DPP

DAILY PRACTICE PROBLEMS

CLASS : XIth
DATE :

Solutions

SUBJECT : PHYSICS
DPP No. : 7

Topic :- LAWS OF MOTION

1 **(d)**

From constraint relations we can see that the acceleration of block B in upward direction is

$a_B = \left(\frac{a_C + a_A}{2}\right)$ with proper sings

So $a_B = \left(\frac{3 - 12t}{2}\right) = 1.5 - 6t$

or $\frac{dv_B}{dt} = 1.5 - 6t$ or $\int_0^{v_B} dv_B = \int_0^1 (1.5 - 6t)\, dt$

or $v_B = 1.5t - 3t^2$ or $v_B = 0$ at $t = 1/2$ s

2 **(b)**

Retardation of train = 20/4 = 5 ms^{-2}

It acts in the backward direction. Fictious force on suitcase = $5m$ Newton, wherer m is the mass of suitcase. In act6s in the forward direction. Due to this force, the suitcase has a tendency to slide forward. If suitcase is not to slide, then $5m =$ Newton, where m is the mass of suitcase. In acts in the forward direction. Due to this force, the suitcase has a tendency to slide forward. If suitcase is not to slide, then $5m =$ force f of friction

or $5m = m\,mg$ or $m = \frac{5}{10} = 0.5$

3 **(a)**

When

$P = mg\,(\sin\theta - \mu\cos\theta)$

$f = \mu mg\cos\theta$ (upwards)

when $P = mg\sin\theta$

$f = 0$

and when $P = mg(\sin\theta + \mu\cos\theta)$

$f = \mu\, mg\cos\theta$ (downwards)

Hence, friction is first positive, then zero and then negative.

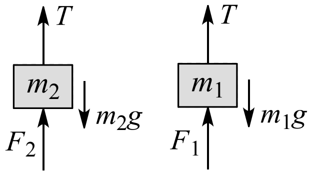
5 **(b)**

As the springs have natural length initially, if one spring is compressed, the other must be expanded. Hence, the compression will be negative

The free-body diagram of m_2 [figure]

$T + F_2 = 80$ N and $F_2 = 70 \times 0.5 = 35$ N

$\therefore\ T = 80 - 35 = 45$ N



FBD of m_1 (figure)

$T + F_1 = m_1 g$ or $F_1 = -25$ N

$\therefore\ X_1 = \frac{-25}{k_1} = \frac{-25}{50} = -0.5$ m

Therefore, compression in first spring is - 0.5 m

(negative sing indicates that it is extension)

6 **(a)**

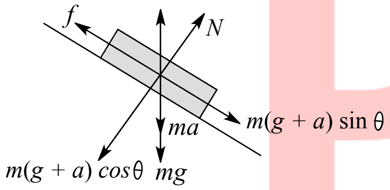
For upward acceleration of M_1:

$M_2 g \geq M_1 g \sin\theta + \mu M_1 g \cos\theta$

$\Rightarrow\ (M_2)_{\min} = M_1(\sin\theta + \mu\cos\theta)$

7 **(b)**

Figure, $F_c = \sqrt{f^2 + N^2} = m(g + a)$

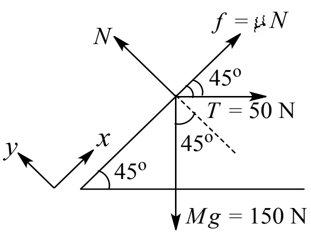


$f = m(g + a)\sin\theta$, $N = m\,(g + a)\cos\theta$

Net contact force: $F_C = \sqrt{f^2 + N^2} = m(g + a)$

8 **(a)**

The string is under tension, Hence there is limiting friction between the block and the plane figure



$\sum F_x = 0$

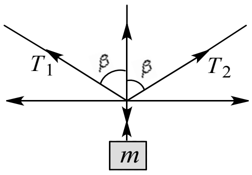
$\Rightarrow \mu N + 50\cos 45° = 150\sin 45°$ (i)

$\sum F_y = 0$

$\Rightarrow\ N = 50\sin 45° + 150\cos 45°$ (ii)

Solving (i) and (ii), we get $m = 1/2$

9 **(b)**



$\tan\beta = \dfrac{12}{5} \quad \therefore \cos\beta = \dfrac{5}{13}$

$T_1\cos\beta + T_2\cos\beta = mg$ (i)

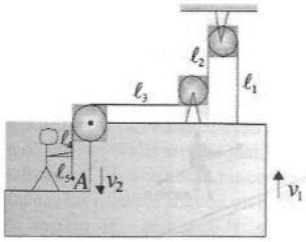
$T_1\sin\beta = T_2\sin\beta$ (ii)

$\therefore T_1 = T_2 = T$

$\therefore 2T\cos\beta = mg \Rightarrow T = \dfrac{mg}{2\cos\beta} \Rightarrow T = \dfrac{13}{10}mg$

10 **(d)**

Let v_1 be the velocity of block and v_2 be the velocity of end A of the string, w.r.t. man



$\dfrac{d\ell_5}{dt} = v_2 = 2$ ms^{-1} (given) , $\dfrac{d\ell_1}{dt} = \dfrac{d\ell_2}{dt} = -v_1$

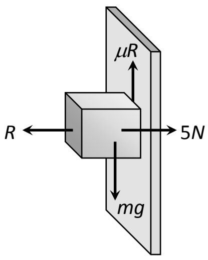
Now $\ell_1 + \ell_2 + \ell_3 + \ell_4 + \ell_5 =$ constant

$\Rightarrow \dfrac{d\ell_1}{dt} + \dfrac{d\ell_2}{dt} + 0 + 0 + \dfrac{dls}{dt} = 0$

$\Rightarrow -v_1 - v_1 + v_2 = 0 \Rightarrow v_1 = \dfrac{v_2}{2} = \dfrac{2}{2} = 1$ ms^{-1}

11 **(b)**

Limiting friction $F_1 = \mu_s R = 0.5 \times (5) = 2.5\ N$



Since downward force is less than limiting friction therefore block is at rest so the static force of friction will work on it

$F_s =$ downward force $=$ Weight

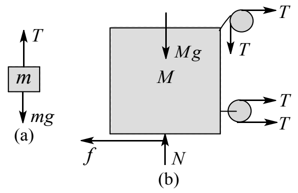
$= 0.1 \times 9.8 = 0.98\ N$

12 **(c)**

In the free-body diagram of m [figure (a)],

$T = mg$ (i)

[No friction will act between M and m



In the free-body diagram of M (figure (b))

$f = \mu_2 N = 3T$ (ii)

and $T + Mg = N$ (iii)

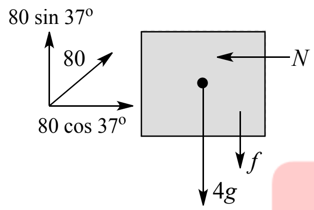
From Eq. (iii), $N = (m + M)g$

From Eq. (ii), $\mu_2(m + M)g = 3\,mg$

$$m = \frac{\mu_2 M}{(3 - \mu_2)} = \frac{1/3 \times 8}{(3 - 1/3)} = 1\,kg$$

13 **(a)**

The FBD of the block is as shown in the figure



$N = 80\cos 37° = 64$ N

So, $f_L = 0.2 \times 64 = 32$ N

As $4g < 80\sin 37°$, friction force will act downwards. Net applied force in upward direction (excluding friction force) is

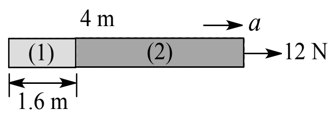
$80\sin 37°$ - $40 = 48 - 40 = 8$ N

As F_{applied} in vertical direction is less than f_L, block won't move in vertical direction and value of static friction force is $f = 8$ N

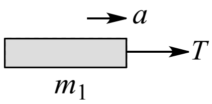
14 **(b)**

As in the figure, mass of the rope: $m = 4 \times 1.5 = 6$ kg

Acceleration: $a = 12/6 = 2$ ms^{-2}



Mass of part 1 as in the figure 7.567 $m_1 = 1.6 \times 1.5 = 2.4$ kg



$T = m_1 a = 2.4 \times 2 = 4.87$ N

15 **(d)**

$$\vec{a} = \frac{\vec{F}}{m} = -10\hat{j}\,(\text{ms}^{-1})^2$$

Displacement in y-direction

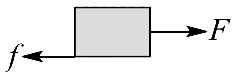
$y = ut + \frac{1}{2}at^2 \Rightarrow 0 = 4 \times t \times -\frac{1}{2} \times 10 \times t^2$

$t = \frac{4}{5}s \Rightarrow x = 4t = 4 \times \frac{4}{5} = 3.2 \text{ m}$

16 **(a)**

$f_l = mM\text{g}$. If motion does not start, then $f = F = F_0 t$

Motion will start when $f = f_1$



$\Rightarrow F_0 T = \mu M\text{g} \Rightarrow T = \frac{\mu M\text{g}}{F_0}$

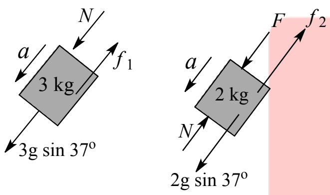
17 **(c)**

The free-body diagrams of two blocks are shown in figure. Under the assumption that blocks are moving together,

$F + 2\text{g} \sin 37° + 3 \text{ g} \sin 37° - f_1 - f_2 = 5a$

Where $f_1 = \mu \times 3\text{g}\cos 37°$

And $f_2 = \mu \times 2\text{g}\cos 37°$

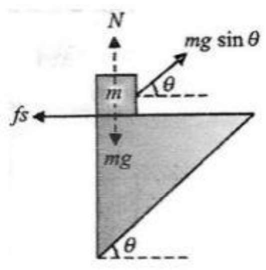


$\Rightarrow a = \frac{46}{5} \text{ms}^{-2}$

For 3 kg block, $N + 3\text{g}\sin 37° - f_1 = 3a \Rightarrow N = 12$ N

18 **(d)**

As the block does not slip on prism, the combined acceleration of the prism is $a = \text{g}\sin\theta$



$mg\sin\theta$ is the pseudo force on m

$N + mg\sin\theta + \sin\theta = mg$ or $N = mg\cos^2\theta$

And for no slipping, $mg\sin\theta\cos\theta \geq \mu N$

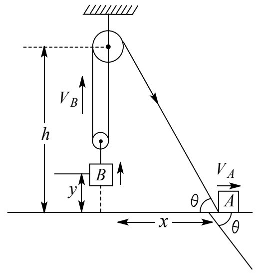
$mg\sin\theta\cos\theta \leq \mu mg\cos^2\theta$ or $\mu \geq \tan\theta$

19 **(c)**

From figure $L = 2h - 2y + \sqrt{x^2 + \text{h}^2}$

Differentiating the equation, we get

$$\frac{dy}{dy} = \frac{x}{2\sqrt{h^2 + x^2}} \frac{d}{dt} \Rightarrow V_B = \frac{xV_A}{2\sqrt{h^2 + x^2}}$$



20 **(a)**

$$a = \frac{\sqrt{R_1^2 + R_2^2}}{m} = \frac{R_3}{m} \quad \left[\therefore\ R_3 = \sqrt{R_1^2 + R_2^2}\right]$$

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