

# GATE 2020

## Graduate Aptitude Test in Engineering 2020

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Organising Institute



### CE1: Civil Engineering

#### GA - General Aptitude

#### Q1 - Q5 carry one mark each.

Q.No. 1 It is a common criticism that most of the academicians live in their \_\_\_\_\_, so, they are not aware of the real life challenges.

- (A) homes
- (B) ivory towers
- (C) glass palaces
- (D) big flats

Q.No. 2 His hunger for reading is insatiable. He reads indiscriminately. He is most certainly a/an \_\_\_\_\_ reader.

- (A) all-round
- (B) precocious
- (C) voracious
- (D) wise

Q.No. 3 Select the word that fits the analogy:

Fuse : Fusion :: Use : \_\_\_\_\_

- (A) Usage
- (B) User
- (C) Uses
- (D) Usion

Q.No. 4 If 0, 1, 2, ..., 7, 8, 9 are coded as O, P, Q, ..., V, W, X, then 45 will be coded as \_\_\_\_\_.

- (A) TS
- (B) ST
- (C) SS
- (D) SU

Q.No. 5 The sum of two positive numbers is 100. After subtracting 5 from each number, the product of the resulting numbers is 0. One of the original numbers is \_\_\_\_\_.

- (A) 80
- (B) 85
- (C) 90
- (D) 95

#### Q6 - Q10 carry two marks each.

Q.No. 6

The American psychologist Howard Gardner expounds that human intelligence can be sub-categorised into multiple kinds, in such a way that individuals differ with respect to their relative competence in each kind. Based on this theory, modern educationists insist on prescribing multi-dimensional curriculum and evaluation parameters that enable development and assessment of multiple intelligences.

Which of the following statements can be inferred from the given text?

- (A) Howard Gardner insists that the teaching curriculum and evaluation needs to be multi-dimensional.
- (B) Howard Gardner wants to develop and assess the theory of multiple intelligences.
- (C) Modern educationists want to develop and assess the theory of multiple intelligences.
- (D) Modern educationists insist that the teaching curriculum and evaluation needs to be multi-dimensional.

Q.No. 7 Five friends P, Q, R, S and T went camping. At night, they had to sleep in a row inside the tent. P, Q and T refused to sleep next to R since he snored loudly. P and S wanted to avoid Q as he usually hugged people in sleep.

Assuming everyone was satisfied with the sleeping arrangements, what is the order in which they slept?

- (A) RSPTQ
- (B) SPRTQ
- (C) QRSPT
- (D) QTSPR

Q.No. 8 Insert seven numbers between 2 and 34, such that the resulting sequence including 2 and 34 is an arithmetic progression. The sum of these inserted seven numbers is \_\_\_\_\_.

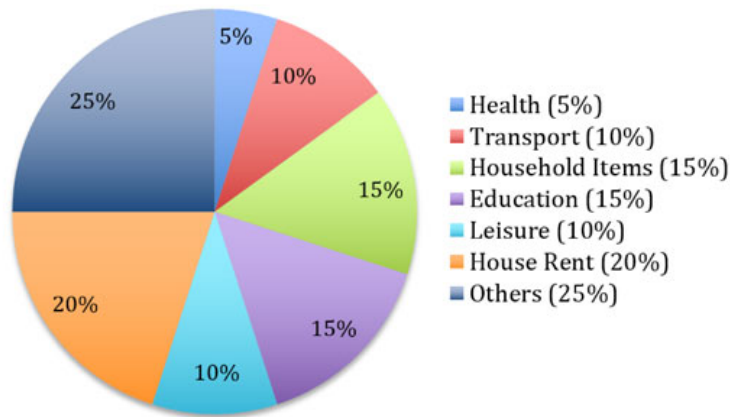
- (A) 120
- (B) 124
- (C) 126
- (D) 130

Q.No. 9 The unit's place in  $26591749^{110016}$  is \_\_\_\_\_.

- (A) 1
- (B) 3
- (C) 6
- (D) 9

Q.No. 10

The total expenditure of a family, on different activities in a month, is shown in the pie-chart. The extra money spent on education as compared to transport (in percent) is \_\_\_\_\_.



- (A) 5  
 (B) 33.3  
 (C) 50  
 (D) 100

## CE1: Civil Engineering

### Q1 - Q25 carry one mark each.

- Q.No. 1 In the following partial differential equation,  $\theta$  is a function of  $t$  and  $z$ , and  $D$  and  $K$  are functions of  $\theta$

$$D(\theta) \frac{\partial^2 \theta}{\partial z^2} + \frac{\partial K(\theta)}{\partial z} - \frac{\partial \theta}{\partial t} = 0$$

The above equation is

- (A) a second order linear equation  
 (B) a second degree linear equation  
 (C) a second order non-linear equation  
 (D) a second degree non-linear equation

- Q.No. 2 The value of  $\lim_{x \rightarrow \infty} \frac{x^2 - 5x + 4}{4x^2 + 2x}$  is

- (A) 0  
 (B)  $\frac{1}{4}$   
 (C)  $\frac{1}{2}$   
 (D) 1

- Q.No. 3 The true value of  $\ln(2)$  is 0.69. If the value of  $\ln(2)$  is obtained by linear interpolation between  $\ln(1)$  and  $\ln(6)$ , the percentage of absolute error (*round off to the nearest integer*), is

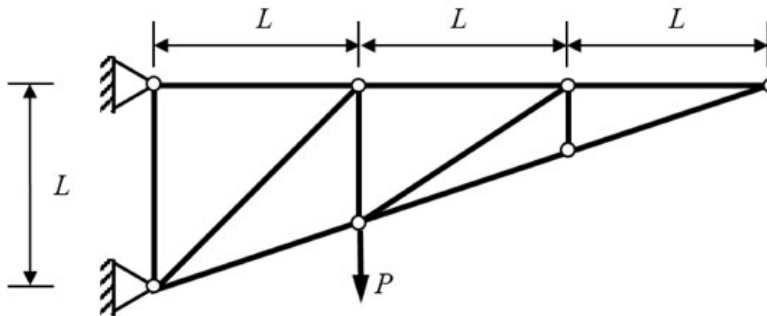
- (A) 35  
 (B) 48  
 (C) 69

(D) 84

Q.No. 4 The area of an ellipse represented by an equation  $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$  is

- (A)  $\frac{\pi ab}{4}$   
 (B)  $\frac{\pi ab}{2}$   
 (C)  $\pi ab$   
 (D)  $\frac{4\pi ab}{3}$

Q.No. 5 Consider the planar truss shown in the figure (*not drawn to the scale*)



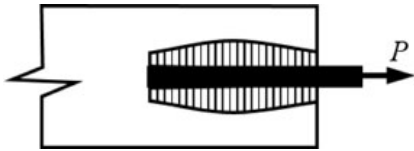
Neglecting self-weight of the members, the number of zero-force members in the truss under the action of the load  $P$ , is

- (A) 6  
 (B) 7  
 (C) 8  
 (D) 9

Q.No. 6 A reinforcing steel bar, partially embedded in concrete, is subjected to a tensile force  $P$ . The figure that appropriately represents the distribution of the magnitude of bond stress (represented as hatched region), along the embedded length of the bar, is

- (A)
- (B)
- (C)

(D)



Q.No. 7 In a two-dimensional stress analysis, the state of stress at a point  $P$  is

$$[\sigma] = \begin{bmatrix} \sigma_{xx} & \tau_{xy} \\ \tau_{xy} & \sigma_{yy} \end{bmatrix}$$

The necessary and sufficient condition for existence of the state of pure shear at the point  $P$ , is

- (A)  $\sigma_{xx}\sigma_{yy} - \tau_{xy}^2 = 0$   
 (B)  $\tau_{xy} = 0$   
 (C)  $\sigma_{xx} + \sigma_{yy} = 0$   
 (D)  $(\sigma_{xx} - \sigma_{yy})^2 + 4\tau_{xy}^2 = 0$

Q.No. 8 During the process of hydration of cement, due to increase in Dicalcium Silicate ( $C_2S$ ) content in cement clinker, the heat of hydration

- (A) increases  
 (B) decreases  
 (C) initially decreases and then increases  
 (D) does not change

Q.No. 9 The Los Angeles test for stone aggregates is used to examine

- (A) abrasion resistance  
 (B) crushing strength  
 (C) soundness  
 (D) specific gravity

Q.No. 10 Which one of the following statements is **NOT** correct?

- (A) A clay deposit with a liquidity index greater than unity is in a state of plastic consistency.  
 (B) The cohesion of normally consolidated clay is zero when triaxial test is conducted under consolidated undrained condition.  
 (C) The ultimate bearing capacity of a strip foundation supported on the surface of sandy soil increases in direct proportion to the width of footing.  
 (D) In case of a point load, Boussinesq's equation predicts higher value of vertical stress at a point directly beneath the load as compared to Westergaard's equation.

Q.No. 11 In a soil investigation work at a site, Standard Penetration Test (SPT) was conducted at every 1.5 m interval up to 30 m depth. At 3 m depth, the observed number of hammer blows for three successive 150 mm penetrations were 8, 6 and 9, respectively. The SPT N-value at 3 m depth, is

- (A) 23  
 (B) 17  
 (C) 15  
 (D) 14

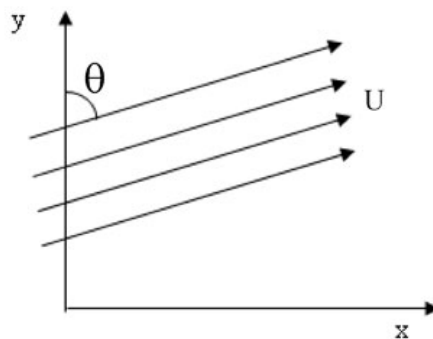
Q.No. 12 Velocity of flow is proportional to the first power of hydraulic gradient in Darcy's law. This law is applicable to

- (A) laminar flow in porous media  
 (B) transitional flow in porous media  
 (C) turbulent flow in porous media  
 (D) laminar as well as turbulent flow in porous media

Q.No. 13 A body floating in a liquid is in a stable state of equilibrium if its

- (A) metacentre lies above its centre of gravity  
 (B) metacentre lies below its centre of gravity  
 (C) metacentre coincides with its centre of gravity  
 (D) centre of gravity is below its centre of buoyancy

Q.No. 14 Uniform flow with velocity  $U$  makes an angle  $\theta$  with the  $y$ -axis, as shown in the figure



The velocity potential ( $\phi$ ), is

- (A)  $\pm U(x \sin\theta + y \cos\theta)$   
 (B)  $\pm U(y \sin\theta - x \cos\theta)$   
 (C)  $\pm U(x \sin\theta - y \cos\theta)$   
 (D)  $\pm U(y \sin\theta + x \cos\theta)$

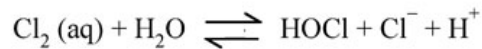
Q.No. 15 The data for an agricultural field for a specific month are given below:

|                       |   |
|-----------------------|---|
| Pan Evaporation       | = 100 mm  |
| Effective Rainfall    | = 20 mm (after deducting losses due to runoff and deep percolation) |
| Crop Coefficient      | = 0.4   |
| Irrigation Efficiency | = 0.5   |

The amount of irrigation water (in mm) to be applied to the field in that month, is

- (A) 0  
 (B) 20  
 (C) 40  
 (D) 80

Q.No. 16 During chlorination process, aqueous (aq) chlorine reacts rapidly with water to form  $\text{Cl}^-$ , HOCl, and  $\text{H}^+$  as shown below



The most active disinfectant in the chlorination process from amongst the following, is

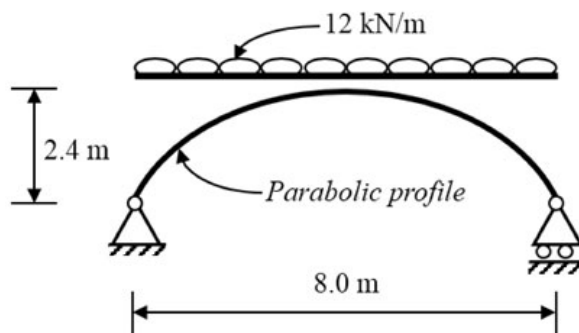
- (A)  $\text{H}^+$   
 (B) HOCl  
 (C)  $\text{Cl}^-$   
 (D)  $\text{H}_2\text{O}$

Q.No. 17 An amount of 35.67 mg HCl is added to distilled water and the total solution volume is made to one litre. The atomic weights of H and Cl are 1 and 35.5, respectively. Neglecting the dissociation of water, the pH of the solution, is

- (A) 3.50  
 (B) 3.01  
 (C) 2.50  
 (D) 2.01

Q.No. 18 The probability that a 50 year flood may **NOT** occur at all during 25 years life of a project (*round off to two decimal places*), is \_\_\_\_\_.

Q.No. 19 A planar elastic structure is subjected to uniformly distributed load, as shown in the figure (*not drawn to the scale*)



Neglecting self-weight, the maximum bending moment generated in the structure (in kN.m, *round off to the nearest integer*), is \_\_\_\_\_.

- Q.No. 20 In an urban area, a median is provided to separate the opposing streams of traffic. As per IRC:86-1983, the desirable minimum width (in m, *expressed as integer*) of the median, is \_\_\_\_\_.
- Q.No. 21 A road in a hilly terrain is to be laid at a gradient of 4.5%. A horizontal curve of radius 100 m is laid at a location on this road. Gradient needs to be eased due to combination of curved horizontal and vertical profiles of the road. As per IRC, the compensated gradient (in %, *round off to one decimal place*), is \_\_\_\_\_.
- Q.No. 22 In a drained triaxial compression test, a sample of sand fails at deviator stress of 150 kPa under confining pressure of 50 kPa. The angle of internal friction (in degree, *round off to the nearest integer*) of the sample, is \_\_\_\_\_.
- Q.No. 23 A fully submerged infinite sandy slope has an inclination of  $30^\circ$  with the horizontal. The saturated unit weight and effective angle of internal friction of sand are  $18 \text{ kN/m}^3$  and  $38^\circ$ , respectively. The unit weight of water is  $10 \text{ kN/m}^3$ . Assume that the seepage is parallel to the slope. Against shear failure of the slope, the factor of safety (*round off to two decimal places*) is \_\_\_\_\_.
- Q.No. 24 A 4 m wide rectangular channel carries  $6 \text{ m}^3/\text{s}$  of water. The Manning's ' $n$ ' of the open channel is 0.02. Considering  $g = 9.81 \text{ m/s}^2$ , the critical velocity of flow (in m/s, *round off to two decimal places*) in the channel, is \_\_\_\_\_.
- Q.No. 25 A river has a flow of 1000 million litres per day (MLD),  $\text{BOD}_5$  of 5 mg/litre and Dissolved Oxygen (DO) level of 8 mg/litre before receiving the wastewater discharge at a location. For the existing environmental conditions, the saturation DO level is 10 mg/litre in the river. Wastewater discharge of 100 MLD with the  $\text{BOD}_5$  of 200 mg/litre and DO level of 2 mg/litre falls at that location. Assuming complete mixing of wastewater and river water, the immediate DO deficit (in mg/litre, *round off to two decimal places*), is \_\_\_\_\_.



### Q26 - Q55 carry two marks each.

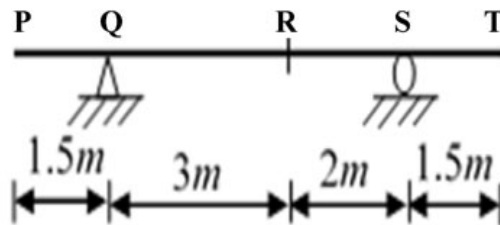
Q.No. 26 For the Ordinary Differential Equation  $\frac{d^2x}{dt^2} - 5\frac{dx}{dt} + 6x = 0$ , with initial conditions  $x(0) = 0$  and  $\frac{dx}{dt}(0) = 10$ , the solution is

- (A)  $-5e^{2t} + 6e^{3t}$   
 (B)  $5e^{2t} + 6e^{3t}$   
 (C)  $-10e^{2t} + 10e^{3t}$   
 (D)  $10e^{2t} + 10e^{3t}$

Q.No. 27 A continuous function  $f(x)$  is defined. If the third derivative at  $x_i$  is to be computed by using the fourth order central finite-divided-difference scheme (with step length =  $h$ ), the correct formula is

- (A)  $f'''(x_i) = \frac{-f(x_{i+3}) + 8f(x_{i+2}) - 13f(x_{i+1}) + 13f(x_{i-1}) - 8f(x_{i-2}) + f(x_{i-3})}{8h^3}$   
 (B)  $f'''(x_i) = \frac{f(x_{i+3}) - 8f(x_{i+2}) - 13f(x_{i+1}) + 13f(x_{i-1}) + 8f(x_{i-2}) + f(x_{i-3})}{8h^3}$   
 (C)  $f'''(x_i) = \frac{-f(x_{i+3}) - 8f(x_{i+2}) - 13f(x_{i+1}) + 13f(x_{i-1}) + 8f(x_{i-2}) - f(x_{i-3})}{8h^3}$   
 (D)  $f'''(x_i) = \frac{f(x_{i+3}) - 8f(x_{i+2}) + 13f(x_{i+1}) + 13f(x_{i-1}) - 8f(x_{i-2}) - f(x_{i-3})}{8h^3}$

Q.No. 28 Distributed load(s) of 50 kN/m may occupy any position(s) (either continuously or in patches) on the girder **PQRST** as shown in the figure (*not drawn to the scale*)



The maximum negative (hogging) bending moment (in kN.m) that occurs at point **R**, is

- (A)  
 (B)  
 (C)  
 (D)

Q.No. 29

- (A)  
 (B)  
 (C)  
 (D)

Q.No. 30

- (A)

- (B)
- (C)
- (D)

**Q.No. 31**

- (A)
- (B)
- (C)
- (D)

**Q.No. 32**

- (A)
- (B)
- (C)
- (D)

**Q.No. 33**

- (A)
- (B)
- (C)
- (D)

**Q.No. 34**

- (A)
- (B)
- (C)
- (D)

**Q.No. 35**

- (A)
- (B)
- (C)
- (D)

**Q.No. 36**

- (A)
- (B)
- (C)
- (D)

**Q.No. 37**

- (A)
- (B)
- (C)
- (D)

**Q.No. 38**

- (A)
- (B)
- (C)
- (D)

Q.No. 39

Q.No. 40

Q.No. 41

Q.No. 42

Q.No. 43

Q.No. 44

Q.No. 45

Q.No. 46

Q.No. 47

Q.No. 48

Q.No. 49

Q.No. 50

Q.No. 51

Q.No. 52

Q.No. 53

Q.No. 54

Q.No. 55

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