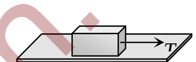
Block On Block

1. **In the figure shown, a block of weight 10 *N* resting on a horizontal surface. The coefficient of static friction between the block and the surface $\mu_s = 0.4$. A force of 3.5 *N* will keep the block in uniform motion, once it has been set in motion. A horizontal force of 3 *N* is applied to the block, then the block will**



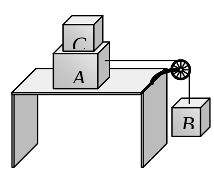
(a) Move over the surface with constant velocity

(b) Move having accelerated motion over the surface

(c) Not move

(d) First it will move with a constant velocity for some time and then will have accelerated motion

2. **Two masses A and B of 10 *kg* and 5 *kg* respectively are connected with a string passing over a frictionless pulley fixed at the corner of a table as shown. The coefficient of static friction of A with table is 0.2. The minimum mass of C that may be placed on A to prevent it from moving is**



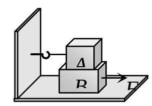
(a) 15 *kg*

(b) 10 *kg*

(c) 5 *kg*

(d) 12 *kg*

3. A block *A* with mass 100 *kg* is resting on another block *B* of mass 200 *kg*. As shown in figure a horizontal rope tied to a wall holds it. The coefficient of friction between *A* and *B* is 0.2 while coefficient of friction between *B* and the ground is 0.3. The minimum required force *F* to start moving *B* will be



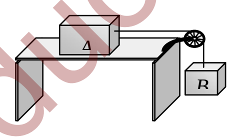
(a) 900 *N*

(b) 100 *N*

(c) 1100 *N*

(d) 1200 *N*

4. The blocks A and B are arranged as shown in the figure. The pulley is frictionless. The mass of *A* is 10 *kg*. The coefficient of friction of *A* with the horizontal surface is 0.20. The minimum mass of *B* to start the motion will be



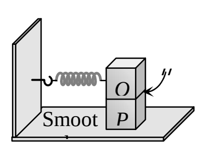
(a)2 *kg*

(b)0.2 *kg*

(c)5 *kg*

(d)10 *kg*

5. A block *P* of mass *m* is placed on a frictionless horizontal surface. Another block *Q* of same mass is kept on *P* and connected to the wall with the help of a spring of spring constant *k* as shown in the figure. μ_s is the coefficient of friction between *P* and *Q*. The blocks move together performing *SHM* of amplitude *A*. The maximum value of the friction force between *P* and *Q* is



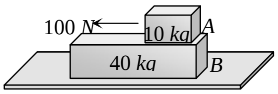
(a) kA

(b) $\frac{kA}{2}$

(c) Zero

(d) $\mu_s mg$

6. **A 40 *kg* slab rests on a frictionless floor as shown in the figure. A 10 *kg* block rests on the top of the slab. The static coefficient of friction between the block and slab is 0.60 while the kinetic friction is 0.40. The 10 *kg* block is acted upon by a horizontal force 100 *N*. If $g = 9.8\, m/s^2$, the resulting acceleration of the slab will be**



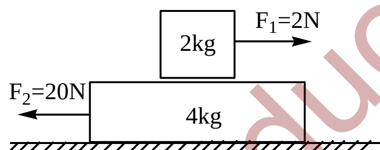
(a) $0.98\, m/s^2$

(b) $1.47\, m/s^2$

(c) $1.52\, m/s^2$

(d) $6.1\, m/s^2$

7. **In the arrangement shown in figure, coefficient of friction between the two blocks is 0.5. The force of friction acting between the two blocks is**



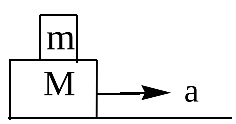
a) 8N

b) 10N

c) 6N

d) 4N

8. **A block of mass m is placed on the top of another block of mass M as shown in figure. The co–efficient of friction between them is μ, the maximum acceleration with which the block M may move so that m also moves along with it is**



a) $g\mu$ b) g/μ

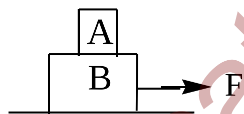
c) μ/g d) $\mu^2 g$

9. A 2kg block is placed over a 4kg block and both are placed on a smooth horizontal surface. The coefficient of friction between the blocks is 0.20. The acceleration of the two blocks if a horizontal force of 12N is applied to the upper block ($g=10ms^{-2}$)

a) 4 ms^{-2}, 2 ms^{-2}　　b) 2 ms^{-2}, 2 ms^{-2}

c) 3 ms^{-2}, 3 ms^{-2}　　d) 4 ms^{-2}, 1 ms^{-2}

10. A 4 kg block A is placed at the top of 8 kg block B which rests on a smooth table. A just slips on B when a force of 20 N is applied on A. The maximum horizontal force F required to make both A & B move together is



a) 36 N　　b) 5 N

c) 40 N　　d) 60 N

Key

1)c　2) a　3) c　4) a　5)b　6) a 7) a　8) a　9) d　10) d

Hints

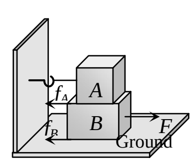
1. (c) $F_l = \mu_s R = 0.4 \times mg = 0.4 \times 10 = 4N$ *i.e.* minimum $4N$ force is required to start the motion of a body. But applied force is only $3N$. So the block will not move.

2. (a) For limiting condition $\mu = \frac{m_B}{m_A + m_C} \Rightarrow 0.2 = \frac{5}{10 + m_C} \Rightarrow 2 + 0.2m_C = 5 \Rightarrow m_C = 15kg$

3. (c) $F = f_{AB} + f_{BG}$

$= \mu_{AB} m_a g + \mu_{BG}(m_A + m_B)g$

$= 0.2 \times 100 \times 10$



$+0.3(300)\times 10$

$= 200 + 900 = 1100\ N$

4. (a) $\mu = \frac{m_B}{m_A} \Rightarrow 0.2 = \frac{m_B}{10} \Rightarrow m_B = 2kg$

5. (b) When two blocks performs simple harmonic motion together then at the extreme position (at amplitude =*A*)

Restoring force $F = KA = 2ma \Rightarrow a = \frac{KA}{2m}$

There will be no relative motion between *P* and *Q* if pseudo force on block *P* is less than or just equal to limiting friction between *P* and *Q*.

i.e. $m\left(\frac{KA}{2m}\right) =$ Limiting friction

$\therefore$ Maximum friction $= \frac{KA}{2}$

6. (a) Limiting friction between block and slab $= \mu_s m_A g$

$= 0.6 \times 10 \times 9.8 = 58.8\,N$

But applied force on block *A* is 100 *N*. So the block will slip over a slab.

Now kinetic friction works between block and slab $F_k = \mu_k m_A g \ = 0.4 \times 10 \times 9.8 = 39.2\ N$

This kinetic friction helps to move the slab

$\therefore$ Acceleration of slab $= \frac{39.2}{m_B} = \frac{39.2}{40} = 0.98\ m/s^2$

7. Let the acceleration of both the blocks towards left is 'a', then

$$a = \frac{f-2}{2} = \frac{20-f}{4}$$

The maximum friction between the two blocks can be.

$\therefore f = 8N$

Friction between the two blocks is 8N

$f_{\max} = \mu mg$

$f_{\max} = (0.5)\,2(10) = 10N$

$\therefore f < f_{\max}$

8. For the block in does not slip on M.

$ma = f_{max}$

$ma = \mu\ mg$

$a = \mu g$

9. For 2kg block

$12 - \mu mg = ma$

12 - 0.2 (2) (10) = 2a

8 = 2a

$a = 4\ ms^{-2}$

The 4 kg block moves towards right because of frictional force

f = 4a

0.2 (2) 10 = 4a

$a = 1\ ms^{-2}$

10. 20 = 4a

$a = 5\ ms^{-2}$

$F = (m_1 + m_2)\ a$

F = (4 + 8) 5

F = 60 N