GATE NUMERICALS

4th Edition

29

YEARS

2019-1991

By

Faculty of Architecture

GATE ARCHITECTURE

gatearchitecture.com

2020

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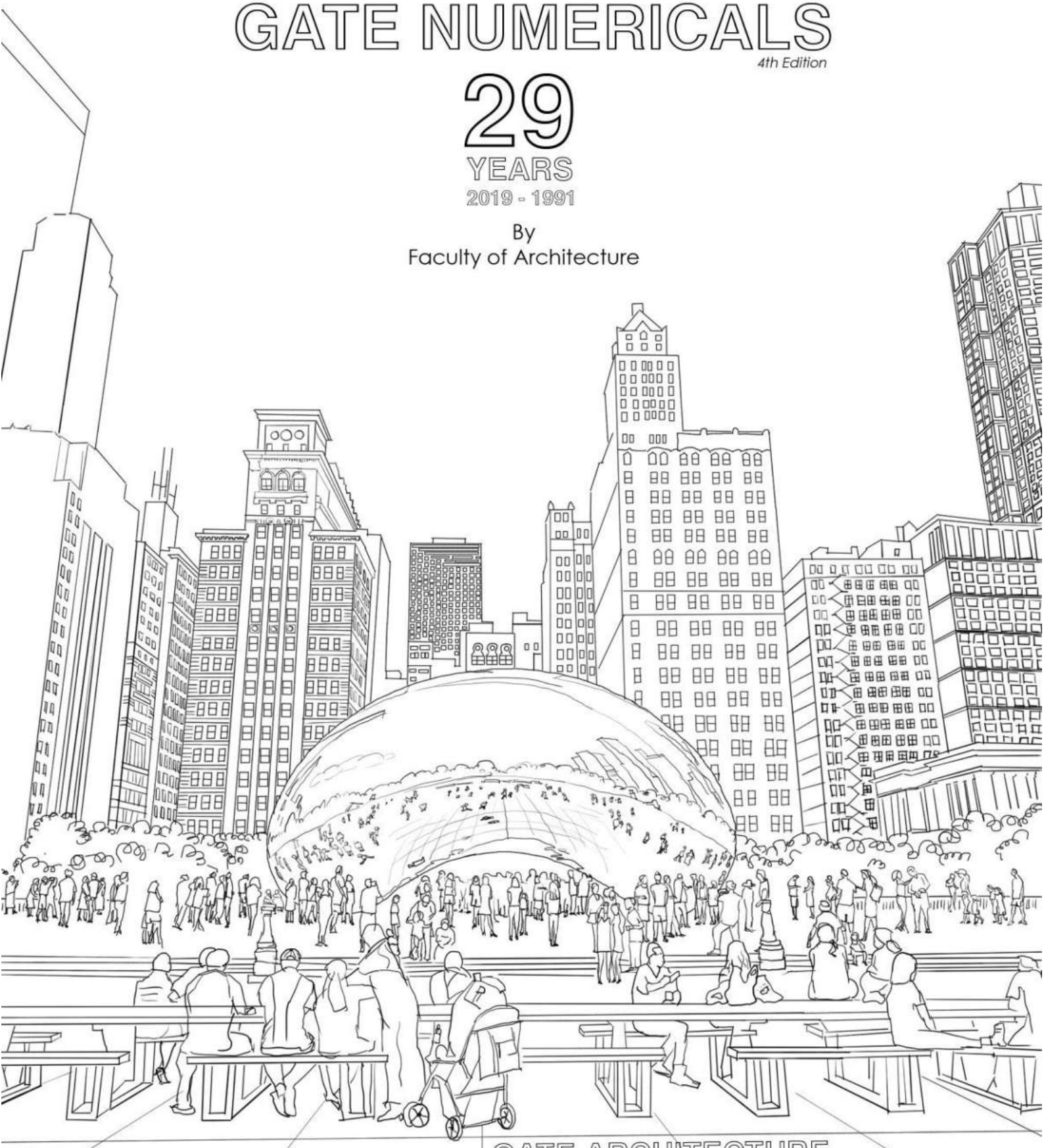

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Preface

If you have already prepared for the exam, this book would be fruitful to you. This book is meant for last stage of preparation and add an edge to your preparation by reviewing sets of numerical questions asked in previous years. In past few years, the pattern of numerical question has changed. It is observed that upto 40% marks are of numerical questions. There would be approx. 7 numerical question of 1 or 2 marks of which no option would be given. You have to answer the question by using keypad displayed on the screen. (Use of keyboard is prohibited. Touching any key would lock your monitor screen and you may not able to answer any further question!)

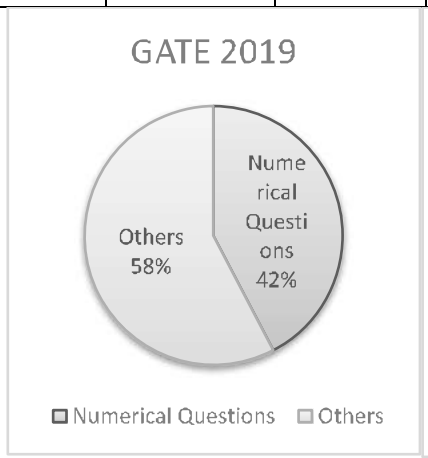
So, for such question pattern, you need through practice. We are hopeful that this book would meet the requirement.

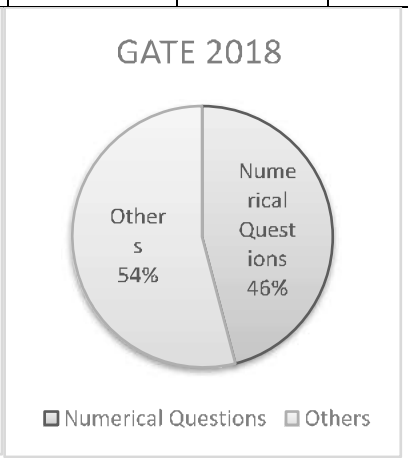
Answering an objective question has its own rule to follow when you have a doubt in choosing the right answer. For so, we have also attached expert opinion for handling objective question well.

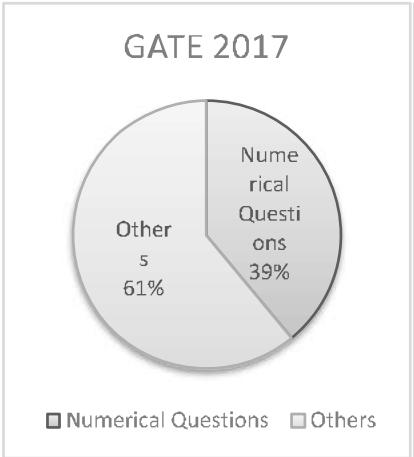
In this book, we have also provided basics of theories which are very essential before you solve a question.

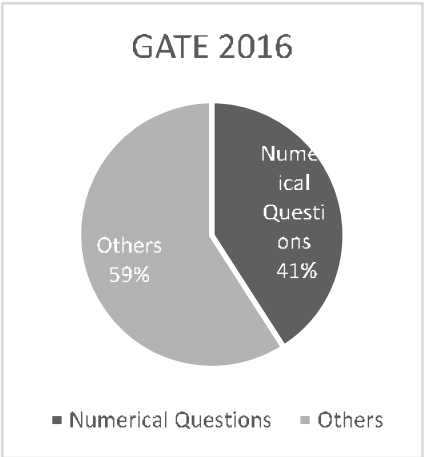
(GATE 2016 AR trend):

No. of students applied (Approx.)	No. of students appeared (Approx.)	No. of students qualified	Highest marks obtained	Lowest mark obtained	Cut-off Mark	Average marks obtained	Standard deviation
6300	5900	1240	75.67	26.00	38.90	43.37	8.32









Most of the questions has been solved. You are always welcome for your valuable suggestion and feedback about this book. If you find better contents or alternative solution, send us to gatearchitecture@gmail.com

We may add contents or solution by you in next reprint or edition!

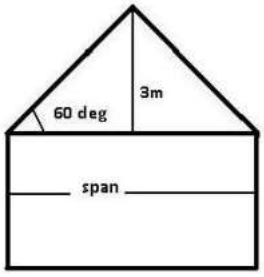
We wish you all the best for GATE 2020.

Tips & Tricks

Followings are tips & tricks for handling multiple choice questions suggested by experts from open source online resources. Please note that following insights are not only for Numerical Questions but also for all topics. Some of following are for paper bound exam (not online). You should skip those.

Tips for solving numerical problems:

- **Drawing the picture of the problem** is very important! The correct picture of a numerical problem is more than 80 % of success.

  Example (GATE 2013): If the slope of a hipped roof is 60º and height of the roof is 3 m, span of the room, in m, would be _____
  Solution: Span of the room = 2 * (3/tan60 º) = 3.46 answer.

- **Having the same units for all variables in the proble m**. You must ensure that you solve the problem in the same unit. For example, in a given question, force may be given 40 Newton (N) and length of the beam would be *l*= 50 centimetre. For easy and correct solution, you should change the length in meter (*l*= 0.5m). Tip: If the option is given as follows: (A) 50Pa (B) 5Pa (C) 10Pa (D) 100Pa. For this type of question, you must recheck your solution before you choose an answer.

- **Checking the dimensionality of analytical expressions**. To arrive at correct answer, you should always write the numerical value with it's unit.

  Example: Area of tense steel per meter width of a reinforced concrete slab is 335 sq mm. If 8 mm rods are used as reinforcement, then centre to centre spacing of the reinforcement in mm is

  Solution: Total area of steel is 335 sq mm. (which is spread in 1m of width)
  Area of 8 mm rod = Πr^2 = 3.14 x 4mm x 4mm = 50.24 sq mm { *8mm rod means it has diameter of 8mm*

  So, total no. of rods spread in 1m of width = $\frac{335 sqmm}{50.24 sqmm}$ = 335 /50.24 = 6.67 { *When' sqmm' is divided by 'sqmm', it becomes a dimensionless quantity. So, the result is a just number without any unit. Here, we want to calculate 'no. of rods', which does not have any dimension. So, our calculation is in right direction .*

  So, distance between two rods will be 1m/6.67 = 1000 mm/6.67 = 150 mm Answer { *Here, please note that we are dividing 1000mm /6.67 and not 1m/6.67. In the question "per meter" is mentioned. But for correct answer we need to convert 1m to 1000mm.*

Taking Multiple Choice Exams *(Source:1)*

Studying for a multiple choice exam requires a special method of preparation distinctly different from an essay exam. Multiple choice exams ask a student to recognize a correct answer among a set of options that include3 wrong answers (called *distracters)*, rather than asking the student to produce a correct answer entirely from his/her own mind.

For many reasons, **students commonly consider multiple choice exams easier than essay exams**. Perhaps the most obvious reasons are that:

- The correct answer is *guaranteed* to be among the possible responses. A student can score points with a lucky guess.
- Many multiple choice exams tend to emphasize basic definitions or simple comparisons, rather than asking students to analyze new information or apply theories to new situations.
- Because multiple choice exams usually contain many more questions than essay exams, each question has a lower point value and thus offers less risk.

Important Topics

Acoustics

Sound is such a common part of everyday life that we rarely appreciate all of its functions. It provides enjoyable experiences such as listening to music or to the singing of birds.

Yet, too often in our modern society, sound annoys us. Many sounds are unpleasant or unwanted- these are called noise. However, the level of annoyance depends not only on the quality of the sound, but also our attitude towards it. For example the type of music enjoyed by some people could be regarded as noise by others, especially if it is loud.

The branch of science which deals with the planning of abuilding to provide the best quality audible sound to audience is termed as architectural acoustics or acoustics of the building.

Intensity Level (dB)

Bel & Decibell:

Whenever the intensity of sound increases by a factor of 10, the increase in the intensity is said to be 1 bel *(A unit named after Alexander Graham Bell, the inventor of telephone)*

Therefore dynamic range of audibility of the human ear is 12 bels or 120 dB. When the intensity increases by a factor of $10^{0.1}$, the increase in intensity is 0.1 bel or 1dB.

$\therefore$ in decibel

$$L = 10 \log_{10} \left(\frac{I}{I_0}\right)$$

I_0: base intensity (10^{-16} W/cm^2, hearing threshold)
I: intensity (W/cm^2)

For the intensity level change = 1 dB

$$1 = 10 \log_{10} \left(\frac{I}{I_0}\right)$$

$$\therefore \frac{I}{I_0} = 1.26 \quad \ldots(1.4)$$

If $I = I_0$,

$$L = 10 \log 1 = 0$$

This represents the threshold of audibility.
It means that intensity level alters by 1dB when intensity of sound changes by 26%

Intensity levels of different sounds

Sr. No.	Sound	Intensity level (in db)
(1)	Threshold of hearing	0
(2)	Rustle of leaves	10
(3)	Whisper	15 – 20
(4)	Normal conversation	60 – 65
(5)	Heavy traffic	70 – 80

Illumination

Terms

Visible Light Transmission (VLT)
The percentage of visible light that is transmitted through the glazing assembly. This is the essential characteristic for daylighting calculations. A perfectly clear window would have a VLT of 100 percent. Most practical assemblies for architectural use are between 35 and 80 percent.

Solar Heat Gain Coefficient (SHGC)
The percentage of total solar radiant energy that is transmitted through the assembly. This is the essential characteristic for solar gain calculations. For ordinary windows without special coatings, the SHGC and the VLT are the same and sometimes called the shading coefficient (SC). However, with modern coated windows, the SHGC is almost always lower than the VLT. Such window systems are generically referred to as *low-emissivity* or *lowE* and are used in most commercial construction.

Candela

The candela (unit cd) has its origin in the brightness of a "standard candle", but it has received a more precise definition in the International System of Units (SI) — and at that time the unit was also renamed from "candle" to "candela".

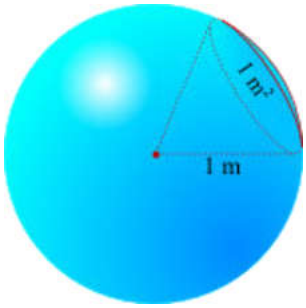


Figure: Creation of a solid angle.

The candela measures the amount of light emitted in the range of a (three-dimensional) angular span. Since the luminous intensity is described in terms of an angle, the distance at which you measure this intensity is irrelevant. For ease of illustration, in the picture at the right the three dimensions have been flattened to two. In this picture, screen B would catch exactly the same amount of light rays (emitted from the light source) as screen A —provided that screen A were removed to not obscure screen B. This is because screen B covers the same angle as screen A.

The angular span for candela is expressed in steradian, a measure without unit (like radian for angles in a two-dimensional space). One steradian on a sphere with a radius of one metre gives a surface of one m^2. A full sphere measures 4π steradians.

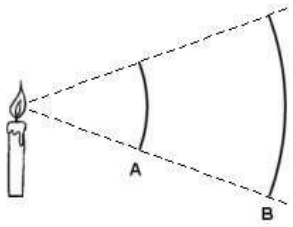


Figure: The candela measures the amount of light emitted in the range of a (three-dimensional) angular span. The luminous intensity is described in terms of an angle.

Lumen

If you look at LEDs, especially high-brightness LEDs, you may notice that the LEDs with a high luminous intensity (in candela or milli-candela, mcd) typically have a narrow apex angle. Similarly, LEDs with a wide apex angle typically have a relatively low luminous intensity. The same is true for halogen spots with reflector: those with a narrow-beam reflector have a higher rating in candela than the "floodlight" spots of the same power.

The cause for this relation is the total energy produced by the LED. LEDs of a specific class (for example, "high flux") all produce roughly the same amount of luminous energy. However, when a LED emits its total energy in a beam with a narrow angle, the intensity will be greater (in the direction of that angle) than when *the same* energy had been emitted over a wide angle.

The lumen (unit lm) gives the total luminous flux of a light source by multiplying the intensity (in candela) by the angular span over which the light is emitted. With the symbol Φv for lumen, Iv for candela and Ω for the angular span in steradian, the relation is:

$\Phi v = Iv \cdot \Omega$

CPM/PERT

Introduction

Basically, CPM (Critical Path Method) and PERT (Programme Evaluation Review Technique) are project management techniques, which have been created out of the need of Western industrial and military establishments to plan, schedule and control complex projects.

Brief History of CPM/PERT

CPM/PERT or Network Analysis as the technique is sometimes called, developed along two parallel streams, one industrial and the other military.

CPM was the discovery of M.R.Walker of E.I.Du Pont de Nemours & Co. and J.E.Kelly of Remington Rand, circa 1957. The computation was designed for the UNIVAC-I computer. The first test was made in 1958, when CPM was applied to the construction of a new chemical plant. In March 1959, the method was applied to a maintenance shut-down at the Du Pont works in Louisville, Kentucky. Unproductive time was reduced from 125 to 93 hours.

PERT was devised in 1958 for the POLARIS missile program by the Program Evaluation Branch of the Special Projects office of the U.S.Navy, helped by the Lockheed Missile Systems division and the Consultant firm of Booz-Allen & Hamilton. The calculations were so arranged so that they could be carried out on the IBM Naval Ordinance Research Computer (NORC) at Dahlgren, Virginia.

The Framework for PERT and CPM

Essentially, there are six steps which are common to both the techniques. The procedure is listed below:

1. Define the Project and all of it's significant activities or tasks. The Project (made up of several tasks) should have only a single start activity and a single finish activity.
2. Develop the relationships among the activities. Decide which activities must precede and which must follow others.
3. Draw the "Network" connecting all the activities. Each Activity should have unique event numbers. Dummy arrows are used where required to avoid giving the same numbering to two activities.
4. Assign time and/or cost estimates to each activity
5. Compute the longest time path through the network. This is called the critical path.
6. Use the Network to help plan, schedule, monitor and control the project.

The Key Concept used by CPM/PERT is that a small set of activities, which make up the longest path through the activity network control the entire project. If these "critical" activities could be identified and assigned to responsible persons, management resources could be optimally used by concentrating on the few activities which determine the fate of the entire project.

Non-critical activities can be replanned, rescheduled and resources for them can be reallocated flexibly, without affecting the whole project.

Five useful questions to ask when preparing an activity network are:

- Is this a Start Activity?
- Is this a Finish Activity?
- What Activity Precedes this?
- What Activity Follows this?
- What Activity is Concurrent with this?

Some activities are serially linked. The second activity can begin only after the first activity is completed. In certain cases, the activities are concurrent, because they are independent of each other and can start simultaneously. This is especially the case in organisations which have supervisory resources so that work can be delegated to various departments which will be responsible for the activities and their completion as planned.

When work is delegated like this, the need for constant feedback and co-ordination becomes an important senior management pre-occupation.

Heat

Understanding fundamental heat flows from conduction, convection, and radiation is key to creating energy efficient buildings. Moisture flows are also important because moisture holds energy as "latent heat."

Sensible vs. Latent Heat Flows

There are of two forms of heat flows: **sensible heat** and **latent heat**. Sensible heat flow results in a change in temperature. Latent heat flow results in a change in moisture content (often humidity of the air). Total heat flow is the sum of sensible and latent flows. Human comfort depends on providing acceptable levels of both temperature (sensible heat) and humidity (latent heat).

Sensible heat: The heat associated with change in temperature of a substance/

Latent heat: The release or storage of heat associated with change in phase of a substance, without a change in the substance's temperature. In building design, this is often heat required to add/remove moisture content (humidity) in the air. Hot dry air is actually less uncomfortable than hot humid air, because moisture holds energy as latent heat.

Whenever an object is at a temperature different from its surroundings, heat flows from hot to cold. Likewise, moisture flows from areas of greater concentration to areas of lower concentration.

Conduction, Convection, and Radiation

Buildings lose sensible heat to the environment (or gain sensible heat from it) in three principal ways:

1) Conduction: The transfer of heat between substances which are in direct contact with each other. Conduction occurs when heat flows through a solid.

2) Convection: The movement of gasses and liquids caused by heat transfer. As a gas or liquid is heated, it warms, expands and rises because it is less dense resulting in natural convection.

3) Radiation: When electromagnetic waves travel through space, it is called radiation. When these waves (from the sun, for example) hit an object, they transfer their heat to that object.

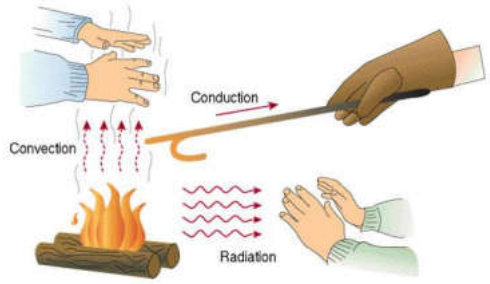


Figure: The way that you experience the heat from a fire is a good example of conduction, convection, and radiation. Heat conducts through materials placed in the fire, like a metal poker. You can stop the conduction to your hand by using an insulating pad Heat (and smoke) travels away from the fire through the air. The direction it travels depends on the wind and pressure differences (convection).Heat radiates from the fire to where you are. You can avoid the radiation by putting a material between you and the fire, or stepping away.

GATE QUESTION PAPERS

GATE 2019

Q.1 The radius as well as the height of a circular cone increases by 10%. The percentage increase in its volume is ____.
(A) 17.1 (B) 21.0 (C) 33.1 (D) 72.8

Q.2 Five numbers 10, 7, 5, 4 and 2 are to be arranged in a sequence from left to right following the directions given below:
1. No two odd or even numbers are next to each other.
2.The second number from the left is exactly half of the left-most number.
3.The middle number is exactly twice the right-most number.

Which is the second number from the right?
(A) 2 (B) 4 (C) 7 (D) 10

Q.3 In a country of 1400 million population, 70% own mobile phones. Among the mobile phone owners, only 294 million access the Internet. Among these Internet users, only half buy goods from e-commerce portals. What is the percentage of these buyers in the country?
(A) 10.50 (B) 14.70 (C) 15.00 (D) 50.00

Q.4 Two trains started at 7AM from the same point. The first train travelled north at a speed of 80km/h and the second train travelled south at a speed of 100 km/h. The time at which they were 540 km apart is_____ AM.
(A) 9 (B) 10 (C) 11 (D) 11.30

Q.5 The illumination level of a room is 300 lux and the efficacy of the lamps is 60. The Light Power Density (LPD) of the room in Watt/m^2 is _____.

Q.6 The load on a RCC column is 150 kN. The soil bearing capacity is 80 kN/m^2. Assuming a factor of safety of 1.2, the side of the square column footing is _____ meter *(rounded off to one decimal place).*

Q.7 A room is separated by a partition wall. The average intensities of sound in the source and receiving sides across the partition are 10^{-4} W/m^2 and 10^{-7} W/m^2 respectively. The transmission loss (TL) of the partition wall is _____ dB.

Q.8 If the purchase price of 2BHK flat rises by 10 percent, the demand for such flats is observed to decrease by 8 percent. The price elasticity of the housing demand for 2BHK flats is _____ *(rounded off to one decimal place*).

Q.9 Threshold of enclosure created by vertical surfaces or series of vertical elements in an urban plaza, represented by the ratio of height and distance, is given by an angle of _____ degrees *(rounded off to one decimal place).*

Q.10 A colony of 50 people is served by a septic tank. The rate of water supply is 90 lpcd in the colony and 40% of it is going to the septic tank. The retention period of the tank is 24 hours. The length of the septic tank is_____ meter (*rounded off to two decimal places*).
Assume, storage capacity/person = 0.085m^3 (3 years)
Space for digestion = 0.0425 m^3/person
Depth of tank = 1.4 m
Length: Width = 2:1

Q.11 A cone, with a base of 10 cm diameter and axis of 12 cm, is lying on Horizontal Plane (HP) along its generator. The internal angle which the base of the cone makes with the HP is _____degrees.

Q.12 A public utility building of 5000 $m^2$was constructed 5 years before, on a site of 1 hectare. The present value of open land in that location is Rs. 100/$m^2$and present construction cost of such building is Rs. 2500/m^2. If the value of the

GATE 2009

Q1. A simply supported beam of length L carries a concentrated load of intensity P at its centre. The bending moment of the centre of the beam will be (A) PL/2 (B) PL/4 (C) PL/6 (D) PL/8

Q2. As per IS:456-2000, the maximum area of tension reinforcement in a RCC beam shall not exceed x% of its cross-sectional area, where x is equal to
(A) 2 (B) 4 (C) 6 (D) 8

Q3. A commercial plot measures 100 m x80 m. if the permissible Floor Space Index (FSI) is 3.0, and 50% of the ground is covered, then the maximum number of floors that can be built is (A) 3 (B) 4 (C) 6 (D) 12

Q4. A microwave oven of 3 kW rating is operated for 30 minutes, a hot water geyser of 1 kW rating is operated for 15 minutes, and 5 fluorescent lamps of 60 W are operated for 6 hours. The total power consumed (in kWh) will be
(A) 1.80 (B) 3.55 (C) 18.01 (D) 35.50

Q5. A site has 6 contour lines and length of the line joining the midpoints of the highest contour and lowest contour is 300 m. If the slope of the line is 1 in 10, then the contour interval (in m) is (A) 5 (B) 6 (C) 50 (D) 60

Q6. A neighborhood with a total of 200 hectares has a gross density of 300 persons per hectare (pph). If the residential area is 60% of the total area, then net density in (pph) of the neighborhood is
(A) 300 (B) 450 (C) 500 (D) 750

Q7. A town with a population of 50000 has an average household size of 5.0. The number of occupied dwelling units is 8400 of which 10% are in dilapidated condition. The housing demand of the town is
(A) 760 (B) 1600 (C) 2440 (D) 10840

Q8. A building has a rooftop area of 300 sq. m. If the average annual rainfall in the region is 700 mm and the runoff Coefficient of the rooftop is 0.8, then the maximum amount of rainfall than can be harvested from the rooftop (in litres) is
(A) 168 (B) 262 (C) 168000 (D) 262500

Common Data Questions
Common Data Questions 10 and 11:

A construction project has the following data:

Activity	Duration (days)	Predecessors
P	4	-
Q	3	P
R	7	P
S	2	P
T	4	Q
U	6	S
V	4	R,T,U

Q9. The normal project duration (in days) is
(A) 14 (B) 15 (C) 16 (D) 17

Q10.The critical activities of the project are
(A) P, Q, R, V (B) P, R, S, U (C) P, Q, T, V (D) P, S, U, V

Common Data for Questions 12 and 13:
A seminar hall has a volume of 2000 cu.m, and the total absorption of all acoustic materials without any audience is 80 m^2-sabines.
Q11. The reverberation time of the empty hall (in seconds) will be (A) 1.0 (B) 4.0 (C) 8.0 (D) 12.0

Q12. When the same seminar hall is filled with audience, the reverberation time is recorded as 2.0 seconds. Then the total absorption of all acoustic materials (in m^2-sabines) will be
(A) 40 (B) 80 (C) 160 (D) 320

Q4. An investor has a capital of Rs. 15 lacs from which he expects a return of 14.5%. He intends to purchase a small workshop from which the net annual income is expected to be Rs. 5 lacs. Calculate the maximum price which the investor can invest for the workshop if money can be borrowed in mortgage at 16% interest for 8 years.

Q5. A studio has dimensions 10m x 8m x 5m. The ceiling of studio is provided with acoustical tiles having absorption coefficient = 0.40. Curtains in heavy folds (absorption coefficient = 0.50) are provided on one short wall. The absorption power of other surfaces of the studio may be taken as 8 sq.m. sabines. What will be extra absorption units required to make reverberation time t = 0.75 sec.?

Q6. A property has been sold by the Housing Board on a conditional sale. The Board is to receive Rs. 24,000 at the end of every year for 10 years, and further, the Board is to receive Rs. 200,000 at the end of 10 years. A period of 4 years has already lapsed. Estimate the current value of the property (Interest rate for Years Purchase is 8%)

Q7. The distance between two points in a map on 1:100,000 is 2 cm. Distance between the same two points in an aerial photograph is 10 cm. The camera of the aerial photograph was flown with a focal length of 6 inches. Find out the scale of the photograph and calculate the flying height.

GATE 1996

1. If 'a' is the optimistic time, 'b' is the pessimistic time and 'm' is the most likely time of an activity, the expected time of the activity is

(A) $\frac{a+5m+b}{6}$ (B) $\frac{a+4m+b}{6}$ (C) $\frac{a+2m+b}{6}$ (D) $\frac{a+m+b}{6}$

2. As per Indian Road Congress the 'Width of formation' of highway in plain land is
(A) 6.0 m (B) 12.0 m (C) 18.0 m (D) 21.0 m

3. In a lecture auditorium the seating pattern from the speaker should fall within maximum angle of
(A) 70° (B) 90° (C) 120° (D) 140°

4. When two pigments of contrasting value are mixed, the most striking change observed is in
(A) Hue dimension (B) Occult rhythm (C) Occult balance (D) None of the above

5. Number of common clay bricks required to make one cubic meter of brick masonry is
(A) 350 (B) 420 (C) 500 (D) 550

6. Sinking fund refers to
(A) Reserve fund (B) Fund loss due to damage (C) Bad debts (D) Fund for underground construction

7. BASIC is a
(A) Compiler (B) Hardware item (C) Interpreter (D) Plotter type

8. Minimum strength of cement mortar used in load bearing brick masonry is
(A) 50 N/cm^2 (B) 60 N/cm^2 (C) 80 N/cm^2 (D) 100 N/cm^2

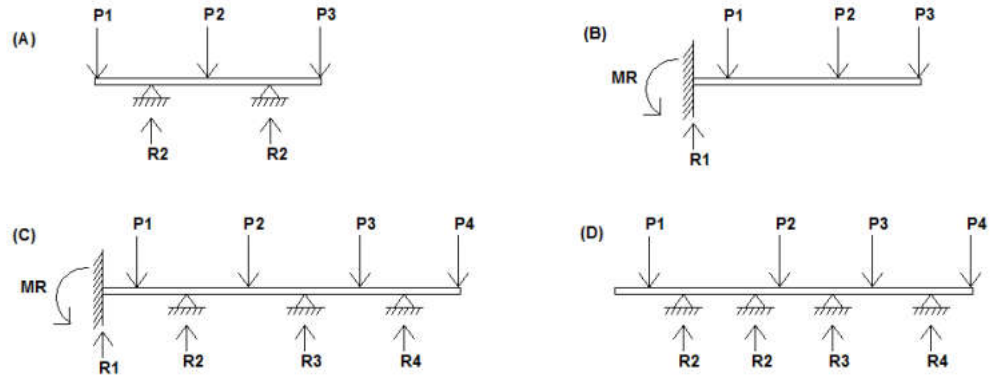
9. If 'P' denotes the total population, the age-dependency ratio is expressed as
(A) $[P_{(60+)}] / [P_{(0-59)}]$
(B) $[P_{(0-14)}] / [P_{(15-59)}]$
(C) $[P_{(60+)} + P_{(0-14)}] / [P_{(0-59)}]$
(D) $[P_{(60+)} + P_{(0-14)}] / [P_{(15-59)}]$

10. Compute the capacity and workout the dimension of a septic tank for a small colony of 500 persons with average daily sewage flow of 75 litres per head. Detention period is 36 hours. Cleaning interval is sixmonths. Assume rate of deposited sludge as 25 litres per capita per year.

11. Compute the thermal transmittance (U) value for a 230 mm brick wall with 12.5 mm thick cement plaster on both sides (value of thermal conductivity for brick wall and cement plaster are 69 and 80 respectively in K cal cm/ m^2h deg C. Thermal conductance of outside and inside walls are 0.05 and 0.16 respectively.)

12. A newly built property fetches an annual rent of Rs. 18,00. As per agreement tenant is liable to pay out -going equivalent to 18% of the annual rent. Calculate the present value of the property. (Assume rate of interest as 8.5%)

13. Determine which of the following are determinate or indeterminate structures.



14. A reinforced concrete slab (having balanced section) has an overall depth of 100 mm. The effective cover is 20mm. If the stresses in concrete and steel are not to exceed 5N.mm2 and 140N/mm2. Find the safe uniformly distributed load which can be placed on the slab. The slab is supported on beams at 3.0m c¢ on both sides. The maximum bending moment for a meter strip of slab may be taken as Wl2/12. Take the moment ofresistance of the balanced section as equal to 0.85 bd^2Nmm.

15. The time estimate of various activities of a project in the following Table. Determine the standard deviation of the critical path.

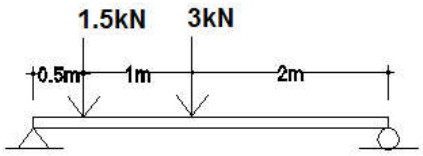
Activity	Optimistic Time (Weeks)	Most Likely Time (Weeks)	Pessimistic Time (Weeks)
1-2	8	12	22
1-3	6	12	18
2-4	1	4	7
3-4	5	9.5	11
2-5	9	15	21
4-5	3	4	5

16. A main sewer is to be designed to receive a flow from 2 sq. Km. Area of a community, where the population density is 250 persons/hectare. The average sewage flow is 120 litres per capita per day. What will be the design flow of the main sewer? Assume peak factor as 3.

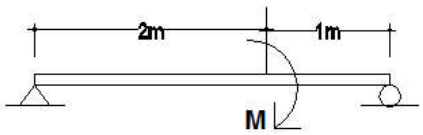
17. a) Explain the concept of relief displacement on aerial photography.
17. b) A flat area is photographed in a scale of 1:10,000 with a camera of 15 cm focal length. The bottom of a chimney stack is found to lie at a distance of 12.01 cm from the principle point of the photograph and the top at a distance of 12.22 cm. Find the height of the chimney stack.

18. Explain the significance of 'Z' score in the statistical analysis and mention its properties.

(i)



(ii)



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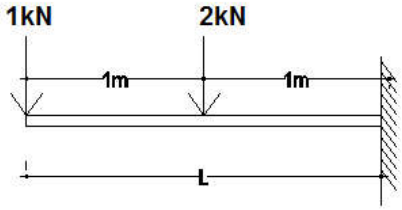
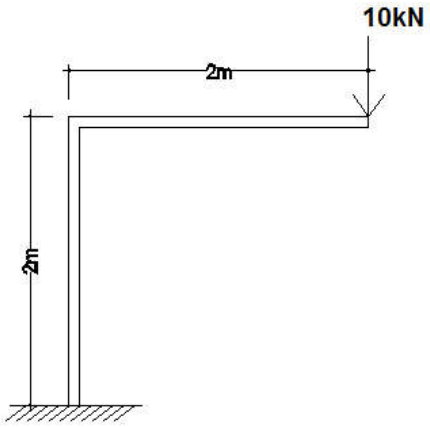


(iv)



Q3. Draw the CPM network and determine the critical path from the following data:

Serial No.	Activity	Duration (days)	Preceding activity
1	A	4	-
2	B	10	-
3	C	6	-
4	D	6	A
5	E	8	B
6	F	3	C
7	G	7	D
8	H	2	E, F

GATE 1991

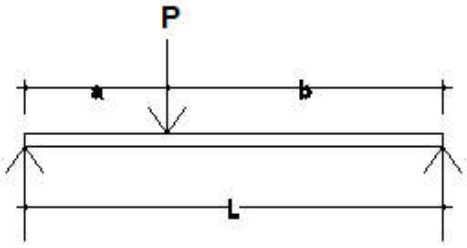
Q1. Ratio 'Golden Mean' is:

(A) 1:2.261 (B) 1 : 1.618 (C) 1: 1.15 (D) 1: 1.44

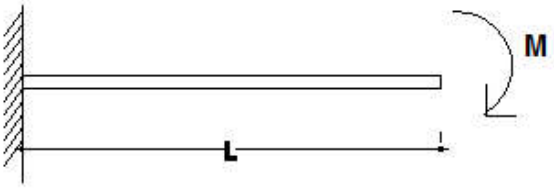
Q2. An urban area with a population of 2,15,000 is having housing stock of 39,000 and average household size of 5.0 . The city is expected to have 2,70,000 by 2001 with an average family size of 4.5, Estimate the housing demand of the city by 2001assuming there will be depletion of existing housing stock by 3,500 during this period.

Q3. Draw the bending moment and shear force diagrams for the following:

(i)



(ii)



Q4. The residential landuse of an urban area accounts for 50% of the developed land of the city. The vacant undeveloped land is about 30% of the total urban area, which amounts to 2,400 hectares of land. Estimate the quantum of land put to residential uses and also the overall density of the urban area if the population is of 2,00,000 size.

Q5. Sketch the bending moment and shear force diagrams (values not required)

GATE Solution, Explanation & Notes

GATE 2019

Q.1 Answer (C) 33.1 **The increase in volume of circular cone is 33.1 %**

We know for volume of a (right circular) cone is $\frac{1}{3}\pi r^2 h$

Original volume (V_o)

$(V_o) = \frac{1}{3}\pi r_1^2 h_1$

Now we know radius and height both are increased by 10%. So, after increase, the new volume will be:

$(V_n) = \frac{1}{3}\pi(1.1r_1)^2(1.1)h_1 = 1.331*(\frac{1}{3}\pi r_1^2 h_1) = 1.331 *(V_o)$

% change in volume = $\frac{Vn-Vo}{Vo}$ x 100% = $\frac{1.331Vo-Vo}{Vo}$ x 100% = 33.1% Answer

Q.2 Answer (C) 7 **According to given data, the only possible arrangement is:**

10 5 4 7 2

So, second from right will be 7.

Q.3 Answer (A) 10.50 **Total population = 1400 million**

Number of people who having own mobile phones

= 70% of 1400 = 0.7 x 1400 = 980 million

Number of people who have access of internet = 294 million

Number of people who buy goods from e-commercial portals = half of interest users

= $\frac{294}{2}$ = 147 million

Percentage buyers = $\frac{147\ million}{1400\ million}$ x 100% = 10.5%

Q.4 Answer (B) 10 **The time at which they were 540 km apart is 10 AM.**

According to the concept of relative sped in opposite direction, speed should be added:

Time of activity = Sum of distance/ Sum of speeds = 540/(100+80) = 540/180 = 3 hours from 7 am = 10 am Answer.

Q.5 The Light Power Density (LPD) of the room is 5 Watt/m^2.

Illumination, E = 300 lux = 300 lumen/sqm

Efficacy = 60 lumen/watt

LPD = Illumination / Efficacy = (300 lumen/sqm) / (60 lumen/Watt) = 5 Watt/sqm Answer

Tips: Please solve this type of question with numerical value and unit attached.

Q.6 The side of the square column footing is 1.5 meter

Load on column = 150 kN

Design load consisting factor of safety = 150 * 1.2 = 180 kN

Soil bearing capacity = 80kN/m^2

Let side of the square column footing be S

So, area of the column = S^2

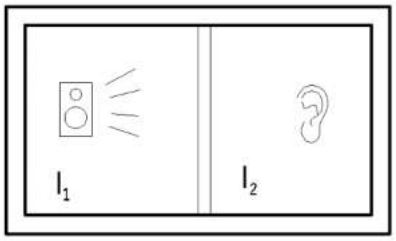
So, total load on column = 80kN/m^2 * S^2

As per question,

80kN/m^2 * S^2 = 180kN

- ⇨ S^2 = 2.25
- ⇨ S = 1.5 m Answer.

(GATE official answer range: 0.75 to 0.85)



Q.7 The transmission loss (TL) of the partition wall is 30 dB.

Here $I_1 = 10^{-4}$ W/m^2 and $I_2 = 10^{-7}$ W/m^2

We simply cannot subtract intensities I_1 and I_2. We have to take *log* value.

Also the required answer is in dB.
Sound level at source side = 10 log (10^{-4} / 10^{-12}) = 80 dB
Sound level at receiver side = 10 log (10^{-7} / 10^{-12}) = 50 dB
So, transmission loss = 80 – 50 = 30dB Answer.

Q.8 The price elasticity of the housing demand for 2BHK flats is 0.8
Price elasticity of demand = Change in quantity / Change in demand = 8% / 10% = 0.8 Answer

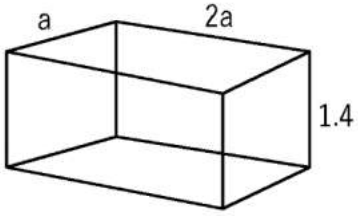
Q.9 Ratio of height and distance for 'Threshold of enclosure' = ½
Tan θ – ½
So, θ – 26.5° Answer

Q.10 The length of the septic tank is 3.42 meters

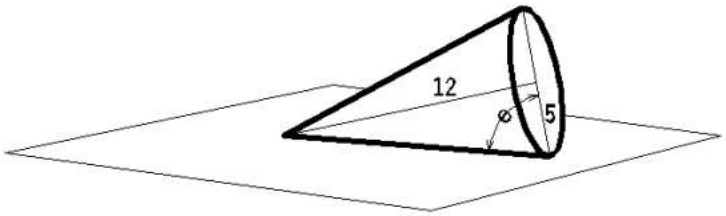
Volume of water in septic tank	40% * 50* 90	1.8 cum
Storage volume of septic tank	0.085 * 50	4.25 cum
Digestion volume of septic tank	0.0425 * 50	2.125 cum
Total volume		**8.175 cu.m**

Volume of septic tank V = a*2a*1.4 = 8.175
- ⇨ $2.8a^2 = 8.175$
- ⇨ $a2 = 2.919$
- ⇨ $a = 1.708$

So, length of septic tank = 2a = 2*1.708 = 3.42 Answer



Q.11 The internal angle which the base of the cone makes with the HP is 67.38 degrees.



Tanθ = height/ base = 12/5
- ⇨ $\Theta = \text{Tan}^{-1}(12/5) = 67.38$ degree Answer

Q.12 The present value of the property using 'Valuation by Cost Method' is 91.738 Lakhs
Present land value = Rs. 100/m^2*1 hectare = Rs. 100/m^2*100m x 100m = Rs. 10 Lakh
Value of new construction = 5000 m^2 * Rs. 2500/m^2 = 125 Lakh
Depreciating rate = 6% per annum
Value after depreciation of construction in 5 years = 125 $(1-r)^n$ = 125*$(1-0.06)^5$ = 91.738 Lakh
Present value of property = 91.738 Lakhs **Answer**

Q.13 The net residential density of the area in persons per hectare is 159.48
Plot area = 20 Ha

Type	Area per plot (sqm)	Number	Total area (type)
A	500	100	50000
B	300	120	36000
C	200	150	30000
Total		**370**	**116000**

Population = 370 x 5 = 1850 person
Net residential density = population / net area = 1850 / 11.6 = 159.48 pph Answer

Q.14 The velocity of the shock wave generated is 10 km/h.

Speed of the shock-wave = Q_2-Q_1/K_2-K_1
Q1 = Flow before Jam = 1000 V/h
Q2 = Flow after jam = 0 (because V= 0)
K1 = Density before jam = 1000 / 20 = 50 V/km
K2 = 150 Vehicle / Km (Jam density)

Therefore, Speed of the shock-wave = Q_2-Q_1/K_2-K_1 = 0-1000 / 150-50 = -10 km/h
So, the answer in absolute value is 10 km/h Answer

Q.15 The maximum built-up area for the residential building will be 450m ^{2}.

As per question, 16 mm width of road = 4m = 4000 mm
So, 1 mm = 250 mm or scale is 1:250

Therefore, actual dimension of the plot would be,
Length = 150 mm * 250 = 375000 mm = 37.5 m
Width = 40 mm * 250 = 10000 mm = 10 m

So, the area of site = 37.5*10 = 375 m ^{2}
So built-up area = 375*FAR = 375*1.2 = 450 m ^{2} Answer

Q.16 If all the doors and windows of the room are kept fully open, the reverberation time will be 0.956 seconds

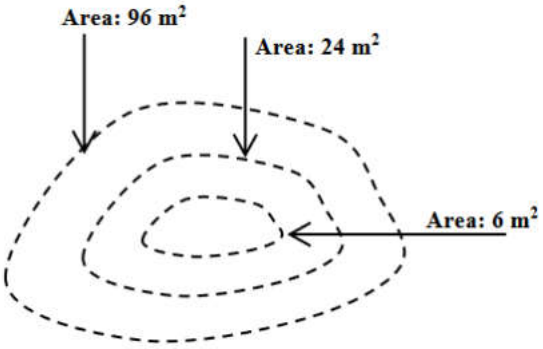
Consider the uniform absorption coefficient = a
Using, R_T = 0.16V/A

- ⇨ 1.2 = 0.16 * 400/360a (Total surface area of the room is 360 m^2)
- ⇨ 360a = 400*0.16/1.2
- ⇨ A = 0.148

New RT = 0.16 * 400/ (344*0.148 + 16*1) = 0.956 Answer
Note: Out of 360m^2 of room area, 344m^2 has absorption coefficient of 0.148 and rest 15m^2 area has absorption coefficient of 1 because opened door or window has absorption coefficient of 1 as it would absorb all sound)

Q.17 Using prismoidal method, the volume of the earth needed to fill the land depression is 66 m^3.

Prismoidal method is used in calculation of earthwork quantities. It states that the volume of any prismoid is equal to one-sixth it's length multiplied by the sum of the two end-areas plus four times the mid-area.
So, volume of earth fill = d/3 (A_1 + 4A_{odd} + 2A_{even} + A_n)
Depth of depression, d = 1m
Volume of earth-fill = 1/3 (96 + 4*24 + 2*0 + 6) = 198/6
= 66 Answer



Notes: In many construction projects, earthwork involve the excavation, removal and dumping of earth, therefore it is required to make good estimate of volume of earthwork. Volume computation are also required to determine the capacity of reservoirs.

Computing of areas and volumes is an important part of the office work involved in surveying. For computation of the volume of earthwork, the sectional area of the cross-section which are taken to the longitudinal section during profile leveling are first calculated.
After calculating the cross-sectional areas, the volume of earth work is calculated by:

- *The Trapezoidal Rule*
- *The Prismoidal Rule.*

Computation of Volume:

Trapezoidal Rule

Volume (Cutting or Filling) V= d/2 [Λ1 + Λn + 2 (Λ2 + Λ3 + …….Λn-1)

i.e. Volume = Common Distance/2 x [First section area + Last section area + 2 (sum of areas of other sections)

Prismoidal Formula

Volume,V= d/3* [A1 + An + 4 (A2 + A4 + An -1) + 2 (Λ3 + Λ5 + ….. Λn-2)]

i.e. Volume = Common Distance/3* [Area of First Section + Area of Last Section + 4 (Sum of areas of even Section) + 2 (Sum of Area of Odd Sections)]

The Prismoidal formula is applicable when there are odd number of sections. If the number of sections are even, the end section is treated separately and the area is calculated according to the trapezoidal rule. The volume of the remaining section is calculated in the usual manner by the prismoidal formula. Then both the result are added to obtain the total volume.

Prismoidal Correction

The prismoidal rule gives the correct volume directly. The trapezoidal rule does not give the correct volume. Prismoidal correction should be applied for this purpose.

This correction is always subtractive.

Prismoidal Correction for the section

$Cp = (L (h_1 - h_2)^2 * S) / 6$

Side Slope= S:1

Considering traverse Slope = 1 in n

Example: An embankment of width 10 m and side slope 1 ½ : 1 is required to be made on a ground which is level in a direction traverse to centre line. The central height at 20 m intervals are as follows:

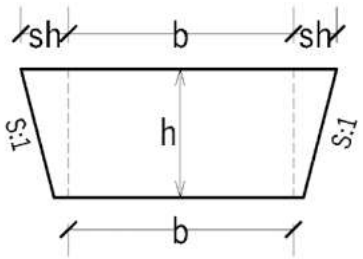
0.8, 1.2, 2.25, 2.6, 1.9,1.4 and 0.9

Calculate the volume of earth work according to:

(1) The trapezoidal formula

(2) The prismoidal formula

Solution: Level Section : Ground is level along the traverse direction



Here, b = 10 m, s = 1.5, interval = 20 m

The cross-Sectional Area are calculated by equation: Area= (b + sh) h

Δ1 = (10 − 1.5 x 0.8) x 0.8 = 8.96 m^2

Δ2 − (10 − 1.5 x 1.2) x 1.2− 14.16 m^2

Λ3 − (10 − 1.5 x 2.25) x 2.25 − 30.09 m^2

Λ4 = (10 − 1.5 x 2.6) x 2.6 = 36.14 m^2

Δ5 − (10 − 1.5 x 1.9) x 1.9 − 24 .42 m^2

Δ6 − (10 − 1.5 x 1.4) x 1.4 − 16.94 m^2

Λ7 − (10 − 1.5 x 0.9) x 0.9 − 10.22 m^2

Volume according to Trapezoidal Rule,

V = 20/2* [8.96 + 10.22 + 2 (14.16 + 30.09 + 36.14 + 24.42 + 16.94)]

= 10 [19.18 + 242.10]

= 2612.80 m^3

Volume according to Prismoidal Formula,

V = 20/3* [8.96 + 10.22 + 4 (14.16 + 36.14 + 16.94) + 2 (30.09 + 24.42)]

= 20 x (19.18 + 268.96 + 109.02) /3

= 2647.73 m^3

Example: Calculate the volume of earthwork in an embankment for which the Cross-Sectional areas at 20 m interval are as follows:

Distance	0	20	40	60	80	100	120
Cross-section area (m^2)	38	62	74	18	22	28	13

V= d/3 (A1 + A7 + 4 (A2 + A4 + A6) + 2 (A3 + A5)]
= 20/3* [38 + 13 + 4 (6 2 + 18 + 28) + 2 (74 + 22)]
= 20/3 [51 + 4 (108) + 2 (96)]
= 20/3 [51 + 432 + 192]
= 20 x 675 3
= 4500 m^3

Capacity of Reservoir: The plane containing any contour represents a horizontal plane and the area bounded by a contour is treated as the area of the cross-section. The contour interval is the vertical distance between any two adjacent crosssectional bounded by the contours. The area bounded by the contour is measured by a planimeter.
Reservoir are made for water supply, irrigation, hydropower etc. A contour map is very useful to study the possible location of a reservoir and the volume of water to be confined. All the contours are closed lines within the reservoir area.
The area A1, A2, A3,…… An between successive contour lines can be determined by a planimeter and if h is the contour interval, the capacity of the reservoir can be estimated either by the prismoidal formula or by the trapezoidal formula. In practice, the capacity of a reservoir is measured in terms of volume of water stored up t o full reservoir level (FRL) which is the level of water at its full capacity.

Example: From a contour plan of a proposed reservoir area, the following data were found:

Contour (m)	100	105	110	115	120	125
Area of contour (ha)	3	8	13	17	23	29

The capacity of the reservoir if the FRL is 125 m. The volume below the contour of 100 may be ignored.

Solution: Prismoidal formula can be used when odd number of section are there So, the volume up to the contour 120 m is:
V_{120} = d/3 [(A1 + A5 + 4 (A2 + A4) + 2 (A 3)] 3
= 5 [(3 + 23) + 4 (8 + 17) + 2 x 13)]
= 5/3 [26 + 100 + 26]
= 255.33 ha.m
And by trapezoidal formula, the volume, the formula, the volume between 120 and 125 m is
$V_{120\text{-}125} = h *(A_5 + A_6) / 2 = 5 x (23 + 29) / 2 = 130$ ha.m

Total Volume, $V= V_{120} + V_{120\text{-}125} = 253.33 + 130 = 383.33$ ha.m

Volume by the trapezoidal formula:
V= h/2* [First Area + Last Area + 2 (Sum of area of other section)]
= 5/2* [3 + 29 + 2 (8 + 13 + 17 + 23)]
=5/2 * (32 +122) = 385 ha -m

Example: The area enclosed by the contour in a reservoir are as follows:

Contour (m)	175	180	185	190	195
Area (m^2)	460	750	2500	3500	3950

The top water level is 195 m and the lowest point in the reservoir is 175 m. Find the volume of water (reservoir capacity) between 175 m and 195 m by:

- Trapezoidal formula
- Prismoidal formula

Contour Interval = 5 m
Volume according to trapezoidal formula, V= h/2* [A1 + A5 + 2 (A2 + A3+ A4)] = 5/2* [460 + 3950 + 2(750 + 2500 + 3500)] = 44775 m^3
Volume according to Prismoidal formula, V= h/3 [A1 + A5 + 4 (A2 + A4) + 2 (A3)] = 5/3* [(460 + 3950) + 4 (750 + 3500) + 2 (2500)] = 5/3 [4410 + 1700 + 5000] = 44016. 66 m^3

Source: "Surveying and Leveling" Vol- I Kanetkar and Kulkarni (2011) "Surveying and Leveling" N.N.Basak
https://www.slideshare.net/gauravhtandon1/volume-28486423

Q.18 As per the proposal, 28.5 kWh solar power will be generated daily.

Given data				*Data calculation*	
Orientation	No. of Panels	Average daily solar radiation in W/m2	Average solar hours per day	*Total electricity generation*	*At 75% efficiency*
South	10	400	4	*10*400W/m^2*2m^2*4hours = 32 kWh*	*0.75*32 kWh = 24kWh*
West	5	300	2	*5*300W/m^2*2m^2*2hours = 6 kWh*	*0.75*6 kWh = 4.5 kWh*

Total energy generation = 24 + 4.5 = 28.5 kWh Answer
GATE official answer range: 28.4 to 28.6

Q.19 The amount of soil excavated by the power shovel per day is 720m^3.

Total working hour = 6 hrs (given)
Time wasted = 10 minutes per hour. So, total time wasted = 10 minutes * 6 = 1 hour
Therefore, effective working hours = 5 hours = 300 minutes = 18000 seconds

As it takes 45 seconds for 1 excavation.
So, no. of excavations in 18000 seconds = 18000/45 = 400 excavations

As 1.8m^3 of soil is excavated in 1 excavation.
So, in 400 excavations, amount of soil excavated would e = 1.8m^3 * 400 = 720 m^3 Answer
GATE official answer range: 719.75 to 720.25

Q.20 The capacity of the air-conditioner for the room will be 1.5 Ton.
General formula to be used is $Q - msΔT$ for energy Q required to raise the temperature by $ΔT$ of material of mass m with specific heat of s. This formula is for solid material but equally holds good for gaseous item like air.

In this question, m will be volume of air.
Volume of air = 3 * volume of room ….. *(Room volume is multiplied by 3 as there are three air changes per hour.)*
= 3* (12 x 10 x 3.5) = 1260 m^3

In this question, s will be 1250 J/m^3 °C and $ΔT$ would be 12°C
Therefore, Q = msΔT = 1260 m^3 * 1250 J/m^3 °C * 12°C = 18900000 Joule and this much energy is required per hour.

So, rate of energy flow = Q/Time = 18900000 Joule / 36000 Seconds = 5250 Joule per second = 5250 Watt = 5250 W = 5.25 kW

As per question, 3.5 kW = 1 Ton (given)
So, 5.25 kW = 5.25/3.5 Ton = 1.5 Ton Answer.

The angle covered $2\pi r/l = 2\pi\ (5/13) = 10\pi/13$ Answer.

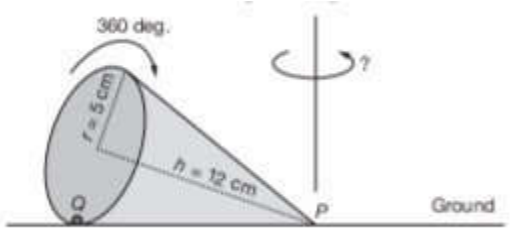


Figure: Cone with radius 5cm and height 12 cm

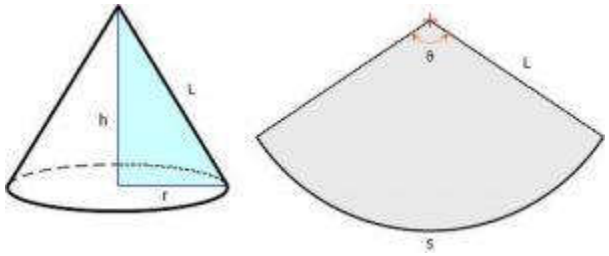


Figure: The right circular cone is unfolded

Alternative solution: This problem can also be replicated as below.
Given, h = 12 & r = 5
First, let us focus on unfolded cone.
By symmetry,
$(2\pi/2\pi L) = (0/S)$
So, $0 = S/L$ (Answer)
Now, let us find S and L.
L = Square root of (12^2 + 5^2) = Square root of (144+25) Square root of 169 = 13
$S = 2\pi r = 10\pi$
Therefore, $0 = S/L = 10\pi/13$ Answer (D)

Q16. If S has 1 or 2 cars both Q and R would be right. If S has 3 or more both P and R would be right. Therefore, S has 0 cars. Only Q is right. Hence, the correct option is (A) i.e. zero.

Q17. The paragraph clearly states that Stuart was reprimanded (criticized), by his superiors (commander-in-cheif), for fighting for his Sepoy's right to wear their caste-marks. He then resorts by saying that, he has never come across a better example of European prejudice than this instance. Further more, the last phrase 'it had no effect' shows that the commander-in-chief had not been moved by Stuart's retort or fight. Hence, option A can be eliminated. Option B is negated in the given stanza. Option D is inapt as the commander-in-chief believed in the European prejudice and he is - as understood from the stanza-very much a part of it. Only option C which can be clearly understood from the stanza is accurate.
Hence, the correct option is (C).

Q18. Mark and Steve are brothers who play for the same country. When James replied to Mark saying that he is the best player in his own family, James took a dig (make sarcastic or critical remarks) at Mark for teasing him. What he meant by that statement is that Steve is a better player than Mark. Or rather that Mark is not the best player in his own family. Hence, the correct option is (B)

Q19. 5% of x = 10000 So, value of x = 2 lakh

Q20. Maximum buildable area = FAR * Site Area = 2.5 * 60750 = 151870 sq.m
Actual buildable area = Site Area * Ground Coverage * No. of floors = 60750 * 45% * 5 floors = 60750 * 0.45 * 5 = 136687 sq.m.
(Please note that, *actual buildable area* is always less than the *maximum buildable area*. Height of the building given is 15m and the floor height is 3m, so no. of floors = 15/3 = 5 floors)
According to question, HIG units owns 30% of the buildable area. So, 30% of 136687sq.m. = 0.3 * 136687 = 41006 sq.m. Answer.

Q21. The salary distribution is given below. The salary is in thousands of rupees.

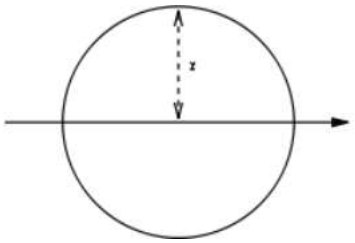
Salary	20	30	40	60	150
Number	45	25	20	8	2

The median is 30,000. Half the staff earns 30,000 or less. The other half earns 30,000 or more.
Hence, the correct option is (B).

Q22. The correct answer is 40 (This answer was challenged, earlier it was 0.4)
Pigment Volume Concentration (PVC)
% PVC = $100 * V_{pigment} / (V_{pigment} + V_{non\text{-}volatile\ binder})$
$V_{pigment}$ = pigment volume

neutral axis to the most extreme fiber. It is also often used to determine the yield moment (My) such that My = S × σy, where σy is the yield strength of the material.

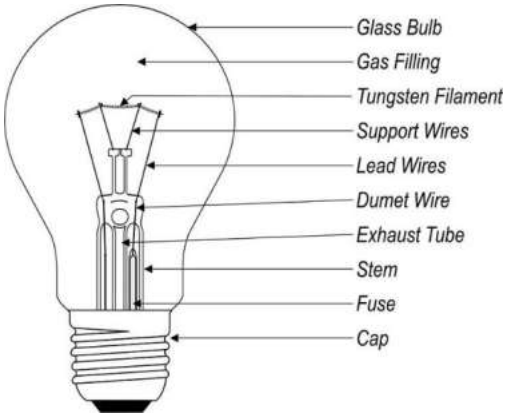
(Source: https://www.engineersedge.com/material_science/section_modulus_12893.htm)



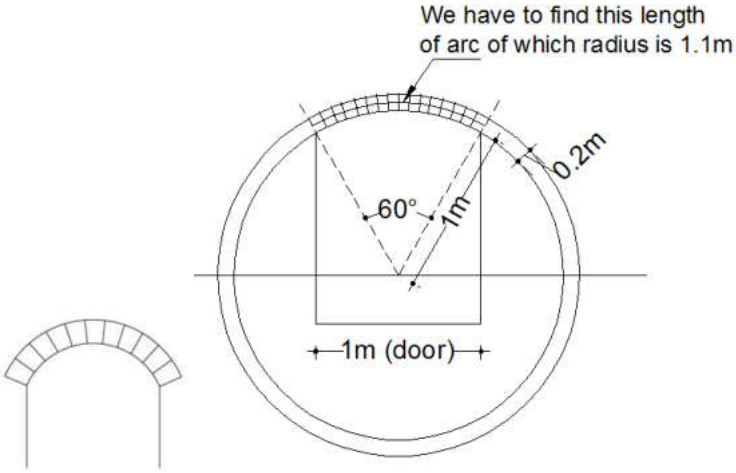
$$S = \frac{\pi r^3}{4} = \frac{\pi d^3}{32}$$ (Section Modulus)

15. Answer (A) **For incandescent lamps the distribution of total energy emission is 5% light & 95% heat.**

An **incandescent lamp** is an electric light with a wire filament heated to such a high temperature that it glows with visible light (incandescence). The filament, heated by passing an electric current through it, is protected from oxidation with a glass or fused quartz bulb that is filled with inert gas or evacuated.



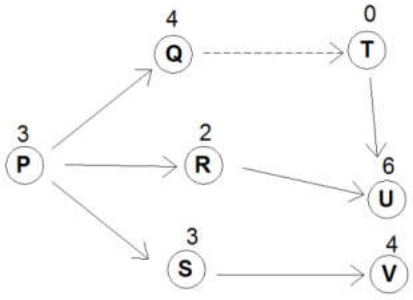
16. Answer (B) **The mean length of the arch is 1.15 meters.**



Length of arc = $\frac{60^\circ}{360^\circ}(2\pi r) = \frac{1}{6}(2\pi r) = \frac{1}{6}(2\pi 1.1) = 1.15\text{m}$

17. Not Answered

18. Answer (C) **The normal project time for the given network is 13 days.**



next largest city and more than twice as significant." A primate city is number one in its country in most aspects, like politics, economy, media, culture and universities.

Significance: Not all countries have primate cities, but in those that do, the rest of the country depends on it for cultural, economic, political, and major transportation needs. On the other hand the primate city depends on the rest of the country as paying consumers of the cultural, economic, political and other services produced in the city.

The presence of a primate city in a country may indicate an imbalance in development usually a progressive core, and a lagging periphery, on which the city depends for labor and other resources. However, the urban structure is not directly dependent on a country's level of economic development.

Examples: Among the best known examples of primate cities are alpha world cities London and Paris. Budapest and Vienna have also been described as primate cities.

Figure: Lux meter

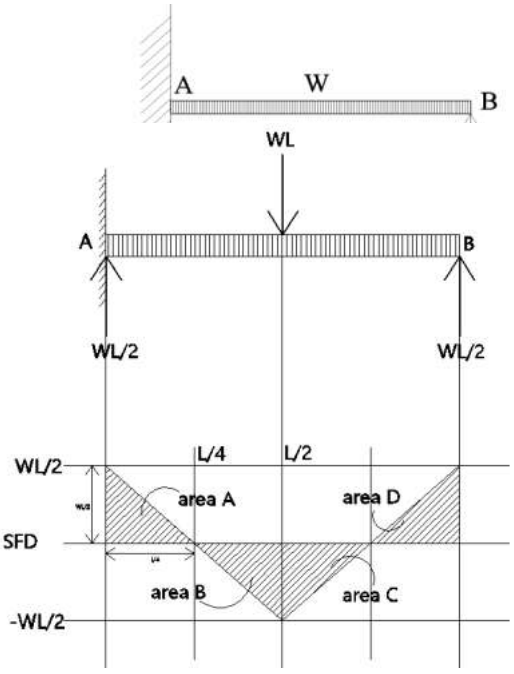
Rank-size usually indicates a country wherein all of the people have access to services because there are many cities of the differing sizes needed to spread services equally. A primate city can indicate and LDC wherein the people away from that city do not have access to services. Note: This rule is not always true and you need to think about whether or not this applies.

Q8. Unanswered

Q9. Answer (B) **110 cars can be parked in 400m stretch along the kerb?**
Thumb rule for car space of 2.5m*5m:
30◦ parking: , L = 0.58+5N
45◦ parking: L= 3.54 N+1.77
60◦ parking: L = 2.89N+2.16

Q10. Answer (C) **Moment at the fixed end 'A' of the beam is $-WL^2/8$**
Let's start from the basic. Unit of Moment is Newton-meter. In the question, W is UDL (uniformly distributed load). So, its unit is Newton /meter. Unit of length L is meter.
Now, unit of WL is (W Newton/meter)*(L meter) = WL Newton (which is essentially a force. So WL/16 is also a force, not a moment. Therefor options (B) and (D) are incorrect).

Now, you are left with options (A) and (D). You should try your luck. If not, you should know that the area in SFD (Shear Force Diagram) is actually a value of moment.
Here, Moment at A should be sum of area of triangle A & B.
Moment at A = Area (AA + AB) = Area [(1/2*WL/2*L/4) – (1/2*WL/2*L/4)] = $WL^2/8$ Answer



Q11. Answer (B) **30 m should be spacing between the lamps if the desired average lux on the pathway is 6.**
Area of the road to be illuminated = 300m x 6m = 1800sq.m.
We have,
E = (N x F x UF x MF) / A
Where, E = average illuminance over the horizontal working plane
N = number of luminaire

GATE 1994

1. Answer (D) **Density control of residential area is expressed in terms of Floor Area Ratio**

F.A.R. Perhaps the best way to define an FAR is to give an example. An FAR of 1.0 means that the developer is allowed to build the equivalent of a one-story building over her entire lot, or a 2 -story over half the lot. An FAR of 2.0 means the developer is allowed to build the equivalent of a two-story building over her entire lot, or a 4 -story over half the lot.
F.A.R. is the ratio of total building floor area to the area of the plot.

Why FAR is used:

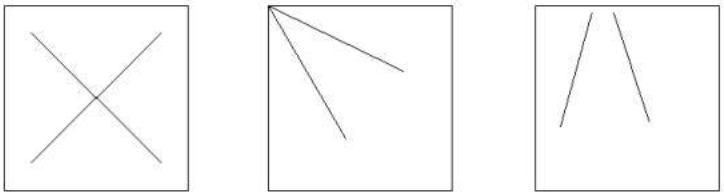
- Various tools are used by for regulating or guiding the development of our urban areas. The primary objective of using such tools is the optimal utilization of precious land considering its use, reuse, misuse, disuse and abuse . Among various development regulations adopted, Floor Area Ratio (F.A.R.) is one of the most important one, which regulates he bulk of the built space. Higher the F.A.R. value, more will be floor area within the same plot, and higher the pressure on land for infrastructure. Carrying capacity and development priorities assigned by the plan to each locality are the major factors which decide F.A.R. that can be permitted i n an area.
- F.A.R. values mainly determine the density or intensity of development of an area. Hence different F.A.R. values are prescribed for different locations in development plans.
- In brief; the permissible F.A.R. values are decided in relation to dif ferent inter-related aspects such as adequacy of water supply, sewerage system, solid waste disposal, road capacity, land availability, harmony with surrounding developments and other facilities, amenities and services.

2. Unanswered

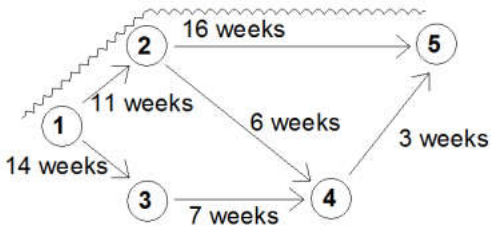
3. Answer (C) **The permissible height of a building on a plot is determined by abutting road width and floor area ratio**

4. Unanswered

5. Balanced Compositions in a square frame of 6 cm x 6cm as required:



6. Solution: 1 > 2 > 5 is the longest path and it should be given prime importance.

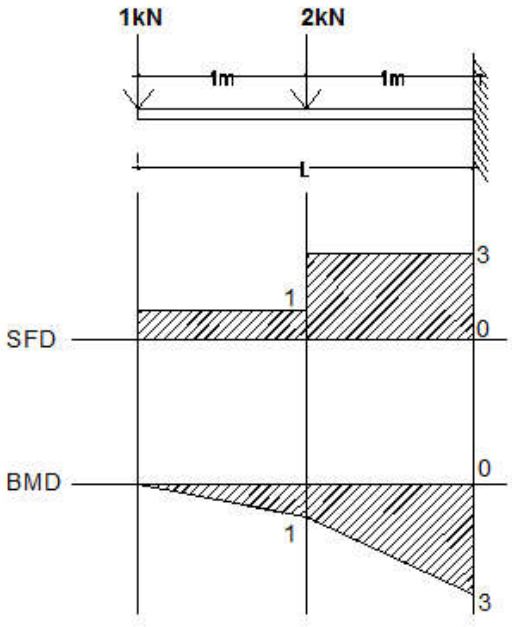


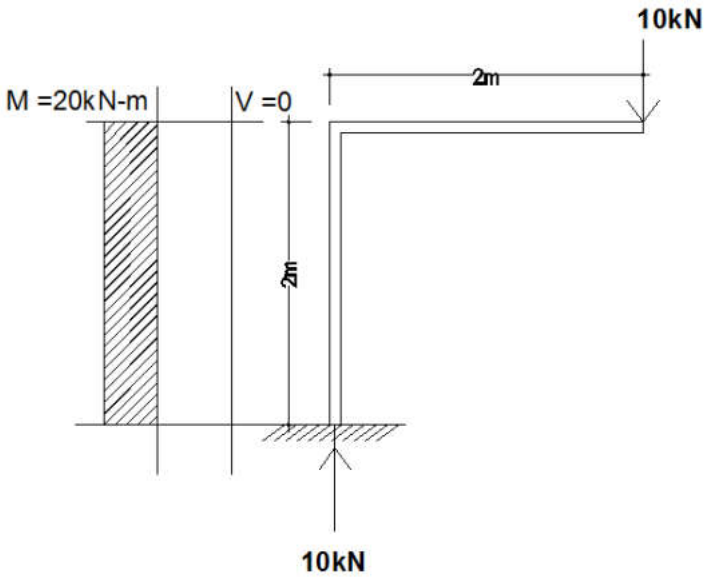
8. Volume of RCC slab = Slab area* Thickness = (3.5 m x 5.0 m) * (0.12 m) = 2.1 m^3
So, Quantity of steel = 0.8% of 2.1m^3*Density of steel = 0.0168m^3 *
Density of steel = 0.0168 m^3*7850 kg/m^3 = 132kg

Quantity of cement required = 2.1*6.2 bags = 13 bags
Quantity of sand required = 2.1*434 litres = 911.4 litres
Quantity of stone aggregates = 2.1*868 litres = 1822.8 litres

9. Unanswered

10. (a) The scale of the aerial photograph is 1:100000
(b) The total area of the settlement is 40000 hectares





Q3. B > E > H is the critical path.

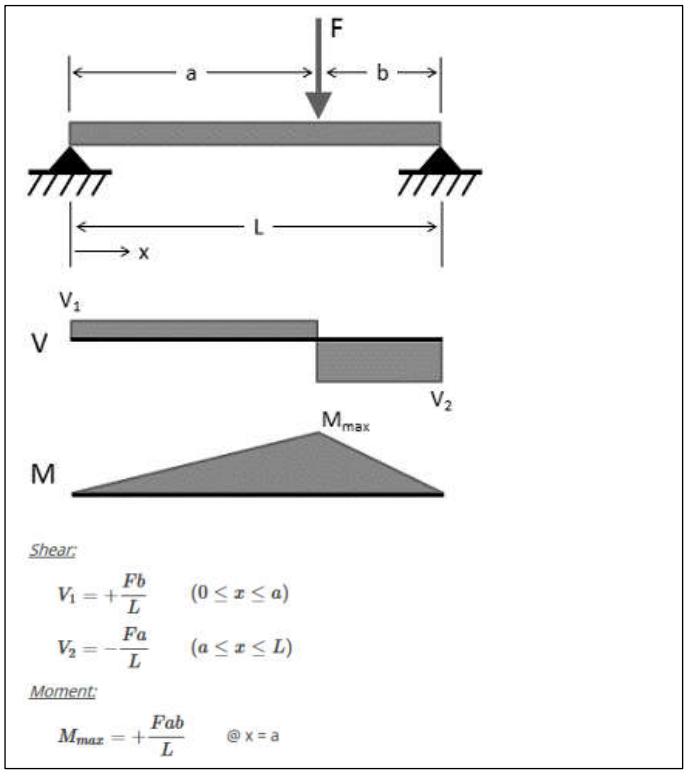
GATE 1991

Q1. Answer (B) **Ratio 'Golden Mean' is 1 : 1.618.**

Q2. Current Demand = Population / Household size = 2,15,000 / 5 = 43,000 Houses
Housing Demand in 2001 = Population / Household size = 2,70, 000 / 4.5 = 60,000 Houses
Demand difference = 60,000 – 43,000 = 17,000 Houses

Initially we needed 43,000 houses but we had only 39,000. So, Initial Shortage = 43,000 – 39,000 = 4,000 Houses
Depleted Houses = 3,500 Houses
So, total demand = Demand difference + Initial shortage + Depleted houses = 17,000 + 4,000 + 3,500 = 24,500 Answer

Q3.



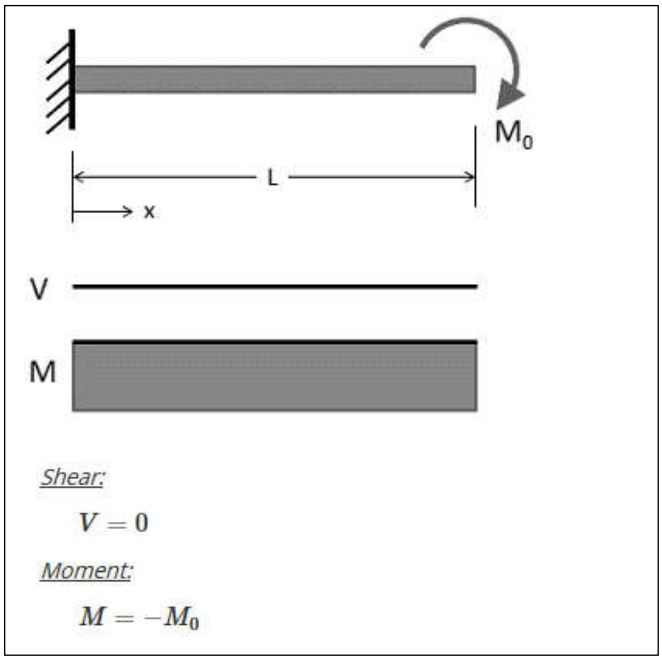
Shear:

$$V_1 = +\frac{Fb}{L} \qquad (0 \le x \le a)$$

$$V_2 = -\frac{Fa}{L} \qquad (a \le x \le L)$$

Moment:

$$M_{max} = +\frac{Fab}{L} \qquad @\ x = a$$



Shear:

$$V = 0$$

Moment:

$$M = -M_0$$