3.3.1 Tables, graphs and percentage calculations

Name: _____ Class: _____ Date: _____ **Total: 23 marks**

KEY WORDS bar chart • line graph • significant figures

Objective

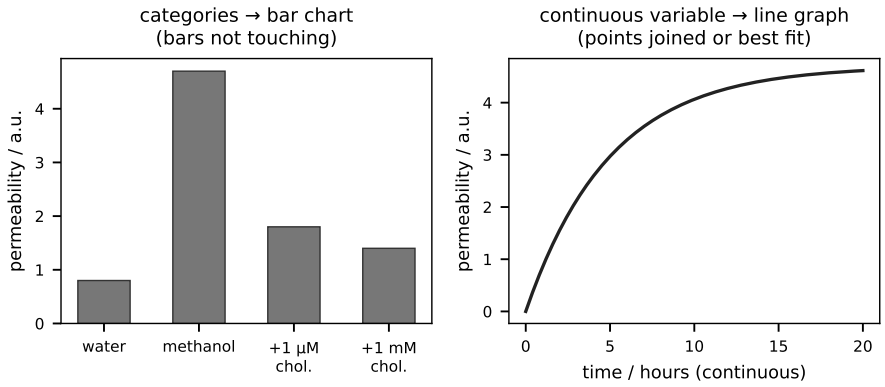
Present and process data the way WBI13 credits: table headings and units, choosing bar chart or line graph, the percentage family of calculations, and significant figures that do not over-claim. Original practice for the Unit 3 processing-results criteria.

1 Key knowledge and worked examples

■ A table is marked on its headings

Every column headed with quantity *and* unit (permeability / a.u.; starch / g per 100 g of tissue). Units never appear inside cells. Enter data exactly as measured. For categoric treatments, one row per treatment.

■ Bar chart or line graph



Categoric independent variable (named liquids, named stages) → **bar chart**, bars not touching. Continuous independent variable (time, concentration, temperature) → **line graph**, points with a best-fit line or smooth curve. Axes: quantity and unit, independent on x, scale using most of the grid with sensible steps, no broken axis unless stated.

■ The percentage family

$$\text{percentage change} = \frac{\text{final} - \text{initial}}{\text{initial}} \times 100\%$$

$$\text{percentage difference} = \frac{\text{difference of two values}}{\text{mean of the two values}} \times 100\%$$

A bar chart converts to counts: percentage of cells × total cells, rounded to a whole cell. **Significant figures** : $4.01 \div 31.645 \times 100 = 12.67$ % is accepted; 12.70 % is not the correct 4 s.f. rounding of this calculation, although it also has 4 significant figures.

2 Practice

2.1 Write the column headings, with units, for a table of the absorbance of leaking pigment measured for four named liquids after 20 hours. [2]

2.2 For each pair, choose bar chart or line graph and justify: (a) permeability of four named liquids; (b) permeability against time from 0 to 20 hours; (c) number of cells against stage of mitosis 1–4 for two treatments. [3]

2.3 A potato cylinder of initial mass 2.50 g has final mass 2.75 g. Calculate the percentage change and state its meaning in one sentence. [3]

2.4 Of 98 cells, 80 % are in stage 2. Calculate the number of cells, giving your reasoning for the form of your answer. [2]

3 Exam-style questions

3.1 At 20 hours the permeability readings were: water 0.8, methanol 4.7, methanol with 1 µmol dm^{-3} cholesterol 1.8, methanol with 1 mmol dm^{-3} cholesterol 1.4 (a.u.). Draw the table these results need, then describe the graph you would plot, including axis labels, the scale decision and the chart form. [6]

3.2 Nine cassava regions measure (g per 100 g of tissue): 31.40, 31.79, 29.76, 33.65, 33.26, 32.14, 30.06, 29.64, 30.56. Calculate the percentage difference between the highest and lowest using the mean of the two, and state why your answer has the significant figures you give. [4]

3.3 Describe how to determine the total mass of starch in one section of a root whose three layers' starch contents are known in g per 100 g of tissue. [3]

Solutions

Original-task marking: M1 method, A1 accuracy, B1 reasoning.

2.1 Column 1: liquid (treatment) – no unit. Column 2: permeability at 20 hours / a.u.. (No units inside data cells.)

2.2 (a) Bar chart – the independent variable is categoric. (b) Line graph – time is continuous. (c) Bar chart – stages are numbered categories; two bars per stage with a key.

2.3 $(2.75 - 2.50)/2.50 \times 100 = +10\%$: net water entry into the cylinder by osmosis.

2.4 $0.80 \times 98 = 78.4$, so 78 cells: a fraction of a cell cannot be observed, so round to the nearest whole cell.

3.1 Table: columns "liquid" and "membrane permeability at 20 hours / a.u.", rows water 0.8, methanol 4.7, +1 µmol dm^{-3} cholesterol 1.8, +1 mmol dm^{-3} cholesterol 1.4, units not in cells. Graph: bar chart because the treatments are categoric; x-axis liquid, y-axis permeability / a.u. with a linear scale 0–5 in steps of 1 using most of the grid, no break; bars separated with labels or a key.

3.2 Highest 33.65, lowest 29.64. Difference = 4.01; mean = $(33.65 + 29.64)/2 = 31.645$. $4.01 \div 31.645 \times 100 = 12.67\%$. The unrounded result is approximately 12.6718 %: 12.67 is 4 s.f., 12.7 is 3 s.f. and 13 is 2 s.f. Use the precision justified by the inputs; 12.70 is not the correct rounding, rather than being wrong simply because it ends in zero.

3.3 Cut out the section and determine its mass; use the three layer contents from the table (31.79, 33.26, 29.64 g per 100 g) to find the section's mean content, i.e. $(31.79 + 33.26 + 29.64)/3 = 31.56$ g per 100 g; total starch = section mass $\times 31.56/100$.