

1. Points A, B, and C are collinear.

Points D, A, and E are collinear.

Points C, E, and F are collinear.

Points F, G, and D are collinear.

2. Points H, I, and J are collinear.

Points M, N, and L are collinear.

Points L, J, and K are collinear.

Points M, H, and K are collinear.

3. For the line with A, B, and C:  $\overleftrightarrow{AB}$ ,  $\overleftrightarrow{AC}$ , or  $\overleftrightarrow{BC}$

For the line with D, A, and E:  $\overleftrightarrow{DA}$ ,  $\overleftrightarrow{DE}$ , or  $\overleftrightarrow{AE}$

For the line with F, C, and E:  $\overleftrightarrow{FC}$ ,  $\overleftrightarrow{FE}$ , or  $\overleftrightarrow{CE}$

For the line with F, G, and D:  $\overleftrightarrow{FG}$ ,  $\overleftrightarrow{FD}$ , or  $\overleftrightarrow{GD}$

4. For the line with H, I, and J:  $\overleftrightarrow{HI}$ ,  $\overleftrightarrow{HJ}$ , or  $\overleftrightarrow{IJ}$

For the line with L, M, and N:  $\overleftrightarrow{MN}$ ,  $\overleftrightarrow{ML}$ , or  $\overleftrightarrow{NL}$

For the line with H, K, and M:  $\overleftrightarrow{MH}$ ,  $\overleftrightarrow{MK}$ , or  $\overleftrightarrow{HK}$

For the line with J, K, and L:  $\overleftrightarrow{LJ}$ ,  $\overleftrightarrow{LK}$ , or  $\overleftrightarrow{JK}$

5.  $\overline{RS}$  or  $\overline{SR}$

6.  $\overline{WT}$  or  $\overline{TW}$

7.  $\angle QRS$  or  $\angle SRQ$

8.  $\angle YXZ$  or  $\angle ZXY$

9.  $\overrightarrow{RS}$

10.  $\overrightarrow{WT}$

11.  $\overleftarrow{RS}$

12.  $\overleftarrow{WT}$

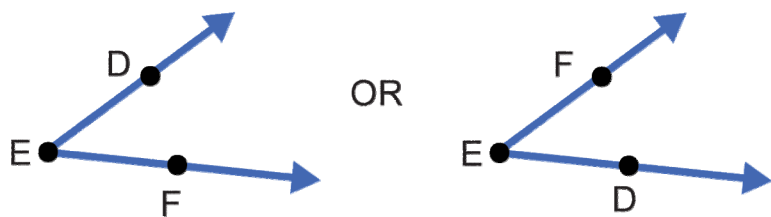
13.   
D S

14.   
R Z

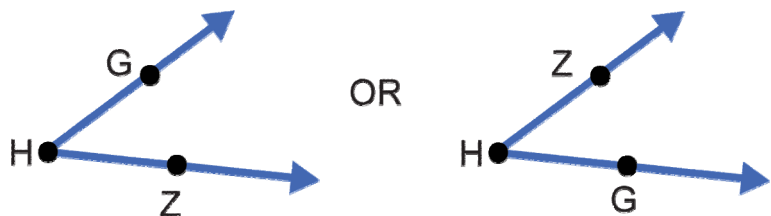
15.   $\ell$

16.   $n$

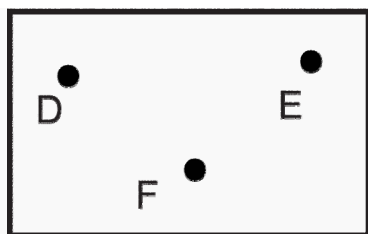
17.



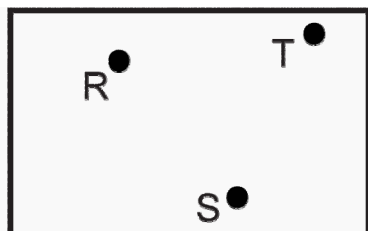
18.



19. The answer is not unique.



20. The answer is not unique.



21.



22.



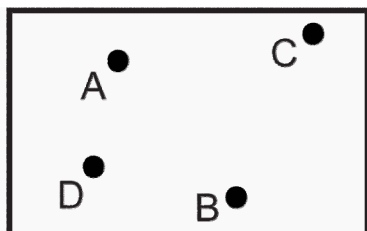
23. The answer is not unique.



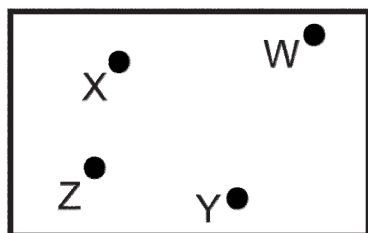
24. The answer is not unique.



25. The answer is not unique.



26. The answer is not unique.



27. Answer:  $d = 2$

Detailed Solution:

Find the distance between  $(-4, 8)$  and  $(-4, 6)$ .

Use the formula:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$d = \sqrt{((-4) - (-4))^2 + (6 - 8)^2}$$

$$d = \sqrt{(-4 + 4)^2 + (6 - 8)^2}$$

$$d = \sqrt{(0)^2 + (-2)^2}$$

$$d = \sqrt{0 + 4}$$

$$d = \sqrt{4}$$

$$d = 2$$

28.  $d = \sqrt{13}$

29. Answer:  $d = 4\sqrt{13}$

Detailed Solution:

Find the distance between  $(10, -1)$  and  $(-2, -9)$ .

Use the formula:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$d = \sqrt{(-2 - 10)^2 + (-9 - (-1))^2}$$

$$d = \sqrt{(-12)^2 + (-9 + 1)^2}$$

$$d = \sqrt{(-12)^2 + (-8)^2}$$

$$d = \sqrt{144 + 64}$$

$$d = \sqrt{208}$$

$$d = 4\sqrt{13}$$

30.  $d = \sqrt{13}$

31. Answer:  $d = \sqrt{730}$

Detailed Solution:

Find the distance between (5, 11) and (22, 32).

Use the formula:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$d = \sqrt{(22 - 5)^2 + (32 - 11)^2}$$

$$d = \sqrt{(17)^2 + (21)^2}$$

$$d = \sqrt{289 + 441}$$

$$d = \sqrt{730}$$

32.  $d = \sqrt{85}$

33. Answer:  $d = 5\sqrt{2}$

Detailed Solution:

Find the distance between  $(-8, 3)$  and  $(-9, -4)$ .

Use the formula:  $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$

$$d = \sqrt{(-9 - (-8))^2 + (-4 - 3)^2}$$

$$d = \sqrt{(-9 + 8)^2 + (-7)^2}$$

$$d = \sqrt{(-1)^2 + (-7)^2}$$

$$d = \sqrt{1 + 49}$$

$$d = \sqrt{50}$$

$$d = 5\sqrt{2}$$

34.  $d = 9$



35. Answer:  $d = 4\sqrt{34}$

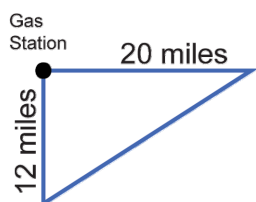
Detailed Solution:

Mary and Jan are both at the gas station at Hill and Elm. From the station, Mary drives 20 miles east and Jan drives 12 miles south. Find the distance between Mary and Jan.

Consider the gas station to be at the origin of the xy plane.

Mary's position after driving 20 miles east is (20, 0).

Jan's position after driving 12 miles south is (0, -12).



$$d = \sqrt{(0 - 20)^2 + (-12 - 0)^2}$$

$$d = \sqrt{(-20)^2 + (12)^2}$$

$$d = \sqrt{400 + 144}$$

$$d = \sqrt{544}$$

$$d = 4\sqrt{34}$$

36.  $d = \sqrt{13}$

37. Answer: (10, 16)

Detailed Solution:

Given A(4, 8) and B(19, 28), find the point that divides the line segment AB two-fifths of the way from A to B.

Use the formula:  $\left( x_1 + (x_2 - x_1)\frac{2}{5}, y_1 + (y_2 - y_1)\frac{2}{5} \right)$

A = (x<sub>1</sub>, y<sub>1</sub>) = (4, 8) and B = (x<sub>2</sub>, y<sub>2</sub>) = (19, 28)

$$\left( 4 + (19 - 4)\frac{2}{5}, 8 + (28 - 8)\frac{2}{5} \right)$$

$$\left( 4 + (15)\frac{2}{5}, 8 + (20)\frac{2}{5} \right)$$

$$(4 + 6, 8 + 8)$$

$$(10, 16)$$

38. (14, 20)

39. Answer: (15, 10)

Detailed Solution:

Given A(9, 4) and B(25, 20), find the point that divides the line segment AB three-eighths of the way from A to B.

Use the formula:  $\left( x_1 + (x_2 - x_1)\frac{3}{8}, y_1 + (y_2 - y_1)\frac{3}{8} \right)$

A = (x<sub>1</sub>, y<sub>1</sub>) = (9, 4) and B = (x<sub>2</sub>, y<sub>2</sub>) = (25, 20)

$$\left( 9 + (25 - 9)\frac{3}{8}, 4 + (20 - 4)\frac{3}{8} \right)$$

$$\left( 9 + (16)\frac{3}{8}, 4 + (16)\frac{3}{8} \right)$$

$$(9 + 6, 4 + 6)$$

$$(15, 10)$$

40. (15, 24)

41. Answer: (20, 23)

Detailed Solution:

Given A(10, 13) and B(26, 29), find the point that divides the line segment AB five-eighths of the way from A to B.

Use the formula:  $\left( x_1 + (x_2 - x_1)\frac{5}{8}, y_1 + (y_2 - y_1)\frac{5}{8} \right)$

A = (x<sub>1</sub>, y<sub>1</sub>) = (10, 13) and B = (x<sub>2</sub>, y<sub>2</sub>) = (26, 29)

$$\left( 10 + (26 - 10)\frac{5}{8}, 13 + (29 - 13)\frac{5}{8} \right)$$

$$\left( 10 + (16)\frac{5}{8}, 13 + (16)\frac{5}{8} \right)$$

$$(10 + 10, 13 + 10)$$

$$(20, 23)$$

42. (23, 22)

43. Answer:  $MP = (-4, 1)$

Detailed Solution:

Find the midpoint between  $(-4, 8)$  and  $(-4, -6)$ .

Use the formula:  $MP = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

$$MP = \left( \frac{-4 + (-4)}{2}, \frac{8 + (-6)}{2} \right)$$

$$MP = \left( \frac{-4 - 4}{2}, \frac{8 - 6}{2} \right)$$

$$MP = \left( \frac{-8}{2}, \frac{2}{2} \right)$$

$$MP = (-4, 1)$$

44.  $MP = \left( \frac{5}{2}, -1 \right)$

45. Answer:  $MP = (4, -5)$

Detailed Solution:

Find the midpoint between  $(10, -1)$  and  $(-2, -9)$ .

Use the formula:  $MP = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

$$MP = \left( \frac{10 + (-2)}{2}, \frac{-1 + (-9)}{2} \right)$$

$$MP = \left( \frac{10 - 2}{2}, \frac{-1 - 9}{2} \right)$$

$$MP = \left( \frac{8}{2}, \frac{-10}{2} \right)$$

$$MP = (4, -5)$$

46.  $MP = \left( -\frac{5}{2}, -4 \right)$

47. Answer:  $MP = (14, 22)$

Detailed Solution:

Find the midpoint between  $(5, 12)$  and  $(23, 32)$ .

Use the formula:  $MP = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

$$MP = \left( \frac{5 + 23}{2}, \frac{12 + 32}{2} \right)$$

$$MP = \left( \frac{28}{2}, \frac{44}{2} \right)$$

$$MP = (14, 22)$$

48.  $MP = \left( -\frac{15}{2}, -3 \right)$

49. Answer:  $MP = \left( \frac{-17}{2}, \frac{-1}{2} \right)$

Detailed Solution:

Find the midpoint between  $(-8, 3)$  and  $(-9, -4)$ .

Use the formula:  $MP = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$

$$MP = \left( \frac{-8 + (-9)}{2}, \frac{3 + (-4)}{2} \right)$$

$$MP = \left( \frac{-8 - 9}{2}, \frac{3 - 4}{2} \right)$$

$$MP = \left( \frac{-17}{2}, \frac{-1}{2} \right)$$

50.  $MP = \left( \frac{-1}{2}, 2 \right)$



51. Answer: (9, 2)

Detailed Solution:

The midpoint of two points is (5, 3). If one of the points is (1, 4), find the other point.

Use the formula:  $MP = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = (x, y)$

$$\left( \frac{1 + x_2}{2}, \frac{4 + y_2}{2} \right) = (5, 3)$$

Split this into two equations:

$$\frac{1 + x_2}{2} = 5 \quad \text{and} \quad \frac{4 + y_2}{2} = 3$$

$$1 + x_2 = 2 \cdot 5 \quad \text{and} \quad 4 + y_2 = 2 \cdot 3$$

$$1 + x_2 = 10 \quad \text{and} \quad 4 + y_2 = 6$$

$$x_2 = 10 - 1 \quad \text{and} \quad y_2 = 6 - 4$$

$$x_2 = 9 \quad \text{and} \quad y_2 = 2$$

Therefore the other point is (9, 2).

52. The other point is (3, 0)

53. Answer: (-15, -7)

Detailed Solution:

The midpoint of two points is (-4, -5). If one of the points is (7, -3), find the other point.

Use the formula:  $MP = \left( \frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right) = (x, y)$

$$\left( \frac{7 + x_2}{2}, \frac{-3 + y_2}{2} \right) = (-4, -5)$$

Split this into two equations:

$$\frac{7 + x_2}{2} = -4 \quad \text{and} \quad \frac{-3 + y_2}{2} = -5$$

$$7 + x_2 = 2 \cdot (-4) \quad \text{and} \quad -3 + y_2 = 2 \cdot (-5)$$

$$7 + x_2 = -8 \quad \text{and} \quad -3 + y_2 = -10$$

$$x_2 = -8 - 7 \quad \text{and} \quad y_2 = -10 + 3$$

$$x_2 = -15 \quad \text{and} \quad y_2 = -7$$

Therefore the other point is (-15, -7).

54. The other point is (15, 24)

55. Answer:  $x = 14$   
Detailed Solution;

Since  $\overrightarrow{QS}$  is the mid-ray then  $\angle PQS = \angle SQR$ . Therefore:

$$x + 8 = 2x - 6$$

$$x - 2x + 8 = -6$$

$$-x + 8 = -6$$

$$-x = -6 - 8$$

$$-x = -14$$

$$x = 14$$

56.  $x = 16$