PHYSICS

DPP

DAILY PRACTICE PROBLEMS

DPP No. 24

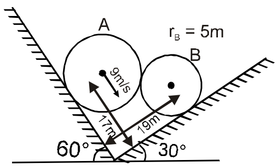
Total Marks : 24

Max. Time : 25 min.

Topics : Relative Motion, Newtons's Law of Motion, Projectile Motion

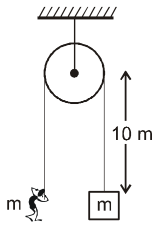
Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6	(3 marks, 3 min.)	[18, 18]
True or False (no negative marking) Q.7	(2 marks, 2 min.)	[2, 2]
Subjective Questions ('–1' negative marking) Q.8	(4 marks, 5 min.)	[4, 5]

1. System is shown in the figure. Velocity of sphere A is 9 m/s. Then speed of sphere B will be:



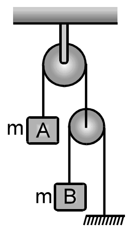
(A) 9 m/s (B) 12 m/s (C) $9 \times \frac{5}{4}$ m/s (D) none of these

2. A boy and a block, both of same mass, are suspended at the same horizontal level, from each end of a light string that moves over a frictionless pulley as shown. The boy starts moving upwards with an acceleration 2.5 m/s^2 relative to the rope. If the block is to travel a total distance 10 m before reaching at the pulley, the time taken by the block in doing so is equal to :



(A) $\sqrt{8}$ s (B) 4s (C) $\frac{10}{\sqrt{2}}$ s (D) 8s

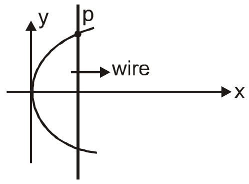
3. In the figure shown neglecting friction and mass of pulleys, what is the acceleration of mass B ?



(A) $\frac{g}{3}$ (B) $\frac{5g}{2}$

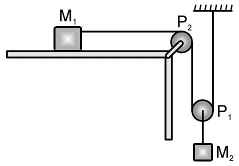
(C) g (D) $\frac{2g}{5}$

4. A wire is bent in a parabolic shape followed by equation $x = 4y^2$. Consider origin as vertex of parabola. A wire parallel to y axis moves with constant speed 4 m/s along x-axis in the plane of bent wire. Then the acceleration of touching point of straight wire and parabolic wire is (when straight wire has x coordinate = 4 m) :



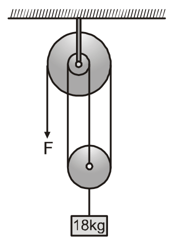
(A) $\frac{1}{2}\hat{i}$ (B) $-\frac{1}{4}\hat{j}$ (C) $2\hat{j}$ (D) $4\hat{i}$

5. Blocks of mass M_1 and M_2 are connected by a cord which passes over the pulleys P_1 and P_2 as shown in the figure. If there is no friction, the acceleration of the block of mass M_2 will be:



(A) $\frac{M_2 g}{(4M_1+M_2)}$ (B) $\frac{2M_2 g}{(4M_1+M_2)}$ (C) $\frac{2M_1 g}{(M_1+4M_2)}$ (D) $\frac{2M_1 g}{(M_1+M_2)}$

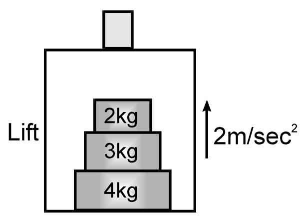
6. In the figure, at the free end of the light string, a force F is applied to keep the suspended mass of 18 kg at rest. Then the force exerted by the ceiling on the system (assume that the string segments are vertical and the pulleys are light and smooth) is: ($g = 10 m/s^2$)



(A) 60 N (B) 120 N
(C) 180 N (D) 240 N
(E) 200 N

7. **True/False**
(i) Two particles are in projectile motion. The path of one particle as seen by another particle will be a straight line.
(ii) In order to cross a river of uniform width (flow is also uniform) in shortest time, swimmer must swim in perpendicular direction of river flow.

8. A lift is moving upwards with an acceleration of $2 m/sec^2$. Inside the lift a 4 kg block is kept on the floor. On the top of it, 3 kg block is placed and again a 2 kg block is kept on the 3 kg block. Calculate:



(i) contact force between 2 kg block and the 3 kg block.
(ii) contact force between 4 kg block and floor of the lift.
Draw the free body diagrams properly & take $g = 10 m/sec^2$.

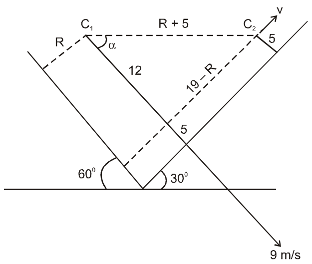
Answers Key

DPP NO. - 24

1. (B) **2.** (B) **3.** (D) **4.** (B) **5.** (A)
6. (D) **7.** (i) False (ii) True
8. (i) 24 N (ii) 108 N

Hint & Solutions

DPP NO. - 24

1. 

$9 \cos\alpha = v \sin\alpha \quad \rightarrow \quad (i)$

$\frac{19 - R}{12} = \tan\alpha \quad \rightarrow \quad (ii)$

$(R + 5)^2 = (12)^2 + (19 - R)^2$

$\Rightarrow \quad R = 10$

Hence from (i) and (ii)

$v = 12 \text{ m/s}^2$

2. Acceleration of boy and block will be same equal to 1.25 m/s^2 w.r.t. ground. Hence

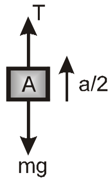
$10 = \frac{1}{2}(1.25)\, t^2$

$\Rightarrow t = 4$ sec.

3. From constraint relation , if acceleration of mass B is a then acceleration of mass A will be a/2 :

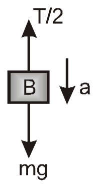
FBD of A :

$T - mg = \frac{ma}{2} \quad \ldots\ldots\ldots\ldots\ldots(i)$



FBD of B :

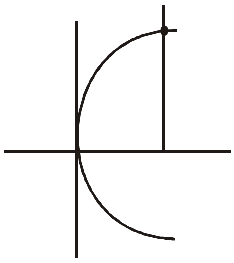
$mg - \frac{T}{2} = ma \quad \ldots\ldots\ldots\ldots\ldots(ii)$



From (i) & (ii)

$$a = \frac{2g}{5}$$

4. $x = 4y^2$



$$\frac{dx}{dt} = 8y\frac{dy}{dt}$$

$V_x = 8y\, V_y$
$V_x = 4$
$a_x = 0$
$0 = a_x = 8[y.a_y + V^2_y]$
$-y\, a_y = V^2_y$

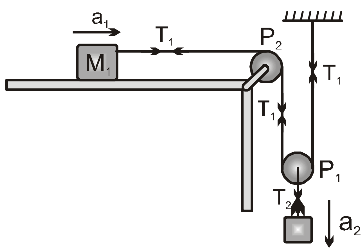
$$|a_y| = \frac{v_y^2}{y}$$

$$|a_y| = \frac{v_x^2}{64\,y^3} = \frac{16}{64 \times y^3}$$

at $y = 1 \Rightarrow |a_y| = \frac{1}{4}$

$y = 1 \Rightarrow |a_y| = \frac{1}{4}$

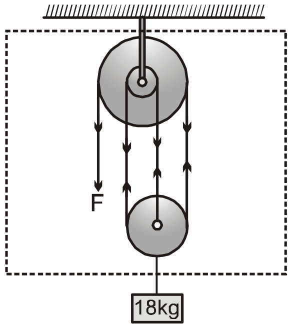
5.



Relative between a_1 & a_2
$a_1 = 2a_2 = 2a$
Relative between T_1 & T_2
$T_2 = 2T_1 = 2T$
$T_1 = M_1a_1$ ....(i)
$M_2g - T_2 = M_2a_2$ ....(ii)
$2T = 4M_1a$
$M_2g - 2T = M_2a$

$$M_2g = a(4M_1 + M_2) \Rightarrow a = \frac{M_2g}{4M_1 + M_2}.$$

6.



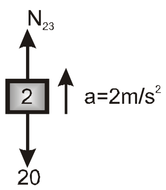
3F = 180
F = 60 N
T = 4F = 210 N
Force balance on system
T = F + 180
T = 60 + 180 = 240 N.

7. False There acceleration may be different.

True $T = \frac{W}{V}$ to minimize T, V will be maximum.

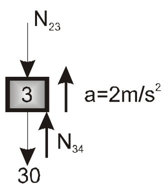
i.e whole effort of swimmer must towards opposite bank.

8. (i) FBD of 2kg



$N_{23} - 20 = 2(2)$
$N_{23} = 24$ N

(ii) FBD of 3 kg
$N_{34} - N_{23} - 30 = 3(2)$

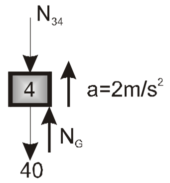


$N_{34} = N_{23} + 30 + 6$

$N_{34} = 24 + 30 + 6 \quad = 60\ N$

FBD of 4kg

$N_G - N_{34} - 40 = 4(2)$



$N_G = N_{34} + 40 + 8$

$N_G = 60 + 40 + 8 \quad = \quad 108\ N$