CAPSTONE

Mathematics: Geometry

Lecture 10

Overview	Next Lecture
◆ Basic Geometry: 1. Angle 2. Triangle 3. Quadrilateral	◆ Advance Geometry: 1. Circle 2. Solid Geometry

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Math Lecture Sheet: 10

Some Common Terms:

Triangle	ত্রিভুজ	Circle	বৃত্ত
Right triangle	সমকোণী ত্রিভুজ	Semicircle	অর্ধবৃত্ত
Equilateral triangle	সমবাহু ত্রিভুজ	Arc	চাপ
Isosceles triangle	সমদ্বিবাহু ত্রিভুজ	Chord	জ্যা
Scalene triangle	বিষমবাহু ত্রিভুজ	Diameter	ব্যাস
Similar triangle	সদৃশ/ সদৃশকোণী ত্রিভুজ	Radius	ব্যাসার্ধ
Angle	কোণ	Circumference	পরিধি
Central Angle	কেন্দ্রস্থ কোণ	Tangent	স্পর্শক
Exterior Angle	বহিঃস্থ কোণ	Quadrilateral	চতুর্ভুজ
Interior Angle	অন্তঃস্থ কোণ	Rectangle	আয়তক্ষেত্র
Right Angle	সমকোণ	Square	বর্গ
Obtuse Angle	স্থূলকোণ	Parallelogram	সামান্তরিক
Acute Angle	সূক্ষ্মকোণ	Rhombus	রম্বস
Reflex Angle	প্রবৃদ্ধ কোণ	Altitude	উচ্চতা
Straight Angle	সরল কোণ	Base	ভূমি
Complementary Angle	পূরক কোণ	Perpendicular	লম্ব
Supplementary Angle	সম্পূরক কোণ	Hypotenuse	অতিভুজ
Adjacent Angle	সন্নিহিত কোণ	Vertex	শীর্ষ
Vertical Angle	বিপ্রতীপ কোণ	Median	মধ্যক
Alternate Angle	একান্তর কোণ	Area	ক্ষেত্রফল
Corresponding Angle	অনুরূপ কোণ	Perimeter	পরিসীমা
Cube	ঘনক	Congruent	সর্বসম
Inscribed	অন্তঃস্থ	Volume	আয়তন
Diagonal	কর্ণ	Parallel	সমান্তরাল
Bisector	সমদ্বিখন্ডক		

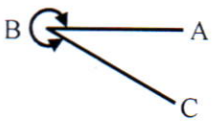
Angle: Two line or line-segments are required to form an angle. An angle is represented by ∠sign.

Right angle: Right angle is 90° angle. When two lines are perpendicular, a right angle is formed and it is expressed with ⊥ sign. Below is a right angle.

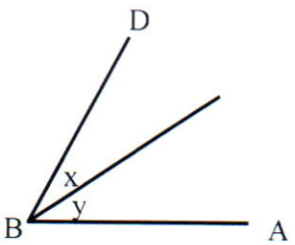
Obtuse angles: Angles greater than 90° but smaller than 180°.
Acute angles: Angles greater than 0° but less than 90°.
Straight angle: An angle whose degree measure is exactly 180°.

Acute [$x<90^\circ$] Obtuse $90^\circ < y < 180^\circ$ Straight ($z = 180^\circ$)

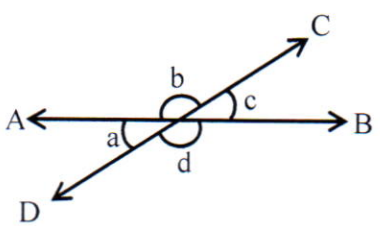
Reflex angle: Angle larger than 180° but smaller than 360°.



Adjacent angle: Adjacent angels are angles having common vertex and common leg. $\angle x$ and $\angle y$ are adjacent angles in the figure below –

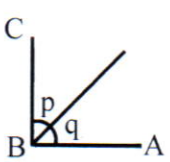


Vertical angle: Vertical angles are formed when two lines intersect. Of the four angles formed, each opposite two are vertical, Vertical angles are equal. In the figure below a and c are vertical angles.

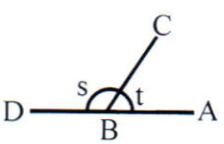


($a + b + c + d = 180^\circ$; $a = c$, $b = d$)

Complementary angles: Complementary angles are two adjacent angles whose sum is 90°. p and q are complementary in the figure below, because their sum is 90°. 20° is the complementary angle for 70°.

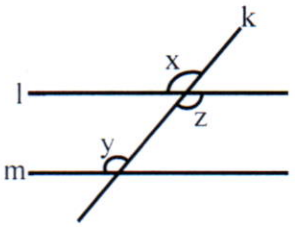


Supplementary angle: Supplementary angles are two adjacent angles whose sum is 180°. s and t are supplementary in the figure below, because their sum is 180°. 120° is the supplementary angle for 60°.



Parallel lines & Angles

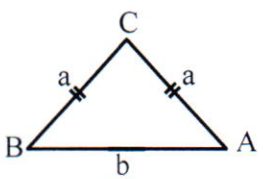
In the figure below l and m are parallel and k intersects them. The angles x and y are "corresponding angles" and x = y. The angles z and y are alternate angles and z = y.



Triangles and their properties

- The sum of interior angles of any triangle is 180°.
- Sum of two sides must be larger than third side.
- The degree measure of an exterior angle is equal to the sum of the measures of two non-adjacent.

Isosceles triangle a triangle that has two sides of equal length, but not equal to the third one.

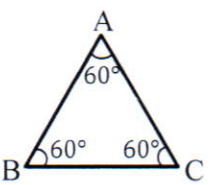


ΔABC is an isosceles triangle where, $\angle CAB = \angle CBA$, AC = BC

Area = $\frac{b}{4}\sqrt{4a^2 - b^2}$

Here, a = equal side, b = third side.

Equilateral triangle: Equilateral triangles have all three sides of equal length and angles equal to 60° each.



Facts of equilateral triangle:

1. All three sides equal.
2. All angles are equal to 60°.
3. The median of an equilateral triangle is perpendicular on the opposite side.
4. If a is the length of one side then:

Area = $\frac{\sqrt{3}}{4}a^2$

Perimeter = 3a.

Scalene triangle is a triangle having all the three sides of different length.

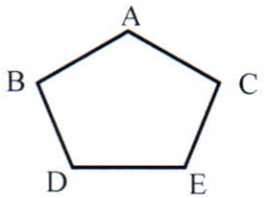
Area = $\sqrt{s(s-a)(s-b)(s-c)}$

Where, s in the half of the perimeter; a, b, c are the length of three sides.

Then, S = $\frac{1}{2}$ (a+b+c)

Polygon

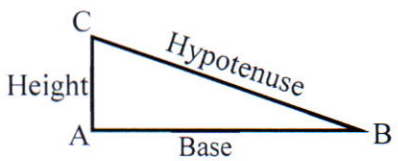
*** The sum of the interior angles of a polygon of N sides is 180 (N – 2)



The figure above has 5 sides, so the sum of five angles is 180 (5 – 2) = 180 × 3 = 540.

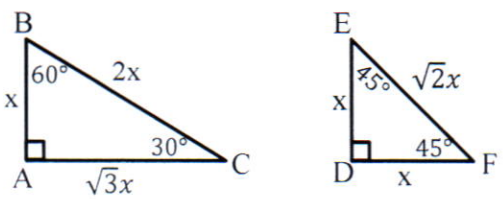
Right triangle and its properties

- Right triangle has one angle equal to 90° (or, right angle)
- The opposite side of the right is the longest side, and is called hypotenuse. Other two sides are called base and height.



Two common right triangles:

Right triangles having angles 30°, 60°, 90° and 45°, 45°, 90° are most important



30°, 60°, 90° triangle: 30°, 60°, 90° triangle's sides are $x, x\sqrt{3}, 2x$

45°, 45°, 90° triangle: 45°, 45°, 90° triangle's sides are $x, x, x\sqrt{2}$

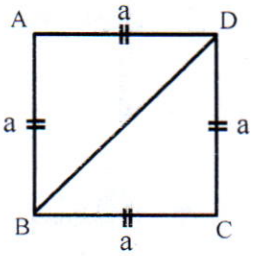
Memorize this chart (at least first four)

Triangle	Length of three sides		
	Leg	Leg	Hypotenuse
30-60-90	1	$\sqrt{3}$	2
45-45-90	1	1	$\sqrt{2}$
Angle measure not required	3	4	5
	5	12	13
	6	8	10
	7	24	25
	8	15	17
	9	40	41
	11	60	61

Rectangles:

Square:

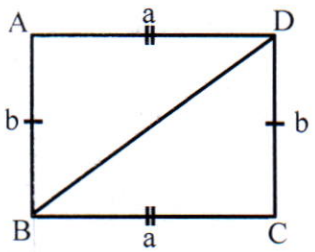
- Area = $(\text{Side})^2 = a^2$
- Perimeter = 4×length of one side = $4a$
- Diagonal = $\sqrt{2} \times$ One side = $\sqrt{2}a$
- Diagonals bisect each other



Here, AB = BC = CD = AD = a
BD = diagonal

Rectangle:

- Area = length × width = $a \times b$
- Perimeter = 2(length + width) = $2(a + b)$
- Diagonals bisect each other.

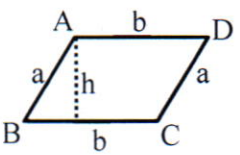


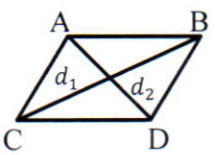
Here, AB = CD & AD = BC
BD = diagonal = $\sqrt{a^2 + b^2}$

Parallelogram

Area 3 methods:

- Area = base×height = b×h
- If height is unknown, then, A = $ab \sin x$
  [x is any angle between the sides]
- Using diagonals, A = $\frac{1}{2} \times d_1 \times d_2 \times \sin y$
  [y is any angle between at the intersection point of the diagonals]

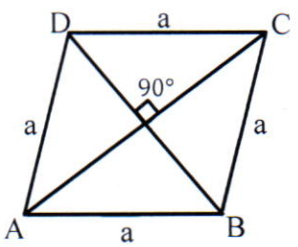




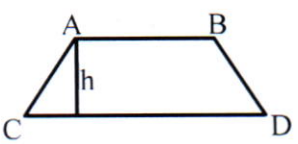
Rhombus:

Area = $\frac{1}{2} \times$ diagonal$_1$ ×diagonal$_2$

- Perimeter = 4×(length of one side) = 4a
- Opposite sides and angle are equal.
- Opposite sides are parallel.



Trapezium:



Area = $\frac{1}{2}$ (height x sum of parallel sides)

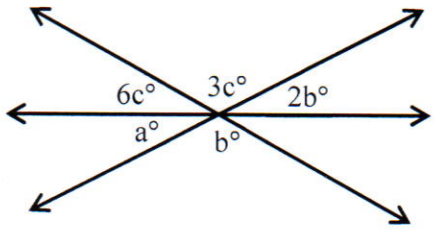
Practice Test

1. The one third of the complementary angle to 60° is -

A. 150° B. 100° C. 40° D. 30° E. None of these

2. In the figure, what is the value of 'a'?

A. 30
B. 45
C. 60
D. 75
E. 72



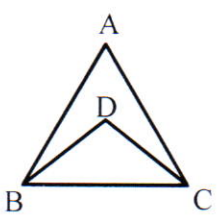
3. Points A, B, C and D in that order, lie out a line. If AB = 3 cm, AC = 4 cm, BD = 6 cm, what is the CD in cm?

A. 2 B. 3 C. 4 D. 5 E. 6

4. B and C are points on a straight line AD, where AB = BC = CD. What percent of AC is AD?

A. 1.5% B. 50% C. 66.67% D. 150% E. None of these

5. In the figure below, ∠ABD = ∠DBC and ∠ACD = ∠DCB. If ∠BAC = 70°, what is the value of ∠BDC?

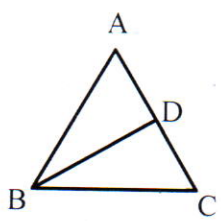


A. 55° B. 70° C. 90° D. 125° E. None of these

6. Three angles of a triangle are in proportion 5: 6: 7. These what is the difference in degrees between the biggest and the smallest angles?

A. 10° B. 20° C. 25° D. 30° E. None of these

7. In this diagram AB = AC. ∠A = 40° and BD is perpendicular to AC at D. How many degrees are there in ∠DBC?



A. 20 B. 40 C. 50 D. 70 E. None of these

8. The length of two sides of a triangle are 7 cm and 4 cm respectively. The length of the third side is -

A. Greater than 3 cm B. Less than 3 cm C. Equal to 3 cm

D. All are three E. None of these

9. If the length of the three sides of a triangle are consecutive integers, then smallest possible value of the sum of the length of the three sides is -

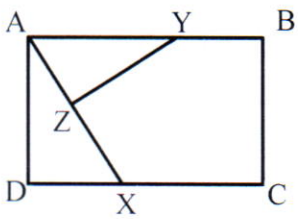
A. 9 B. 7 C. 6 D. 12 E. None of these

10. In triangle ABC, AB = AC. All of the following statements are true except?

A. $AB < AC + BC$ B. $AC < AB + AC$ C. $BC + AC > AB + BC$

D. $AC + BC = AB + BC$ E. None of these

11. ABCD is rectangle. $\angle ZXD = 30°$ and $\angle AZY = 80°$. Find $\angle ZYB$. [BBA 14-15]

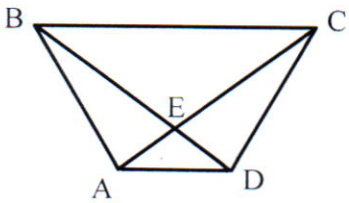


A. 100° B. 110° C. 120° D. 130° E. None of these

12. A towel, when balanced was found to have lost 20% of its length and 10% of its breadth. The percentage of decreases in area is -

A. 10% B. 10.08% C. 20% D. 28% E. 30%

13. In the figure, AD is parallel to BC. BC = 12 cm and AD = 3 cm. If AE = 2 cm what is the length of EC in cm? [BBA 14-15]



A. 6 B. 8 C. 9 D. 12 E. None of these

14. The diagonal of a rectangle is $\sqrt{41}$ cm and its area is 20 cm^2. What is the perimeter of the rectangle?

A. 16 cm B. 17 cm C. 20 cm D. 18 cm E. None of these

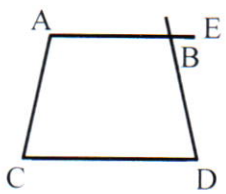
15. The rhombus ABCD has diagonals intersecting at X, with BC = 13 cm and CX = 5 cm. Calculate the area of the rhombus in cm^2.

A. 65 B. 90 C. 120 D. 130 E. None of these

16. The length of a rectangular field X is 2 kilometers greater than the side of a square field Y and the width of the field X is 2 kilometer less than the side of filed Y. If Y^2 is the area of Y in square kilometer, which of the following gives the area, in square kilometers, of field X?

A. $Y^2 - 4$ B. $Y^2 - 2$ C. Y^2 D. $Y^2 + 2$ E. None of these

17. In the figure, $\angle CAB = 2\angle CDB$, $\angle ABD = 3\angle ACD$ and $\angle CDB = 2\angle ACD$. Calculate $\angle ABD$.

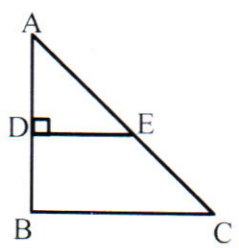


A. 90° B. 60° C. 88° D. 72° E. None of these

18. Mr. Mymuny is a vegetable farmer. His neighbors go regularly enter his vegetable garden and destroys his vegetables. To protect his vegetables Mr. Mymuny wants to put up fencing around three sides of his rectangular yard and leave a side of 20 feet unfenced that side is facing the canal and needs no fence. If the garden has an area of 680 sq. feet, how many feet of facing does he need?

A. 34 B. 40 C. 68 D. 88 E. None of these

19. In the triangle ABC, $\angle ABC = 90°$ and DE is parallel to BC, AD = DB = 3 cm, DE = 4 cm, what is the area of BCDE in sq. cm?



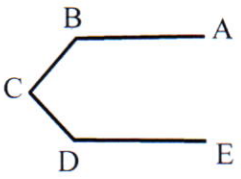
A. 18 B. 24 C. 27.5 D. 32 E. None of these

20. Danesh and Sham, who live 10 miles apart, meet at a café that is directly north of Danesh's house and directly east of Sham's house. If the café is 2 miles. closer to Danesh's house than to Sham's house, how many miles is the café from Sham's house?

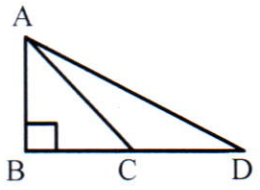
A. 6 B. 7 C. 8 D. 9 E. 10

21. In the diagram, BA is parallel to DE, ∠ABC = 110° and ∠CDE = 140°. Calculate the value of ∠BCD. [July 2016]

A. 90°
B. 100°
C. 110°
D. 135°
E. None of these

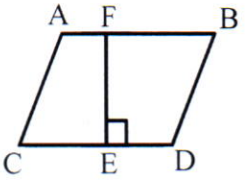


22. In the figure, C is the midpoint of BD and the area of ACD is 12 sq. cm. If CD = 4 cm, what is the length of AB in cm? [Dec 2016]



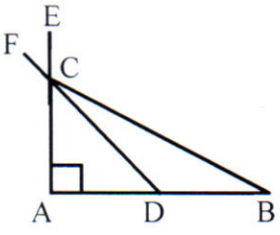
A. 4 B. 6 C. 8 D. 12 E. None of these

23. Given that EF = 5 cm and AB = 12 cm. What is the area of the parallelogram in sq. cm? [Dec 2017]



A. 30 B. 45 C. 60 D. 72 E. None of these

24. In the figure ∠ABC = 24° and ∠FCE = ∠BCD. Find ∠ECF. [Dec 2017]



A. 33° B. 35° C. 44° D. 52° E. None of these

25. In a rectangle, the length of the diagonal is 8 meters and the length of the perpendicular drawn on that diagonal from the opposite corner is 4 meters. What is the area of the rectangle in square meter? [June 2018]

A. 32 B. 24 C. 16 D. 12 E. None of these

Home Task

1. The length of two sides of a triangle are 7 and 11. If the length of the third side is an integer, what is the least possible perimeter of the triangle?

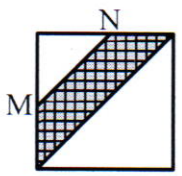
A. 18 B. 20 C. 23 D. 25 E. None of these

2. If a, b and c are three sides of a right triangle, which of the following statements cannot be true?

A. $a = b$ or $b = c$ or $a = c$ B. $a = b = c$ C. $a > b$ and $a > c$

D. $b > a$ and $b = c$ E. None of these

3. What is the perimeter of the shaded region in the following square whose length of the side is 2 and M and N are the middle points of the two sides?



A. 3 B. $2 + 3\sqrt{2}$ C. $3 + 2\sqrt{2}$ D. 5 E. None of these

4. If the hypotenuse of an isosceles right triangle has length of 8, then the area of the triangle is -

A. 4 B. $4\sqrt{2}$ C. 8 D. 16 E. None of these

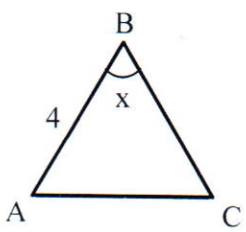
5. The longest side of an isosceles right triangle measure 16 m. What is the perimeter of the triangle?

A. $32\sqrt{2}$ m B. $32 + 16\sqrt{2}$ C. $16 + 16\sqrt{2}$ D. $32 + \sqrt{2}$m E. None of these

6. If the length of a side of an equilateral triangle is 4 cm. Its height is -

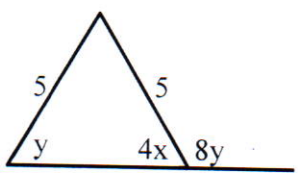
A. $2\sqrt{3}$ B. $4\sqrt{3}$ C. $16\sqrt{3}$ D. $33\sqrt{2}$ E. None of these

7. In the figure below, triangle ABC is isosceles with base AC. If $x = 60°$, than AC = ?



A. 2 B. 3 C. 4 D. $\frac{14}{3}$ E. 5

8. What is the value of 'x' in the figure below?



A. 36 B. 5 C. 20 D. 10 E. None of these

9. The area of a triangle with sides 3 cm, 5 cm and 6 cm is -

A. $2\sqrt{3}cm^2$ B. $2\sqrt{14}cm^2$ C. $5\sqrt{12}cm^2$ D. $4\sqrt{4}cm^2$ E. None of these

10. If the length of rectangle A is one-half the length of rectangle B, and the width of rectangle A is one-half the width of rectangle B, what is the ratio of the area of rectangle A to the area of rectangle B?

A. $\frac{1}{4}$ B. $\frac{1}{2}$ C. 1 D. 2 E. $\frac{3}{7}$

11. The length of one edge of a square equals 4. What is the distance between the center of the square and one of its vertices?

A. 2 B. $2\sqrt{2}$ C. $2\sqrt{3}$ D. $4\sqrt{2}$ E. None of these

12. The length and breadth of a square are increased by 40% and 30% respectively. The area of the resulting rectangle exceeds the area of the square by -

A. 50 B. 76 C. 82 D. 41 E. None of these

13. If the length of each of the sides of three square garden's plots is increased by 50 percent, by what percent is the sum of the areas of the three plots increased?

A. 125% B. 150% C. 200% D. 375% E. None of these

14. A square carpet with an area of 169 cm^2 must have 2 cm cut off one of its edge in order to be a perfect fit for a rectangle room. What is the area (in cm^2) of this rectangular room?

A. 117 B. 143 C. 145 D. 165 E. None of these

15. The area of a rectangle R with width 4 ft is equal to the area of a square S, which has a perimeter of 24 ft. The perimeter of the rectangle R, in feet is -

A. 9 B. 16 C. 24 D. 26 E. 30

16. The length of a rectangle is three times its breadth. What is the perimeter of the rectangle (in meter) if its length is 48 meters?

A. 50 B. 60 C. 96 D. 128 E. None of these

17. The ratio between the perimeter and the breadth of rectangle is 5: 1. If the area of rectangle is 216 sq. cm, what is the length of the rectangle?

A. 16 cm B. 24 cm C. 20 cm D. 18 cm E. 15 cm

18. A rectangular rug covers half of a rectangular floor that is 9 feet wide and 12 feet long. If the dimensions of the rug are in the same ratio as those of the floor, how many feet long is the rug?

A. 6 B. 8 C. 10 D. 12 E. None of these

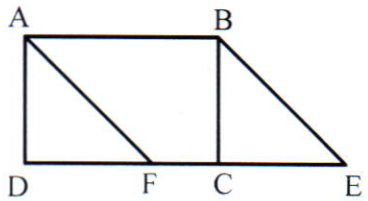
19. The area of a rectangular plot is 460 square meters. If the length is 15% more than the breadth, what is the breadth of the plot?

A. 14 B. 20 C. 24 D. 28 E. None of these

20. If the area of a rhombus is 54 sq. cm and the length of one of the diagonals is 6 cm then the length of the other diagonal is -

A. 18 B. 12 C. 9 D. 6 E. None of these

21. In the figure, ABCD is a rectangle and AF is parallel to BE. If BC = CE = 5 cm and AB = 10 cm, then what is the area of ΔAFD in cm^2?

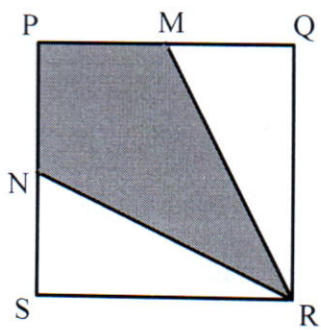


A.12.5 B. 15 C. 25 D. 50 E. None of these

22. If the area of a rectangular is equal to the area of a square, then the perimeter of the rectangular must be -

A. Half the perimeter of the square
B. Equal to the perimeter of the square
C. Equal to twice the perimeter of the square
D. Equal to the square of the perimeter of the square
E. None of these

23. In the figure below, PQRS is a square and M and N are midpoints of their respective sides. Each side of the square has a length of 4 inches. What is the area of quadrilateral PMRN?

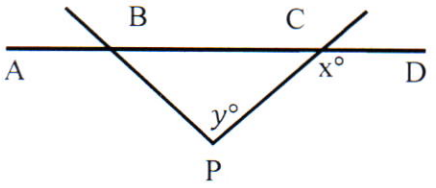


A.8 sq. inches B. 10 sq. inches C. 12 sq. inches D. 14 sq. inches E. None of these

24. One of the sides of a square measures 20 cm in length. If we increase the length of two opposite sides by 4 centimeters and decreases the length of the remaining two opposite sides by the same measure, then what be the area of the resulting figure in sq. cm? [MBA 2013]

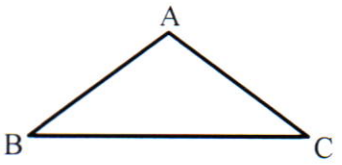
A. 324 B. 360 C. 384 D. 400 E. None of these

25. In the figure, if CP = BP and X = 120°, then y = ?



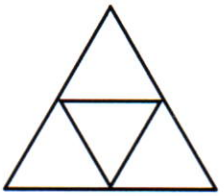
A. 30 B. 45 C. 60 D. 75 E. None of these

26. In the figure AB = AC = 4 cm and ∠BAC = 120°. Find the area of the triangle.



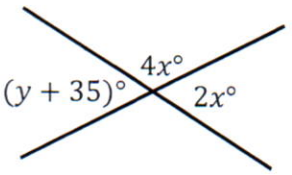
A. $8\sqrt{12}$ B. $4\sqrt{12}$ C. $2\sqrt{12}$ D. 16 E. None of these

27. The figure below is an equilateral triangle divided into four congruent small, equilateral triangle. If the perimeter of a smaller triangle is 1, what is the perimeter of the larger triangle?



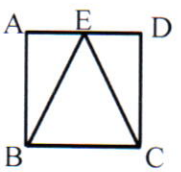
A. 2 B. 4 C. 6 D. 8 E. 16

28. In the figure, what is the value of y? [July 2016]



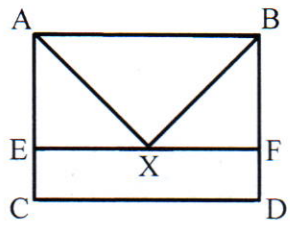
A. 20 B. 25 C. 30 D. 35 E. None of these

29. In ABCD rectangle, ∠ABE = 30°, BC = 6 cm and ED = 2AE. What is the area of the triangle AEB in cm^2?



A. 4 B. $2\sqrt{3}$ C. $3\sqrt{2}$ D. $8\sqrt{3}$ E. None of these

30. In the parallelogram, E is the midpoint of AC and EF is parallel to AB. If the area of ABCD is 36 sq.cm and EX = 6 cm, what is the area of triangle ABX in sq.cm?



A. 16 B. 15 C. 12

D. 9 E. None of these