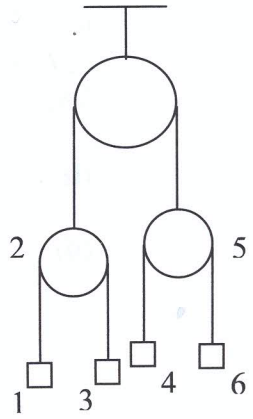
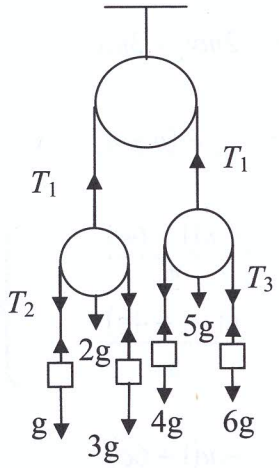
2011

4 (b) A smooth pulley, of mass 2 kg, is connected by a light inextensible string passing over a smooth light fixed pulley to a smooth pulley of mass 5 kg. Two particles of masses 1 kg and 3 kg are connected by a light inextensible string passing over the 2 kg pulley.
Two particles of masses 4 kg and 6 kg are connected by a light inextensible string passing over the 5 kg pulley.
Find the tension in each string, when the system is released from rest.





$$6g - T_3 = 6(c + a)$$
$$T_3 - 4g = 4(c - a) \quad \Rightarrow \quad 24g - 5T_3 = 24a \qquad 5$$

$$3g - T_2 = 3(b - a)$$
$$T_2 - g = (b + a) \quad \Rightarrow \quad 6g - 4T_2 = -6a \qquad 5$$

$$T_1 - 2T_2 - 2g = 2a$$
$$2T_3 + 5g - T_1 = 5a \quad \Rightarrow \quad 2T_3 - 2T_2 + 3g = 7a \qquad 5$$

$$2\left\{\frac{24g - 24a}{5}\right\} - 2\left\{\frac{6g + 6a}{4}\right\} + 3g = 7a$$

$$\Rightarrow \quad a = 4.8 \text{ m s}^{-2}$$

$$\left.\begin{aligned} T_1 &= 73 \text{ N} \\ T_2 &= 21.9 \text{ N} \\ T_3 &= 24 \text{ N} \end{aligned}\right\} \qquad 5$$

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