ANSWER QUESTION 5 ONLY

(b)(ii) Take moments of ladder about contact point of ladder with wall. For equilibrium this must equal zero:

$$-(N_g \sin 30^\circ) \times 8 + (f_s \cos 30^\circ) \times 8 + (W_p \sin 30^\circ)(8 - x) + (W_l \sin 30^\circ) 4 = 0$$

$$-980 \times \tfrac{1}{2} \times 8 + f_s \tfrac{\sqrt{3}}{2} 8 + 588 \tfrac{1}{2} (8 - x) + 392 \tfrac{1}{2} 4 = 0$$

$$\Rightarrow f_s \tfrac{\sqrt{3}}{2} 8 = -392 \tfrac{1}{2} 4 + 980 \tfrac{1}{2} 8 - 588 \tfrac{1}{2} (8 - x)$$

$$= 784 + 294x$$

$$f_s = (113 + 42x)\,N$$

(c) $f_s \leq \mu_s N_g = 0.3 \times 980 = 294\,N$

As x increases so does f_s until it reaches its maximum value 294 N. If x increases further ladder will slip.

$f_s = 294\,N$ when $113 + 42x_{max} = 294$

$$x_{max} = (294 - 113)/42$$

$$= 4.3\,m$$