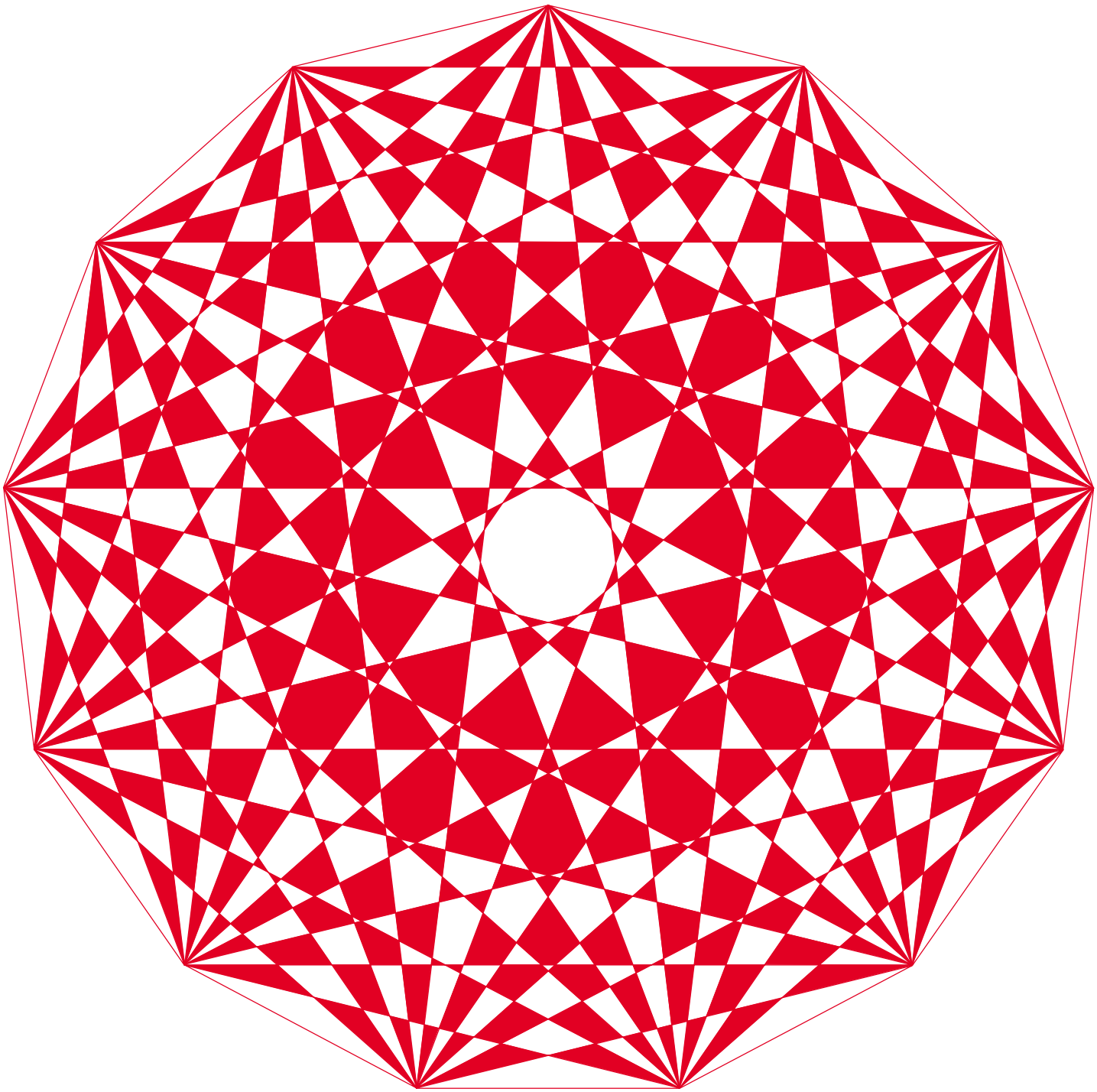
Geometric Patterns



Geometric Patterns

Introduction

In working with shapes, whether mathematically or artistically, it is necessary to have a good feeling for how more complex shapes can be made from simpler shapes. Their analysis or deconstruction is important to understanding them and to their creation. This unit is intended to help foster that sort of insight by means of some pleasurable practice in the construction of geometric patterns.

No instructions are given on the sheets themselves so that they may be used in any way deemed suitable. Notes are given here which, together with a look at the material available, will provide some guidance as to how a suitable package can be put together. It is certainly not envisaged that any one pupil would encounter every sheet.

As well as various blank "grids" provided at the back of this unit, other suitable sheets can be found from the ***trol*** menu under the headings of 'Lined Grids' and 'Dotted grids'.

One thing which needs to be borne in mind when planning this work, is the balance needed between the various aspects of the overall activity. Copying is a part of it, but should not become the whole of it, and there should be a development into exploration and creation. Even colouring-in has a part to play in encouraging the activity overall, but must not be allowed to consume an undue proportion of the time.

Geometric Patterns 1 ~ Border Patterns

This is a very good introductiory activity since it involves no more than counting squares but, for some, it does present difficulties in visually carrying something across from one sheet to another, especially when crossings are involved. A good size of square to use is 5 or 7 mm. A dotted grid is better than a lined one, since then there are no obtrusive lines in the finished drawing.

Once a straight length of border has been made it could prompt the question "How do we turn a corner with it?" This has been done in the bottom right-hand corner (No. 8) of the sheet. Notice that what happens in the detail of the corner is different from the straight border itself, but retains the style without breaking any of the lines. Going round a corner can be difficult. One technique is to draw the the straight border first and make a tracing of it. Then give the tracing a quarter-turn relative to the original (which way?) and move it around - in and out, up and down, but always keeping it at right-angles to the original - until a position is found that seems to offer a good way of allowing the lines to 'flow' between the two. There is always more than one possibility. Notice that fixing the design of a corner also determines which is the 'inside' of the border and which the 'outside'. 5 mm squared-paper is a good size to use.

Geometric Patterns 2 ~ Tile Patterns

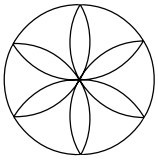
This would also be a suitable introduction as it is again based on squares. A 10 mm square is a suitable size here. One drawback is the appearance of the grid-lines in the finished drawing. Some "rubbing-out" is implied, but this is not possible with a pre-printed grid. One way of improving on this is to use a lined-grid for the initial construction work and do the final tile on a dotted-grid. This sheet could be used as a basis for launching a small project.

Geometric Patterns 3 to 6

All of these are concerned with the basic idea of dividing a circle into a number of equal parts, a topic which has an important place in much geometrical work, called **cyclotomy**.

> **cyclotomy** is the topic concerned with dividing the circumference of a circle into equal parts, using geometrical constructions which involve the use of only a pair of compasses and a straight-edge; the measuring of lengths or angles is not allowed. The early Greek mathematicians knew it was possible for cases where the number of divisions was 2^n, 3 or 5 and all other numbers obtained by multiplying any *two* of those together. So it was known to be possible for 2, 3, 4, 5, 6, 8, 10, 12, 15, … divisions. The problem of whether other divisions might be possible was unresolved until Gauss (who started on the problem when aged 19) proved that it was possible to construct $(2^2)^n + 1$ divisions provided only that the expression yielded a prime. That added 17, 257 and 65537 (n = 2, 3, 4) to the list.

Now it is one thing to know it can be done, but quite another to actually do it, and the constructions are so involved that they are useless for all practical drawing purposes. Also, why not use all the tools at our disposal?



The easiest and most well-known of the circle divisions is into 6 equal parts by using the radius of the circle itself (that is the unaltered setting of the compass), and the "flower pattern", shown on the right, made by the 6 intersecting arcs must be the most widely drawn pattern of all, as it is nearly always seen by those practising the skill of using a compass. Just marking the off the circumference into 6 equal parts and joining them up in order to make a regular hexagon should follow.

Having got the initial idea of using compasses to step-off the distances around the circle, it is a logical move to think about stepping-off other distances. Suppose we wish to divide the circle into 5 equal parts. Since 5 is less than 6 the steps will need to be bigger (won't they? - try asking first). How much bigger? There is only one way to find out - do it. A period of 'trial and adjustment' now starts, but it needs to be done in an orderly manner. Patience is needed. Open out the compasses a little, make a starting mark, and step around the circle making as faint a mark as possible, counting as you go. The 5th mark should coincide with the starting mark. When it doesn't, use the difference to adjust the setting on the compass, don't just yank at them savagely! First off, note the direction they have to be moved. If the distance is short they need to be opened, if it went past the starting mark then they have to be closed. But further than that, we can estimate the amount by which they need to be altered, it is one-fifth of the error. If it all sounds very simple and obvious, just wait until your class tries out this technique!

In case this seems unnecessarily complicated, it isn't. It has the merits of being easily understood, applicable to all cases (whatever the number of divisions) and extremely accurate. Of course that amount of accuracy may not be necessary but, if it is, it cannot be achieved any other way - unless you can measure angles to at least 0.1 of a degree. A test of accuracy would be the requirement to draw the 13-point circle and all its diagonals, as on the front page of this unit, and see that all those small triangles appeared. It perhaps needs to be said that such work requires very good drawing instruments, especially a pair of needle-point dividers with a fine-adjustment facility, if it is to be done by hand. The usual basic school compass with a blunt pencil does not rate highly for doing the best work. Of course, a good computer drawing program, with its ability to draw angles to an accuracy of 0.01° makes it much easier!

Having 'mastered' the technique, or by using the appropriate templates from those given at the back of this unit, some work based on sheets 3 to 6 could be done.

Polygons

It will be clear that polygons underlie much of this work, if only implicitly, but it should be made explicit whenever opportunity offers. Attaching the correct names to the various polygons as well as the other technical words associated with them would be a good starting-point.

The last page in this unit (Polygons ~ Vocabulary and Data) would help in this, and all pupils could benefit from having a copy of that page to keep in their notebooks. The table on that sheet could be used in several ways, one of the more obvious being for some formal mensuration. But it can be used to find what the edge-length of the underlying polygon must be for any given number of divisions of the circle. This is the setting needed on the compasses to step around the circle. It reduces some of the work needed for the 'trial and adjustment' method described earlier, though it will still be necessary for the most exacting work.

Focussing upon the polygons themselves could lead to some other work. For any given polygon, how many diagonals can be drawn? The data-table does provide this information so, if that table is generally available, ask instead how many diagonals must there be in a 20-gon? This not very difficult since there is an easily seen pattern of growth, but that could lead to a request for a general formula. Then, having drawn all the diagonals, how many regions are there within the (regular) polygon? This is much harder.

Returning to the patterns. The symmetry of various patterns should be remarked upon, that is for both line- and rotational-symmetry. Also the effect that colouring can have upon those symmetries.

The last few pages contain a miscellany of examples which the more adventurous might like to look at for ideas.

Other Work and Sources

Other work which would help with the exploration and understanding of shapes would be

Tangrams, **Tessellations**, **Pentominoes**,

each can be found in the ***trol*** menu under ‘Other Activities’.

additionally, there is some related work, in a different context, provided under

Calendar Models (to be found at the top of the ***trol*** menu)

and, in there, the Wall Calendars identified as **Geometric Patterns**

The greatest form of Geometric Patterns is to be found in Islamic Art, and some representation of that ought to be available for all to see. There are many books on it. A highly recommended one is

Geometric Concepts in Islamic Art by Issam El-Said and Ayse Parman

ISBN 0 905035 03 8

It generously illustrated not only with pictures of the actual art in its place, but also with clear diagrams showing how the patterns are made. There should be a copy in any half-decent library either at school or departmental level. First published in 1976, it is still in print and not at all expensive considering what it offers. Great value.

A smaller book, but very useful to have available in the classroom, is

Geometric Patterns from Roman Mosaics by Robert Field

ISBN 0 906212 63 4

This one is published by those excellent people at Tarquin Publications

There is quite a lot on the Web. Call up a Search-engine, **www.google.com** is recommended, and give it “islamic patterns” to get over a thousand possibilities. (note the inverted commas are needed or else you will get nearer one-hundred thousand!). Unfortunately many of them are only concerned with selling books, but that still leaves plenty of sites which show beautifully detailed pictures of this type of work, which does mean they are rather large files if down-loading times are a consideration. Several schools have put up examples of work done by pupils.

Geometric Patterns ~ 1

Border Patterns

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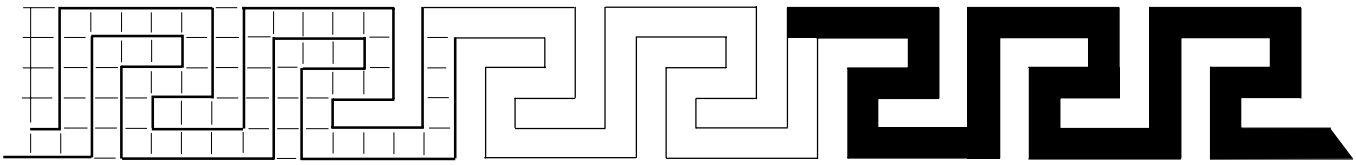

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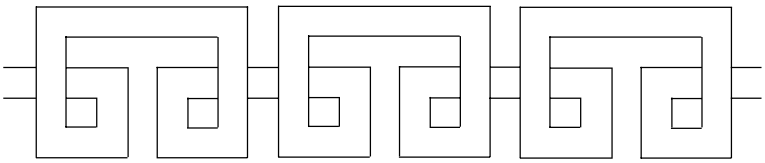

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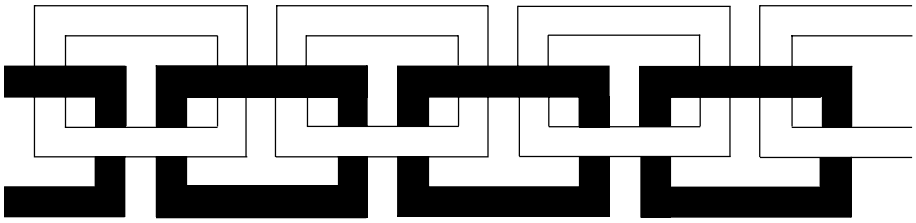

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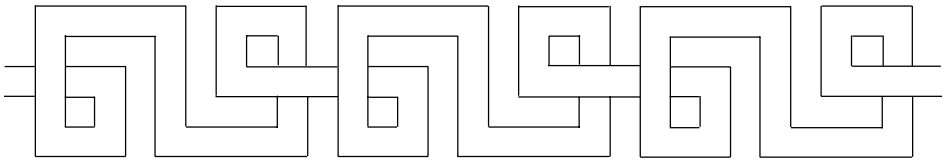

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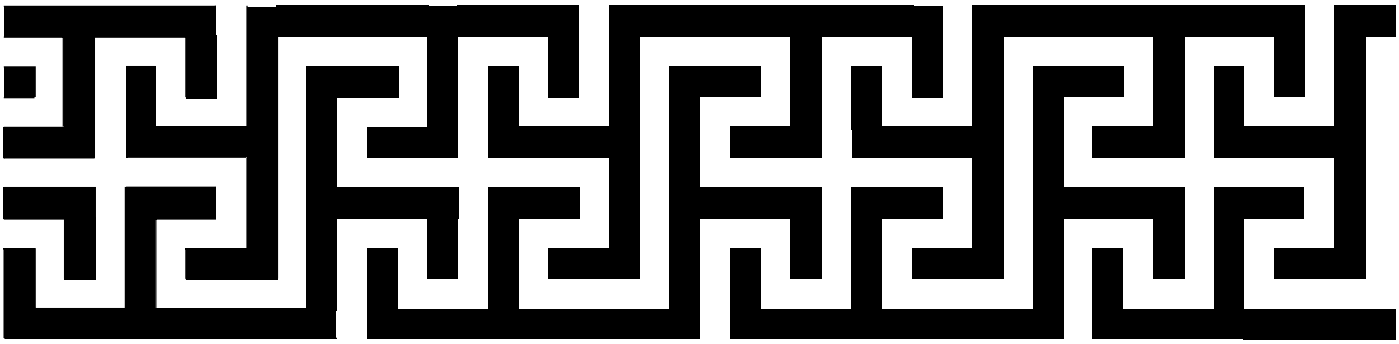

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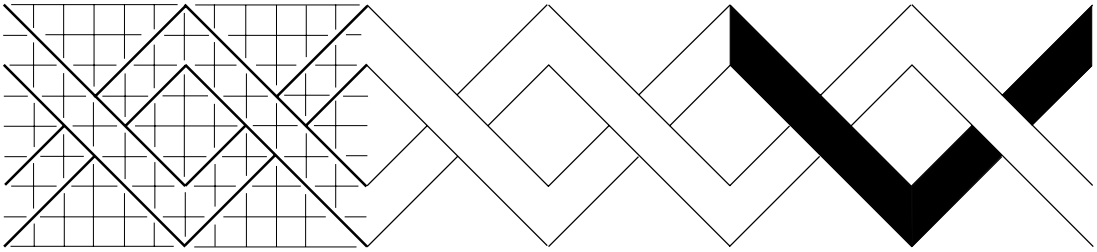

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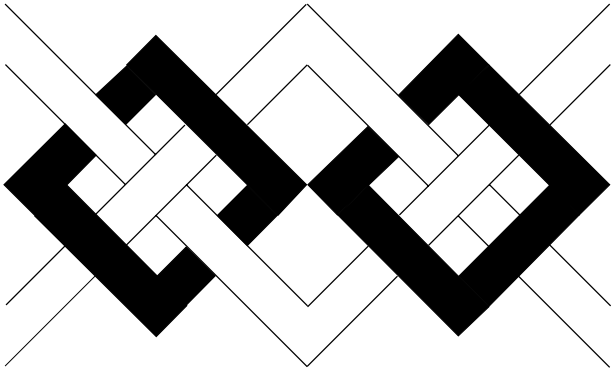

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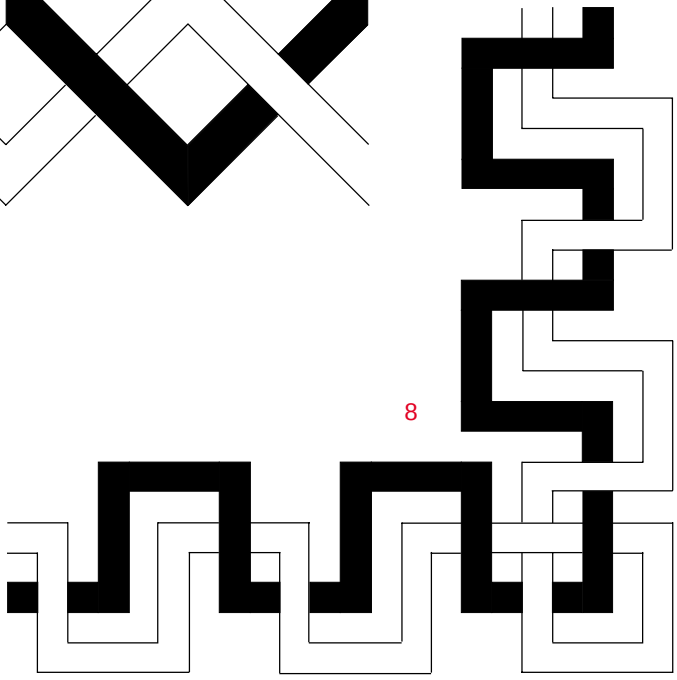
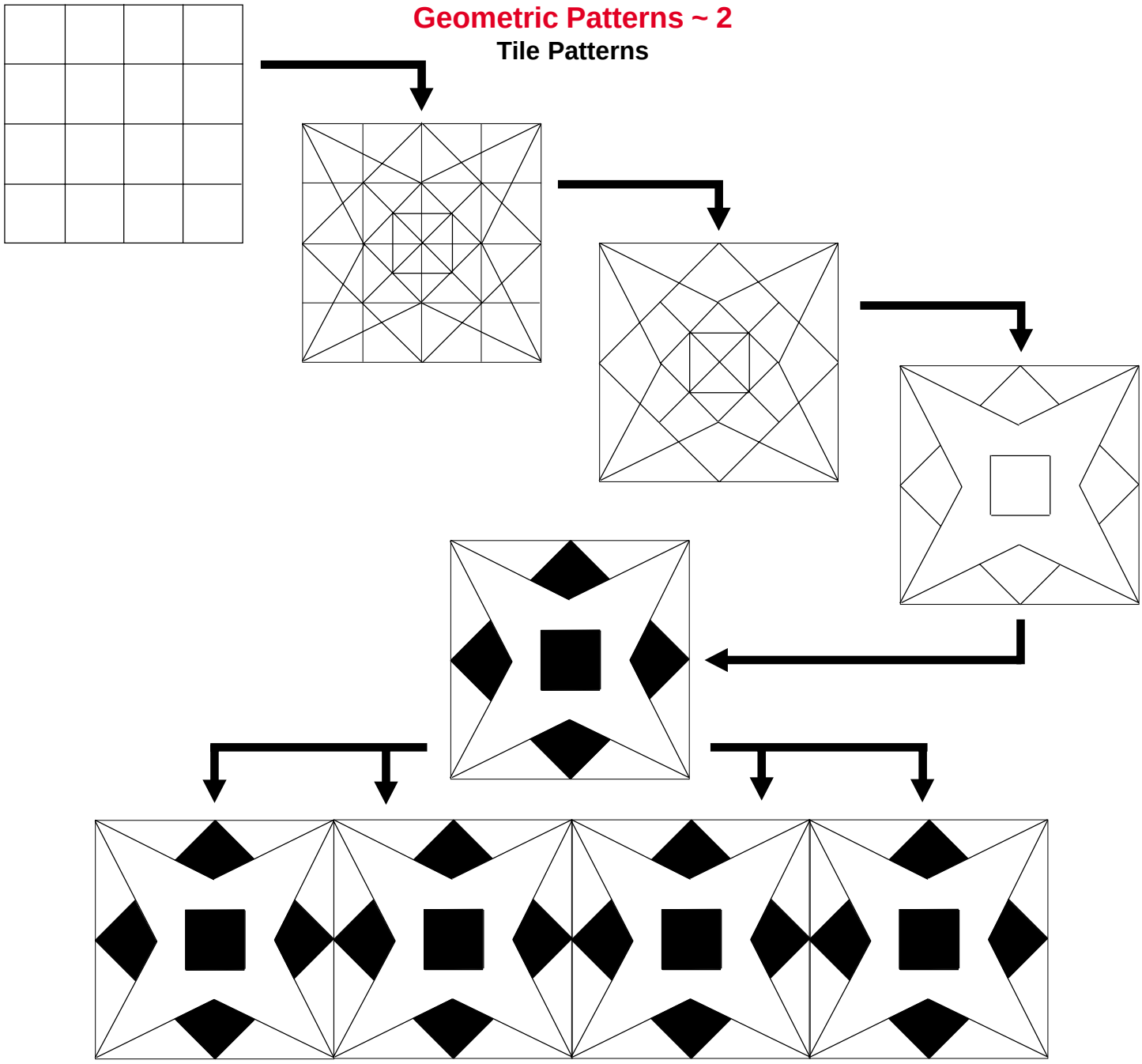
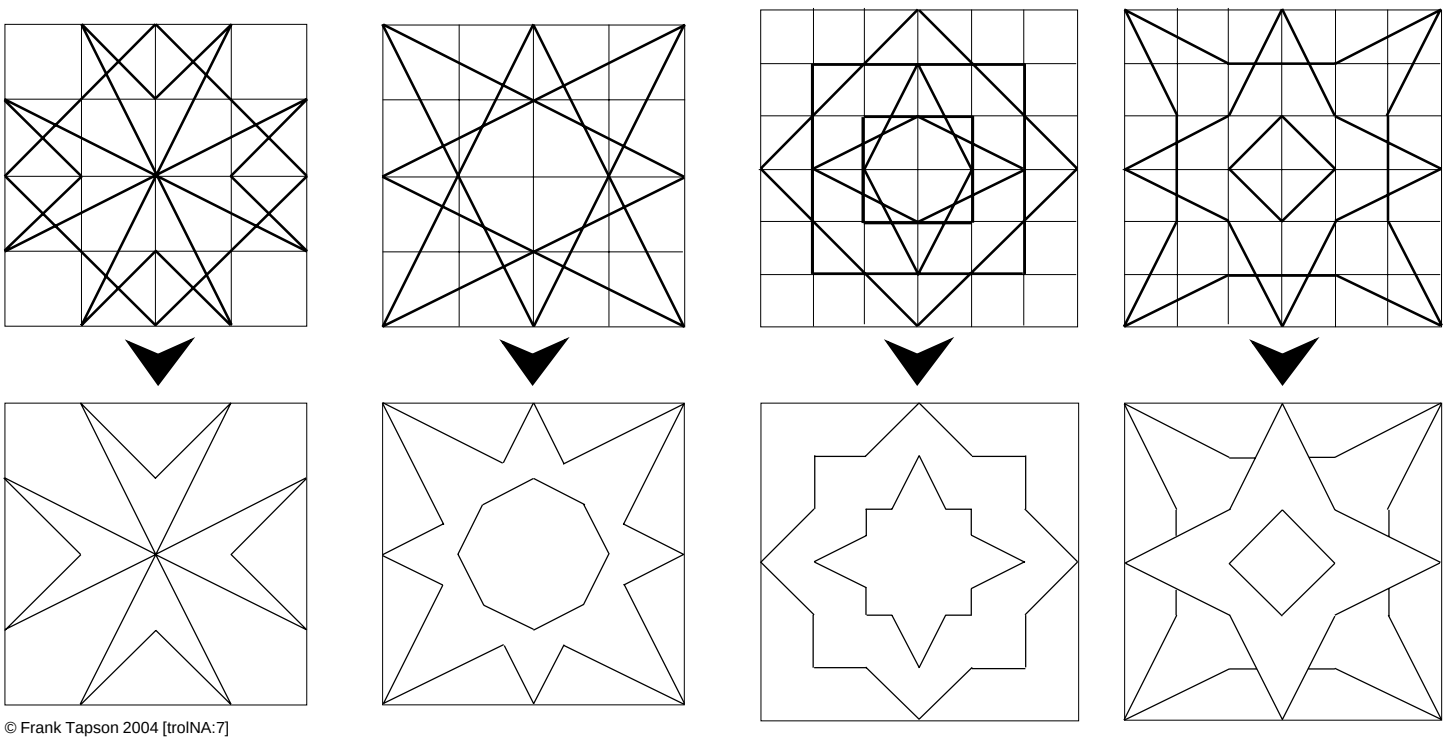


Geometric Patterns ~ 2

Tile Patterns





Geometric Patterns ~ 3

The 6 - point circle

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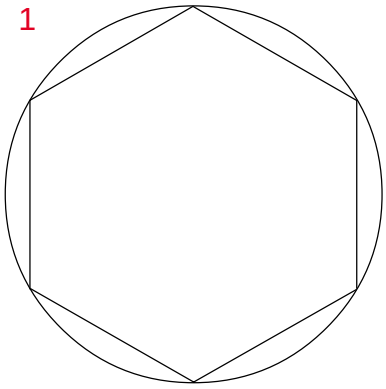

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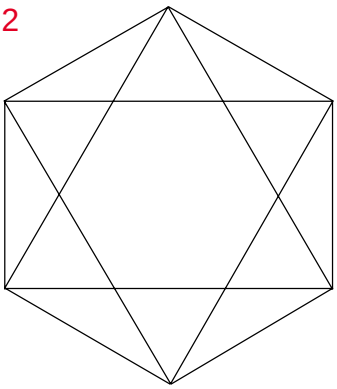

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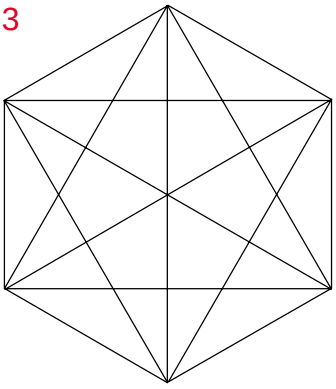

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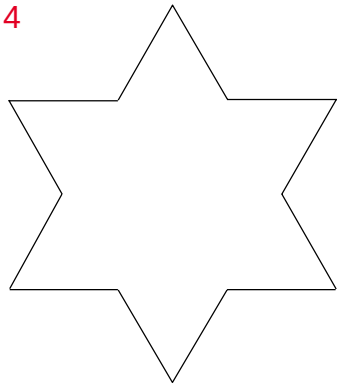

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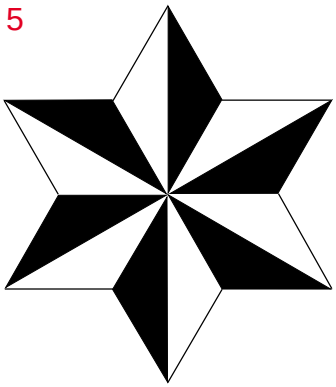

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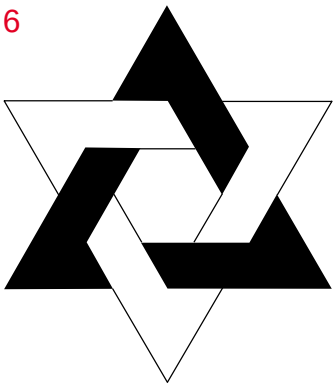

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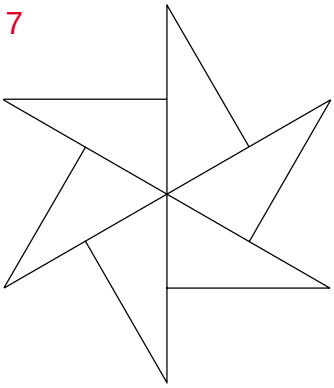

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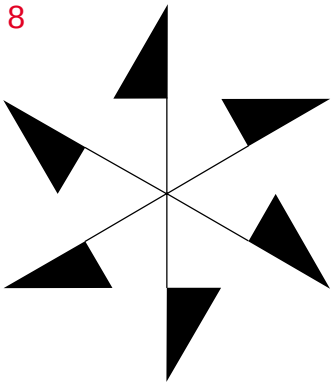

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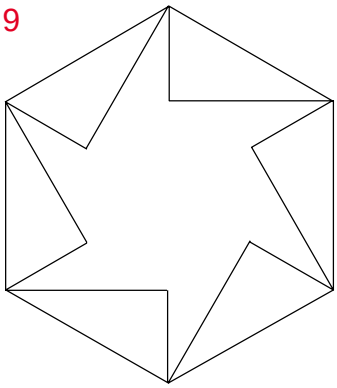

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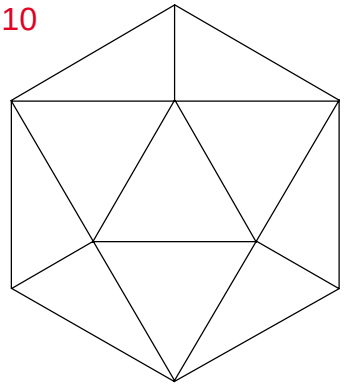

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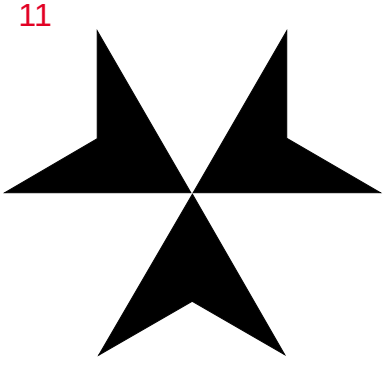

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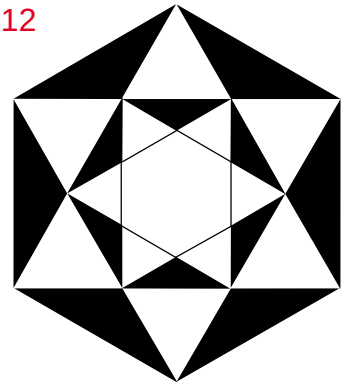

Geometric Patterns ~ 4

The 8 - point circle

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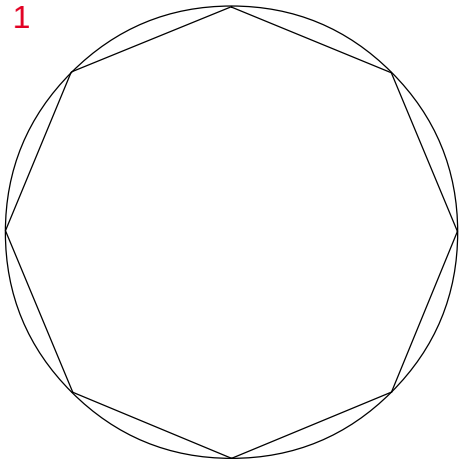

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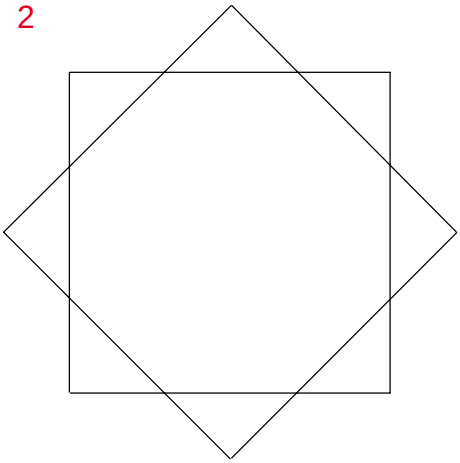

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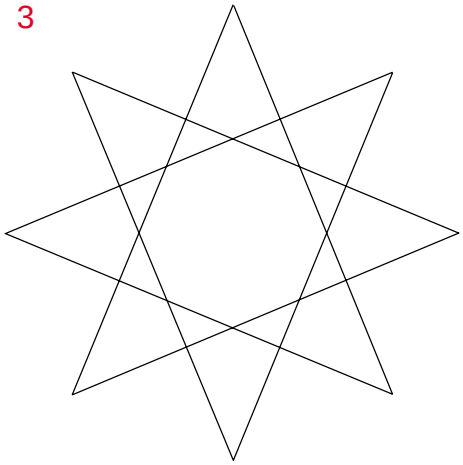

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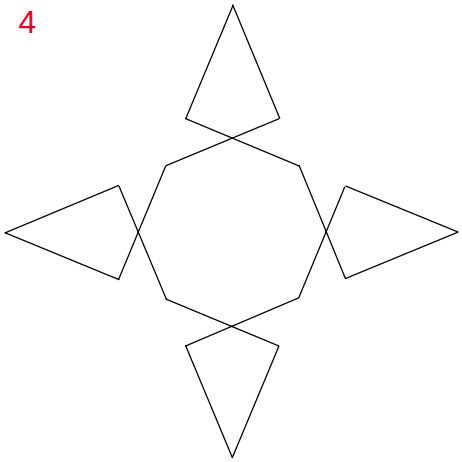

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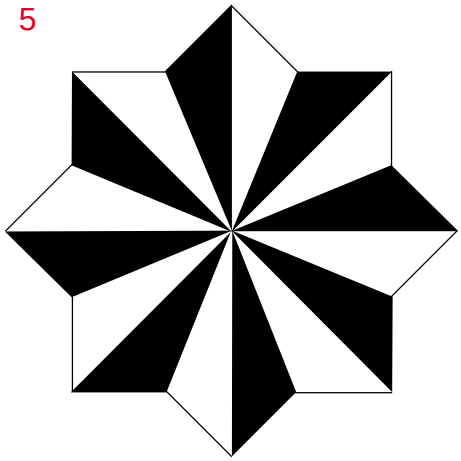

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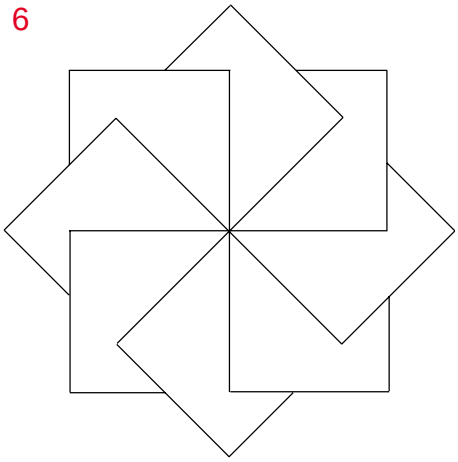

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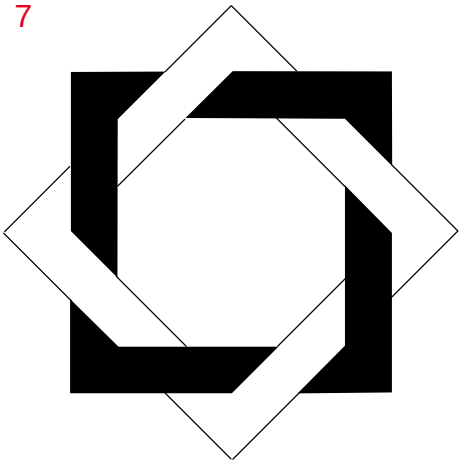

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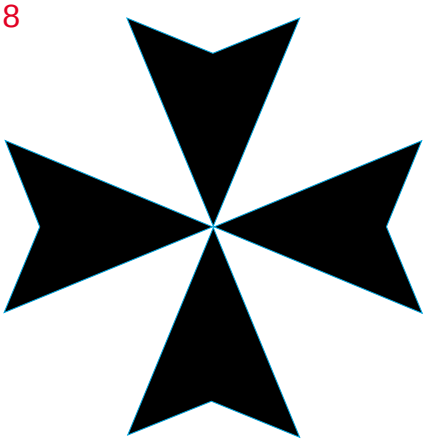

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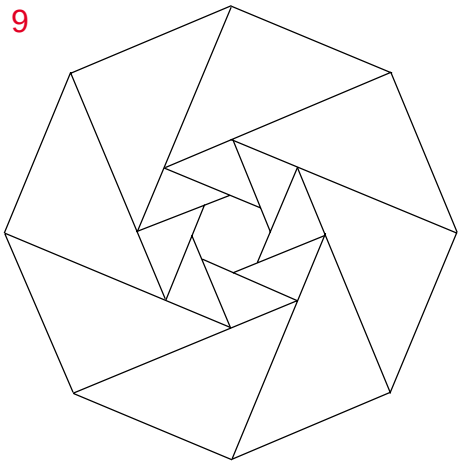

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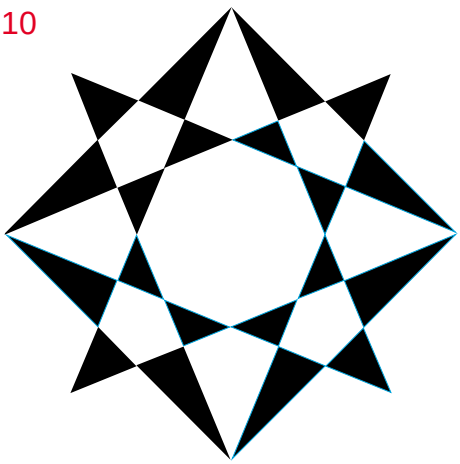

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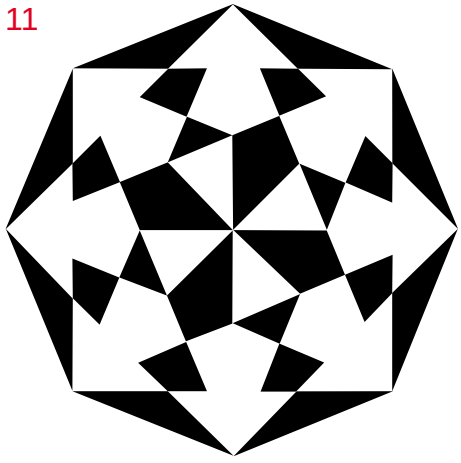

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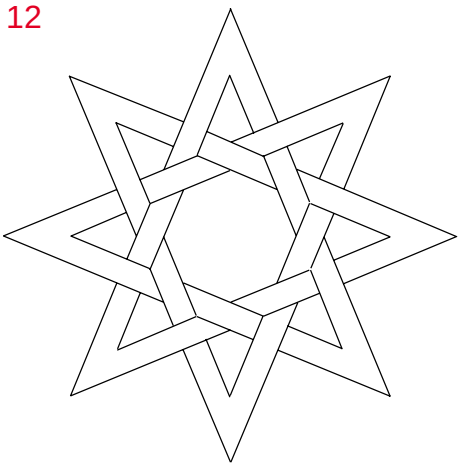

Geometric Patterns ~ 5

The 5/10 - point circle

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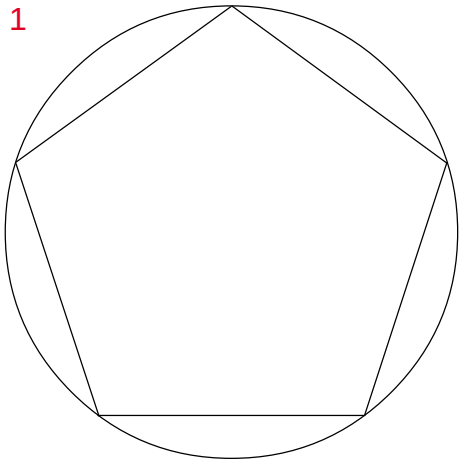

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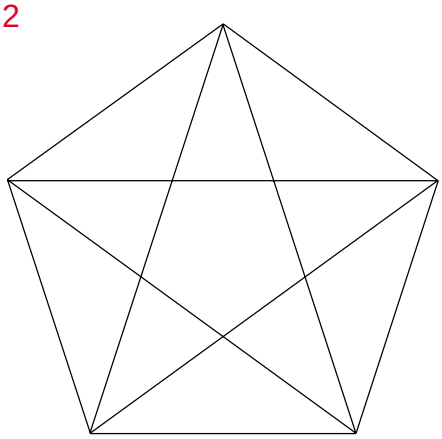

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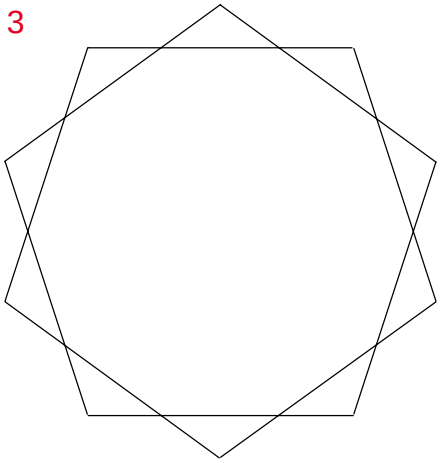

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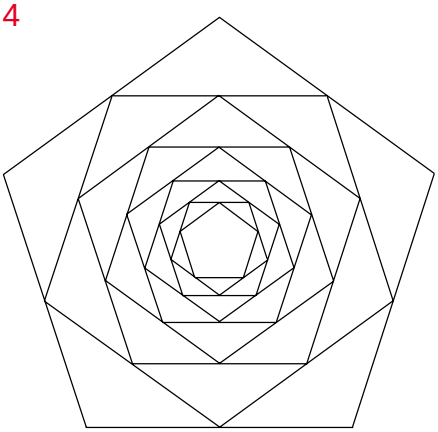

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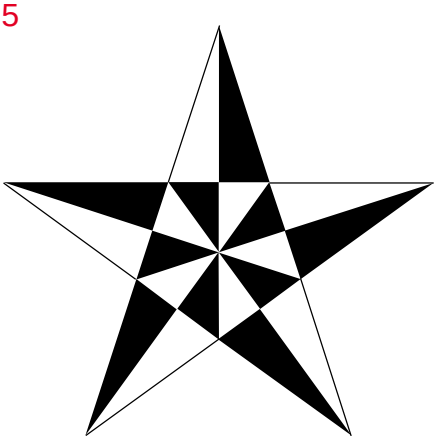

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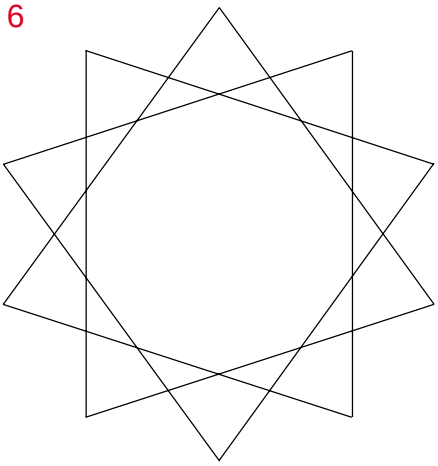

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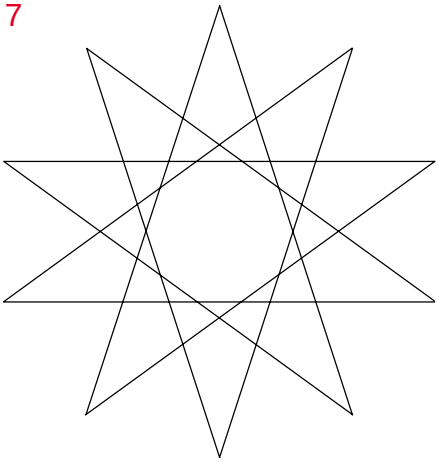

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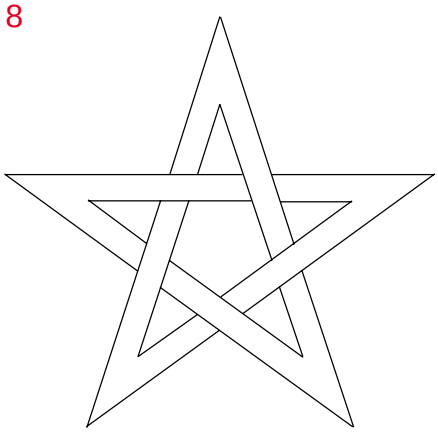

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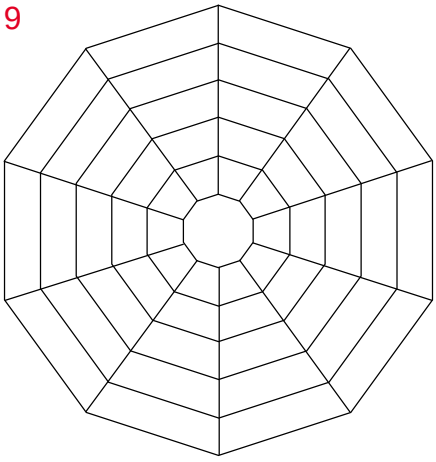

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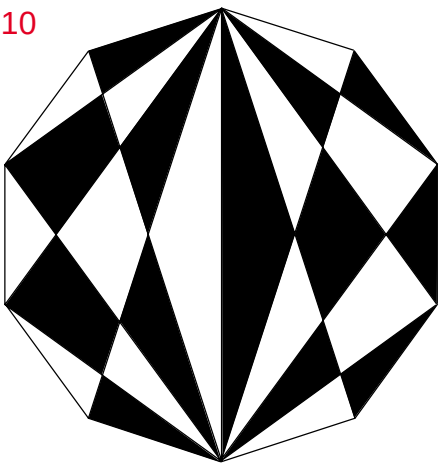

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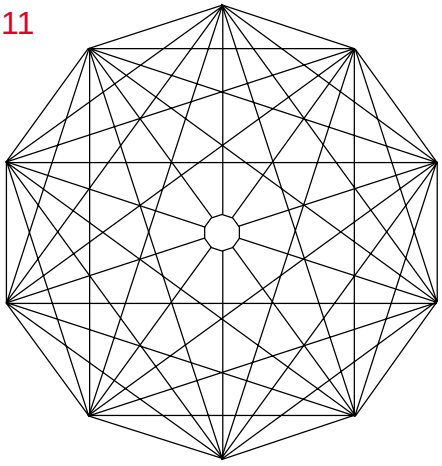

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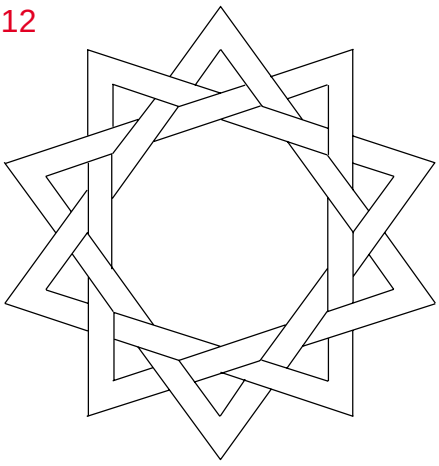

Geometric Patterns ~ 6

The 12 - point circle

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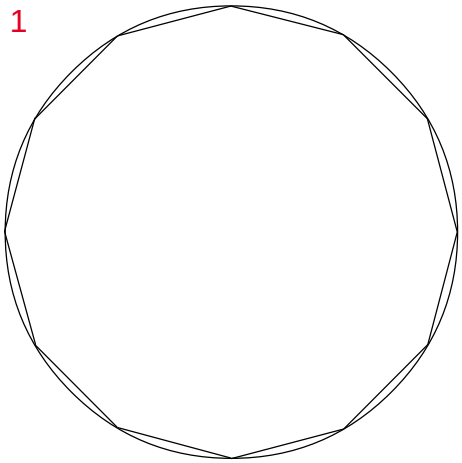

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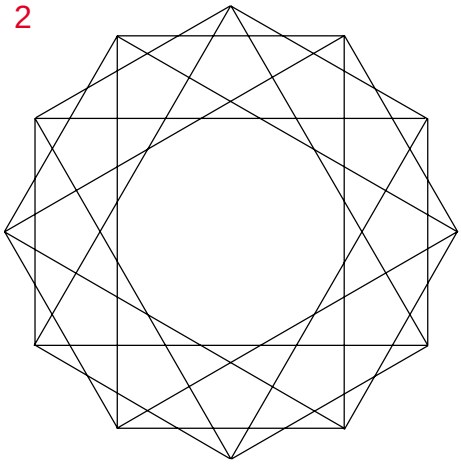

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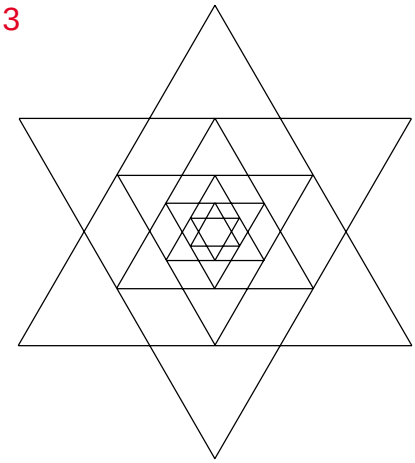

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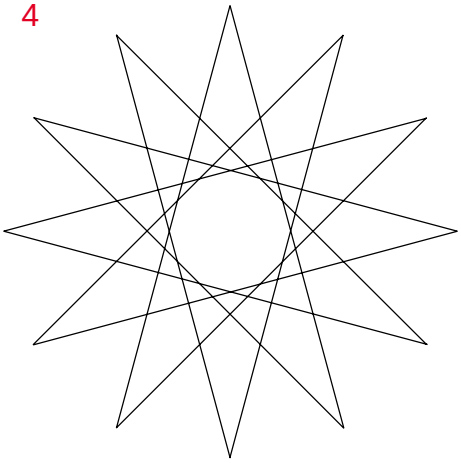

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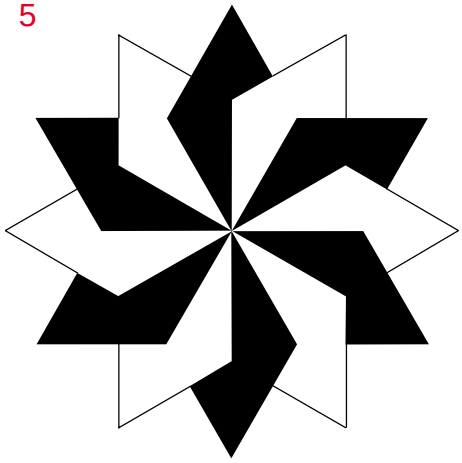

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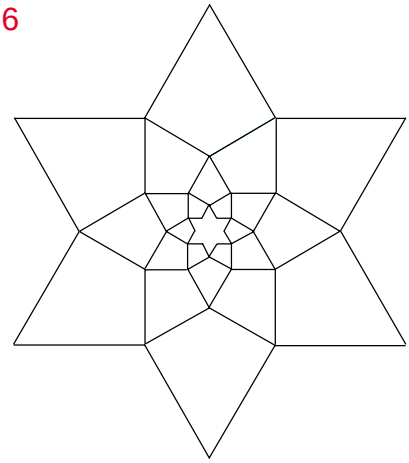

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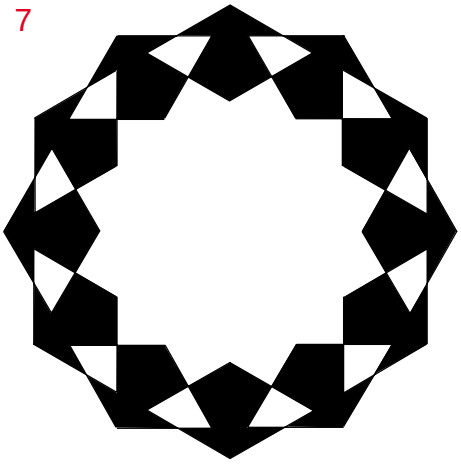

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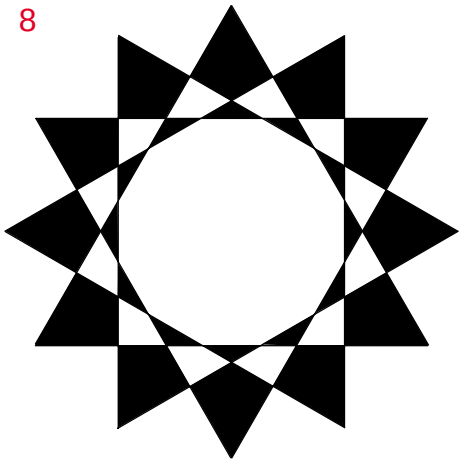

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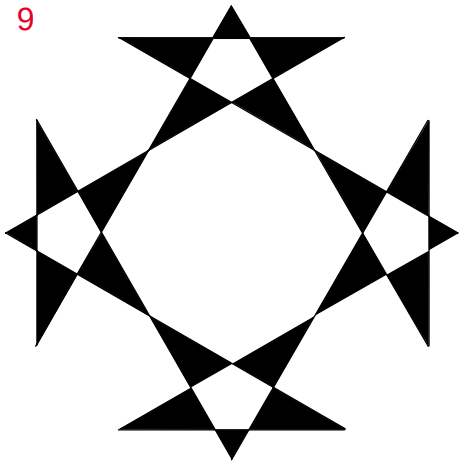

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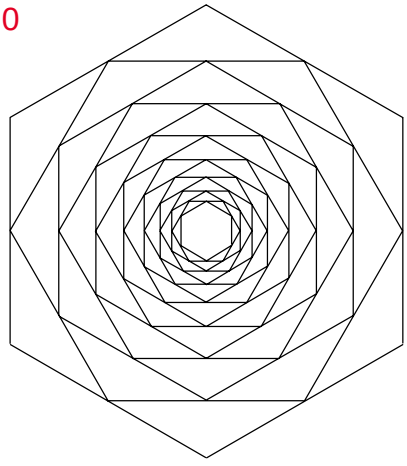

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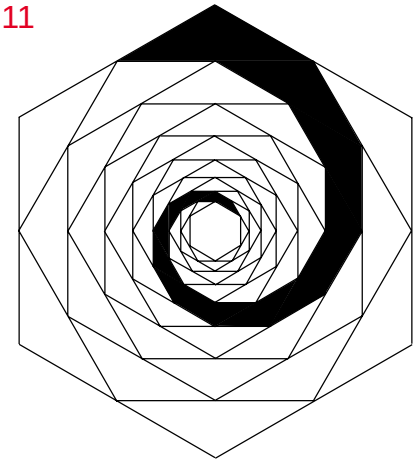
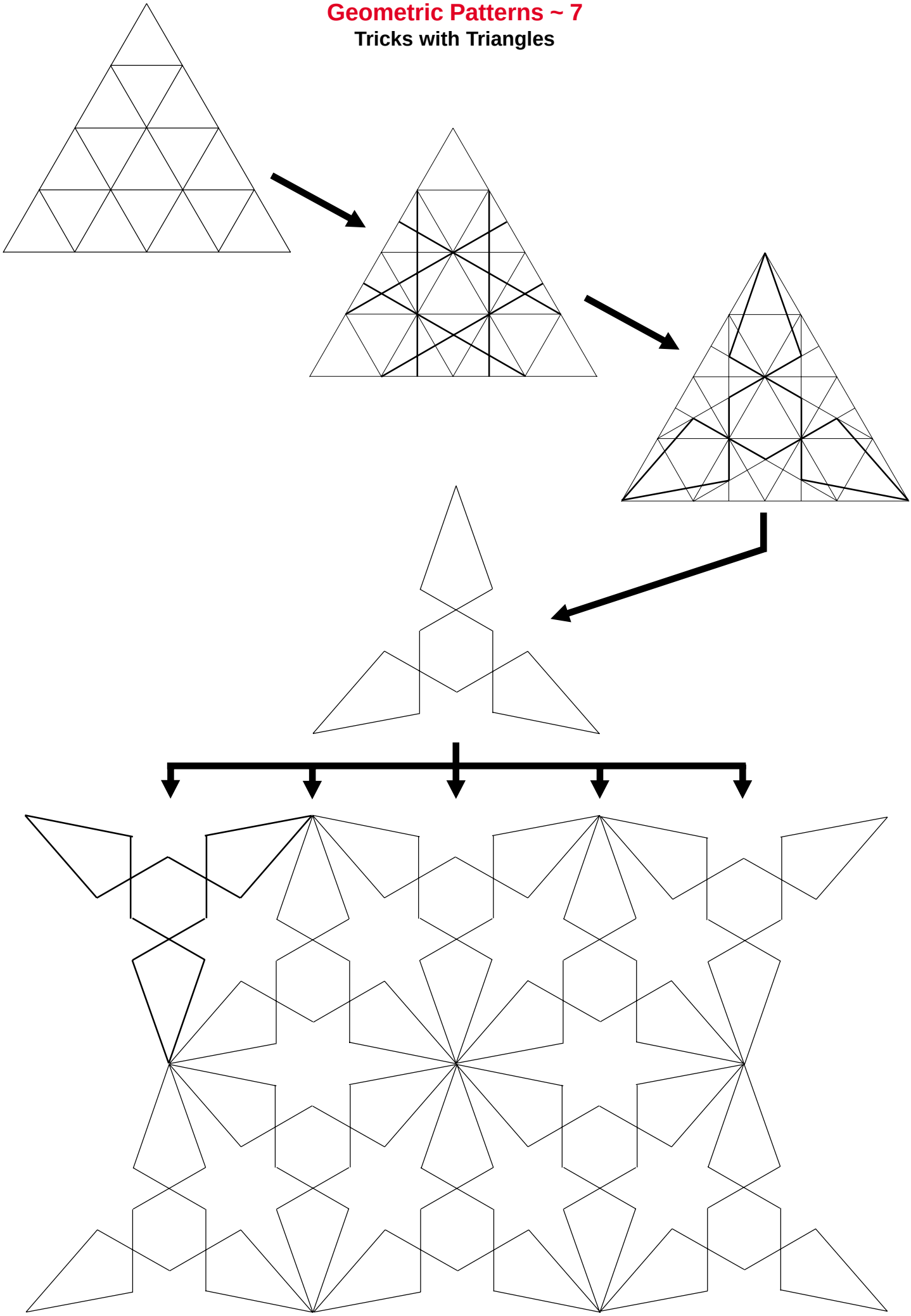
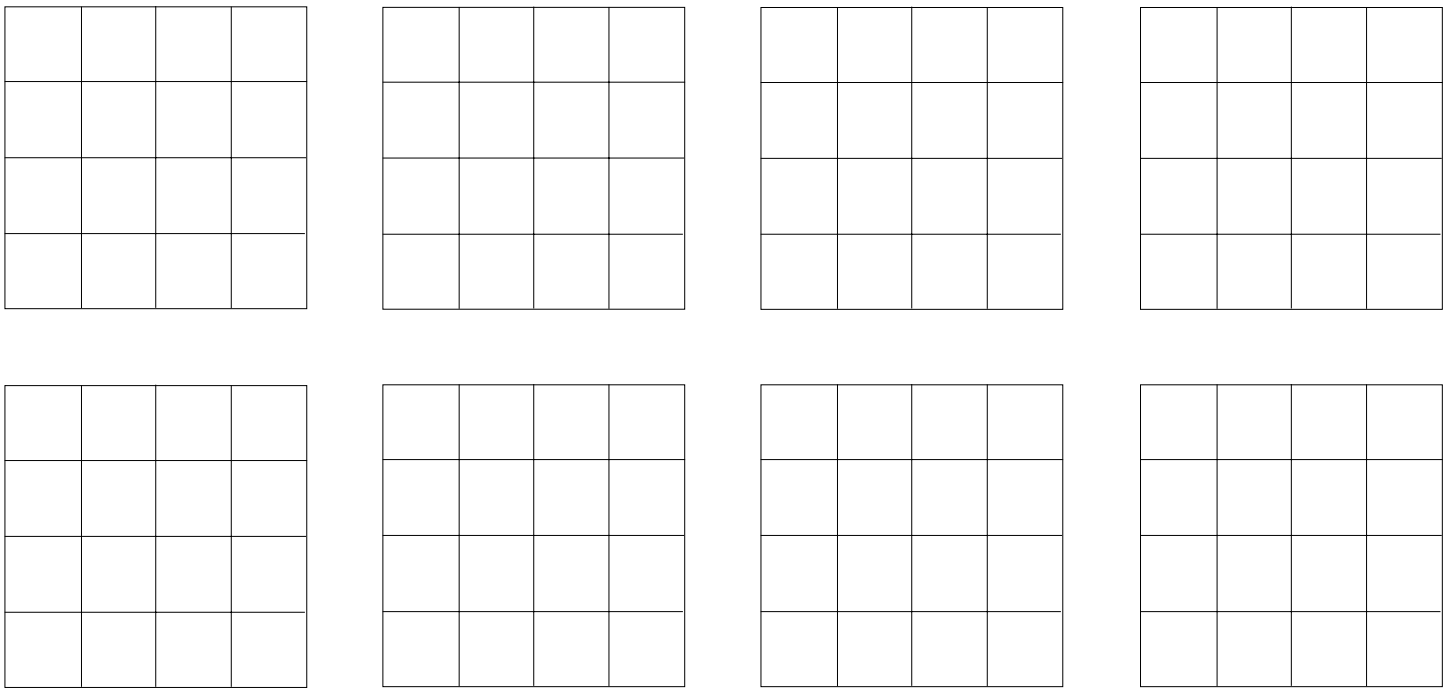


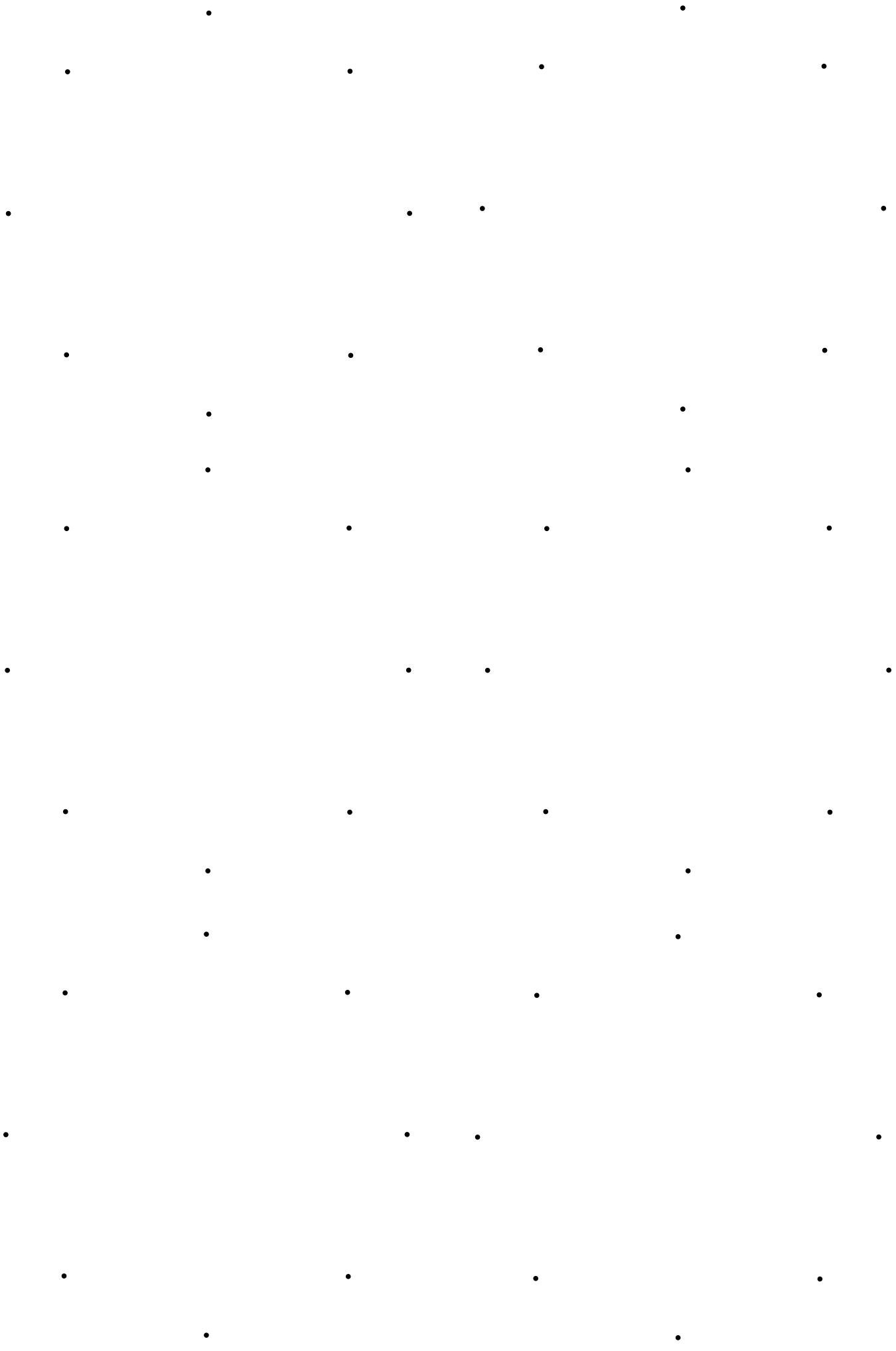
12

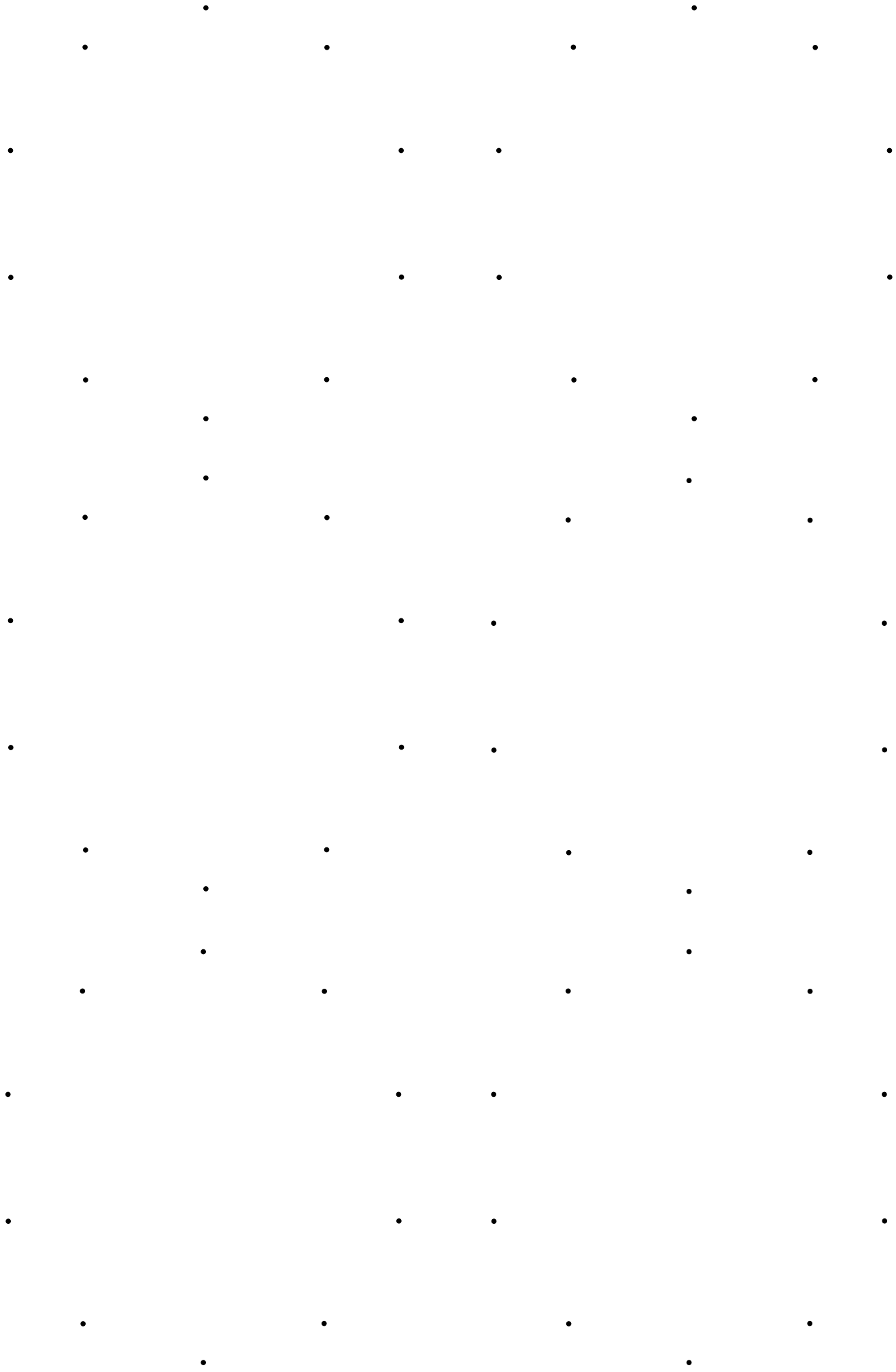
Geometric Patterns ~ 7

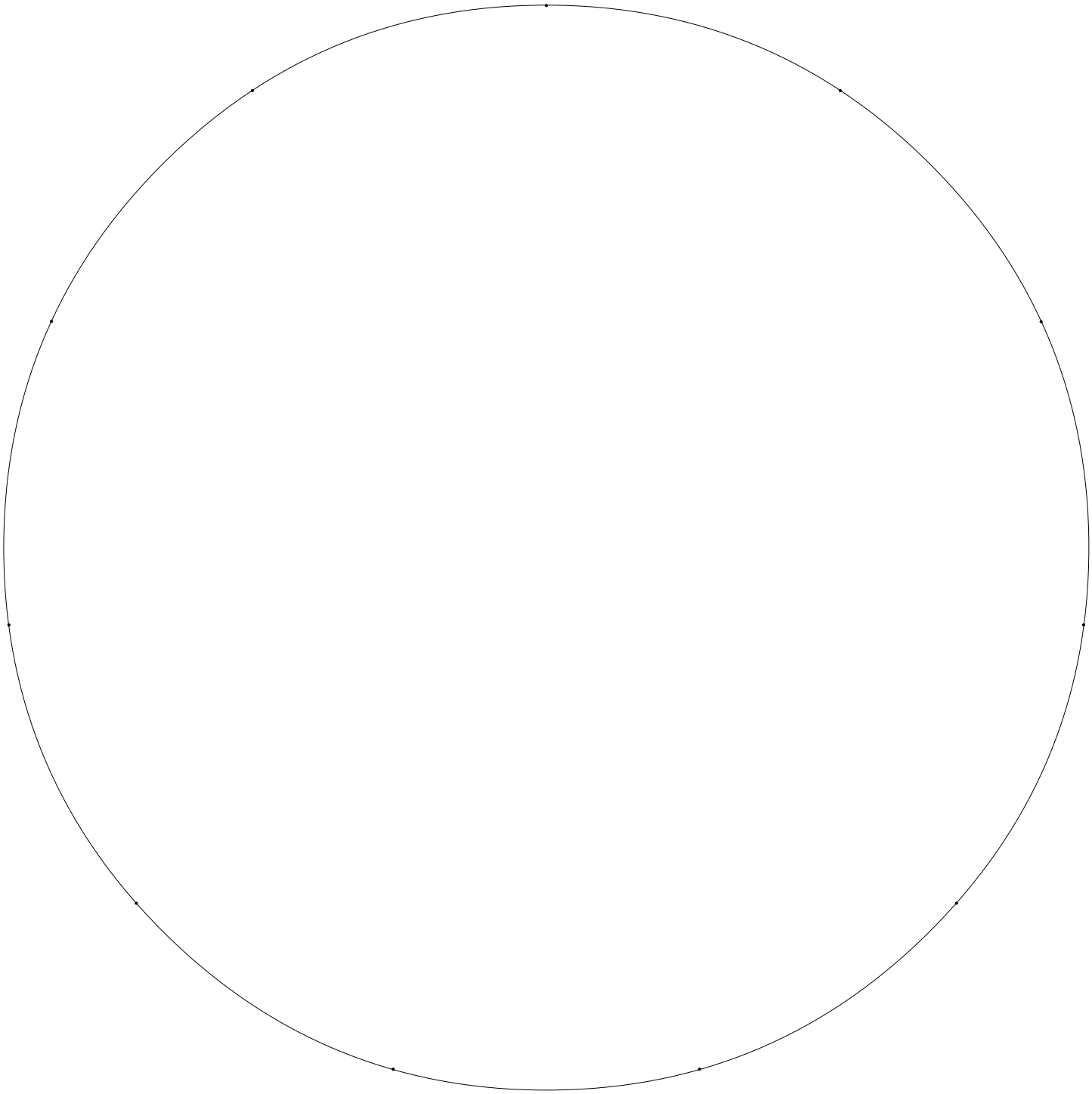
Tricks with Triangles

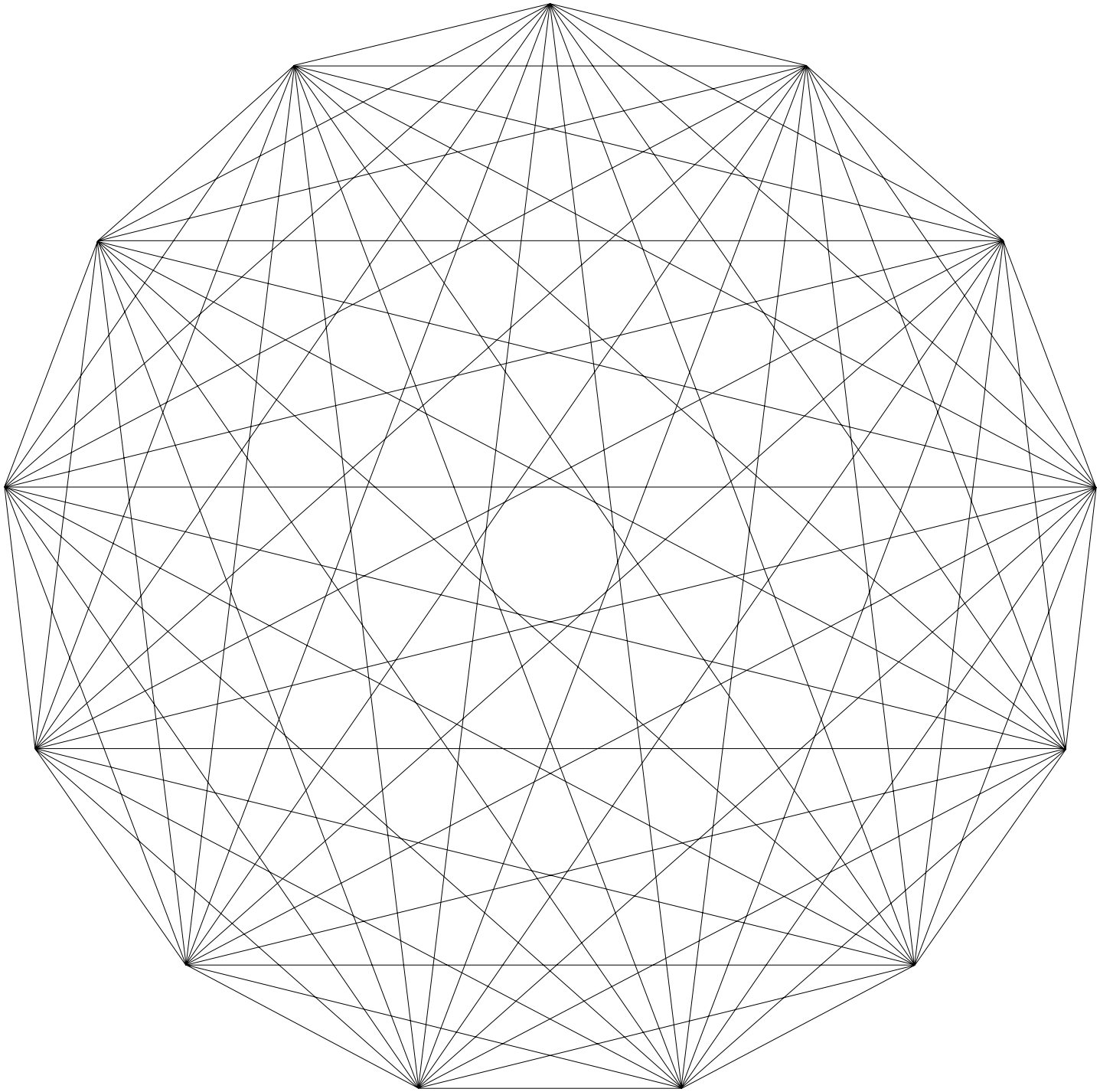












Polygons ~ Vocabulary and Data

polygon A polygon is a plane (= *flat*) shape completely enclosed by three or more straight edges. *Usually, edges are not allowed to cross one another, and the word is not used for shapes having less than 5 edges. Polygons are named by reference to the number of edges or angles they have - see table below.*

vertex A vertex is a point where two edges of a polygon meet to form a corner.

equilateral An equilateral polygon is one whose edges are all the same length.

equiangular An equiangular polygon is one which has the same angle at every vertex.

isogon An isogon is another name for an equiangular polygon.

regular A regular polygon is one which is both equilateral and equiangular.

irregular An irregular polygon is one which is not regular

concave A concave polygon is one which has at least one vertex with an interior angle which is greater than 180°

convex A convex polygon is one in which the interior angle of every vertex is less than 180°. *All regular polygons are convex. All its diagonals lie inside the polygon.*

re-entrant A re-entrant polygon is another name for a concave polygon

diagonal A diagonal of a polygon is any straight line drawn between two vertices which are not next to each other. *A diagonal can lie outside the polygon, as in the concave case.*

circumcircle A circumcircle to any polygon is the circle drawn around the outside of that polygon which touches all of its vertices. *Since it is necessary for the circle to touch every vertex of the polygon, it is not possible to draw a circumcircle for every polygon (for example not for concave polygons), but is is always possible for regular polygons and for any triangle. The circumcircle is also the 'base' circle often used in the construction of regular polygons.*

incircle An incircle to any polygon is the circle drawn on the inside of that polygon which touches all its edges. *Each edge is a tangent to the incircle. As with the circumcircle, not every polgon has an associated incircle, but every regular polygon has one, and so do all triangles.*

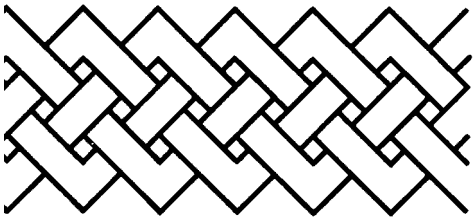
star polygon A star polygon is made by joining every $\boldsymbol{r}^{\text{th}}$ vertex of a polygon having $\boldsymbol{n}$ vertices ($1 < \boldsymbol{r} < \boldsymbol{n}-1$); $\boldsymbol{n}$ and $\boldsymbol{r}$ having no factors in common, and $\boldsymbol{n} > 4$. *They are described as star polygons{**n/r**} and also known as **n**-grams.*

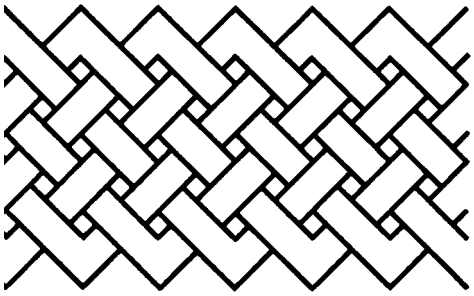
Circles and their related Regular Polygons

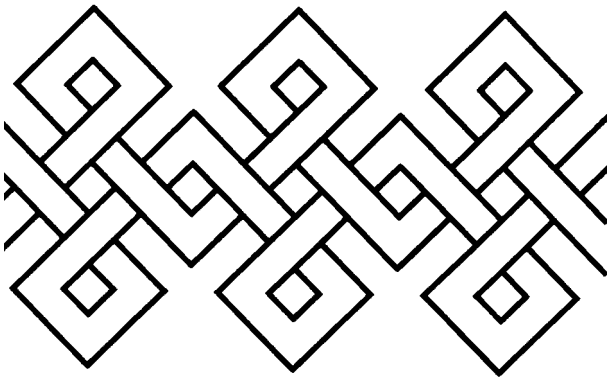
No. of divisions	Name of polygon	Edge = $\boldsymbol{r}$ × …	Perimeter = $\boldsymbol{r}$ × …	Area = $\boldsymbol{r}^2$ × …	I-radius = $\boldsymbol{r}$ × …	Number of Diagonals
3	**triangle**	1.7321	5.1962	1.299	0.5	0
4	**quadrilateral**	1.4142	5.6569	2	0.70711	2
5	**pentagon**	1.1756	5.8779	2.3776	0.80902	5
6	**hexagon**	1	6	2.5981	0.86603	9
7	**heptagon**	0.86777	6.0744	2.7364	0.90097	14
8	**octagon**	0.76537	6.1229	2.8284	0.92388	20
9	**nonagon***	0.68404	6.1564	2.8925	0.9397	27
10	**decagon**	0.61803	6.1803	2.9389	0.95106	35
11	**undecagon**	0.56347	6.1981	2.9735	0.95949	44
12	**dodecagon**	0.51764	6.2117	3	0.96593	54

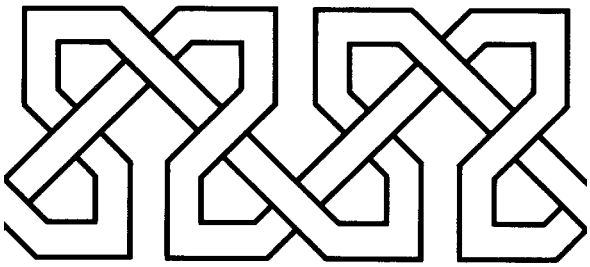
Given the radius $\boldsymbol{r}$ of a base-circle, used to draw a regular polygon, the table enables the edge-length of the polygon, its perimeter, area and the radius of its inscribed-circle (= I-radius), all to be calculated by using the multiplier given in conjunction with the radius $\boldsymbol{r}$.
Note the base-circle is the circumcircle to that polygon.
The number of diagonals that polygon has is also given.
Values are given to 5 significant figures, but unnecessary 0's at the end have been left off.

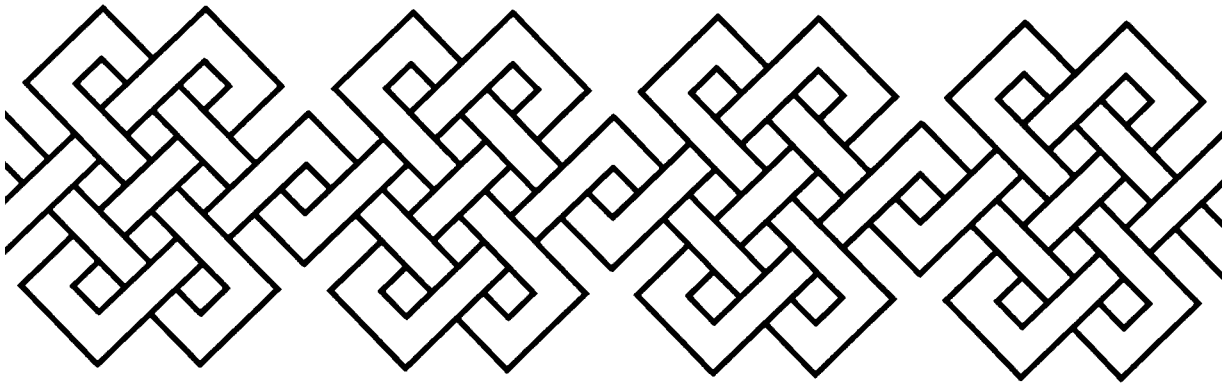
*a nonagon is also known as an enneagon

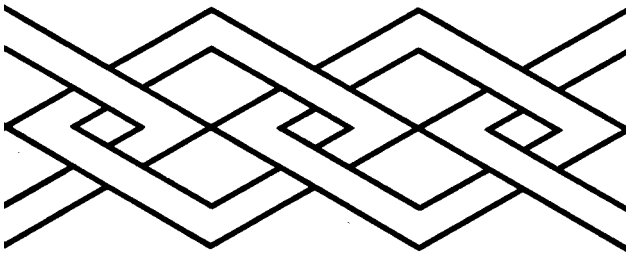


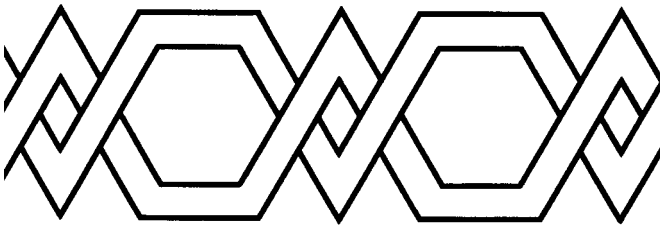


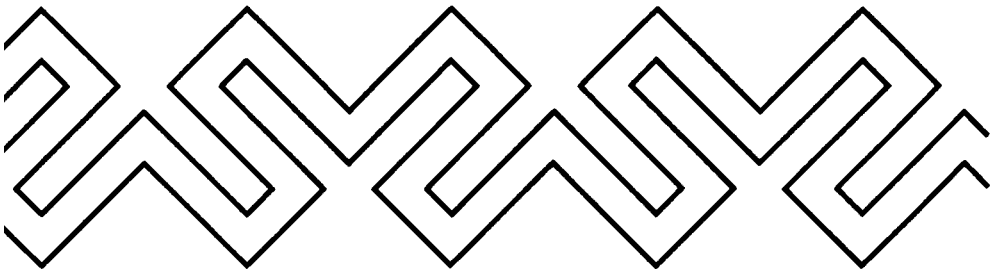


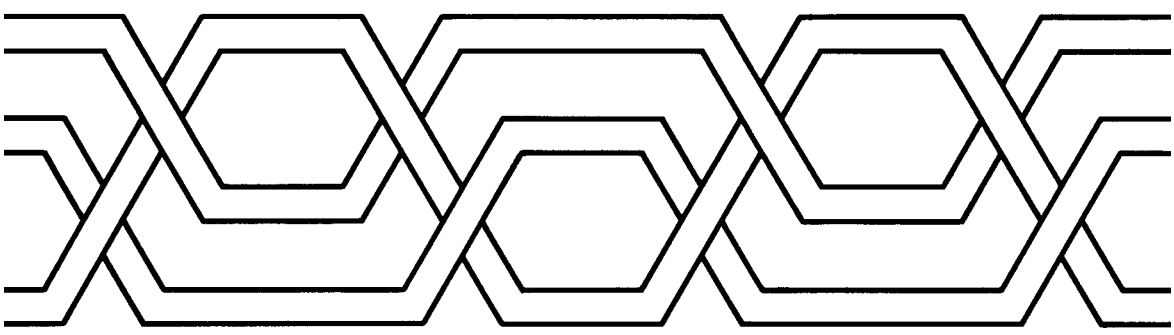


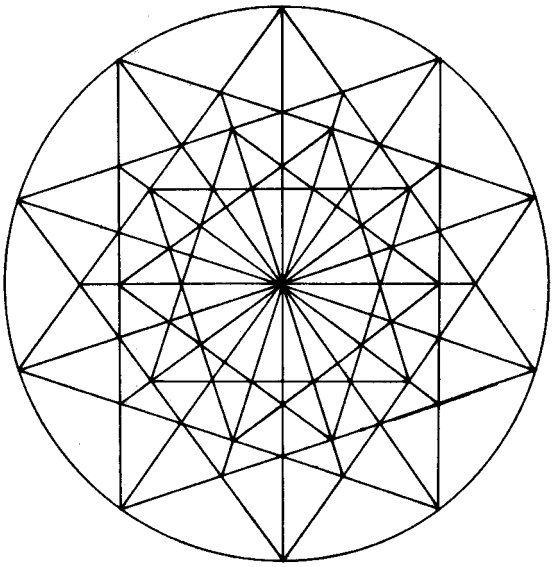


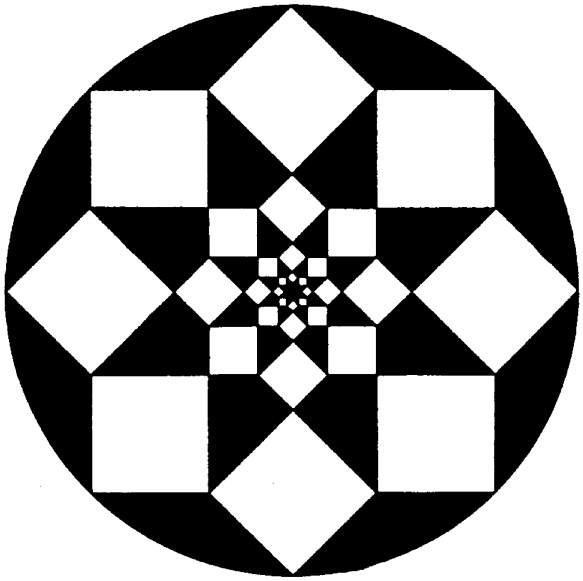


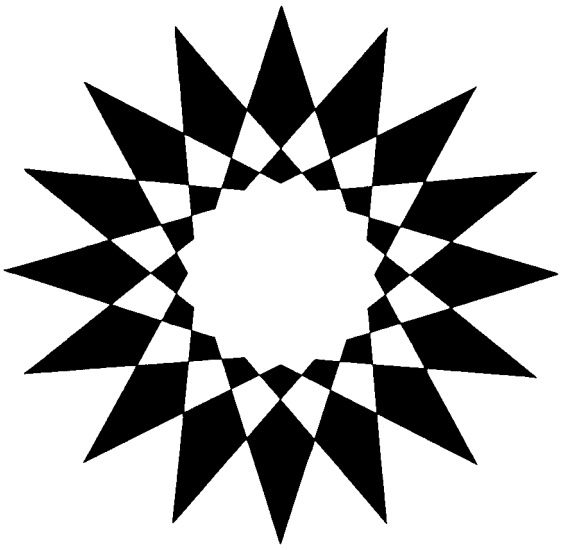


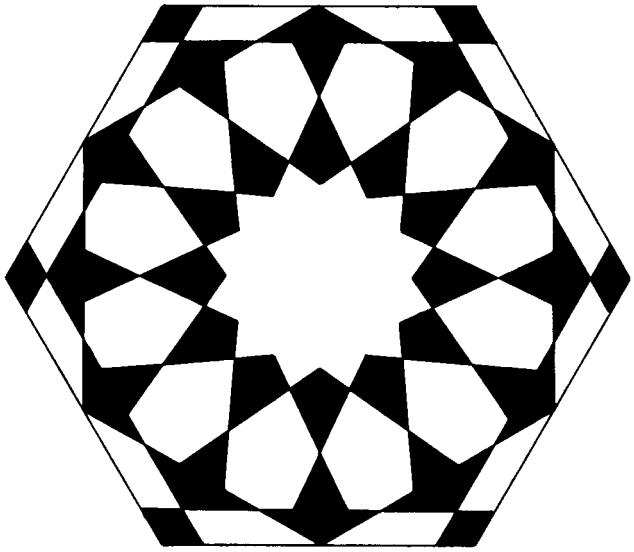


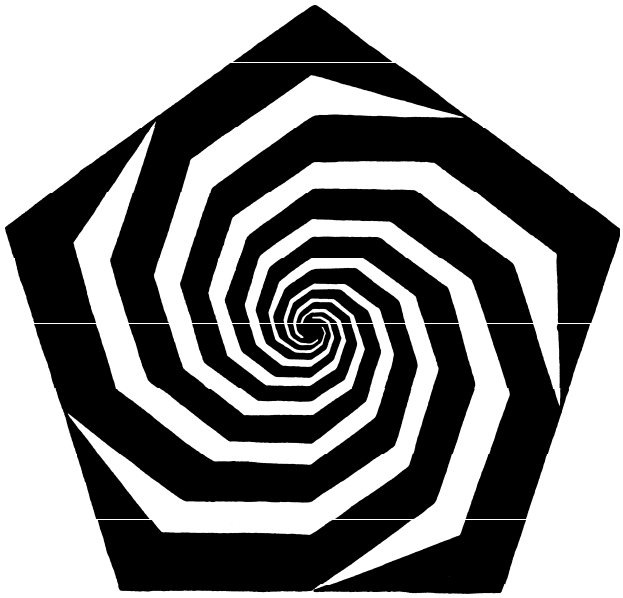


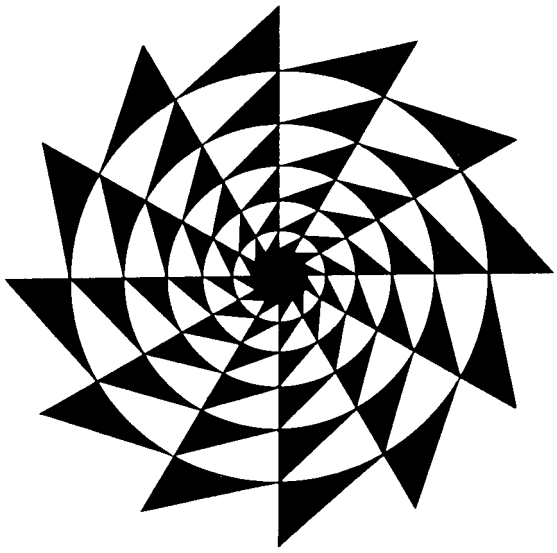


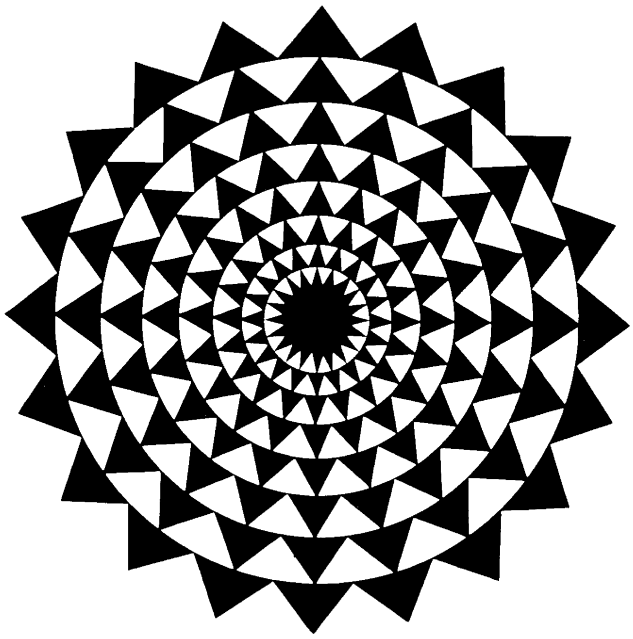


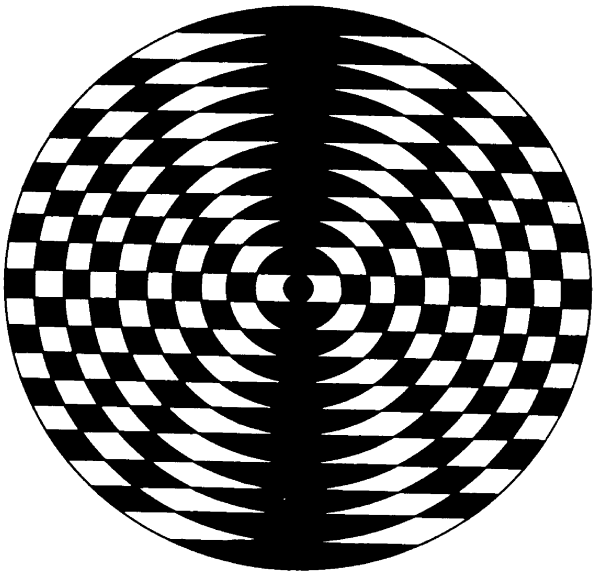


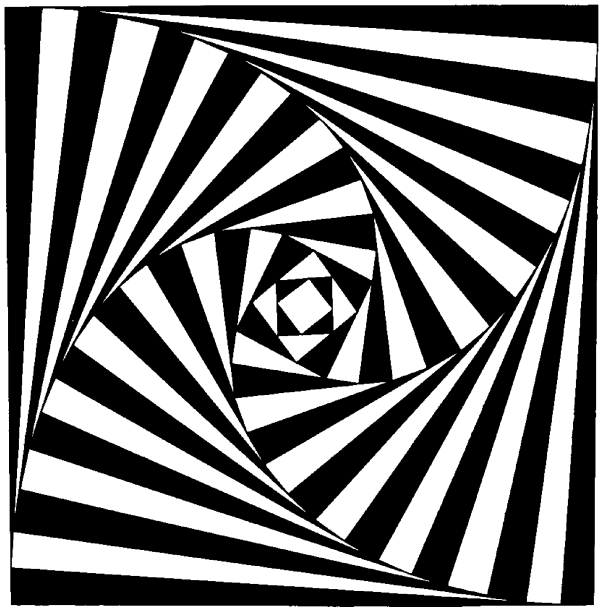


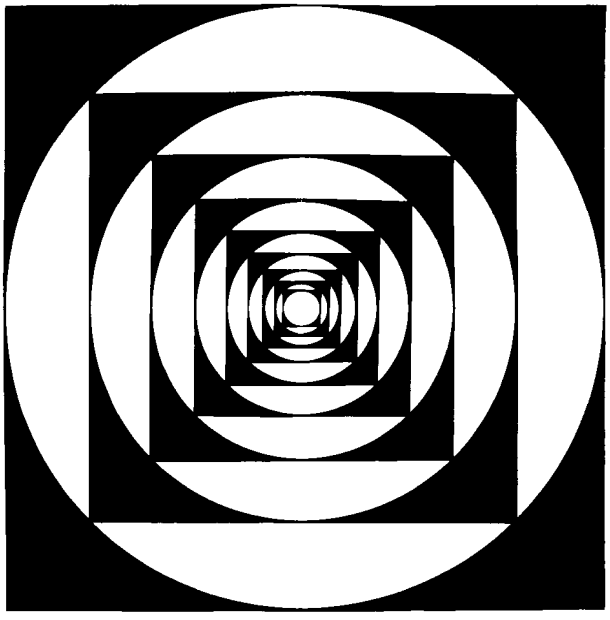


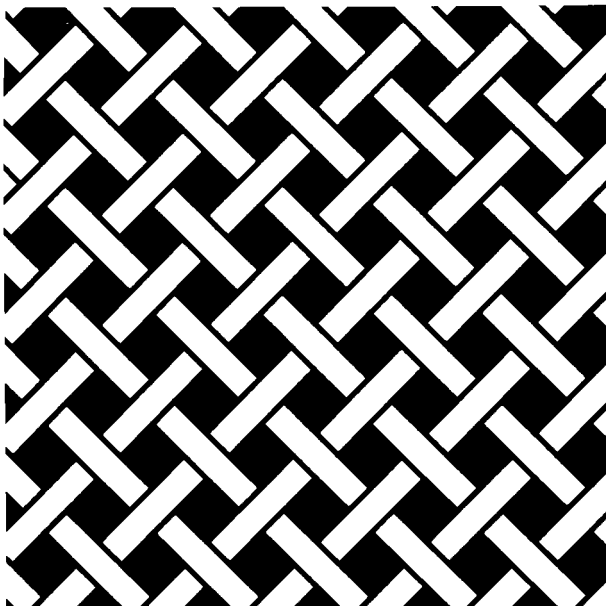


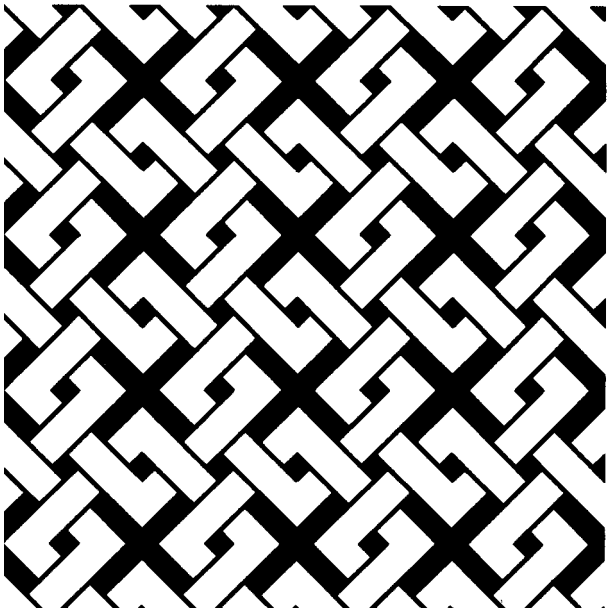


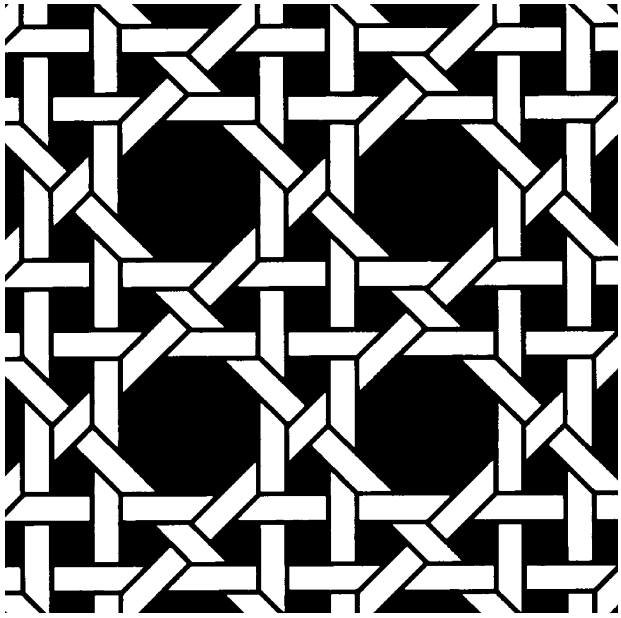


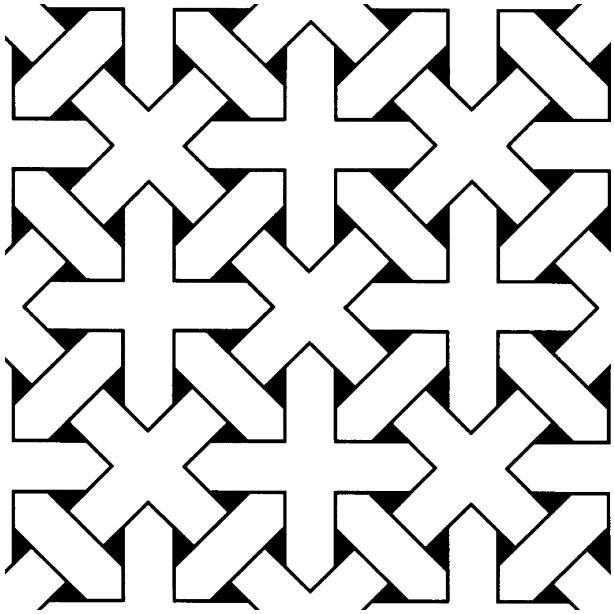


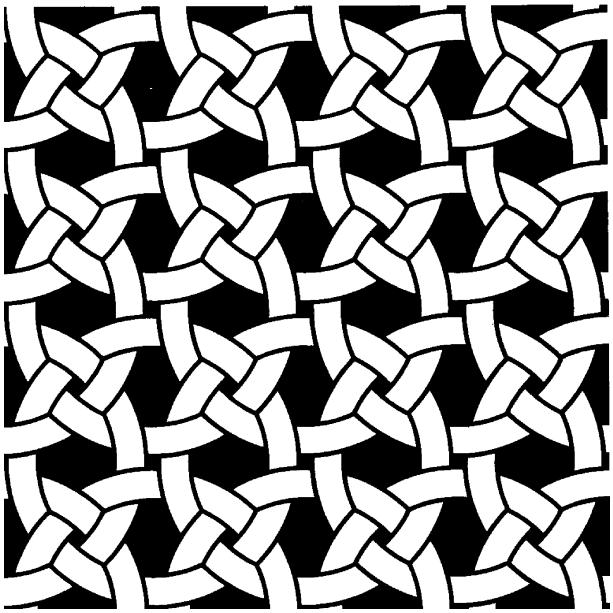


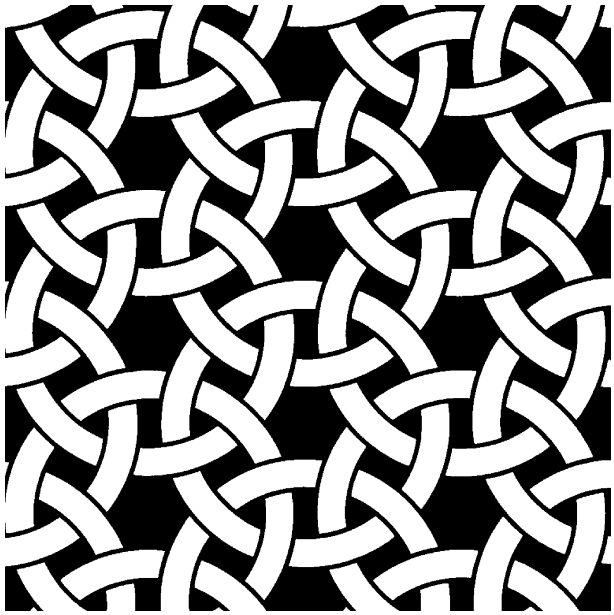








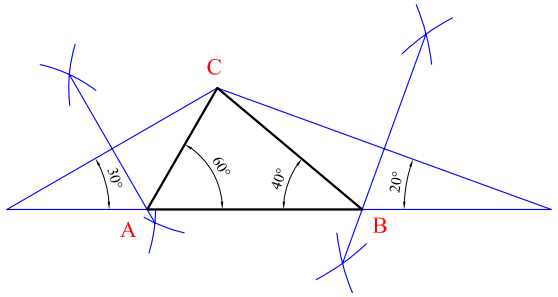




- Perimeter and the two base angles

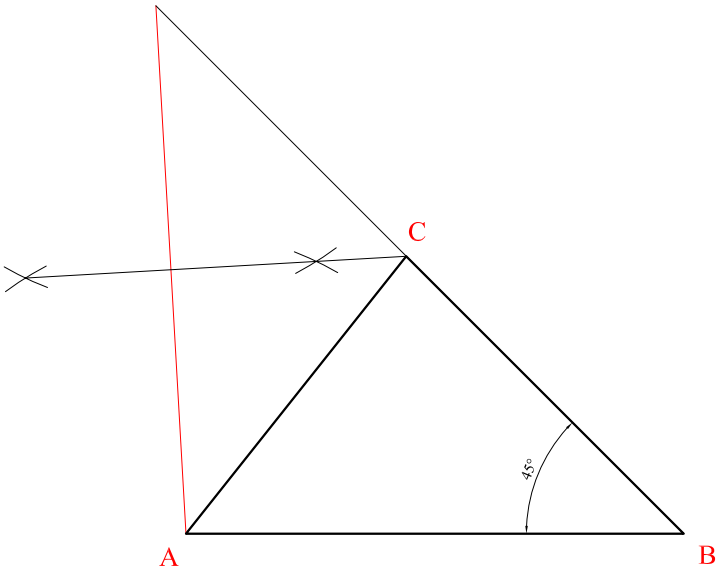
Perimeter = 105
Angle CAB = 60°
Angle CBA = 40°

Method No 1



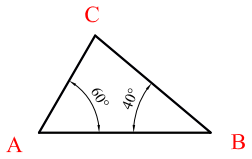
- Perimeter, base and base angle

Perimeter = 240
Base AB = 96
Base angle CBA = 45°



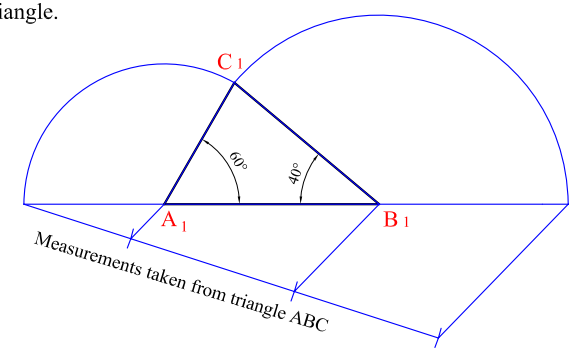
- Perimeter and the two base angles

Perimeter = 105
Angle CAB = 60°
Angle CBA = 40°



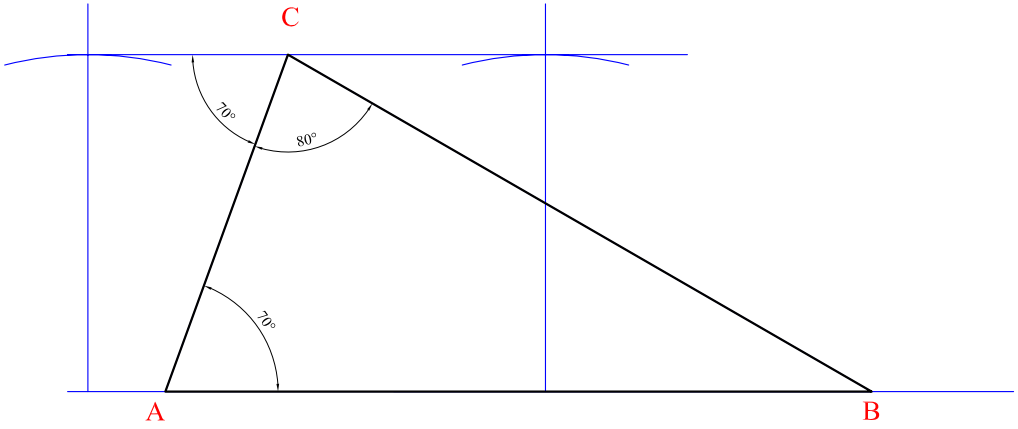
Method No 2

Construct a triangle of any dimension and having base angles of 60° and 40°. Using the proportional division method divide the given perimeter into three parts. Swing arcs to construct a similar triangle.



- Base angle, apex angle and altitude

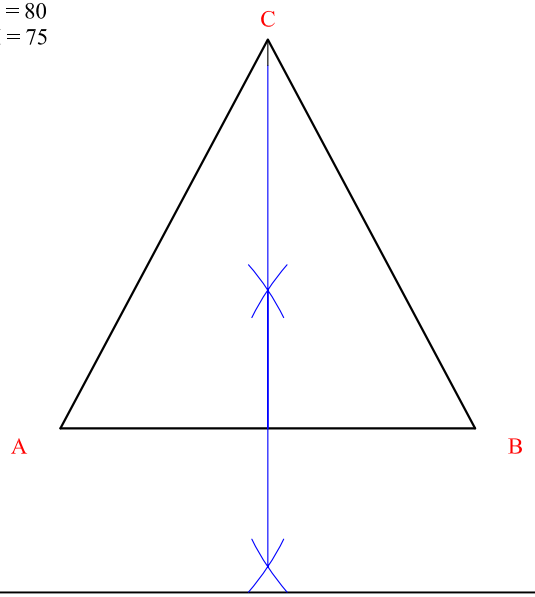
Base angle CAB = 70°
Apex angle ACB = 80°
Altitude = 65



CONSTRUCTION OF TRIANGLES Examples 13-15

- The base and altitude of an isosceles triangle

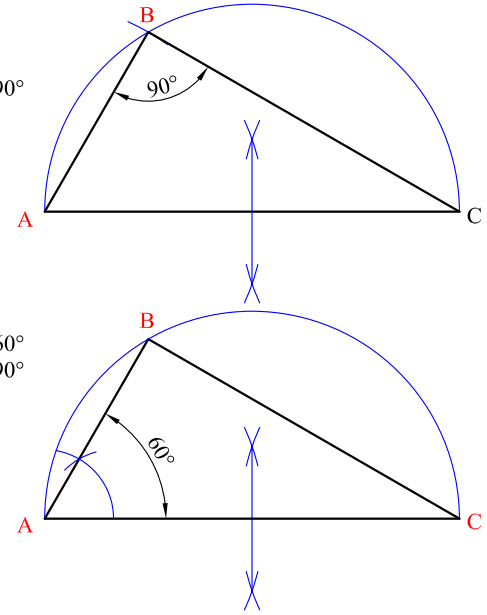
AB = 80
VH = 75



- Length of one side / angle and hypotenuse of a right angle triangle

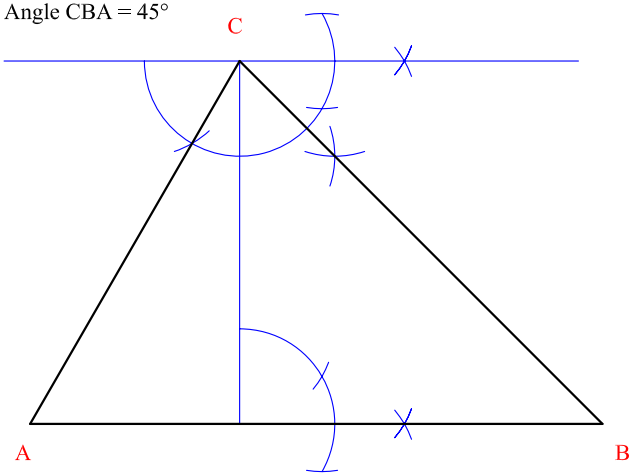
AC = 80
AB = 40
Angle ABC = 90°

AC = 80
Angle BAC = 60°
Angle ABC = 90°



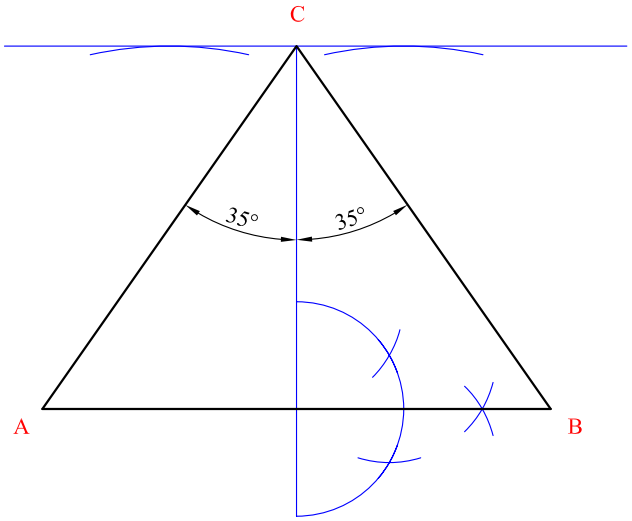
- Two base angles and the altitude

VH = 70
Angle CAB = 60°
Angle CBA = 45°



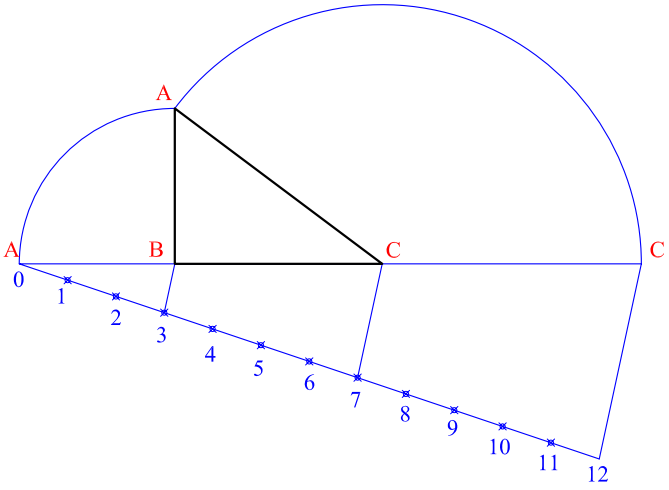
- Altitude and apex angle of an isosceles triangle

VH = 70
Angle ACB = 70°



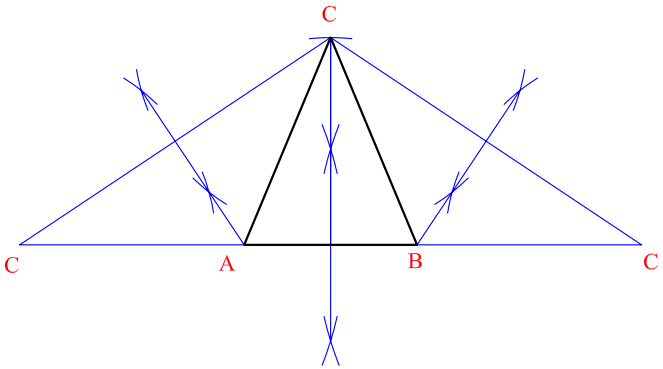
- Perimeter and the ratio of the three sides

Perimeter = 120
AB(3) : BC(4) : AC(5)



- Perimeter and altitude of an isosceles triangle

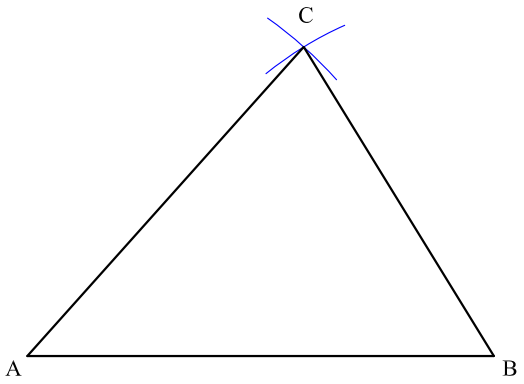
Perimeter = 120
VH = 40



CONSTRUCTION OF TRIANGLES Examples 7 - 12

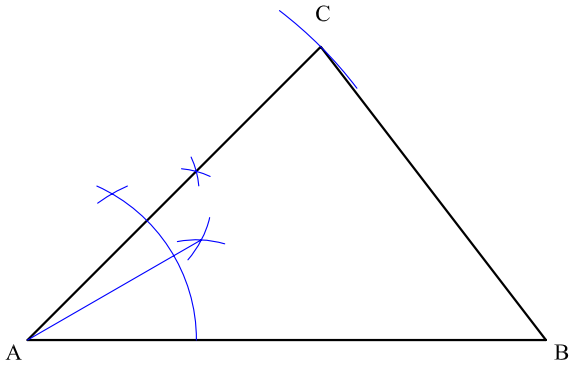
- Three sides

AB = 90
BC = 70
AC = 80



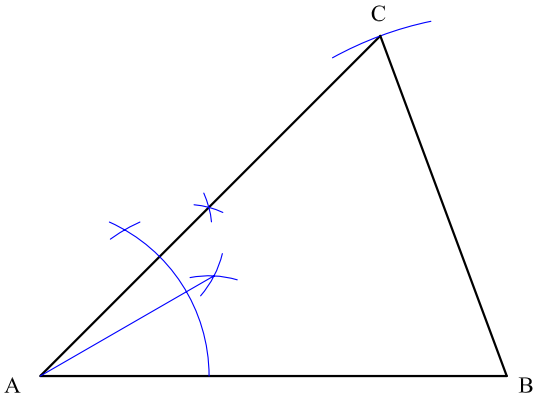
- Two sides and their included angle

AB = 100
AC = 80
Angle CAB = 45°



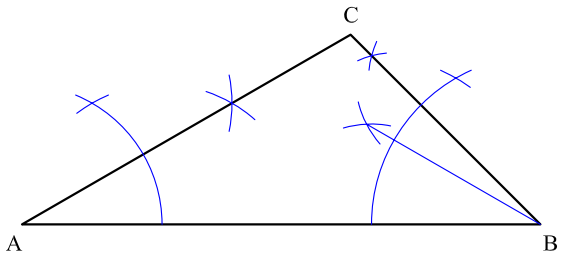
- Base, one base angle and the length of the side opposite the base angle

AB = 90
BC = 70
Angle CAB = 45°



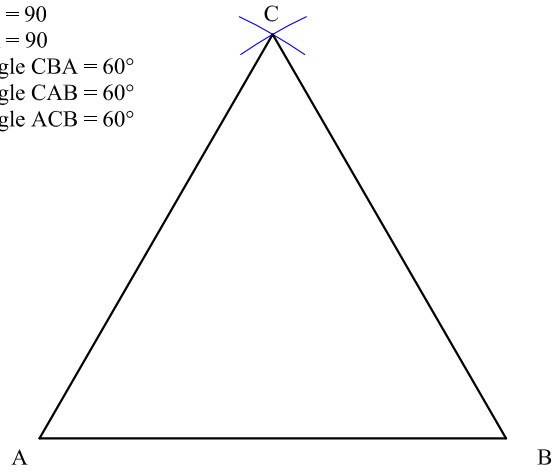
- Base and two base angles

AB = 100
Angle CBA = 45°
Angle CAB = 30°



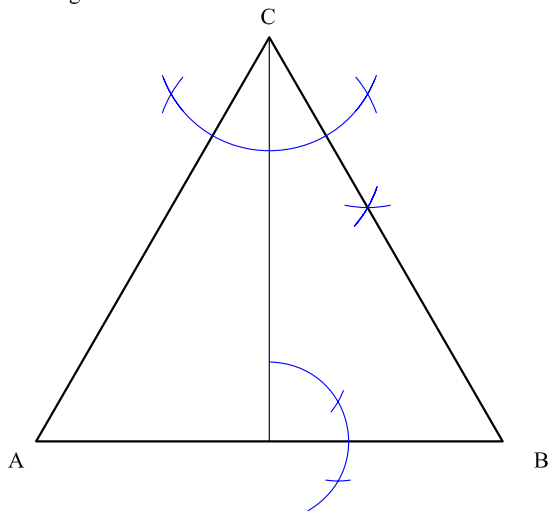
- The base of an equilateral triangle

AB = 90
BC = 90
CA = 90
Angle CBA = 60°
Angle CAB = 60°
Angle ACB = 60°



- The altitude of an equilateral triangle

Vertical height = 80



CONSTRUCTION OF TRIANGLES Examples 1 - 6

Safety signs are legally regulated through standards organizations. Different forms and colours are employed depending on their use. For example, triangles always denote warning about particular hazards. Other signs such as mandatory, prohibition, safe conditions and general information make use of other specific forms and colours.

GRAPHIC SIGNS

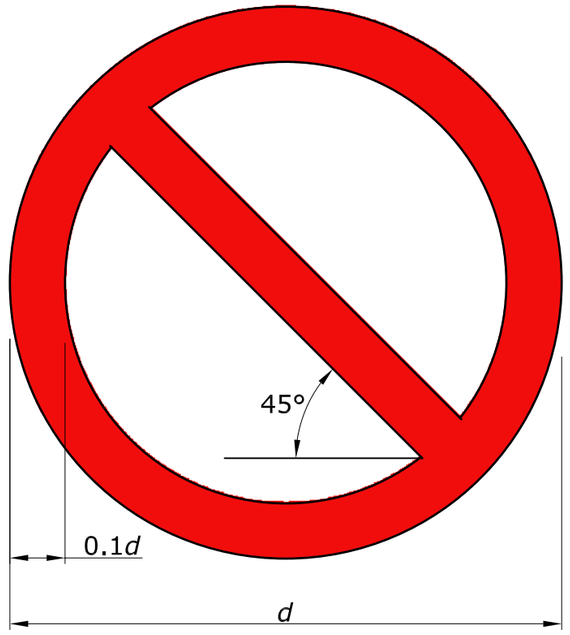
Prohibition signs
'YOU MUST NOT'

Signs telling the individual not to carry out an action as it may increase or cause danger.

Properties

- Red bordered circle and diagonal having a white background.
- The image should be black and centrally placed. It should not obscure the diagonal.
- Red should at least cover 35% of the area of the safety sign.

Note: Any text that complements the sign should be placed beneath.



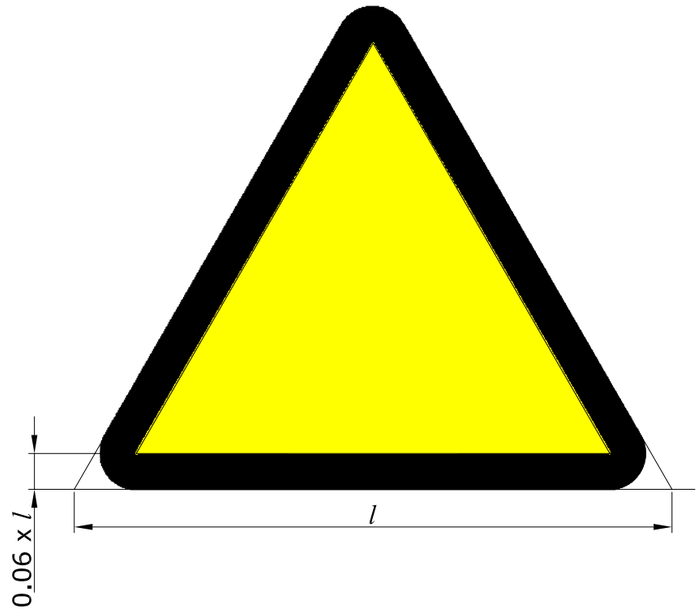
Examples:

Warning signs
'CAUTION'

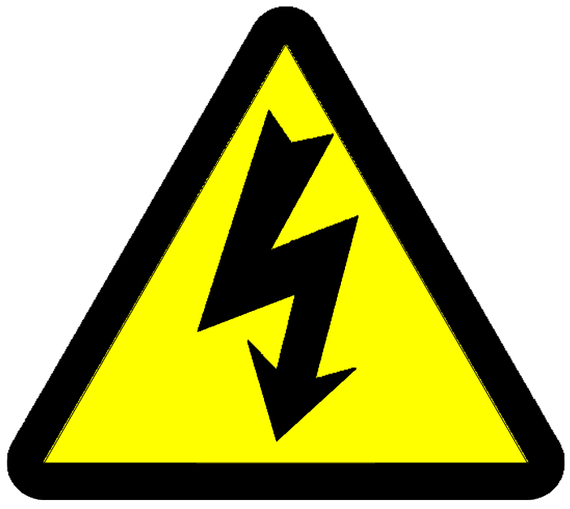
Signs that give a warning of a hazard or danger.

Properties

- Black bordered triangle having a yellow background.
- The image should be centrally placed on the yellow background.
- The background colour should at least cover 50% of the area of the safety sign.



Examples:

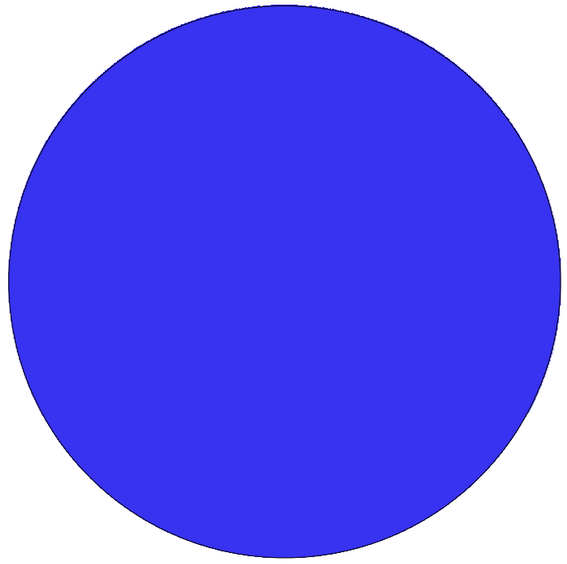


Mandatory signs
'YOU MUST DO'

Signs that show an action or behaviour that should take place.

Properties

- White image on a blue circular background.
- The image should be white and centrally placed over the background.
- The background colour should at least cover 50% of the area of the safety sign.



Examples:

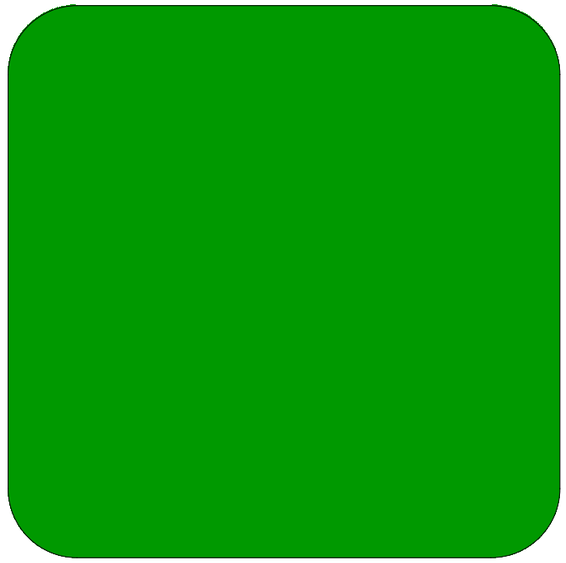
Safe condition signs

'Information signs'

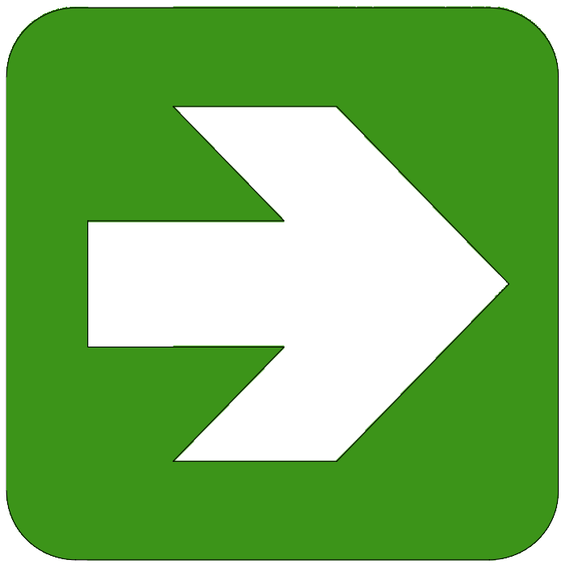
These signs indicate the way to 'safe conditions' or provision of services.

Properties

- White image centrally placed over a green background.
- The shape should be either rectangular or square.
- The background colour should at least cover 50% of the area of the safety sign.



Examples:



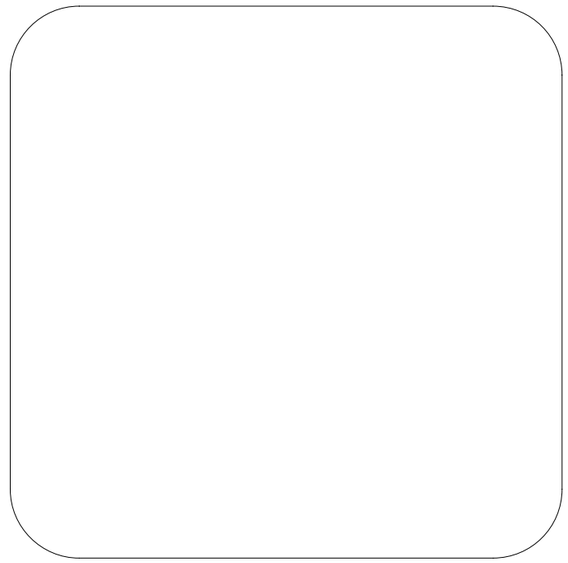
General Information signs

'Information signs'

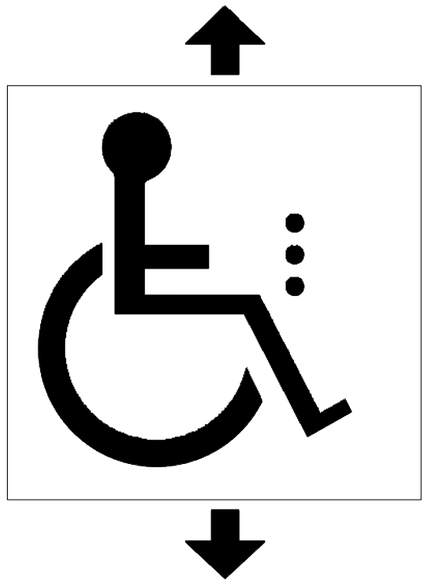
Signs that give general information on behaviour and use of services, objects, etc…

Properties

- Black image centrally placed over a white background.
- The shape should be either rectangular or square.
- The white area should at least cover 50% of the sign.



Examples:



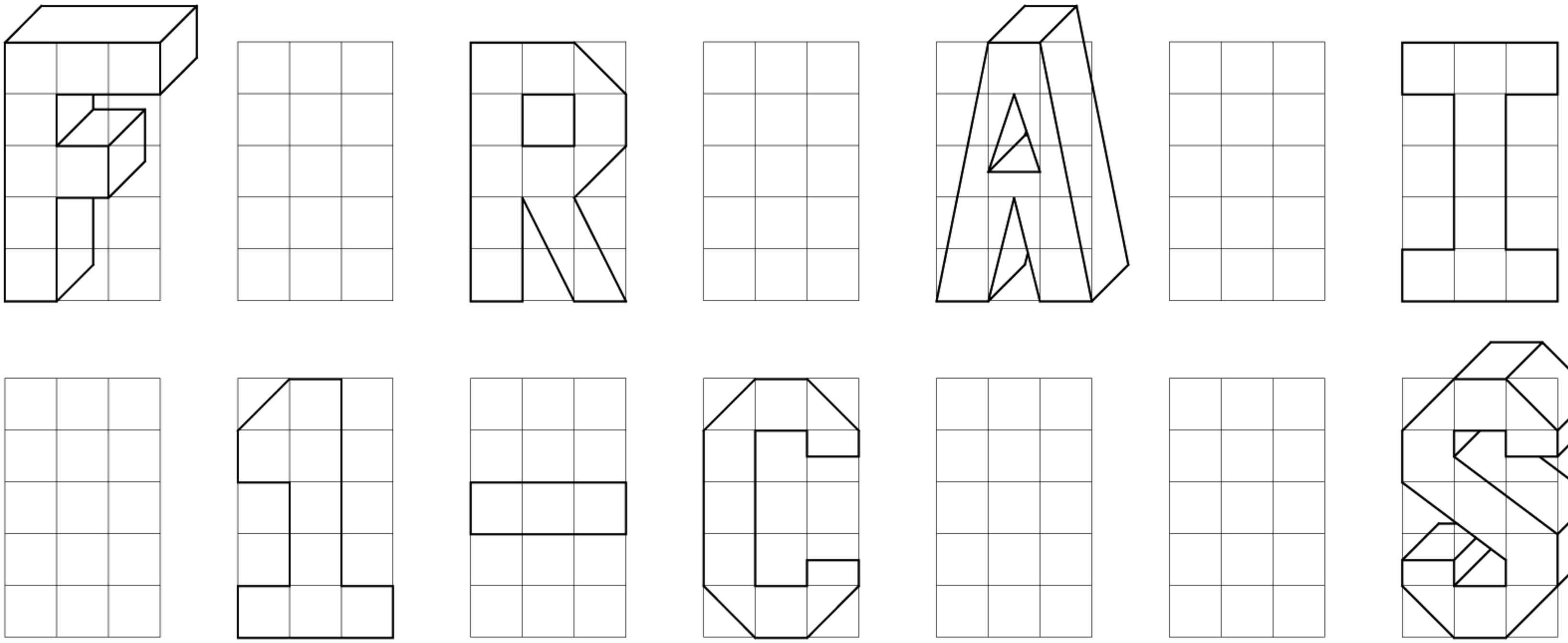
Reference:

British Standards Institution Education. (1987). Graphical Symbols for use in schools and colleges. BSI

GRAPHIC SIGNS

Cabinet Oblique view (45°, ½ depth)

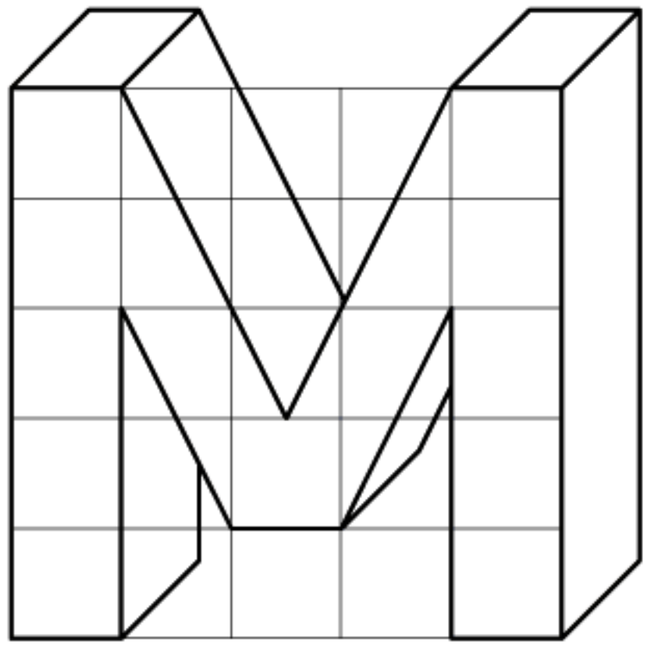
FERRARI F-1 CARS

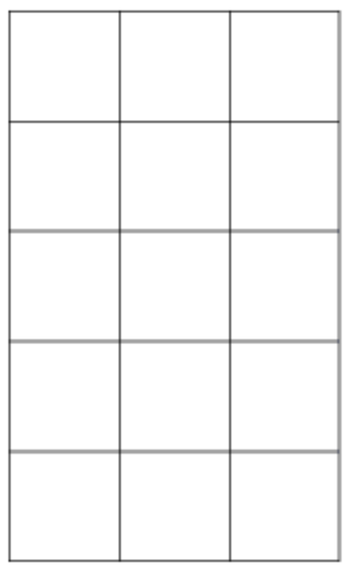


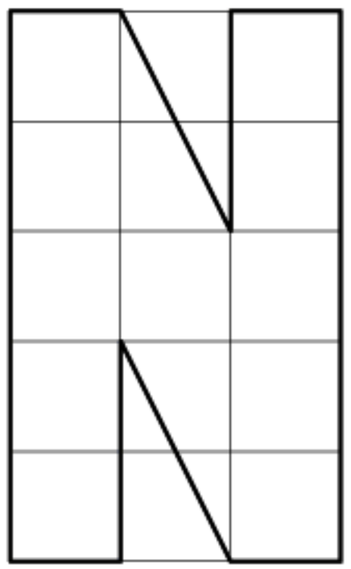
Draw the missing letters and add depth
in oblique using the 45° set-square.

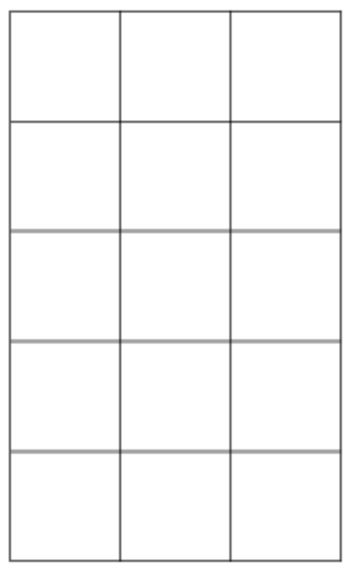
Cabinet Oblique view (45°, ½ depth)

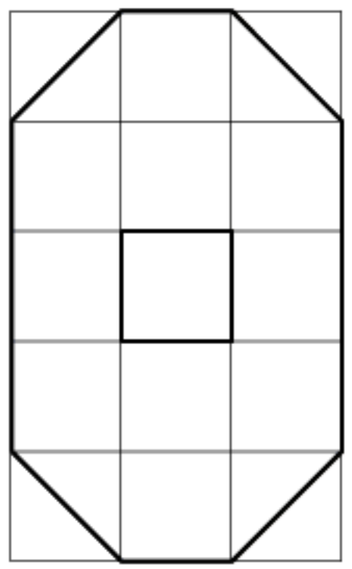
MINION RUSH

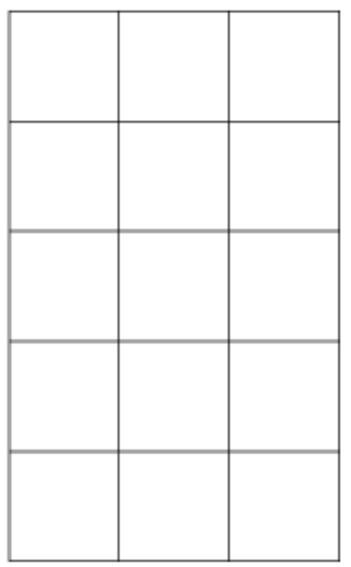


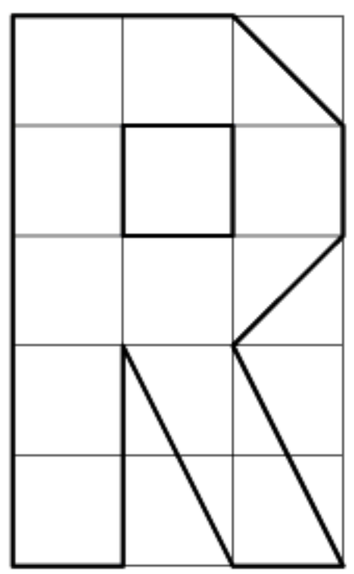


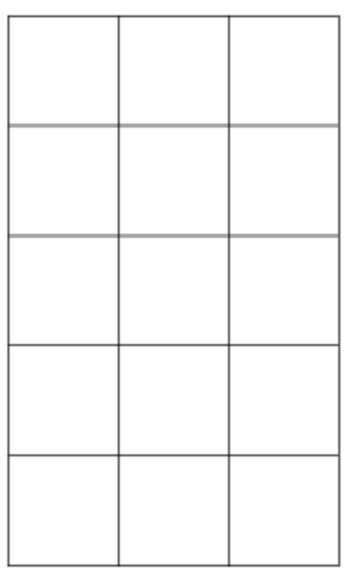


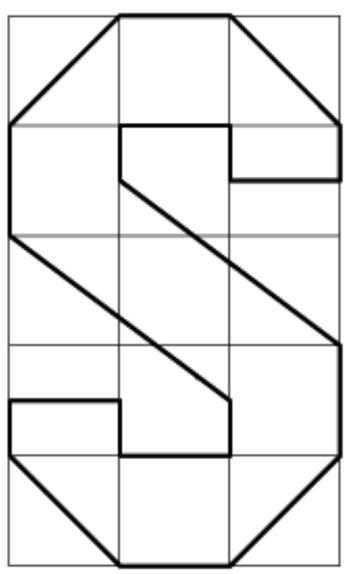


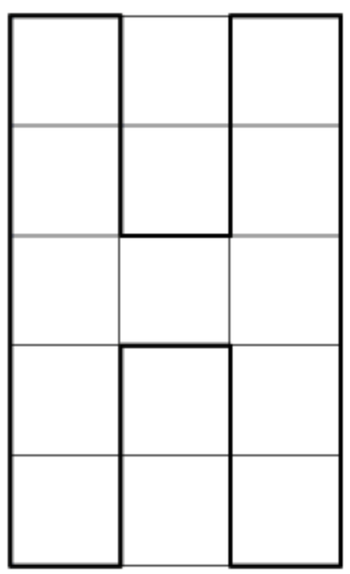








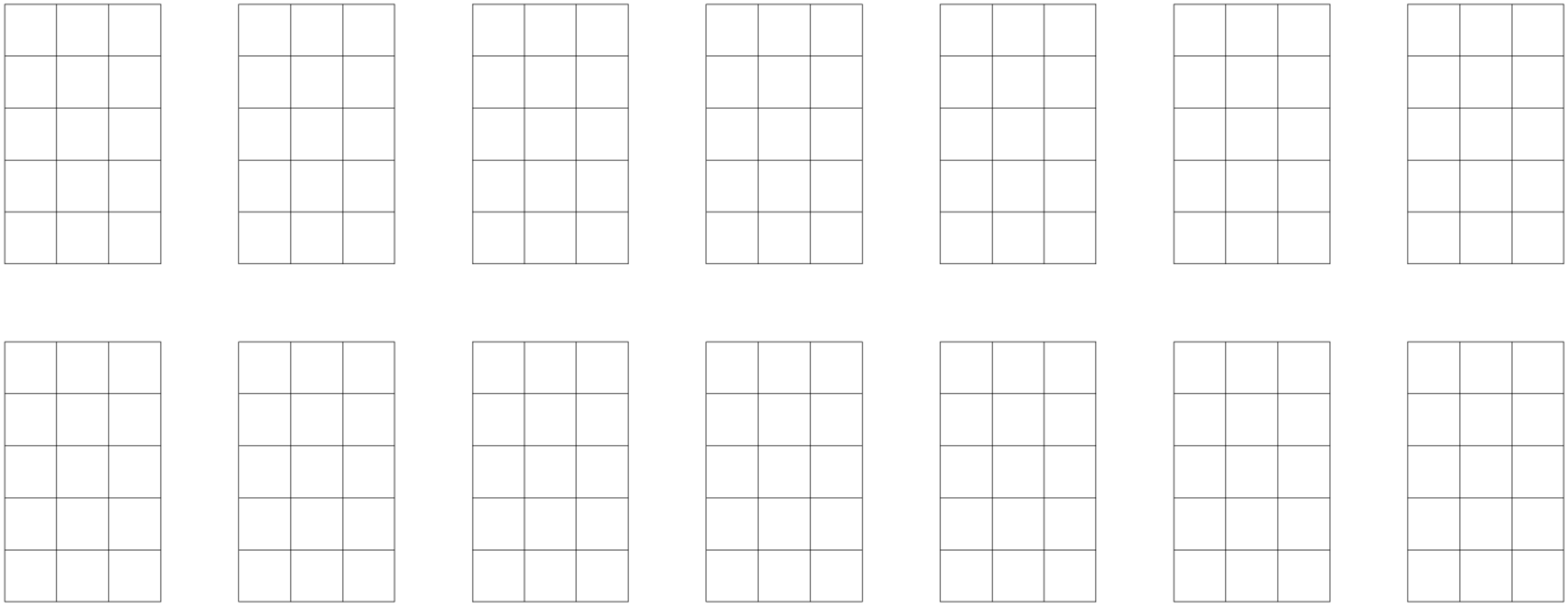




Draw the missing letters and add depth
in oblique using the 45° set-square.

Cabinet Oblique view (45°, ½ depth)

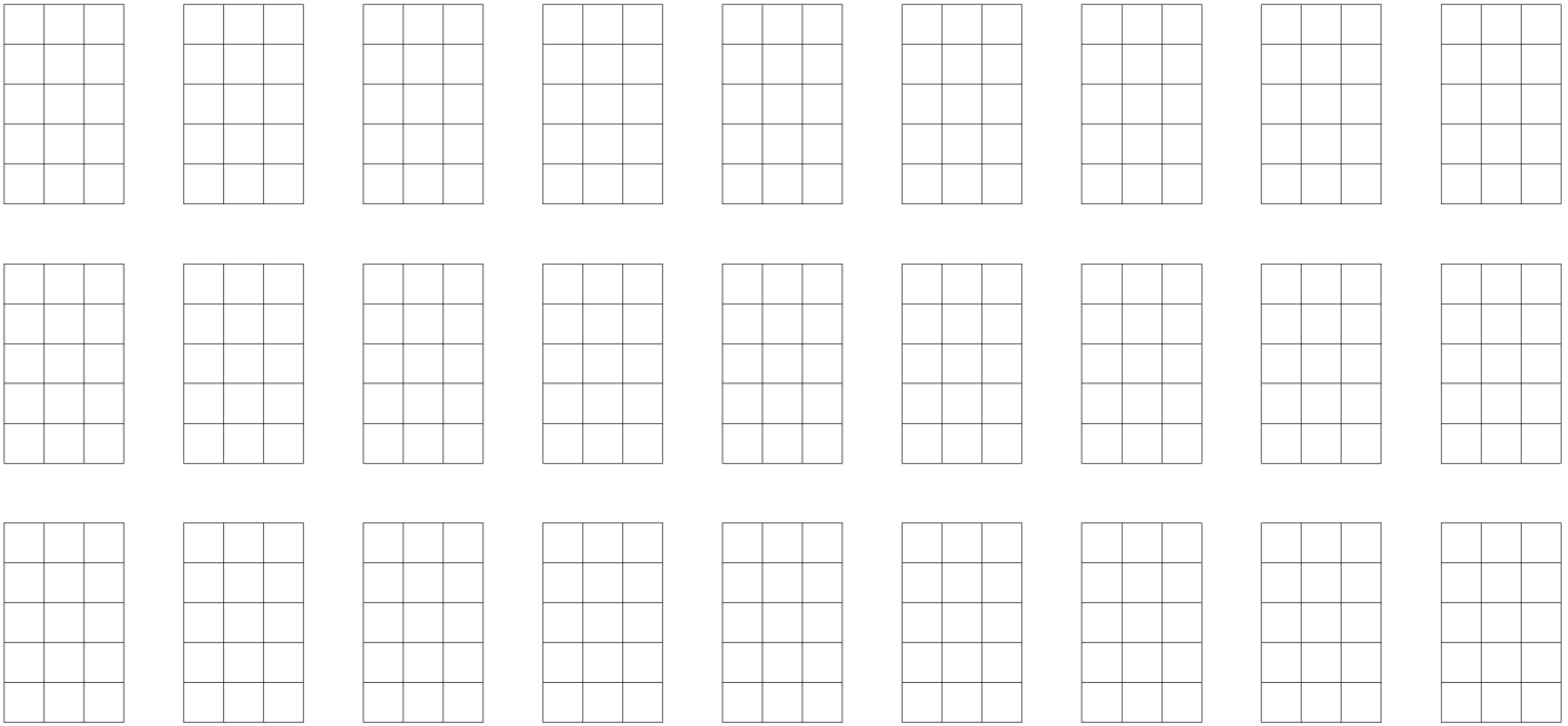
Design your own slogan.



Draw your personal slogan and add depth
in oblique using the 45° set-square.

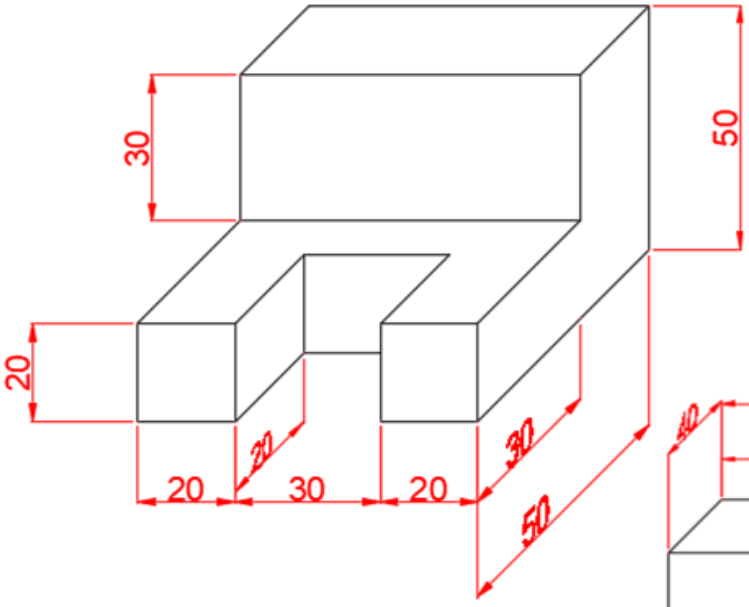
Cabinet Oblique view (45°, ½ depth)

Design your own slogan.

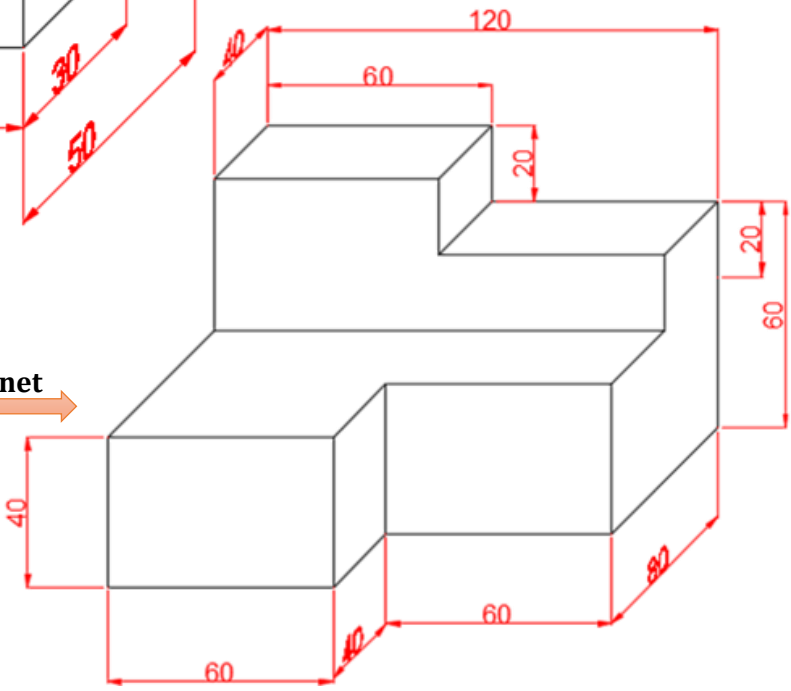


Draw your personal slogan and add depth in oblique using the 45° set-square.

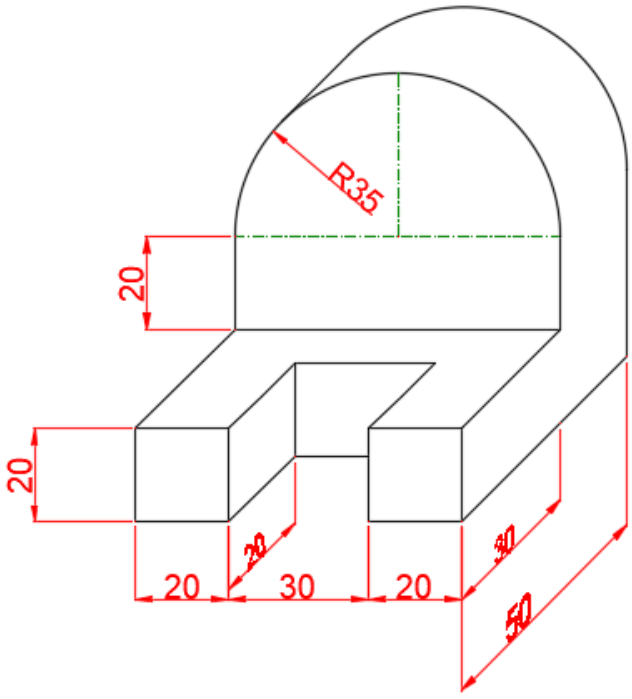
Oblique Projection



A. Oblique Cabinet



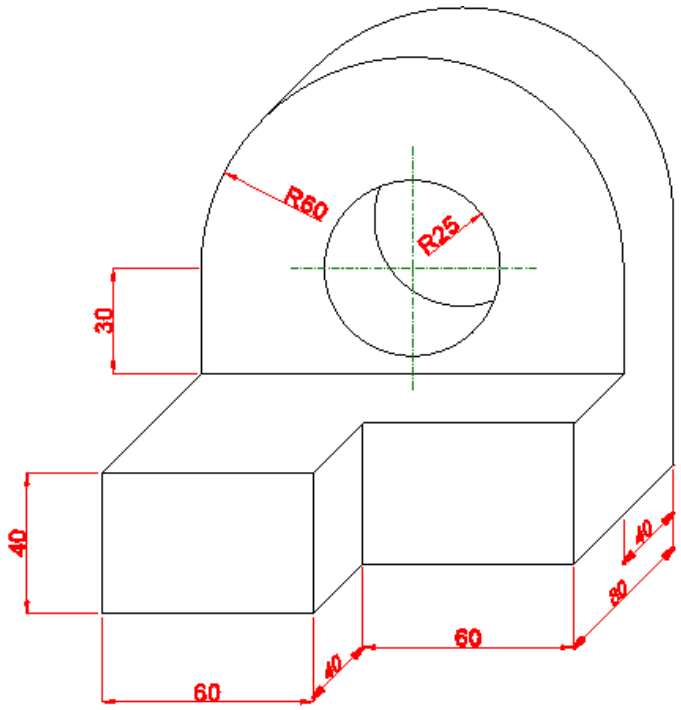
B. Oblique Cabinet



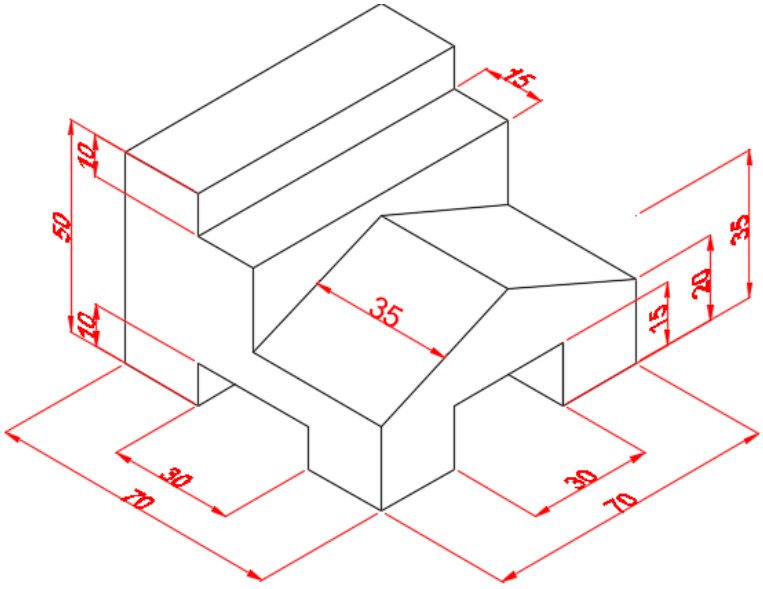
C. Oblique Cabinet

Ms Marilyn Stellini

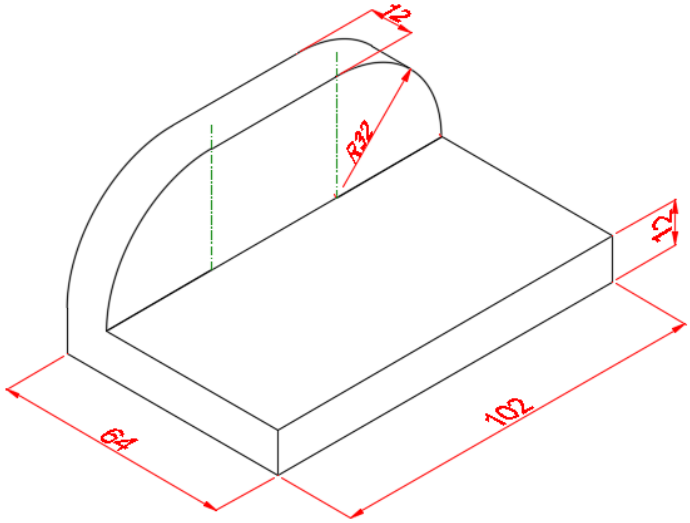
Oblique Projection



D. Oblique Cabinet



E. From isometric to Oblique Cabinet



F. From isometric to Oblique Cabinet

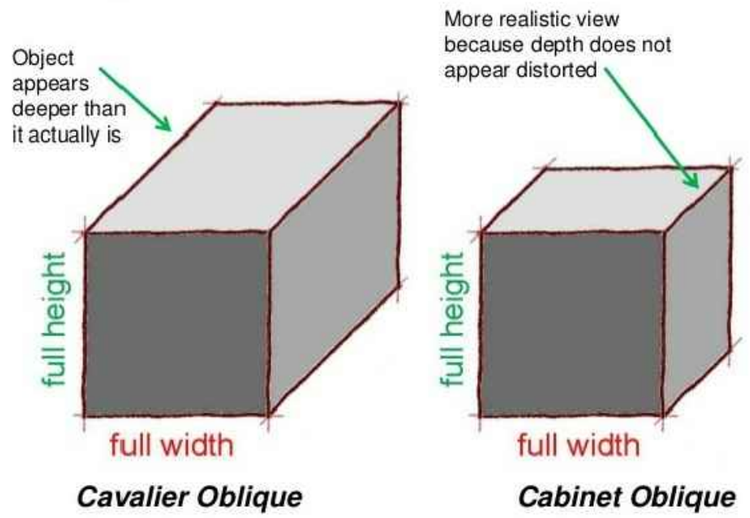
Notes:

Oblique Projection is a type of projection where three different views are present.

The front of the object is drawn to its original length i.e. its true lengths. It is useful for circles which can be drawn with a compass if they appear on the front of the object.

Such projection is created by making use of the 45 degree angle set-square.

There are two types of Oblique Projections, Cavalier and Cabinet. Both have characteristics which make them slightly different from each other.



A

B

DRG NO. : 1	OBLIQUE PROJECTION	NAME:
DATE:		CLASS:

Notes:

Oblique Projection is a type of projection where three different views are present.

The front of the object is drawn to its original length i.e. its true lengths. It is useful for circles which can be drawn with a compass if they appear on the front of the object.

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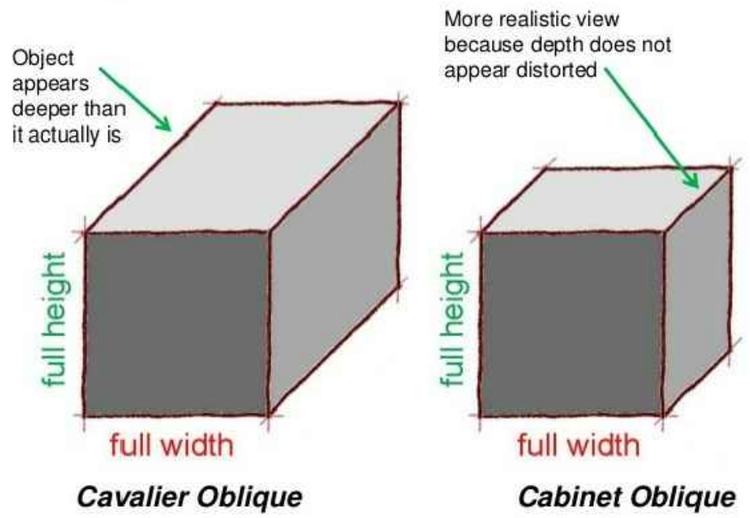
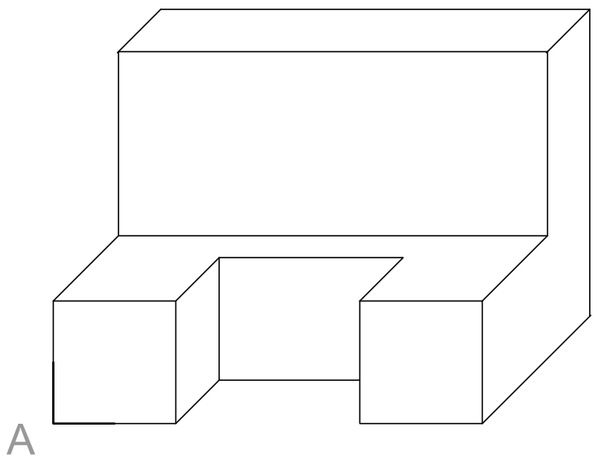
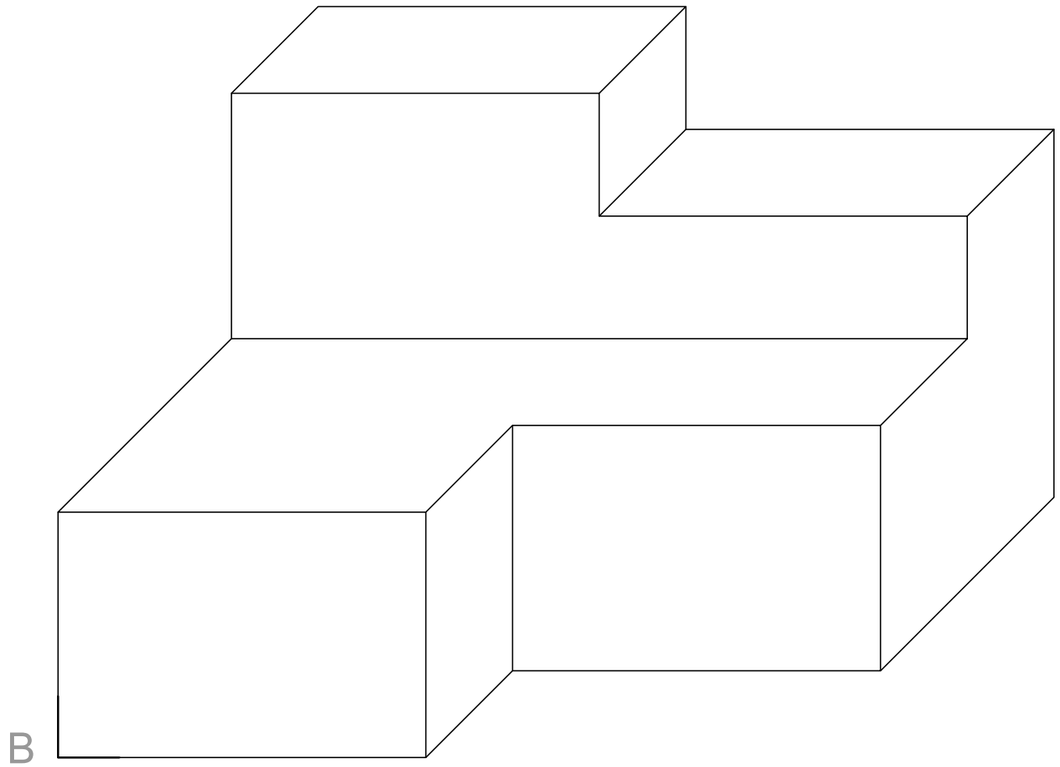






DRG NO. : 1	OBLIQUE PROJECTION	NAME:
DATE:		CLASS:

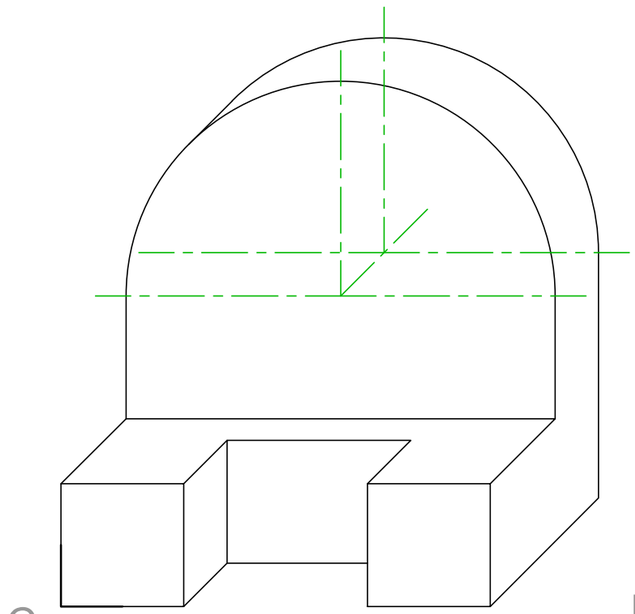
C

F

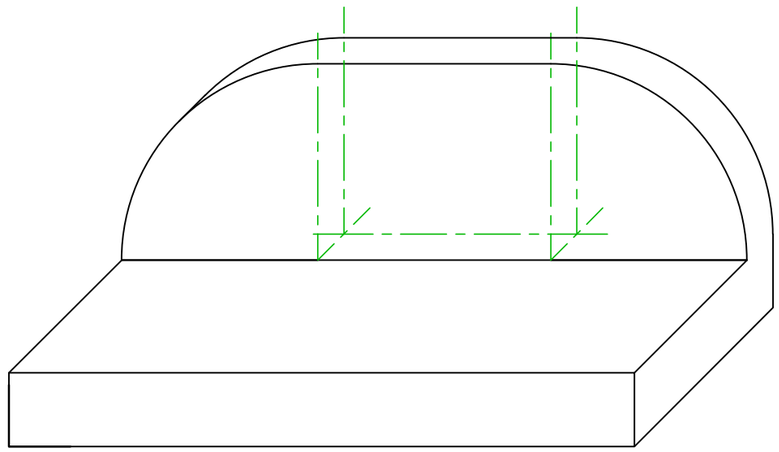
E

D

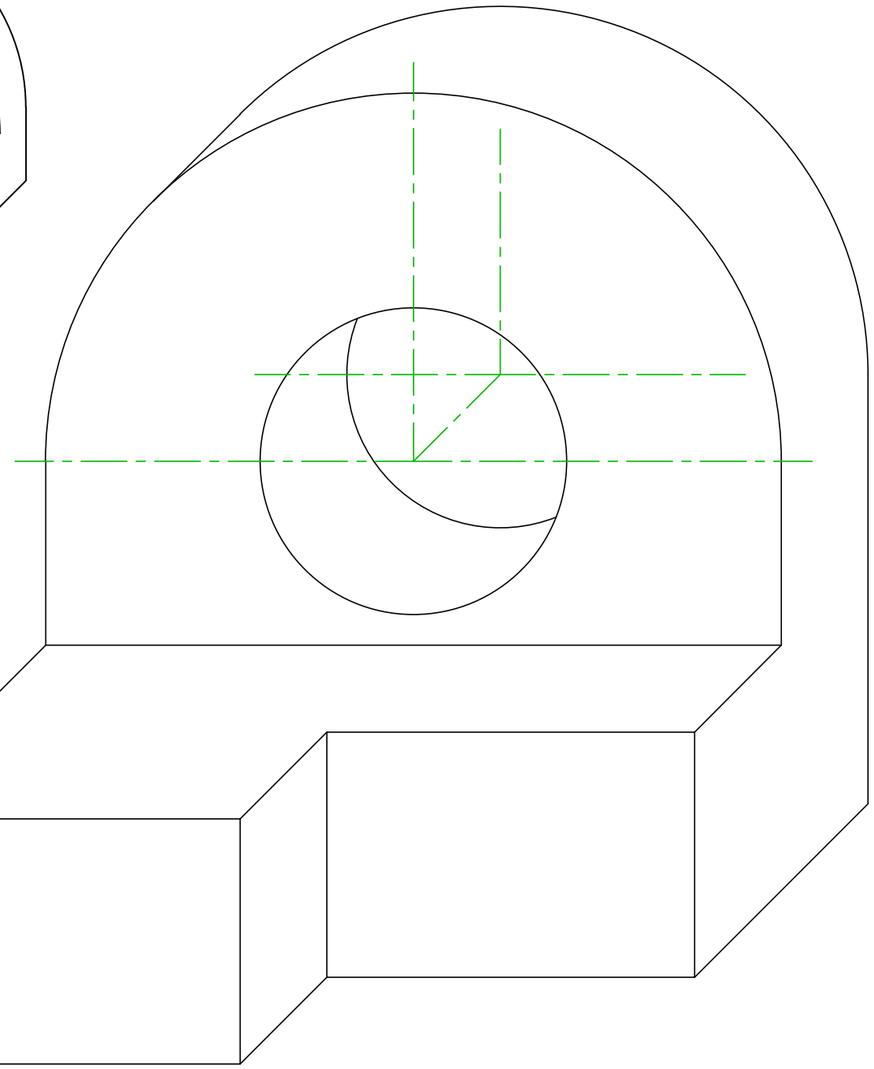
DRG NO. : 2	OBLIQUE PROJECTION	NAME:
DATE:		CLASS:



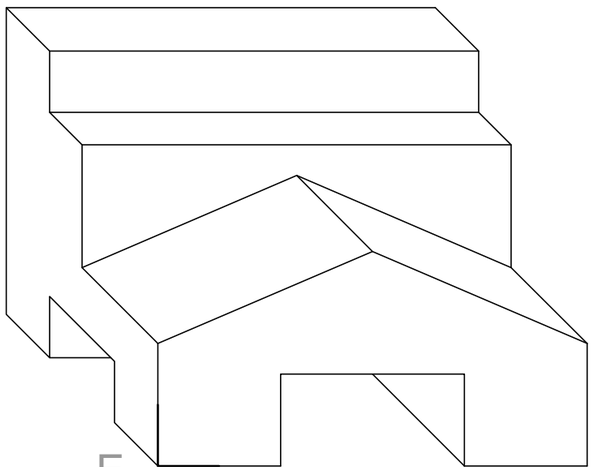
C



F



D



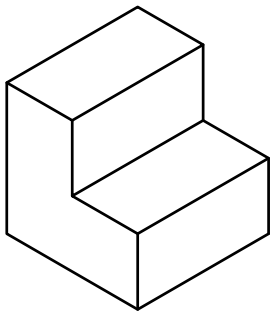
E

DRG NO. : 2	OBLIQUE PROJECTION	NAME:
DATE:		CLASS:

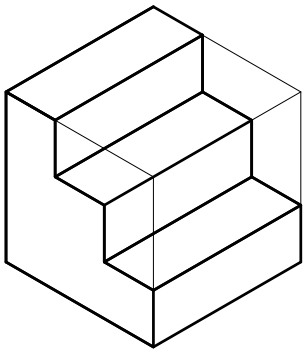
Examples 1 and 2 are to be drawn within crates that have the shape of a cube.

The cube has a lenght, height and width of 45mm.

1)



2)



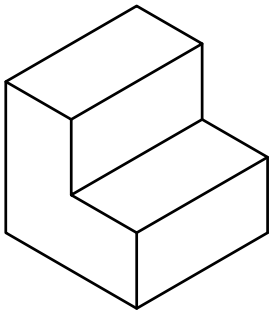
NAME: _____

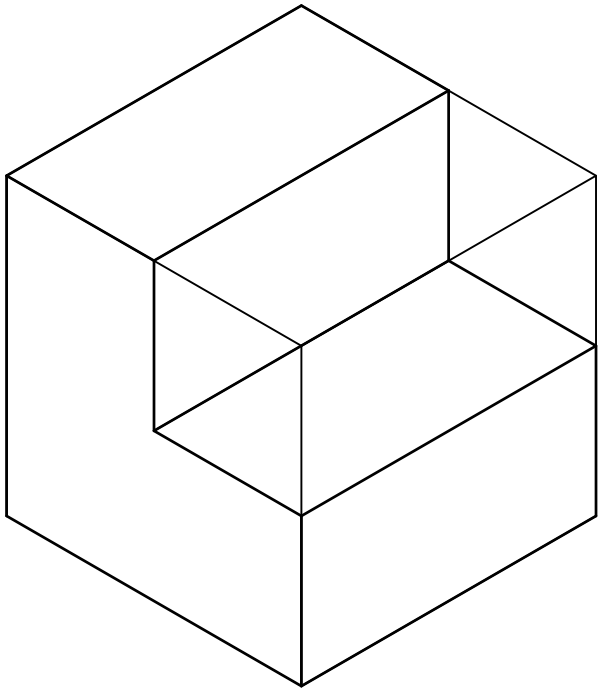
ISOMETRIC PROJECTION

Examples 1 and 2 are to be drawn within crates that have the shape of a cube.

The cube has a lenght, height and width of 45mm.

1)





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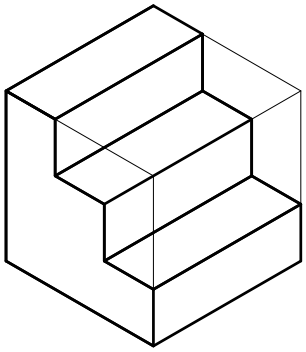
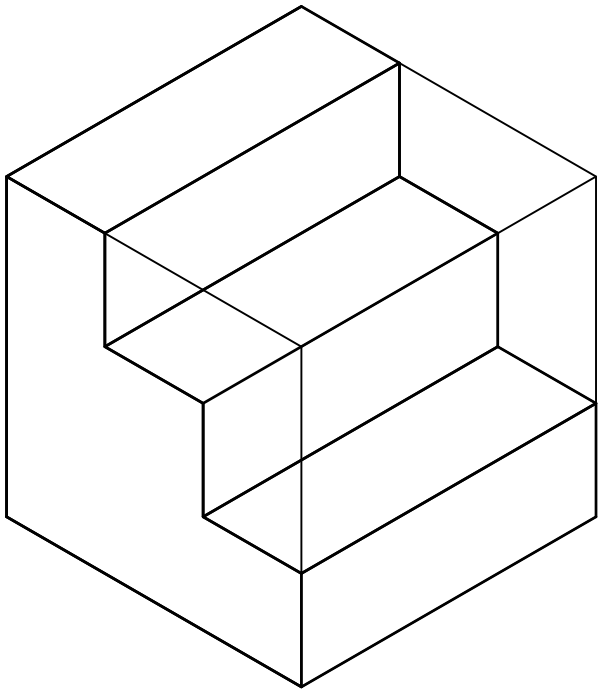
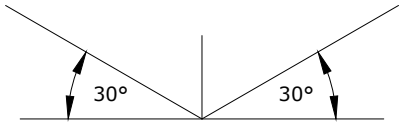




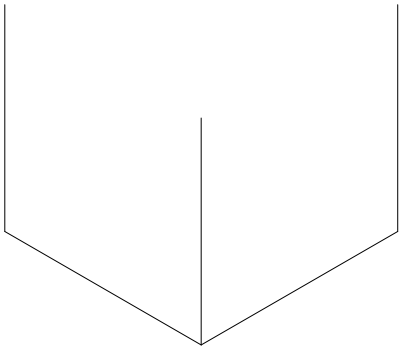
NAME: _____

ISOMETRIC PROJECTION

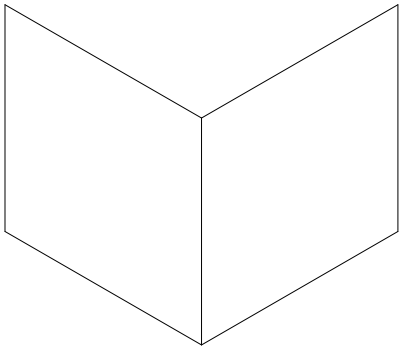
The following are some notes on how to draw a cube in **Isometric Projection.**



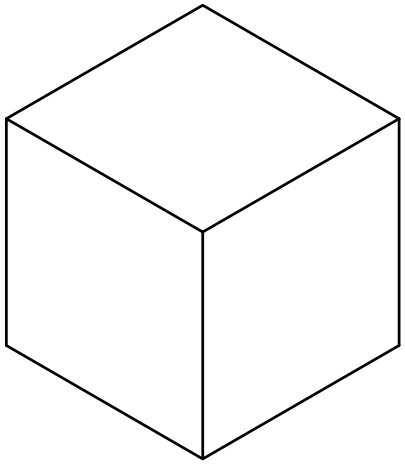
STEP 1



STEP 2



STEP 3



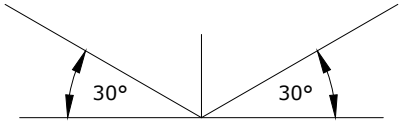
STEP 4

Draw the cube on the axes given on the right.

The cube has a length, height and width of 40mm.

Learning Intentions:

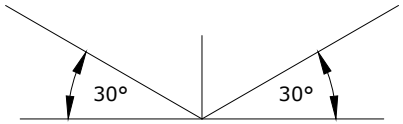
- I can draw three axes to start an Isometric Projection
- I can draw lines parallel to the axes to produce the crate
- I can finish the final drawing within the drawn crate



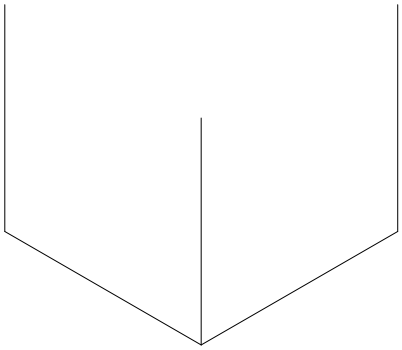
NAME:

TITLE: ISOMETRIC PROJECTION

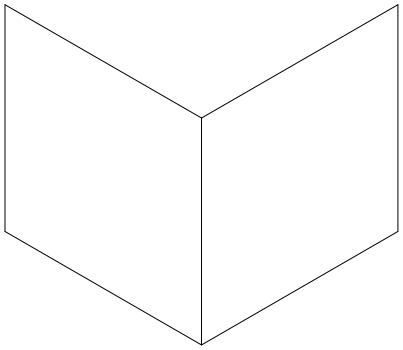
The following are some notes on how to draw a cube in **Isometric Projection.**



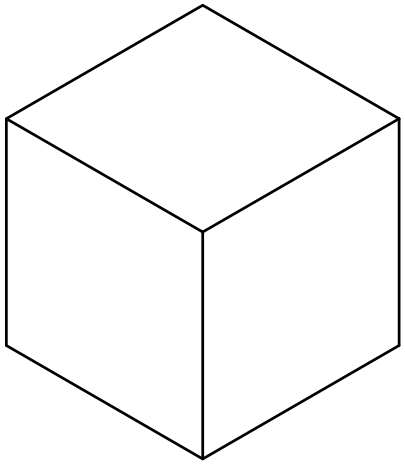
STEP 1



STEP 2



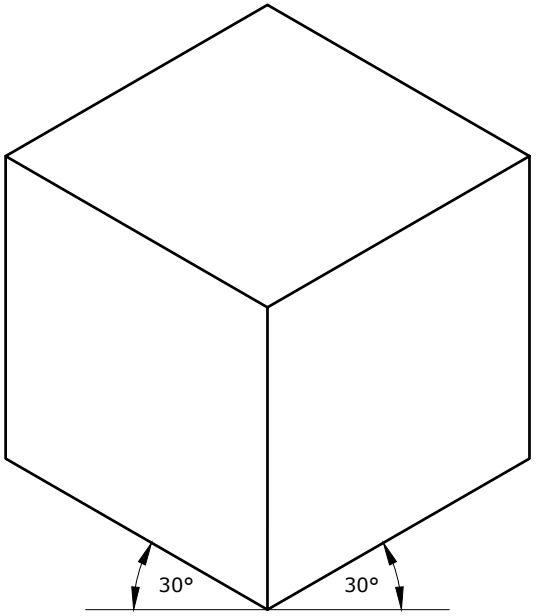
STEP 3



STEP 4

Draw the cube on the axes given on the right.

The cube has a length, height and width of 40mm.

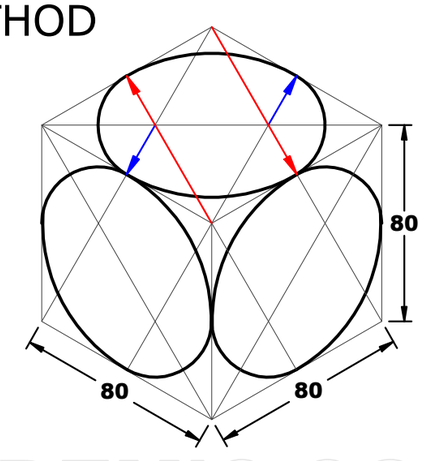


Learning Intentions:

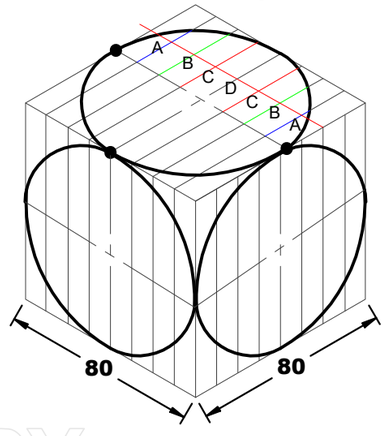
- I can draw three axes to start an Isometric Projection
- I can draw lines parallel to the axes to produce the crate
- I can finish the final drawing within the drawn crate

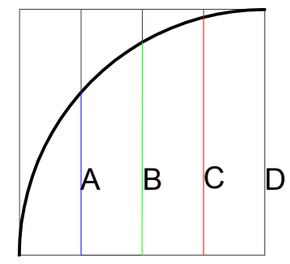
NAME:	TITLE: ISOMETRIC PROJECTION

COMPASS METHOD



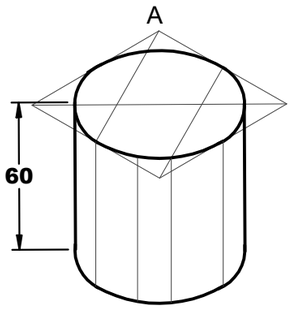
ORDINATES METHOD

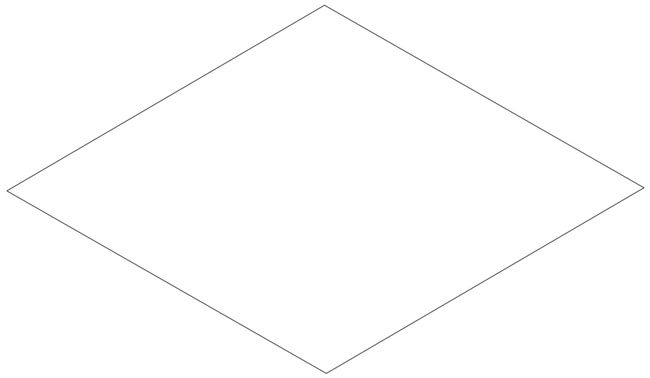


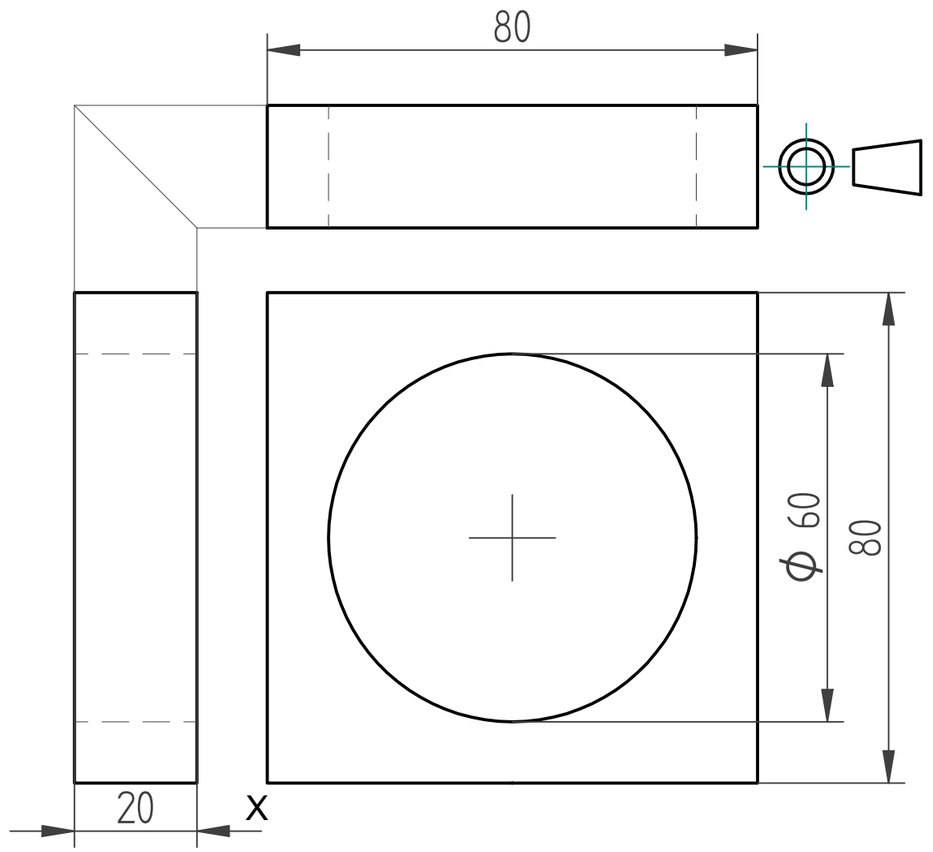


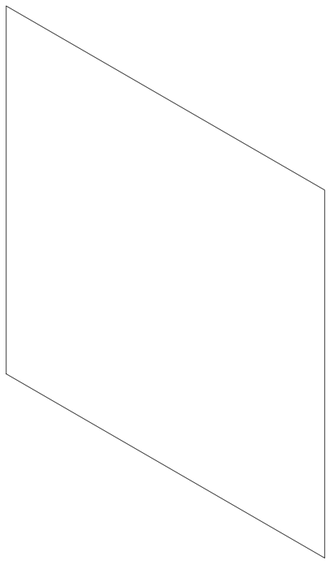
ISOMETRIC CIRCLES & ARCS

A

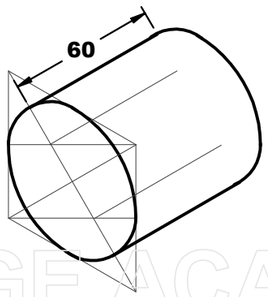


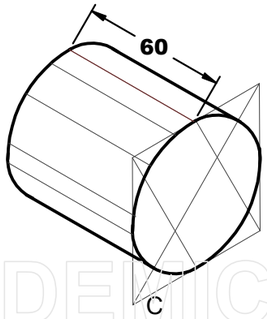




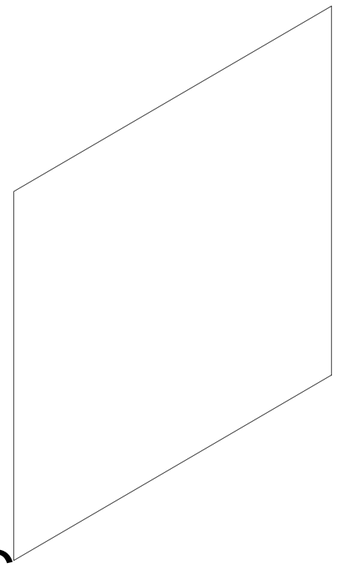


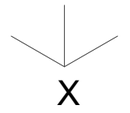
B

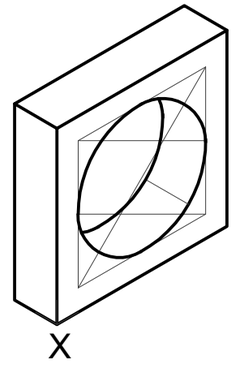




C







DEPARTMENT FOR CURRICULUM,
LIFELONG LEARNING AND EMPLOYABILITY
Directorate for Learning and Assessment Programmes
Educational Assessment Unit

Annual Examinations for Secondary Schools 2019

YEAR 9 **GRAPHICAL COMMUNICATION** **TIME: 2 hours**

Instructions

- Write your name and class on all sheets.
- Attempt ALL questions.
- All answers are to be drawn accurately, with instruments, unless otherwise stated.
- All construction lines MUST be left on each solution to show the method employed.
- Drawing aids may be used.

Information

- All dimensions are in millimetres.
- Estimate any missing dimensions.
- Marks will be awarded for accuracy, clarity and appropriateness of construction.

This section is for teachers' use only.

Question	1	2	3	4	5	6	**Total**
Marks allotted	14	16	14	18	18	20	100
Marks awarded							

Question 1: Polygons.

Draw the table clock shown in Fig. 1 by:

1. constructing an **octagon** inside square **ABCD**;
2. drawing three circles R27, R30 & R40 using centre **O**;
3. constructing a **hexagon** inside circle R40;
4. drawing the two rectangles attached to the top and bottom of the hexagon;
5. drawing the numbers on the clock face and the hands as shown.

(14 marks)

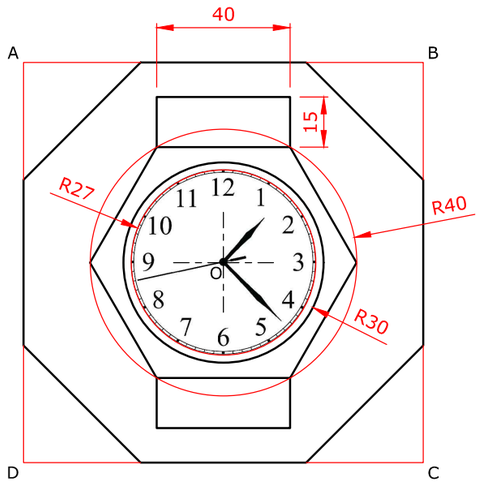
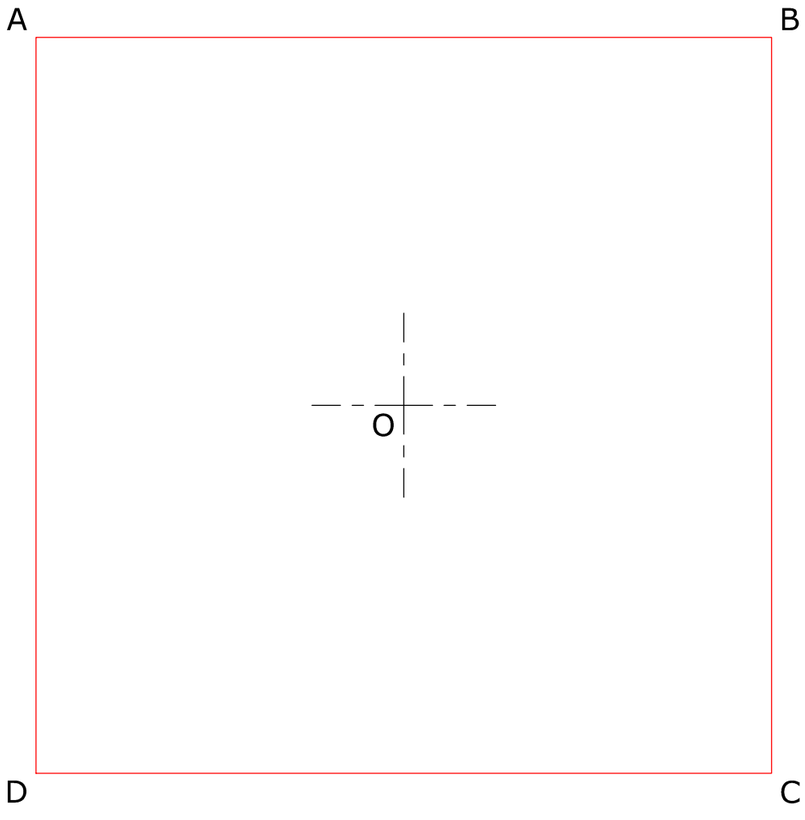


Fig. 1



Question 2: Division of a line, parts of the circle and construction of angles.

The design of a traditional Maltese door is shown in Fig. 2. Complete the door by:

1. dividing line **A-B** into 5 equal parts;
2. dividing line **C-B** into the ratio of 1:5:1:3:1 starting from point **C** and finishing off the door panels;
3. constructing angles 30°, 45° and 75° at point **O** using ruler and compasses. Mirror these angles;
4. labeling the two parts of the circle shown.

(16 marks)

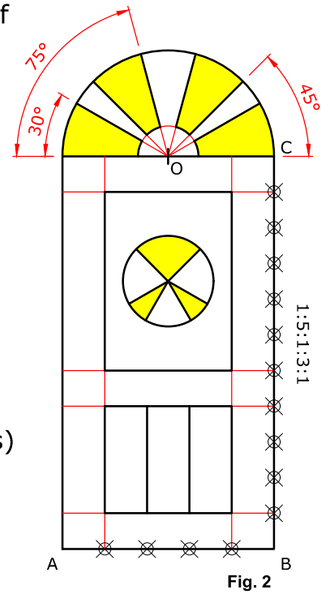
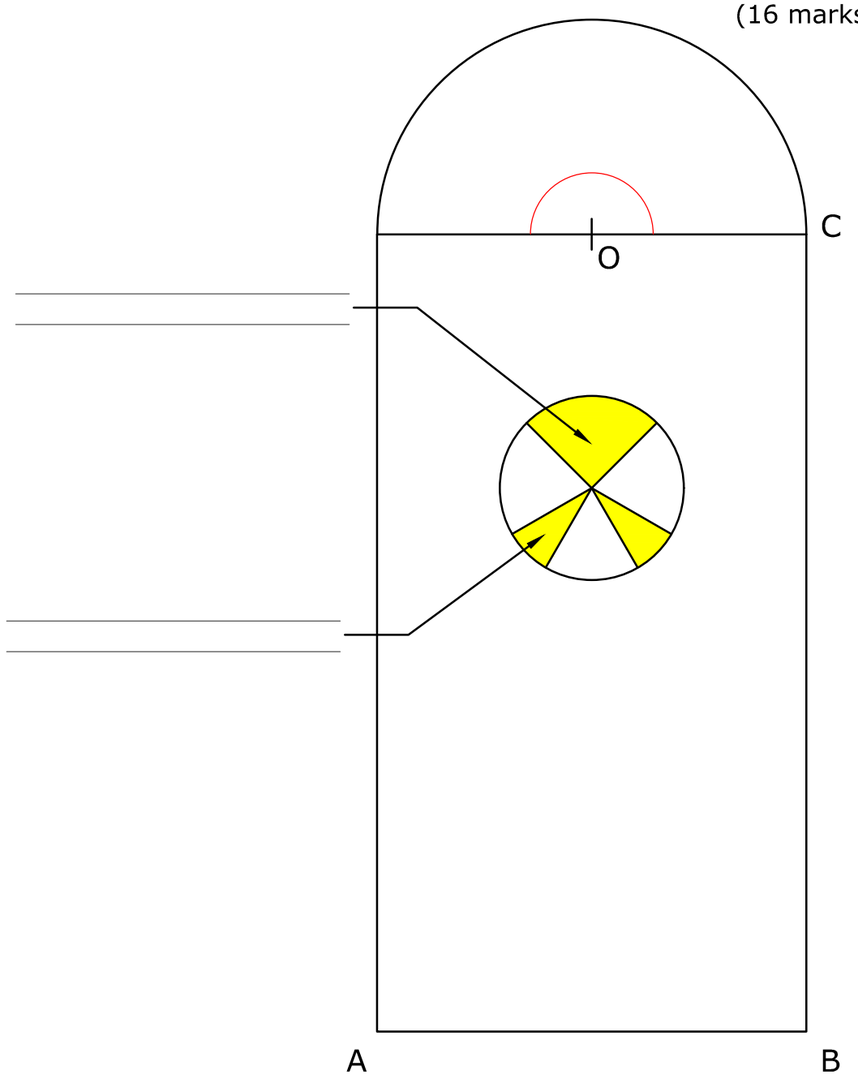


Fig. 2



Question 3: Triangles and quadrilaterals.

George designed a royal crown made up of a rectangle (A), a trapezium (B), two isosceles triangles (C), an equilateral triangle (D) and three rhombuses (E).

Fig. 3 and shows an exploded view and Fig. 4 shows an assembly of this crown.

Construct the **assembled** crown according to the dimensions given.

The starting point for rectangle (A) is given.

(14 marks)

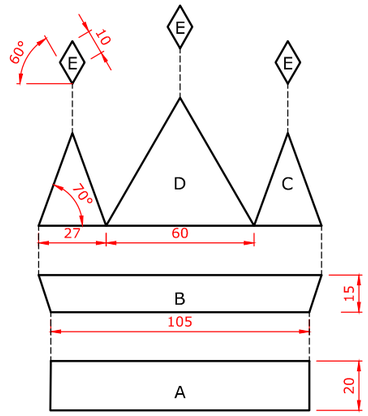


Fig. 3

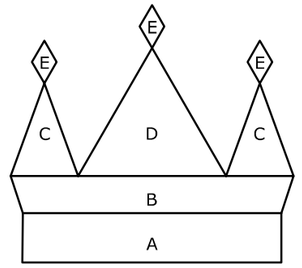


Fig. 4

Question 4: Circles in contact.

Rudolph has decided to grow a moustache as shown in Fig. 5. Using your compasses and the given dimensions, draw the design on the centre lines given by:

1. drawing arc R28 from centre W;
2. drawing arc R42 from centre O;
3. drawing arc R42 touching the arc with centre A and the arc with centre O;
4. drawing arc R110 from centre K;
5. drawing arc R30 touching the arc with centre B and the arc with centre K;
6. marking at least 2 points of tangency by short dashes.

(18 marks)

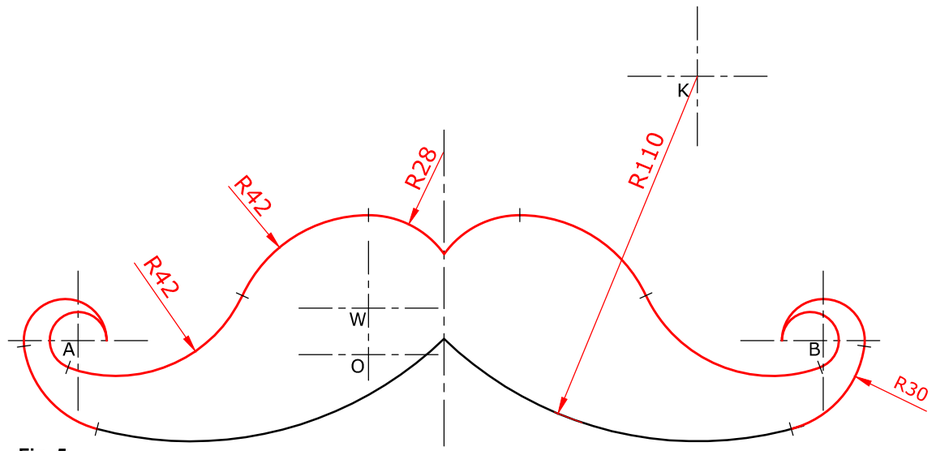
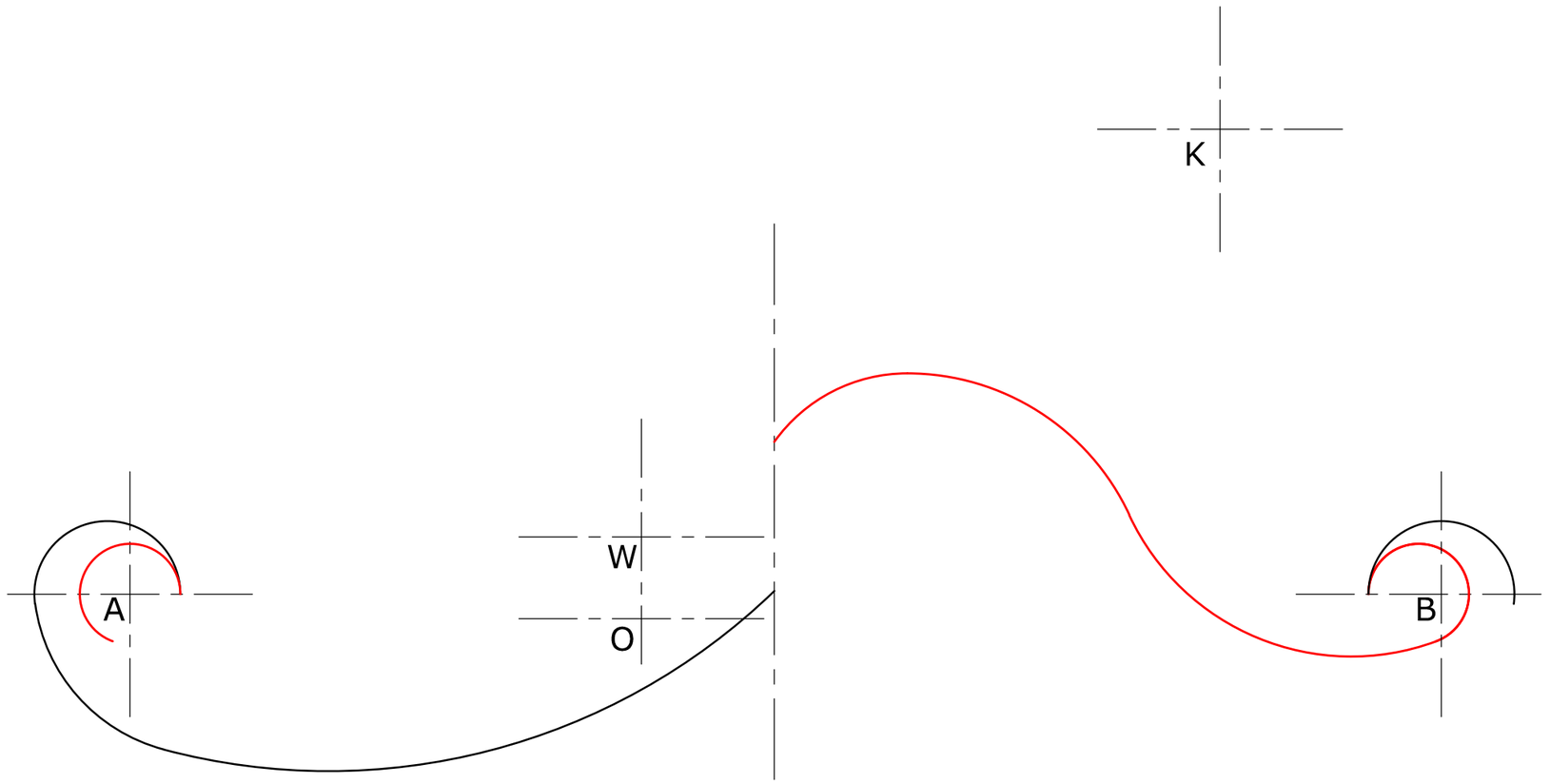


Fig. 5



Question 5: Development of truncated cylinder.

A sticker on a cylindrical container is shown in Fig. 6. The front elevation and plan in first angle projection have been given.

1. Draw the full **development** of the sticker starting from cut line **X-X**.
2. Draw the symbol for first angle orthographic projection.

(18 marks)

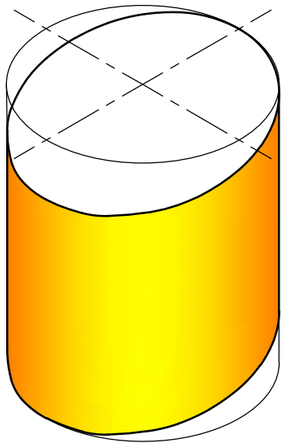
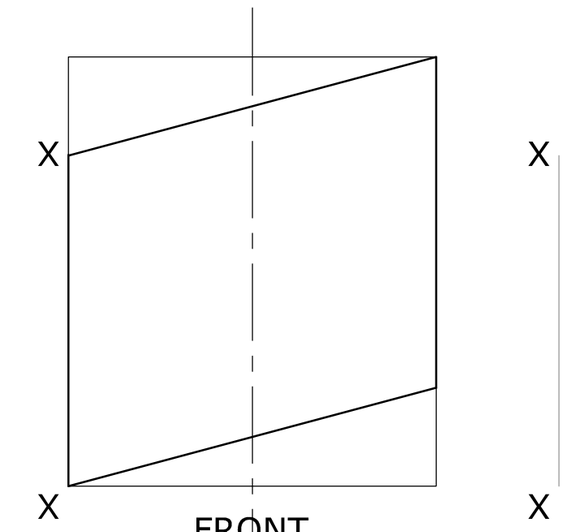
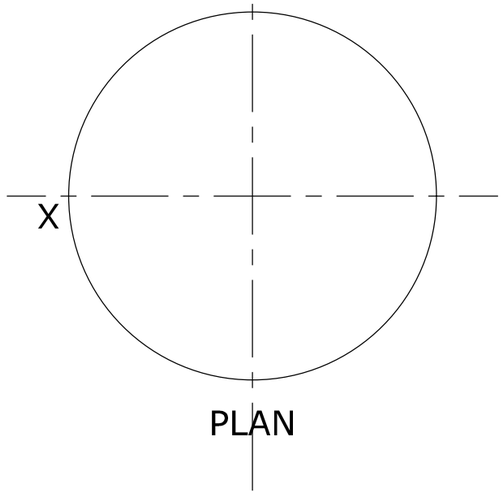


Fig. 6



FRONT



PLAN

DEVELOPMENT

SYMBOL

Question 6: Isometric projection.

The front elevation, end elevation and plan of a Sports Turbo (ST) car racing logo are shown below. An oblique view of the logo is shown in Fig. 7.

On the given starting lines, construct an **ISOMETRIC** projection of the logo by taking the dimensions from the orthographic projection and placing point X as the lowest corner.

(20 marks)

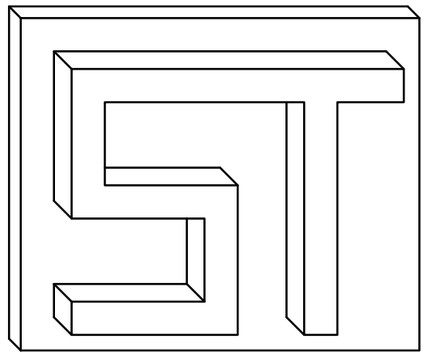
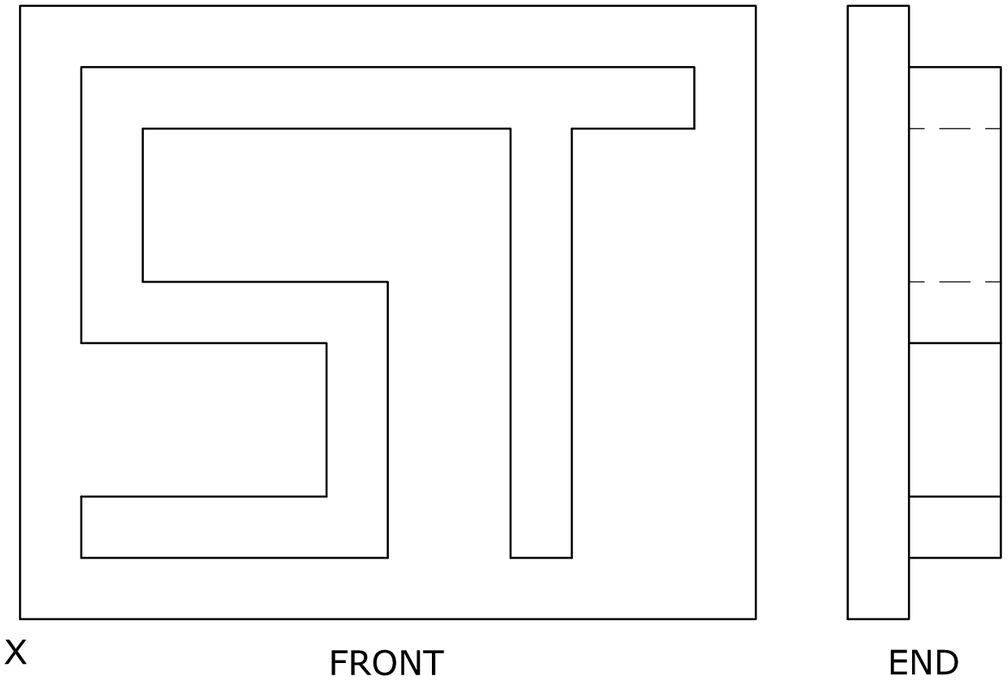
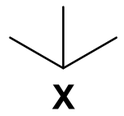
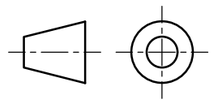


Fig. 7







DEPARTMENT FOR CURRICULUM,
RESEARCH, INNOVATION AND LIFELONG LEARNING
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YEAR 9 **GRAPHICAL COMMUNICATION** **TIME: 2 hours**

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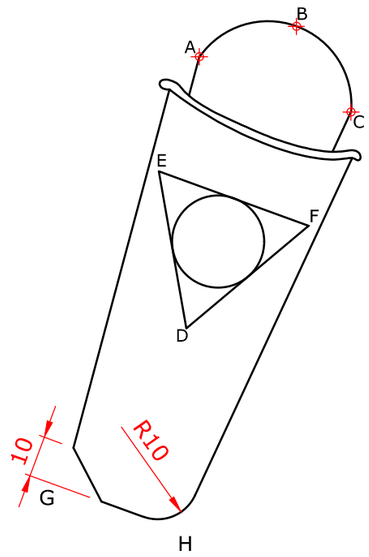
Question	1	2	3	4	5	6	7	**Total**
Marks allotted	14	11	14	14	12	17	18	100
Marks awarded								

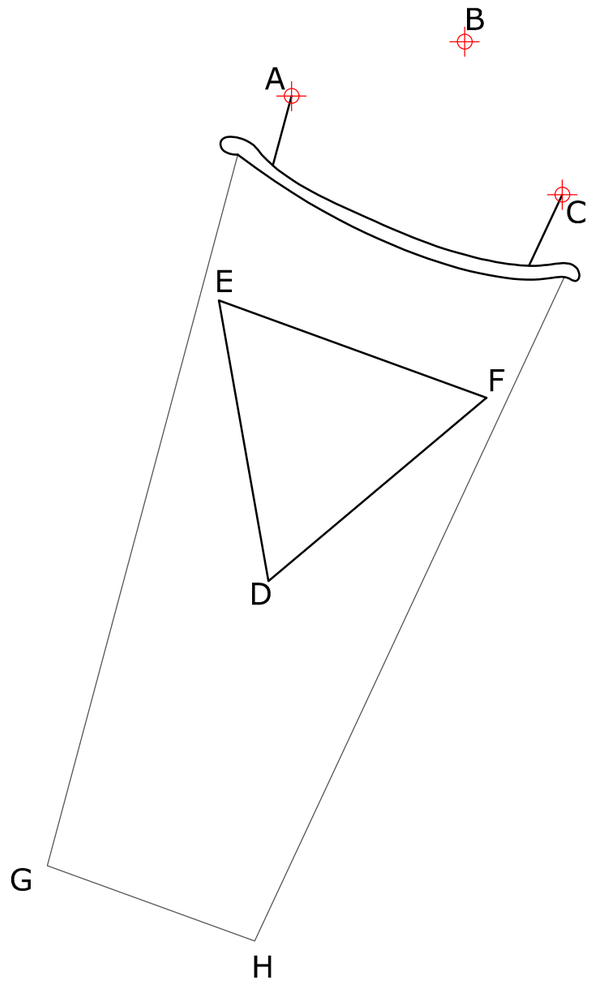
Question 1: Geometrical construction.

The drawing on the right shows an ice-lolly sticker.
Reproduce this drawing by using the following information.
On the starting lines given:

1. draw the 10X10 chamfer at corner **G**;
2. add the R10 fillet arc at corner **H**;
3. construct a 3-point circle passing from points **A**, **B** and **C**;
4. inscribe a circle to triangle **DEF**.

(14 marks)





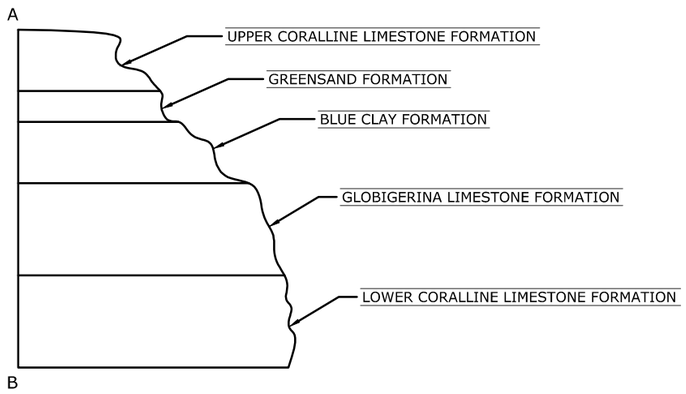
Question 2: Division of a line and Lettering.

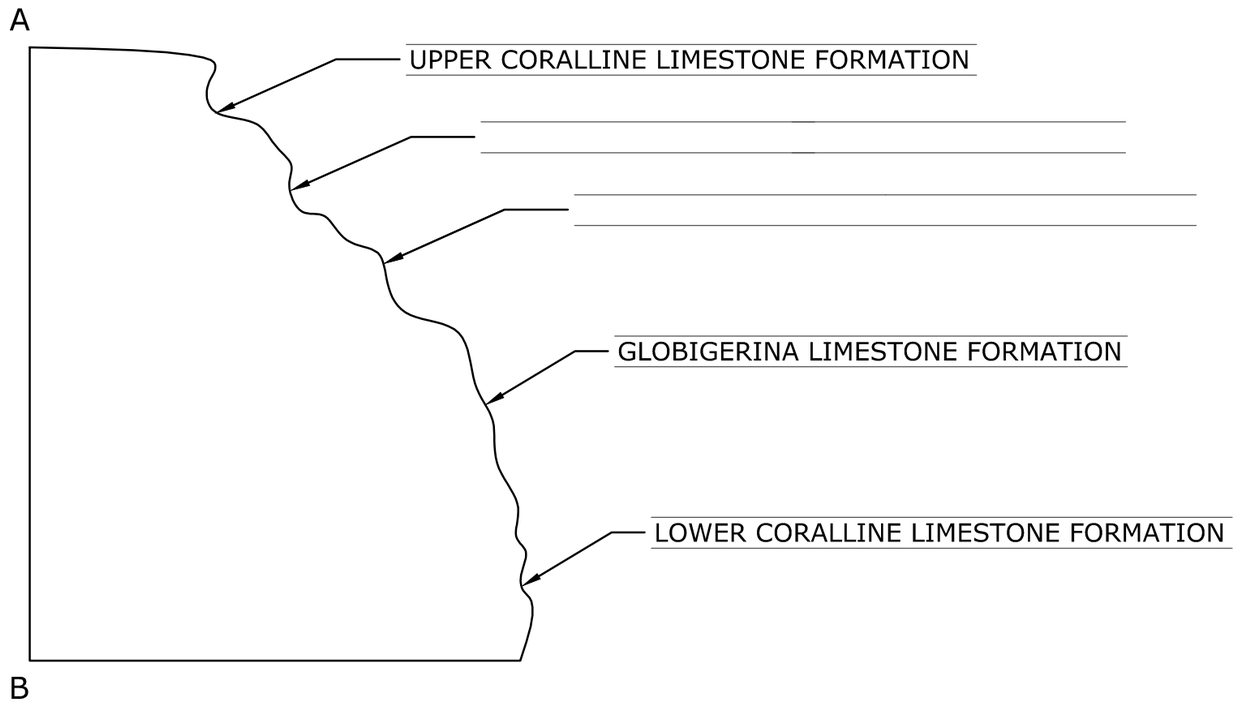
In his Geography class, Ronnie learnt that Malta is made up of different layers of rock. The drawing below represents a typical Maltese rock layer formation.

Complete the design by:

1. dividing height **A**-**B** into the ratio of 2:1:2:3:3 starting from point **A**;
2. use simple block letters to fill in the 2nd and 3rd label.

(11 marks)

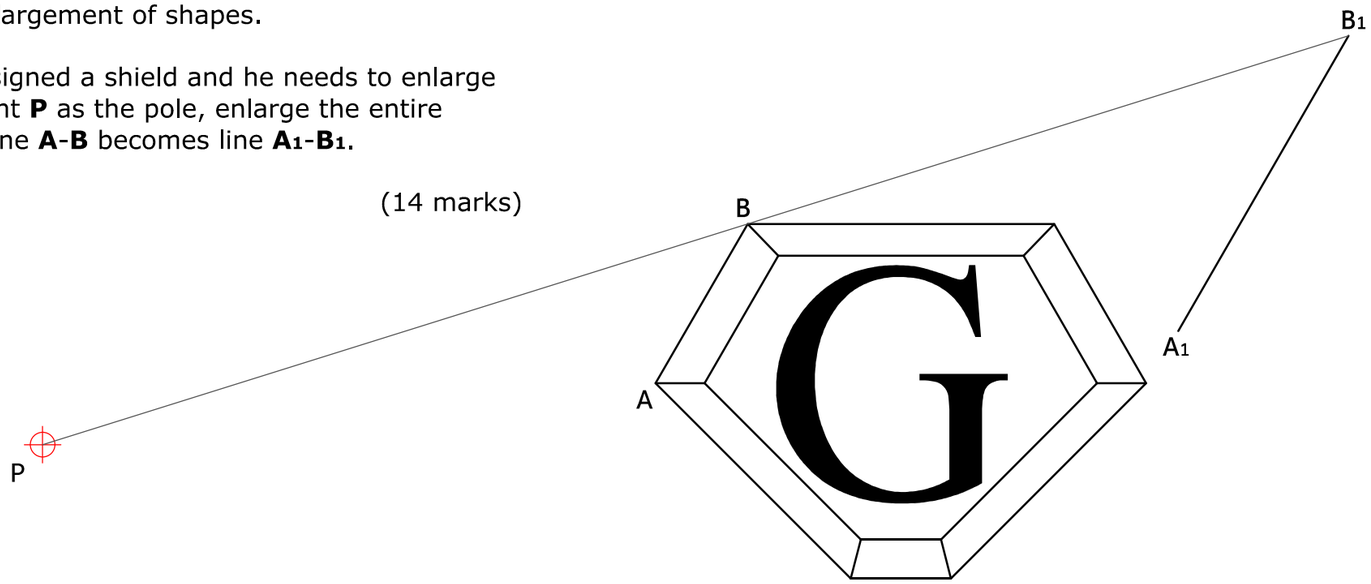




Question 3: Enlargement of shapes.

George has designed a shield and he needs to enlarge it. By using point **P** as the pole, enlarge the entire shield so that line **A**-**B** becomes line **A_1**-**B_1**.

(14 marks)



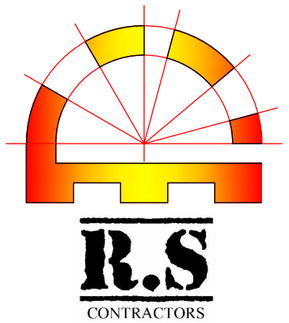
Question 4: Construction of angles.

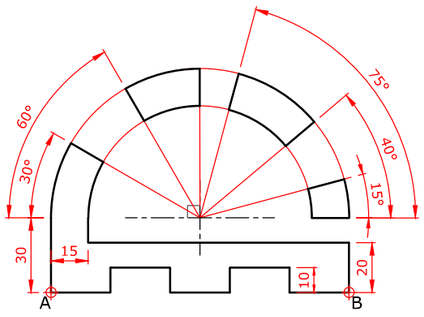
A building construction company commissioned a team of designers to design a logo. This logo is shown below. You are requested to redraw this logo using the information given:

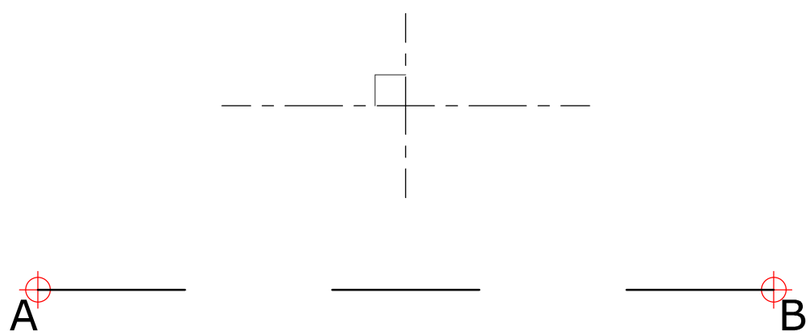
1. complete the base of the logo with the given measurements;
2. use your compasses to construct the **60°**, **30°** and **75°** angles;
3. use your protractor to mark and draw the remaining angles;
4. finish off the drawing accordingly.

Note: Do not draw the lower part of the drawing where it shows "R.S CONTRACTORS".

(14 marks)





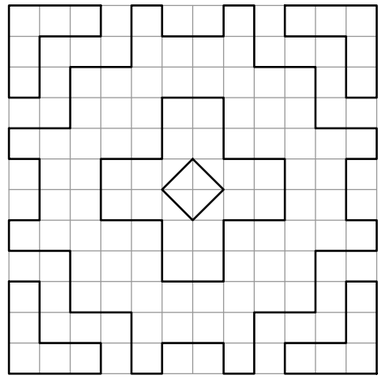


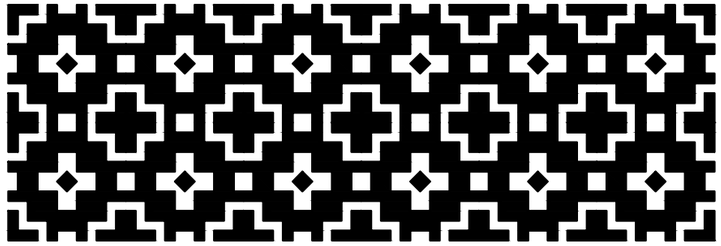
Question 5: Tessellations.

The drawing below shows the design of a single tile that will be used to cover the entire floor of a newly constructed chapel. Beside this drawing you can see the floor when a number of tiles are put together.

1. In the provided squared grid, design a new tile pattern which must be **different** to the one shown.
2. Use colour/shading to embellish your design.

(12 marks)





(Number of tiles put together)

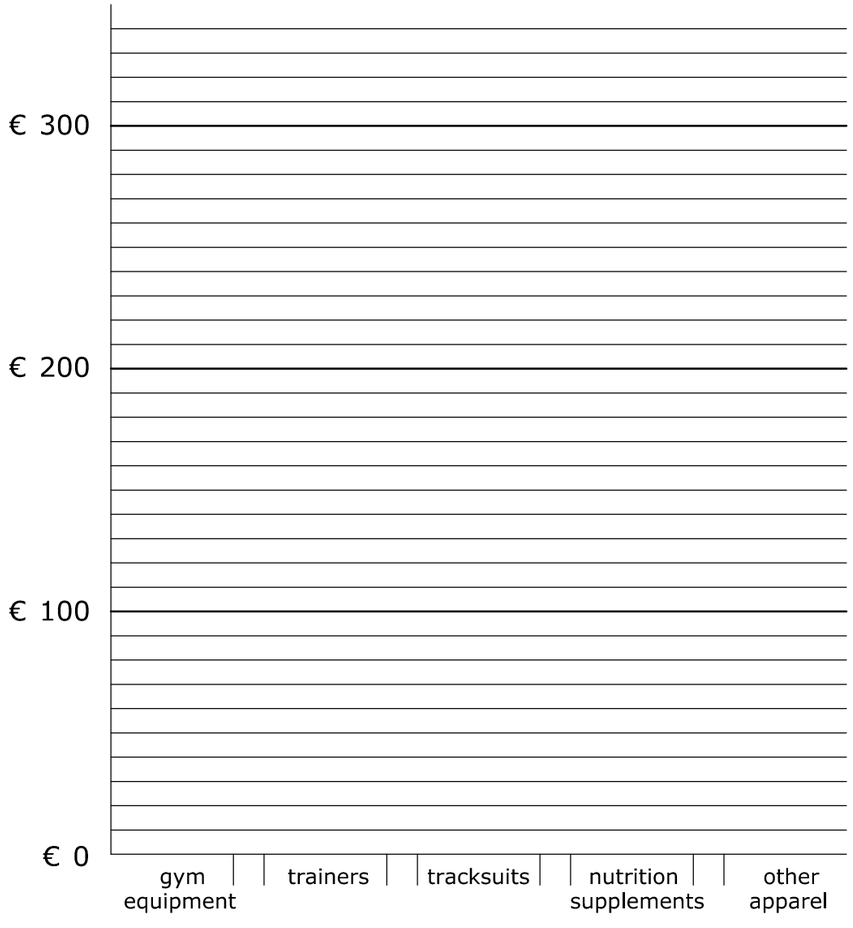
Question 6: Graphs, Charts and Pictograms.

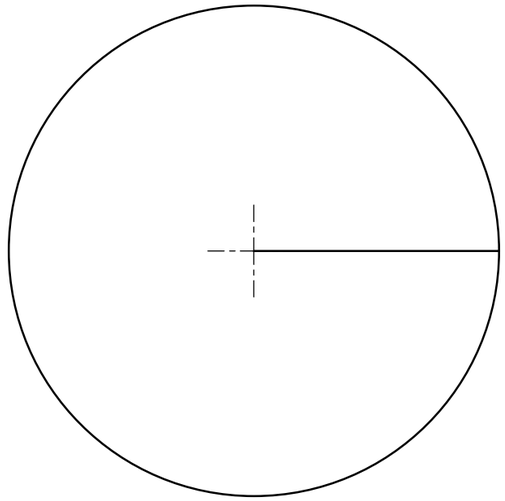
A new shop selling sports equipment has opened in town. The table below shows the items it sold and the profit generated during the first month of activity. Use the information contained in this table and:

1. add colour to the **KEY**;
2. draw a vertical Bar graph on the given starting lines below and add colour to your drawing;
3. draw a Pie Chart in the circle provided on the right and add colour to your drawing;
4. draw a pictogram for the **GYM** equipment. Use the space provided for preparatory sketches.

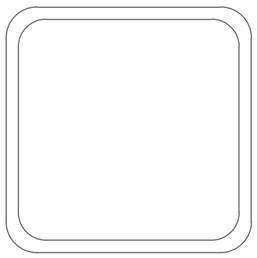
(17 marks)

KEY	ITEMS	PROFIT
	GYM EQUIPMENT	€ 270
	TRAINERS	€ 210
	TRACKSUITS	€ 120
	NUTRITION SUPPLEMENTS	€ 150
	OTHER APPAREL	€ 330





Space for preparatory sketches



GYM EQUIPMENT

TRAINERS

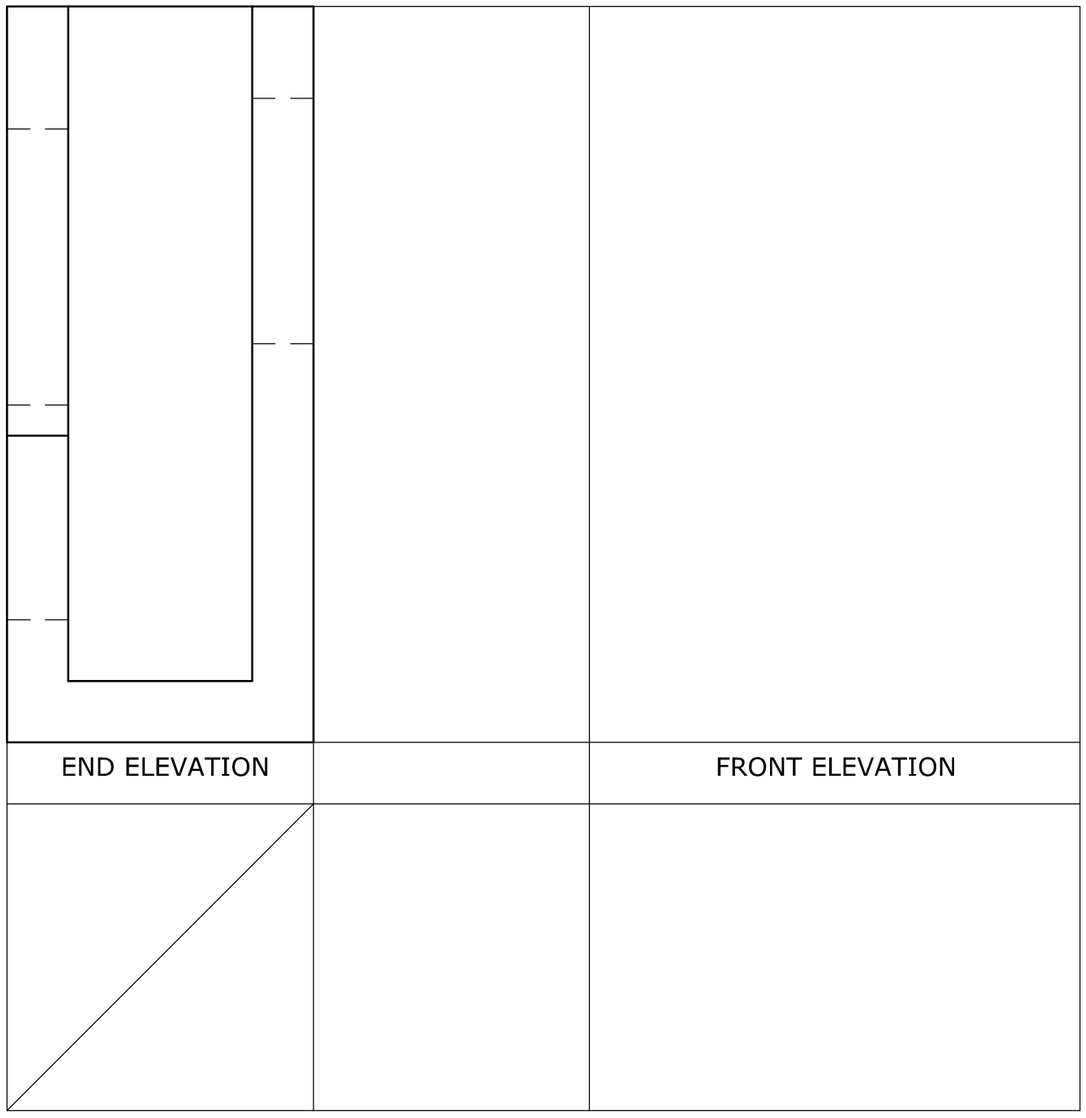
TRACKSUITS

Question 7: Orthographic projection.

The Isometric drawing on the right shows a wooden file storage for paper leaflets. The **END** elevation of this file storage is given below. In the space provided:

1. complete the Orthographic projection by adding the remaining **FRONT** elevation and **PLAN** accordingly;
2. use colour to render the Isometric drawing according to its material;
3. draw the symbol of the projection used.

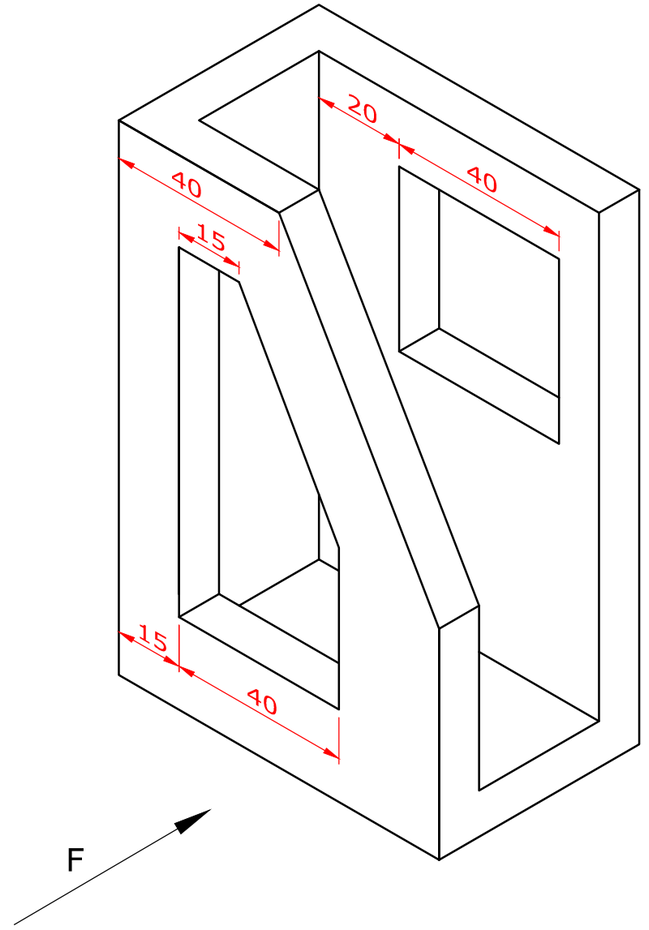
(18 marks)



END ELEVATION

FRONT ELEVATION

PLAN

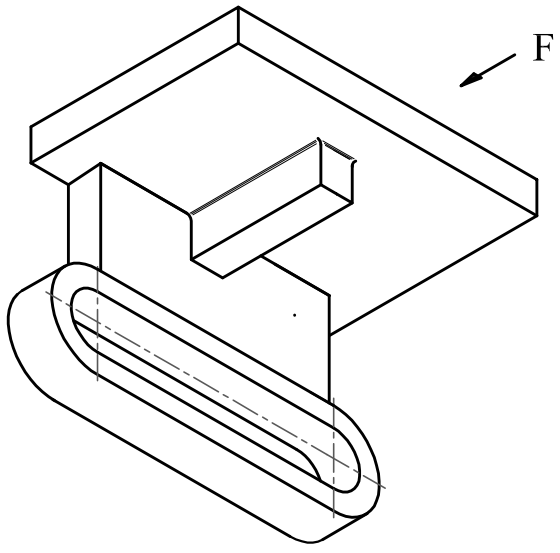


Material thickness: 10mm

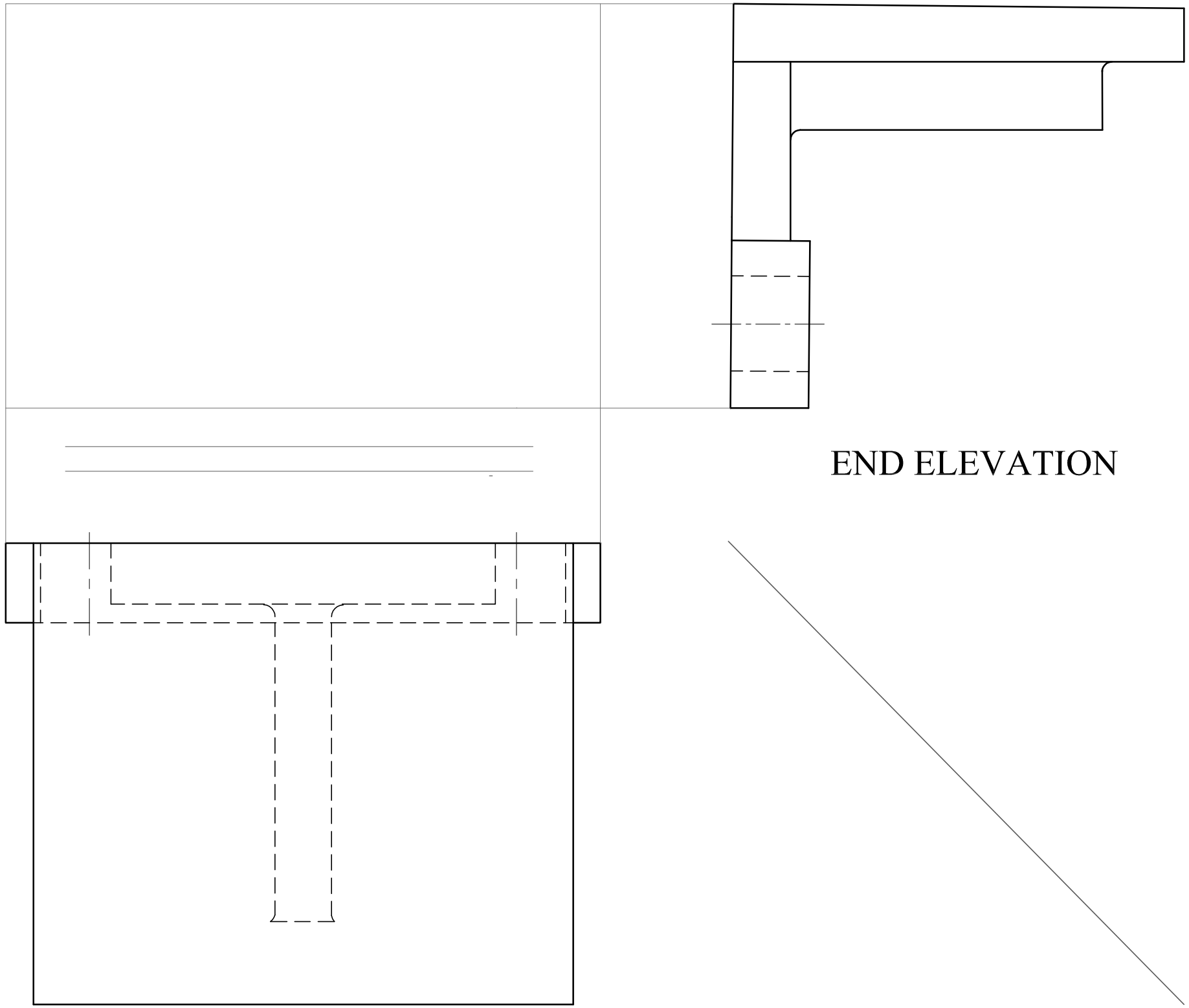
SYMBOL

1. A pictorial illustration, an End Elevation and a Plan of a Tool Grinding Rest are given.
   a. In first angle orthographic projection, project a Front Elevation as indicated by the arrow F.
   b. Label the Front Elevation in block letters.
   c. Draw the symbol of projection on the given centre-line.

14 marks



SYMBOL OF PROJECTION

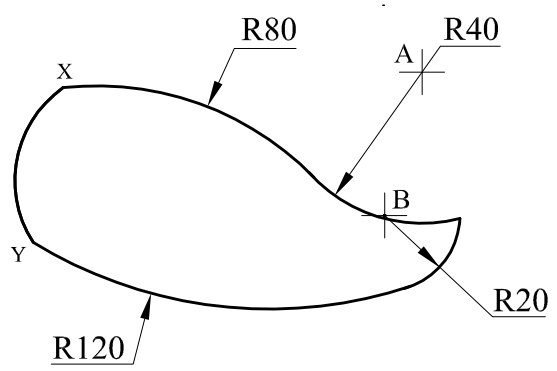


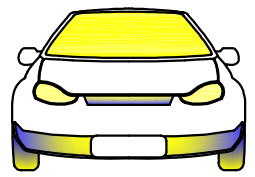
END ELEVATION

PLAN

2. Details of one of the headlamps of a modern car are given.
Using the given start lines and dimensions, draw the headlamp showing clearly the construction to obtain the centres of the arcs.
Show points of tangency.

12 marks

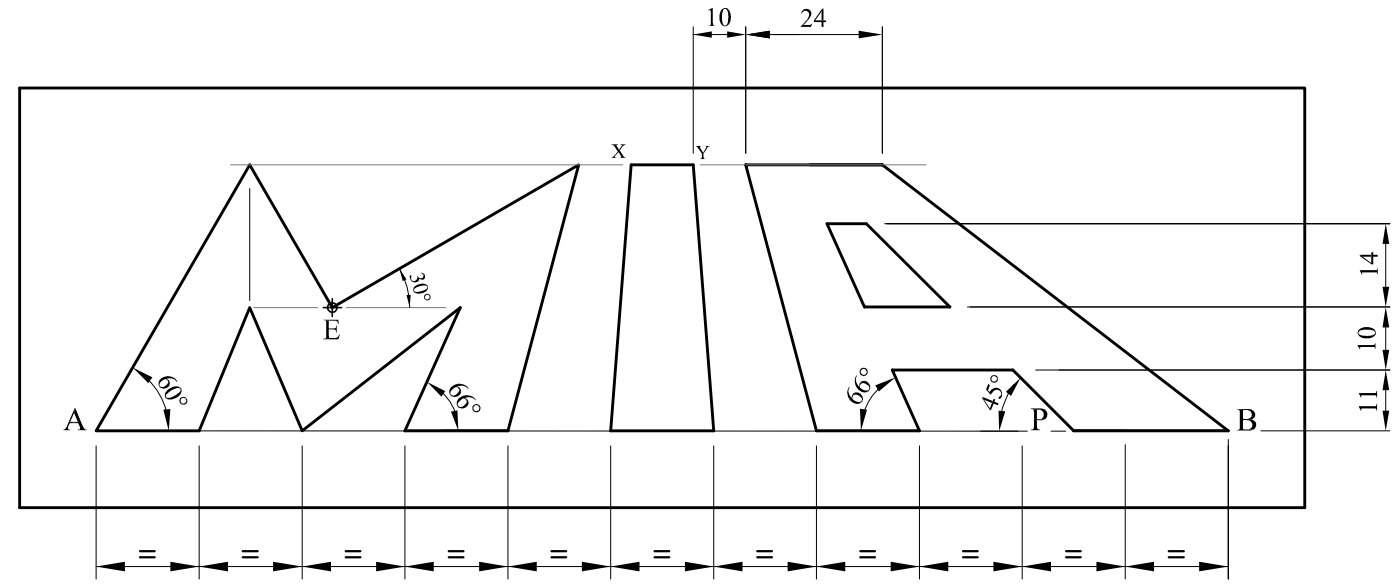


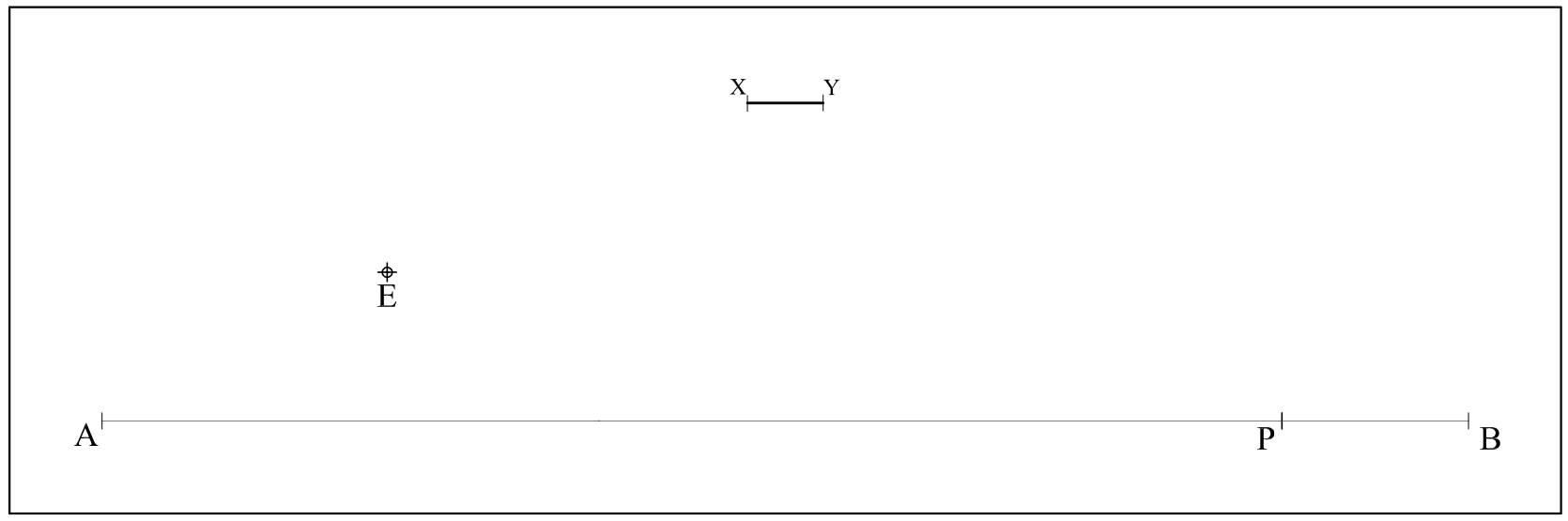


3. The sign of a beauty salon, named after its owner, is shown at the side.
Details of the sign are given below.
On the start line AB shown at the bottom, draw the sign to the given dimensions.

Notes: a. *Start by dividing line AB into 11 equal divisions by construction, using the set-squares.*
b. *The 60° angle at A, the 30° angle at E and the 45° angle at P must be constructed using the compass.*
c. *Use the protractor for the remaining angles.*

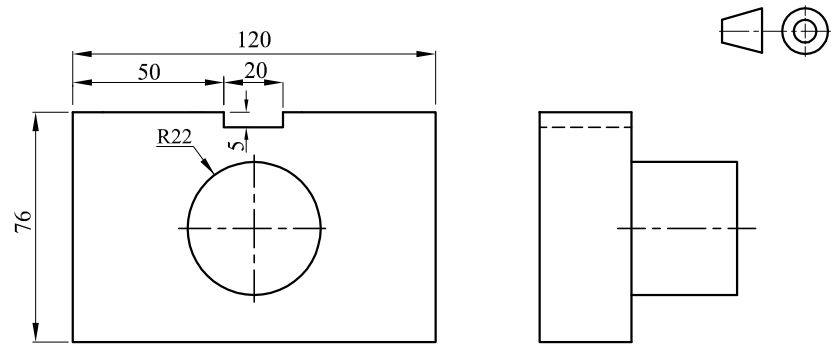
18 marks





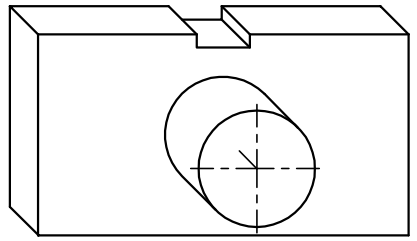
4. Orthographic views and an oblique projection of a photo camera are given.
On the given start lines, draw to the dimensions given, an isometric projection of the camera.
Note: The camera fits exactly in the given crate.

14 marks

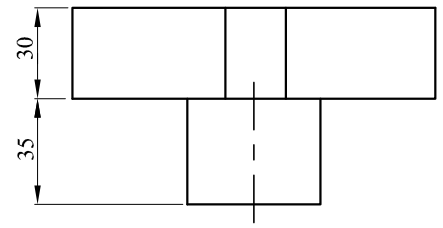


FRONT VIEW

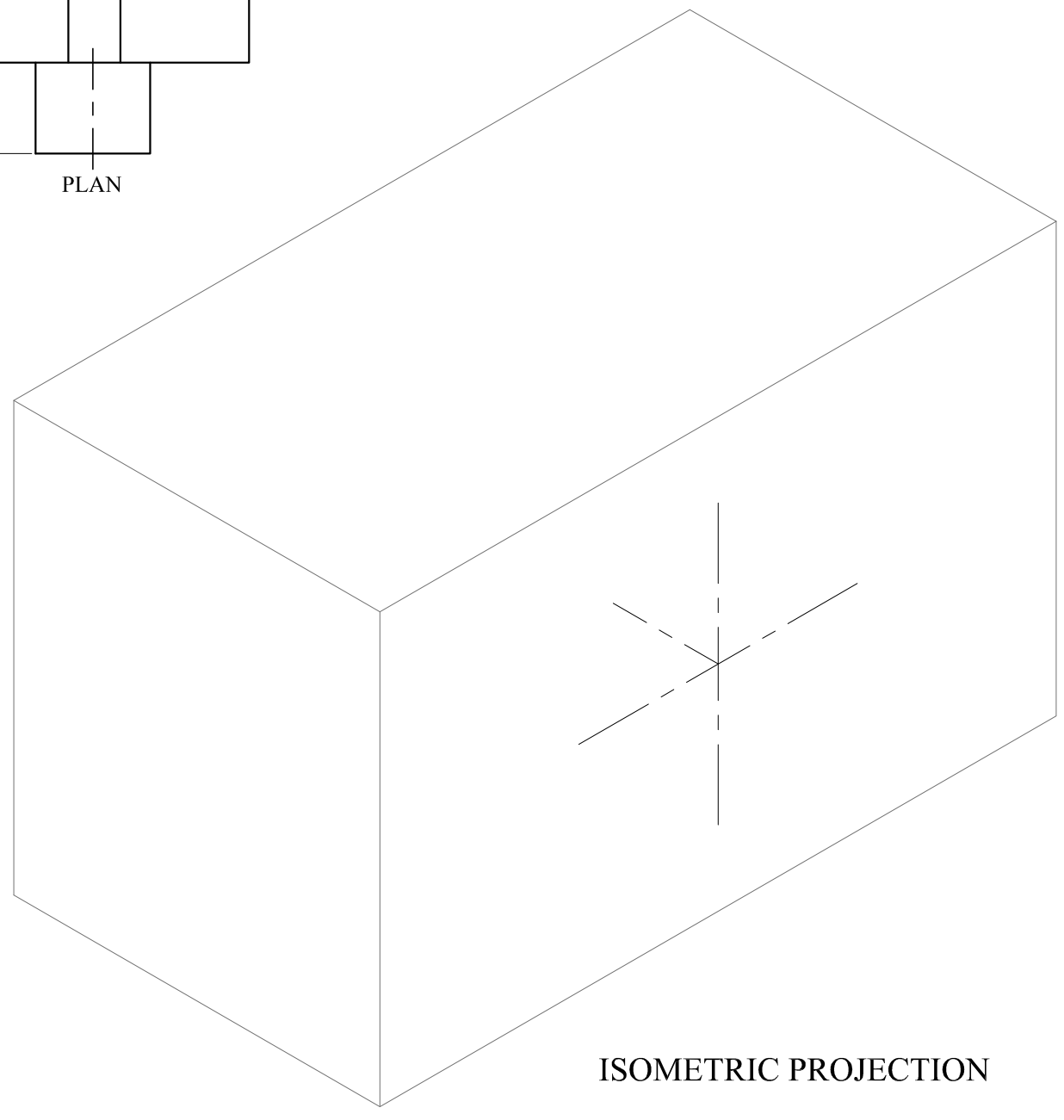
END VIEW



OBLIQUE PROJECTION



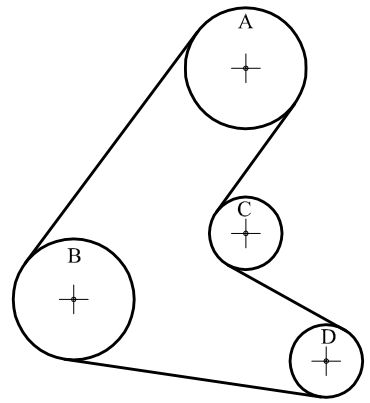
PLAN

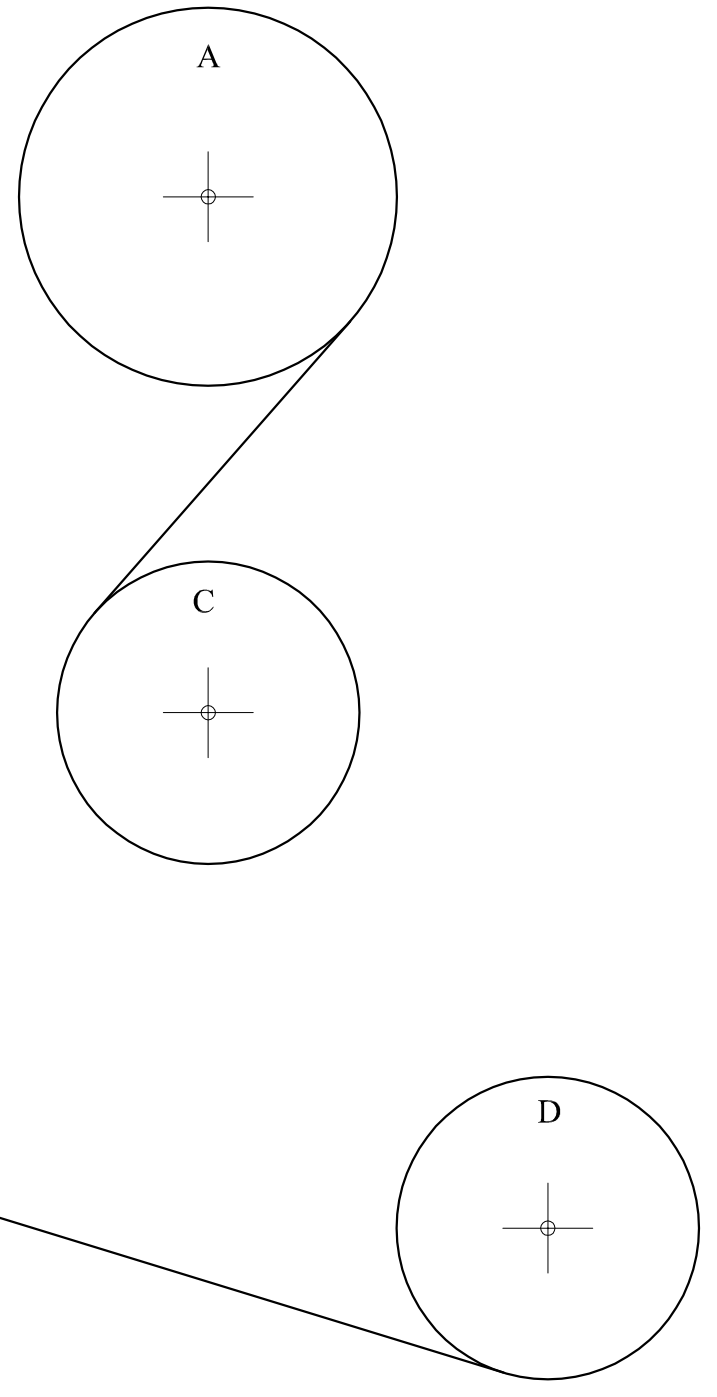


ISOMETRIC PROJECTION

5. A nylon belt is fitted over four pulleys as shown.
Pulley A and pully B have the same diameter while pulley C and pulley D are also of the same diameter.
Complete the drawing given below by constructing:
a. a common (external) tangent between pulleys A and B and
b. a transverse (internal) tangent between pulleys C and D.

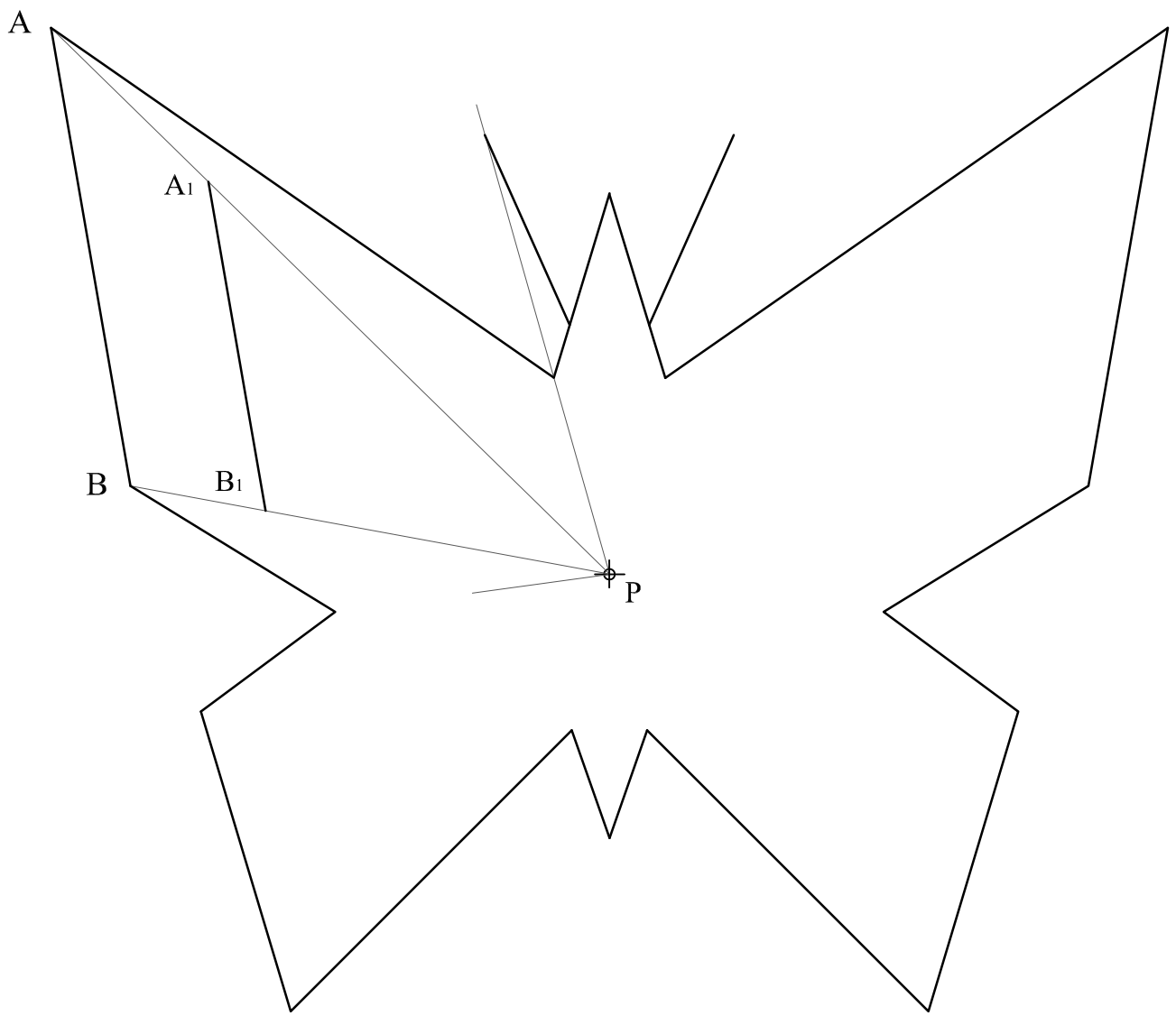
12 marks





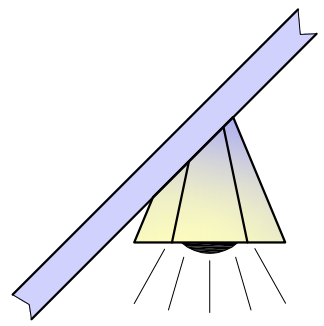
6. A simple drawing of a butterfly is given. Line AB is geometrically reduced to A_1 B_1.
Complete the construction to reduce the butterfly using centre P as the pole.

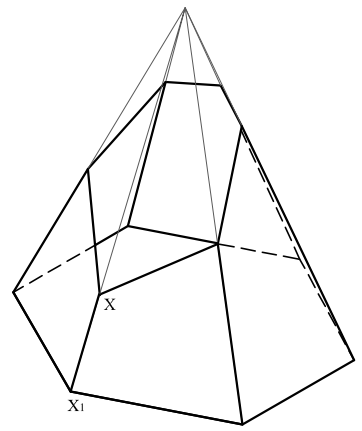
12 marks



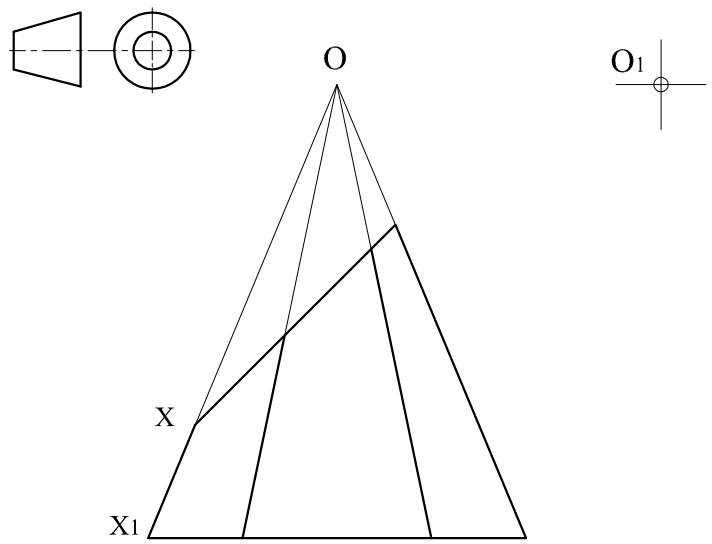
7. An industrial lamp-shade is fixed to the inside of a slant ceiling.
The shade has the shape of a truncated hexagonal pyramid which is shown in a pictorial view.
A Front Elevation and an incomplete Plan of the shade are given below.
a. Complete the Plan.
b. Construct the Development, using the given centre O_1.
Note: Make the joint line along XX_1.

18 marks



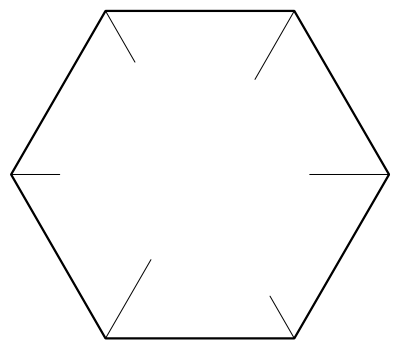


PICTORIAL VIEW



FRONT ELEVATION

DEVELOPMENT

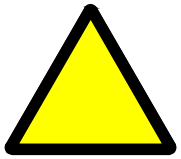


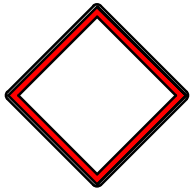
PLAN

NEW CHEMICAL HAZARD SIGNS

SAFETY SIGNS	GLOBALLY HARMONIZED SYSTEM	Designed and researched by Mr.Johan Spiteri (Graphical Communication teacher)

Chemical Hazard Signs





In the coming years the orange or yellow triangular signs (i.e. hazard signs) will no longer be used to warn against chemical hazards. They will be replaced by the 'Globally Harmonized System' (GHS) of labels. The new signs will take the form of a diamond-shape with a black symbol on a white background and a red border. This system has the aim of ensuring that, for example, the term 'corrosive substances' means the same everywhere in the world.

Some background information about the need for the GHS system

GHS is a system that defines and classifies the hazards of chemical products. Through it health and safety information is communicated on labels and material safety data sheets (called Safety Data Sheets, or SDSs in GHS). The aim of all this is to have a set of rules, a format and content for labels and safety data sheets (SDS) that will be used throughout the world. This system was developed by an international team of hazard communication experts.

At the moment many different countries use different systems for classification and labelling of chemical products. In some cases different systems exist in the same country. This proved to be expensive for governments to regulate and enforce and costly for companies who have to abide by the different systems imposed. It has also been confusing for workers since they have to understand the hazards involved in order to be safe at work.

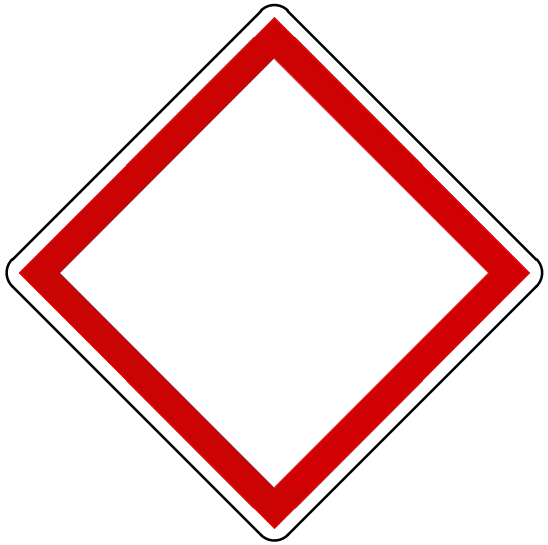
The GHS system is designed to cover all hazardous chemicals. It can be adopted to cover chemicals that are dealt with in workplaces, transport, consumer products, pesticides and pharmaceuticals. It is of interest to various parties such as workers, transport workers and emergency responders.

In the coming pages one will find the nine signs used in the GHS system.

Hazard Pictograms

Properties

- Red diamond frame.
- The symbol should be black and placed on a white background.



Aspiration hazard

Irritant

Aquatic environment hazard

GLOBALLY HARMONIZED SYSTEM

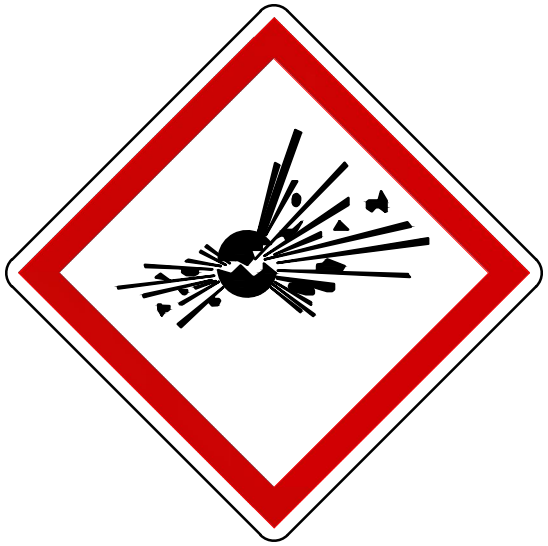
Toxic

Flammable liquids

Compressed gases

Corrosive

Oxidizing liquids



Explosive

GLOBALLY HARMONIZED SYSTEM

References/Bibliography:

- Chemical Substances. (2012, November 5). *Department of Physics, Cavendish Laboratory, University of Cambridge*. Retrieved March 28, 2013, from http://www.phy.cam.ac.uk/hands/hazards/chemicals.php.

- Globally Harmonized System (GHS). (2013, February 19). *Canadian Centre for Occupational Health and Safety.* Retrieved March 29, 2013, from http://www.ccohs.ca/oshanswers/chemicals/ghs.html#_1_1.

- A Guide to The Globally Harmonized System of Classification and Labelling of Chemicals (GHS). (n.d.). *U.S. Department of Labor, Occupational Safety & Health Administration.* Retrieved March 29, 2013, from http://www.osha.gov/dsg/hazcom/ghs.html.

DEPARTMENT FOR CURRICULUM,
LIFELONG LEARNING AND EMPLOYABILITY
Directorate for Learning and Assessment Programmes
Educational Assessment Unit

Annual Examinations for Secondary Schools 2019

YEAR 9 **GRAPHICAL COMMUNICATION** **TIME: 2 hours**

Instructions

- Write your name and class on all sheets.
- Attempt ALL questions.
- All answers are to be drawn accurately, with instruments, unless otherwise stated.
- All construction lines MUST be left on each solution to show the method employed.
- Drawing aids may be used.

Information

- All dimensions are in millimetres.
- Estimate any missing dimensions.
- Marks will be awarded for accuracy, clarity and appropriateness of construction.

This section is for teachers' use only.

Question	1	2	3	4	5	6	**Total**
Marks allotted	14	16	14	18	18	20	100
Marks awarded							

Question 1: Polygons.

Draw the table clock shown in Fig. 1 by:

1. constructing an **octagon** inside square **ABCD**;
2. drawing three circles R27, R30 & R40 using centre **O**;
3. constructing a **hexagon** inside circle R40;
4. drawing the two rectangles attached to the top and bottom of the hexagon;
5. drawing the numbers on the clock face and the hands as shown.

(14 marks)

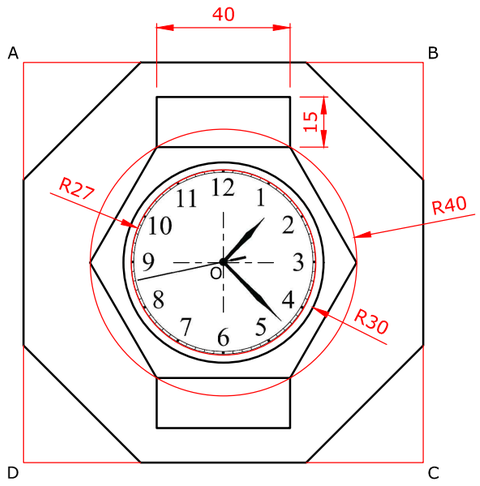
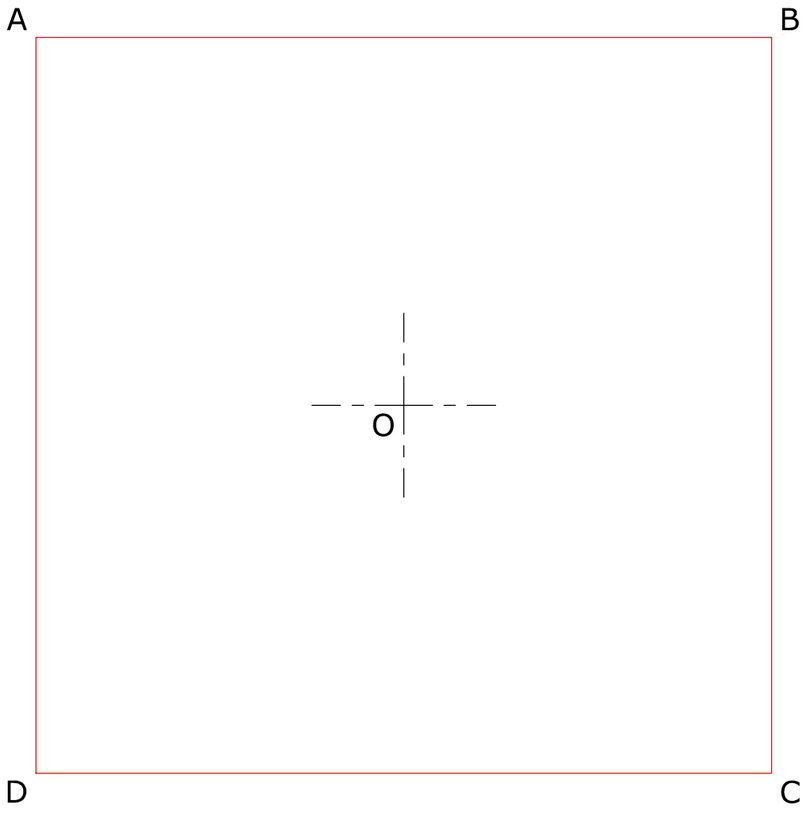


Fig. 1



Question 2: Division of a line, parts of the circle and construction of angles.

The design of a traditional Maltese door is shown in Fig. 2. Complete the door by:

1. dividing line **A-B** into 5 equal parts;
2. dividing line **C-B** into the ratio of 1:5:1:3:1 starting from point **C** and finishing off the door panels;
3. constructing angles 30°, 45° and 75° at point **O** using ruler and compasses. Mirror these angles;
4. labeling the two parts of the circle shown.

(16 marks)

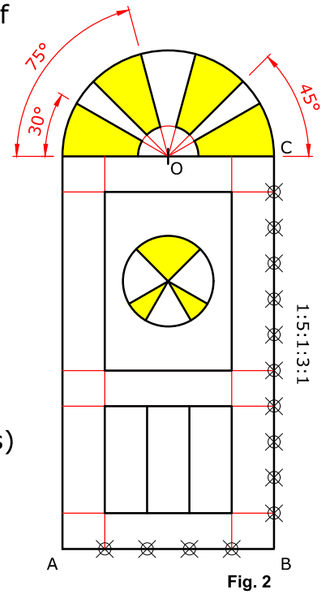
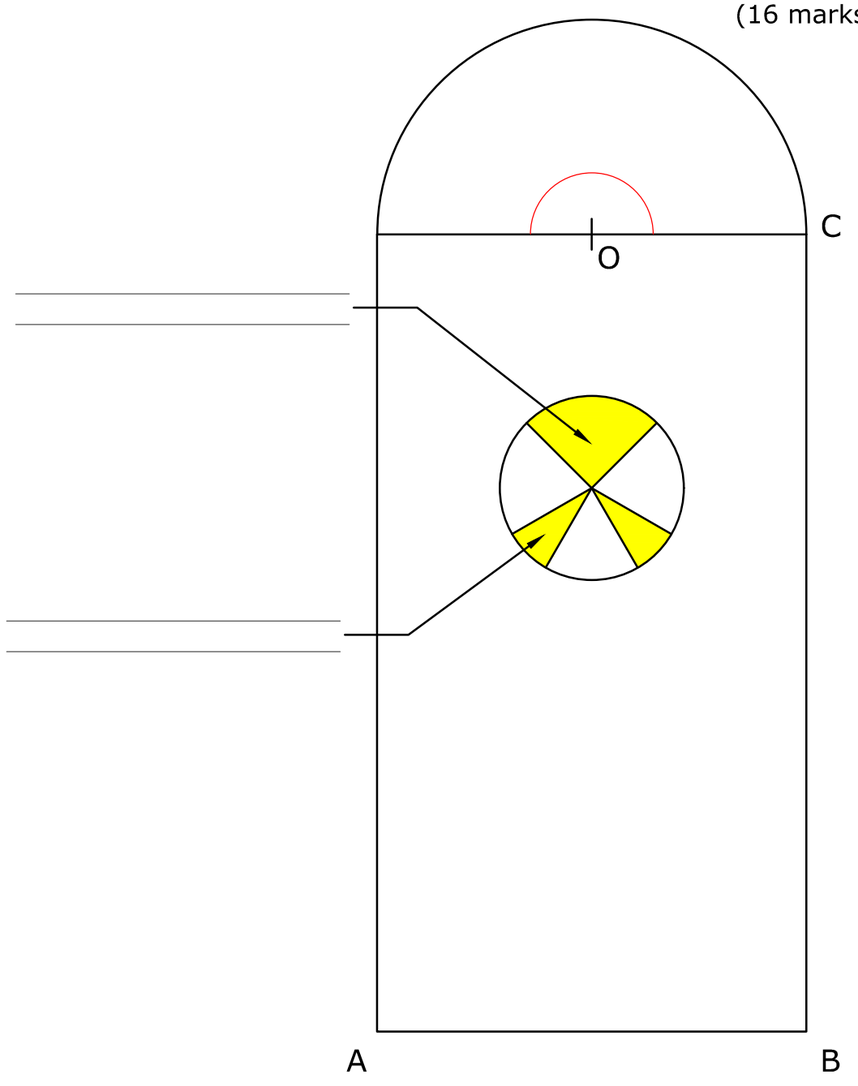


Fig. 2



Question 3: Triangles and quadrilaterals.

George designed a royal crown made up of a rectangle (A), a trapezium (B), two isosceles triangles (C), an equilateral triangle (D) and three rhombuses (E).

Fig. 3 and shows an exploded view and Fig. 4 shows an assembly of this crown.

Construct the **assembled** crown according to the dimensions given.

The starting point for rectangle (A) is given.

(14 marks)

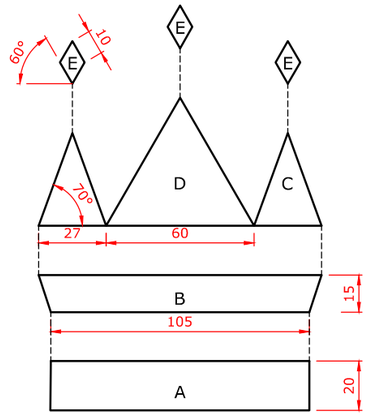


Fig. 3

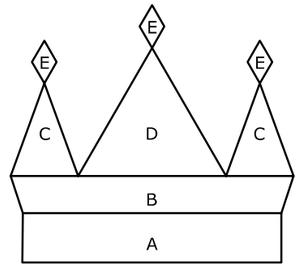


Fig. 4

Question 4: Circles in contact.

Rudolph has decided to grow a moustache as shown in Fig. 5. Using your compasses and the given dimensions, draw the design on the centre lines given by:

1. drawing arc R28 from centre W;
2. drawing arc R42 from centre O;
3. drawing arc R42 touching the arc with centre A and the arc with centre O;
4. drawing arc R110 from centre K;
5. drawing arc R30 touching the arc with centre B and the arc with centre K;
6. marking at least 2 points of tangency by short dashes.

(18 marks)

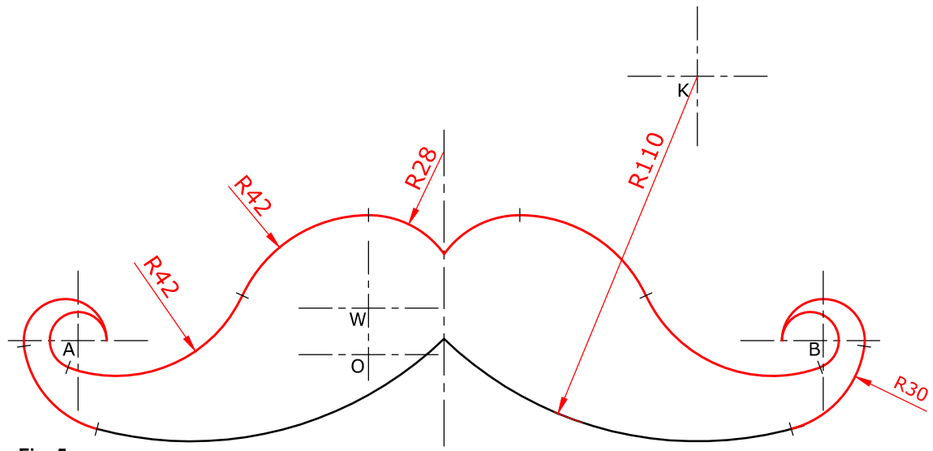
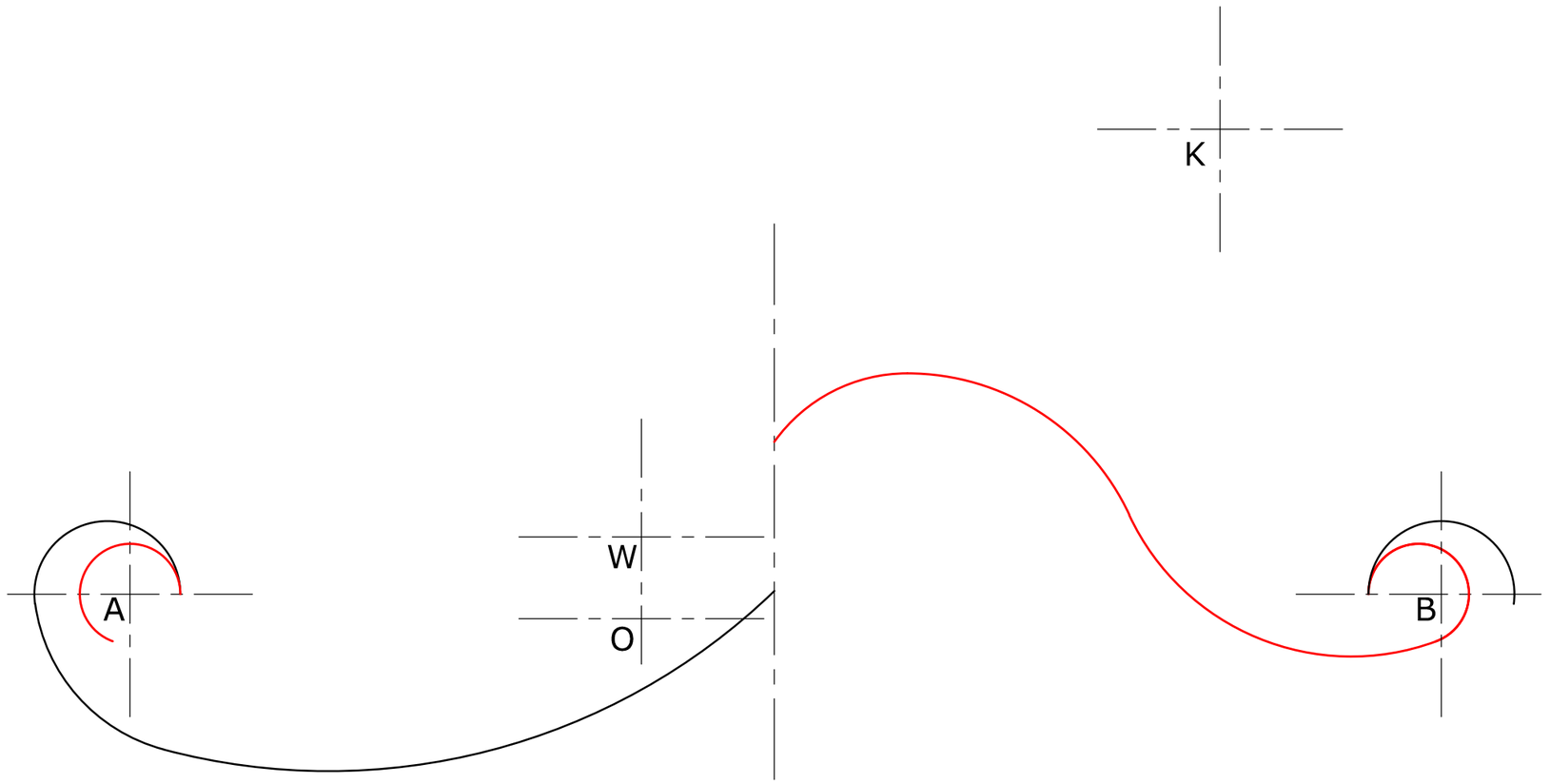


Fig. 5



Question 5: Development of truncated cylinder.

A sticker on a cylindrical container is shown in Fig. 6. The front elevation and plan in first angle projection have been given.

1. Draw the full **development** of the sticker starting from cut line **X-X**.
2. Draw the symbol for first angle orthographic projection.

(18 marks)

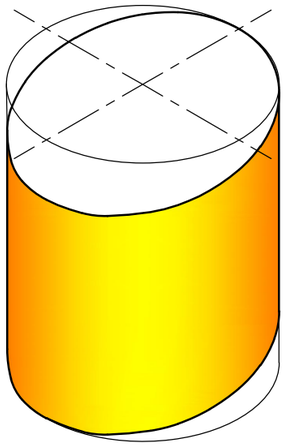
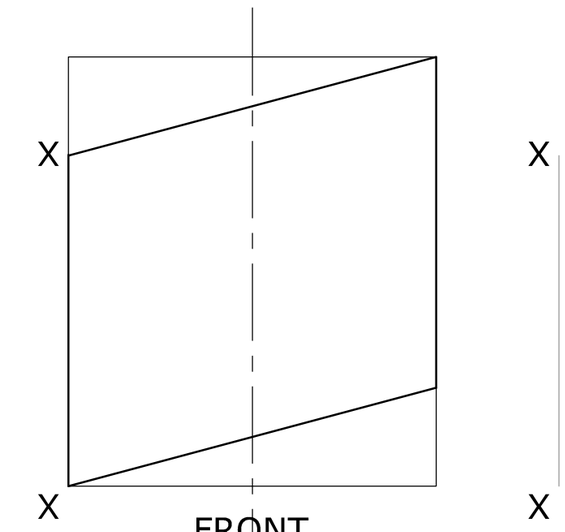
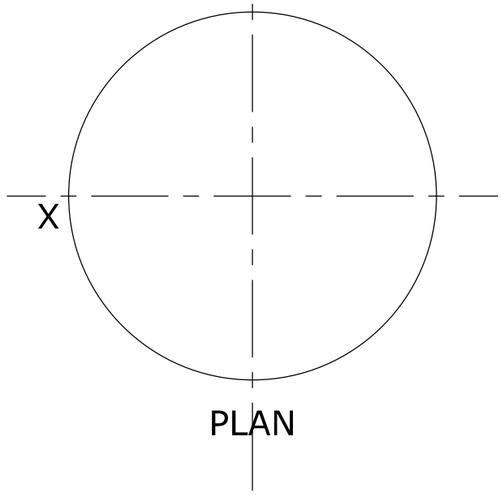


Fig. 6



FRONT



PLAN

DEVELOPMENT

SYMBOL

Question 6: Isometric projection.

The front elevation, end elevation and plan of a Sports Turbo (ST) car racing logo are shown below. An oblique view of the logo is shown in Fig. 7.

On the given starting lines, construct an **ISOMETRIC** projection of the logo by taking the dimensions from the orthographic projection and placing point X as the lowest corner.

(20 marks)

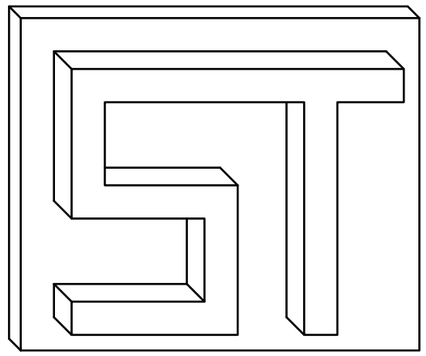
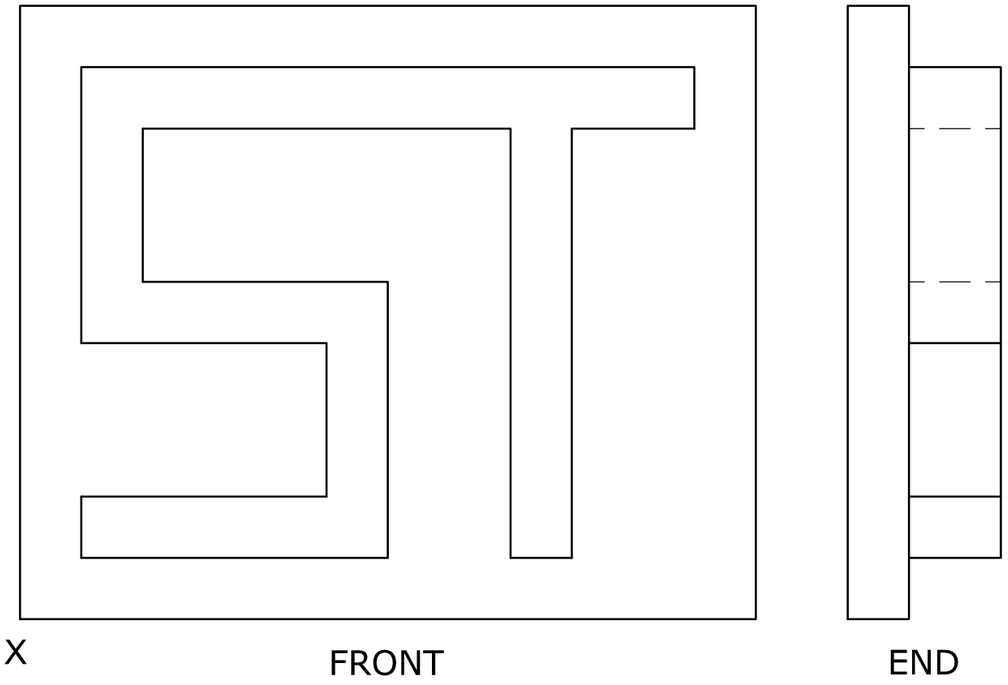
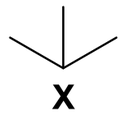
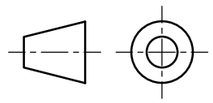


Fig. 7







DEPARTMENT FOR CURRICULUM,
RESEARCH, INNOVATION AND LIFELONG LEARNING
Directorate for Learning and Assessment Programmes
Educational Assessment Unit

Annual Examinations for Secondary Schools 2018

YEAR 9 **GRAPHICAL COMMUNICATION** **TIME: 2 hours**

Instructions

- Write your name and class on all sheets.
- Attempt ALL questions.
- All answers are to be drawn accurately, with instruments, unless otherwise stated.
- All construction lines MUST be left on each solution to show the method employed.
- Drawing aids may be used.

Information

- All dimensions are in millimetres.
- Estimate any missing dimensions.
- Marks will be awarded for accuracy, clarity and appropriateness of construction.

This section is for teachers' use only.

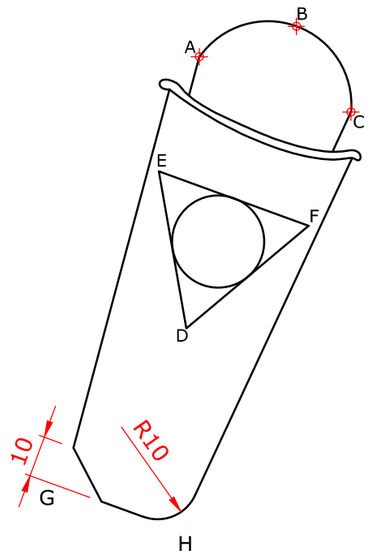
Question	1	2	3	4	5	6	7	**Total**
Marks allotted	14	11	14	14	12	17	18	100
Marks awarded								

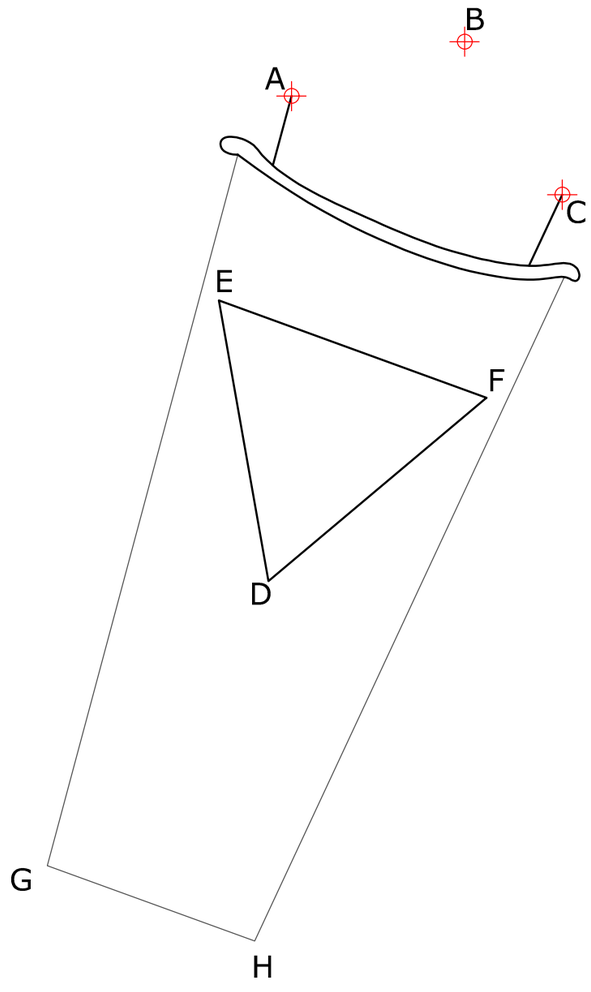
Question 1: Geometrical construction.

The drawing on the right shows an ice-lolly sticker.
Reproduce this drawing by using the following information.
On the starting lines given:

1. draw the 10X10 chamfer at corner **G**;
2. add the R10 fillet arc at corner **H**;
3. construct a 3-point circle passing from points **A**, **B** and **C**;
4. inscribe a circle to triangle **DEF**.

(14 marks)





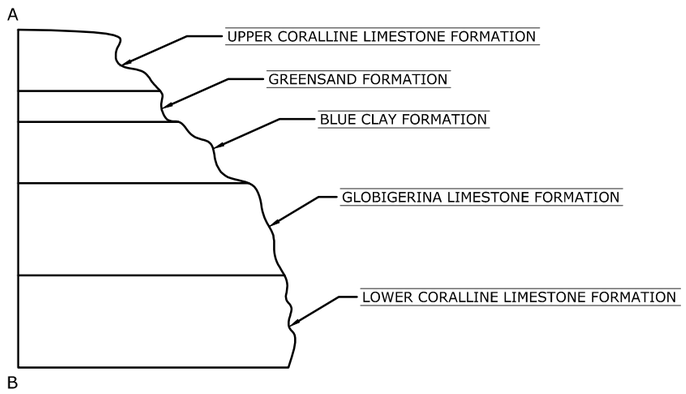
Question 2: Division of a line and Lettering.

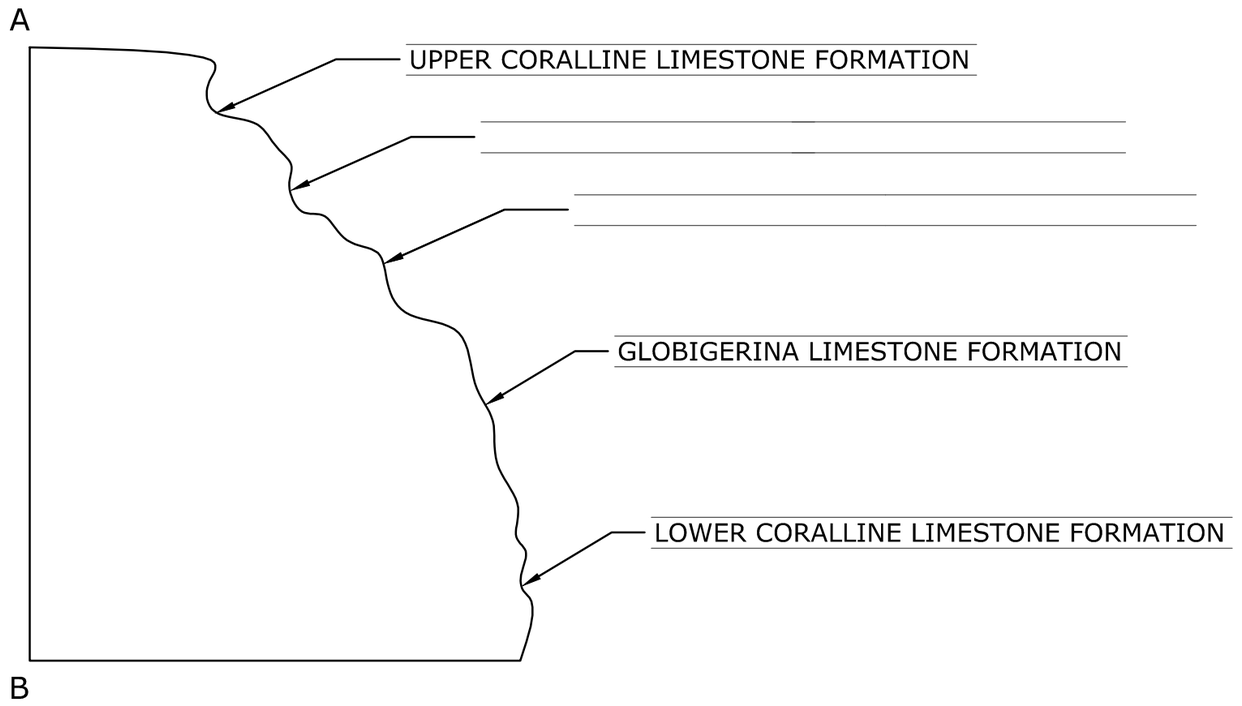
In his Geography class, Ronnie learnt that Malta is made up of different layers of rock. The drawing below represents a typical Maltese rock layer formation.

Complete the design by:

1. dividing height **A**-**B** into the ratio of 2:1:2:3:3 starting from point **A**;
2. use simple block letters to fill in the 2nd and 3rd label.

(11 marks)

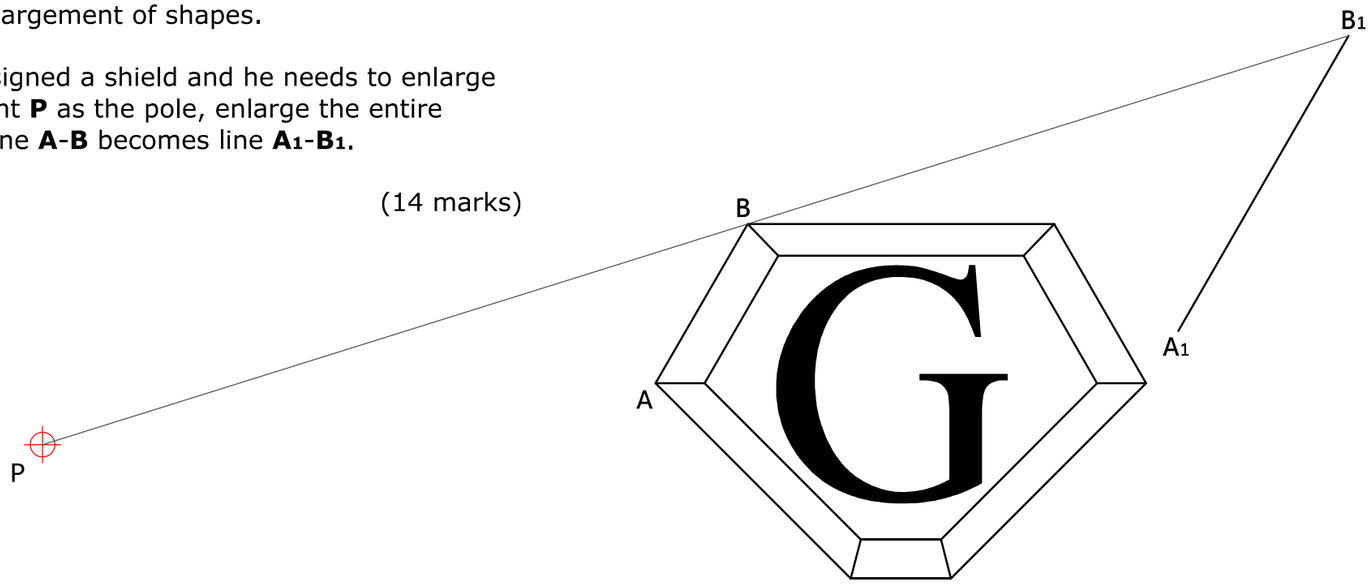




Question 3: Enlargement of shapes.

George has designed a shield and he needs to enlarge it. By using point **P** as the pole, enlarge the entire shield so that line **A**-**B** becomes line **A_1**-**B_1**.

(14 marks)



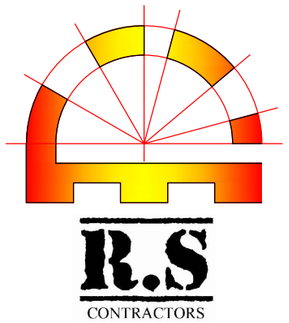
Question 4: Construction of angles.

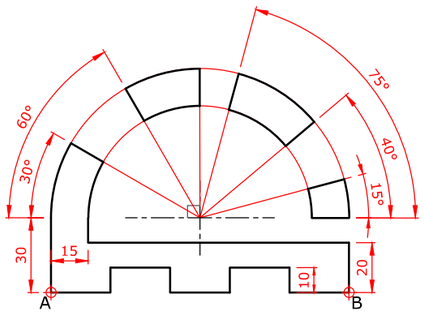
A building construction company commissioned a team of designers to design a logo. This logo is shown below. You are requested to redraw this logo using the information given:

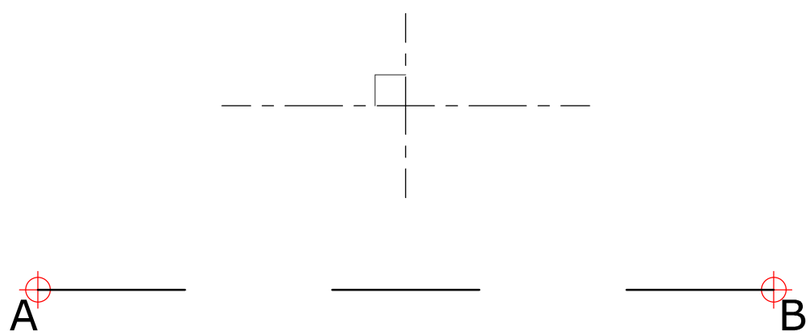
1. complete the base of the logo with the given measurements;
2. use your compasses to construct the **60°**, **30°** and **75°** angles;
3. use your protractor to mark and draw the remaining angles;
4. finish off the drawing accordingly.

Note: Do not draw the lower part of the drawing where it shows "R.S CONTRACTORS".

(14 marks)





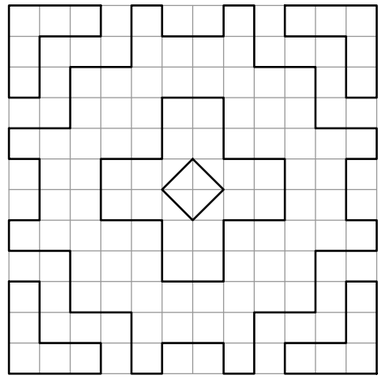


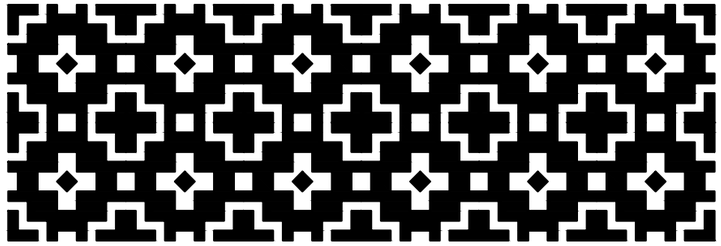
Question 5: Tessellations.

The drawing below shows the design of a single tile that will be used to cover the entire floor of a newly constructed chapel. Beside this drawing you can see the floor when a number of tiles are put together.

1. In the provided squared grid, design a new tile pattern which must be **different** to the one shown.
2. Use colour/shading to embellish your design.

(12 marks)





(Number of tiles put together)

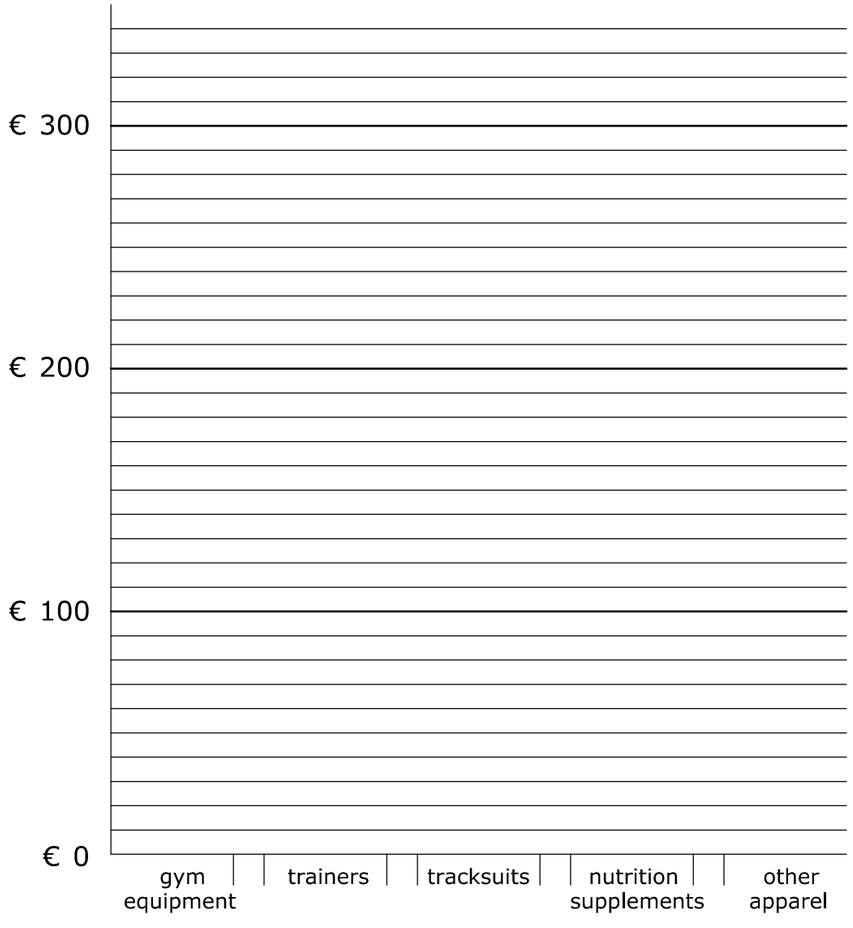
Question 6: Graphs, Charts and Pictograms.

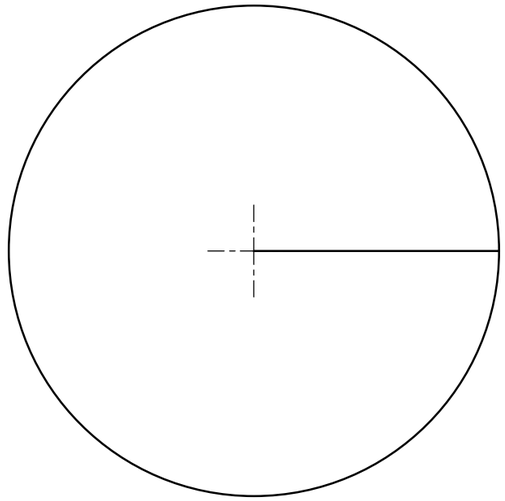
A new shop selling sports equipment has opened in town. The table below shows the items it sold and the profit generated during the first month of activity. Use the information contained in this table and:

1. add colour to the **KEY**;
2. draw a vertical Bar graph on the given starting lines below and add colour to your drawing;
3. draw a Pie Chart in the circle provided on the right and add colour to your drawing;
4. draw a pictogram for the **GYM** equipment. Use the space provided for preparatory sketches.

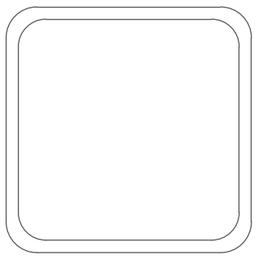
(17 marks)

KEY	ITEMS	PROFIT
	GYM EQUIPMENT	€ 270
	TRAINERS	€ 210
	TRACKSUITS	€ 120
	NUTRITION SUPPLEMENTS	€ 150
	OTHER APPAREL	€ 330





Space for preparatory sketches



GYM EQUIPMENT

TRAINERS

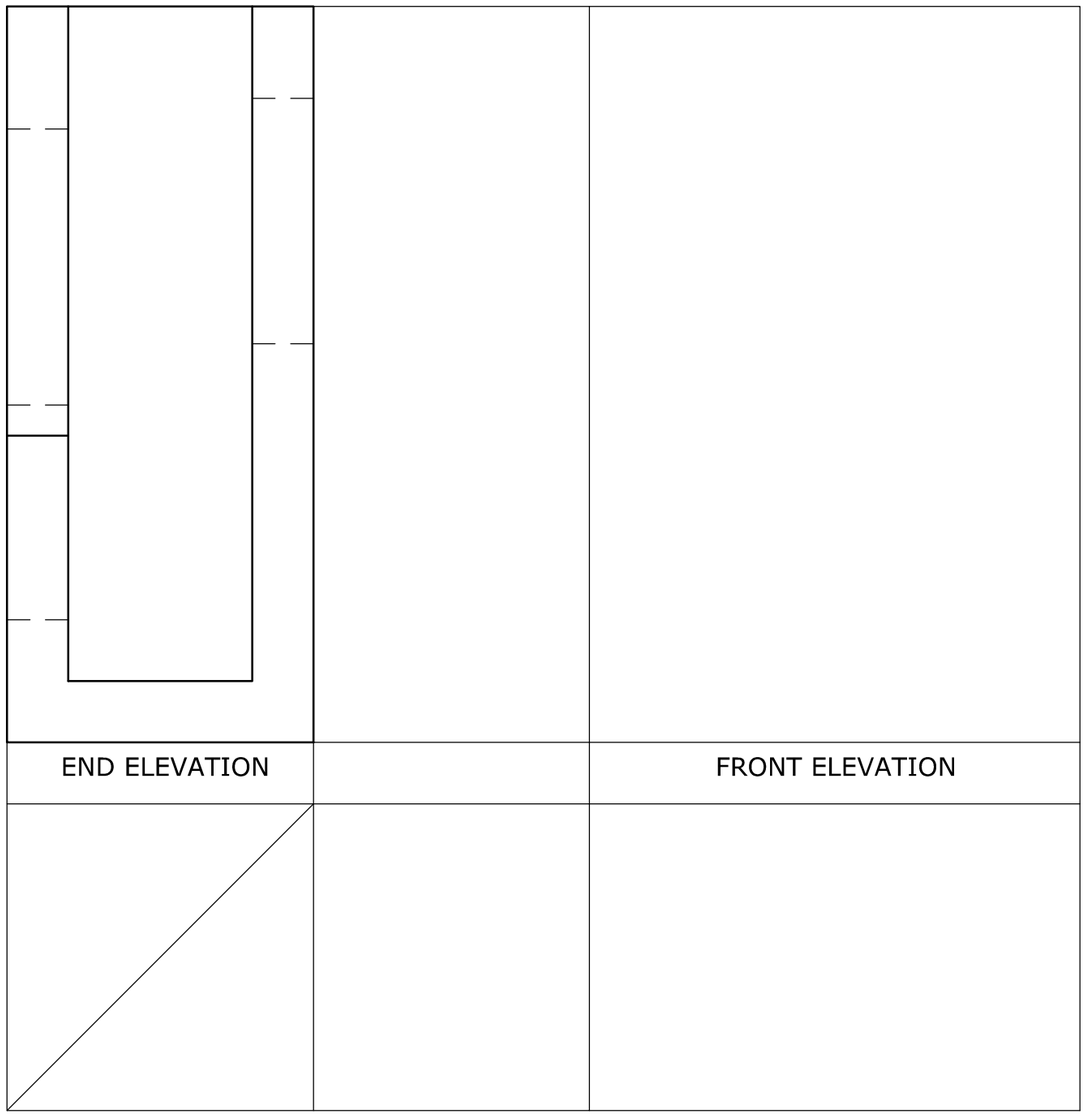
TRACKSUITS

Question 7: Orthographic projection.

The Isometric drawing on the right shows a wooden file storage for paper leaflets. The **END** elevation of this file storage is given below. In the space provided:

1. complete the Orthographic projection by adding the remaining **FRONT** elevation and **PLAN** accordingly;
2. use colour to render the Isometric drawing according to its material;
3. draw the symbol of the projection used.

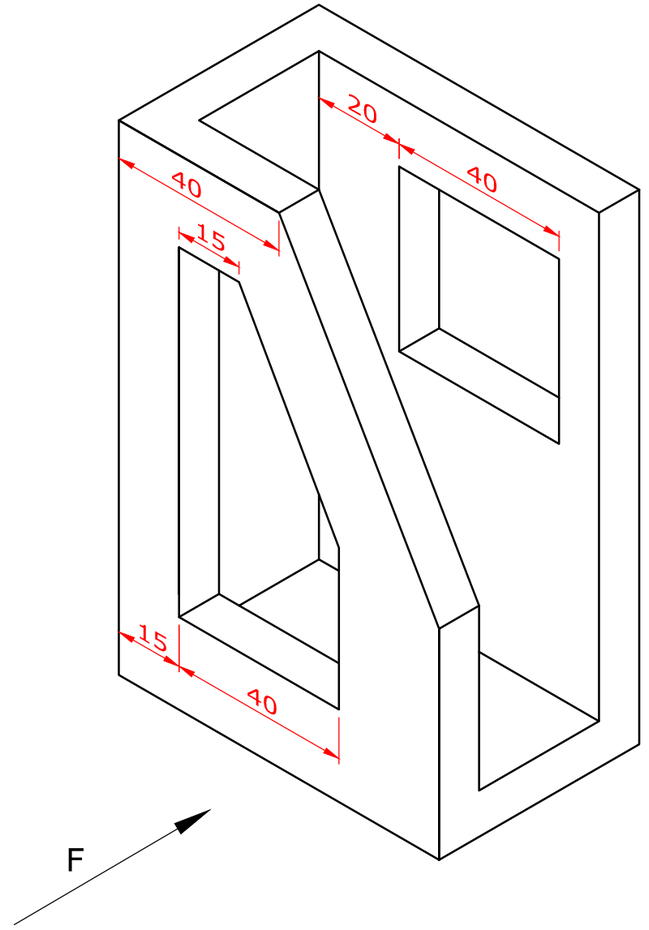
(18 marks)



END ELEVATION

FRONT ELEVATION

PLAN

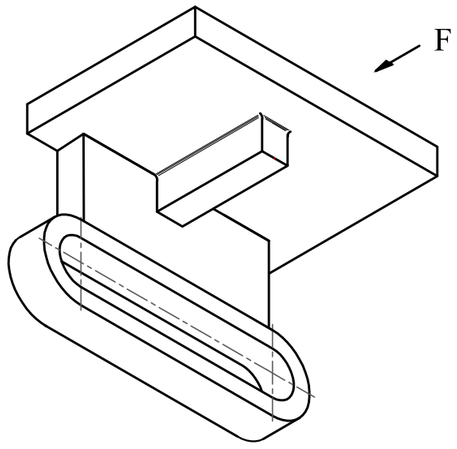


Material thickness: 10mm

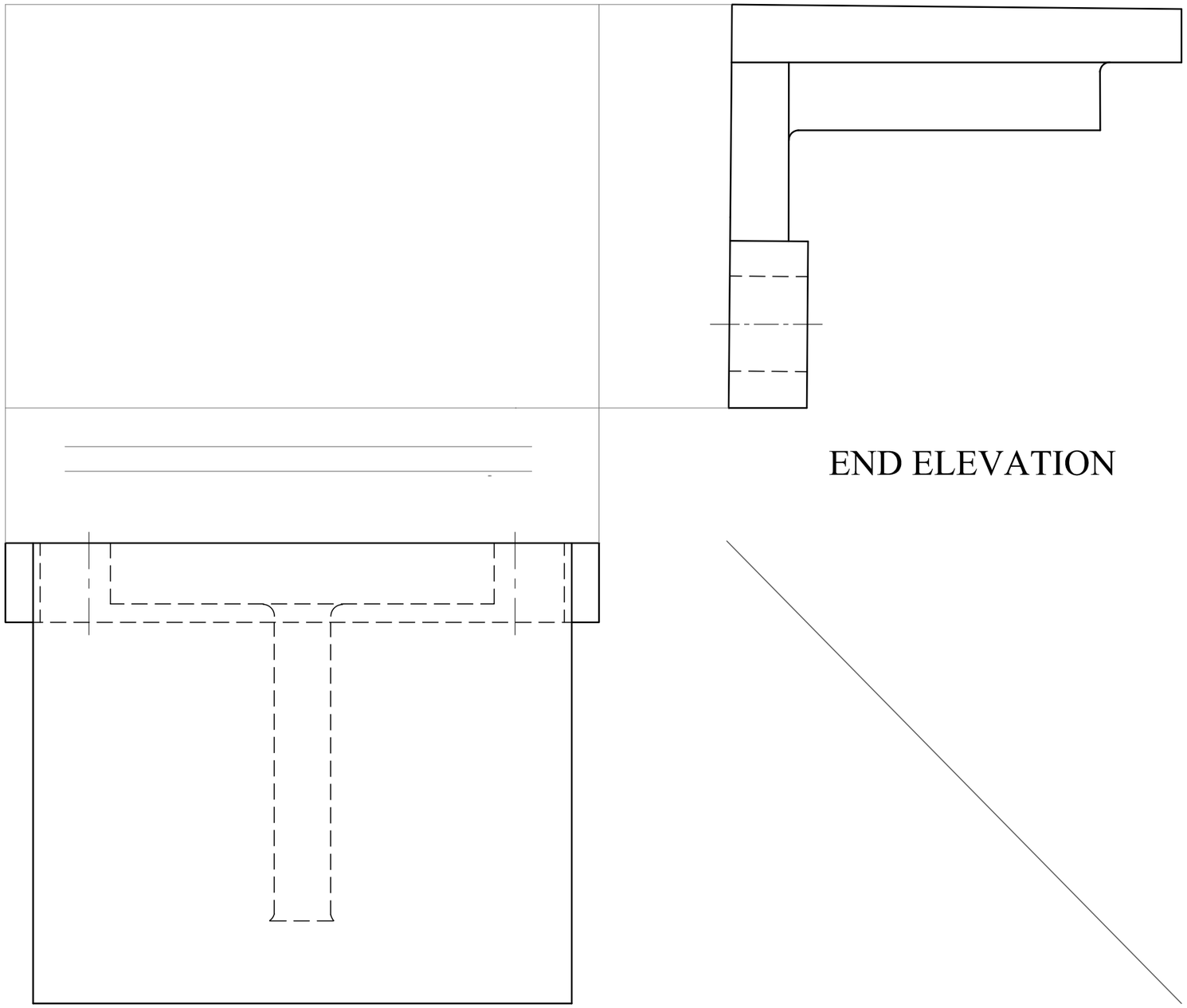
SYMBOL

1. A pictorial illustration, an End Elevation and a Plan of a Tool Grinding Rest are given.
   a. In first angle orthographic projection, project a Front Elevation as indicated by the arrow F.
   b. Label the Front Elevation in block letters.
   c. Draw the symbol of projection on the given centre-line.

14 marks



SYMBOL OF PROJECTION

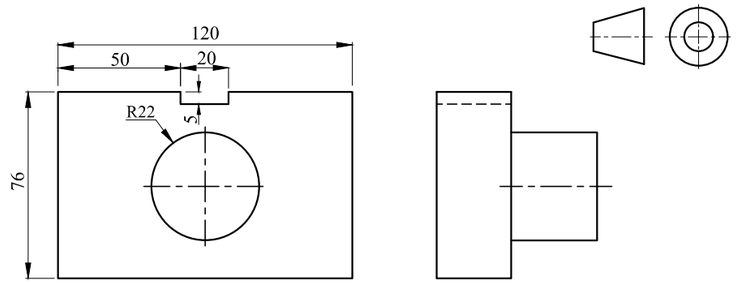


END ELEVATION

PLAN

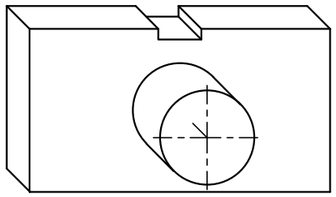
4. Orthographic views and an oblique projection of a photo camera are given.
On the given start lines and to the given dimensions, draw an isometric projection of the camera.
Note: The camera fits exactly in the given crate.

14 marks

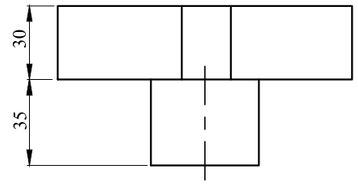


FRONT VIEW

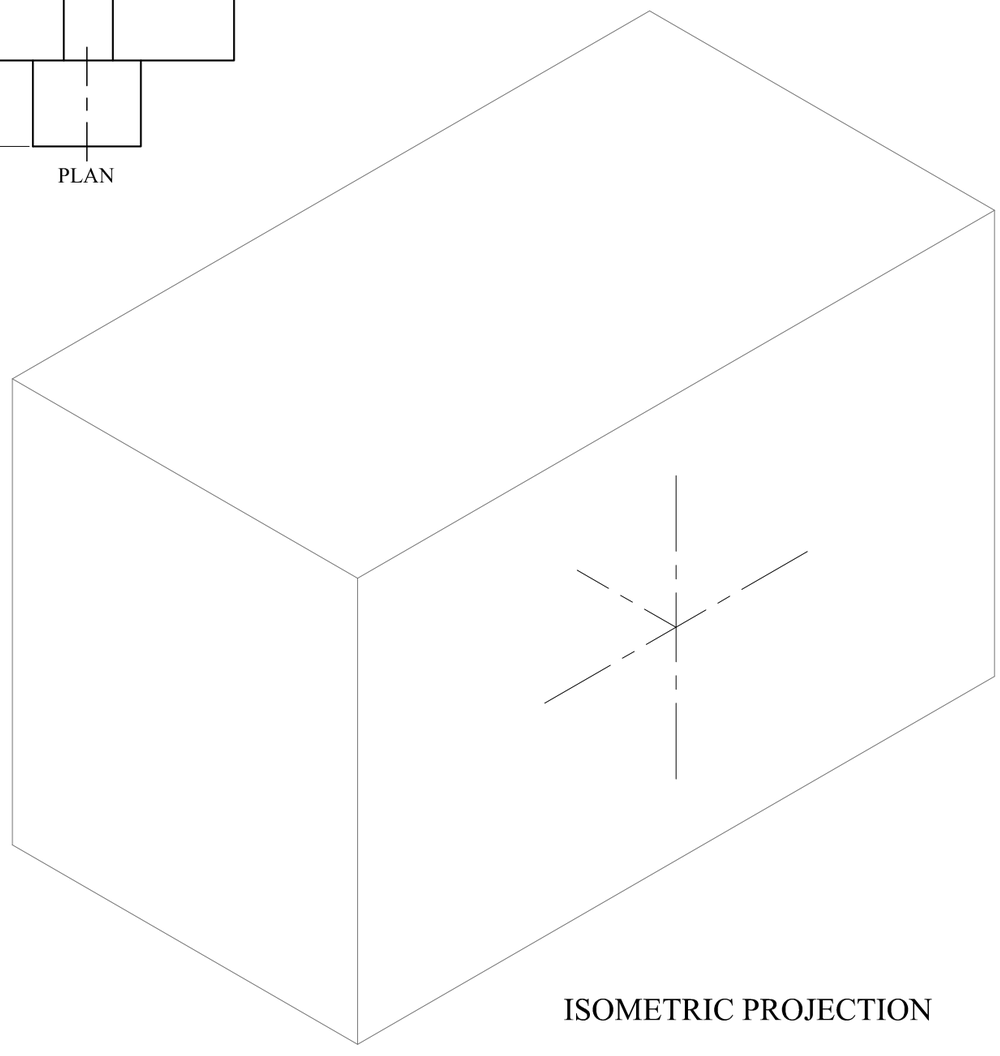
END VIEW



OBLIQUE PROJECTION



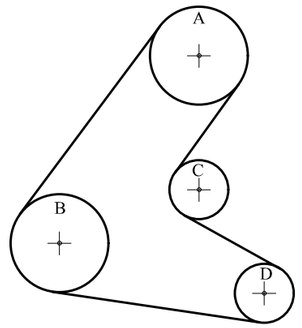
PLAN

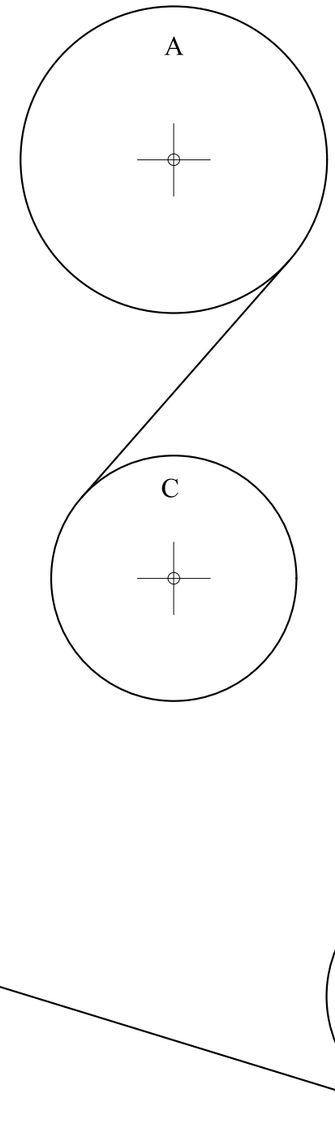


ISOMETRIC PROJECTION

5. A nylon belt is fitted over four pulleys as shown.
Pulley A and pulley B have the same diameter while pulley C and pulley D are also of the same diameter.
Complete the drawing given below by constructing:
a. a common (external) tangent between pulleys A and B and
b. a transverse (internal) tangent between pulleys C and D.

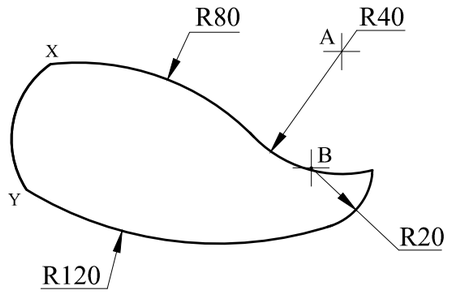
12 marks

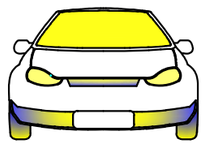




2. A detailed drawing of a car headlamp is given below.
Using the given start lines and dimensions, draw the headlamp showing clearly the construction to obtain the centres of the arcs.
Show points of tangency.

12 marks

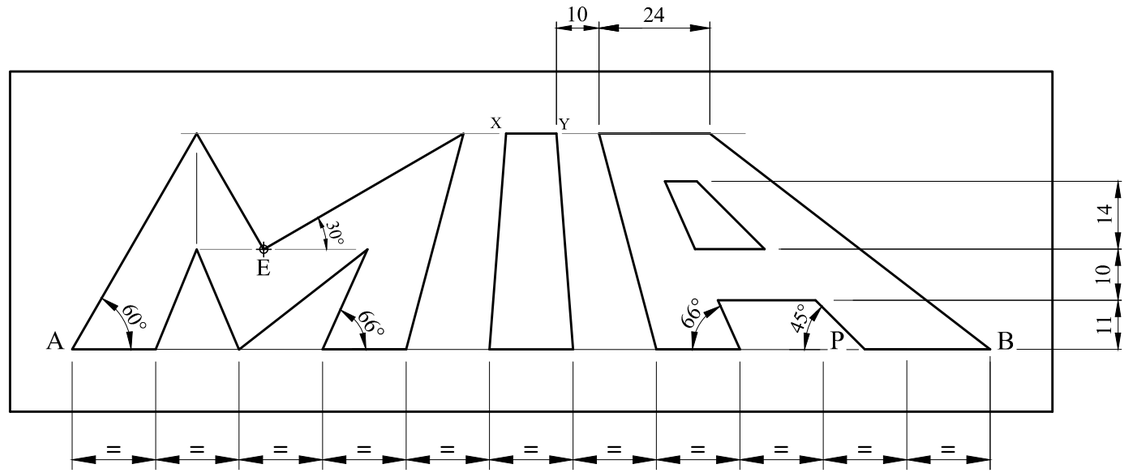


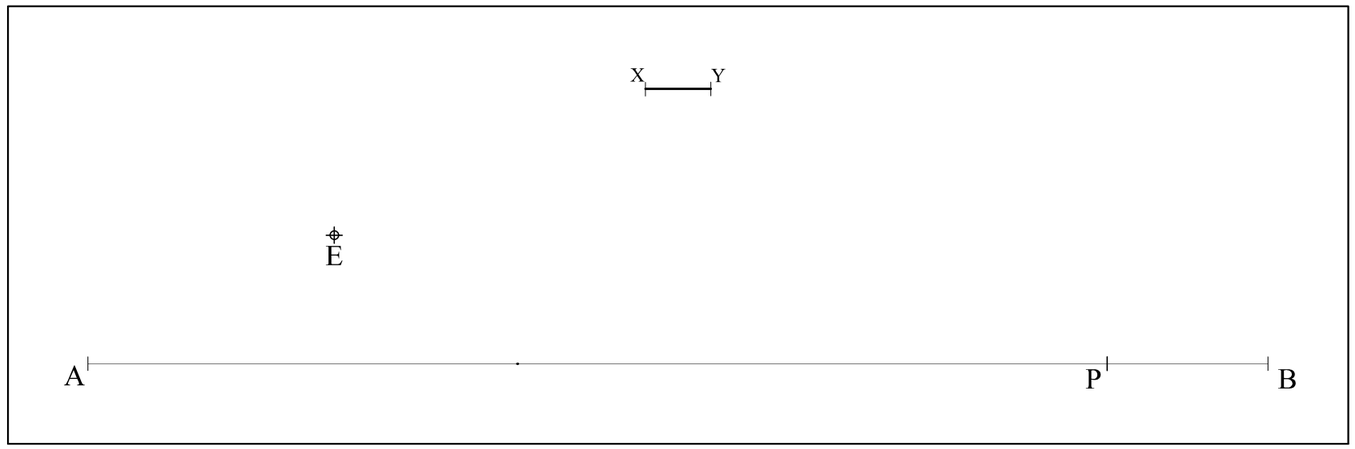


3. The sign of a beauty salon, named after its owner, is shown at the side.
Details of the sign are given below.
On the start line AB shown at the bottom, draw the sign to the given dimensions.

Notes: a. *Start by dividing line AB into 11 equal divisions by construction.*
b. *The 60° angle at A, the 30° angle at E and the 45° angle at P must be constructed using the compass.*
c. *Use the protractor for the remaining angles.*

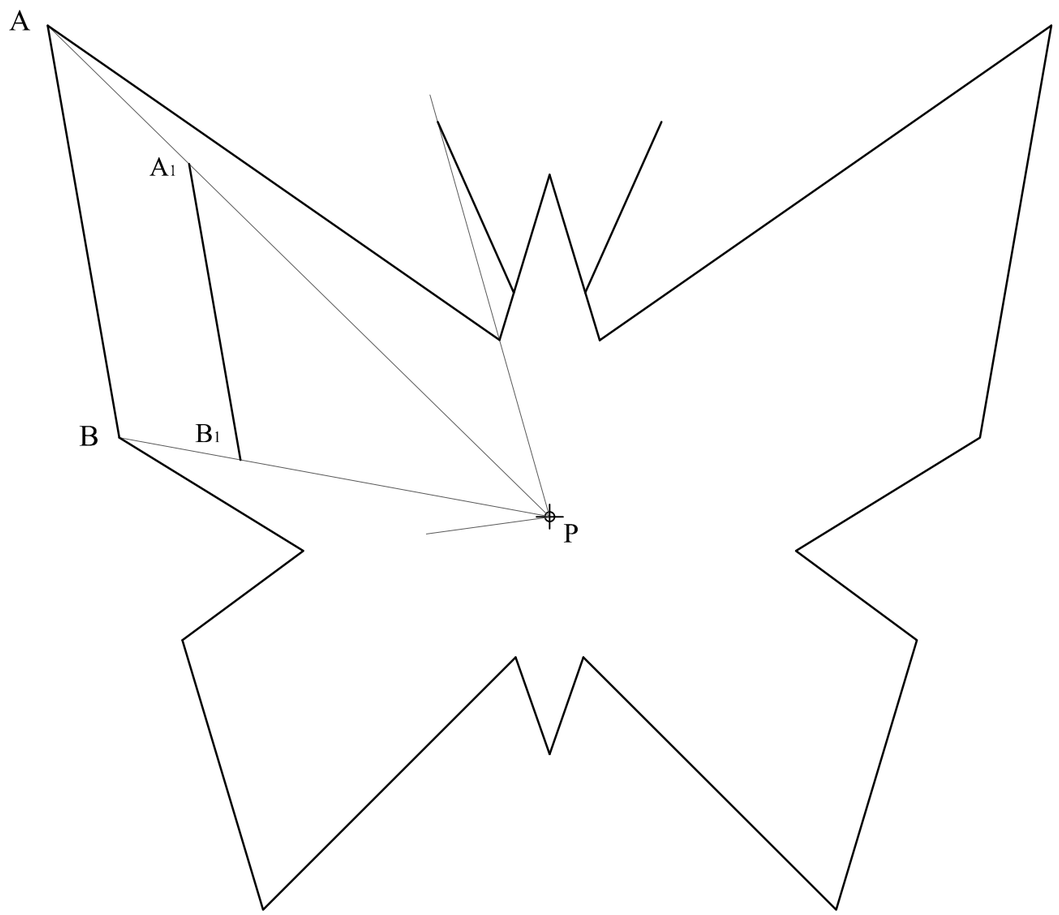
18 marks





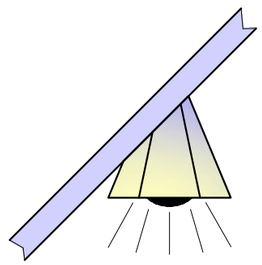
6. A simplified drawing of a butterfly is given. Line AB is geometrically reduced to A_1B_1.
Complete the construction to reduce the butterfly using point P as the pole.

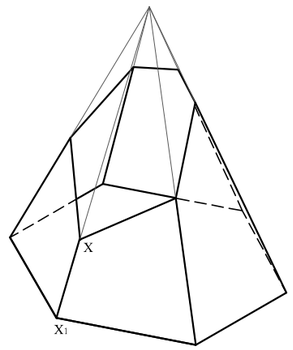
12 marks



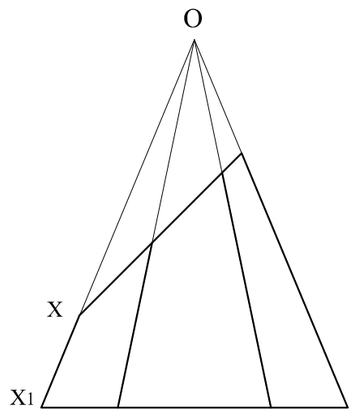
7. An industrial lamp-shade is fixed to the inside of a slanting ceiling.
The shade has the shape of a truncated hexagonal pyramid which is shown in the pictorial view.
A Front Elevation and an incomplete Plan of the shade are given below.
a. Complete the Plan.
b. Construct the Development, using the given centre O_1.
Note: Make the joint line along XX_1.

18 marks



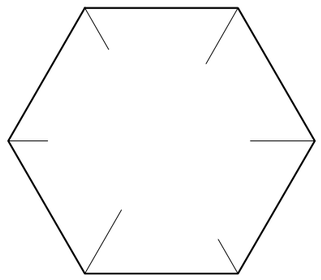


PICTORIAL VIEW

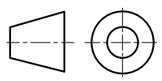


FRONT ELEVATION

DEVELOPMENT



PLAN



JUNIOR LYCEUM ANNUAL EXAMINATIONS 2008

DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION

Educational Assessment Unit

FORM 3 (3rd year) GRAPHICAL COMMUNICATION (Tech. Des.) Time: 2 hours

NAME : _____ **CLASS :** _____

Instructions

- Write your name and class on all sheets.
- Attempt **ALL** questions.
- All answers are to be drawn accurately, with instruments, unless otherwise stated.
- All construction lines **MUST** be left on each solution to show the method used.
- Drawing aids may be used.

Information

- All dimensions are in millimetres.
- Estimate any dimension not given.
- Marks will be awarded for accuracy, clarity and appropriateness of construction.

Question	1	2	3	4	5
Max. mark	36	18	16	12	18
Mark					

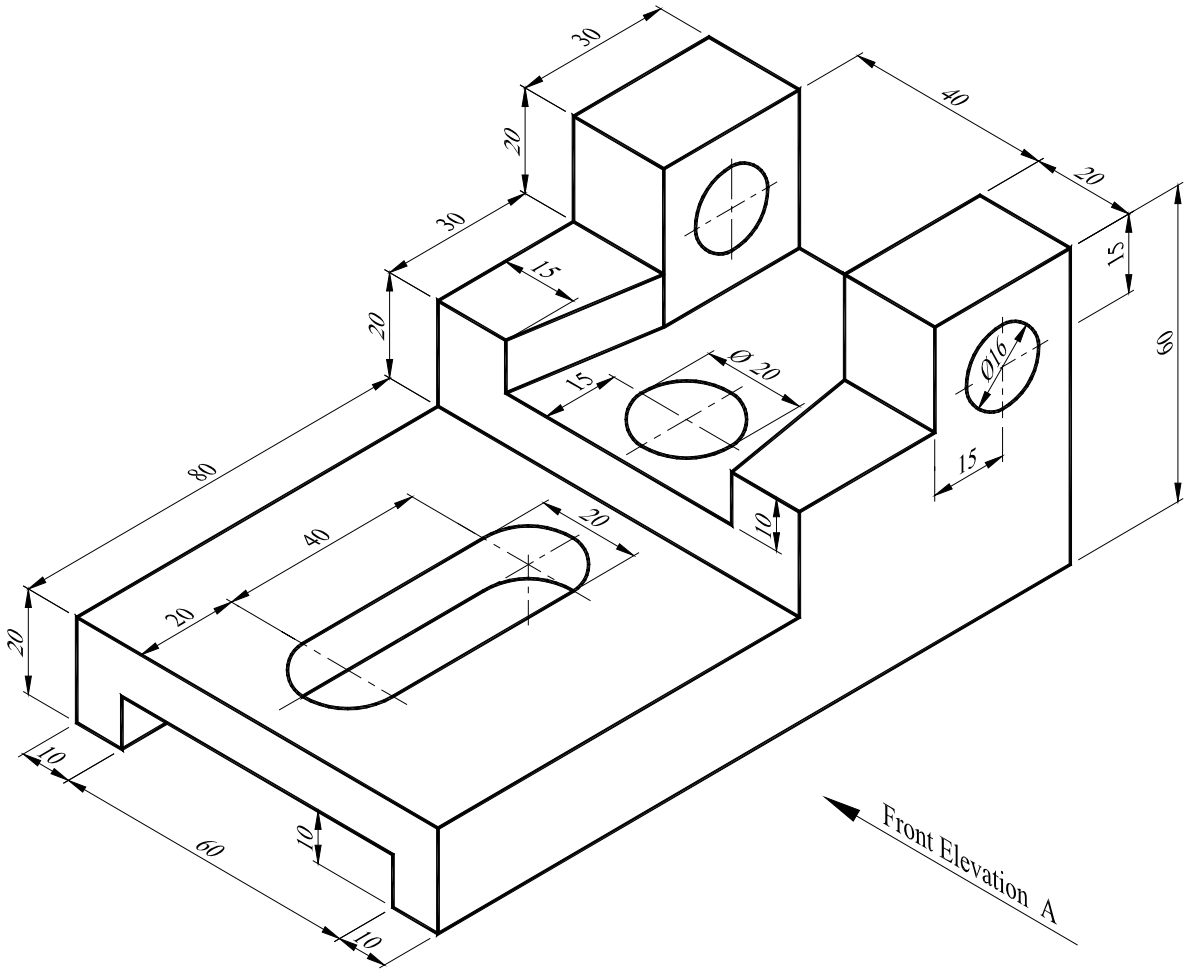
1. The figure below shows a pictorial view of a **BRACKET**.
Draw, in **third angle projection**, the following views:

(a) a front elevation from arrow '**A**'. (**including all hidden details**) 16 marks

(b) a complete plan. 15 marks

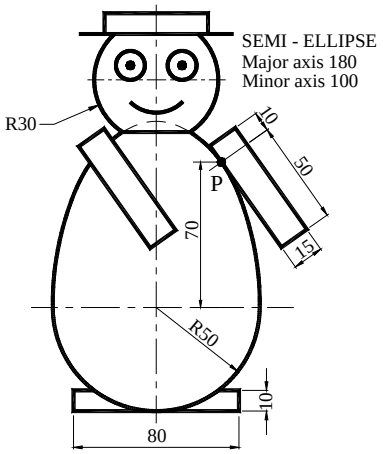
Note: (i) Show the scale used. 2 marks
(ii) Draw the symbol of projection used. 3 marks

Total 36 marks



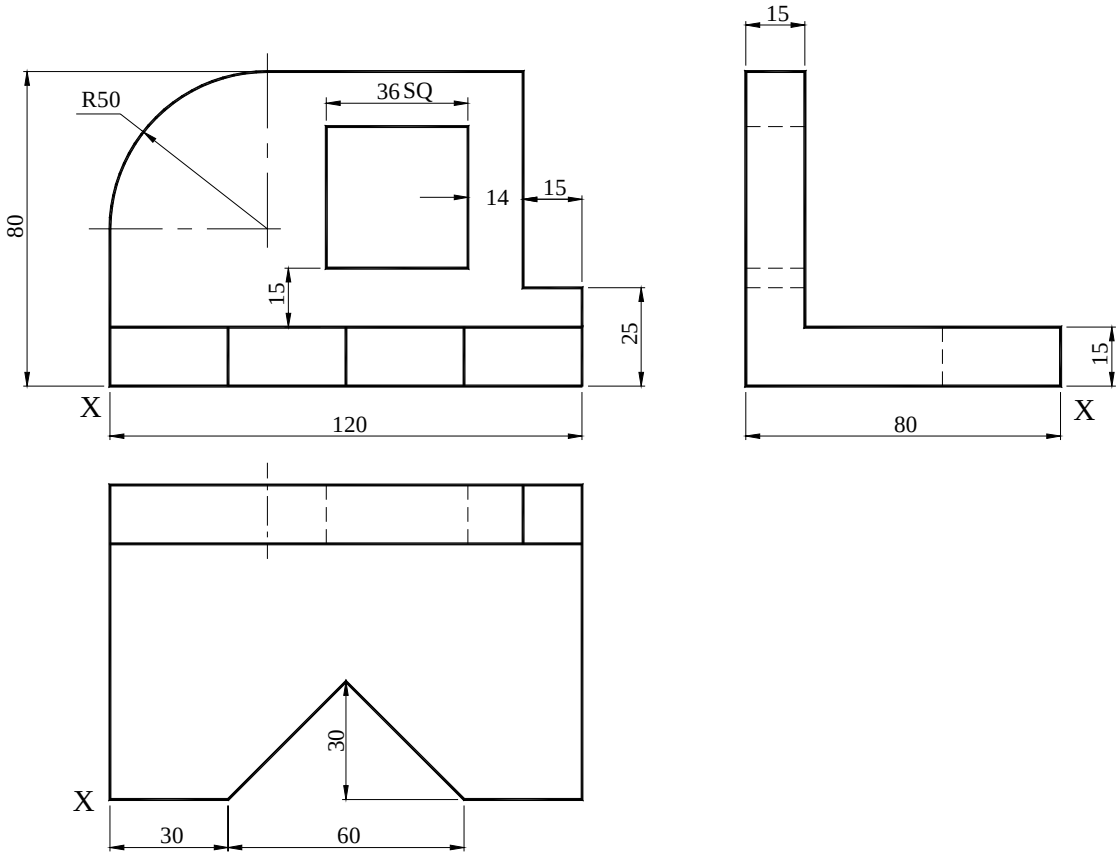
2. The drawing shows the outline of a small plastic toy.
The arm is tangential to the ellipse at point 'P'.
On the given centre lines, complete, full size, the outline of the toy.
Clearly show your constructions for:
- the semi-ellipse (**use any recognized method other than a trammel**),
- the line tangential to the ellipse.

18 marks



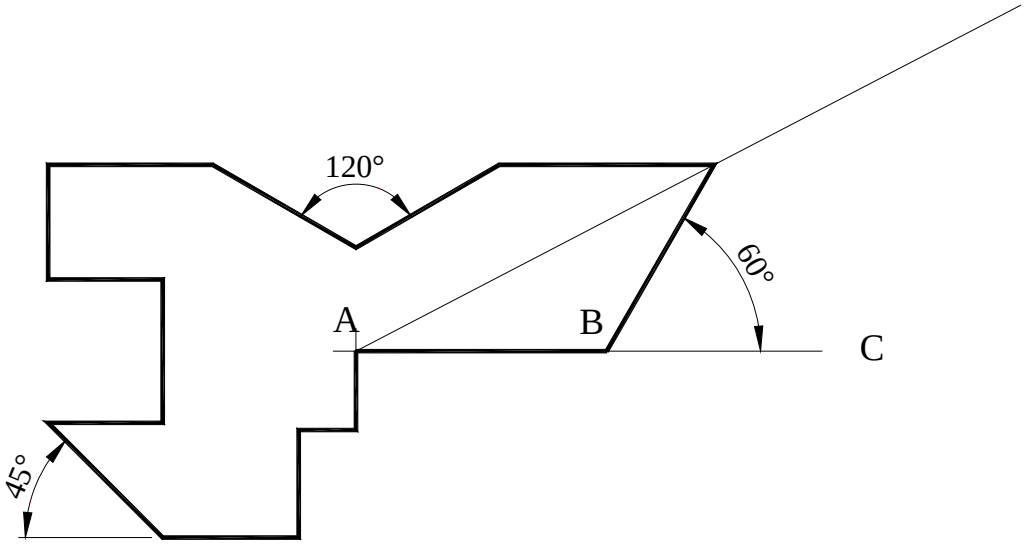
3. The figure below shows an orthographic projection in first angle of an 'Angle Vee Block'.
Draw an isometric projection of the component, positioning face X in the foreground.

16 marks

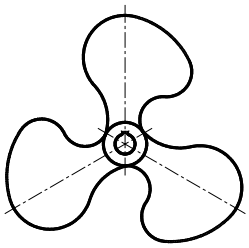


4. A template is shown in the figure below.
Using geometrical construction, enlarge the template proportionally if **AB** is extended to **C**.

12 marks

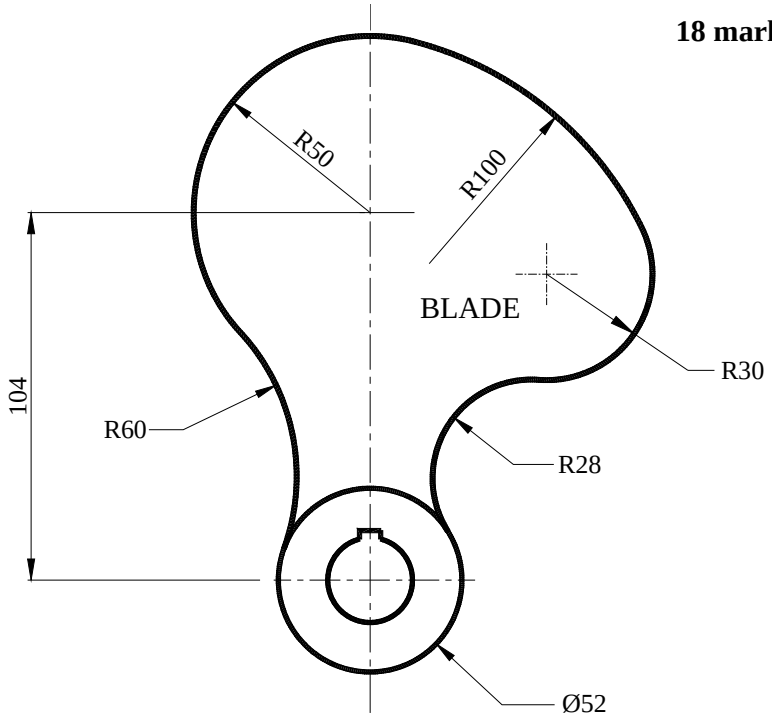


5. A view of a fan and a dimensioned detail drawing of one of the three blades are shown.
On the given centre lines draw **one** of the blades showing clearly the geometrical construction for finding the centres of the circular arcs.
All construction lines must be shown.
Note: The drawing of the blade given below is not to scale.

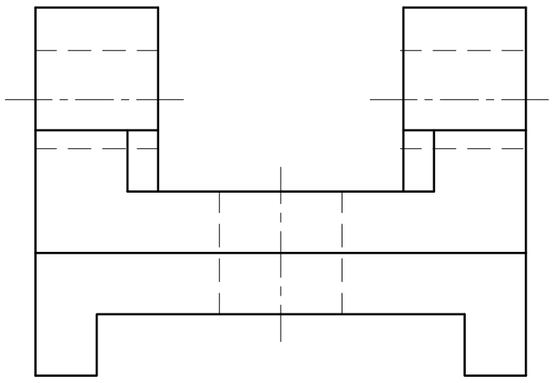


FAN

18 marks

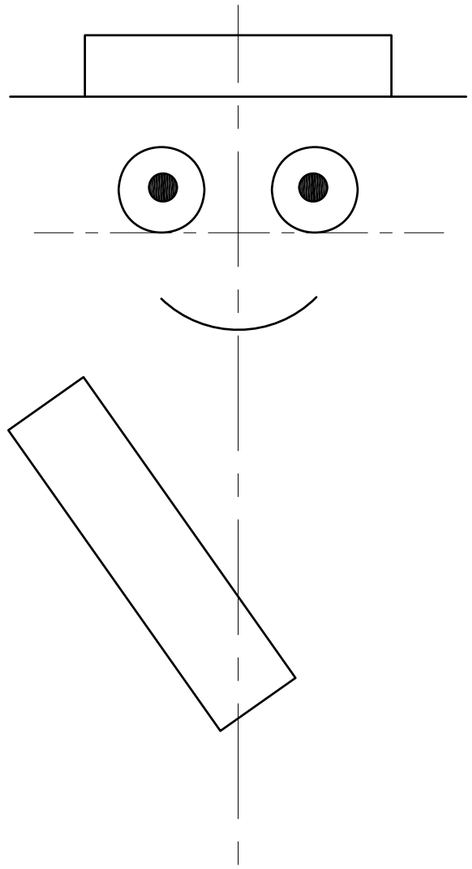


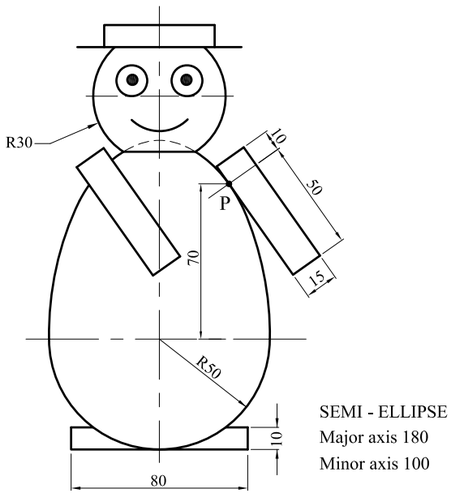
QUESTION No.1



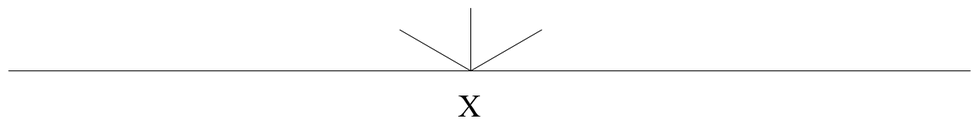
END ELEVATION

QUESTION No.2





QUESTION No.3



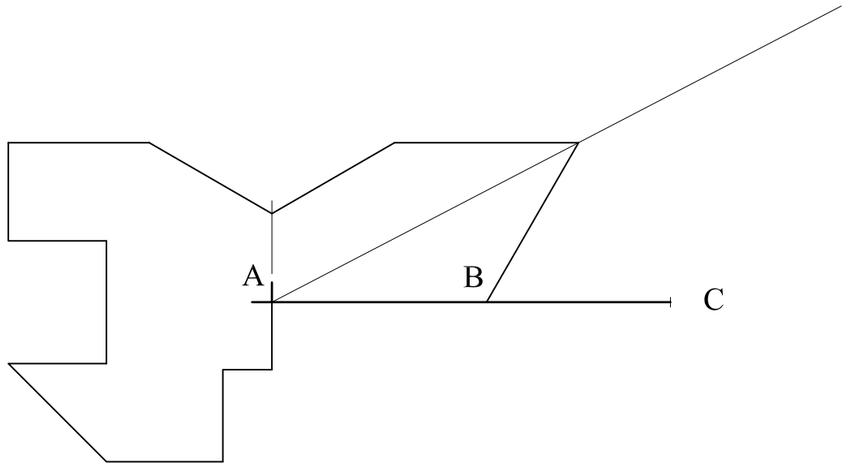
JL FORM 3_3rd Year_2008
GRAPHICAL COMMUNICATION (Tech. Des.)

Educational Assessment Unit

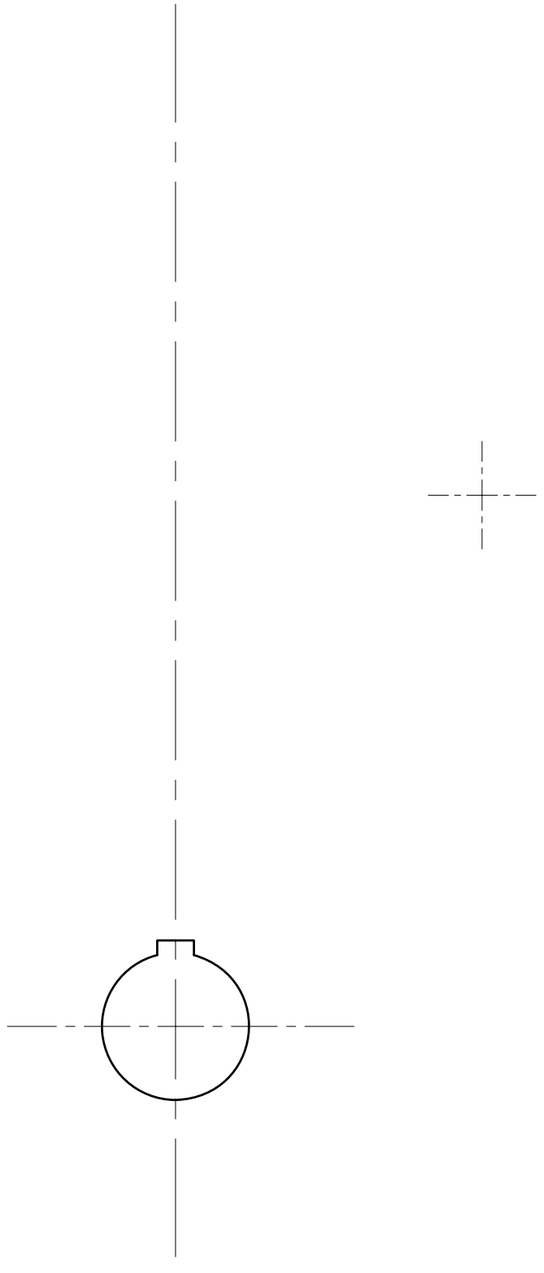
Name:

Class:

QUESTION No.4



QUESTION No.5



Sheet 3 of 3

JUNIOR LYCEUM ANNUAL EXAMINATIONS 2008

DIRECTORATE FOR QUALITY AND STANDARDS IN EDUCATION

Educational Assessment Unit

FORM 3 (3rd year) GRAPHICAL COMMUNICATION (Tech. Des.) Time: 2 hours

NAME : _____ **CLASS :** _____

Instructions

- Write your name and class on all sheets.
- Attempt **ALL** questions.
- All answers are to be drawn accurately, with instruments, unless otherwise stated.
- All construction lines **MUST** be left on each solution to show the method used.
- Drawing aids may be used.

Information

- All dimensions are in millimetres.
- Estimate any dimension not given.
- Marks will be awarded for accuracy, clarity and appropriateness of construction.

Question	1	2	3	4	5
Max. mark	36	18	16	12	18
Mark					

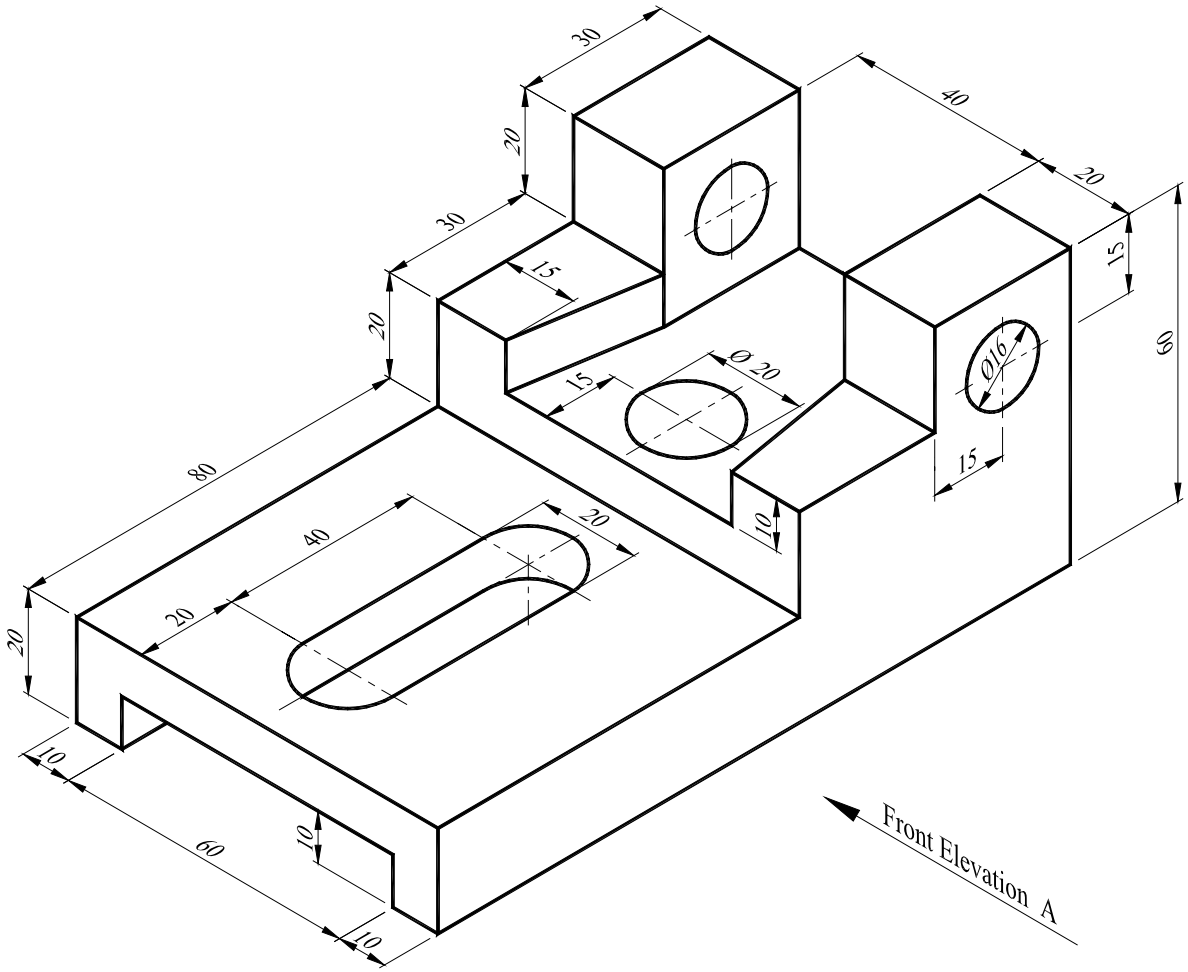
1. The figure below shows a pictorial view of a **BRACKET**.
Draw, in **third angle projection**, the following views:

(a) a front elevation from arrow '**A**'. (**including all hidden details**) 16 marks

(b) a complete plan. 15 marks

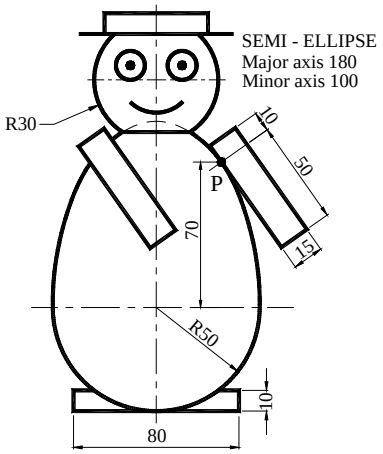
Note: (i) Show the scale used. 2 marks
(ii) Draw the symbol of projection used. 3 marks

Total 36 marks



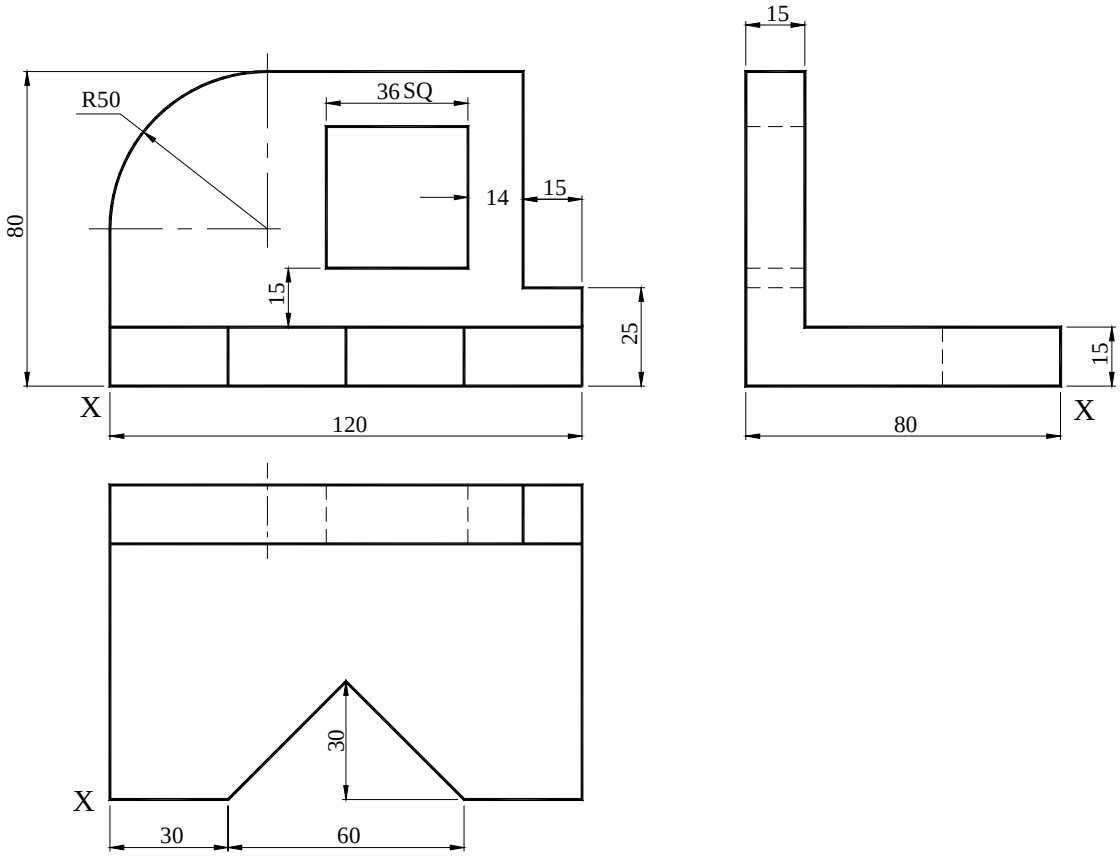
2. The drawing shows the outline of a small plastic toy.
The arm is tangential to the ellipse at point 'P'.
On the given centre lines, complete, full size, the outline of the toy.
Clearly show your constructions for:
- the semi-ellipse (**use any recognized method other than a trammel**),
- the line tangential to the ellipse.

18 marks



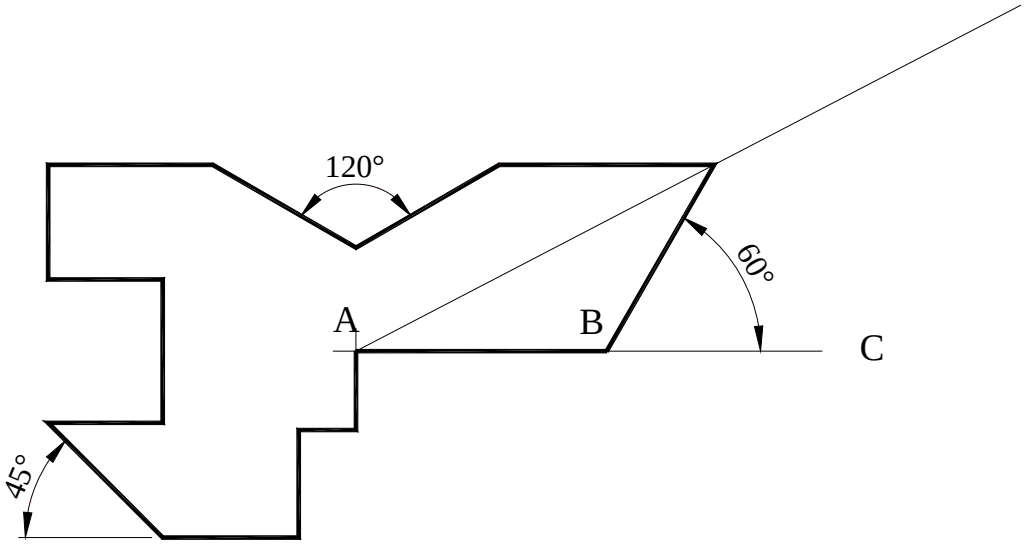
3. The figure below shows an orthographic projection in first angle of an 'Angle Vee Block'.
Draw an isometric projection of the component, positioning face X in the foreground.

16 marks

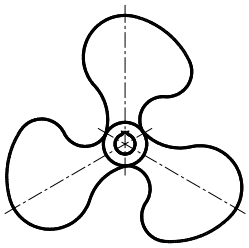


4. A template is shown in the figure below.
Using geometrical construction, enlarge the template proportionally if **AB** is extended to **C**.

12 marks

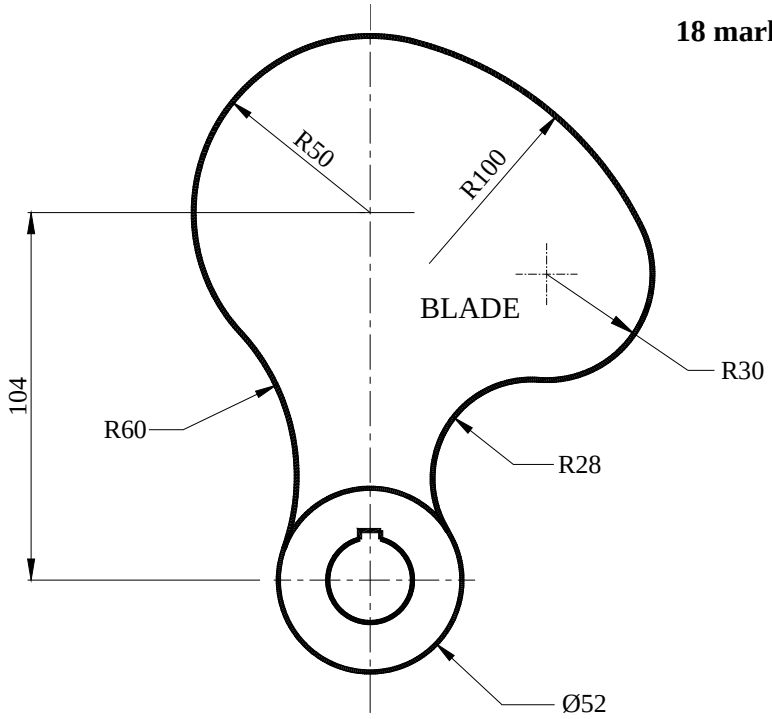


5. A view of a fan and a dimensioned detail drawing of one of the three blades are shown.
On the given centre lines draw **one** of the blades showing clearly the geometrical construction for finding the centres of the circular arcs.
All construction lines must be shown.
Note: The drawing of the blade given below is not to scale.

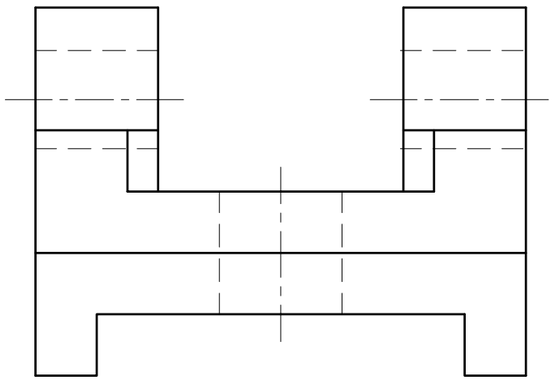


FAN

18 marks

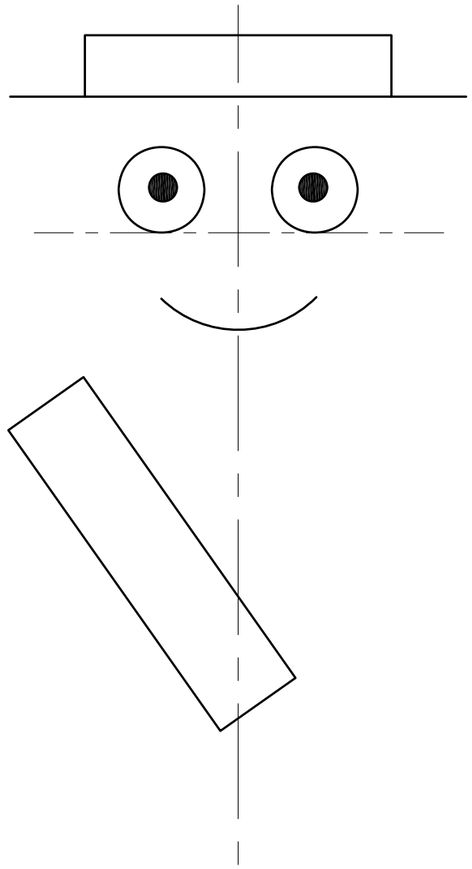


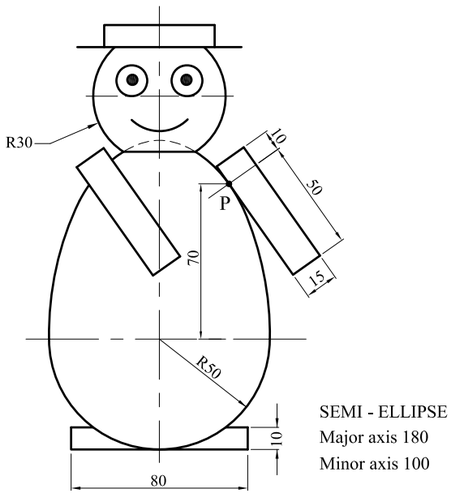
QUESTION No.1



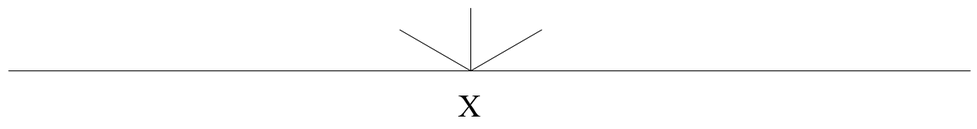
END ELEVATION

QUESTION No.2





QUESTION No.3



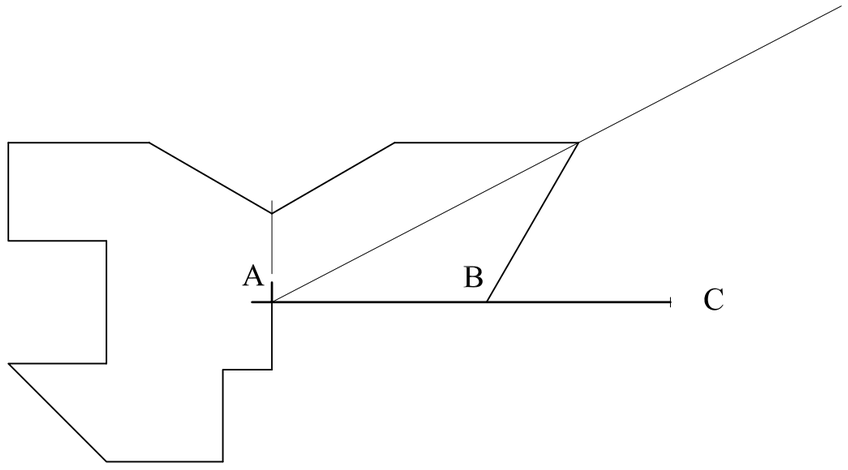
JL FORM 3_3rd Year_2008
GRAPHICAL COMMUNICATION (Tech. Des.)

Educational Assessment Unit

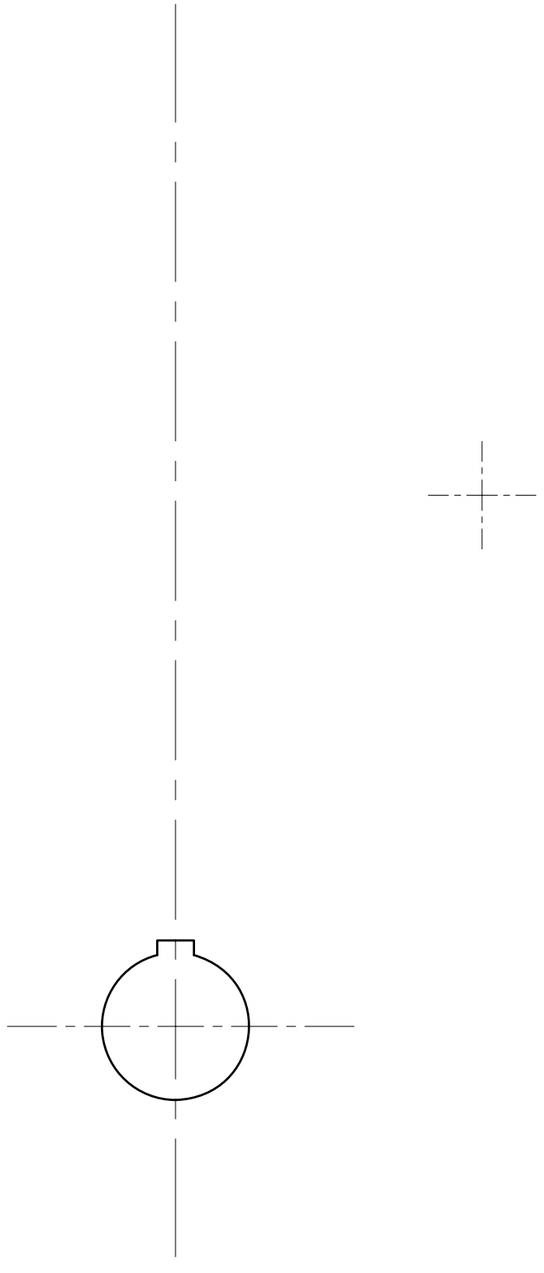
Name:

Class:

QUESTION No.4



QUESTION No.5



Sheet 3 of 3

1. A pictorial view and two orthographic views of a toy helicopter are given.

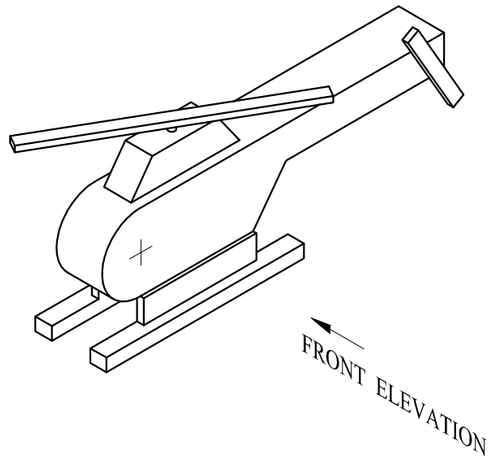
a) Draw the front view in the direction of the arrow.

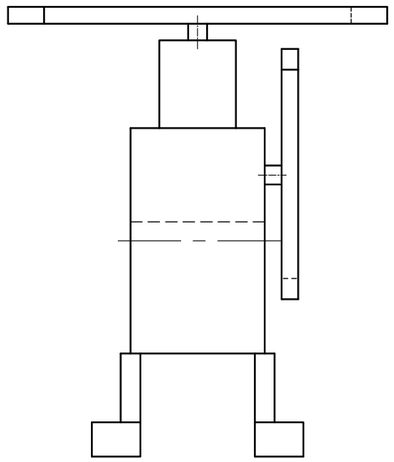
b) Lable the front view and the correct symbol of projection.

c) Shade (in colour or pencil) the pictorial view.

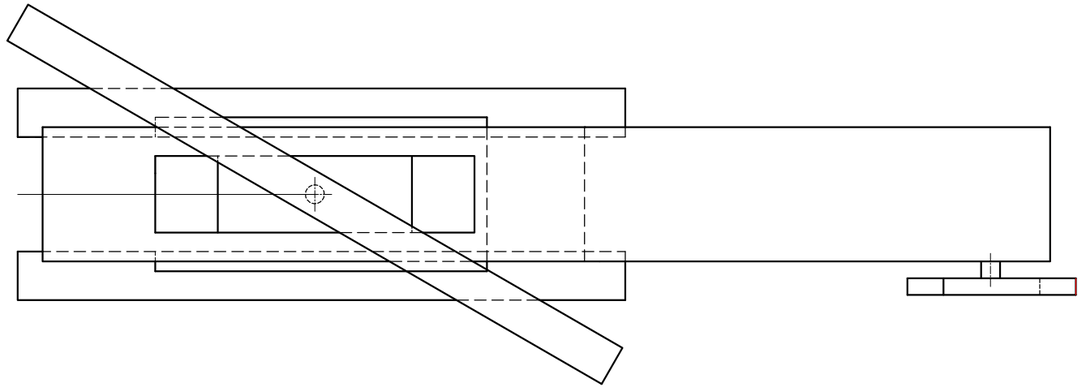
Note: The centre lines of the curved part of the front elevation are already drawn.

16 marks





END VIEW



PLAN

ANGLE PROJECTION

Sheet 1 of 4

2. The alarm clock shown at the side has an elliptical face. Two tiny screws are fixed to the clock face exactly at the focal points.

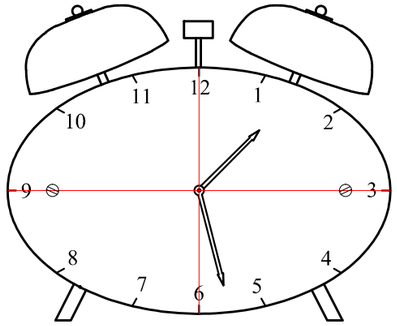
a) Complete the clock started below by constructing an ellipse on the given major and minor axes.

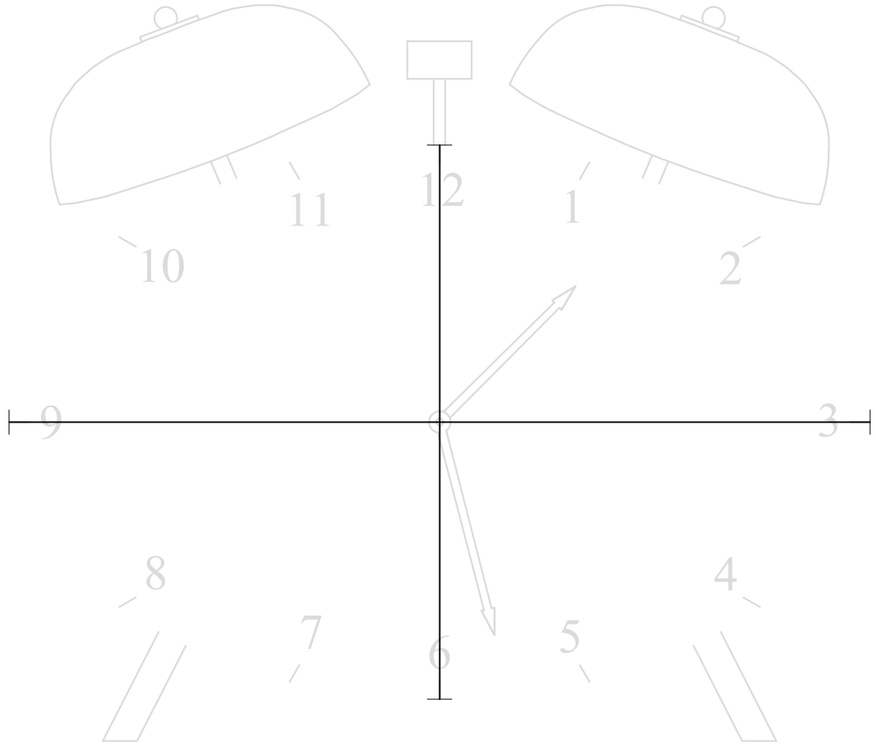
b) Find the two focal points (foci) of the ellipse.

Notes: 1. Do not draw the screws.

2. Leave all faint construction lines.

12 marks



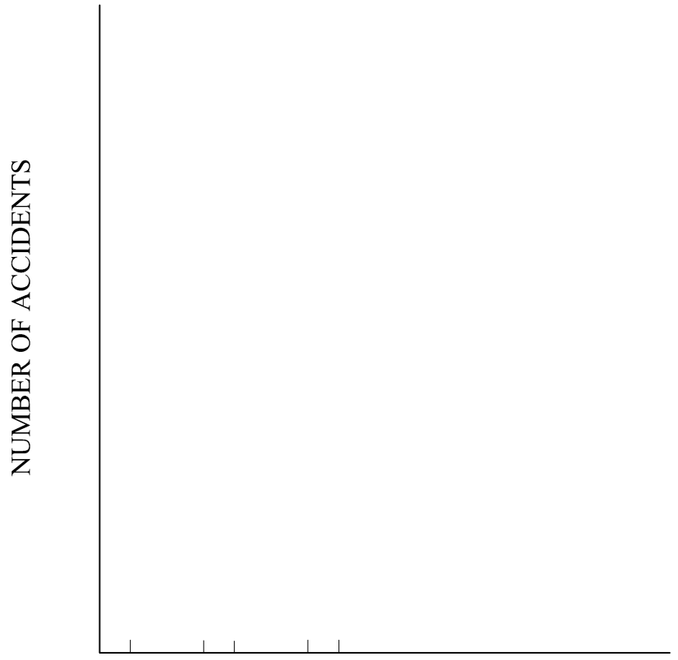


3. In a particular city, road accidents happening over a period of time, were recorded and classified as follows:
40 accidents involved trucks,
90 accidents involved cars,
55 accidents involved motorbikes,
30 accidents involved bicycles and
45 accidents involved pedestrians.

a) Using the given start lines draw a vertical bar graph with five columns to explain graphically the relationship between each of the above accidents. Use a scale of 10mm to represent 10 accidents.

b) Add colour and notation making use of the key.

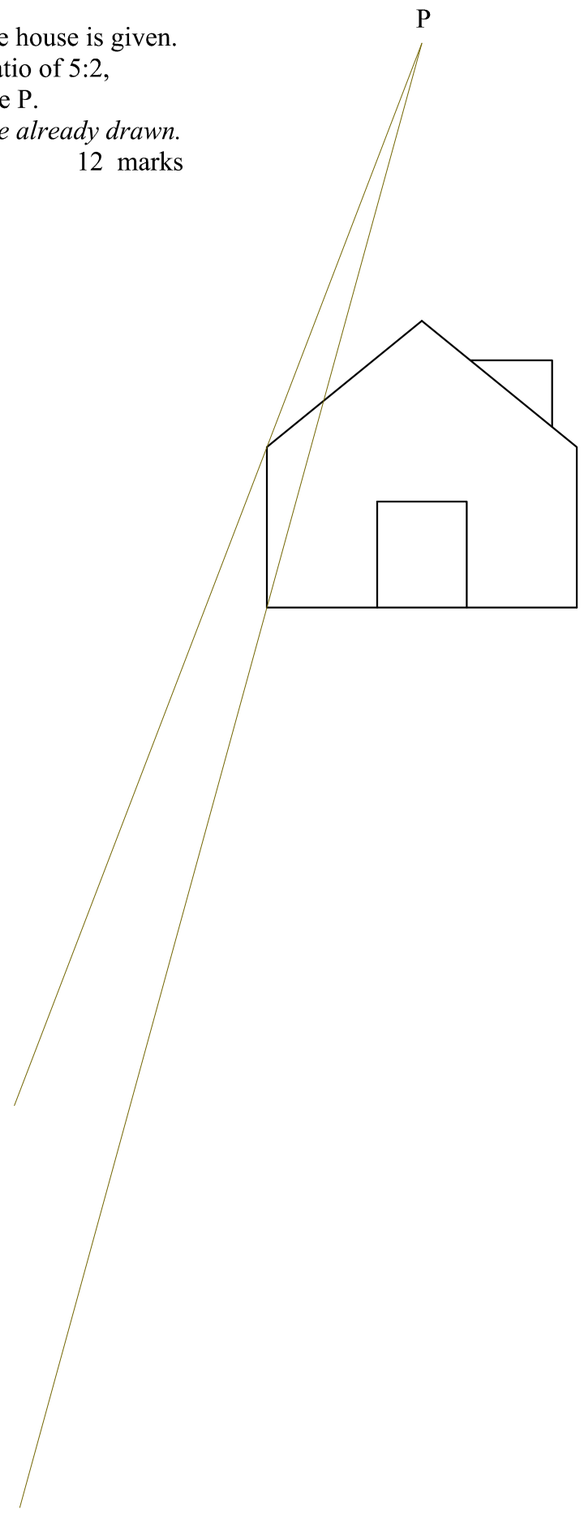
12 marks



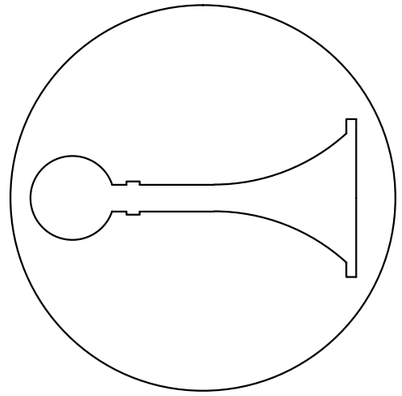
KEY	
	TRUCKS

SCALE: _____

4. The drawing of a simple house is given.
Enlarge the drawing by a ratio of 5:2,
taking radial lines from pole P.
Note: Some radial lines are already drawn.
12 marks



5. a) The drawing below shows a **mandatory** sign.
i) Colour the sign with the appropriate colours.
ii) Print down a title in the guidelines provided to explain the meaning of the sign.
6 marks



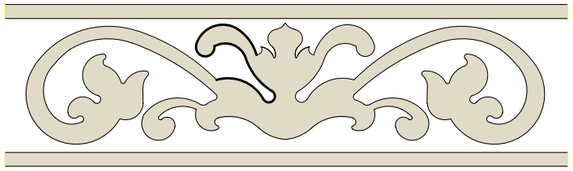
b) A **prohibition sign** is needed at the main entrance of Valletta to inform people not to feed the pidgeons.
i) In the rectangle provided draw freehand sketches to develop the required sign.
ii) Use your sketches to make a final drawing of the prohibition sign in the circle given, using drawing instruments where required.
iii) Colour the sign using the appropriate colours for a prohibition sign.
12 marks

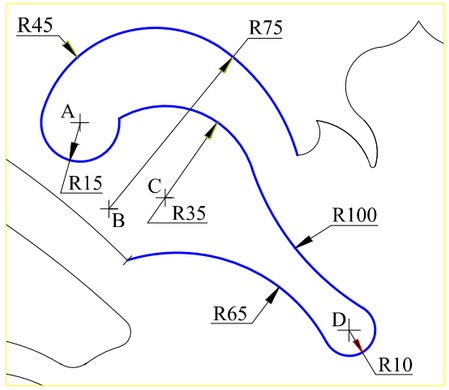
FREEHAND SKETCHES

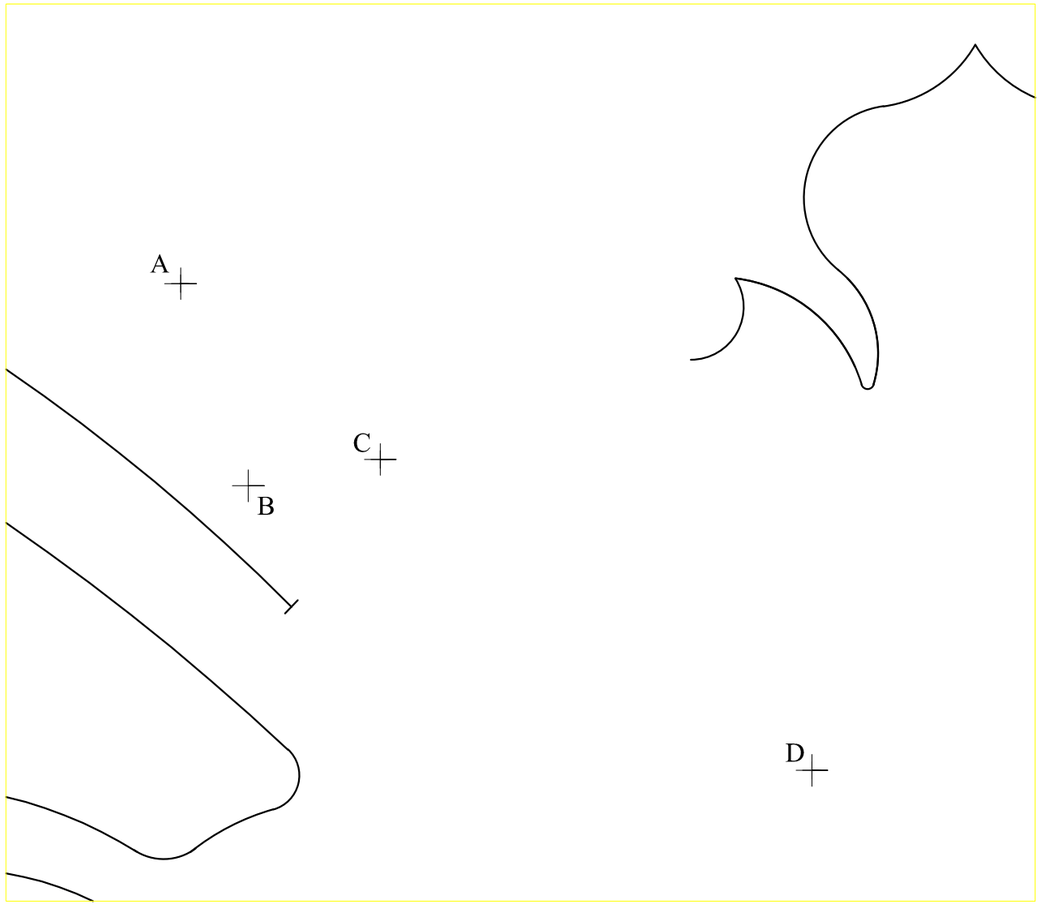
PROHIBITION SIGN

6. The design shown below is part of the marble floor of the Cathedral at Mdina. An enlarged dimensioned part of the design is also given at the side.
Complete the missing part of a similar enlarged design given at the bottom to the given dimensions, showing the construction for obtaining the centre of the arcs.
Show three points of tangency.
Note: It is advisable to start by drawing the arcs with centres A, B, C and D.

14 marks

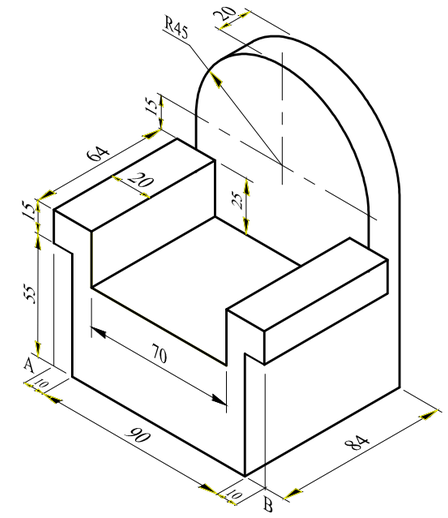


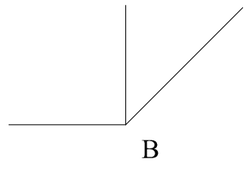




7. An isometric projection of an arm-chair is drawn.
On the start-lines shown below and using the given dimensions, draw a cabinet oblique projection of the arm-chair putting AB on the forefront.

16 marks





FORM 3 (3rd Year) _ 2016
GRAPHICAL COMMUNICATION

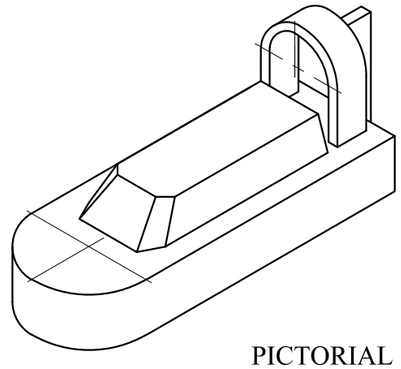
Educational Assessment Unit

Name: _____ Class: _____

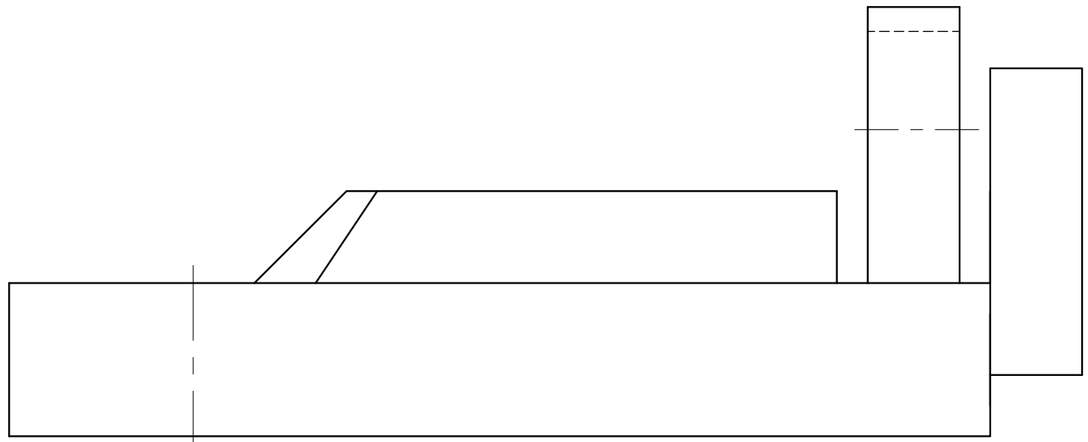
Question 1. Two pictorial views and two orthographic views of a model of a hovercraft (without the rear propellor) are given.
The model is made out of solid wood.

a) By projecting lines from the end view and the front view, draw the plan of the model. Include hidden details.
b) Lable the end view and plan in neat block letters.
c) Draw the symbol of projection used.
d) State whether the views are drawn in *1st angle* or in *3rd angle* orthographic projection. Mark an X in the right box at the bottom.
e) Lightly shade one of the pictorial views to represent the hovercraft as being made of wood.

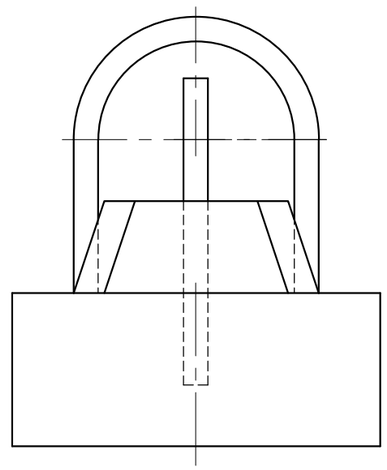
20 marks

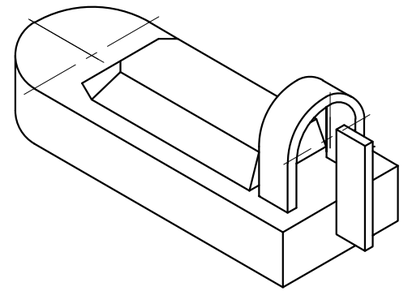


PICTORIAL VIEWS



FRONT VIEW





SYMBOL OF PROJECTION

FIRST ANGLE ORTH. PROJ.

THIRD ANGLE ORTH. PROJ.

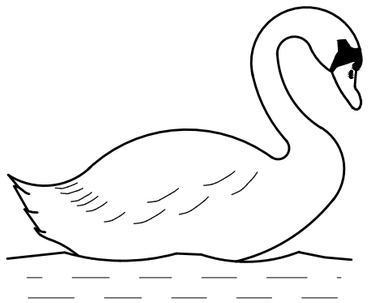
FORM 3 (3rd Year) _ 2015
GRAPHICAL COMMUNICATION

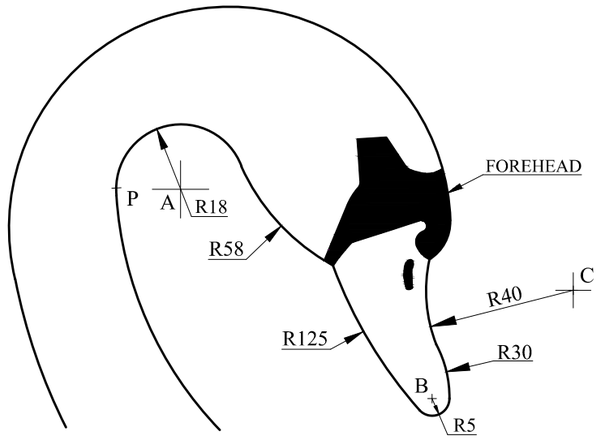
Educational Assessment Unit

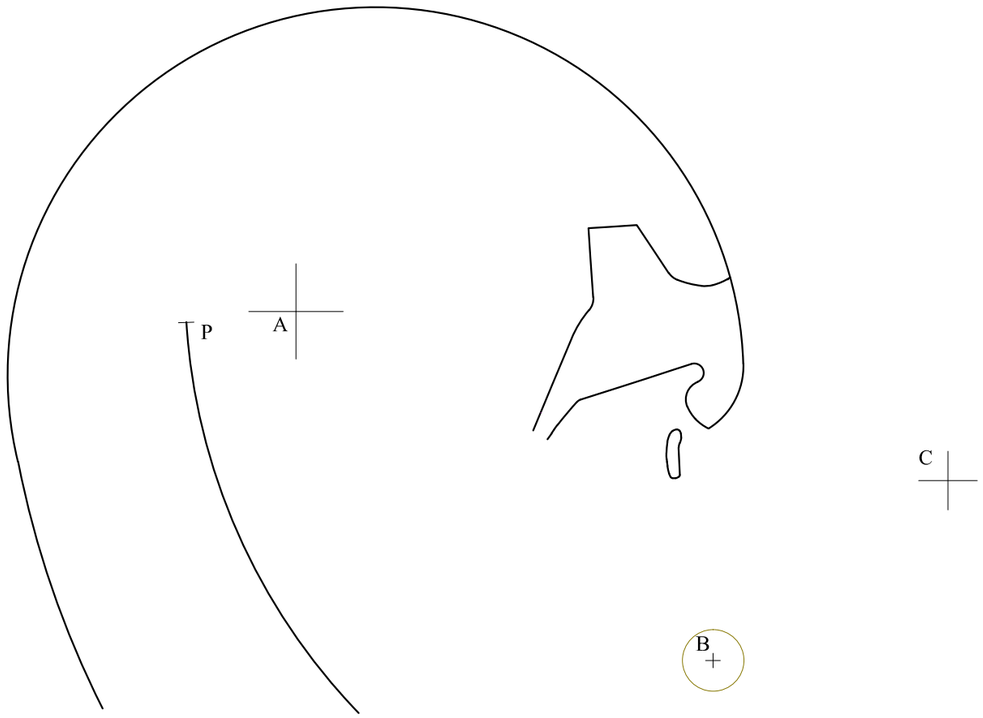
Name: _____ Class: _____

Question 2. The drawing of a swan together with a dimensioned enlarged version of the swan's head are given.
a) Complete the drawing started below to the given dimensions, showing clearly the construction for obtaining the centre of the arcs.
b) Show three points of tangency.
c) Shade the forehead in pencil
Note: P is a point of tangency.

16 marks

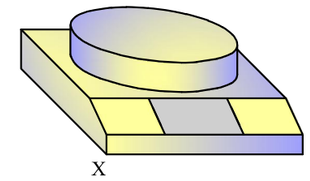




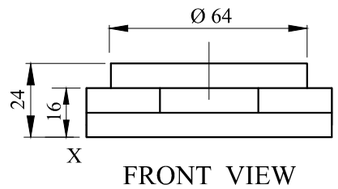


Question 3. Three orthographic views and an oblique projection of an electronic kitchen scale are given.
a) Draw an isometric projection of the scale, putting X as the lowest point of your drawing.
b) Shade the rectangular part where the weight is displayed as if being made of dark coloured glass.

16 marks

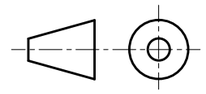


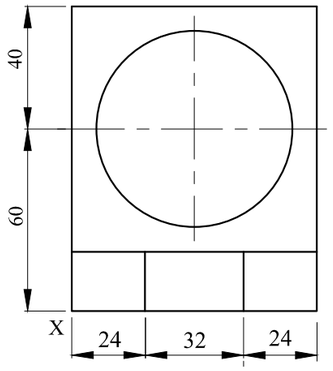
OBLIQUE PROJECTION



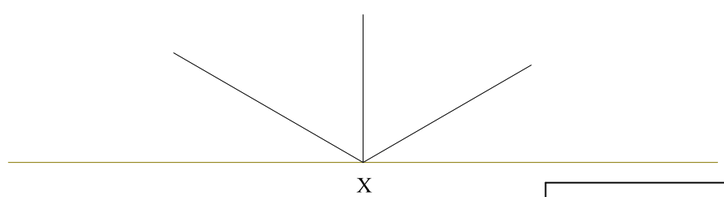
FRONT VIEW

END VIEW





PLAN



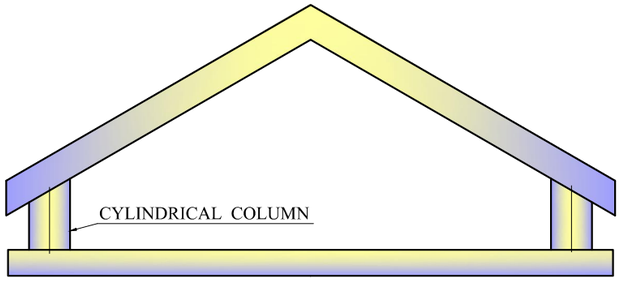
FORM 3 (3rd Year) _ 2015
GRAPHICAL COMMUNICATION

Educational Assessment Unit

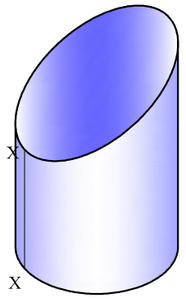
Name: _____ Class: _____

Question 4. The slanting ceiling of a wooden model building is supported by a number of cylindrical columns. Each column is to be covered by a thin sheet of aluminium having the shape of a truncated cylinder. A pictorial view, a front view and plan of one of these truncated cylinders are given.
Using the necessary construction, draw the development of the truncated cylinder.
Note: Place the joint line along XX.

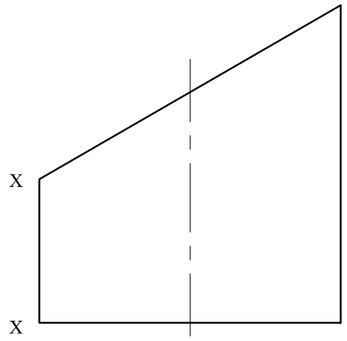
14 marks



MODEL BUILDING

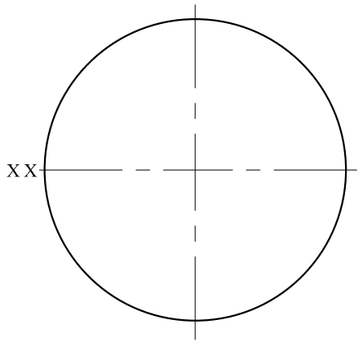


TRUNCATED CYLINDER



FRONT VIEW

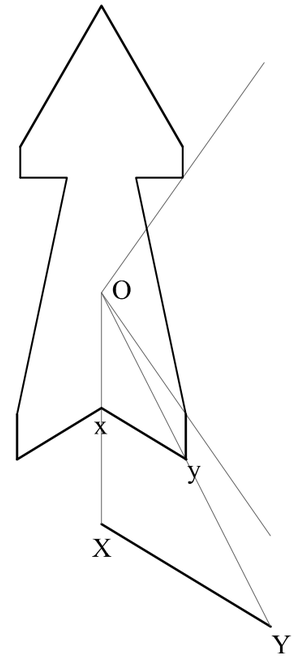
DEVELOPMENT



PLAN

Question 5. The drawing given below shows the outline of an arrow. Enlarge proportionally the size of the arrow by geometrical means such that line xy is enlarged to line XY.

10 marks

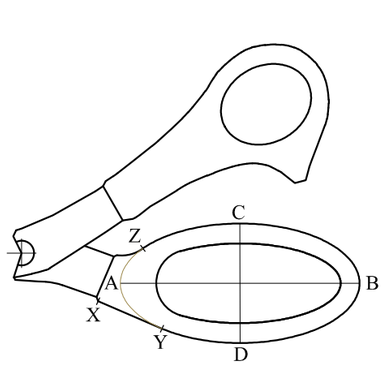


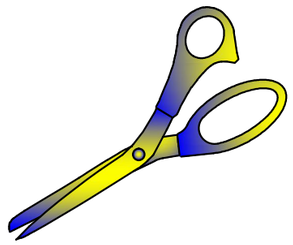
FORM 3 (3rd Year) _ 2015
GRAPHICAL COMMUNICATION

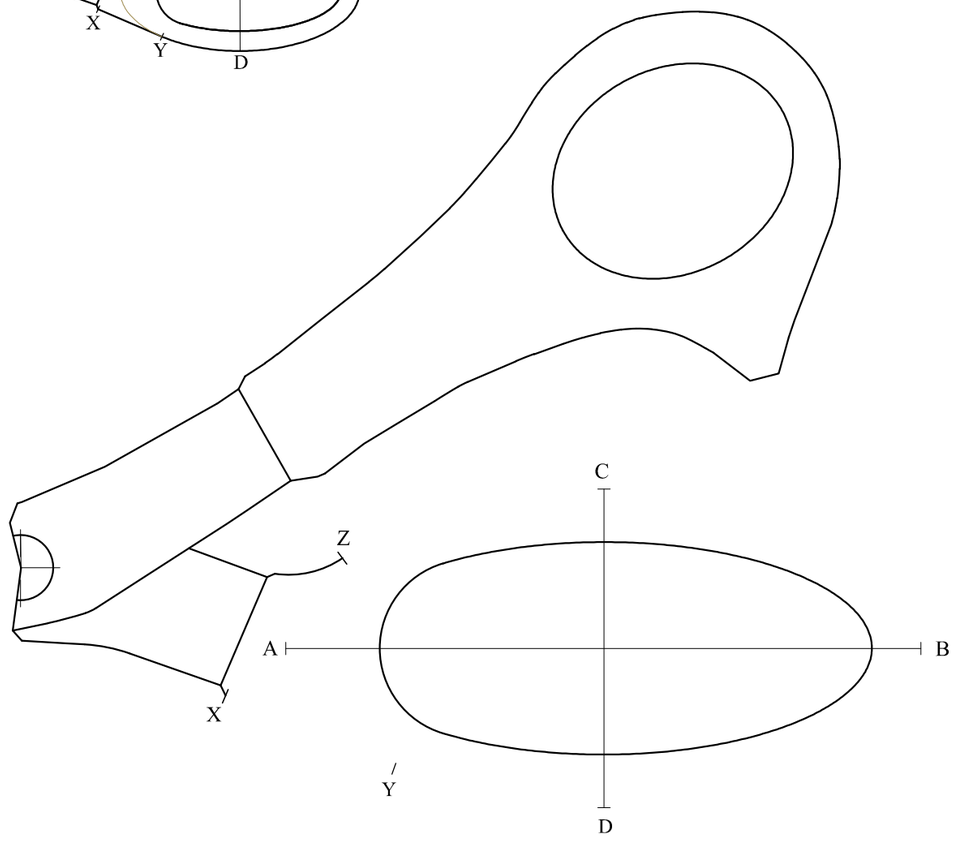
Educational Assessment Unit

Name: _____ Class: _____

Question 6. A scissors is shown below. The lower part of the scissors handle consists of a part ellipse ZCBDY and a tangent XY to the ellipse at point Y.
Continue the enlarged version of the scissors given below by drawing:
a) the part ellipse having a major axis AB and a minor axis CD,
b) the tangent to the ellipse at Y.
Note: Show all construction required to draw both the ellipse and the tangent.
10 marks

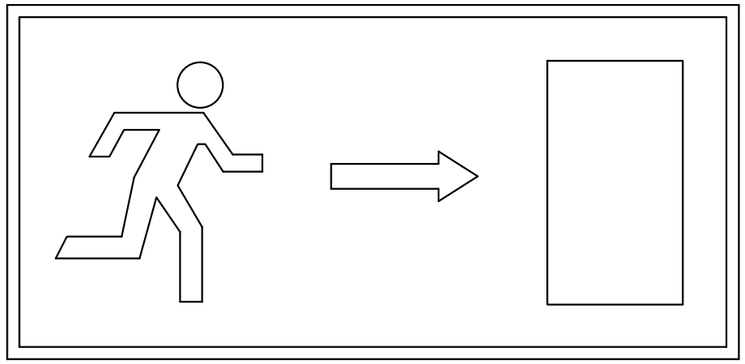






Question 7. a) The figure below shows a *Safe Condition* sign.
i) Colour the drawing using the standard colours for such a sign.
ii) Write down the meaning of the sign.
b) The roof of a building site is still without a boundary wall. A sign is needed to warn all persons on the roof to be careful as they might fall over the building.
Draw a *Hazard Warning Sign* to indicate the above message.
i) Start by drawing preliminary freehand sketches in the rectangle provided.
ii) Make your final drawing using the given triangular shape.
iii) Colour your drawing using the standard colours for such a sign.
14 marks

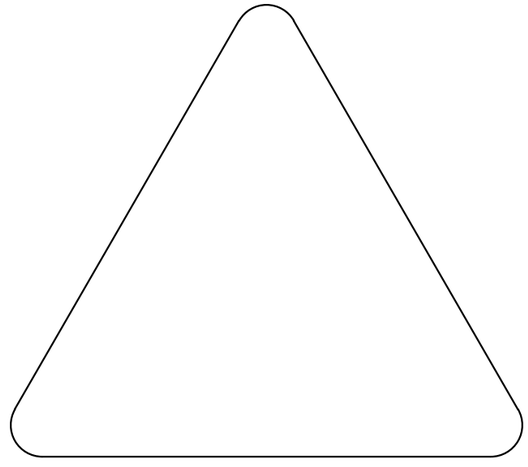
a)



MEANING: _____

b)

FREEHAND SKETCHES



FINAL DRAWING

FORM 3 (3rd Year) _ 2015
GRAPHICAL COMMUNICATION

Educational Assessment Unit

Name: _____ Class: _____

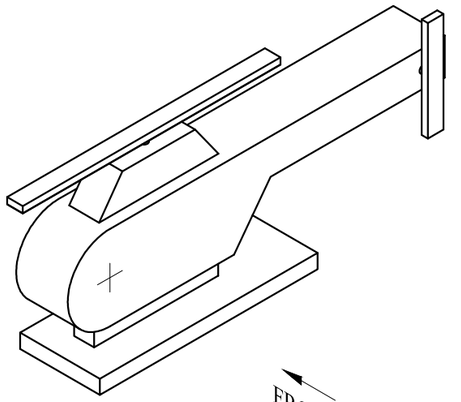
Question 1. A pictorial view and two orthographic views of a toy helicopter are given.

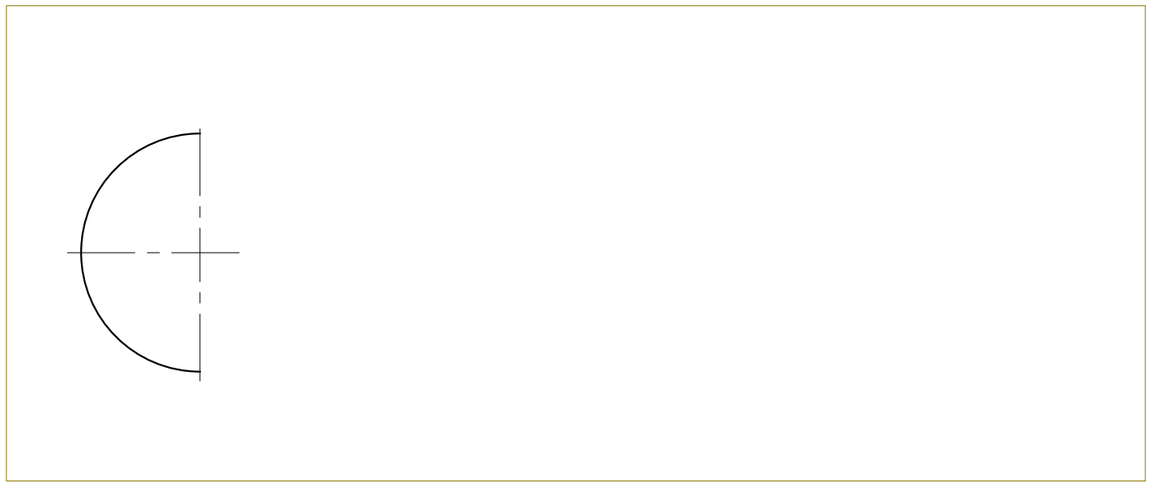
a) Draw the front elevation in the direction of the arrow.

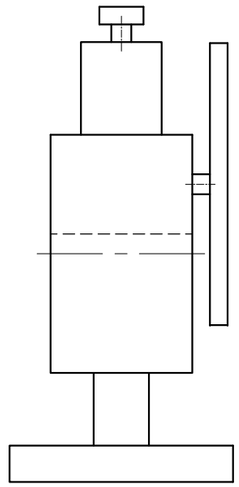
b) Label the front view and the correct symbol of projection.

Note: The curved part of the front elevation is already drawn.

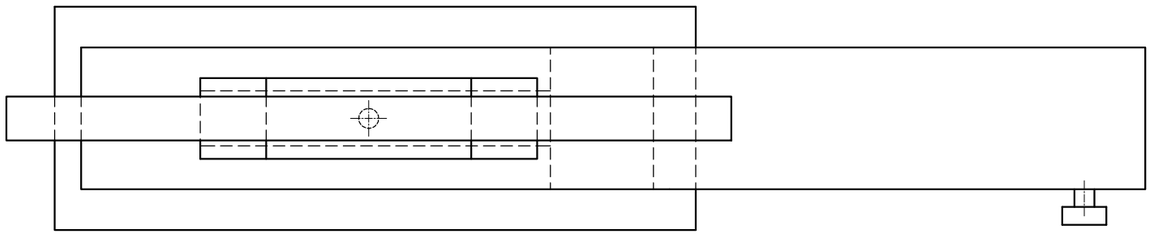
14 marks.



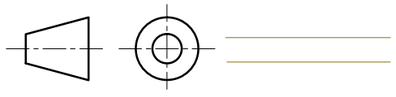




END VIEW



PLAN



ANGLE PROJECTION

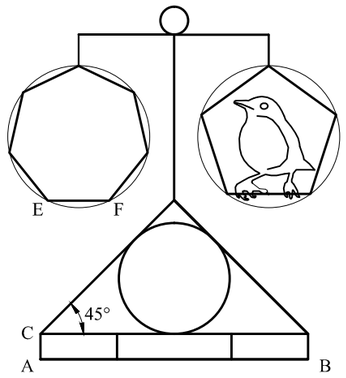
FORM 3 (1st Year) _ 2016
GRAPHICAL COMMUNICATION

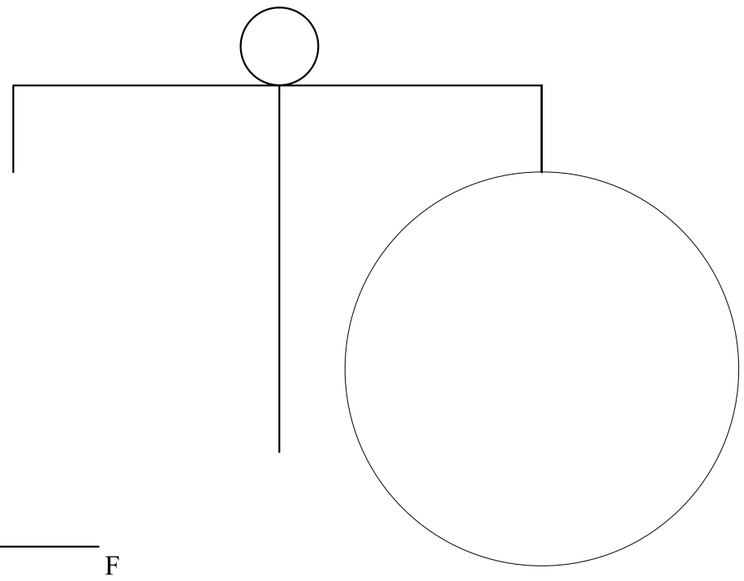
Educational Assessment Unit

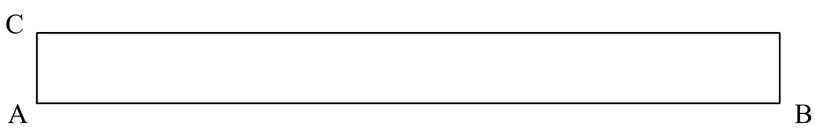
Name: _____ Class: _____

2. The drawing at the side shows a gadget used in bird cages.
Using the given starting lines, make a drawing similar to the one shown by following these instructions:
a) Divide line AB in the ratio of 2:3:2 and draw the two lines within the rectangle.
b) Construct the angle of 45° at C using the compass and complete the isosceles triangle using the set-square.
c) Inscribe a circle in the triangle.
d) Construct the regular pentagon in the circle provided.
e) Construct the regular heptagon with line EF as the base.
Note: Do not draw the bird.

18 marks

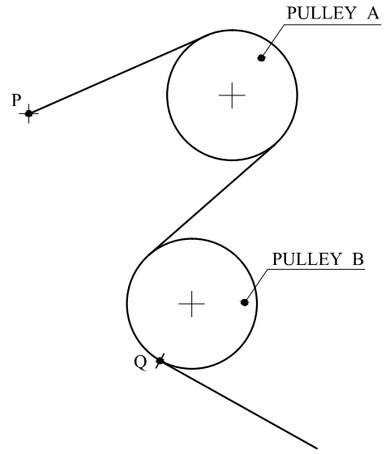


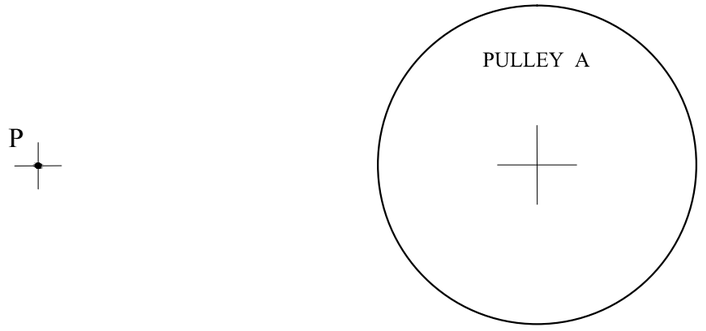


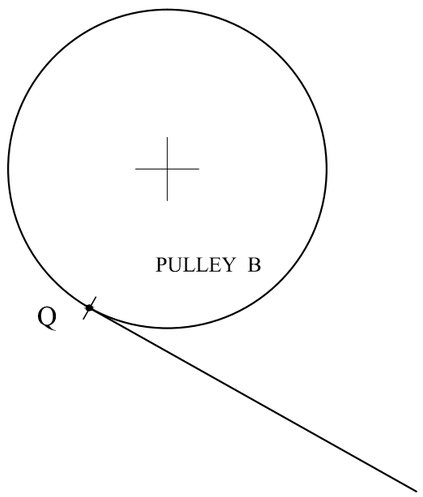


3. The figure at the side shows part of a system of pulleys with a belt.
The arrangement consists of three tangents.
Both pulleys have the same diameter.
Draw a similar arrangement on pulleys A and B given below using the following instructions:
a) Construct a tangent from point P to pulley A.
b) Construct a transverse (internal) tangent between pulleys A and B.
Note: The tangent at Q is already drawn.

12 marks







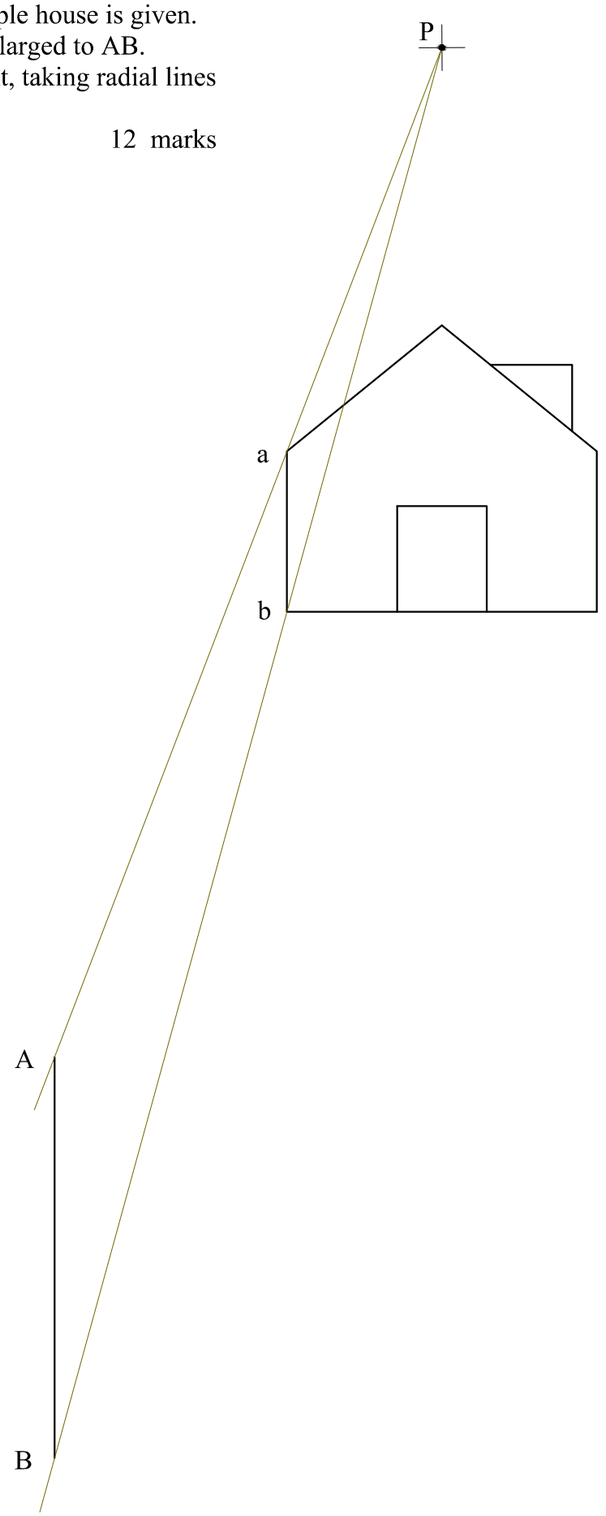
FORM 3 (1st Year) _ 2016
GRAPHICAL COMMUNICATION

Educational Assessment Unit

Name: _____ Class: _____

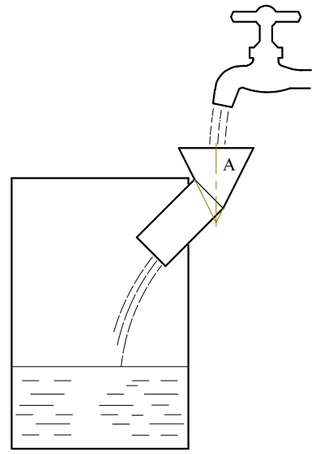
4. The drawing of a simple house is given.
Side ab of the house is enlarged to AB.
Complete the enlargement, taking radial lines from pole P.

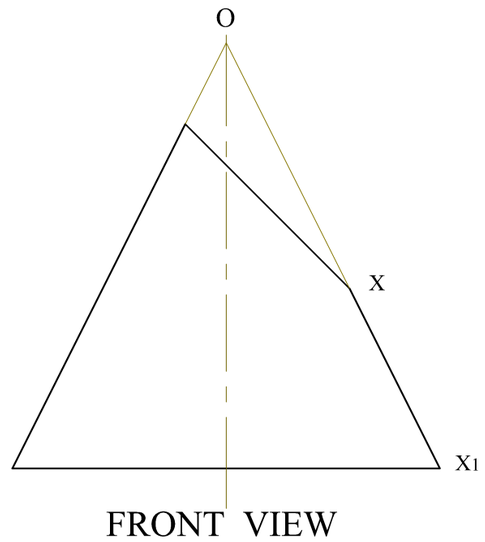
12 marks



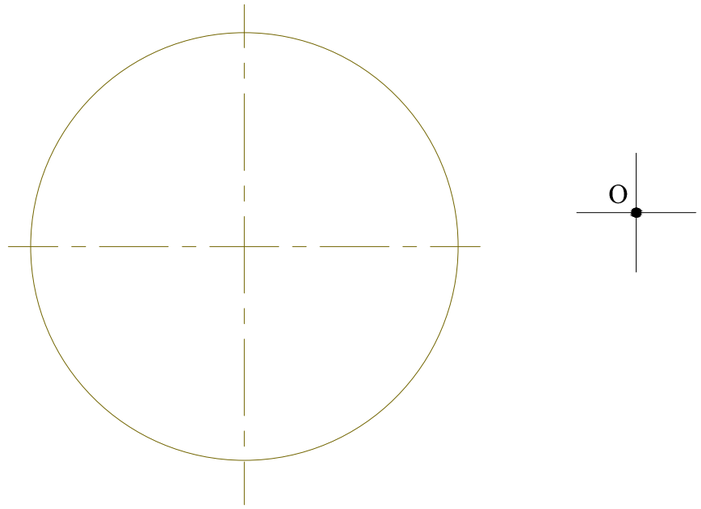
5. A funnel used to fill up a tank is made up of thin sheet metal.
It consists of a truncated cone A and a truncated elliptical pipe.
The front view of the truncated cone (shown inverted) is given below.
Starting from the given point O, construct the development of the truncated cone.
Note: Take the joint line along XX1.

12 marks





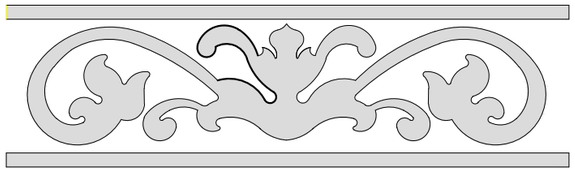
FRONT VIEW

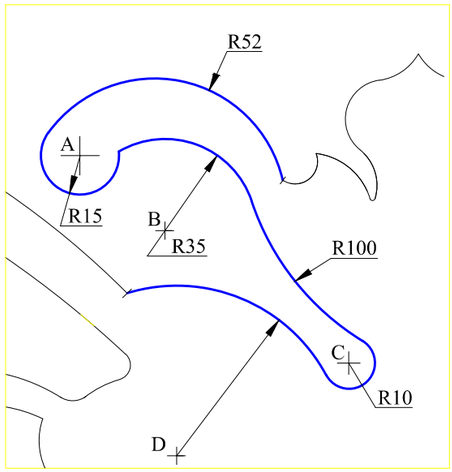


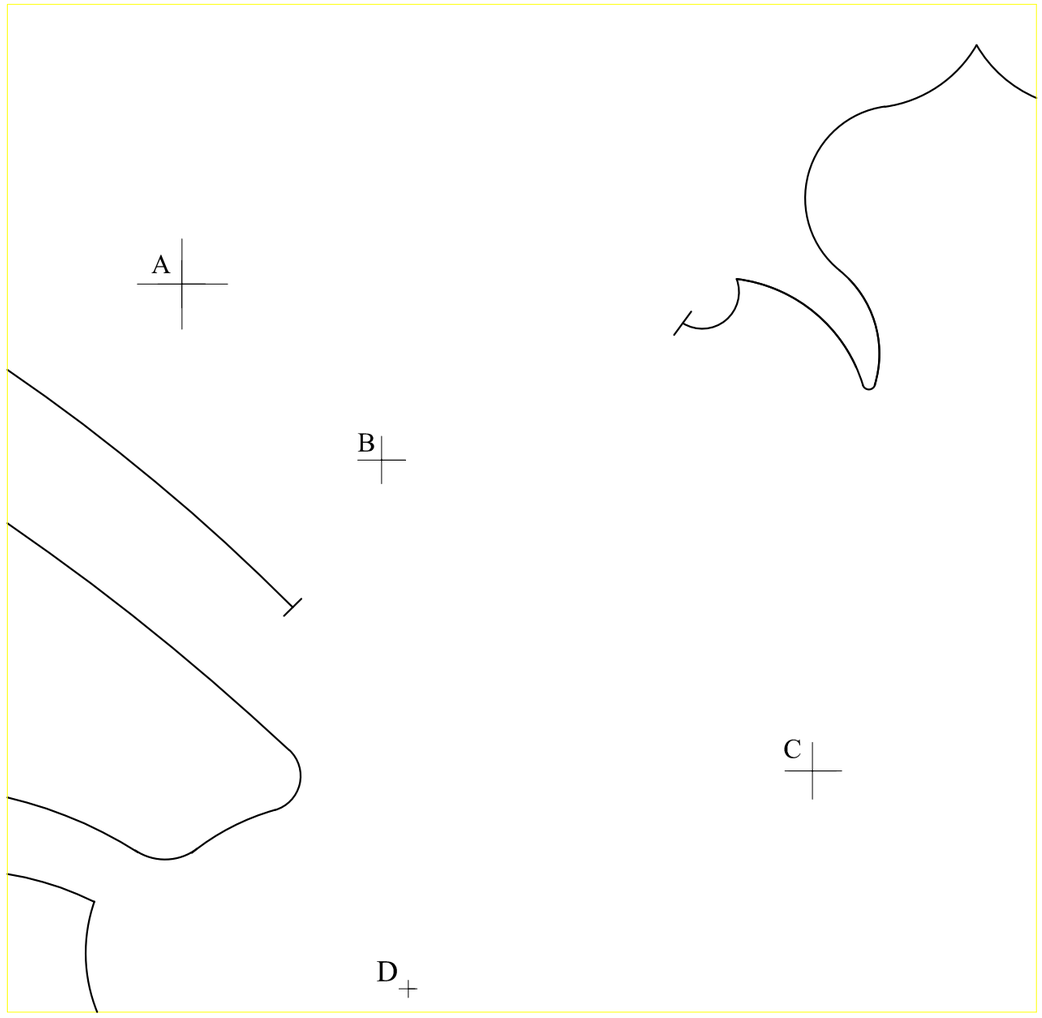
DEVELOPMENT

6. The design shown below is part of the marble floor of the Cathedral at Mdina. An enlarged dimensioned part of the design is also given at the side.
Complete the missing part of a similar design shown at the bottom to the given dimensions, showing the construction for obtaining the centre of the arcs.
Show two points of tangency.
Note: It is advisable to start by drawing the arcs with centres A, B, C and D.

16 marks

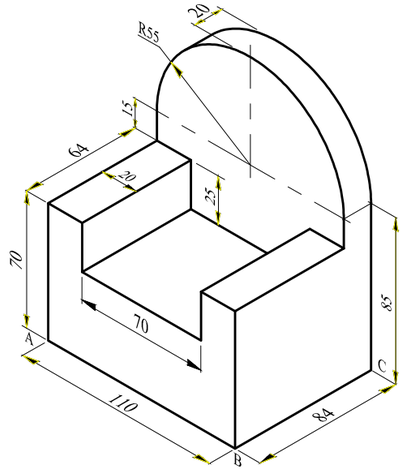


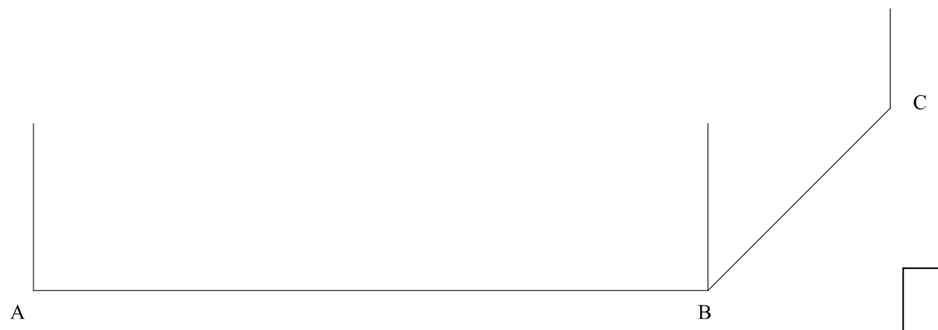




7. An isometric projection of an arm-chair is drawn.
On the start-lines shown below and using the given dimensions, draw a cabinet oblique projection of the arm-chair putting AB on the forefront.

16 marks





FORM 3 (1st Year) _ 2016
GRAPHICAL COMMUNICATION

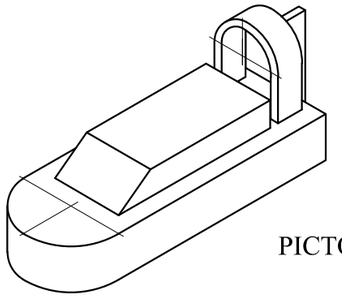
Educational Assessment Unit

Name: _____ Class: _____

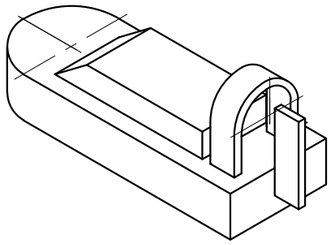
Question 1. Two pictorial views and two orthographic views of a model of a hovercraft (without the rear propellor) are given. The model is made out of solid wood.

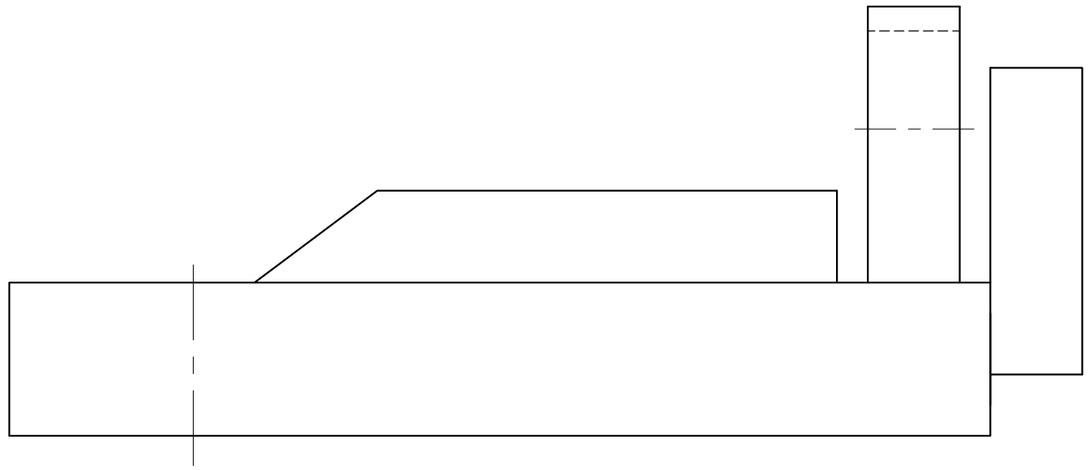
a. By projecting lines from the end view and the front view, draw the plan of the model. Include hidden details.
b. Label the end view and plan in neat block letters.
c. Draw the symbol of projection used.
d. Lightly shade one of the pictorial views to represent the hovercraft as being made of wood.

20 marks

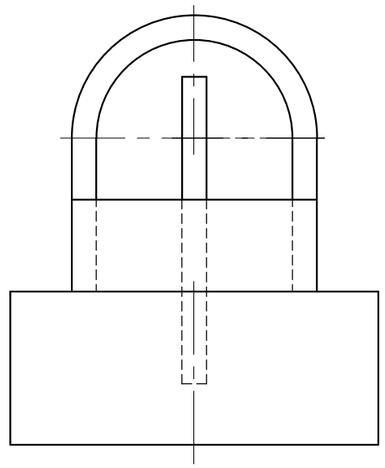


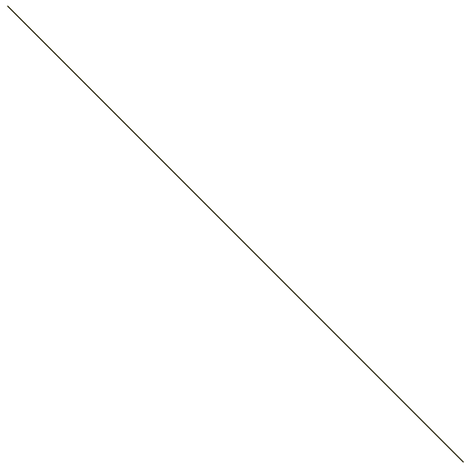
PICTORIAL VIEWS





FRONT VIEW

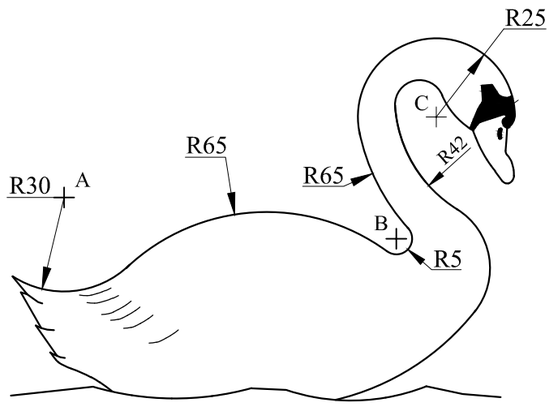


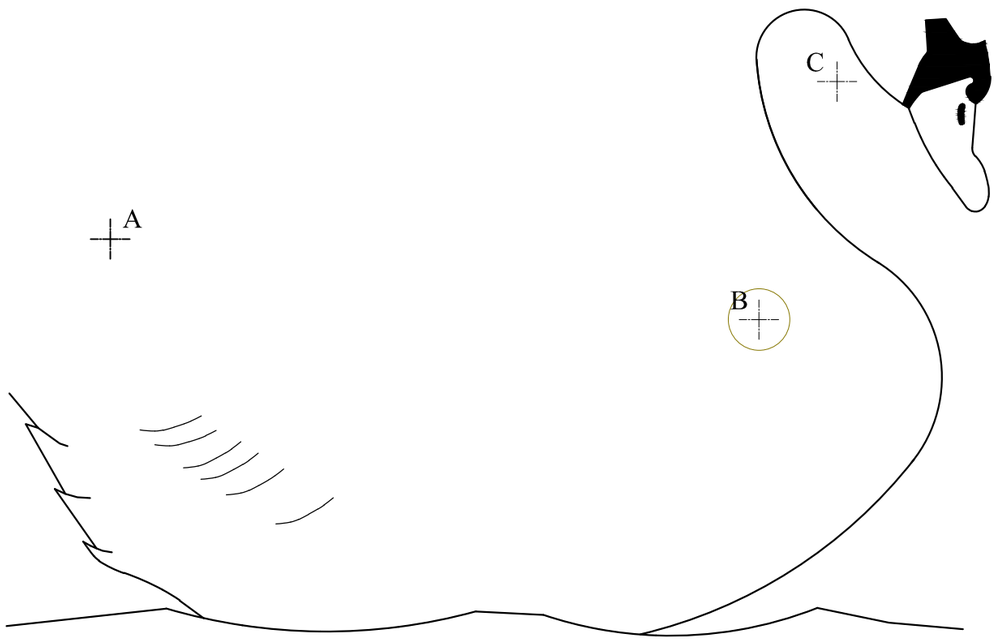


SYMBOL OF PROJECTION

Question 2. The drawing of a dimensioned swan is given.
a) Complete the drawing started below to the given dimensions, showing clearly the construction for obtaining the centre of the arcs.
b) Show three points of tangency.

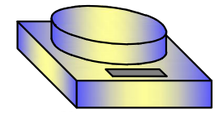
16 marks



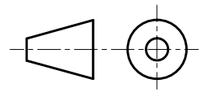


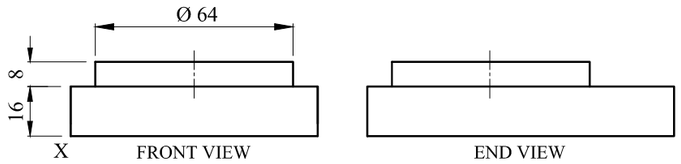
Question 3. Three orthographic views and an oblique projection of an electronic kitchen scale are given.
a) Draw an isometric projection of the scale, putting X as the lowest point of your drawing.
b) Shade the rectangular part where the weight is displayed as if being made of dark coloured glass.

16 marks



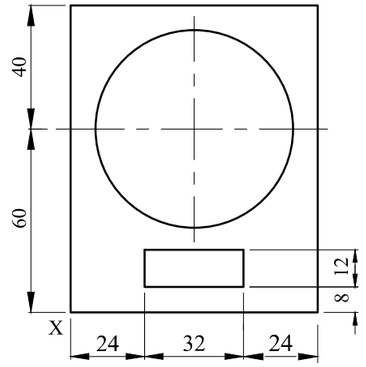
OBLIQUE PROJECTION



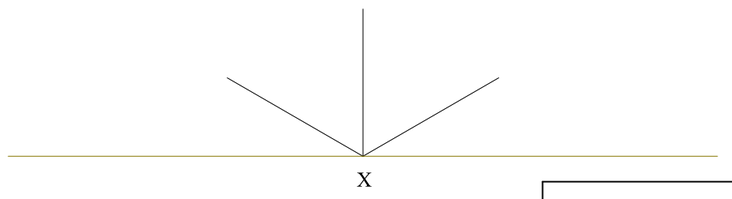


FRONT VIEW

END VIEW



PLAN



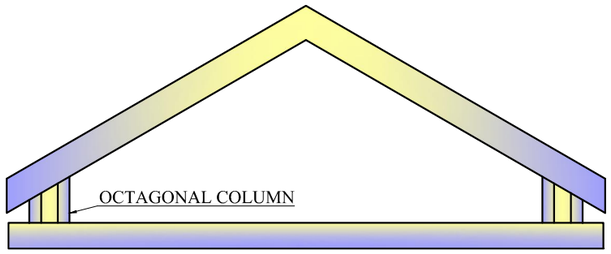
FORM 3 (1st Year) _ 2015
GRAPHICAL COMMUNICATION

Educational Assessment Unit

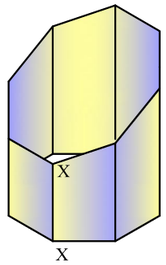
Name: _____ Class: _____

Question 4. The slanting ceiling of a model building shown below in front elevation is supported by a number of octagonal columns.
Each column is to be covered by a thin sheet of aluminium, forming a truncated octagonal prism.
A pictorial view, a front view and a plan of one of these truncated prisms are given.
Using the necessary construction, and on the given start lines, draw the development of the prism.
Note: Place the joint line along XX.

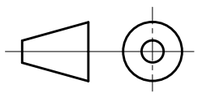
14 marks

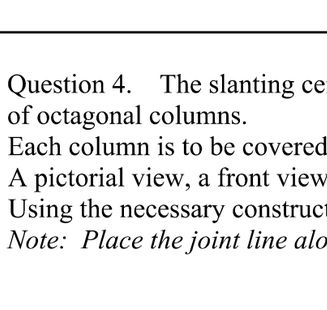


MODEL BUILDING



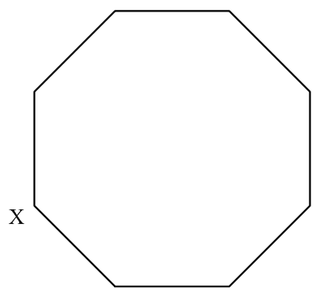
TRUNCATED PRISM





FRONT VIEW

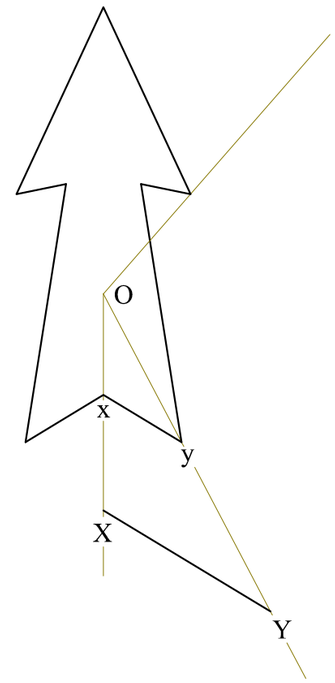
DEVELOPMENT



PLAN

Question 5. The drawing given below shows the outline of an arrow.
Enlarge proportionally the size of the drawing by geometrical means such that line xy is enlarged to line XY.

12 marks



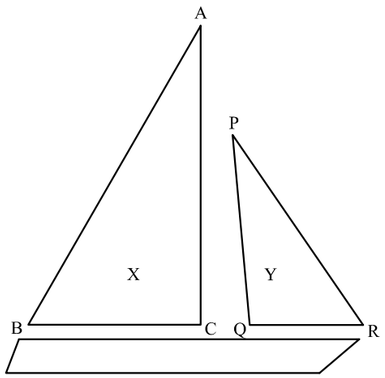
FORM 3 (1st Year) _ 2015
GRAPHICAL COMMUNICATION

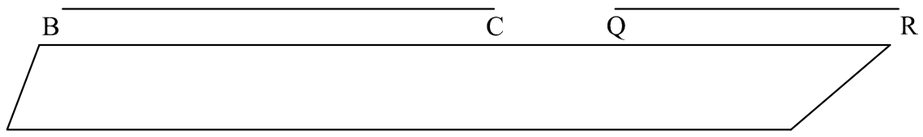
Educational Assessment Unit

Name: _____ Class: _____

Question 6. Complete the sailing boat shown at the bottom using the following instructions:
a) Sail X: Construct a triangle ABC on base BC where angle B is 60° and angle C is 90°.
Both angles must be constructed using the compass.
b) Sail Y: Construct a triangle PQR on base QR where angle Q is 95° and PR is 95mm.
Use your protractor where required.

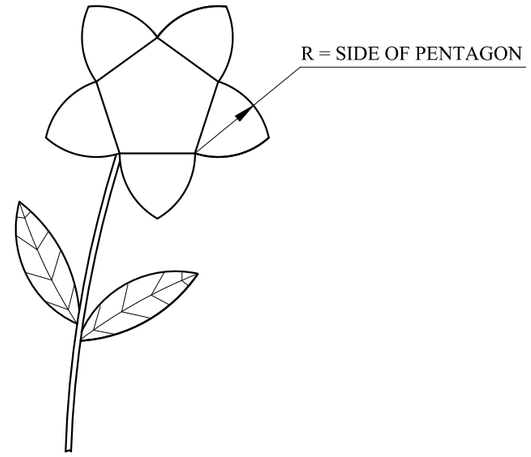
12 marks

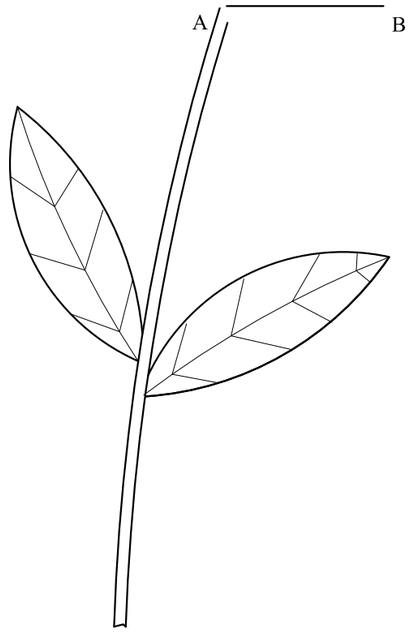




Question 6. The flower shown below is based on a regular pentagon.
Complete a similar flower started at the bottom by:
a) constructing a regular pentagon on base AB,
b) drawing the arcs by placing the compass at the corners of the pentagon.
Colour your flower using coloured pencil.

10 marks





FORM 3 (1st Year) _ 2015
GRAPHICAL COMMUNICATION

Educational Assessment Unit

Name: _____ Class: _____