   
(C)  $1/4$  and  $2/4$  (D)  $2/4$  and  $1/4$
11. Which of the following factor *does not* affect fatigue of a material ?
- (A) Loading condition  
(B) Corrosion  
(C) Temperature  
(D) Toughness
12. What is the ratio of Young's modulus to modulus of rigidity for a material having Poisson's ratio of 0.2 ?
- (A)  $12/5$  (B)  $5/12$   
(C)  $5/14$  (D)  $14/5$
13. A straight wire 15 m long is subjected to a tensile stress of  $2000 \text{ kg(f)/cm}^2$ . Elastic modulus is  $1.5 \times 10^6 \text{ kg(f)/cm}^2$ . The coefficient of linear expansion for the material is  $16.66 \times 10^{-6}/^\circ\text{F}$ . The temperature change (in  $^\circ\text{F}$ ) to produce the same elongation as due to the  $2000 \text{ kg(f)/cm}^2$  tensile stress in the material will approximately be :
- (A) 40 (B) 80  
(C) 120 (D) 160

14. The plane of maximum shear stress has normal stress that is :
- (A) maximum
  - (B) minimum
  - (C) zero
  - (D) None of the above
15. A thick cylinder is subjected to external pressure. The magnitude of hoop stress at internal radius will be :
- (A) equal to the magnitude of hoop stress at external radius.
  - (B) less than the magnitude of hoop stress at external radius.
  - (C) greater than the magnitude of hoop stress at external radius.
  - (D) equal to the magnitude of radial stress at internal stress.
16. A cantilever beam of span 'L' and uniform flexural rigidity 'EI' is loaded with an upward force 'W' at the mid-point and downward force 'P' at the free end. The deflection at the free end will be zero, if :
- (A)  $W = 3P/2$
  - (B)  $W = 2P$
  - (C)  $W = 16P/5$
  - (D)  $W = 5P$



20. The 'Euler' load for a column is 1000 kN and crushing load is 1500 kN. The 'Rankine' load is equal to :
- (A) 600 kN (B) 3000 kN  
(C) 2500 kN (D) 4500 kN
21. A simply supported beam of uniform cross-section is subject to a maximum bending moment of 2.25 t-m. If it has rectangular cross-section with width 15 cm and depth 30 cm, then the maximum bending stress induced in the beam (in kg/cm<sup>2</sup>) will be :
- (A) 50 (B) 100  
(C) 150 (D) 225
22. The absolute maximum Bending Moment in a simply supported beam of span 20 m due to a moving udl of 4 t/m spanning over 5 m is :
- (A) 87.5 t-m at the support  
(B) 87.5 t-m near the midpoint  
(C) 12.5 t-m at the midpoint  
(D) 87.5 t-m at the midpoint
23. In a two-hinged arch an increase in temperature induces :
- (A) no bending moment in the arch rib.  
(B) uniform bending moment in the arch rib.  
(C) maximum bending at the crown.  
(D) minimum bending moment at the crown.

24. A symmetrical parabolic arch of span 20 meters and rise 5 meters is hinged at the springings. It supports a uniformly distributed load of 2 tonnes per meter run of the span. The horizontal thrust in tonnes at each of the springing is :
- (A)  $8t$  (B)  $16t$   
(C)  $20t$  (D) Zero
25. The Indian Standard (IS) code used for design of prestressed concrete is :
- (A) IS 4326 : 2013 (B) IS 3920 : 2012  
(C) IS 6512 : 2013 (D) IS 1343 : 2012
26. A concrete beam is post-tensioned by a cable carrying an initial stress of  $1000 \text{ N/mm}^2$ . The slip at the jacking end was observed to be 5 mm. The modulus of elasticity of steel is  $210 \text{ kN/mm}^2$ . What is the percentage loss of stress due to anchorage slip if the length of the beam is 30 m ?
- (A) 3.5% (B) 0.35%  
(C) 7% (D) 35%
27. Which one of the following statements is *not* correct in reinforced concrete design ?
- (A) In the cracked section, concrete below the neutral axis is neglected in calculations  
(B) When section is subjected to external loading, resisting moment is developed due to compression in concrete and tension in steel  
(C) In the cracked section, the steel area below the neutral axis is converted into equivalent concrete area  
(D) The neutral axis depth does not depend on the modular ratio

**28. Statement (I) :** The theory of reinforced concrete is developed with the assumption that there is perfect bond between steel and concrete, in other words, there is no slip.

**Statement (II) :** In case of ribbed bars, there is no need to check the bond failures.

You are to examine these two statements carefully and select the answers to these items using the code given below :

- (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

Read the following information and answer the three questions i.e. **Q. Nos. 29—31** that follow :

A singly reinforced concrete beam with an effective span of 4 m has a rectangular cross cross-section width of 300 mm and an overall depth of 550 mm. The beam is reinforced with steel of Fe-415 grade of area 250 mm<sup>2</sup> at an effective depth of 500 mm. The self-weight with dead load of the beam is 4 kN/m. Consider M-15 grade concrete and  $\sigma_{cbc} = 5$  MPa ;  $\sigma_{st} = 230$  MPa.

**29.** What is the bending moment due to dead load ?

- (A) 8000 Nm
- (B) 80 kNm
- (C) 32 kNm
- (D) 3200 kNm



30. What is the modular ratio ?
- (A)  $28/3$  (B)  $40/3$   
(C)  $56/3$  (D)  $86/3$
31. What is the depth of critical Neutral axis ?
- (A) 134.33 mm (B) 124.33 mm  
(C) 154.33 mm (D) 144.33 mm
32. In the IS 456 : 2000 criteria for accepting concrete, the variation in strength between each specimen shouldn't be more than :
- (A)  $\pm 30\%$  of the average  
(B)  $\pm 20\%$  of the average  
(C)  $\pm 15\%$  of the average  
(D)  $\pm 35\%$  of the average
33. A hole is to be punched through a steel plate of 8 mm thickness. What is the least diameter of hole which can be punched, if the steel punch can be worked to a compressive stress of  $800 \text{ N/mm}^2$  and the ultimate shear strength is  $300 \text{ N/mm}^2$  ?
- (A) 1.2 mm (B) 12 mm  
(C) 2.1 mm (D) 21 mm
34. In a steel plate with bolted connection, the rupture of the net section is a mode of failure under :
- (A) Tension (B) Compression  
(C) Flexure (D) Shear

35. The plastic modulus of a section is  $4.8 \times 10^{-4} \text{ m}^3$ . The shape factor is 1.2. The plastic moment capacity of the section is 120 kN-m. The yield stress of the material is :
- (A) 100 MPa (B) 240 MPa  
(C) 250 MPa (D) 300 MPa
36. A propped cantilever of span  $L$  is carrying a vertical concentrated load acting at mid-span. The plastic moment of the section is  $M_p$ . The magnitude of the collapse load is :
- (A)  $8M_p/L$  (B)  $4M_p/L$   
(C)  $6M_p/L$  (D)  $2M_p/L$
37. Which of the following cross-section shapes has the largest shape factor ?
- (A) Square (B) I-Section  
(C) Solid Circle (D) Diamond
38. In a construction project, generally 50% of total project cost is attributed to :
- (A) Equipment cost only  
(B) Material cost only  
(C) Manpower cost only  
(D) Material plus equipment cost
39. The value of Poisson's ratio for Brass material is :
- (A) 0.14 (B) 0.20  
(C) 0.34 (D) 0.42

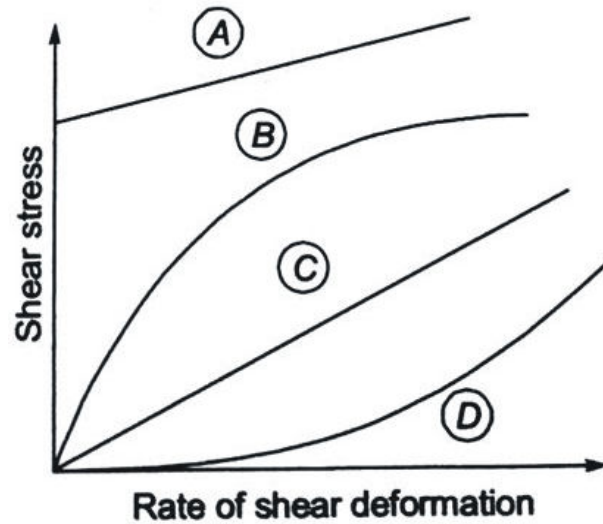
40. Most of the Indo-Gangetic and Brahmaputra flood plains, which are located north of the Vindhya-Satpura range, are :
- (A) The colluvial soils                      (B) The aeolian soils  
(C) The alluvial soils                      (D) The talus soils
41. Marble is an example of :
- (A) Metamorphic Rock                      (B) Sedimentary Rock  
(C) Igneous Rock                      (D) Argillaceous Rock
42. For non-homogeneous clays, the coefficient of permeability in (mm/s) should range in between :
- (A)  $10^{-1}$  to  $10^{-2}$                       (B)  $10^{-2}$  to  $10^{-3}$   
(C)  $10^{-3}$  to  $10^{-4}$                       (D)  $10^{-4}$  to  $10^{-6}$
43. The maximum test load on a working pile should not exceed :
- (A) 250 kN  
(B) 180 kN  
(C) two and a half times the design load  
(D) one and a half times the design load
44. In an SPT test gave the average blow count for N value of 35 in fine sand below water table, then what is the correct value of N due to dilatancy ?
- (A) 20                      (B) 25  
(C) 22                      (D) 24

45. A 300 mm  $\times$  300 mm square bearing plate settles by 15 mm in a plate load test on a cohesive soil when the intensity of loading is 0.25 N/mm<sup>2</sup>. The settlement of a prototype shallow footing 5 m  $\times$  5 m square under the same intensity of loading is :
- (A) 15 mm (B) 50 mm  
(C) 250 mm (D) 25 mm
46. Critical stress ratio from a cyclic tri-axial test is given by the one of the following ?  
Where  $\sigma_d$  = Deviatoric stress and  $\sigma_c$  = Confining pressure
- (A)  $\sigma_d/(2\sigma_c)$  (B)  $\sigma_d/(3\sigma_c)$   
(C)  $\sigma_c/(2\sigma_d)$  (D)  $\sigma_c/(3\sigma_d)$
47. Which of the following is *not* a method to identify expansive soils ?
- (A) Free-swell test  
(B) Differential free-swell test  
(C) Atterberg's limit tests  
(D) Resonant column test
48. In under-reamed pile construction, the ratio of bulb diameter to shaft diameter is :
- (A) 1.5 (B) 2.5  
(C) 3.5 (D) 5
49. Vibroflotation is most suitable for :
- (A) very loose sands submerged under water.  
(B) dense sands not submerged under water  
(C) silt and clay submerged under water  
(D) All of the above

50. The void ratio and specific gravity of a soil are 0.65 and 2.72 respectively. The degree of saturation (in percent) corresponding to water content of 20% is :
- (A) 53.5% (B) 63.5%  
(C) 73.7% (D) 83.7%
51. A soil has a liquid limit of 45% and lies above the A-line when plotted on a plasticity chart. What will be the group symbol of the soil as per IS soil classification ?
- (A) CI (B) CL  
(C) CH (D) CL-ML
52. Given that coefficient of curvature = 1.4,  $D_{30} = 3$  mm,  $D_{10} = 0.6$  mm. Based on this information of particle size distribution for use as subgrade, what will be the gradation of this soil ?
- (A) Well graded (B) Gap graded  
(C) Poorly graded (D) Uniformly graded
53. A soil sample has a void ratio of 0.5. What shall be its porosity ?
- (A) 23% (B) 33%  
(C) 43% (D) 63%
54. Given that  $c = 2$  t/m<sup>2</sup>,  $\phi = 0^\circ$  and  $\gamma = 2$  t/m<sup>3</sup>, what is the depth of tension crack developing in a cohesive soil backfill ?
- (A) 2 m (B) 3 m  
(C) 4 m (D) 5 m

55. If an infinite slope of clay at a depth 2 m has cohesion of  $1 \text{ t/m}^2$  and unit weight of  $2 \text{ t/m}^3$ , then the stability number will be :
- (A) 0.15 (B) 0.25  
(C) 0.36 (D) 0.42
56. Quick sand condition can occur when :
- (A) The soil's void ratio becomes 1  
(B) The soil's upward seepage pressure becomes 0  
(C) The soil's upward seepage pressure becomes the same as its saturated unit weight  
(D) The soil's upward seepage pressure becomes the same as its submerged unit weight
57. When a brick's corner is cut off along the line connecting the midpoints of two adjacent sides, the segment that's left is called :
- (A) Closer (B) Squint brick  
(C) Queen closer (D) King closer
58. According to IS Code, the maximum slenderness ratio for load-bearing masonry walls constructed with cement mortar shall not exceed :
- (A) 13 (B) 20  
(C) 27 (D) 30
59. Wood is impregnated with creosote oil in order to :
- (A) Change its colour (B) Protect against fungi  
(C) Protect the annular rings (D) Fill up the pores

60. Match List—I (Curve identification in figure) with List—II (Nature of fluid) and select the correct answer using the codes given below the lists :



**List—I**

- a. Curve A
- b. Curve B
- c. Curve C
- d. Curve D

**List—II**

- 1. Newtonian
- 2. Dilatant
- 3. Ideal Bingham plastic
- 4. Pseudo-plastic

**Codes :**

	a	b	c	d
(A)	3	4	1	2
(B)	2	4	1	3
(C)	3	1	4	2
(D)	2	1	4	3

61. The surface tension in a soap bubble of 20 mm diameter, when the inside pressure is  $2.0 \text{ N/m}^2$  above the atmospheric pressure, is :
- (A)  $0.025 \text{ N/m}$
  - (B)  $0.0125 \text{ N/m}$
  - (C)  $5 \times 10^{-3} \text{ N/m}$
  - (D)  $4.25 \times 10^{-3} \text{ N/m}$
62. As the depth of immersion of a vertical plane surface increases, the location of centre of pressure :
- (A) Falls closer to the centre of gravity of the area
  - (B) Moves away from the centre of gravity of the area
  - (C) Ultimately coincides with the centre of gravity of the area
  - (D) Falls much below the centre of gravity of the area
63. While conducting the flow measurement using a triangular notch, an error of 2% in head over the notch is observed. The percentage error in the computed discharge would be :
- (A) + 7%
  - (B) - 3%
  - (C) + 5%
  - (D) - 4%
64. A circular pipe of radius  $R$  carries a laminar flow of a fluid. The average velocity is indicated as the local velocity at what radial distance, measured from centre to centre ?
- (A)  $0.50R$
  - (B)  $0.71R$
  - (C)  $0.67R$
  - (D)  $0.29R$



65. Which one of the following phenomena in a pipe flow is termed as water hammer ?
- (A) The sudden rise of pressure in a long pipe due to sudden closure of valve.
  - (B) The rise of pressure in a pipe flow due to gradual closure of valve.
  - (C) The rise of negative pressure.
  - (D) The zero pressure in a pipe flow.
66. The depth of flow of a channel section at which the specific energy is minimum, is called :
- (A) Critical velocity
  - (B) Hydraulic depth
  - (C) Critical depth
  - (D) Subcritical depth
67. Which one of the following statements is *correct* with respect to Kaplan turbine ?
- (A) The peripheral velocity at inlet is more than peripheral velocity at outlet.
  - (B) Velocity of flow at inlet is more than velocity of flow at outlet.
  - (C) The peripheral velocity at inlet and outlet are equal.
  - (D) Velocity of flow at outlet is more than velocity of flow at inlet.
68. A single acting reciprocating pump has a plunger of diameter 250 mm and stroke of 350 mm. If the speed of the pump is 60 rpm and it delivers 16.5 lit/sec of water against a suction head of 5 m and a delivery head of 20 m, what is the co-efficient of discharge ?
- (A) 0.72
  - (B) 0.79
  - (C) 0.86
  - (D) 0.96

69. The stream function is given by the expression  $\psi = 2x^2 - y^2$ . What is the resultant velocity at a point denoted by  $x = 2$  and  $y = 3$  ?
- (A) 10 (B) 12  
(C) 15 (D) 18
70. A rectangular open channel of width 5.0 m is carrying a discharge of  $100 \text{ m}^3/\text{s}$ . The Froude number of the flow is 0.8. The depth of flow (in m) in the channel is :
- (A) 2 (B) 4  
(C) 6 (D) 10
71. For subcritical flow in an open channel, the control section for gradually varied flow profile is :
- (A) At the downstream end  
(B) At the upstream end  
(C) At both ends  
(D) At any intermediate section
72. If duty (D) is 1428 hectares/cumec and base period (B) is 120 days for an irrigated crop, then delta (A) in meters is given by :
- (A) 102.8 (B) 1.38  
(C) 0.73 (D) 0.01

73. A tube well having a capacity of  $4 \text{ m}^3/\text{hour}$  operates for 20 hours each day during the irrigation season. How much area (in Ha) can be commanded if the irrigation interval is 20 days and depth of irrigation is 7 cm ?
- (A) 1.71
- (B) 1.41
- (C) 22.9
- (D) 2.29
74. A hyetograph is a graph representing :
- (A) rainfall volume with time
- (B) rainfall intensity with time.
- (C) rainfall volume with duration
- (D) rainfall intensity over an area
75. The direct runoff hydrograph of a storm obtained from a catchment is triangular in shape and has a base period of 80 hours. The peak flow rate is  $30 \text{ m}^3/\text{s}$  and catchment area is  $86.4 \text{ km}^2$ . The rainfall excess that has resulted the above hydrograph is :
- (A) 5
- (B) 8
- (C) 10
- (D) 16

76. Consider the following valves in a water distribution system :

1. Check valve
2. Pressure-reducing valve
3. Air relief valve
4. Scour valve
5. Sluice valve

Which of these work automatically ?

- (A) 1, 3 and 4  
(B) 3, 4 and 5  
(C) 2, 4 and 5  
(D) 1, 2 and 3

77. **Statement (I)** : The flow in water distribution pipes takes place due to gravity.

**Statement (II)** : The flow in sewers takes place due to gravity.

Using the code given below select the correct answer :

- (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

78. The discharge per unit drawdown at the well is known as :

- (A) Specific yield (B) Specific storage  
(C) Specific retention (D) Specific capacity

79. Match List—I (Parameters) with List—II (Permissible concentration in drinking water) and select the correct answer using the codes given below the lists :

**List—I**

- a. Hardness  
b. Nitrate concentration  
c. Iron concentration  
d. Fluoride concentration

**List—II**

1. 0.1 mg/l.  
2. 1 mg/l.  
3. 200 mg/L  
4. 45 mg/l

**Codes :**

- |     | a | b | c | d |
|-----|---|---|---|---|
| (A) | 3 | 4 | 2 | 1 |
| (B) | 3 | 4 | 1 | 2 |
| (C) | 4 | 3 | 2 | 1 |
| (D) | 4 | 3 | 1 | 2 |

80. If the slope of sewer A is 1/100 and that of sewer B is 1/400, the velocity of flow in the two sewers A and B will have a ratio of (size of both the sewers being same) :

- (A)  $1/2$  (B) 1  
(C)  $(2)^{2/3}$  (D) 2

- 81.** Match List—I (Impurities to be removed from sewage) with List—II (Treatment unit used) and select the correct answer using the codes given below the lists :

**List—I**

- a. Large floating matter
- b. Suspended inorganic matter
- c. Suspended organic matter
- d. Dissolved organic matter

**List—II**

- 1. Trickling filter
- 2. Primary clarifier
- 3. Grit chamber
- 4. Screens

**Codes :**

- |     | a | b | c | d |
|-----|---|---|---|---|
| (A) | 3 | 4 | 2 | 1 |
| (B) | 3 | 4 | 1 | 2 |
| (C) | 4 | 3 | 2 | 1 |
| (D) | 4 | 3 | 1 | 2 |

- 82.** A town is required to treat  $4.2 \text{ m}^3/\text{min}$  of raw water for daily domestic supply. Flocculating particles are to be produced by chemical coagulation. A column analysis indicated that an overflow rate of  $0.2 \text{ mm/s}$  will produce satisfactory particle removal in a settling basin at a depth of  $3.5 \text{ m}$ . The required surface area (in  $\text{m}^2$ ) for settling is :

- |          |           |
|----------|-----------|
| (A) 210  | (B) 350   |
| (C) 1728 | (D) 21000 |

- 83.** At the same mean velocity, the ratio of head loss per unit length for a sewer pipe that is running at full capacity to the same sewer pipe that is running at half capacity would be :

- |         |       |
|---------|-------|
| (A) 0.5 | (B) 1 |
| (C) 1.5 | (D) 2 |

84. A waste water sample diluted to 100 times with aeration water had an initial dissolved oxygen (DO) of 7.0 mg/L and after 5 days of incubation at 20°C, the DO was zero. The BOD of waste water is :
- (A) 700 mg/L (B) 100 mg/L  
(C) Cannot be determined (D) 7 mg/L
85. Sewage treatment in an oxidation pond is accomplished primarily by :
- (A) algal-bacterial symbiosis  
(B) algal photosynthesis only  
(C) bacterial oxidation only  
(D) chemical oxidation only
86. Chlorine is sometimes used in sewage treatment :
- (A) to avoid flocculation  
(B) to increase biological activity of bacteria  
(C) to avoid bulking of activated sludge  
(D) to help in grease separation
87. The two air pollution control devices that are usually used to remove very fine particles from the flue gas are :
- (A) Cyclone and Venturi Scrubber  
(B) Cyclone and Packed Scrubber  
(C) Electrostatic Precipitator and Fabric Filter  
(D) Settling Chamber and Tray Scrubber

- 88.** During temperature inversion in atmosphere, air pollutants tend to :
- (A) accumulate above inversion layer
  - (B) accumulate below inversion layer
  - (C) disperse laterally
  - (D) disperse vertically
- 89.** For traffic surveys using origin and destination studies, the most suitable method in case of heavy traffic and absence of skilled or trained personnel is :
- (A) Road side interview method
  - (B) License plate method
  - (C) Work spot or home interview method
  - (D) Return post card method
- 90.** A vehicle has wheel base of 6.5 m. What is the off tracking while negotiating a curved path with a mean radius 32 m ? (take  $n = 1$ )
- (A) 0.66 m
  - (B) 1.32 m
  - (C) 0.33 m
  - (D) 1.2 m
- 91.** According to Highway Research Board (HRB) classification system, which one of the following is *not* relevant for dependency of group index of soil ?
- (A) The amount of material passing the 75-micron IS sieve
  - (B) The liquid limit
  - (C) The plastic limit
  - (D) The shrinkage limit



92. The plate load test conducted with a 75 cm diameter plate on soil subgrade yielded a deflection of 2.5 mm under a stress of 800 N/cm<sup>2</sup>. The modulus of elasticity of the subgrade soil, in kN/cm<sup>2</sup>, is :
- (A) 141.6 (B) 154.6  
(C) 160 (D) 185.4
93. On the Broad Gauge stretch of the railway, the gradient is 1 in 150 and there is a 4° curve. What is the allowed ruling gradient ?
- (A) 1 in 137 (B) 1 in 167  
(C) 1 in 197 (D) 1 in 237
94. A light house of 120 m height is just visible above the horizon from a ship. The correct distance (m) between the ship and the light house considering combined correction for curvature and refraction, is :
- (A) 39.098 (B) 39098  
(C) 42.226 (D) 42226
95. Analytic lens provided in a tacheometer is a :
- (A) concave lens (B) convex lens  
(C) plano-convex lens (D) plane lens
96. The magnetic bearing of a line AB is S 45°E and the declination is 5° West. The true bearing of the line AB is.....
- (A) S45°E (B) S50°E  
(C) S45°W (D) N45°E

97. The latitude and departure of a line AB are + 78 m and – 45.1 m respectively.

The whole circle bearing of the line AB is :

- (A)  $30^\circ$  (B)  $150^\circ$   
(C)  $210^\circ$  (D)  $330^\circ$

98. If the focal length of lens ( $f$ ), flying height ( $H$ ) and height of ground above mean sea level ( $h$ ) are known, then the scale at height ' $h$ ' ( $S_h$ ) is equal to :

- (A)  $f/(H - h)$  (B)  $(H - h)/f$   
(C)  $(h - H)/2f$  (D)  $2f/(H - h)$

99. A bar chart is commonly used because :

- (A) It is simple to draw and easy to understand.  
(B) It indicates at a glance the overall progress of the project.  
(C) It shows critical and non-critical activities.  
(D) It incorporates uncertainties for delay in estimation of time required for completion of activities.

100. The father of a teen kid observes that his son frequently uses the phone. He never answers the phone for less than five minutes and often takes an hour. The 20-minute call is the most common call duration. The time (in minutes) it takes to complete a phone call while using the PERT is estimated as :

- (A) 20.16 (B) 22.16  
(C) 24.16 (D) 26.16

### GENERAL APTITUDE

101. Find the missing number from the given alternatives :

6	8	2	20
7	2	4	30
8	7	6	?
5	5	9	50

- (A) 55 (B) 50  
(C) 45 (D) 40

102. **Direction :** Read the following information carefully and answer the question given below :

8 persons from A to H sit around a square table such that 2 persons sit in the middle of each of the sides. The persons sitting on one side of the table face the persons sitting exactly opposite to them on the opposite side of table.

A sits on the immediate right of E. G faces the one who is second to the left of B. 3 persons sit between A and G. Two persons sit between F and D (when counted from one side only), who is adjacent to E. Only one person sits between G and C (when counted from one side only). A is not adjacent to F.

Which of the following pairs represents the immediate neighbors of G ?

- (A) D-E (B) H-D  
(C) H-F (D) D-F

103. Select the related numbers from the given alternatives :

85 : 55 :: 95 : ?

- (A) 60 (B) 65  
(C) 70 (D) 75

**104. Direction :** The following three statements are followed by three conclusions numbered I, II and III. Read the conclusions and then decide which of the given conclusions logically follows from the given statements, disregarding commonly known facts :

**Statements :**

Some applicants are examiners.

All invigilators are examiners.

Some students are applicants.

**Conclusions :**

I. At least some invigilators being applicants is a possibility.

II. All students being examiners is a possibility.

III. Some applicants are not students.

- (A) Only I and II follow                      (B) Only III follows  
(C) Only II and III follow                      (D) Only I and III follow

**105. Direction :** Read the given instructions carefully and answer the question given below :

$P + Q$  states that P is 2 m East Of Q

$P \wedge Q$  states that P is 2 m South Of Q

$P \& Q$  states that P is 4 m East Of Q

$P - Q$  states that P is 2 m West Of Q

$P / Q$  states that P is 2 m North Of Q

Read the following information carefully and answer the question below :

$U \& V \wedge W - X / Y \& Z$

What is the area of the square formed by the points V, Y, X and W ?

- (A) 8 m                                              (B) 5 m  
(C) 4 m                                              (D) 5 m

**106. Direction :** Read the following information carefully and answer the question given below :

In a certain code language,

‘lavish lifestyle high desires’ is coded as “@16f \$36i @9d \$16g”

‘humanity seldom exhibit mercy’ is coded as “@25h #16f @16g \$16e”

‘opinion matters heart felt’ is coded as “#9g \$25g %9e \$9d”

‘push yourself achieve goals’ is coded as “&9d \$25h \$9g %9e”

**Code** – ‘\$25h’ stands for which of the following words ?

- |                  |                    |
|------------------|--------------------|
| (A) irreversible | (B) reconciliation |
| (C) eminently    | (D) prudence       |

**107. Direction :** Study the following information carefully and answer the question given below :

The Hansraj family consists of eight members P, Q, R, S, T, U, V and W. Among these eight members, there are three generations in which there are four male and four female members. Among all, each off-spring has both the parents alive. The husband of R’s sister has two daughters. The husband of T’s daughter is married to V. V has only one sibling. U’s father-in-law has two granddaughters. W’s brother has only one nephew and W is not V’s mother. R is unmarried and Q has only one niece.

Who among the following is the Uncle of U’s spouse ?

- |       |       |
|-------|-------|
| (A) W | (B) T |
| (C) R | (D) Q |

108. Noise is related to Din in the same way as Quiet is related to.....

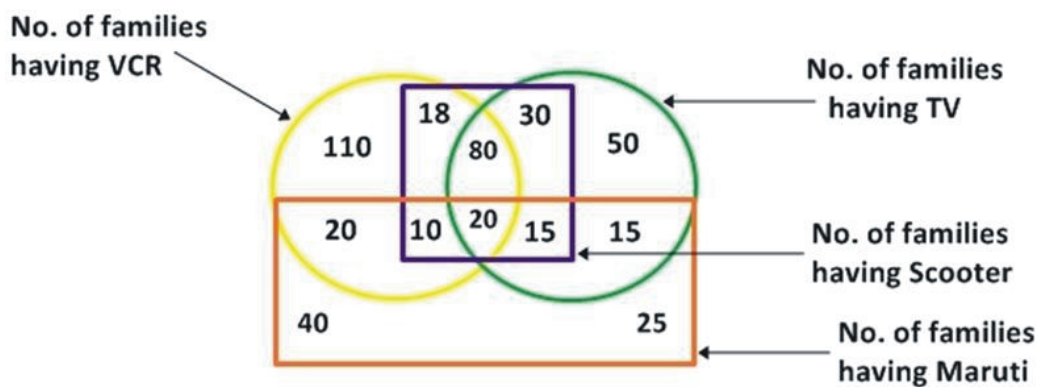
- (A) Hush (B) Dumb  
(C) Gag (D) Mouth

109. **Direction** : Arrange the following words in a meaningful order.

1. Frog
2. Eagle
3. Grasshopper
4. Snake
5. Grass

- (A) 5, 3, 4, 2, 1 (B) 1, 3, 5, 2, 4  
(C) 3, 4, 2, 5, 1 (D) 5, 3, 1, 4, 2

110. Study the diagram given below and answer the question :



Find out the number of families which have TV and scooter both but have neither VCR nor Maruti.

- (A) 50 (B) 45  
(C) 30 (D) 15

## GENERAL ENGLISH

**111.** Fill in the blank with correct phrasal verb :

The robber was so strong that there was no way we could have.....

- (A) fought over                      (B) fought back  
(C) fought in back                (D) fought against

**112.** The four sentences (labelled 1, 2, 3 and 4) given in this question, when properly sequenced, form a coherent paragraph. Decide on the proper order for the sentences and key in this sequence of four numbers as your answer :

1. Self-management is thus defined as the ‘individual’s ability to manage the symptoms, treatment, physical and psychosocial consequences and lifestyle changes inherent in living with a chronic condition’.
2. Most people with progressive diseases like dementia prefer to have control over their own lives and health-care for as long as possible.
3. Having control means, among other things, that patients themselves perform self-management activities.
4. Supporting people in decisions and actions that promote self-management is called self-management support requiring a cooperative relationship between the patient, the family and the professionals.

- (A) 1 2 3 4                      (B) 2 3 1 4  
(C) 3 2 4 1                      (D) 4 2 3 1

**113.** Fill in the blank :

He is anxious.....hear from his daughter.

- (A) about (B) to
- (C) of (D) on

**114. Direction :** The given sentence has been broken up into four different parts. The error, if any, will be in any one part of the sentence. Select the option which contains the part of the sentence which has an error (spelling, grammatical or contextual) :

It will be more better (A)/if one of the parents (B)/stays at home (C)/to look after the children. (D)

- (A) It will be more better
- (B) if one of the parents
- (C) stays at home
- (D) to look after the children.

**115. Direction :** The following question has two blanks, each blank indicating that something has been omitted. Choose the set of words for each blank that best fits in the context of the sentence :

Occupational safety and health are important for improved..... and.....

- (A) men, women
- (B) boys, girls
- (C) assets, markets
- (D) productivity, growth



116. Find the correctly spelt word :

- |                  |                  |
|------------------|------------------|
| (A) Sovereignty  | (B) Soveriegnty  |
| (C) Sovereignity | (D) Soveriegnity |

117. **Direction** : Identify the words that are contextually similar to the phrase given in bold and mark that as your answer. The options do not need to be correct grammatically :

Indian politicians love to stage dharnas or sit-ins at the **drop of a hat**, quite often taking their political melodrama to ridiculous levels.

- |                 |               |
|-----------------|---------------|
| (A) Immediately | (B) Instantly |
| (C) Diligently  | (D) Factual   |

118. Out of the four alternatives choose the one which can be substituted for the given words/sentence in the question :

**Having superior or intellectual interests and tastes**

- |                   |                |
|-------------------|----------------|
| (A) Elite         | (B) Highbrow   |
| (C) Sophisticated | (D) Fastidious |

119. Find the synonym of **Philanderer** :

- |                 |                 |
|-----------------|-----------------|
| (A) Time waster | (B) Spendthrift |
| (C) Make flirt  | (D) Wanderer    |

120. Find the antonym of **Dauntless** :

- |                |              |
|----------------|--------------|
| (A) Mutinous   | (B) Intrepid |
| (C) Intriguing | (D) Timid    |