

MAKER SPACE LAB MS101 – Spring 2025

INTRODUCTION TO Maker's Space

WHY, WHAT, HOW, WHERE, WHEN?

Instructors

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Acknowledgements: IIT Bombay Alumni

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STAFF ASSOCIATED WITH MS101

IMPORTANCE OF STUDYING MAKER SPACE LAB - WHY

- Engineer – Use tools and materials, developed by scientists or available in nature, to make products
- Products that enhance our functioning in ways that were not possible before
- Invent/Design, Develop, Analyze, Standardize, Communicate, Scale-up, etc., are some important aspects of Engineering

Maker space lab is developed to provide a simple journey through this process of Engineering a Product

WHAT DO WE STUDY IN MAKER SPACE LAB

A Simple Pen to a Complex Aero-Engine are all products, to do something for us

- **Designed** – with a purpose including functionality, aesthetics, usability, cost, etc.
- **Developed** – realized into a physical form that can be tested
- **Analyzed** – does it work or not? Are there any flaws, current and future?
- **Verified/validated** – to meet desired performance
- **Marketed** – generate value e.g., through perception, comparison, etc. (economics)

Maker space lab is developed to provide a simple journey through this process of Engineering a Product

HOW DO WE GO ABOUT LEARNING IN MAKER SPACE LAB

- 1. SKETCH – Putting your thought on paper (e.g., cartoon)**
- 2. DRAW/MODEL – Formalize and Communicate with drawings (specifications) to realize the product (iterate 1-2)**
- 3. ANALYSIS – Evaluate performance (can it do what you envisioned), identify issues, iterate on 1-2-3, finalize the specifications**
- 4. MANUFACTURE – Make the product, validate and iterate 1-2-3-4 (e.g., Can you make it to your specifications?)**



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The Goal of Maker Space Lab is to Design and Develop an Electro-Mechanical Machine with a Purpose

MS101 – (L-T-P-C: 1-0-6-8)

- **Institute Core Course for UG 1st year**
 - Replacement course for the Engineering Drawing and Workshop courses
 - Currently run jointly by ME and EE – both semesters
- **Summary**
 - ME (6 lectures + 6 lab experiments)
 - EE (12 lectures + 5 lab experiments)
 - Final project (in groups of 6): 5 - 6 weeks – requires ME and EE skills
 - Evaluations: Quizzes, Final Demo (for Endsem)

Timetable for ME Lectures

Day	Time	Venue	Section
Monday	10:35 - 11:30(3A)	LA202	P13,P14,P15, P1, P2, P3, P4, (Div./Lab group)
		IC1	P16
Wednesday	11:05 - 12:30(6A)	LA202	P19, P20, P21,P22, P7,P8,P9,P10 (Div./Lab group)

OVERALL TEACHING PLAN FOR MECHANICAL PART

WEEK NO.	DATES	DAY	THEORY	DATE	LAB
1	6 th & 8 th Jan	Mon, Wed	Sketching and Visualisation	9 th , 10 th & 13 th , 14 th Jan	Sketching and Visualisation
2	13 th & 15 th Jan	Mon, Wed	Orthographic Projection - Fusion 360	16 th , 17 th & 20 th , 21 st Jan	Orthographic Projection (OP)
3	20 th & 22 nd Jan	Mon, Wed	3D modelling & modification - Fusion 360	23 rd , 24 th & 27 th , 28 th Jan	OP - Fusion 360
4	27 th & 29 th Jan	Mon, Wed	Components & assembly - Fusion 360	3 rd , 4 th & 10 th ,11 th Feb	3D – Fusion 360
5	3 rd & 5 th Feb	Mon, Wed	Generative design - Fusion 360	13 th , 14 th & 17 th , 18 th Feb	Assembly - Fusion 360
6	10 th & 12 th Feb	Mon, Wed	Manufacturing Theory	20 th , 21st Feb & 3 rd , 4 th Mar	3D printing, laser cutting
7			MID-SEMESTER EXAMINATION	22nd February (Saturday) to 2nd March (Sunday)	
8			14 th Holi	6 th , 7 th & 10 th , 11 th Mar	PROJECT WORK
9				13 th , 14 th Mar	PROJECT WORK
10				17 th ,18 th & 20 th , 21 st Mar	PROJECT WORK
11			31 March: Id-il-fitr 10 th Apr: Mahavir Jayanti	24 th , 25 th & 27 th , 28 th Mar 31 st Mar, 1 st & 3 rd , 4 th Apr	PROJECT WORK
13				7 th , 8 th & 10 th , 11 th Apr	PROJECT WORK
14			18 th Apr: Good Friday	14 th , 15 th Apr 17 th , 18 th Apr	PROJECT WORK
					EVALUATION

21st APRIL 2023 – 1st May END SEMESTER EXAMINATION

SCHEDULING OF MECHANICAL AND ELECTRICAL LABS ALONG WITH PHYSICAL LOCATION

	Morning Session		Afternoon Session	
	Drawing Hall	ESE LAB (101,108)	Drawing Hall	ESE LAB (101,108)
Monday	P19,P20-120 (Mechanical Part) 9:30am-12:30pm (2A,3A,4A)	P20-47,P8-9,P10-3 (Electrical Part) 9:30am-12:30pm (2A,3A,4A)	P13,P14 - 132 (Electrical Part) 2:00pm-5:00pm (L1)	P14-44, P2-7,P4 – 15 (Mechanical Part) 2:00pm-5:00pm (L1)
Tuesday	P21,P22-120 (Mechanical Part) 8:30am-11:30am (4B,1B,2B)	P22– 42,P7-3,P9-5 (Electrical Part) 8:30am-11:30am (4B,1B,2B)	P15, P16 – 132 (Electrical Part) 2:00pm-5:00pm (L2)	P16 – 43, P1-12,P3-9 (Mechanical Part) 2:00pm-5:00pm (L2)
Thursday	P19, P20 – 120 (Electrical Part) 9:30am-12:30pm (4C,1C,2C)	P20–47,P8-9,P10-3 (Mechanical Part) 9:30am-12:30pm (4C,1C,2C)	P13, P14 – 132 (Mechanical Part) 2:00pm-5:00pm (L3)	P14-44,P2-7,P4-15 (Electrical Part) 2:00pm-5:00pm (L3)
Friday	P21,P22–120 (Electrical Part) 9:30am-12:30pm (5B,6B)	P22–42,P7-4,P9-5 (Mechanical Part) 9:30am-12:30pm (5B,6B)	P15, P16 – 132 (Mechanical Part) 2:00pm-5:00pm (L4)	P16-43,P1-12,P3-9 (Electrical Part) 2:00pm-5:00pm (L4)

LAB TIME SLOT FOR ME FACULTY

	Morning Session	Afternoon Session
	Drawing Hall	ESE LAB (101,108)
Monday	P19,P20-120 (Prof. Sripriya)	P14-44, P2-7,P4 – 15 (Prof. Date)
Tuesday	P21,P22-120 (Prof. Date)	P16–43, P1-12,P3-9 (Prof. Shankar)
Thursday	ESE LAB (101,108) P20–47,P8-9,P10-3 (Prof. Tewari)	Drawing Hall P13, P14 – 132 (Prof. Shankar)
Friday	P22–42,P7-4,P9-5 (Prof. Sripriya)	P15, P16 –132 (Prof. Tewari)

LAB TIME SLOT FOR RESEARCH ASSOCIATES (to be updated)

LAB SESSION	SLOTS	RA
MONDAY	BN (8:30-11:30)	Shreyas Singh
	AN (2:00-5:00)	Chollangi Bhavaniprasad
TUESDAY	BN (8:30-11:30)	Pragyila Kumar Mishra
	AN (2:00-5:00)	Lokesh Bhamare
THURSDAY	BN (8:30-11:30)	Abhishek Sokhal
	AN (2:00-5:00)	Sahil Sayyad
FRIDAY	BN (9:30-12:30)	Sajal Thomas
	AN (2:00-5:00)	Sourag Suresh

Where?



MS101 Mechanical Engineering Syllabus

- **Engineering Drawing Basics**
- **Projections, Sections with Fusion 360**
- **3D Modeling with Fusion 360**
- **Assembly of components with Fusion 360**
- **Generative design with Fusion 360**
- **Manufacturing Practices (conventional and Advanced)**

MODE OF CONDUCT OF LAB SESSIONS (ME PORTION)

- Lab sessions are almost of self-help in nature
- Teaching assistant or the teacher will not help you, that essentially means you need to come prepared for the lab
- In case, if you seek help, marks would be deducted accordingly
- Usually, lab sessions are easy, provided
 - You attend corresponding theory lectures
 - Come prepared to the lab about the lab session material which would be provided apriori (few days before the lab session)

MS 101 Project (after midsem)

- There will be 5 weeks (10 lab sessions / student) Project Lab sessions.
- Projects to be carried out in groups of 6
- **PROJECT DEMO AND VIVA will be held on the last two lab days in the lab itself (in Transit Building)**
- **PROJECT EVALUATION:**
 - In-semester evaluation by ME and EE separately during the seven project sessions (evaluation of submissions –short videos detailing project progress and individual contributions)
 - Project Demo cum Viva : during the last two days (during the Lab sessions). Jointly done by ME and EE faculty in two groups

GRADING POLICY

- Senate requirement of 80% attendance; else DX grade may be allocated.
- Makeup labs to be done for missed Labs with valid institute permitted reasons (no attendance will be given for makeup labs)
- Makeup exams – in case missed due to medical or genuine reasons

GRADING POLICY for ME PORTION

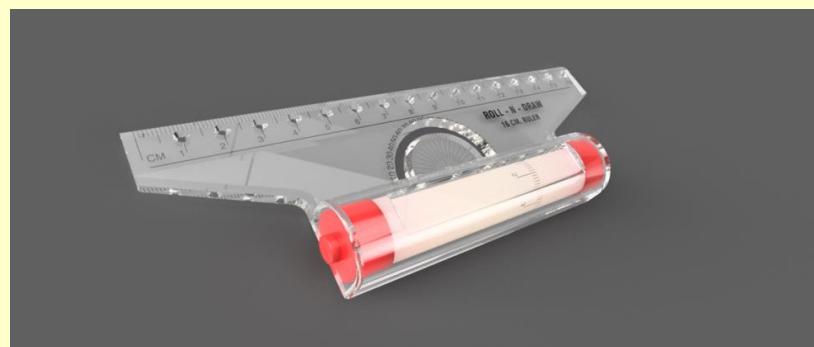
- **Lab quizzes:**
 - 30%
 - 6% for each lab session
 - 6 lab sessions in total
 - Best of 5 lab sessions marks will be chosen for final grade.
- **Project: 40% (COMBINED ME AND EE)**
 - Design and progress:
 - Final Project demo and Viva:

THEME OF THIS COURSE

Fun and joy of learning and doing

ITEMS that would be given in the lab and to be returned on daily basis

1. Pencils – HB and H
2. Eraser
3. Simple Scale – 30 cm and 15 cm
4. Rolling Scale (preferred)
5. Pencil sharpener
6. Compass



1st Lab session: Bring pencil, eraser & sharpener

Expectations from Students

- Come to the class and lab on time – Discipline (10% penalty for late entry beyond 10 mins)
- No mobile usage is allowed in the theory class and laboratory class
- Attire – no shorts ALLOWED and come with full pants, sleeve shirts/tops and shoes (10% penalty for violation). This is in view of the safety requirement.
- Work on lab sheets independently. IT IS CONDUCTED LIKE A QUIZ. Do not copy from others.
- Best way is to
 - Study the material taught in the theory class – NOTES
- In case, if you are stuck and cannot make headway at all, your teaching assistant will help you but few marks would be deducted.

Expectations from Students

- **Students can attend only their assigned slots. If they miss their assigned slots for any reason (including valid reasons like illness, etc.) and show up for another slot, it will be considered as absence.**
- **Institute rules regarding academic honesty will be applicable. Cases of academic misconduct/malpractice will be processed as per rules.**

Expectations from Students

For the execution of the project

- Work in groups while doing projects. Team spirit and mutual learning key to the success of the project
- Using resources from internet is fine for learning but, do not copy
- Also, if you don't know, refer to books and ask one of us (Teachers, RAs, Lab Staff)
- You cannot take the project material to your hostel. Need to keep the project material within the lab and leave.

MS 101

ME LECTURE 1

SKETCHING AND VISUALIZATION

TEXTBOOKS REFERRED TO

MAIN BOOKS

- **Text Book 1:** Dennis K. Lieu and Sheryl Sorby, Visualization, Modeling, and Graphics for Engineering Design
- **Text Book 2:** N. D. Bhatt and V. M. Panchal, Engineering Drawing, Charotar Publishers

REFERENCE BOOKS :

- Warren J. Luzadder and Jon M. Duff, Fundamentals of Engineering Drawing, Prentice-Hall of India
- Thomas E. French, Charles J. Vierck and Robert Foster, Engineering Drawing and Graphic Technology, McGraw Hill
- Dhananjay A. Jolhe, Engineering Drawing, Tata McGraw Hill Publishing Co. Ltd.
- M. B. Shah and B. C. Rana, Engineering Drawing, Dorling Kindersley (India) Pvt. Ltd., Pearson Education

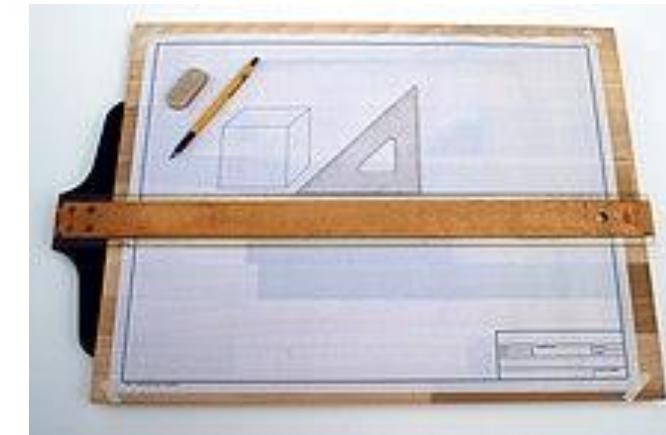
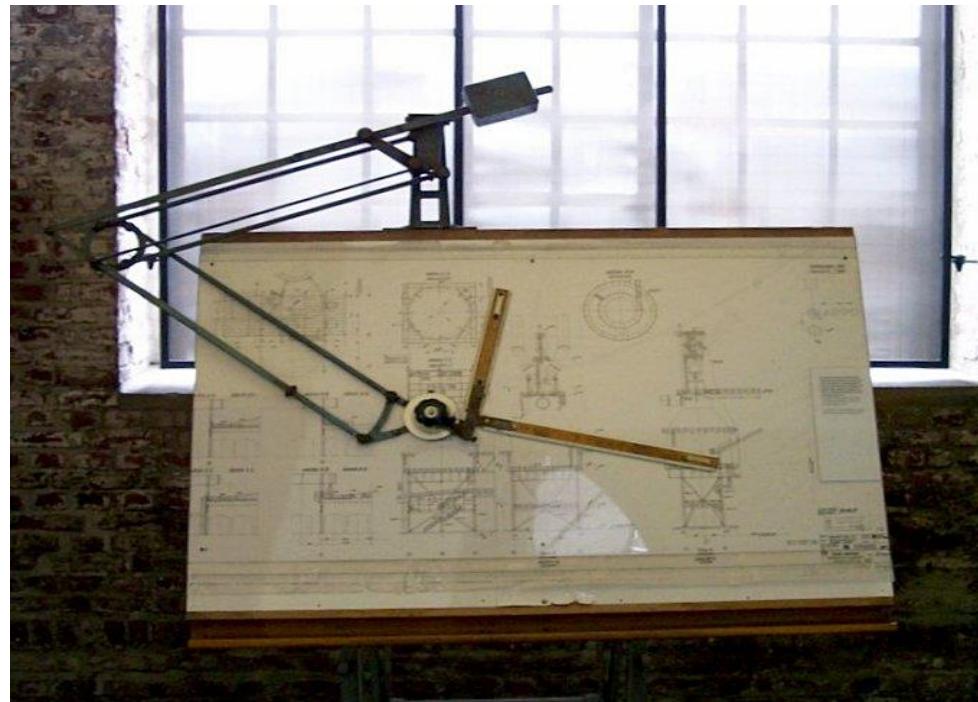
CREDITS FOR SLIDES

- Many slides are taken from Prof. Anirban Guha, ME, IITB, Prof. Amit Singh, ME, IITB Prof. Krishna Jonnalagadda, ME, IITB

Engineering Graphics Technology

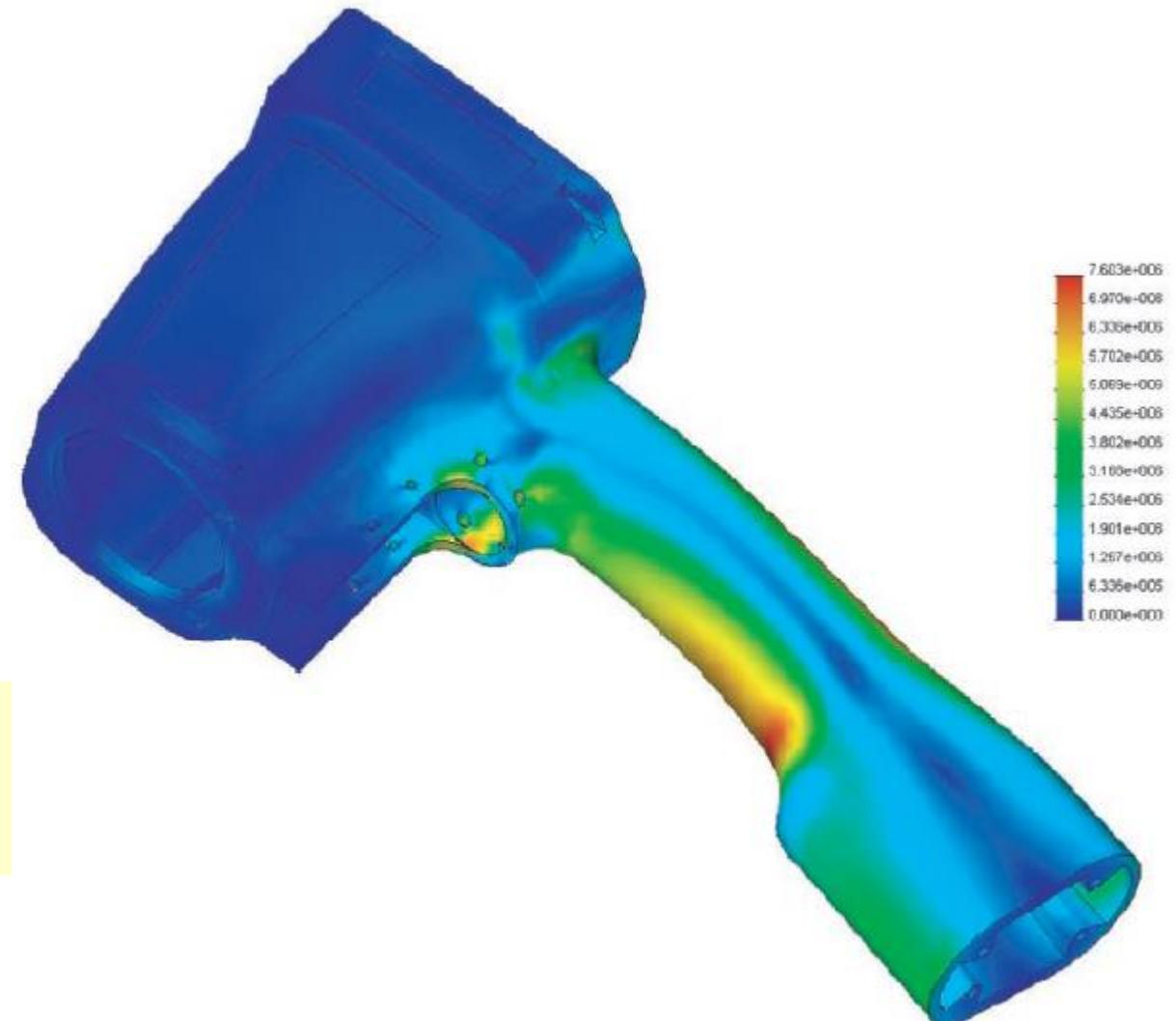
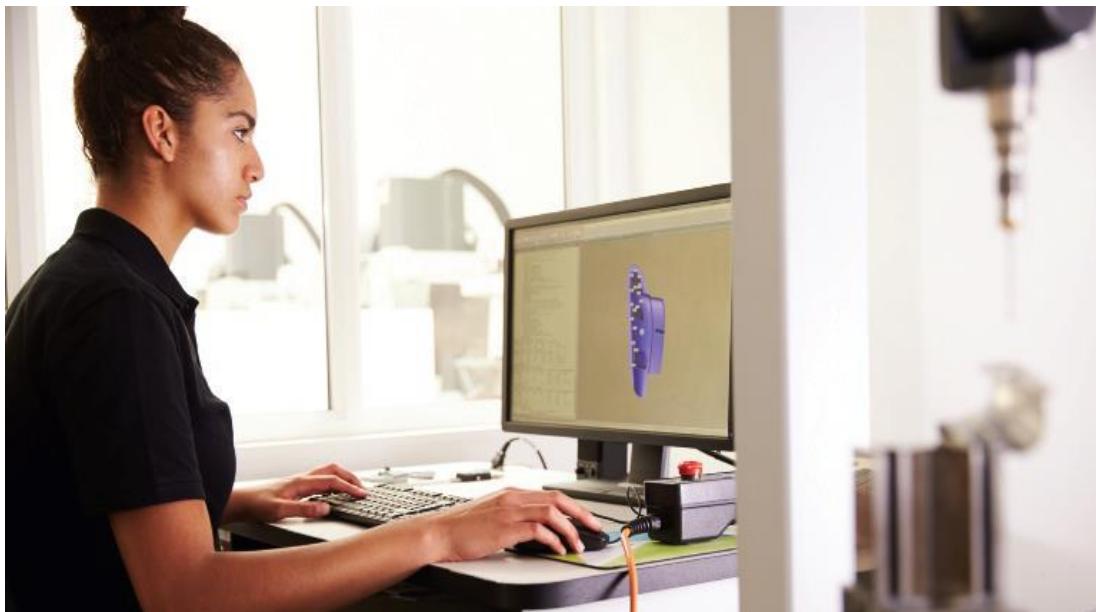
INSTRUMENT DRAWING:

Drafting board, T-square, Set-square, Scale, Compass, Protractor, French Curves, Drawing papers, Pencils, Eraser, Drawing pins, Sand paper, Duster, Drafting machine.



Engineering Graphics Technology

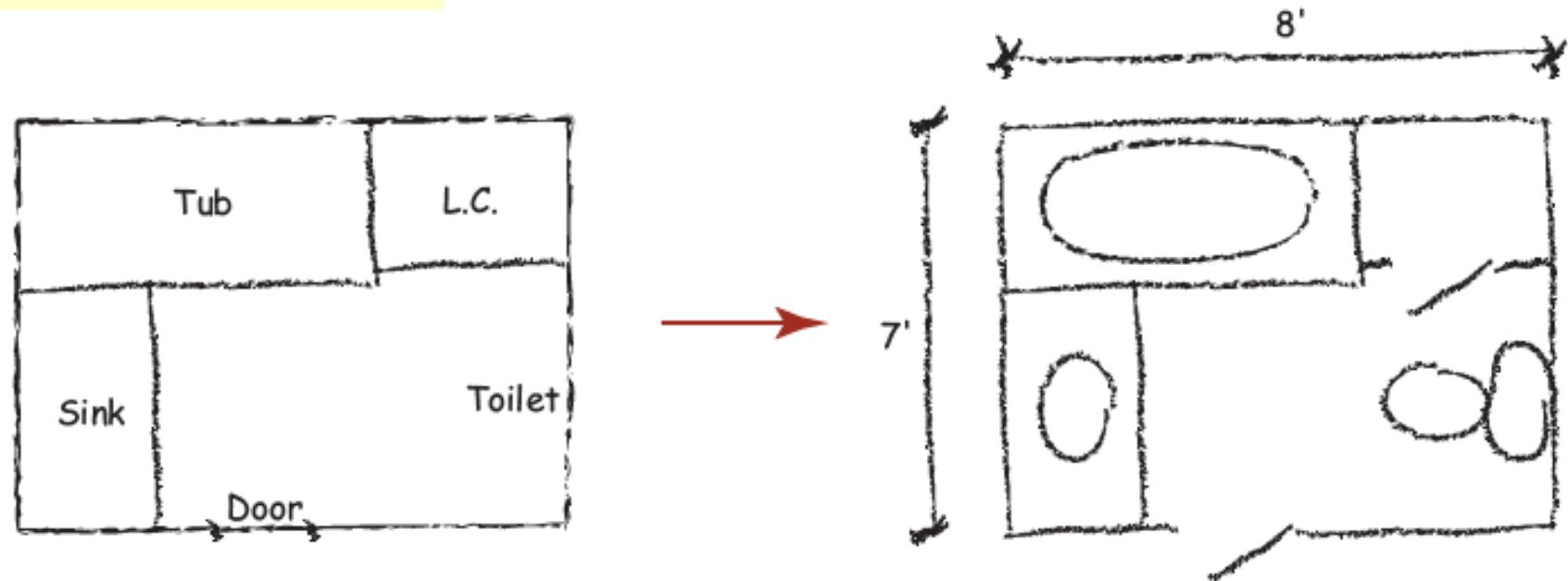
COMPUTER AIDED WITH SOFTWARE:



**THIS COURSE WILL ADOPT THIS
METHOD: AUTODESK FUSION 360**

SKETCHING - A drawing without the use of drawing instrument

A rough idea, e.g. sketch of a bathroom



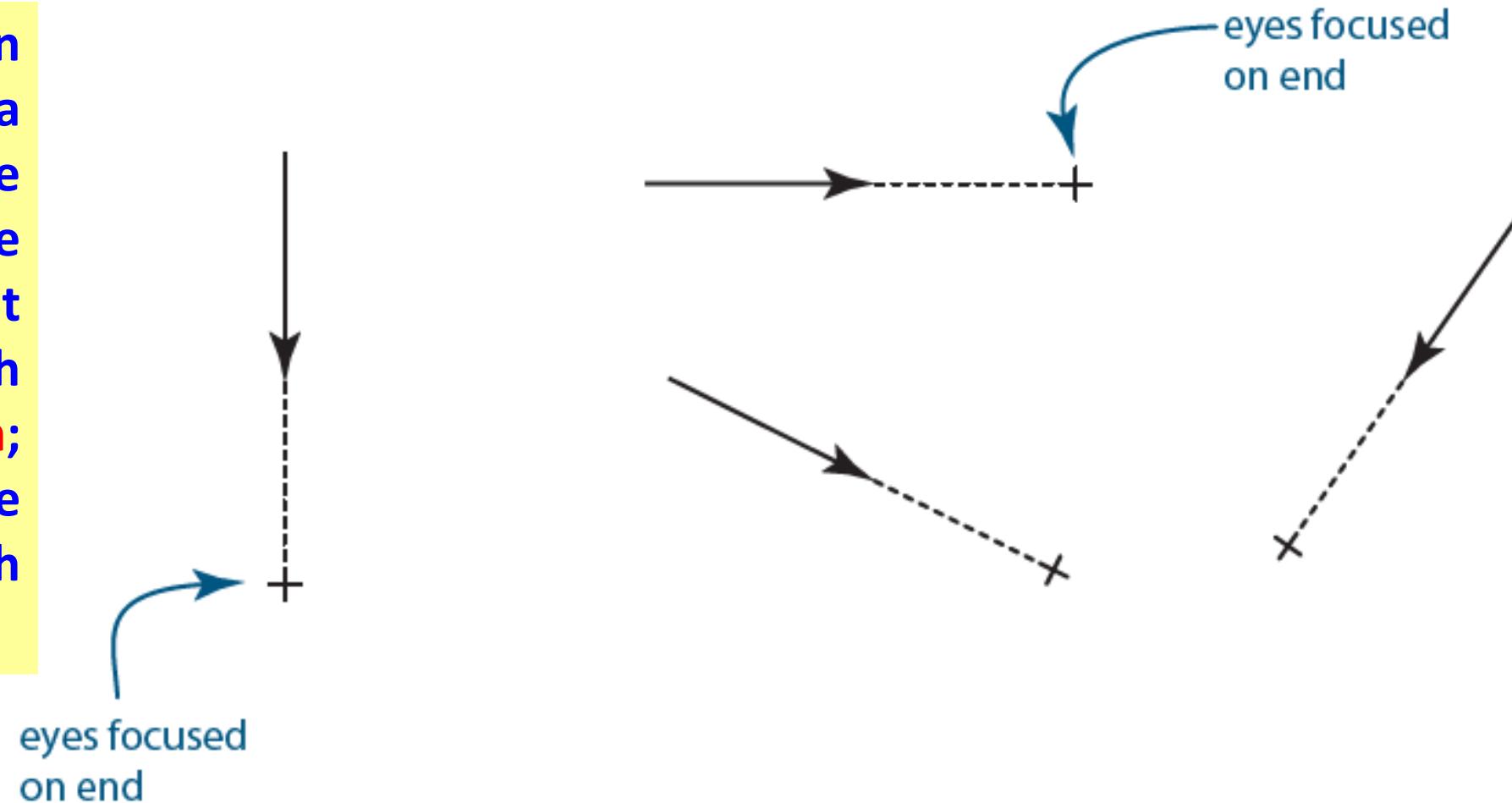
- When engineers sit down to brainstorm solutions to problems, before long, one of them usually takes out a sheet of paper and sketches an idea on it.
- The others in the discussion may add to the original sketch, or they may create sketches of their own.
- The paper-and-pencil sketches become media for the effective exchange of ideas

SKETCHING LINES

When sketching lines, the key is to make them as straight as possible.

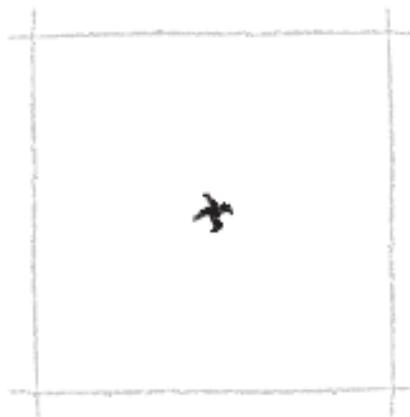
Sketch your vertical lines from top to bottom and your horizontal lines from left to right.

If you are sketching an angled line, choose a direction that matches the general inclination of the line—for angled lines that are mostly vertical, sketch them from top to bottom; for angled lines that are mostly horizontal, sketch them from left to right.



For right-handed person

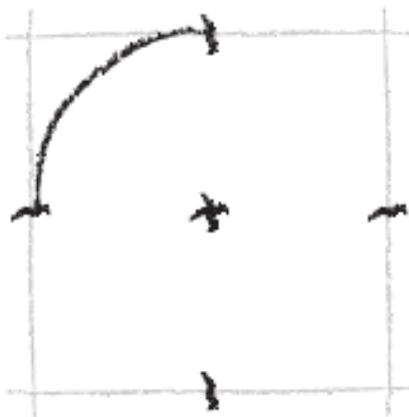
SKETCHING CURVED ENTITIES



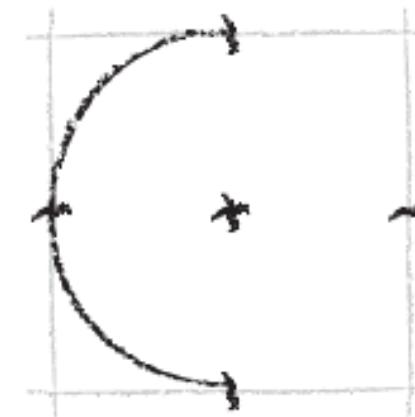
Bounding box
with circle center



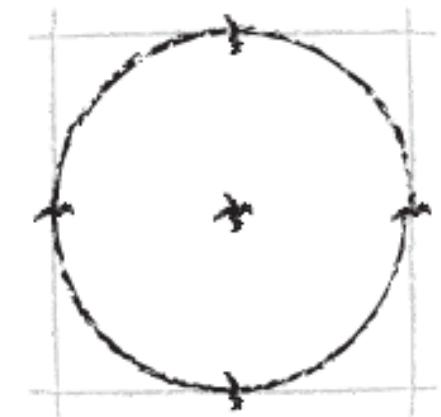
Radial tick
marks added to
boundary box



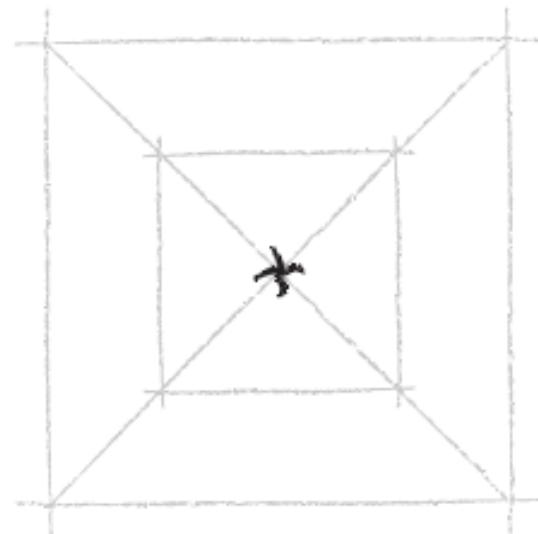
First arc drawn



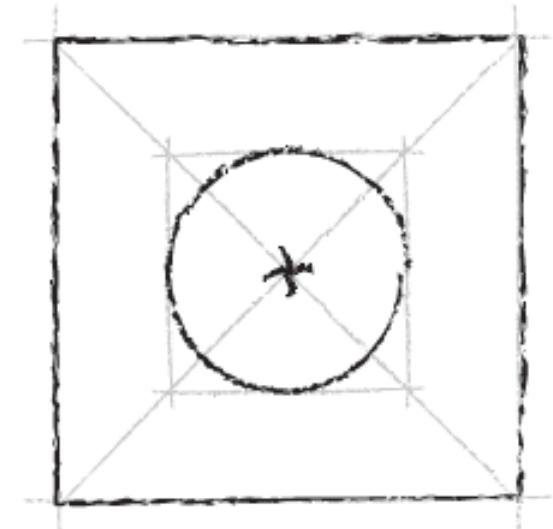
Second arc drawn



Circle complete

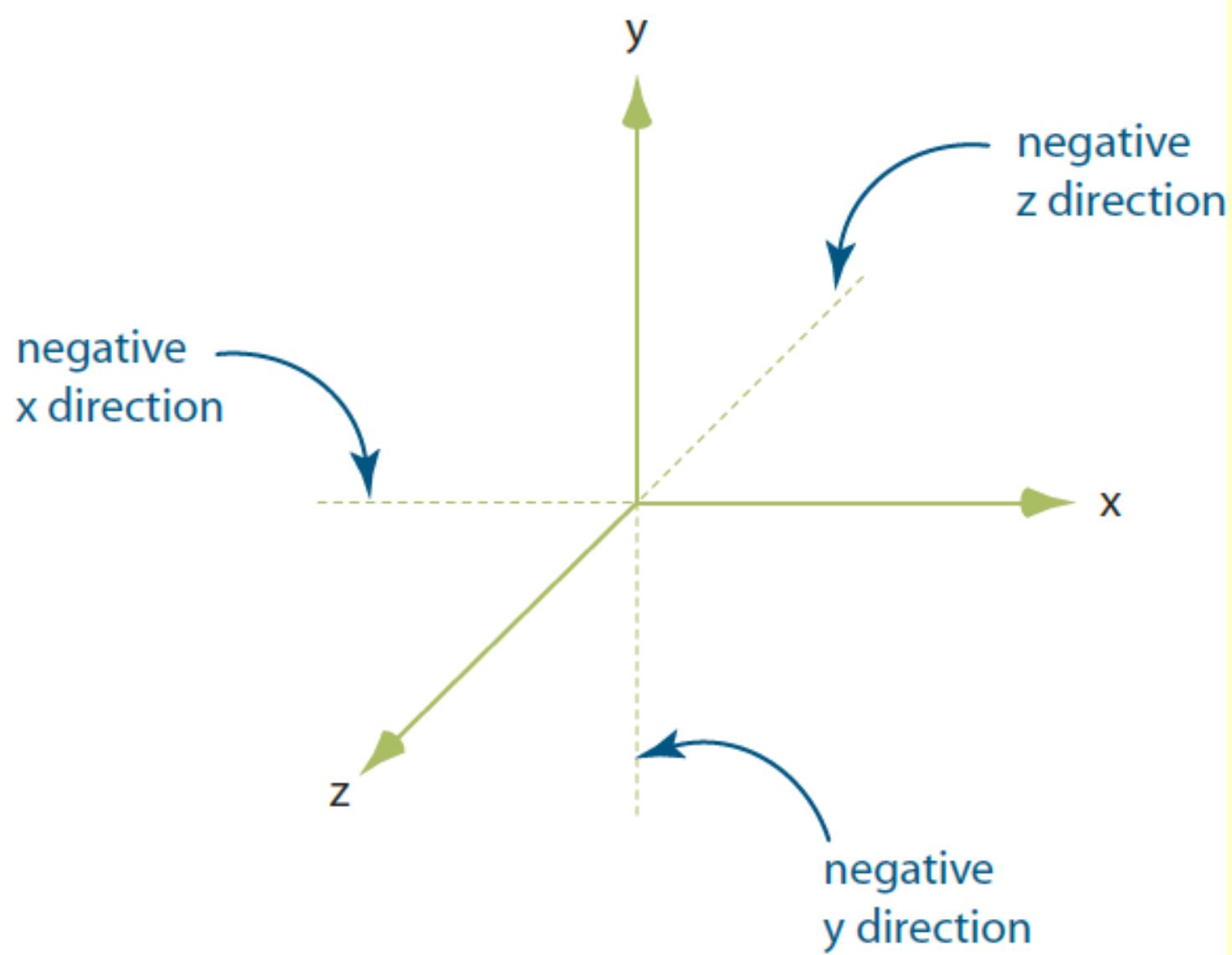


Concentric bounding boxes



Circle centered in square

COORDINATE SYSTEM - Need to portray 3-D objects on a flat 2-D sheet of paper



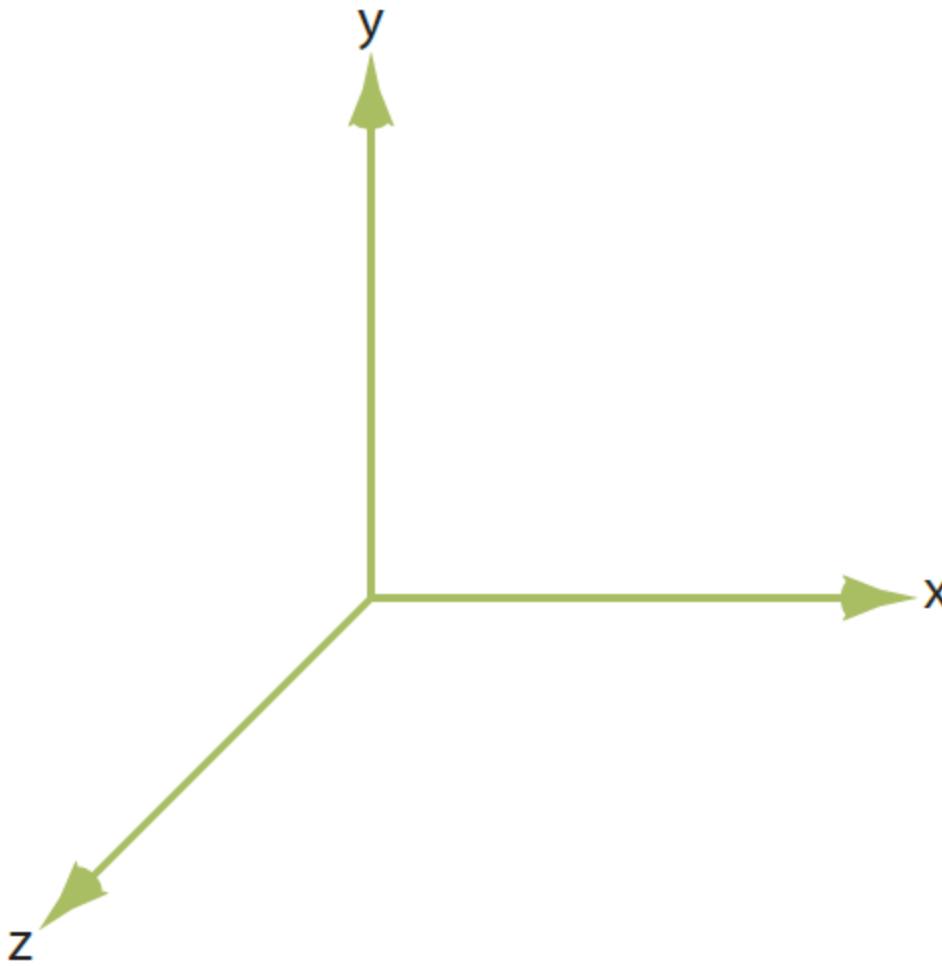
3-D COORDINATE SYSTEM

Space can be represented by three mutually perpendicular coordinate axes, typically the x-, y-, and z-axes

To visualize these three axes, look at the bottom corner of the room. Notice the lines that are formed by the intersection of each of the two walls with the floor and the line that is formed where the two walls intersect. we can think of these lines of intersection as the x-, y-, and z-coordinate axes.

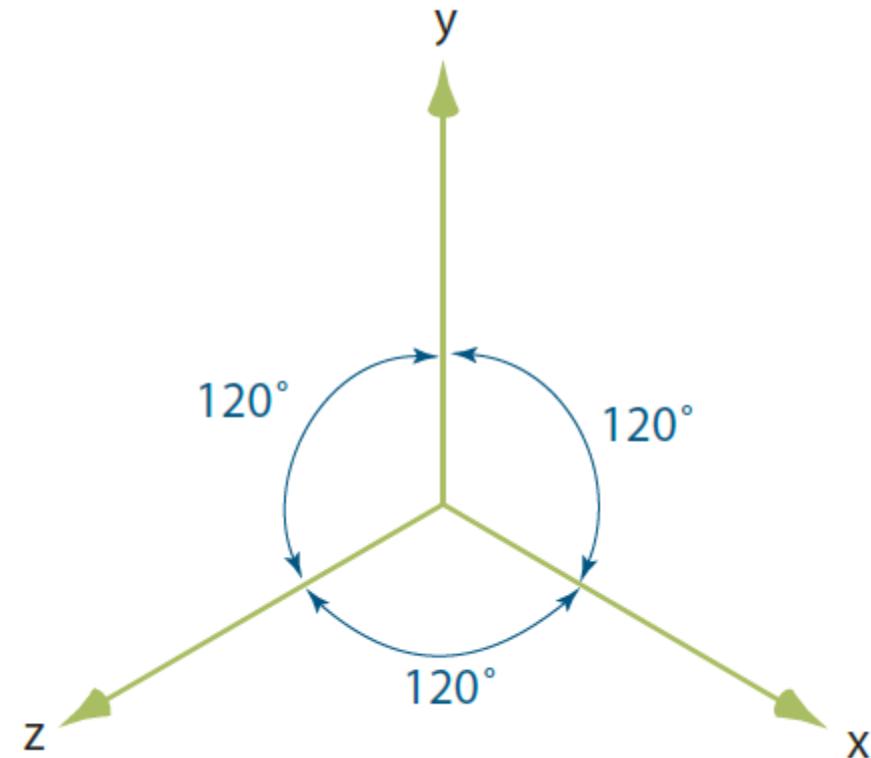
We can define all locations in the room with respect to this corner, just as all points in 3-D space can be defined from an origin where the three axes intersect.

OBLIQUE AXIS REPRESENTATION



Two axes perpendicular, third at an angle
of 45 degrees to both axes

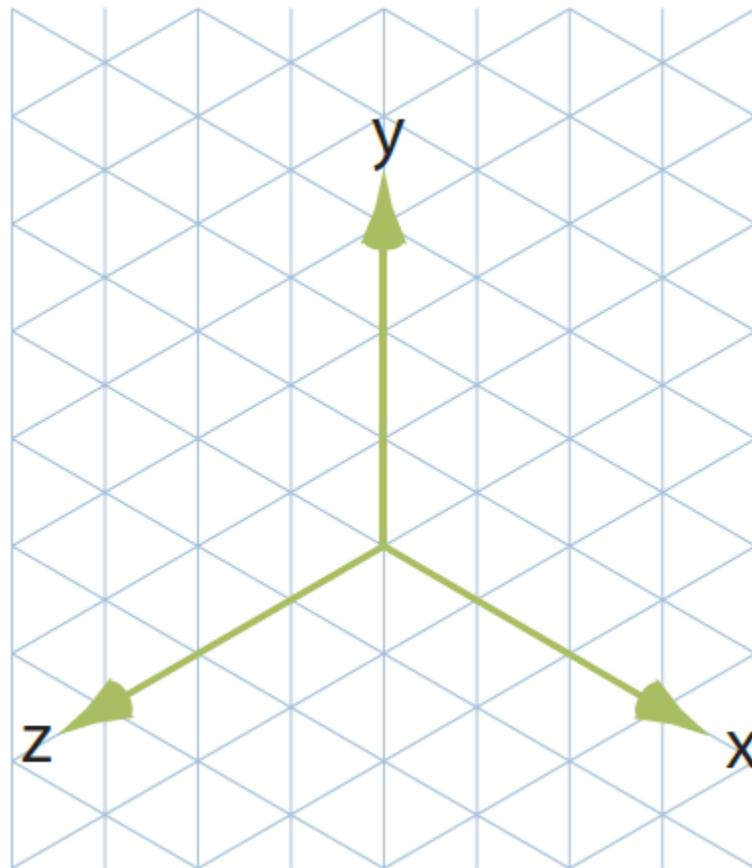
ISOMETRIC REPRESENTATION



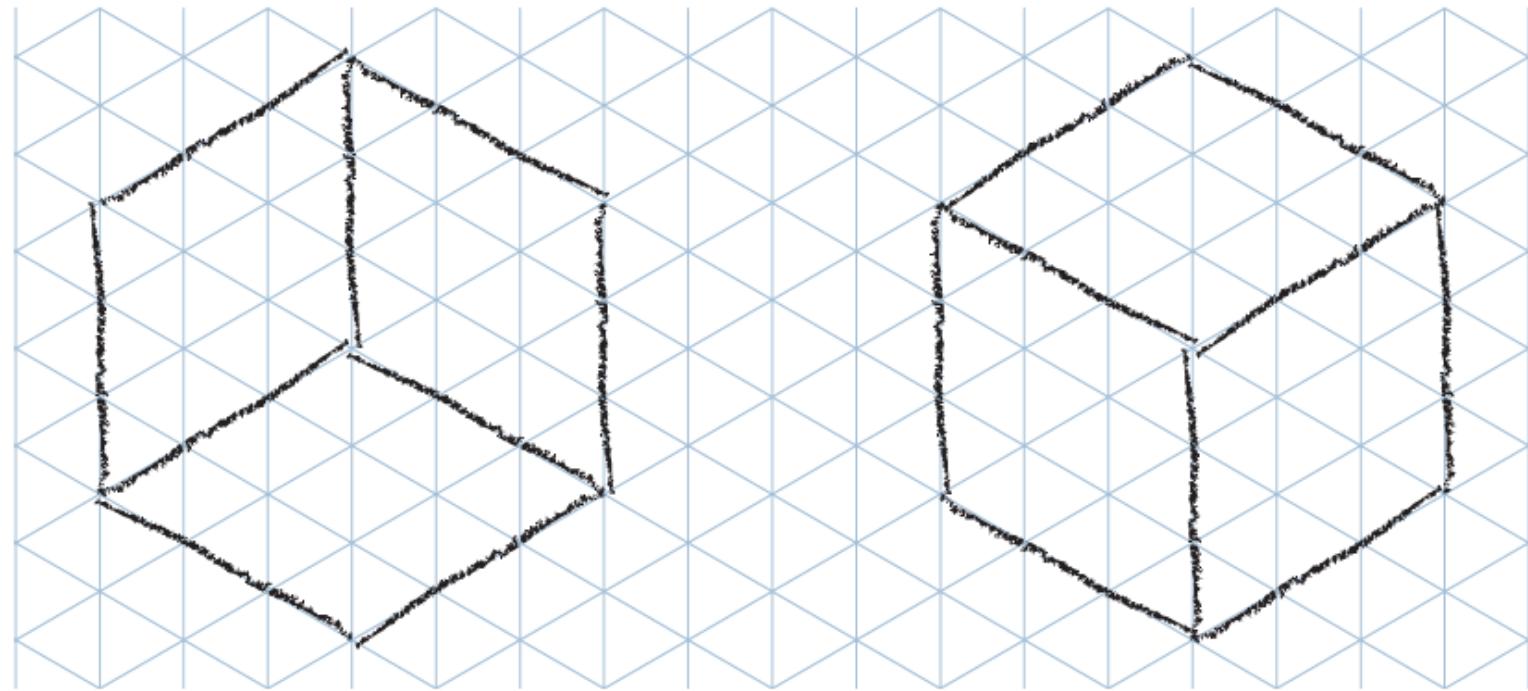
Axes projection as if looking down
diagonal of the cube. 120 degrees all axes

ISOMETRIC SKETCHES

ISOMETRIC GRID : Lines drawn are oriented in such a manner that standard 120 degree coordinate axes are obtained.

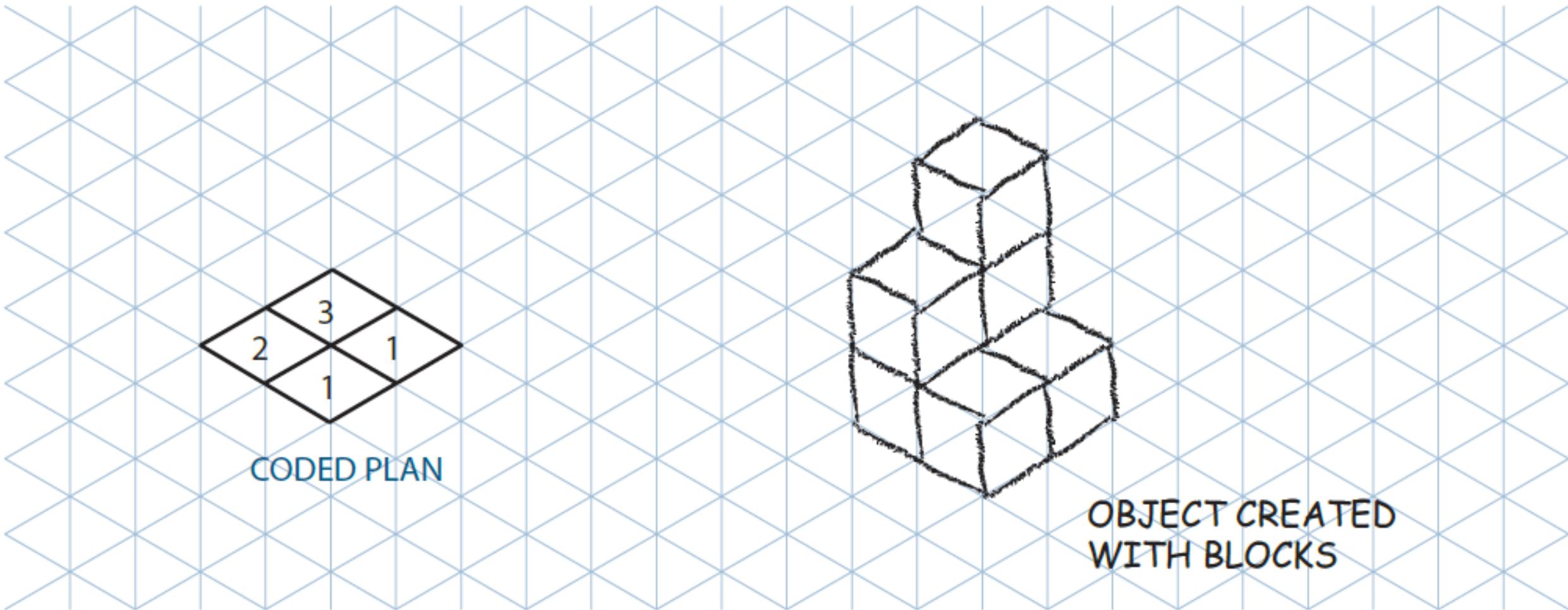


USING ISOMETRIC GRID PAPER TO SKETCH A BLOCK

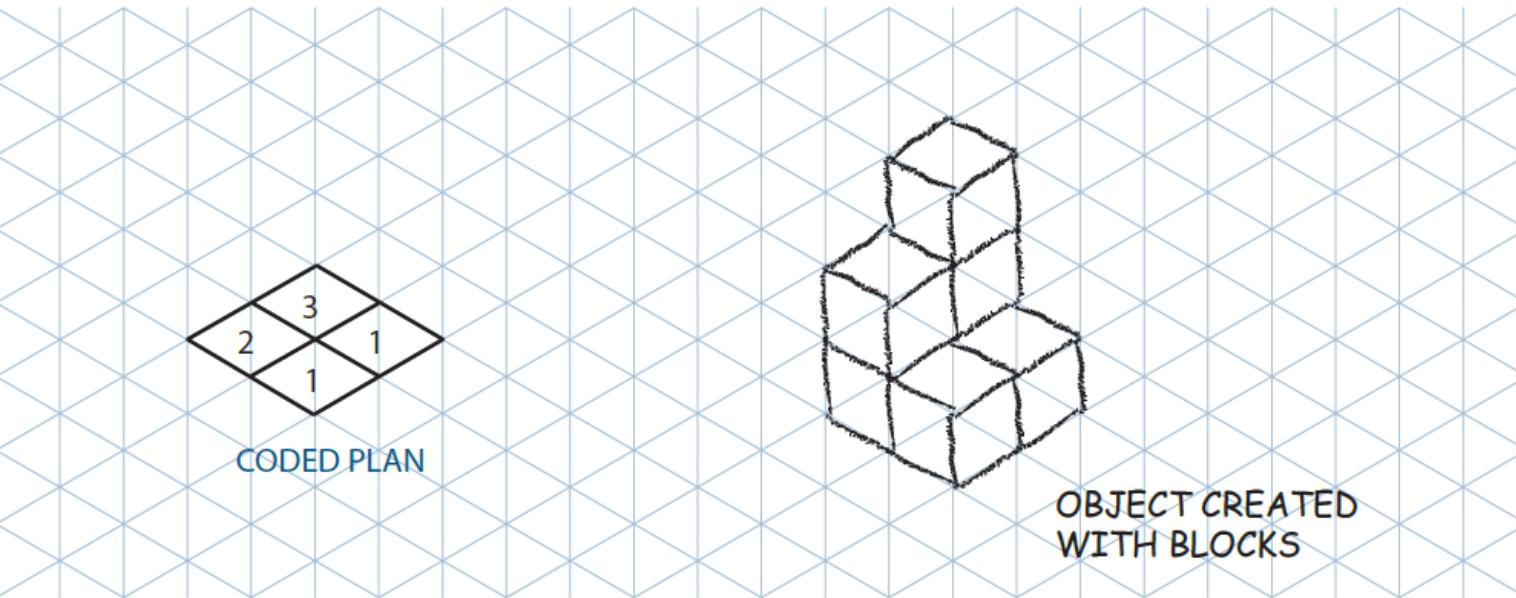


ISOMETRIC SKETCHES

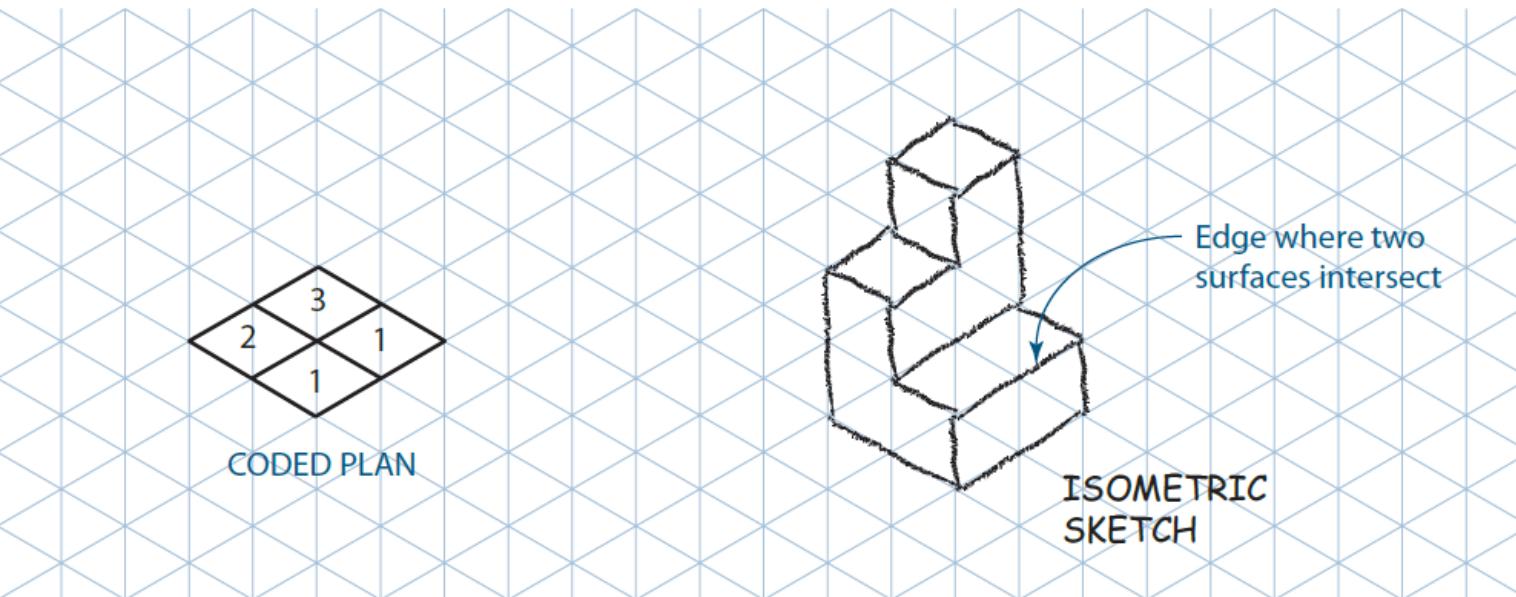
Coded plans: Lines appear only when two surfaces intersect



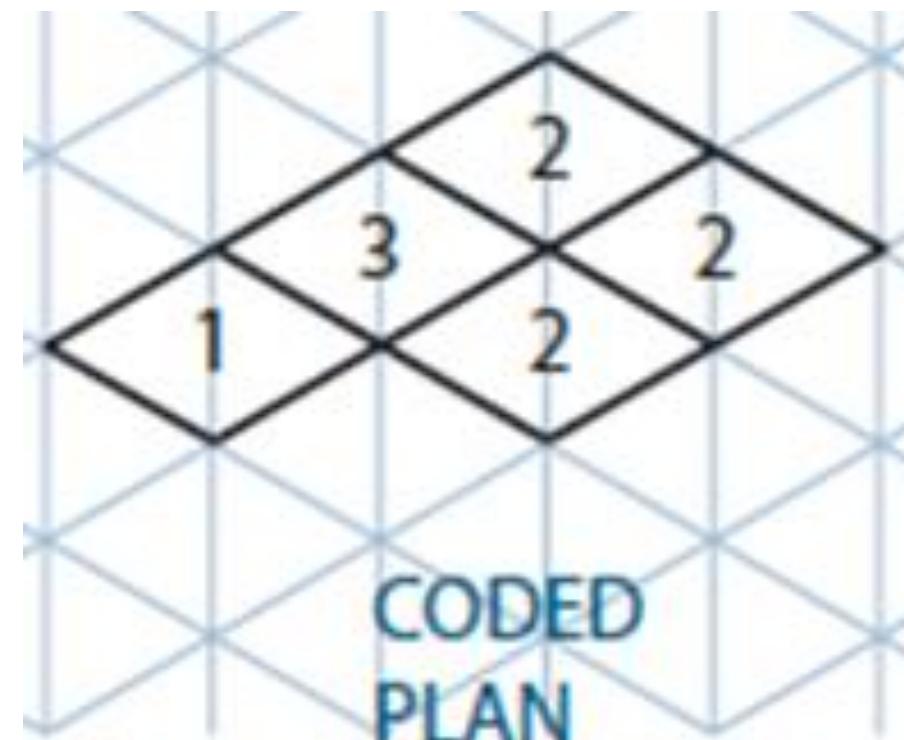
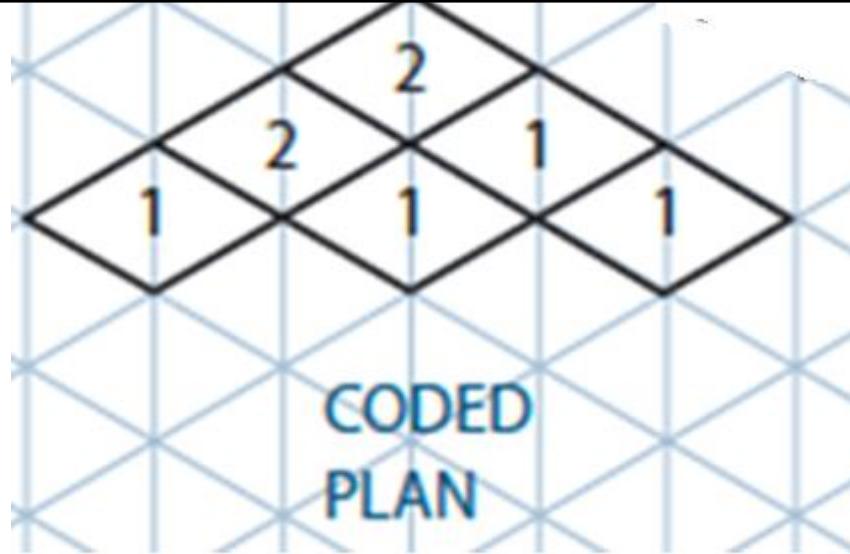
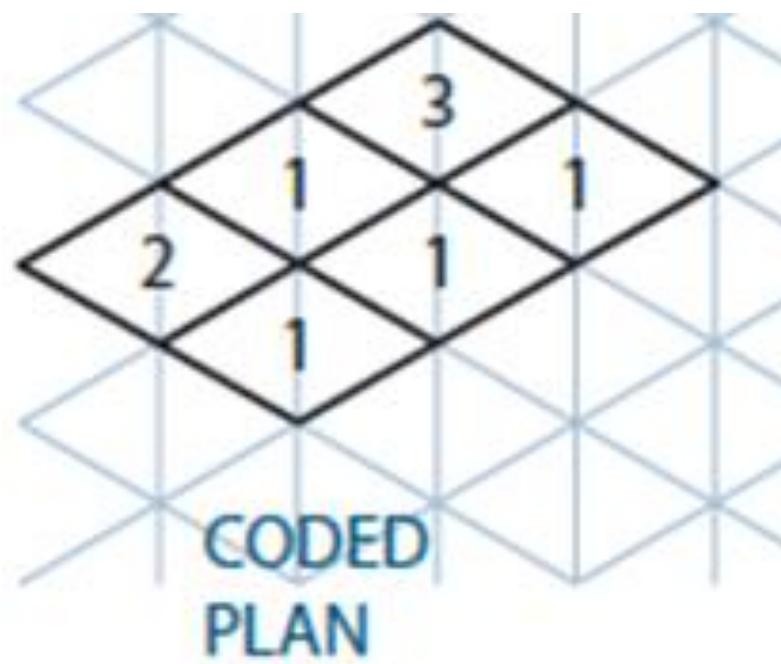
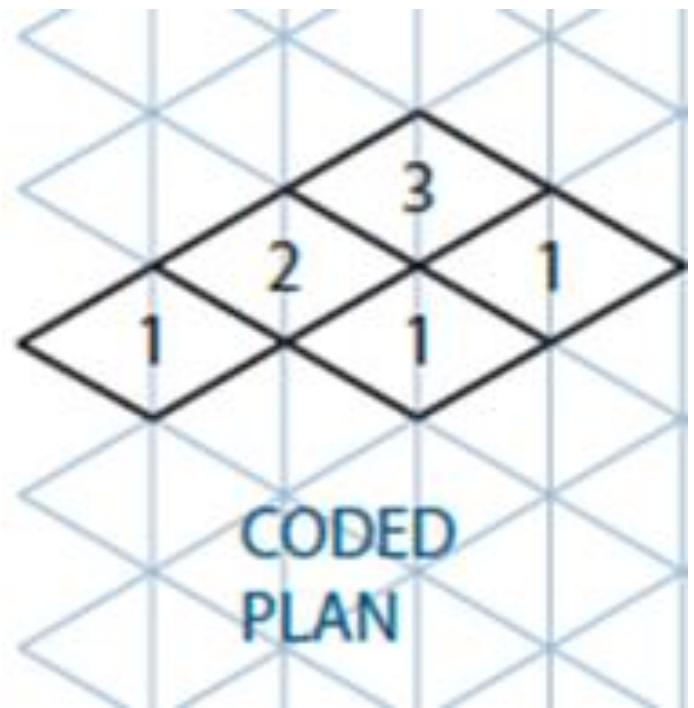
ISOMETRIC SKETCHES



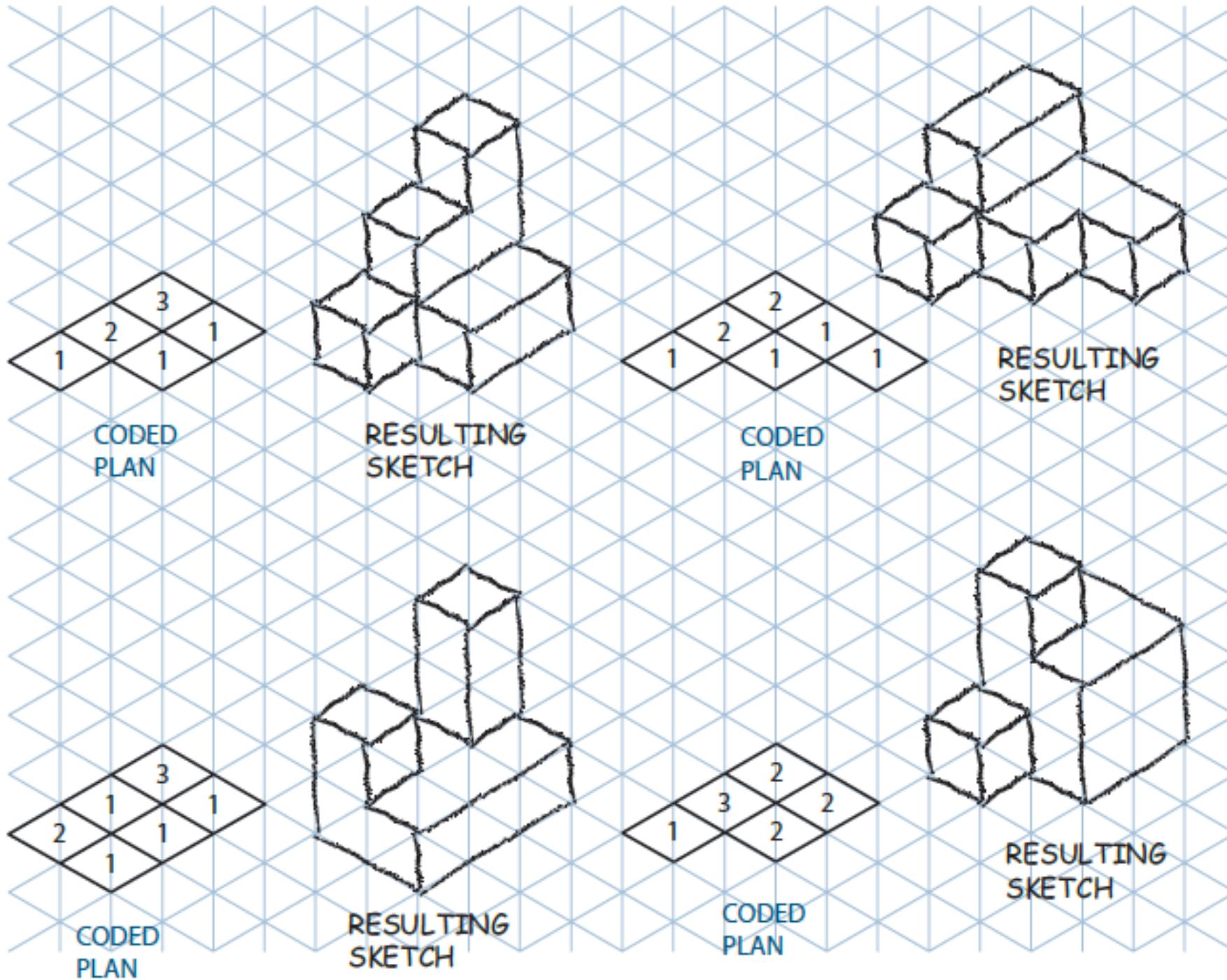
A coded plan and the resulting object



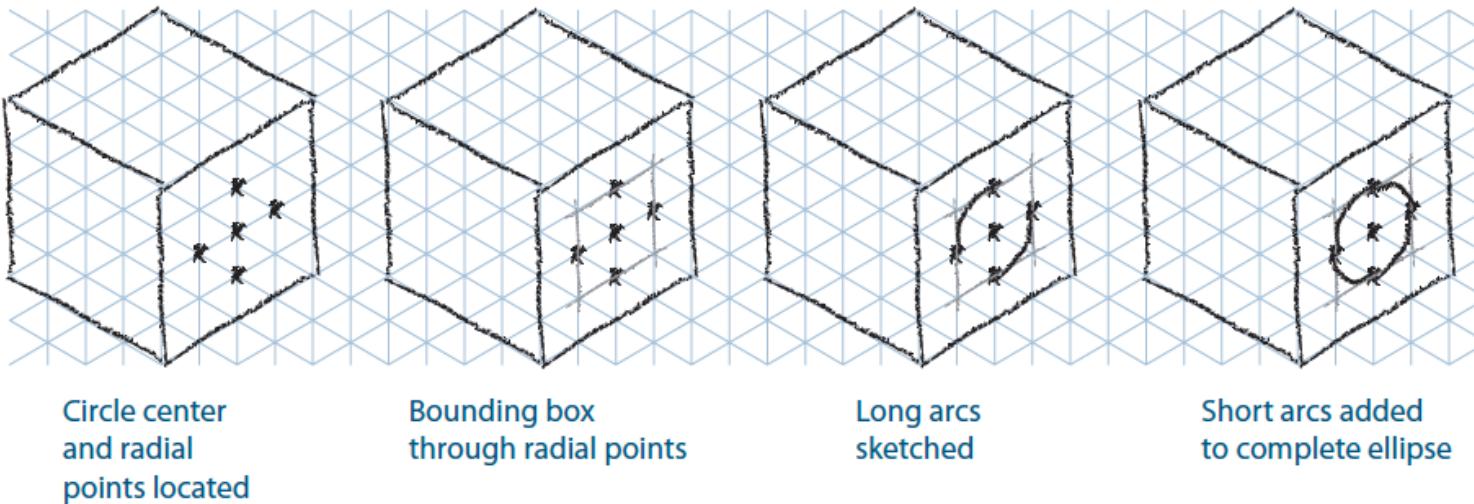
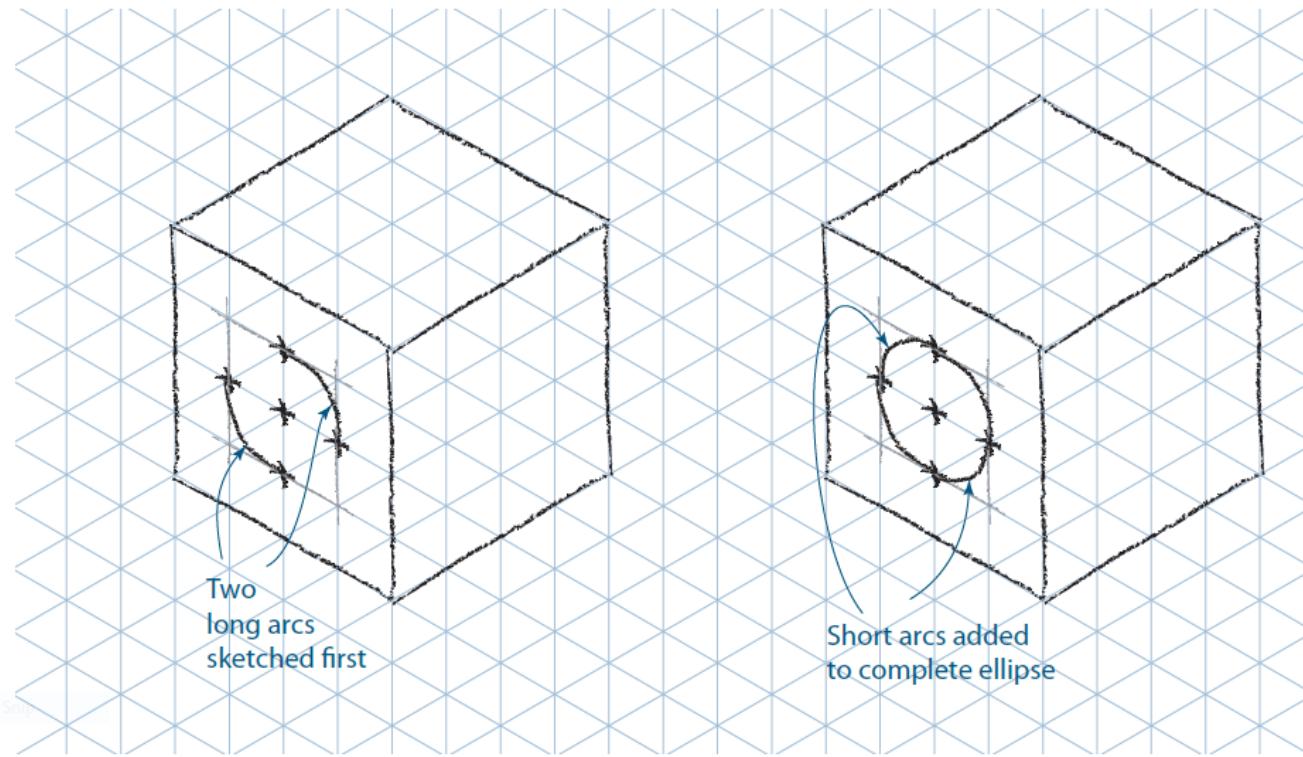
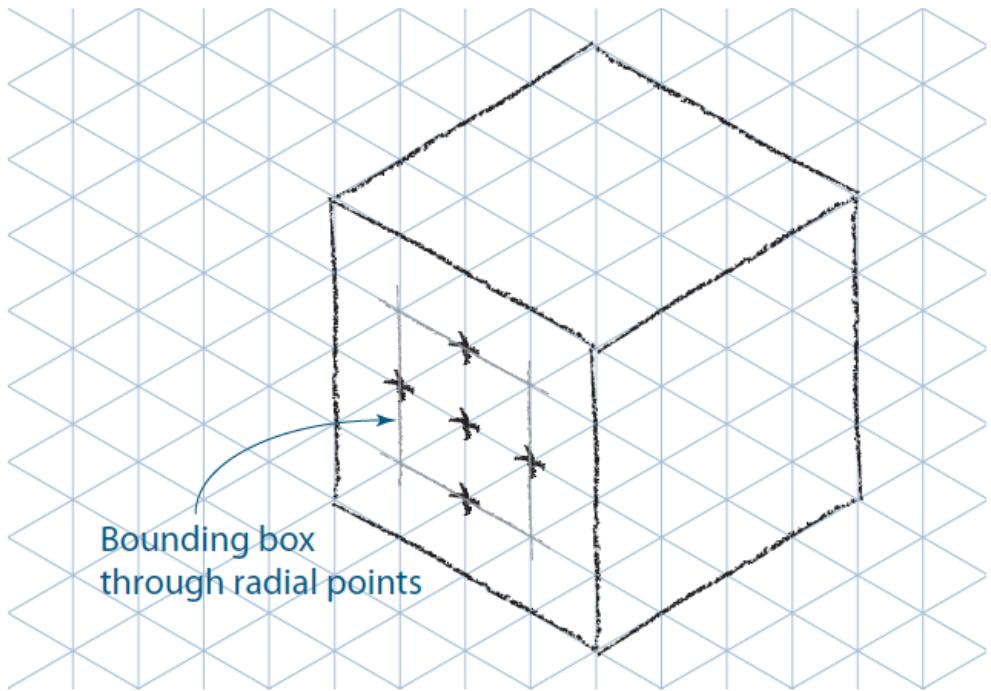
A properly drawn isometric sketch of the object from the coded plan



ISOMETRIC SKETCHES

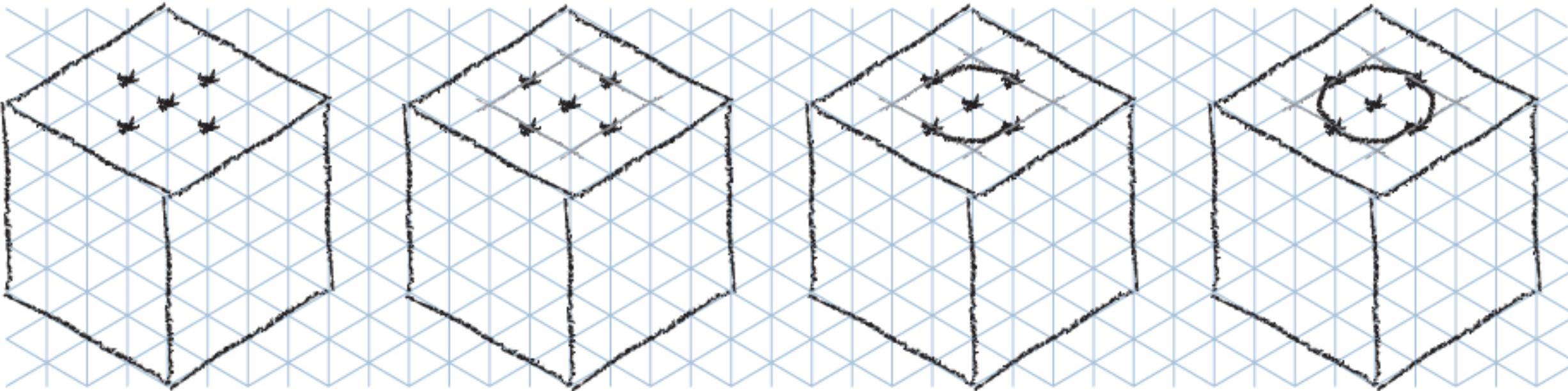


Circles and holes in isometric sketches



Sketching an ellipse on the side face of a cube

Sketching an ellipse on the top surface of a cube



Circle center
and radial
points located

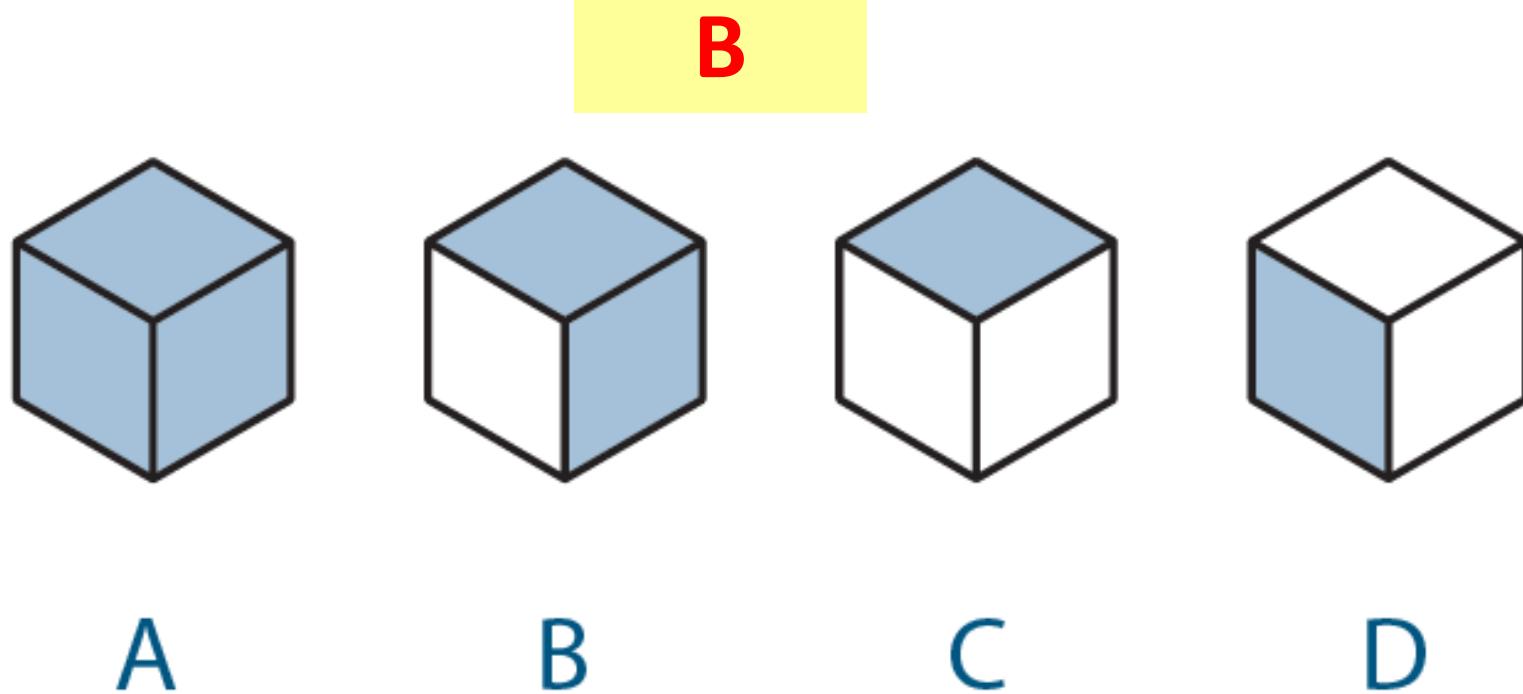
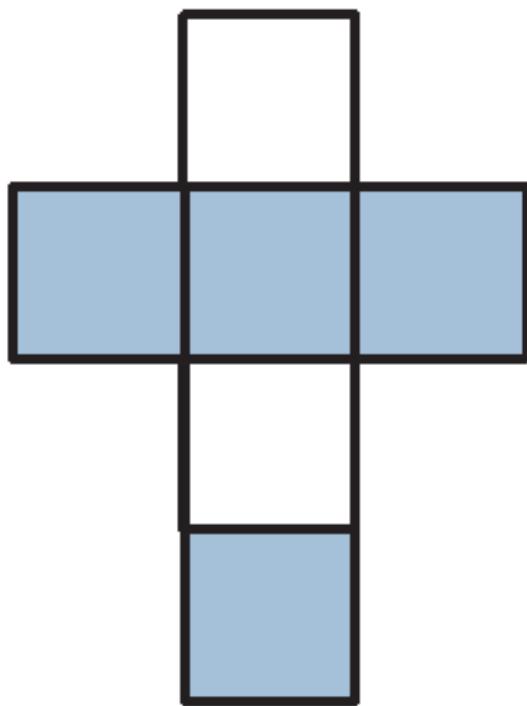
Bounding box
through radial points

Long arcs
sketched

Short arcs added
to complete ellipse

Differential Aptitude Test: Space Relations – DEVELOPMENT OF SURFACES

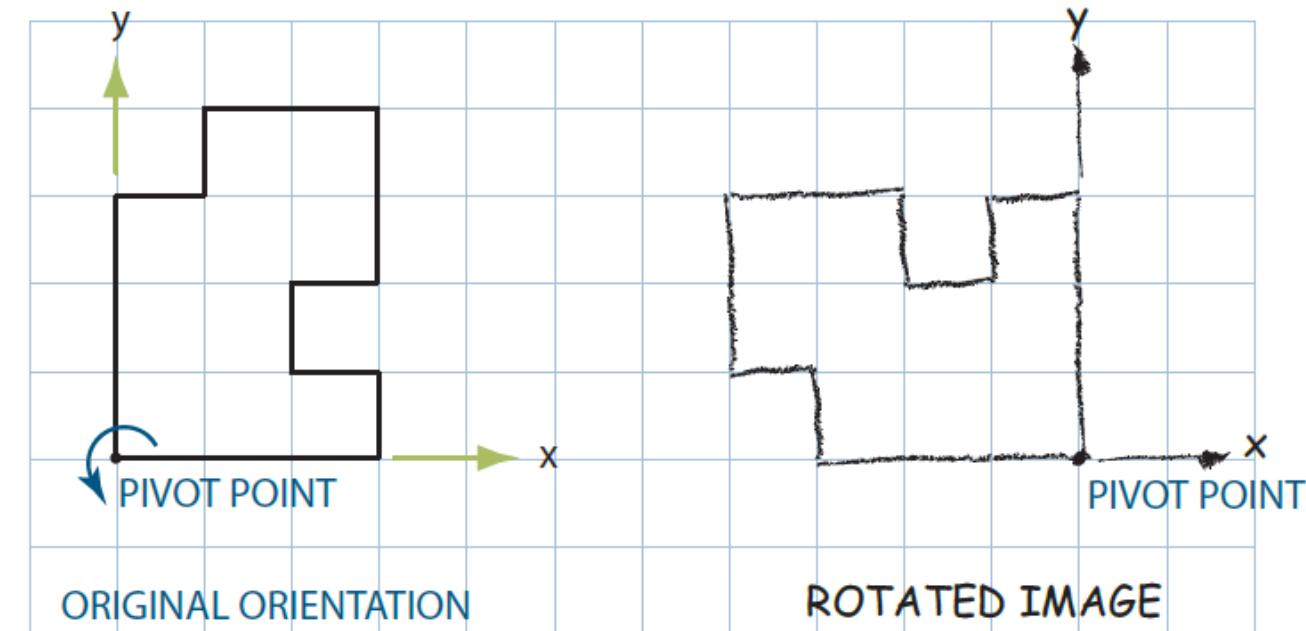
This test is designed to measure your ability to move from the 2-D to the 3-D world. The objective is to mentally fold the 2-D pattern along the solid lines, which designate the fold lines, so the object will result in the 3-D shape



OBJECT ROTATIONS ABOUT A SINGLE AXIS

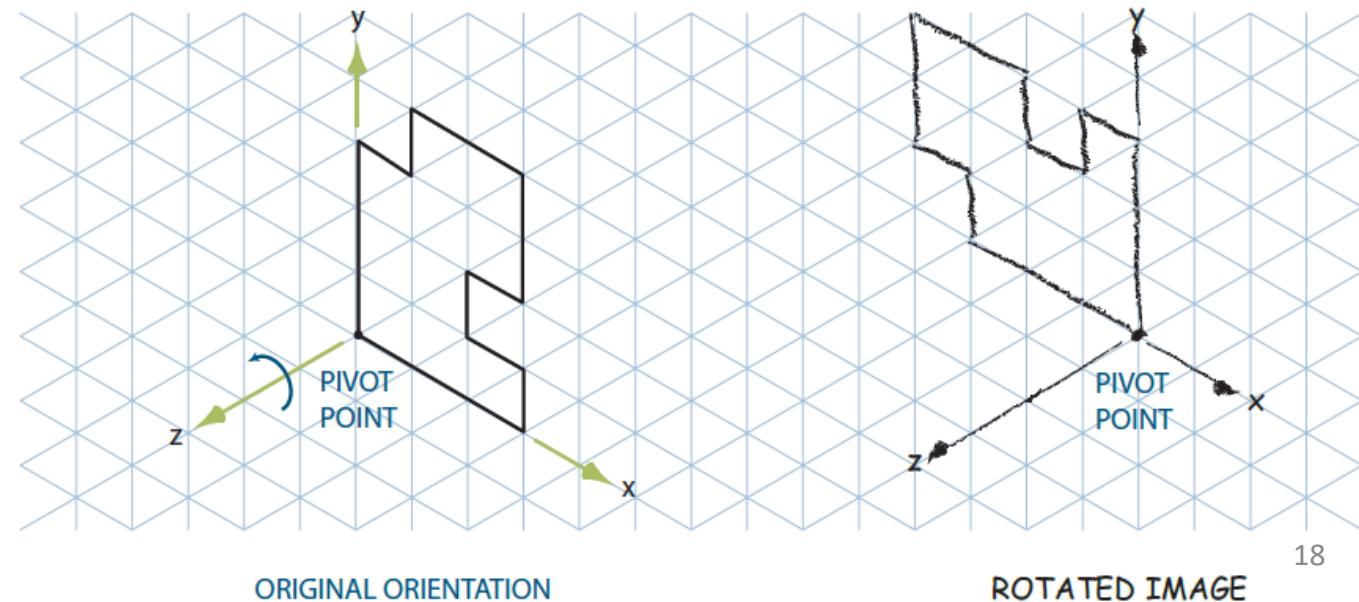
A shape rotated about a pivot point in 2-D space

A 2-D object rotated 90 degrees counterclockwise (CCW) about the pivot point



A 2-D shape rotated in 3-D space

A 2-D object rotated 90 degrees counterclockwise (CCW) about the z-axis



OBJECT ROTATIONS ABOUT A SINGLE AXIS

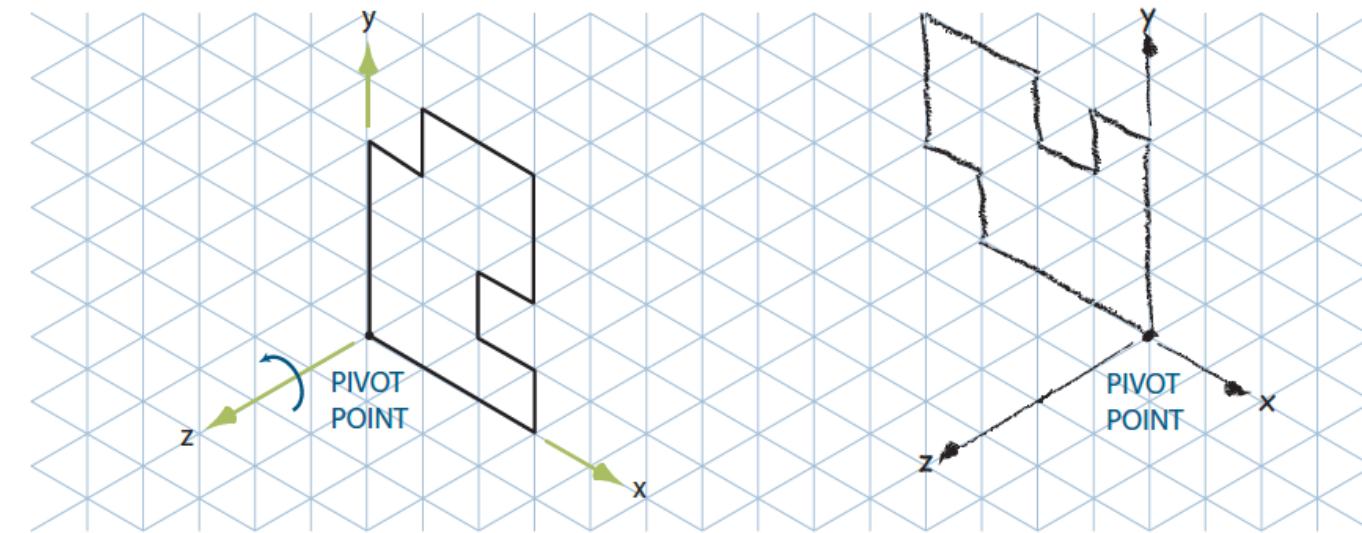
A 2-D shape rotated in 3-D space

A 2-D object rotated 90 degrees counterclockwise (CCW) about the z-axis

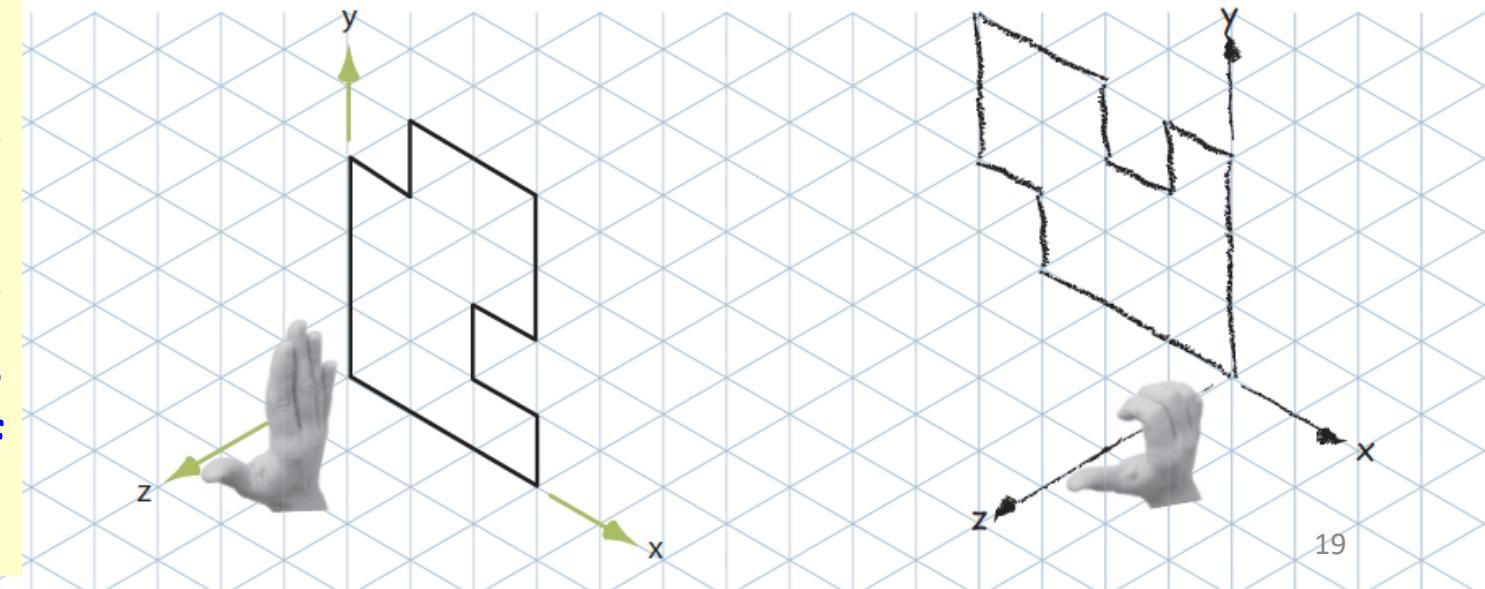
If you point the thumb of your right hand in the positive direction of the z-axis and curl your fingers, you will see that the 90-degree CCW rotation mimics the direction that your fingers curl as in Figure.

This CCW rotation of the 2-D shape represents a *positive* 90-degree rotation about the z-axis.

The CCW rotation is positive because the thumb of your right hand was pointing in the positive direction of the z-axis as the shape was rotated.



Positive rotation of a 2-D shape about the z-axis



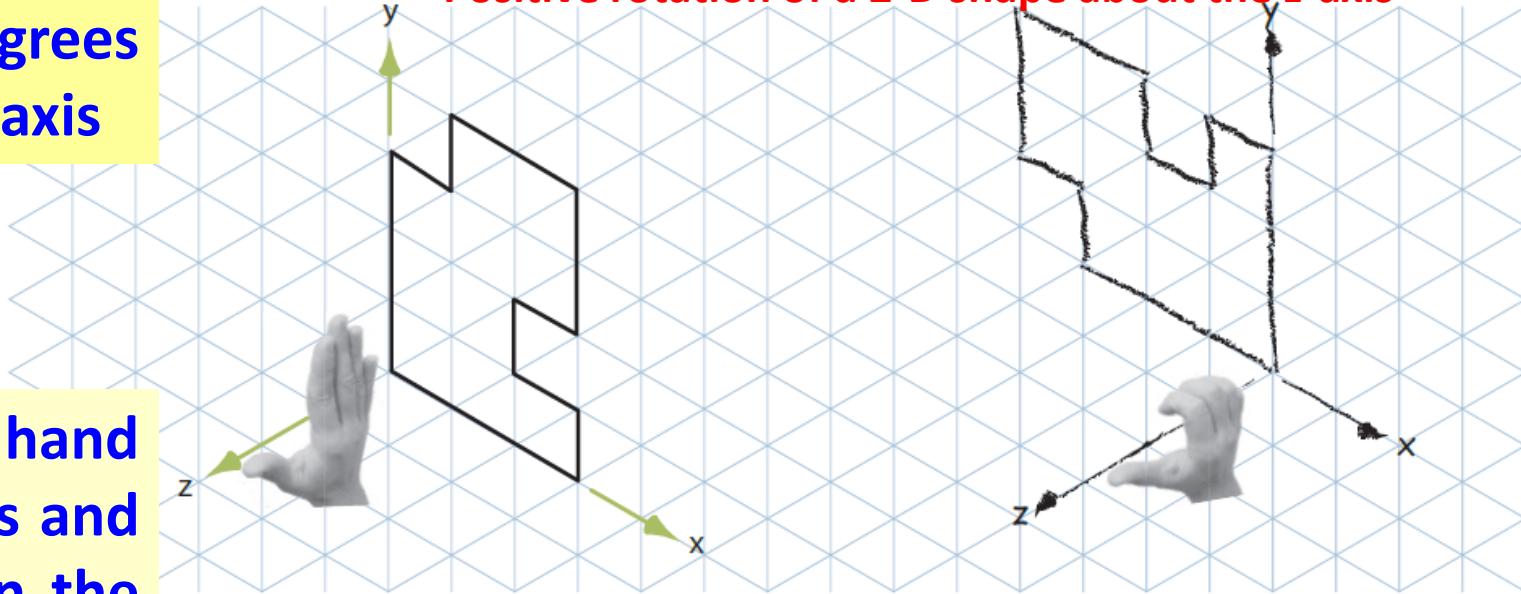
OBJECT ROTATIONS ABOUT A SINGLE AXIS

A 2-D object rotated 90 degrees counterclockwise (CCW) about the z-axis

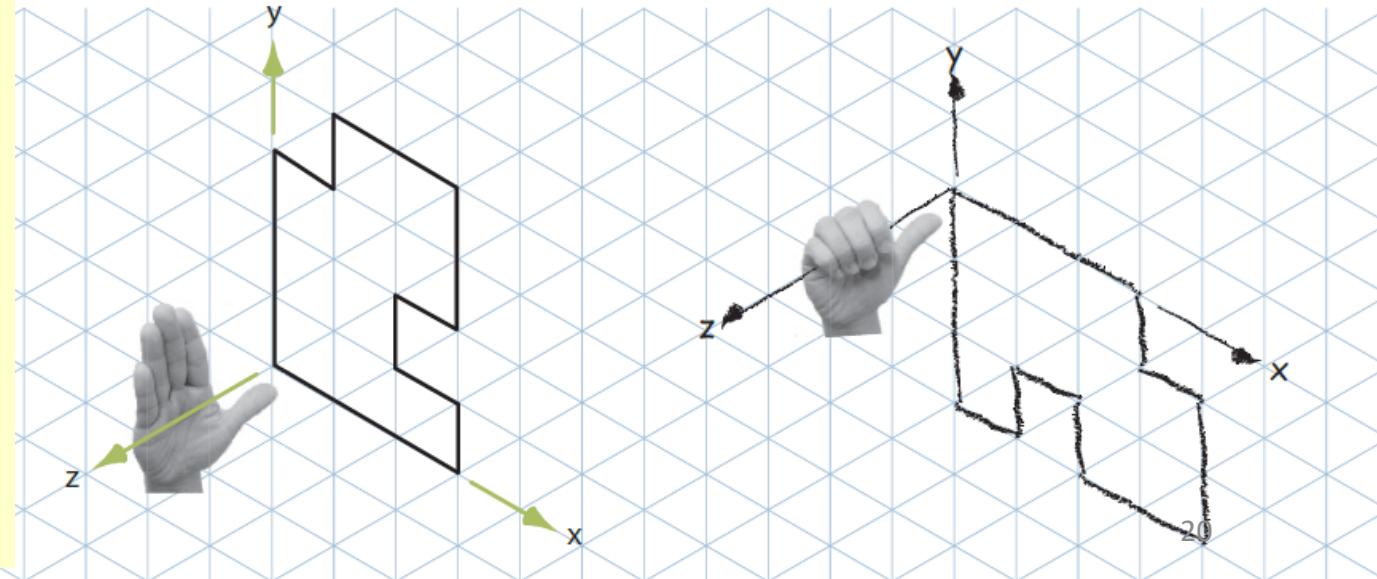
If you point the thumb of your right hand in the negative direction of the z-axis and the shape is rotated in the direction the fingers of your right hand curl, your fingers indicate a clockwise (CW) rotation of the shape about the z-axis, as in Figure. A CW rotation about an axis is defined as a negative rotation.

Remember that the thumb of your right hand is pointing in the negative z-direction.

Positive rotation of a 2-D shape about the z-axis

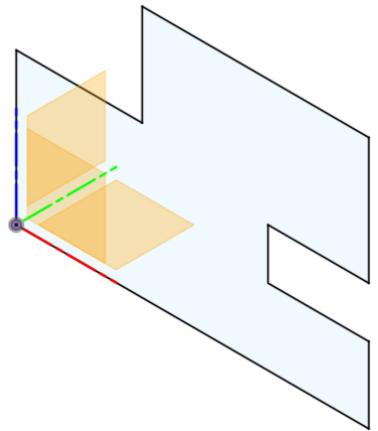


Negative rotation of a 2-D shape about the z-axis

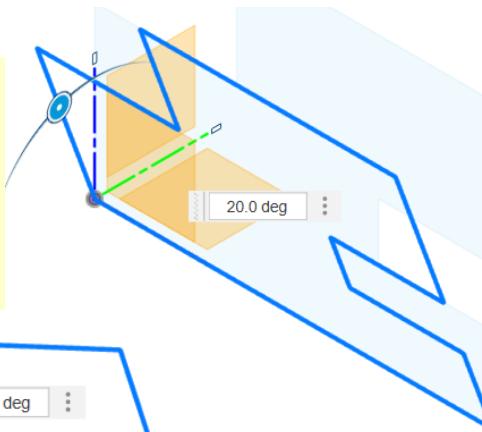


OBJECT ROTATIONS ABOUT A SINGLE AXIS

A 2-D shape rotated in 3-D space

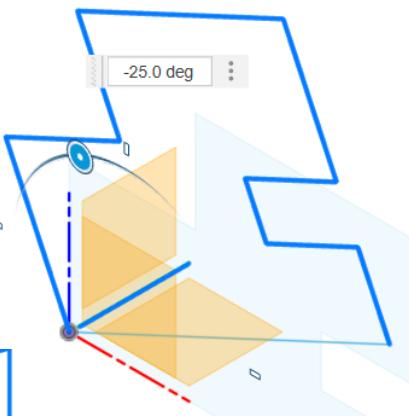


Counter
Clockwise(CCW)
X-axis



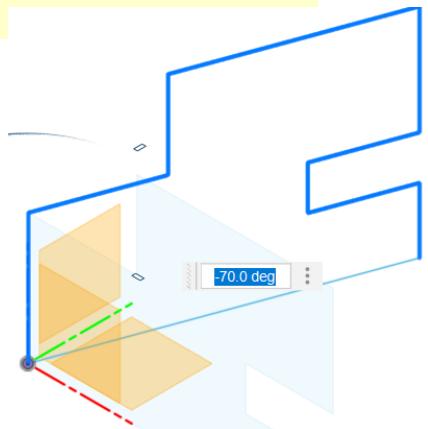
Clockwise(CW)
X-axis

Counter
Clockwise(CCW)
Y-axis

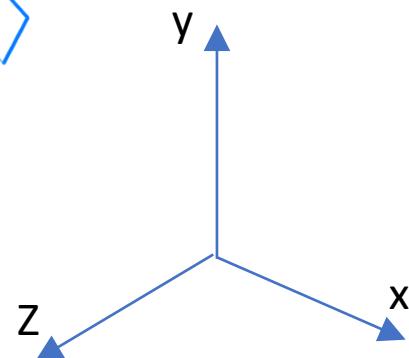
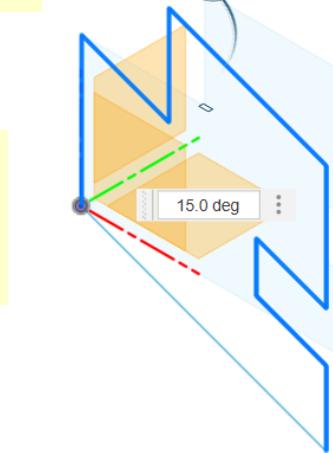


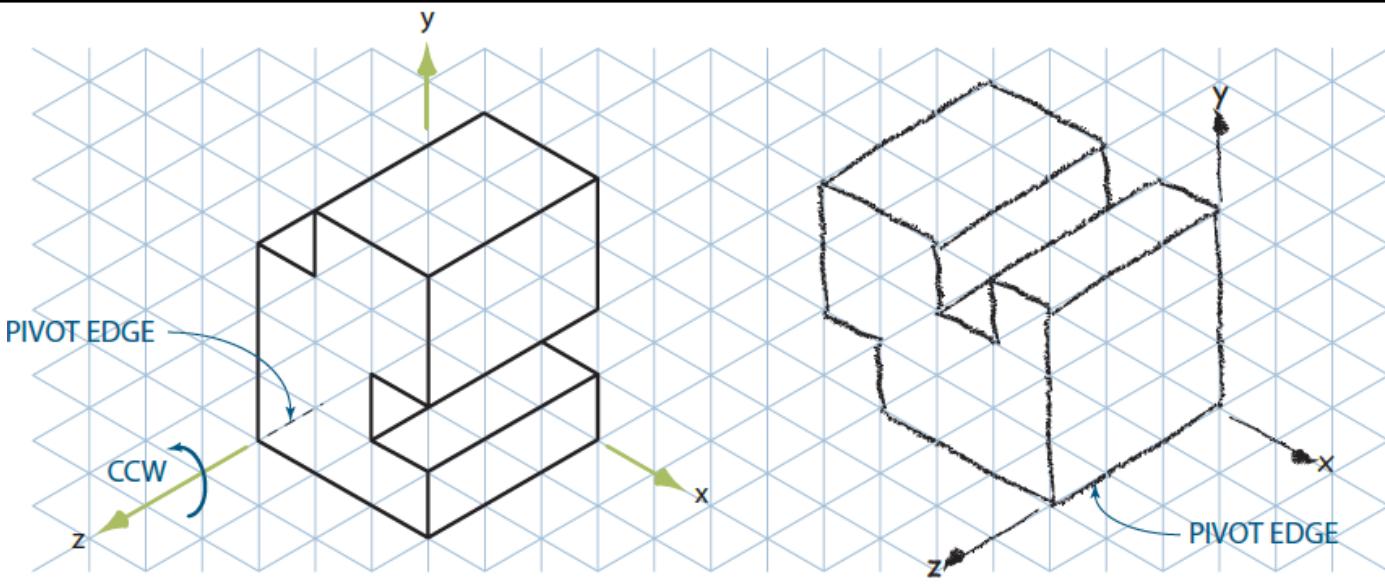
Clockwise(CW)
Y-axis

Counter
Clockwise
(CCW)
Z-axis

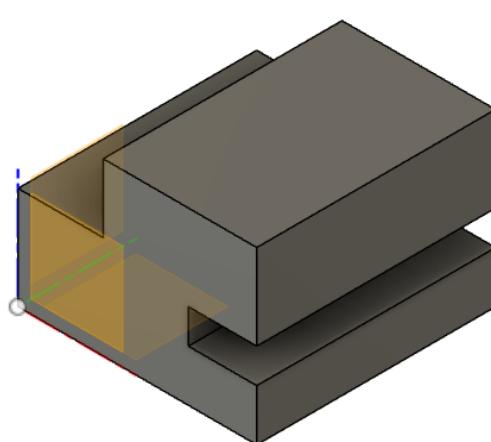


Clockwise(CW)
Z-axis

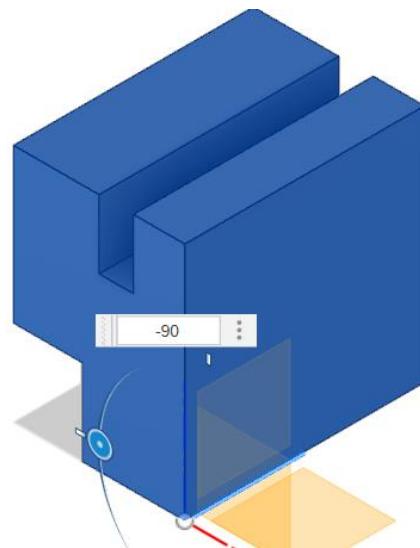


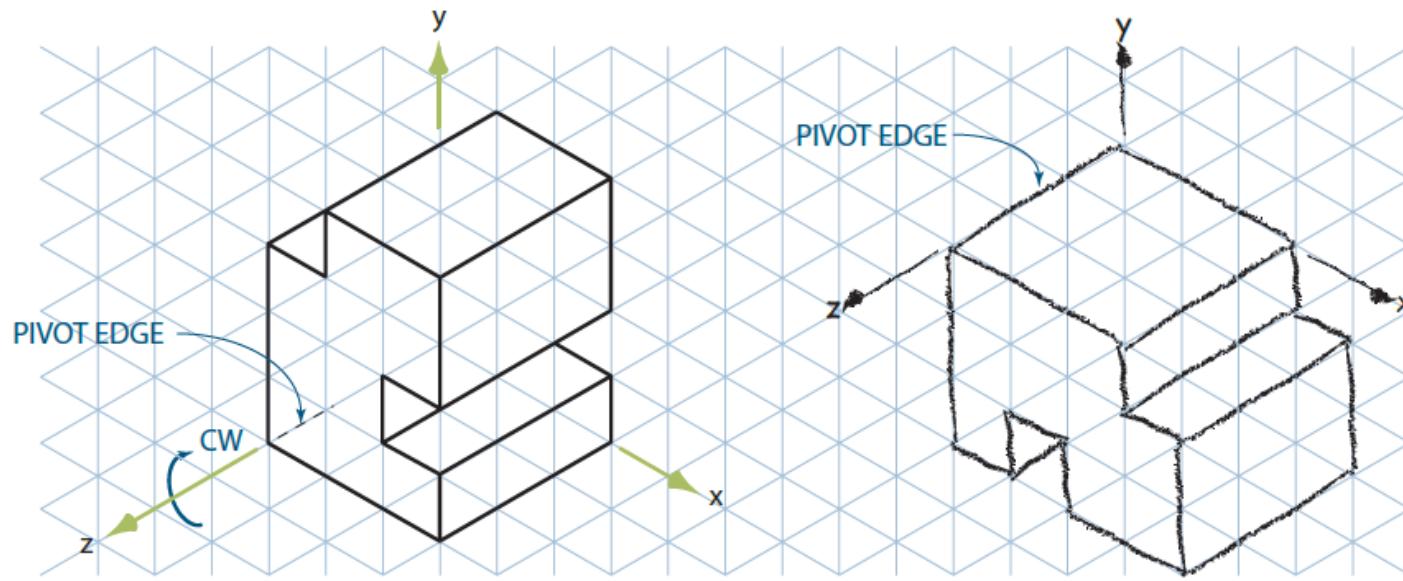


A 3-D object rotated 90 degrees
counterclockwise about the z-axis



90° CCW: Z-axis

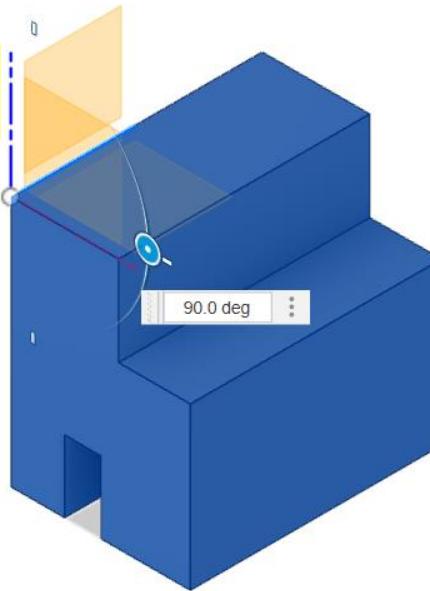
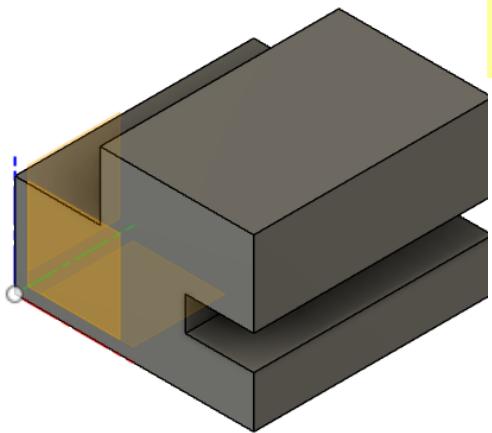


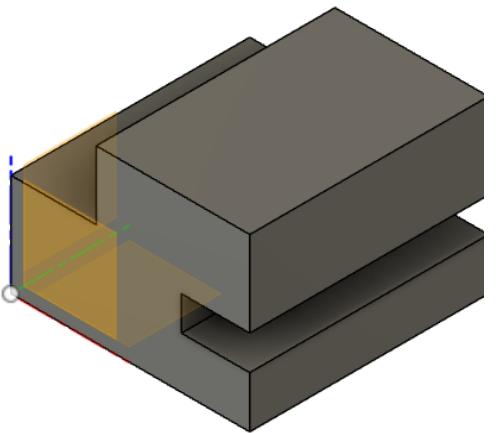


A 3-D object rotated 90 degrees clockwise about the z-axis.

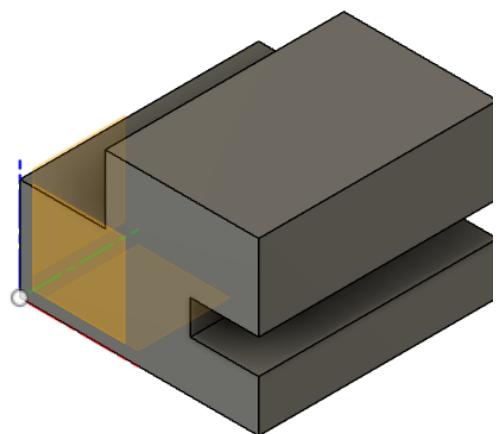
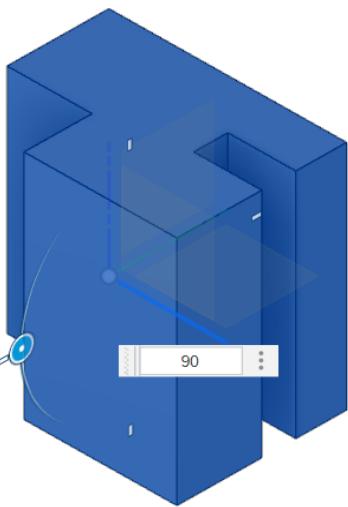
ORIGINAL ORIENTATION

ROTATED IMAGE

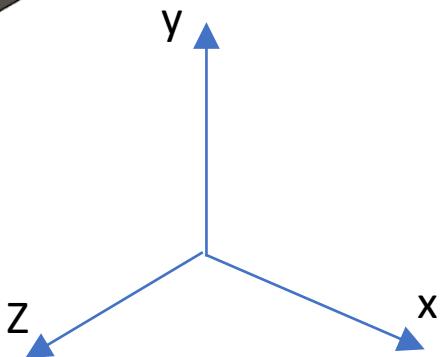
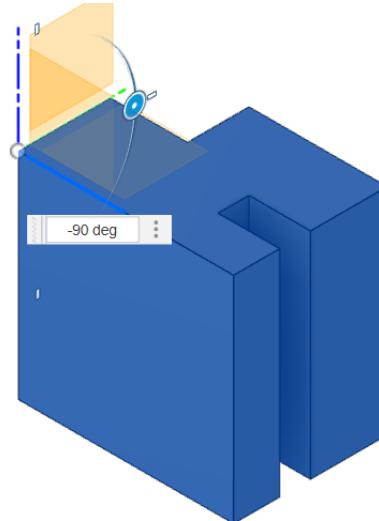




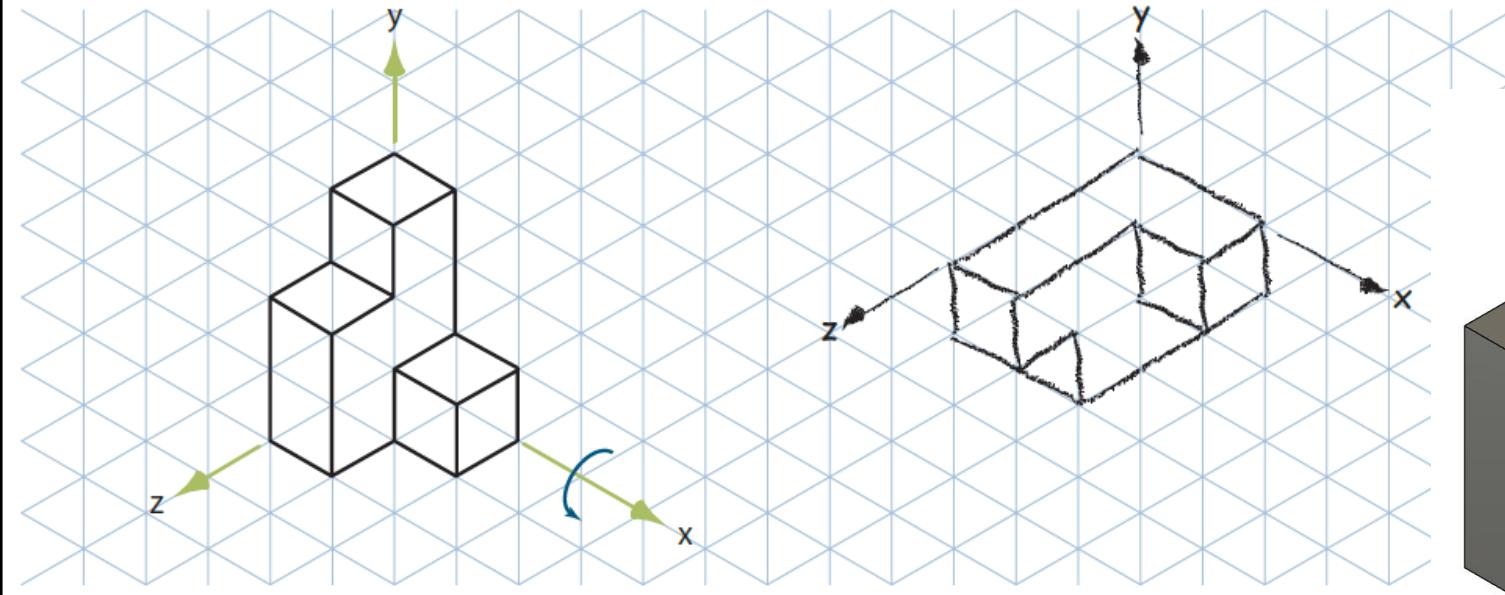
90° CCW: X-axis



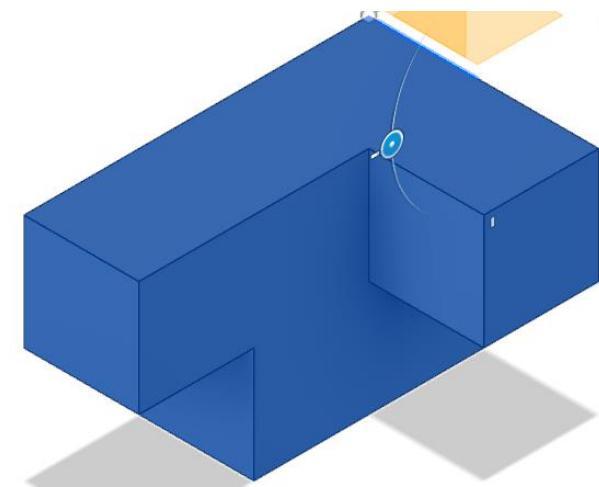
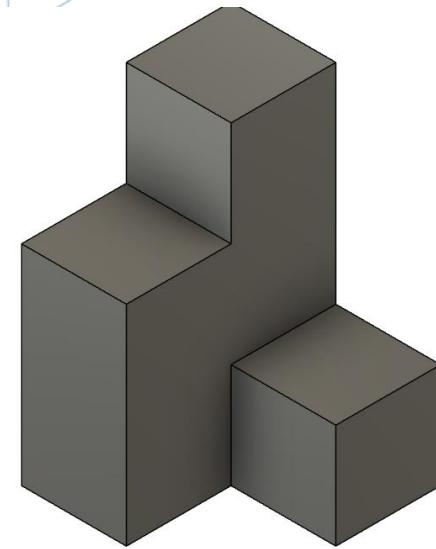
90° CW: X-axis



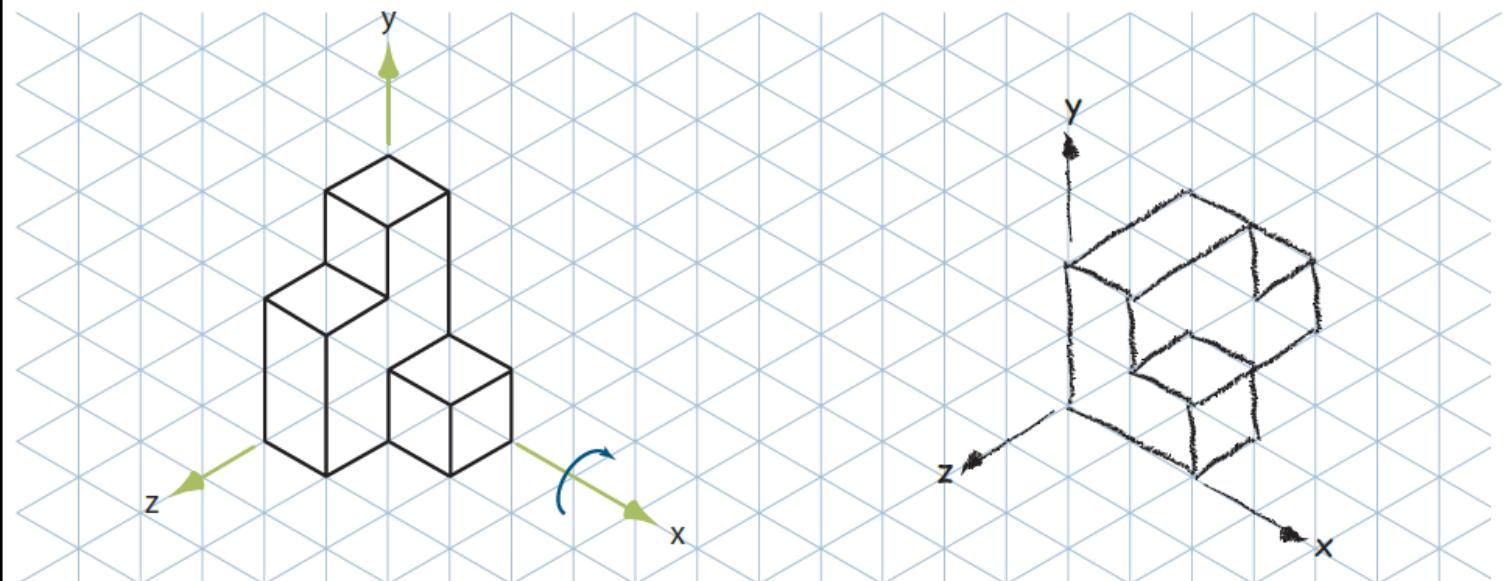
Positive rotation about the x-axis



POSITIVE x-ROTATION

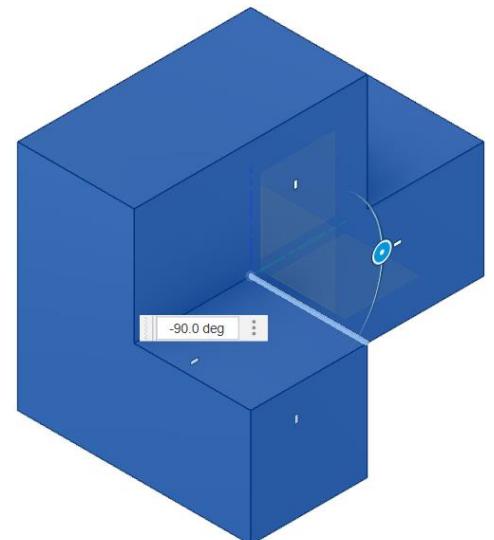
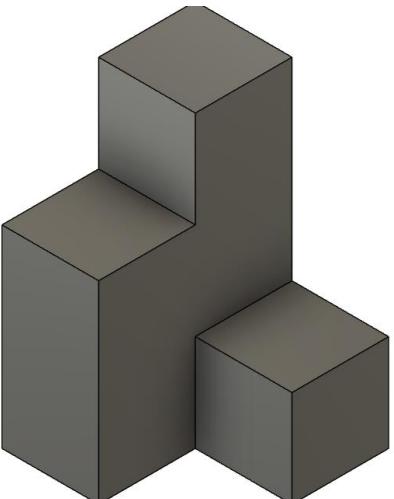


ROTATED IMAGE



NEGATIVE x-ROTATION

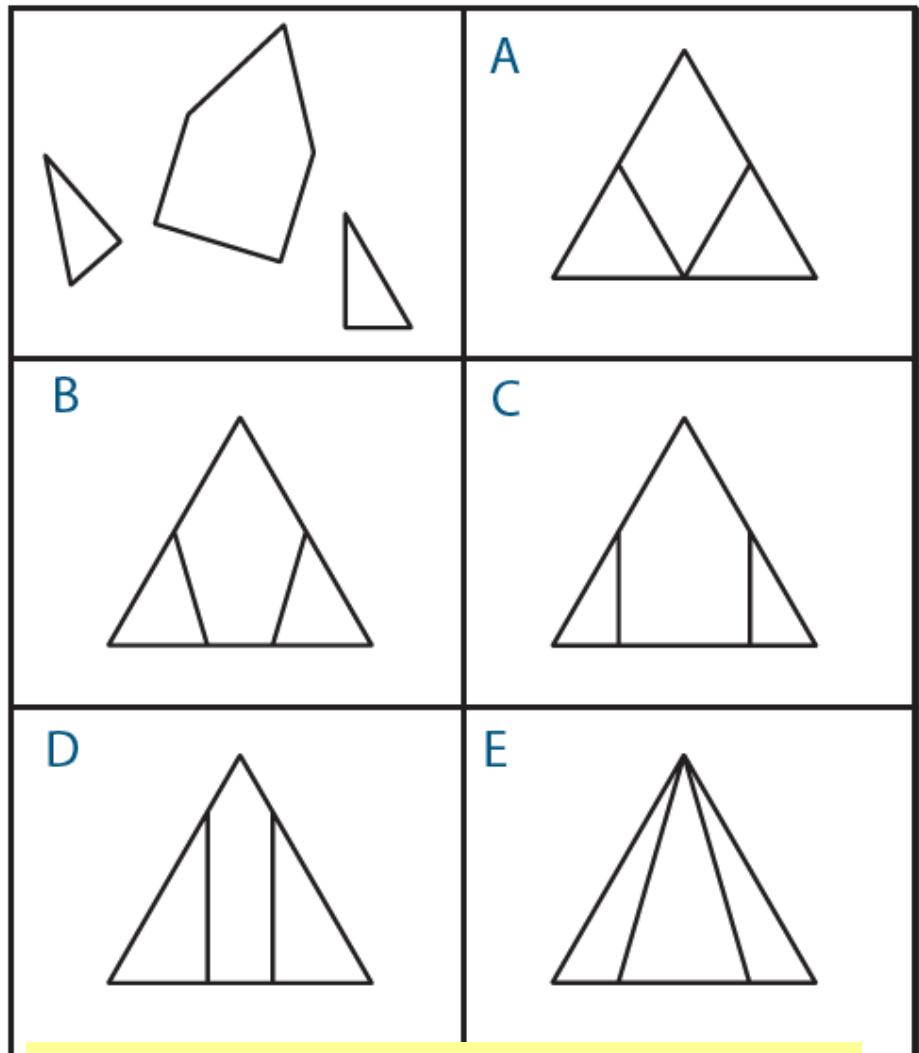
Negative rotation about the x-axis



ROTATED IMAGE

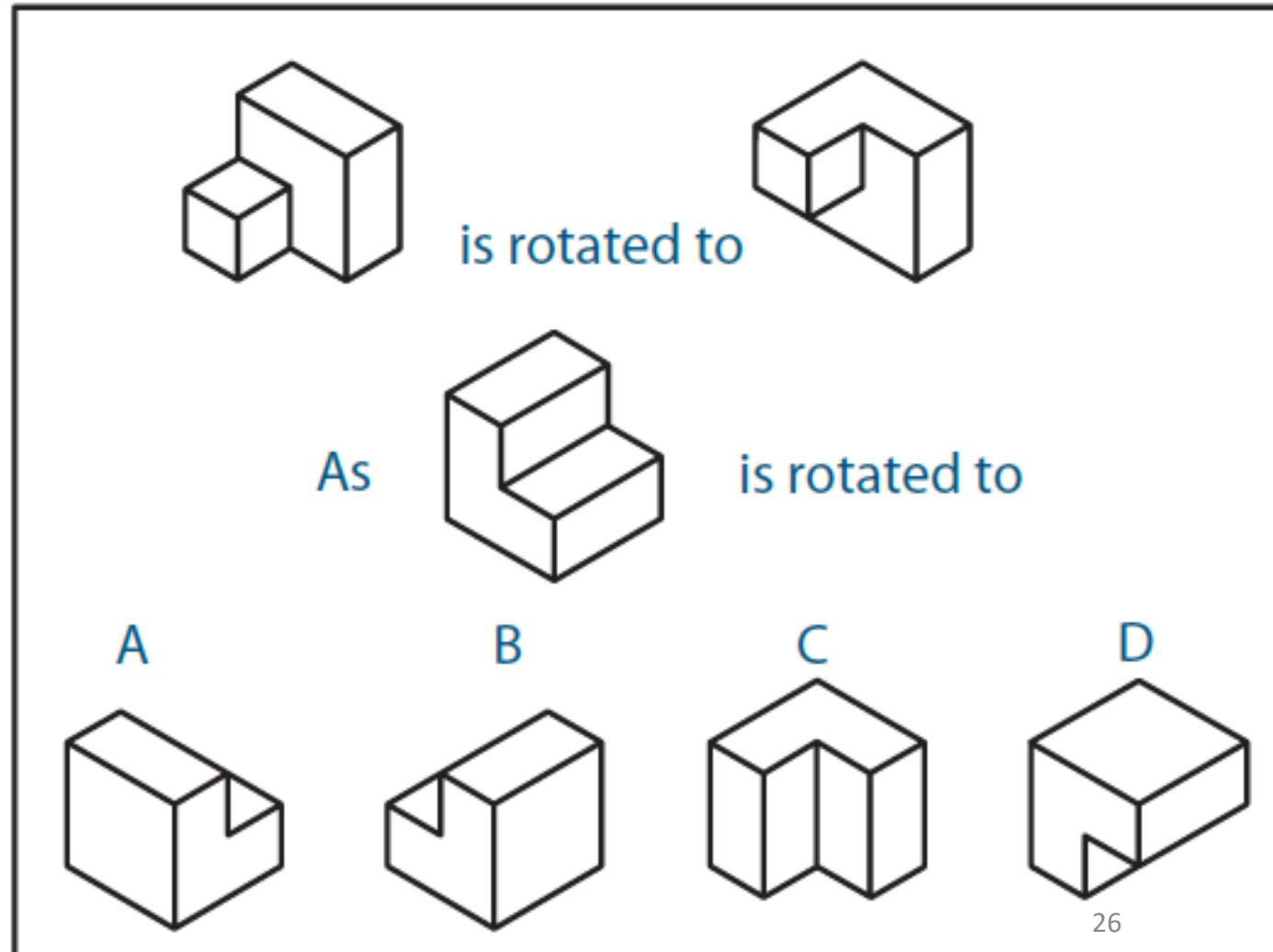
VISUALIZATION - Assessing spatial skills

SPATIAL ABILITY: the ability to mentally manipulate, rotate, twist, or invert pictorially presented visual stimuli



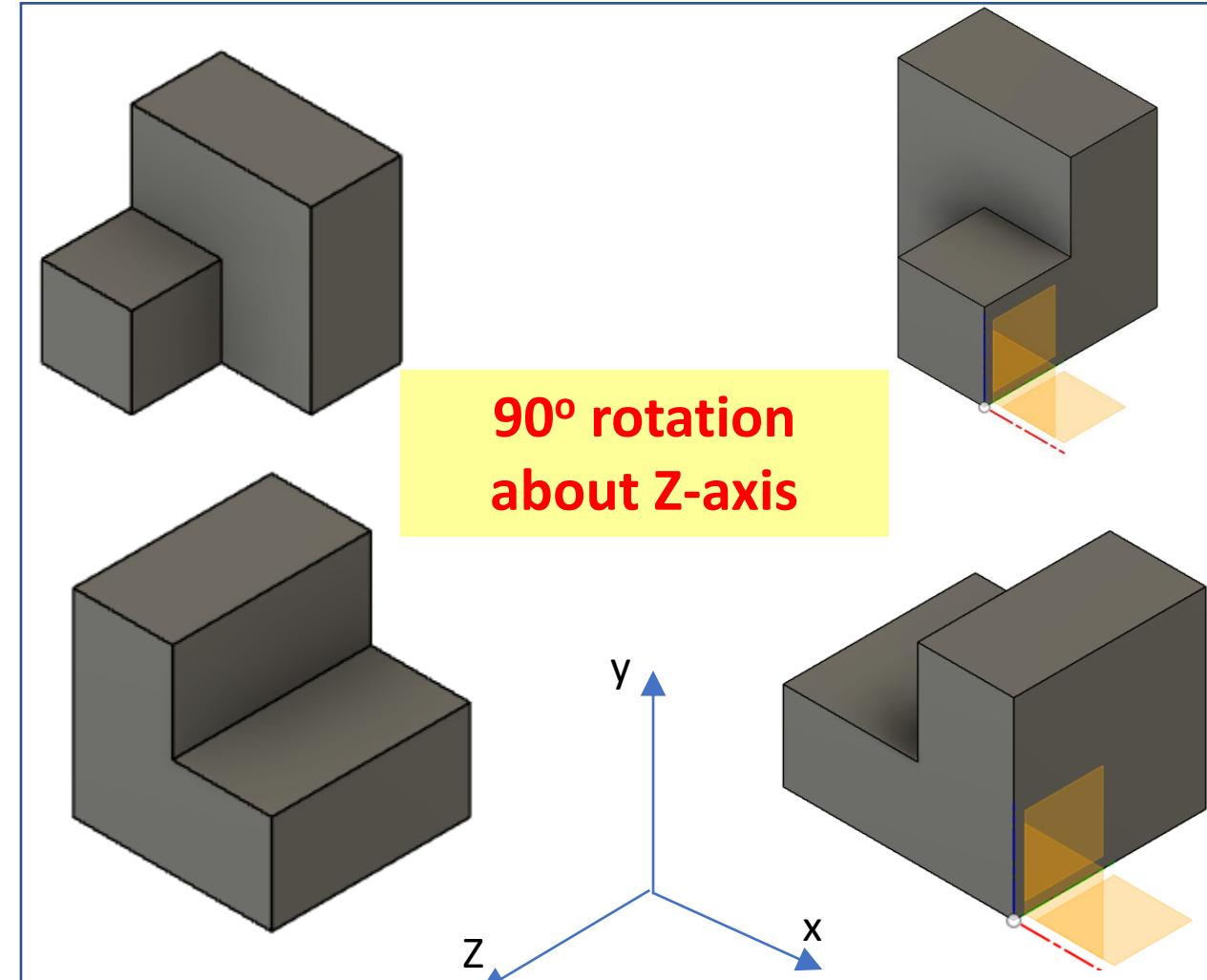
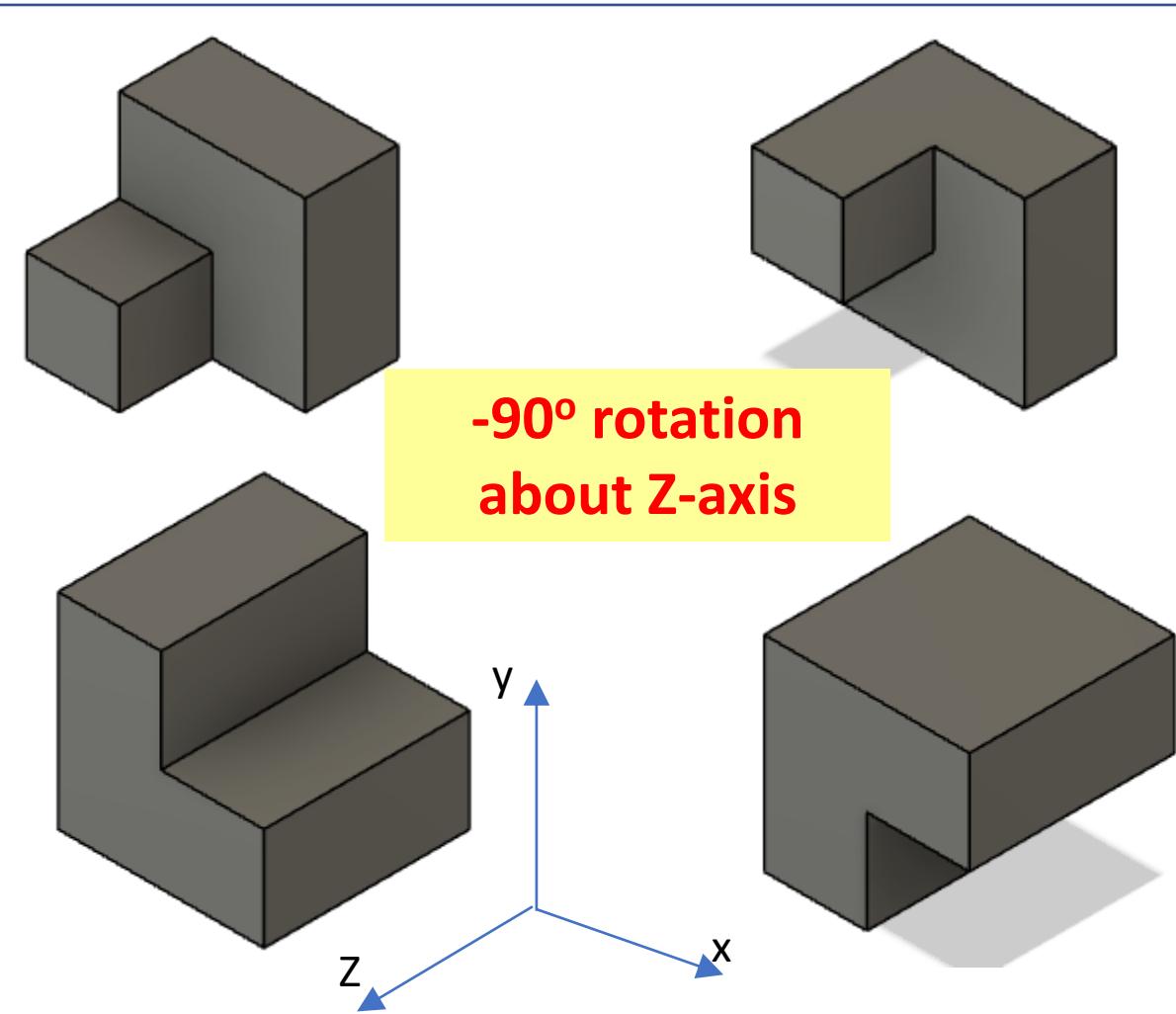
PAPER FORM BOARD TEST - C

3D ROTATION



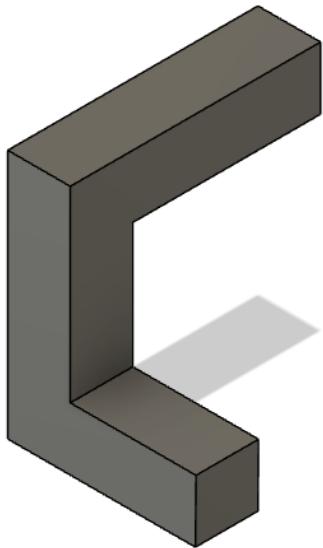
VISUALIZATION - Assessing spatial skills

SPATIAL ABILITY: the ability to mentally manipulate, rotate, twist, or invert pictorially presented visual stimuli

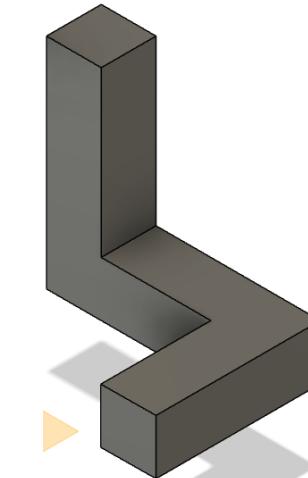
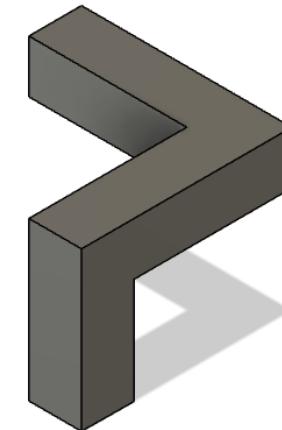
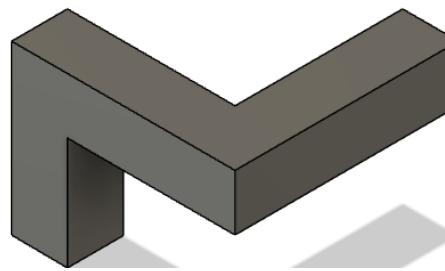
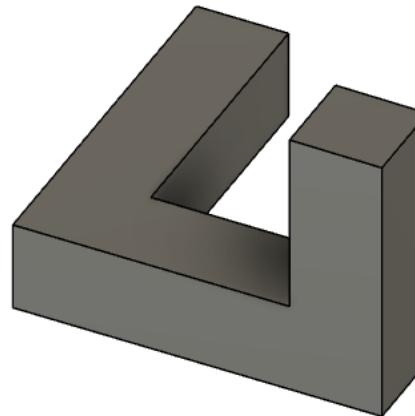


VISUALIZATION - Assessing spatial skills

3D ROTATION

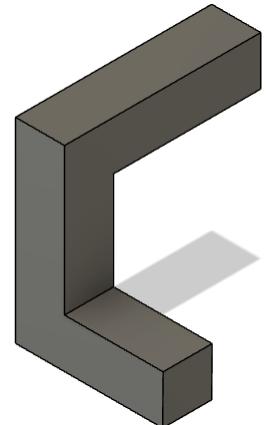


Identify the rotation of the left body to obtain the right side configuration

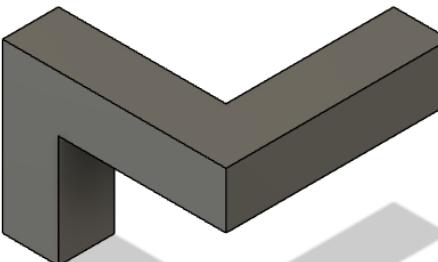


VISUALIZATION - Assessing spatial skills

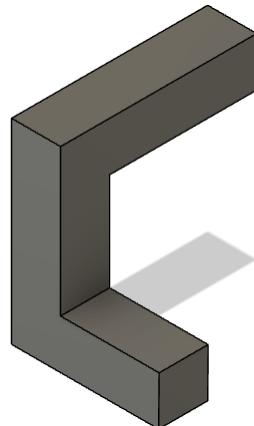
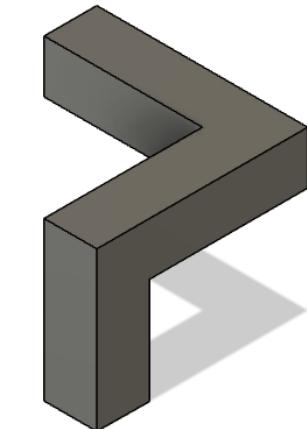
3D ROTATION



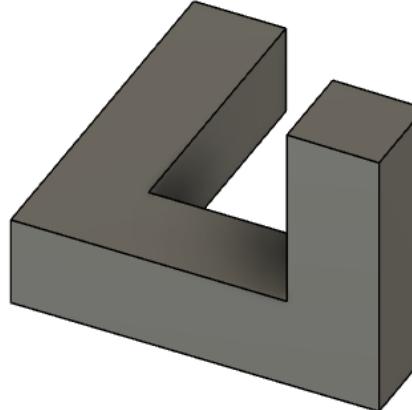
-90° rotation
about Z-axis



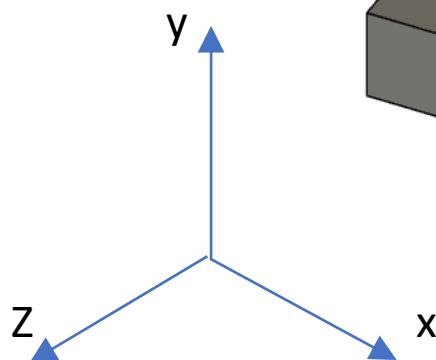
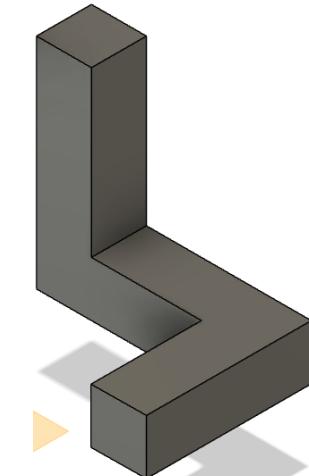
Another 90°
rotation
about Y-axis



90° rotation
about Z-axis

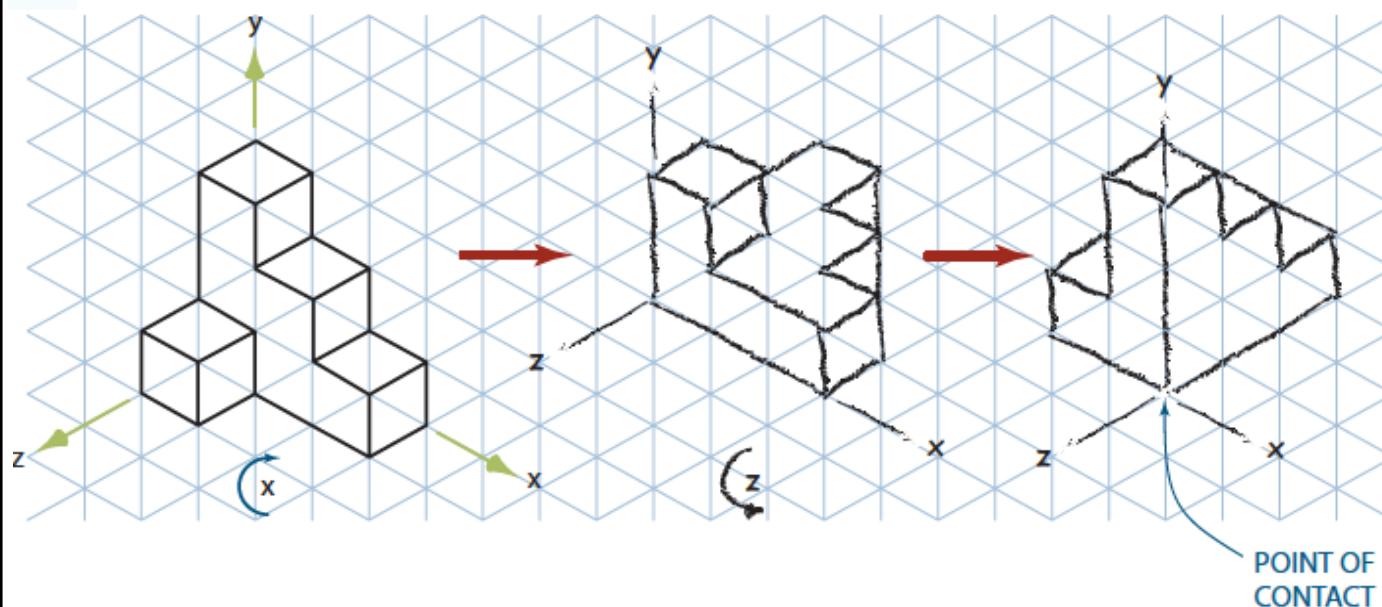
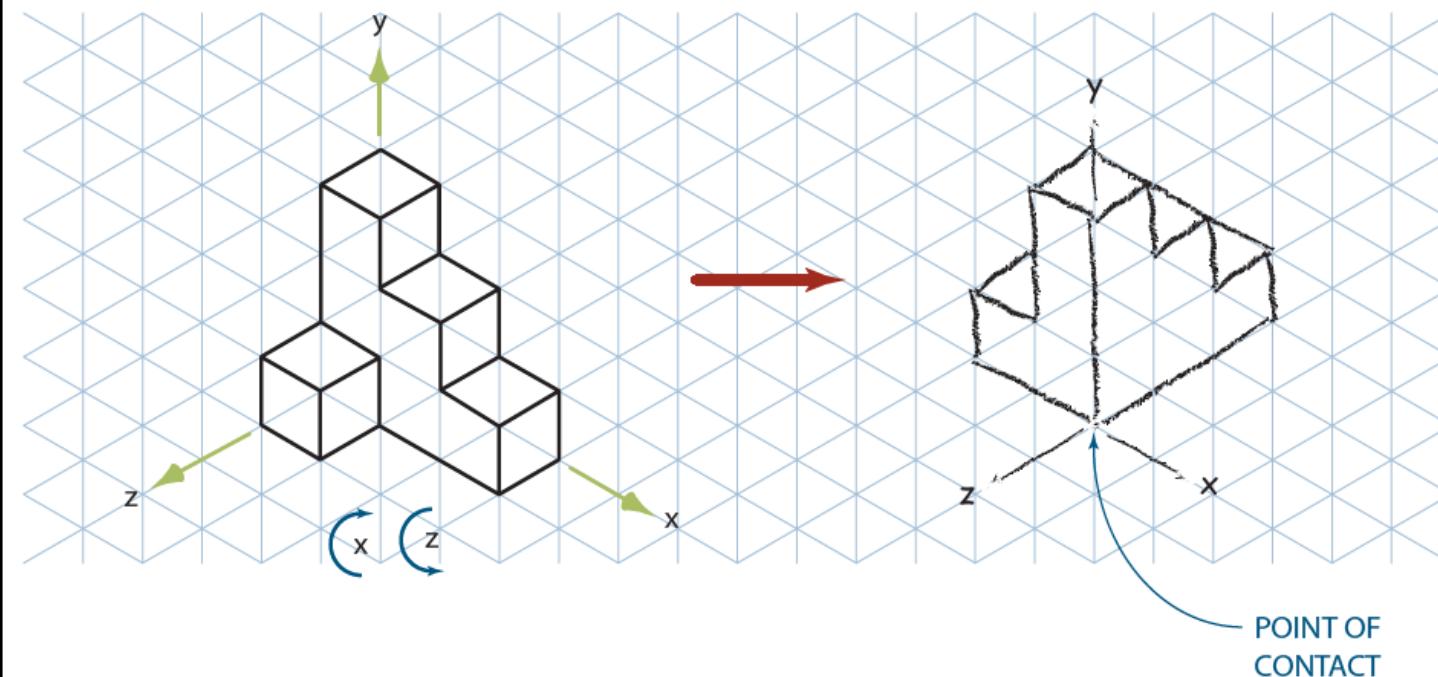


Another 90°
rotation
about X-axis



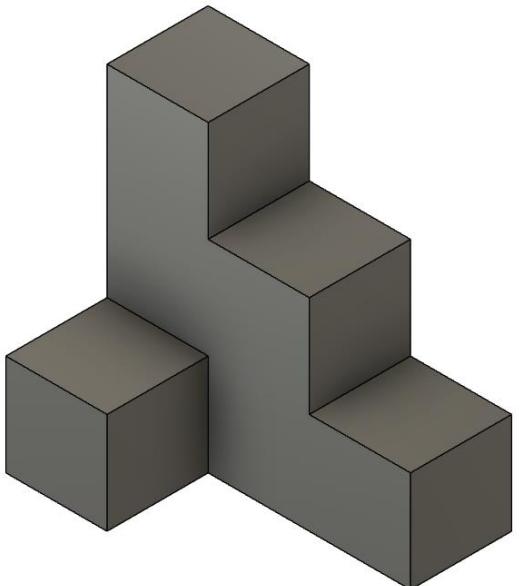
ROTATION ABOUT TWO OR MORE AXES

An object rotated about two axes

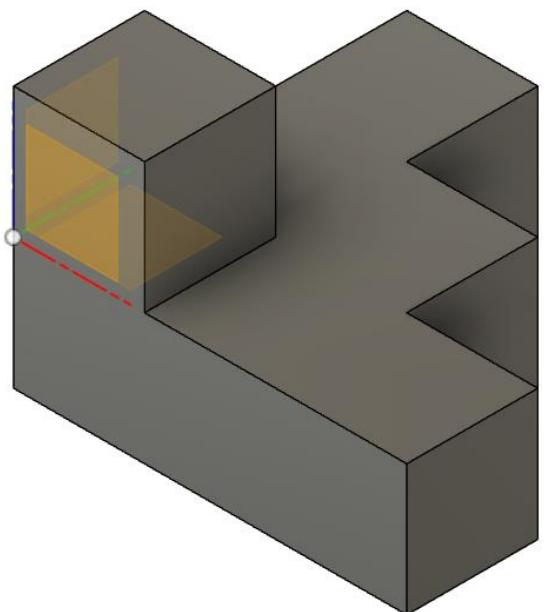
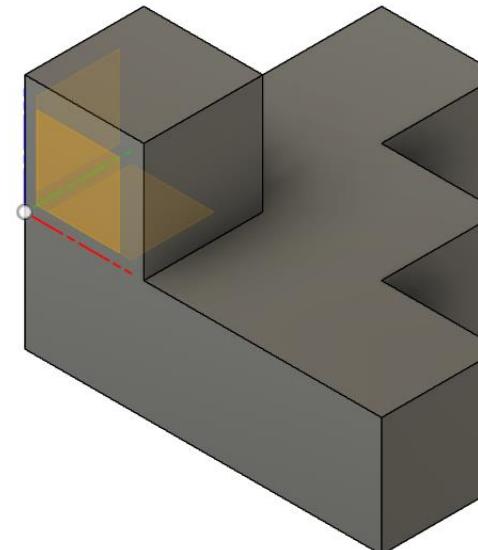


An object rotated in two steps

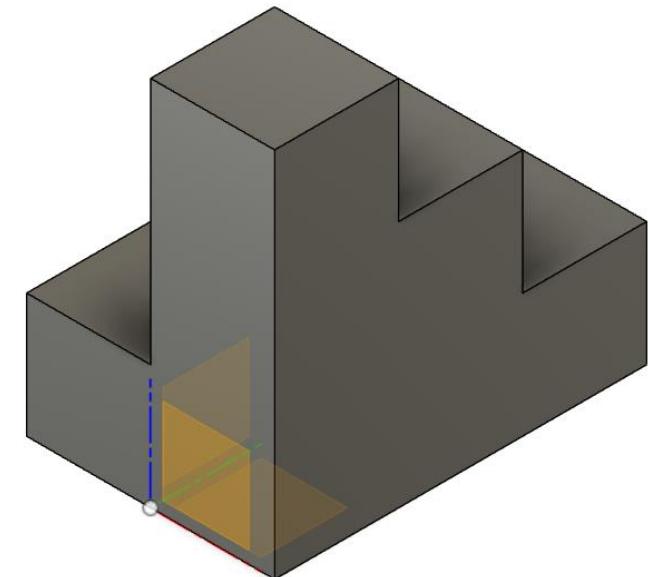
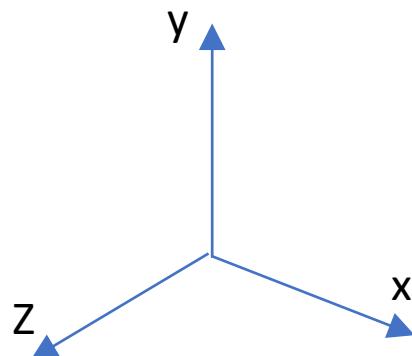
ROTATION ABOUT TWO OR MORE AXES



**CW rotation: X-axis
-ve rotation: X-axis**

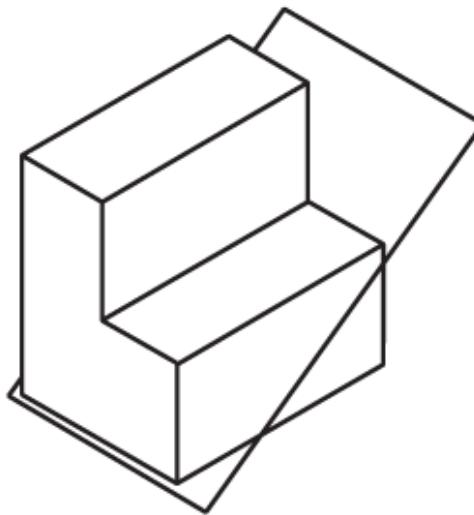


**CCW rotation: Z-axis
+ve rotation: Z-axis**



VISUALIZATION - Assessing spatial skills

CUTTING AN OBJECT BY A PLANE



A



B



C

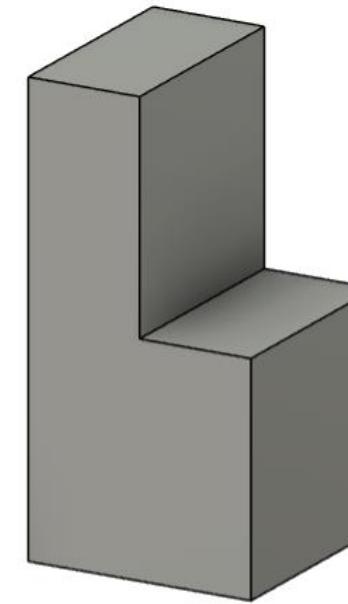
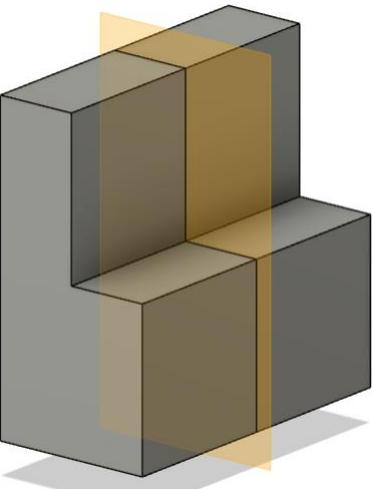
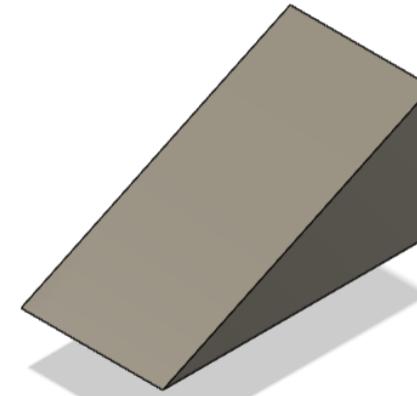
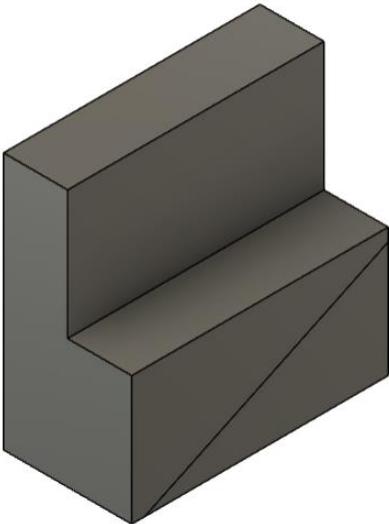


D

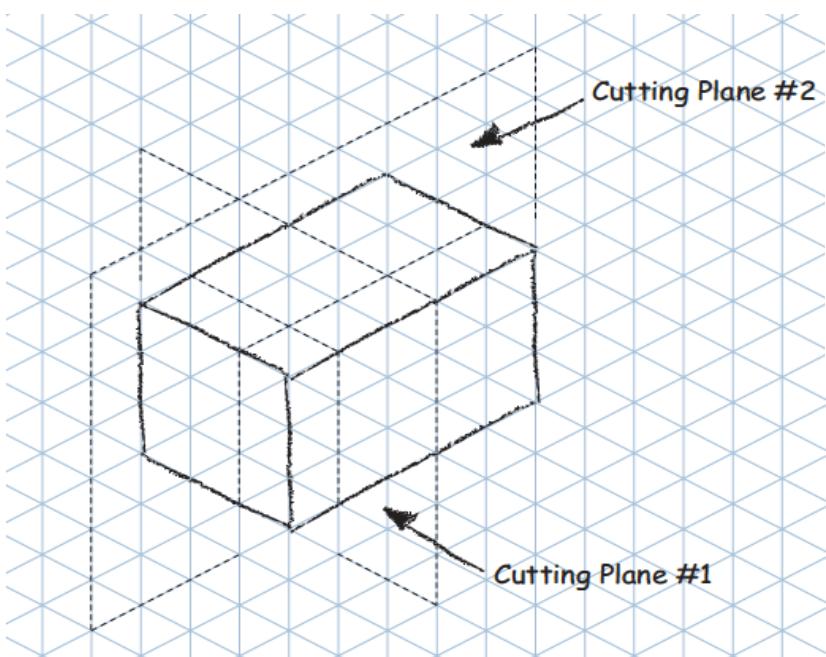


VISUALIZATION - Assessing spatial skills

CUTTING AN OBJECT BY A PLANE



CROSS SECTIONS OF SOLIDS



Cross Section #1



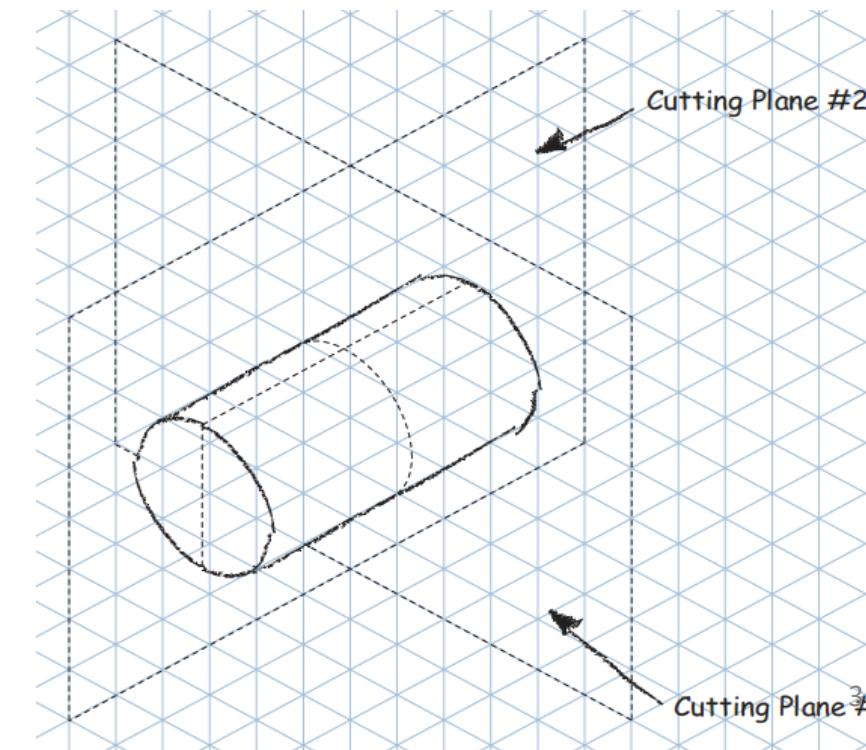
Cross Section #2

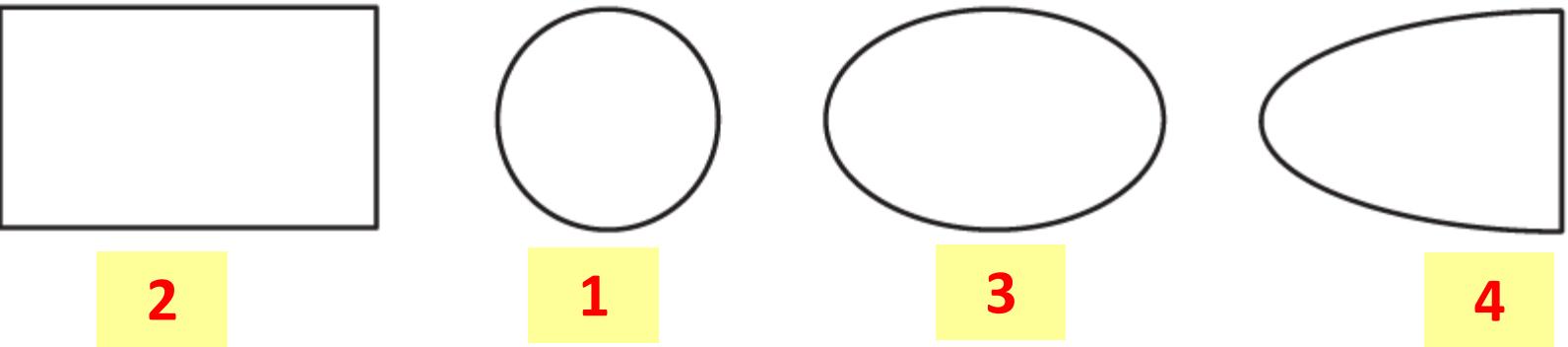
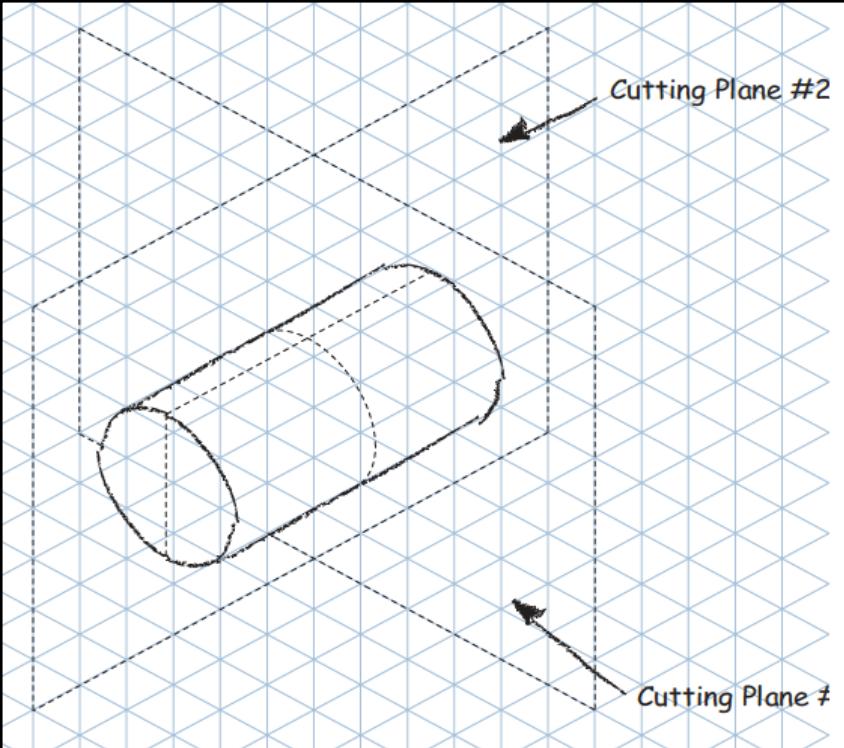


Cross Section #1

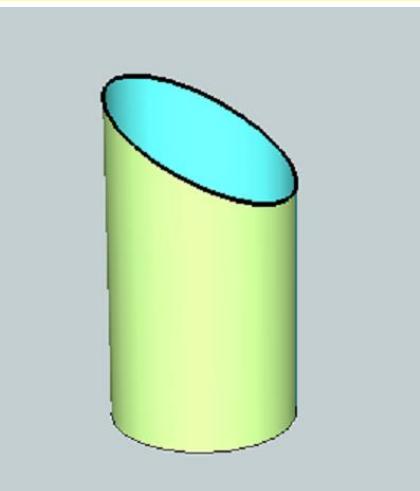


Cross Section #2

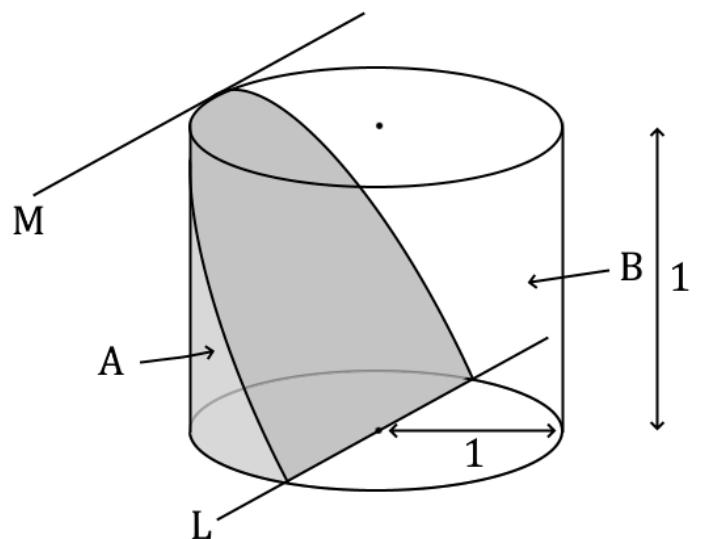




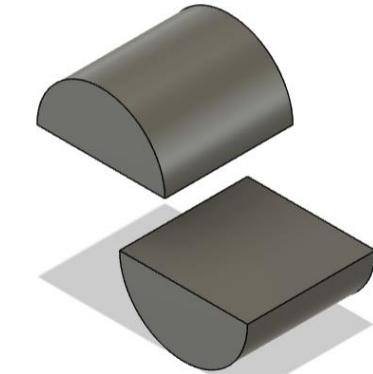
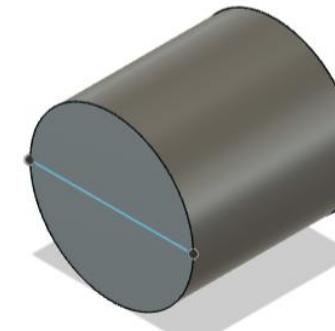
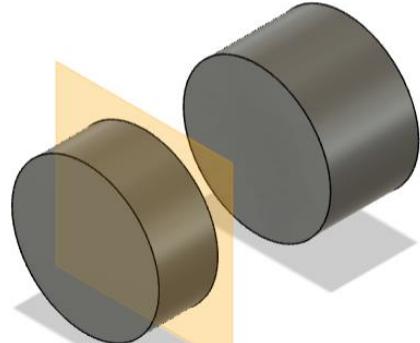
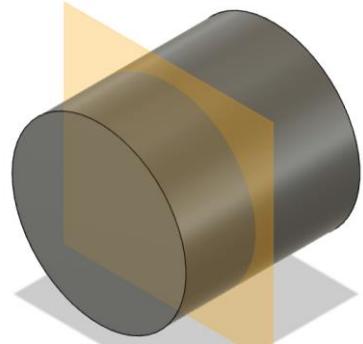
SEVERAL CROSS SECTIONS OF A CYLINDER



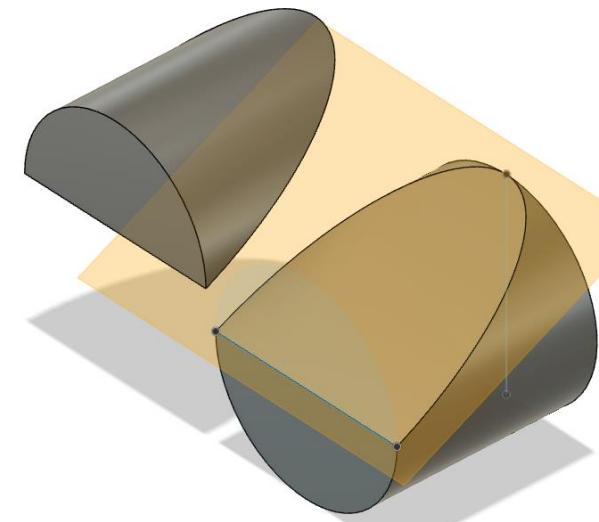
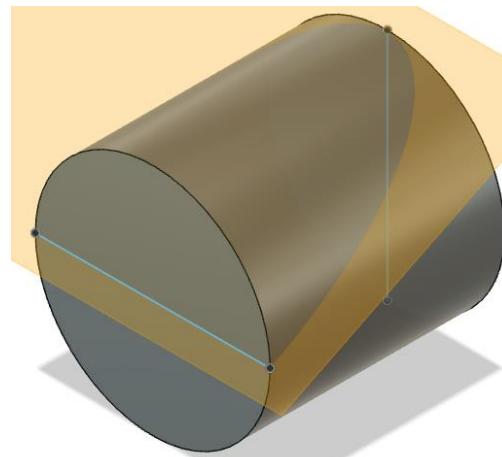
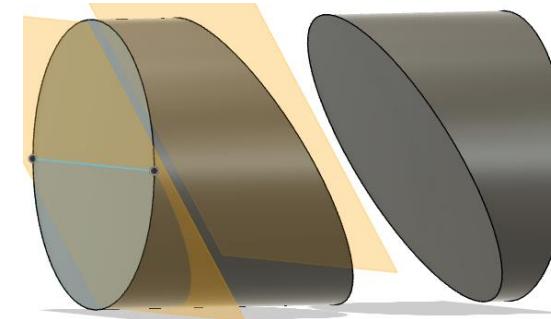
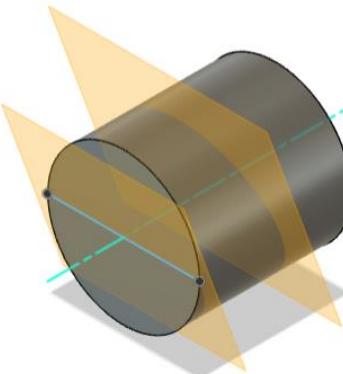
Third cross section - obtained by orienting the cutting plane at an angle with respect to the axis of the cylinder



Fourth cross section - obtained by angling the cutting plane with respect to the cylinder axis, but the angle was such that a portion of the cutting plane went through the flat circular end surface of the cylinder

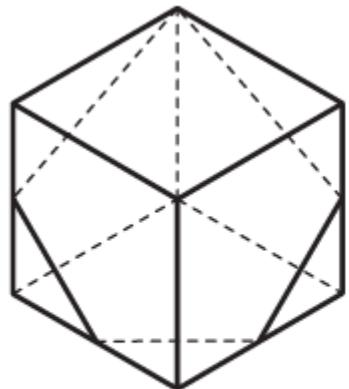


**Construct plane angle to diameter
Construct offset plane**

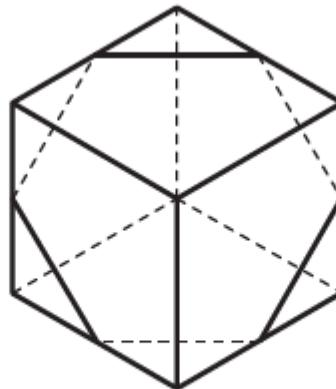


**Construct plane
through 3 points**

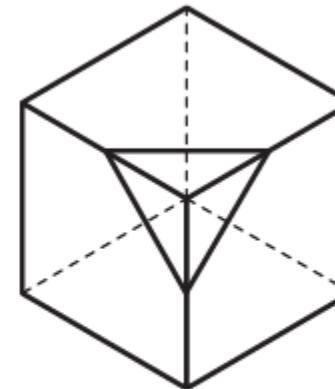
SEVERAL CROSS SECTIONS OBTAINED BY SLICING A CUBE WITH CUTTING PLANES AT DIFFERENT ORIENTATIONS



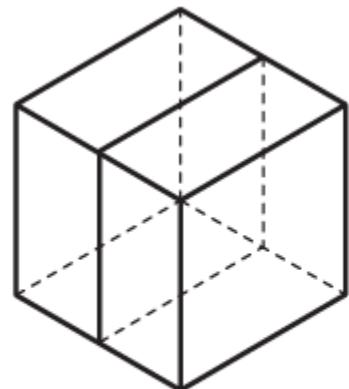
Pentagon



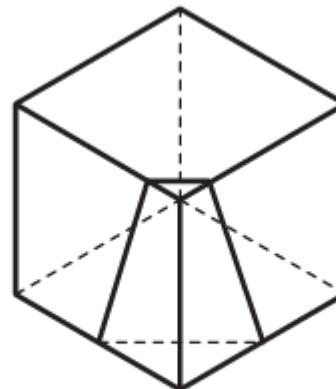
Hexagon



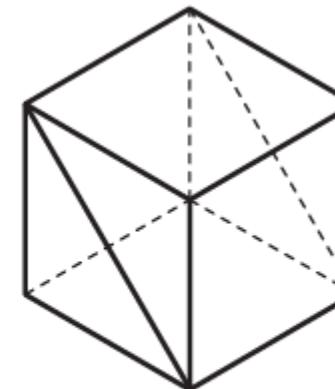
Triangle



Square

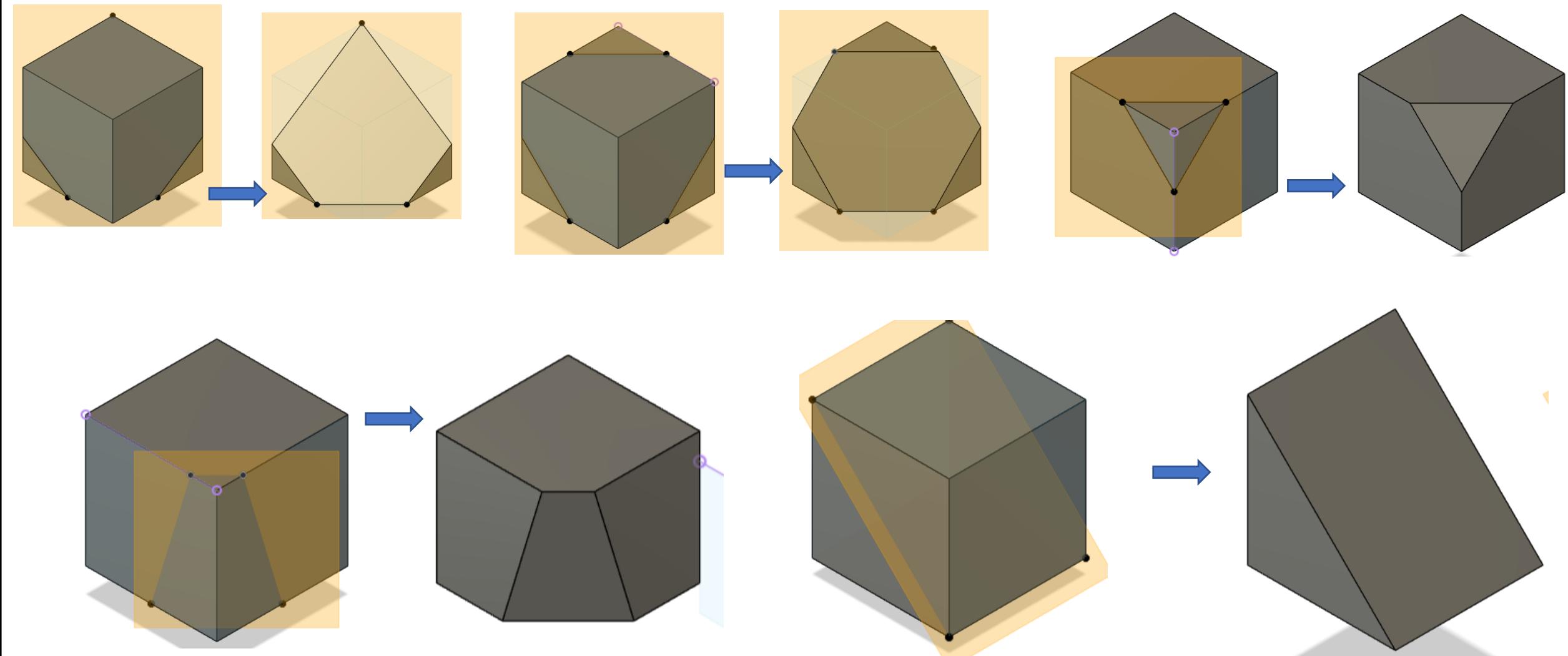


Trapezoid



Rectangle

SEVERAL CROSS SECTIONS OBTAINED BY SLICING A CUBE WITH CUTTING PLANES AT DIFFERENT ORIENTATIONS



COMBINING SOLIDS

The ability to visualize combining solids will be helpful as you learn how to use solid modeling software.

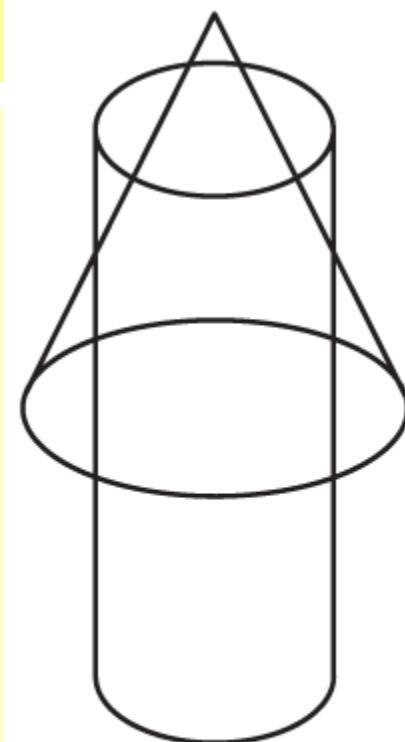
In early versions of 3-D CAD software, commands used to combine solids were sometimes known as Boolean operations.

Two overlapping objects can be combined to form a third object with characteristics of each original object apparent in the final result.

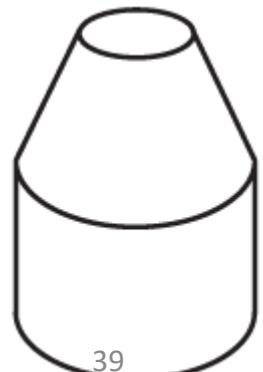
To perform any Cut, Join, or Intersect operation to combine objects, the objects must be overlapping initially.

OVERLAPPING – objects share a common volume in 3-D space—called the **VOLUME OF INTERFERENCE**

Volume of interference takes shape and size characteristics from each of the two initial objects.

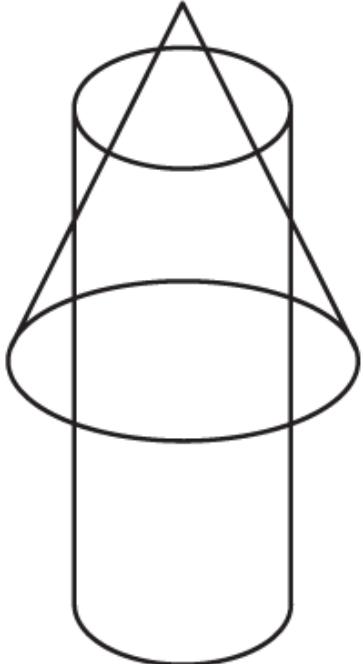


Overlapping
Objects



Volume of interference

COMBINING SOLIDS



Volume of
interference

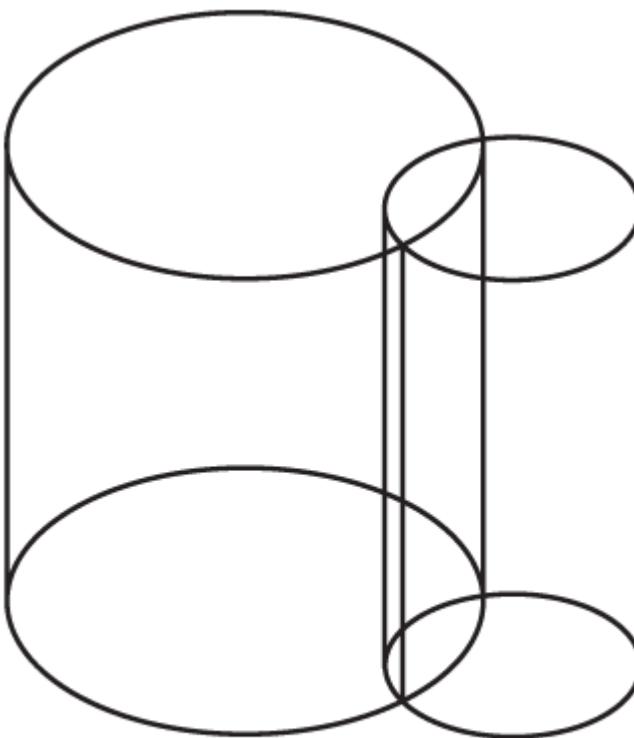
Overlapping
Objects

THE BOOLEAN JOIN OPERATION

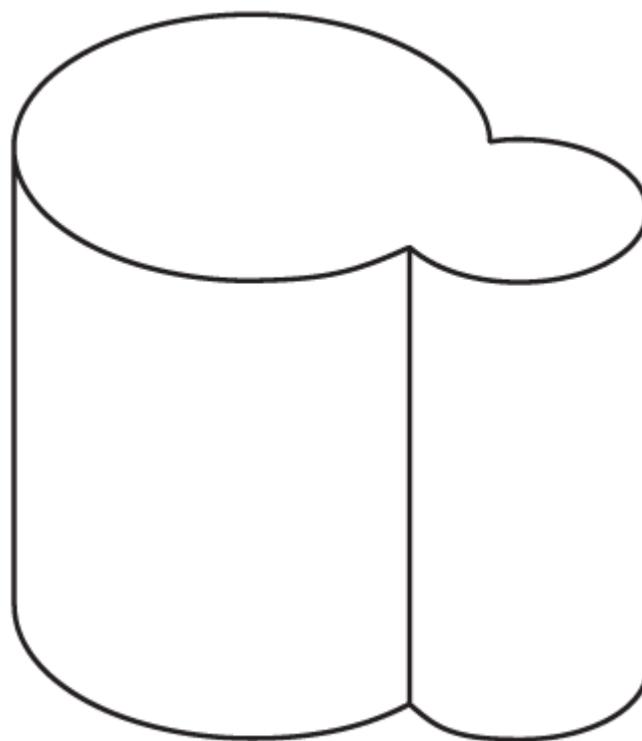
When two objects are joined, the volume of interference is absorbed into the combined object.

The result is a single object that does not have “double” volume in the region of interference.

Volume of interference takes shape and size characteristics from each of the two initial objects.



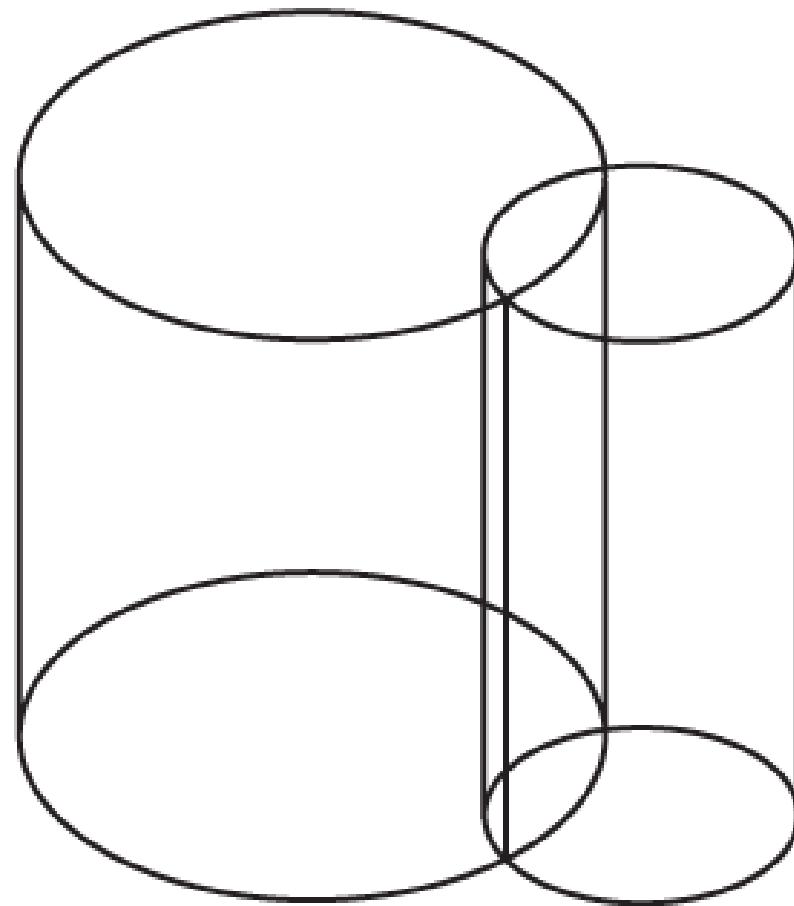
Overlapping Objects



Objects Joined

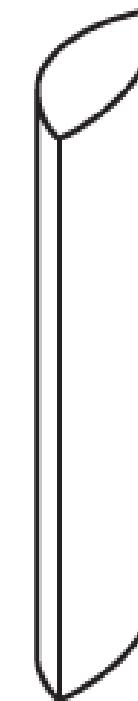
COMBINING SOLIDS

Result of two objects intersected



Overlapping Objects

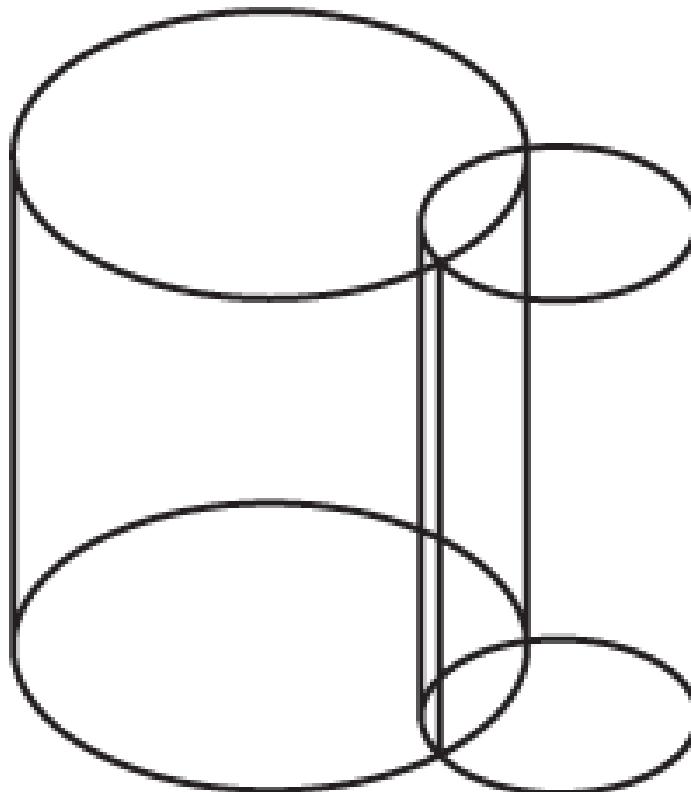
When two objects are combined by intersecting, the combined object that results from the intersection is the volume of interference between them



Objects Intersected

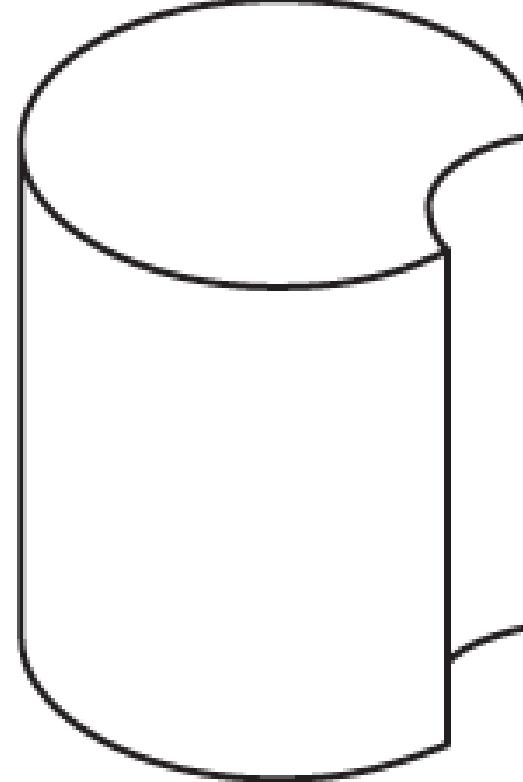
COMBINING SOLIDS

Result of two objects cutting

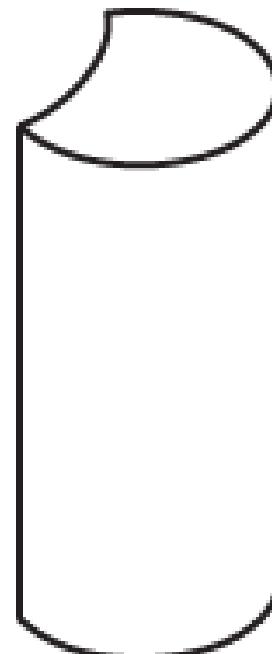


Overlapping Objects

In the cutting of two objects, the combined object that results from the cutting depends on which object serves as the cutting tool and which object is cut by the other object. The result of a cutting operation is that the volume of interference is removed from the object that is cut,



Small Cylinder Cuts
Large Cylinder



Large Cylinder Cuts
Small Cylinder

COMBINING SOLIDS

Cutting tool: cone



intersection: cone

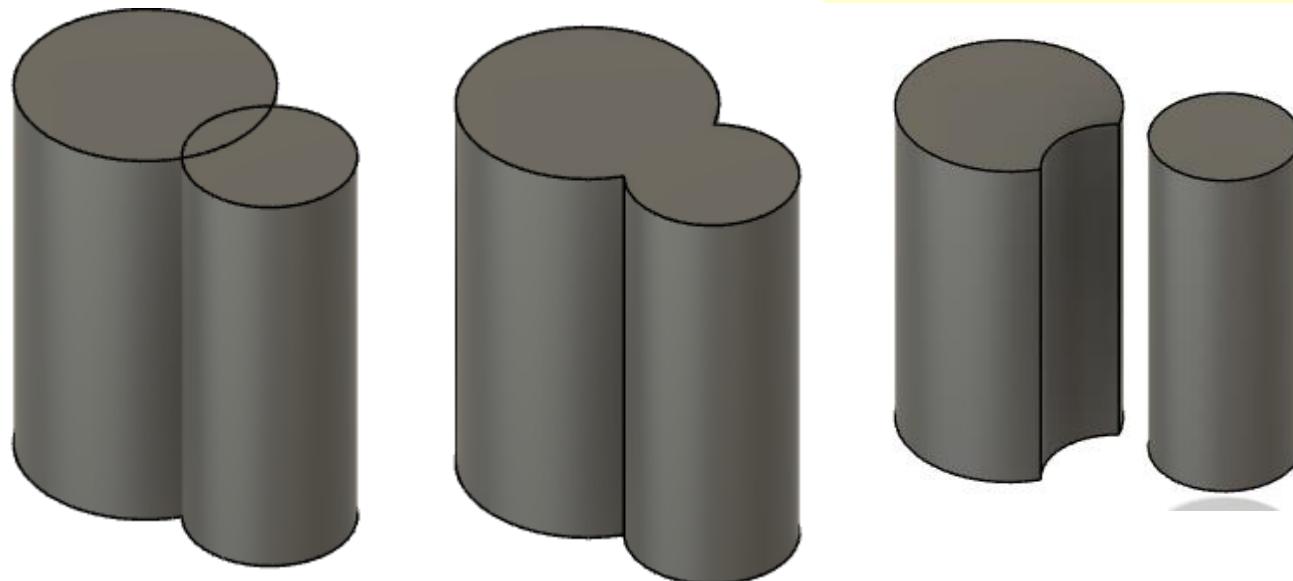
Cutting tool: cylinder



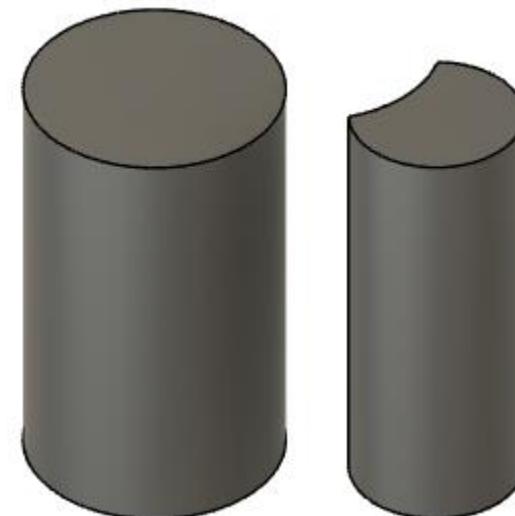
intersection: cylinder

COMBINING SOLIDS

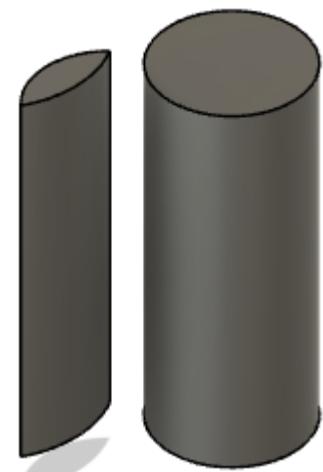
Cutting tool:
smaller cylinder



Cutting tool:
bigger cylinder



intersection



LABORATORY EXERCISE

- Already the laboratory exercise questions are kept in the moodle
- Content of the material taught (taken from Lieu or Sorby) is in moodle
- You will be given the same questions when you come over to lab, you need to solve all of them without consulting your friends or teaching assistants
- Work on lab sheets independently. **IT IS CONDUCTED LIKE A QUIZ.** Do not copy from others.
- In case, if you are stuck and cannot make headway at all, your teaching assistant will help you but few marks would be deducted

Best way is to

Study the material taught in the theory class – NOTES

Solve the laboratory sheet before coming to the lab class.

LABORATORY EXERCISE

- Basis of evaluation of Lab submissions :
 - Effort
 - Correctness
 - Neatness