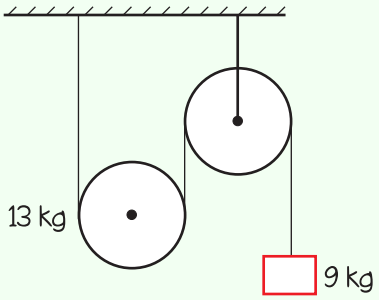
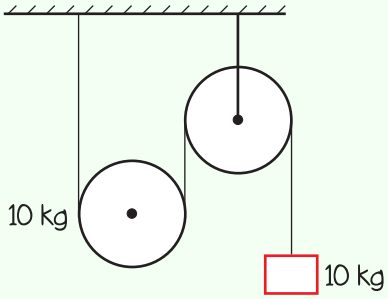
Exercise 9. Free Movable Pulleys

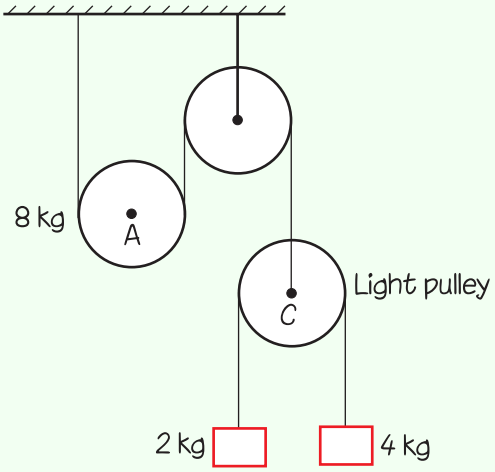
1. All pulleys are smooth. Show that the acceleration of the 9 kg particle is 2 m s^{-2} and that of the 13 kg movable pulley is 1 m s^{-2}. Find the tension in the string.



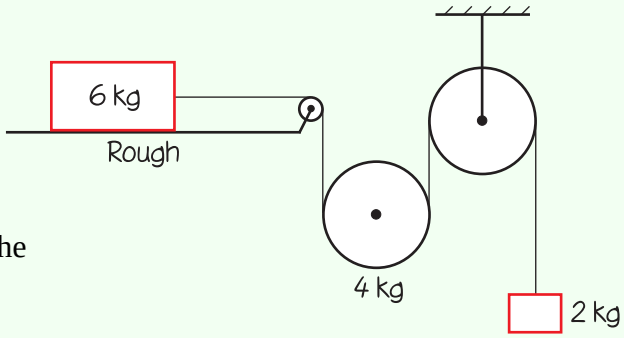
2. All pulleys are smooth. Draw a force acceleration diagram for each moving particle. Calculate the acceleration of each particle and the tension in the string.



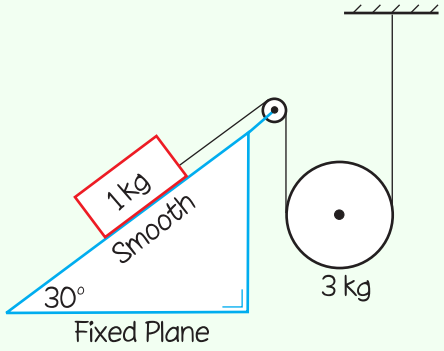
3. All the pulleys are smooth. Find the accelerations of pulley A and pulley C and the accelerations of the two particles.



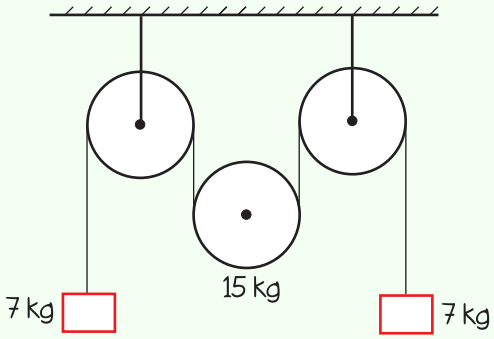
4. All pulleys are smooth. The table is rough, the coefficient of friction between the mass and the table is $\frac{1}{6}$. Show in separate diagrams the forces acting on each moving particle.
Find the acceleration of each particle and the tension in the string.



5. All surfaces and pulleys are smooth.
Find the acceleration of the particle and the pulley and the tension in the string.



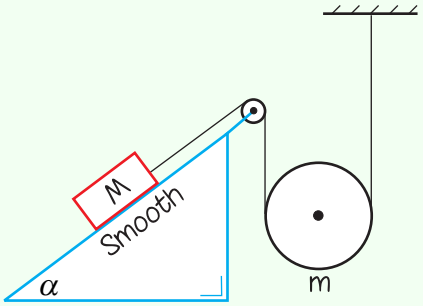
6. All pulleys are smooth. Find the acceleration on the movable pulley.
If the movable pulley is given an upward velocity of 4 m s^{-1} find the time for it to reverse direction.



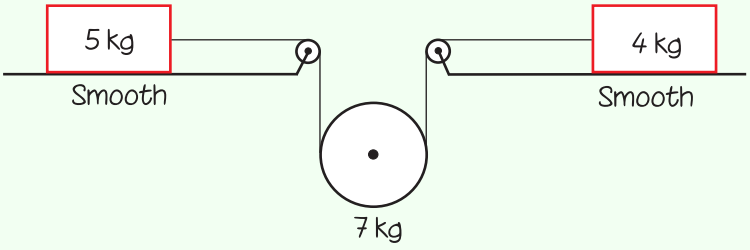
7. All surfaces and all planes are smooth. Show that the acceleration of M down the plane is

$$\frac{2g(2M\sin\alpha - m)}{(4M + m)}.$$

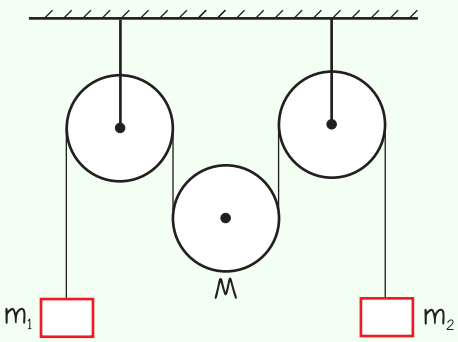
If $\alpha = 30^\circ$, $M = 0.05$ kg, $m = 0.01$ kg show that the 0.05 kg mass moves down the plane and find its speed when it has moved 3 m starting from rest.



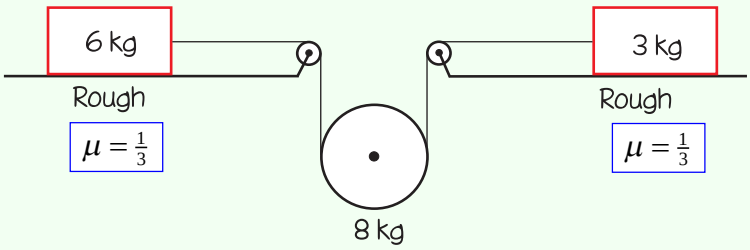
8. All pulleys and all surfaces are smooth. Find the acceleration of each particle and the pulley and the tension in the string.



9. All pulleys are smooth. Show that the tension in the string is $\dfrac{4Mm_1m_2g}{M(m_1 + m_2) + 4m_1m_2}$.



10. All pulleys are smooth.
Find the acceleration of each particle and the pulley and the tension in the string.



Answers

Exercise 9

1. 70.2 N

2. $\frac{2}{5}g$ ms^{-2}, $\frac{1}{5}g$ ms^{-2}, $6g$ N

3. Pulley A: $\frac{1}{11}g$ ms^{-2} up
Pulley C: $\frac{2}{11}g$ ms^{-2} down
2 kg mass: $\frac{1}{11}g$ ms^{-2} up
4 kg mass: $\frac{5}{11}g$ ms^{-2}

4. 6 kg mass: $\frac{3}{20}g$ ms^{-2} right
4 kg mass: $\frac{1}{20}g$ ms^{-2} down
2 kg mass: $\frac{1}{20}g$ ms^{-2} down
Tension: $\frac{19}{10}g$ N

5. 1 kg mass: $\frac{4}{7}g$ ms^{-2} up
3 kg mass: $\frac{2}{7}g$ ms^{-2} down
Tension: $\frac{15}{14}g$ N

6. $\frac{1}{29}g$ ms^{-2} down, 11.84 s

7. 4.73 m s^{-1}

8. 5 kg mass: $\frac{56}{143}g$ ms^{-2}
4 kg mass: $\frac{70}{143}g$ ms^{-2}
Pulley: $\frac{63}{143}g$ ms^{-2}
Tension: $\frac{280}{143}g$ N

10. 6 kg mass: $\frac{1}{9}g$ ms^{-2} right
3 kg mass: $\frac{5}{9}g$ ms^{-2} left
8 kg pulley: $\frac{1}{3}g$ ms^{-2}
Tension: $\frac{8}{3}g$ N