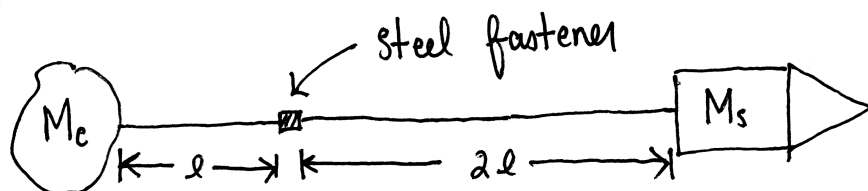


**Challenge Problem 11**

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As shown in the figure below, a spaceship of mass  $M_s$  tows cargo of mass  $M_c$  with two pieces of adamantium cable joined by a small steel fastener whose length and mass are negligible. One piece is of length  $\ell$ , the other is of length  $2\ell$ , and they both have mass per unit length  $\lambda$ . The steel fastener can be under a maximum tension  $T_{\max}$  before it breaks.



- (a) What is the maximum allowable thrust (force) that the spaceship's engine can exert on the spaceship before the fastener breaks?
- (b) At this maximum thrust, what is the tension in the entire cable (both pieces) as a function of  $x$ , where  $x$  is the coordinate along the cable and its point of contact with the cargo is  $x = 0$ ?