

(a) we are not sure what is happening at A, but if we take Moments about A, we don't need to know:

Figure 2

$M(A): mga + 2mg(\frac{3}{2}a) = F \sin 30^\circ (2a)$
(clockwise = anticlockwise) (2marks)

A uniform rod AB has mass m and length $2a$.

A particle of mass $2m$ is attached to the rod at the point C, where $AC = 1.5a$

The rod is freely hinged at its end A to a fixed vertical wall.

The rod is held in equilibrium in a horizontal position by a force applied to its end B.

The force has magnitude F and acts at 30° to the horizontal, as shown in Figure 2.

The line of action of the force and the rod lie in the same vertical plane that is perpendicular to the wall.

(a) $mga + 3mga = F(\frac{1}{2})2a$

(a) Show that $F = 4mg$

$4mga = Fa$
 $\Rightarrow F = 4mg$ (1mark) (3)

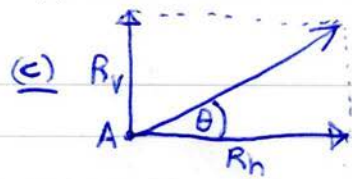
(b) Find the magnitude, in terms of m and g , of the vertical component of the force exerted on the rod by the wall at A.

(b) Resolving vertically, total down = total up

$R(\uparrow): mg + 2mg = R_v + F \sin 30^\circ \Rightarrow 3mg = R_v + 4mg(\frac{1}{2}) \Rightarrow R_v = mg$ (2marks) (2)

The line of action of the force exerted on the rod by the wall at A makes an angle θ with the horizontal.

(c) Find the exact value of $\tan \theta$.



$\tan \theta = \frac{R_v}{R_h}$

We know R_v , and need to now find R_h :

$R(\leftrightarrow): R_h = F \cos 30^\circ = 4mg(\frac{\sqrt{3}}{2}) = 2\sqrt{3}mg$ (2marks)

$\tan \theta = \frac{R_v}{R_h} = \frac{mg}{2\sqrt{3}mg} = \frac{1}{2\sqrt{3}} (\times \frac{\sqrt{3}}{\sqrt{3}} = \frac{\sqrt{3}}{6})$ (2marks)