

# QUESTION BANK

Q&A *with* ESSENTIAL NOTES  
For Architecture & Planning

All Pages Printed in  
**COLOUR**

For Better Recall in Exam

&

**EMMERSIVE  
READING  
EXPERIENCE**

**LATEST  
UPDATE**  
Better  
Contents



By Faculty of Architecture

**GATE ARCHITECTURE.com**

**4 BOOKS**

Volume

**1 2 3 4**

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Volume

4

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Volume

1

Original  
Photograph

# Unique Features

## ★ The Question Bank in 4 Volumes

Easy to buy with friends by sharing.  
Easy to study in groups for best result.

## ★ All pages colour prints

For Immersive Reading Experience  
For better recall in exam!

## ★ Extensive coverage

Question Paper of GATE since 1991 to 2021 (31 Years)

## ★ Essential Notes

Notes has been provided not just for answering a question but also for extra coverage!

## ★ Comprehensive content

With total 672 pages. And it can be added further for upgrade without prior information!

## ★ QR-coded text

You can scan QR-code printed in the book from your phone for extra reading related of the subject.

## Preface

**Complete Syllabus through Question Bank:** The best way to prepare for an exam like GATE is through a comprehensive study of previous-year question papers. It takes less time to cover most part of the syllabus. Solving the previous GATE questions helps aspirants to understand the exam pattern, knowing the level of questions, and predict the pattern. At the same time, you may be aware that just knowing the answers of previous-year question paper is just not enough.

For example, if the question is: The teahouse is a feature of which type of landscape architecture? And you learnt that the answer is 'Japanese Garden'. It is best to support the answer with additional notes & figures about different types of gardens, i.e. French, English, and Chinese, etc. One reason for providing such notes is that it is rarely possible that in the next few years, the same question will be repeated. But it is quite possible that if a question is asked from a related topic, you should answer it if you have gone through additional studies or notes.

**Essential Notes:** Providing answer with essential notes & explanation is the main features of this Question Bank. It's been tried to cover the maximum part of the syllabus through providing supportive notes and answer itself.

**QR-code based book:** We have been using QR-code based deep learning for our GATE reference books since 2015. It gave us encouragement when it came to news that a teacher **Ranjitsinh Disale** won \$1mn Global Teacher Prize 2020 for using QR-codes based book for teaching in school.

This book is very concise. It contains a very exhaustive source of reference material for a deep understanding of the subject. So, it has QR-codes. Scan the code for further studies if you need. There are many QR code scanners available on Google Play Store or apple App Store.

We recommend, you scan the QR-codes with the app that comes with your phone itself. Installing the 'QR Code Reader' app from the Google Play Store or the Apple App Store may contain advertisement that could be irritating and downgrade reading experience. Some phone can scan QR-codes directly with its camera itself without any app!

**All Pages Color Printed:** All pages and illustrations of this Question Bank are color printed. Paper published by National Center for Biotechnology Information; US suggests that there are positive effects of color illustration on cognitive process.

**Complete Package:** This question bank contains question papers of last 31 years from 2021 to 1991. All it makes it the complete Question Bank. When you go through all these, you will get an idea of how question pattern and trend has changed over time. This will greatly help you to focus on the part of the syllabus which are frequently asked in exams.

**Feedback:** We keep improving the contents of this book through the feedback and suggestion from the readers. 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](mailto:gatearchitecture@gmail.com)

We request you to write a fair review on the ecommerce webpage from where you have bought the book.

This book should provide an edge to your study. Hopeful that it will make you confident and feel easy on question pattern.

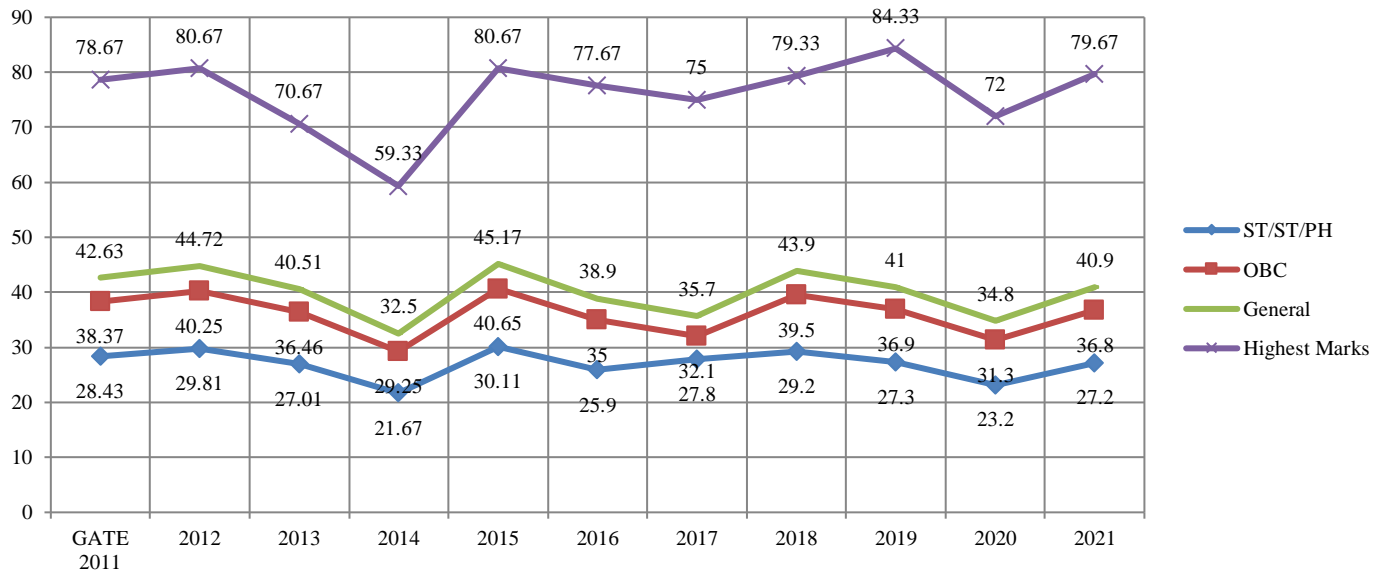
### Fab Quote”

“The interesting observation is to try to work with people, but even more than that, to try to make them successful. If you try to make others successful, they, in turn, will try to make you successful. No matter how brilliant you are, no matter how good you are, no matter how hard you work, if you rely only on yourself and believe you don't need the help of others, you are sadly mistaken. If you engage everybody around you by helping them, they will help you, in turn. And you will be more successful than you ever dreamed of.” – Former Director, Goldman Sachs

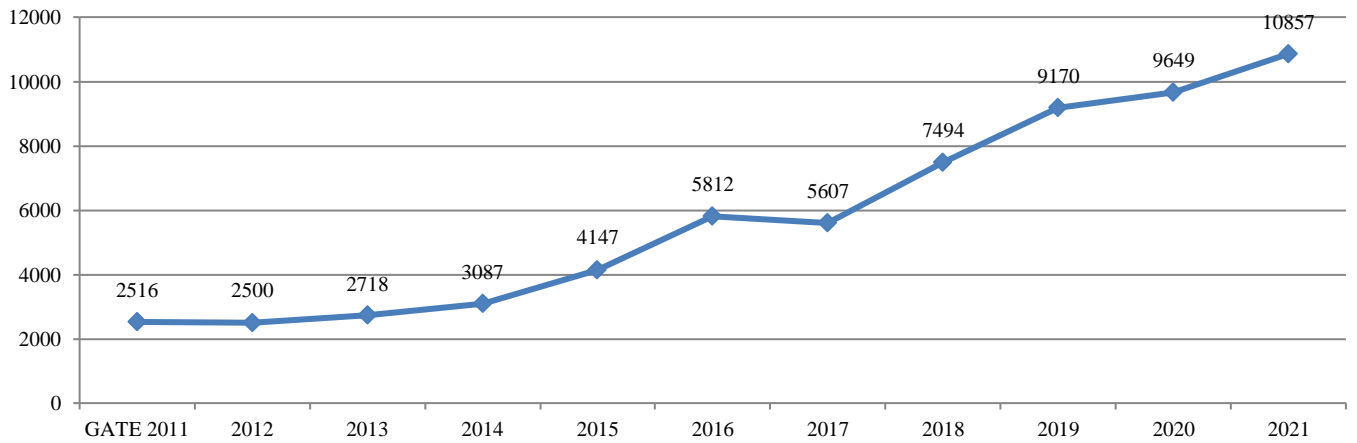
Happy reading. Make most of this book. We wish you all the best for GATE 2022.



### Cutoff Marks



### Appeared for GATE AR



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In pursuit of constantly improving this book, we would delete or add contents without prior information!

# Benefits of Colour Illustration

## Why is the Question Bank *COLOUR* printed?

A color printed book has numerous benefits to the readers in comparison to a black & white printed book. Following are the articles published in reputed journals and media elaborating the impacts of color illustrations. (Color: US spelling, Colour: UK spelling)

### Color Images More Memorable Than Black and White (Article)

Psychologists have found that colors enhance an individual's visual memory. From a series of experiments, researchers learned that subjects were more likely to recall the color version of an image than the same scene in black and white. The results, which appear in a issue of the *Journal of Experimental Psychology: Learning, Memory and Cognition*, also indicate that natural colors make a difference.



Felix Wichmann of the Max Planck Institute for Biological Cybernetics and his colleagues conducted five experiments, using subjects with normal vision. Participants initially viewed 48 images, half in color and half in black and white. The picture subjects fell into four different categories: landscapes, flowers, rock formations and man-made objects. Each category provided a different check on the results. For example, the flower pictures varied in terms of color, not shape, but those of rock formations offered the opposite. After presenting these images, the team mixed in 48 new scenes, showed the entire set of 96, and then recorded whether the subjects remembered the originals. The color images, they found, made much longer-lasting impressions than did the black-and-white ones.

To assess whether the visual memory system treats natural color and false color differently, the researchers presented subjects with altered images, such as scenes with reddish grass. They found that people did not remember these scenes any better than they did the black-and-white versions. According to study co-author Karl Gegenfurtner, this indicates that the visual memory system is tuned to the color schemes of the natural world. "If stimuli are too strange," Gegenfurtner says, "the system simply doesn't engage them as well." Advertising or design industries might do well to take note of the findings. To catch someone's eye, bright colors might be best, but if "the aim is more to have an image 'stick' in the viewer's memory," Wichmann suggests, "unnatural colors may not be suitable."

**SCIENTIFIC  
AMERICAN**

(Author: Greg Mone, 2002, Scientific American: <https://www.scientificamerican.com/article/color-images-more-memorab/>)

### The Influence of Colour on Memory Performance: A Review (Research Paper)

Human cognition involves many mental processes that are highly interrelated, such as perception, attention, memory, and thinking. An important and core cognitive process is memory, which is commonly associated with the storing and remembering of environmental information. An interesting issue in memory research is on ways to enhance memory performance, and thus, remembering of information. Can colour result in improved memory abilities? The present paper highlights the relationship between colours, attention, and memory performance. The significance of colour in different settings is presented first, followed by a description on the nature of human memory. The role of attention and emotional arousal on memory performance is discussed next. The review of several studies on colours and memory are meant to explain some empirical works done in the area and related issues that arise from such studies.

#### Introduction

Memory refers to the mental process of encoding, retaining, and retrieving environmental information. How the human cognitive system deals with the memorization process remains the centre of research among cognitive psychologists. One of the most interesting and challenging questions in contemporary memory research is on ways to enhance human memory performance. Many variables have been proposed to contribute to the retrieval operations and one of the variables is colour, which will be discussed thoroughly in the present paper.

Colour is believed to be the most important visual experience to human beings. It functions as a powerful information channel to the human cognitive system and has been found to play a significant role in enhancing memory performance. Colour can be very effective in learning and educational setting, marketing, communication, or even sport. For instance, a marketing study has found that colour can increase brand recognition by up to 80%. Most advertisements use colour as one of the important element in influencing people's attention, attitude towards the product, and pressuring decision making. According to White, coloured advertisements can attract people to read the advertisement up to 42% more often than the non-coloured advertisement. This shows the importance of colour in making the information or message more attractive to the public.

In the educational setting, higher demand is put on excellent academic achievement. The extent to which students utilize their cognitive abilities is also important and may contribute to better academic achievement. The cognitive abilities of the students refer to the way the students perceive, pay attention, remember, think, and understand the lessons. There need to be strategies to facilitate the learning process and colours can play a role in motivating students to learn and profit from their educational experiences.

## Memory Techniques

### How to enhance your memory so that you can remember fast to get best of the Question Bank?

For that, we have already this book printed in **Colour** as it supports better cognitive activity of your brain. On our website: [gatearchitecture.com](http://gatearchitecture.com), there is a tab '**Student Yoga**' that may help perform you better in exam. Other than this, following articles can help you in better learning. Many students complain that they can't remember necessary material. They say they understand the content when they read it, but can't recall it later. There is a difference between understanding and remembering. You may understand all the systems of the human body (they make sense when you read about them), but that doesn't mean you'll be able to recall the necessary terms. Fortunately, there are memory techniques and strategies for you to use. Some will be more useful for some subjects and content than others.

#### Baker/baker paradox

There is a term "elaborative encoding" that is well-illustrated by a nifty paradox known as the Baker/baker paradox, which goes like this: If a person tells two people (you and your friend) to remember the same word, if the person says to your friend, "Remember that there is a guy named Baker." That's his name. And the person says to you, "Remember that there is a guy who is a baker." The person comes back to your friend at some point later on, and says, "Do you remember that word that I told you a while back? Do you remember what it was?" The friend who was told his name is Baker is less likely to remember the same word than what was told to you that his job is a baker. Same word, different amount of remembering; that's weird. What's going on here?



Well, the name Baker doesn't actually mean anything to you. It is entirely untethered from all of the other memories floating around in your skull. But the common noun "baker" -- we know bakers. Bakers wear funny white hats. Bakers have flour on their hands. Bakers smell good when they come home from work. Maybe we even know a baker. And when we first hear that word, we start putting these associational hooks into it, that make it easier to fish it back out at some later date.

**20 Memory Techniques** Experiment with these techniques to make a flexible, custom-made memory system that fits your style of learning.

#### 1. Learn from the general to the specific.

Imagine looking at a new painting this way. Blindfold yourself. Put a magnifying glass up to your eye. Move your face within inches of the painting. Now, yank the blindfold off and begin studying the painting, one square inch at a time. Chances are, even after you finished "looking" at the painting this way, you wouldn't know what it is. Unfortunately, many students approach new courses and textbooks just this way. They feel driven to jump right in and tackle the details before they get the big picture. Here is a different approach. Before you begin your next reading assignment, skim it for the general idea. You can also use this technique at the beginning of a course. Ask someone who has taken it to quickly review it with you. Do a textbook reconnaissance of the reading assignments for the entire course. This technique works best at the beginning of a term, but it's never too late to use it. If you're lost, step back and look at the big picture. The details might make more sense.



## Meditation for Memory

Meditation is the most effective way of improving the ability of our mind to pay attention to tasks – which is important for improving retention and converting a short-term memory into a long-term memory.

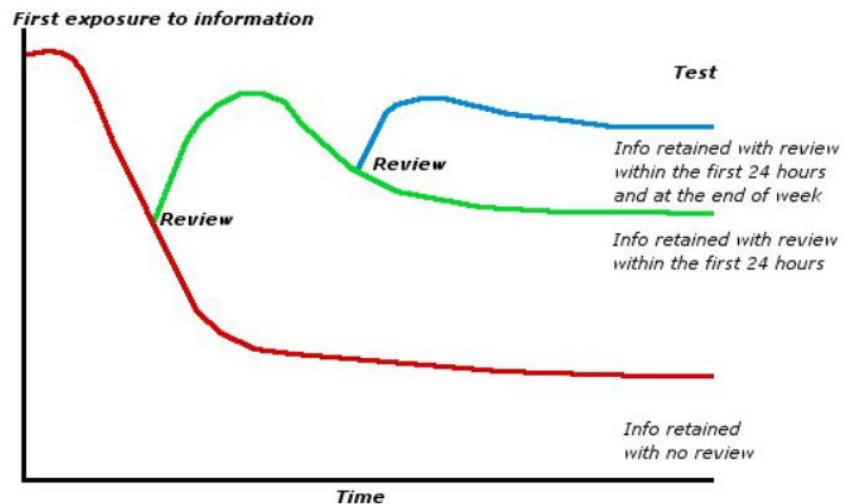
Studies have demonstrated that practicing meditation improves our ability to focus on smaller details. (Maclean et al. 2010).

Source: <https://www.magneticmemorymethod.com/how-to-remember-things/>

## The Importance of Review

The most important part of note taking is reviewing your notes after class. Notes do very little if they are never looked at again! The average student forgets up to 80 percent of the information within 24 hours of learning it. Students can dramatically increase the amount of information they retain by reviewing the information within that first 24 hours. When reviewing, edit and clarify notes, focusing on main ideas and key points. One way of doing this is by using the Cornell System. To further improve retention, do a weekly review as well. Choose one night of the week (weekends work well for this) to go over notes from the past week of class for all of your classes. Plan to spend about 30 minutes per class. Review also improves retention of information from textbooks and can be done in almost the same manner. After reading

each chapter or section of the text, do a short review within 24 hours and a comprehensive review on a weekly basis. Nobody is anxious to add another task to their list of things to do, but reviewing often saves time in the long run, since consistent review leads to less cramming before tests. Studying for a short period of time each day is more effective than studying for many hours on a single day.



(Figure: Adapted from WWU's Tutorial Center)

Source: <https://selkirk.ca/sites/default/files/Learning/Selkirk-College-Learning-Success-Memory-Techniques-Workshop.pdf>



**TEDx**  
**YouTube**

How to remember?



# Syllabus 2022

## Architecture and Planning (AR): New Pattern

New

The Paper contains General Aptitude (GA) section (15 Marks) as applicable for all papers of GATE 2022.

The Paper consists of two parts covering the syllabus: Part A (60 marks) and Part B (25 marks).

**Part A** is compulsory for all the candidates.

**Part B** contains two **optional** sections: Part B1 (Architecture) and Part B2 (Planning).

*Candidates have to choose any one of these during the examination! (Part B1 or Part B2)*

### Part A: General

#### Section 1: Architecture, Planning and Design

Architectural Graphics; Visual composition in 2D and 3D; Computer application in Architecture and Planning; Anthropometrics; Organization of space; Circulation- horizontal and vertical; Space Standards; Universal design; Building byelaws; Codes and standards;

#### Section 2: Construction and Management

Project management techniques e.g. PERT, CPM etc. ;Estimation and Specification; Professional practice and ethics; Form and Structure; Principles and design of disaster resistant structures; Temporary structures for rehabilitation;

#### Section 3: Environmental Planning and Design

Natural and man-made ecosystem; Ecological principles; Environmental considerations in Planning and design; Environmental pollution- types, causes, controls and abatement strategies; Sustainable development, goals and strategies; Climate change and built environment; Climate responsive design;

#### Section 4: Urban Design, landscape and Conservation

Historical and modern examples of urban design; Elements of urban built environment –urban form, spaces, structure, pattern, fabric, texture, grain etc.; Concepts and theories of urban design; Principles, tools and techniques of urban design; Public spaces, character, spatial qualities and Sense of Place; Urban design interventions for sustainable development and transportation; Development controls – FAR, densities and building byelaws.; Urban renewal and conservation; heritage conservation; historical public spaces and gardens; Landscape design; Site planning;

#### Section 5: Planning process

Salient concepts, theories and principles of urban planning; concepts of cities - Eco-City, Smart City; Concepts and theories by trendsetting planners and designers; Ekistics; Urban sociology; Social, Economic and environmental cost benefit analysis; Methods of non-spatial and spatial data analysis; Development guidelines such as URDPFI;

#### Section 6: Housing

Housing typologies; Concepts, principles and examples of neighbourhood; Residential densities; Affordable Housing; Real estate valuation;

#### Section 7: Services and Infrastructure

Firefighting Systems; Building Safety and Security systems; Building Management Systems; Water treatment; Water supply and distribution system; Water harvesting systems; Principles, Planning and Design of storm water drainage system; Sewage disposal methods; Methods of solid waste management - collection, transportation and disposal; Recycling and Reuse of solid waste; Land-use – transportation - urban form inter-relationships; Design of roads, intersections, grade separators and parking areas; Hierarchy of roads and level of service; Para-transits and other modes of transportation, Pedestrian and slow moving traffic planning;

### Part B1: Architecture

#### Section B1.1: History and Contemporary Architecture

Principles of Art and Architecture; World History of Architecture: Egyptian, Greco-Roman classical period, Byzantine, Gothic, Renaissance, Baroque-Rococo, etc.; Recent trends in Contemporary Architecture: Art nouveau, Art Deco, Eclecticism, International styles, Post Modernism, Deconstruction in architecture, etc.; Influence of Modern art and Design in Architecture; Indian vernacular and traditional Architecture, Oriental Architecture; Works of renowned national and international architects;

#### Section B1.2: Building Construction and Structural systems

Building construction techniques, methods and details; Building systems and prefabrication of building elements; Principles of Modular Coordination; Construction planning and equipment; Building material characteristics and applications; Principles of strength of materials; Alternative building materials; Foundations; Design of structural elements with different materials; Elastic and Limit State design; Structural systems; Principles of Pre-stressing; High Rise and Long Span structures, gravity and lateral load resisting systems;

#### Section B1.3: Building Services and Sustainability

Solar architecture; Thermal, visual and acoustic comfort in built environments; Natural and Mechanical ventilation in buildings; Air-Conditioning systems; Sustainable building strategies; Building Performance Simulation and Evaluation; Intelligent Buildings;

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Volume

**1**

Where,  
 $PMV = \text{Predicted Mean Vote Index}$   
 $M = \text{metabolic rate}$   
 $L = \text{thermal load - defined as the difference between the internal heat production and the heat loss to the actual environment - for a person at comfort skin temperature and evaporative heat loss by sweating at the actual activity level}$

**What is PPD?**

Through PMV, we can predict the thermal sensation of a population, but this doesn't paint the whole picture. We also need to consider the level of satisfaction of the occupants in a space, to get a more holistic idea of if and how thermal comfort can be achieved. For this, Fanger developed another equation to relate the PMV to the predicted percentage of dissatisfied (PPD).

(Source: <https://www.simscale.com/blog/2019/09/what-is-pmv-ppd/>, [https://www.engineeringtoolbox.com/predicted-mean-vote-index-PMV-d\\_1631.html](https://www.engineeringtoolbox.com/predicted-mean-vote-index-PMV-d_1631.html))

Q3. Indian satellite sensor that can be used for very high resolution mapping of urban areas is

- (A) LANDSAT (B) CARTOSAT (C) RESOURCESAT (D) MODIS (Marks to all)

Cartosat series of satellites launched by ISRO (Indian Space Research Organization) with high-resolution imaging sensors are primarily intended for applications in the areas of cartography and large-scale mapping. Some of the important applications include monitoring of irrigation infrastructure created under Accelerated Irrigation Benefit Program, NUIM (National Urban Information System), Topo-thematic mapping at 1:10,000 scale, Urban Infrastructure planning, and many State level Geospatial applications.

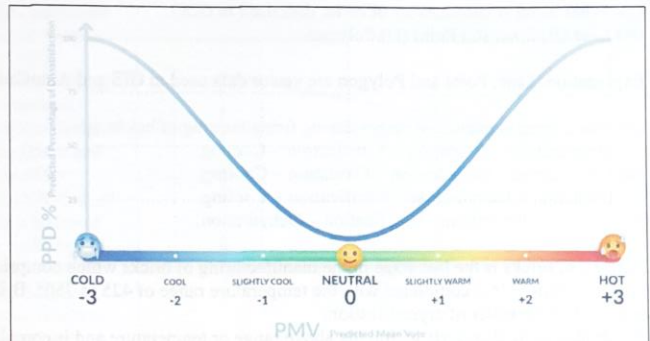


Figure: Once the PMV is calculated, the PPD, or index that establishes a quantitative prediction of the percentage of thermally dissatisfied occupants (i.e., too warm or too cold), can be determined. PPD essentially gives the percentage of people predicted to experience local discomfort. The main factors causing local discomfort are unwanted cooling or heating of an occupant's body. Common contributing factors are drafts, abnormally high vertical temperature differences between the ankles and head, and/or floor temperature.



Figure: Imaginary by Cartosat -3 of an urban area in Doha

Cartosat-3 is a third-generation agile advanced earth observation satellite with high-resolution imaging capability. Developed by the ISRO, it will replace the IRS series. Cartosat-3 has a panchromatic resolution of 0.25 metres making it the imaging satellite with highest resolution and Mx of 1 metre with a high-quality resolution, which is a major improvement from the previous payloads in the Cartosat series.

(Source: <https://www.isro.gov.in>, <https://www.sciencedirect.com/topics/earth-and-planetary-sciences/cartosat>, <https://www.business-standard.com>)

Figure: Environmental and psychophysical factors that influence thermal comfort

Gordon Cullen, the humanist and urbanist designer, first published his seminal work "Townscape" in 1961, and a concise version of it was published ten years later (Cullen 1961, 1971). Cullen liked to call his theory and approach to understanding and manipulating the elements of townscape an "Environment Game." He presented his discovery of humanistic urban design in three "gateways": Motion (Serial Vision), Position (Here and There), and Content (This and That). A detailed review of the entire Townscape treatise is not intended here but a short revisit of the serial vision. In concerning "Optics," Cullen calls a series of "jerks or revelations" that we may experience when walking through a town or city at a uniform speed as Serial Vision. He considers that a town can become visible in a deeper sense if vivid contrasts can be felt, as "the human mind reacts to the difference between things," or "the drama of juxtaposition" (Source: [http://papers.cuminead.org/data/works/att/cf2003\\_m\\_017.content.pdf](http://papers.cuminead.org/data/works/att/cf2003_m_017.content.pdf))

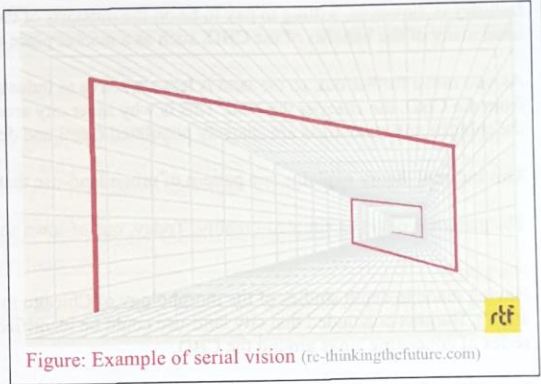


Figure: Example of serial vision (re-thinkingthefuture.com)

**Rashtrapati Bhavan, New Delhi, India**

Designed by Herbert Baker and Edward Lutyens, the new capital was envisioned on the principles of Garden City. The Rajpath that

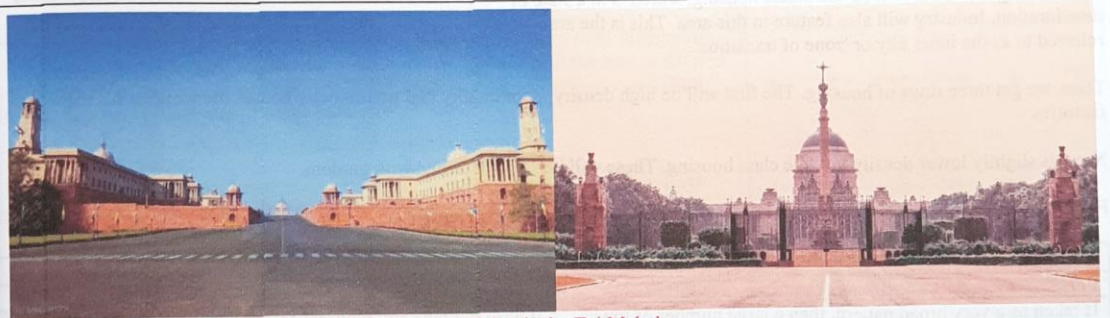


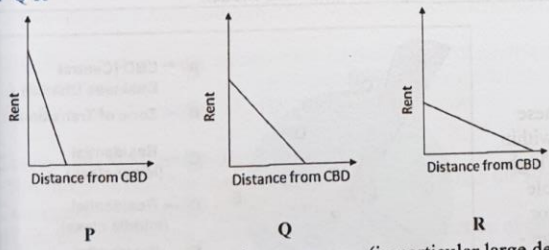
Figure: Another example may be considered as serial vision is the Taj Mahal.

leads to the Rashtrapati Bhavan has a series of visual screening as well as enhancing elements, thus, creating a progression of frames. A sense of progression is created and keeps the observer moving forward. The avenues and the water bodies confine you to the focal point and as you move forward your frame gets bigger with multiple buildings and different views. An illusion of nearness and closeness that is created in the first frame fades out as one approaches the main building in focus, revealing more and more buildings of different scales and functions. In this example, serial vision is used to suggest the majestic and authoritative nature of the building in focus.



Q8. A waste water pipe connecting two inspection chambers (IC) is laid at a slope of 1:200. The Invert Level of the starting IC is -450 mm. The Invert level of the second pit at a distance of 40 m from the first IC is (A) -650 mm (B) -200 mm (C) -250 mm (D) -550 mm

Q9. From the images P, Q and R given below, select the corresponding land use categories according to Alonso's Bid Rent Theory. P Q R



- (A) P-Manufacturing; Q-Residential; R-Retail
- (B) P-Retail; Q-Residential; R-Manufacturing
- (C) P-Residential; Q-Retail; R-Manufacturing
- (D) P-Retail; Q-Manufacturing; R-Residential

Explanation: It can be seen that commerce (in particular large department stores/chain stores) is willing to pay the greatest rent to be located in the CBD. The CBD is very valuable for them because it is traditionally the most accessible location for a large population. This large population is essential for department stores, which require a considerable turnover. As a result, they are willing and able to pay a very high land rent value. They maximise the potential of their site by building many stories.

As you move from the CBD, commerce is unwilling to pay as much for a site. In fact, what they are willing to pay declines rapidly.

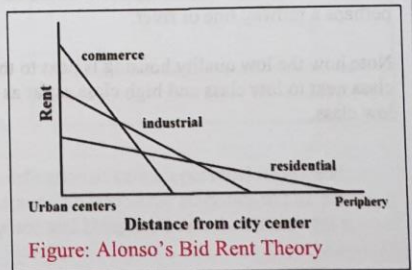


Figure: Alonso's Bid Rent Theory

**Evaluation:**

For	Against
Some cities seem to follow Hoyt's sectors. Bristol, for example, has a very clear industrial sector following a main rail line and the River Avon.	Like Burgess' there is little reference to the physical environment.
It provides us with an alternative set of explanations to Burgess.	The growth of sector can be stopped as land-use leapfrogs out of the old inner city. For example, out of town council estates have prevented large high-class sector developing in other areas of Bristol.
Communication routes (Rivers, roads, railways) do often provide a very definite boundary to a sector/land-use.	Again, like Burgess, there is no reference to out of town developments.

In addition, the division between land-uses in both models is far too clear-cut. Firstly, you would not suddenly walk from lower to middle to higher class housing. Also, all zones will have a mixture of land-uses. Residential zones will have shops and industry in amongst them.

They do, however, give us a bench mark for comparison and allow us to have a basic understanding of the complex set of processes that determine the distribution of land-use within a city.

**Central place theory**

Christaller's **central place theory** basically tells us that if there is an even distribution of population, all with equal money and transport opportunities, and the land is flat and featureless, then settlements will follow a distribution pattern according to size. **The distribution will follow one of three patterns:**

**1. Market Optimising:**

The shoppers in smaller settlements divide into three equal groups when shopping in the three nearest larger settlements.

**2. Transport Optimising:**

Shoppers in smaller settlements divide into two equal groups when shopping in the two nearest larger settlements.

**3. Administration Optimising:**

All shoppers in the smaller settlements shop in the nearest large settlement.

The largest settlement, which is in the centre of the hexagon, will be surrounded by a number of smaller settlements. People from the small settlements will visit the large settlement for a particular good or service that their village does not provide. People cannot cross the boundary hexagons because Christaller says they must shop in their nearest central place.

He also introduced the concepts of **threshold** and **range**:

**Threshold** is the minimum number of people needed to support a service.

**Range** is the maximum distance people are prepared to travel to purchase a good or service.

Source: <https://s-cool.co.uk/a-level/geography/urban-profiles/revise-it/models-from-burgess-and-hoyt>

Q10. The urban land use model based on the concept of a polycentric city is known as

- (A) Burgess Model
- (B) Harris and Ullman model
- (C) Hagerstrand's Model
- (D) Homer Hoyt's model

**Concept and need for Multiple Nuclei Model**

This model is based on the structure of Chicago just like the Burgess model or Concentric zone model of 1925.

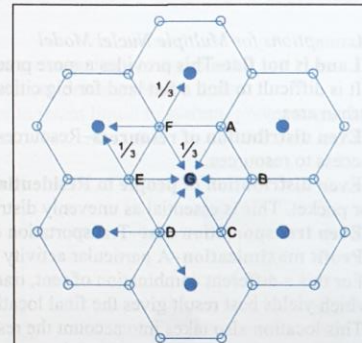
It can be considered as an attempt to explain the structure of city taking into account the complexity and growth over time.

Harris and Ullman argued that a city might start with a single central business district (CBD) but over the time the activities scatter and gets modified.

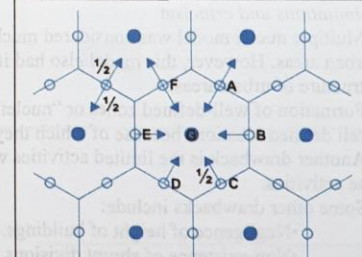
The scattered activities attract people from surrounding areas and acts as smaller nuclei in itself.

These small nuclei gain importance and grow in size and starts influencing the growth of activities around them.

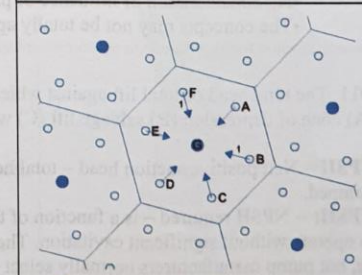
The need for this model was to provide a more realistic explanation of the cities. The influence of cars on personal travel and greater movement of goods provided opportunity in different places instead of concentrating all economic activities in one place. People started optimizing their business for maximum profit by locating at different place and bringing down their rent with a slight increase in transportation cost.



● Highest order settlements ○ Lower order settlements  
**Figure: Market Optimising**



● Highest order settlements ○ Lower order settlements  
**Figure: Transport Optimising**



● Highest order settlements ○ Lower order settlements  
**Figure: Administration Optimising**

- A - CBD (Central Business District)
- B - Zone of Transition
- C - Residential (lower class)
- D - Residential (middle class)
- E - Residential (upper class)

**Zone Model by Ernest Burgess**

purchase land. The further from the center, the lower the rent for houses, flats and high rises) in the concentric ring model. These have influenced the pattern of land use in cities. The Zone Model by Ernest Burgess shows the workers for the factory moving into the area. Features into account. Burgess' model does not follow the pattern of any city will be influenced by the area. It is available allowing more people to mean that commuter villages have moved from the edge of the urban area. This has been this. The introduction of car has meant that some people can now be found in traditional council estates have built up on the outskirts. These are now some of the most expensive areas. The manufacturing industry has influenced his model.

- A - CBD (Central Business District)
- B - Zone of Transition
- C - Residential (lower class)
- D - Residential (middle class)
- E - Residential (upper class)
- F - Industry

Example of liner regression in a trip generation model:

$$Y = 0.91 + 1.44X_1 + 1.07X_2$$

number of trips
number of workers
number of cars

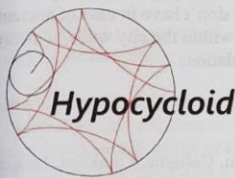
Where,

- Y = No. of trips per household = Independent variable
- X<sub>1</sub> = No. of workers per household = Dependent variable
- X<sub>2</sub> = No. of cars per household = Dependent variable

(Source: <https://ocw.tuelft.nl/wp-content/uploads/2015/08/comprehensive-guide-regression-1.pdf>  
<https://www.analyticsvidhya.com/blog/2015/08/comprehensive-guide-regression/>)

Q15. The curve traced by a point on a circle rolling inside another circle is known as

- (A) hypocycloid (B) helix (C) involute (D) hyperbola



(Source: <https://mathimages.swarthmore.edu/index.php/Involute>)

Q16. The law of Primate City was first proposed by

- (A) Samuel A. Stouffer (B) Colin Clark
- (C) Mark Jefferson (D) Harold Hotelling

The idea of primacy was first introduced by Mark Jefferson in 1939. His proposition was that nationalism crystallizes in primate cities which are super eminent in both size and national influence. He assessed the degree of primacy by computing the ratio of the size of the second and third ranking cities to that of the largest one. He found that in the forty-six countries of the world the largest cities were two or three times as large as the next largest city. The ratio of the population of the three largest cities approximated the sequence 100:30:20 (i.e. the third largest is one-fifth the size of the largest). According to him there are various reasons for a city to exceed its neighbors in size, but once it did so the process became cumulative giving it an impetus to grow and draw away from all other cities in character as well as size. The particular ratio sequence has been later ignored, though the concept of the primate city and primacy is widely used.

A primate city is the largest city in its country or region, disproportionately larger than any others in the urban hierarchy. A primate city distribution is a rank-size distribution that has one very large city with many much smaller cities and towns, and no intermediate-sized urban centers: a King effect, visible as an outlier on an otherwise linear graph, when the rest of the data fit a power law or stretched exponential function. The law of the primate city was first proposed by the geographer Mark Jefferson in 1939. He defines a primate city as being "at least twice as large as the next largest city and more than twice as significant." Aside from size and economic influence, a primate city will usually have precedence in all other aspects of its country's society, such as being a center of politics, media, culture and education and receive most internal migration. The Rank-Size Rule.

**Examples of Countries with Primate Cities**

- Paris (9.6 million) is definitely the focus of France while Marseilles has a population of 1.3 million.
- Similarly, the United Kingdom has London as its primate city (7 million) while the second-largest city, Birmingham, is home to mere one million people.
- Mexico City, Mexico (8.6 million) outshines Guadalajara (1.6 million).
- A huge dichotomy exists between Bangkok (7.5 million) and Thailand's second city, Nonthaburi (481,000).

The rank-size rule says that 'when ranks of cities, arranged in descending order, are plotted against their populations (rank 1 being given to the largest, and so on) in a doubly logarithmic graph, a rank-size distribution results' (Das and Dutt 1993: 125), or to put it in much simpler words: 'In an ordered set of cities representing a given country, the product of the rank and size of a city is constant' (Dziewonski 1972: 73). The rank-size rule is also commonly referred to as Zipf's Law because the model describing a constant relation between the size of an event and its rank was at first developed by G. Zipf. In the case of cities distribution by population, when the natural logarithms of the rank and of the city size (in terms of the number of people) are calculated and

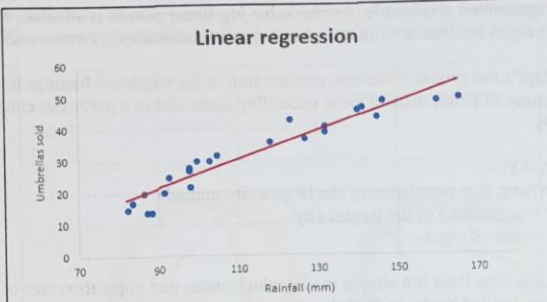


Figure: Example of linear regression. It is finding of the formula of the line (here in red) that would represent the best relationship between the variables. The regression line will demonstrate the relationship between the independent variable (rainfall) and dependent variable (umbrella sales)

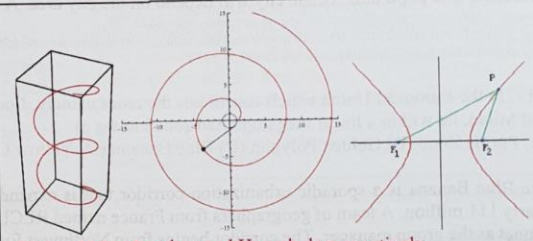


Figure: Helix, Involute and Hyperbola respectively



Figure: "A primate city as being at least twice as large to the next largest city, and more than twice as significant."  
 ~ Mark Jefferson

Q18. An urban governance tool to mobilize financial resources by permitting additional FAR over and above the prescribed FAR by imposing a charge or fee for the same is known as  
 (A) Betterment Levy (B) Impact Fee (C) Land Value Increment Tax (D) Floor Area Incentive Tax (Answer to all)

Q19. Identify the colour palette that is created using any three equally spaced hues around the colour wheel.  
 (A) Split – complementary (B) Analogous (C) Triads (D) Complementary

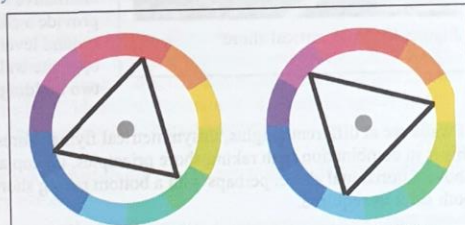
Q20. Coefficient of Performance (COP) for heat pump is used to calculate  
 (A) the number of air changes. (B) the Energy Efficiency Ratio  
 (C) the Energy Select Sector index. (D) the Indoor Air Quality index.

$$\text{COP} = \frac{\text{energy out}}{\text{energy in}}$$

Energy out, or the heat pump's expected output  
 Energy In, or how much energy it takes to run the heat pump

The efficiency of refrigeration systems and heat pumps is denoted by its Coefficient Of Performance (COP). The COP is determined by the ratio between energy usage of the compressor and the amount of useful cooling at the evaporator (for a refrigeration installation) or useful heat extracted from the condenser (for a heat pump). A high COP value represents a high efficiency.

Most of the electric energy needed to drive the compressor is released to the refrigerant as heat. Therefore, more heat is available at the condenser than is extracted at the evaporator of the heat pump. (Source: [https://industrialheatpumps.nl/en/how\\_it\\_works/cop\\_heat\\_pump/](https://industrialheatpumps.nl/en/how_it_works/cop_heat_pump/))



Red Green Blue  
Triad Color Harmony

Cyan Magenta Yellow  
Triad Color Harmony

Figure: Three colors that are evenly spaced on the Color Wheel form a Triad or Triadic Color Harmony. Two fundamental triad color combinations on an RGB Color Wheel are the Red, Green, and Blue (RGB) primaries and the Cyan, Magenta and Yellow (CMY) set used in printing. (Source: <https://medium.com/nightingale/three-way-color-in-a-donut-visualization-b22aad7b9617>)

Q21. Freight flows are converted to truck flows using  
 (A) Volume factor (B) Weight factor  
 (C) Payload factor (D) Distance load factor

Q22. Rebound hammer test is used to measure  
 (A) permeability of concrete  
 (B) bond stress between rebar and concrete  
 (C) compressive strength of concrete  
 (D) tensile strength of concrete

Q23. Which type of temporary supporting structure can be used in case of rebuilding the lower part of a load bearing wall at ground floor above plinth level? (A) Dead Shore (B) Pit Underpinning (C) Flying Shore (D) Needle Scaffolding

Q24. During earthquake, soft storey failure in a building is due to  
 (A) shear failure initiated by short column effect.  
 (B) stress discontinuity initiated by abrupt changes of stiffness.  
 (C) failure of column initiated by weak column – strong beam effect.  
 (D) drift of building storey initiated by pounding effect.

**Shoring** is the technique of using a temporary support, usually a form of prop, to make a structure stable and safe. It is often used to provide lateral support:

- To walls undergoing repair or reinforcement.
- During excavations.
- To prevent walls bulging out.
- When an adjacent structure is to be pulled down.
- When openings in a wall are made or enlarged.

There are three basic types of **shoring** system that can be used separately or in combination depending on the nature of the support required.

**Raking shores** involve inclined members, or rakers, typically placed at 3-4.5 m centres, and braced at regular intervals. They tend to be inclined at between 40-75°. Typical materials that are used include timber, structural steel, and framed tubular scaffolding.



Scan to watch on Youtube about the Rebound hammer test.

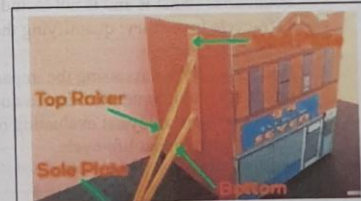


Figure: Raking shore  
 (Source: civilconcept.com)





The IPCC provides regular assessments of the scientific basis of climate change, its impacts and future risks, and options for adaptation and mitigation

Created in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), the objective of the IPCC is to provide governments at all levels with scientific information that they can use to develop climate policies. IPCC reports are also a key input into international climate change negotiations. The IPCC is an organization of governments that are members of the United Nations or WMO. The IPCC currently has 195 members. Thousands of people from all over the world contribute to the work of the IPCC. For the assessment reports, IPCC scientists volunteer their time to assess the thousands of scientific papers published each year to provide a comprehensive summary of what is known about the drivers of climate change, its impacts and future risks, and how adaptation and mitigation can reduce those risks. An open and transparent review by experts and governments around the world is an essential part of the IPCC process, to ensure an objective and complete assessment and to reflect a diverse range of views and expertise. Through its assessments, the IPCC identifies the strength of scientific agreement in different areas and indicates where further research is needed. The IPCC does not conduct its own research.

In a recent publications, a series of special reports published over the last year, cover living on a planet with 1.5 degrees Celsius of global warming, and the effects of climate change on land, oceans and icy places.

In 2007, the IPCC was awarded the Nobel Peace Prize.

[Source: <https://www.ipcc.ch/about/>, <https://www.dw.com/en/what-is-the-ipcc-and-what-does-it-do/a-50552119>]

### toe

**Tonne of oil equivalent (toe)** is a unit of energy, defined as the amount of energy released by burning one tonne (1000 Kilograms) of crude oil. The toe is used to describe large amounts of oil or natural gas in transport or consumption, and will often use a prefix of mega (1 000 000) in order to communicate this as Mtoe.

### Mtoe

Millions of tonnes of oil equivalent (Mtoe) is a unit of energy used to describe the energy content of all fuels, typically on a very large scale. It is equal to  $4.1868 \times 10^{16}$  Joules, or 41.868 petajoules which is a tremendous amount of energy. The Mtoe is much smaller than the quad, but can be multiplied by 1000 in order to compare to it (1000 Mtoe = 1 Gtoe = 39.68 quad).

[Source: [https://energyeducation.ca/encyclopedia/Tonne\\_of\\_oil\\_equivalent](https://energyeducation.ca/encyclopedia/Tonne_of_oil_equivalent)]

### Green Building Rating Systems list in various countries

SN	Rating System	Full Form	Country	Year
1	BREEAM	Building Research Establishment's Environmental Assessment Method	UK	1990
2	BEPAC	Building Environmental Performance Assessment Criteria	Canada	1993
3	LEED	Leadership in Energy and Environmental Design	US	1998
4	PromiseE	The Finnish Environmental Assessment and Classification System	Finland	2002
5	BEAM Plus	Built Environmental Assessment Method	Hong Kong	2010
6	EcoEffect	-	Sweden	1997
7	GBA/GBTTool	Green Building Assessment (GBA)	Canada	1998
8	NABERS/ABGR	National Australian Built Environment Rating System/ Australian Building Greenhouse Rating system	Australia	1999
9	EEWH	-	Taiwan	1999
10	Eco-Quantum	-	Netherlands	1999
11	CG	Green Globes	Canada	2000
12	BEAT	Building Evaluation Assessment Tool	Denmark	2000
13	Ecoprofil	Ökoprofil	Norway	2000
14	CASBEE	Comprehensive Assessment System for Building Environmental Efficiency	Japan	2001
15	CASBEE	Comprehensive Assessment System for Building Environmental Efficiency	Hong Kong	2002
16	CEPAS	Comprehensive Environmental Performance Assessment Scheme	Korea	2002
17	KGBC	Korea Green Building Certification System	Australia	2003
18	GS	Green Star	India	2004
19	GRIHA	Green Rating for Integrated Habitat Assessment	France	2005
20	HQE	Haute Qualite Environment	Israel	2005
21	Si-5281	Israel Standard 5281: Building with Reduced Environmental Impact	Singapore	2005
22	GM	Green mark	America	2006
23	LBC	Living Building Challenge	America	2006
24	GPR	Green Point Rated	China	2006
25	ASGB	Assessment Standard for Green Building	Germany	2006
26	DGNB	Deutsche Gesellschaft Fur Nachhaltiges Bauen	UK	2006
27	CSH	Code for Sustainable Homes	Abu Dhabi	2007
28	EPRS	Estidama Pearl Rating System	Mexico	2008
29	SICES	Sustainable Building Rating Tool/Sistema de Calificación de Edificación Sustentable	America	2008
30	NGBS	National Green Building Standard	Brasil	2008
31	AQUA-HQE	Alta Qualidade Ambientale	Portugal	2008
32	LiderA	The Sistema de Acaliacao da Sustentabilidade (Certification System of Environmentally Sustainable Construction)	Italy	2009
33	ITACA Protocol	Protocollo Itaca	Malaysia	2009
34	GBI	Green Building Index	Philippine	2009
35	BERDE	Building for Ecologically Responsive Design Excellence	Qatar	2009
36	GSAS	Global Sustainability Assessment System	Spain	2009
37	VERDE	Herramienta VERDE	Egypt	2010
38	GPRS	Green Pyramid Rating System Levels		



Figure: Centre Georges Pompidou, Paris, 1971–77, Photo credit: Charles Leonard/Shutterstock.

**Whitney Museum of American Art, New York (2015)**  
 Situated between the Hudson River and New York's High Line, Frank Gehry's Whitney Museum of American Art was designed to bring the gallery, which had been scattered in various buildings after outgrowing its Marcel Breuer-designed Madison Avenue home, back together on one site.



Figure: Whitney Museum of American Art, New York, 2015, Photography: Nic Lehoux4. The Menil Collection, Houston (1987)

**California Academy of Sciences, San Francisco (2008)**  
 When it was completed more than a decade ago, Frank Gehry's California Academy of Sciences, signalled a significant development in sustainable architecture. Designed to be the greenest museum in the world, the building received LEED Platinum (the highest green standard in the US) and featured many elements which contributed to its eco-credentials.

The 37,000m<sup>2</sup> project, which includes exhibition space, research spaces, an aquarium and a planetarium, is designed as if a piece of park has been lifted up out of the ground. Its living roof circulates into a series of domes marking out the various spaces beneath, and contributing to the natural movement of air through the building.

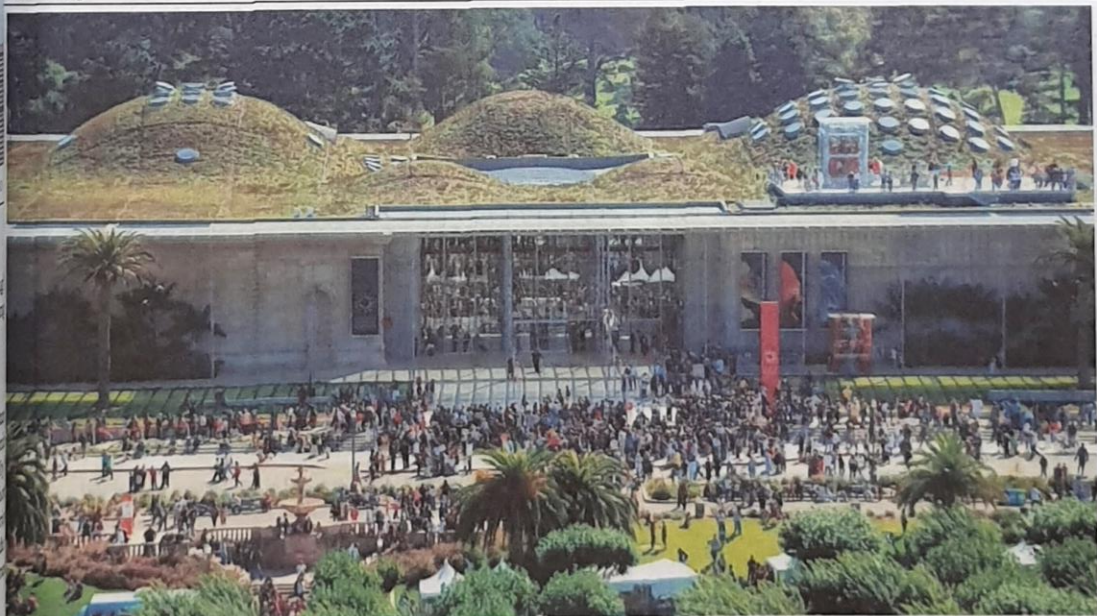


Figure: California Academy of Sciences, 2008, Photography: Shunji Ishida.

**Centro Botin, Santander (2017)**

Located in the Spanish city of Santander, the Centro Botin is a space for art, culture and education, and is Piano's first building in Spain. The 10,000m<sup>2</sup> project is split across two D-shaped blocks joined by an elevated glass and steel walkway that cantilevers over the sea. The building is clad in more than 280,000 round ceramic tiles which reflect the sunlight and the sea.



Figure: Centro Botin, Santander. Photo © Enrico Cano.

(Source: Renzo Piano Building Workshop <http://www.rpbw.com>, <https://www.royalacademy.org.uk/article/renzo-piano-8-buildings-to-know-shard>)



Figure: Daniel Libeskind



Figure: Royal Ontario Museum Rom in Toronto (2007) by Daniel Libeskind

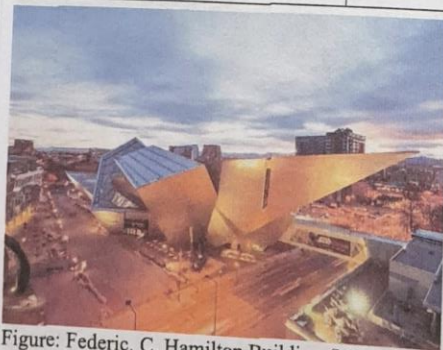


Figure: Federic. C. Hamilton Building (Museum, 2006), Denver, USA by Daniel Libeskind



Figure: Jewish Museum, Berlin (2001) by Daniel Libeskind



Figure: Museum of Modern Art, New York City by Daniel Libeskind

Q28. Match the heritage c

*Group 1*

- P. Washington C
- Q. Florence Cha
- R. Venice Char
- S. Burra Charter

The Washington Charter protection and conservation individual monument. It ad

- integration of pres
- qualities of histori
- participation of re
- the social and econ

The Florence Charter sets gardens as architectural con maintenance, conservation, features, and use of water. I legal and administrative issu specific class of cultural pro

The Venice Charter codifie forth principles of conservat context of a site or building. Venice Charter states that m the principles of preservatio

The Burra Charter is a nat Australia. The Charter is par cultural significance to mana the values and needs of a par

Q32 Match the temples in Group I with their style of Architecture in Group II

Group I	Group II	Options
P. Badami Cave Temples	1. Pandya style	(A) P-3, Q-1, R-2, S-5
Q. Kalugumalai Temple Complex	2. Chola style	(B) P-3, Q-4, R-2, S-1
R. Airavatesvara Temple	3. Chalukya style	(C) P-2, Q-1, R-3, S-5
S. Chennakeshava Temple	4. Vijayanagara style	(D) P-5, Q-1, R-4, S-2
	5. Hoysala style	

**Badami Cave Temples:** The city of Badami in Northern Karnataka, formerly known as Vatapi, was the capital of one of the greatest and most enduring dynasties in Southern India – the Chalukyas. There were three branches of the Chalukyas, the first of them being the 'Badami Chalukyas', who reigned from here from 543 – 753 CE.

The valley of the Mallaprabha (where Badami lies) and the Ghataprabha (both tributaries of the Krishna river) formed the very fertile heart of the farmed based economy of this early empire. Nestled in an imposing ravine that cuts through the heart of the sandstone landscape by the Mallaprabha, the site is graced by some beautiful rock-cut temples that are remnants of a bygone era.

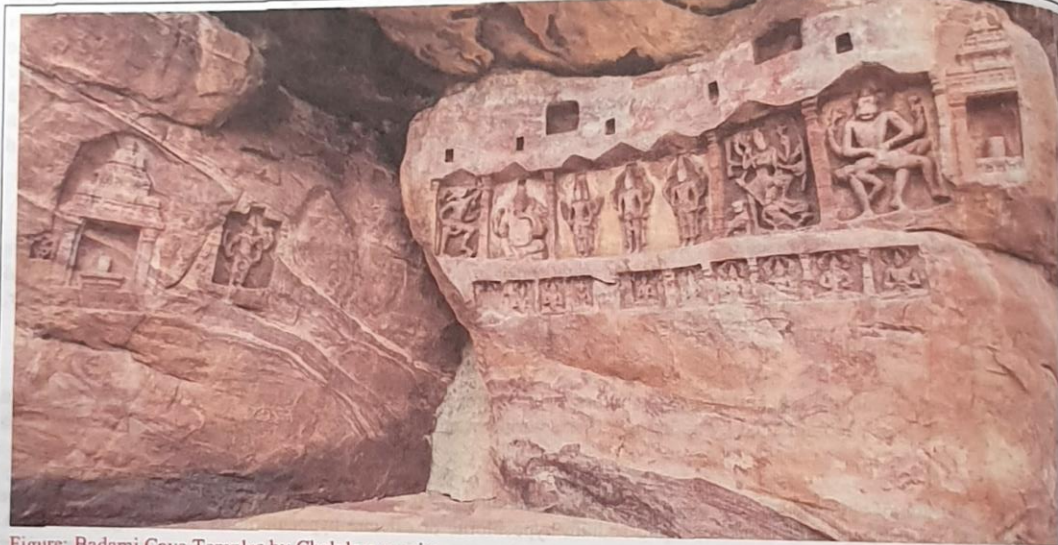


Figure: Badami Cave Temples by Chalukya empire

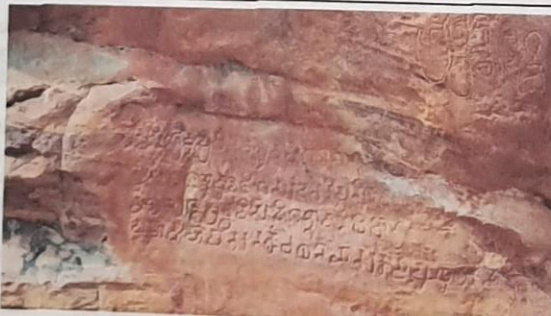


Figure: Old Kannada inscription of Chalukya King Mangalesha dated 578 CE at Badami Cave 3

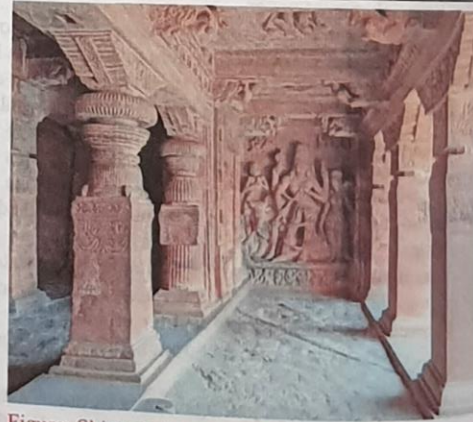


Figure: Shive sculpture and engraved pillars in cave no.

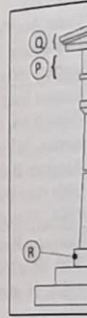
Q33. Match the urban form/structure in Group I with their respective proponents in Group II.

Group I	Group II	Options
P. Trabantenstadte	1. Arturo Soria Y Mata	(A) P-4, Q-1, R-5, S-3
Q. Linear city	2. Le Corbusier	(B) P-5, Q-1, R-4, S-2
R. Bloomsbury Precinct	3. Ernst May	(C) P-3, Q-1, R-5, S-2
S. Radiant city	4. Frank Lloyd Wright	(D) P-3, Q-4, R-1, S-2
	5. Patrick Abercrombie	

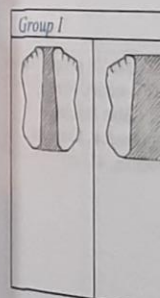
Arturo Soria Y Mata: The... but was promoted by the... enterprises and schools in... appearance was in an article... a radical measure for the f... long of the strip would be... strip, the main actor would... building exclusively for m... that the cities should ad... grouping of building in... rural life, this is the proble... implying the lack of attent... that this perpetuate the con...

Ernst May (Germany city... on open land outside... May combined uncompro... set... May's "brigade" of Ger... successfully applied urban... twentieth century". (Source:...

Q34. Match the elements in



Q35. Match the position of



Q36. Match the buildings in

- Group I
- P. Empire State
  - Q. John Hancock
  - R. Taipei 101
  - S. Sears Tower

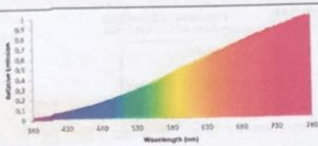
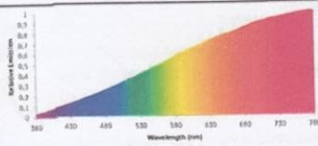
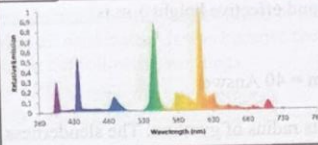
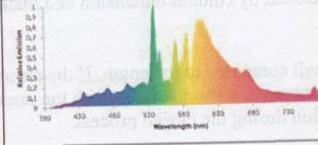
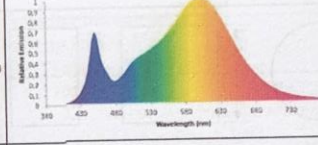
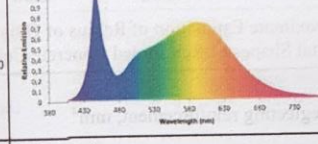
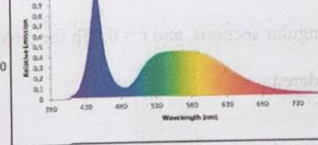
Description	Spectrum	Lamp or module luminous flux, measured (lm)	Observed luminous efficacy (lm/W)	Energy conversion efficiency	Theoretical maximum luminous efficacy (lm/W)
High voltage halogen, 120 W		2249	17.7	11.9	148.7
Low voltage halogen, 60 W		1535	25.6	15.4	166.3
Fluorescent lamp T 5, 54 W, 830		4184	81.6	23.7	344.4
Metal halide lamp, 70 W, 830		7912	99.2	31.5	314.5
LED, 35 W, 830		4739	138.6	42.3	327.6
LED, 35 W, 840		4806	139.3	43.7	318.8
LED, 16 W, 750		2436	150.5	48.7	309

Figure: The table shows observed and the theoretical maximum luminous efficacy of different spectra.

From the table we can see that the typical spectrum of a warm white LED achieves a theoretical module luminous efficacy of approx. 320 lm/W. However, since the assumption is that there is loss-free conversion of physical radiated power into the wavelengths of the spectrum, then the actual realisable module luminous efficacy is much smaller. In future it may be possible to achieve system luminous efficacy in the range of 200–250 lm/W.

In addition, the overview shows energy conversion efficiency of the lamps examined. The energy conversion efficiency describes how much of the power is converted into visible light. In this respect efficient LEDs are clearly well ahead of conventional lamps. While energy conversion efficiency of incandescent lamps, for example, is between 10% and 20%, very efficient LEDs at present achieve values between 40% and 50%. Nevertheless, this is still only 40 – 50%, so 50% to 10% of the power is lost as heat.

Source: <https://www.dial.de/en/blog/article/efficiency-of-leds-the-highest-luminous-efficacy-of-a-white-led/>



Scan for reading about efficacy of lamps.

**GATE 2020**

**Numerical Questions:**

Q1. The difference between the sum of the first  $2n$  natural numbers and the sum of the first  $n$  odd natural numbers is  
 (A)  $2n^2 + n = 36$  (B)  $n^2 - n = 12$  (C)  $2n^2 - n = 28$  (D)  $n^2 + n = 20$

**Solution:** Sum of the first  $2n$  natural numbers is:

$$1 + 2 + 3 + \dots + 2^n = \frac{2(n)(2n+1)}{2} = 2n^2 + n$$

Sum of the first  $n$  odd natural numbers is:

$$1 + 3 + 5 + \dots + 2(n-1) = n^2$$

So, required difference =  $2n^2 + n - n^2 = n^2 + n$  Answer. So, correct option is (D)

For student of architecture, the above formulae may not help as not frequently used. We will solve the above question by taking an example.

Let,  $n = 4$

So, first  $2n$  natural numbers = first  $2 \times 4$  natural numbers = first 8 natural numbers  
 = 1, 2, 3, 4, 5, 6, 7, 8

So, Sum of first  $2n$  natural numbers =  $1+2+3+4+5+6+7+8 = 36$

First  $n$  odd natural number = First 4 odd natural numbers (because  $n=4$ ) = 1, 3, 5, 7

So, sum of first  $n$  odd natural numbers =  $1+3+5+7 = 16$

Therefore, the difference between =  $36 - 16 = 20$  .....(e)

Now, we will check which of the given four options gives answer 20 when  $n = 4$ .

(A)  $2n^2 + n = 36$  (B)  $n^2 - n = 12$  (C)  $2n^2 - n = 28$  (D)  $n^2 + n = 20$

So, as per equation (e), the correct option is (D)  $n^2 + n$  Answer

Q2. The profit shares of two companies P and Q are shown in the figure. If the two companies have invested a fixed and equal amount every year, then the ratio of the total revenue of company P to the total revenue of company Q, during 2013 - 2018 is \_\_\_\_\_.

- (A) 16 : 17 (B) 17 : 16  
 (C) 17 : 15 (D) 15 : 17

**Solution:** Suppose Rs. X is invested every year by Company P and Company Q.

The total revenue by P from 2013 - 2018 is:  
 $\frac{x}{100} * [110 + 120 + 140 + 140 + 150 + 140] = 8x$

The total revenue by Q company from 2013 - 2018 is:  
 $\frac{x}{100} * [120 + 130 + 130 + 150 + 160 + 160] = \frac{17x}{2}$

So, Required ratio is  $8x : \frac{17x}{2} = 16:17$  Answer

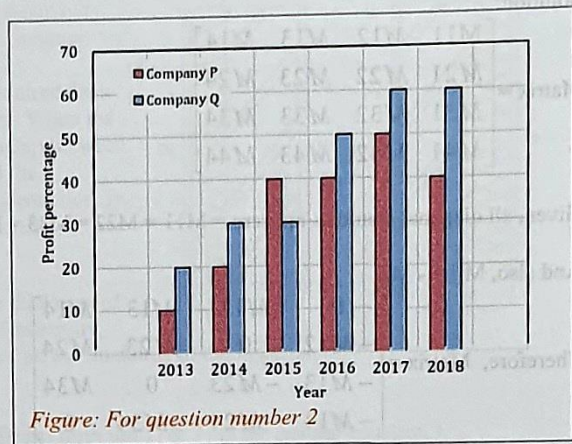


Figure: For question number 2

Q3. P, Q, R, S, T, U, V. and Ware seated around a circular table.

- I. S is seated opposite to W.
- II. U is seated at the second place to the right of R.
- III. T is seated at the third place to the left of R.
- IV. V is a neighbour of S.

Which of the following must be true?

- (A) Q is a neighbour of R.
- (B) P is not seated opposite to Q.
- (C) R is the left neighbour of S.
- (D) P is a neighbour of R.

**Solution:** From the given data, we have following diagram:  
 So, P is not seated opposite to Q.

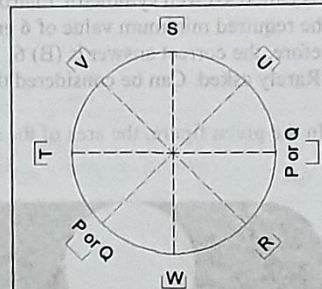
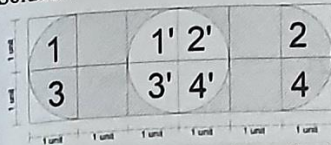


Figure: Answer to question number 3

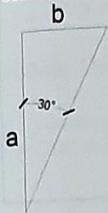
Solution:



Here, Area of region 1 = Area of void region 1' and so on.  
Therefore, area of the shaded portion = 8 units Answer.

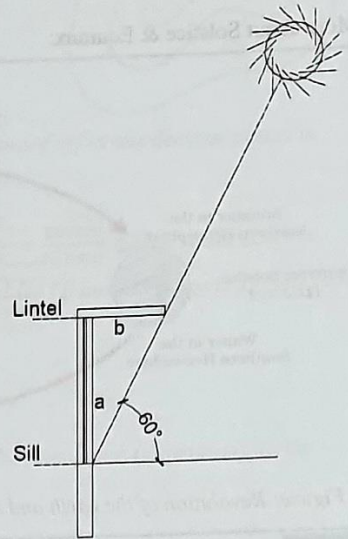
Q7. A 1.2 m high window is located on a south facing wall. The solar azimuth angle is equal to the wall azimuth angle and the solar altitude angle is 60°. The minimum depth (in metres, rounded off to two decimal places) of overhang required to completely shade the window is \_\_\_\_\_.  
(Assume that the overhang is located at the lintel level of the window)

Solution:



$$\tan 30^\circ = \frac{b}{a} = \frac{b}{1.2}$$

$$\Rightarrow b = 0.69 \text{ Answer}$$



Official GATE answer range: 0.68 to 0.70

Q8. For the same thickness of material layers, relative position of insulation in the wall sections 1 and 2 shown below will have an impact on

- (A) Thermal Time Constant
- (B) Thermal Resistivity
- (C) Thermal Transmittance
- (D) Thermal Conductivity

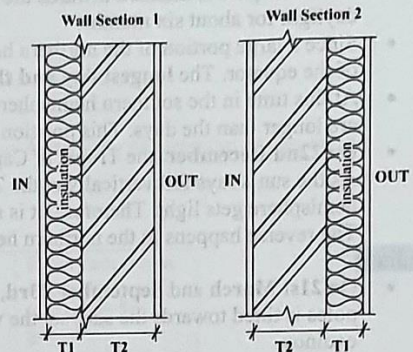
Solution: The **Thermal Time Constant** indicates a time required for a thermistor to respond to a change in its ambient temperature. When the ambient temperature is changed from T1 to T2, the relationship between the time elapsed during the temperature change  $t$  (sec.) and the thermistor temperature  $T$  can be expressed by the following equation. [ $\tau$  (tau in sec.) in the equation denotes the thermal time constant.]

$$T = (T_2 - T_1) (1 - \exp(-t/\tau)) + T_1$$

Please note that the above equation does not depend on the thickness of the material. But when we look at the formula of Thermal Resistivity, Thermal Transmittance & Thermal Conductivity, all depend on the thickness of the material.

So, the correct option is (A) Thermal Time Constant.

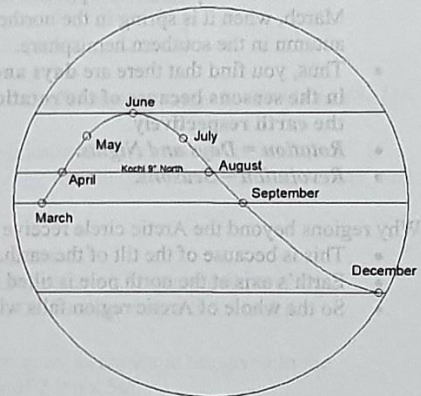
(Please also note that T1 & T2 in the question figure is different from the T1 & T2 in the answer equation.)



Q9. The solar altitude angle on April 16 at 7:00 AM in Kochi is 16°. The same solar altitude angle will occur at the same time in the same year at the same location on

- (A) October 21
- (B) July 21
- (C) August 27
- (D) September 23

Solution: March and September, we have Equinox. June and December we have summer and winter solstice. It means during June, the sun has direct rays on tropic of cancer in Northern hemisphere. And in the same way during Dec it will be on tropic of Capricorn in Southern hemisphere. So if the sun starts moving slowly towards tropic of cancer from March to June. It will go via Kochi (which is northern hemisphere) on April (one month after equinox) so then after reaching June Solstice it will



Q18. Plan and section of an isolated foundation is given below. The volume of concrete up to Ground Level (GL) (in m<sup>3</sup>, rounded off to two decimal places) is \_\_\_\_\_.

Solution: Let's divide the foundation in 3 parts.

Part I: Rectangular base with height 0.4m

Part II: Slant base with height 0.5m

Part III: Column part with height 1.1m

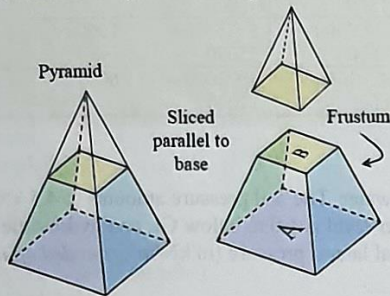
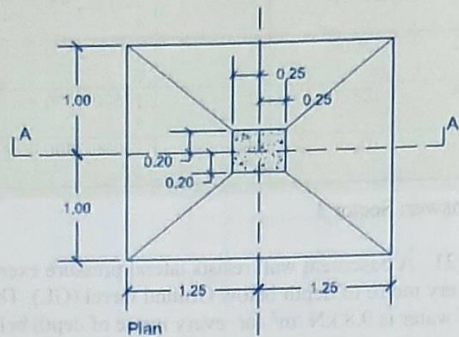
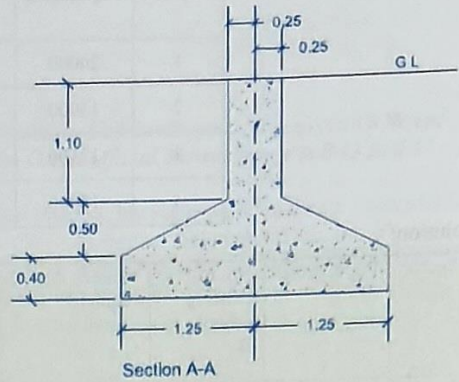
Part I, Volume = Base area \* 0.4m = (2m x 2.5m) \* 0.4 = 2m<sup>3</sup>

Part II, Volume = Average base area \* 0.5m =  $\frac{(2m \times 2.5m) + (0.4m \times 0.5m)}{2} * 0.5m = 2.51m^2 * 0.5m = 1.23 m^3$

Part III, Volume = Column cross sectional area \* 1.1m = (0.4m x 0.5m) \* 1.1m = 0.22 m<sup>3</sup>

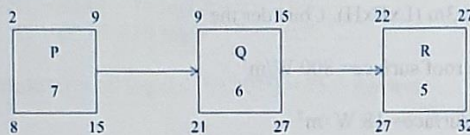
Total volume = 2 + 1.23 + 0.22 = 3.43m<sup>3</sup>

Please note that volume of the Part II is not accurate (Average area used for faster calculation). It is actually a frustum.



Volume of Frustum =  $\frac{1}{3} * h * (A + B + \sqrt{AB}) = \frac{1}{3} * 0.5 * (5 + 0.2 + \sqrt{5 * 0.2}) = \frac{1}{3} * 0.5 * 6.2 = 1.03 m^3$   
 Official GATE answer range is 3.1 to 3.4

Q19. The activity duration, early start, early finish, late start and late finish of the three activities 'P', 'Q' and 'R' are shown in the following figure. The independent float of activity 'Q' is



Solution: Independent Float

= ES of succeeding activity - LF of preceding - Duration of the activity of which Independent float is to be counted

= ES of R - LF of P - Duration of Activity Q

= 22 - 15 - 6

= 1 Answer

Scan for pdf on Total, Free, Independent & Interfering float.

Scan for video lecture on Total float & Free float.

Scan for video lecture on Independent float

Figure: Scan for explanation on YouTube for Independent Float

Q20. A population of 2500 persons requires a minimum area of 3000 m<sup>2</sup> for primary schools. For the population in four different sectors given in the table below, the Sector having maximum shortage of school area per person is \_\_\_\_\_.



Q31. Repo rate is the rate at which Reserve Bank of India (RBI) lends commercial banks, and reverse repo rate is the rate at which RBI borrows money from commercial banks.

Which of the following statements can be inferred from the above passage?

- (A) Increase in repo rate will decrease cost of borrowing and decrease lending by commercial banks.  
 (B) Decrease in repo rate will decrease cost of borrowing and increase lending by commercial banks.  
 (C) Decrease in repo rate will increase cost of borrowing and decrease lending by commercial banks.  
 (D) Increase in repo rate will decrease cost of borrowing and increase lending by commercial banks.

Q32. Shyam-Rai temple of Bishnupur in West Bengal, is an example of

- (A) Pancha-ratna type terracotta temple (B) Stone carved Dravidian type temple  
 (C) Nava-ratna type terracotta temple (D) Stone carved Nagara type temple

Notes: Made of bricks, with square-shaped towers at the corners, the Shyam Rai Temple is massive in terms of its scale and embellishments. It was built by king Raghunatha Singh (1702-1712) of Mallabhum, in 1643, to honour Lord Vishnu in his form as Lord Krishna. It is built in the **Panchratna Architectural style (in which five pillars stand on the roof)** and is probably the state's oldest temple reflecting this design. One can also catch a few glimpses of the Gandhar style (Buddhist art) on the walls. The artists have displayed remarkable skill and craftsmanship in intricately engraving designs on the baked bricks to make the temple. The four sides of the temple are followed by arched gateways leading to the sanctum. The temple has figurines and floral motifs, which were the first of its kind in the state. The inner and outer walls, along with the ceiling, are adorned with **terracotta sculptures depicting Krishna leela and episodes from great Indian epics like Ramayana and Mahabharata.** Answer (A)

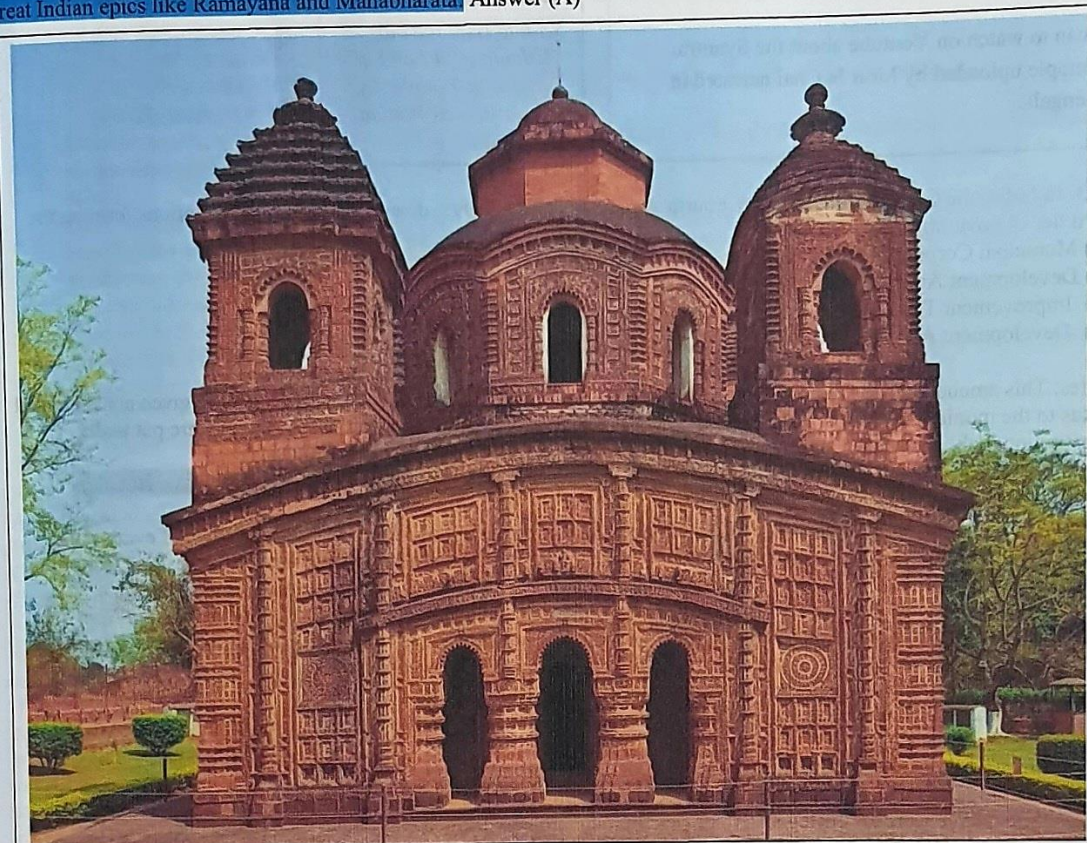


Figure: Shyam Rai Temple, Bishnupur, West Bengal. It is built in the Panchratna Architectural style (in which five pillars stand on the roof). Four pillar stands at four corners and one at the centre. The word Panchratna means Panch = five & Ratna = Gems.

Q35. As on 2018, 'Right to Property' in India is a  
(A) Constitutional Right (B) Tertiary Right (C) Secondary Right (D) Fundamental Right

Notes: The right to property is not a Fundamental Right but it is a constitutional right. In the original Constitution the right to property was listed as a fundamental right. By the 44th Amendment to the Constitution, the right to property was removed as a fundamental right and instead, a new provision was added to the Constitution i.e. Article 300-A making it a constitutional right.

The 'Right to Property' was initially the Fundamental Right but it caused many issues and then converted into Constitutional Right. Why was this done so? An insightful answer by Prateek Singotiya on Quora.com is given below:

Right to property as a fundamental right was guaranteed by Article 19(1)(f) and 31.

Article 19(1)(f) gave every citizen a right to acquire, hold and dispose her property. Whereas article 31 ensured that any person (citizen + foreigners) cannot be deprived of her property except by authority of law. It also mentioned that state can acquire property only for public purposes and in return of which compensation had to be paid.

But India's economic structure was still dominated by zamindar, big landlords etc. Freedom fighters were committed to land reforms to bring justice to poor people. It was perhaps a necessary action to lift people from poverty. So govt started bringing legislations, such as land ceiling act (a person cannot own land above a certain limit, excess land will become a govt property, which would be distributed among poor people), zamindari abolition, tenancy regulation etc.

But this act of govt was challenged in the court as it violated fundamental right to property of some sections of people. The supreme Court being the guarantor of fundamental right generally ruled in favor of property holders. This had created a paradoxical situation, a new question emerged, should the directive principles of state policy prevail over fundamental rights or not? Should the welfare prevail over fundamental rights? Under directive principles, it is the moral duty of the govt to take action for welfare of people.

The confrontation between parliament and judiciary started, and it became more aggressive later. To nullify Court's order, parliament had to enact multiple constitutional amendment acts- 1st, 4th, 25th, 39th, 40th, 42nd etc. It finally paved a way forward for land reforms. But still, there was possibility of many challenges in future, as the root cause of the issue was still not addressed. Parliament has just cured from symptoms but not the disease. Therefore, in 1978, it abolished right to property as a fundamental right and removed article 19(1)(f) and 31 out of part III of constitution.

Right to property was now no more a fundamental right but it was made a legal right well within the constitution itself, by inserting article 300A in part XII. Now if this right is violated, the aggrieved person cannot approach to supreme Court directly, but he can move to high courts. This right can now be regulated, abridged even by an ordinary law.

Answer (A)

Q36. In the architectural style of ancient North Indian Temples, the term 'Adhithana' refers to  
(A) Base Platform (B) Vestibule (C) Pinnacle (D) Transept



Scan to read the blog  
'Temple architecture –  
Devalaya Vastu' by  
Sreenivasa Rao at  
sreenivasaraos.com

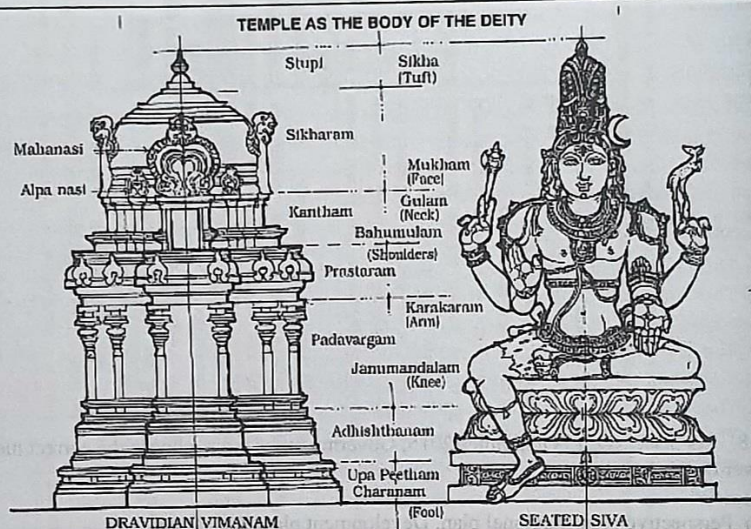


Figure: The nomenclature 'Adhishthanam' fits with most of the form of Temple Architecture. Answer (A)  
Image Source: sreenivasaraos.com



Figure: Plan of Shyam Rai Temple, Bishnupur. This brick-built Temple is situated within the fort and consists of a square roof surmounted by five towers and is thus an example of Panchratna type. The central tower itself is octagonal enclosed by an octagonal corridor. The temple is the most profusely carved temple in Bishnupur. Inscription records erection by Raghunatha Singha in 1643 AD. Source: [asikolkata.in/bankura.aspx](http://asikolkata.in/bankura.aspx)



Scan to watch on Youtube about the Syamrai Temple uploaded by Mon Ja Chai narrated in Bengali.



Scan to read the blog 'Bishnupur: A Land of Terracotta Temple' by Ayeeta Biswas Paul at [sahapedia.org](http://sahapedia.org)

Q33. In India, the Constitution (Seventy Fourth Amendment) Act, 1992, delegates powers to institutions forming the third tier of government, which are:

- (A) Municipal Corporation, Municipality and Nagar Panchayat
- (B) Development Authority, Improvement Trust and Panchayat
- (C) Improvement Trust, Nagar Panchayat and Panchayat
- (D) Development Authority, Municipal Corporation and Municipality

Notes: This amendment, also known as **Nagarpalika Act**, came into force on 1st June 1993. It has given constitutional status to the municipalities and brought them under the justifiable part of the constitution. States were put under constitutional obligation to adopt municipalities as per system enshrined in the constitution.

Definition of Metropolitan area: **Metropolitan area in the country is an area where population is above 10 Lakh** (Article 243P)

Three Kinds of Municipalities: Article 243Q provides for establishment of 3 kinds of Municipalities of every state.

- **Nagar Panchayat:** A Nagar Panchayat is for those areas which are transitional areas i.e. transiting from Rural Area to Urban areas. "Governor" will by public notice, will define these three areas based upon the population, density of population, revenue generated for local administration, % of employment in Non-agricultural activities and other factors. Further, a Governor may also if, he fits it necessary, based upon industrial establishments, can specify the Industrial Townships by public notice.
- **Municipal Council:** A Municipal council is for smaller urban area
- **Municipal Corporation:** A municipal Corporation for Larger urban Areas

### Background of the Constitution (Seventy - Fourth Amendment) Act, 1992

The Constitution of India has assigned the subjects pertaining to the urban areas to the State Legislates. In so far as urban issues are concerned, the legislative powers of the Union are limited only to the following subject/areas:

- Delhi and other Union Territories
- Property of the Union
- A subject of the state list which two or more state legislatures authorise Union Parliament to legislate.
- Amendment of the Constitution of India.

Constitution (Seventy-Fourth Amendment) Act 1992 is a revolutionary piece of legislation by which Constitution of India was amended to incorporate a separate Chapter on urban local bodies, which seeks to redefine their role, powers and finances. The salient features of this Act are:

- Urban local bodies, to be known as Municipal Corporations, Municipal Councils and Nagar Panchayat depending on the population, shall be constituted through universal adult franchise in each notified urban area of the country.

GATE 2

These shall be constituted for...  
be completed before the expiration...  
Not less than one-third of total nu...  
The Legislature of a State may by...  
enable them to function as institu...  
The Twelfth Schedule of the Con...  
1. Urban Planning including...  
2. Regulation of land-use an...  
3. Planning for economic an...  
4. Roads and bridges.  
5. Water supply for domesti...  
6. Public health, sanitation...  
7. Fire services.  
8. Urban forestry, protection...  
9. Safeguarding the interests...  
retarded.  
10. Slum improvement and u...  
11. Urban poverty alleviation...  
12. Provision of Urban ameni...  
13. Promotion of cultural, ed...  
14. Burials and burial ground...  
15. Cattle pounds; preventio...  
16. Vital statistics including...  
17. Public amenities includin...  
18. Regulation of slaughter h...  
• In order that the urban local bodie...  
assign them specific taxes, duties...  
same.  
• Each State shall also constitute a...  
local bodies and recommend the p...  
in-aid from the Consolidated Fun...  
• The superintendence, direction an...  
elections to the urban local bodie...  
• In each district a District Planni...  
and rural local bodies.  
• Similarly for each metropolitan a...  
development plan for the metrop...

Q34. 'Tendon' is primarily used  
(A) to prepare a tender document  
(B) as a compression member  
(C) to pre-stress concrete  
(D) as roof sheathing

Notes: **Prestressed Concrete:** Although...  
concrete was patented by a San Francis...  
1866, it did not emerge as an accepted b...  
material until a half-century later. The s...  
in Europe after World War II coupled w...  
technological advancements in high-str...  
and steel made prestressed concrete the...  
material of choice during European pos...  
reconstruction. North America's first p...  
in Philadelphia, the Walnut Lane Me...  
completed until 1951.

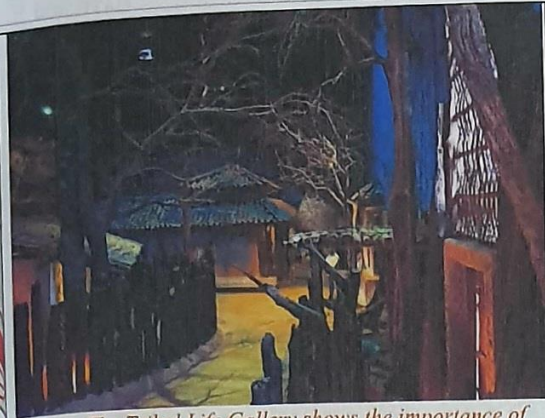


Figure: The Tribal Life Gallery shows the importance of everyday things like having a tree in the courtyard and cattle inside the premises. – © Michael Turtle

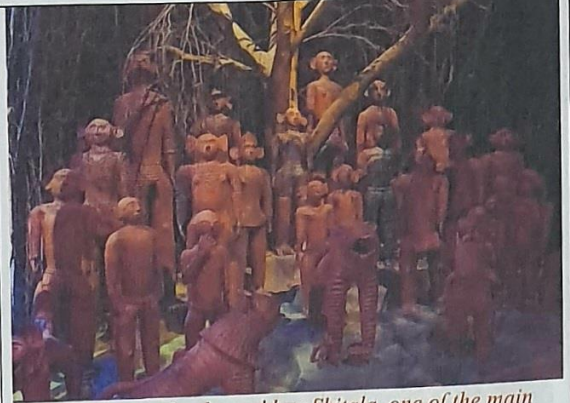


Figure: Shrines for the goddess Shitala, one of the main deities of the Bastar region, who protects villages from diseases and other troubles. – © Michael Turtle

### Cholamandal Artists' Village, Chennai

Cholamandal Artists' Village, established in 1966, is the largest artists' commune in India, whose artists are credited for the Madras Movement of Art, which brought modernism to art in the South India. It has earned reputation world over and is now, one of the major tourist attractions in the Coastal city. The initial design was made by a visiting Dutch couple, the design for the art centre was made by architects Sheila Sri Prakash of Shilpa Architects and M. V. Devan. The original Artists Handicrafts Association is still in charge of the colony, and Paniker's son, sculptor S. Nandagopal, is the secretary of the village. Out of the original 40 artists, many are no more, and some have moved out, only 21 remain today. This co-operative artists colony started as a joint effort of more than 30 painters and sculptors. The creative work is happening there in an ongoing basis and all the paintings by different artists ranging from classical to modern art are displayed for viewing and for sale also. This is the first of its kind in the world where a colony of artists are formed in an excellent ambiance on the shores of Bengal sea.



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Sheila Sri Prakash

Q51. Match the plant forms in Group I with the botanical names in Group II, as per 'A Handbook of Landscape', CPWD 2013, Government of India

Group I	Group II
(P) Columnar	(1) <i>Pinus roxburghii</i>
(Q) Globular	(2) <i>Ipomoea grandiflora</i>
(R) Weeping	(3) <i>Juniperus chinensis</i>
(S) Pyramidal	(4) <i>Salix babylonica</i>
	(5) <i>Mimusops elengi</i>


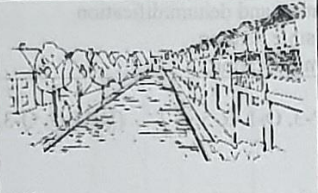
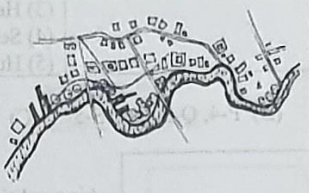
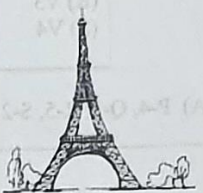
- (A) P-3, Q-4, R-2, S-1    (B) P-1, Q-3, R-4, S-5    (C) P-3, Q-5, R-4, S-1    (D) P-1, Q-5, R-2, S-3

*Juniperus chinensis*, commonly called Chinese juniper, is a dioecious evergreen conifer that is native to China, Japan, Mongolia and the Himalayas. It is often seen in the wild as a conical tree to 50' tall and 20' wide, but also appears in much shorter shrubby or spreading forms. Foliage is dark green. Brown bark on mature stems peels in strips. Although species plants are rarely sold in commerce, a large number of cultivated varieties ranging in size from large trees to large/small shrubs to low-growing groundcovers have become popular ornamental landscape plants. Chinese juniper leaves come in two types: scale-like (adult) and awl/needle-like (juvenile). Cones (pollen and seed-bearing) appear on different plants. Male plants produce catkin-like pollen cones. Female plants produce fleshy, berry-like, whitish-blue seed cones that usually acquire violet-brown tones as they mature over two years.



Figure: Abstract proportions and primary colours of the Gerrit Rietveld-designed Schröder House in Utrecht. The house was awarded protected UNESCO World Heritage status in 2000.

Q56. Match the graphical representations in Group I with corresponding elements in Group II

Group I				
				
(P)	(Q)	(R)	(S)	
Group II (1) Pathway (2) Node (3) District (4) Edge (5) Landmark				

- (A) P-1, Q-2, R-3, S-5 (B) P-4, Q-1, R-3, S-2 (C) P-2, Q-3, R-4, S-5 (D) P-2, Q-1, R-4, S-5

**The City Image and Its Elements – Kevin Lynch**

Kevin Lynch was an American urban planner and author. His ideas about city and its perception can be seen in his work 'The Image of the City.' Which I will try to summarize in this post.

According to Lynch, the city is about the way the people perceive it. He called it as imageability. Some elements in the city gives people more than only information. In the book those elements called as paths, edges, districts, nodes and landmark.

First element that is mentioned is paths. Paths are the channels that helps observer to move along to city. They can be streets, canals, railroads or so on. Paths are linear and continuous channels. They are important since the way we observe city depends on the ways we walk.

Second element is edges. He basically defined edges as a boundary of two phases. They are linear elements that in between city and sea for example. Opposite from the paths, the edges broke the continuity of a phases and from the edges there is another phase that began.

Third one is districts. It is like the sections of the city. The observer can go inside of the districts. Districts can be defined with different

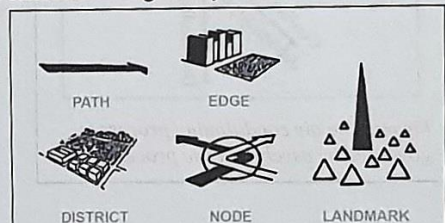


Figure: This famous depiction is called imageability. A city is known by this 5 elements as per Kevin Lynch



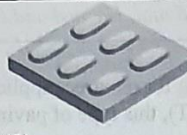
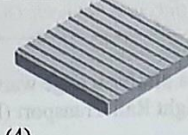



Scan this to go to [illinois.edu](http://illinois.edu) and learn about the 3D visualization of the Hypars)

**Hypars**

We use the term **hypar** to mean a hyperbolic paraboloid shape, or more formally a partial hyperbolic paraboloid, cut from the full infinite surface. The term hypar was introduced by the architect Heinrich Engel in his 1967 book *Structure Systems*

Q60. Match the names of tactile paving in **Group I** with their patterns in **Group II**

Group I	(P) Lozenge	(Q) Offset blister	(R) Corduroy	(S) Directional	
Group II	 (1)	 (2)	 (3)	 (4)	 (5)

- (A) P-4, Q-2, R-3, S-1    (B) P-3, Q-5, R-4, S-1    (C) P-2, Q-5, R-1, S-4    (D) P-3, Q-2, R-4, S-1

**Tactile Paving**

The key element with tactile paving is that different surface profiles are intended to denote different hazards, and these are outlined below.

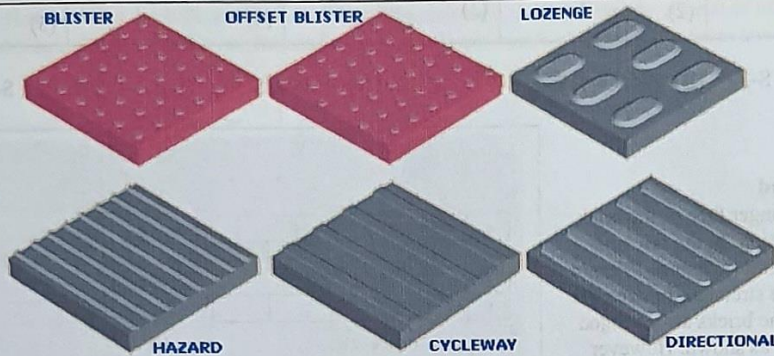


Figure: There are mainly six types of Tactile Pavings.

There are two types of Blister paving: the most common type features 6mm high 'blisters' in a square pattern and these are used to indicate pedestrian crossings with dropped kerbs.

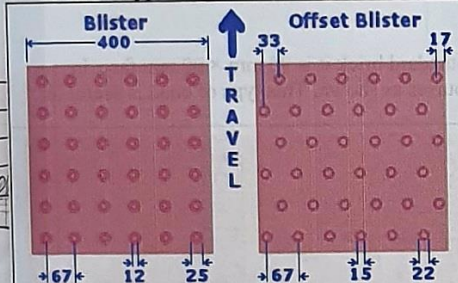


Figure: There is slight difference in the layout of blisters that makes Blister and Offset Blister paving distinct.

Normally, the red-coloured units are used with light-controlled crossings, and buff for those crossings with no traffic lights. However, when natural stone units are used, this colour-coding is disregarded.

The Offset Blister units are used to indicate the edge of the platform at Rail and Tram stations, also referred to as off-street applications. Note that the orientation of the offset blister units is critical - the rows of blisters MUST be parallel to the platform edge, and they are generally placed approximately 500mm back from the edge.


Hazard Warning units use continuous half-rods, raised 6mm higher than the surface of the paving, to denote a hazard, such as the top/bottom of a flight of steps. Again, the rods should be parallel to the edge of the hazard.

André Le Nôtre is known for the finesse of his formal flowerbed compositions and for optical illusions without precedent. The use of large, sweeping perspectives allows for **impressive panoramas**. In reality, however, it's nearly impossible to see the Versailles domaine all at once, a fact which bears witness to the talent of Le Nôtre. Indeed, thanks to a series of flat parterres the gardens unveil themselves with every step. As a result, as the visitor advances so does the landscape reveal itself slowly but surely, much like the succession of theatre scenes that end up creating a complete story.



Figure: Jardins de Vaux le Vicomte, created by Le Nôtre. The embroidery parterre, or a formal flowerbed garden, is a theme specific to French gardening that harks back to a veritable tradition. This type of garden is geometric in nature and traces symmetric, *arabesque* lawns in front of buildings. There's no such thing as a French-style garden without an embroidery parterre! Those that currently exist at Versailles are reconstructed ones that date from the 1920s and are therefore not entirely faithful to the originals. Old etchings show that rather than lawns bordered by a hedge of small bushes, as is the case today, parterres were the outlines of lawns traced directly onto gravel.



 **YouTube**

Scan to watch on  
Youtube to learn  
more about The  
Gardens of  
Versailles.

most famous and influential  
on every side from a terrace  
the terrace is the Latona Fountain  
main depicts the events of the

A geodesic dome consists of a network of triangles that are joined together to create a roughly spherical surface. If a sufficiently large number of triangles are used, the geodesic dome approximates a true sphere. Furthermore, different sized triangles allow the geodesic dome to be divided symmetrically by 31 different great circles. A great circle is the largest circle that can be drawn around a sphere. On Earth, for example, the equator represents the only latitude line that is a great circle. On the other hand, all longitude lines are great circles. Because of these properties of symmetry, geodesic domes get their name from the Latin word *geodesic*, meaning "Earth-dividing".

The benefits of a geodesic dome structure can be realized by examining the properties of a sphere. For example, a sphere represents a shape that has the highest volume to surface area ratio. This means that material costs can be minimized without sacrificing interior space. Furthermore, a half-sphere (the shape used for most residential domes) allows for a maximum amount of floor space for a given surface area. Compared with a traditional 1500 square foot home, a 1500 square foot geodesic structure (with a 23-foot high ceiling) uses almost 20% less building materials. Since they have less surface area, geodesic domes are able to reduce heating costs by as much as 50% when compared with traditional buildings. Because the spherical shape also tends to absorb the most external light, additional energy savings can be realized by reducing the need for artificial lighting.

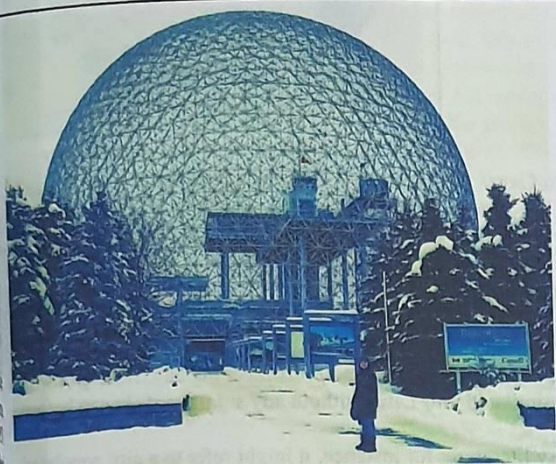


Figure: Expo 67 in Montreal, Quebec, Canada. The museum's geodesic dome was designed by Buckminster Fuller.

Photo credit - *aquigabo!*

<https://www.flickr.com/photos/138047837@N02/24356393675/sizes/l>

Geodesic domes are extremely stable structures. This is partly due to the fact the triangles, which are naturally stable polygons, are used throughout. This is one of the reasons triangles are so popular in homes, buildings, and bridges. In a geodesic dome, these triangles eliminate the need to include load-bearing walls without sacrificing stability. In addition, its curved surface offers a natural layer of protection from high winds and other environmental stresses. Geodesic domes have been used in such places as Antarctica where wind speeds can reach 200 miles per hour. Bucky Fuller built many domes using geodesic principles, including a 250-foot diameter dome for the 1967 World's Fair in Montreal, Canada. Answer (C)

Q.39 The abrupt change or junction between two ecological zones is termed as

- (A) Ecological niche (B) Ecosystem (C) Ecotype (D) Ecotone

Notes: An ecotone acts as the boundary or barrier between two biomes. It is the area where two distinct types of environments merge and blend.

Ecotones could be the border where forestland and grassland meet or the boundary where wetlands meet prairie. Many things form a sharp boundary such as natural formations. The area where the land meets water such as where the mangrove fields meet the ocean is also considered an ecotone. The estuary between freshwater and saltwater is also a natural ecotone.

An ecotone can be a narrow or wide area of the ecosystem. It is considered a zone of tension.

The word 'ecotone' was derived from the word ecology and the Greek word *tonos*, which means tension. The ecotone often shares many of the animal and plant species that both areas contain but it is also unique because it is the blending of two distinct areas.

Plants and trees tend to live along an ecotone and stretch as far into the other area as possible but because of the transition the plants or trees cannot survive past the ecotone.



Figure: The sphere would remain open to the public for nine years until an accident involving some routine welding maintenance caused the acrylic covering to catch fire, engulfing the entire sphere in a spectacular ball of fire with flames that burned for 30 minutes. When the flames subsided, there was no sign of the acrylic walls to be seen, but the steel trusses of the dome remained. After the fire, the dome was closed to the public for over fifteen years. (Photo credit - *collectionscanada*)



The 'Make In India' program is an initiative launched to encourage companies to increase manufacturing in India. Prime Minister Narendra Modi launched the Make in India initiative on September 25, 2014, with the primary goal of making India a global manufacturing hub. This not only includes attracting overseas companies to set up shop in India, but also encouraging domestic companies to increase production within the country. 'Make in India' aims at increasing the GDP and tax revenues in the country, by producing products that meet high quality standards, and minimising the impact on the environment.

Fostering innovation, protecting intellectual property, and enhancing skill development are the other aims of the program according to the 'Make in India' website.



#### Policies under 'Make in India' initiative:

There are 4 major policies under the 'Make in India' program:

**1. New Initiatives:** This initiative is to improve the ease of doing business in India, which includes increasing the speed with which protocols are met with, and increasing transparency.

Here's what the government has already rolled out

- Environment clearances can be sought online.
- All income tax returns can be filed online.
- Validity of industrial licence is extended to three years.
- Paper registers are replaced by electronic registers by businessmen.
- Approval of the head of the department is necessary to undertake an inspection.

#### Foreign Direct Investment (FDI):

The government has allowed 100% FDI in all the sectors except Space(74%), Defence (49%) and News Media (26%). FDI restrictions in tea plantation has been removed, while the FDI limit in defence sector has been raised from the earlier 26% to 49% currently.

#### Intellectual Property Facts:

The government has decided to improve and protect the intellectual property rights of innovators and creators by upgrading infrastructure, and using state-of-the-art technology.

The main aim of intellectual property rights (IPR) is to establish a vibrant intellectual property regime in the country, according to the website.

These are the various types of IPR:

- Patent: A patent is granted to a new product in the industry.
- Design: It refers to the shape, configuration, pattern, colour of the article.
- Trade mark: A design, label, heading, sign, word, letter, number, emblem, picture, which is a representation of the goods or service.
- Geographical Indications: According to the website, it is the indication that identifies the region or the country where the goods are manufactured.
- Copyright: A right given to creators of literary, dramatic, musical and artistic works.
- Plant variety Protection: Protection granted for plant varieties, the rights of farmers and plant breeders and to encourage the development of new varieties of plants.
- Semiconductor Integrated Circuits Layout-Design: The aim of the Semiconductor Integrated Circuits Layout-Design Act 2000 is to provide protection of Intellectual Property Right (IPR) in the area of Semiconductor.

#### National manufacturing:

Here the vision is,

- to increase manufacturing sector growth to 12-14% per annum over the medium term.
- to increase the share of manufacturing in the country's Gross Domestic Product from 16% to 25% by 2022.
- to create 100 million additional jobs by 2022 in manufacturing sector.
- to create appropriate skill sets among rural migrants and the urban poor for inclusive growth.
- to increase the domestic value addition and technological depth in manufacturing.
- to enhance the global competitiveness of the Indian manufacturing sector.
- to ensure sustainability of growth, particularly with regard to environment.

#### 25 major 'Make in India' focus areas:

1. Automobiles
2. Automobile Components
3. Aviation
4. Biotechnology
5. Chemicals

**Solution: Option (i)** From the graph, we see that the curve flattens at around 100 min (37° C), while this happens at around 140 min for 25°C. This indicates a slowing down (but not a stop) earlier for 37°C. The growth stops (as per the graph) at 160 min for 37°C and 180 min for 25°C. So, even the stop in the growth occurs earlier at the higher temperature; (i) is true.  
 (ii) At 37°C, the concentration of 0.8 is attained at round 85 min. At 25°C, it is attained at around 125 min. This is much less than the twice 85 min; ii is false.  
 Hence, the correct option is (A)

Q.29 Match the architectural movements in Group-I with their proponents in Group-II.

GROUP I		GROUP II	
P.	Deconstruction	1.	Joseph Paxton
Q.	Historicism	2.	Kenzo Tange
R.	Metabolism	3.	Walter Gropius
S.	Art Nouveau	4.	Victor Horta
		5.	Frank O. Gehry

(A) P-5, Q-1, R-2, S-4 (B) P-5, Q-4, R-2, S-3 (C) P-5, Q-2, R-3, S-3 (D) P-2, Q-4, R-1, S-5

If you knew Victor Horta, the question could have been so easy.

**Art Nouveau** is a French word meaning "New Art". Belgium was an early center of the art nouveau, thanks largely to the architecture of **Victor Horta**, who designed the first art nouveau houses, the Hôtel Tassel in 1893, and the Hôtel Solvay in 1894.

**Answer: (A)**

Q.30 The Pritzker Architecture prize for the year 2016 has been awarded to  
 (A) Alejandro Aravena (B) Frei Otto (C) Stephen Breyer (D) Yung Ho Chang



Figure: There are two photographs here. Aravena provided a concrete frame, with kitchen, bathroom and a roof (left), which were designed to allow families to fill in the gaps (right). So, the architect provided a basic concrete frame, complete with kitchen, bathroom and a roof, allowing families to fill in the gaps, and stamp their own identity on their homes in the process. Photograph: Cristobal Palma, Source: www.theguardian.com

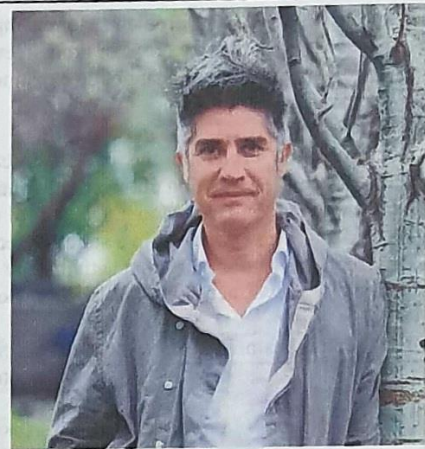


Figure: Pritzker Architecture Prize 2016 **Alejandro Aravena**

The architect Alejandro Aravena is from Chile. Runs a design firm ELEMENTAL. He is known his pioneering social housing projects in Latin America.

**Answer: (A)**

Q.31 Match the classical urban planning theories in Group-I with their proponents in Group-II

GROUP I		GROUP II	
P.	Concentric Zone Model	1.	Beny and Horton
Q.	Sector Model	2.	Homer Hoyt
R.	Multiple Nuclei Model	3.	Ernest Burgess
S.	Factorial Ecology	4.	Shevky and Bell
		5.	Harris and Ullman

(A) P-4, Q-1, R-3, S-5 (B) P-3, Q-2, R-3, S-5 (C) P-2, Q-4, R-5, S-1 (D) P-3, Q-2, R-5, S-1

# QUESTION BANK

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Volume

**2**

GATE 2016

The GATE 2016 AR was a bit unpredictable. Questions were slightly off the patterns this year in comparison to 2015. Numericals were twisted. Questions were also asked from current affairs. For example, in Earthquake 2015 in Nepal, many heritage buildings collapsed such as 'Dharahara'. When Charles Correa died in 2015 in Mumbai, a movie was made in the memory of called 'Volume Zero'. Cut-off was 38.90.

Section 1: Numerical Questions

Q1. It takes 10s and 15s, respectively, for two trains travelling at different constant speeds to completely pass a telegraph post. The length of the first train is 120 m and that of the second train is 150 m. The magnitude of the difference in the speeds of the two trains (in m/s) is \_\_\_\_\_. (1 mark)  
(A) 2.0 (B) 10.0 (C) 12.0 (D) 22.0

Solution: Speed of the first train = length/time = 120/10 = 12m/s  
Speed of the second train = length/time = 150/15 = 10m/s  
2.0 m/s is the difference in the train speed.

Q2. The number that least fits this set: (324, 441, 97 and 64) is \_\_\_\_\_. (1 mark)  
(A) 324 (B) 441 (C) 97 (D) 64

Solution: 97 is the odd number out. All other numbers are squares.  
324 = 18\*18  
441 = 21\*21  
64 = 8\*8

Q3. A straight line is fit to a data set (ln x, y). This line intercepts the abscissa at ln x = 0.1 and has a slope of -0.02. What is the value of y at x = 5 from the fit? (2 marks)  
(A) -0.030 (B) -0.014 (C) 0.014 (D) 0.030

Solution: The equation of a line is y = mx + c where m is the slope & c is the y-intercept  
Now, In this question x is replaced with ln x

So, the equation of line becomes, y = m\*lnx + c  
or, y = -0.02lnx + c  
We have given with **abscissa** which is essentially x-intercept. So, now we have to find 'c' the y-intercept.  
for, y = 0, lnx = 0.1 (given in the question)  
Putting the value,  
0 = -0.02x0.1 + c  
or, c = 0.002  
So, the equation of line becomes,  
y = -0.02lnx + 0.002  
putting x = 5 (asked in the question)  
y = -0.002ln5 + 0.002 = -0.002x1.6 + 0.002 = -0.03  
(ln5 = 1.6)

Q4. Find the area bounded by the lines 3x+2y=14, 2x-3y=5 in the first quadrant. (2 marks)  
(A) 14.95 (B) 15.25 (C) 15.70 (D) 20.35

Solution: Let the upper line in figure be, 3x + 2y = 14  
and the lower line in figure be, 2x - 3y = 5

Solving both equation, we get, (x = 4, y = 1) the intersection points of the lines.

We have to calculate the area of the shaded reason shown in the figure.  
Area of the shaded reason = Area of ΔEDC - Area of ΔABC

Let us first calculate the area bounded by the upper line 3x + 2y = 14 and X & Y axis  
Area of ΔEDC = (1/2) \* base \* height = (1/2) \* DC \* DE  
= (1/2) x (x-intercept) x (y-intercept)  
= 1/2 \* 14/3 \* 7 = 98/6 .....(Q)

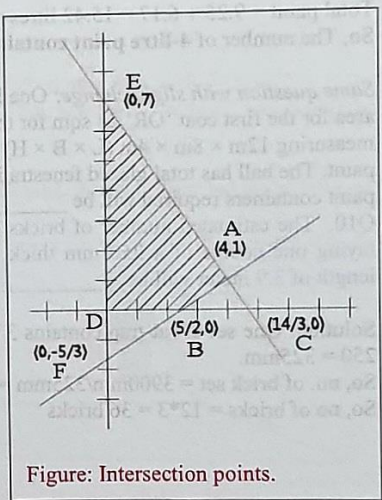


Figure: Intersection points.

Essential Notes -

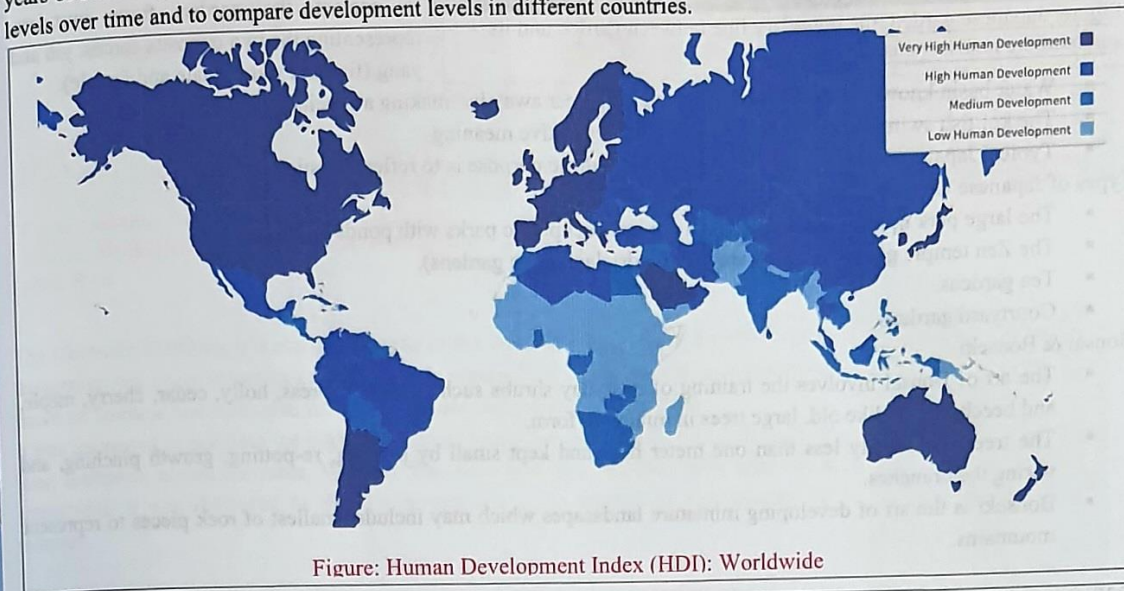
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ITAG

Q35. The components measuring Human Development Index (HDI) of a nation are (1 mark)

- (A) Life expectancy, Education and Per Capita Income
- (B) Life expectancy, Economy and Housing
- (C) Health, Development and Per Capita Income
- (D) Housing, Health and Hygiene

The Human Development Index (HDI) is a tool developed by the United Nations to measure and rank countries' levels of social and economic development based on four criteria: Life expectancy at birth, mean years of schooling, expected years of schooling and gross national income per capita. The HDI makes it possible to track changes in development levels over time and to compare development levels in different countries.



Answer: (A) Life expectancy, Education & Gross national income per capita.

Q36. The concept of 'Dry Garden' is associated with

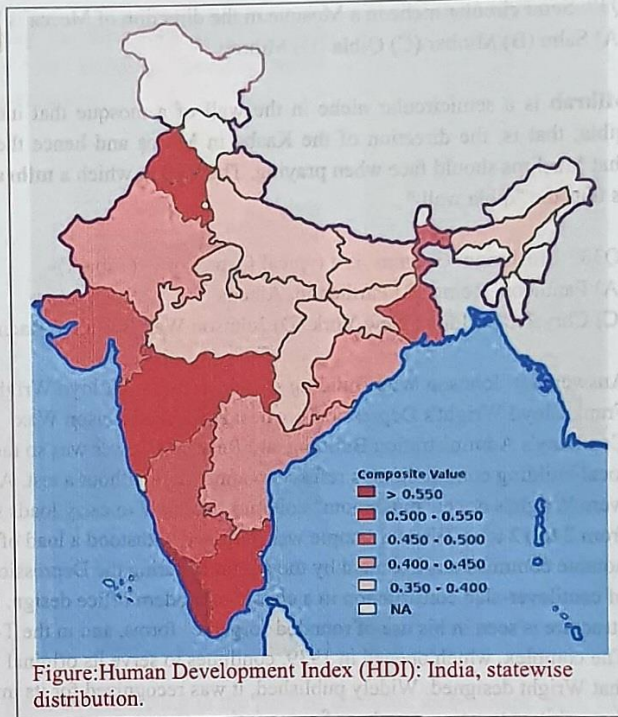
- (A) Japanese Garden
- (B) Chinese Garden
- (C) Mughal Garden
- (D) Egyptian Garden

**Japanese Garden**

- The art of gardening is believed to be an important part of Japanese culture for many centuries.
- The garden design in Japan is strongly connected to the philosophy and religion of the country.
- Shinto, Buddhism and Taoism were used in the creation of different garden styles in order to bring a spiritual sense to the gardens and make them places where people could spend their time in a peaceful way and meditate.

**Essential Aspects**

- The line between garden and its surrounding landscape is not distinct.
- Gardens incorporate natural and artificial elements and thus, fuse the elements of nature and architecture.



Answer: 3

8. Fill in the missing value:



Figure: Part of Q.No. 8

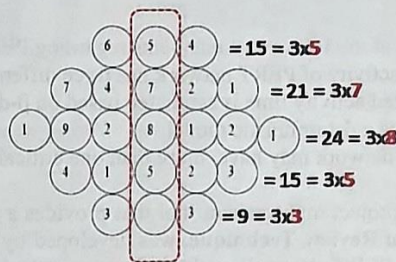


Figure: Solution of Q.No. 8

9. A cube of side 3 units is formed using a set of smaller cubes of side 1 unit. Find the proportion of the number of faces of the smaller cubes visible to those which are NOT visible.  
 (A) 1:4 (B) 1:3 (C) 1:2 (D) 2:3

Notes: Let us take an example of a Rubik's cube assuming each side of 3 units. A Rubik's cube is made up of 27 small cubes assuming each side of 1 unit.  
 A cube has 9 faces. So total no. of faces in 27 cubes are  $27 \times 6 = 162$ . Out of which  $6 \times 9 = 54$  are visible.  
 So NOT visible faces will be  $= 162 - 54 = 108$   
 Therefore, required ratio  $= 54/108 = \frac{1}{2} = 1:2$

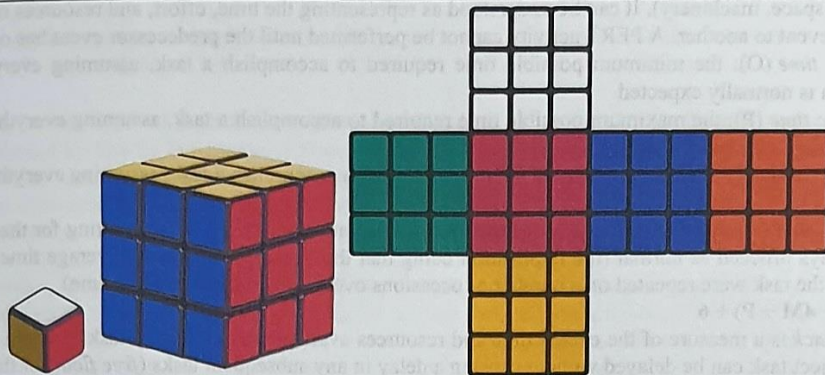


Figure: Rubik's Cube [Support illustration for answer to Q.No.9]

Answer : C

10. Humpty Dumpty sits on a wall every day while having lunch. The wall sometimes breaks. A person sitting on the wall falls if the wall breaks.

- (A) Humpty Dumpty always falls while having lunch.
- (B) Humpty Dumpty does not fall sometimes while having lunch.
- (C) Humpty Dumpty never falls during dinner.
- (D) When Humpty Dumpty does not sit on the wall, the wall does not break.

Answer : B

11. A Housing Finance Institution in the private sector is:

- (A) HUDCO (B) SBI (C) PNB (D) HDFC

Notes: HUDCO: The **Housing and Urban Development Corporation Limited (HUDCO)** is a government-owned corporation in India. It is under the administrative control of the Ministry of Housing and Urban Poverty Alleviation. It is mandated with building affordable housing and carrying out urban development. HUDCO lays an emphasis on the housing needs of the 'deprived' i.e Economically Weaker Sections (EWS) and Lower Income Groups (LIG). It was incorporated on April 25, 1970. It has worked with architects such as B. V. Doshi, Charles Correa, Christopher Charles Benninger etc.

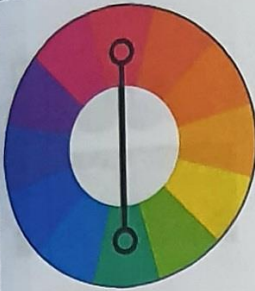
HDFC: Housing Development Finance Corporation, a premier housing finance company set up in 1977. Later it was more involved in banking sector. HDFC Bank Ltd was incorporated on August 30, 1994 by Housing Development Finance Corporation Ltd. In the year 1994, Housing Development Finance Corporation Ltd was amongst the first to receive an 'in principle' approval from the Reserve Bank of India to set up a bank in the **private sector**, as part of the RBI's

Inside and out the Vitra fire station is a series of complex spatial arrangements that evoke a sense of illusive instability while still retaining some semblance of stability and structure. Yet all the while exhibiting simple, clean lines that converge together to create a compositional complexity throughout the station. Today, the fire house has been converted into a museum that showcases Vitra's chair designs after the fire district lines had been redrawn.

25. A combination of colours forming an equilateral triangle in a Colour Wheel is called
- (A) Analogous Scheme  
(B) Triad Scheme  
(C) Split Complementary Scheme  
(D) Double Complementary Scheme

Answer : A

Notes: Below are shown the basic color chords based on the color wheel.

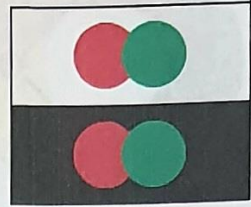


### Complementary

Colors that are opposite each other on the color wheel are considered to be complementary colors (example: red and green).

The high contrast of complementary colors creates a vibrant look especially when used at full saturation. This color scheme must be managed well so it is not jarring.

Complementary colors are tricky to use in large doses, but work well when you want something to stand out. Complementary colors are really bad for text.



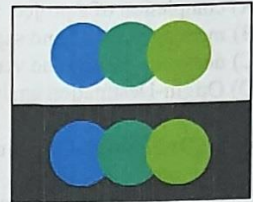
### Analogous

Analogous color schemes use colors that are next to each other on the color wheel. They usually match well and create serene and comfortable designs.

Analogous color schemes are often found in nature and are harmonious and pleasing to the eye.

Make sure you have enough contrast when choosing an analogous color scheme.

Choose one color to dominate, a second to support. The third color is used (along with black, white or gray) as an accent.

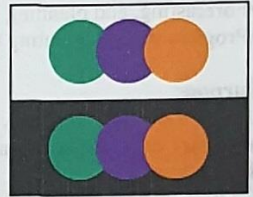


### Triad

A triadic color scheme uses colors that are evenly spaced around the color wheel.

Triadic color harmonies tend to be quite vibrant, even if you use pale or unsaturated versions of your hues.

To use a triadic harmony successfully, the colors should be carefully balanced - let one color dominate and use the two others for accent.

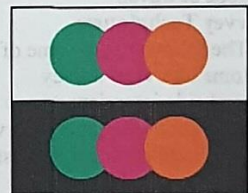


### Split-Complementary

The split-complementary color scheme is a variation of the complementary color scheme. In addition to the base color, it uses the two colors adjacent to its complement.

This color scheme has the same strong visual contrast as the complementary color scheme, but has less tension.

The split-complementary color scheme is often a good choice for beginners, because it is difficult to mess up.



The huge entrance pylon is actually unfinished, as attested by the unequal height of its upper regions, the uncut clocks which project from its undecorated surfaces and the remains of the mud-brick construction ramp that is still present on its interior side. Originally, it stood some 40 meters high (131 feet). This structure may have been built as late as the 30th dynasty by Nectanebo I, who at least constructed the temenos walls to which the pylon is attached. However, this is uncertain and it is possible that an earlier pylon once stood on the same spot. High upon this gate is an inscription left by Napoleon's Expedition, which is still visible.

Passing through this pylon, the first courtyard now encloses an area that was originally outside of the temple, as evidenced by a number of cryosphinxes like those outside that were displaced from their original positions along the processional route. Inside this courtyard to the left is the granite and sandstone triple barque chapel of Seti II, which contains three chambers for the barques of Mut (left), Amun (center) and Khonsu (right). Opposite this shrine is a small sphinx with the features of Tutankhamun.

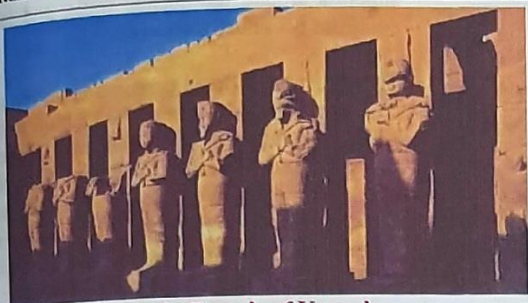


Figure: Remains the Temple of Karnak.

Centered within the courtyard are the remains of the kiosk of Taharqa, which was later usurped by Psammetichus II and later still, restored during Egypt's Greek Period. It originally consisted of ten huge papyrus columns linked by a low screening wall and open at its eastern and western ends. Now there is only one great column and a large, altar-like block of calcite (Egyptian alabaster). The function of this structure has been assumed to be a barque shrine but, because it is open to the sky, it has been suggested that the structure may have served another

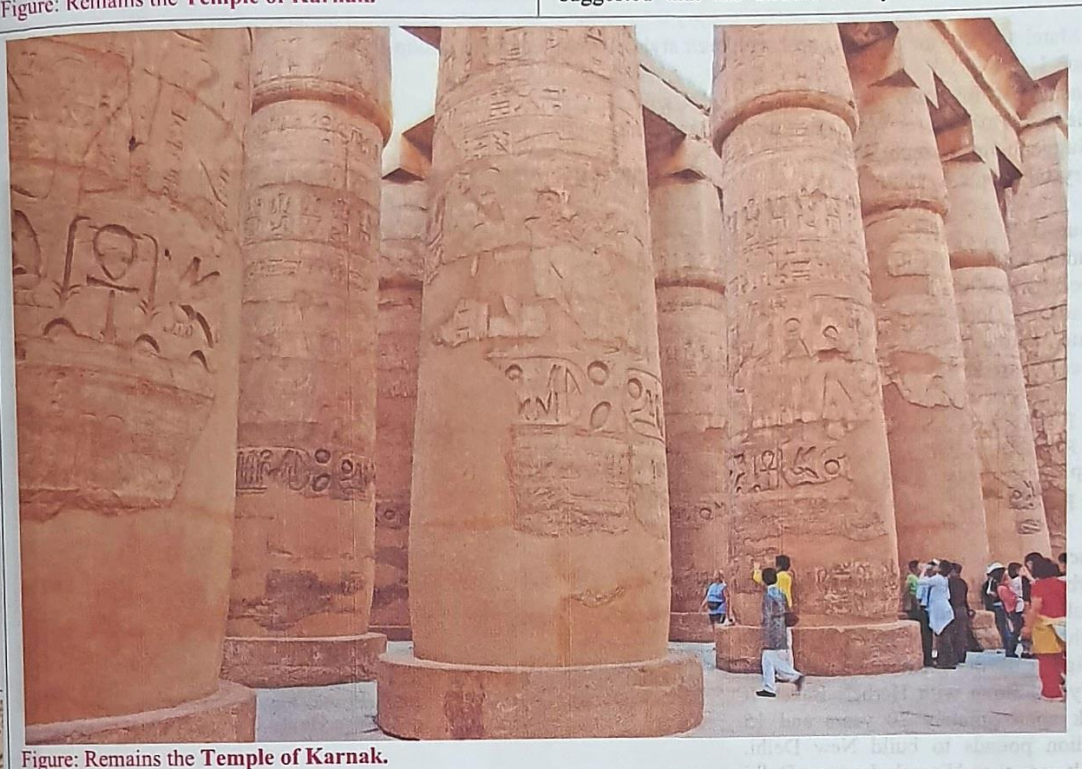
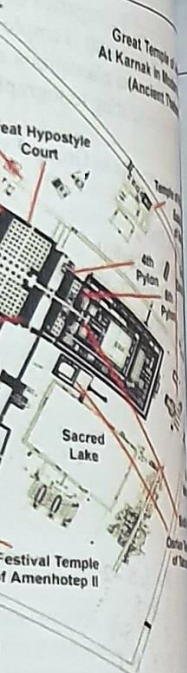


Figure: Remains the Temple of Karnak.



Temple of Karnak.

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roach the of a quay g ancient oris (393- ds to and ple's first mun, and



Figure: Remains the Temple of Karnak.

ritual purpose.

**Notre Dame Cathedral** is widely considered one of the finest examples of French Gothic architecture in the world. It was restored and saved from destruction by Eugène Viollet-le-Duc, one of France's most famous architects. The name Notre Dame means "Our Lady" in French, and is frequently used in the names of Catholic church buildings in Francophone countries. The Notre Dame Cathedral was one of the first Gothic cathedrals, and its construction spanned the Gothic period. Its sculptures and stained glass show the heavy influence of naturalism, unlike that of earlier Romanesque architecture.





### Underpinning: Pile and Beam

Underpinning with pile and beams is another great and preferred method to alleviate footing. Using this system requires that a min-pile must be installed on either side of the affected wall. After the piles have been installed, then brickwork is moved below the wall and reinforced concrete needle beam is used to connect the piles and support the wall. Reducing the distance between needle beams can accommodate very high loads. The bearing capacity of the underlying strata will determine the number, diameter, depth and spacing of piles used. Augered piles or case driven piles can be used with this method of underpinning. The advantages of underpinning with pile and beams are:

- Suitable for restricted access
- Faster than traditional underpinning
- High load capability
- Less disruption, less spoil generated and completed quickly

### Underpinning: Piled Raft

Underpinning with piled raft, must be used when the whole structure need to be underpinned. It is recommended when foundations are too deep for other underpinning methods or in areas where the soil is so hard that small equipment could not excavated up to require depth. Piles are placed at determined locations by loading conditions; then pockets below footings are broken, and reinforced needle beams are placed to bear the wall's load. A ring beam is then built to link all needles and the structure is poured with concrete.

Answer: A

### k. Match following Scientific Names in Group-I with their common Indian Names in Group-II

Group-I	Group-II
P Lagerstroemia speciosa	1 Amaltas
Q Cassia fistula	2 Neem
R Azadarachta indica	3 Jarul
S Acacia auriculiformis	4 Babul
	5 Peepal

- A) P-2, Q-4, R-3, S-4 (B) P-5, Q-3, R-2, S-4 (C) P-3, Q-1, R-4, R-2 (D) P-3, Q-1, R-2, S-4

Notes: Lagerstroemia speciosa, also known by the common name **Pride-of-India**, is a shrub to large tree with multiple trunks or stems diverging from just above ground level. This species can grow up to 15 m in height and has a wide spreading crown.



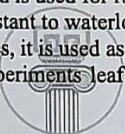
Figure: Jarul (*Lagerstroemia speciosa*)

In India, the wood is used for railroad sleepers and the construction of furniture, wagons, and buildings.

The wood is resistant to waterlogging and therefore is valuable for the construction of boats.

In the Philippines, it is used as a folk medicine for the treatment of diabetes and kidney diseases.

In laboratory experiments leaf extracts are reported to stimulate glucose uptake in a dose-dependent manner in similar ways to insulin.



Answer (B)

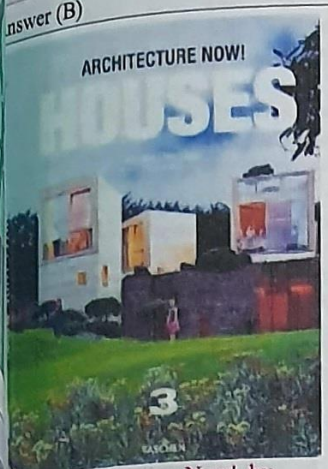


Figure: Architecture Now! by Phillip Jodidio

The methods and theory that his book develops are uncompromisingly rigorous and rightly formed, they are everywhere related to actual building, through specific examples and through the use of over 100 photographs. The structure that Norberg-Schulz has fashioned is surely one of the most impressive intellectual edifices that any architect has ever produced. The materials that are organically worked into it include Gestalt psychology, the mechanics of perception, information theory, modern analytic philosophy, and in particular, linguistic analysis, and the general theory of signs and symbols. The result, however, is not an eclectic hodge-podge; all these materials have their place and purpose; none is applied extraneously for "show" or purely decorative effect. And all this divergent material had to be joined according to plan within formal bounds in order to produce a theory with equally divergent applications: one that can treat not only of the aesthetics of architecture but equally well of its social, psychological, and cultural effects. The chief focus of the book is on the symbolic and linguistic. The purpose is to develop an integrated theory of architectural description and architectural intention (and this includes the intention of the user as well as that of the designer), insofar as architecture is an art.

'Complexity and contradiction in architecture' expresses in the most compelling and original terms the postmodern rebellion against the purism of modernism. Three hundred and fifty architectural photographs serve as historical comparisons and illuminate the author's ideas on creating and experiencing architecture.

The first book to describe an ecologically sound approach to the planning and design of communities, **Design with Nature** has done much over the past 25 years to shape public environmental policy. This paperback edition makes this classic accessible to a wider audience than ever before. Lavishly illustrated with more than 300 color photos and line drawings.

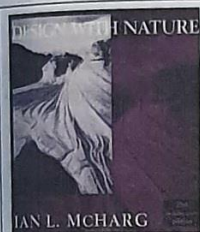


Figure: Design with Nature by Ian Mc Harg

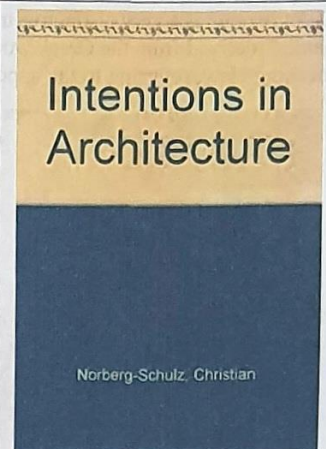


Figure: Intentions in Architecture by Christian Norberg Schulz

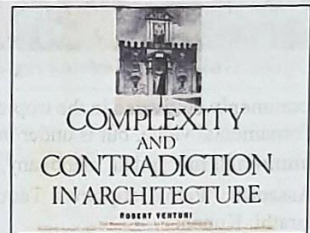


Figure: 'Complexity and contradiction in architecture' by Robert Venturi

Q.64 Match the common names of the trees in Group I with their botanical names in Group II

Group I	Group II
P. Gulmohar	1. Dalbergia Sissoo
Q. Palash	2. Ficus Bengalensis
R. Indian Mahogany	3. Delonix Regia
S. Banyan	4. Toona Ciliata
	5. Butea Monosperma

(A) P-5, Q-3, R-4, S-2 (B) P-4, Q-5, R-2, S-1 (C) P-3, Q-5, R-4, S-2 (D) P-3, Q-1, R-5, S-2

**Common name:** Flame of the Forest • Hindi: Palash पलाश, Dhak ढाक, Tesu टेसू • Manipuri: ৩৩ ৩৩ Pangong • Marathi: पळस Palas

The plant has lent its name to the town of Palashi, famous for the historic Battle of Plassey fought there.

In the state of Jharkhand Palash is associated with the folk tradition. Many folk literary expressions describe palash as the forest fire. The beauty of dry deciduous forests of Jharkhand reach their height when most trees have fallen their leaves and Palash is in its full bloom. Palash is also the State Flower of Jharkhand.

It is said that the tree is a form of Agnidev, God of Fire. It was a punishment given to Him by Goddess Parvati for disturbing Her and Lord Shiva's privacy.

In the Telangana region of Andhra Pradesh, these flowers are specially used in the worship of Lord Shiva on occasion of Shivratri. In Telugu, this tree is called Modugu chettu.



Figure: Palash (*Butea monosperma*)



Figure: Palash (*Butea monosperma*)

In Kerala, this is called 'plasu' and 'chamata'. Chamata is the vernacular version of Sanskrit word 'Samidha', small piece of wood that is used for 'agnihotra' or fire ritual. In most of the old namboodiri (Kerala Brahmin) houses, one can find this tree because this is widely used for their fire ritual.

Q.65 Associate the plans in Group I with the options in Group II

Group I	Group II
P. City Development Plan	1. PMGSY
Q. Slum Free City Plan	2. JNNURM
R. Transport Network Plan	3. RAY
S. Disaster Management Plan	4. NDMA
	5. RSVY

(A) P-2, Q-3, R-1, S-4 (B) P-2, Q-1, R-5, S-4 (C) P-1, Q-3, R-2, S-5 (D) P-3, Q-2, R-1, S-4

Answer (A)

PMGSY The primary objective of the PMGSY is to provide connectivity, by way of an all-weather to the eligible unconnected habitations in the rural areas.

JnNURM

JnNURM is a state sector scheme for Urban Renewal initiated by Govt. of India (GOI) to be implemented over a 7-year period. The scheme envisages providing financial assistance to urban local bodies (ULBs) & parastatal agencies of the order of Rs. 50,000 crores, spread over 7 years

JNNURM covers 63 cities across India. The cities have been divided into 3 categories, namely, A, B and C. This classification is based on population.

Match the organism type from Group I with the appropriate example from Group II

Group I	Group II
P. Autotroph	1. Nitrifying Bacteria
Q. Heterotroph	2. Grasshopper
R. Chemotroph	3. Grass
S. Saprophyte	4. Vulture
	5. Fungus

P-5, Q-4, R-1, S-2 (B) P-2, Q-1, R-5, S-4 (C) P-1, Q-2, R-4, S-5 (D) P-3, Q-2, R-1, S-5

As: An **autotroph** ("self-feeding", from the Greek autos "self" and trophe "nourishing") or "producer". Example- plants. **heterotroph** is an organism that cannot fix carbon and uses organic carbon for growth. This contrasts with autotrophs, such as plants and algae, which can use energy from sunlight (photoautotrophs) or inorganic compounds (lithoautotrophs). **chemotrophs** are organisms that obtain energy by the oxidation of electron donors in their environments. These molecules can be organic (chemoorganotrophs) or inorganic (chemolithotrophs). The chemotroph designation is in contrast to phototrophs, which use solar energy. Chemotrophs can be either autotrophic or heterotrophic. **saprotroph**, a term used for organisms which obtain nutrients from dead organic matter.

Match the concepts in Group I with their corresponding authors in Group II

Group I	Group II
P. Proxemics Theory	1. Gordon Cullen
Q. Serial Vision	2. Edward T. Hall
R. Urban Imageability	3. Oscar Newman
S. Defensible Space	4. Paul Zucker
	5. Kevin Lynch

P-2, Q-1, R-5, S-3 (B) P-2, Q-1, R-3, S-4 (C) P-4, Q-1, R-5, S-2 (D) P-3, Q-5, R-2, S-1

**T. Hall – Proxemics /Personal Space in Different Cultures**

Edward T. Hall (\*16.04.1914) was the most popular founder of Intercultural Communication. He put up three theories: High / Low context, Monochrone / Polychrone Conception of Time and Proxemics. Personal Space varies depending on the culture.

- **Intimate distance – 6 to 18 inches (15-45cm)**  
This level of physical distance often indicates a closer relationship or greater comfort between individuals. It often occurs during intimate contact such as hugging, whispering, or touching.
- **Personal distance – 1.5 to 4 feet (45-120cm)**  
Physical distance at this level usually occurs between people who are family members or close friends. The closer the people can comfortably stand while interacting can be an indicator of the intimacy of the relationship.
- **Social distance – 4 to 12 feet (1,20m-3,50m)**  
This level of physical distance is often used with individuals who are acquaintances. With someone you know fairly well, such as a co-worker you see several times a week, you might feel more comfortable interacting at a closer distance. In cases where you do not know the other person well, such as a postal delivery driver you only see once a month, a distance of 10 to 12 feet may feel more comfortable.
- **Public distance – 12 to 25 feet (3,50-7,50m)**  
Physical distance at this level is often used in public speaking situations. Talking in front of a class full of students or giving a presentation at work are good examples of such situations.

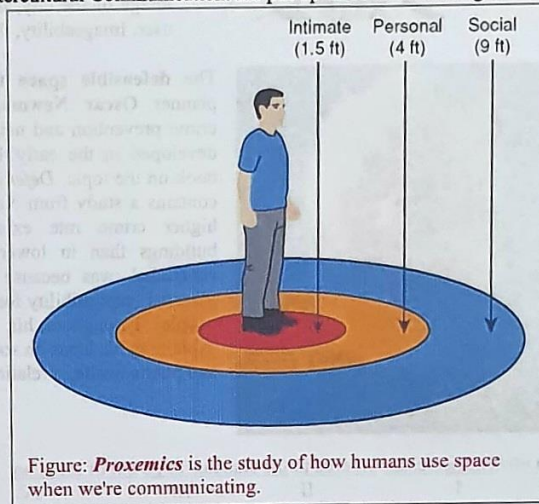


Figure: **Proxemics** is the study of how humans use space when we're communicating.

**Gordon Cullen** studied architecture at the Royal Polytechnic Institution, but never qualified as an architect. He started his career working as a **draughtsman** in various architectural **practices**. He then returned to Britain and joined the Architectural Review as assistant Editor in 1946. He later became a writer on planning policy and contributed numerous editorials and case studies in urban and rural planning.

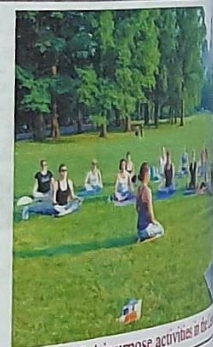


Figure: Multipurpose activities in a park

# QUESTION BANK

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Section J: Numerical Questions

Q1. The minimum road curb length required for parking 10 cars perpendicular to the road is  
 (A) 15 m (B) 25 m (C) 35 m (D) 40 m

Solution: The minimum road curb length required for parking 10 cars perpendicular to the road is 25m.

Notes: 2.5m wide for 1 car if row parking is provided otherwise 3.0m wide for individual car park.

Street Parking: if N = Number of cars parked, L = Length of parking bay, then for:  
 Parallel Parking: L = N

30° Parking: L = 0.58 + 5N

45° Parking: L = 3.54 N + 1.77

60° Parking: L = 2.89N + 2.16

Q2. Maximum horizontal angle from the speaker in a seating area of a lecture theatre should be  
 (A) 70° (B) 90° (C) 120° (D) 140°

Q3. A room measuring 5 m x 3.5 m enclosed by brick wall has a ceiling at 3 m height. The room has a door and a window opening of 1 m x 2 m and 1 m x 1 m respectively. The quantity of plastering required for interior walls (in sqm) is  
 (A) 46.5 (B) 48 (C) 51 (D) 68.5

Solution: Surface area of 4 interior walls =  $2(5+3.5) \times 3 = 51 \text{ sqm}$   
 Surface area of door =  $1 \text{ m} \times 2 \text{ m} = 2 \text{ sqm}$   
 Surface area of window =  $1 \text{ m} \times 1 \text{ m} = 1 \text{ sqm}$   
 So, net surface area for plastering =  $51 - 2 - 1 = 48 \text{ sqm}$  Answer

Q4. One cubic metre of Ordinary Portland Cement yields a volume of M15 concrete in the range of  
 (A) 2 to 3 cum (B) 4 to 5 cum (C) 7 to 8 cum (D) 8 to 9 cum

Solution: Nominal Mix Concrete: In the nominal mix concretes the constituents of concrete are measured by volume and the proportions are pre-determined such as 1:8:16, 1:4:8, 1:3:6 and 1:2:4 etc. The unit of measurement of cement is a bag of 50 kg having a volume of 0.035 cum. The batch boxes are made with the size 35x25x40cm which corresponds to one bag of cement. Nominal mix concretes 1:5:10, 1:4:8, 1:3:6, 1:2:4 and 1:1.5:3 roughly correspond to M5, M7.5, M10, M15 and M20 grades of concrete so far as their compressive strength is concerned.  
 M15 = 1:2:4 (cement:stone:sand)

So, for 1cum of cement will require 2 cum of sand and 4 cum of coarse aggregate. Total  $1+2+4 = 7 \text{ cum}$  of concrete will be required. Also note that the volume of concrete is reduced by a factor of 1.54. Therefore, effective volume of the concrete would be  $= 7/1.54 = 4.54 \text{ cum}$  Answer.

What is M15: It is designation of grades of concrete mix. Letter M refers to the mix and number to specified characteristic compressive strength of 15 cm cube at 28 days expressed in N/square mm. Thus M 15 concrete means a concrete of characteristic strength 15N/square mm. Grades of concrete lower than M 15 shall not be used in reinforced concrete.

Q5. A site in a map drawn to scale of 1:16000 measures 75 sqcm. The actual area of the site in hectares is  
 (A) 120 (B) 162 (C) 192 (D) 256

Solution:  $75 \text{ sqcm} = \sqrt{75} \text{ cm} \times \sqrt{75} \text{ cm}$   
 So, actual area =  $(\sqrt{75} \text{ cm} \times 16000) \times (\sqrt{75} \text{ cm} \times 16000) = (\sqrt{75} \times 160 \text{ m}) \times (\sqrt{75} \times 160 \text{ m}) = 192 \text{ hectares}$  {1 hectare = 100m x 100m}

Q6. In a construction project schedule, A is the first activity. Activities B and C follow A. Activity D follows B and C. Activity E follows C. Activity F follows D and E.

Activity	A	B	C	D	E	F
Duration(in days)	3	2	5	6	5	3

The critical time to complete the project will be

(A) 14 days (B) 16 days (C) 17 days (D) 20 days

Q7. The maintenance cost of a building will be Rs. 2 lacs after 10 years. The annual sinking fund required for such maintenance @ 6% interest per annum will be  
 (A) Rs. 17,200/- (B) Rs. 15,200/- (C) Rs. 13,200/- (D) Rs. 11,200/-

Solution: Sinking Fund = (Maintenance Cost) /  $[(1+r)^n / r] \dots \dots \dots [r = \text{interest rate, } n = \text{no. of years}]$

Sinking Fund =  $(200000) / [(1+0.06)^{10} - 1] / 0.06]$

Sinking Fund =  $(200000) / [(1+0.06)^{10} - 1] / 0.06]$

Sinking Fund =  $(200000) / [(1.06)^{10} / 0.06] = (200000) / [1.79 - 1 / 0.06] = (200000) / [0.79 / 0.06] = 200000 / 13.167$

Sinking Fund = 15189 = Answer

Common Data Questions

Common Data for Questions 8 and 9:

Q8. A beam of span L is simply supported at two ends. One half span of the beam weighs W and the remaining half span weighs 2W. Maximum shear force in the beam will be



Partial Notes -

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allowing energy saving.



Figure: City Hall, London

The design of the building heavily borrows from the design of the Reichstag Dome in Berlin, with its helical stairway structure and the oval/rounded shape of the building. Also, thanks to the materials used and the overall design, the building is a symbol for "transparency", just like Reichstag is.

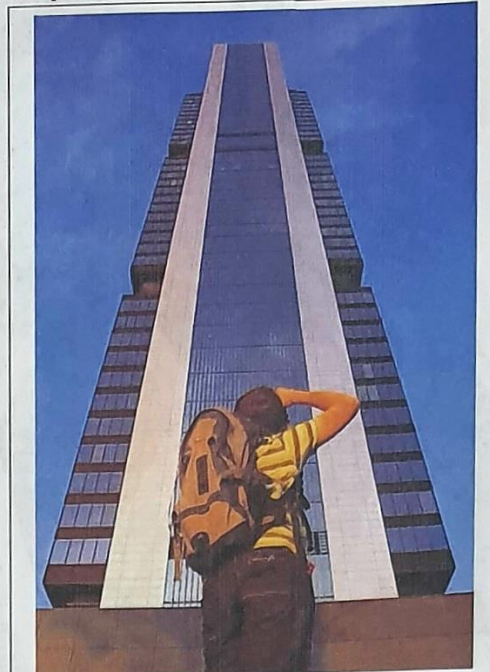


Figure: Torre Caja Madrid, Spain

**Torre Caja Madrid, Spain**

This is a skyscraper with 250 meters in height, and it easily earns its place on the Top 200 Tallest Buildings in the World. It was completed in 2009, and it took 6 years to complete. Currently, the building serves as the main office space for the largest banking institution in Spain (Caja Madrid). It is a highly modern structure not only on the outside, but offering great flexibility and large comfortable office spaces and conference rooms inside.

**Clyde Auditorium Glasgow**

This beautiful, contemporary style building is a very popular concert venue of Glasgow Scotland, also known as "The Armadillo" (because of its resemblance to the armadillo mammal). It has been opened to public in 1997, and it has 30,000 seats. The shape of the building was not only chosen for pure design, but it also has a very practical side: to get the best acoustic experience.

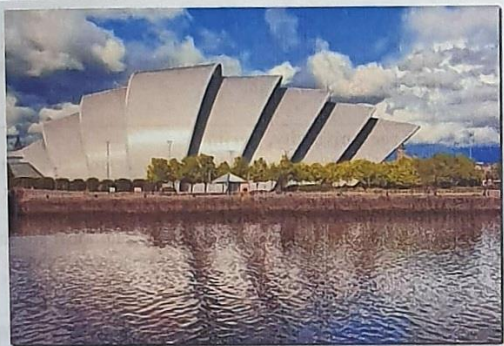
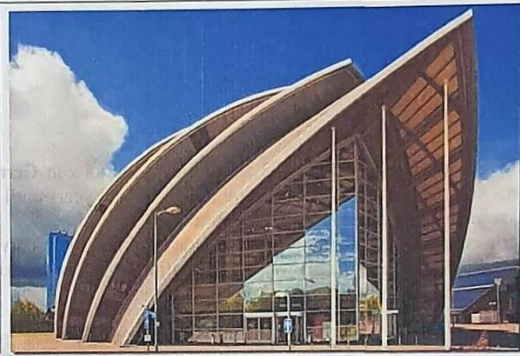


Figure: Torre Caja Madrid, Spain



Many critics have compared the Clyde Auditorium with the Sydney Opera House; there are indeed many similarities, however the Sydney structure did not serve as a prime model for the architects to design the Scottish Auditorium. The exterior shell-like structure is made of titanium alloy, which is the sole material that allows the creation of such beautiful, perfectly sleek and curved designs.

**30 St. Mary Axe London**

Known as the Gherkin Building (or even sometimes the "Cucumber"), this wonderful architectural landmark is not only beautiful but also a very environmentally friendly building. It was completed in 2003 based upon the master plans of Norman Foster and associates. The building is very famous for its natural ventilation system - which thanks to the huge shafts or cylinders placed on each floor the natural air can circulate in the building.

With the use of passive solar heating system, in winter the building warms up the air it subtracts from the outside. In summer periods, the shafts work as huge warm air pumps, thus creating a cool atmosphere within the building. Energy is also being saved, because these huge shafts also have the purpose of letting natural light into the building.

- The properties of the internal and external faces of the constructional element under scrutiny need to be allowed for. These are called external resistances and are fixed values.
- The U value is defined as being reciprocal of all the resistances of the materials found in the building element.
- The resistance of a building material is derived by the following formula:  
 $R = (1/k) \times d$
- where k is the conductivity of the building material and d is the material thickness.
- The formula for the calculation of a U value is  
 $U(\text{element}) = 1 / (R_{so} + R_{si} + R_1 + R_2 \dots)$
- where  $R_{so}$  is the fixed external resistance
- where  $R_{si}$  is the fixed internal resistance
- and  $R_1 \dots$  is the sum of all the resistances of the building materials in the constructional element. **Answer (B)**



Figure: Infrared imaging.

Q34. Consistency of cement is measured by

- (A) Pycnometer
- (B) Slump cone
- (C) Universal Testing Machine
- (D) Vicat's apparatus

**Vicat's apparatus:** a device for determining the normal consistency and time of setting of portland cements that consists of a rod weighing 300 grams, having a needle in each end, and supported in a frame with a graduated scale to measure the distance to which the needle penetrates the cement.

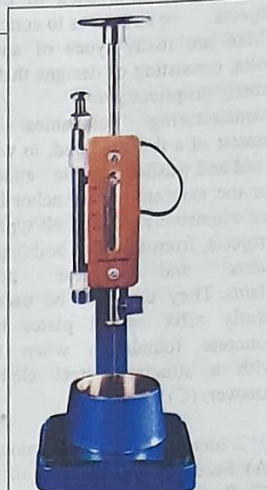


Figure: Vicat's apparatus for determining consistency of cement.

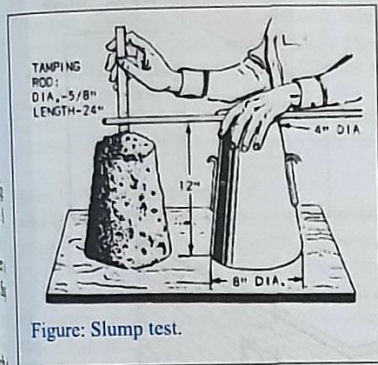


Figure: Slump test.

The **concrete slump test** is an empirical test that measures the workability of fresh concrete. More specifically, it measures the consistency of the concrete in that specific batch. This test is performed to check the consistency of freshly made concrete. Consistency is a term very closely related to workability. It is a term which describes the state of fresh concrete. It refers to the ease with which the concrete flows. It is used to indicate the degree of wetness. Workability of concrete is mainly affected by consistency i.e. wetter mixes will be more workable than drier mixes, but concrete of the same consistency may vary in workability. It is also used to determine consistency between individual batches.



Figure: Pycnometer.

A **universal testing machine**, also known as a **universal tester**, **materials testing machine** or **materials test frame**, is used to test the tensile stress and compressive strength of materials. It is named after the fact that it can perform many standard tensile and compression tests on materials, components, and structures.

A **pycnometer** or specific gravity bottle is a flask with a stopper that has a capillary tube through it, which allows air bubbles to escape. The pycnometer is used to obtain accurate measurements of density. **Answer: (D)**

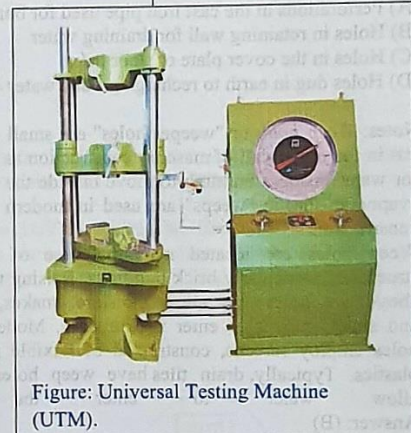


Figure: Universal Testing Machine (UTM).

Q35. The appropriate material for flooring of an external ramp of a building would be

- (A) Polished granite
- (B) Wax polished marble
- (C) Glazed ceramic tile
- (D) Rough finish sandstone

**Sandstone** would be non-slippery in rain and add more friction in comparison to other options available here.

Q36. Which of the following is NOT a member of a Steel Truss?

- (A) Gusset Plate
- (B) Wall Plate
- (C) Fish Plate
- (D) Anchor Bolts

**Answer: (D)**



000 people, it used to be the largest Christian church in the world, but in 1989 it was exceeded in size by the church in Moussoukro, Cote d'Ivoire.

#### Interior Decoration: Nave, Chapels, Sculpture

pilgrims entering the basilica are monitored by church officials and members of The Swiss Guard. Inside, the basilica is cruciform in shape, with an elongated nave in the form of a Latin cross. The nave is framed by wide aisles giving access to a number of chapels. These include: the Chapel of the Presentation of the Virgin, the Clementine Chapel, the Chapel of the Madonna of Lonna, the Gregorian Chapel, the Chapel of the Pieta and several other altars. In addition, beneath the high altar, is the Chapel of Confession.

The interior of Saint Peter's contains a number of priceless treasures in marble and bronze by the greatest Renaissance sculptors - works such as Pieta (1500) by Michelangelo - as well as Baroque sculpture - such as the baldachin or ceremonial canopy over the altar, and the traditional Chair of St Peter (Cathedra Petri), both designed by Bernini - and works by the greatest neoclassical sculptors such as the marble statue of Pope Pius VI by the Italian genius Antonio Canova (1757-1822). It also contains numerous other tombs ornamented with marble statues and reliefs - such as the Tomb of Pope Leo XI (1634-44) by Alessandro Algardi (1688-1754) - as well as mosaics and precious metalwork. Ironically, the huge and aggressive fund-raising campaign required to pay for the cost of the basilica and its contents (46 million ducats), led to protest across Europe and became an important factor in bringing the Reformation and the birth of Protestantism.

#### Exterior Architecture: Facade, Dome

Saint Peter's is approached via St. Peter's Square, an elliptical forecourt encircled by a Doric colonnade, derived from Greek architecture. It ends at the facade of Saint Peter's which is 376 feet wide and 150 feet high. Designed by Carlo Maderno, the facade features a giant order of Corinthian columns (each 90 feet high) and is topped by thirteen statues - Christ flanked by eleven of the Apostles (excluding Peter) plus John the Baptist. At ground level it is approached by steps guarded by two 18-foot high statues of Saints Peter and Paul.

The Basilica of St. Peter is one of four Major Basilicas of Rome, the others being Santa Maria Maggiore, St. Paul and St. John Lateran, but it is the dome of Saint Peter's - the tallest dome in the world - that dominates the skyline of Rome. Designed largely by Michelangelo, and built during the short but active papacy of Sixtus V (1585-1590) by Michelangelo's pupil Giacomo della Porta, the dome rests on four pendentives and massive piers, each 60 feet thick. It was Michelangelo

who increased the size and strength of the load-bearing structure without destroying the central unity of Bramante's original design. Immediate rivals of St Peter's dome include Florence Cathedral of the Early Renaissance, designed by Filippo Brunelleschi and completed in 1434 - for details, see Florence Cathedral, Brunelleschi and the Renaissance (1420-36); Constantinople's Hagia Sophia church, completed in 537; and the dome designed by Christopher Wren for St Paul's Cathedral, finished in 1710. St Peter's Basilica is maintained by the Sampietrini, a specialist group of workers who continually scale and inspect the building's surfaces.

#### Tombs and Relics

About 100 tombs are to be found within St. Peter's Basilica, including a number located in the Vatican grotto, underneath the basilica. They contain 91 popes, the Holy Roman Emperor Otto II, St. Ignatius of Antioch and Pope John Paul II. In a subterranean crypt, directly below the dome and the main altar, is the tomb of St. Peter himself. Positioned in niches set into the four piers supporting the dome are a number of statues associated with the holy relics of the



Section 1: Numerical Questions

Q1. The cubical content of a cement bag of 50 kg is generally  
 (A) 0.25 cu.m (B) 0.034 cu.m (C) 0.043 cu.m (D) 0.05 cu.m

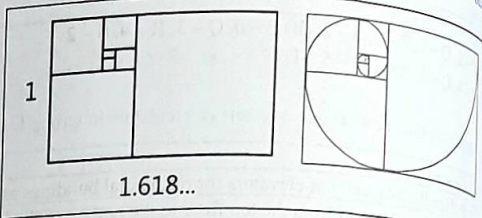
Solution: Volume = Mass / Density  
 $\Rightarrow$  Density = Mass / Volume  
 $\Rightarrow$  Density = 50kg / 1440kg/m<sup>3</sup> = 0.034 cu.m. Answer (B)  
 Normal density of cement = 1440kg/m<sup>3</sup>

Q2. A line segment PQ is divided into two parts using the Golden Mean ratio. Segment A is smaller than segment B. The relationship that holds true for the line PQ is

- (A)  $A/B = A/(A+B)$
- (B)  $A/B = B/(A+B)$
- (C)  $(A+B)/A = (B-A)/B$
- (D)  $(A+B)/A = (P+Q)/P$

The Golden ratio is a special number found by dividing a line into two parts so that the longer part divided by the smaller part is also equal to the whole length divided by the longer part.

Various uses of Golden ratio:




Q3. A typical fire fighting undergro  
 (A) 2400 lit/hour and press  
 (B) 2400 gallons/min and  
 (C) 2400 gallons/min and press  
 (D) 2400 lit/min and press

Solution: Pressure energy =  $\rho gh =$   
 $= 200000 \text{ (kg-m/sec}^2\text{)(m}^2\text{)}$   
 $= 200000 \text{ N/m}^2$   
 $= 0.2 \text{ N/mm}^2$  Answer

From conservation of energy:

$\rho gh = \frac{1}{2} \rho v^2$   
 $\Rightarrow gh = \frac{1}{2} v^2$   
 $\Rightarrow 10 \text{ m/sec}^2 * 20 \text{ m} = \frac{1}{2} v^2$   
 $\Rightarrow v = 20 \text{ m/sec}$

Let diameter of the hose = 50 mm  
 So, Area =  $\pi r^2 = 22/7 * (25/1000\text{m})^2$   
 So, volume of water released =  $v * A$   
 $= 3.92 * 10^{-3} * (60 * 100) \text{ l/hour}$   
 $= 2352 \text{ litre/min Answer (D)}$   
 Sizes: The nominal internal diame

Q4. The first four terms of a Fibon  
 (A) 5 (B) 8 (C) 11 (D) 18

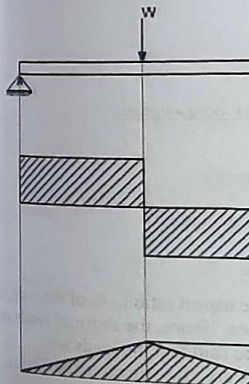
Solution: The Fibonacci Sequence  
 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, ...

The next number is found by adding  
 • The 2 is found by adding  
 • Similarly, the 3 is found  
 • And the 5 is (2+3),  
 • and so on!

Example: the next number in the s  
 Here is a longer list:  
 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55,  
 121393, 196418, 317811, ...

Q5. Two loading diagrams P an  
 (A)WL/4, WL/8 (B)WL/2, W

Solution: Please note that in figur

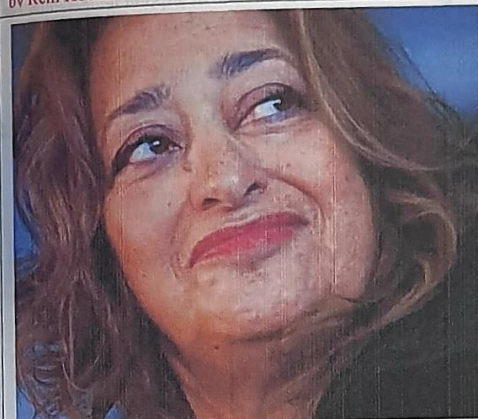


**Rem Koolhaas**

Known for his striking, often gravity-defying structures, Rem Koolhaas has built a reputation as one of the top architects of the 21st century. Born in Rotterdam, the Netherlands, Koolhaas worked as a journalist and screenwriter before attending the Architecture Association School in London. After graduating in 1972, he conducted research in the United States, during which time he wrote *Delirious New York: A Retroactive Manifesto for Manhattan*. In 1975 he founded the Office for Metropolitan Architecture, or OMA, along with fellow architects.



The De Rotterdam complex, located in the Dutch city of the same name, was devised as a vertical city and is composed of three towers that house apartments, offices, shops, restaurants, and a hotel. At nearly 500 feet tall and with 1.7 million square feet of floor space across the towers, the building is the largest in the country. Designed by Rem Koolhaas



Zaha Hadid's projects are characterized by their dynamic formal qualities of sinuously, curving shapes, or crystallized strata. This sums up as a kind of new Baroque, a sensuous, more vibrant and engaging type of architecture.

**Zaha Hadid**, (born October 31, 1950, Baghdad, Iraq—died March 31, 2016, Miami, Florida, U.S.), Iraqi-born British architect known for her radical deconstructivist designs. In 2004 she became the first woman to be awarded the Pritzker Architecture Prize. Hadid began her studies at the American University in Beirut, Lebanon, receiving a bachelor's degree in mathematics. In 1972 she traveled to London to study at the Architectural Association, a major centre of progressive architectural thought during the 1970s. There she met the architects Elia Zenghelis and Rem Koolhaas, with whom she would collaborate as a partner at the Office of Metropolitan Architecture. Hadid established her own London-based firm in 1979.

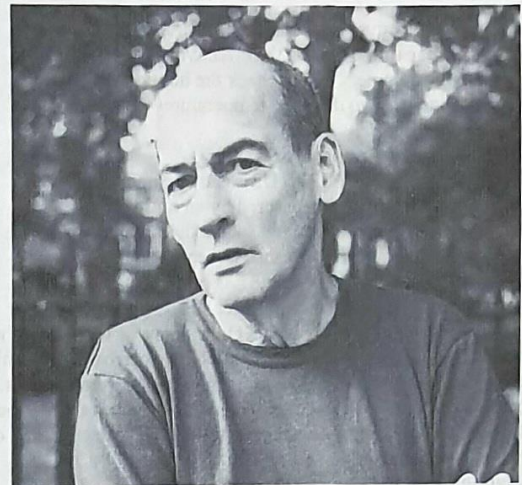
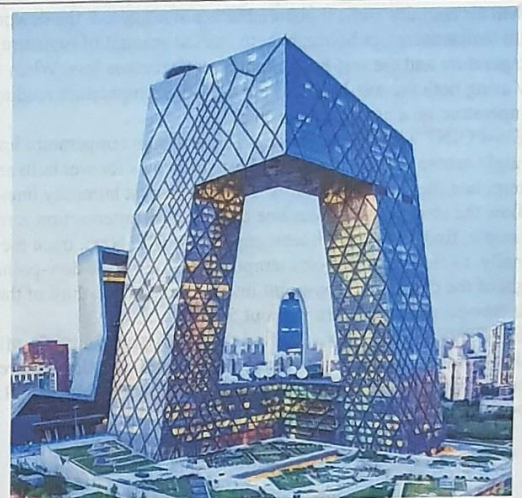


Figure: Rem Koolhaas



Koolhaas reinvented the skyscraper with his Beijing headquarters for CCTV. The building's two towers are connected by a 246-foot cantilevered section known as the Overhang. The exterior is sheathed in sun-shaded glass with a striking pattern of triangulated steel tubes, which form part of the support structure. Designed by Rem Koolhaas

# QUESTION BANK

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Volume

**4**

Section 1: Numerical Questions

Q1. The value of runoff coefficient C in  $Q = CIA$  that represents a completely impervious and wetted surface from which there is total runoff is (A) 0 (B) 1 (C) 10 (D) 1%

Notes: **Runoff coefficient (C)** is a dimensionless coefficient relating the amount of runoff to the amount of precipitation received. It is a larger value for areas with low infiltration and high runoff (pavement, steep gradient), and lower for permeable, well vegetated areas (forest, flatland).

Formula:

$Q = CIA$

Q = Runoff in cubic feet per second (cfs)

C = Runoff coefficient (dimensionless)

I = Rainfall intensity (inches per hour)

A = Drainage area (acres)

Runoff Coefficient (C):

Pavement = 0.9

Business area = 0.8

Playground = 0.2

Sandy soil = 0.1

Example1: Calculate the peak stormwater runoff rate from a watershed of 15 acres, with a runoff coefficient of 0.35, from a storm of intensity 2.4 in/hr.

Solution:

This requires simply substituting into the equation ( $Q = CIA$ ),

thus:  $Q = (0.35)(2.4)(15) = 12.6$  cfs

Example2: The catchment area is of 300 hectares. The surface cover in the catchment can be classified as given below:

Type of cover	Coefficient of runoff	Percentage
Roofs	0.90	15
Pavements and yards	0.80	15
Lawns and gardens	0.15	25
Roads	0.40	20
Open ground	0.10	15
Single family dwelling	0.50	10

Calculate the runoff coefficient and quantity of storm water runoff, if intensity of rainfall is 30 mm/h for rain with duration equal to time of concentration. If population density in the area is 350 persons per hectare and rate of water supply is 200 LPCD, calculate design discharge system. Assume 80% becomes waste water.

Solution: Estimation of storm water discharge for storm water drain of separate system,

Overall runoff coefficient  $C = [A1.C1 + A2.C2 + \dots + An.Cn] / [A1 + A2 + \dots + An]$

$= (0.15 \times 0.90 + 0.15 \times 0.80 + 0.25 \times 0.15 + 0.20 \times 0.4 + 0.15 \times 0.1 + 0.10 \times 0.5) / (0.15 + 0.15 + 0.25 + 0.20 + 0.15 + 0.10)$

$= 0.44$

Therefore quantity of storm water,  $Q = C.I.A = 0.44 \times (0.03m/3600Sec) \times (30 \times 10000 m^2)$

$= 0.44 \times 30 \times 300/360$

$= 11 m^3/sec$

Estimation of sewage discharge for sanitary sewer system:

Quantity of sanitary sewage =  $300 \times 350 \times 200 \times 0.80 = 16800 m^3/day$

$= 0.194 m^3/sec$

Q2. A sector has a gross area of 65 hectares and a residential area of 50 hectares. If net residential density is 325 pph, what is the gross density of the sector (A) 275 pph (B) 225 pph (C) 300 pph (D) 250 pph

Answer: Net density = population / Residential area

$\Rightarrow 325 = x / 50$

$\Rightarrow x = (50 * 325) \dots \dots \dots$  population

Gross density = population / Gross area

$\Rightarrow y = 50 * 325 / 65 = 250$  Answer (D)

Q3. A plot of land measuring 25 m x 40 m has a Ground +4 storeyed building with uniform floor areas. If the land has been utilised to its fullest and FAR is 2.5, calculate the permissible ground coverage?

(A) 50% (B) 5% (C) 25% (D) 40%

Answer: FAR = total built up area / plot area

$\Rightarrow 2.5 = x / 25 * 40$

Essential Notes -

duced into a retrieval sys  
ording or otherwise) with  
n relation to this publica

administration, % of employment in Non-agricultural activities and other factors. Further, a Governor may also if, he fits it necessary, based upon the industrial establishments, can specify the Industrial Townships by public notice. Its tenure is five years.

**Municipal councils** are created for smaller urban areas. Its tenure is five years.  
**Municipal corporations** are created for larger urban areas. Its tenure is 5 years.

(Source: <http://www.yourarticlelibrary.com/law/74th-amendment-act/highlights-of-74th-amendment-act-1992-in-india/66687/>)

Q.28 The best example of synthesis between Indo-Aryans and Dravidian stylistic features in an temple is  
(A) Hoysaleswara (B) Maduri (C) Konark (D) Dilwara

The Indo-Aryan style prefers a tower with rounded top and curvilinear outline while the tower of the Southern or Dravidian style is usually in a shape of a rectangular truncated Pyramid. The north Indian or Orissa style or nagara style is referred to as Aryan style and the vimana style is so called Dravidian style

**Dravidian Style**

From 12th century, under the Dravidian Style, it became usual to fortify the temple often with three square concentric walls with gates on four sides. The gates were surmounted by watch towers or gate houses further developed into soaring towers or Gopuram generally much taller than the modest Sikhara over the central shrine.

The entrance tower was usually in the form of an oblong pyramid with its broadest side parallel to the wall. This new style is often called Pandyan style. This style introduced more elaborate ornamentation and the use of animal forms as pilasters and columns including the rampant horses and leoglyphs that further give a distinctive character of Dravidian architecture. The platforms and walls are covered with narrow carved friezes of elephants, horsemen, monsters and scenes of mythology and legend.

Every important temple in South India there was provisions of a building for amman the God's chief wife which was often nearly as large as the main shrine itself and a marriage hall or Kalyanmandapam wherein the icons of god and goddess were ceremonially united on festival days.

Another feature in the Vijayanagar style is the profusion of string yet delicate carving which adorns the pillared halls, the columns of which are so decorated that they become sculptures in their own right. Prancing horses, vigorous and energetic leap from the stone with leoglyphs and other fantastic monsters. For brilliancy of decorative imagination the Vijayanagar style of architecture was never surpassed in Hindu India.

**Indo-Aryan Style**

Most of the original structures of this type do not exist today due to wave on Non-Hindu conquests in the Northern parts of India except in Gujrat, Khajurao, Bihar and Odisha. Even the great temples at Varanasi and Mathura are reconstructions and do not have the original structures built. Some of the existing excellent examples are of Khajurao Temple, Konark Sun Temple, Lingaraj Temple and Jagantha Temple at Puri.

The North Indian Sikhara was a tower which begins to curve inwards at about one third of its heights with rounded top crowned by a flat stone disc and final Kalasa. The Lingaraj like most Indo-Aryan Style is built as a series of four halls-a hall of offerings, (bhog mandap), dancing hall (natmandir), a assembly hall (Jagmohana) and a sanctuary (Garvagriha or deul). The Odia architects were lavish with their exterior decoration, and their sculptures produced works of great merit but the interiors are unadorned. In the larger temples the carbelled roofs of the halls rested on large pilasters but pillars were not generally used and roofs were often partly supported by iron girders.

Q.29 Urushringa is the design component used in Shikhara of one of the following temple styles  
(A) Bhubaneshwari (B) Dravidian  
(C) Khajuraho (D) Deccan

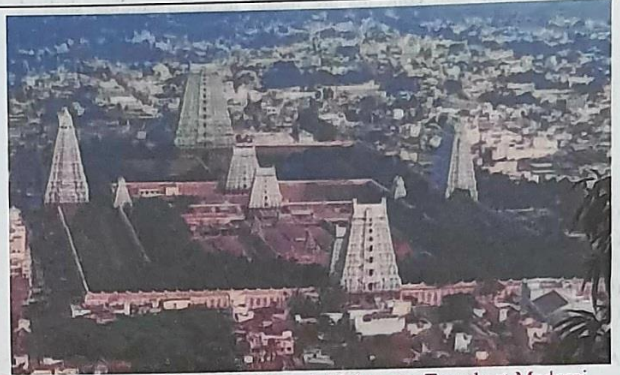


Figure: The figure shows the Meenakshi Amman Temple at Madurai the quintessential example of the Dravidian Architecture.

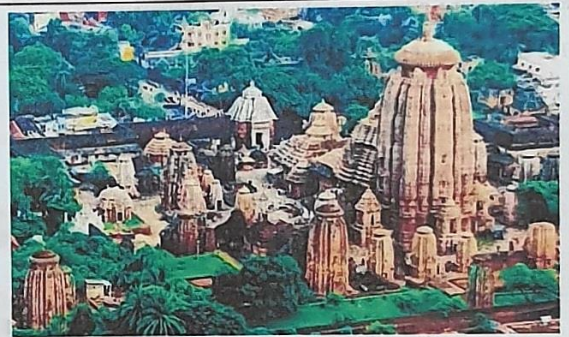


Figure: The figure shows the Lingaraja temple at Bhubaneswar the quintessential example of the Indo-Aryan Architecture.

1.10 The duct size for an air conditioning system is dependent on amount of airflow and its

- (A) velocity
- (B) temperature
- (C) relative humidity
- (D) latent heat

The air inside AC duct can be treated as a fluid. If the duct size is decreased the flow will increase as per law of continuity.

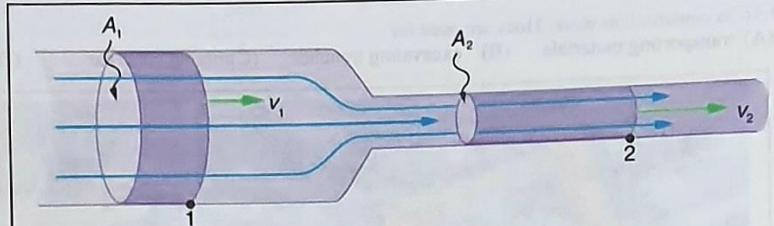


Figure: law of continuity.  $A_1V_1 = A_2V_2$

1.11 The botanical name of 'Neem' tree, used for roadside landscaping is

- (A) Lagerstroemia speciosa
- (B) Ficus benghalensis
- (C) Kleinhamia hospita
- (D) Azadirachta Indica



Figure: *Lagerstroemia speciosa*, Common name: Hindi: Jarul ज़रूल • Manipuri: Jarol • Tamil: கடலி Kadali • Marathi: Taman  
This is a beautiful tropical flowering tree with flowers that are pink, purple or purplish - pink. leaves are used against diabetes mellitus and for weight loss. Leaves are able to lower blood sugar, effective in weight loss.  
Source: [https://toptropicals.com/catalog/uid/Lagerstroemia\\_speciosa.htm](https://toptropicals.com/catalog/uid/Lagerstroemia_speciosa.htm)



Figure: *Azadirachta Indica* [Neem]. Leaves, flowers and its fruits are edibles.



Figure: *Ficus benghalensis*, Barh or Banyan, a remarkable tree of India and tropical Africa sends down from its branches great numbers of shoots, which take root and become new trunks.

(Source: <http://www.flowersofindia.net/catalog/slides/Queen%20Crape%20Myrtle.html>)

1.12 Symbolic representation of water by sand is frequently found in

- (A) Mughal Garden
- (B) English Garden
- (C) Japanese Garden
- (D) Moorish garden

1.13 Kenzo Tange developed the concept of

- (A) Deconstruction
- (B) Arcology
- (C) Metabolism
- (D) Anamorphosis

1.14 The maximum slope in a ramp for wheel chair movement is

- (A) 1 : 8
- (B) 1 : 12
- (C) 1 : 20
- (D) 1 : 25



Figure: sand and gravel had long been a feature of **Japanese gardens**. In the Shinto religion, it was used to symbolize purity, and was used around shrines, temples, and palaces. In zen gardens, it represents water.

Less Is More vs Less Is A Bore

	Less Is More	Less Is A Bore
Definition	A rule of thumb for minimalism in art and architecture.	A rule of thumb for postmodern architecture that embraces expressive form and ornamentation.
Attributed To	Ludwig Mies van der Rohe	Robert Venturi
Associated With	Modernism Minimalism	Postmodern architecture

1.8 Turbidity of water is due to

- A) Algae
- B) Fungi
- C) Orange salt
- D) Suspended matters

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulates. Turbidity is the cloudiness or haziness of a fluid caused by large numbers of individual particles that are generally invisible to the naked eye, similar to smoke in air.

1.9 The only architect-president of a nation was

- A) Richard Nixon
- B) F. Marcos
- C) Thomas Jefferson
- D) L. B. Johnson

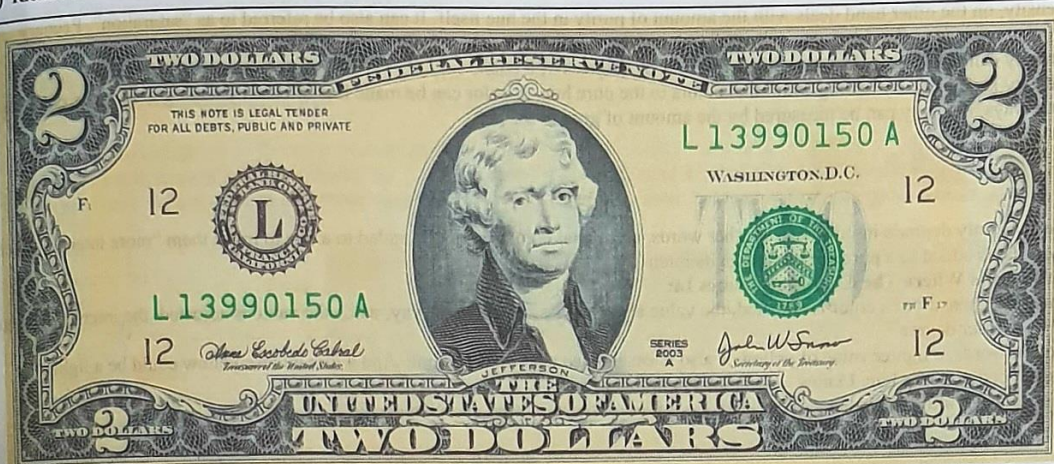


Figure: Thomas Jefferson was the third President of the United States. He was the first President to be inaugurated in Washington DC, a city that he helped plan. The foremost spokesperson for Democracy of his time, he was the author of the Declaration of Independence.

Source: [http://www.sheppardsoftware.com/History/presidents/Presidents\\_3\\_Jefferson.htm](http://www.sheppardsoftware.com/History/presidents/Presidents_3_Jefferson.htm)

1.10 Intensity of color refers to

- A) brightness
- B) darkness
- C) pigment density
- D) quantity

Notes: Value vs. Intensity

The words, "value" and "intensity" are thrown around quite a bit in the world of art-making. And although their definitions are quite different, they are often confused with each other.

While value and intensity are different, they do have somewhat overlapping applications. This is one of the reasons that they are so often confused. Even though their applications are sometimes used interchangeably, knowing the difference between the two can help us make better aesthetic decisions in our drawings and paintings.

What is Value?

Let's start by discussing value. Value, in terms of art, is the darkness or lightness of a color. Value is one of the seven elements of art and in many circles, it is considered to be the most important. Its importance in creating the illusion of light, form, and texture in a drawing or painting cannot be denied.

- (D) Charles Corva
- All values can be measured using a value scale, which theoretically has an infinite number of values. Most value scales are sufficient enough when showing 7-9 values.



Value Scale with 8 Tones

All colors have an inherent value associated with them. For example, purely pigmented yellows are generally lighter in value when compared to purely pigmented blues, which are darker.

- (D) 1 in 20

- (D) Joseph Paxton



1.15 The pH scale runs from 0-14, the nearest value of drinking water is

- (A) 0
- (B) 4.5
- (C) 7.0
- (D) 12.6

1.16 The emission of auto consists of

- (A) CO
- (B) SO<sub>2</sub>
- (C) NO<sub>x</sub>
- (D) All of three

1.17 According to architecture of Mansara a building is called 'female' when its plan is

- (A) Octagonal
- (C) Circular

- (B) Rectangular
- (D) Square

1.18 The unit of measurement for intensity of sound level is

- (A) Bel
- (C) Hertz
- (B) Decibel
- (D) Soncs

(Source: <http://www.animations.physics.unsw.edu.au/jw/dB.htm>)

1.19 To prevent excessive contrast between wall and window which creates glare, the ratio of wall to window area should generally exceed

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

Notes: Window area or window-to-wall ratio (WWR) is an important variable affecting energy performance in a building. Window area will have impacts on the building's heating, cooling, and lighting, as well as relating it to the natural environment in terms of access to daylight, ventilation and views. The window-to-wall ratio is the measure of the percentage area determined by dividing the building's total glazed area by its exterior envelope wall area.

1.20 Permissible stress in bending compression (N/mm<sup>2</sup>) for M20 grade concrete is

- (A) 3.0
- (C) 7.0
- (B) 5.0
- (D) 8.5

1.21 Non-degradable pollutant is

- (A) Sewage
- (C) Detergents
- (B) Algae
- (D) DDT

**Non-degradable pollutant:** A pollutant that is not broken down by natural processes.

**DDT,** plastics, polythene, bags, insecticides, pesticides, mercury, lead, arsenic, metal articles like aluminium cans, synthetic fibres, glass objects, iron products and silver foils are non-biodegradable pollutants.

1.22 Maximum airflow at body level in a room can be achieved through

- (A) High inlet and high outlet
- (C) Low inlet and high outlet
- (B) High inlet and low outlet
- (D) Low inlet and low outlet

1.23 The 'Bread Basket' region refers to

- (A) Tropical desert
- (B) Coniferous forest
- (C) Temperature grass-land
- (D) Tropical grass-land

1.24 'Tap root' concept was initiated by

- (A) Le Corbusier
- (B) F.L. Wright
- (C) Tony Garnier
- (D) Robert Millart

1.25 'Extreme Simplicity' was proposed by

- (A) J.J.P. Oud
- (B) C.A. Doxiadis
- (C) Mies Van der Rohe
- (D) Walter Gropius

(Source: Architects with stamps [https://www.stampcommunity.org/topic.asp?TOPIC\\_ID=26283](https://www.stampcommunity.org/topic.asp?TOPIC_ID=26283))

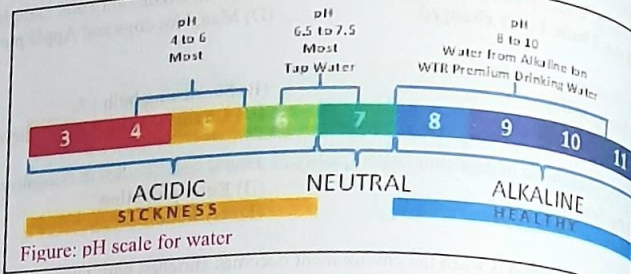


Figure: pH scale for water



Figure: He created an influential twentieth-century architectural style, stated with extreme clarity and simplicity.

Biological name for 'Gulmohar' is  
 (A) Hamelia Patens  
 (B) Cordia Sebestina  
 (C) Poloxia Regia  
 (D) Gonolua Philippensis

Type of village should be built as per architecture of Mansara  
 (A) Nadyabaria  
 (B) Karmukha  
 (C) Swastika  
 (D) Prastara

CPCB is an organisation which  
 (A) Pest control  
 (B) Poverty control  
 (C) Population control  
 (D) Pollution control

Central Pollution Control Board  
 Website: [www.cpcb.nic.in](http://www.cpcb.nic.in)

Heliiodome is used to measure  
 (A) Atmospheric pressure  
 (B) Sound level  
 (C) Sun path  
 (D) Intensity of light

Multi layer dome was found during  
 (A) Greek period  
 (B) Renaissance period  
 (C) Indus valley civilization  
 (D) Egyptian civilization

2. Match the following

a. Principles and practices	1. Site planning
b. Site planning	2. The city in History
c. The city in History	3. Four books of architecture
d. Four books of architecture	4. Future shock
e. Future shock	5. Complexity and contraction
f. Complexity and contraction	6. Human aspects of urban
g. Human aspects of urban	7. The new landscape
h. The new landscape	8. Writings and buildings
i. Writings and buildings	9. Tropical architecture
j. Tropical architecture	

a. Ringlemann chart
b. Waldram diagram
c. Electro static precipitator
d. Stereoscope
e. Micro processor

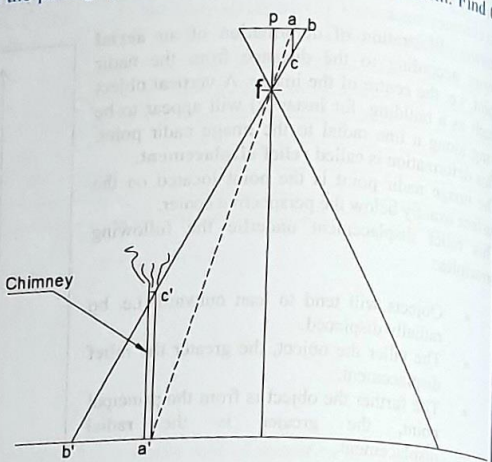
A. Linear City
B. Dynapolis
C. National Institute of

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 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.

**Solution:** In the figure, point 'p' is called the principle point of the photograph.  
 Given: pf = 15cm (focal length), pb = 12.22 cm and pa = 12.01 cm. So, ab = pb - pa = 12.22 - 12.01 = 0.21 cm

Now, consider triangle abc and triangle pbf:  
 $\frac{ac}{ab} = \frac{pf}{pb} \Rightarrow \frac{ac}{0.21} = \frac{15}{12.22} \Rightarrow ac = \frac{15 \cdot 0.21}{12.22} = 0.26$  cm

Here, ac is the virtual image of the chimney a'c'. We know the length of ac = 0.26 cm and its scale is 1:10,000  
 Therefore, height of chimney a'c' = 0.26 cm \* 10,000 = 26 meter **Answer.**



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

**Answer:** A z-score (a standard score) indicates how many standard deviations an element is from the mean. A z-score can be calculated from the following formula.

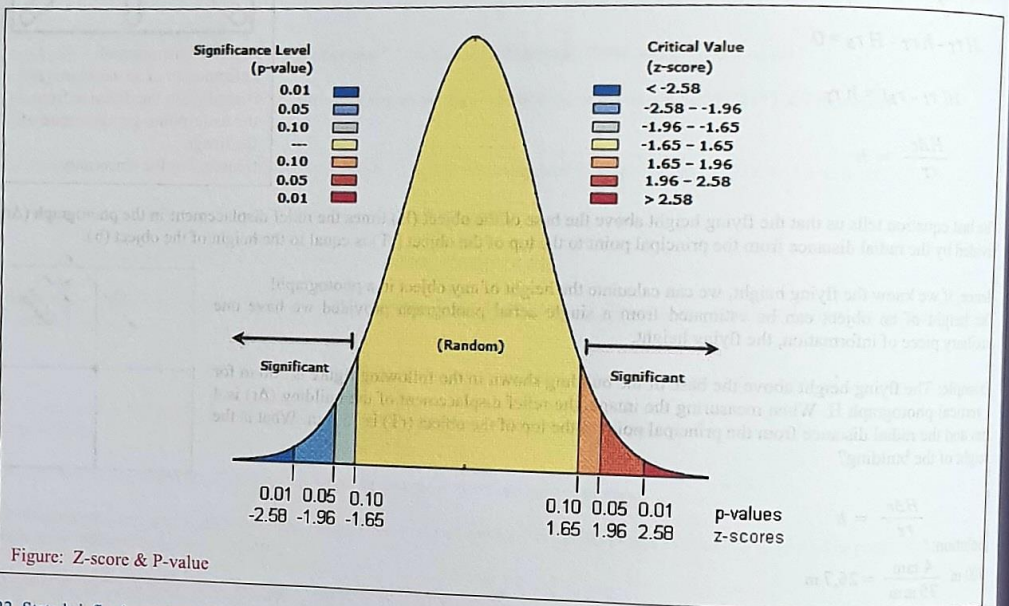
$z = \frac{X - \mu}{\sigma}$   
 where z is the z-score, X is the value of the element,  $\mu$  is the population mean, and  $\sigma$  is the standard deviation.

Here is how to interpret z-scores.

- A z-score less than 0 represents an element less than the mean.
- A z-score greater than 0 represents an element greater than the mean.
- A z-score equal to 0 represents an element equal to the mean.
- A z-score equal to 1 represents an element that is 1 standard deviation greater than the mean; a z-score equal to 2, 2 standard deviations greater than the mean; etc.
- A z-score equal to -1 represents an element that is 1 standard deviation less than the mean; a z-score equal to -2, 2 standard deviations less than the mean; etc.
- If the number of elements in the set is large, about 68% of the elements have a z-score between -1 and 1; about 95% have a z-score between -2 and 2; and about 99% have a z-score between -3 and 3.

Here is another way to think about z-scores. A z-score is the normal random variable of a standard normal distribution.

(Source: <http://stattrek.com/statistics/dictionary.aspx?definition=z%20score>)



22. State briefly the various Site Analysis Techniques for appropriate decision making in urban landscape projects.

## GATE 1991

1. Ratio 'Golden Mean' is:  
 (A) 1: 2.216 (B) 1: 1.618 (C) 1: 1.50 (D) 1: 1.44 Answer: (B)
2. 'Mihrab' is found  
 (A) inside wall of a mausoleum (B) on the crown of minaret  
 (C) on the west wall of a mosque (D) in the stepped well of Gujarat
3. Which one falls under Indo-Sarasanic architecture?  
 (A) Qutab Minar (B) Taj Mahal (C) Sher Shah's tomb (D) Bahai Temple
4. Which of the following is not a function of a good mulch:  
 (A) Aid in water retention (B) Prevent soil temperature fluctuations  
 (C) Encourage weed growth (D) Improve landscape appearance
5. Byzantine architecture is famous for:  
 (A) Stone carving (B) Pointed arches (C) Fluted columns (D) New type dome construction
6. 'Gopuram' refers to  
 (A) Temple (B) Gateway (C) Village (D) Brick dome
7. Most efficient arch in transferring load:  
 (A) Semi circular (B) Flat (C) Pointed (D) Catenary

Notes: The catenary curve is interesting because there are many examples of it in the world around us. The best way to visualize a catenary curve is to imagine the shape of a hanging chain. (The word comes from the Latin word *catena* meaning "chain.") Catenaries are used in engineering and architecture, for example in the shape of hanging bridges, or when inverted, in the shape of some arches. One of the most impressive examples is the St. Louis Gateway Arch. Catenaries can also be found in nature, for example in the curve of a spider web.

At first glance, catenaries might look like parabolas, but they have a completely different formula. The formula gives a shape that has a special structural property when used as an arch. When the chain shape is inverted into an arch and divided into building blocks, the blocks can support each other by gravity alone. To fully understand how catenaries differ from parabolas and why chains take the shape of catenary curves, we need some calculus background which is out of syllabus.



Figure: St. Louis Gateway Arch by Eero Saarinen

8. Dimension of Corbusier's modular human scale are in:  
 (A) Arithmetic progression (B) Geometric Progression  
 (C) Unrelated natural order (D) None of the above
9. Find odd one out of the following:  
 (A) T-trap (B) Q-trap (C) S-trap (D) P-trap

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