PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 38

Total Marks : 27

Max. Time : 29 min.

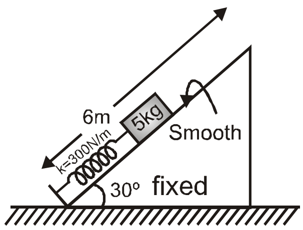
Topics : Relative Motion, Work, Power and Energy, Friction

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.2	(3 marks, 3 min.)	[6, 6]
Multiple choice objective ('–1' negative marking) Q.3	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.4 to Q.5	(4 marks, 5 min.)	[8, 10]
Comprehension ('–1' negative marking) Q.6 to Q.8	(3 marks, 3 min.)	[9, 9]

1. Two bikes A and B start from a point. A moves with uniform speed 40 m/s and B starts from rest with uniform acceleration 2 m/s^2. If B starts at t = 0 and A starts from the same point at t = 10 s, then the time interval during the journey in which A was ahead of B is :

(A) 20 s
(B) 8 s
(C) 10 s
(D) A is never ahead of B

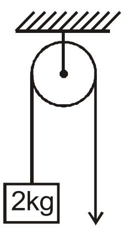
2. A block of mass 5 kg is released from rest when compression in spring is 2m. Block is not attached with the spring and natural length of the spring is 4m. Maximum height of block from ground is : (g = 10 m/s^2)



(A) 5.5 m
(B) 4.5 m
(C) 6 m
(D) 7.5 m

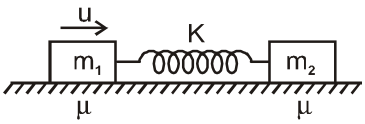
3. A block of mass 2 kg is hanging over a smooth and light pulley through a light string. The other end of the string is pulled by a constant force F = 40 N. At t = 0 the system is at rest as shown. Then in the time interval from

t = 0 to t = $\frac{2}{\sqrt{10}}$ seconds, pick up the correct statement (s) : (g = 10 m/s^2)



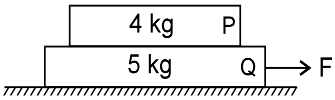
(A) tension in the string is 40 N
(B) work done by gravity is – 20 J
(C) work done by tension on block is 80 J
(D) None of these

4. The blocks of mass m_1 = 1 kg and m_2 = 2 kg are connected by an ideal spring, rest on a rough horizontal surface. The spring is unstressed. The spring constant of spring is K = 2 N/m. The coefficient of friction between blocks and horizontal surface is $\mu = \frac{1}{2}$. Now the left block is imparted a velocity u towards right as shown. The largest value of u (in m/s) such that the block of mass m_2 never moves is (Take g = 10m/s²)



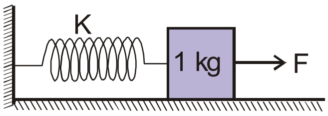
Fixed rough horizontal surface

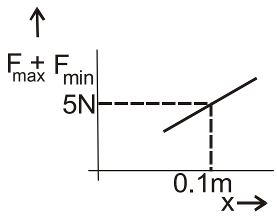
5. If the lower block is held fixed & force is applied to P, minimum force required to slide P on Q is 12 N. Now if Q is free to move on frictionless surface and force is applied to Q then the minimum force F required to slide P on Q is _______.



COMPREHENSION

A block of mass 1 kg is placed on a rough horizontal surface. A spring is attached to the block whose other end is joined to a rigid wall,as shown in the figure. A horizontal force is applied on the block so that it remains at rest while the spring is elongated by x $\left(x \geq \frac{\mu mg}{k}\right)$. Let F_{max} and F_{min} be the maximum and minimum values of force F for which the block remains in equilibrium. For a particular x, $F_{max} - F_{min}$ = 2 N. Also shown is the variation of $F_{max} + F_{min}$ versus x, the elongation of the spring.





6. The coefficient of friction between the block and the horizontal surface is :
(A) 0.1 (B) 0.2 (C) 0.3 (D) 0.4

7. The spring constant of the spring is:
(A) 25 N/m (B) 20 N/m (C) 2.5 N/m (D) 50 N/m

8. The value of F_{min} , if x = 3 cm is :
(A) 0 (B) 0.2N (C) 5N (D) 1N

Answers Key

DPP NO. - 38

1.	(D)	**2.**	(A)	**3.**	(A), (C)	**4.**	10m/s.
5.	27 N	**6.**	(A)	**7.**	(A)	**8.**	(A)

Hint & Solutions

DPP NO. - 38

1. A will be ahead of B when $x_A > x_B$

$40 (t - 10) > (0) t + \quad (2) t^2$

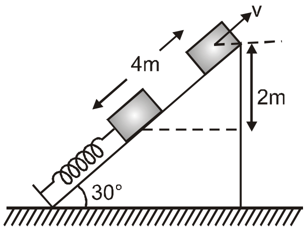
as A is 10 sec. late than B.

$\Rightarrow t^2 - 40t + 400 < 0$

$\Rightarrow (t - 20)^2 < 0$

Which is not possible. So A will never be ahead at B.

2. By energy conservation,



$$\frac{1}{2}kx^2 = mgh + \frac{1}{2}mv^2$$

$$= \frac{1}{2} \times 300 \times (2)^2 = 5 \times 10 \times 2 + \frac{1}{2} \times 5v^2$$

$\Rightarrow \quad v^2 = 200$

Also, $H = \dfrac{v^2 \sin^2 30^\circ}{2g} = 2.5$ m

So, total height from ground = 3 + 2.5 = 5.5m.

3. Acceleration of block is $= 10\ m/s^2$

$\therefore$ displacement $s = \frac{1}{2}at^2 = \frac{1}{2} \times 10 \times \frac{4}{10}$

$= 2m$

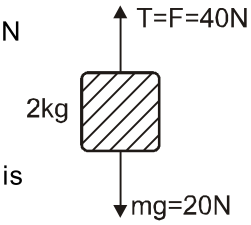
Tension in the string is 40 N

Work done by gravity is

$-20 \times 2 = -40$ J

and work done by tension is

$40 \times 2 = 80$ J



4. For the block of mass m_2, not to move, the maximum compression in the spring x_o should be such that

$kx_o = \mu m_2 g$ .... (1)

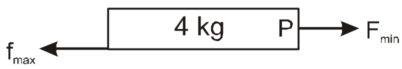
Applying work energy theorem to block of mass m_1 we get

$$\frac{1}{2}m_1u^2 = \frac{1}{2}kx_o^2 + \mu m_1 g x_o \quad .... (2)$$

From equation (1) and (2) we get

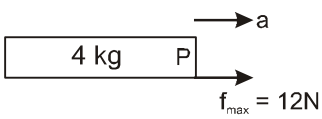
$$\frac{1}{2}m_1u^2 = \frac{1}{2}\frac{\mu^2 m_2^2 g^2}{K} + \frac{\mu^2 m_1 m_2 g^2}{K}$$ putting the appropriate value we get u=10m/s.

5. **Case (i):**



$f_{max} = F_{min} = 12$ N

Case (ii) :



$a = \frac{F}{9}$

$f_{max} = 12$

$\Rightarrow$ 4a = 12

$\Rightarrow$ $4\left(\frac{F}{9}\right) = 12$ F = 27 N

6. $F_{max} = kx + \mu mg$

$F_{min.} = kx - \mu mg$

$\therefore F_{max} - F_{min.} = 2 \mu mg$

or $2 = 2 \mu 10$

$\therefore m = 0.1$

7. $F_{max} + F_{min.} = 2 kx$ .... (1)

from graph $F_{max} + F_{min.} = 5$

and $x = 0.1$

Putting in equation (1)

$t = 2 k(0.1)$

$k = 25$ N/m.

8. When $x = 0.03$

$kx = 25 \times 0.03$

$= 0.75$ N, which is less than $\mu mg = 0.1 \times 10$

$= 1$ N

$\therefore$ The block will be at rest, without applying force F.