PHYSICS

DPP
DAILY PRACTICE PROBLEMS

DPP No. 25

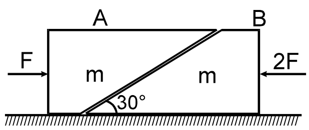
Total Marks : 25

Max. Time : 26 min.

Topic : Newtons's Law of Motion

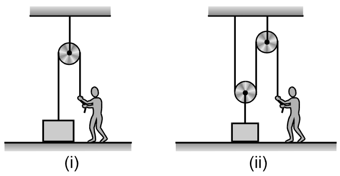
Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.4	**(3 marks, 3 min.)**	**[12, 12]**
Subjective Questions ('–1' negative marking) Q.5	**(4 marks, 5 min.)**	**[4, 5]**
Comprehension ('–1' negative marking) Q.6 to Q.8	**(3 marks, 3 min.)**	**[9, 9]**

1. Two blocks 'A' and 'B' e!ach of mass 'm' are placed on a smooth horizontal surface. Two horizontal force F and 2F are applied on the two blocks 'A' and 'B' respectively as shown in figure. The block A does not slide on block B. Then the normal reaction acting between the two blocks is : (A and B are smooth)



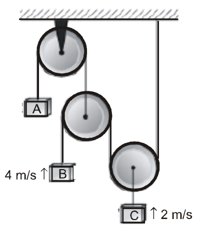
(A) F
(B) F/2
(C) $\frac{F}{\sqrt{3}}$
(D) 3F

2. In the figure shown, a person wants to raise a block lying on the ground to a height h. In both the cases if time required is same then in which case he has to exert more force. Assume pulleys and strings light.



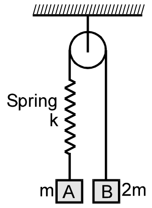
(A) (i)
(B) (ii)
(C) same in both
(D) Cannot be determined

3. In the pulley system shown in figure, block C is going up at 2 m/s and block B is going up at 4 m/s, then the velocity of block A on the string shown in figure, is equal to :



(A) 2 m/s ↓
(B) 4 m/s ↓
(C) 6 m/s ↓
(D) 8 m/s ↓

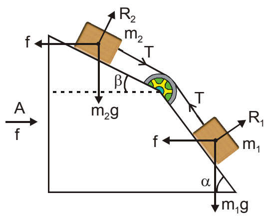
4. Two blocks A and B of masses m & 2m respectively are held at rest such that the spring is in natural length. Find out the accelerations of blocks A and B respectively just after release (pulley, string and spring are massless).



(A) g ↓, g ↓ (B) $\frac{g}{3}\downarrow, \frac{g}{3}\uparrow$

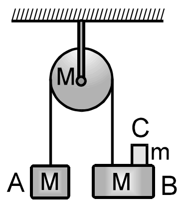
(C) 0, 0 (D) g ↓, 0

5. Two cubes of masses m_1 and m_2 lie on two frictionless slopes of block A which rests on two frictionless slopes of block A which rests on a horizontal table. The cubes are connected by a string which passes over a pulley as shown in figure. To what horizontal acceleration f the whole system, (i.e. block and cubes) be subjected, so that the cubes do not slide down the planes ? What is the tension in the string in this situation ?



COMPREHENSION

For the following system shown assume that pulley is frictionless, string is massless (m remains on M) :



6. The acceleration of the block A is :

(A) $\frac{mg}{2M+m}$ (B) $\frac{2mg}{2M+m}$ (C) $\frac{mg}{M+2m}$ (D) $\frac{Mg}{M+2m}$

7. Normal reaction on m is (force on C due to B).

(A) $\frac{Mmg}{2M+m}$ (B) $\frac{2Mmg}{2M+m}$ (C) $\frac{Mmg}{M+2m}$ (D) $\frac{2Mmg}{M+m}$

8. The force on the ceiling is

(A) $\frac{(M+m)\,mg}{2M+m}$ (B) $\frac{(6M+5m)\,mg}{M+m}$ (C) $\frac{(M+m)\,mg}{M+m}$ (D) $\frac{(6M+5m)\,Mg}{2M+m}$

Answers Key

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1. (D) **2.** (A) **3.** (B)

4. (A) **5.** $T = \dfrac{m_1 m_2 g \sin(\alpha - \beta)}{m_1 \cos\alpha + m_2 \cos\beta}$ **6.** (A)

7. (B) **8.** (D)

Hint & Solutions

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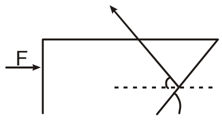
1. Acceleration of two mass system is $a = \dfrac{F}{2m}$

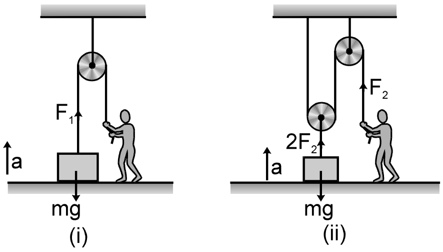
leftward

FBD of block A



$N \cos 60° - F = ma = \dfrac{mF}{2m}$ solving N = 3 F

2. Since, $h = \dfrac{1}{2}at^2 \Rightarrow a$ should be same in both cases, because h and t are same in both cases as given.



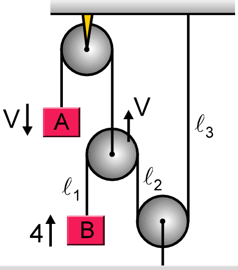
In (i) $F_1 - mg = ma$.

$\Rightarrow$ $F_1 = mg + ma$.

In (ii) $2F_2 - mg = ma$

$\Rightarrow$ $F_2 = \dfrac{mg + ma}{2}$ $\therefore$ $F_1 > F_2$.

3. $\ell_1 + \ell_2 + \ell_3 = \text{constant}$



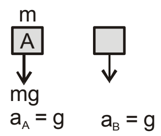
$\ell \quad \ell \quad \ell \quad 0$

$(V - 4) + (V - 2) + (-2) = 0$

$\Rightarrow 2V = 8$

$\Rightarrow V = 4$ m/s $\downarrow$

4. In this case spring force is zero initially F.B.D. of A and B



5. If the block has an acceleration towards right, the blocks would have some acceleratidon towards left.

Resolving horizontally and vertically, we have

$R_2 = m_2 g \cos\beta + m_2 f \sin\beta$ .... (1)

$m_2 f = T \cos\beta + R_2 \sin\beta$ .... (2)

and

$R_1 = m_1 g \cos\alpha + m_1 f \sin\alpha$ .... (3) $m_1 f = R_1 \sin\alpha - T \cos\alpha$ .... (4)

From equation. (2) and (1), we get

$m_2 f = T\cos\beta + [m_2 g \cos\beta + m_2 f \sin\beta] \sin\beta$

$= T\cos\beta + m_2 g \cos\beta \sin\beta + m_2 f \sin^2\beta$

$\therefore T\cos\beta = m_2 f - m_2 f \sin^2\beta - m_2 g \cos\beta \sin\beta$

or $T\cos\beta = m_2 f \cos^2\beta - m_2 g \cos\beta \sin\beta$

or$T = m_2 f \cos\beta - m_2 g \sin\beta$ .... (5)

From equations (3) and (4), we have

$m_1 f = (m_1 g \cos\alpha + m_1 f \sin\alpha) \sin\alpha - T\cos\alpha$

$= m_1 g \cos\alpha \sin\alpha + m_1 f \sin^2\alpha - T\cos\alpha$

$\therefore T\cos\alpha = m_1 g \cos\alpha \sin\alpha + m_1 f(\sin^2\alpha - 1)$

or $T = m_1 g \sin\alpha - m_1 f \cos\alpha$ .... (6)

Equating (5) and (6), we get

$m_2 f \cos\beta - m_2 g \sin\beta = m_1 g \sin\alpha - m_1 f \cos\alpha$

$$\therefore f = g\, g\left[\frac{(m_1 \sin\alpha + m_2 \sin\beta)}{(m_2 \cos\beta + m_1 \cos\alpha)}\right] \quad .... (7)$$

Substituting the value of f in eqn. (6) , we get

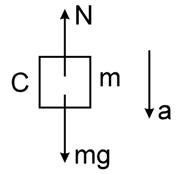
$T = m_1 g \sin\alpha - m_1 g$

$$\left\{\frac{(m_1 \sin\alpha + m_2 \sin\beta)}{(m_2 \cos\beta + m_1 \cos\alpha)}\right\} \cos\alpha$$

Simplifying, we get

$$T = \frac{m_1 m_2 g \sin(\alpha - \beta)}{m_1 \cos\alpha + m_2 \cos\beta}$$ **Ans.**

(6 to 8). free body diagram 'C' block

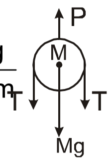


$$mg - N = ma$$

$$\therefore \quad N = m\left(g - \frac{gm}{2M+m}\right) \qquad N = \frac{2Mmg}{2M+m}$$

7. $T - mg = M\dfrac{mg}{2M+m}$ for A block

$$\therefore \quad T = Mg + \frac{Mmg}{2M+m}$$



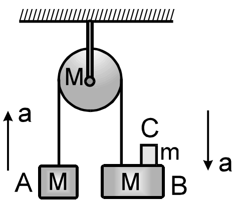
for pulley

$P = 2T + Mg$

$$= 2Mg + \frac{2Mmg}{2M+m} + Mg = \frac{6M+3m+2m}{2M+m}Mg$$

$$P = \left(\frac{6M+5m}{2M+m}\right)Mg$$

8.



By newtons law on system of (A, B, C)

5. $(M + m - m)\, g = (2M + m)\, a$

$$\therefore \quad a = \frac{mg}{2M+m}$$