Design & Technology
(Product Design)

DTBase©

OCR A-Level

Communicating Design Ideas with Sketching & Digital Tools (4.1a)

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 annotation would *most effectively* support design development for a hinge mechanism?

A "Looks nice and modern."

B "Pivot point redesigned to reduce friction; expected 20% smoother movement."

C "Could be made in various colours."

Q2. A designer uses CAD to perform a motion study on a mechanical arm but notices unexpected oscillation in the animation. What is the *most likely* implication?

A The rendered material texture is inaccurate.

B The lighting environment in the software is incorrectly calibrated.

C The joints or constraints in the digital model need revising to reflect real-world behaviour.

Q3. A designer builds a quick card model of a floor lamp and discovers it tips over despite the CAD model appearing stable. What is the *best explanation*?

A CAD always overestimates material density.

B The designer did not account for real-world mass distribution and centre of gravity effects.

C Card modelling cannot be used to evaluate stability.

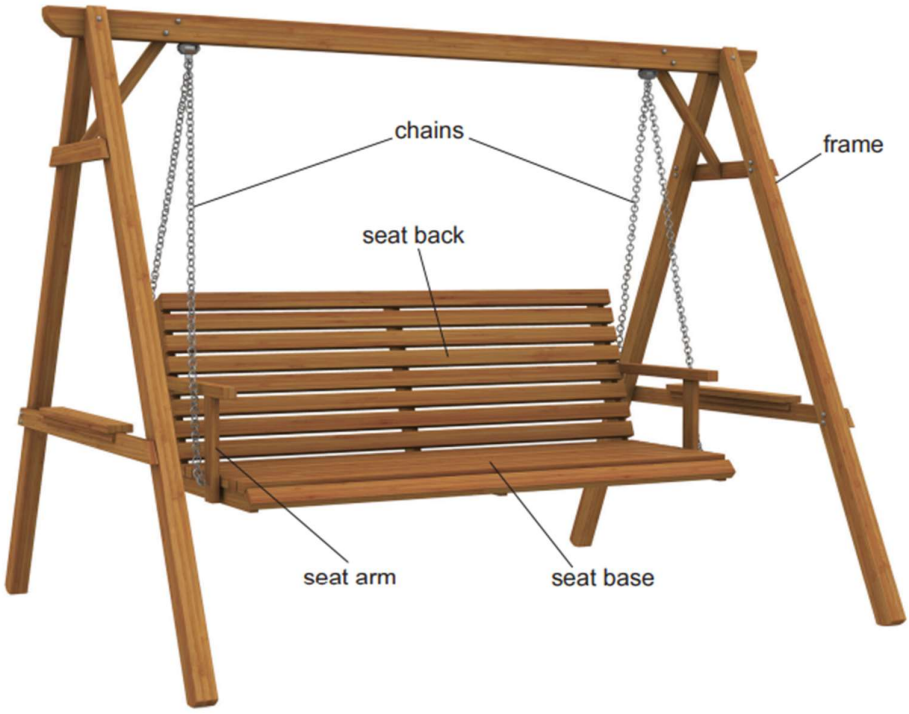
Q4. The image below shows a drawing compass used for drawing circles.

A company is looking into whether the component parts of the compass could be manufactured in large quantities.

Use annotated sketches and/or notes to show how a single prototype of the adjusting wheel and threaded bar could be manufactured in a workshop environment.

Identify any relevant tools, machinery and materials **(5 marks)**

Q5. The image below shows a swing seat manufactured from hardwood.



The swing seat shown in the image is manufactured as a batch of 100 from hardwood.

Use annotated sketches and/or notes to show how the seat could be manufactured.

Your answer must include the following:

- seat base and back
- seat arms.

Identify any relevant equipment, machinery and materials **(8 marks)**

Q6. The image below shows a metal drying pan.

The frying pan shown in the image is manufactured as a batch of 1000 from a non-ferrous metal.

Q6a. Use annotated sketches and/or notes to show how part A would be manufactured.

Identify any relevant specialist tooling and quality control checks. **(5 marks)**

Q6b. Use annotated sketches and/or notes to show how part B would be manufactured and permanently joined to part A. Identify any relevant specialist tooling and quality control checks. **(5 marks)**

Answers

Q1. B
Q2. C
Q3. B

Q4.
Use annotated sketches and/or notes, to show how a single prototype of the adjusting wheel and threaded bar could be manufactured.

Indicative content:

The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes.

There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to-end process.

To manufacture the screw both hand, machine (centre lathe) and CNC methods are acceptable including the use of a 3D printer. With all references to CAD CAM there would be an expectation for all the relevant stages. This should include explaining how the files were created to program the machine, how the machine works and how the end product is removed and finished.

Metal rod could be mounted in a three-jaw chuck on the lathe. Select the speed, appropriate pitch and threading direction with clear markings on the rod for the start and finish of the thread. Set the threading tool into the tool post, ensuring it Is square and at the correct height. A thread is cut into the rod using the automatic feed. Use of the chamfering tool to remove any burrs or sharp edges. The ends of the rod are then finished and faced off.

A tap and die could be used to cut the screw thread – involving use of a die cutter to cut an external thread and possibly a tap to cut internal thread in the adjusting wheel.

The adjusting wheel could be cast (resin or pewter) or cut with a CNC machine or plasma cutter or cut from a larger diameter rod with a hacksaw or faced and parted with a lathe (grip could be knurled). It could also be 3D printed, a CAD drawing would be produced then the part would be 3D printed from PLA or ABS layer by layer.

As this is a prototype candidates could also be rewarded for considering that the adjusting wheel and screw could be manufactured from an alternative material e.g. the adjusting wheel could be PLA.

Any other valid suggestion.

Q5.
Give details of materials, specialist tooling and quality control checks that would be used.

Indicative content:

The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to end process.

Variety of construction techniques can be assumed for this question and there is no "right" answer. Must be suitable for batch of 100, so methods must include production aids to ensure sizes are identical etc.

Construction techniques could include consideration that the pack is likely to be purchased flat pack and the side of the seat could be made from one or multiple parts.

Possible response could include:

- Creation of a cutting jig/ production aid for the slats of the seat base, to ensure consistent length and width.
- Use of a circular saw, to cut the pieces to size.
- H&S Use of PPE and training.
- Pilot holes to be drilled in the slats and supports again using a jig to ensure spacing. Design of the jig/production aid to be detailed. Countersink bit used to create a flush surface with the screw head.
- Supporting bars to be cut down to size and angled cuts made.
- Glass paper used to smooth edges if needed.
- Use of mortise and tenon joint and tool for the arm of the chair.
- Assembly and testing of a final product to ensure it works & parts are correct.

- Accept use of CNC machinery. This is an example of a low level 3 response that is clearly presented with technical detail that includes relevant specialist tooling and quality control checks.

Q6a.

Indicative content:

The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to end process.

Process:

- Aluminium sheet prepared, steel die prepared
- Disk stamped, hydraulic press to create the blank
- Sheet metal clamped over female die (shape of part A)
- Hydraulic male die pushes blank into female die with a punch
- (Holes for handle could also be punched in at this stage or in additional stage)
- Edges trimmed by cutting blade & edges rounded
- Die opened and Part A removed
- Turned on lathe & base machined flat
- Any scrap recycled
- Thickness of metal check in QC process. Defects removed.
- Reference made to batch manufacture

Alternative process could include spinning:

- Aluminium sheet prepared
- Disk stamped, hydraulic press to create the blank
- Mandrel in the chuck
- Blank held in between mandrel (shape of part A) and tail stock
- Mandrel is spun and roller tool rolled along the blank to stretch the metal
- Pressure is applied and tool is rolled over blank as it takes the form of the mandrel (shape of part A)
- Excess trimmed & edges rounded.
- Scrap recycled

- Reference made to batch manufacture Any other valid suggestion

Q6b.

Indicative content:

The candidate is expected to demonstrate their understanding of the process involved through a series of annotated sketches and/or notes. There may be variations to the process as indicated but to get into L3 candidates must demonstrate a clear understanding of the end to end process.

Process:

- Aluminium sheet prepared
- Handle stamped, hydraulic press to create the blank
- Sheet metal clamped over female die (shape of part A)
- Hydraulic male die pushes blank into female die with a punch
- Holes punched in pan (Give credit if this is stated in part i)
- Holes punched in handle
- Holes aligned and clamped into place
- Rivet shaft inserted
- Set is placed over the head of the rivet
- Rivet shaft hammered compressing the two parts together
- Parts riveted together
- Joint checked for strength and removed & recycled if doesn't pass checks
- Reference made to batch manufacture Any other valid suggestion