DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
DATE :

Solutions

SUBJECT : PHYSICS
DPP No. : 9

Topic :- LAWS OF MOTION

1 **(d)**

Let the tension in the strings AP_2 and P_2P_1 be$T$. Considering the force on pulley P_1, we get $T = W_1$. Further, let $\angle AP_1P_1 = 2\theta$

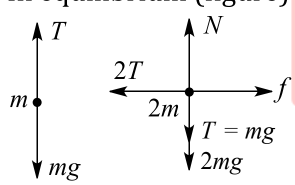
Resolving tensions in horizontal and vertical directions and considering the forces on pulley P_2, we get $2T\cos\theta = W_2$

or $2\,W_1\cos\theta = W_2$ or $\cos\theta = 1/2$

or $\theta = 60°$ So $\angle AP_2P_1 = 2\theta = 120°$

2 **(c)**

In equilibrium (figure)



$T = mg$, $N = 3\,mg$ and $f = 2T = 2\,mg$

In limiting case $f < f_{\max}$

$$2mg < \mu N \Rightarrow 2mg \le 3\mu\, mg \Rightarrow \mu \ge \frac{2}{3}$$

3 **(d)**

Time taken by the bullet and ball to strike the ground is

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 5}{10}} = 1\text{ s}$$

Let v_1 and v_2 are the velocities of ball and bullet after collision. Then applying $x = vt$

We have, $20 = v_1 \times 1$

or $v_1 = 20$ m/s

$100 = v_2 \times 1$ or $v_2 = 100$ m/s

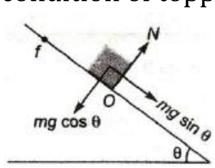
Now, from conservation of linear momentum before and after collision we have,

$0.01v = (0.2 \times 20) + (0.01 \times 100)$
On solving, we get
$v = 500 \text{ m/s}$

4 **(b)**
Before cutting the string, the tension in string joining m_4 and the ground is $T = (m_1 + m_2 - m_3 - m_4)g$ and the spring force in the spring joining m_3 and m_4 is $T + m_4 g$. As the string is cut, the spring forces do not change instantly, so just after cutting the string the equilibrium of m_1,m_2 and m_3 would be maintained but m_4 accelerates in upward direction with acceleration given by

$$a = \frac{T + m_4 g - m_4 g}{m_4}$$

5 **(d)**
Condition of sliding is
$mg \sin\theta > \mu\, mg \cos\theta$
or $\tan\theta > \mu$
ortan $\theta > \sqrt{3}$ ...(i)
condition of toppling is

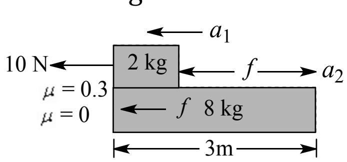


Torque of $mg\sin\theta$ about $O >$ torque of $mg\cos\theta$ about.

$$\therefore \quad (mg \sin\theta)\left(\frac{15}{2}\right) > (mg \cos\theta)\left(\frac{10}{2}\right)$$

or $\tan\theta > \frac{2}{3}$ ....(ii)
With increase in value of θ, condition of sliding is satisfied first.

6 **(c)**
Friction between 2 kg and 8 kg blocks is kinetic in nature, so
$F = m \times 2g = 0.3 \times 2 \times 10 = 6\text{N}$



For 2 kg block, $10 - 6 = 2a_1$
For 8 kg block, $6 = 8a_2$
$\Rightarrow a_1 = 2 \text{ ms}^{-2}, a_2 = \frac{3}{4}\text{ms}^{-2}$
Acceleration of 2 kg block relative to 8 kg block is

$a_{\text{ref}} = a_1 - a_2 = \frac{5}{4}\,\text{ms}^{-2}$

Using the equation of motion, $3 = \frac{1}{2} \times \frac{5}{4} r^2$

$t = 2.19$ s

7 **(c)**

From 0 to 2 s: at any time t, $F = 10\,t$

$\Rightarrow a = F/m = 10t/m$

$\Rightarrow \int_0^v dv = \int_0^t \frac{10t}{m} dt \Rightarrow v = \frac{5t^2}{m}$

Momentum: $P = mv = 5t^2$

At $t = 2$ s, $P = 5(2)^2 = 20$ kg ms^{-1}, $v = 20/m$

From 2 to 4 s; $F = 40 - 10\,t$

$\int_{20/m}^{v} dv = \int_2^t \frac{40 - 10t}{m} dt \;\Rightarrow\; v = \frac{1}{m}[40t - 40 - 5t^2]$

$P = mv = 40t - 40 - 5t^2$

8 **(a)**

$V_{\max} = \sqrt{\frac{Rg\,(\tan\theta - \mu)}{1 - \mu\tan\theta}}$

9 **(a)**

Initially under equilibrium of mass m

$T = mg$

Now, the string is cut. Therefore, $T = mg$ force is decreased on mass m upward and downwards on mass $2m$.

$\therefore\; a_m = \frac{mg}{m} = g \quad (downwards)$

$and\ a_{2m} = \frac{mg}{2m} = \frac{g}{2}\ (upwards)$

10 **(b)**

For the equilibrium of block of mass M_1:

Frictional force, f = tension in the string, T

Where $T = f = \mu(m + M_1)$g (i)

For the equilibrium of block of mass M_2:

$T = M_2$g (ii)

Form (i) and (ii), we get $\mu(m + M_1)g = M_2$g

$m = \frac{M_2}{\mu} - M_1$

11 **(d)**

If the blocks move together,

$$a=\frac{F}{m_A+m_B}=\frac{10}{6}=\frac{5}{3}\text{ms}^{-1}$$

f_B (frictional force on B) $= m_B a = \frac{m_B F}{m_A+m_B} = \frac{20}{3}$N

$f_{B\max} = \mu m_A g = 0.4 \times 2 \times 10 = 8$ N

As $f_{B\max} > f_B$, the blocks will not be separated and move together with common acceleration $5/3$ ms^{-2}

12 **(c)**

As sand particles are sliding down, the slope of the hill gets reduced. The sand particle stops coming down when component of gravity force alone hill is balanced by limiting friction force

$mg\sin\theta = \mu_s mg\cos\theta$

$\Rightarrow \theta = \tan^{-1}(\mu_s) \cong 37°$ where θ is the new slope angle of hill

13 **(b)**

Suppose $F =$ upthrust due to buoyancy

Then while descending, we find

$Mg - F = Ma$ (i)

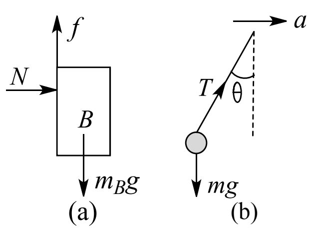
When ascending, we have

$F - (M-m)g = (M-m)a$ (ii)

Solving Eqs. (i) and (ii), we get $m = \left[\frac{2\alpha}{\alpha+g}\right]M$

14 **(d)**

In the free-body diagram of B (figure (a))



$N = m_B a$ (i)

$f = m_B g$

$\mu N = m_B g$ (ii)

Form (i) and (ii), $a = \frac{g}{\mu} = 20$ ms^{-2}

FBD of bob:

$T\sin\theta = ma$ (iii)

$T\cos\theta = mg$ (iv)

From (iii) and (iv)

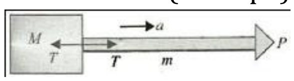
$\tan\theta = \frac{a}{g} \Rightarrow \theta = \tan^{-1}(2)$

15 **(c)**

Let a be the common acceleration of the system

Here $T = Ma$ (for block)

$P - T = Ma$ (for rope)



$P - Ma = ma$

or $P = (m + M)a$ or $a = P/(m + M)$

now $T = Ma = \frac{MP}{M+m}$

16 **(d)**

Maximum acceleration of B or C can be mg so that they do not slip with each other or on A

For the system of $(A + B + C)$

$T = 3\,ma = 3\,\mu\,mg$

For D:

$Mg - T = Ma$

$\Rightarrow Mg - 3\mu\, mg = M\mu g \Rightarrow M = \dfrac{3\mu m}{1-\mu}$

17 **(a)**

$v_2 \cos\alpha + v_1 \cos\alpha = v_1 \;\Rightarrow\; v_2 = v_1\left[\frac{2\sin^2(\alpha/2)}{\cos\alpha}\right]$

18 **(b)**

The cloth can be pulled out without dislodging the dishes from the table due to law of inertia, which is Newton's first law. While, the statement II is true, but it is Newton's third law.

19 **(b)**

Velocity of liquid through inclined limbs $= \frac{v}{2}$

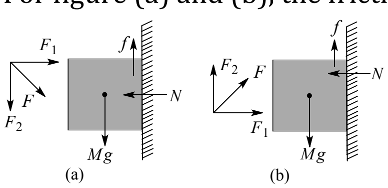
Rate of change of momentum of the liquid is

$\rho A v^2 + 2\left[\rho A\left(\frac{v}{2}\right)^2 \cos 60°\right] = \dfrac{5}{4}\rho A v^2$

20 **(c)**

As the eraser is at rest w.r.t. board, friction between two is static in nature

For figure (a) and (b), the friction force is same as that of gravity force as shown in figure



For (c), $f = F_2 + Mg > Mg$

For (d) Mg - $F_2 < Mg$ as angle by which arm is tilted is very small, so F_2 would be small

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