Oxford Cambridge and RSA

# Thursday 18 November 2021 – Afternoon

## GCSE (9–1) Design and Technology

**J310/01** Principles of Design and Technology

**Time allowed: 2 hours**

**You must have:**
- the Insert (inside this document)

**You can use:**
- a scientific calculator
- a ruler (cm/mm)
- geometrical instruments

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) _____

Last name _____

**INSTRUCTIONS**
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.
- Answer **all** the questions.
- Use the Insert to answer the questions in Section B.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.

**INFORMATION**
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **24** pages.

**ADVICE**
- Read each question carefully before you start your answer.

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## SECTION A

Answer **all** the questions.

**1** **Fig. 1** shows images of a box of chocolates.

**Fig. 1**

**(a)** The box is made from cardboard.
Give **three** reasons why cardboard is a suitable material for the chocolate box.

1 .....

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2 .....

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3 .....

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**[3]**

**(b)** The tray in the chocolate box is made from a thermo polymer.

Name **one** thermo polymer.

..... **[1]**

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**(c)** Some of the chocolates are wrapped in aluminium foil, a non-ferrous metal.

Name **one** other non-ferrous metal.

..... **[1]**

**(d)** Explain **three** ways the packaging of the chocolates shown in **Fig. 1** could be designed or manufactured in a more sustainable way.

1 .....

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2 .....

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3 .....

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**[6]**

**(e)** Designers are increasing the use of biopolymers in product packaging.

What is a biopolymer?

.....

..... **[1]**

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**(f)*** Many designers and manufacturers are using biopolymers and sustainable materials in the design of packaging.

Discuss the reasons why biopolymers and sustainable materials are used in packaging.

Use examples to support your answer.

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..... **[8]**

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**Turn over for the next question**

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**2** **Fig. 2** shows a traditional style deck chair.

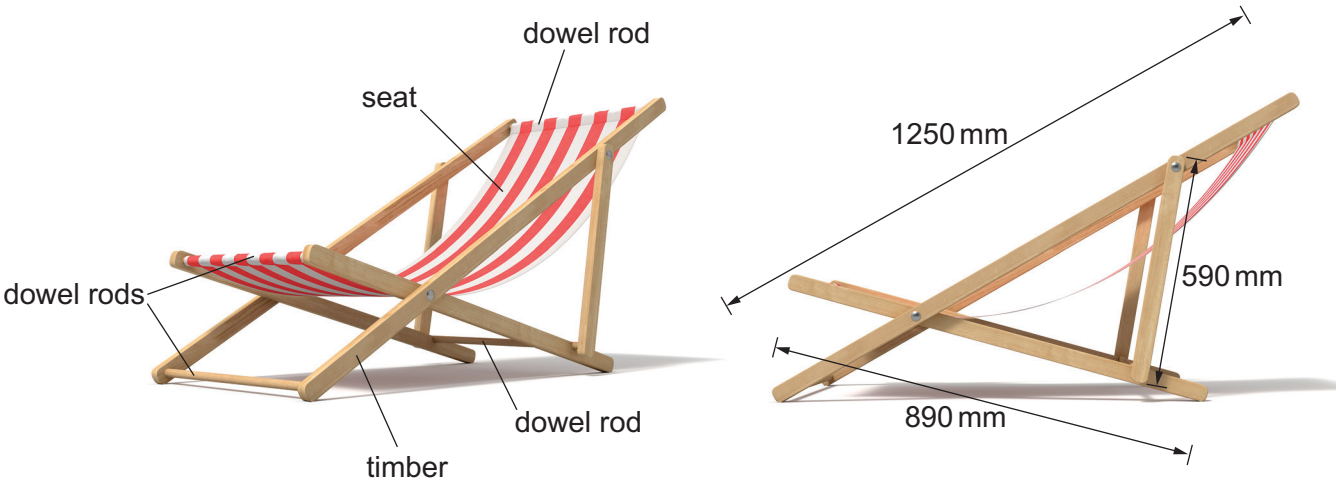


**Fig. 2**

**(a)** **(i)** The deck chair seat is made from a rectangular piece of woven fabric measuring 500 mm wide and 1370 mm long.

Calculate the area of fabric needed to make **one** deck chair.

State the unit for your answer.

Area of fabric ..... Unit ..... **[2]**

**(ii)** The woven fabric is manufactured in 1 m × 50 m rolls.

Calculate how many deck chair seats can be cut from **one** roll of fabric.

Number of deck chair seats ..... **[3]**

**(iii)** The deck chair seat is made from a woven fabric, which makes it strong.

Describe how the construction of a woven fabric makes it strong.

.....

..... **[1]**

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**(b)** The deck chair frame in **Fig. 2** is made from six pieces of timber (excluding dowel rods).

The timber is supplied in standard lengths of 1800 mm.

The standard lengths of timber **cannot** be joined.

Calculate the **minimum** number of standard lengths of timber needed to make the frames (excluding dowel rods) for a batch of **50** deck chairs.

Number of standard lengths ..... **[4]**

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**(c)** Hex-headed bolts are used in the manufacture of the deck chair.

The bolts are supplied in packs of 10.

One pack of 10 bolts cost £19.99.

**(i)** Each deck chair uses **four** bolts.

Calculate the total cost of the bolts needed to make **50** deck chairs.

Total cost £ ..... **[2]**

**(ii)** The supplier of the bolts gives a discount if the manufacturer buys the bolts in bulk.

The manufacturer purchases 400 packs of bolts at a cost of £5997.

Calculate the percentage discount the supplier has given.

Discount ..... % **[3]**

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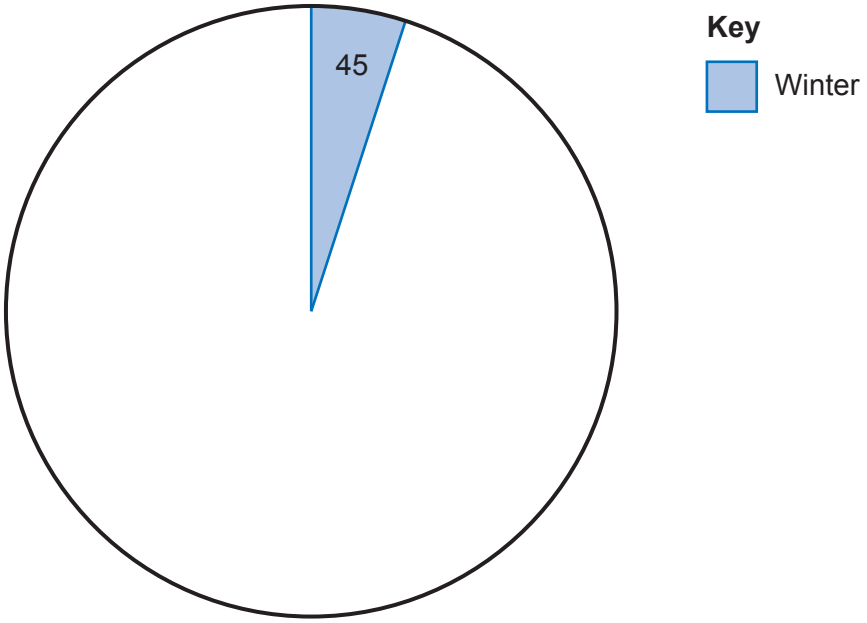
**(d)** The table below shows deck chair sales per season in the year 2020.

| **Season** | **Number of sales per season** |
|---|---|
| **Winter** | 45 |
| **Spring** | 315 |
| **Summer** | 450 |
| **Autumn** | 90 |
| **Total sales in 2020** | 900 |

Complete the pie chart to show the total deck chair sales in 2020 for each season.

Winter has been done for you.

Add labels or a key.




**Total sales per season in 2020**

**[3]**

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**3** **Fig. 3a** shows a children's night light.

The night light is hollow and moulded from a polymer material in a shell form.

The night light turns on automatically when it gets dark as shown in **Fig. 3b**.

**Fig. 3a**

**Fig. 3b**

**Fig. 4** shows the instructions for the night light.

**How to use**
Batteries located under the light.

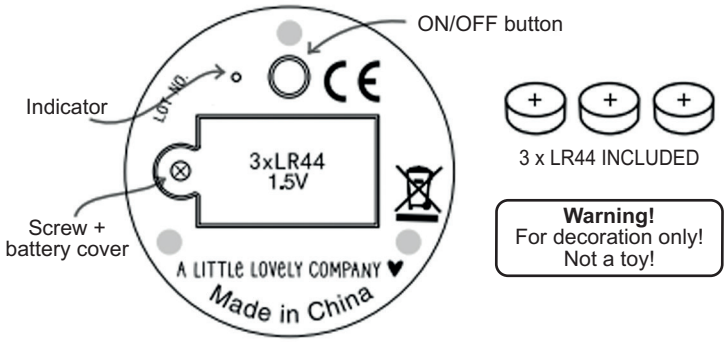


**Fig. 4**

**(a)** **(i)** Complete the missing information in the table below for the children's night light.

| **Function** | **Input or output** | **Electronic component** |
|---|---|---|
| Detects light and produces a signal | ..... | ..... |
| Produces light | Output | ..... |
| ..... | Input | Switch |

**[4]**

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**(ii)** The night light has been designed to be powered by batteries.

Give **one** advantage of using batteries instead of mains electricity.

..... **[1]**

**(iii)** Describe **one** way the designer has made sure the night light is safe for use by children.

.....

..... **[1]**

**(b)** Renewable energy can be used to create electricity.

**(i)** Complete the missing information in the table below.

| **Description of how renewable energy is used to create electricity** | **Type of renewable energy** |
|---|---|
| A dam is used to trap water; when water is released it turns turbines which turn generators | ..... |
| ..... ..... | Wind power |
| Photovoltaic cells convert light to electricity | ..... |
| Fuel (wood, organic material, sugar cane etc) is burnt to generate heat which creates steam and turns turbines which turn generators | ..... |

**[4]**

**(ii)** Give **two** reasons why fossil fuels are considered bad for the environment.

1 .....

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2 .....

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**[2]**

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**(c)** The wall stickers shown below contain a phosphorescent pigment that glows in the dark.

**(i)** Phosphorescent pigment is a smart material.

Identify **one** other smart material.

..... **[1]**

**(ii)** Describe **two** other ways designers are using smart materials in products to improve their functionality or benefit the users.

1 .....

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2 .....

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**[4]**

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## SECTION B

Answer **all** the questions.

For **all** questions in Section B you **must** refer to the **Insert** which contains images and information about products that are used in a kitchen.

**4** Refer to **page 8** of the Insert.

**(a)** **Image A** shows a garlic crusher. The user places the garlic bulb into the chamber and squeezes the handles to crush the garlic.

**(i)** Identify the type of mechanism used in the garlic crusher.

..... **[1]**

**(ii)** Explain why mechanisms are commonly used in kitchen gadgets.

.....

..... **[2]**

**(b)** **Image B** shows a saucepan. The body of the saucepan is made from a metal and the handle is made from a thermosetting polymer.

Explain **one** reason why a thermosetting polymer is suitable for the saucepan handle.

.....

.....

..... **[2]**

**(c)** **Image C** shows a wooden chopping board and utensils.

**(i)** Name **one** hardwood.

..... **[1]**

**(ii)** Give **two** reasons why the designer may have chosen to make the chopping board and utensils from wood.

1 .....

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2 .....

.....
**[2]**

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You need to answer questions **5** and **6** in relation to **one** of the products listed below covering an area you have studied in depth.

Information about the products is contained in the **Insert**.

Before you choose a product, read all parts of questions 5 and 6.

You **must** tick **one** box below to indicate your chosen product.

- ☐ **Product 1:** Recipe cards – (papers and boards)
- ☐ **Product 2:** Oven glove – (fibres and fabrics)
- ☐ **Product 3:** Electronic thermometer – (design engineering)
- ☐ **Product 4:** Cutlery tray – (polymers)
- ☐ **Product 5:** Food grater – (metals)
- ☐ **Product 6:** Recipe book/tablet stand – (timbers)

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Study and use the images and information about your chosen product given in the Insert.

**5** The table below shows the manufacturing processes used to make your chosen product commercially.

| **Product** | **Commercial manufacturing process** |
|---|---|
| Product 1: Recipe cards (papers and boards) | Lithography printed, lamination |
| Product 2: Oven glove (fibres and fabrics) | Quilted, overlocked and sewn |
| Product 3: Electronic thermometer (design engineering) | Surface mounted printed circuit board (PCB) **or** injection moulded casing |
| Product 4: Cutlery tray (polymers) | Vacuum formed |
| Product 5: Food grater (metals) | Stamped and press formed |
| Product 6: Recipe book/tablet stand (timbers) | Lamination |

**(a)** Explain the key features of the manufacturing process that has been used to manufacture your chosen product.

Include details of **any jigs, templates and formers** used.

You may use sketches and notes.

**[9]**

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**(b)** The choice of materials is important when designing products for use in a kitchen.

**(i)** Choose **one** material used in your chosen product. Identify **two** properties of the material that make it suitable for the product.

Material .....

1 .....

.....

2 .....

.....

**[2]**

**(ii)** Describe **two** environmental factors the designer may have considered when selecting the specific material(s) used in your chosen product.

1 .....

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2 .....

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**[2]**

**(c)** Designers often use iterative models when designing new products.

**(i)** Explain **three** reasons why designers use iterative modelling during the design process.

1 .....

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3 .....

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**[6]**

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**(ii)** Describe the materials or techniques you could use in a school workshop to make **two different** early iterative models of your chosen product.

Include details of:
- any tools or processes
- the methods you would use.

Iterative model 1 .....

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Iterative model 2 .....

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**[6]**

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**6** You should use the **same** product you chose for Question 5 to answer this question.

**(a)** When designing products for use in a kitchen environment ergonomics must be considered.

Describe **two** ergonomic features of your chosen product.

1 .....

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2 .....

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**[4]**

**(b)*** 'Form follows function' is a principle often used to describe when the aesthetic shape of a product is based on its function.

Discuss the importance of this principle when designing products suitable for use in a kitchen.

Use examples to support your answer. **[8]**

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**END OF QUESTION PAPER**

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## ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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