Design & Technology
(Product Design)

DTBase©

OCR A-Level

Manufacturing Processes for Prototypes (7.2b)

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 of the following processes is classified as a **wasting technique** used on both wood and metal prototypes?

A Vacuum forming

B Drilling

C Resin casting

Q2. Vacuum forming is a suitable moulding method for manufacturing a final prototype made from which material?

A Mild steel sheet

B Thermoplastic sheet (e.g., acrylic, ABS)

C Solid hardwood

Q3. The process of **turning** is typically performed on a lathe and is used primarily to create what type of geometry?

A Flat surfaces and slots

B Cylindrical or conical shapes

C Complex curved sheet forms

Q4. Which casting method would be most appropriate for producing a detailed, one-off jewellery prototype in silver?

A Sand casting

B Lost wax casting

C Low-temperature metal casting (e.g., pewter in silicone moulds)

Q5. Describe the stages required to produce a vacuum formed polymer product. **(6 marks)**

Q6. Explain two disadvantages of the vacuum forming process. **(6 marks)**

Q7. Describe the process of machining a slot in a steel block using a manual milling machine. **(5 marks)**

Q8. State four safety precautions to be taken by the user when turning a wooden bowl on a wood lathe. **(4 marks)**

Q9. Explain one property of mahogany that makes it a suitable material for turning on a wood lathe. **(2 marks)**

Q10. The prototype of the clamping bracket will be sand cast. Outline how the mould is prepared for the casting of the prototype clamping bracket. **(6 marks)**

Q11. Describe the process of forming a timber product using lamination. **(6 marks)**

Q12. The image below shows a car door.

Outline the process used to form the front wing panel from the steel roll. **(6 marks)**

Answers

Q1. B
Q2. B
Q3. B
Q4. B

Q5.
Indicative content
Mould production

- An accurate mould resembling the desired product is manufactured.
- The mould may feature elements such as tapered sides, radiused edges, vacuum holes etc to aid a successful polymer moulding.
- The completed mould is placed on the bed of the machine known as the 'platen'.

Mounting the polymer sheet in the machine

- The thermoplastic polymer sheet is clamped into the machine above the mould creating an airtight seal.

Heating the polymer sheet

- The polymer is then heated via a radiant heater.

Moulding the product

- When the polymer is heated and has softened, the heat is removed.
- The polymer sheet may be blown a little before raising the platen and mould into the softened sheet.
- The vacuum pump is switched on and the air removed forcing the sheet to take the shape of the mould.

Removal of the mould

- Once cooled, the mould is removed by lowering the platen.
- Air can be blown in between the mould and moulding to aid its release.
- The moulding is unclamped and removed from the vacuum forming machine.

Trimming and finishing of the polymer product

- Waste material is trimmed from the mould and can then be recycled.
- Any apertures can be cut out and any decals or printed details can be added to the moulded product.

This list is not exhaustive. Accept any other valid responses.

Q6.

Any two explanations that include identification of disadvantages of vacuum forming (1) and linked reasons for that being a disadvantage (1) + (1).

- Complex shapes cannot be produced (1) because the pattern has to be removed from the rear of the form (1) which limits the features that can be incorporated / only allows open backed designs to be produced (1)
- Products cannot have intricate surface detail / finishes / sharp edges (1) because the plastic forms over the pattern (1) and the thickness of the plastic sheet limits the detail that can be achieved on the outer surface of the moulding (1)
- Vacuum forming only forms open backed shapes / does not allow undercuts (1) so the object has limited structural integrity (1) and the sides of the finished artefact can splay out / distort when forces are applied (1)
- The plastic is stretched over the pattern (1) resulting in thinner side walls / webbing can form (1) limiting the depths / height of the moulding and depth of the recesses (1)
- Vacuum forming produces a lot of waste (1) which is not environmentally friendly / a single sheet to suit the machine/bed size is used (1) and excess material has to be cut/trimmed from the finished form (1)
- Relatively slow process because of the heating/cooling/removal time (1) reduces output/production/efficiency levels (1) meaning that multiple machines with be required / longer waiting time for consumers/clients (1)
- Not cost effective for one-off production (1) because the mould/pattern needs to be produced (1) therefore only suitable for batch/mass production (1)

Q7.

Any five of the following points:-

- Block clamped to table / clamped in machine vice (1)
- Cutter selected / fitted into chuck / collet / onto mandrel (1) • Table manoeuvred into position (1)
- Appropriate speed / feed selected (1)
- Cutter rotates (1)

- Block fed into cutter (1)
- References to up milling / down milling (1)
- Several small cuts taken (1)
- Cutting fluid applied (1)

[Do not award marks for stopping the machine, removing the work or safety issues.]

Q8.
State four safety precautions to be taken by the user when turning a wooden bowl on a wood lathe.

1 mark for each of the following to a maximum of 4 marks.

- Completion of appropriate safety training/use of instructions before use. • Appropriate face shield PPE worn at all times.
- Entanglement risk
- Checking that the bowl is secured to the appropriate faceplate/chuck before turning begins.
- The use of effective wood work extraction.
- Use of a rest to support the tool.
- Positioning of the rest to reduce the gap from bowl.
- The use of sharp tools etc to reduce the risk of snatching at tools.
- Use of machine guards to reduce risk of contact with moving parts.
- Check machine is running freely before starting motor.
- Use of appropriate lighting for wood turning equipment.
- Avoid use of laminated timber blocks.
- Machine maintenance

Note: Only accept one reference to PPE. Only accept one reference to entanglement

This list is not exhaustive. Accept any other valid responses.

Q9.
A valid explanation with linked justification:
- Fine / tight / straight / even / dense grain (1) allows for a good finish / fine detail / machines well (1)
- Interlocking grain reduces the risk of splitting / cracking / splintering during turning (1) because Mahogany is a hard material (1)

- Mahogany has relatively few knots/blemishes (1) which would reduce the strength of the turned spindle / reduce the risk of an accident during manufacture (1)

Q10.
An outline covering six of the following stages
- Parting powder / French chalk is sprinkled over the pattern. (1)
- Sand is then packed around the first half of the pattern in the drag. (1)
- The drag is turned over and the cope is placed on top. (1)
- The second half of the pattern and the sprue pins are then positioned. (1)
- The cope is then filled with sand. (1)
- The mould is separated and the pattern and sprue pins are removed. (1)
- Gates and channels are cut. (1)
- The cope and drag are then reassembled in readiness for casting. (1)

Q11.
Indicative content:
- Several thin layers of veneer or thin plywood (1.2 mm – 3 mm thickness) can successfully be combined to the required thickness
- Adhesive is placed between each layer
- A two part former is used and pressure applied with clamps or a press while the lamination dries
- Excess adhesive from the moulding process can be removed
- A bag press or vacuum bag could be used with a styrofoam mould or equivalent former
- Simple curved shapes can be achieved
- Cross linked adhesive or 'cascamite' can be used to create a stronger glued joint
- Lamination can be trimmed to size once formed
- Laminated products can also be achieved by combining several sheets of kerfed flexible MDF.

Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.

Q12.
An outline covering six of the following stages
- Steel is straightened (1)

- Steel is cut to required blank size (1)
- Blank passes through an automated feeder (1)
- Blank loaded into press/ former/die (1)
- Press is activated (1)
- High pressure forces sheet steel to take the shape of the former (1)
- Die cuts/stamps out any apertures / openings / holes / outline shape (1)
- Finished pressing is removed from the machine (1)