



Beatrix decorates the faces of a cube, whose edges have length 2. For 18. each face, she either leaves it blank, or draws a single straight line on it. Every line drawn joins the midpoints of two edges, either opposite or adjacent, as shown.



What is the length of the longest unbroken line that Beatrix can draw on the cube?



A 8

B  $4 + 4\sqrt{2}$  C  $6 + 3\sqrt{2}$  D  $8 + 2\sqrt{2}$  E

12

1488



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18. D To draw the longest unbroken line Beatrix must be able to draw her design on the net of a cube without taking her pen off the paper. She must minimise the number of lines of length  $\sqrt{2}$  and maximise the number of lines of length 2. If no lines of length  $\sqrt{2}$  are used, the maximum number of lines of length 2 is four, forming a loop and leaving two faces blank. Thus the longest possible unbroken line would have four lines of length 2 and two lines of length  $\sqrt{2}$ . A possible configuration to

achieve this is shown in the diagram. The length of Beatrix's line is then  $8 + 2\sqrt{2}$ . Note: This path is not a loop but it is not required to be.

