Please write clearly, in block capitals

Centre number _____ **Candidate number** _____

Surname _____

Forenames(s) _____

Candidate's signature _____

A-Level - Design & Technology (Product Design)

Date of Exam _____ **Time allowed: 2 hours 30 minutes**

Materials

For this paper you must have:

- normal writing and drawing instruments
- a scientific calculator

Instructions

- Use black ink or black ball-point pen. Use pencil only for drawing
- Fill in the information at the top of this page
- Answer all questions
- You must answer the questions in the spaces provided. Do not write on blank pages
- Do all rough work in this paper. Cross through any work that you do not want to be marked

Information

- The marks for questions are shown in brackets
- The maximum mark for this paper is 120

1. Select the most suitable adhesive from the list below to complete the table in **figure 1**. **[3 marks]**

   You may only use an adhesive **once**.

   - Contact adhesive
   - Epoxy resin
   - PVA
   - Solvent cement

Figure 1

Materials to be bonded	Specific adhesive
Plywood sheet to beech veneer	
HIPS (high impact polystyrene) sheet to acrylic rod	
Melamine formaldehyde veneer to MDF (medium density fibreboard) board	

2. Stainless steel is an example of a metal alloy.

   (a) Give the meaning of the term 'alloy' and briefly explain why they are created. **[2 marks]**

   (b) Give **two** specific examples of an alloy, aside from stainless steel. **[2 marks]**

3. Timber is sold in a variety of stock forms. Describe the stock forms given below.

(a) Planed square edge (PSE) **[2 marks]**

(b) Mouldings **[2 marks]**

4. A wooden garden shed is to be repainted to improve its aesthetic appearance and provide a longer working life.

   Identify, in the correct sequence, **six** appropriate stages required in the preparation and painting of the garden shed. **[6 marks]**

Stage 1

Stage 2

Stage 3

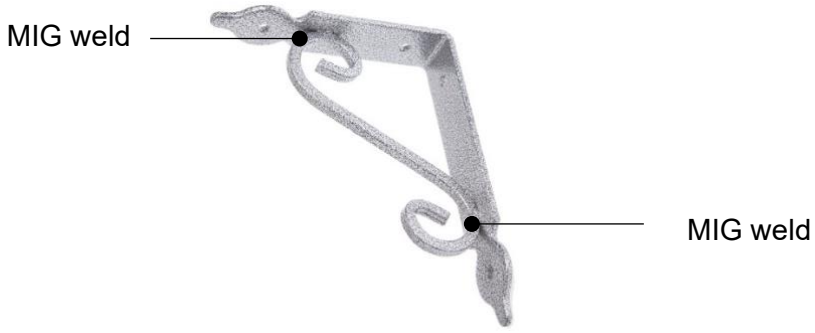
Stage 4

Stage 5

Stage 6

5. Define the meaning of the term 'biodegradable polymer' and evaluate the use of biodegradable polymers in consumer products. **[4 marks]**

6. The steel bracket below has been joined permanently by MIG (metal inert gas) welding. Describe, using notes and sketches, the process of MIG welding the two separate parts of the bracket together. **[9 marks]**



7. The photographs below show the end section of two different timber beams used in the construction of timber framed houses.

   One is made from single, solid timber lengths, the other has been fabricated using lamination.

Figure 2	Figure 3
	
Manufactured from whole timber lengths	Fabricated from laminated pieces

Compare and evaluate the suitability of the two different types of timber for the construction of a timber framed house. Your answer should make reference to:

- Manufacturing processes
- Physical and working properties
- Environmental implications **[12 marks]**

8. The photo below shows a small set of aluminium steps for use around the home. A design company has been asked to redesign the steps to reduce the manufacturing costs.

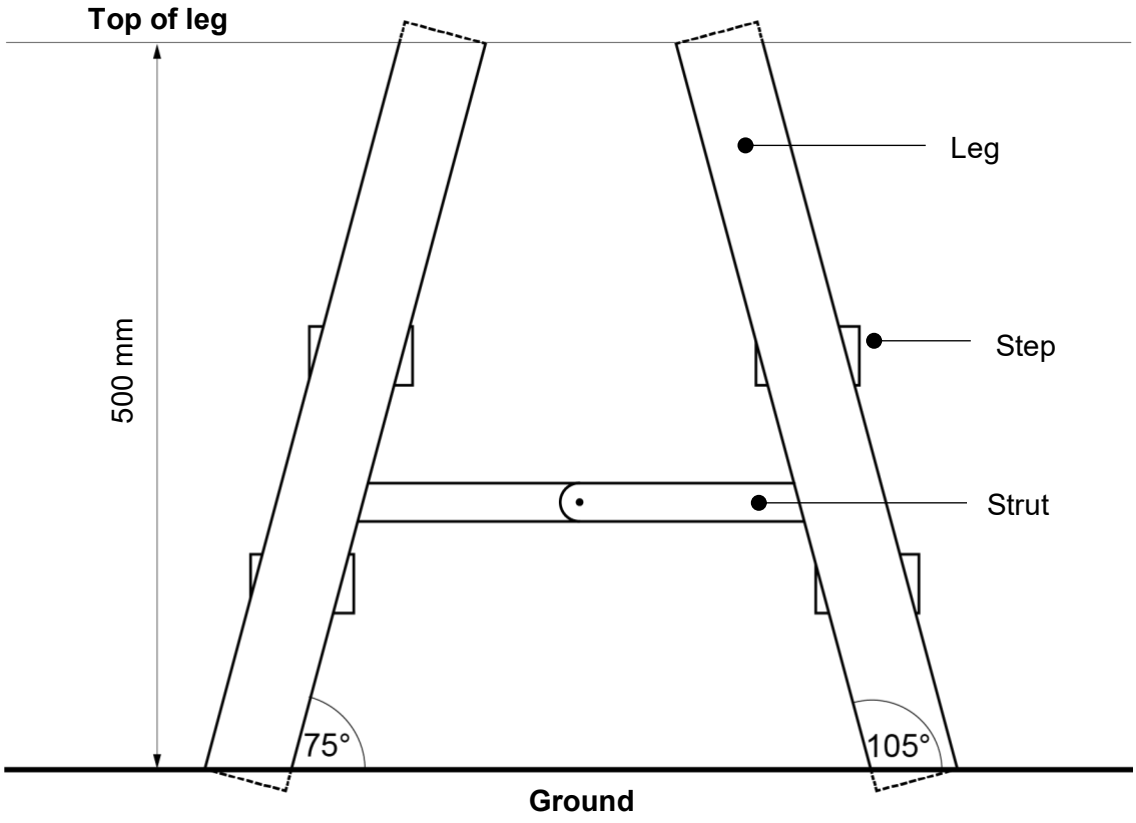
(a) As part of the design process, the designer needs to calculate the mass of the four legs in order to establish the total mass of the final product. They know that:

- The density of aluminium is 2.7g/cm^3
- The design requires 2.4 metres of a hollow aluminium extrusion with the following rectangular profile: 40mm x 20mm; wall thickness 2mm.

Calculate the mass of the 2.4 metres of aluminium extrusion required for one set of legs for the steps. Round your answer to the nearest whole gram. **[4 marks]**

(b) The designer now needs to calculate the exact amount of material required to make four identical legs. They know that:

- The safe opening angle between each leg and the ground needs to be 75 degrees
- When the steps are erected, the height from the ground to the top of the leg is 500mm
- The ends of each leg will be cut at an identical angle of 105 degrees



Calculate the length of material required to make one leg. Round up to the nearest whole millimetre. **[4 marks]**

(c) The required rectangular extrusion is sold in 5 metre lengths at the cost of £12.82 per length.

Calculate the cost of manufacturing 4 legs for 100 sets of steps.
Assume no waste from saw cuts. **[3 marks]**

(d) The designer is considering the viability of producing a second similar set of steps using steel which requires a powder coated finish.

State **three** reasons why a powder coated finish would be appropriate for this product. **[3 marks]**

1.

2.

3.

(e) Give **five** stages in the process of powder coating a product. **[5 marks]**

1.

2.

3.

4.

5.

9. The cordless drill shown below is manufactured using injection moulding with elastomer elements on its body.

(a) Give a specific polymer used in the manufacture of the main drill body. **[1 mark]**

(b) Give a suitable elastomer for the grip of the drill. **[1 mark]**

(c) Explain **one** reason why an elastomer would be used on the handle of the cordless drill. **[2 marks]**

(d) Describe the benefits to the manufacturer of using the injection moulding process in the production of the cordless drill. **[6 marks]**

10. Designers and manufacturers must ensure products are safe for consumers to use.

Explain how each of the following promote safety in products:

(a) The British Standards Institute (BSI). **[4 marks]**

(b) The Consumer Rights Act (2015) **[4 marks]**

11. Metals can have their properties altered and enhanced using heat treatments.

    Explain how heat is used to perform the following treatments. Make reference to carbon in each case:

    (a) Case hardening. **[4 marks]**

    (b) Hardening and tempering. **[4 marks]**

12. Name and accurately sketch a wood joining method for each category listed in the following **three** boxes.

Wood joining method
Name a traditional timber frame joint **[1 mark]**
Sketch of named joint **[3 marks]**

Name a traditional carcase/box joint **[1 mark]**

Sketch of named joint **[3 marks]**

Name a knock down (KD) fitting **[1 mark]**

Sketch of named knock down fitting **[3 marks]**

13. Study the two different types of signs pictured below.

Fluted polypropolene polymer 'sold' sign bolted to a softwood post

Aluminium sheet metal road sign bolted to a galvanised steel post

Compare and evaluate the suitability of the two types of sign used to perform their function. **[12 marks]**

In your answer, you should make reference to:

- The materials used
- Fabrication and construction

14. This Dyson vacuum cleaner is protected by over 50 patents covering filters, suction mechanisms and so on. There are seven elements of the product that are registered designs and the Dyson branding and packaging is protected by copyright laws.

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It is advisable for companies, designers and manufactures to protect their designs and intellectual property.

Evaluate the statement above with reference to the Dyson product above. **[9 marks]**

In your answer you should refer to:

- Copyright
- Patents
- Registered designs

END OF QUESTIONS