3 A bullet of mass 2.0 g is fired horizontally into a block of wood of mass 600 g. The block is suspended from strings so that it is free to move in a vertical plane.
The bullet buries itself in the block. The block and bullet rise together through a vertical distance of 8.6 cm, as shown in Fig. 3.1.

For Examiner's Use

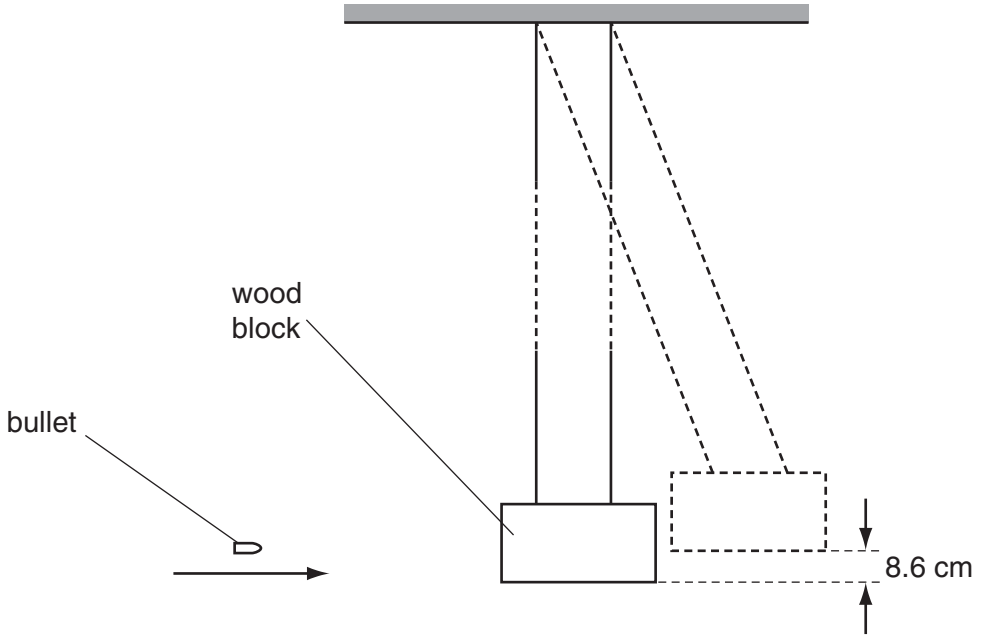

Fig. 3.1

(a) (i) Calculate the change in gravitational potential energy of the block and bullet.

change = ... J [2]

(ii) Show that the initial speed of the block and the bullet, after they began to move off together, was 1.3 m s^{-1}.

[1]

(b) Using the information in **(a)(ii)** and the principle of conservation of momentum, determine the speed of the bullet before the impact with the block.

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speed = ... $m\,s^{-1}$ [2]

(c) **(i)** Calculate the kinetic energy of the bullet just before impact.

kinetic energy = ... J [2]

(ii) State and explain what can be deduced from your answers to **(c)(i)** and **(a)(i)** about the type of collision between the bullet and the block.

.....

.....

.....[2]

[Turn over

4 A glass fibre of length 0.24 m and area of cross-section 7.9×10^{-7} m^2 is tested until it breaks. The variation with load F of the extension x of the fibre is shown in Fig. 4.1.

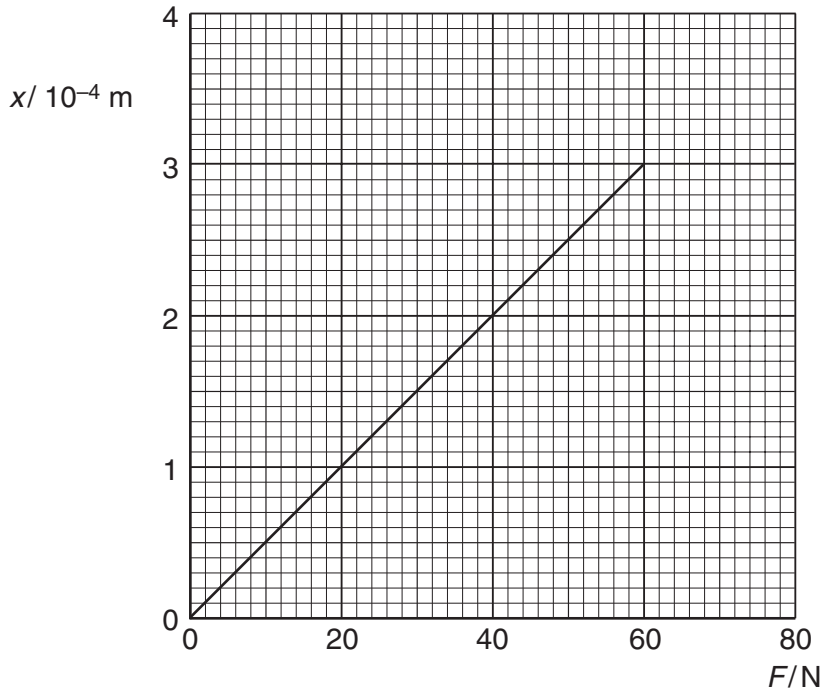

Fig. 4.1

(a) State whether glass is ductile, brittle or polymeric.

.....[1]

(b) Use Fig. 4.1 to determine, for this sample of glass,

(i) the ultimate tensile stress,

ultimate tensile stress = ... Pa [2]

(ii) the Young modulus,

For Examiner's Use

Young modulus = ... Pa [3]

(iii) the maximum strain energy stored in the fibre before it breaks.

maximum strain energy = ... J [2]

(c) A hard ball and a soft ball, with equal masses and volumes, are thrown at a glass window. The balls hit the window at the same speed. Suggest why the hard ball is more likely than the soft ball to break the glass window.

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.....[3]

[Turn over