PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 37

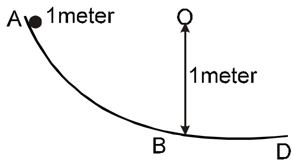
Total Marks : 27

Max. Time : 29 min.

Topics : Work, Power and Energy, Friction

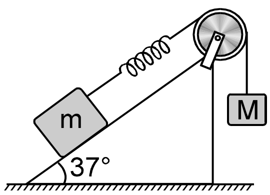
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.5	(3 marks, 3 min.)	[15, 15]
Multiple choice objective ('–1' negative marking) Q.6	(4 marks, 4 min.)	[4, 4]
Subjective Questions ('–1' negative marking) Q.7 to Q.8	(4 marks, 5 min.)	[8, 10]

1. In the track shown in figure section AB is a quadrant of a circle of 1 metre radius. A block is released at A and slides without friction until it reaches B. After B it moves on a rough horizontal floor and comes to rest at distance 3 metres from B. What is the coefficient of friction between floor and body ?



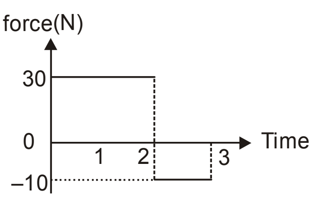
(A) 1/3
(B) 2/3
(C) 1/4
(D) 3/8

2. A block of mass m is attached with a massless spring of force constant k. The block is placed over a fixed rough inclined surface for which the coefficient of friction is $\mu = \frac{3}{4}$. The block of mass m is initially at rest. The block of mass M is released from rest with spring in unstretched state. The minimum value of M required to move the block up the plane is (neglect mass of string and pulley and friction in pulley.)



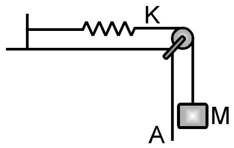
(A) $\frac{3}{5}$m
(B) $\frac{4}{5}$m
(C) $\frac{6}{5}$m
(D) $\frac{3}{2}$m

3. Starting at rest, a 10 kg object is acted upon by only one force as indicated in figure. Then the total work done by the fo rce is



(A) 90 J
(B) 125 J
(C) 245 J
(D) 490 J

4. Block A in the figure is released from rest when the extension in the spring is $x_{0.}$ (x_0 < mg/k). The maximum downward displacement of the block is (ther is no friction) :



(A) $\frac{2Mg}{K} - 2x_0$ (B) $\frac{Mg}{2K} + x_0$

(C) $\frac{2Mg}{K} - x_0$ (D) $\frac{2Mg}{K} + x_0$

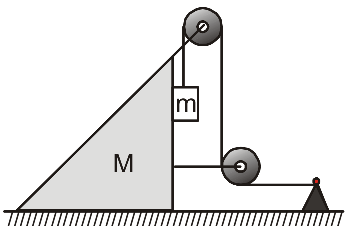
5. The minimum work done required to accelerate a truck on a horizontal road from rest to speed v
(A) is less than that required to accelerate it from v to 2v.
(B) is equal than that required to accelerate it from v to 2v.
(C) is more than that required to accelerate it from v to 2v.
(D) may be any one of the above since it depends on the force acting on the truck and the distance over which it acts.

6. Which of the following relations are always true?

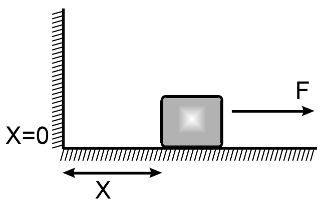
$\vec{v}$ = velocity , $\vec{a}$ = acceleration, K = $\frac{1}{2}mv^2$ = Kinetic energy

(A) $\frac{dK}{dt} = m\vec{v}\cdot\vec{a}$ (B) $\frac{d|\vec{v}|}{dt} = \frac{\vec{a}\cdot\vec{v}}{|\vec{v}|}$ (C) $\frac{d|\vec{v}|}{dt} = \left|\frac{d\vec{a}}{dt}\right|$ (D) $|\Delta\vec{v}| = \left|\int_{t_1}^{t_2}\vec{a}\,dt\right|$

7. In the arrangement shown in Fig. the masses of the wedge M and the body m are known. The appreciable friction exists only between the wedge and the body m, the friction coefficient being equal to μ. The masses of the pulley and the thread are negligible. Find the acceleration of the body m relative to the horizontal surface on which the wedge Slides.



8. The block of mass m initially at x = 0 is acted upon by a horizontal force at any position x is given as F = a – bx^2(where a > μmg), as shown in the figure. The co-efficient of friction between the surfaces of contact is μ. The net work done on the block is zero, if the block travels a distance of ______.



Answers Key

DPP NO. - 37

1. (A) **2.** (A) **3.** (B) **4.** (A) **5.** (A)

6. (A), (B), (D) **7.** w = $\left(a = \frac{g\sqrt{2}}{\mu + 2 + (M/m)}\right)$

8. x = $[3(a - \mu mg)/b]^{1/2}$

Hint & Solutions

DPP NO. - 37

1. $mg \times 1 = \frac{1}{2}mu^2 \Rightarrow u^2 = 2g$ .... (1)

$v^2 = u^2 + 2as \quad \Rightarrow 0 = 2g - 2a(3)$

$\Rightarrow a = \frac{g}{3} \quad \Rightarrow \because \mu_k g = a$

$\therefore \mu_k g = \frac{g}{3} \therefore u_K = \frac{1}{3}$

2. As long as the block of mass m remains stationary, the block of mass M released from rest comes down by $\frac{2Mg}{K}$ (before coming it rest momentanly again).

Thus the maximum extension in spring is

$x = \frac{2Mg}{K}$ .... (1)

for block of mass m to just move up the incline

$kx = mg \sin\theta + \mu\, mg \cos\theta$ .... (2)

$2Mg = mg \times \frac{3}{5} + \frac{3}{4}\, mg \times \frac{4}{5}$

or $M = \frac{3}{5}\, m$ **Ans.**

3. Change in velocity = $\frac{\text{area under } F - T \text{ graph}}{\text{mass}}$

$= \frac{60 + (-10)}{10} = 5$ m/s

$W_F = \Delta K.E. = \frac{1}{2}(10)\, 5^2 = 125$ J

4. $\frac{1}{2}kx_0^2 + Mgh = \frac{1}{2}k(x_0+h)^2 + 0$

$\Rightarrow h = \frac{2Mg}{k} - 2x_0$

Maximum downward displacement

$= [\frac{2Mg}{k} - 2x_0]$

5. Minimum work done to accelerate the truck from speed 0 to v and from v to 2v are

$\Delta W_1 = \frac{1}{2}mv^2 - \frac{1}{2}m(0)^2 = \frac{1}{2}mv^2$

and $\Delta W_2 = \frac{1}{2}m(2v)^2 - \frac{1}{2}m(v)^2 = \frac{3}{2}mv^2$

$\therefore\ \Delta W_1 < \Delta W_2$

Sol. For W to be maximum ; $\frac{dW}{dx} = 0$;

i.e. $F(x) = 0 \quad \Rightarrow x = \ell$, $x = 0$

Clearly for $d = \ell$,the work done is maximum.

Alternate Solution :

External force and displacement are in the same direction

$\therefore$ Work will be positive

continuosly so it will be maximum when displacement is maximum.

6. $\vec{a} = \frac{d\vec{v}}{dt} \quad \Rightarrow \quad d\vec{v} = \vec{a}\,dt$

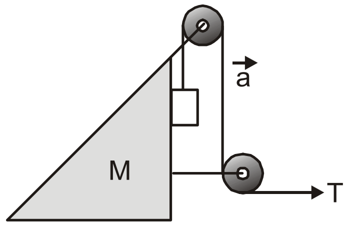
$\Rightarrow \quad \Delta\vec{v} = \int_{t_1}^{t_2} \vec{a}\,dt$

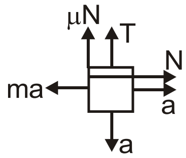
Rate of change of speed = component of acceleration along velocity

$\Rightarrow \frac{d|\vec{v}|}{dt} = \vec{a} \cdot \frac{\vec{v}}{v}$

$K = \frac{1}{2}m\vec{v}\cdot\vec{v} \quad \Rightarrow \quad \frac{dK}{dt} = m\vec{v}\cdot\vec{a}$

7.



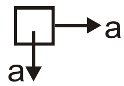


$N = ma \qquad T = (M + m)a$

$mg - T - \mu ma = ma$

$mg - (M + m)a - \mu ma = ma$

$a = \dfrac{g}{\mu + 2 + (M/m)}$



$a_m = \sqrt{2}\,a = \dfrac{\sqrt{2}g}{\mu + 2 + (M/m)}$.

8. $W_f + W_F = -\mu mgx + \int_0^x (a - bx^2)dx$

$0 = (-\mu mg + a)\,x - \dfrac{bx^3}{3}$

$\Rightarrow \quad x = \sqrt{\dfrac{3(a - \mu mg)}{b}}$