

1 CHAPTER OVERVIEW

Your visual roadmap through the chapter

The Coordinate System

Axes, quadrants, plotting points, slope, forms of a straight line

1

Application in Business

Cost, revenue, demand/supply and profit functions modelled as straight lines

2

Break-even Analysis

Contribution margin and break-even point, algebraically & graphically

3

WHAT IT'S ABOUT

Representing points and straight lines on an x-y coordinate plane, deriving the equation of a line in several forms, and reading where two lines intersect.

WHY IT MATTERS FOR QAB

Straight-line modelling underlies cost/revenue/profit functions and break-even analysis — core techniques reused throughout financial mathematics and decision-making topics.

EXAM SKILLS REQUIRED

Plot and read coordinates; derive a line's equation from slope/points/intercepts; solve simultaneous equations graphically; compute break-even point and revenue.

2 KEY DEFINITIONS

Source-based terminology, exam-ready

Coordinate System

A method of representing points in a space of given dimensions by coordinates; positions points in a two- or three-dimensional plane.

Key word: representing points

Coordinate

A group of numbers used to indicate the position of a point or line; by convention the x value is always given first, e.g. (10, 15).

Key word: (x, y) pair

Axes & Origin

The x axis (horizontal) and y axis (vertical) meet at right angles at the point of origin, usually denoted 0.

Key word: origin = 0

Quadrants

The origin divides the plane into 4 quadrants: Q1 (x,y both +), Q2 (x -, y +), Q3 (x,y both -), Q4 (x +, y -).

Key word: four regions

Slope (Gradient)

A number describing how steep a line is — the change in the dependent variable (y) resulting from a change in the independent variable (x).

Key word: steepness

y-Intercept / x-Intercept

y-intercept: value of y where the line crosses the y axis (x=0). x-intercept: value of x where the line crosses the x axis (y=0).

Key word: where it crosses

Plotting

Identifying the exact location of a point on the coordinate plane using its x and y values.

Key word: locating a point

Break-even Point

The sales volume at which total revenue equals total cost, i.e. no profit or loss — found where fixed cost is fully covered by contribution margin.

Key word: no profit, no loss

3 CORE CONCEPT

Explained in exam-oriented language

CONCEPT → The Coordinate Plane & Straight Lines

MEANING

Any point on the plane is located by an (x, y) pair; a straight line is the set of all points satisfying a linear equation.

APPLICATION

Deriving a line's equation from slope, points or intercepts; reading where two lines intersect.

PURPOSE

Visualise and calculate relationships between two variables that change at a constant rate.

CONCEPT → Linear Functions in Business

MEANING

Cost, revenue and profit can be modelled as straight-line (linear) functions of the number of units.

APPLICATION

Cost/average-cost function, revenue function, demand & supply function, profit/loss function, break-even (algebraic & graphical).

PURPOSE

Find the point where total revenue equals total cost — the break-even point.

4 KEY RULES & PRINCIPLES

Every source rule, exam-ready

RULE 1 Quadrant sign rules

- Quadrant 1: x and y both positive
- Quadrant 2: x negative, y positive
- Quadrant 3: x and y both negative
- Quadrant 4: x positive, y negative

RULE 2 Slope sign rules

- Positive slope: upward left→right — x increase causes y increase
- Negative slope: downward left→right — x increase causes y decrease
- Zero slope: flat line (parallel to x-axis)
- Infinite/undefined slope: vertical line (parallel to y-axis)

RULE 3 Intercept form — limitation

- Only applies if the line intercepts BOTH the x and y axis
- Does NOT apply to a line parallel to either axis
- Does NOT apply to a line passing through the origin

RULE 4 Simultaneous equations on a graph

- Two simultaneous equations can be plotted on a single graph
- Where the two lines cross, there is a single (x, y) that satisfies both equations
- Solving graphically = finding the point of intersection

5 FORMULA ZONE

Every formula supported by the source text

SLOPE OF A STRAIGHT LINE

$$\text{Slope} = (y_2 - y_1) \div (x_2 - x_1)$$

(x1, y1) and (x2, y2) are any two pairs of coordinates on the line.

SLOPE-INTERCEPT FORM

$$y = b + m x$$

b = y-intercept (value where line crosses y axis, x=0) **m** = slope/gradient.

POINT-SLOPE FORM

$$y - y_1 = m (x - x_1)$$

(x1, y1) = a known point on the line; **m** = slope. Used when one point & the slope are known.

INTERCEPT FORM

$$x/a + y/b = 1$$

a = x-axis intercept, **b** = y-axis intercept. Does not apply to lines through the origin or parallel to an axis.

TWO-POINT FORM

$$(y - y_1)/(y_2 - y_1) = (x - x_1)/(x_2 - x_1)$$

Used when two known points (x1,y1) and (x2,y2) are given.

BREAK-EVEN POINT & CONTRIBUTION MARGIN

$$BE = FC \div CM \quad | \quad CM = s - v$$

FC=fixed cost, **CM**=contribution margin per unit, **s**=selling price/unit, **v**=variable cost/unit.

6 CALCULATION ROADMAP

General path for any coordinate-geometry question

1- Read Question

Identify what's given: points, slope, intercepts

2- Identify Required

Equation, intercept, intersection or break-even?

3- Select Formula

Point-slope, two-point, intercept or BE formula

4- Substitute

Put known values into the formula

5- Calculate & Check

Solve, recheck, state final answer

7 STEP-BY-STEP METHODS

Kept separate — do not mix methods

METHOD A · Equation from a Point + Slope (Point-Slope Form)

- 1 Note the known point (x_1, y_1) and slope m
- 2 Substitute into $y - y_1 = m(x - x_1)$
- 3 Simplify to isolate y
- 4 To find the y -intercept, set $x = 0$ and solve for y

METHOD C · Deriving the Line from Two Intercepts

- 1 Note the x -intercept (a) and y -intercept (b)
- 2 Substitute into $x/a + y/b = 1$
- 3 Multiply through by $(a \times b)$ to clear fractions
- 4 Rearrange into slope-intercept form $y = b + mx$

METHOD B · Equation from Two Points (Two-Point Form)

- 1 Label the two given points (x_1, y_1) and (x_2, y_2)
- 2 Substitute into $(y - y_1)/(y_2 - y_1) = (x - x_1)/(x_2 - x_1)$
- 3 Cross-multiply and simplify
- 4 Rearrange into the required form

METHOD D · Solving Simultaneous Equations Graphically

- 1 Compute a table of (x, y) values for each equation
- 2 Plot both lines on the same coordinate plane
- 3 Identify the point where the two lines cross
- 4 That (x, y) is the solution satisfying both equations

METHOD E · Break-even Point (Algebraic)

- 1 Identify selling price (s) , variable cost (v) , fixed cost (FC)
- 2 Calculate contribution margin per unit: $CM = s - v$
- 3 Divide fixed cost by CM: $BE \text{ (units)} = FC \div CM$
- 4 For break-even revenue: $BE \text{ units} \times \text{selling price}$

8 DIFFERENT CASES / SCENARIOS

Recognise what's given, pick the right formula

IF one point and the slope are given

→ USE **point-slope form**: $y - y_1 = m(x - x_1)$

IF two points on the line are given

→ USE **two-point form**

IF the x-intercept and y-intercept are given

→ USE **intercept form**: $x/a + y/b = 1$

IF the line passes through the origin, or is parallel to an axis

→ Intercept form **does not apply** — use slope-intercept or point-slope instead

IF two equations must be solved together

→ Plot both; the **intersection point** is the solution

IF selling price, variable cost & fixed cost are known

→ USE **break-even formula** $BE = FC \div CM$

IF a point's x and y are both positive

→ Point lies in **Quadrant 1**

IF x is negative and y is positive

→ Point lies in **Quadrant 2**

9 COMPARISON TABLES

Don't confuse these!

Form	Formula	When to use
Slope-Intercept	$y = b + mx$	Slope (m) and y-intercept (b) are known
Point-Slope	$y - y_1 = m(x - x_1)$	One point and the slope are known
Intercept Form	$x/a + y/b = 1$	Both the x-intercept (a) and y-intercept (b) are known
Two-Point Form	$(y - y_1)/(y_2 - y_1) = (x - x_1)/(x_2 - x_1)$	Two known points on the line are given

Quadrant	Sign of x	Sign of y
Quadrant 1	Positive	Positive
Quadrant 2	Negative	Positive
Quadrant 3	Negative	Negative
Quadrant 4	Positive	Negative

10 GRAPH INTERPRETATION

Reading coordinate-plane graphs

Reading a single line

The line crosses the y-axis at its y-intercept (b) and the x-axis at its x-intercept. Its steepness and direction (up or down, left to right) are read from the sign and size of the slope (m).

Reading two intersecting lines

When two equations are plotted together, the single point where the lines cross gives the (x, y) pair that satisfies both equations simultaneously — this is how simultaneous equations are solved graphically.

11 WORKED CALCULATION LOGIC

Method students must reproduce in the exam

GIVEN → FORMULA → SUBSTITUTION → CALCULATION → ANSWER

A company sells a product at Rs. 16,000/unit; variable cost Rs. 9,000/unit; fixed costs Rs. 50,000,000. Find the break-even sales volume and revenue.

GIVEN: $s = 16,000$, $v = 9,000$, $FC = 50,000,000$

FORMULA: $CM = s - v$ then $BE = FC \div CM$

SUBSTITUTION: $CM = 16,000 - 9,000 = 7,000$ | $BE = 50,000,000 \div 7,000$

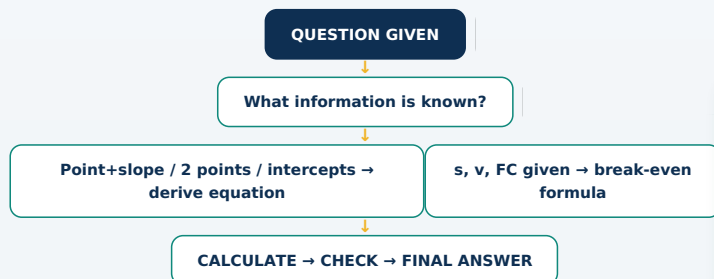
CALCULATION: $BE = 7,142.857$ units $\approx 7,143$ units. Break-even revenue $= 7,143 \times 16,000$

FINAL ANSWER: Break-even $\approx 7,143$ units, or Rs. 114,288,000 in sales revenue

12 EXAM QUESTION PATTERNS

- **Slope/intercept** — find slope, y-intercept or x-intercept from an equation
- **Equation-derivation** — from two points, a point + slope, or two intercepts
- **Parallel/perpendicular lines** — comparing slopes of two lines
- **Cost/total-cost function** — deriving $C(x)$ from two given cost points
- Break-even application — units, revenue, or profit-function word problems

14 QUICK DECISION TREE



13 EXAM TRAPS

⚠ WATCH OUT

✗ **x-intercept vs y-intercept** — mixing up which axis a value belongs to.

✗ **Using intercept form** on a line through the origin or parallel to an axis — it does not apply there.

✗ **Quadrant sign errors** — forgetting that Q2 and Q4 have one negative coordinate each.

✗ **Sign slips** substituting negative coordinates into point-slope or two-point form.

✗ **Confusing CM per unit with total CM** when applying the break-even formula.

CHAPTER 2 IN 60 SECONDS

Slope: $(y_2 - y_1) / (x_2 - x_1)$

Slope-intercept: $y = b + mx$

Point-slope: $y - y_1 = m(x - x_1)$

Intercept form: $x/a + y/b = 1$

Two-point form: ratio of differences

Break-even: $BE = FC \div CM$, $CM = s - v$

Intersection = simultaneous solution

Trap: intercept form fails at origin