# DPP
DAILY PRACTICE PROBLEMS

CLASS : XIth
DATE :

**Solutions**

SUBJECT : PHYSICS
DPP No. : 8

## Topic :- LAWS OF MOTION

1 **(b)**

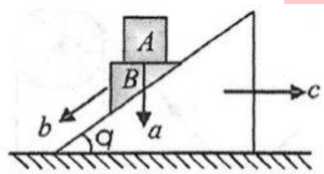
For $A$:

$5g - T = 5(2C)$

For $C$:$2T - 8g = 8C \Rightarrow C = \frac{8}{14} = \frac{5}{7}$ ms$^{-2}$

2 **(b)**

1. Acceleration of block $A$ downwards w.r.t. ground




2. Acceleration of block $B$ w.r.t. inclined plane
3. Acceleration of block $C$ w.r.t. ground right side. $\vec{b} + \vec{c}$ acceleration of $B$ w.r.t. ground

Applying Newton's law on system along horizontal direction, we have

$mc + m(c - b\cos\theta) = 0$ (i)

Applying Newton's law on $(A + B)$ along the inclined plane,

$2mg\sin\theta = m(b - c\cos\theta) + ma\sin\theta$

$2g\sin\theta = b - c\cos\theta + a\sin\theta$ (ii)

From wedge constraint between $A$ and $B$,

$a = b\sin\theta$ (iii)

From Eq. (i), (ii) and (iii), $b = \frac{4g\sin\theta}{1 + 3\sin^2\theta}$

3 **(a)**

For chain to move with constant speed, $P$ needs to be equal to frictional force on the chain. As the length of chain on the rough surface increases. Hence, the friction force $f_k = \pi_k N$ increases

4 **(d)**

Let at any time, their velocities are $v_1$ and $v_2$, respectively, then $v_1 = v_2 \cos\theta$

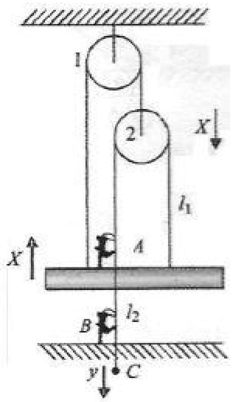
Differentiating: $a_1 = a_2 \cos\theta$ - $v_2 \sin\theta \frac{d\theta}{dt}$

Hence, none of them is correct

[Note: Option (a) is correct initially, because initially $v_2 = 0$]

5 **(c)**

Let the plank move up by $x$, then pulley 2 will move down by $x$. Let the end of string $C$ moves down by a distance $y$




Let the initial length of string passing over pulley 2 $l_1 + l_2$ (i)

After displacement $x$ and $y$ mentioned above, the lengths becomes

$(l_1 - 2x) + (l_2 + y - x)$ (ii)

Equating (i) and (ii), we get $y = 3x$

Length of string that slips through $A$ is $y + x = 4x$

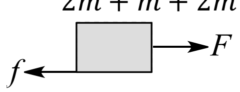
Length of string that slip[s through $A$ is $y + x = 4x$ and the through $B$ is $y = 3x$

Required ratio $\frac{4x}{3x} = \frac{4}{3}$

6 **(b)**

Horizontal acceleration of the system is

$$a = \frac{F}{2m + m + 2m} = \frac{F}{2m}$$




Let $N$ be the normal reaction between $B$ and $C$. Free-body diagram of $C$ gives

$$N = 2ma = \frac{2}{5}F$$

Now $B$ will nor slide downwards if $\mu N \geq m_B g$

Or $\mu\left(\frac{2}{5}F\right) \geq mg$ *or* $F \geq \frac{5}{2\mu}mg$

Or $F_{\min} = \frac{5}{2\mu}mg$

7 **(b)**

$t_A = \sqrt{\dfrac{2s}{a_A}} \Rightarrow \; t_D = \sqrt{\dfrac{2s}{a_D}}, \;\; t_A = \dfrac{1}{2} t_D$

$\sqrt{\dfrac{2s}{g\sin\theta + \mu g\cos\theta}} = \dfrac{1}{2}\sqrt{\dfrac{2s}{g\sin\theta - \mu g\cos\theta}}$

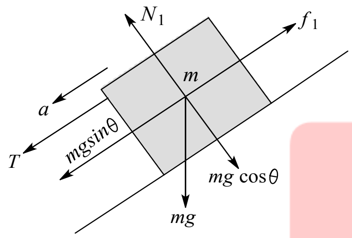
$4g\sin\theta - 4\mu g\cos\theta = g\sin\theta + \mu g\cos\theta$

$3g\sin\theta = 5\mu g\cos\theta$ or $\mu = \dfrac{3}{5}\tan\theta = \dfrac{3}{5}$

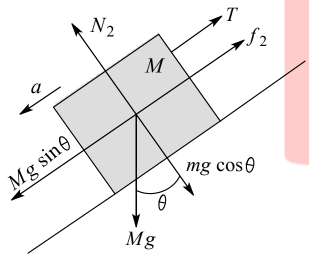
$(\because \; \theta = 45°)$

8 **(c)**

$N_1 = mg\cos\theta$ and $f_1 = \mu\, mg\cos\theta$




$N_2 = Mg\cos\theta$ and $f_2 = \mu\, Mg\cos\theta$




Equation of motion are

$T - f_1 = mg\sin\theta = ma$ (i)

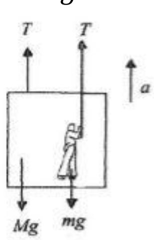
$Mg\sin\theta - T - f_2 = Ma$ (ii)

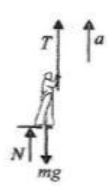
Solving Eqs. (i) and (ii), we get $T = 0$

9 **(a)**

$2T - (M + m)g = (M + m)a$ (i)

$T - mg + N = ma$ (ii)



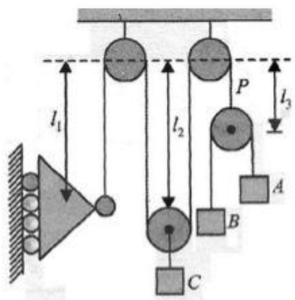
From (i) and (ii), we get

$N = \left(\frac{m - M}{2}\right)(g + a) > 0$

As $m > M$, if $T$ increase, $a$ increase and if $a$ increase $N$ increases

10 **(d)**

Using constraint theory




$l_1 + 2l_2 + l_3 =$ constant

$\Rightarrow v_1 + 2v_2 + v_3 = 0$

Take downward as positive and upward as –ve

So $+12 + 2(-4) + v_3 = 0$

$v_3 =$ velocity of pulley $P = -4\ ms^{-1}$

$= 4 ms^{-1}$ In upward direction

$\vec{v}_{AP} = -\vec{v}_{BP} \Rightarrow V_{AP} = -(v_B - v_P)$

$v_B = v_P - v_{AP} = -4 - (3) = -7\ ms^{-1}$

i.e., block $B$ is moving up with speed 7 $ms^{-1}$

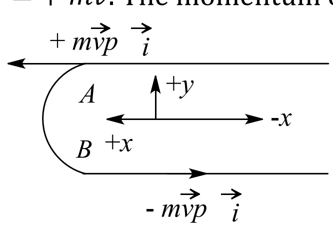
11 **(d)**

$\vec{v}_{B,1} = 4\ ms^{-1}\uparrow, \vec{V}_{B,1} = \vec{V}_{B}, g - \vec{V}_{1}, g$

$\Rightarrow 4\ ms^{-1} = \vec{V}_{Bg}, - 2\ ms^{-1}; \vec{V}_{Bg}, = 6\ ms^{-1}\uparrow$

12 **(b)**

Choosing the positive $x - y$ axis as shown in the figure, the momentum of the bead at $A$ is $\vec{p}_i$ $= + m\vec{v}$. The momentum of the bead at $B$ is $\vec{p}_f = -m\vec{v}$




Therefore, the magnitude of the change in momentum

Between $A$ and $B$ is $\Delta\vec{p} = \vec{p}_f - \vec{p}_i = -2m\vec{v}$

i.e., $\Delta p = 2\ mv$ along the positive $x$-axis

the time taken by the bead to reach from $A$ to $B$ is

$$\Delta t = \frac{\pi d/2}{v} = \frac{\pi d}{2v}$$

Therefore, the average force exerted by the bead on the wire is

$$F_{\text{av}} = \frac{\Delta p}{\Delta p} = \left(2mv/\frac{\pi d}{2v}\right) = \frac{4mv^2}{\pi d}$$

13 **(d)**

The acceleration of block-rope system is $a = \frac{F}{(M+m)}$

Where $M$ is the mass of block and $m$ is the mass of rope

So the tension in the middle of the rope will be

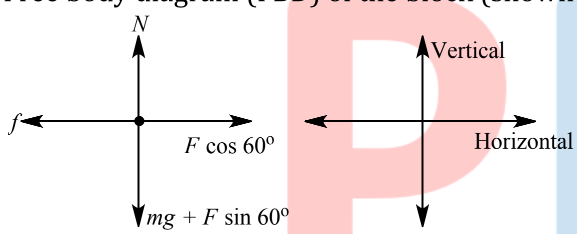
$$T = \{M + (m/2)\}a = \frac{M + (m/2)F}{M + m}$$

Given that $m = M/2$

$$\therefore T = \left[\frac{M + (M/4)}{M + (M/2)}\right]F = \frac{5F}{6}$$

14 **(a)**

Free body diagram (FBD) of the block (shown by a dot) is shown in figure.




For vertical equilibrium of the block,

$$N = mg + F \sin 60^\circ = \sqrt{3}\, g + \sqrt{3}\frac{F}{2} \quad \text{....(i)}$$

For no motion, force of friction

$f \geq F \cos 60^\circ$

or $°\mu\, N \geq F \cos 60^\circ$

or $\frac{1}{2\sqrt{3}}\left(\sqrt{3}\, g + \frac{\sqrt{3}\, F}{2}\right) \geq \frac{F}{2}$

or $g \geq \frac{F}{2}$ or $F \leq 2\, g$ or 20 N

Therefore, maximum value of $F$ is 20 N.

15 **(a)**

Applying Newton's law on system along horizontal direction, we have

$mc + m(c - b\cos\theta) = 0$ (i)

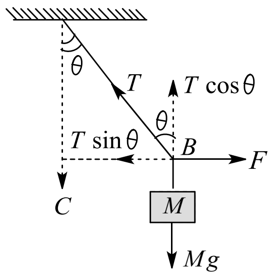
$$c = \frac{b\cos\theta}{2}$$

16 **(a)**

During downward motion:

$F = mg\sin\theta - mg\cos\theta$
During upward motion:
$2F = mg\sin\theta + \mu mg\cos\theta$
Solving above two equations, we get $m = (\tan\theta)/3$

17 **(b)**
In figure, the point $B$ is in equilibrium under the action of $T$, $F$ and Mg




Here $T\sin\theta - F$ or $T = F/\sin\theta$

18 **(c)**

$$a_1 = \frac{F - f}{m_1} = \frac{F - \mu m_1 g}{m_1} = 10\ \text{ms}^{-2}$$

$$a_2 = \frac{F - \mu m_2 g}{m_2} = 1\ \text{ms}^{-2}$$

$$\therefore\ s = \frac{1}{2}a_{\text{real}}t^2 = \frac{1}{2}[10 + 1]t^2 \Rightarrow t = 2\text{s}$$

19 **(c)**
Due to acceleration in forward direction, vessel is in an accelerated frame therefore a Pseudo force will be exerted in backward direction. Therefore water will be displaced in backward direction

20 **(a)**
$x = 0$, till $mg\sin\theta < \mu mg\cos\theta$ and gradually $x$ will increase. At angle $\theta > \tan^{-1}(\mu)$
$kx + \mu mg\cos\theta = mg\sin\theta$
or $x = \frac{mg\sin\theta - \mu\, mg\cos\theta}{k}$
Here $k$ is the force constant of spring

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