AVIRAL
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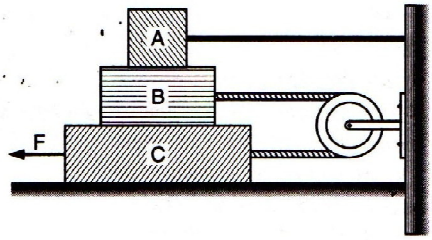
JEE ADV - PHYSICS
DPP -02
21 JAN 2020

TOPICS : LAWS OF MOTION

1. In Fig. 7.80 shown, the blocks A, B and C weigh 3 kg, 4 kg and 8 kg respectively. The coefficient of sliding friction between any two surfaces is 0.25. A is held at rest by a massless rigid rod fixed to the wall while B and C are connected by a light flexible cord passing around a fixed pulley. Find the force F necessary to drag C along the horizontal at constant speed.



[**Ans.** 8g N]

2. A 40 kg slab rests on a frictionless floor. A 10 kg block rests on the top of the slab [Fig. 7.81 (a)]. The coefficients of static and dynamic friction are 0.60 and 0.40 respectively. The 10 kg block is pulled by a horizontal force of 100 N. What are the resulting accelerations of (a) the block (b) the slab? ($g = 10\,m/s^2$)

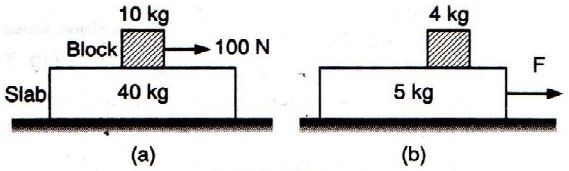


Fig. 7.81

[**Ans.** $a_B = 6\,m/s^2$ and $a_S = 1\,m/s^2$]

3. A block of mass M rests on a smooth horizontal surface over which it can move without friction. A body with mass m lies on the block as shown in Fig. 7.82. The coefficient of friction between the body and the block is μ. (a) For what force F applied to the block in horizontal direction, the body begins to slide over the block? (b) In what time will the body fall from the block if the length of the block is L?

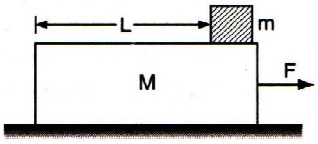
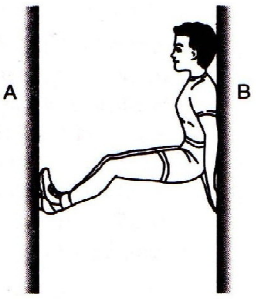


Fig. 7.82

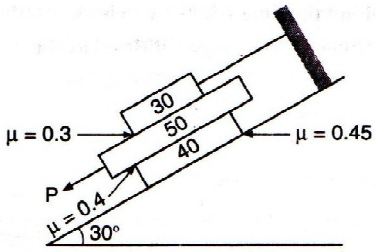
[**Ans:** $F > \mu(m+M)g$ and $t = \sqrt{\dfrac{2ML}{F-\mu(m+M)g}}$]

4. A rock-climber (49 kg) is managing to be at rest between two vertical rocks pressing one rock A by his feet and the other B by his back. If the coefficient of friction between his shoes and wall A is 1.2 while between his back and wall B is 0.8 and limiting friction acts at all the contacts, then: (a) What is his push against the rock? (b) What percent of the weight is supported by the frictional force on legs?



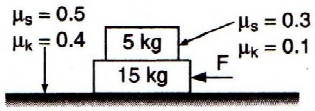
[**Ans.** (a) 240 N, (b) 60%]

5. The three flat blocks in the figure are positioned on the 30° incline and a force parallel to the inclined plane is applied to the middle block. The upper block is prevented from moving by a wire which attaches it to the fixed support. The coefficient of static friction for each of the three pairs of contact surfaces is shown in the figure. Determine the maximum value which P may have before any slipping takes place.



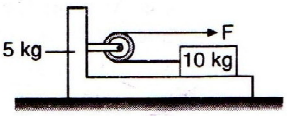
[**Ans.** $P = 93.8$ N]

6. In the Fig. 7.85 shown a constant force is applied on the lower block, just large enough to make this block sliding out from between the upper block and the table. Determine the acceleration of each block.



[**Ans.** 0.98 m/s^2, 1.96 m/s^2]

7. A 10 kg block rests on a 5 kg bracket as shown in Fig. 7.86. The 5 kg bracket rests on a horizontal frictionless surface. The coefficients of friction between the 10 kg block and the bracket on which it rests are $\mu_s = 0.40$ and $\mu_k = 0.30$. (a) What is the maximum force F that can be applied if the 10 kg block is not to slide on the bracket? (b) What is the corresponding acceleration of the 5 kg bracket?



[**Ans.** (a) 24 N; (b) 1.6 m/s^2]