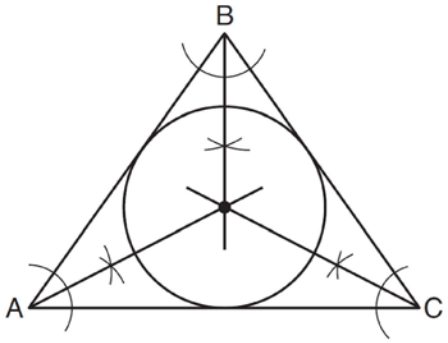
Name: _____

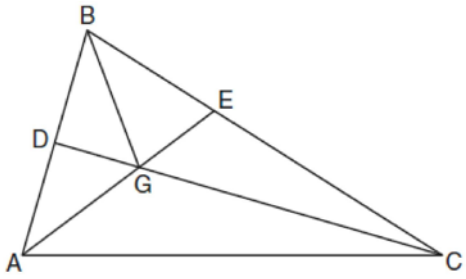
# G.CO.C.10: Centroid, Orthocenter, Incenter and Circumcenter

1 Which geometric principle is used in the construction shown below?



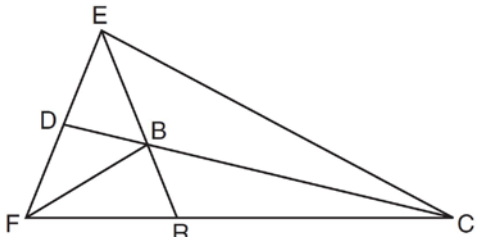

1) The intersection of the angle bisectors of a triangle is the center of the inscribed circle.
2) The intersection of the angle bisectors of a triangle is the center of the circumscribed circle.
3) The intersection of the perpendicular bisectors of the sides of a triangle is the center of the inscribed circle.
4) The intersection of the perpendicular bisectors of the sides of a triangle is the center of the circumscribed circle.

2 In the diagram below of $\triangle ABC$, $\overline{CD}$ is the bisector of $\angle BCA$, $\overline{AE}$ is the bisector of $\angle CAB$, and $\overline{BG}$ is drawn.



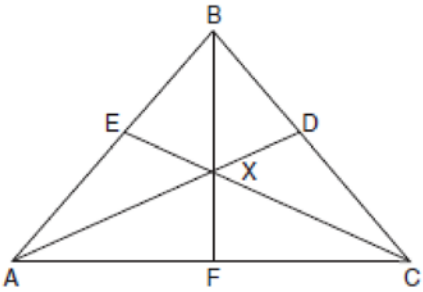

Which statement must be true?
1) $DG = EG$
2) $AG = BG$
3) $\angle AEB \cong \angle AEC$
4) $\angle DBG \cong \angle EBG$

3 In the diagram below, point $B$ is the incenter of $\triangle FEC$, and $\overline{EBR}$, $\overline{CBD}$, and $\overline{FB}$ are drawn.




If $m\angle FEC = 84$ and $m\angle ECF = 28$, determine and state $m\angle BRC$.

4 In the diagram below of isosceles triangle $ABC$, $\overline{AB} \cong \overline{CB}$ and angle bisectors $\overline{AD}$, $\overline{BF}$, and $\overline{CE}$ are drawn and intersect at $X$.




If $m\angle BAC = 50°$, find $m\angle AXC$.

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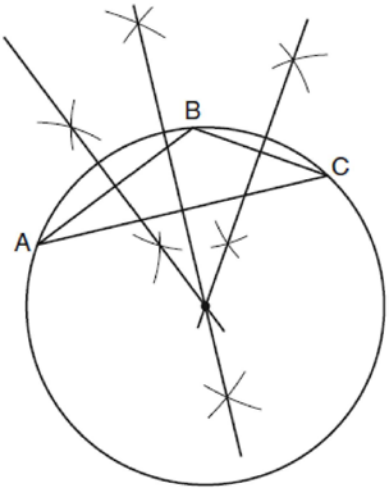
5 The diagram below shows the construction of the center of the circle circumscribed about $\triangle ABC$.




This construction represents how to find the intersection of

1) the angle bisectors of $\triangle ABC$
2) the medians to the sides of $\triangle ABC$
3) the altitudes to the sides of $\triangle ABC$
4) the perpendicular bisectors of the sides of $\triangle ABC$

6 If the altitudes of a triangle meet at one of the triangle's vertices, then the triangle is

1) a right triangle
2) an acute triangle
3) an obtuse triangle
4) an equilateral triangle

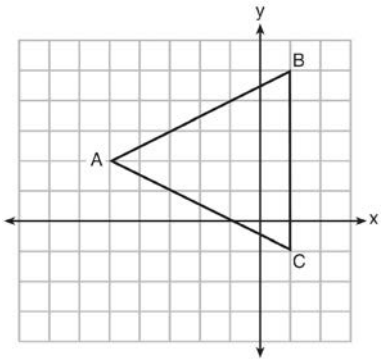
7 In which triangle do the three altitudes intersect outside the triangle?

1) a right triangle
2) an acute triangle
3) an obtuse triangle
4) an equilateral triangle

8 For a triangle, which two points of concurrence could be located outside the triangle?

1) incenter and centroid
2) centroid and orthocenter
3) incenter and circumcenter
4) circumcenter and orthocenter

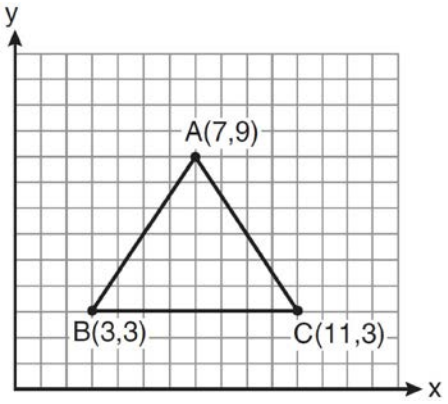
9 Triangle $ABC$ is graphed on the set of axes below.




What are the coordinates of the point of intersection of the medians of $\triangle ABC$?

1) $(-1,2)$
2) $(-3,2)$
3) $(0,2)$
4) $(1,2)$

10 The vertices of the triangle in the diagram below are $A(7,9)$, $B(3,3)$, and $C(11,3)$.




What are the coordinates of the centroid of $\triangle ABC$?

1) $(5,6)$
2) $(7,3)$
3) $(7,5)$
4) $(9,6)$

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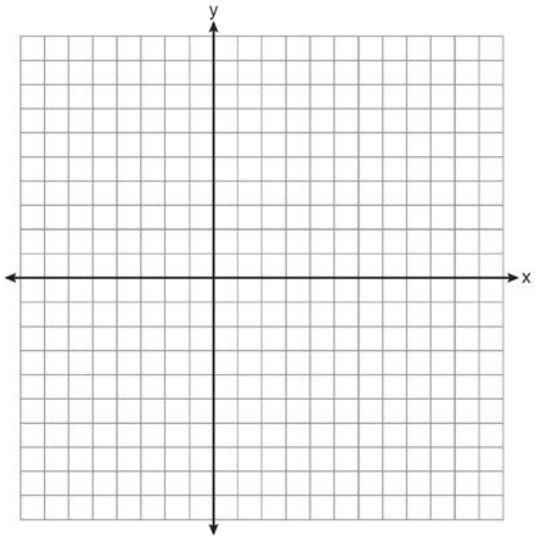
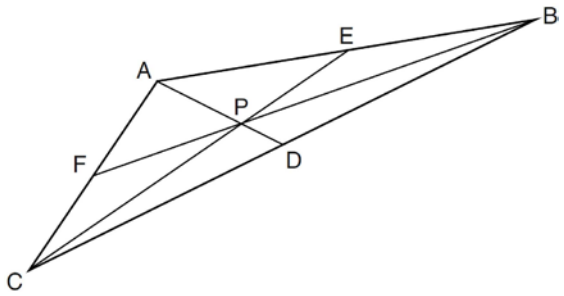
11 In a given triangle, the point of intersection of the three medians is the same as the point of intersection of the three altitudes. Which classification of the triangle is correct?
1) scalene triangle
2) isosceles triangle
3) equilateral triangle
4) right isosceles triangle

12 Triangle $ABC$ has vertices $A(3,3)$, $B(7,9)$, and $C(11,3)$. Determine the point of intersection of the medians, and state its coordinates. [The use of the set of axes below is optional.]

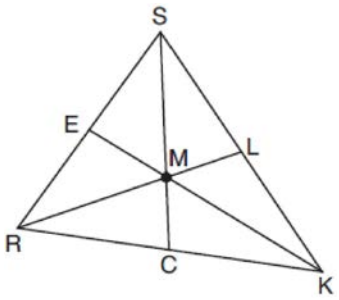



13 In the diagram below of $\triangle ABC$, $\overline{AE} \cong \overline{BE}$, $\overline{AF} \cong \overline{CF}$, and $\overline{CD} \cong \overline{BD}$.



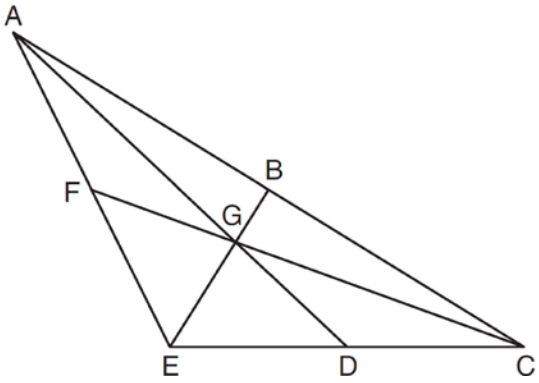

Point $P$ must be the
1) centroid
2) circumcenter
3) incenter
4) orthocenter

14 In triangle $SRK$ below, medians $\overline{SC}$, $\overline{KE}$, and $\overline{RL}$ intersect at $M$.




Which statement must always be true?
1) $3(MC) = SC$
2) $MC = \frac{1}{3}(SM)$
3) $RM = 2MC$
4) $SM = KM$

15 In the diagram below of $\triangle ACE$, medians $\overline{AD}$, $\overline{EB}$, and $\overline{CF}$ intersect at $G$. The length of $\overline{FG}$ is 12 cm.




What is the length, in centimeters, of $\overline{GC}$?
1) 24
2) 12
3) 6
4) 4

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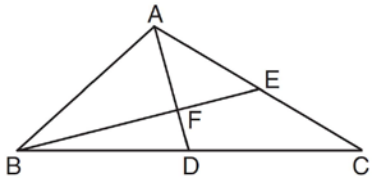
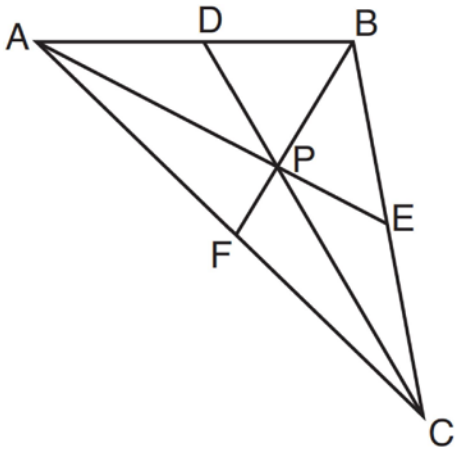
16 In the diagram of $\triangle ABC$ below, medians $\overline{AD}$ and $\overline{BE}$ intersect at point $F$.



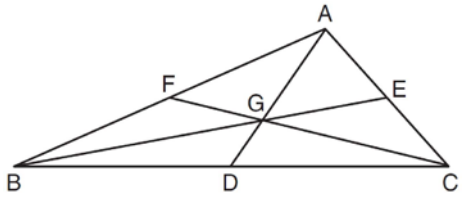

If $AF = 6$, what is the length of $\overline{FD}$?
1) 6
2) 2
3) 3
4) 9

17 In $\triangle ABC$ shown below, $P$ is the centroid and $BF = 18$.



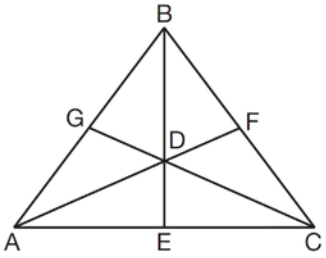

What is the length of $\overline{BP}$?
1) 6
2) 9
3) 3
4) 12

18 In the diagram below of $\triangle ABC$, medians $\overline{AD}$, $\overline{BE}$, and $\overline{CF}$ intersect at $G$.



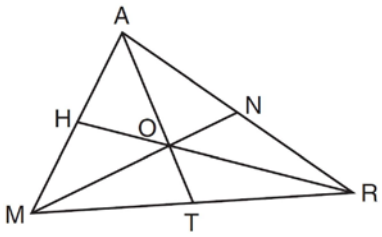

If $CF = 24$, what is the length of $\overline{FG}$?
1) 8
2) 10
3) 12
4) 16

19 As shown below, the medians of $\triangle ABC$ intersect at $D$.




If the length of $\overline{BE}$ is 12, what is the length of $\overline{BD}$?
1) 8
2) 9
3) 3
4) 4

20 In the diagram below of $\triangle MAR$, medians $\overline{MN}$, $\overline{AT}$, and $\overline{RH}$ intersect at $O$.




If $TO = 10$, what is the length of $\overline{TA}$?
1) 30
2) 25
3) 20
4) 15

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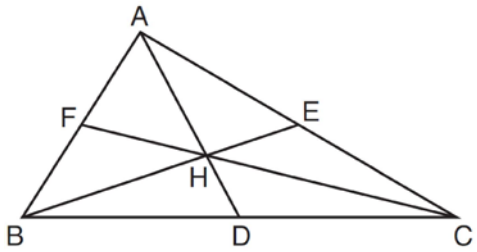
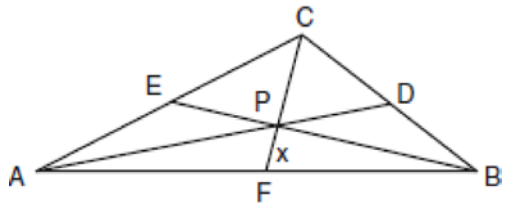
21 In the diagram below of $\triangle ABC$, point $H$ is the intersection of the three medians.




If $\overline{DH}$ measures 2.4 centimeters, what is the length, in centimeters, of $\overline{AD}$?

1) 3.6
2) 4.8
3) 7.2
4) 9.6

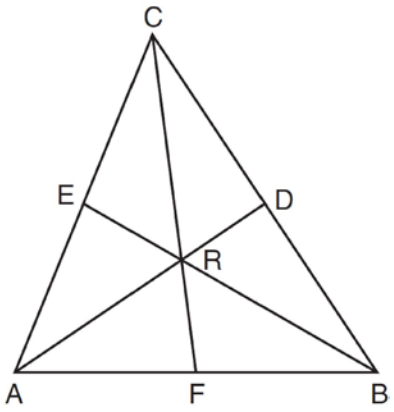
22 In the diagram of $\triangle ABC$ below, Jose found centroid $P$ by constructing the three medians. He measured $\overline{CF}$ and found it to be 6 inches.




If $PF = x$, which equation can be used to find $x$?

1) $x + x = 6$
2) $2x + x = 6$
3) $3x + 2x = 6$
4) $x + \frac{2}{3}x = 6$

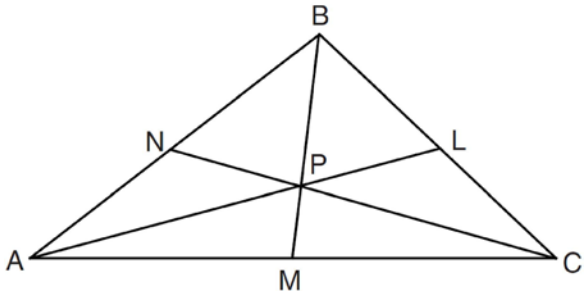
23 In $\triangle ABC$ shown below, medians $\overline{AD}$, $\overline{BE}$, and $\overline{CF}$ intersect at point $R$.




If $CR = 24$ and $RF = 2x - 6$, what is the value of $x$?

1) 9
2) 12
3) 15
4) 27

24 In the diagram below, point $P$ is the centroid of $\triangle ABC$.




If $PM = 2x + 5$ and $BP = 7x + 4$, what is the length of $\overline{PM}$?

1) 9
2) 2
3) 18
4) 27

25 The three medians of a triangle intersect at a point. Which measurements could represent the segments of one of the medians?

1) 2 and 3
2) 3 and 4.5
3) 3 and 6
4) 3 and 9

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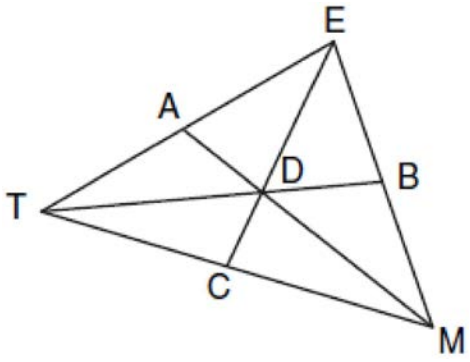
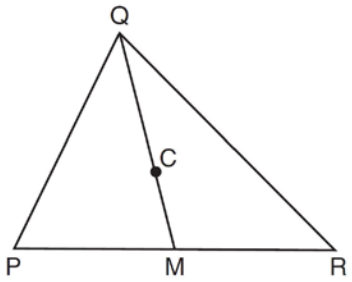
26 In the diagram below of $\triangle TEM$, medians $\overline{TB}$, $\overline{EC}$, and $\overline{MA}$ intersect at $D$, and $TB = 9$. Find the length of $\overline{TD}$.

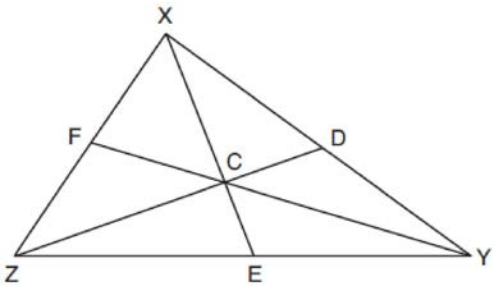



27 In the diagram below, $\overline{QM}$ is a median of triangle $PQR$ and point $C$ is the centroid of triangle $PQR$.




If $QC = 5x$ and $CM = x + 12$, determine and state the length of $\overline{QM}$.

28 In $\triangle XYZ$, shown below, medians $\overline{XE}$, $\overline{YF}$, and $\overline{ZD}$ intersect at $C$.




If $CE = 5$, $YF = 21$, and $XZ = 15$, determine and state the perimeter of triangle $CFX$.

## G.CO.C.10: Centroid, Orthocenter, Incenter and Circumcenter
## Answer Section

1 ANS: 1 REF: 081028ge

2 ANS: 4

$\overline{BG}$ is also an angle bisector since it intersects the concurrence of $\overline{CD}$ and $\overline{AE}$

REF: 061025ge

3 ANS:

$$180 - \left(\frac{84}{2} + 28\right) = 180 - 70 = 110$$

REF: 061534ge

4 ANS:

$180 - 2(25) = 130$

REF: 011730geo

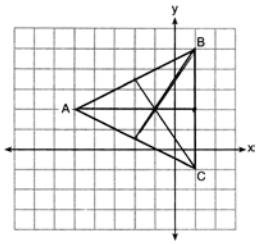
5 ANS: 4 REF: 080925ge

6 ANS: 1 REF: 081904geo

7 ANS: 3 REF: fall0825ge

8 ANS: 4 REF: 081224ge

9 ANS: 1

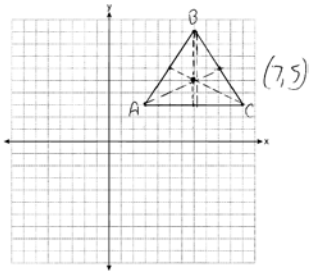



REF: 011516ge

10 ANS: 3 REF: 011110ge

11 ANS: 3 REF: 011202ge

12 ANS:




(7,5) $m_{\overline{AB}} = \left(\frac{3+7}{2}, \frac{3+9}{2}\right) = (5,6)$ $m_{\overline{BC}} = \left(\frac{7+11}{2}, \frac{9+3}{2}\right) = (9,6)$

REF: 081134ge

13 ANS: 1 REF: 061214ge

14 ANS: 1
$M$ is a centroid, and cuts each median 2:1.

REF: 061818geo
15 ANS: 1 REF: 061104ge
16 ANS: 3
The centroid divides each median into segments whose lengths are in the ratio 2 : 1.

REF: 081307ge
17 ANS: 4
The centroid divides each median into segments whose lengths are in the ratio 2 : 1.

REF: 081220ge
18 ANS: 1
The centroid divides each median into segments whose lengths are in the ratio 2 : 1.

$$\overline{GC} = 2\overline{FG}$$
$$\overline{GC} + \overline{FG} = 24$$
$$2\overline{FG} + \overline{FG} = 24$$
$$3\overline{FG} = 24$$
$$\overline{FG} = 8$$

REF: 081018ge
19 ANS: 1
$2x + x = 12$. $\overline{BD} = 2(4) = 8$

$3x = 12$

$x = 4$

REF: 011408ge
20 ANS: 1 REF: 061527ge
21 ANS: 3
$2.4 + 2(2.4) = 7.2$

REF: 081526ge
22 ANS: 2
The centroid divides each median into segments whose lengths are in the ratio 2 : 1.

REF: 060914ge

23 ANS: 1

$2(2x - 6) = 24$

$2x - 6 = 12$

$2x = 18$

$x = 9$

REF: 011619ge

24 ANS: 1

$7x + 4 = 2(2x + 5)$. $PM = 2(2) + 5 = 9$

$7x + 4 = 4x + 10$

$3x = 6$

$x = 2$

REF: 011226ge

25 ANS: 3 REF: 061424ge

26 ANS:

6. The centroid divides each median into segments whose lengths are in the ratio 2 : 1. $\overline{TD} = 6$ and $\overline{DB} = 3$

REF: 011034ge

27 ANS:

$5x = 2(x + 12)$ $QM = 5(8) + (8) + 12 = 60$

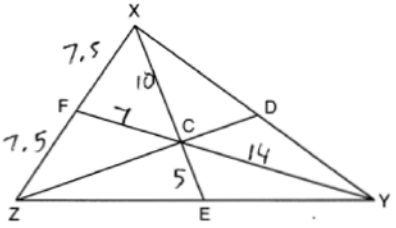
$5x = 2x + 24$

$3x = 24$

$x = 8$

REF: 081433ge

28 ANS:




$7.5 + 7 + 10 = 24.5$

REF: 012030geo