# NCEA Level 2 · AS 91257: Graphs & Graphical Methods

Name: _____ Date: _____

This standard is all about drawing, reading and transforming graphs, lines, parabolas, exponentials and more, and using them to model real situations. Work through the sections in order and check every step against the worked answers.

**Revision summary**

- Line: $y = mx + c$, where m = gradient = rise/run and c = y-intercept. Parallel lines share m; perpendicular lines have gradients that multiply to −1.
- Parabola: $y = a(x - h)^2 + k$ has vertex (h, k). $y = a(x - p)(x - q)$ has x-intercepts at p and q; axis of symmetry midway between them.
- Transformations of $y = f(x)$: $y = f(x) + k$ shifts up k; $y = f(x - h)$ shifts right h; $y = af(x)$ stretches vertically by factor a; $y = -f(x)$ reflects in the x-axis.
- Exponential: $y = a \cdot b^x$ has a horizontal asymptote ($y = 0$ unless shifted); $b > 1$ grows, $0 < b < 1$ decays; y-intercept is a.
- Intercepts: set $y = 0$ for x-intercepts (roots), set $x = 0$ for the y-intercept.
- Asymptotes: lines a curve approaches but never reaches, key for exponential and reciprocal ($y = 1/x$) graphs.
- To model: pick the graph type that matches the pattern (constant rate → linear, constant multiplier → exponential, single turning point → quadratic), then fit features to the data.
- Solve simultaneously by finding where two graphs intersect, equal y-values.

## Key skills

1. State the gradient and y-intercept of the line $y = 3x - 5$, then find the x-intercept.

2. Write the coordinates of the vertex of $y = (x - 4)^2 + 2$ and state whether it is a maximum or minimum.

3. Describe the transformation that takes $y = x^2$ to $y = x^2 - 6$.

4. For the exponential $y = 2^x$, state the y-intercept and the equation of the horizontal asymptote.

## Achieved

5. A water tank at a bach near Muriwai starts with 500 L and is filled at a constant 40 L per minute. Write an equation for the volume V after t minutes and find the volume after 12 minutes.

6. Sketch $y = (x + 1)(x - 5)$ by finding its x-intercepts, axis of symmetry and vertex.

7. The population of a rabbit colony is modelled by $P = 30 \times 1.5^t$, where t is in years. Find the starting population and the population after 3 years.

8. A line passes through (0, 4) and (2, 10). Find its equation in the form $y = mx + c$.

## Merit

9. A drone is launched from a 5 m platform. Its height (m) after t seconds is $h = -5t^2 + 20t + 5$. Find the maximum height reached and when it hits the ground.

10. The graph of $y = x^2$ is transformed to $y = 2(x - 3)^2 - 4$. Describe the sequence of transformations, then state the coordinates of the new vertex and the y-intercept.

11. Two courier companies charge for a delivery. FastVan charges $8 plus $2 per km; QuickGo charges a flat $20. Write an equation for each, find the distance where the costs are equal, and state which is cheaper for a 10 km trip.

## Excellence

12. A parabola has x-intercepts at $x = -2$ and $x = 6$ and passes through $(2, -32)$. Find its equation in the form $y = ax^2 + bx + c$, and justify why the vertex must lie on $x = 2$.

13. An exponential model $y = a \cdot b^x$ passes through $(0, 12)$ and $(2, 3)$. Find a and b, and explain what value of b tells you about the situation and the behaviour of the graph.

14. Prove that the line $y = x + k$ is tangent to the parabola $y = x^2$ only when $k = -1/4$, and state the point of tangency.