# DPP - Daily Practice Problems

**Date :** ______ **Start Time :** ______ **End Time :** ______

# PHYSICS

**CP03**

**SYLLABUS :** Laws of Motion

**Max. Marks : 74** **Time : 60 min.**

**GENERAL INSTRUCTIONS**

- The Daily Practice Problem Sheet contains 20 Questions divided into 5 sections.
  **Section I** has **5** MCQs with ONLY 1 Correct Option, **3** marks for each correct answer and **–1** for each incorrect answer.
  **Section II** has **4** MCQs with ONE or MORE THAN ONE Correct options.
  For each question, marks will be awarded in one of the following categories:
  Full marks: **+4** If only the bubble(s) corresponding to all the correct option(s) is (are) darkened.
  Partial marks: **+1** For darkening a bubble corresponding to each correct option provided NO INCORRECT option is darkened.
  Zero marks: If none of the bubbles is darkened.
  Negative marks: **–2** In all other cases.
  **Section III** has **4** Single Digit Integer Answer Type Questions, **3** marks for each Correct Answer and 0 marks in all other cases.
  **Section IV** has Comprehension/Matching Cum-Comprehension Type Questions having **5** MCQs with ONLY ONE correct option, **3** marks for each Correct Answer and 0 marks in all other cases.
  **Section V** has **2** Matching Type Questions, **2** mark for the correct matching of each row and 0 marks in all other cases.
- You have to evaluate your Response Grids yourself with the help of Solutions.

## Section I - Straight Objective Type

This section contains 5 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

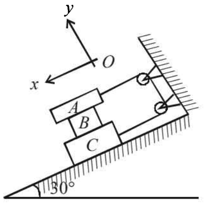
**1.** Three blocks $A, B, C$ of weights 40N, 30N, 80N respectively are at rest on an inclined plane as shown in figure. Determine the smallest value of coefficient of limiting friction ($\mu_s$) for which equilibrium of system is maintained.

(a) 0.1757

(b) 0.2757

(c) 0.5757

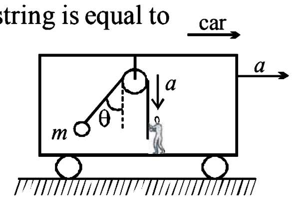
(d) 0.8757




| RESPONSE GRID | 1. ⓐⓑⓒⓓ |
|---|---|

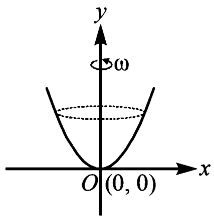
*Space for Rough Work*

2. A bob is hanging over a pulley inside a car through a string. The second end of the string is in the hand of a person standing in the car. The car is moving with constant acceleration $a$ directed horizontally as shown in figure. Other end of the string is pulled with constant acceleration $a$ vertically. The tension in the string is equal to




(a) $m\sqrt{g^2+a^2}$
(b) $m\sqrt{g^2+a^2}-ma$
(c) $m\sqrt{g^2+a^2}+ma$
(d) $m(g+a)$

3. In the given figure, a smooth parabolic wire track lies in the $xy$-plane (vertical). The shape of track is defined by the equation $y = x^2$. A ring of mass m which can slide freely on the wire track, is placed at the position A (1,1). The track is rotated with constant angular speed ω such that there is no relative slipping between the ring and the track. The value of ω is

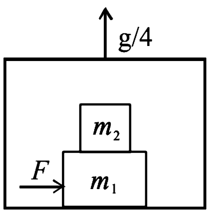



(a) $\sqrt{g/2}$ (b) $\sqrt{g}$ (c) $\sqrt{2g}$ (d) $2\sqrt{g}$

4. A block of mass m is placed on a surface with a vertical cross section given by $y = \frac{x^3}{6}$. If the coefficient of friction is 0.5, the maximum height above the ground at which the block can be placed without slipping is:

(a) $\frac{1}{6}$m (b) $\frac{2}{3}$m (c) $\frac{1}{3}$m (d) $\frac{1}{2}$m

5. A plank of mass $M_1 = 8$ kg with a bar of mass $M_2 = 2$ kg placed on its rough surface, lie on a smooth floor of elevator ascending with an acceleration g/4. The coefficient of friction is $\mu = 1/5$ between $m_1$ and $m_2$. A horizontal force $F = 30$ N is applied to the plank. Then the acceleration of bar and the plank in the reference frame of elevator are




(a) 3.5 m/s$^2$, 5 m/s$^2$ (b) 5 m/s$^2$, 50/8 m/s$^2$
(c) 2.5 m/s$^2$, 25/8 m/s$^2$ (d) 4.5 m/s$^2$, 4.5 m/s$^2$

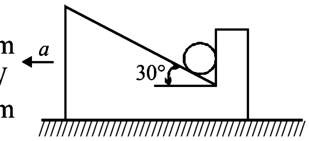
## Section II - Multiple Correct Answer Type

This section contains 4 multiple correct answer(s) type questions. Each question has 4 choices (a), (b), (c) and (d), out of which **ONE OR MORE** is/are correct.

6. A horizontal force $P$ is exerted on a 20 kg box in order to slide it up a 30° incline. The friction force retarding the motion is 80N. If the acceleration of the moving box is to be

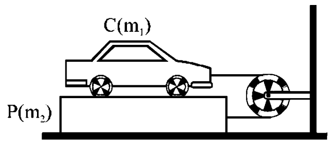
(a) zero then $P$ is 223N (b) 0.75 m/s$^2$ then $P$ is 206 N
(c) zero then $P$ is 206 N (d) 0.75 m/s$^2$ then $P$ is 223 N

7. The system in figure is given an acceleration. Weight of the ball is $W$.



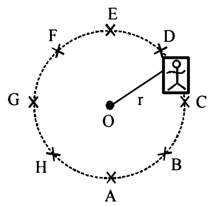

(a) The force on the ball from vertical surface is 1.15 W
(b) The force on the ball from inclined surface is $W\left(0.58+\frac{a}{g}\right)$
(c) The force on the ball from vertical surface is $W\left(0.58+\frac{a}{g}\right)$
(d) The forces on the ball from inclined surface is 1.15 W

8. A car C of mass $m_1$ rests on a plank P of mass $m_2$. The plank rests on a smooth floor. The string and pulley are ideal. The car starts and moves towards the pulley with acceleration.




(a) If $m_1 > m_2$, the string will remain under tension
(b) If $m_1 < m_2$, the string will become slack
(c) If $m_1 = m_2$, the string will have no tension, and C and P will have accelerations of equal magnitude
(d) C and P will have acceleration of equal magnitude if $m_1 \geq m_2$

9. A machine, in an amusement park, consists of a cage at the end of one arm, hinged at O. The cage revolves along a vertical circle of radius r (ABCOEFGH) about its hinge O, at constant linear speed $v = \sqrt{gr}$.




The cage is so attached that the man of weight 'w' standing on a weighing machine, inside the cage, is always vertical. Then which of the following is correct?

(a) The reading of his weight on the machine is the same at all positions
(b) The weight reading at A is greater than the weight reading at E by 2 w.
(c) The weight reading at G = w
(d) The ratio of the weight reading at E to that at A = 0

## Section III - Integer Type

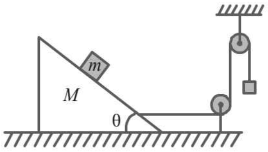
This section contains 4 questions. The answer to each of the questions is a single digit integer ranging from 0 to 9.

10. A block slides down a smooth inclined plane to the ground when released from the top, in time $t$ seconds. Another block is dropped vertically from the same point, in the absence of the inclined plane and reaches the ground in $t/2$ second. Then find the angle (in degree in multiple of 10) of inclination of the plane with the vertical.

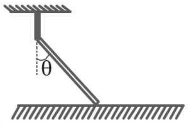
| RESPONSE GRID | | | | | |
|---|---|---|---|---|---|
| | 2. ⓐⓑⓒⓓ | 3. ⓐⓑⓒⓓ | 4. ⓐⓑⓒⓓ | 5. ⓐⓑⓒⓓ | 6. ⓐⓑⓒⓓ |
| | 7. ⓐⓑⓒⓓ | 8. ⓐⓑⓒⓓ | 9. ⓐⓑⓒⓓ | 10. ⓪①②③④⑤⑥⑦⑧⑨ | |

*Space for Rough Work*

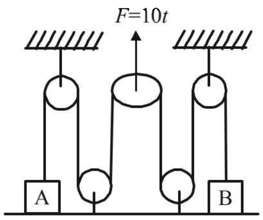
**11.** Find the mass of the hanging block which will prevent the smaller block from slipping over the triangular block. All the surfaces are frictionless and the strings and the pulleys are light. Given $m = M = 1$kg; $\cot\theta = 2$.




**12.** A uniform rod of length $2\ell$ and mass $m$ is suspended from one end by inextensible string and other end lies on smooth ground. The angle made by rod with vertical is $\theta = \sin^{-1}(1/\sqrt{3})$. If $N_1$ and $N_2$ represents the contact force from ground on rod just before and just after cutting string then find the ratio of $N_1/N_2$.




**13.** In the arrangement shown in figure $m_A = 1$ kg and $m_B = 2$ kg, while all the pulleys and strings are massless and frictionless. At $t = 0$, a force $F = 10\,t$ starts acting over central pulley in vertically upward direction. Find the velocity of A (in deca m/s) when B loses contact with floor.

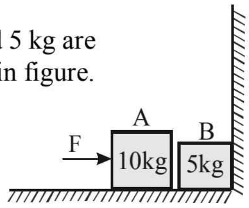



## Section IV - Comprehension/Matching Cum-Comprehension Type

**Directions (Qs. 14 and 15) :** Based upon the given paragraph, 2 multiple choice questions have to be answered. Each question has 4 choices (a), (b), (c) and (d), out of which **ONLY ONE** is correct.

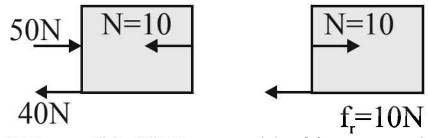
**PARAGRAPH**

Two bodies A and B of masses 10 kg and 5 kg are placed very slightly separated as shown in figure. The coefficients of friction between the floor and the blocks are as $\mu_s = \mu_k = 0.4$. Block A is pushed by an external force F.



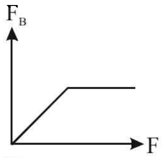

The value of F can be changed. When the welding between block A and ground breaks, block A will start pressing block B and when welding of B also breaks, block B will start pressing the vertical wall.

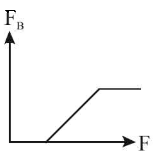
**14.** If F = 50 N, the friction force acting between block B and ground will be –

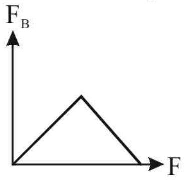


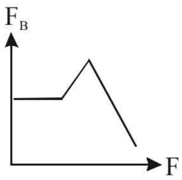

(a) 10 N (b) 20 N (c) 30 N (d) 15 N

**15.** The force of friction acting on B varies with the applied force F according to curve –

(a)


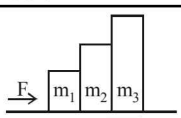
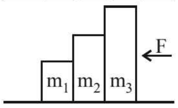
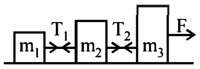
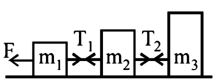

(b)



(c)



(d)



**Directions (Qs. 16-18) :** This passage contains a table having 3 columns and 4 rows. Based on the table, there are three questions. Each question has four options (a), (b), (c) and (d) **ONLY ONE** of these four options is correct.

The acceleration of a particle as measured from an inertial frame is given by the vector sum of all the forces acting on the particle divided by its mass. Column I shows the motion of blocks ($m_1$, $m_2$, $m_3$) in contact/connected by massless string on a smooth horizontal surface. If $f_1$ is the contact force between body $m_1$ and $m_2$, $f_2$ between body $m_2$ and $m_3$, $T_1$ be the tension in the string between body $m_1$ and $m_2$, $T_2$ between body $m_2$ and $m_3$. Column II and III shows different values of $f_1$, $f_2$, $T_1$ and $T_2$ in different situations shown in column I.

| Column I | | Column II | | Column III | |
|---|---|---|---|---|---|
| I. |  | (i) | $T_1 = \dfrac{(m_2+m_3)F}{m_1+m_2+m_3}$ | (P) | $f_2 = \dfrac{(m_1+m_2)F}{m_1+m_2+m_3}$ |
| II. |  | (ii) | $T_1 = \dfrac{m_1F}{m_1+m_2+m_3}$ | (Q) | $f_2 = \dfrac{m_3F}{m_1+m_2+m_3}$ |
| III. |  | (iii) | $f_1 = \dfrac{m_1F}{m_1+m_2+m_3}$ | (R) | $T_2 = \dfrac{(m_1+m_2)F}{m_1+m_2+m_3}$ |
| IV. |  | (iv) | $f_1 = \dfrac{(m_2+m_3)F}{m_1+m_2+m_3}$ | (S) | $T_2 = \dfrac{m_3F}{m_1+m_2+m_3}$ |

| RESPONSE GRID | |
|---|---|
| | 11. ⓪①②③④⑤⑥⑦⑧⑨ 12. ⓪①②③④⑤⑥⑦⑧⑨ |
| | 13. ⓪①②③④⑤⑥⑦⑧⑨ 14. ⓐⓑⓒⓓ 15. ⓐⓑⓒⓓ |

*Space for Rough Work*

**16.** If the acceleration of body $m_1$, $m_2$ and $m_3$ respectively shown in situation Column I (I) are (2, 2, 2) then the correct matching is [Take $m_1 = 1$ kg, $m_2 = 2$ kg, $m_3 = 3$ kg, F = 12 N]

(a) I (iv) Q (b) IV (iv) P (c) III (ii) P (d) I (iii) Q

**17.** If the value of $T_1$ and $T_2$ shown in the situation column I (IV) are 10N and 6N respectively then find the correct matching. [Take $m_1 = 1$ kg, $m_2 = 2$ kg, $m_3 = 3$ kg, F = 12 N].

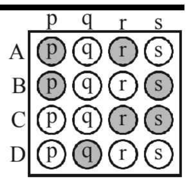
(a) II (i) R (b) IV (i) S (c) IV (iii) S (d) III (ii) S

**18.** Which of the following does not show the correct matching?

(a) II (iii) P (b) III (ii) R (c) I (iv) Q (d) IV (i) R

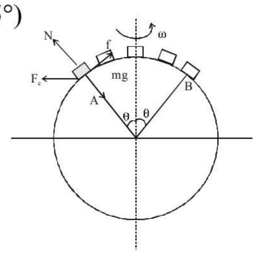
## Section V - Matrix-Match Type

This section contains 2 questions. It contains statements given in two columns, which have to be matched. Statements in column I are labelled as A, B, C and D whereas statements in column II are labelled as p, q, r and s. The answers to these questions have to be appropriately bubbled as illustrated in the following example. If the correct matches are A-p, A-r, B-p, B-s, C-r, C-s and D-q, then the correctly bubbled matrix will look like the following:




**19.** The block is placed at different position of earth from A to B as shown. Then the following parameters for different positions from A to B will vary as follows. Consider the effect of rotation of earth about its own axis. Neglect the effect of rotation of earth around the sun and assume earth as a perfect sphere, (F = centrifugal force; f = frictional force; $\theta < 45°$)

Match the two columns.




| Column I | Column II |
|---|---|
| (A) Gravity force | (p) first increases and then decreases |
| (B) Normal force | (q) first decreases and then increases |
| (C) Centrifugal force | (r) remains constant |
| (D) Frictional force | (s) increases only |

**20.** Match the columns ($g = 10$ m/s$^2$)

| Column I | Column II |
|---|---|
| (A) Block of mass 2 kg on a rough horizontal surface pulled by a horizontal force of 20N, $\mu_s = 0.5$ | (p) Tension at the mid point of block is 10N |
| (B) Block of mass 2 kg pulled with constant speed up an incline of inclination 30° and coefficient of friction $1/\sqrt{3}$ | (q) Acceleration of block is 5 m/s$^2$ |
| (C) Block of mass 0.75kg pulled by a constant force of 7.5N upon incline of inclination 30° and coefficient of friction $1/\sqrt{3}$ | (r) Force of friction acting is 5N |
| (D) Block of mass 2 kg pulled vertically by a force of 20N | (s) Resultant force on the block is zero |

| RESPONSE GRID | |
|---|---|
| | **16.** ⓐⓑⓒⓓ **17.** ⓐⓑⓒⓓ **18.** ⓐⓑⓒⓓ |
| | **19.** A - ⓟⓠⓡⓢ; B - ⓟⓠⓡⓢ; C - ⓟⓠⓡⓢ; D - ⓟⓠⓡⓢ |
| | **20.** A - ⓟⓠⓡⓢ; B - ⓟⓠⓡⓢ; C - ⓟⓠⓡⓢ; D - ⓟⓠⓡⓢ |

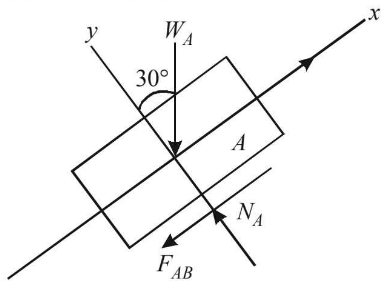
| DAILY PRACTICE PROBLEM DPP CP03 - PHYSICS | | | |
|---|---|---|---|
| Total Questions | 20 | Total Marks | 74 |
| Attempted | | Correct | |
| Incorrect | | Net Score | |
| Cut-off Score | 24 | Qualifying Score | 35 |

$$\text{Net Score} = \sum_{i=I}^{V}\left[\left(\text{correct}_i \times MM_i\right) - \left(In_i - NM_i\right)\right]$$

*Space for Rough Work*

1. **(a)** For the impending motion, block $A$ must slip up and block $C$ down the inclined plane. Since the normal force between $A$ and $B$ is less than that between block $B$ and $C$, the maximum frictional force (limiting friction) will be reached first between $A$ and $B$ while $B$ and $C$ will stay together.

**From FBD of block A :**




Writing equilibrium equations :

$\Sigma F_y = 0$ ;

$N_A - W_A \cos 30° = 0$

$N_A = W_A \cos 30°$

$N_A = 20\sqrt{3}$N

Also for impending motion if $F_{AB}$ is frictional force between blocks $A$ and $B$, then

$F_{AB} = \mu_s . N_A = 20\sqrt{3}\ \mu_s N$ ......... (1)

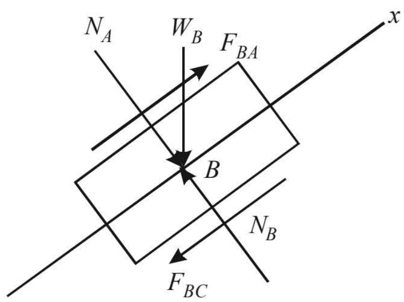
$\Sigma F_x = 0$ :

$T - W_A \sin 30° - F_{AB} = 0$

$T - 40.\frac{1}{2} - 20\sqrt{3}\mu_s = 0$

$T = 20\,(1 + \sqrt{3}\mu_s)$ ......... (2)

From FBD of block B and C combined




Writing equilibrium equation

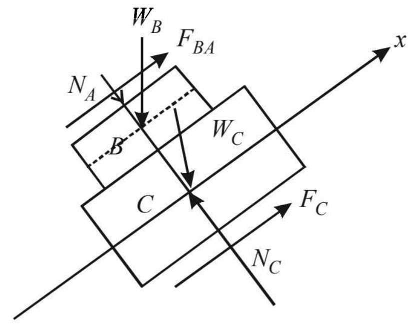
$\Sigma F_y = 0$ ;

$N_C - N_A - (W_B + W_C) \cos 30° = 0$

$N_C - 20\sqrt{3} - 110.\frac{\sqrt{3}}{2} = 0$

$N_C = 75\sqrt{3}$ N

Also for impending motion :




$F_C = \mu_s . N_C = 75\sqrt{3}\ \mu_s$ ......... (3)

For $\Sigma F_x = 0$, we have

$T_A + (F_{BA} + F_C) - (W_B + W_C) \sin 30° = 0$

$T + [20\sqrt{3} + 75\sqrt{3}\mu_s] - \frac{110}{2} = 0$

$T = (55 - 95\sqrt{3}\mu_s)$

Since tension is same, so from (2) and (4), we get

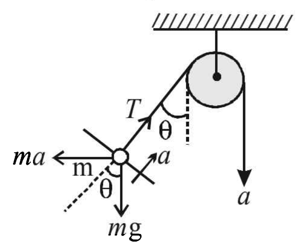
$20\,(1 + \sqrt{3}\mu_s) = (55 - 95\sqrt{3}\ \mu_s)$

Solving for $\mu_s$ we get, $115\sqrt{3}.\mu_s = 35$

or $\mu_s = \frac{35}{115\sqrt{3}} = 0.1757$

$\therefore$ Minimum $\mu_s = 0.1757$

2. **(c)**




(Force diagram in the frame of the car)

Applying Newton's law perpendicular to string $mg \sin\theta = ma \cos\theta$

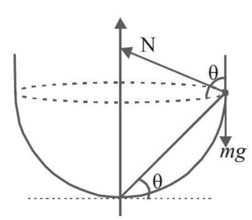
$\Rightarrow \tan\theta = \frac{a}{g}$

Applying Newton's law along string

$\Rightarrow T - m\sqrt{g^2 + a^2} = ma$

or $T = m\sqrt{g^2 + a^2} + ma$

3. **(c)**



$N\cos\theta = mg$ and $N\sin\theta = m\omega^2 r$

$$\therefore \quad \tan\theta = \frac{\omega^2 r}{g} \quad \ldots\text{(i)}$$

Given $\quad y = x^2$

$$\therefore \quad \frac{dy}{dx} = 2x$$

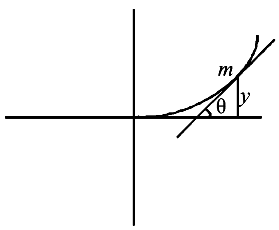
or $\quad \tan\theta = 2\times 1 = 2 \quad \ldots\text{(ii)}$

From above equations, we get

$$\omega = \sqrt{2g} \qquad (r = 1\text{ m})$$

**4. (a)** At limiting equilibrium, $\mu = \tan\theta$

$$\tan\theta = \mu = \frac{dy}{dx} = \frac{x^2}{2} \text{ (from question)}$$



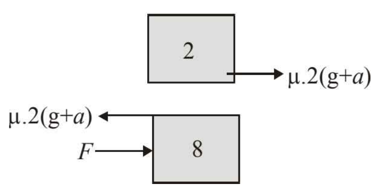

$\because$ Coefficient of friction $\mu = 0.5$

$$\therefore \quad 0.5 = \frac{x^2}{2}$$

$$\Rightarrow \quad x = \pm 1$$

Now, $y = \frac{x^3}{6} = \frac{1}{6}m$

**5. (c)** FBD in reference frame of the lift

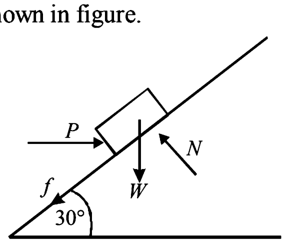



$$a_2 = \frac{1}{5}\left(g + \frac{g}{4}\right) = \frac{g}{4} = 2.5\text{ m/s}^2$$

$$a_8 = \frac{30 - \left[\mu.2\left(g + \frac{g}{4}\right)\right]}{8}$$

$$= \frac{30 - \left[\frac{1}{5}\times 2\times\frac{50}{4}\right]}{8} = \frac{25}{8}\text{m/s}^2$$

**6. (c, d)** Here we choose the $x$-axis along the incline with positive upward. All the forces on the block are shown in figure.

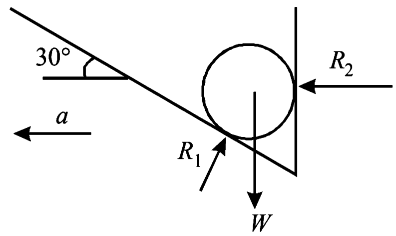



From $\Sigma F_x = ma_x$ we have $P\cos 30° - W\sin 30° - f = ma_x$, where $m = 20$ kg, $W = mg = 196$ N, and $f = 80$ N

For $a_x = 0$, $P = 206$ N.

For $a_x = 0.75\text{ m/s}^2$, $P = 223$ N

**7. (c, d)** From figure, $\Sigma F_{ver} = R_1\cos 30° - W = ma_{ver} = 0$ and $\Sigma F_{hor} = R_2 - R_1\sin 30° = ma$.




Thus, the acting forces are

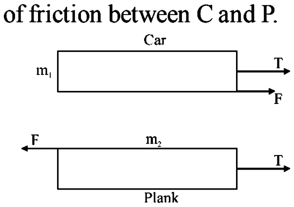
$$R_1 = \frac{W}{\cos 30°} = 1.15W$$

$$R_2 = R_1\sin 30° + \frac{W}{g}a$$

$$= (1.15\,W)(0.5) + \frac{W}{g}a$$

$$= W\left(0.58 + \frac{a}{g}\right)$$

**8. (a, b, c, d)** Let T = tension in the string, F = force of friction between C and P.




If the string is under tension, the acceleration of C to the right = acceleration of P to the left = a.

$T + F = m_1 a \qquad F - T = m_2 a$

$$\therefore \quad T = \frac{1}{2}(m_1 - m_2)a \quad \text{or } T > 0 \text{ if } m_1 > m_2.$$

If $m_1 < m_2$, T becomes < 0, i.e., it becomes slack.

If $m_1 = m_2$, $T = 0$

**9. (b, c, d)**

Let N be the normal reaction (Reading of the weighing machine)

at A $\Rightarrow \quad N_A - mg = \frac{mv^2}{r}$

put v $\therefore \quad N_A - mg = mg \Rightarrow N_A = 2mg = 2W$

Also, at E, $N_E + mg = \frac{mv^2}{r} = mg \quad \therefore N_E = 0$

hence $\quad N_A > N_E$ by 2W

Now at G, $N_G = \frac{mv^2}{r} = mg = W = N_c$

Also $\frac{N_E}{N_A} = 0$ and $\frac{N_A}{N_C} = 2$

**10. 6**

If θ is the angle which the inclined plane makes with the vertical direction, then the acceleration of the block sliding down the plane of length ℓ will be g cosθ.

Using the formula, $s = ut + \frac{1}{2}at^2$, we have $s = \ell$, $u = 0$, $t = t$ and $a = g\cos\theta$.

So $\ell = 0 \times t + \frac{1}{2}g\cos\theta t^2 = \frac{1}{2}(g\cos\theta)t^2$ ...(i)

Taking vertical downward motion of the block, we get

$\therefore\ h = 0 + \frac{1}{2}g(t/2)^2 = \frac{1}{2}gt^2/4$ ...(ii)

Dividing (ii) by (i), we get $\frac{h}{\ell} = \frac{1}{4\cos\theta}$ $[\because \cos\theta = h/\ell]$

or $\cos\theta = \frac{1}{4\cos\theta}$ ; or $\cos^2\theta = \frac{1}{4}$ ; or $\cos\theta = \frac{1}{2}$

or θ = **60°**

**11. 2** For m not to slide over *M*, acceleration of the triangular block should be *g*tan θ.

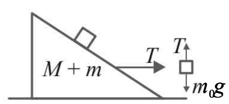
If $m_0$ is the required mass, then

$mg - T = m_0(g\tan\theta)$ ...(i)

and $T = (M + m)g\tan\theta$

or $T = 2g\tan\theta$ ...(ii)

$\cot\theta = 2$ ...(iii)



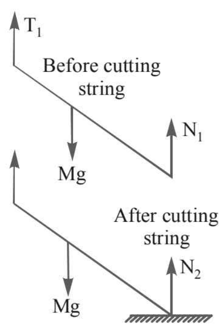

After simplifying above equation, we get $m_0 = 2$ kg.

**12. 1** Before cutting string

$N_1 = T = Mg/2$

After cutting string

$Mg - N_2 = Ma$ ...(i)




$N_2\ell\sin\theta = M\alpha(2\ell)^2/12$ ...(ii)

By constraint that lower end will have acceleration only in horizontal direction.

$\ell\alpha\sin\theta = a$ ...(iii)

From (i), (ii) and (iii)

$\Rightarrow\ N_2 = Mg/(3\sin^2\theta + 1)$

$\Rightarrow\ N_1/N_2 = (3\sin^2\theta + 1)/2 = 1$

**13. 1**

$10t = 2T$

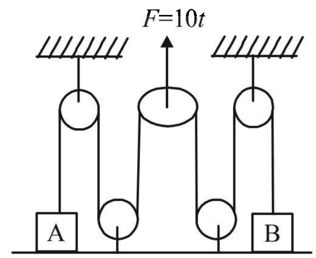
$\Rightarrow T = 5t$

Block A will lose contact when

$T = m_A g$

$5t = m_A g$

$\Rightarrow t_1 = \frac{m_A g}{5}$ sec = **2sec**




While block B will lose contact, when

$T' = m_B g$

$\Rightarrow 5t = 2m_B g$

or $t_2 = \frac{2g}{5}$ sec = 4 sec

At $t_1 \le t$ for block *A*

$T - mg = ma$

$5t - mg = \frac{mdv}{dt}$

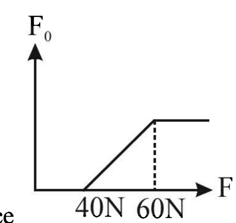
$\Rightarrow m\int_0^v dv = \int_{t_1}^{t_2}(5t - mg)dt$

$v$ = **10 m/s**

**14. (a)** If F = 50N, force on 5 kg block = 10N

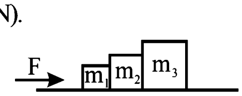
So friction force = 10N

**15. (b)** Until the 10 kg block is sticked with ground (F = 40N), No force will be felt by 5 kg block.



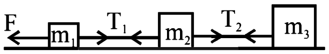

After F = 40 N, the friction force on 5 kg increases, till F = 60 N and after that, the kinetic friction start acting on 5 kg block, which will be constant (20N).

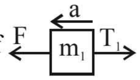
**16. (a)**



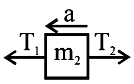

All the body of mass $m_1$, $m_2$ and $m_3$ will move with the same acceleration $= \frac{F}{m_1 + m_2 + m_3}$

$= \frac{12}{1 + 2 + 3} = 2\,\text{ms}^{-2}$

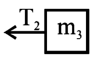
**17. (b)** 


F.B.D. of 

$F - T_1 = m_1 a$ ...(i)



$T_1 - T_2 = m_2 a$ .... (ii)



$T_2 = m_3 a$ ....(iii)

(i) + (ii) + (iii)

$a = {}^{F}/(m_1 + m_2 + m_3)$

$T_2 = m_3 F \Big/ _{m_1+m_2+m_3} = \dfrac{3 \times 12}{1+2+3} = 6N$

$T_1 = m_2 a + T_2 = (m_2 + m_3) F/(m_1 + m_2 + m_3)$

$= \dfrac{(2+3)12}{1+2+3} = 10N$

**18. (d)** For situation (I),

$f_1 = \dfrac{(m_2 + m_3)F}{m_1 + m_2 + m_3}, f_2 \dfrac{m_3 f}{m_1 + m_2 + m_3}$

Situation (II), $f_1 = \dfrac{m_1 F}{m_1 + m_2 + m_3}$,

$f_2 = \dfrac{(m_1 + m_2)F}{m_1 + m_2 + m_3}$

Situdation (III), $T_1 = \dfrac{m_1 F}{m_1 + m_2 + m_3}$,

$T_2 = \dfrac{(m_1 + m_2)F}{m_1 + m_2 + m_3}$

Situation (IV), $T_1 = \dfrac{(m_2 + m_3)F}{m_1 + m_2 + m_3}$,

$T_2 = \dfrac{m_3 F}{m_1 + m_2 + m_3}$

**19. (A) → r; (B) → p; (C) → q; (D) → q**

Gravity force (mg) will remain constant and always directed towards the centre of the earth. Normal force depends on cos θ, whereas centrifugal force and friction force depends on sin θ. As θ first decreases then increases. Normal force first increases then decreases whereas centrifugal force and friction force first decreases then increases.

**20. (A) → p, q; (B) → s; (C) → s; (D) → p, s**

(A) $20 - 0.5 \times 2 \times 10 = ma$ ; $a = 5$ m/s$^2$, $f = 10$N

Tension at mid point,

$T - 0.5 \times 1 \times 10 = 1 \times 5 \Rightarrow T = 10$ N

(B) Speed constant $\Rightarrow a = 0$

Pulling force = mg sin θ + $f$

(C) $F_{net} = 7.5 - 0.75 \times g \times \sin 30° - \dfrac{1}{\sqrt{3}} \times 0.75 g \cos 30°$

$= 7.5 - 0.75 g \times \dfrac{1}{2} - \dfrac{1}{\sqrt{3}} 0.75 g \dfrac{\sqrt{3}}{2} = 0$

(D) $F_{net} = 20 - 2g = 0$ ; $T - 1g = 1 \times 0 \Rightarrow T = 10$ N