16 A steel object is held by an electromagnet. The magnetic force prevents the steel object falling.

(a) State **two** reasons why the weight of the object and the force from the electromagnet are not a Newton third law pair.

(2)

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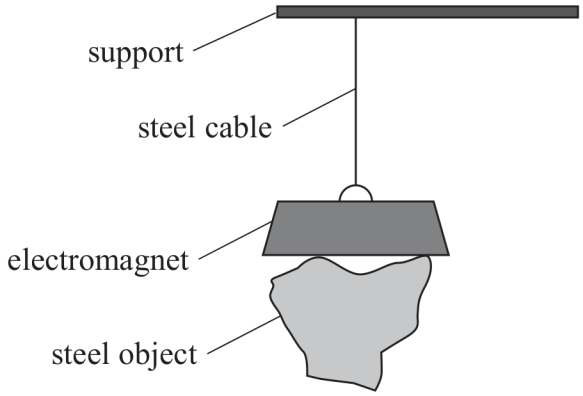
(b) The electromagnet is suspended from a support by a steel cable, as shown.



(i) When the object is suspended, the strain in the cable is 3.0×10^{-4}

Calculate the Young modulus of the steel in the cable.

cross-sectional area of cable = $5.1 \times 10^{-4}\,m^2$
unstretched length of cable = 3.8 m
stiffness of cable = $2.8 \times 10^{7}\,N\,m^{-1}$

(4)

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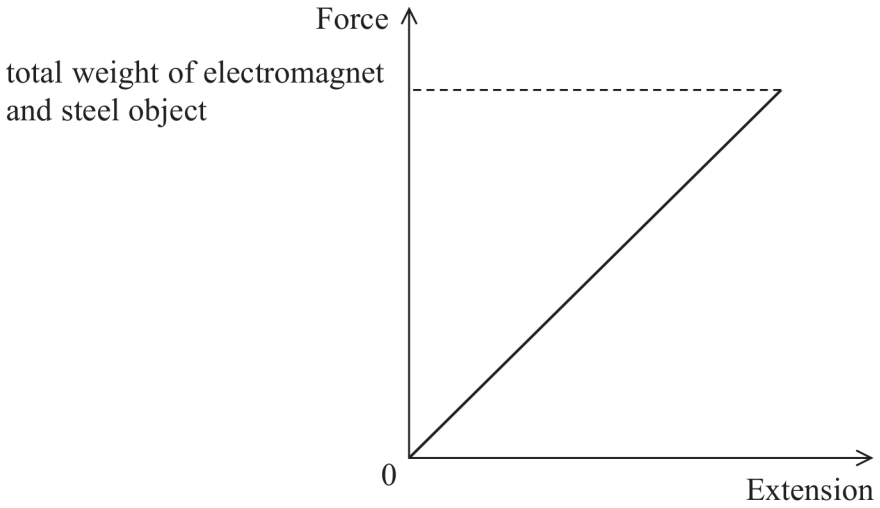
Young modulus = ...

(ii) The force-extension graph for the steel cable is shown below.



When the electromagnet is switched off, the steel object falls.

A student states that "the change in elastic strain energy stored in the cable will be transferred to the gravitational potential energy of the electromagnet".

Discuss the student's statement. You should add to the force-extension graph as part of your discussion.

(5)

(Total for Question 16 = 11 marks)