TESSELATIONS AND PATTERN & FRACTALS

"Filling two-dimensional planes has become a real mania to which I have become addicted and from which I sometimes find it hard to tear myself away."

- M. C. Escher

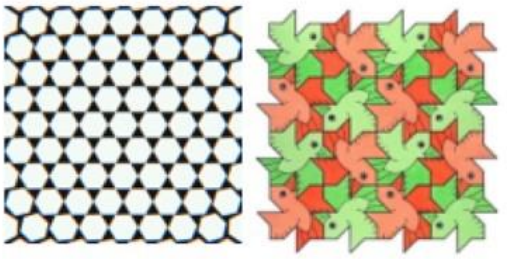
There a three types of tessellations:
Translation, Rotation, and Reflection.

TRANSLATION

A Tessellation which the shape repeats by moving or sliding.

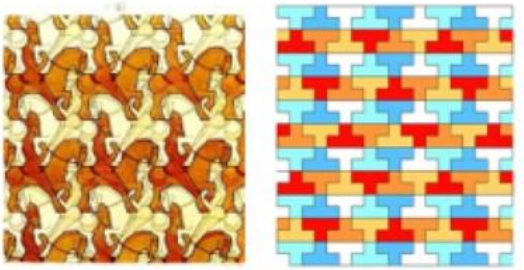
ROTATION

A Tessellation which the shape repeats by rotating or turning.



REFLECTION

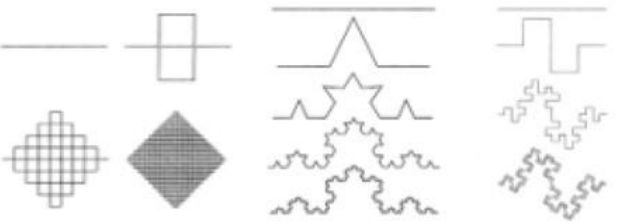
A Tessellation which the shape repeats by reflecting or flipping.



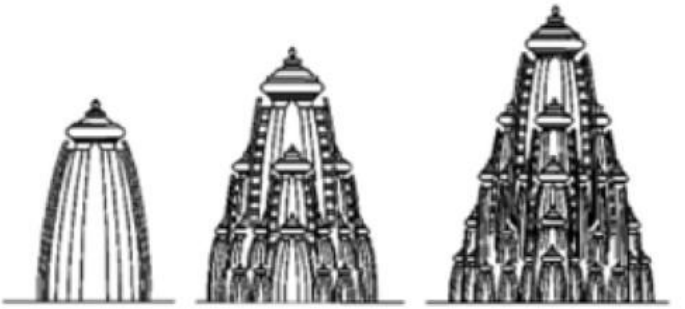
Reference: Tessellation Unit

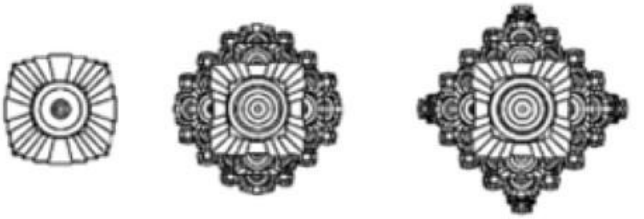
FRACTALS IN ARCHITECTURE

French mathematician Benoit Mandelbrot, who famously introduced the concept of fractals and its applications. He named the phenomenon fractal, derived from the latin word fra'ctus, meaning broken.



An aspect of fractal architecture is how it affects humans from an environmental psychological point of view. In the article Fractal Architecture Could Be Good For You (Joye, 2007) the author presents numerous architectural examples where fractal geometry plays an important role, from Hindu temples, where the self repeating and self-similar components are supposed to reflect the idea that every part of cosmos contain all information about the whole cosmos, to gothic architecture, with a high degree of self similarity and complex detailing.





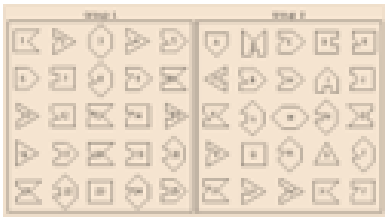
04 GEOMETRY *(Diagrammatic/Logical/Inductive reasoning)*

INTRODUCTION TO SPATIAL ABILITY ASSESSMENT (Few Samples)

- ***Diagrammatic reasoning*** is about the understanding of concepts and information that is visualized with the use of diagrams and figures.
- ***Logical reasoning*** consists of aptitude questions that require a logical level of analysis to arrive at the correct solution. Most of the questions are constructed based on concepts and the rest involve out of the box thinking.
- ***Inductive reasoning*** is a method of logical thinking that combines observations with experiential information to reach a conclusion.

01. SHAPE MATCHING (TWO DIMENSIONAL)

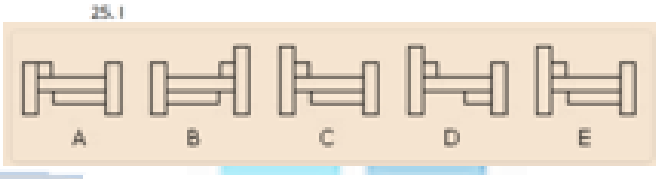
In this method, two groups of simple, flat objects are given and the question is to match the pairs by same size and shape. Each drawing in the first group is exactly the same as a drawing in the second group. The objects in the second group may have been moved and some may have been rotated.



Answers: 1. X; 2. P; 3. M; 4. V; 5. G; 6. A; 7. D; 8. T; 9. C; 10. B; 11. W; 12. E; 13. U; 14. Y; 15. F; 16. S; 17. H; 18. K; 19. J; 20. L; 21. O; 22. N; 23. Q; 24. R; 25. I

02. VISUAL COMPARISION (TWO DIMENSIONAL)

Several objects will be grouped together in the question and the identical pair has to be marked out.

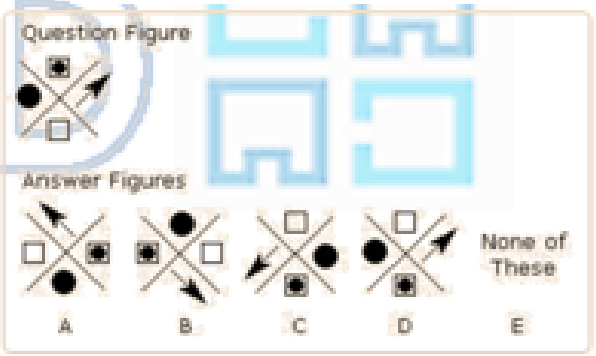


Answer: C and E are the only two pictures that are identical

03. GROUP ROTATION (TWO DIMENSIONAL)

In this method, the task is to identify the choices to the original shape/pattern. The multiple choices comprise of the original shape/pattern after single/ multiple rotations.

Key Strategy - Choose the asymmetrical shape in the group and determine how the shape would look when rotated clockwise or anticlockwise.

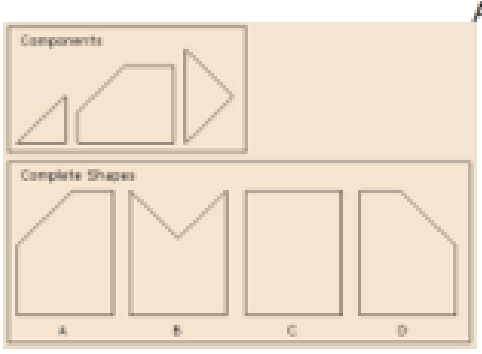


Answer: C

04. COMBINING TWO-DIMESNIONAL SHAPES

In this pattern, question comprise of series of two dimensional shapes which are cut from a parent shape. The question is to identify the parent shape.

Key Strategy: Observe parent shape from the choices and look for distinct features that matches with the element. Also parent shape does not have elements sticking out.

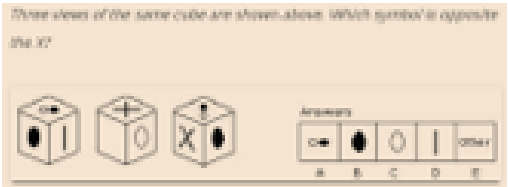


Answer: B

05. CUBE VIEWS IN THREE DIMENSIONS

These questions comprise of different views of a patterned cube. Question will be to identify the pattern on a particular face of the cube.

Key Strategy: Use the process of elimination



Answer: D

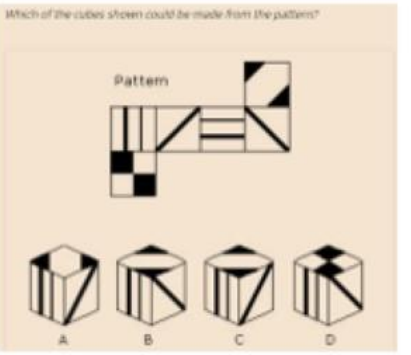
Reference: www.wikijob.co.uk.

INTRODUCTION TO SPATIAL ABILITY ASSESSMENT

06. CUBES IN TWO & THREE DIMENSIONS

These type of questions have the layout of the cube in two dimension and is to identify the right cube when the layout is folded. The question can be vice-versa too.

Key Strategy - Mark the faces of the cube as Front, Back, Top, Bottom, Right side and Left side in the layout and work on the cube formation.

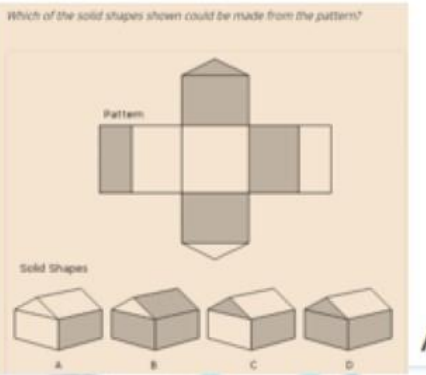


Answer: A

07. OTHER SOLIDS IN TWO & THREE DIMENSIONS

These questions use irregular solid shapes as a layout and the question is to identify the three dimensional form arrived at by folding. This is similar to cube exercise (Point no 6)

Key strategy - Use the process of elimination. Consider the connection between four visible faces and look out for patterns / shades.

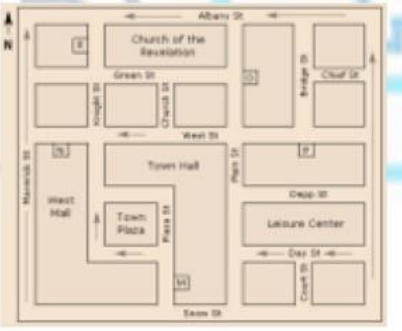


Answer: D

08. TWO-DIMENSIONAL MAPS

Simple two-dimensional maps will be given in the question to test the ability to follow instructions and visualizing a route.

Key Strategy - Basic sense of direction and imagine yourself following the instructions.



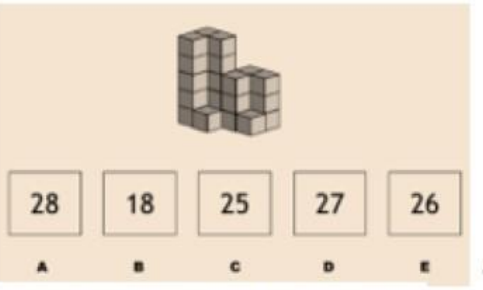
Answer: B

Officer Wilkinson is in Depp St and can see the Town Hall to her right.
What direction is she facing?

09. BLOCK COUNTING IN THREE DIMENSIONS

This type of question will be having a three dimensional form made up of multiple units/ blocks, some of which may be hidden. The question will be to quantify the hidden elements that comprise the three-dimensional form.

Key Strategy - Count the number of units as rows and columns and calculate the hidden blocks numerically.



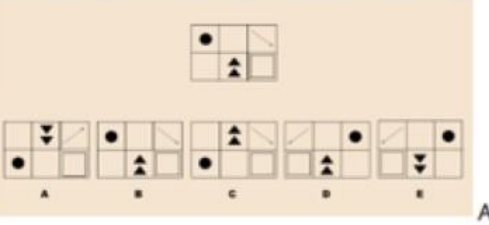
Answer: E

How many blocks make up the shape below?

10 TWO -DIMENSIONAL MIRROR REFLECTIONS

This question presents an image and will be asked to identify its mirror image.

Key Strategy - Use the process of elimination



Answer: D

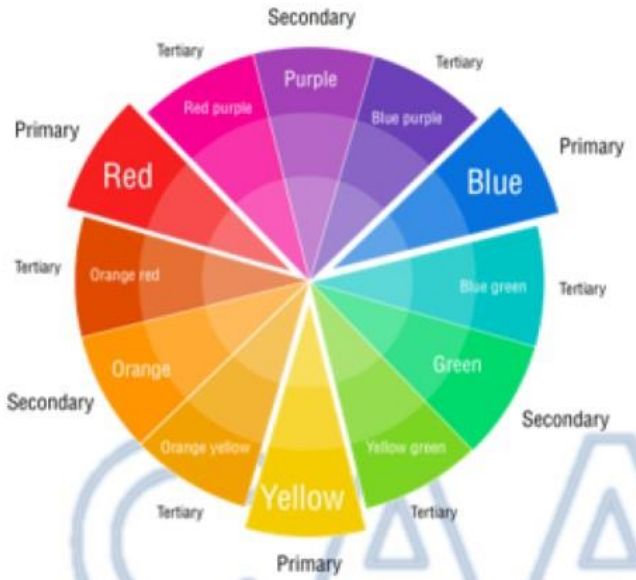
Which answer shows a reflection of the image below?

Reference: www.wikijob.co.uk.

INTRODUCTION TO COLOUR THEORY

A colour circle, based on red, yellow and blue, is traditional in the field of art. Sir Isaac Newton developed the first circular diagram of colours in 1666. Since then scientists and artists have studied and designed numerous variations of this concept. Colour theory is a body of practical guidance to colour mixing and the visual effects of a specific colour combination. There are also definitions (or categories) of colours based on the colour wheel: primary colour, secondary colour, and tertiary colour.

COLOUR WHEEL



PRIMARY COLOURS

These are the three pigment colours that cannot be mixed or formed by any combination of other colours. All other colours are derived from these three hues.

SECONDARY COLOURS

These are the colours formed by mixing the primary colours.

TERTIARY COLOURS

These are the colours formed by mixing a primary and a secondary colour. So it is referred as a two word name, such as blue-green, red-violet, and yellow-orange.

WARM & COOL COLOURS

Warm colours , such as red, yellow, and orange evoke warmth when observed.

Cool colours ,such as blue, green, and purple (violet) evoke a cool feeling when observed.

NEUTRAL COLOURS

Grey, Brown. These are not on most colour wheels, but they're considered neutral because they don't contrast with much of anything.

TINTS, SHADES AND TONES

Tint – adding white to pure colour

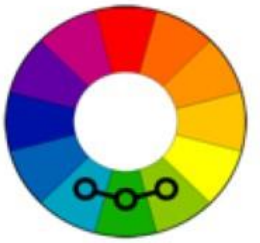
Shade – adding black to pure colour

Tone – adding grey to pure colour

COLOUR SCHEME/HARMONY

Complimentary *colours*

Red and Green, Blue and Orange, Purple and Yellow - located directly opposite to each other on the colour wheel.



Analogous Colours

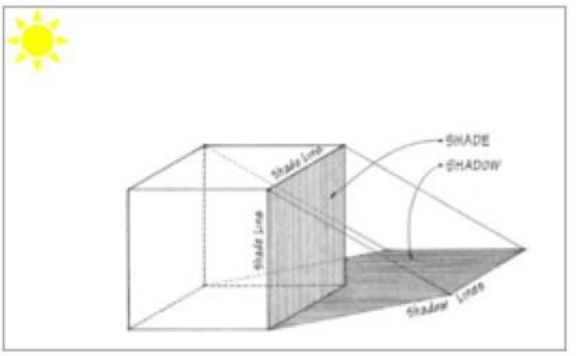
Red and Orange, Blue and Green, etc. – located right next to each other on the colour wheel.

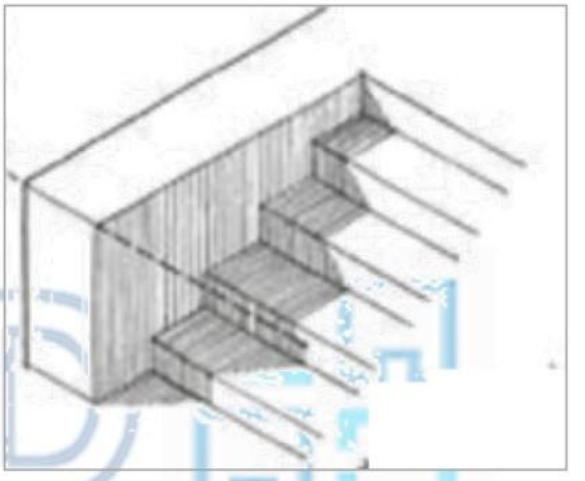
Triad Colours

Uses colours that are evenly spaced around the colour wheel.

INTRODUCTION TO SCIOGRAPHY (SHADE & SHADOWS

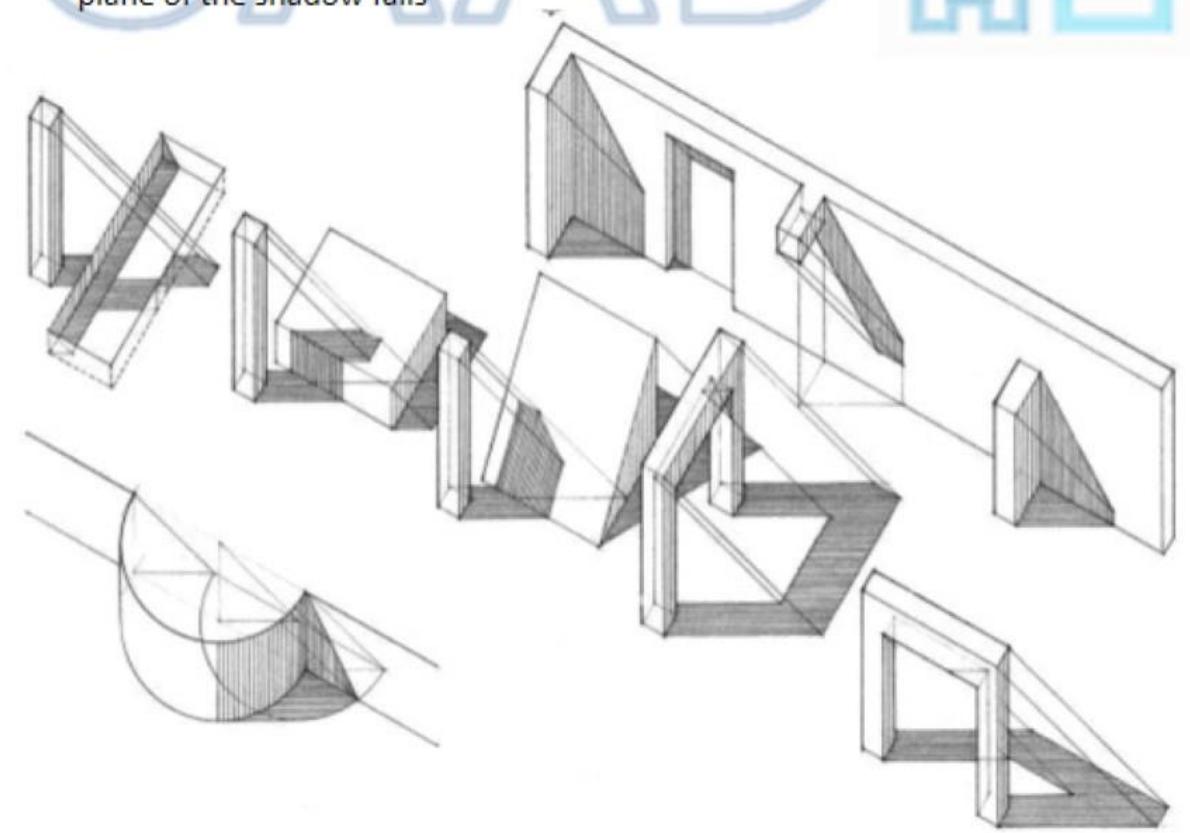
Sciography is a science of perspective dealing with the projection of shadows or delineation of an object in perspective with its gradations of light and shade.





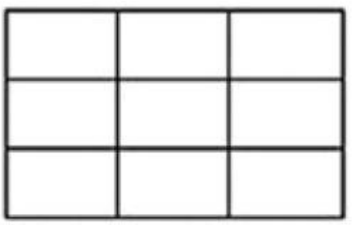
SHADE & SHADOWS:

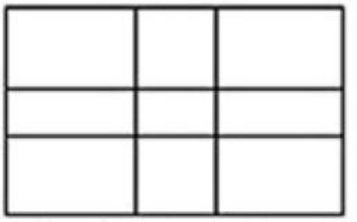
- Shade refers to the relatively dark area on those parts of a solid that are tangent to or turned away from a light source.
- Shadows are the relatively dark figures cast upon a surface by an opaque body or part of a body intercepting the rays from a light source.
- A shade line or casting edge separates an illuminated surface from one in shade.
- A shadow line is the shadow cast by a shade line on a receiving surface
- The shape of the shadow is dependent on
  - The position of shade line
  - The position of the observer
  - The direction of the light and
  - The form of the surfaces on which the plane of the shadow falls

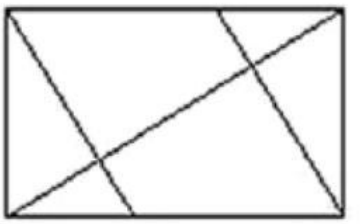


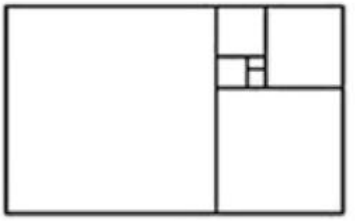
COMMON METHODS OF VISUAL COMPOSITION

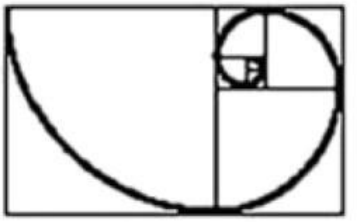
GOLDEN PROPORTIONS


Rule of Thirds

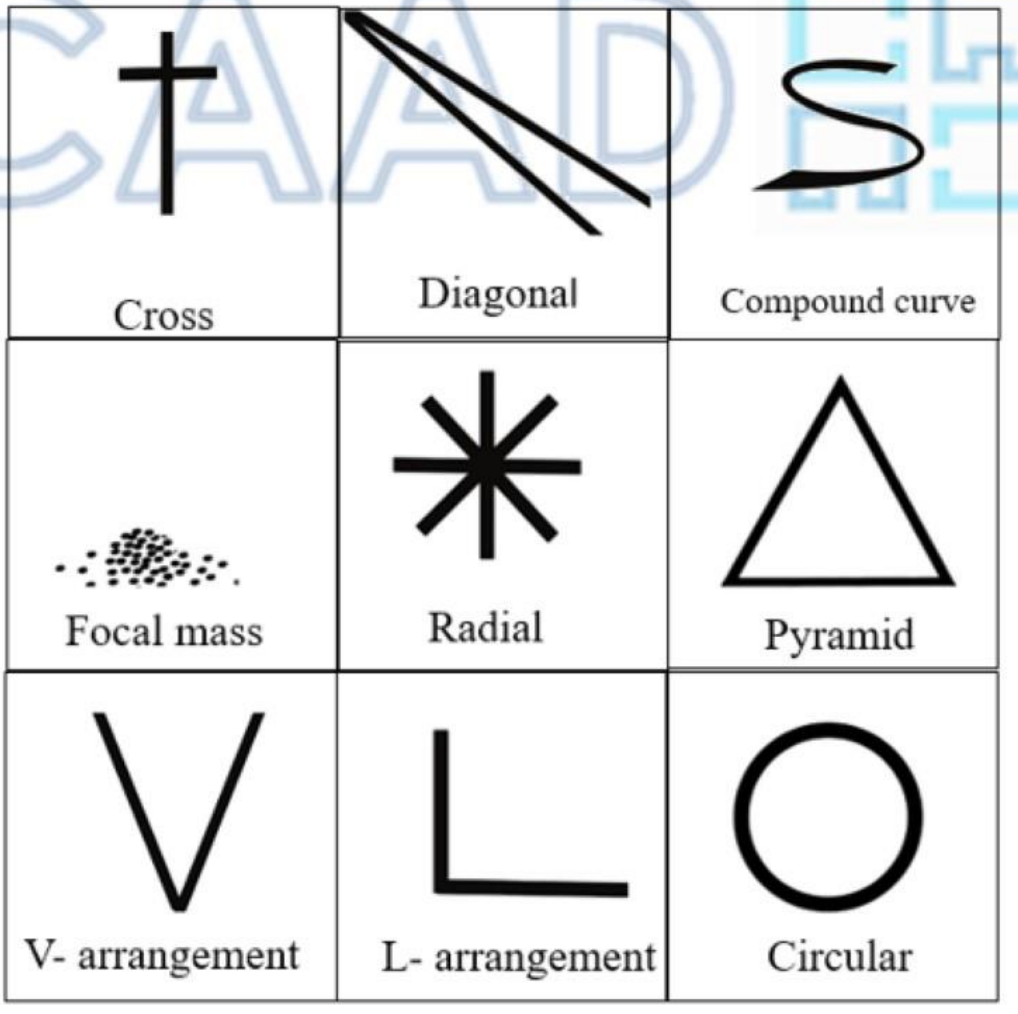

Golden Section


Golden Triangles


Spiral Section


Golden Spiral

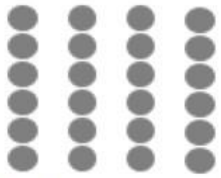

Harmonious Triangles



INTRODUCTION TO GESTALT'S THEORY

LAW OF PROXIMITY:

The closer objects are to each other, the more likely they are to be perceived as a group.

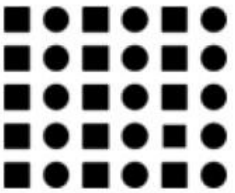


The above image is perceived as columns rather than rows

The above image is perceived as rows rather than columns

LAW OF SIMILARITY:

The principle of similarity states that things which share visual characteristics such as shape, size, color, texture, value or orientation will be seen as belonging together (form groups).

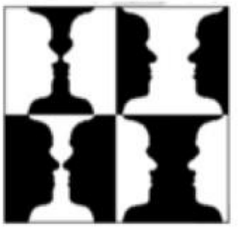


This image is grouped together by shapes

This image is grouped together by colours

LAW OF FIGURE – GROUND:

Figure and Ground explains how different elements are put together to make one scene or a whole image. "Figure" is the more dominant shape. "Ground" can be referred to as the background. Once the figure is identified, the rest of the image becomes the ground.

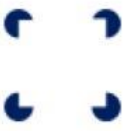


LAW OF GOOD PRAGNANZ:

"Prägnanz means, in simple terms, "good form" and refers to organizing shapes to simple forms. Figures are seen as their simple elements instead of complicated shapes." Prägnanz is a German word that directly translates to mean "pithiness" and implies the ideas of salience, conciseness and orderliness

LAW OF CLOSURE:

In perception there is the tendency to complete unfinished or partially obscured objects. (If a large pattern is with missing components, the eye tends to fill in the missing parts to create the actual image



The eye perceives the square

LAW OF SYMMETRY

The human brain perceives symmetrical objects as parts of the same group. They create an impression of stability and order.

LAW OF GOOD CONTINUATION:

Objects will be grouped as a whole if they are co-linear, or follow a direction. Objects arranged in either a straight line or a smooth curve tends to be seen as an unit. In cases where there is an intersection between objects, individuals tend to perceive the two objects as two single uninterrupted entities.

LAW OF COMMON FATE

It states that humans perceive visual elements that move in the same speed and/or direction as parts of a single stimulus. A common example of this is a flock of birds.

LAW OF PAST EXPERIENCE

Elements or objects frequently seen together in the past experience of a person are perceived to be as a group or in one single entity. The below three colours are perceived as traffic lights

FIGURE-GROUND PERCEPTION

Figure-ground perception refers to the tendency of the visual system to simplify a scene into the main object that we are looking at (the figure) and everything else that forms the background (or ground).

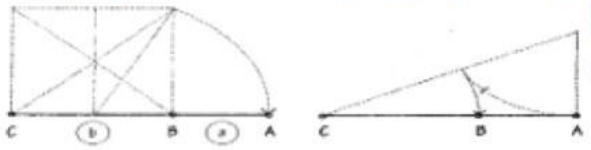
SCALE AND PROPORTION

PROPORTION

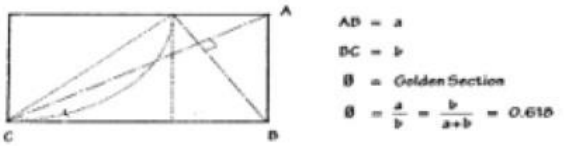
Proportion is a central principle of architectural theory and an important connection between mathematics and art. It is the visual effect of the relationships of the various objects and spaces that make up a structure to one another and to the whole.

GOLDEN SECTION

A proportion between two dimensions of a plane figure or two divisions of a line, in which the ration of the smaller to the larger is the same as the ratio of the larger to the whole: a ratio of approx. 0.618 to 1.000.

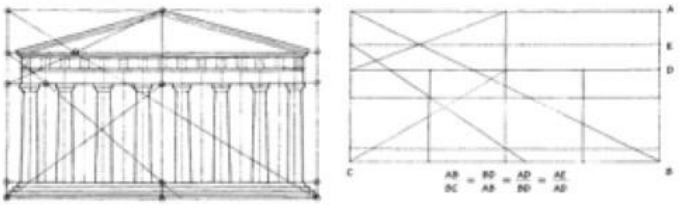


The geometric construction of the Golden Section, first by extension, and then by division



A rectangle whose sides are proportioned according to the Golden Section is known as a Golden Rectangle.

If a square is constructed on its smaller side, the remaining portion of the original rectangle would be a smaller but similar Golden Rectangle.

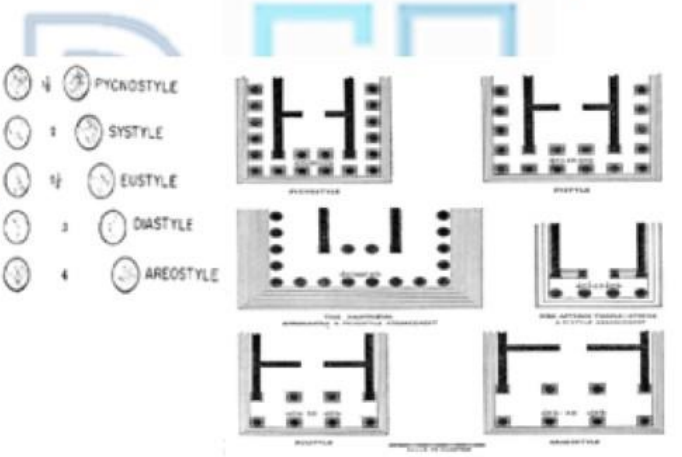


CLASSICAL ORDERS

To the Greeks and Romans, the Orders represented in their proportioning of elements the perfect expression of beauty and harmony.

The basic unit of dimension was the diameter of the column. From this module were derived the dimensions of the shaft, the capital, as well as the pedestal and the entablature above, the spacing between two adjacent columns, down to the smallest detail. INTERCOLUMNIATION is the system of spacing between columns, which is also based on the diameter of the column.

Standardized by Marcus Vitruvius Polio during the reign of Augustus in his "The Ten Books on Architecture." Vignola remodified these rules for the Italian Renaissance and his forms for the Orders are probably the best known today.



RENAISSANCE THEORIES

The architects of the Renaissance, believing that their buildings had to belong to a higher order, returned to the Greek mathematical system of proportions. The Pythagorean creed was " Everything is arranged according to numbers." The Greeks conceived music to be geometry translated into sound, Renaissance architects believed that architecture was mathematics translated into spatial units.

Reference: Summary of D.K.Ching book by Arch. Janice Ma.