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Design technology
Higher level and standard level
Paper 2

Friday 14 May 2021 (morning)

Candidate session number

1 hour 30 minutes

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Instructions to candidates

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all questions.
- Section B: answer one question.
- Answers must be written within the answer boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[50 marks]**.



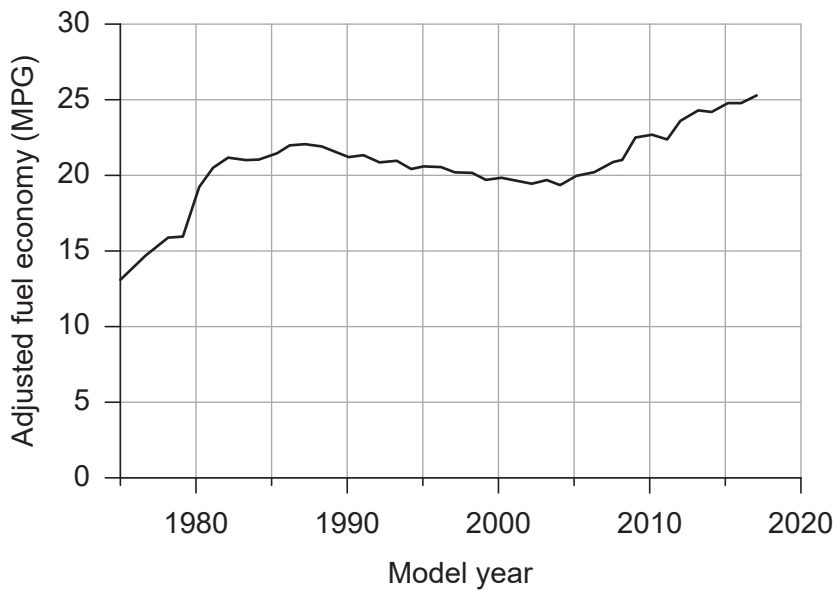
Section A

Answer **all** questions. Answers must be written within the answer boxes provided.

- 1. The United States Corporate Average Fuel Economy (CAFE) standards were created to improve the energy efficiency of vehicles. The standards are aimed at reducing oil consumption and air pollution.

Figure 1 shows average adjusted fuel economy of vehicles in the United States in miles per gallon (MPG).

Figure 1: Adjusted fuel economy of vehicles in the United States



- (a) (i) Define the term *non-renewable resource*. [1]

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- (ii) Describe **one** characteristic of waste mitigation strategies. [2]

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(Question 1 continued)

- (b) (i) Outline why the United States is using CAFE to encourage car makers to improve fuel efficiency and carbon emissions. [2]

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- (ii) List **two** ways that car manufacturers can improve fuel efficiency. [2]

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(Question 1 continued)

- (c) (i) Many governments have tried to reduce the quantity of oil consumed.

Outline **one** strategy a government can use that will lead to a reduction in oil consumption.

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- (ii) Explain why some governments may be reluctant to introduce environmental legislation.

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(Question 1 continued)

Many aircraft manufacturers have tried to reduce the weight of their aircraft as much as possible without compromising the performance or safety.

Boeing has focussed on the development and use of composite materials and have developed what they claim is the lightest metal in the world. It is made from nano sized nickel tubes in a 3D polymer cell structure. It is similar to human bones which have a hollow open cellular structure, see **Figure 2**.

As well as being incredibly light, see **Figure 3**, these composite materials have a high compressive strength and are used as structural components in planes.

Figure 2: Interior of human bones

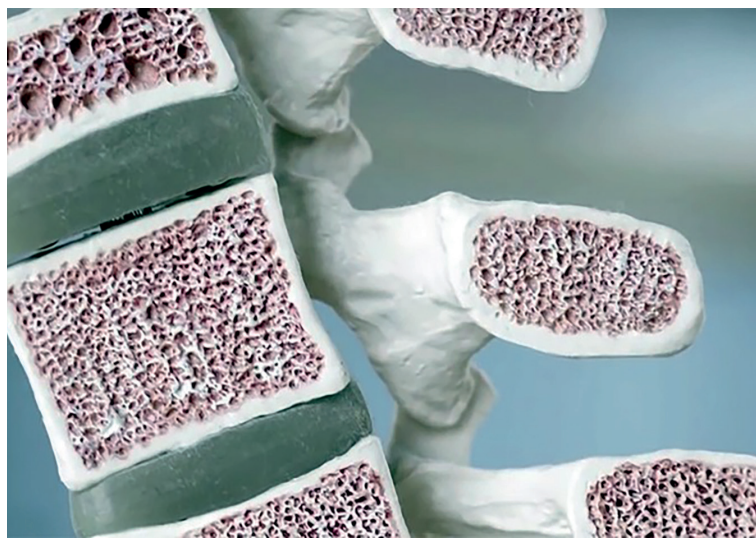


Figure 3: An example of the lightness of the Boeing composite



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(Question 1 continued)

(d) (i) Define the term *compressive strength*. [1]

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(ii) Outline why aircraft require components of high compressive strength. [2]

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(Question 1 continued)

(e) (i) Describe how a carbon reinforced plastic component could be manufactured. [2]

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(ii) Many components in aircraft are composites.

Explain why composites are used in the production of an aircraft. [3]

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2. Peel is a company that is pioneering the use of social media to market its cell/mobile phone cases. These cases are made from polypropylene (PP) and are both functional and stylish, see **Figure 4**.

Figure 4: The Peel cell/mobile phone case

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- (a) Outline why polypropylene (PP) is used as a material for a cell/mobile phone case. [2]

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- (b) Describe the difference between a thermoplastic and a thermosetting plastic. [2]

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3. Explain **one** disadvantage of using multidisciplinary teams in the design and development of a new product such as the Peel cell/mobile phone case.

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4. Explain the impact of dematerialization on a product's life cycle analysis (LCA).

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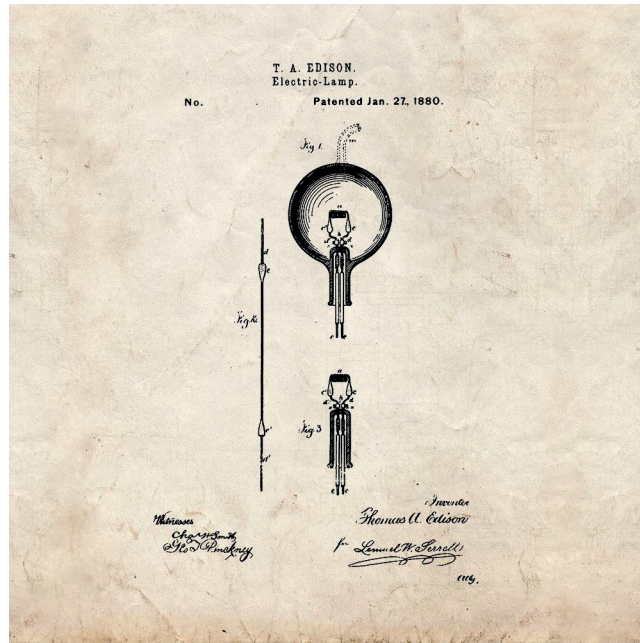


Section B

Answer **one** question. Answers must be written within the answer boxes provided.

- 5. The electric light globe (bulb) was first produced in the 19th Century. Over a long period of time, there were many people involved in its introduction and development, although Thomas Edison is the person who is normally credited with inventing it. **Figure 5** shows the original drawing of the electric lamp by Edison used to patent the light globe.

Figure 5: The light globe



- (a) List **two** characteristics of a patent.

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(Question 5 continued)

- (b) It has been proved that Edison was not the inventor of the light globe as they existed 50 years prior to his patent. However, he is known for improving the light globe and making them commercially successful.

Explain the impact of innovators and innovation with relation to Edison's light globe. [3]

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- 6. The DOT Braille Smartwatch project has won the Grand LIA for Design at the 2016 London International Awards. The DOT Braille Smartwatch was developed in South Korea and sets out to provide an interactive device for blind and visually impaired people. The DOT Braille Smartwatch was launched in 2017, see **Figure 6**.

The patented DOT Active Braille Technology reduces the size, weight and price by more than ten times compared to existing digital Braille reading devices which rely on piezoelectricity.

The DOT Braille Smartwatch can be connected to Apple Mobile via the DOT Watch App.

Figure 6: The DOT Braille Smartwatch



- (a) Outline how a prototype might be used to evaluate the accessibility of the user interface on the DOT Braille Smartwatch.

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(Question 6 continued)

(b) Explain how the form relates to the function for the DOT Braille Smartwatch.

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(Question 6 continued)

- (c) When designing the DOT Braille Smartwatch, designers would have considered the use of haptic technology.

Explain **two** ways that haptic technology is used in the function of the DOT Braille Smartwatch.

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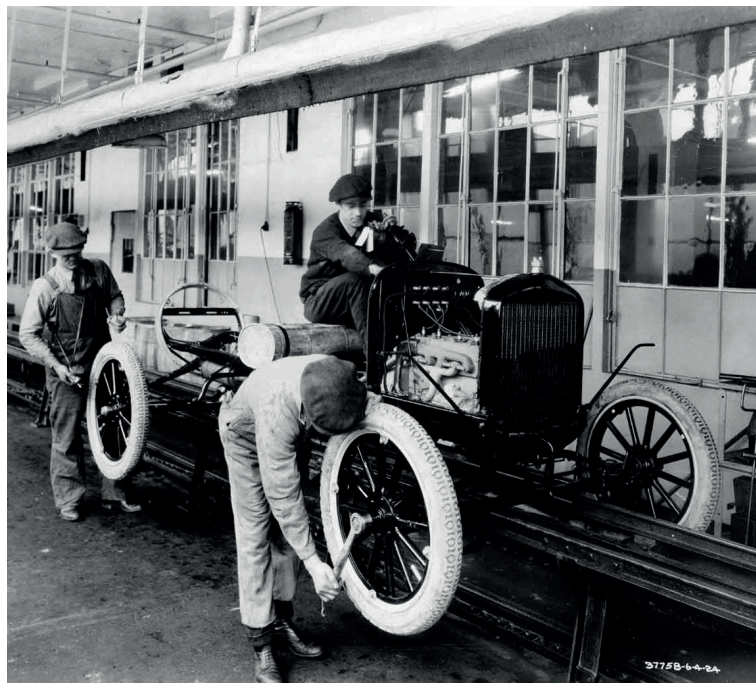


7. In 1908, Henry Ford introduced the Model T Ford in the United States, see **Figure 7**. It was the first car that was affordable for the majority of Americans due to the use of a production line, see **Figure 8**.

Figure 7: An example of the Model T Ford



Figure 8: The Model T Ford production line



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(Question 7 continued)

- (a) Part drawings and assembly drawings were used in the design and production of the Model T Ford.

Describe the differences between part and assembly drawings.

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- (b) The Model T Ford was one of the first products to be manufactured using assembly line production.

Explain **one** advantage of using assembly line production.

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(Question 7 continued)

(c) Suggest **two** reasons why the Model T Ford is considered to be a classic design.

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(Question 7 continued)

- (d) Explain how the design of the Model T Ford ensured the optimum use of existing manufacturing capability in relation to design for materials, design for process **and** design for assembly. [9]

A large rectangular area with a dotted grid pattern, intended for the student to write their answer to question 7(d).



References:

Figure 1 U.S. Environmental Protection Agency.

Figure 2 Christine Schneider / Cultura Creative RF / Alamy Stock Photo.

Figure 3 Photo by Dan Little. © HRL Laboratories.

Figure 5 Thomas Edison's patent drawing for an improvement in electric lamps, patented January 27, 1880; Records of the Patent and Trademark Office; Record Group 241; National Archives.

Figure 6 *[left]* Copyright © 2021 Dot Incorporation.
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Figure 7 Shawshots / Alamy Stock Photo.

Figure 8 Shawshots / Alamy Stock Photo.



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24EP23

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