GATE Civil Engineering 1999 Question Paper

1. This question consists of 35 (Thirty five) multiple choice type sub-questions, each carrying one mark. The answer to the multiple choice questions MUST be written only in the boxes corresponding to the question by writing A, B, C, or D in the answer book. (35 x 1 = 35)

1.1 Limit of the function lim n ® ¥ $\frac{n}{\sqrt{n^2+n}}$ is

(a) $\frac{1}{2}$

(b) 0

(c) ¥

(d) 1

1.2 The function f(x) = e x is

(a) Even (b) Odd

(c) Neither even nor odd (d) None of the above

1.3 If A is any n x n matrix and k is a scalar, | kA | = a | A |, where a is

(a) kn (b) n k

(c) k n (d) k/n

1.4 The infinite series $\sum_{n=1}^{\infty} \frac{(n!)^2}{(2n)!}$

(a) Converges (b) Diverges

(c) is unstable (d) Oscillates

1.5 Number of inflection points for the curve y = x + 2 x 4 is

(a) 3 (b) 1

(c) n (d) (n + 1) 2

1.6 Number of terms in the expansion of general determinant of order n is

(a) n 2 (b) n!

(c) n (d) (n + 1) 2

1.7 Two perpendicular axes x and y of a section are called principal axes when

(a) Moments of inertia about the axes are equal (I x =I y)

(b) Product moment of inertia (I xy) is zero

(c) Product moments of inertia (I x x I y) is zero

(d) Moment of inertia about one of the axes is greater than the other

1.8 In a section, shear centre is a point through which, if the resultant load passes, the section will not be subjected to any

(a) Bending (b) Tension

(c) Compression (d) Torsion

1.9 For a fixed beam with span L, having plastic moment capacity of M p, the ultimate

central concentrated load will be

(a) $\frac{4M_p}{L}$

(b) $\frac{M_p}{8L}$

(c) $\frac{6M_p}{L}$

(d) $\frac{8M_p}{L}$

1.10 In reinforced concrete, pedestal is defined as compression member, whose effective length does not exceed its dimension by

(a) 12 times (b) 3 times

(c) 16 times (d) 8 times

1.11 The minimum area of tension reinforcement in a beam shall be greater than

(a) $\frac{0.85bd}{f_y}$

(b) $\frac{0.87f_y}{bd}$

(c) $0.04bd$

(d) $\frac{0.4bd}{y}$

1.12 The characteristic strength of concrete is defined as that compressive strength below which not more than

(a) 10% of results fall (b) 5% of results fall

(c) 2% of results fall (d) None of the above

1.13 Maximum strain at the level of compression steel for a rectangular section having effective cover to compression steel as d' and neutral axis depth from compression face as x u is

(a) $0.0035\left(1-\frac{d'}{x_u}\right)$

(b) $0.002\left(1-\frac{d'}{x_u}\right)$

(c) $0.0035\left(1-\frac{x_u}{d'}\right)$

(d) $0.002\left(1-\frac{x_u}{d'}\right)$

1.14 A steel beam supporting loads from the floor slab as well as from wall is termed as

(a) Stringer beam (b) Lintel beam

(c) Spandrel beam (d) Header beam

1.15 The problem of lateral buckling can arise only in those steel beams, which have

(a) moment of inertial about the bending axis larger than the other

(b) moment of inertial about the bending axis smaller than the other

(c) fully supported compression flange

(d) None of the above

1.16 The values of liquid limit and plasticity index for soils having common geological origin in a restricted locality usually define

(a) a zone above A - line

(b) a straight line parallel to A - line

(c) a straight line perpendicular to A - line

(d) points may be anywhere in the plasticity chart

1.17 The toughness index of clayey soils is given by

(a) Plasticity index/Flow index (b) Liquid limit/Plastic limit

(c) Liquidity index/Plastic limit (d) Plastic limit/Liquidity index.

1.18 Principle involved in the relationship between submerged unit weight and saturated weight of a soil is based on

- Equilibrium of floating bodies
- Archimedes' principle
- Stokes' law
- Darcy's law

1.19 For an anisotropic soil, permeabilities in x and y directions are k_x and k_y respectively in a two dimensional flow. The effective permeability k_{eff} for the soil is given by

(a) $k_x + k_y$

- $\frac{k_x}{k_y}$
- $(k_x^2 + k_y^2)^{1/2}$
- $(k_x k_y)^{1/2}$

1.20 Cohesion in soil

(a) decreases active pressure and increases passive resistance

(b) decreases both active pressure and passive resistance

(c) increases the active pressure and decreases the passive resistance

(d) increases both active pressure and passive resistance

1.21 Consolidation in soils

(a) is a function of the effective stress

(b) does not depend on the present stress

(c) is a function of the pore water pressure

(d) is a function of the total stress

1.22 The sequent depth ratio of a hydraulic jump in a rectangular horizontal channel is 10.30. The Froude Number at the beginning of the jump is

(a) 5.64 (b) 7.63

(c) 8.05 (d) 13.61

1.23 In an iceberg, 15% of the volume projects above the sea surface. If the specific weight of sea water is 10.5 kN/m 3, the specific weight of iceberg in kN/m 3 is

(a) 12.52 (b) 9.81

(c) 8.93 (d) 7.83

1.24 The ordinate of the Instantaneous Unit Hydrograph (IUH) of a catchment at any, time t, is

(a) the slope of the 1-hour unit hydrograph at that time

(b) the slope of the direct runoff unit hydrograph at that time

(c) difference in the slope of the S - curve and 1 - hour unit hydrograph

(d) the slope of the S-curve with effective rainfall intensity of 1cm/hr

1.25 An isochrone is a line on the basin map

(a) joining raingauge stations having equal rainfall duration

(b) joining points having equal rainfall depth in a given time interval

(c) joining points having equal time of travel of surface runoff to the catchment outlet.

(d) joining points which are at equal distance from the catchment outlet.

1.26 In a steady radial flow into an intake, the velocity is found to vary as (1/r 2), where r is the radial distance. The acceleration of the flow is proportional to

(a) $\frac{1}{r^5}$

(b) $\frac{1}{r^3}$

(c) $\frac{1}{r^4}$

(d) $\frac{1}{r}$

1.27 A soil formation through which only seepage is possible, being partly permeable and capable of giving insignificant yield, is classified as

(a) Aquifer (b) Aquitard

(c) Aquifuge (d) Aquiclude

1.28 Temporary hardness in water is caused by the presence of

(a) Bicarbonates of Ca and Mg (b) Sulphates of Ca and Mg

(c) Chlorides of Ca and Mg (d) Nitrates of Ca and Mg

1.29 Blue baby disease (methaemoglobinemia) in children is caused by the presence of excess

(a) Chlorides (b) Nitrates

(c) Fluoride (d) Lead

1.30 Standard 5-day BOD of a waster water sample is nearly x% of the ultimate BOD, where x is

- 48
- 58
- 68
- 78

1.31 The minimum dissolved oxygen content (ppm) in a river necessary for the survival of aquatic life is

(a) 0 (b) 2

(c) 4 (d) 8

1.32 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

1.33 The total length (in km) of the existing National Highways in India is in the range of

- 15,000 to 25,000
- 25,000 to 35,000
- 35,000 to 45,000
- 45,000 to 55,000

1.34 The relationship between the length (I) and radius (r) of an ideal transition curve is given by

- l a r

- I a r 2
- I a (1/r)
- I a (1/r 2)

1.35 Rapid curing cutback bitumen is produced by blending bitumen with

(a) Kerosene (b) Benzene

(c) Diesel (d) Petrol

2. This question consists of 20 (Twenty) multiple choice type sub-questions, each carrying TWO marks. The answers to the multiple choice questions MUST be, written only in the boxes corresponding to the question numbers writing A, B, C or D in the answer book. (20 x 2 = 40)

2.1 If c is a constant, solution of the equation $\frac{dy}{dx}$ = 1 +y 2 is

(a) y = sin (x + c) (b) y = cos (x + c)

(c) Y = tan (x + c) (d) Y = e x + c

2.2 The equation $\begin{vmatrix} 2 & 1 & 1 \\ 1 & 1 & -1 \\ y & x^2 & x \end{vmatrix} = 0,$ represents a parabola passing through the points

(a) (0, 1), (0, 2), (0, - 1) (b) (0, 0), (- 1, 1), (1, 2)

(c) (1, 1), (0, 0), (2, 2) (d) (1, 2), (2, 1), (0, 0)

2.3 The Laplace transform of the function f(t) = k, 0 < t < C

= 0, c < t < ¥ , is

(a) $\left(\frac{k}{s}\right)e^{-sc}$

(b) $\left(\frac{k}{s}\right)e^{sc}$

(c) ke^{-sc}

(d) $\left(\frac{k}{s}\right)(1-e^{-sc})$

2.4 Value of the function lim (x- a) (x-a) is

x ® a

- 1
- 0
- ¥
- a

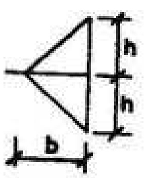

Fig. 1.

2.5 The shape factor of the section shown in Fig. 1 is

- 1.5
- 1.12
- 2
- 1.7

2.6 The slope of the elastic curve at the free end of a cantilever beam of span L, and with flexural rigidity EI, subjected to uniformly distributed load of intensity w is

(a) $\frac{wL^3}{6EI}$

(b) $\frac{wL^3}{3EI}$

(c) $\frac{wL^4}{8EI}$

(d) $\frac{wL^3}{2EI}$

2.7 If an element of a stressed body is in a state of pure shear with a magnitude of

80N/mn 2, the magnitude of maximum principal stress at that location is

(a) 80 N/mm 2 (b) 113.14 N/mm 2

(c) 120 N/mm 2 (d) 56.57 N/mm 2

2.8 Two steel plates each of width 150 mm and thickness 10 mm are connected with three 20 mm diameter rivets placed in a zig - zag pattern. The pitch of the rivets is 75 mm and gauge is 60 mm. If the allowable tensile stress is 150 MPs, the maximum tensile force that the joint can withstand is

(a) 195.66 kN (b) 195.00 kN

(c) 192.75 kN (d) 225.00 kN

2.9 The two tubes shown in Fig. 2 may be considered to be permeameters. Dimensions of the

sample in Fig. 2 (i) & (ii) are alike, and the elevations of head water and tail water are

the same for both the figures. A, B,……..etc. indicate points and AB, AE,….etc. indicated

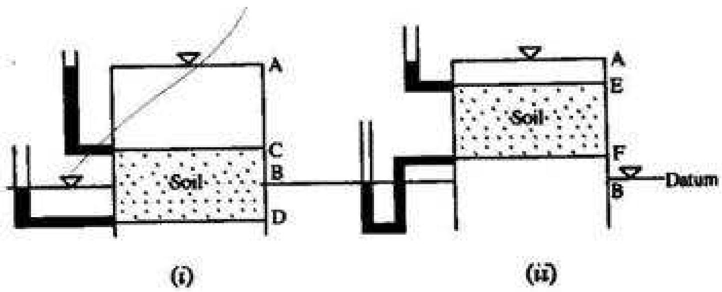

Fig. 2.

heads. Head loss through these samples are

- (i) BD, (ii) FE
- (i)AC, (ii)AE
- (i) AD, (ii) AF
- (i) AB, (ii) AB

2.10 A river 5 m deep consists of a sand bed with saturated unit weight of 20 kN/m 3

v w = 9.81 kN/m 3. The effective vertical stress at 5m from the top of sand bed is

(a) 41 kN/m 2 (b) 51 kN/m 2

(c) 55 kN/m 2 (d) 53 kN/m 2

2.11 A soil sample in its natural state has mass of 2.290 kg and a volume of 1.15 x10 -3 m 3. After being oven dried, the mass of the sample is 2.035 kg. G s for soil is 2.68. The void ratio of the natural soil is

(a) 0.40 (b) 0.45

(c) 0.55 (d) 0.53

2.12 Triaxial compression test of three soil specimens exhibited the patterns of failure as shown in Fig. 3. Failure modes of the samples respectively are

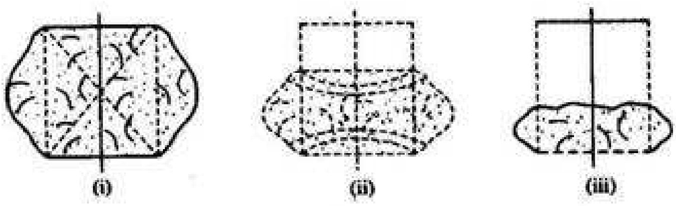

Fig. 3.

- (i) brittle, (ii) semi-plastic, (iii) plastic
- (i) semi-plastic, (ii) brittle, (iii) plastic
- (i) plastic, (ii) brittle, (iii) semi-plastic
- (i) brittle, (ii) plastic, (iii) semi-plastic

2.13 A direct runoff hydrograph due to an isolated storm with an effective rainfall of 2 cm was trapezoidal in shape as shown in Fig. 4. The hydrograph cores ponds to a catchment area (in sq. km.) of

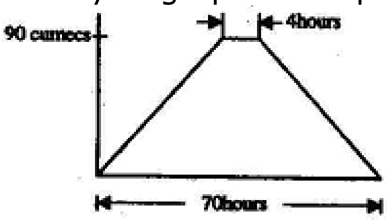

Fig. 4.

- 790.2
- 599.4
- 689.5
- 435.3

2.14 The number of revolutions of a current meter in 50 seconds were found to be 12 and 30 corresponding to the velocities of 0.25 and 0.46 m/s respectively. What velocity (in m/s) would be indicated by 50 revolutions of that current meter in one minute?

- 0.42
- 0.50
- 0.60
- 0.73

2.15 In a river, discharge is 173 mp 3/s; water surface slope is 1 in 6000; and stage at the gauge

station is 10.0 m. If during a flood, the stage at the gauge station is same and the water

surface slope is 1 in 2000, the flood discharge in m 3/s, is approximately

- 371
- 100
- 519
- 300

2.16 A hydraulic turbine has a discharge of 5 m 3/s, when operating under a head of 20 m with a speed of 500 rpm. If it is to operate under a head of 15 m, for the same discharge, the rotational speed in rpm will approximately be

(a) 433 (b) 403

(c) 627 (d) 388

2.17 Two samples of water A and B have pH values of 4.4 and 6.4 respectively. How many times more acidic sample A is than sample B?

(a) 0 (b) 50

(c) 100 (d) 200

2.18 In a BOD test, 5 ml of waste is added to 295 ml of aerated pure water. Initial dissolved oxygen (D.O.) content of the diluted sample is 7.8 mg/l. After 5 days of incubation at 20°C, the D.O. content of the sample is reduced to 4.4 mg/l. The BOD of the waste water is

- 196 mg/l
- 200 mg/l
- 204 mg/l
- 268 mg/l

2.19 A parabolic curve is used to connect a 4% upgrade with a 2% downgrade as shown in Fig.5. The highest point on the summit is at a distance of (measured horizontally from the first tangent point-FTP).

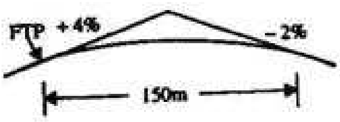

Fig. 5.

- 50 m
- 60 m
- 75 m
- 100 m

2.20 A two lane single carriageway is to be designed for a design life period of 15 years. Total two - way traffic intensity in the year of completion of construction is expected to be 2000 commercial vehicles per day. Vehicle damage factor = 3.0, Lane distribution factor = 0.75. Assuming an annual rate of traffic growth as 7.5%, the design traffic expressed as cumulative number of standard axles, is

(a) 42.9 x 16 6 (b) 22.6 x 16 6

(c) 10.1 X 16 6 (d) 5.3 X 16 6