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Design technology

Higher level and standard level

Paper 2

11 May 2023

Zone A afternoon | **Zone B** morning | **Zone C** afternoon

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.

- Volvo has a reputation for safety and is a market leader in luxury vehicle design.

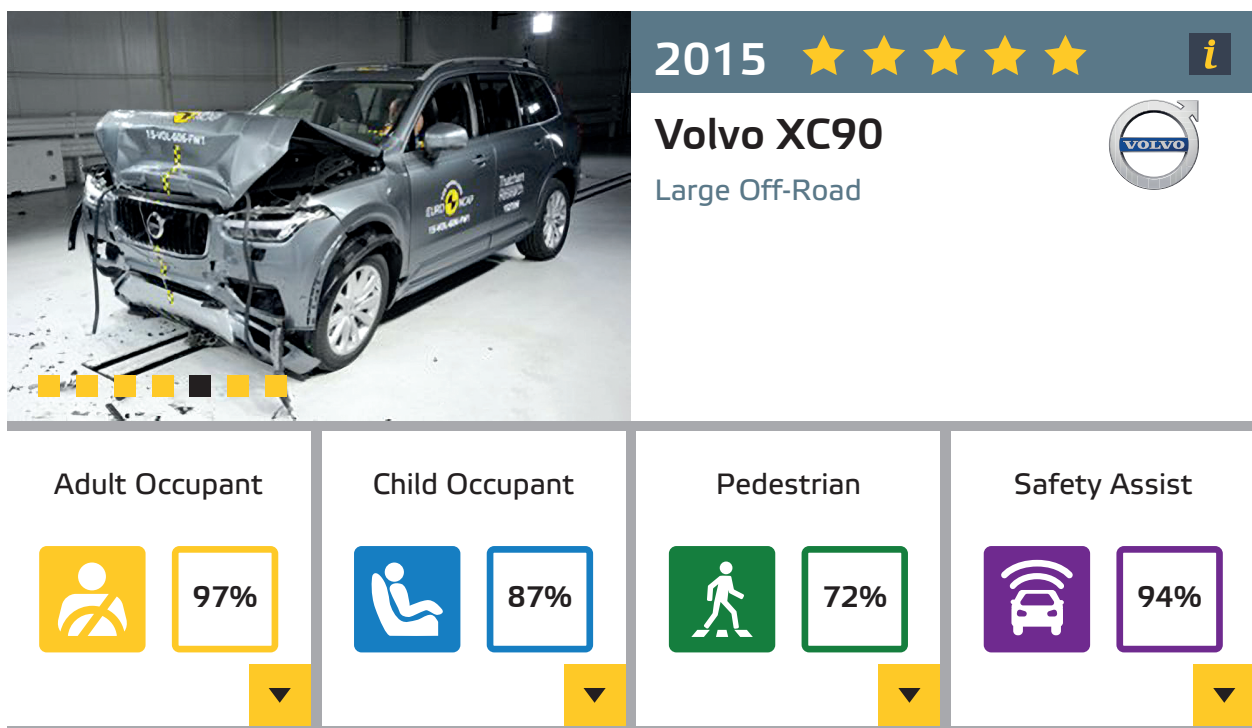
Introduced by Volvo in 2004, the latest version of the XC90 is considered by some to be the safest car on the market, see **Figure 1**. It uses all of the safety features first brought to market by Volvo, such as seat belts, airbags, side impact protection and blind spot monitoring, see **Figure 2**.

In 2016 Volvo started manufacturing the XC90 with a hybrid system – running on both petrol (gasoline) and electricity. This hybrid system uses 23 % less petrol (gasoline) than the standard engine.

Figure 1: Volvo XC90



Figure 2: Volvo XC90 safety report



(This question continues on the following page)



24EP02

(Question 1 continued)

- (a) (i) State **one** reason why Volvo introduced a hybrid system. [1]

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- (ii) Outline why the Volvo XC90 is considered a dominant design. [2]

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- (b) (i) In 1959 Volvo introduced the first seat belt, even though there was no market demand for this product. Outline the strategy for innovation used by Volvo. [2]

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- (ii) Outline why the seat belt could be considered a ubiquitous classic design. [2]

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(Question 1 continued)

- (c) (i) The Volvo XC90 hybrid needs a battery to power it.

Outline **one** environmental risk when disposing of batteries.

[2]

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- (ii) In 2030 many countries will prohibit the sale of petrol (gasoline) and diesel engines to reduce the environmental impact of cars.

Explain why legislation is used as a driver for the introduction of clean technology.

[3]

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(This question continues on the following page)



(Question 1 continued)

To maximize the quality and safety of its cars, Volvo makes extensive use of technology such as robots and instrumented models for testing and manufacturing, see **Figure 3**, **Figure 4** and **Figure 5**.

Figure 3: Robots on the Volvo assembly line



Figure 4: A crash test dummy is an example of an instrumented physical model



Figure 5: A crash test dummy inside a tested car



[Source: 2016 Volvo XC90 driver-side small overlap IIHS crash test (CEN1543)] n.d. [Image online] Available at: www.iihs.org/ratings/vehicle/volvo/xc90-4-door-suv/2019 [Accessed 24 May 2023]. Insurance Institute for Highway Safety, Arlington, Virginia USA. www.iihs.org. (IIHS).]

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(Question 1 continued)

- (d) (i) State the generation of robot used for simple tasks such as drilling holes. [1]

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- (ii) Outline **one** reason why alloys would be used in the production of the Volvo XC90. [2]

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- (e) (i) A crash test dummy is an example of an instrumented model.

Outline why instrumented models would be used in the development of the Volvo XC90.

[2]

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- (ii) Explain **one** advantage for Volvo of using digital humans before physical models. [3]

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2. Hydroponics Africa was founded in Kenya in 2013 by Peter Chege. Chege builds hydroponic systems that enable farmers to quickly grow animal feed (fodder) without soil. Chege has installed hydroponic systems in Kenya, Rwanda, Somalia, Tanzania and Uganda, training over 5000 people on how to use them, see **Figure 6** and **Figure 7**.

Figure 6: Hydroponics Africa fodder system



Figure 7: Hydroponics Africa fodder tray

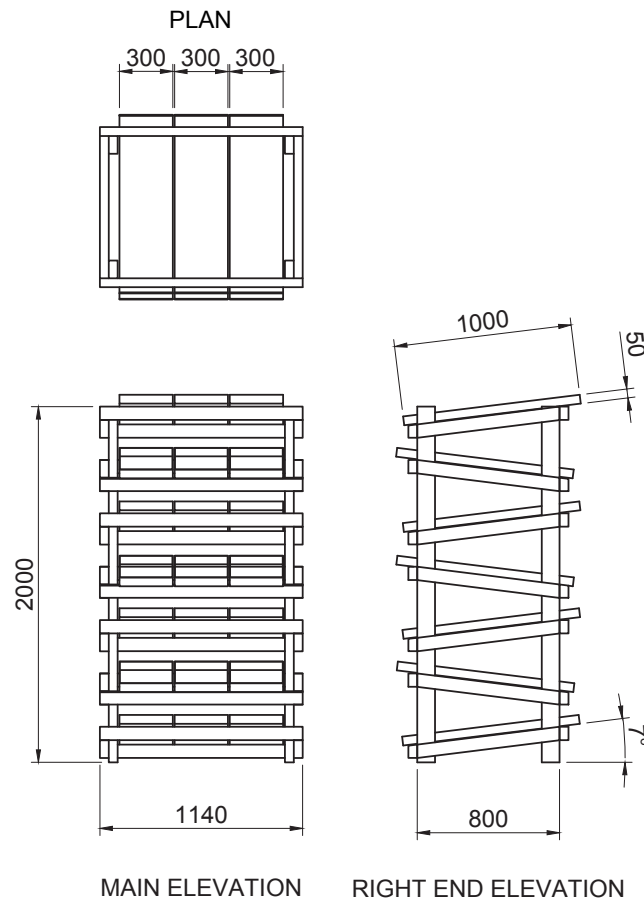


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(Question 2 continued)

Figure 8: Hydroponics Africa fodder system graphical model



(a) Describe the type of graphical model used in **Figure 8**.

[2]

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(b) Outline why Hydroponics Africa used aluminium, rather than steel, for the animal feed (fodder) trays.

[2]

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3. Explain why end-of-pipe technology is considered to be the least effective way of cleaning up production. [3]

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4. Explain the differences between comfort and fatigue. [3]

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Section B

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

5. Woolkin™ is concerned about toxins that can be harmful to the health and wellbeing of children. This has inspired them to create fun, engaging products that are safe and made from renewable materials with responsible manufacturing practices.

Brave Dave™ is a toy fire truck by Woolkin™, see **Figure 9** and **Figure 10**. Brave Dave™ is made from an innovative wool material the company developed, and Forest Stewardship Council (FSC) certified pine. In 2019 Brave Dave™ won the Best Sustainable Product Design award.

Once manufactured, Brave Dave™ is flat packed with a click and lock assembly system.

Figure 9: Brave Dave™



Figure 10: The red felted wool parts



- (a) Outline the target audience for Brave Dave™.

[2]

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(This question continues on the following page)



(Question 5 continued)

- (b) Explain the driver for invention for Brave Dave™.

[3]

[illegible]

- (c) Explain why high compressive strength **and** low mass are important properties of the wool used for Brave Dave™.

[6]

[illegible]

(This question continues on page 15)



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(Question 5 continued)

- [9]



6. FTN Motion is an electric motorbike manufacturer whose focus is on timeless design, minimalist style and genuine practicality. They claim that “while the world focuses on ‘louder, bigger, more’, we’ve figured out how to enjoy a whole lot more with a whole lot less”.

FTN Motion, see **Figure 11**, takes its design cues from classic designs such as the 1972 Ducati Desmo Racer, see **Figure 12**. Compared to the Desmo Racer, the Streetdog is a bike that is smooth and easy to manoeuvre, especially in urban environments.

The FTN Motion Streetdog offers a unique opportunity for customization where customers can upload graphics to be printed onto vinyl and applied to their bike in the factory, see **Figure 13** and **Figure 14**.

Figure 11:
2021 FTN Motion Streetdog



Figure 12:
1972 Ducati Desmo Racer

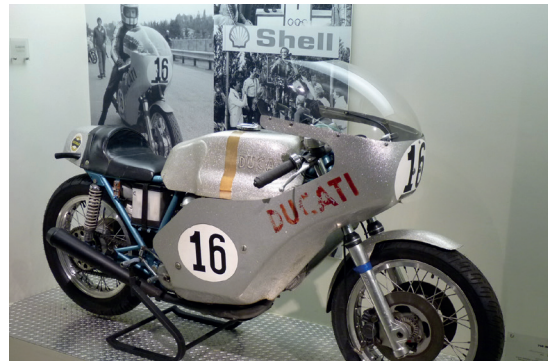


Figure 13:
FTN Motion Streetdog
CAD rendering

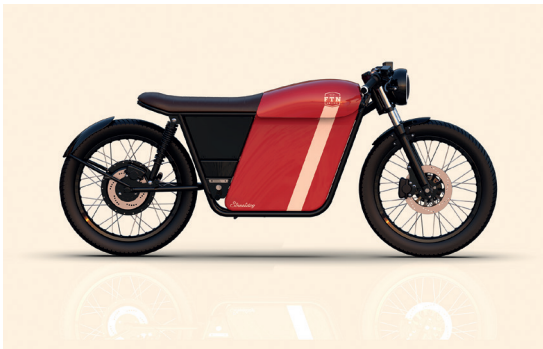


Figure 14:
Customized FTN
Motion Streetdog



- (a) Outline the percentile that the Streetdog is designed for.

[2]

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[3]

[illegible]

- [6]

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(Question 6 continued)

- (d) Explain how FTN Motion may utilize one-off, batch **and** mass customization strategies in the development and production of the Streetdog.

[9]

[illegible]

7. Refold is the designer and maker of folded cardboard furniture. Refold is dedicated to simple, recyclable, good design that is made to move, see **Figure 15**. This philosophy is the cornerstone of Refold values, each new idea or decision is always measured against this philosophy for compatibility. Refold continues to champion this brand story as it grows.

The Refold standing desk, see **Figure 16**, was launched in 2014 via a successful Kickstarter campaign in response to unsatisfactory designs of similar products.

Refold used Kickstarter to test if their idea was viable and to raise funds for the first production run. The Kickstarter campaign went viral and Refold gained worldwide media attention.

Figure 15:
Refold standing desk in use and in transport



Figure 16:
Refold standing desk



- (a) Describe the subtractive technique that would be used to shape the cardboard used for the Refold standing desk. [2]

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(Question 7 continued)

- (b) Explain how the Refold standing desk addresses clearance.

[3]

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- (c) Explain how scale models **and** mock-ups would have been used in the development of the Refold standing desk.

[6]

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(Question 7 continued)

(d) Explain how the Refold team are inventors, product champions **and** entrepreneurs.

[9]



References:

- Figure 1** © Volvo Car Corporation. Used under permission from Volvo Car Corporation.
- Figure 2** [Volvo XC90 safety report] n.d. [image online] Available at: <https://www.euroncap.com/en/results/volvo/xc90/20976> [Accessed 7 March 2022]. Source adapted.
- Figure 3** ABB robots in BIW production line at Volvo Daqing factory.
- Figure 4** [Crash test dummy] n.d. [image online] Available at: www.kistler.com/US/en/c/crash-testdummies/CG31-crash-test-dummies [Accessed 31 January 2022].
- Figure 5** 2016 Volvo XC90 driver-side small overlap IIHS crash test (CEN1543) n.d. [Image online] Available at: www.iihs.org/ratings/vehicle/volvo/xc90-4-door-suv/2019 [Accessed 24 May 2023]. Insurance Institute for Highway Safety, Arlington, Virginia USA. www.iihs.org. (IIHS).
- Figure 6** Hydroponics Africa, n.d. [Hydroponic fodder systems trays]. [image online] Available at: www.hydroponicsafrica.org/wp-content/uploads/2020/10/Fooder.jpg [Accessed 31 January 2022].
- Figure 7** Hydroponics Africa, n.d. [Hydroponic fodder systems trays with grass]. [image online] Available at: www.hydroponicsafrica.org/wp-content/uploads/2020/10/ICSE-8457-1536x1024.jpg [Accessed 31 January 2022].
- Figure 9** Woolkin Brave Dave Fire Engine. With permission from Woolkin. www.woolkin.co.
- Figure 10** Woolkin flat-packed Brave Dave fire engine. With permission from Woolkin. www.woolkin.co.
- Figure 11** Streetdog image provided with permission from FTN Motion.
- Figure 12** Ducati 750 Paul Smart DM.JPG. Image by Khruner. https://commons.wikimedia.org/wiki/File:Ducati_750_Paul_Smart_DM.JPG. Under copyright and licensed under the Creative Commons Attribution-ShareAlike 3.0 Unported. <https://creativecommons.org/licenses/by-sa/3.0/deed.en>.
- Figure 15** [Transported Refold standing desk] n.d. [image online] Available at: https://cdn.shopify.com/s/files/1/0833/2651/files/Refold-worklife_series-modelled_states_f039cf36-1c06-42f9-af95-f0d988a27c9f.jpg?v=1621211659 [Accessed 1 February 2022]. Source adapted.
- Figure 16** [Refold standing desk] n.d. [image online] Available at: https://cdn.shopify.com/s/files/1/0833/2651/products/standing_1024x1024.png?v=1433157579 [Accessed 1 February 2022].



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