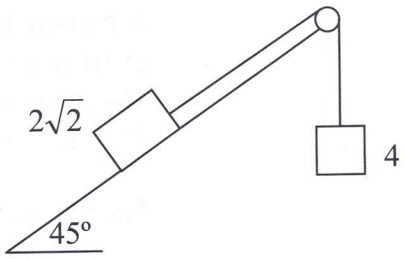
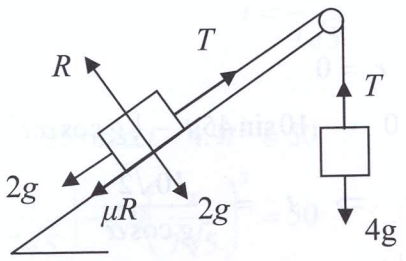
2011

4. (a) A block of mass $2\sqrt{2}$ kg rests on a rough plane inclined at 45° to the horizontal. It is connected by a light inextensible string which passes over a smooth, light, fixed pulley to a particle of mass 4 kg which hangs freely under gravity. The coefficient of friction between the block and the plane is $\frac{1}{4}$.



Find the acceleration of the 4 kg mass.



$$4g - T = 4f$$

$$T - 2g - \mu R = 2\sqrt{2}f$$

$$T - 2g - \tfrac{1}{4}(2g) = 2\sqrt{2}f$$

$$4g - 2g - \frac{1}{2}g = \left(4 + 2\sqrt{2}\right)f$$

$$\frac{3g}{2} = \left(4 + 2\sqrt{2}\right)f$$

$$f = \frac{3g}{2\left(4 + 2\sqrt{2}\right)}$$

$$\Rightarrow \quad f = 2.15 \text{ m s}^{-2}$$

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