Problems of Practices
Of
Mechanics
Chapter-6 Friction

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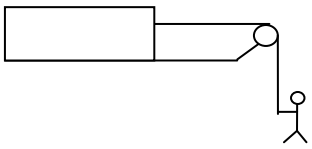
PROBLEMS ON FRICTION

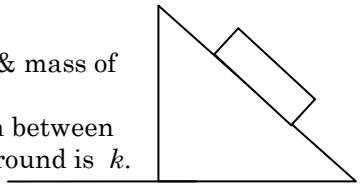
1. Find out the maximum acceleration with which the man can move vertically upward such that the block does not slip on the ground.

Mass of the block is M
Mass of the man is $2M$
Coefficient of friction between the block and the ground is 1/3.

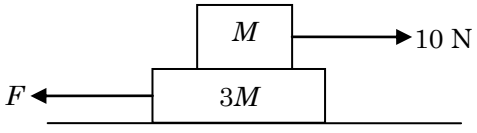


2. A block is placed on wedge. If no relative motion takes place between the block and the wedge then find out the friction acting on the wedge from the ground.

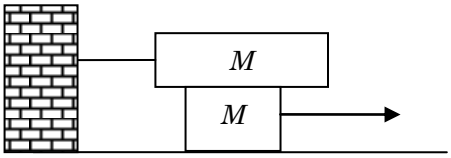
Mass of the block is & mass of the wedge is M
Coefficient of friction between the wedge and the ground is k.



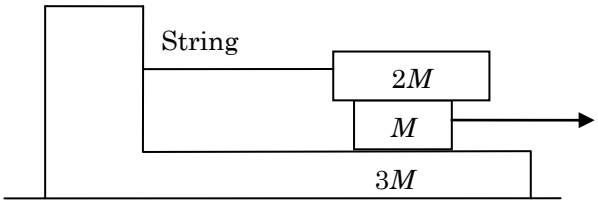
3. In the diagram shown, find out the range of the value of force F such that no relative motion takes place between the blocks. Coefficient friction between the blocks is 1/2. No friction between the $3M$ mass and ground.



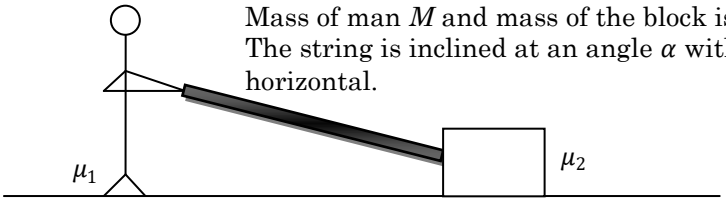
4. The coefficient of friction at all the contact surfaces is k. Find out the minimum force that should be applied on the block so that it just starts moving.



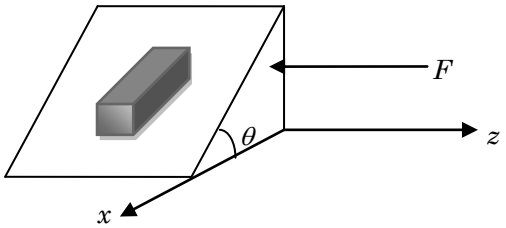
5. Repeat the analysis of Q. no. 4. Find out the minimum value of F so that relative motion just starts. Consider the horizontal ground to be smooth.



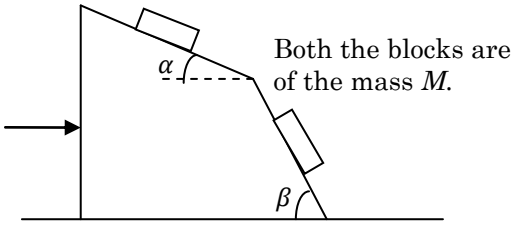
6. A man is trying to pull a block as shown. Find out the condition for the man to successfully pull the block.



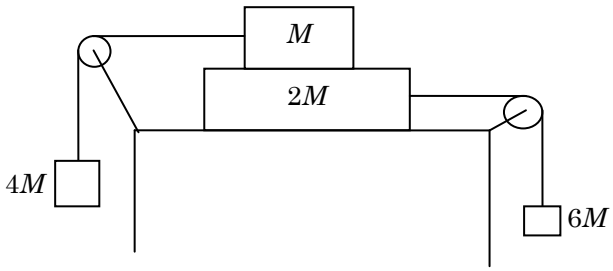
7. A wedge of mass M is placed on a smooth xz plane as shown. On rough inclined surface of the wedge, a block of mass m is placed. By applying a force F in the $-z$ direction it is desired to just start relative motion between the wedge and the block. Find the minimum value of F. The coefficient of friction between the wedge and the block is $2 \tan \theta$.



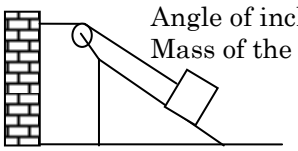
8. In the diagram shown, the upper block has no tendency of relative motion with respect to wedge. What will be the direction of friction acting on the lower block? Assume the lower block to remain in the state of rest with respect to the wedge. Find out the magnitude of friction force acting on the lower block.



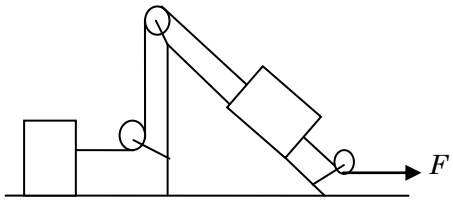
9. Find out the coefficient of friction between the M and the $2M$ such no relative motion can take place between them. Assume no friction to be present at any other surface.



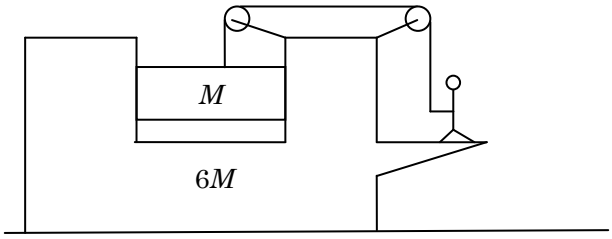
10. No friction is present between the block and the wedge. The coefficient of friction between the wedge and the ground is 1/2. If the wedge is of mass M then find out the minimum value of the mass of the block such relative motion can just start between the wedge and the ground. No friction anywhere else.



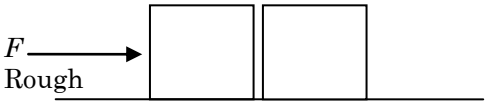
11. Find out a relation between μ_1 and μ_2 such that when sufficient force is applied then the relative motion firstly starts between the M mass and ground. Mass of the wedge is $3M$, mass of the block placed on the wedge is $2M$, and mass of the block placed on ground is M. Angle of inclination is θ.. μ_1 is coefficient of friction between the wedge & ground. μ_2 is the coefficient between the mass M and ground.



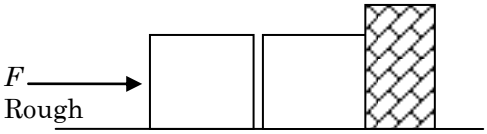
12. Find out the minimum value of friction between the smaller block and the larger block such that no relative motion can take place between them. The force applied by the man is $2Mg$. Man remains in the state of rest with respect to the bigger block.



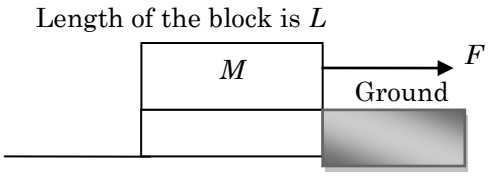
13. In the diagram shown, the two blocks are initially just not touching each other. If the force F is linearly increasing with time then draw the variation of the friction force acting on the two blocks as a function time till the blocks start moving.



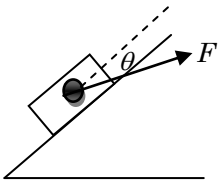
14. In the previous question, suppose the second block is in contact with a wall. Draw the variation of the friction force as a function of time.



15. The coefficient of friction between the blocks is 0.5. A constant force F is acting on the block as shown. The force is sufficient to start relative motion between the blocks. The ground on which the block comes is perfectly smooth. Draw the variation of acceleration of the block as a function of displacement. What is the velocity of the block when it just completely comes on the ground?

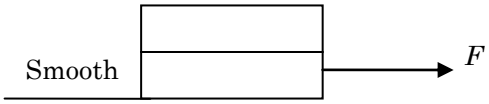


16. A force $F = mg/\sqrt{2}$ is applied as shown. The angle θ varies according to the relation $\theta = kt$ in the clockwise sense. The coefficient of friction is equal to $\sqrt{2}$. Draw the variation of friction force as θ varies from 0° to π. The mass of the block is m. Angle of inclination is 45°.

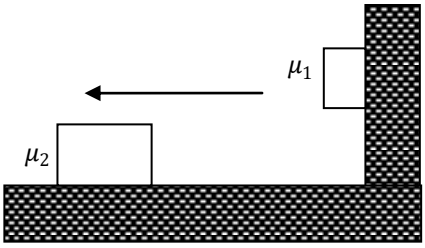


17. If the angle $\theta = \pi/2 + \alpha$ then find out a relation for obtaining the value of the angle α so that relative motion may just start.

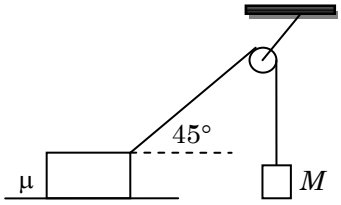
18. The coefficient of static friction between the blocks is 0.2 and coefficient of kinetic friction is 0.18. Both the blocks have the same mass 1 kg. A force increasing linearly with respect to time according to the relation $F = 2t$, has been applied. Draw the acceleration versus time graph of both the blocks.



19. In the diagram shown, both the blocks are just in the state of rest with respect to the L shaped bigger block. This block is moving horizontally under some acceleration. Find out a relation between the coefficients of friction shown in the figure by using the information given.



20. Find out the value of the mass of the block on the plane such that the whole system may just be held in the state of rest.



21. In the diagram shown, the coefficient of friction between the $9M$ block and M block is k. All the other surfaces are frictionless. Find out the maximum value of the mass of the hanging block, such that no relative motion takes place between the other two blocks.