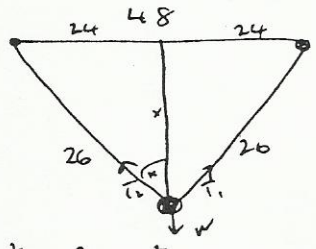
7. (a) 1997

7. (a) (i) A particle of weight W is attached to two light inextensible strings each of length 26 cm. The other ends of the strings are attached to two points on the same horizontal level 48 cm apart. Find the tension in each of the strings in terms of W.

(ii) The strings are replaced by two light elastic strings, each of natural length 26 cm and elastic constant k, attached in the same way. The position of equilibrium of the particle is now 8 cm below its previous position of equilibrium. Find the value of k in terms of W.



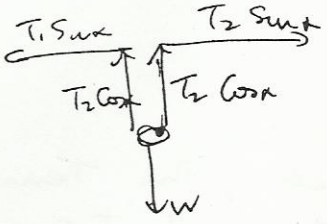
$x^2 + 24^2 = 26^2$

$x^2 = 100$

$x = 10$

$\therefore \sin\alpha = \frac{12}{13}$

$\cos\alpha = \frac{5}{13}$



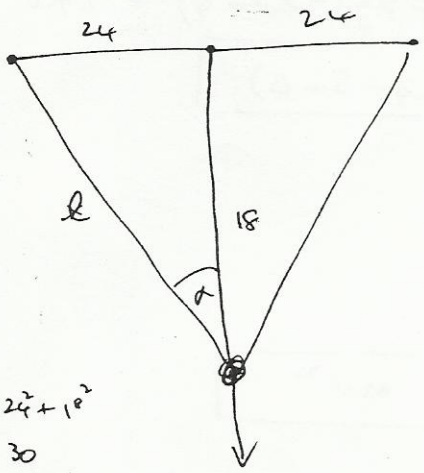
$T_1 \sin\alpha = T_2 \sin\alpha$

$T_1 = T_2 = T$

$2T\cos\alpha = W$

$2T\left(\frac{5}{13}\right) = W$

$T = \frac{13W}{10}$



$\ell^2 = 24^2 + 18^2$

$\ell = 30$

$\sin\alpha = \frac{4}{5}$

$\cos\alpha = \frac{3}{5}$

$2T\cos\alpha = W$

$\frac{6}{5}T = W$

$T = \frac{5W}{6}$

$T = k(\ell - \ell_0)$

$\frac{5W}{6} = k(0.3 - 0.28)$

$\frac{5W}{6} = k(0.02)$

$k = \frac{125W}{6}$