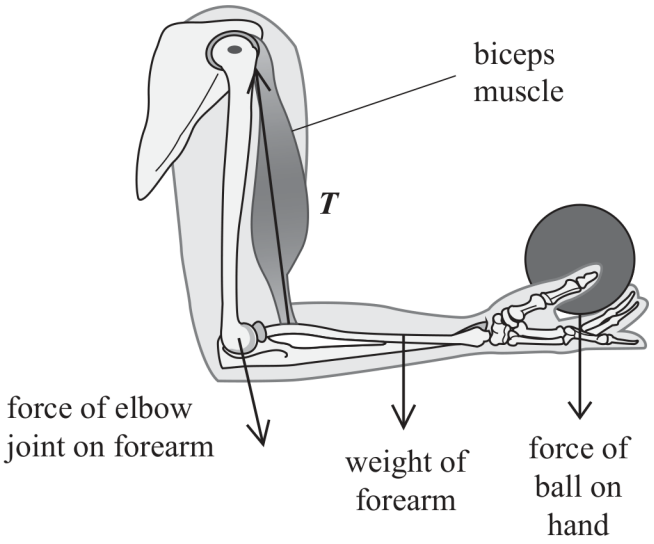
15 Muscles move body parts by contracting and relaxing. For the forearm to hold a ball in the position shown, the biceps muscle contracts, creating a tension T in the muscle as shown.



A student modelled the forces on the forearm using a uniform beam and spring arrangement as shown below. The length and weight of the beam were the same as the length and weight of the forearm.

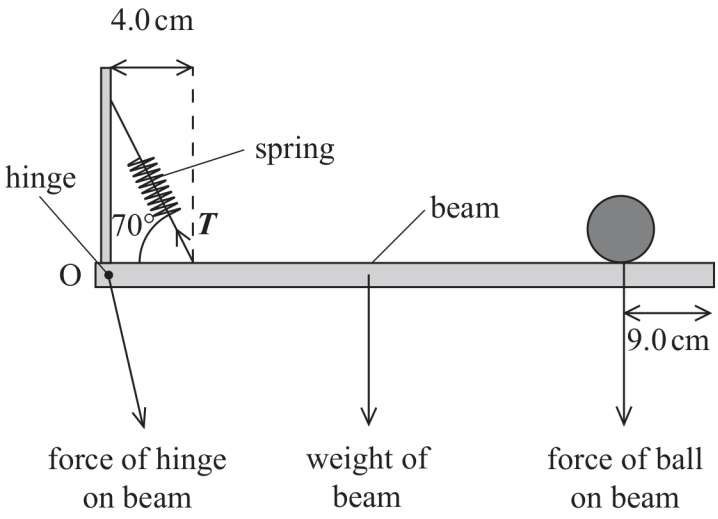


Diagram not to scale

(a) It can be assumed that the biceps muscle acts as a spring at an angle of 70° to the beam, 4.0 cm from the pivot O.

Determine the magnitude of T. You will need to estimate the total length of the forearm and hand.

force of ball on beam = 4.5 N
weight of beam = 15 N

(5)

Estimate of total length of forearm and hand = ...

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T = ...

(b) Explain a limitation of using a beam to model the forearm.

(2)

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(Total for Question 15 = 7 marks)