



KNOX
GRAMMAR
SCHOOL

STATE

DA VINCI DECATHLON 2022

CELEBRATING THE ACADEMIC GIFTS OF STUDENTS
IN YEARS 5 & 6



ENGINEERING

TEAM NUMBER _____

Total	Rank
/54	

Complete the above table with question numbers and marks as required.

ANCIENT PATTERNS

BACKGROUND

Throughout history bridges have been one of the most fundamental pieces of architecture. Not only have they provided greater access and shaped civilizations, but they are also some of the most spectacular demonstrations of workmanship.

The Romans were famous for constructing viaducts and bridges, which have not only stood the test of time but allowed them to expand across the world. Many of these bridges are still standing today, but whilst modern bridge construction has moved beyond stones and mortar, there is still one fundamental piece that has remained.

A key aspect of bridge building during the Roman times was using arches, yet the more fundamental factor is a pattern of structures that allow for the bridge to be present. Shown below is a famous example of such a construction.



World Heritage Site

The Pont du Gard aqueduct is a Roman aqueduct that crosses the Gard River in France and is classified as a UNESCO world heritage site.

Aqueducts themselves were not invented by the Romans and were used frequently in ancient Persia, India and Egypt to great effect. An aqueduct is defined as a conduit (channel or pipe) that is built to convey water from one place to another. They are commonly used to transport water from its source to the main point of distribution.

The Pont du Gard aqueduct presents a uniquely Roman design, whereby a different pattern is used for each level of the aqueduct. This is because arches, whilst strong, when built out of stone rely on compression to stay in place. When constructing large arch structures extremely complicated jigs are needed to keep the bridge in place. This pattern of a repeating arch shape is seen throughout ancient construction as well as modern day bridge building.

The bridge below is a Truss style construction with a repeating pattern of triangles, which form the main component of the bridge's construction.

The use of patterns in construction has been key for centuries and still is today, using the theme of a repeating pattern.



THE TASK

Construct a two-storey viaduct inspired by the Pont du Gard. Your construction must fulfil the following criteria:

- Be at least 15 centimetres high, 20 centimetres long and 3 centimetres wide. (Bonus 2 marks if it reaches 30 centimetres long)
- Cannot be of a circular arch construction, the arch design must be another novel shape.
- The pattern must repeat at least 4 times on the top and bottom level
- Must be able to transport 50ml of water from one side of the bridge to the other (this only needs to be in one direction, clearly indicate the start point and end point of the water)
- Bridge must be free standing
- Must bear resemblance to the Pont du Gard in that it possesses a repeating pattern, which must be of a unique shape.
- You are required to complete 2 side view sketches of potential viaduct designs and label them
- Complete associated questions

You will be provided with a range of materials. Not all materials have to be used and it is up to your discretion as to which ones are used. However, no extra material can be used. The provided materials are;

- 3 A4 sheets of paper
- 3 A4 cardboard (thin sheets)
- 20 Paddle pop sticks
- 20 Straws
- 10 pipe cleaners
- 1 line of bluetack
- Sticky tape (team to provide their own)
- 50g approx. item to test strength of bridge e.g., golf ball, playdoh, water balloon for demonstration purposes.

SKETCH 1

SKETCH 2

MARKING CRITERIA

CRITERIA	SKILFUL	EFFECTIVE	SOUND	LIMITED
Sketches: Clear and labelled	8-7	6-5	4-3	2-0
Model is freestanding	5-4	3	2	1-0
Quality and integrity of build	8-7	6-5	4-3	2-0
Ability of design to transport water	5-4	3	2	1-0
Use of materials	4	3	2	1-0
Originality in design	8-7	6-5	4-3	2-0
Effectiveness in design presented	8-7	6-5	4-3	2-0

END OF PAPER



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DESIGN EVALUATION

- a) Describe providing two reasons why using a repeating pattern such as an arch is preferable than a single beam bridge. A beam bridge is shown below; (4 marks)



Reasons can include:

- Suited the building materials that were available at the time
- Allowed them to cover greater distances than would have been possible with a normal beam bridge design.
- Were a more aesthetic design choice
- Was a wide use of arches at the time so suited the knowledge of people
- Other reasons that are realistic can be accepted

2 marks	1 mark for each relevant reason
2 marks	1 mark for each complete description of a reason

A key asset of arch bridges is that they are under compression throughout the arch and this transfers to the column. Meaning that in ancient roman arch bridges the individual rock slabs were essentially being pushed together.

- b) If this was in fact the opposite and the stone slabs were being pulled apart explain why the bridge would collapse. (4 marks)

Must note that if the bridge were being pulled apart the concrete holding the stones together would fail. This would lead to the stones falling out of place as there is nothing to bind them. Rocks are not able to 'pulled apart' they can only be compressed so if the forces were pulling rather than pushing the rocks than it would fail.

2 marks	Correctly identifies that rocks and concrete cannot act under tension only compression
2 marks	Notes that this would cause the concrete to fail and hence pull the rocks apart as the rocks cannot stretch unlike other materials.