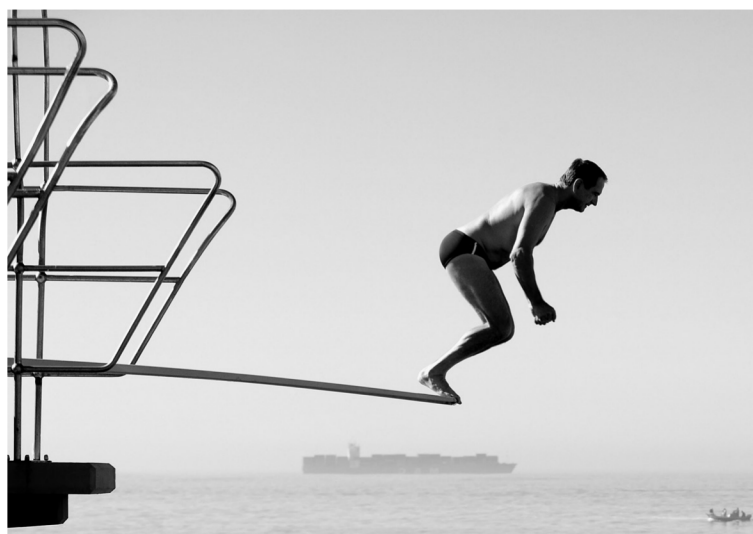**17** A man is about to dive into the sea from a high diving board. The board is horizontal before he walks to the end of the board.

When the man stands on the end of the board, it bends as shown.

(Source: © Fuse / Getty Images)

(a) By pushing on the board, the man displaces the end of the board a small distance downwards. The man and the board then oscillate with approximate simple harmonic motion.

State the conditions for simple harmonic motion.

(2)

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(b) The man stands at the end of the board. The board is in equilibrium when the end of the board has a vertical displacement of 18 cm.

mass of man = 75 kg

(i) The board obeys Hooke's law as it deforms.

Show that the stiffness of the diving board is about 4000 N m^{-1}.

(2)

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(ii) Calculate the frequency of oscillation of the man on the board. Ignore the mass of the board.

(3)

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Frequency of oscillation = ...

(c) If the amplitude of oscillation is large enough, the man will lose contact with the board at a point above the equilibrium position.

Explain why.

(3)

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(Total for Question 17 = 10 marks)