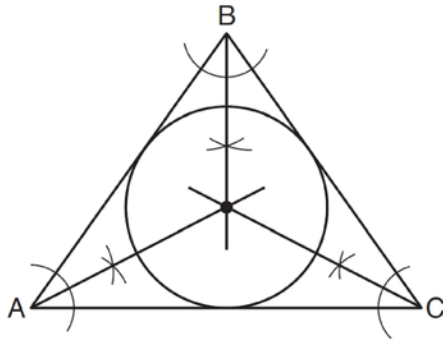
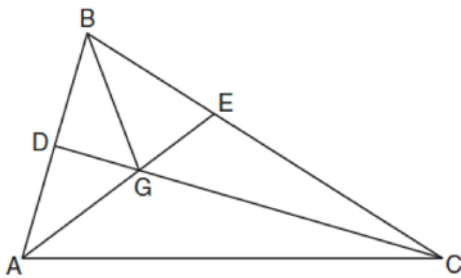


**G.SRT.B.4: Centroid, Orthocenter, Incenter and Circumcenter**

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



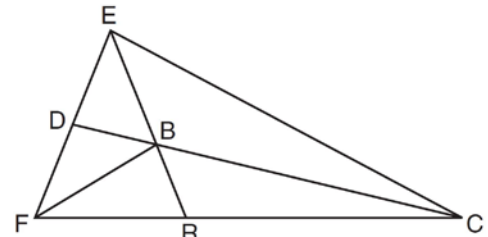
- 1) The intersection of the angle bisectors of a triangle is the center of the inscribed circle.
  - 2) The intersection of the angle bisectors of a triangle is the center of the circumscribed circle.
  - 3) The intersection of the perpendicular bisectors of the sides of a triangle is the center of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

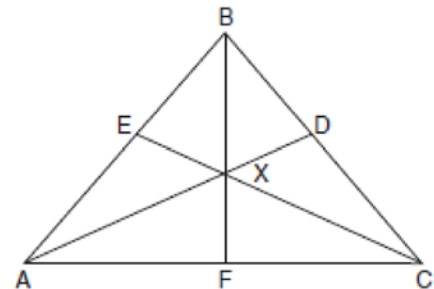
- 1)  $DG = EG$
- 2)  $AG = BG$
- 3)  $\angle AEB \cong \angle AEC$
- 4)  $\angle DBG \cong \angle EBG$

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



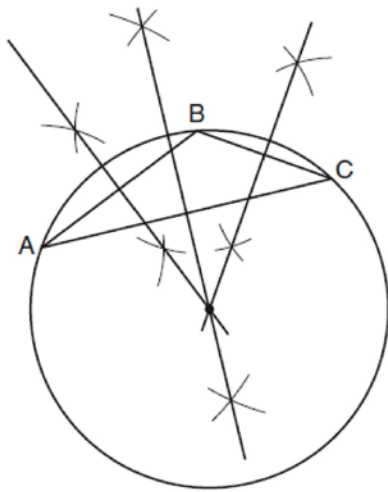
If  $m\angle FEC = 84$  and  $m\angle ECF = 28$ , determine and state  $m\angle BRC$ .

- 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  $m\angle BAC = 50^\circ$ , find  $m\angle AXC$ .

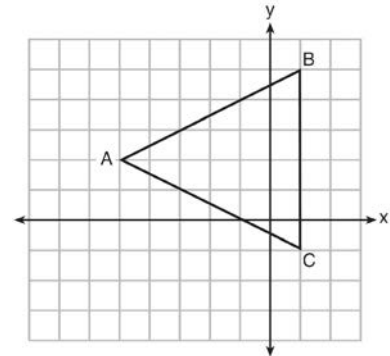
- 5 The diagram below shows the construction of the center of the circle circumscribed about  $\triangle ABC$ .



This construction represents how to find the intersection of

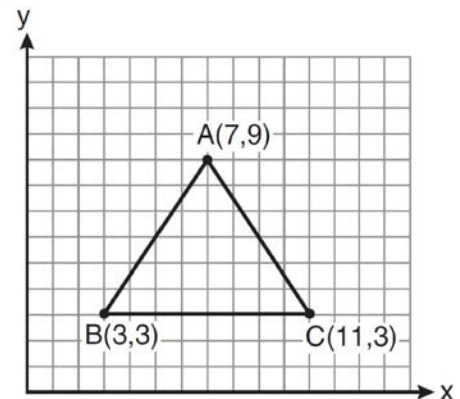
- 1) the angle bisectors of  $\triangle ABC$
  - 2) the medians to the sides of  $\triangle ABC$
  - 3) the altitudes to the sides of  $\triangle ABC$
  - 4) the perpendicular bisectors of the sides of  $\triangle ABC$
- 6 If the altitudes of a triangle meet at one of the triangle's vertices, then the 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  $C(11, 3)$ .



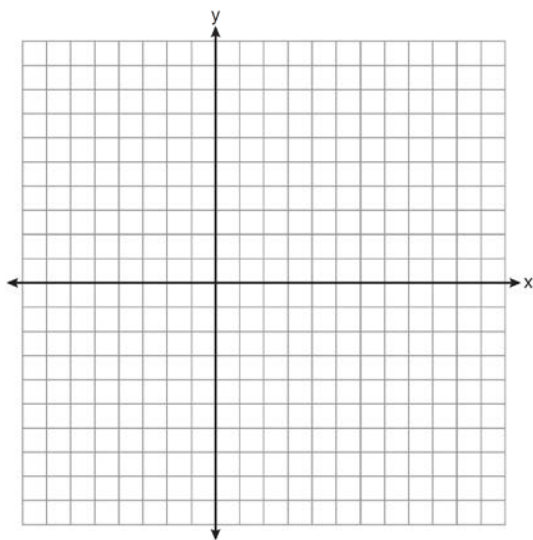
What are the coordinates of the centroid of  $\triangle ABC$ ?

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

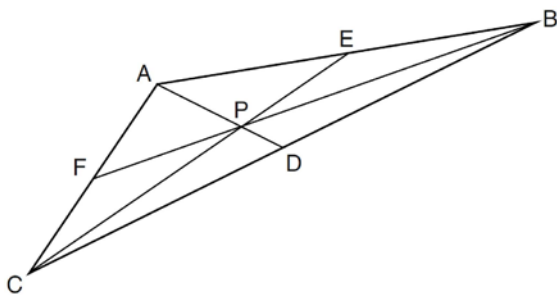
11 In a given triangle, the point of intersection of the three medians is the same as the point of intersection of the three altitudes. Which classification of the triangle is correct?

- 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.]



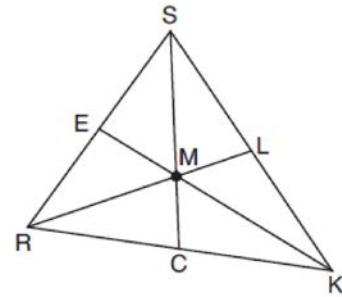
13 In the diagram below of  $\triangle ABC$ ,  $\overline{AE} \cong \overline{BE}$ ,  $\overline{AF} \cong \overline{CF}$ , and  $\overline{CD} \cong \overline{BD}$ .



Point  $P$  must be the

- 1) centroid
- 2) circumcenter
- 3) Incenter
- 4) orthocenter

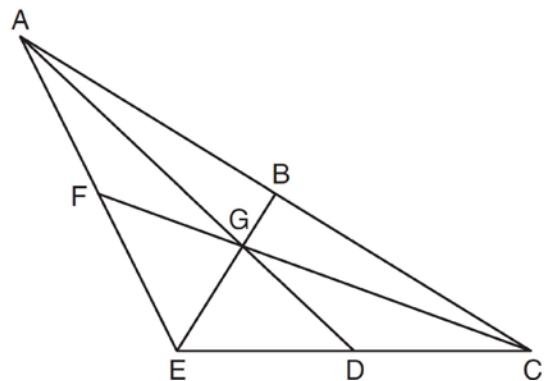
14 In triangle  $SRK$  below, medians  $\overline{SC}$ ,  $\overline{KE}$ , and  $\overline{RL}$  intersect at  $M$ .



Which statement must always be true?

- 1)  $3(MC) = SC$
- 2)  $MC = \frac{1}{3}(SM)$
- 3)  $RM = 2MC$
- 4)  $SM = KM$

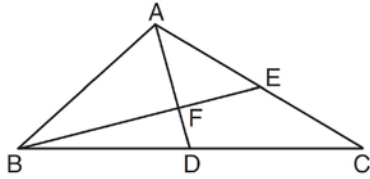
15 In the diagram below of  $\triangle ACE$ , medians  $\overline{AD}$ ,  $\overline{EB}$ , and  $\overline{CF}$  intersect at  $G$ . The length of  $\overline{FG}$  is 12 cm.



What is the length, in centimeters, of  $\overline{GC}$ ?

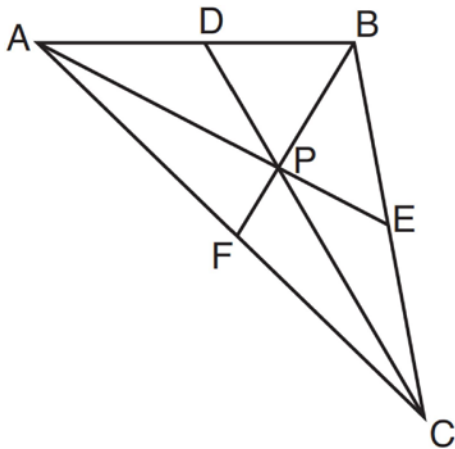
- 1) 24
- 2) 12
- 3) 6
- 4) 4

- 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  $\overline{FD}$ ?

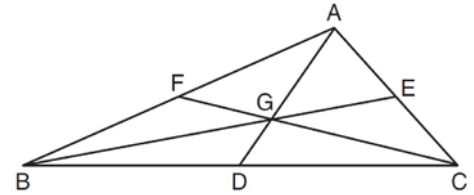
- 1) 6
  - 2) 2
  - 3) 3
  - 4) 9
- 17 In  $\triangle ABC$  shown below,  $P$  is the centroid and  $BF = 18$ .



What is the length of  $\overline{BP}$ ?

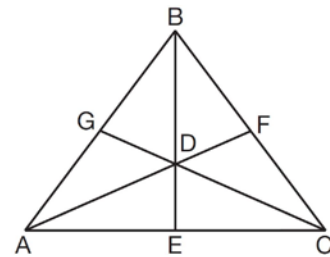
- 1) 6
- 2) 9
- 3) 3
- 4) 12

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



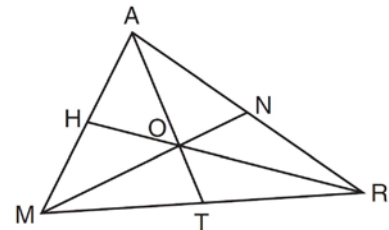
If  $CF = 24$ , what is the length of  $\overline{FG}$ ?

- 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  $\overline{BD}$ ?

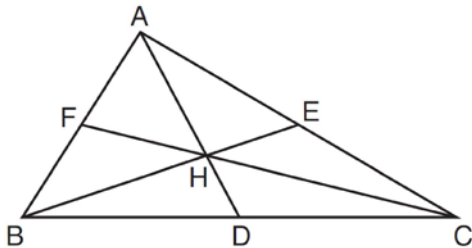
- 1) 8
  - 2) 9
  - 3) 3
  - 4) 4
- 20 In the diagram below of  $\triangle MAR$ , medians  $\overline{MN}$ ,  $\overline{AT}$ , and  $\overline{RH}$  intersect at  $O$ .



If  $TO = 10$ , what is the length of  $\overline{TA}$ ?

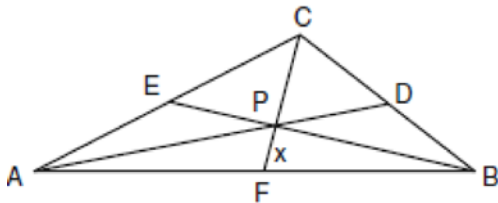
- 1) 30
- 2) 25
- 3) 20
- 4) 15

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



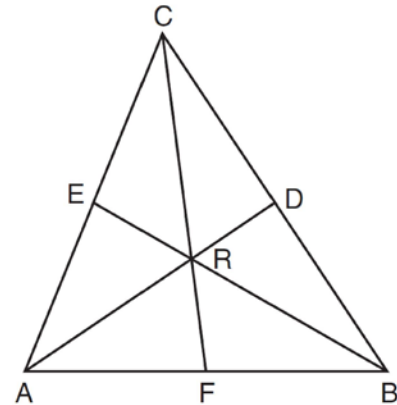
If  $\overline{DH}$  measures 2.4 centimeters, what is the length, in centimeters, of  $\overline{AD}$ ?

- 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.



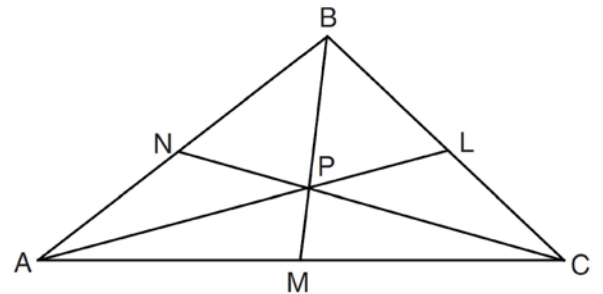
If  $PF = x$ , which equation can be used to find  $x$ ?

- 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  $x$ ?

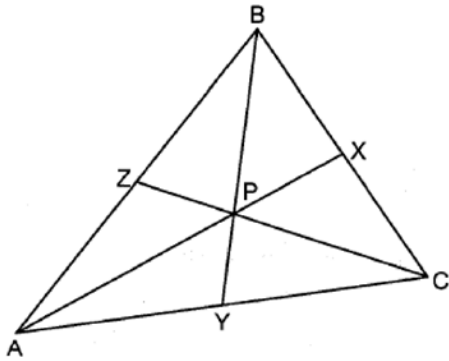
- 1) 9
  - 2) 12
  - 3) 15
  - 4) 27
- 24 In the diagram below, point  $P$  is the centroid of  $\triangle ABC$ .



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

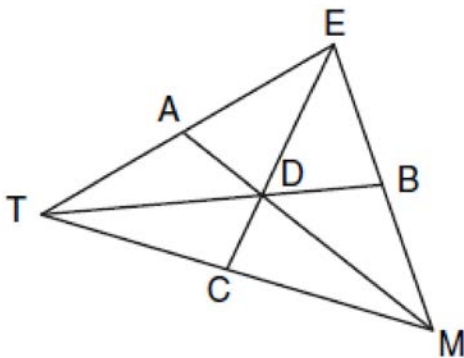
- 1) 9
  - 2) 2
  - 3) 18
  - 4) 27
- 25 The three medians of a triangle intersect at a point. Which measurements could represent the segments of one of the medians?
- 1) 2 and 3
  - 2) 3 and 4.5
  - 3) 3 and 6
  - 4) 3 and 9

- 26 In the diagram below,  $\triangle ABC$  has medians  $\overline{AX}$ ,  $\overline{BY}$ , and  $\overline{CZ}$  that intersect at point  $P$ .

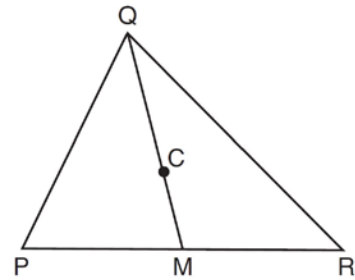


If  $AB = 26$ ,  $AC = 28$ , and  $PC = 16$ , what is the perimeter of  $\triangle CZA$ ?

- 1) 57
  - 2) 65
  - 3) 70
  - 4) 73
- 27 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  $\overline{TD}$ .

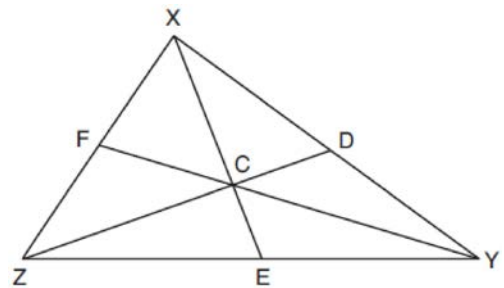


- 28 In the diagram below,  $\overline{QM}$  is a median of triangle  $PQR$  and point  $C$  is the centroid of triangle  $PQR$ .



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

- 29 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.SRT.B.4: 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

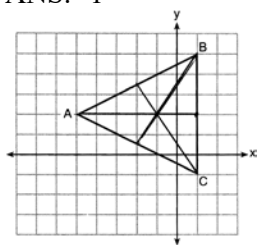
5 ANS: 4 REF: 080925ge

6 ANS: 1 REF: 081904geo

7 ANS: 3 REF: fall0825ge

8 ANS: 4 REF: 081224ge

9 ANS: 1



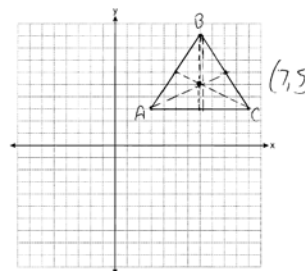
REF: 011516ge

10 ANS: 3 REF: 011110ge

11 ANS: 3 REF: 011202ge

12 ANS:

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



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

$$2x + x = 12. \quad \overline{BD} = 2(4) = 8$$

$$3x = 12$$

$$x = 4$$

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



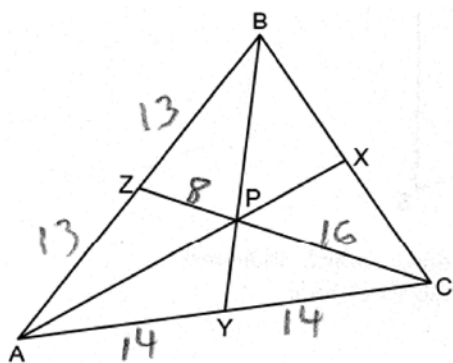
23 ANS: 1  
 $2(2x - 6) = 24$   
 $2x - 6 = 12$   
 $2x = 18$   
 $x = 9$

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: 2



$$\frac{x}{16} = \frac{1}{2} \quad 8 + 16 + 13 + 14 + 14 = 65$$

$$x = 8$$

REF: 082408geo

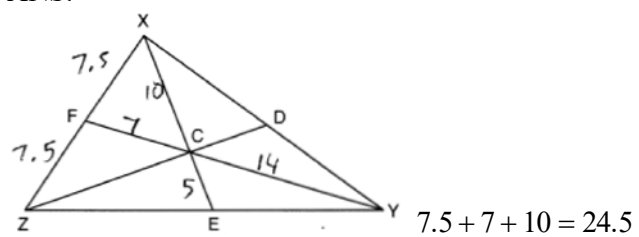
27 ANS:  
 6. The centroid divides each median into segments whose lengths are in the ratio 2 : 1.  $\overline{TD} = 6$  and  $\overline{DB} = 3$

REF: 011034ge

28 ANS:  
 $5x = 2(x + 12)$   $QM = 5(8) + (8) + 12 = 60$   
 $5x = 2x + 24$   
 $3x = 24$   
 $x = 8$

REF: 081433ge

29 ANS:



REF: 012030geo