

2.1 Models, materials and iterative prototyping

Name: _____ Class: _____ Date: _____

Total: 10 marks

KEY WORDS prototype • iteration

Objective

Models, materials and iterative prototyping. Supported HL concept preparation; original classroom practice, not an official IB paper or assessed learner work.

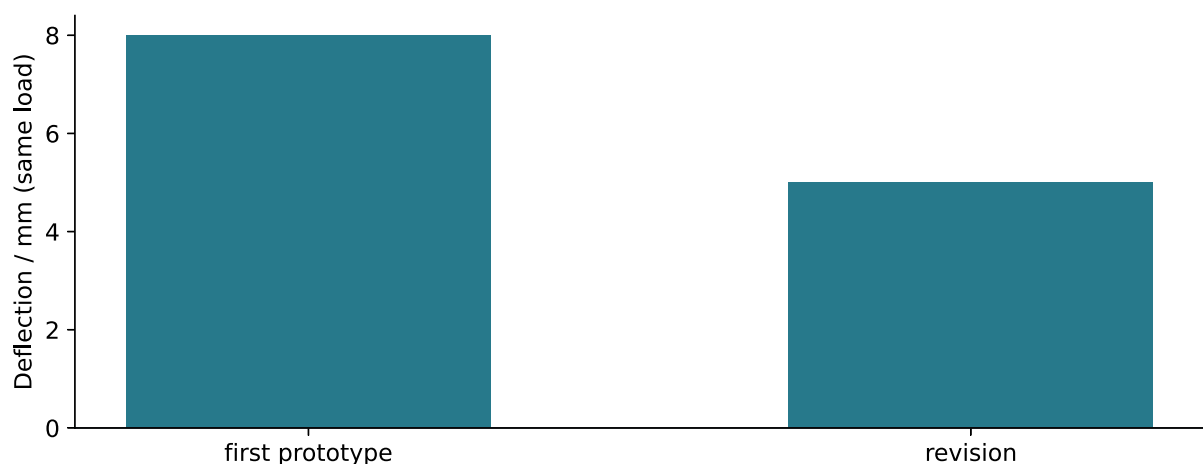
1 Key knowledge and worked examples

■ What would explain this observation?

- A cardboard **prototype** can reveal reach and arrangement without proving that the final material is strong enough. Different models answer different questions.
- Start with a prediction. State the quantities or features you would compare, then decide what evidence could distinguish two explanations.

■ Build the model

- A model represents selected features of a design. A prototype supports testing before or during development. Material selection depends on mechanical properties, manufacture, use conditions and end-of-life choices.
- prototype: A developing version used to test a solution; **iteration** : Revision guided by evidence and repeated testing.



■ Choose evidence that can test it

- State what each model includes and omits. Compare tests with the same load, geometry and conditions. Iteration means using evidence to revise a solution and testing the revision against the original success criteria.
- Make a low-risk model under school workshop rules. Record dimensions, material, process and test method. Use photographs, measurements and user feedback as evidence. Machines and load tests require teacher supervision and approved guards.

■ Work from known quantities

- State the known values and their units. Choose the relation because its assumptions fit this case, then rearrange before substitution.
- Known: a beam prototype deflects 8 mm under a stated load; a revision deflects 5 mm under the same conditions. $\text{Reduction} = (8-5)/8 \times 100 = 37.5\%$. The result supports greater stiffness in that test, not proof of every strength or fatigue property.

Example:

Deflection falls from 10 mm to 6 mm under equal conditions. Find percentage reduction. Use the same sequence: known quantities → model → relation → substitution → unit and interpretation.

■ Check the conclusion and its limits

- Stiffness is resistance to elastic deformation; strength concerns failure stress. A visually accurate model need not reproduce material behaviour.
- Return to the original observation. Explain what the result supports, which conditions it assumes, and one way to test a competing explanation.

Warn:

An attractive model proves the final product mechanical safety. This claim is false: Stiffness is resistance to elastic deformation; strength concerns failure stress. A visually accurate model need not reproduce material behaviour.

Key:

Models, materials and iterative prototyping: State what each model includes and omits. Compare tests with the same load, geometry and conditions. Iteration means using evidence to revise a solution and testing the revision against the original success criteria.

2 Practice

2.1 What can a scale appearance model establish directly? Choose one answer.

- **A** Full-size fatigue strength
- **B** Its represented layout and form
- **C** All production costs

[1]

2.2 Deflection falls from 10 mm to 6 mm under equal conditions. Find percentage reduction. Show the relation, substitution and units.

[2]

2.3 Decide whether this claim is true and justify: An attractive model proves the final product mechanical safety.

[2]

2.4 A developing version used to test a solution: write the technical term.

[1]

3 Exam-style questions

3.1 Fictional prototypes deflect 8 and 5 mm under one equal load. Find reduction and propose evidence distinguishing stiffness from failure strength. [4]

Solutions

2.1 B State what each model includes and omits. Compare tests with the same load, geometry and conditions. Iteration means using evidence to revise a solution and testing the revision against the original success criteria.

2.2 $\text{reduction} = (10 - 6) / 10 \times 100 = 40\%$.

2.3 False. Stiffness is resistance to elastic deformation; strength concerns failure stress. A visually accurate model need not reproduce material behaviour.

2.4 prototype. prototype means A developing version used to test a solution.

3.1 Reduction 37.5% supports greater stiffness at that load. Controlled load-deflection and supervised strength evidence test different properties. Record geometry, supports and material.