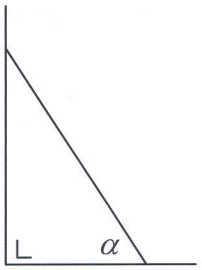
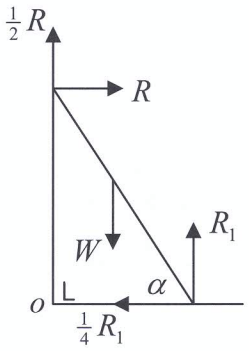
2008 **7.** **(a)** One end of a uniform ladder, of weight W, rests against a rough vertical wall, and the other end rests on rough horizontal ground. The coefficient of friction at the ground is $\frac{1}{4}$ and at the wall is $\frac{1}{2}$.



The ladder makes an angle α with the horizontal and is in a vertical plane which is perpendicular to the wall.

The ladder is on the point of slipping.
Find $\tan\alpha$.



$$R = \tfrac{1}{4}R_1 \qquad 5$$

$$\tfrac{1}{2}R + R_1 = W \qquad 5$$

Take moments about o for system :

$$R(\ell\sin\alpha) + W\left(\tfrac{1}{2}\ell\cos\alpha\right) = \\ = R_1(\ell\cos\alpha) \qquad 5$$

$$R\tan\alpha + \tfrac{1}{2}W = R_1$$

$$\tfrac{1}{4}R_1\tan\alpha + \tfrac{1}{2}\left(\tfrac{1}{8}R_1 + R_1\right) = R_1 \qquad 5$$

$$\tfrac{1}{4}\tan\alpha + \tfrac{9}{16} = 1$$

$$\Rightarrow \tan\alpha = \frac{7}{4} \qquad 5$$

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