Section A

Answer two questions from one of the Parts A, B or C.

Part A – Product Design

1 Fig. 1 shows the design of a holder used to display ear rings.

(a) State a suitable material for the holder giving reasons for your choice. [3]

(b) Describe, using sketches and notes, how you would make the prototype holder. [8]

(c) Explain what changes may be necessary in the manufacturing method used and in the material selected if 10 000 holders were required.

Use notes and sketches to support your answer. [9]
When selecting an appropriate surface finish for a product, a designer must consider:

- the material from which the product is made;
- visual / functional requirements;
- the environment in which the product is to be used.

Discuss how these factors are taken into consideration in the design of

either

- a coffee table for an executive business suite

or

- a mild steel ornamental garden gate.

[20]
Choose two of the items shown in Fig. 2 and for each:

(a) use notes and sketches to describe the manufacturing process that relates to the chosen item; [7 × 2]

(b) explain why the process is particularly suitable for the production of the item. [3 × 2]
4 (a) Use one example from each of the three classes of lever to explain how mechanical advantage is calculated. [9]

(b) Use one example to explain how energy efficiency is calculated. [3]

(c) (i) Use notes and sketches to explain how linear motion is achieved by using a pneumatic force. [5]

(ii) Identify a product that uses pneumatic force to create linear motion.
Describe why pneumatic force is appropriate in your chosen product. [3]

5 (a) Draw out and complete the table shown in Fig. 3 by selecting four materials from the list below.

Aluminium has been completed as an example.

Concrete  Timber  Rubber  Copper  Lead  Thermosetting plastic

<table>
<thead>
<tr>
<th>Material</th>
<th>Properties</th>
<th>Specific applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>aluminium</td>
<td>lightweight, very good anti-corrosion properties, can be alloyed to increase strength</td>
<td>cooking foil, pans, building cladding, car components</td>
</tr>
</tbody>
</table>

Fig. 3 [12]

(b) Give two examples of new materials and explain how they have affected the design and manufacture of products. [8]

6 (a) The truth table for five logic gates, V, W, X, Y and Z are given below.

Draw the symbol and give the name for each gate. [10]

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>V</td>
</tr>
<tr>
<td>0 0</td>
<td>0</td>
</tr>
<tr>
<td>0 1</td>
<td>0</td>
</tr>
<tr>
<td>1 0</td>
<td>0</td>
</tr>
<tr>
<td>1 1</td>
<td>1</td>
</tr>
</tbody>
</table>

(b) Use two examples to explain the purpose and function of a digital – analogue converter. [10]
Fig. 4 shows orthographic views of a lectern.

(a) Produce, to a scale of approximately 1:10, a two point perspective presentation drawing of the lectern.

Select a view that gives maximum detail. [15]

(b) Render the drawing to show that the plinth and table are made of wood and that the column is made of polished steel. [5]
Fig. 5 shows details of a model for a wastepaper bin.

(a) Draw, to an appropriate scale, a development (net) of the wastepaper bin.
   Include the development of the top to show the true shape of the wastepaper bin lid. [10]

(b) A foot-operated pedal is to be included to enable the user to open the lid.
   Use notes and sketches to show full details of a mechanism that could be used to open the lid when the pedal is depressed. [10]
Fig. 6 shows a full size isometric view of a bracket.

(a) (i) Take measurements from Fig. 6 to draw views A and B to a scale of 2:1 in orthographic projection. Do not include hidden detail. Include the symbol to show the angle of projection. [7]

(ii) Fully dimension the drawings. [3]

(b) Designers use a range of graphical techniques to communicate ideas.

Give one example to describe each of the following:

- sectional drawing;
- exploded drawing.

Use notes and sketches to support your answer. [5 × 2]
Section B

Answer one question on the A3 paper provided.

You should approach the design question of your choice in the following manner:

Analysis
   Produce an analysis of the given situation/problem, which may be in written or graphical form. [5]

Specification
   From the analysis produce a detailed written specification of the design requirements. [5]

Exploration
   Use bold sketches and brief notes to show your exploration of ideas for a design solution, with reasons for selection. [25]

Development
   Show, using bold sketches and notes, the development, reasoning and composition of ideas into a single design proposal. Give details of materials, constructional and other relevant technical details. [25]

Proposed solution
   Produce drawings of an appropriate kind to show the complete solution. [15]

Evaluation
   Give a written evaluation of the final design solution. [5]

[Total: 80]
The caretaker at a local school often has to move chairs from rooms around the school to use in the main hall for music or drama productions.

Design a device that:

- can transport up to six chairs at a time;
- can be easily folded or disassembled for storage.

To assist you in your design work, dimensions of a chair are given in Fig. 7.
The teaching of mechanisms to students between the ages of 14 and 16 can be made more interesting and exciting by using working models to demonstrate the basic principles involved.

Design a working model to demonstrate the mechanical principles of **two** of the following:

- levers;
- linkages;
- cams;
- cranks.

The model must allow for a range of interchangeable parts to be used e.g. different cam profiles.

Sunrise Farm requires containers made from card to enable customers to pick their own tomatoes, have them weighed for payment and take them home.

Design a container that:

- is made from one A3 sheet of card;
- is easily assembled, without the need for adhesives, into a container with a carrying handle;
- includes graphics to help promote ‘Sunrise Farm Products’.

Your proposed solution must include a development (net) of the container.