

## Design technology

### Higher level

### Paper 3

Friday 15 May 2015 (morning)

Candidate session number

1 hour 15 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.
- Answer all of the questions from one of the options.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[40 marks]**.

Option	Questions
Option A — Food science and technology	1 – 7
Option B — Electronic product design	8 – 14
Option C — CAD/CAM	15 – 21
Option D — Textiles	22 – 28
Option E — Human factors design	29 – 35



**Option A — Food science and technology**

1. **Figures A1 and A2** show two similar but different symbols used to indicate that a food is gluten free. Both use a head of wheat.

**Figure A1: Gluten-free symbol**

**Figure A2: Crossed Grain symbol**



[Source: NFCA. Used with permission]

[Source: www.coeliac.org.uk. Used with permission]

- (a) State **one** reason for the selection of a head of wheat for the gluten-free symbols shown in **Figures A1 and A2**. [1]

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- (b) Outline **one** way in which gluten intolerance impacts on diet. [2]

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**(Option A continues on the following page)**



**(Option A, question 1 continued)**

- (c) Explain why many food retailers have produced ranges of gluten-free foods. [3]

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2. (a) Define *genetically modified organism*. [1]

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- (b) Describe the significance of the FlavrSavr™ tomato. [2]

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**(Option A continues on the following page)**



(Option A continued)

- 3. **Figure A3** shows the Coca-Cola logo<sup>®</sup>, which is an important part of the branding for Coca-Cola<sup>®</sup>.

**Figure A3: The Coca-Cola logo<sup>®</sup>**

Image removed for copyright reasons  
Please go to: [http://www.popandroll.com/coke-art/Coca-Cola-Art\\_Enjoy\\_Logo\\_Ribbon.jpg](http://www.popandroll.com/coke-art/Coca-Cola-Art_Enjoy_Logo_Ribbon.jpg)

- (a) Describe **one** way in which the packaging of Coca-Cola<sup>®</sup> has contributed to the development of the Coca-Cola<sup>®</sup> brand. [2]

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- (b) Outline **one** purpose of food labelling. [2]

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(Option A continues on the following page)



(Option A continued)

4. Explain **two** principal causes of chemical spoilage of food.

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**(Option A continued)**

5. (a) Outline the role of market testing in the development of a new food product. [2]

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- (b) Outline **one** factor that determines the need for primary processing. [2]

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- (c) Outline the role of food manufacturers in the food chain between the farmer and the consumer. [2]

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**(Option A continues on the following page)**



**(Option A continued)**

6. (a) Explain how the design of food preparation areas can help prevent food poisoning in commercial kitchens. [3]

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- (b) Explain how an understanding of food poisoning contributes to the design of individual convenience foods. [3]

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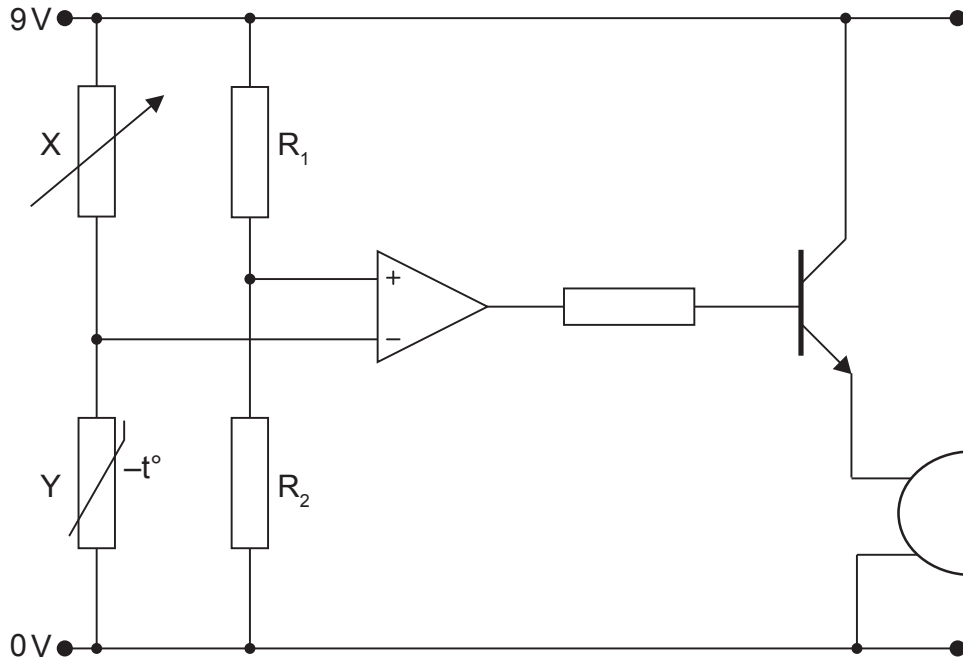
40EP09

Turn over

**Option B — Electronic product design**

8. **Figure B1** shows a circuit for an alarm to indicate if a freezer malfunctions.

**Figure B1: An alarm circuit for a freezer**



(a) State the function of the component labelled Y in the circuit shown in **Figure B1**. [1]

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(b) Outline the function of the arrangement of components X, Y, R<sub>1</sub> and R<sub>2</sub>. [2]

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(Option B continues on the following page)



**(Option B, question 8 continued)**

- (c) Explain how the circuit works so that the buzzer sounds if the freezer malfunctions. [3]

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9. (a) Define *converging technology*. [1]

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- (b) Outline **one** advantage of “The Communicator” for global cooperation. [2]

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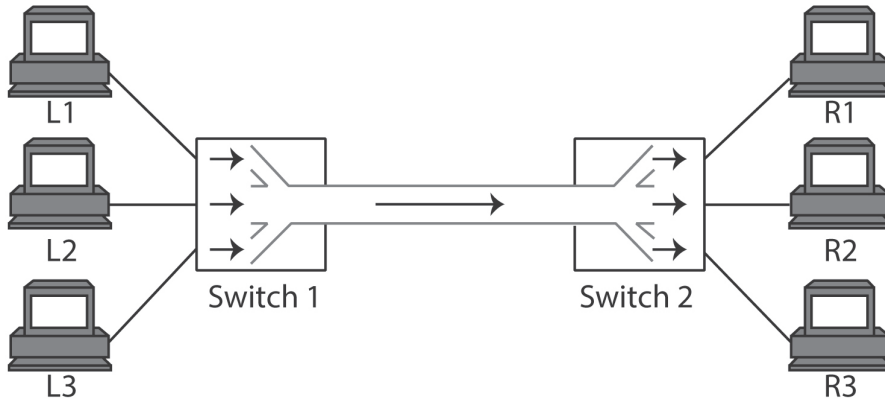
**(Option B continues on the following page)**



(Option B continued)

10. Figure B2 shows a multiplexing system.

Figure B2: A multiplexing system



[Source: © International Baccalaureate Organization 2015]

(a) Describe an optical fibre. [2]

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(b) Describe the role of synchronization in time division multiplexing. [2]

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(Option B continues on the following page)



**(Option B continued)**

11. Explain **two** benefits of a manufacturer adopting a generic standard to implement a particular function in an electrical product.

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40EP13

**Turn over**

**(Option B continued)**

12. (a) Outline **one** input device applicable to a home security system. [2]

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(b) Outline **one** output device applicable to a home security system. [2]

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(c) Outline **one** ethical issue relating to the use of home security systems. [2]

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**(Option B continues on the following page)**



**(Option B continued)**

13. (a) Explain **one** disadvantage of upgradeability for the manufacturer. [3]

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(b) Explain how digital photography can be used to minimize waste. [3]

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**(Option B continues on the following page)**







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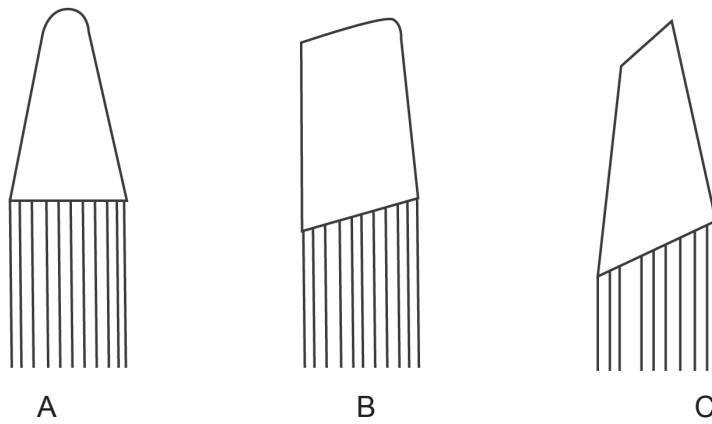
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**Option C — CAD/CAM**

15. **Figure C1** shows the shape profile of three cutting tools used in a computer numerical control (CNC) lathe.

**Figure C1: CNC lathe cutting tools**



[Source: © International Baccalaureate Organization 2015]

(a) State the name of cutting tool A shown in **Figure C1**. [1]

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(b) Outline why the feed rate of a CNC lathe would be changed according to the material being processed. [2]

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(Option C continues on the following page)



**(Option C, question 15 continued)**

- (c) Compare the effects of using tools with large and small diameter cutting ends for CNC machining.

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- 16. (a) State a physical property of modelling wax which makes it appropriate for use in a CNC machining process.

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- (b) List **two** reasons why modelling wax is cost effective to use as a modelling material in a CNC process.

[2]

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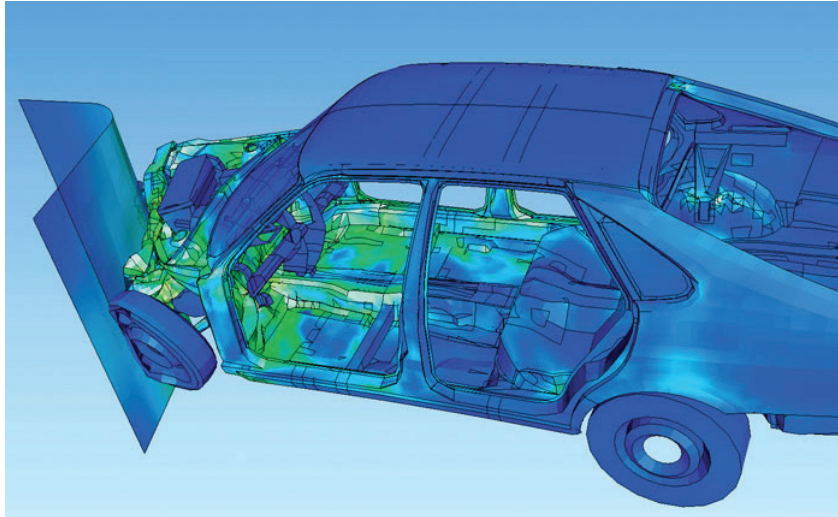
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**(Option C continued)**

17. **Figure C2** shows a finite element analysis (FEA) CAD image of a crash (impact) test for a car.

**Figure C2: FEA CAD image of a crash (impact) test for a car**



[Source: "FAE visualization". Licensed under Public Domain via Wikimedia Commons - [https://commons.wikimedia.org/wiki/File:FAE\\_visualization.jpg#/media/File:FAE\\_visualization.jpg](https://commons.wikimedia.org/wiki/File:FAE_visualization.jpg#/media/File:FAE_visualization.jpg)]

- (a) Describe the relationship of the dark and light colours in the FEA image shown in **Figure C2**.

[2]

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- (b) Outline **one** reason why the designer would carry out a series of tests to obtain reliable data from FEA CAD images similar to that in **Figure C2**.

[2]

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**(Option C continues on the following page)**



**(Option C continued)**

18. Explain **two** ways in which the use of rapid prototyping influences the design development cycle for a new product.

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40EP21

Turn over

(Option C continued)

19. **Figure C3** shows a hardwood spindle used in the hardwood staircase shown **Figure C4**. The spindles are turned using a CNC lathe.

**Figure C3: A hardwood spindle for use in a staircase**



**Figure C4: A hardwood staircase**



[Source: www.StairBox.com. Used with permission]

- (a) Describe one task which could be done by a robot to aid the manufacture of the spindle shown in **Figure C3**.

[2]

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(Option C continues on the following page)



**(Option C, question 19 continued)**

- (b) List **two** characteristics of the hardwood timber which are important for accurate turning of the spindles on the CNC lathe. [2]

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- (c) Outline **one** health and safety consideration if the step (tread) was manufactured from medium density fibreboard (MDF) rather than hardwood. [2]

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- 20. (a) Explain how rapid prototyping can reduce the use of natural resources. [3]

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**(Option C continues on the following page)**



**(Option C, question 20 continued)**

- (b) Explain why multi-national corporations (MNCs) need to take out patents in different countries for a new invention.

[3]

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**(Option C continues on the following page)**





**(Option C continued)**

**21.** Discuss **three** reasons why car manufacturers often use animation to promote new vehicles on their websites.

[9]

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**End of Option C**



40EP25

**Turn over**

**Option D — Textiles**

- 22. **Figure D1** shows the Cedars men’s fleece jacket manufactured by the company Patagonia. The jacket is made from polyester fleece whereas the lining, shoulder panels and handwarmer pockets are made from 96 % nylon and 4 % Spandex (Lycra®).

**Figure D1: Cedars men’s fleece jacket**



[Source: www.moosejaw.com. Used with permission]

- (a) State **one** property of Spandex (Lycra®) which makes it suitable for use in the jacket shown in **Figure D1**.

[1]

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(Option D continues on the following page)



(Option D, question 22 continued)

- (b) Outline **one** material characteristic of polyester that makes it suitable for the jacket shown in **Figure D1**. [2]

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- (c) Explain **one** disadvantage of nylon for the lining of the jacket shown in **Figure D1**. [3]

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- 23. (a) State the country which originally benefited from trading silk with China via the silk route. [1]

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- (b) Outline **one** limitation of the commercial production of spider silk (“bio steel”). [2]

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(Option D continues on the following page)



(Option D continued)

24. Figure D2 shows a textile vascular prosthesis.

Figure D2: Textile vascular prosthesis



[Source: H. Khlif, S. Ben Abdesslem, S. Dhoub and F. Sakli, 2011. Contribution to the Improvement of Textile Vascular Prostheses Crimping. *Trends in Applied Sciences Research*, 6: 1019–1027.  
DOI: 10.3923/tasr.2011.1019.1027  
URL: <http://scialert.net/abstract/?doi=tasr.2011.1019.1027>]

(a) Outline **one** reason why weaving is an appropriate technique to manufacture the prosthesis shown in **Figure D2**. [2]

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(b) Outline **one** reason why the design of textile vascular prostheses requires a large and diverse design team. [2]

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(Option D continues on the following page)



**(Option D continued)**

**25.** Compare mass customization with craft production in relation to value-for-money for a consumer wishing to purchase a one-off item of clothing.

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**(Option D continues on the following page)**



(Option D continued)

- 26. **Figure D3** shows a gymnast wearing a haptic textile suit. This technology provides feedback to the gymnast in order to perfect her routine.

**Figure D3: Gymnast wearing a haptic technology suit**



[Source: Picture courtesy of Birmingham City University © Centre for Excellence in Posture, Movement & Handling]

- (a) Describe how haptic output device technology helps the gymnast to perfect her routines.

[2]

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- (b) Outline **one** advantage of using laser welding in the manufacture of wearable computing garments, such as the gymnast’s haptic textile suit.

[2]

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(Option D continues on the following page)



**(Option D, question 26 continued)**

- (c) Outline **one** disadvantage of using laser welding for the manufacture of wearable computing garments in relation to sustainability. [2]

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- 27. (a) Explain the impact of the introduction of automation on the health of the textile industry employees. [3]

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- (b) Explain the impact on the wider community of the introduction of mechanisation in the textile industry rather than just the textile industry employees. [3]

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**(Option D continues on the following page)**



40EP31

**Turn over**





**Option E — Human factors design**

**29.** **Figure E1** shows a five-point comfort rating scale used to obtain data from a user trial for the prototype of a chair.

**Figure E1: Five-point comfort rating scale**

4	very comfortable
3	comfortable
2	average
1	slightly uncomfortable
0	very uncomfortable

(a) State the type of data scale represented by the comfort rating scale shown in **Figure E1**. [1]

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(b) Outline why the responses from the user trial are qualitative. [2]

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(c) Explain why a designer might choose to represent qualitative information from the trial quantitatively. [3]

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(Option E continues on the following page)



Turn over

**(Option E continued)**

30. (a) State **one** type of feedback that could be used in the design of a microwave oven to alert the user that the cooking cycle is complete. [1]

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- (b) Describe why affordance is an important consideration in relation to the design of a product. [2]

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**(Option E continues on the following page)**



**(Option E continued)**

31. **Figure E2** shows an ironing board adjustable to three different height positions. The same model is available in three different board widths.

**Figure E2: Height adjustable ironing board**



[Source: Brabantia ironing board]

- (a) Outline which percentiles the designer would use for the three height positions of the ironing board.

[2]

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- (b) Outline **one** reason for providing the ironing board in three different board widths.

[2]

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**(Option E continues on the following page)**



**Turn over**

(Option E continued)

32. Suggest **two** ways in which human factors specialists determine adequate product safety. [6]

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33. (a) Outline which aspect of the “four pleasure framework” relates to the success of a new type of perfume. [2]

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(Option E continues on the following page)



**(Option E, question 33 continued)**

- (b) Describe why the purchase of a fashionable (trendy) item of clothing may promote a combination of socio-pleasure and psycho-pleasure. [2]

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- (c) Outline **one** way in which **ideo-pleasure** may contribute to a company's corporate social responsibility for promoting green design. [2]

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**(Option E continues on the following page)**



**(Option E continued)**

34. (a) Explain how motion capture is used to digitally represent motion. [3]

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(b) Explain **one** limitation of designers relying exclusively on human factors data from digital humans. [3]

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**(Option E continues on the following page)**



**(Option E continued)**

**35.** Discuss **three** design constraints which might compromise the user interface for a new product.

[9]

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**End of Option E**



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40EP40