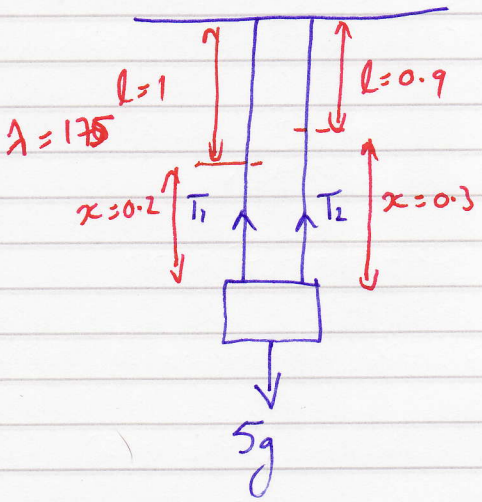
# M3 - JAN 03

Q1




In equilibrium $\therefore \quad T_1 + T_2 = 5g$

Hooke's Law $\quad T_1 = \frac{175 \times 0.2}{1}$

$T_1 = 35\,N$

$\therefore \quad T_2 = 5g - 35 = 14\,N$

Hooke's Law: $\quad 14 = \frac{\lambda \times 0.3}{0.9}$

$\lambda = 42\,N$

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Q3 if density of cylinder = $\rho$, density of hemisphere = $6\rho$

(a) $\left(\frac{2}{3}\pi r^3 \cdot 6\rho + \pi r^2 h \cdot \rho\right) d = \frac{2}{3}\pi r^3 \cdot 6\rho \left(r - \frac{3}{8}r\right) + \pi r^2 h \rho \left(r + \frac{1}{2}h\right)$

$\left(4r^3 + r^2 h\right) d = 4r^3\left(\frac{5}{8}r\right) + r^3 h + \frac{1}{2}r^2 h^2$

$\div r^2$

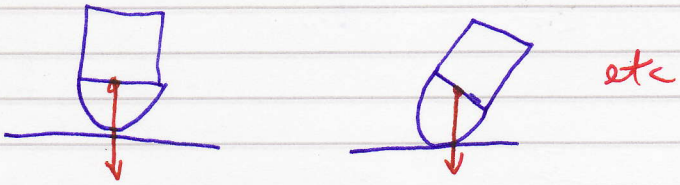
$(4r + h) d = \frac{5}{2}r^2 + rh + \frac{1}{2}h^2$

$(4r + h) d = \frac{5r^2 + 2rh + h^2}{2}$

$d = \frac{5r^2 + 2hr + h^2}{2(h + 4r)}$ As required.

(b) For equilibrium throughout contact with curved surface, $d = r$

eg



etc

$\therefore \quad r = \frac{5r^2 + 2hr + h^2}{2(h + 4r)}$

$2rh + 8r^2 = 5r^2 + 2hr + h^2$

$3r^2 = h^2$

$h = r\sqrt{3}$

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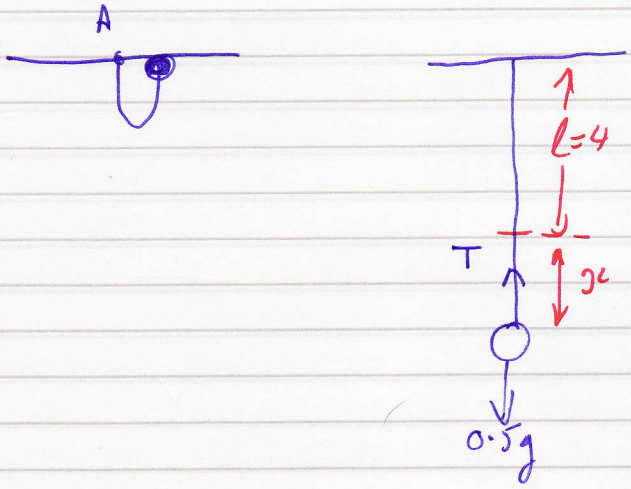
Q6 (a)




Released from rest, instantaneously at rest $\therefore$ no change in KE

Gain in EPE = loss in PE

$$\frac{\lambda x^2}{2l} = mg(x+l)$$

$$\frac{58.8x^2}{2\times 4} = 0.5g(x+4)$$

$1.5x^2 = x+4$

$1.5x^2 - x - 4 = 0$

$$\frac{3x^2}{2} - x - 4 = 0$$

$3x^2 - 2x - 8 = 0$

$(3x+4)(x-2) = 0$

either $x = -\frac{4}{3}$ ✗ or $x = 2$ ✓

$\therefore$ P comes to instantaneous rest after falling 6m

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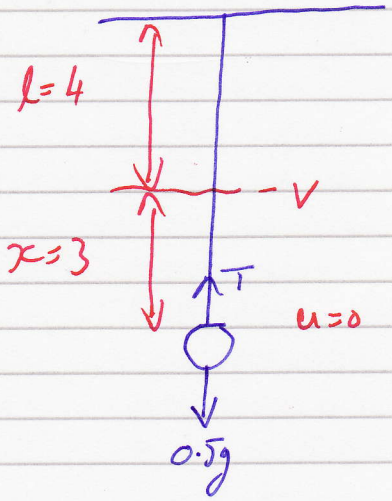
Q6)




EPE lost = KE gained + PE gained

$$\frac{58.8 \times 3^2}{2 \times 4} = \frac{1}{2} \times 0.5 V^2 + 0.5g \times 3$$

$$66.15 = 0.25V^2 + 14.7$$

$$V^2 = 205.8$$

$$V = 14.3 \text{ ms}^{-1}$$