Design Technology Assessment: Structural Engineering and Stability

Learning objective: To evaluate understanding of structural integrity, material properties, and the application of reinforcement techniques to create stable structures.

Read each question carefully. Use your knowledge of forces, materials, and structural design to provide precise answers. Ensure you use technical vocabulary where appropriate.

Max the monkey is planning to build a high-altitude observation platform in the jungle canopy so that Nova the owl can study the stars. The structure must be lightweight but strong enough to withstand high winds and support the weight of several animals. Max is considering using bamboo poles and natural vines to create his frame. He needs to ensure the platform remains rigid and does not collapse under pressure.

Word bank: compression · tension · reinforcement · triangulation · stability · struts · beams · tessellation · structural integrity · load-bearing

1. Explain why Max should use triangulation (triangular shapes) when designing the frame for the observation platform. How does this improve stability? (2 marks)

2. Define the term 'load-bearing' and describe one way a structure can be reinforced to support a heavier load. (2 marks)

3. Compare and contrast 'tension' and 'compression' forces. Provide an example of how each force might act upon the observation platform. (3 marks)

4. If Max decides to use a recycled plastic frame instead of bamboo, suggest two properties he should look for in the material to ensure the structure is durable. Justify your choices. (4 marks)

5. What might happen to the stability of the platform if the base is too narrow compared to the height? Explain the importance of a low centre of gravity. (4 marks)

6. Max has a budget of £50.00 for materials. If he buys three bundles of bamboo at £12.50 each and rope for £8.75, calculate the total cost and explain if he has enough money left for safety netting costing £6.00. (3 marks)

7. Extended Writing Task: Imagine you are an engineer helping Max. Write a proposal explaining your design choices for the platform. Include details on how you will ensure the structure is rigid, weather-resistant, and safe for Nova. Use technical vocabulary from the word bank. (5 marks)

Draw: In the space provided, draw a diagram of a reinforced frame. Label the struts and indicate where triangulation has been used to increase the structural integrity of the design.

Extension challenge: Total: /25. Extension: If you were tasked with building a bridge to connect two trees, how would your design differ from the platform? Consider the impact of 'dynamic loads' (moving weight) versus 'static loads' (stationary weight).