DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
DATE :

Solutions

SUBJECT : PHYSICS
DPP No. : 10

Topic :- LAWS OF MOTION

1 **(d)**

Speed $v = \sqrt{v_x^2 + v_y^2}$

Rate of change of speed

$$\frac{dv}{dt} = \frac{2v_x \frac{dv_x}{dt} + 2v_y \frac{dv_y}{dt}}{2\sqrt{v_x^2 + v_y^2}}$$

$$= \frac{v_x a_x + v_y a_y}{\sqrt{v_x^2 + v_y^2}}$$

2 **(d)**

Force $\mathbf{F} = \frac{\mathbf{dp}}{dt} = -k\,A\sin(kt)\,\hat{\mathbf{i}} - k\,A\cos(kt)\,\hat{\mathbf{j}}$

$\mathbf{p} = A\cos(kt)\,\hat{\mathbf{i}} - A\sin(kt)\,\hat{\mathbf{j}}$

Since, $\mathbf{F} \cdot \mathbf{p} = 0$

$\therefore$ Angle between **F** and **p** should be 90°

3 **(c)**

Given ($V = 10$ ms^{-1})

After 2s: $V_x = \frac{V}{\sqrt{2}} - \frac{g}{\sqrt{2}} \times 2 \Rightarrow V_x = \frac{10}{\sqrt{2}} - \frac{10}{\sqrt{2}} \times 2$

$V_x = -\frac{10}{\sqrt{2}}$ ms^{-1}and $V_y = -\frac{10}{\sqrt{2}}$ ms^{-1}

$V = \sqrt{\frac{100}{2} + \frac{100}{2}} = 10\sqrt{\frac{1}{2} + \frac{1}{2}} = 10$ ms^{-1}

4 **(b)**

Frictional force $= \mu R = \mu(mg + Q\cos\theta)$ and horizontal push $= P - Q\sin\theta$

For equilibrium, we have

$\mu(mg + Q\cos\theta) = P - Q\sin\theta \Rightarrow \mu = \frac{P - Q\sin\theta}{mg + Q\cos\theta}$

5 **(c)**

At any instant, velocity of two wedges would be of same magnitude but it opposite directions. This can be concluded from conservation of momentum or by symmetry

From constraint theory, $v_M = \frac{4}{3}v_m$

From energy conservation,

$\frac{Mv_M^2}{2} \times 2 + \frac{mv_m^2}{2} - 0 = mgh \Rightarrow v_M = \sqrt{\frac{32\,mgh}{32M + 9m}}$

So the velocity with which wedges recede away form each other is

$2v_M = \sqrt{\frac{32mgh \times 4}{32M + 9m}}$

6 **(c)**

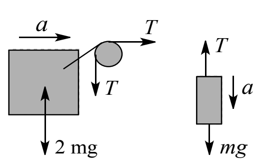
By virtual work method:

Acceleration of B w.r.t. A will be 10 ms^{-2} downward. Apart from this, B also has an acceleration 5 ms^{-1} in horizontal direction along with A, so net acceleration of B is

$\sqrt{10^2 + 5^2} = \sqrt{100 + 25} = \sqrt{125} = 5\sqrt{5}\ ms^{-2}$

7 **(c)**

$T = 2ma$



$mg - T = ma$

$a = g/3$

8 **(c)**

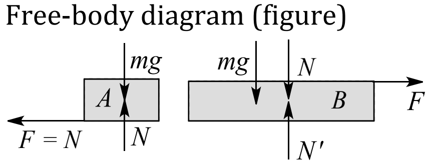
The minimum force required to just move a body will be $f_1 = \mu_s mg$. After the motion is started, the friction will becomes kinetic. So the force which is responsible for the increase in velocity of the block is

$F = (\mu_s - \mu_k)mg = (0.8 - 0.6) \times 4 \times 10 = 8$ N

So, $a = \frac{F}{m} = \frac{8}{4} = 2\ ms^{-2}$

9 **(d)**

Free-body diagram (figure)



Equations of motion:

$a_B = \frac{F}{M}$ (in $+x$ direction)

$a_A = \frac{F}{m}$ (in $-x$ direction)

Relative acceleration of A w.r.t. B:

$\vec{a}_{A.B} = \vec{a}_A - \vec{a}_B = -\frac{F}{m} - \frac{F}{M} = -F\left(\frac{m+M}{mM}\right)$

(along $-x$ direction)

Initial relative velocity of A w.r.t. B

$u_{A.B} = v_0$

Final relative velocity of A w.r.t. $B = 0$

Using $v^2 = u^2 + 2as$

$$0 = v_0^2 - 2\frac{F(m+M)}{mM} S \Rightarrow S = \frac{Mmv_0^2}{2F(m+M)}$$

10 **(b)**

Angular frequency of the system,

$$\omega = \sqrt{\frac{k}{m+m}} = \sqrt{\frac{k}{2m}}$$

Maximum acceleration of the system will be, $\omega^2 A$ or $\frac{kA}{2m}$. This acceleration to the lower block is provided by friction.

Hence, $f_{\max} = ma_{\max}$

$$= m\omega^2 A = m\left(\frac{kA}{2m}\right) = \frac{kA}{2}$$

11 **(c)**

Here friction force would be responsible to cause the acceleration of truck., here maximum friction force can be $f = \mu \times < \frac{Mg}{2}$ where $M \rightarrow$ mass of entire truck

This is the net force acting on tyre, so $Ma = \frac{\mu Mg}{2}$

$$\Rightarrow a = \frac{0.6 \times 10}{2} = 3 \text{ ms}^{-2}$$

12 **(a)**

The water jet striking the block at the rate of 1 kg s^{-1} at a speed of 5 ms^{-1} will exert a force on the block

$$F = v\frac{dm}{dt} = 5 \times 1 = 5 \text{ N}$$

Under the action of this force of 5 N, the block of mass 2 kg will move with an acceleration given by

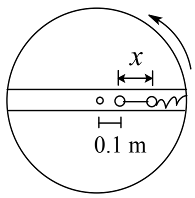
$$a = \frac{F}{m} = \frac{5}{2} = 2.5 \text{ ms}^{-2}$$

13 **(a)**

Minimum effort is required by pulling a block at the angle of friction

14 **(b)**

$K = 10^2 \text{N cm}^{-1} = 10^4 \text{Nm}^{-1}$. Let the ball move distance x away from the centre as shown in figure



$kx = mw^2(0.1 + x)$

$\Rightarrow 10^4 x = \frac{90}{1000} \times (10^2)^2 \times (0.1 + x)$

Solve to get $x \approx 10^{-2}$ m

15 **(c)**

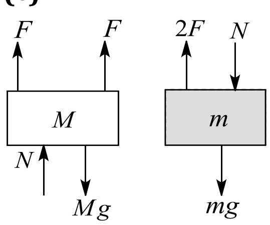
Distance travelled in t^{th} second is,

$s_t = u + at - \frac{1}{2}a$

Given, $u = 0$

$$\therefore \quad \frac{s_n}{s_n + 1} = \frac{an - \frac{1}{2}a}{a(n+1) - \frac{1}{2}a} = \frac{2n - 1}{2n + 1x}$$

16 **(c)**



From figure,

$2F + N - Mg = Ma$

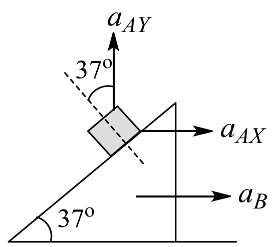
$2F - mg - N = ma$

$4\,F - (M + m)g = (M + m)a$

$a = \frac{4F - (M + m)g}{M + m}$

17 **(d)**

From constraint, the acceleration of both block and wedge should be same in a direction perpendicular to the inclined plane as shown in figure



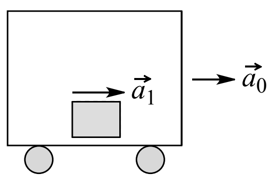
$(a_A)_\perp = (a_B)_\perp$, $a_{AX} = 15$, $a_{AY} = 15$

$a_{AX}\cos 53^\circ - a_{AY}\cos 37^\circ = a_B \cos 53^\circ$

or $a_B = -5\ \text{ms}^{-1}$ or $\vec{a}_B = -5\hat{i}$

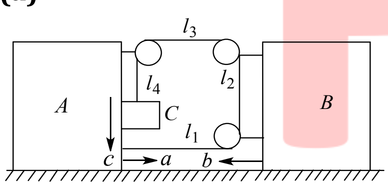
18 **(a)**

Let $\vec{a}_0$ be the acceleration of choosen non-inertial frame of reference w.r.t some inertial frame of reference and $\vec{a}_1$ be the acceleration of the object in non-inertial frame



For $\vec{a}_1$ to be non-zero, the net force acting on object (including pseudo force) must be non-zero

19 **(a)**



From length constraint $l_1 + l_2 + l_3 + l_4 = C$

$\ddot{l}_1 + \ddot{l}_2 + \ddot{l}_3 + \ddot{l}_4 = 0$

$(-a - b) + 0 + (-a - b) + c = 0$

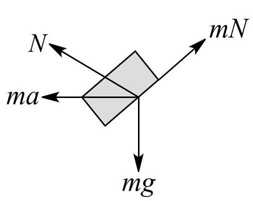
$c = 2a + 2b$

From wedge constraints, acceleration of C is right side is$a$. Acceleration of C w.r.t. ground

$= a\hat{i} - 2(a + b)\hat{j}$

20 **(b)**

FBD of m in frame of wedge



$N = mg\cos\alpha - ma\sin\alpha$

Now $f = \mu N = ma\cos\alpha + mg\sin\alpha$

$$\mu = \frac{a\cos\alpha + g\sin\alpha}{g\cos\alpha - a\sin\alpha}$$

$$\mu = \frac{a + g\tan\alpha}{g - a\tan\alpha} = \frac{5}{12}$$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	D	D	C	B	C	C	C	C	D	B
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	A	A	B	C	C	D	A	A	B