Break-even analysis

On page 256 of *It's the Business* textbook, the authors refer to an alternative approach to drawing a break-even chart.

In order to survive businesses must at least break even, which means they need to generate enough income to cover all of their costs.

Break-even analysis is a financial tool that can be used by managers to determine the impact of costs and revenues on profitability. It will illustrate the number of products that must be sold in order to cover all the costs associated with production.

At the break-even point total sales revenue is equal to total business costs**. [TR = TC].**

TR = Selling Price [SP] x Quantity Sold

TC = Fixed Costs [FC] + Variable Costs [VC]

At this level of sales the firm is not making either a profit or a loss, but is simply recouping the costs associated with producing goods. While this may be sustainable in the short-term, it should be remembered that all commercial businesses need to make a profit, so firms will aim to sell more than the break-even quantity. Being able to calculate this break-even quantity therefore represents an important step in achieving this goal of business survival. For a proposed start-up business, break-even analysis can be used to establish whether it is commercially viable or not.
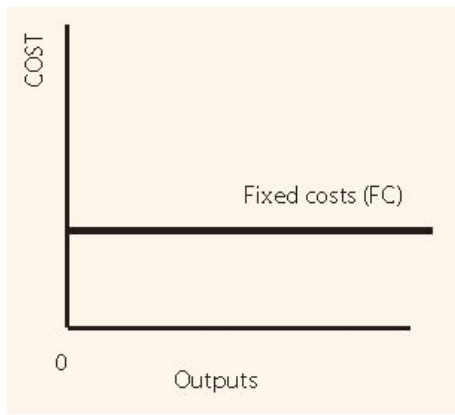
The break-even point can be calculated mathematically and can also be illustrated using a graph.

In order to work out the break-even point a business will need to know its **fixed costs**, the **variable costs** per unit and the **selling price.**

Fixed Costs (FC): These are expenses that do <u>not</u> change as output changes. They tend to be linked to time rather than output and will have to be paid even when no goods are being produced. Examples include rent, insurance and depreciation. Diagram 1A below illustrates that fixed costs remain the same even as output levels increase.

On the break-even chart fixed costs are illustrated by a line drawn parallel to the horizontal axis.
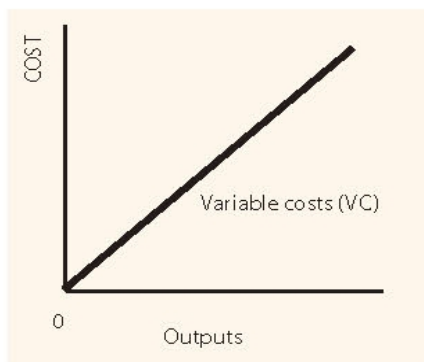
Diagram 1A

Variable Costs (VC): These expenses <u>will</u> change as the level of output changes. Examples include raw materials, direct wages and packaging. Diagram 1B below illustrates that variable costs will increase as output increases.
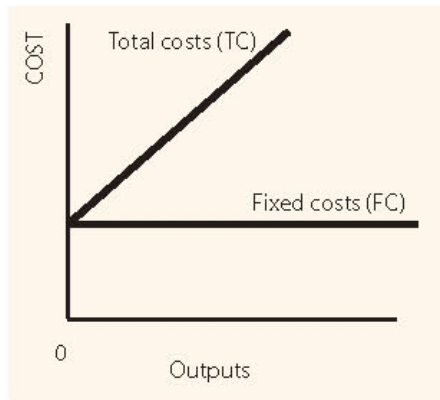
The break-even chart does not contain a VC line although variable costs are represented by the gap between fixed costs and total costs.

Diagram 1B

Total Costs (TC): Total costs are calculated by adding all fixed and variable costs. Since fixed costs are paid even when output is zero, total costs will never be less than fixed costs. On the break-even chart TC will not start at origin, but begins at FC level. See diagram 1C.

Diagram 1C

A business supplies the following information about its activities:

Forecast output (Sales)   20,000 units

Selling Price   €50 per unit

Fixed Costs   €300,000

Variable Cost per unit   €20

[LC 2005 Q6 (b)]

This alternative approach to drawing a break-even chart is less mathematical than the method outlined in Chapter 13 of the textbook. As such it does not require a table (see page 251) to establish the costs and revenue associated with different levels of output.

The key to using this approach is to accurately calculate and plot the break-even point and then to quickly draw the FC, TC and TR lines. Drawing these lines requires students to understand the unique position of each line.

Using the formula to calculate break-even point:

B/E Point (in units) = Fixed Costs

_____

(Selling Price per unit – Variable cost per unit)

$$= \frac{300{,}000}{SP - VC} = \frac{300{,}000}{(50 - 20)} = 10{,}000 \text{ units}$$

Exam tip

This approach relies on accurate calculation of the B/E point, so it may be worthwhile double-checking your calculations before proceeding to plot the B/E point and completing the diagram.

Finding the break-even point using a break-even chart:

Step 1:Use the formula to calculate the break-even point.
  ➢ This is a useful check for accuracy.

Step 2: Use graph paper to draw the X and Y-axes using appropriate scales.
  ➢ Make sure to put a title on the graph and label both axes. Consider carefully the scale required for each axis before you draw it.

  ➢ The horizontal (X) axis will show output and should extend to at least the target output level. In this case that's 20,000 units. Since we need to plot B/E output at 10,000 units we've chosen to use increments of 2000 units.

  ➢ The Vertical (Y) axis will show money values and can be labeled with a € sign. Remember that this axis is used to indicate both costs and sales revenue, and the labeling should show this fact. It would be incorrect to label it simply as costs or revenue.

➢ The Vertical axis also begins at origin and its highest point will be equal to TR at forecast output level [i.e. target output x selling price per unit].This we calculate as 20,000 units @ €50 per unit = €1 million.

➢ Try to use a scale that will allow you to plot the fixed cost line easily.
In this case FC are set at €300,000 so we've chosen to use increments of €100,000 here.
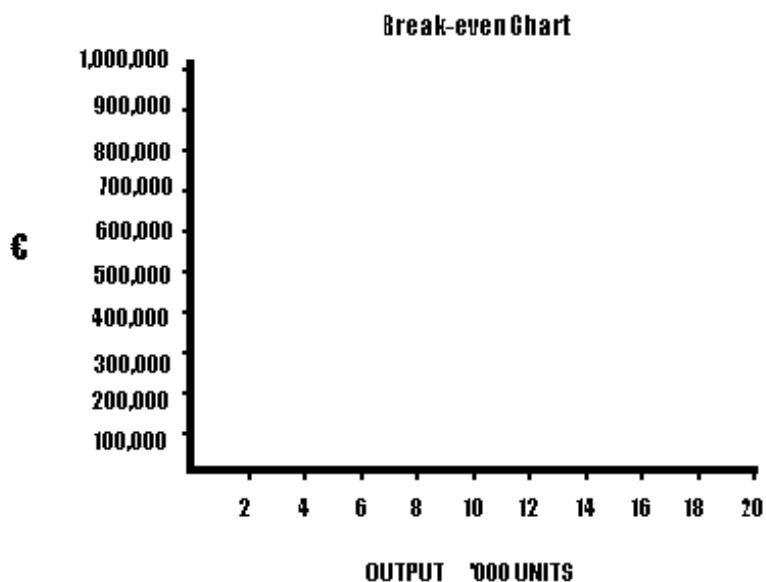
Your diagram should now look like Diagram 2:

Break-even Chart

€	
1,000,000	
900,000	
800,000	
700,000	
600,000	
500,000	
400,000	
300,000	
200,000	
100,000	

2   4   6   8   10   12   14   16   18   20

OUTPUT   '000 UNITS

Diagram 2

Step 3: Plot the FC line at €300,000 on vertical axis.

Note that it runs parallel to output axis, indicating that fixed costs do not change as output levels increase.

Step 4: Plot the B/E point.

It's located above 10,000 on the output axis, but we also need a reference point on the vertical axis. This can be found quite simply by calculating TR at break-even output level. In this case it's 10,000 units @ €50 per unit = €500,000.
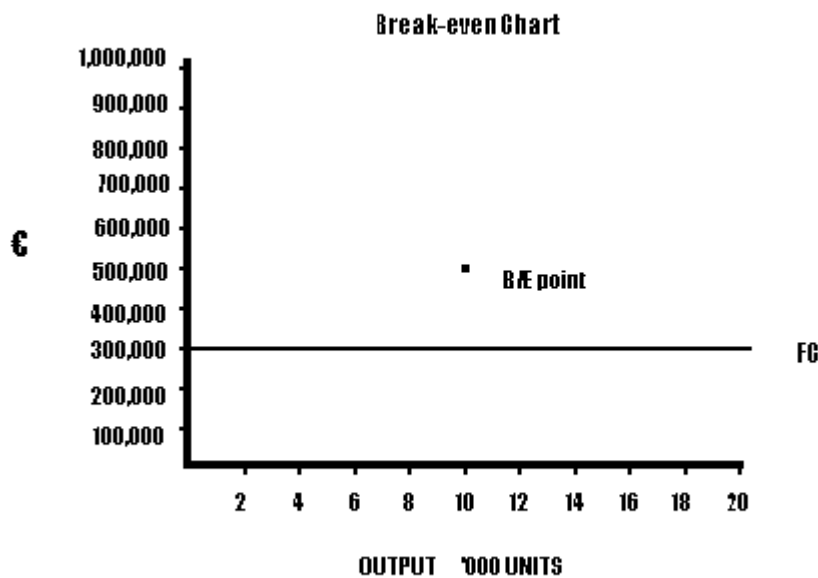
Here's the diagram at this stage (diagram 3).

Break-even Chart

Diagram 3

Step 5: **Plot the TC line**

Start at the point where the FC line meets the vertical axis. With a ruler, draw a line connecting this point to the B/E point and extend it slightly so it reaches the limits of your graph.

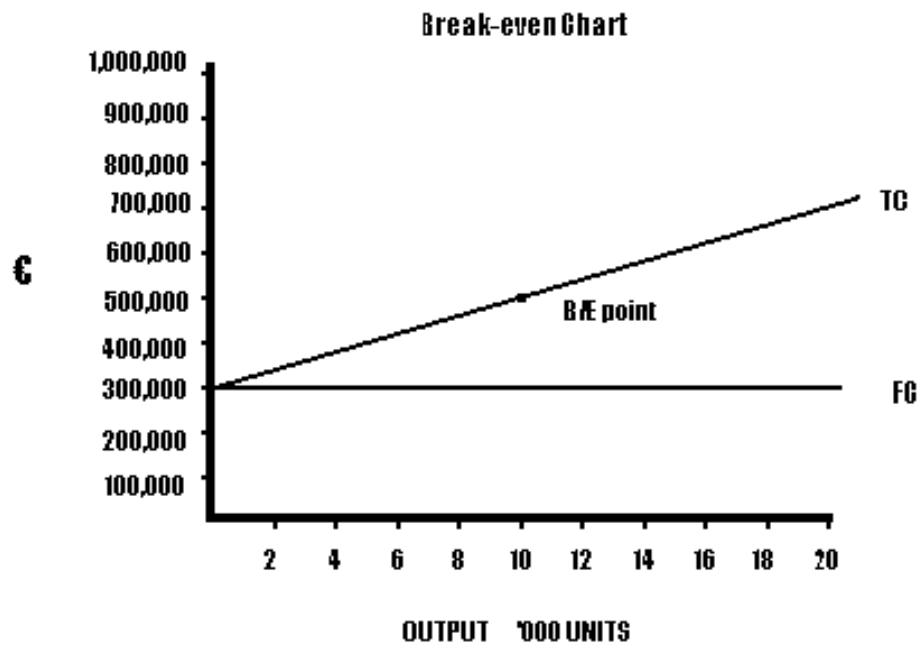At this stage you'll have a diagram like this (diagram 4).

Break-even Chart

Diagram 4

Step 6: Plot TR line

Start at the origin (0,0). Again with the help of a ruler draw a line connecting this point to the B/E point and extend to the limits of your graph. See diagram 5.
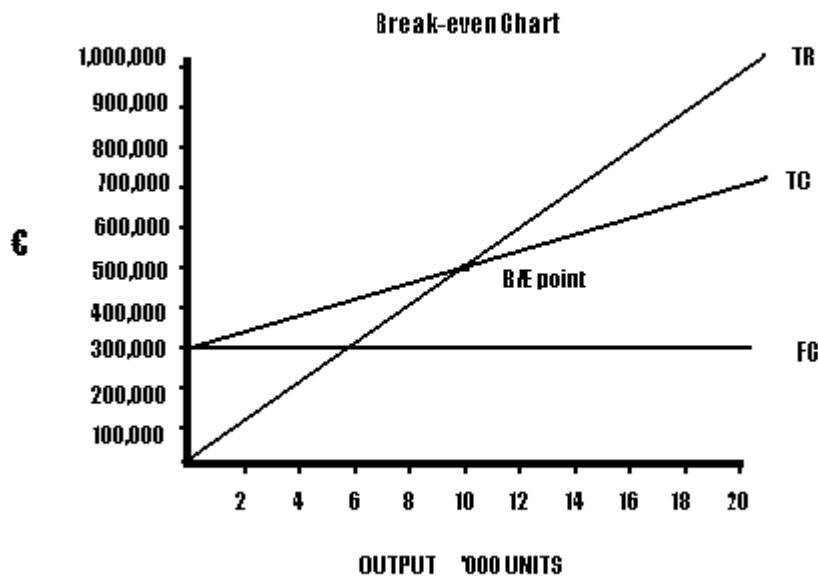
Break-even Chart

OUTPUT   '000 UNITS

Diagram 5

Step 7: You are now required to use your diagram to illustrate some additional information:

(a) Break-even point has already been plotted.
(b) Margin of safety: this is the output level between forecast output and B/E output.
(c) Profit at forecast output: This is the difference between TR and TC at forecast output.

Exam questions typically require students to illustrate the profit at forecast output on the diagram, in which case the relevant area is shaded green. Note that this area is above the B/E point and that TR is greater than TC.

In the 2012 LC exam students were asked to calculate the profit (mathematically) and the answer provided needs to be in €. The answer is still the difference between TR and TC at forecast output. [€1M - €700,000 = €300,000]
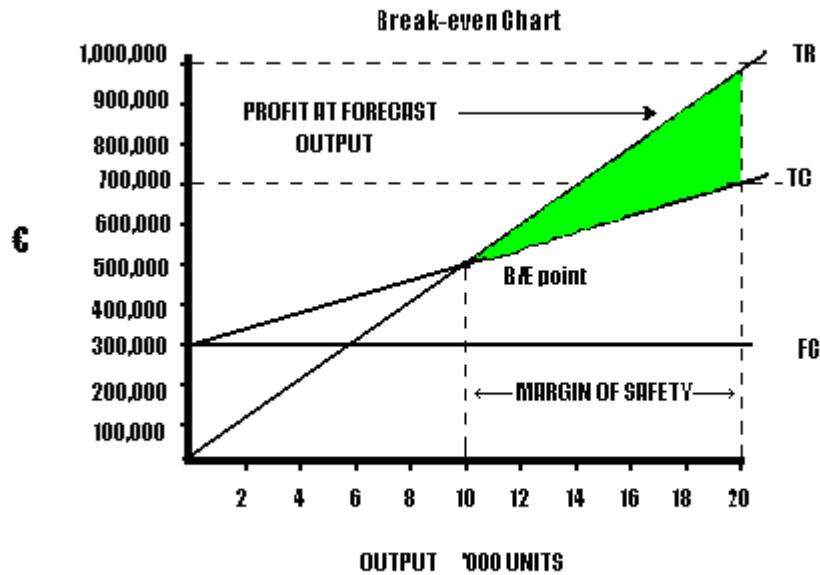
When complete the B/E chart is as follows (see diagram 6).

Break-even Chart

Diagram 6

Changing costs and selling prices

Any changes to costs or selling price will have an impact on the break-even point. If costs increase a greater quantity will have to be sold in order to break even, whereas lower costs will lower the breake-ven quantity.

In a similar way, an increase in selling price will reduce the break-even quantity and vice versa.

Exam questions involving a change in either of these variables will require students to calculate and/or illustrate the new break-even point.

Depending on which variable has changed, it will be necessary to re-draw either the Total Revenue or the Total Cost lines.

Let us revisit our worked example and outline the effect on the break-even point if variable costs increased to €25 per unit.

Return to step 1 and re-calculate the new B/E point using the updated figures:

$$\frac{FC}{(SP - VC)} = \frac{300,000}{(50 - 25)} = 12,000 \text{ UNITS}$$

To plot the new point (B/E P2) we need to work out the revenue co-ordinate:

12,000 units @ €50 each = €600,000.

It's now possible to plot the point and draw the new TC line (as per step 5).

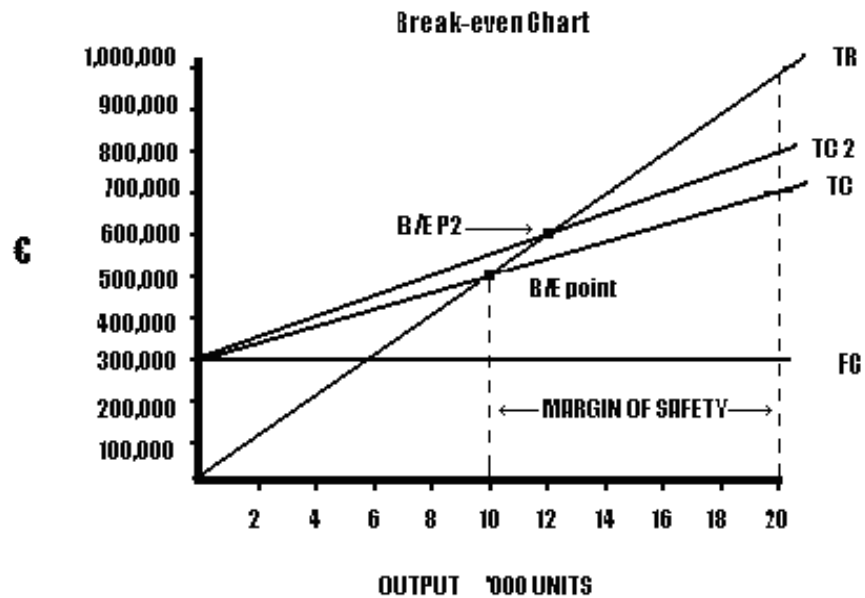For full marks we need to illustrate these as per diagram below (diagram 7).

Break-even Chart

Diagram 7 _____