3.1 Variables, controls and planning

Name: _____ Class: _____ Date: _____ **Total: 26 marks**

KEY WORDS independent variable • dependent variable • control variable • control treatment

Objective

Design fair tests and write defensible plans: independent, dependent and control variables, control treatments, and the planning checklist the WBI13 scheme credits. Original practice for the Unit 3 assessed skills (specification PDF pages 25–26) and the Summer 2025 planning demands.

1 Key knowledge and worked examples

■ Name the variable, then give its reason

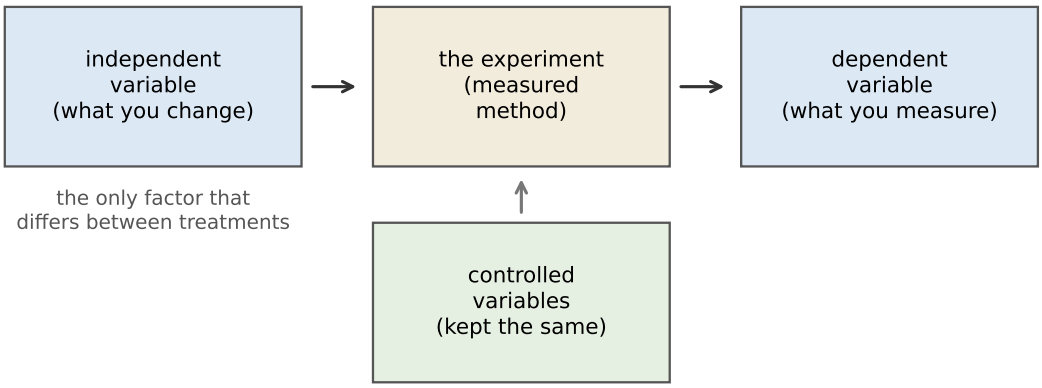
The **independent variable** is what you change; the **dependent variable** is what you measure; every other quantity that could affect the dependent variable is a **control variable** and must be held constant *with a reason*: temperature is controlled because it changes membrane fluidity and enzyme action; solution volume because it dilutes the measured pigment differently. A mark needs both halves – the variable and the effect it would have.

■ A control treatment is not a control variable

A **control treatment** leaves the independent variable out (solvent without trifluralin; water instead of methanol) so any measured difference can be attributed to the independent variable alone. It allows a valid comparison; it is not "the control variable".

■ The planning checklist

Apparatus named; variables identified; measuring technique justified (graticule for cell lengths, colorimeter for colour, stopwatch and intervals for time courses); controls with reasons; repeats for reliability and a mean; safety issue plus its control (methanol flammable – keep from flames; cultures incubated below 30 °C); how the data will be used (table headings, graph type); sources of uncertainty and how each is reduced.



Beetroot example: alcohol concentration changed, pigment loss measured; temperature, size, volume, time fixed; a water-only treatment is the control.

2 Practice

2.1 In a seedling investigation, state the independent variable when some seedlings sit in solvent containing trifluralin and others sit in solvent alone. [1]

2.2 Explain why the solvent-only seedlings are needed, in terms of what can be concluded. [2]

2.3 A student measures pigment loss from beetroot at 20 °C and at 60 °C. Give two control variables with the reason each must be fixed. [4]

2.4 Explain why the seedlings were germinated on moist paper before treatment began, rather than placed onto treated discs as dry grains. [2]

3 Exam-style questions

3.1 Brine shrimp hatch rates are measured at 15 °C, 20 °C, 25 °C and 30 °C. Plan this investigation: identify the variables, describe how the dependent variable is measured, state two controls with reasons, and give one ethical consideration in the specification's terms. [6]

3.2 Yeast is grown in glucose solution and its respiration rate followed with a redox indicator. Write a plan that states: the independent and dependent variables; two control variables with reasons; how the data will be presented and used; and one safety point with its control. [6]

3.3 An investigation germinates 40 wheat grains on filter paper soaked in 7 mg cm^{-3} trifluralin solution, incubated at 25 °C, with root tips sampled after 12 hours. Justify the 25 °C incubation temperature, and explain what the data would show if trifluralin arrested mitosis at metaphase. [5]