Poly-gon where?

Carole Greenes

©PRIME Group 2023

Also produced by the PRIME Group

- ***Alge-Grid: What's the a?***
- ***Pattern Grid-unLocks***
- ***Play It Positively or Negatively!***
- ***Factor Max***
- ***Make It Proper***
- ***Shape-Up***
- ***Function Frenzy***

Practice, Research & Innovation in Mathematics Education (PRIME) Group

Center for Mathematics and Teaching, Inc.
https://mathandteaching.org/

Table of Contents

Section	Page
Author Bio and Acknowledgments	4
Poly-gon Where? Description	5
Example	6
Section 1: Two Lines Problems 1 - 36	7
Section 2: Three Lines Problems 37-42	44
Solutions: Section 1 Problems 1 - 36	52
Solutions: Section 2 Problems 37-42	89

AUTHOR BIO

Carole Greenes, Ed.D. is Professor, Emerita, Mathematics Education at Arizona State University. While at ASU, she served as Associate Vice President for STEM Education, Dean of the School of Educational Innovation and Teacher Preparation, Director of the Practice Research and Innovation in Mathematics Education (PRIME) Center, Director of the Vertically Integrated Projects program that provides research experiences for undergraduate students, and Professor of Mathematics Education in the Ira A. Fulton Schools of Engineering, the College of Liberal Arts and Sciences, and the Mary Lou Fulton Teachers College. Currently, she directs the PRIME Group that develops books of challenge problems and games for students, grades K – 12 and writes *Carole's Co*rner for the Center for Mathematics and Teaching, Inc. in California. Carole is author of more than 350 books for students and teachers, PreK-12; 81 articles; six mathematical musicals; and two histories of mathematics in story and song. In 2003, she was inducted into the Massachusetts Mathematics Educators' Hall of Fame. In 2011, she received the NCSM Ross Taylor/Glenn Gilbert National Leadership Award in Mathematics Education. In 2016, she received the Copper Apple Award for Leadership in Mathematics in Arizona, and in 2018 she received the National Council of Teachers of Mathematics Lifetime Achievement Award. Her 2021 and 2022 books/games include: *Alge-Grid: What'the a?*, *Pattern Grid-unLocks, Play It Positively or Negatively!*, *Factor Max, Make It Proper, Shape Up, Function Frenzy,* and *Poly-gon Where?* She is author of *Carole's Corner* and *Carole's Commentary* for the Center for Mathematics and Teaching.

ACKNOWLEDGMENTS: Special thanks to:

Tanner Wolfram for the cover art and suggested types of problems.

Robert Greenes, MD, PhD, for assistance in assembling this book.

Poly-Gon Where?

Poly-Gon Where is designed to develop skills in identifying and naming polygons that are of various sizes, shapes and positions and are "hidden" in larger polygons.

Large polygons are triangles, quadrilaterals, pentagons, hexagons, heptagons, or octagons. Some are convex. Some are concave.

Each large polygon contains two or three blue lines that connect vertices or sides to produce varying types of smaller polygons. In some shapes, lines intersect.

Smaller polygons are each labeled with a letter to enable identification of shapes.

When smaller polygons together form a larger polygon, the larger polygon may contain two or more letters.

Goal: Identify, name, and score polygons. Note that smaller polygons listed below are not in every shape.

Scoring corresponds to the number of sides of each smaller polygon:

- **3 points for each triangle**
- **4 points for each quadrilateral**
- **5 points for each pentagon**
- **6 points for each hexagon**
- **7 points for each heptagon**
- **8 points for each octagon**
- **9 points for each nonagon**
- **10 points for each decagon**

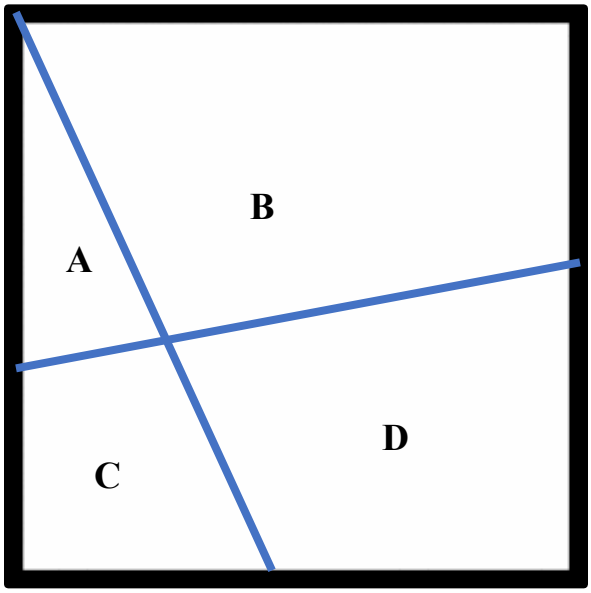
The Total for each shape is the sum of the numbers of points.

Solutions in this book show letters in alphabetical order. However, the order of the letters is not important.

NOTE: The shape itself cannot be counted.

See sample on next page.

Sample Polygon Identification and Scoring



Convex Quadrilateral

Polygon Name	Regions	Points
Triangles:	A, AC	6 points
Quadrilaterals:	B, C, D, AB, BD, CD	24 points
Pentagons:	ACD	5 points
Hexagons:	ABC. ABD, BCD	18 points

Total: 53 points

Section 1: Two Blue Lines

6 triangles

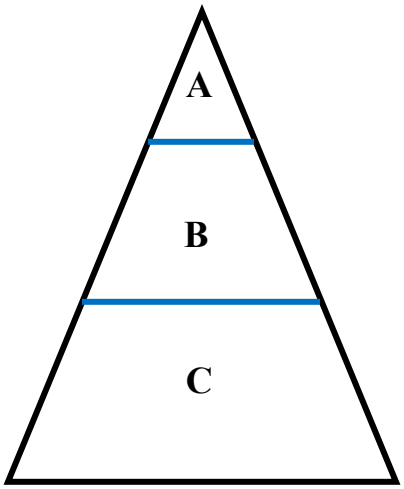
6 quadrilaterals

6 pentagons

6 hexagons

6 heptagons

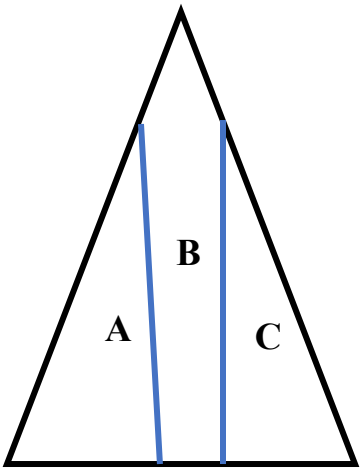
6 octagons



Isosceles Triangle

Polygon Name	Regions	Points

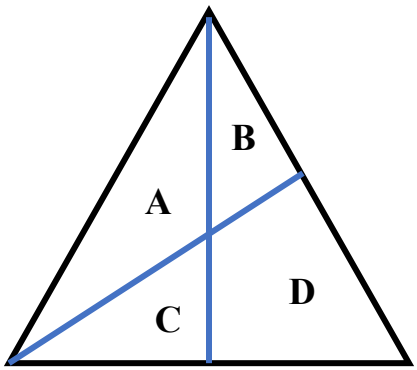
Total: _____ points



Isosceles Triangle

Polygon Name	Regions	Points

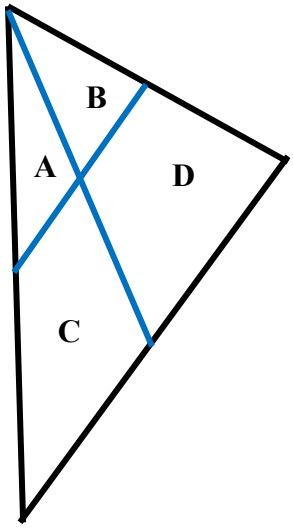
Total: _____ points



Equilateral Triangle

Polygon Name	Regions	Points

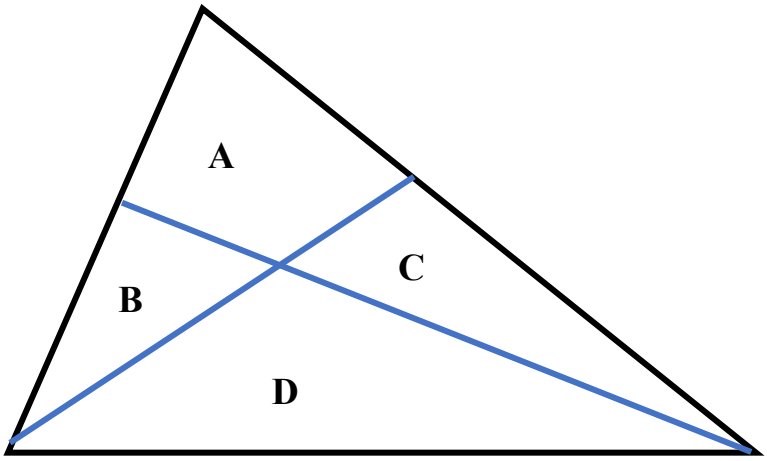
Total: _____ points



Scalene Triangle

Polygon Name	Regions	Points

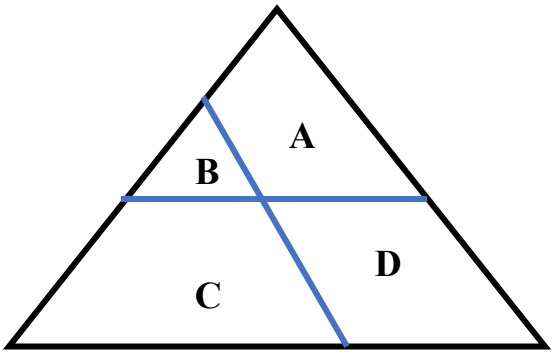
Total: _____ points



Scalene Triangle

Polygon Name	Regions	Points

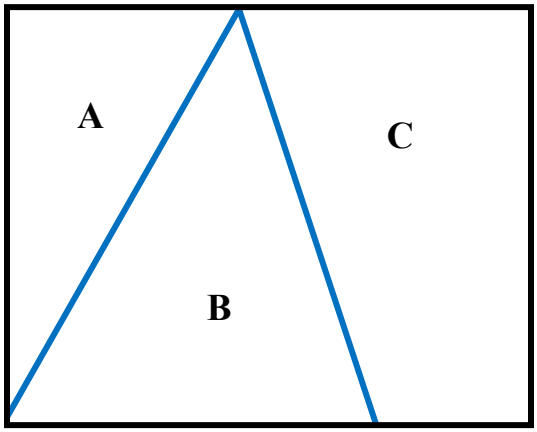
Total: _____ points



Equilateral Triangle

Polygon Name	Regions	Points

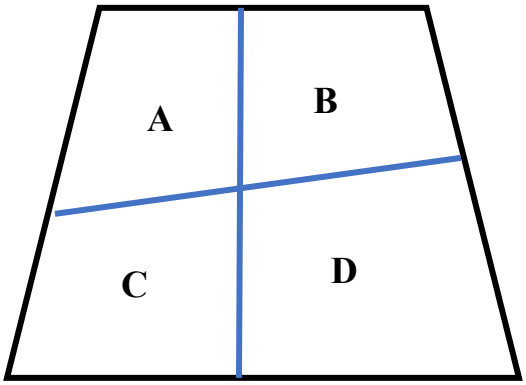
Total: _____ points



Convex Quadrilateral

Polygon Name **Regions** **Points**

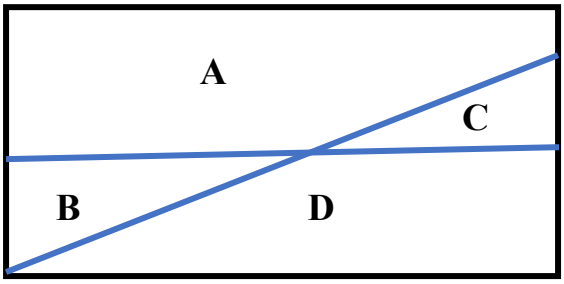
Total: _____ points



Convex Quadrilateral

Polygon Name	Regions	Points

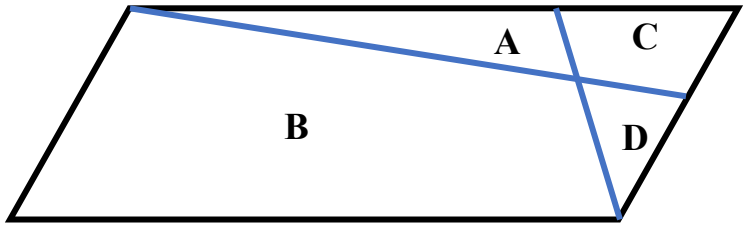
Total: _____ points



Convex Quadrilateral

Polygon Name	**Regions**	**Points**

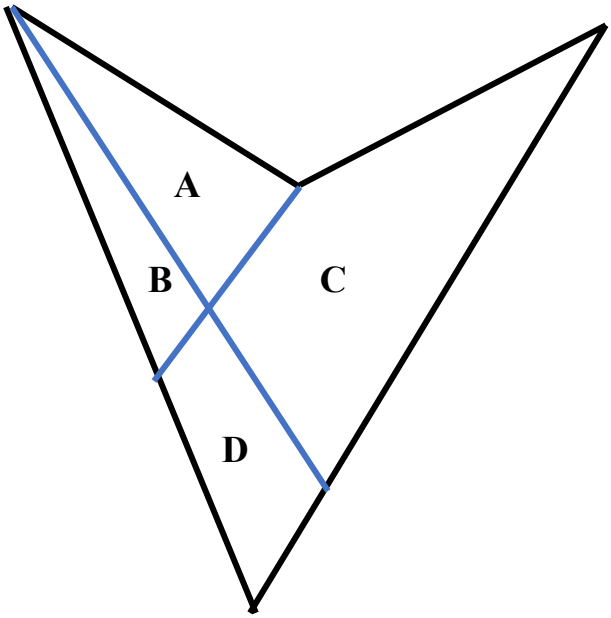
Total: _____ points



Convex Quadrilateral

Polygon Name	Regions	Points

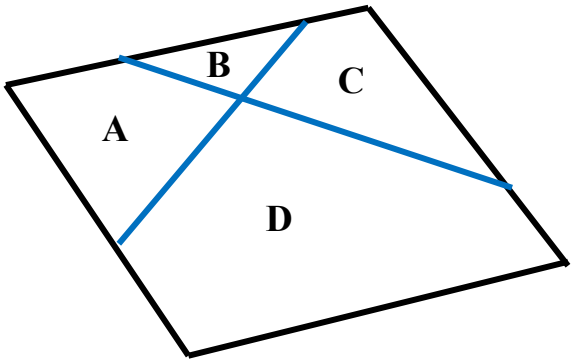
Total: _____ points



Concave Quadrilateral

Polygon Name	Regions	Points

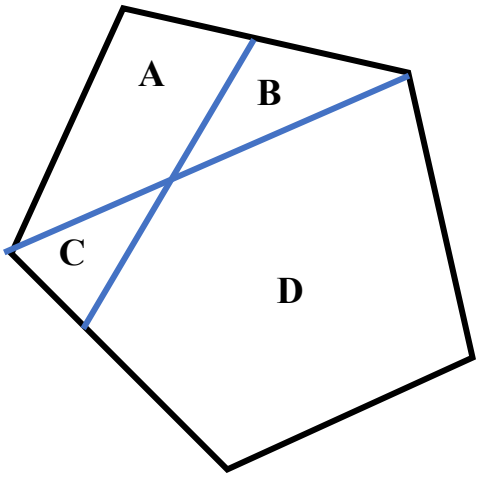
Total: _____ points



Convex Quadrilateral

Polygon Name	Regions	Points

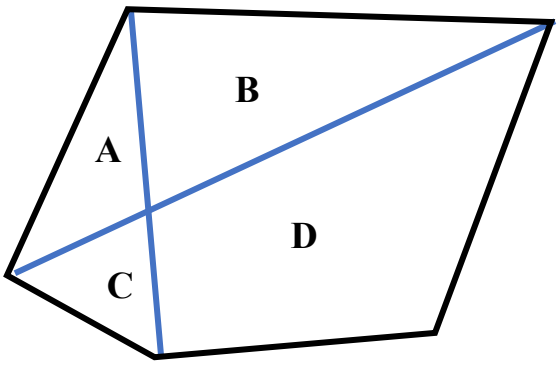
Total: _____ points



Convex Pentagon

Polygon Name	Regions	Points

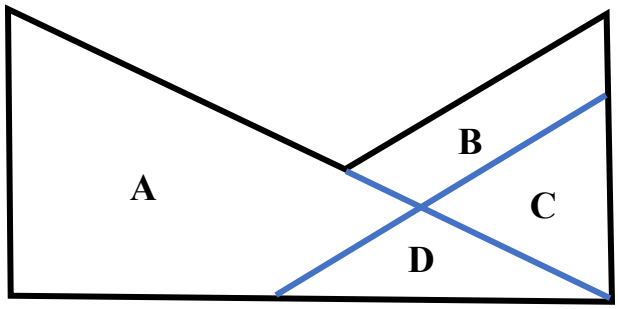
Total: _____ points



Convex Pentagon

Polygon Name	Regions	Points

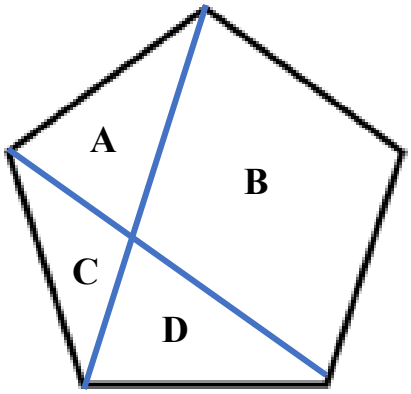
Total: _____ points



Concave Pentagon

Polygon Name	Regions	Points

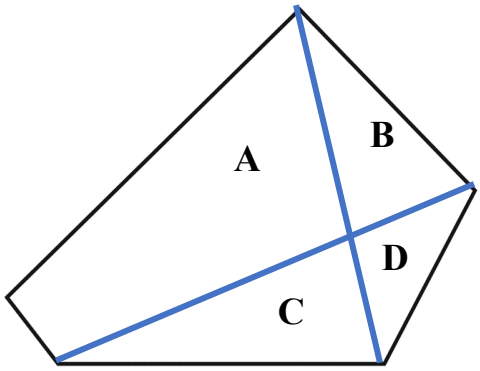
Total: _____ points



Convex Pentagon

Polygon Name	Regions	Points

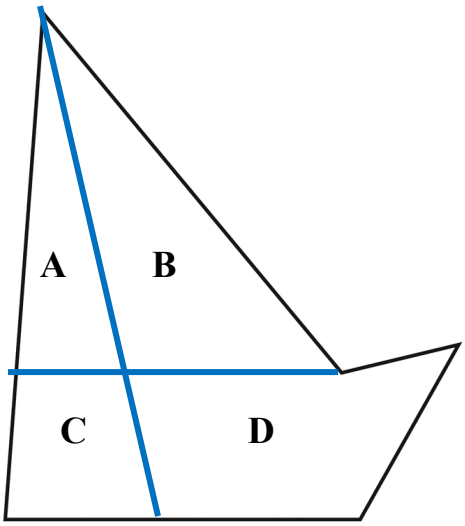
Total: _____ points



Convex Pentagon

Polygon Name	Regions	Points

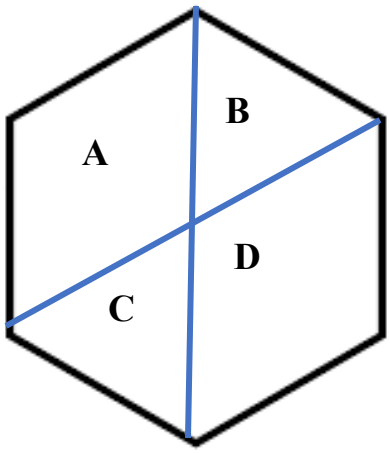
Total: _____ points



Concave Pentagon

Polygon Name	Regions	Points

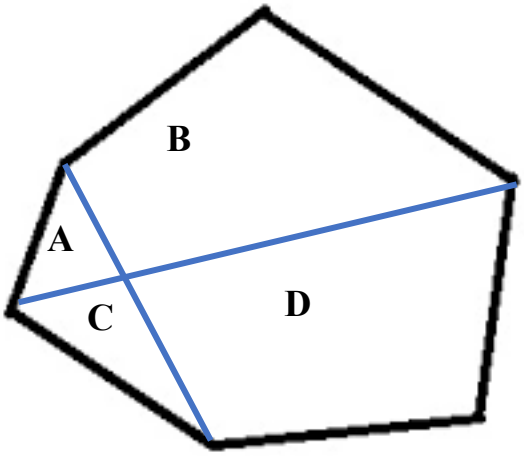
Total: _____ points



Convex Hexagon

Polygon Name	Regions	Points

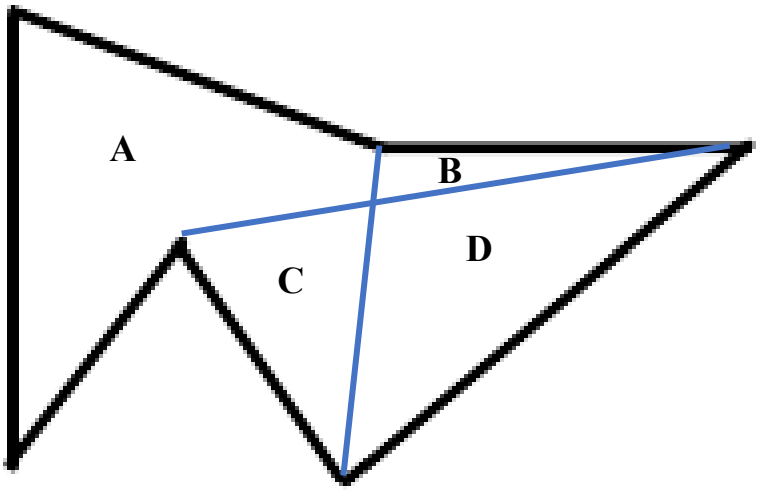
Total: _____ points



Convex Hexagon

Polygon Name	**Regions**	**Points**

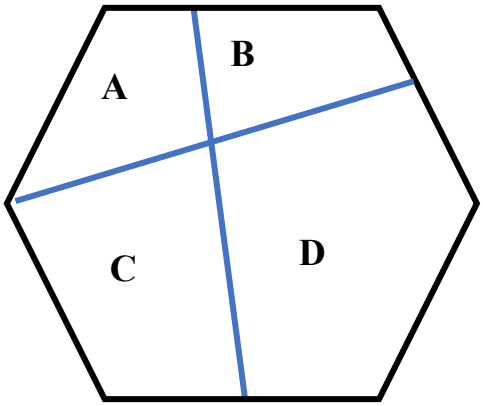
Total: _____ points



Concave Hexagon

Polygon Name	**Regions**	**Points**

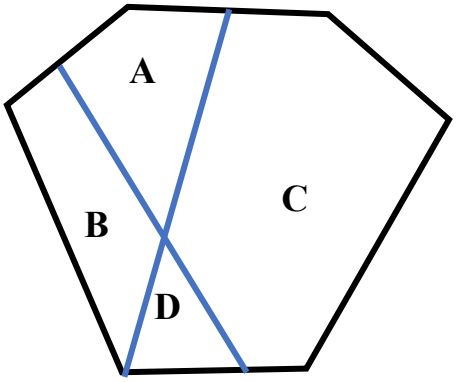
Total: _____ points



Convex Hexagon

Polygon Name	Regions	Points

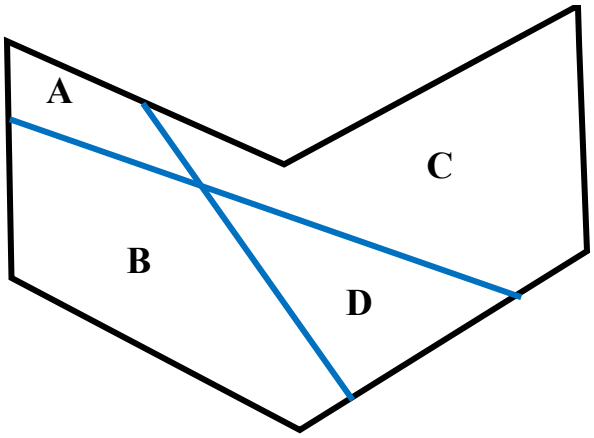
Total: _____ points



Convex Hexagon

Polygon Name	**Regions**	**Points**

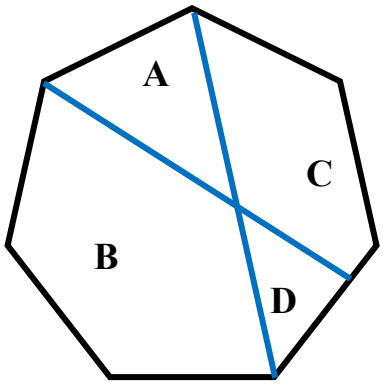
Total: _____ points



Concave Hexagon

Polygon Name	Regions	Points

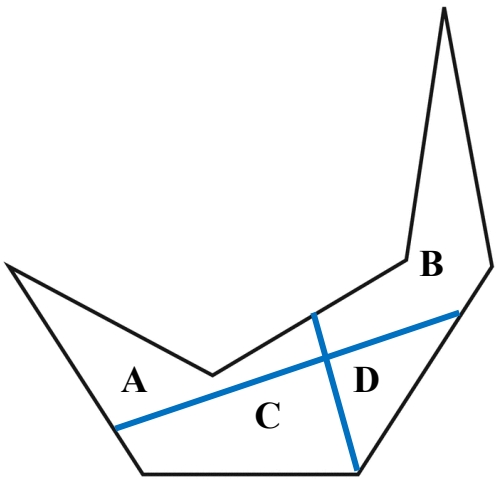
Total: _____ points



Convex Heptagon

Polygon Name	Regions	Points

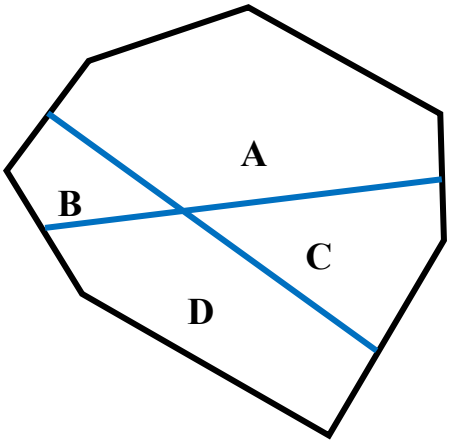
Total: _____ points



Concave Heptagon

Polygon Name	Regions	Points

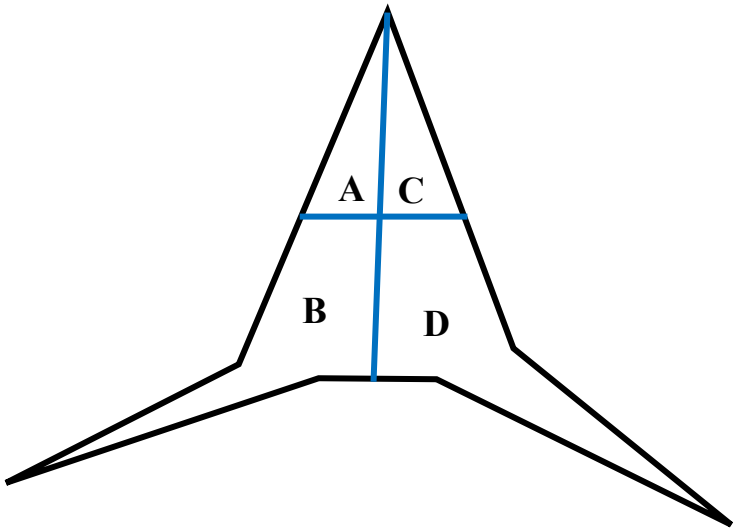
Total: _____ points



Convex Heptagon

Polygon Name	Regions	Points

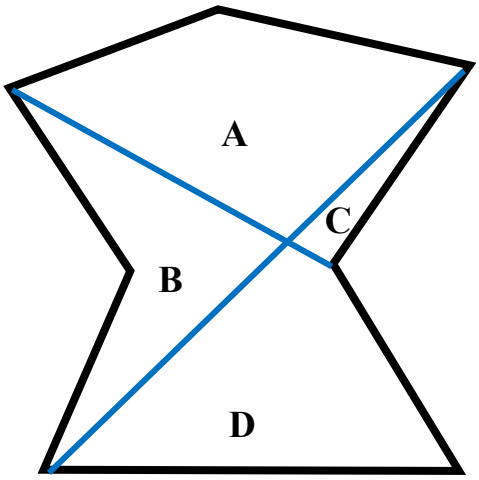
Total: _____ points



Concave Heptagon

Polygon Name	Regions	Points

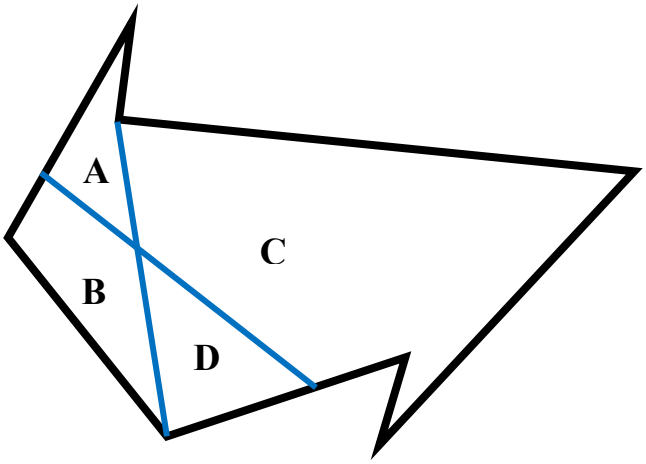
Total: _____ points



Concave Heptagon

Polygon Name	Regions	Points

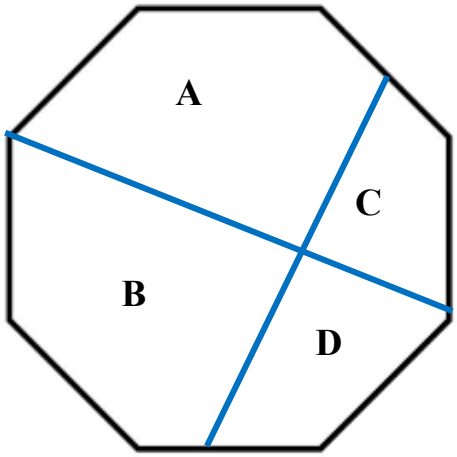
Total: _____ points



Concave Heptagon

Polygon Name	Regions	Points

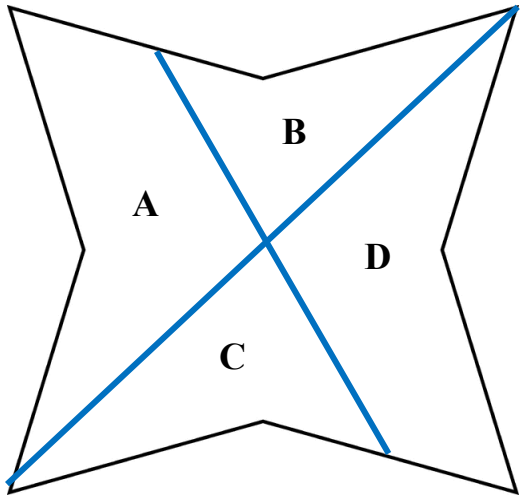
Total: _____ points



Convex Octagon

Polygon Name	Regions	Points

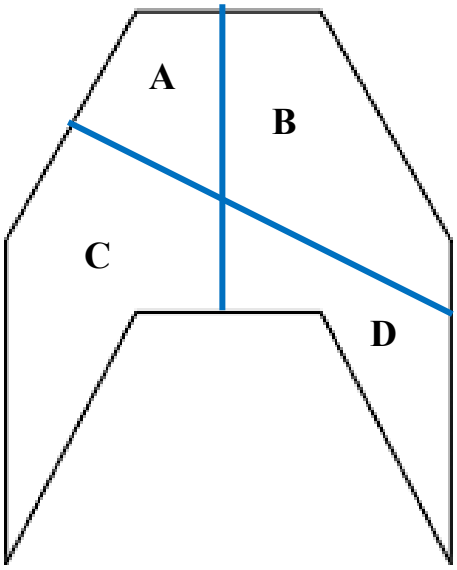
Total: _____ points



Concave Octagon

Polygon Name	Regions	Points

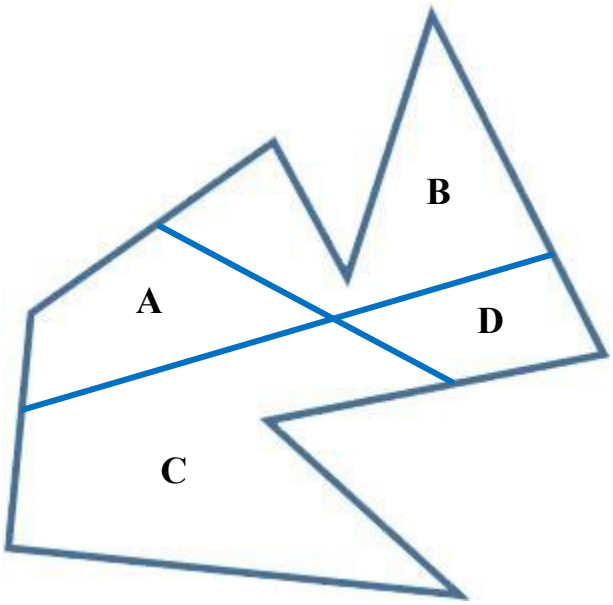
Total: _____ points



Concave Octagon

Polygon Name	**Regions**	**Points**

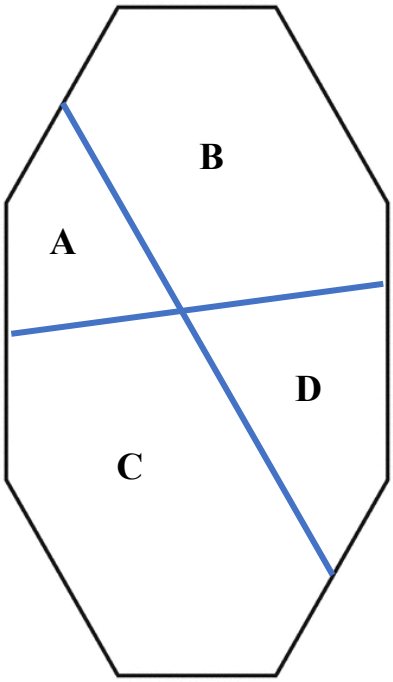
Total: _____ points



Concave Octagon

Polygon Name	**Regions**	**Points**

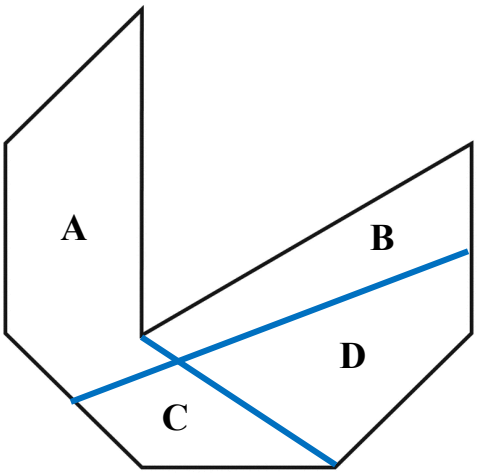
Total: _____ points



Convex Octagon

Polygon Name	Regions	Points

Total: _____ points



Concave Octagon

Polygon Name	Regions	Points

Total: _____ points

Section 2: Three Blue Lines

1 triangle

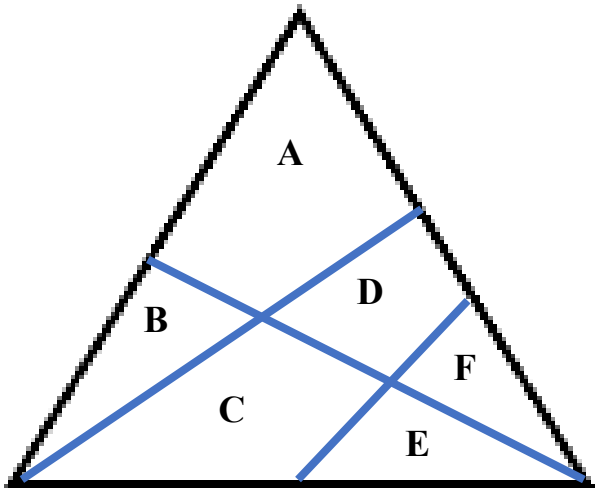
1 quadrilateral

1pentagon

1 hexagon

1 heptagon

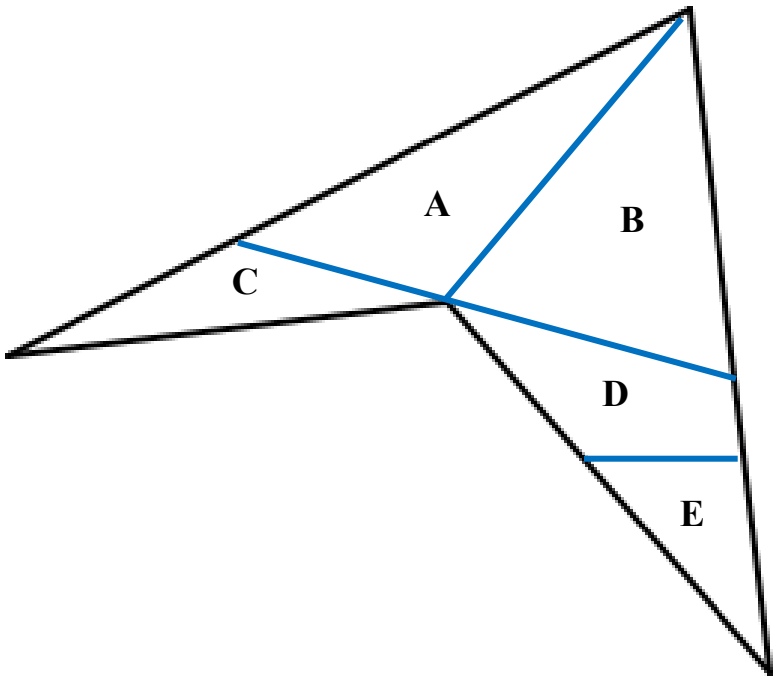
1 octagon



Equilateral Triangle

Polygon Name	Regions	Points

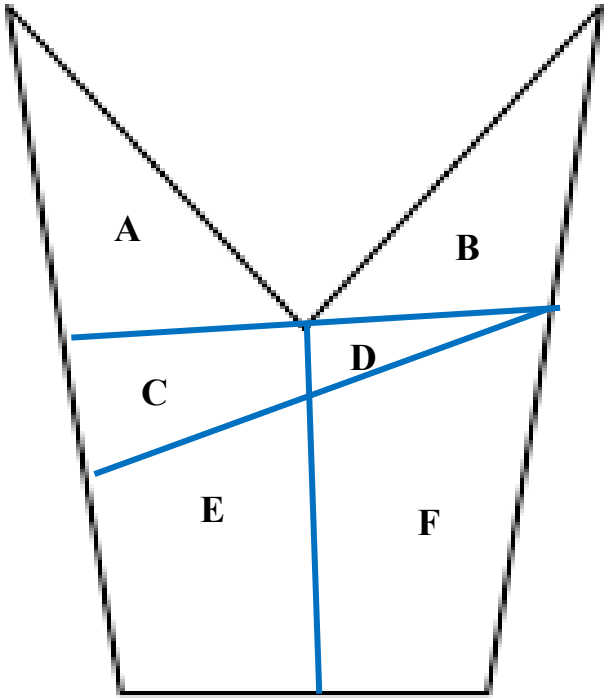
Total: _____ points



Concave Quadrilateral

Polygon Name	**Regions**	**Points**

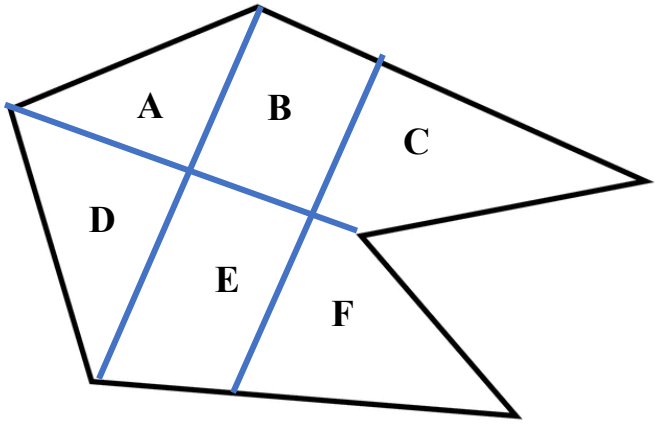
Total: _____ points



Concave Pentagon

Polygon Name	Regions	Points

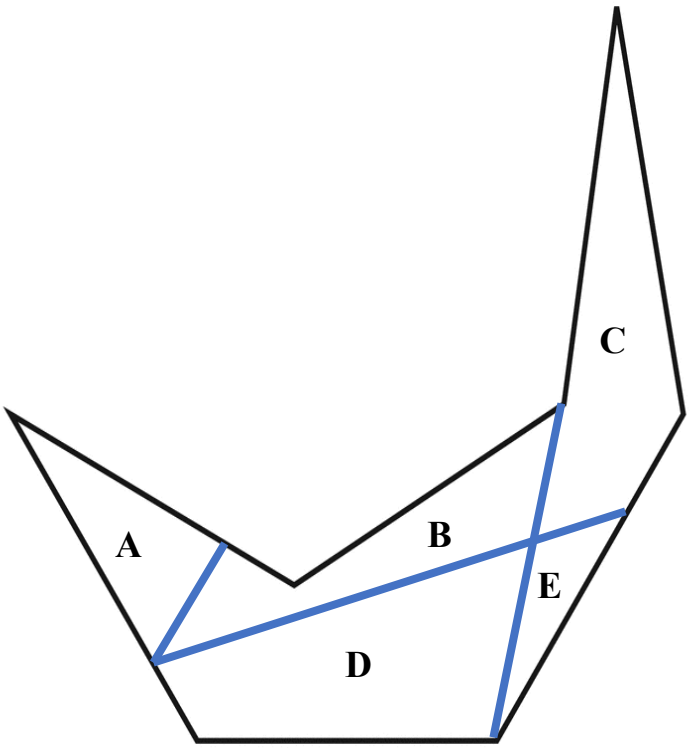
Total: _____ points



Concave Hexagon

Polygon Name	Regions	Points

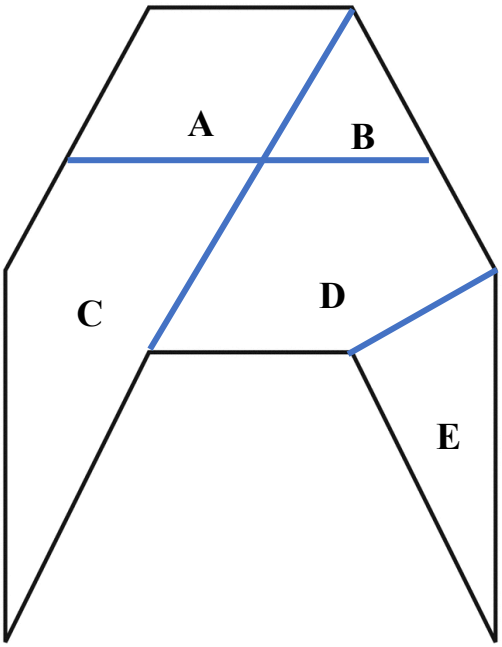
Total: _____ points



Concave Heptagon

Polygon Name	Regions	Points

Total: _____ points



Concave Octagon

Polygon Name	Regions	Points

Total: _____ points

SOLUTIONS

Section 1 Solutions: Two Blue Lines

6 triangles

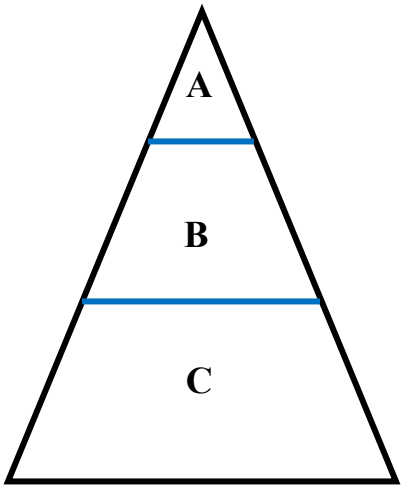
6 quadrilaterals

6 pentagons

6 hexagons

6 heptagons

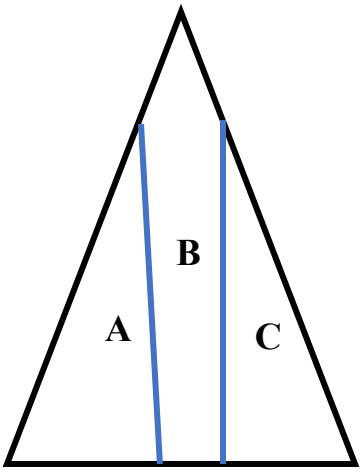
6 octagons



Isosceles Triangle

Polygon Name	Regions	Points
Triangles:	**A, AB**	**6 points**
Quadrilaterals:	**B, C, BC**	**12 points**

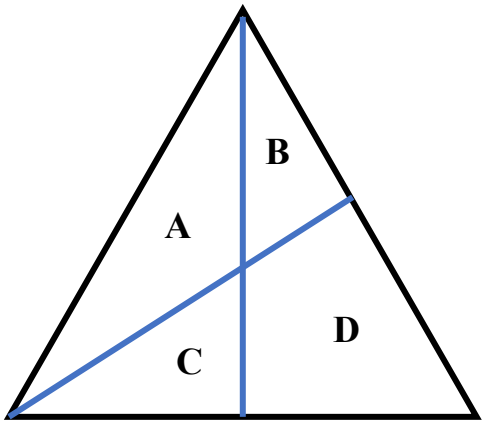
Total: 18 points



Isosceles Triangle

Polygon Name	Regions	Points
Triangles:	A, C	6 points
Quadrilaterals:	AB, BC	8 points
Pentagons:	B	5 points

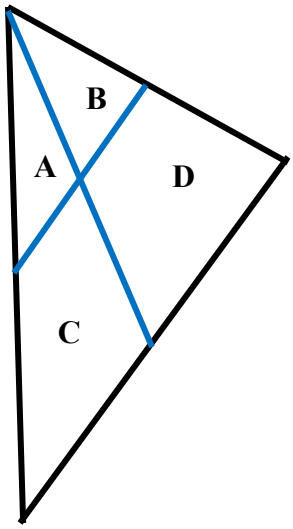
Total: 19 points



Equilateral Triangle

Polygon Name	Regions	Points
Triangles:	A, B, C. AB, AC, BD, CD	21 points
Quadrilaterals:	D, BCD	8 points
Pentagons:	ABC, ACD	10 points

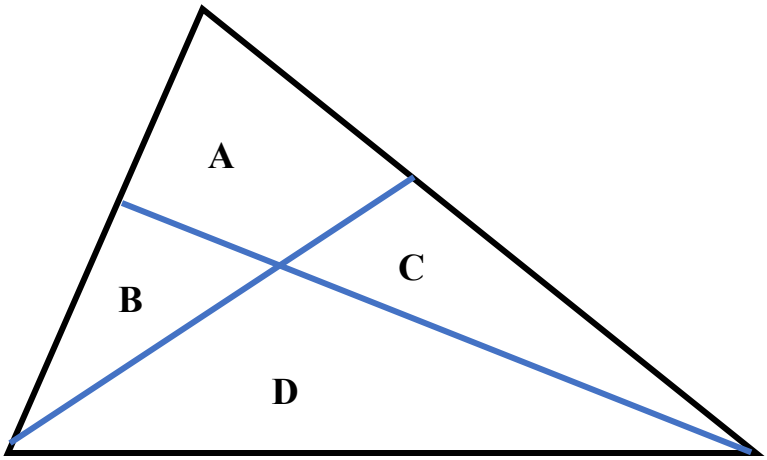
Total 39 points



Scalene Triangle

Polygon Name	Regions	Points
Triangles:	A, B, AB, AC, BD	15 points
Quadrilaterals:	C, D, CD	12 points
Pentagons:	ABD, ACD, BCD	15 points

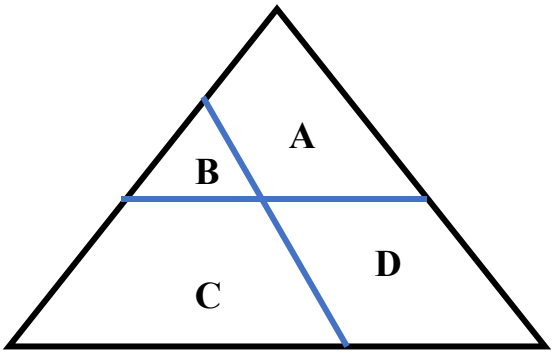
Total **42 points**



Scalene Triangle

Triangles: B, C, D, AB, AC, BD, CD	**21 points**
Quadrilaterals: A, ABC	**8 points**
Pentagons: ABD, ACD, BCD	**15 points**

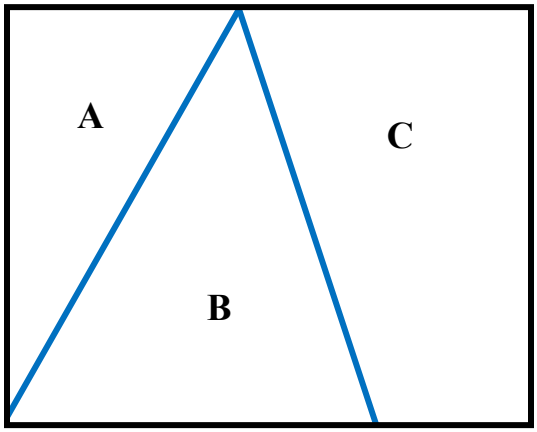
Total: 44 points



Equilateral Triangle

Triangles: B, AB, BC	**9 points**
Quadrilaterals: A, C, D, AD, CD	**20 points**
Pentagons: ABC, ABD, BCD	**15 points**
Hexagons: ADC	**6 points**

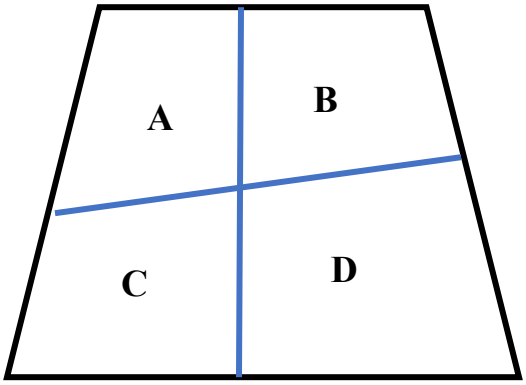
Total: 50 points



Convex Quadrilateral

Polygon Name	Regions	Points
Triangles:	A, B,	6 points
Quadrilaterals:	C, AB, BC	12 points

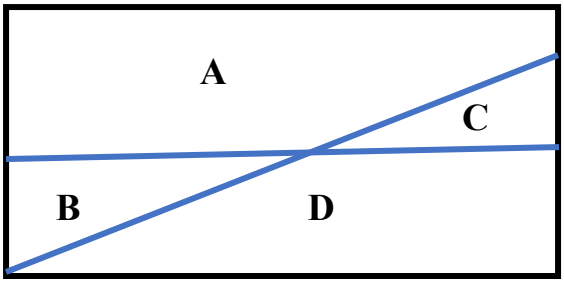
Total: 18 points



Convex Quadrilateral

Polygon Name	Regions	Points
Quadrilaterals:	A, B, C, D, AB, AC, BD, CD	32 points
Hexagons:	ABC, ABD, BCD	18 points

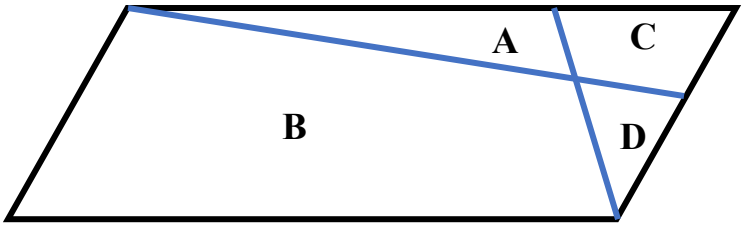
Total 50 points



Convex Quadrilateral

Polygon Name	Regions	Points
Triangles:	B, C, CD	9 points
Quadrilaterals:	D, AB, AC, BD	16 points
Pentagons:	A, ABC, BCD	15 points
Hexagons:	ACD	6 points
Heptagons:	ABD	7 points

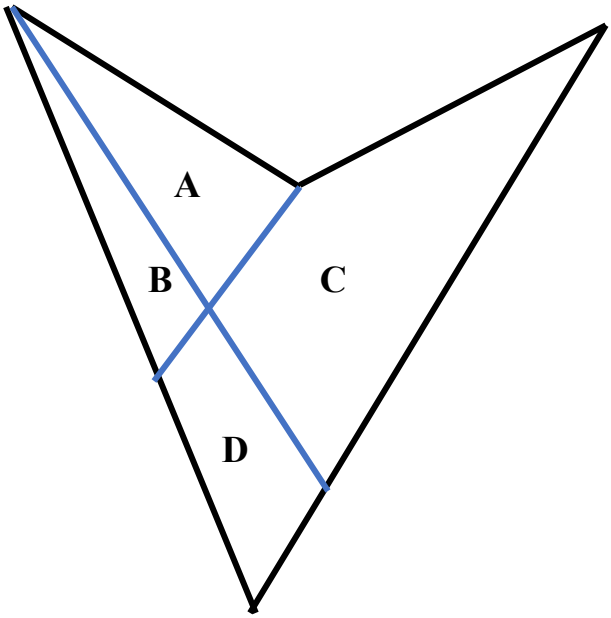
Total: 53 points



Convex Quadrilateral

Polygon Name	Regions	Points
Triangles:	A, D, AC, CD	12 points
Quadrilaterals:	B, C, AB, BD, ACD	20 points
Hexagons:	ABC, ABD, BCD	18 points

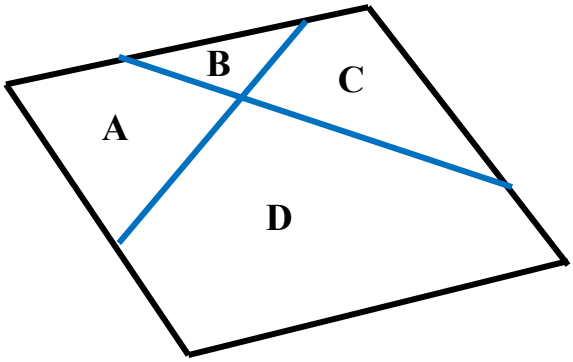
Total: 50 points



Concave Quadrilateral

Polygon Name	Regions	Points
Triangles:	A, B, AB, BD	12 points
Quadrilaterals:	C, D, AC, CD	16 points
Pentagons:	ABD, BCD	10 points
Hexagons:	ABC, ACD	12 points

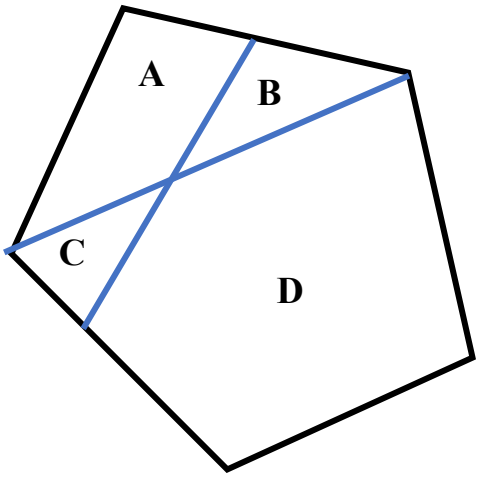
Total: 50 points



Convex Quadrilateral

Polygon Name	Regions	Points
Triangles:	B, AB, BC	9 points
Quadrilaterals:	C	4 points
Pentagons:	D, AD, CD, ABC	20 points
Hexagons:	BAD, BCD	12 points
Heptagons:	ACD	7 points

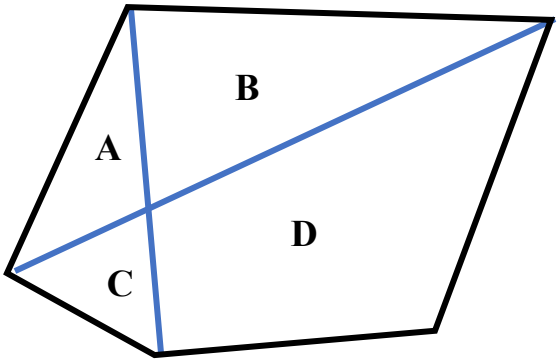
Total: 52 points



Convex Pentagon

Polygon Name	Regions	Points
Triangles:	B, C, AB	9 points
Quadrilaterals:	A, AC, CD	12 points
Pentagons:	D, BD, ABC	15 points
Hexagons:	BCD	6 points
Heptagons:	ACD, ABD	14 points

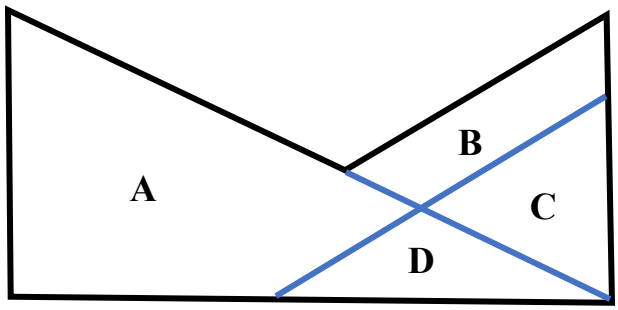
Total: 56 points



Convex Pentagon

Polygon Name	Regions	Points
Triangles:	A, B, C, AB, AC	15 points
Quadrilaterals:	D, BD, CD	12 points
Pentagons:	ABC	5 points
Hexagons:	ABD, BCD	12 points

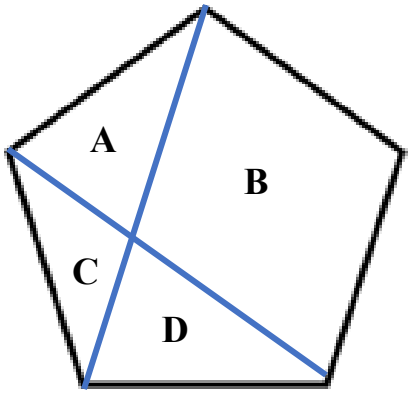
Total: 44 points



Concave Pentagon

Polygon Name	Regions	Points
Triangles:	C, D, AD, BC, CD	15 points
Quadrilaterals:	A, B	6 points
Pentagons:	ACD, BCD	10 points
Hexagons:	AB	6 points
Heptagons:	ABC, ABD	14 points

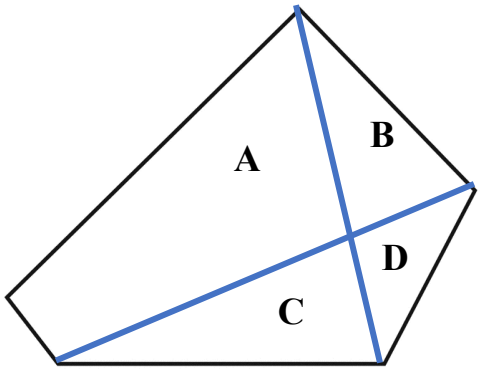
Total: 51 points



Convex Pentagon

Polygon Name	Regions	Points
Triangles:	A, C, D, AC, CD	15 points
Quadrilaterals:	B, AB, BD	12 points
Pentagon:	ACD	5 points
Hexagons:	ABC, ABD, BCD	18 points

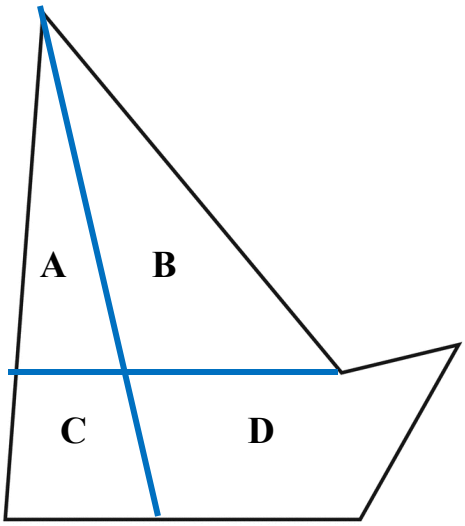
Total: 50 points



Convex Pentagon

Polygon Name	Regions	Points
Triangles:	B, C, D, BD, CD	15 points
Quadrilaterals:	A, AB, AC	12 points
Pentagons:	BCD	5 points
Hexagons:	ABC, ABD, ACD	18 points

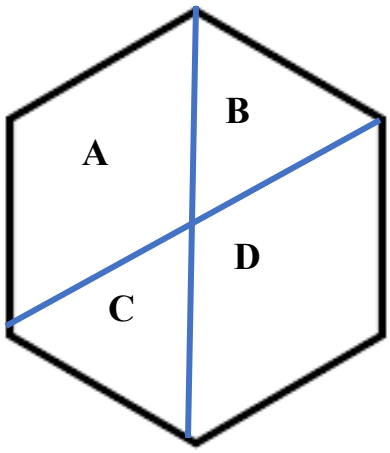
Total: 50 points



Concave Pentagon

Polygon Name	Regions	Points
Triangles:	A, B, AB, AC	12points
Quadrilaterals:	C	4 points
Pentagons:	D, BD, CD, ABC, ACD	25 points
Heptagons:	ABD, BCD	14 points

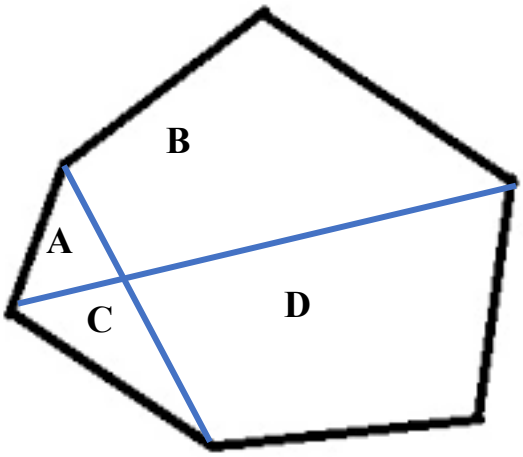
Total: 55 points



Convex Hexagon

Polygon Name	Regions	Points
Triangles:	B, C	6 points
Quadrilaterals:	A, D, AB, AC, BD, CD	24 points
Hexagons:	ABC, BCD	12 points
Heptagon:	ABD, ACD	14 points

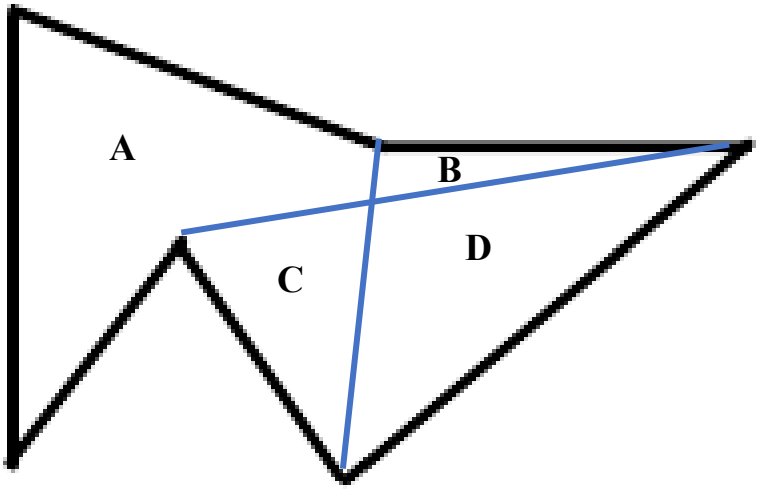
Total: 56 points



Convex Hexagon

Polygon Name	Regions	Points
Triangles:	**A, C, AC**	**9 points**
Quadrilaterals:	**B, D, AB, CD**	**16 points**
Pentagon:	**BD**	**5 points**
Hexagons:	**ABC, ACD**	**12 points**
Heptagons:	**ABD, BCD**	14 **points**

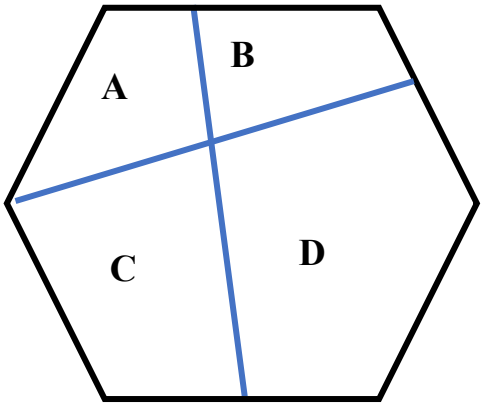
Total: 56 points



Concave Hexagon

Polygon Name	Regions	Points
Triangles:	B, C, D, BD, CD	15 points
Pentagons:	A, AB, AC, BCD	20 points
Heptagons:	ABC, ABD, ACD	21 points

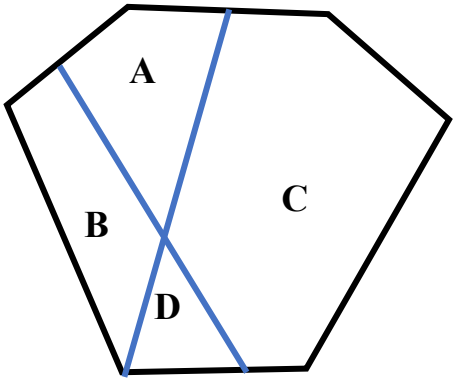
Total: 56 points



Convex Hexagon

Polygon Name	Regions	Points
Quadrilaterals:	A, B, C, AB	16 points
Pentagons:	D, AC, BD, CD	20 points
Heptagons:	ABC, ABD, BCD,	21 points
Octagons:	ACD	8 points

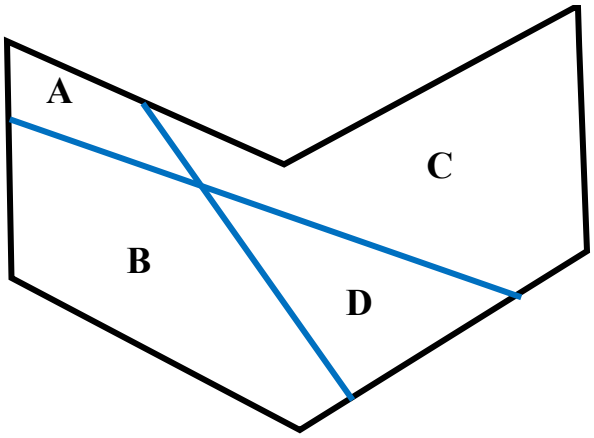
Total: 65 points



Convex Hexagon

Polygon Name	Regions	Points
Triangles:	D	3 points
Quadrilaterals:	A, B, AB, BD	16 points
Pentagons:	CD	5 points
Hexagons:	C, AC, ABD	18 points
Heptagons:	ACD	7 points
Octagons:	ABC, BCD	16 points

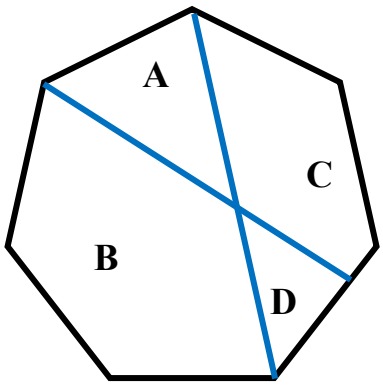
Total: 65 points



Concave Hexagon

Polygon Name	Regions	Points
Triangles:	D	3 points
Quadrilaterals:	A, BD	8 points
Pentagons:	B, AB, CD	15 points
Hexagons:	C, AC, ABD	18 points
Heptagons:	ACD	7 points
Octagons:	BCD	8 points
Nonagons:	ABC	9 points

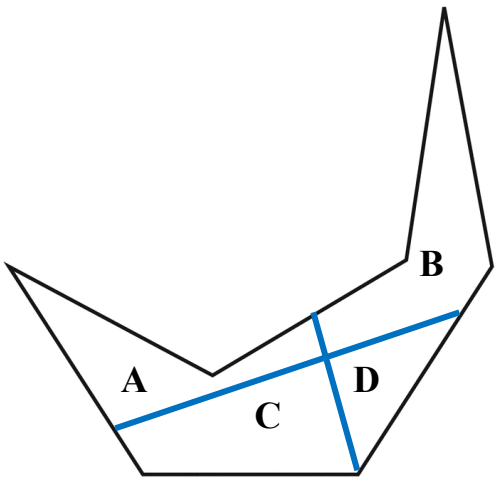
Total: 68 points



Convex Heptagon

Polygon Name	Regions	Points
Triangles:	A, D	6 points
Quadrilaterals:	CD	4 points
Pentagons:	B, C, AB, AC, BD	25 points
Hexagons:	ACD	6 points
Heptagons:	ABD	7 points
Octagons:	BCD	8 points
Nonagons:	ABC	9 points

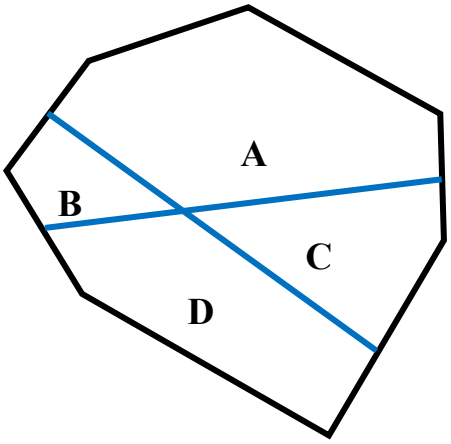
Total: 65 points



Concave Heptagon

Polygon Name	Regions	Points
Triangles:	D	3 points
Quadrilaterals:	C, CD	8 points
Pentagons:	A, AC, BD	15 points
Hexagons:	B	6 points
Heptagons:	AB, ACD	14 points
Octagons:	ABD, BCD	16 points

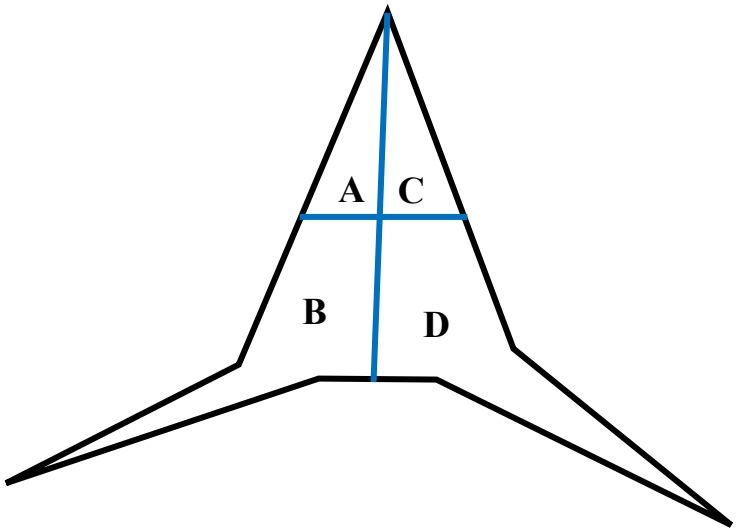
Total: 62 points



Convex Heptagon

Polygon Name	Regions	Points
Quadrilaterals:	B, C	8 points
Pentagons:	D, BD, DC	15 points
Hexagons:	A, AB, AC	18 points
Heptagons:	BCD	7 points
Octagons:	ABC	8 points
Nonagons:	ACD, ABD	18 points

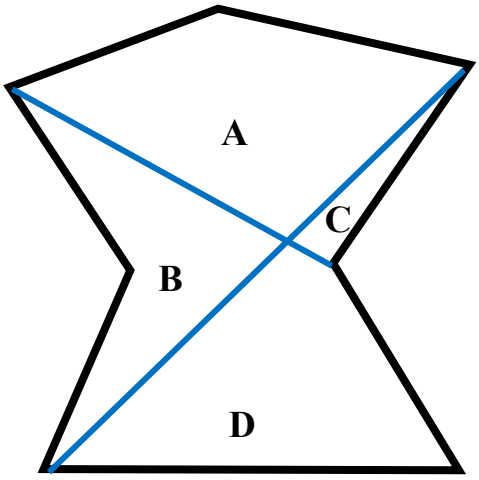
Total: 74 points



Concave Heptagon

Polygon Name	Regions	Points
Triangles:	A, C, AC	9 points
Pentagons:	AB, CD	10 points
Hexagons:	B, D	12 points
Heptagons:	ACB, ACD	14 points
Octagons:	BD	8 points
Nonagons:	BCD, ABD	18 points

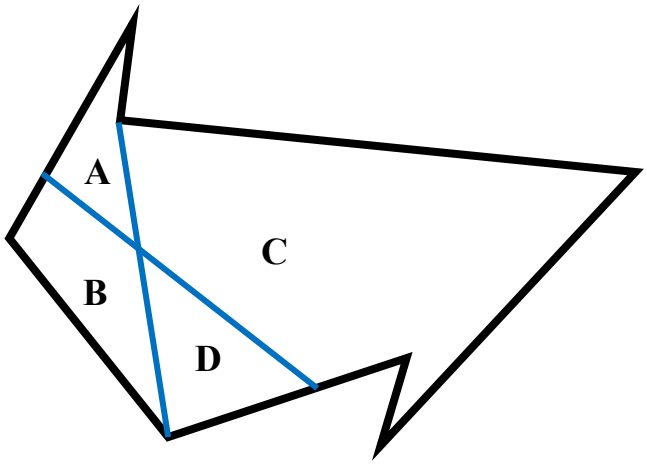
Total: 71 points



Concave Heptagon

Polygon Name	Regions	Points
Triangles:	C	3 points
Quadrilaterals:	A, B, D, AC, CD	20 points
Pentagons:	AB, BD	10 points
Heptagons:	ACD, ABC, BCD	21 points
Octagons:	ABD	8 points

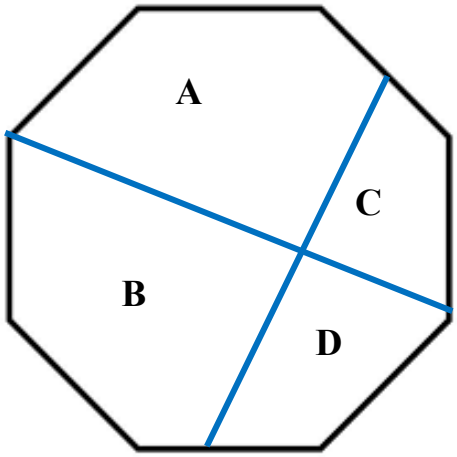
Total: 62 points



Concave Heptagon

Polygon Name	Regions	Points
Triangles:	D	3 points
Quadrilaterals:	A, B, AB, BD	16 points
Pentagons:	CD	5 points
Hexagons:	C, ABD	12 points
Heptagons:	AC	7 points
Octagons:	BCD, ACD	16 points
Nonagons:	ABC	9 points

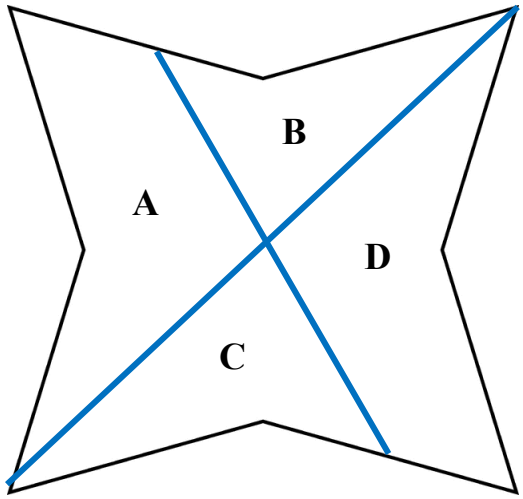
Total: 68 points



Convex Octagon

Polygon Name	Regions	Points
Quadrilaterals:	C, D	8 points
Pentagons:	A, B, AC, BD, CD	25 points
Heptagons:	AB	7 points
Nonagons:	ABC, ABD	18 points

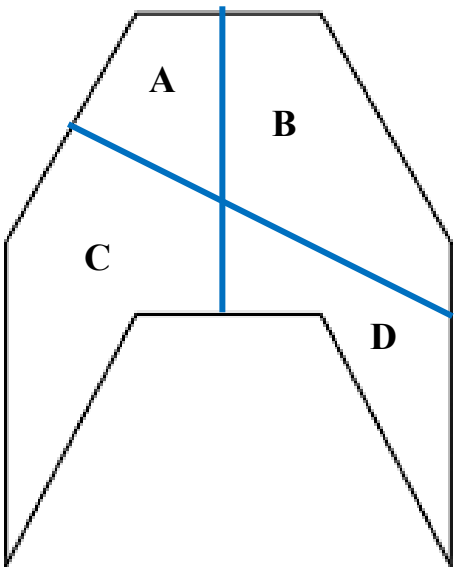
Total: 58 points



Concave Octagon

Polygon Name	Regions	Points
Quadrilaterals:	B, C	8 points
Pentagons:	A, D, AB, CD	20 points
Hexagons:	AC, BD	12 points
Octagons:	ABD, BCD	16 points
Nonagons:	ABD	9 points

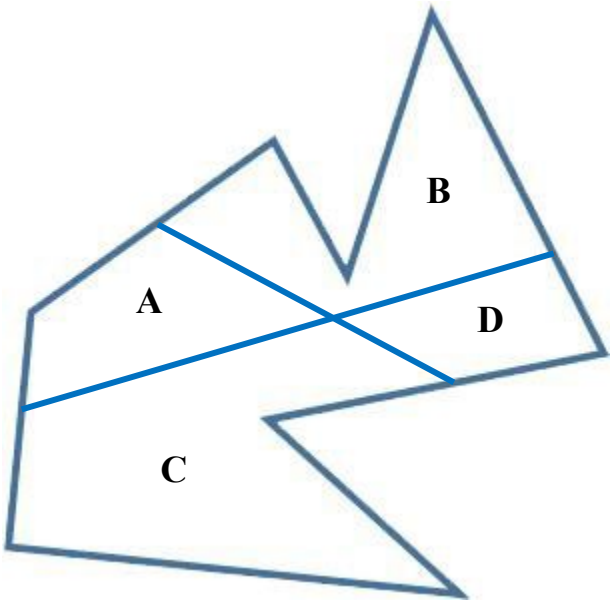
Total 65 points



Concave Octagon

Polygon Name	Regions	Points
Quadrilaterals:	A	4 points
Pentagons:	B, D. AB	15 points
Hexagons:	C, AC, BD	18 points
Heptagons:	CD	7 points
Nonagons:	ABC, ACD	18 points
Decagons:	BCD	10 points

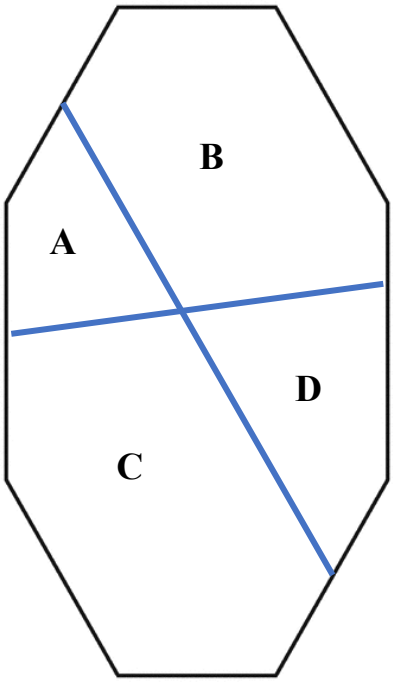
Total: 72 points



Concave Octagon

Polygon Name	Regions	Points
Quadrilaterals:	A, D	8 points
Hexagons:	B, C, AB, AC, BD, CD	48 points
Octagons:	ACD, ABD	16 points
Decagons:	ABC, BCD	20 points

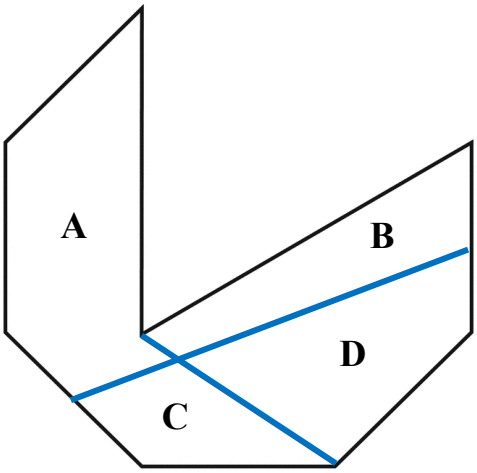
Total: 92 points



Concave octagon

Polygon Name	Regions	Points
Quadrilaterals:	A, D	8 points
Hexagons:	B, X, AB, AC, BD, CD,	36 points
Octagons:	ABD	8 points
Decagon:	ABC, BCD	20 points

Total **72 points**



Concave Octagon

Polygon Name	Regions	Points
Quadrilaterals:	B, C, D, BD	16 points
Pentagons:	CD	5 points
Hexagons:	A, AC	12 points
Heptagons:	AB, BCD	14 points
Nonagons:	ABD, ACD	18 points

Total: 65 points

Section 2 Solutions: Three Blue Lines

1 triangle

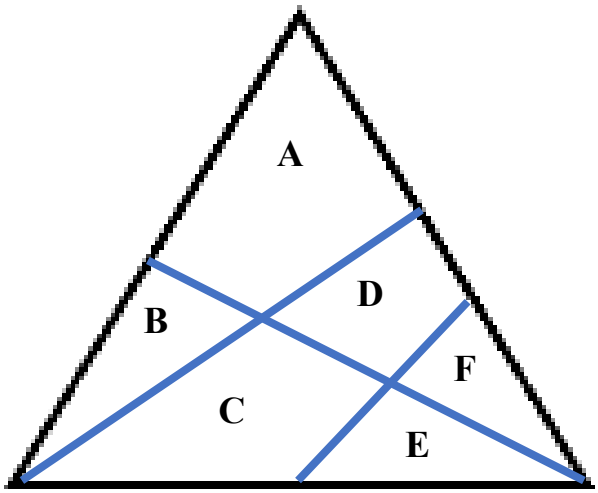
1 quadrilateral

1pentagon

1 hexagon

1 heptagon

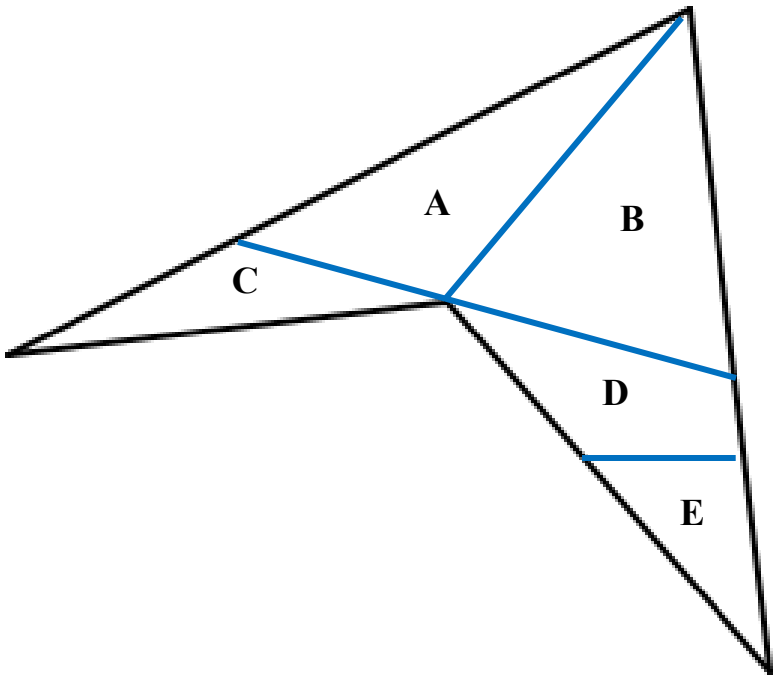
1 octagon



Equilateral Triangle

Polygon Name	Regions	Points
Triangles:	B, E, F, AB, CE, DF, EF, ADF, BCE, CDEF	30 points
Quadrilaterals:	A, C, D, AD, BC, CD, ABCD, ABDF	32 points
Pentagons:	ABD, CEF, DEF, ABCE, ACDEF, BCDEF	30 points
Hexagons:	ABDEF	6 points
Heptagons:	ABCEF	7 points

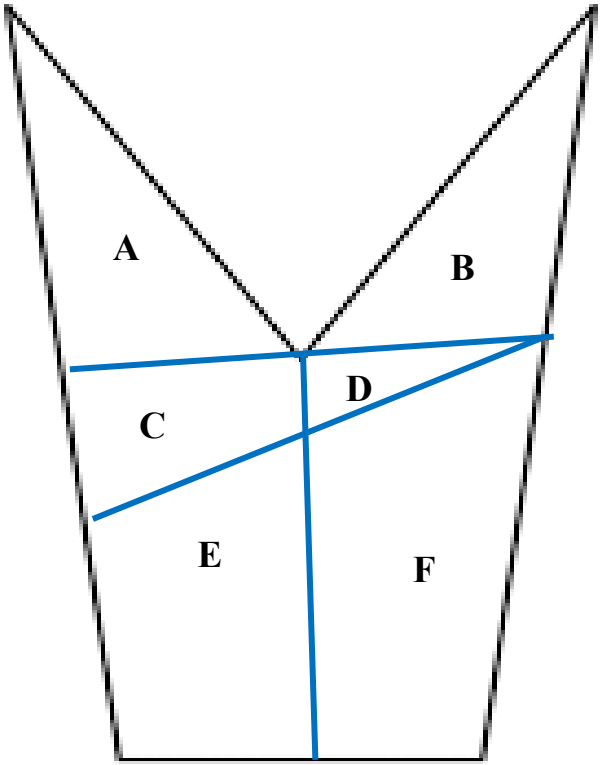
Total: 105 points



Concave Quadrilateral

Polygon Name	Regions	Points
Triangles:	A, B, C, E, AB, AC, DE, BDE	24 points
Quadrilaterals:	D, BD, ABC, ABDE	16 points
Pentagons:	ABD, ABCD	10 points

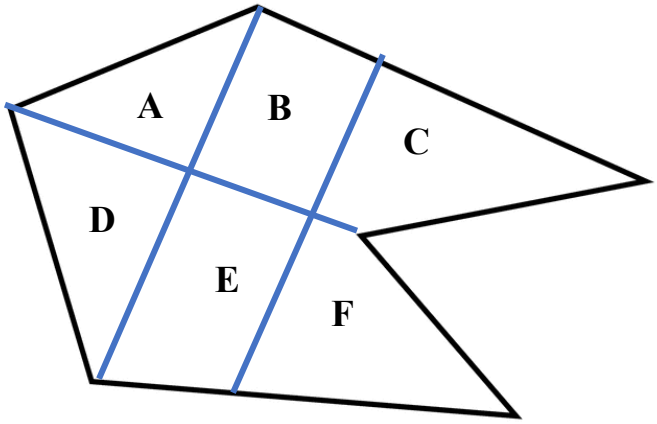
Total: 50 points



Concave Pentagon

Polygon Name	Regions	Points
Triangles:	A, B, D, CD	12 points
Quadrilaterals:	C, E, F, AC, BD, CE, DF,	
	EF, ACD, ACE, BDF, CDEF	48 points
Pentagons:	CDE, ABCD, ACDEF, BCDEF	20 points
Hexagons:	CDF, CEF, DEF, ACDE, ACEF, BDEF	36 points
Heptagons:	BCDE	7 points

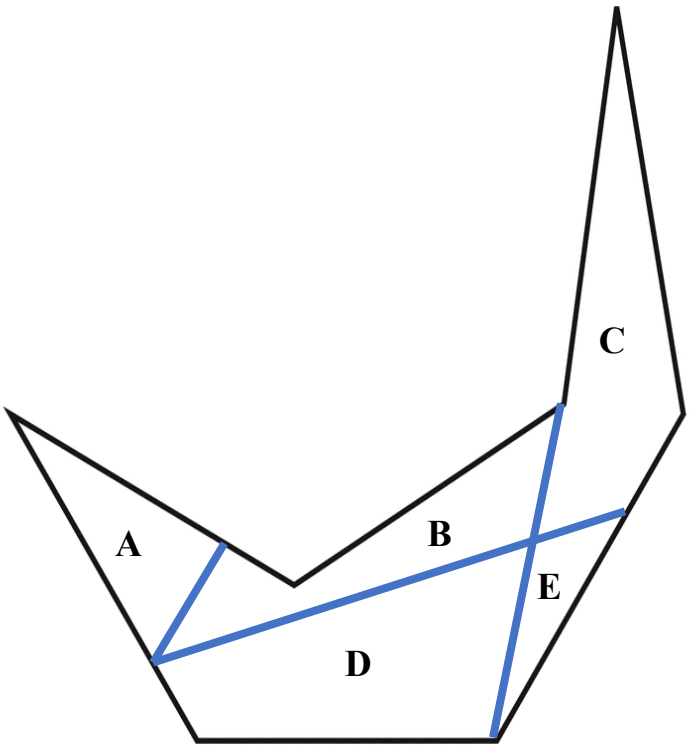
Total: 123 points



Concave Hexagon

Polygon Name	Regions	Points
Triangles:	A, D, AD	9 points
Quadrilaterals:	B, C, E, F, AB, BC, BE, DE, EF, ABC, DEF	44 points
Pentagons: BCEF`		5 points
Hexagons: BDE, ABCD, ADEF		18 points
Heptagons: ABCF, DECF, ABCEF, BCDEF		28 points

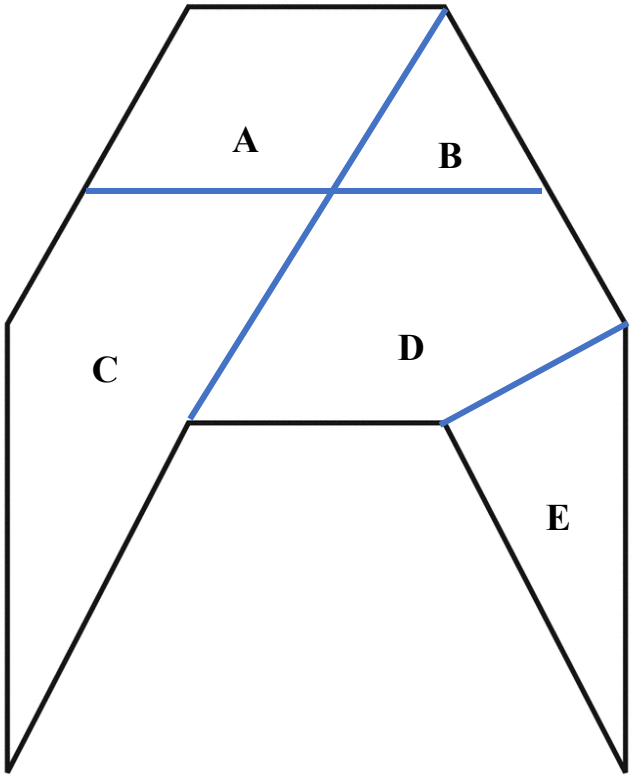
Total: 104 points



Concave Heptagon

Polygon Name	Regions	Points
Triangles:	A, E, CE	9 points
Quadrilaterals:	C, D, DE	12 points
Pentagons:	B, AB, ABD	15 points
Hexagons:	BD, CDE	12 points
Heptagons:	BC, ABC, ABDE	21 points
Nonagons:	ABCD	9 points
Decagons:	BCD	10 points

Total: 88 points



Concave Octagon

Polygon Name	Regions	Points
Triangles:	B, E	6 points
Quadrilaterals:	A, C. AB, AC, BD	20 points
Pentagons:	D, BDE	10 points
Hexagons:	DE, ABC	12 points
Heptagons:	CD, ABD, ABCD	21 points
Octagons:	BCD, CDE, ABDE	24 points
Nonagons:	BCDE	9 points

Total: 102 points

©PRIME Group 2023