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Design & Technology
Eduqas GCSE

Papers and boards: forces, stresses, reinforcing and stiffening

Materials required for questions

- Pencil
- Rubber
- Calculator

Instructions

- Use black ink or ball-point pen
- Try answer all questions
- Use the space provided to answer questions
- Calculators can be used if necessary
- For the multiple choice questions, circle your answer

Advice

- Marks for each question are in brackets
- Read each question fully
- Try to answer every question
- Don’t spend too much time on one question

Good luck!

Q1. Which force pulls a material apart and stretches it along its length?

A Compression

B Tension

C Torsion

Q2. How does thin paper behave under forces?

A Strong in tension but weak in compression and bending

B Weak in tension but strong in compression

C Strong in bending but weak in tension

Q3. Which method glues a wavy fluted layer between two flat liners so the arches resist crushing?

A Laminating

B Adding ribs

C Corrugating

Q4. Which type of corrugated board is the strongest?

A Single wall

B Double wall

C Triple wall

Q5. Which of these makes card much stronger in compression?

A Rolling it into a tube

B Cutting a small nick in the edge

C Making it wet

Q6. Which joining method avoids glue but gives a weaker joint?

A Glue tabs

B Slot together joints and locking tabs

C Staples

Q7. A mobile phone stand is made from 4 mm thick solid whiteboard. It has a back rest that the phone leans against and a support part underneath, joined with a glued joint.

Q7a. State the type of force the back rest is subjected to when the mobile phone is resting on it. **(1 mark)**

Q7b. Explain two working properties of solid whiteboard that make it a suitable material for the mobile phone stand. **(4 marks)**

Q7c. The support part of the stand could be fabricated from separate pieces of solid whiteboard rather than from a single piece. Explain two reasons for fabricating the support part from separate pieces of solid whiteboard rather than manufacturing it from a single piece. **(6 marks)**

Q8. A set of stackable cubes for a children's activity pack is made from copier paper. When the cubes are stacked, the bottom cube is in compression. Explain one possible effect of the compressive force acting on the bottom cube. **(2 marks)**

Q9. A child's chair is made from corrugated cardboard. The curved back rest is made from two layers of corrugated cardboard. The seat is held in place by a paper engineered joint: a folded-over flap of corrugated board on the seat fits into a slot in the curved back rest.

Q9a. Name the specific technique that has been used to manufacture the curved back rest from two layers of corrugated cardboard. **(1 mark)**

Q9b. Explain two working properties of corrugated cardboard that make it a suitable material for the curved back rest. **(4 marks)**

Q9c. Explain two advantages of using a paper engineered joint to join the seat to the curved back rest. **(6 marks)**

Q10. A model windmill is made from board. A flat balcony piece needs to be permanently attached to the flat side of the main body using an adhesive. Use notes and sketches to show how to adapt and support the balcony so that it can be permanently attached to the main body using an adhesive. **(4 marks)**

Q11. An eco-furniture company sells flat-packed stools and chairs made only from corrugated cardboard.

Q11a. Describe how the properties of high quality corrugated cardboard make it suitable for the flat-packed stools and chairs. **(2 marks)**

Q11b. The stools and chairs do not need any glue or fixtures during assembly, because the parts slot together. Explain two advantages this will bring for the consumer. **(4 marks)**

Q12. A plant carrier is made from corrugated board. Explain one benefit of manufacturing the plant carrier from corrugated board. **(2 marks)**

Answers

Q1. B
Q2. A
Q3. C
Q4. C
Q5. A
Q6. B

Q7a.

Compression or compressive (1).

Q7b.

Two working properties (1 each), each with a linked justification (1). For example:

- Solid whiteboard is rigid (1), so it holds its shape once it has been bent into the shape of the holder (1)
- Its surface has good printability (1), so images, logos and designs can be printed on the stand to make it more attractive to consumers (1)
- It has good compressive strength (1), so the support part will not deform or crumble under the weight of the phone (1)

Q7c.

Two reasons (1 each), each with two linked justifications (1) + (1). For example:

- Less waste is produced (1), so less material has to be disposed of (1), reducing the amount going to landfill (1)
- Smaller sections of board can be used (1), so fewer big sheets need to be bought and offcuts are used up (1), making the best use of material and reducing the need for new pulp (1)
- Each section can suit the load placed on it (1), so a thinner piece of board could be used for the base than for the front and back of the support (1)
- Fabrication allows a sharp angle, so the part keeps its shape and is more rigid (1); folding such thick board from a single piece would give a rounded bend (1), which could collapse, unfold or delaminate (1)

Q8.

An effect (1) and a linked justification (1). For example:

- The paper used for the bottom cube may not be thick enough (1), so the cube cannot support the weight of the other cubes (1)
- The weight on the bottom cube could make it deform (1), so the other cubes become unstable (1)
- The joints in the folded paper may lack strength (1), so the sides flex, or the joints separate and gaps appear (1)

Q9a.

Laminating, laminate or lamination (1).

Q9b.

Two working properties (1 each), each with a linked justification (1). For example:

- Corrugated cardboard is flexible (1), so it can be bent into the curved shape of the back rest (1)
- It has good compressive strength and rigidity (1), so the chair back will not buckle or collapse when it is sat on or leaned against (1)
- It is light in weight (low density) (1), so the chair is not too heavy and children can move it around easily (1)

Q9c.

Two advantages (1 each), each with two linked justifications (1) + (1). For example:

- Only a small amount of material is removed from the back rest (1), so the corrugated board is less likely to tear (1), reducing the risk of the chair collapsing and injuring a child (1)
- No adhesive is needed (1), so there is no drying time (1), and the chair can be used as soon as it is assembled (1)
- The joint relies on friction or an interference fit (1), so there is no permanent connection (1), and the chair can be taken apart for storage or transport (1)
- The joint can be strengthened with tape (1), which keeps the fold in the tabs (1), stopping the fold opening if a locking slot is not used (1)

Q10.

Cap at 3 marks if there are no sketches, or sketches with no notes. One mark for each:

- Create an upstand (folded flap) on the end of the balcony to increase the gluing area (1)
- Add a structural member to support the balcony (1)
- Add slots to the balcony (1)
- Apply glue or adhesive to the surfaces (1)
- Support the pieces while the glue sets (1)

An example answer: check the alignment, apply adhesive, push the parts together, remove the excess glue, hold in place while it sets.

Q11a.

1 mark for a simple answer, e.g. the corrugated structure is strong; it will hold the weight of the user; it is fully recyclable after use. 2 marks for a more detailed answer, e.g.:

- The corrugated cardboard is reinforced and rigid, so it can withstand the forces applied when it is placed upright and sat on
- It is a cheap sheet material that can be cut as required by CAM machines for the stool and chair designs
- It is strong and lightweight, so it can be shipped flat and then assembled
- Credit that it can be made from 100% recycled materials and is 100% recyclable at the end of its life

Q11b.

Two advantages, up to 2 marks each: 1 mark for a simple point, 2 marks for a more detailed explanation. For example:

- No specialist tools or equipment are needed, so assembly is simpler for the consumer
- It is quicker to assemble than products with fixtures and glue
- The parts slot together, so the product can be used as soon as it is assembled, with no wait for glue to dry
- Products are cheaper to buy because there are fewer components

- It is more environmentally friendly, using no materials or components other than the parts supplied, and can be fully recycled at the end of its life

Q12.

A benefit (1) and a linked justification (1). For example:

- It has very good impact resistance and shock absorbency (1), so it protects the plants if the carrier is knocked or dropped (1)
- It is available in large flat sheets (1), so fewer pieces are needed to make the carrier (1)
- It has flutes inside (1), so it can fold in the direction of the flutes without needing to be scored (1)