1.13 CAD and CAM workflow

AQA 8552 · Calculator allowed · about 50 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions.

1 State one difference between a CAD model and CNC manufacture.

(Total for Question 1 is 1 mark)

2 Fictional planning data: a hand-made batch takes 2 minutes per item with no setup. A CNC batch takes 30 minutes setup plus 0.5 minutes per item. Assume both rates are constant, setup is once per batch, and times exclude breaks. Calculate both total times for 10 items and for 100 items, then state which method is faster at each quantity.

(Total for Question 2 is 4 marks)

3 Fictional brief: a school needs 6 display plaques, each with a different name and one shared outline. Hand cutting and CNC routing are both available through supervised classroom provision. Recommend a workflow and explain how design, manufacture and checks should be handled. Do not give machine operating instructions.

(Total for Question 3 is 6 marks)

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4 Fictional brief: a community group requests 180 reusable equipment tags. Each tag must have a different short identifier, fit a supplied 40 mm wide strap, and have a clearly readable marking. Two supervised classroom workflows are available: hand cutting/marking, or CAD followed by computer-controlled cutting and marking. Recommend and justify a workflow from design changes through production and checking. Address quantity, customisation, one risk of relying on the digital model alone, and a practical check. No machine operating instructions are required.

(Total for Question 4 is 6 marks)

5 A CAD model specifies a plate as 80 mm wide and 50 mm high. A designer must make it 10 mm wider while retaining the specified height. State the new dimensions.

(Total for Question 5 is 1 mark)

6 A CNC job file names a material and gives the outside profile, but has no thickness or hole positions. Identify two pieces of information to confirm before production.

(Total for Question 6 is 2 marks)

7 A digital model predicts that a phone stand will hold a 220 g phone at 60 degrees. Explain why a physical prototype test is still useful.

(Total for Question 7 is 2 marks)

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8 A CNC-cut panel has a dimension of 120 mm in its CAD model. Identify one reason the finished panel could differ from this dimension, explain how that reason affects the finished dimension, and state what this shows about relying on CAD dimensions alone.

(Total for Question 8 is 3 marks)

9 A team changes a CAD enclosure to add a cable opening. Give three checks to make in the model before sending the revised design for manufacture.

(Total for Question 9 is 3 marks)

10 A one-off prototype is made by hand for a designer who expects several revisions. Another product is needed in 300 identical copies. Explain which workflow is more suitable for each: hand production or a CNC workflow.

(Total for Question 10 is 4 marks)

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11 Fictional workshop data: one CNC batch has a fixed setup time of 35 minutes and takes 4 minutes per item. Assume setup occurs once and the rate remains constant. Calculate the total time for 25 items, showing your working. Give the total in minutes and convert it to hours and minutes.

(Total for Question 11 is 4 marks)

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12 Fictional sheet-yield data: each sheet provides 1,200 cm^2 of usable material after its border is removed. Each component uses 145 cm^2. Assume components cannot overlap, material is not reused, and all usable area may be nested without additional loss. How many complete components can be made from one sheet, and what area remains?

(Total for Question 12 is 4 marks)

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Mark scheme · 1.13 CAD and CAM workflow

Question 1

CAD creates or edits a digital design; CNC uses computer-controlled equipment to make a physical part from instructions. **B1**

Answer: CAD is digital design; CNC is computer-controlled physical manufacture.

Question 2

At 10: hand = 10 x 2 = 20 minutes; CNC = 30 + (10 x 0.5) = 35 minutes. **M1**

At 10, hand is faster. **A1**

At 100: hand = 100 x 2 = 200 minutes; CNC = 30 + (100 x 0.5) = 80 minutes. **M1**

At 100, CNC is faster. **A1**

Answer: 10 items: hand 20 min, CNC 35 min, so hand is faster. 100 items: hand 200 min, CNC 80 min, so CNC is faster.

Question 3

Choose a suitable workflow, for example edit a digital model for each name and use CNC, or use hand production for this very small batch. **B1**

Explain the quantity trade-off: CNC setup may not be worthwhile for six; hand work may have lower setup. **B1**

Explain the customisation: each name must be represented correctly in each version/model. **B1**

Check specified plaque dimensions and name placement in the design data before manufacture. **B1**

A physical sample or first article can be checked for legibility and fit against the brief. **B1**

Recognise that a digital model or successful sample does not guarantee every finished plaque is identical or defect-free. **B1**

Answer: I recommend hand production for the six plaques because its lower preparation requirements may make CNC setup unnecessary for this small batch. Prepare design versions with the shared outline and check that each of the six names is correct. Check the specified dimensions and name placement before manufacture, then hand cut and mark the plaques through supervised classroom provision. Check a physical sample for legibility and fit against the brief. A digital model or successful sample does not guarantee that every finished plaque matches its design or is defect-free, so check each finished plaque too.

Question 4

Choose a workflow that suits a batch of 180, such as CAD and computer-controlled manufacture for repeatable outlines. **B1**

Explain that identifiers can vary between digital versions while common geometry is retained. **B1**

Relate the quantity to setup: setup is spread across a larger run, though preparation still takes time. **B1**

Retain and check the specified 40 mm strap fit dimension and marking legibility in the design. **B1**

Identify a limitation: the model cannot confirm actual fit, material behaviour or marking readability on finished tags. **B1**

Propose a physical sample check against the strap and readable identifier, then check the batch against the requirement. **B1**

Answer: Use a checked CAD design and computer-controlled workflow for the repeated outline and 180 individually named tags, with the quantity helping justify preparation. Preserve the 40 mm fit requirement and identifiers, then physically check a sample for strap fit and readable marking before checking production against the brief. CAD alone cannot establish finished fit or readability.

Question 5

90 mm wide and 50 mm high. **B1**

Answer: 90 mm by 50 mm.

Question 6

Specify the required thickness. **B1**

Specify hole positions, for example dimensions from a datum or centre coordinates. **B1**

Answer: Thickness and hole locations referenced to a datum must be confirmed.

Question 7

The model is a prediction based on its assumptions and may not capture actual material, build or loading behaviour. **B1**

A controlled physical test can reveal problems such as flexing or tipping under the stated load and angle. **B1**

Answer: A model predicts from assumptions; testing a prototype provides evidence of actual behaviour under the specified conditions.

Question 8

Any one relevant reason, such as tool width, material movement, machine setup or measurement variation. **B1**

Relate that reason to the manufactured result, for example a tool path or setup error can leave an edge in a different position. **B1**

CAD dimensions describe the model and do not guarantee the physical part will match exactly. **B1**

Answer: For example, an incorrect tool offset can move the cut edge, so the physical width may differ from the 120 mm model dimension. CAD dimensions do not guarantee that the finished panel will match exactly.

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Question 9

Check the opening has the specified size.	**B1**
Check its position against the stated datum or mating component.	**B1**
Check the change has not removed required wall material or conflicted with another feature.	**B1**

Answer: Check opening size and position against requirements, and check the revised geometry for conflicts or weakened sections.

Question 10

Hand production suits the one-off prototype.	**B1**
It avoids preparing a computer-controlled production file when frequent changes are expected.	**B1**
A CNC workflow suits 300 identical copies.	**B1**
Once set up, repeated controlled manufacture can improve consistency across the batch.	**B1**

Answer: Use hand production for the one-off prototype: it avoids preparing a computer-controlled production file when frequent revisions are expected. Use CNC for the 300 identical copies: once set up, repeated controlled manufacture can improve consistency across the batch.

Question 11

Use total time = setup time + (number of items x time per item).	**M1**
25 x 4 = 100 minutes of item time.	**M1**
100 + 35 = 135 minutes.	**A1**
Convert the total time to 2 hours 15 minutes.	**A1**

Answer: 35 + (25 x 4) = 135 minutes = 2 hours 15 minutes. Assumes one setup and constant 4-minute item time.

Question 12

Divide usable area by area per component: 1,200 / 145.	**M1**
8 complete components, since 8 x 145 = 1,160 and 9 would need 1,305 cm^2.	**A1**
Subtract used area from usable area.	**M1**
1,200 - 1,160 = 40 cm^2 remains.	**A1**

Answer: 8 components; 40 cm^2 remains. The ninth would require 1,305 cm^2, exceeding 1,200 cm^2.

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