Find the distance between each pair of points and the midpoint of the line segment joining the points. Express all radicals in simplest form.

1) $(13, 6), (0, 6)$

Distance: $\boxed{13}$ Midpoint: $\boxed{\left(\frac{13}{2}, 6\right)}$

2) $(0, 8), (-6, 0)$

Distance: $\boxed{10}$ Midpoint: $\boxed{(-3, 4)}$

3) $\left(\frac{1}{2}, -1\right), (-1, 1)$

Distance: $\boxed{\frac{5}{2}}$ Midpoint: $\boxed{\left(-\frac{1}{4}, 0\right)}$

4) $\left(5, \sqrt{5}\right), \left(3, -\sqrt{5}\right)$

Distance: $\boxed{2\sqrt{6}}$ Midpoint: $\boxed{(2, 0)}$

5) $\left(\sqrt{6}+1, \sqrt{3}-\sqrt{2}\right), \left(\sqrt{6}-1, \sqrt{3}+\sqrt{2}\right)$

Distance: $\boxed{2\sqrt{3}}$ Midpoint: $\boxed{\left(\sqrt{6}, \sqrt{3}\right)}$

6) $(a, 7), (a, -9)$

Distance: $\boxed{16}$ Midpoint: $\boxed{(a, 1)}$

7) $(6+r,\ s),\ (r-2,\ s)$

Distance: $\boxed{8}$ Midpoint: $\boxed{(r+2,\ s)}$

8) $(-a,\ b),\ (2a,\ 4b)$

Distance: $\boxed{3\sqrt{a^2+b^2}}$ Midpoint: $\boxed{\left(\frac{a}{2},\ \frac{5b}{2}\right)}$

9) $(w-2,\ w),\ (w,\ 4w)$

Distance: $\boxed{\sqrt{4+9w^2}}$ Midpoint: $\boxed{\left(w-1,\ \frac{5w}{2}\right)}$

10) $\left(a,\ \sqrt{ab}\right),\ \left(b,\ -\sqrt{ab}\right)$

Distance: $\boxed{a+b}$ Midpoint: $\boxed{\left(\frac{a+b}{2},\ 0\right)}$

11) Find all the values of a so that the distance between points at $(a,\ -9)$ and $(-2a,\ 7)$ is 20 units.

$\boxed{a=\pm 4}$

Find the coordinates of Q given that M is the midpoint of $\overline{PQ}$.

12) $P(-4, 0),\ M(3, 3)$

$\boxed{Q(10, 6)}$

13) $P(4, -1),\ M\left(-3, \frac{5}{2}\right)$

$\boxed{Q(-10, 6)}$

14) $P(h, k),\ M(0, 0)$

$\boxed{Q(-h, -k)}$

15) $P(0, 0),\ M(a, b)$

$\boxed{Q(2a, 2b)}$

16) Determine whether the quadrilateral having vertices with the given coordinates is a parallelogram:

$$(-2, 3), (-3, -2), (2, -3), (3, 2)$$

$\boxed{\text{Yes}}$

Use the distance formula to determine whether the given points are collinear.

17) $(1, 2), (7, 4), (-2, 1)$

Yes

18) $(-5, -2), (-2, 1), (1, 3)$

No

19) Find the value of k for which the points $(15, 1), (-3, -8),$ and $(3, k)$ are collinear.

$k = -5$

20) Determine whether the points $A(-3, 0)$, $B\left(-1, 2\sqrt{3}\right)$, and $C(1, 0)$ are the vertices of an equilateral triangle. Justify your answer.

Yes, all sides are the same length.

21) The vertices of a rectangle are at $(-3, 1)$, $(-1, 3)$, $(3, -1)$, and $(1, -3)$. Find the area of the rectangle.

$\boxed{16 \text{ square units}}$

22) Find an equation of the perpendicular bisector of $\overline{AB}$ given $A(2, 1)$, $B(-2, 3)$.

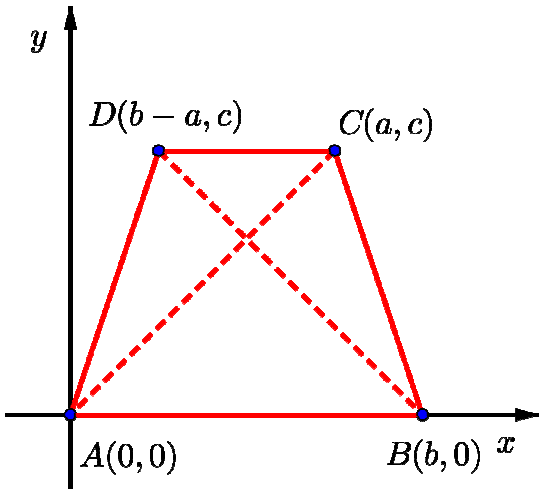
$\boxed{y = 2x + 2}$

23) Find the points on the coordinate axes that are equidistant from the points $A(-3, 0)$, $B(0, 5)$.

$\boxed{\left(\frac{8}{3}, 0\right), \left(0, \frac{8}{5}\right)}$

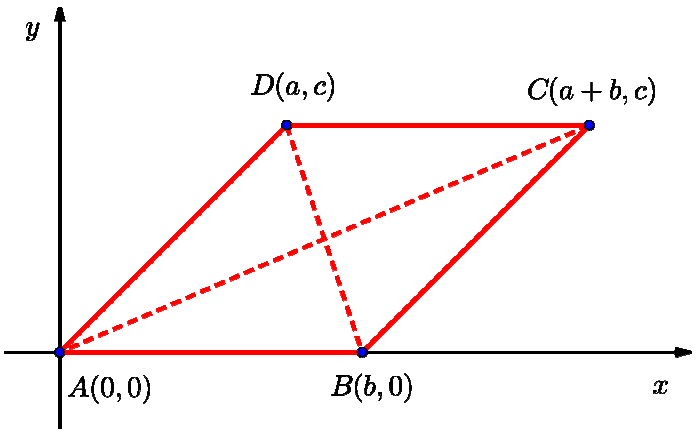
Prove using analytic methods. Be sure to include a coordinate diagram.

24) The diagonals of an isosceles trapezoid are congruent.



$$\overline{AC} = \overline{BD} = \sqrt{a^2 + c^2}$$

25) The diagonals of a parallelogram bisect each other.



$$\overline{AC}_{\text{midpoint}} = \overline{BD}_{\text{midpoint}} = \left(\frac{a+b}{2}, \frac{c}{2} \right)$$