Diploma Programme
Programme du diplôme
Programa del Diploma

Design technology
Higher level and standard level
Paper 2

Wednesday 8 November 2017 (afternoon)

1 hour 30 minutes

Candidate session number

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]**.

8817 – 6203

Section A

Answer **all** questions. Write your answers in the boxes provided.

1. Oil is extracted as a raw material and used for many purposes including being made into plastics, see **Figure 1**. Globally, the demand for oil continues to grow and the use of plastics in manufacturing is increasing, see **Figure 2**.

Figure 1: Global oil consumption per day

	Year						
	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Million barrels per day	99	101	102.5	104	106.5	108	110

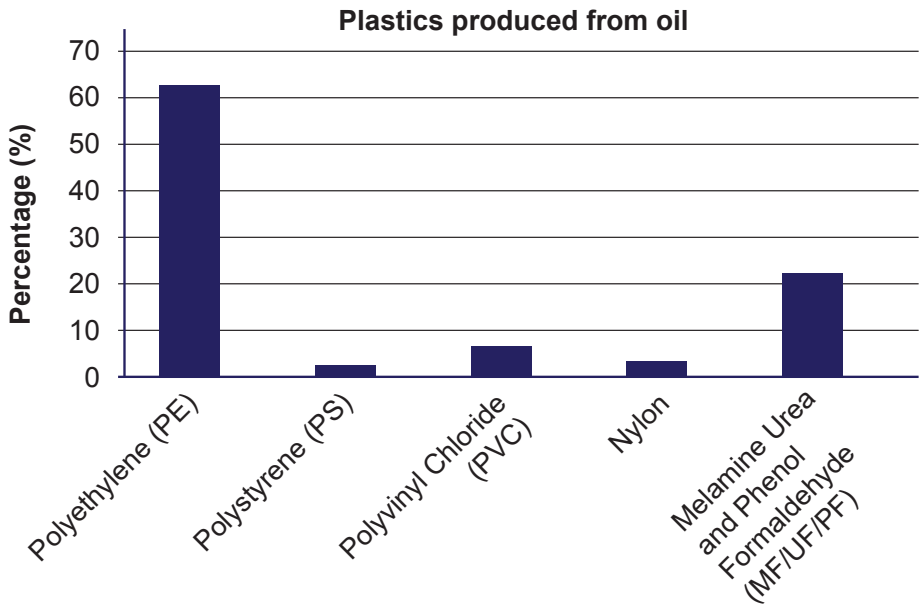
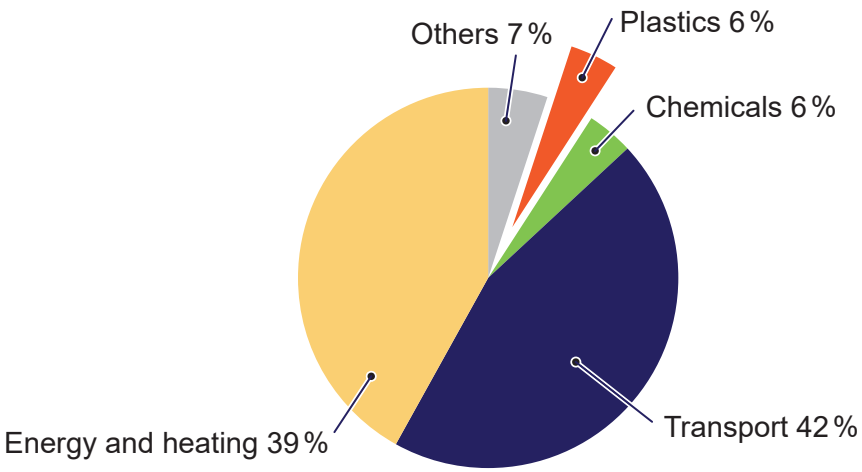


Figure 2: Global oil use in 2014



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(Question 1 continued)

(a) (i) State the percentage of oil used in plastic production in 2014. [1]

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(ii) Calculate how many barrels of oil were used in 2014 for the creation of plastics. Show your workings. [2]

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(b) (i) Outline the difference between a renewable and a non-renewable resource. [2]

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(ii) Outline why manufacturers would use the strategy of dematerializing plastic products. [2]

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(Question 1 continued)

(c) (i) Outline the scale of production that would be most appropriate for the manufacture of plastic products using the process of injection moulding. [2]

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(ii) Compare the ease of recovery and disposal of thermoplastics and thermosetting plastics. [3]

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(Question 1 continued)

The Dish Doctor, shown in **Figures 3a** and **3b**, was designed by Marc Newson in 1998. It is made from injection moulded high gloss polypropylene/plastic.

Figure 3a: Dish Doctor showing two injection moulded parts

[Source: DISH DOCTOR designed by Marc Newson for MAGIS, 1997]

Figure 3b: Dish Doctor in use

[Source: DISH DOCTOR designed by Marc Newson for MAGIS, 1997]

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(Question 1 continued)

(d) (i) Plastic has a high embodied energy. Define *embodied energy*. [1]

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(ii) Outline **one** advantage of injection moulded plastic. [2]

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(e) (i) List **two** drivers for employing clean technology in the production of Dish Doctor. [2]

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(Question 1 continued)

(ii) Explain why solid modelling is advantageous in the development of the Dish Doctor. [3]

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2. The Nikon DF (2013) is styled similarly to the Nikon EL2 (1977). This is shown in **Figures 4** and **5**.

Figure 4: Nikon DF (2013)

[Source: http://www.nikon.com/news/2014/img/pic_140520_01_01.png, with permission from Nikon]

Figure 5: Nikon EL2 (1977)

[Source: http://imgsv.imaging.nikon.com/lineup/filmcamera/slr/el2/img/product_01.png, with permission from Nikon]

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(Question 2 continued)

(a) (i) Identify **two** aesthetic characteristics that the retro styled Nikon DF shares with the original production Nikon EL2? [2]

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(ii) List **two** pieces of anthropometric data that would be used in the design of a camera. [2]

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Answers written on this page
will not be marked.

3. Explain **one** characteristic of retro styling. [3]

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4. Explain how the classic design of a product, such as a classic car, transcends obsolescence. [3]

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Section B

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

5. British engineering company Renishaw has been featured in the 2015 edition of Guinness World Records for manufacturing the world's first 3D printed titanium alloy bicycle frame, see **Figure 6**.

The frame parts are made using an additive manufacturing process. The parts are then joined using an adhesive to make a complete frame.

Figure 6: Renishaw – 3D aluminium printed bike

[Source: Image courtesy Renishaw plc]

[Source: Empire Cycles]

(a) List **two** physical properties that could be improved when alloying a metal. [2]

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(Question 5 continued)

(b) Explain **one** way in which bicycles are adjustable. [3]

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(c) Explain how **two** of Rogers' characteristics that impact consumer adoption of an innovation are applicable to the Renishaw 3D printed bicycle. [6]

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(Question 5 continued)

(d) Explain **three** advantages to the manufacturer of using additive manufacturing for a bicycle frame. [9]

6. In 1999, design engineer Greig Brebner was walking from his home to his office. It was raining heavily and the strong winds were blowing his umbrella inside out, almost to the point that it was broken.

The design of the umbrella had hardly changed since 1928, and Greig thought the incremental changes over the last 70 years had still not created an umbrella that was able to cope in strong winds.

By using a range of modelling techniques, Greig developed a new umbrella design that creates an aerodynamic robust canopy structure. Greig's new design, see **Figure 7**, was a radical change from traditional umbrella design.

Figure 7: Brebner umbrella design

Removed for copyright reasons

(a) Outline the driver for invention used by Brebner. [2]

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(Question 6 continued)

(b) Discuss the advantages and disadvantages of being a lone inventor. [3]

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(c) Explain **two** mechanical properties that are required from the materials used to manufacture the Brebner umbrella. [6]

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(Question 6 continued)

(d) Explain **three** types of physical models the designer could have used in the development of the Brebner umbrella. [9]

7. David Trubridge, an artist, was interested in replicating natural forms using geometric shapes. He was originally inspired by coral.

Originally designed purely as an experiment. This intricate form is made from just one single component repeated 60 times. David tried to find a use for it by putting a bulb inside, this was an important discovery.

It became known as the Coral Pendant Light, see **Figure 8**. The Coral Pendant Light is made from bamboo plywood and is sold as a self assembly kit.

Figure 8: Coral Pendant Light

[Sources: Coral Pendant with Seed System Kitset Packaging (www.davidtrubridge.com)]

(a) Outline the strategy for innovation for the Coral Pendant Light. [2]

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(Question 7 continued)

(b) A computer numeric controlled (CNC) router cuts the pieces for the Coral Pendant Light. Explain **one** benefit of using a CNC router for this process. [3]

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(c) Explain **two** benefits relating to the life cycle analysis (LCA) of selling the Coral Pendant Light as a self assembly kit. [6]

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(Question 7 continued)

(d) Explain **three** design for manufacture strategies that have been used to make the Coral Pendant Light a green design. [9]