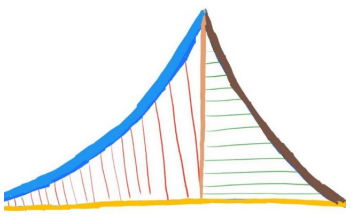
GATE

Previous Year Questions

G. V. V. Sharma



Contents

Introduction

This book contains a typed GATE question set.

Chapter 1

2007

Chapter 2

2008

CE

2.1 The product of matrices $(\mathrm{PQ})^{-1}\mathrm{P}$ is

(a) P^{-1}

(b) Q^{-1}

(c) $\mathrm{P}^{-1}\mathrm{Q}^{-1}\mathrm{P}$

(d) PQP^{-1}

2.2 The general solution of $\frac{d^2y}{dx^2} + y = 0$ is

(a) $y = P\cos x + Q\sin x$

(b) $y = P\cos x$

(c) $y = P\sin x$

(d) $y = P\sin^2 x$

2.3 A mild steel specimen is under uni-axial tensile stress. Young's modulus and yield stress for mild steel are 2×10^5 MPa and 250 MPa respectively. The maximum amount of strain energy per unit volume that can be stored in this specimen without permanent set is

(a) 156 Nmm/mm^3

(b) 15.6 Nmm/mm^3

(c) 1.56 Nmm/mm^3

(d) 0.156 Nmm/mm^3

2.4 A reinforced concrete structure has to be constructed along a sea coast. The minimum grade of the concrete to be used as per IS: 456-2000 is

(a) M 15

(b) M 20

(c) M 25

(d) M 30

2.5 In the design of a reinforced concrete beam the requirement for bond is not getting satisfied. The economical option to satisfy the requirement for bond is by

(a) bundling of bars

(b) providing smaller diameter bars more in number

(c) providing larger diameter bars more in number

(d) providing same diameter bars more in number

2.6 The shape of the cross-section, which has the largest shape factor, is

(a) rectangular

(b) I- section

(c) diamond

(d) solid circular

2.7 Group symbols assigned to silty sand and clayey sand are respectively

(a) SS and CS

(b) SM and CS

(c) SM and SC

(d) MS and CS

2.8 When a retaining wall moves away from the backfill, the pressure exerted on the wall is termed as

(a) passive earth pressure

(b) swelling pressure

(c) pore pressure

(d) active earth pressure

2.9 Compaction by vibratory roller is the best method of compaction in case of

(a) moist silty sand

(b) well graded dry sand

(c) clay of medium compressibility

(d) silt of high compressibility

2.10 A person standing on the bank of a canal drops a stone on the water surface. He notices that the disturbance on the water surface is not traveling upstream. This is because the flow in the canal is

(a) sub-critical

(b) super-critical

(c) steady

(d) uniform

2.11 A flood wave with a known inflow hydrograph is routed through a large reservior. The outflow hydrograph will have

(a) attenuated peak with reduced time-base

(b) attenuated peak with increased time-base

(c) increased peak with increased time-base

(d) increased peak with reduced time-base

2.12 A stable channel is to be designed for a discharge of Q m^3/s with slit factor f as per Lacey's method. The mean flow velocity (m/s) in the channel is obtained by

(a) $\left(Qf^2/140\right)^{1/6}$

(b) $(Qf/140)^{1/3}$

(c) $\left(Q^2f^2/140\right)^{1/6}$

(d) $0.48\,(Q/f)^{1/3}$

2.13 The base width of an elementary profile of a gravity dam of height H is b. The specific gravity of the material of the dam is G and uplift pressure coefficient is K. The correct relationship for no tension at the heel is given by

(a) $\frac{b}{H} = \frac{1}{\sqrt{G\text{-}K}}$

(b) $\frac{b}{H} = \sqrt{G\text{-}K}$

(c) $\frac{b}{H} = \frac{1}{G\text{-}K}$

(d) $\frac{b}{H} = \frac{1}{K\sqrt{G\text{-}K}}$

2.14 Two primary air pollutants are

(a) sulphur oxide and ozone

(b) nitrogen oxide and peroxyacetylnitrate

(c) sulphur oxide and hydrocarbon

(d) ozone and peroxyacetylnitrate

2.15 Two biodegradable components of municipal solid waste are

(a) plastics and wood

(b) cardboard and glass

(c) leather and tin cans

(d) food wastes and garden trimmings

2.16 The specific gravity of paving bitumen as per IS: 73-1992 lies between

(a) 1.10 and 1.06

(b) 1.06 and 1.02

(c) 1.02 and 0.97

(d) 0.97 and 0.92

2.17 A combined value of flakiness and elongation index is to be determined for a sample of aggregates. The sequence in which the two tests are conducted is

(a) elongation index test followed by flakiness index test on the whole sample

(b) flakiness index test followed by elongation index test on the whole sample

(c) flakiness index test followed by elongation index test on non-flaky aggregates

(d) elongation index test followed by flakiness index test on non-elongated aggregates

Chapter 3

2009

Chapter 4

2010

XE

Common Data for Questions 19 and 20:

The velocity field of a two-dimensional fluid flow is as follows:

$$u = U_0 \frac{x}{L}, v = -U_0 \frac{y}{L}$$

Where, U_0 and L are, respectively, the characteristic velocity and length.

4.1 If $L = 0.2$m and the resultant of total accelerations in x- and y- directions at $(x = L, y = L)$ is 10m/s^2, the magnitude of U_0 (m/s) is

(a) 1.414

(b) 2.38

(c) 1.19

(d) 11.90

4.2 The above fluid flow can be described as

(a) rotational and compressible

(b) irrotational and compressible

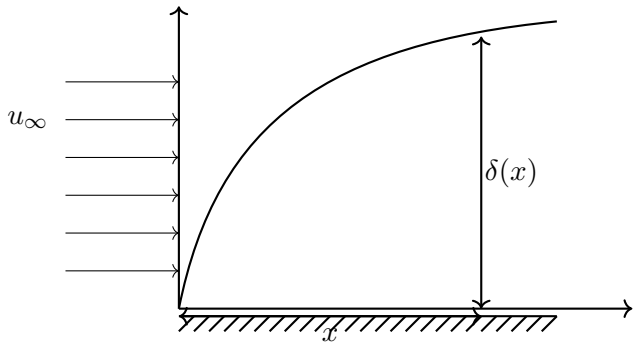
(c) rotational and incompressible

(d) irrotational and incompressible

Linked Answer Questions

Statement for Linked Answer Question 21 and 22

The boundary layer formation over a flat plate is shown in the figure below. The variation of horizontal velocity (u) with y at any x along the plate in the boundary layer is approximated as: $u = Psin\,(Qy) + R$



4.3 The most acceptable boundary conditions are

(a) at $y = 0$, $u = 0$; at $y = \delta, u = U_\infty$; at $y = 0$, $\frac{du}{dy} = 0$

(b) at $y = 0$, $u = U_\infty$; at $y = \delta, u = U_\infty$; at $y = 0$, $\frac{du}{dy} = 0$

(c) at $y = 0$, $u = 0$; at $y = \delta, u = U_\infty$; at $y = \delta$, $\frac{du}{dy} = 0$

(d) at $y = 0$, $u = U_\infty$; at $y = \delta, u = U_\infty$; at $y = \delta$, $\frac{du}{dy} = 0$

4.4 Expressions for P, Q and R are

(a) $P = 0; Q = 0; R = 0$

(b) $P = U_\infty; Q = 0; R = 0$

(c) $P = 0; Q = \frac{\pi}{2\delta}; R = U_\infty$

(d) $P = U_\infty; Q = \frac{\pi}{2\delta}; R = 0$

Useful Data

Avogadro's number	: 6.023×10^{23} mol^{-1}
Boltzmann's constant (k_B)	: 1.38×10^{-23} J K^{-1}
Electron charge (e)	: 1.602×10^{-19} C
Gas Constant	: 8.314 J mol^{-1} K^{-1}
Electron rest mass	: 9.1×10^{-31} kg
Permittivity of vacuum (ε_0)	: 8.854×10^{-12} F m^{-1}
Planck's constant (h)	: 6.626×10^{-34} J s
Bohr magneton (μ_B)	: 9.27×10^{-24} A m^2
Free space permeability (μ_0)	: $4\pi \times 10^{-7}$ H m^{-1}

1J = 6.242×10^{18} eV

1$texteV$ = 1.602×10^{-19} J

1cal = 4.2 J

4.5 The number of lattice points in an ideal Perovskite unit cell is

(a) 1

(b) 2

(c) 4

(d) 5

4.6 A Frenkel defect is

(a) a pair of cation and anion vacancy

(b) a pair of cation interstitial and cation vacancy

(c) a cation vacancy

(d) an anion vacancy

4.7 The angle between the line vector of a screw dislocation and the Burgers vector is

(a) 0 degrees

(b) 45 degrees

(c) 60 degrees

(d) 90 degrees

4.8 The addition of a network modifier to silica

(a) produces vacancies

(b) enchances the network structure

(c) disrupts the network structure

(d) increases the viscosity

4.9 The best semiconductor material for LED in the visible range is

(a) Si

(b) Ge

(c) GaAs

(d) $GaAs_{0.6}P_{0.4}$

4.10 A plain carbon steel sample is water-quenched from 900°C to room temperature. Its microstructure will consist of

(a) pearlite

(b) bainite

(c) martensite

(d) ferrite and pearlite

4.11 Graphite at zero Kelvin is a

(a) good conductor

(b) insulator

(c) semiconductor

(d) semi-metal

4.12 A high molecular weight polyethylene has an average molecular weight of 560,000g/mol. Its average degree of polymerization is

(a) 15,000

(b) 18,660

(c) 19,310

(d) 20,000

4.13 In which region of the spectra crystal lattice absorption is very significant

(a) ultraviolet

(b) visible

(c) microwave

(d) infrared

Chapter 5

2011

Chapter 6

2012

Chapter 7

2013

Chapter 8

2014

Chapter 9

2015

AE

9.1 An aircraft in level and unaccelerated flight with a velocity of $v_\infty = 300$ m/s requires a power of $9 \times 10^6 W$. If the aircraft weighs $1.5 \times 10^5 N$, the lift-to-drag ratio $\frac{L}{D}$ is _____.

9.2 The percentage change in the lift-off distance for a 20 % increase in aircraft weight is _____.

9.3 Consider a monoplane wing and a biplane wing with identical airfoil sections, wingspans and incidence angles in identical conditions in a wind tunnel. As compared to the monoplane, the biplane experiences

(a) a higher lift and a higher drag

(b) a higher lift and a lower drag

(c) a lower lift and a lower drag

(d) a lower lift and a higher drag

9.4 A statically stable trimmed aircraft experiences a gust and the angle of attack reduces momentarily. As a result, the center of pressure of the aircraft

(a) shifts forward

(b) shifts rearward

(c) does not shift

(d) coincides with the neutral point

9.5 Consider a wing of elliptic planform, with its aspect ratio $AR \to \infty$. Its lift-curve slope, $\frac{dC_L}{d\alpha} =$ _____.

9.6 An ideal gas in a reservoir has a specific stagnation enthalpy of h_0. The gas is isentropically expanded to a new specific stagnation enthalpy of $\frac{h_0}{2}$ and velocity u. The flow is one-dimensional and steady. Then $\frac{u^2}{h_0} =$ _____.

9.7 The Reynolds number, Re is defined as $\frac{U_\infty L}{v}$ where L is the length scale for a flow, U_∞ is its reference velocity and v is the coefficient of kinematic viscosity. In the laminar boundary layer approximation, comparison of the dimensions of the convection term $u\frac{\partial u}{\partial x}$ and the viscous term $v\frac{\partial^2 u}{\partial x^2}$ leads to the following relation between the boundary layer thickness δ and Re

(a) $\delta \propto \sqrt{Re}$

(b) $\delta \propto 1/\sqrt{Re}$

(c) $\delta \propto Re$

(d) $\delta \propto 1/Re$

9.8 Isentropic efficiencies of an aircraft engine operating at typical subsonic cruise conditions with the following components - intake, compressor, turbine and nozzle - are denoted by η_i, η_c, η_t and η_n, respectively. Which one of the following is correct?

(a) $\eta_i < \eta_c < \eta_t < \eta_n$

(b) $\eta_t < \eta_i < \eta_c < \eta_n$

(c) $\eta_c < \eta_t < \eta_i < \eta_n$

(d) $\eta_c < \eta_i < \eta_t < \eta_n$

9.9 A rocket nozzle is designed to produce maximum thrust at an altitude, $H = 8km$ from the sea level. The nozzle operates in

(a) under-expanded condition for $H > 8km$

(b) under-expanded condition for $H < 8km$

(c) sonic exit condition for $H < 8km$

(d) unchoked condition for $H < 8km$

9.10 In the solution of $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0$, if the values of the integration constants are identical and one of the initial conditions is specified as $y(0) = 1$, the other initial condition $y'(0) =$ _____.

9.11 For $x > 0$, the general solution of the differential equation $\frac{dy}{dx} = 1 - 2y$ asymptotically approaches _____.

9.12 For a parabola defined by $y = ax^2 + bx + c$, $a \neq 0$, the coordinates (x, y) of the extremum are

(a) $\left(\frac{-b}{2a} + \frac{\sqrt{b^2-4ac}}{2a}, 0\right)$

(b) $\left(\frac{-b}{2a}, \frac{-b^2+4ac}{2a}\right)$

(c) $\left(\frac{-b}{2a}, \frac{-b^2+4ac}{4a}\right)$

(d) $(0, c)$

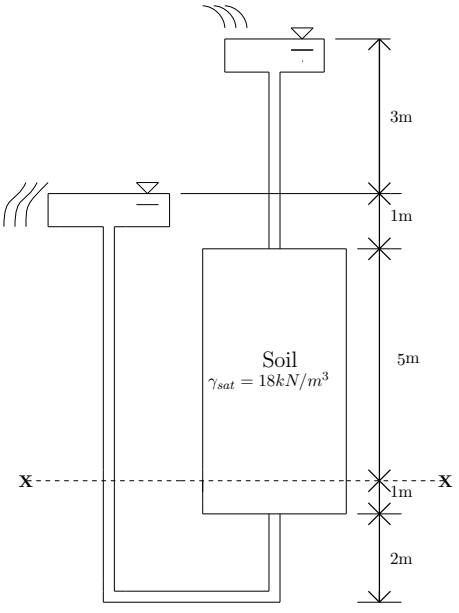
9.13 The 2-D stress state at a point P in the x-y coordinate system is $\begin{bmatrix} 60 & 50 \\ 50 & -40 \end{bmatrix} MPa$. The magnitude of the tangential stress (inMPa) on a surface normal to the x- axis at P is _____.

Chapter 10

2016

CE

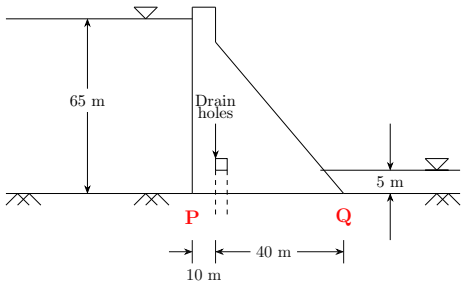
10.1 A seepage flow condition is shown in the figure. The saturated unit weight of the soil $\gamma_{sat} = 18$ kN/m^3. Using unit weight of water, $\gamma_w = 9.81$ kN/m^3, the effective vertical stress (expressed in kN/m^2) on plane $X - X$ is _____



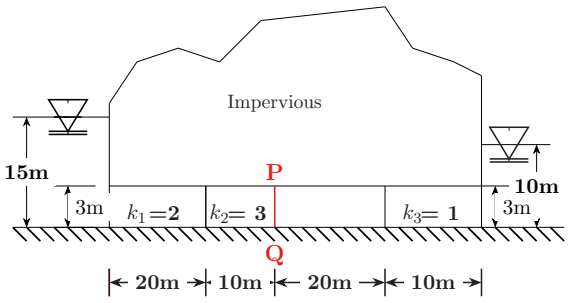
10.2 A drained triaxial compression test on a saturated clay yielded the effective shear

strength parameters as $c' = 15$kPa and $\phi' = 22°$. Consolidates Undrained triaxial test on an identical sample of this clay at a cell pressure of 200 kPa developed a pore water pressure of 150 kPa at failure. The deviator stress (expressed in kPa) at failure is _____

10.3 A concrete gravity dam section is shown in the figure. Assuming unit weight of water as 10kN/m^3 and unit weght of concrete as 24kN/m^3, the uplift force per unit length of the dam (expressed in kN/m) at PQ is _____



10.4 Seepage is occuring through a porous media shown in the figure. The hydraulic conductivity values (k_1, k_2, k_3) are in m/day. The seepage discharge (m^3/day per m)



through the porous media at section PQ is

(a) $\frac{7}{12}$

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

(c) $\frac{9}{16}$

(d) $\frac{3}{4}$

10.5 A 4 m wide rectangular channel, having bed slope of 0.001 carries a discharge of 16 m^3/s. Considering Manning's roughness coefficient = 0.012 and $g = 10$ m/s^2, the category of the channel slope is

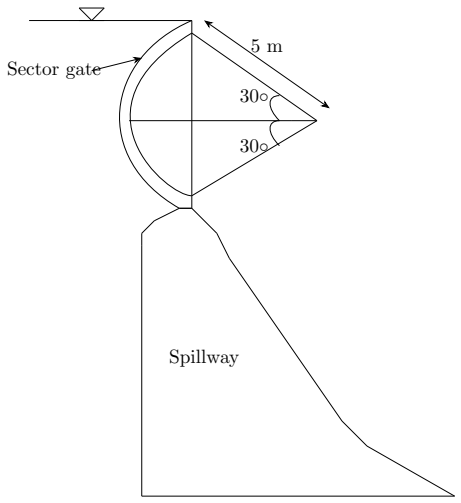
(a) horizontal

(b) mild

(c) critical

(d) steep

10.6 A sector gate is provided on a spillway as shown in the figure. Assuming $g = 10$ m/s^2, the resultant force per meter length (expressed in kN/m) on the gate will be _____



10.7 A hydraulically efficient trapezoidal channel section has a uniform flow depth of 2 m. The bed width (expressed in m) of the channel is _____

10.8 Effluent from an industry 'A' has a pH of 4.2. The effluent from another industry 'B' has double the hydroxyl (OH^-) ion concentration than the effluent from industry 'A'. pH of effluent from the industry 'B' will be _____

10.9 An electrostatic precipitator (ESP) with 5600 m^2 of collector plate area is 96 percent efficient in treating 185 m^3/s of flue gas from a 200 MW thermal power plant. It was found that in order to achieve 97 percent efficiency, the collector plate area should be 6100 m^2. In order to increase the efficiency to 99 percent, the ESP collector plate area (expressed in m^2) would be _____

10.10 The 2-day and 4-day BOD values of a sewage sample are 100 mg/L and 155 mg/L, respectively. The value of BOD rate constant (expressed in per day) is _____

10.11 A two lane, one-way road with radius of 50 m is predominantly carrying lorries with wheelbase of 5 m. The speed of lorries is restricted to be between 60 kmph and 80 kmph. The mechanical widening and psychological widening required at 60 kmph are designated as $w_{me,60}, w_{ps,60}, w_{me,80}, w_{ps,80}$, respectively are

(a) 0.89 m, 0.50 m, 1.19 m, and 0.50 m

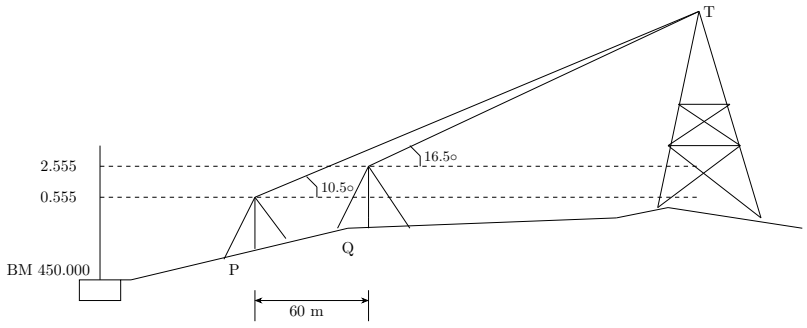
(b) 0.50 m, 0.89 m, 0.50 m, and 1.19 m

(c) 0.50 m, 1.19 m, 0.50 m, and 0.89 m

(d) 1.19 m, 0.50 m, 0.89 m, and 0.50 m

10.12 While traveling along and against the traffic stream, a moving observer measures the relative flows as 50 vehicles/hr and 200 vehicles/hr, respectively. The average speeds of the moving observer while traveling along and against the stream are 20 km/hr and 30 km/hr, respectively. The density of the traffic stream (expressed in vehicles/km) is _____

10.13 The vertical angles subtended by the top of a tower T at two instrument stations set up at P and Q, are shown in the figure. The two stations are in line with the tower and spaces at a distance of 60 m. Readings taken from these two stations on a leveling staff placed at the benchmark (BM = 450.000 m) are also shown in the figure. The reduced level of the top of the tower T (expressed in m) is _____



Chapter 11

2017

Chapter 12

2018

Chapter 13

2019

Chapter 14

2020

Chapter 15

2021

Chapter 16

2022

Chapter 17

2023

Chapter 18

2024