A-LEVEL
Design and Technology: Product Design (3-D Design)

PROD3 – Unit 3  Design and Manufacture
Mark scheme

June 2018

Version/Stage: 1.0 Final
Mark schemes are prepared by the Lead Assessment Writer and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation events which all associates participate in and is the scheme which was used by them in this examination. The standardisation process ensures that the mark scheme covers the students’ responses to questions and that every associate understands and applies it in the same correct way. As preparation for standardisation each associate analyses a number of students’ scripts. Alternative answers not already covered by the mark scheme are discussed and legislated for. If, after the standardisation process, associates encounter unusual answers which have not been raised they are required to refer these to the Lead Assessment Writer.

It must be stressed that a mark scheme is a working document, in many cases further developed and expanded on the basis of students’ reactions to a particular paper. Assumptions about future mark schemes on the basis of one year’s document should be avoided; whilst the guiding principles of assessment remain constant, details will change, depending on the content of a particular examination paper.

Further copies of this mark scheme are available from aqa.org.uk
Level of response marking instructions

Level of response mark schemes are broken down into levels, each of which has a descriptor. The descriptor for the level shows the average performance for the level. There are marks in each level.

Before you apply the mark scheme to a student’s answer read through the answer and annotate it (as instructed) to show the qualities that are being looked for. You can then apply the mark scheme.

Step 1 Determine a level

Start at the lowest level of the mark scheme and use it as a ladder to see whether the answer meets the descriptor for that level. The descriptor for the level indicates the different qualities that might be seen in the student’s answer for that level. If it meets the lowest level then go to the next one and decide if it meets this level, and so on, until you have a match between the level descriptor and the answer. With practice and familiarity you will find that for better answers you will be able to quickly skip through the lower levels of the mark scheme.

When assigning a level you should look at the overall quality of the answer and not look to pick holes in small and specific parts of the answer where the student has not performed quite as well as the rest. If the answer covers different aspects of different levels of the mark scheme you should use a best fit approach for defining the level and then use the variability of the response to help decide the mark within the level, ie if the response is predominantly level 3 with a small amount of level 4 material it would be placed in level 3 but be awarded a mark near the top of the level because of the level 4 content.

Step 2 Determine a mark

Once you have assigned a level you need to decide on the mark. The descriptors on how to allocate marks can help with this. The exemplar materials used during standardisation will help. There will be an answer in the standardising materials which will correspond with each level of the mark scheme. This answer will have been awarded a mark by the Lead Examiner. You can compare the student’s answer with the example to determine if it is the same standard, better or worse than the example. You can then use this to allocate a mark for the answer based on the Lead Examiner’s mark on the example.

You may well need to read back through the answer as you apply the mark scheme to clarify points and assure yourself that the level and the mark are appropriate.

Indicative content in the mark scheme is provided as a guide for examiners. It is not intended to be exhaustive and you must credit other valid points. Students do not have to cover all of the points mentioned in the Indicative content to reach the highest level of the mark scheme.

An answer which contains nothing of relevance to the question must be awarded no marks.
Question 01

01 Compare the two razors shown in Figures 1 and 2.

In your answer you should refer to:

- suitable materials
- manufacturing processes used
- design features.

[12 marks]

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 4     | 10-12 | Both razors are compared referring to all the reference points.  
• Accurate specific materials are stated for both products.  
• Manufacturing processes are accurately identified.  
• Specific design features of each razor are compared |
| 3     | 7-9   | Both razors are compared referring to the reference points.  
• Suitable specific materials are stated for both products.  
• Manufacturing processes are correctly identified.  
• Design features of each razor are discussed. |
| 2     | 4-6   | Both razors are analysed individually.  
• Suitable materials are referred to.  
• Suitable manufacturing processes are identified. |
| 1     | 1-3   | At least one of the razors is analysed referring to materials and manufacturing processes. |
| 0     |       | Nothing worthy of credit. |

Indicative Content: (Guidance)

Figure 1:  
- A disposable injection moulded razor.  
- credit extrusion for handle section  
- Produced from High Impact Polystyrene in extremely large volumes.  
- Produced from simple forms that aid ease of removal from the mould.  
- Indentations on the handle increase grip without the need for separate components and
further assembly.

- Thermoplastic allows the design to be produced in a range of colours using the same mould design.
- The product is sold in high volumes as a functional product where the whole product is replaced.
- The product is an emergency replacement with a single use life expectancy.

**Figure 2:**

- Candidates may assume both razors have been injection moulded in polymer, if so only award once for manufacturing method.
- Accept relevant thermoplastics (do not accept: Acrylic or same polymer as stated for figure 1)
- A multiple part zinc alloy die casting with elastomer inserts.
- The handle is die cast and is reusable with replacement blades.
- The use of TPE or LSR inserts increases the cost of the product due to assembly and increased complexity of the mould designs.
- The use of TPE or LSR inserts adds value to the product and gives an aesthetic value not associated with Figure 1.

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

Total 12 marks
Figure 3 shows a metal tube bracket.

Describe in detail a manufacturing plan for producing four identical tube brackets using wasting, redistribution and/or fabrication processes. [16 marks]

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
</table>
| 4     | 13 -16| - The response details the manufacture of all aspects on the component.  
- Details are given of how multiple identical components can be produced.  
- The manufacturing plan details suitable specific wasting, fabrication or redistribution methods relating directly to the component. |
| 3     | 9 -12 | - The response details the manufacture of all main aspects of the component.  
- Details are given of how major aspects of the component can be accurately replicated multiple times.  
- Suitable wasting, fabrication and redistribution methods are described relating to the component. |
| 2     | 5 - 8 | - The response details the manufacture of the major features of the component.  
- The response refers to making more than one component.  
- Suitable production processes are described. |
| 1     | 1 - 4 | - The response describes the manufacture of some aspects of the component.  
- Manufacture processes are described. |
| 0     |       | Nothing worthy of credit. |

Indicative Content:

Fabrication and wasting example:
- Production of base:  
  - Cut length of mild steel/aluminium etc. to length using cross cut saw/hacksaw  
  - Mark centres of supporting holes using steel rule, scribe and centre punch  
  - Drill through holes using pillar drill and machine vice

Redistribution and wasting example
- Preparation of pattern or mould:  
  - Produce component pattern from timber, or suitable alternative  
  - Prepare sand casting mould  
  - Details of adding a core to remove tube centre  
  - ACCEPT DESCRIPTION OF
### INVESTMENT CASTING
- DO NOT ACCEPT DIE CASTING DUE TO SMALL VOLUME

<table>
<thead>
<tr>
<th>Production of stem</th>
<th>Casting process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine cross section of mild steel using vertical milling machine</td>
<td>Reward details of casting process up to maximum of 3 marks</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Production of tube section</th>
<th>Finishing of cast component</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cut length of mild steel/aluminium tube using cross cut saw</td>
<td>If no core was used reference to boring out tube centre should be rewarded</td>
</tr>
<tr>
<td>Drill hole for grub screw</td>
<td>Marking and drilling of base holes</td>
</tr>
<tr>
<td>Tap hole</td>
<td>Tapping of thread for grub screw</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Assembly</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clamp in jig</td>
</tr>
<tr>
<td>MIG/TIG weld or Braze tube to stem</td>
</tr>
<tr>
<td>MIG/TIG weld or Braze stem to base</td>
</tr>
</tbody>
</table>

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

**Total 16 marks**
Question 02

Figures 4 and 5 show a pedestrian crossing.

Describe how pedestrian crossings are designed to be inclusive to all potential users.

[16 marks]

<table>
<thead>
<tr>
<th>Level</th>
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<th>Description</th>
</tr>
</thead>
</table>
| 4     | 13-16 | • The response describes a range of ergonomic features thoroughly relating each to how it increases inclusivity.  
• Use of colour, texture and symbols are all referred to. |
| 3     | 9-12  | • The response describes ergonomic features relating to how they increase inclusivity.  
• Use of colour, texture and symbols are referred to. |
| 2     | 5-8   | • The response describes relevant ergonomic features clearly.  
• Reference is made to ergonomic elements, such as colour, texture and symbols. |
| 1     | 1-4   | • The response describes basic ergonomic features. |
| 0     |       | Nothing worthy of credit. |

Indicative Content: (Guidance)
Credit to be awarded for reference to other types of pedestrian crossing.
Award reference to driver perspective of the crossing
• Standardised visual symbols are used for walk and stop to avoid use of text requiring
language, this helps younger children and also users who do not speak English.
- The use of red for stop and green for go are standardised colour schemes recognised by all ages.
- Images flash when lights are about to change to warn people crossing of limited time remaining.
- Guard railing can be used as an aid for visually impaired users on the approach to a crossing.
- Dropped kerbs allow ease of use for wheelchair users and people with reduced mobility removing trip hazards
- Tactile paving is installed to aid the safety of blind and visually impaired users
- Audio bleepers are used to indicate when it is safe to cross, this is intended for the visually impaired, but can benefit all users.
- Tactile signals in the form of rotating rubber/polymer cones under the push button box are installed for use by visually impaired users.
- Push button boxes are positioned on the right hand side, or both sides of the crossing to aid visually impaired users with consistency
- The push button box is located at a height suitable for all users (1-1.1 metres from the ground)
- When the button has been pushed visual feedback, in the form of an illuminated sign indicates that it has been pressed.
- The push button is white, contrasting with the black background, which makes it easy to see if visually impaired
- The push button is raised from the surface of the box making it easier to locate by touch if visually impaired.

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

Total 16 marks
Figures 6 and 7 show drinks bottle packaging.

Explain the methods used by the manufacturer to ensure both consistency and customisation in the drinks bottle packaging.  

Figure 6

Figure 7

<table>
<thead>
<tr>
<th>Level</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>9-12</td>
<td>The response explains with accurate technical detail how each individual element of the packaging is manufactured to allow for consistency and customisation</td>
</tr>
<tr>
<td>2</td>
<td>5-8</td>
<td>The response explains with technical detail how customisation and consistency are ensured in individual components of the packaging</td>
</tr>
<tr>
<td>1</td>
<td>1-4</td>
<td>The response explains how customisation or consistency can be achieved within an aspect of the packaging</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

Indicative content: Guidance

Diagrams of manufacturing processes are not relevant to the question

Reference to flexography or offset lithography for printing the label should be credited as technical knowledge

- Reward reference to blow moulding process for main body and injection moulding for bottle lid such as:
  - Use of blow moulding with CNC produced moulds for accuracy.
  - Moulds are made in several parts which are monitored for wear and defects.
  - All bottles are marked with the mould number for traceability.
- Reward reference to relevant QA and QC procedures used to increase consistency e.g. monitoring materials (temperature etc.)
- Labels personalised to give an individual product from a mass produced item.
- Changing label colour to illustrate: diet, cherry etc.
- Only the label is personalised due to ease of flexibility with digital printing.
- Bottle form remains constant due to mould design.
- Speed of personalisation due to simple updates on design software using standard fonts.
- Reward reference to benefits of digital printing due to flexibility
- Reward reference to modifications when using offset lithography and flexography
Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.

Total 12 marks
Question 03

05 With references to examples, discuss the advantages and disadvantages of using 3D CAD modelling to develop design ideas. [12 marks]

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>9-12</td>
<td>A thorough discussion of both the advantages and disadvantages of 3D CAD software related to the examples is given covering a wide range of uses within the design development and modelling process.</td>
</tr>
<tr>
<td>2</td>
<td>5-8</td>
<td>A detailed discussion of the advantages and/or disadvantages of 3D CAD software is given covering uses within the design development and modelling process.</td>
</tr>
<tr>
<td>1</td>
<td>1-4</td>
<td>A basic discussion of how or why 3D CAD software is used, with simple examples.</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

Indicative content:
Advantages
- All components can be assembled on screen to check accuracy of angles etc. prior to production.
- Movement of components can be simulated to avoid interferences before production.
- Using photorealistic images the product can be viewed in a variety of colour schemes to market the product before production.
- CAD Renderings can be used to gain pre-production orders of the product, increasing sales.
- Material costs can be calculated and compared using a central material library within the software.
- Standardised components can be saved within the software reducing modelling time.
- Bought in components, such as bolts etc. can be downloaded and imported removing the need to draw from scratch.
- Design changes can be made promptly to the CAD model during pre-production testing and the results can be modelled/tested instantly.
- Designs can be saved after each change and then versions can be compared using pre-production testing facilities.
- Due to virtual testing prototyping costs are reduced.
- 3D CAD packages can be linked to rapid prototyping machinery to produce accurate 3D models for real world testing.
- CAD files can be sent world-wide instantly to allow rapid prototyping to take place in other countries.
- 3D CAD would allow the simulation of forces on products using FEA (Finite Element Analysis) or other simulations.
- Using CFD (Computational Fluid Dynamics) wind resistance can be calculated and reduced without investment in a wind tunnel.

Disadvantages
- The cost of the CAD software will take time to recoup.
- Investment in software training can be high and may require staff to gain a new skill set.
- Software maintenance contracts require extra investment.

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

Total 12 marks
Explain how modern rapid prototyping techniques can be used in idea development to improve efficiency and reduce product lead time.

[8 marks]

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>4</td>
<td>7-8</td>
<td>Specific rapid prototyping techniques are described with explanations of how they are used to improve efficiency and reduce lead time.</td>
</tr>
<tr>
<td>3</td>
<td>5-6</td>
<td>The response gives an explanation for the reasons of rapid prototyping use to improve efficiency or reduce lead time.</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>Rapid prototyping is explained with some reasons for use.</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>A description of prototyping techniques and uses within design development is given.</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

**Indicative Content:**
- Production of multiple iterations from a single CAD model
- Modelling and testing of wall thicknesses
- Testing of internal details, such as bosses and ribs
- Testing gears and mechanical systems to check operation
- Working prototypes can be tested with electronic components
- Environmental testing can be performed using polymer models
- Wax 3D printed components can be used as patterns in lost wax/investment casting.

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

**Total 8 marks**
Figure 8 shows a modular waterslide chute constructed from a fibre-reinforced polymer.

Suggest a suitable material and explain why it is suitable for the product.

In your answer you must refer to:

- manufacture
- function
- aesthetics.

[8 marks]

1 mark for a suitable fibre reinforced polymer:

Accept GRP or GFRP or Glass Reinforced Polymer or Glass Fibre Reinforced Polymer.

Accept CFRP or Carbon Fibre Reinforced Polymer although expensive as this may be used in some water parks where support structures are limited

Do not accept: Glass Fibre, Carbon Fibre.

1 mark for each suitable property/reason for its use, up to a maximum of 4

Award a second mark for a clear explanation of why the reason/property is applicable to the water slide context.

If only one bullet point is referred to max mark: 4
If only two bullet points are referred to max mark: 6

Indicative content:

Manufacture

- GRP is formed using a layup technique which uses a low cost material for the former, making it suitable for small scale production of modular water chutes with individual designs
- GRP can be reinforced with extra layers at bolt holes to resist stress
- GRP can have wooden inserts moulded into it to allow for easier attachment to other
components.

**Function**
- GRP is weather resistant, essential for a water chute
- GRP is chemical and water resistant, essential for cleaning the chute and during use.

**Aesthetics**
- A range of gel coats can be used to give a wide variety of colours needed for branding/marketing the water chute.
- The former can be exceptionally smooth meaning the GRP on the inside of the chute can have a polished finish to reduce the chance of injury from abrasion

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

*Total 8 marks*
Figure 9 shows a public fire alarm button.

A manufacturer is testing a range of replacement materials for the front transparent panel.

Using annotated diagrams, describe a test that could be used to check the material’s suitability for the front transparent panel.

[10 marks]

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 (Thorough)</td>
<td>8-10</td>
<td>A thorough description of a suitable test for toughness/brittleness is given with appropriate diagrams. Measurements to be taken should reference a contextualised ‘breaking force’.</td>
</tr>
<tr>
<td>3 (Detailed)</td>
<td>5-7</td>
<td>A detailed description of a suitable test for toughness/brittleness is given with reference to what is measured and how. Clear diagrams should be included.</td>
</tr>
<tr>
<td>2 (Clear)</td>
<td>2-4</td>
<td>A suitable test for toughness/brittleness is described, simple diagrams should be included with reference to measurements.</td>
</tr>
<tr>
<td>1 (Basic)</td>
<td>1</td>
<td>Toughness/brittleness has been identified and described.</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>
Indicative Content:

Do not credit reference to a specific material.
Credit reference to safety of broken material (fracture characteristics)
- Toughness is ability of a material to resist impact.
- All sample materials must be of the same cross section/thickness
- The weight must be dropped from the same height each time and must not be forced (gravity only)
- The material must not be supported where the force is applied
- The material used here must break, therefore needs a degree of brittleness to work.
- *The force applied must resemble the force applied by a member of the public hitting the panel with the hand.*

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

Total 10 marks
With the aid of sketches explain each of the following communication methods and where each method would be used during the design process.

- orthographic projection
- 2-Point perspective sketching.

[2 x 6 marks]

<table>
<thead>
<tr>
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</tr>
</thead>
</table>
| 3     | 5-6   | • A detailed and identifiable sketch of the communication method is shown.  
        |       | • The communication method is appropriately linked to the relevant stage in the design process with justification for its use at this point. |
| 2     | 3-4   | • A clear sketch of the communication method is shown.  
        |       | • The communication method is linked to a relevant stage of the design process. |
| 1     | 1-2   | • A basic sketch of the communication method or description of its use is shown. |
|       | 0     | Nothing worthy credit. |

Indicative Content: (Guidance)

Orthographic projection
Diagram below worth 3 marks
hidden detail and dimensions can be given credit in the description or the diagrams.

- Used for 2D elevations of a design
- Ideal for showing dimensions
- Used to communicate within the design team and manufacturers/makers.
### 2-Point perspective sketching

Diagram below worth 3 marks

**NO MARKS FOR A 1 POINT PERSPECTIVE SKETCH**

- Used during generation of design ideas.
- Used in focus groups and client meetings.
- Used to give specific viewpoint related to horizon line.
- Can be colour rendered for final concept presentations.

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

**Total 12 marks**
Below are two specific hazards associated with operating a pillar drill.

For each hazard explain the range of safety measures that are used to reduce the risk to the machine operator.

- entanglement
- flying debris.

[2 x 3 marks]

Award 1 mark for details of a specific safety measure used to address one of the hazards mentioned, up to a maximum of 3 per hazard.

Do not reward generic safety measures, such as use of appropriate PPE unless the PPE is specific.

**Indicative content:**

1 mark for appropriate eyewear (only award for flying debris)
1 mark for appropriate protective clothing (only award once)

**Entanglement with the chuck:**
- Operators instructed to wear workshop coat/apron and tie all loose/dangling items away.
- Installation of kick/knee switch that can be operated if in danger.
- Installation of emergency shut off buttons around workshop to allow others to assist from distance.
- Braking system ensures the chuck stops rotating promptly.
- Machine must conform to current safety regulations.
- Signage on machines to warn operator of hazards.

**Flying Debris**
- Operators instructed to wear appropriately specified eye protection.
- Installation of micro switch cut out on chuck guard to prevent operation without appropriate guarding in place.
- Chuck key fitted with spring to prevent leaving in chuck when the lathe is switched on.

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

**Total 6 marks**
Question 05

11 Explain how quality assurance and quality control procedures can reduce the risk of faults when producing large volumes of products on a production line.

Give specific examples in your answer.

[14 marks]

<table>
<thead>
<tr>
<th>Level</th>
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>11-14</td>
<td>The response uses specific examples to comprehensively discuss a range of appropriate and relevant quality assurance and quality control procedures that are used within large volume production.</td>
</tr>
<tr>
<td>3</td>
<td>7-10</td>
<td>The response uses relevant examples to provide a clear discussion of a range of quality control and/or quality assurance procedures used in large volume production.</td>
</tr>
<tr>
<td>2</td>
<td>3-6</td>
<td>The discussion is clear and provides details of quality assurance or quality control procedures that may be used in large volume production.</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>The discussion provides basic details of possible quality control or quality assurance procedures that could be used in large volume production.</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

Indicative Content:

Quality Assurance:
- Setting appropriate tolerances and schedules/systems to reduce defects
- Use of machine maintenance schedules to check calibration
- Machine tooling will be assessed on a regular basis to check for wear which could affect dimensional accuracy
- Assembly stations are issued with recognised fault list and images to raise awareness
- Computer operated QC machines are regularly checked with failed products to assess calibration and accuracy
- All QC workers are given set break intervals to ensure consistency

Quality Control:
- Using regular interval checks/random sampling every hour will allow manufacturers to check the consistency of production procedures
- Interval checks will be performed away from the production line on a sample of products
- Simple visual checks on the appearance of the product will look for scratches/indentations, colour issues, build quality issues etc.
- Machine alignment checks will take place to ensure consistency within the final product
- Sample dimension checks will take place using a Vernier calliper or micrometer to check that products are being produced within set acceptable tolerances
- Destructive testing may be used on a small sample of products at random intervals, this may take the form of a drop test to check the product will withstand being dropped from a pre-determined height set by the manufacturer as a pass level.
- Any products that go through destructive testing will continue being tested until they are destroyed and a maximum reading is given. They are not returned to the production line.

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

Total 14 marks

12 Modern manufacturing relies on efficient use of resources.

Describe a range of systems used to prevent over-production and reduce storage costs.

Give specific examples in your answer.

[14 marks]

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>11-14</td>
<td>A thorough discussion of how modern manufacturing systems are organised to reduce over-production and storage costs. The response refers to a wide range of systems.</td>
</tr>
<tr>
<td>3</td>
<td>7-10</td>
<td>A detailed discussion of how modern manufacturing systems are organised to reduce over-production and storage costs. The response refers to a range of systems.</td>
</tr>
<tr>
<td>2</td>
<td>3-6</td>
<td>A clear discussion of how modern manufacturing systems are organised to reduce over-production and storage costs.</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>A basic discussion of how modern manufacturing systems are organised to reduce storage costs.</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

Indicative Content:
Below are several areas that may be referred to, each area may be explained with specific details. Candidates should be rewarded with marks for reference to systems and then further rewarded for justification/explanation of the system.

- Flexible manufacturing systems.
- Use of modular designs where components can be interchanged to give vast numbers of variable designs.
- Use of Just In Time/ lean production methods to prevent stock piling.
- Use of suppliers who conform to ISO 9001 to ensure that JIT can be effectively implemented.
- Use of local supply chains.
- Vertical in house production to support JIT.
- Use of EPOS systems to track consumer habits and produce products to deal with this demand.
- Use of Kanban systems to maintain stock levels during assembly.

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

Total 14 marks
Question 6

13 **Figures 10** and **11** show two chaise longue seats (recliners).

Compare and contrast the two seats shown.

In your answer you should refer to:

- practicality
- aesthetics
- target market.

**[12 marks]**

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>9-12</td>
<td>The response compares and contrasts the two products shown with reference to all the bullet points within the question and a clear understanding of the associated design movement.</td>
</tr>
<tr>
<td>2</td>
<td>5-8</td>
<td>The response compares the products referring to the bullet points within the question and with reference to the associated design movements.</td>
</tr>
<tr>
<td>1</td>
<td>1-4</td>
<td>The response analyses the product features referring to the bullet points.</td>
</tr>
<tr>
<td></td>
<td>0</td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

**Indicative Content:**

1 mark for a relevant point
2nd mark for a detailed explanation of the point

**Figure 9: Lockheed Lounge**

- Described as needing to be ‘more comfortable than a bus stop’ by Marc Newson.
- Functionality was secondary to the aesthetics of an amorphous metallic ‘blob’ (blobism).
- Riveted exterior makes the surface uncomfortable, aluminium is hard and cold to sit on.
- Inspired by Aircraft design
- The polished aluminium will show scratches from clothing such as studs on jeans.
- Designed more as a sculpture than a chair the Lockheed lounge was an investigation into what was possible with the material.
- One of only 13 made they sell for in excess of £1 million each.
- Each chair was hand made giving a one off feel.
- A status symbol for the elite rather than a practical chair.

**Figure 10: LC4**
- Using tubular steel and leather the LC4 follows the ‘form follows function’ motto of Bauhaus.
- Technologically advanced for the time it challenged perceptions of how a chaise should look.
- Designed to embrace the machine aesthetic
- Designed for large scale production.
- Adjustable position to suit many users and functions.
- The form of the chaise was designed with function at the heart of it sculpting to fit the body.
- The leather upholstery was minimal in volume for the time, but was forgiving and allowed the seat to mould to the individual.

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

**Total 12 marks**
Using specific examples describe how each of the technological developments listed below has impacted on furniture design.

- injection moulding
- lamination.  

[2 x 8 marks]

<table>
<thead>
<tr>
<th>Level</th>
<th>Marks</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>7-8</td>
<td>A specific product example has been used. A variety of points have been made with justifications for the impact on furniture design. (diagrams may be shown)</td>
</tr>
<tr>
<td>3</td>
<td>5-6</td>
<td>An appropriate product example has been used. The points that have been made are explained clearly and related to the impact on furniture design. (diagrams may be shown)</td>
</tr>
<tr>
<td>2</td>
<td>3-4</td>
<td>An appropriate product has been used to discuss the impact of the technology on furniture design.</td>
</tr>
<tr>
<td>1</td>
<td>1-2</td>
<td>A basic discussion of the introduction of the technology and its impact has been shown.</td>
</tr>
<tr>
<td>0</td>
<td></td>
<td>Nothing worthy of credit.</td>
</tr>
</tbody>
</table>

Award a maximum of 8 marks for each of the technological developments mentioned.

1 mark for a specific example product (MAX 2 PER TECHNOLOGY)

DO NOT REWARD MANUFACTURING PROCESS DIAGRAMS

**Indicative Content:**
Content below may be shown through clear diagrams.

**Injection moulding:**
- The introduction of single piece furniture, not possible with timber.
- Simple mass produced furniture available in a wide range of colours that could be tailored to your household.
- The addition of in mould textures and finishes that removed the need for applied finishes
- The production low maintenance, weather resistant outdoor furniture.
- The addition of internal reinforcements such as ribs etc. to reduce weight.

**Example products:**
Injection moulding: Polyprop chair, Panton chair, Monobloc garden chair, Louis Ghost.

**Lamination: (laminated veneers or laminated surfaces)**
- Combining the aesthetic appeal of natural grain structures in veneers, with the flexibility and curvaceous forms of laminated timber.
- Allowing single piece complex curves to be formed from timber.
- Fits ideally with the functional nature of modern product design due to lack of ornamentation.
- Lamination of thermosetting polymers with manufactured boards to improve material properties, such as water and chemical resistance
- Laminated surface give increased value and variation as seen in the Carlton Dresser by Ettore Sottsass

**Example products:**
Lamination: LCW, Ant chair, Marcel Breuer chaise for Isokon, Ikea furniture, Memphis products.
Note: This indicative content is not exhaustive: other creditworthy responses should be awarded marks as appropriate.

Total 16 marks