

Analytic Geometry Review

Try each problem first. You don't need to finish everything.

Core path ~55 min · Full sheet ~1 h 45 min

Recommended: K1-K5, then one A and one T problem

K = Knowledge & Understanding · A = Application · T = Thinking · Boss = Challenge



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QUICK REFERENCE

Midpoint: $M = \left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2} \right)$. **Length:**

$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$, and the square root is part of the answer.

Slopes: parallel lines have equal slopes; perpendicular lines have slopes whose product is -1 . The shortest distance from a point to a line is measured along the perpendicular.

Four equal sides make a rhombus. It is a **square** only if adjacent sides are also perpendicular.

Show your work on separate paper.

Core Skills (K)

Midpoint & Length · Circles · Classifying Figures · Special Lines · Point-to-Line Distance

K1 Midpoint & Length

- Determine the midpoint of the segment joining $A(-3, 4)$ and $B(5, -2)$.
- Determine the length of the segment joining $C(-1, -3)$ and $D(3, 5)$, in simplest radical form.
- $M(2, -1)$ is the midpoint of PQ , and P is $(-4, 3)$. Find the coordinates of Q .

K2 Circles at the Origin

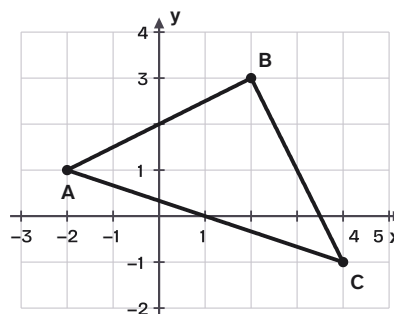
- State the radius and the four intercepts of the circle $x^2 + y^2 = 45$.
- A circle centred at the origin has a diameter with endpoints $(-5, 12)$ and $(5, -12)$. Determine its equation.
- Determine whether each point lies inside, on, or outside the circle $x^2 + y^2 = 45$: $(6, -3)$, $(-4, 5)$, $(5, 5)$.

Circle centred at the origin with radius r : $x^2 + y^2 = r^2$. The number on the right is r^2 , not r .

Median: vertex to the midpoint of the opposite side. **Altitude:** from a vertex, perpendicular to the opposite side. **Perpendicular bisector:** through a side's midpoint, perpendicular to it. Three different lines.

K3 Classify the Triangle

$\triangle ABC$ has vertices $A(-2, 1)$, $B(2, 3)$ and $C(4, -1)$. Each grid square is 1 unit.



- Determine the exact length of each side.
- Determine the slope of each side.
- Classify $\triangle ABC$ by its sides and by its angles.

K4 Three Special Lines

$\triangle ABC$ has vertices $A(-4, 0)$, $B(2, 6)$ and $C(4, 4)$. Write each equation in the form $y = mx + b$.

- Determine the equation of the median from B .
- Determine the equation of the altitude from B .
- Determine the equation of the perpendicular bisector of AC .

K5 Point to Line

Line ℓ has equation $y = 2x - 3$, and P is the point $(6, -1)$.

- Determine the equation of the line through P perpendicular to ℓ .
- Find the point where this line meets ℓ .

- c) Determine the shortest distance from P to ℓ , exactly and to one decimal place.

Real World (A)

Circles in Context · Shortest Distance · Equidistant Points

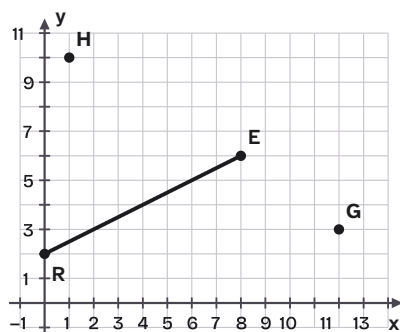
A1 Cell Tower Coverage

A cell tower in rural Northern Ontario stands at the origin of a map where each unit is 1 km. Its signal reaches every point within 13 km of the tower.

- Write the equation of the boundary of the coverage area.
- Cottages stand at $(5, -12)$ and $(-9, 10)$. Determine whether each cottage has coverage.
- A new road starts at $(0, 5)$ and runs due east along the line $y = 5$. How far along the road can a driver travel before losing coverage?

A2 Shortest Driveway

On a farm map, each grid square is 1 unit and each unit is 10 m. A straight road runs from $R(0, 2)$ to a gate at $E(8, 6)$, where it ends. A house stands at $H(1, 10)$.



- Find the equation of the road's line, then the point on the road closest to H .
- Determine the length of the shortest driveway from H to the road, in metres, to the nearest tenth.
- A second house stands at $G(12, 3)$. Determine the length of the shortest driveway from G to the road.

A3 One Lamp for the Park

The corners of a triangular park are given in the table, where each unit is 10 m. The city wants one lamp post that is the same distance from all three corners.

Corner	A	B	C
x	-6	6	2
y	0	0	4

- Determine the coordinates of the point that is the same distance from A , B and C .
- Determine that distance in metres, to the nearest tenth.

- c) The lamp must stand inside the park. Can the city put it at your point from (a)? What does this mean for the plan?

Think It Through (T)

Error Analysis · Explain Why

T1 Square or Not?

Quadrilateral $PQRS$ has vertices $P(-3, 0)$, $Q(1, 3)$, $R(5, 0)$ and $S(1, -3)$. A student writes: " $PQ = QR = RS = SP = 5$, so $PQRS$ is a square."

- Determine the slopes of PQ and QR . Use them to test the student's conclusion.
- Classify $PQRS$ as precisely as possible, and verify one property of its diagonals.
- Keep P and R fixed. Find new coordinates for Q and S that make $PQRS$ a square.

T2 Prove It for Every Triangle

$\triangle OAB$ has vertices $O(0, 0)$, $A(2a, 0)$ and $B(2b, 2c)$, with $a > 0$ and $c > 0$. M is the midpoint of OB and N is the midpoint of AB .

- Determine the coordinates of M and N .
- Show that MN is parallel to OA and half its length.
- A student checks the triangle with vertices $(0, 0)$, $(4, 0)$ and $(2, 6)$ and says this proves the property for all triangles. Explain why that check is not a proof, and why the coordinates in (b) cover every triangle.

Boss Level

Optional challenge

Lattice Points on a Circle

A *lattice point* is a point whose coordinates are both integers.

- List all lattice points on the circle $x^2 + y^2 = 25$.
- How many lattice points lie on the circle $x^2 + y^2 = 65$?
- How many lattice points lie strictly inside the circle $x^2 + y^2 = 10$?



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