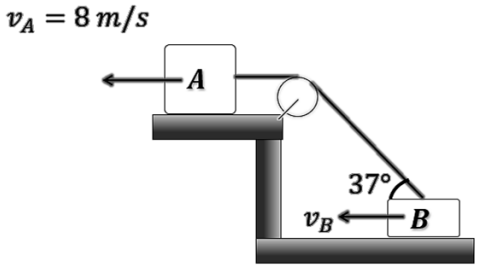
Chapter 6

Newton's Laws of Motion

Exercise

Constrained Motion

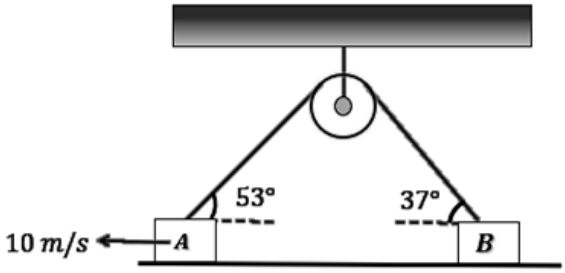
Q.1 Assuming the string to be inextensible and surface and pulley to be frictionless, velocity of block B (v_B) in the given figure is



(**A**)2 m/s (**B**)6 m/s (**C**)8 m/s (**D**)10 m/s

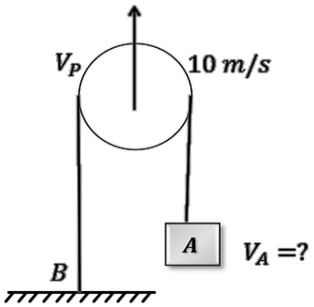
Constrained Motion

Q.2 Assuming the string to be inextensible and surface and pulley to be frictionless, the speed of block B in the pulley block system as shown in figure is



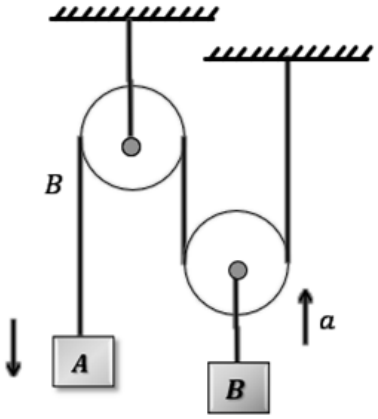
(**A**)5 m/s (**B**)6.5 m/s (**C**)7.5 m/s (**D**)10 m/s

Q.3 In the given constraint, if the string is inextensible and pulley is frictionless, then magnitude of velocity of block A (V_A) is



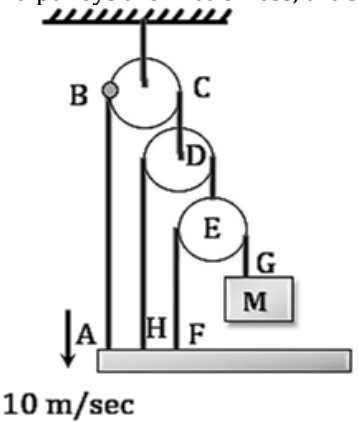
(**A**)10 m/s (**B**)20 m/s (**C**)15 m/s (**D**)5 m/s

Q.4 For the system shown below, block B is moving upward with an acceleration a. What will be the acceleration of block A, if string is inextensible and pulleys are frictionless?



(**A**)a (**B**)2a (**C**)4a (**D**)a/2

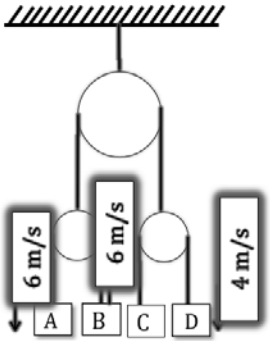
Q.5 If the strings are inextensible and pulleys are frictionless, the speed of point G on block M is



(**A**)50 m/s (**B**)60 m/s (**C**)70 m/s (**D**)80 m/s

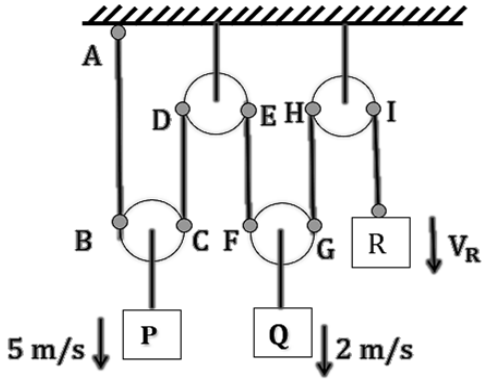
Constrained Motion

Q.6 In the figure given below, velocities of different blocks are shown. What will be the speed of block C, if pulleys are frictionless and strings are inextensible?



(**A**)6 m/s (**B**)4 m/s (**C**)0 m/s (**D**)None of these

Q.7 In the given constraint, what will be the speed of block R (V_R), if the string is inextensible and pulleys are frictionless

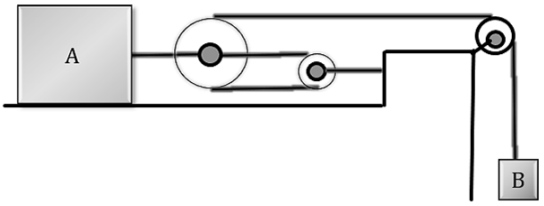


(**A**)10 m/s (**B**)12 m/s (**C**)14 m/s (**D**) 16 m/s

Q.8 Block B moves to the right with a constant velocity V_o. Assuming the pulleys and surface to be smooth and string inextensible, the velocity of block *A* relative to Block *B* is

(**A**) $\frac{V_0}{2}$, towards left (**B**) $\frac{V_o}{2}$, towards right (**C**) $\frac{3V_0}{2}$, towards left (**D**) $\frac{3V_o}{2}$, towards right

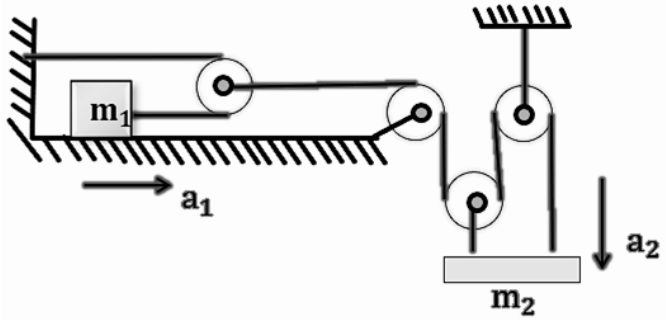
Q.9 If block A has a velocity of 0.6 m/s to the right, determine the velocity of block B. Assume that the surface is frictionless and sting is inextensible.



(**A**)1.8 m/s in downward direction (**B**)1.8 m/s in upward direction

(**C**)0.6 m/s in downward direction (**D**)0.6 m/s in upward direction

Q.10 Two blocks are arranged as shown in the figure. What will be the relation between acceleration a_1 of block m_1 and a_2 of block m_2, if surface and pulleys are frictionless and strings are inextensible?



(**A**)$a_1 = a_2$ (**B**)$a_1 = 6a_2$ (**C**)$a_1 = 3a_2$ (**D**)$a_1 = 4a_2$

WORK SHEET

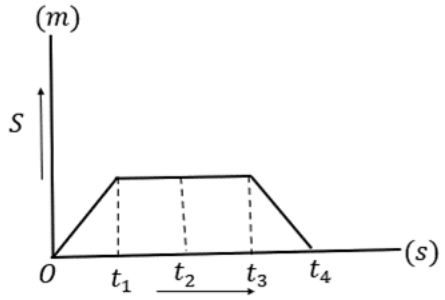
Double Differentiation

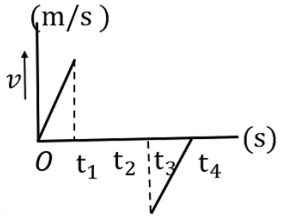
Q.1 Find the minimum value of the function $y = 5x^2 - 2x + 1$.

(**A**)0.4 (**B**)0.8 (**C**)1.2 (**D**)1.6

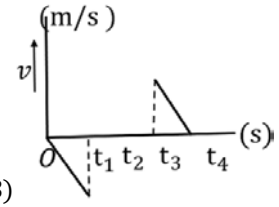
Distance-Time Graph

Q.2 Displacement - time graph of a body travelling in a straight line is shown in the figure.Velocity-time graph for the motion of the body will be.

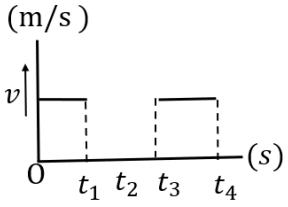




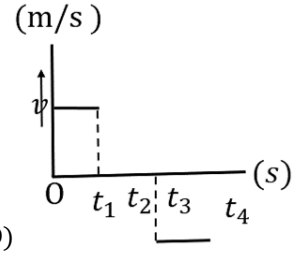
(**A**)



(**B**)



(**C**)



(**D**)

Vector Addition

Q.3 What is the angle between two forces of equal magnitude such that the resultant is one-third as much as either of the original forces?

(**A**) $\cos^{-1}\left(-\frac{17}{18}\right)$ (**B**) $\cos^{-1}\left(\frac{1}{3}\right)$ (**C**)45° (**D**)120°

Equation of motion

Q.4 A particle starts from rest, accelerates at 2 m/s^2 for 10 s and then goes with constant speed for 30 s and then decelerates at 4 m/s^2 till it stops. What is the distance travelled by it?

(**A**)750 m (**B**) 800 m (**C**) 700 m (**D**)850 m

Equation of motion

Q.5 A ball is thrown downwards from the top of a tower of height 'h' with a velocity'v'. Find the relation between 'v' and 'h' if the ball hits the ground with' 3v'.

(**A**) $2v = \sqrt{gh}$ (**B**) $v = \sqrt{gh}$ (**C**) $\frac{v}{2} = \sqrt{2gh}$ (**D**) $v = \sqrt{2gh}$

Projectile Motion

Q.6 The position vector of a projectile is given by $\vec{r} = 3t\,\hat{i} + (4t - 5t^2)\hat{j}$. Find the ratio of maximum height and initial speed.($g = 10\ m/s^2$)

(**A**) $\frac{4}{25}$ (**B**) $\frac{4}{15}$ (**C**) $\frac{8}{25}$ (**D**) $\frac{8}{15}$

Projectile Motion

Q.7 A projectile is fired horizontally with a velocity of 98 m/s from the top of a hill 490 m high. Find the angle that the line joining the top of the hill and the point on the ground where the projectile hits make with the vertical.(Take $g = 9.8\ ms^{-2}$)

(**A**) $\tan^{-1}\left(\frac{1}{2}\right)$ (**B**) $\tan^{-1}(2)$ (**C**) $\tan^{-1}\left(\frac{1}{3}\right)$ (**D**) $\tan^{-1}(3)$

Projectile Motion

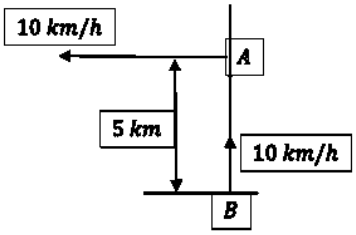
Q.8 A projectile is projected from origin in the $x - y$ plane with a velocity of 60 m/s at an 30° with the horizontal. Find the position vector of the projectile after 2 seconds. Take ($g = 10\ m/s^2$)

(**A**) $40\hat{i} + 40\hat{j}$ (**B**) $60\sqrt{3}\hat{i} + 40\hat{j}$ (**C**) $40\hat{i} + 60\sqrt{3}\hat{j}$ (**D**) $60\hat{i} + 60\hat{j}$

Relative velocity

Q.9 Two cars A and B are 5 km apart on a line joining south to North. Car A further North is streaming west at 10 km/hr and Car B is streaming North at10 km/hr. What is their closest distance of approach?

(**A**) 5 km (**B**) $\frac{5}{\sqrt{2}}$ km (**C**) 2 km **(D)** $\sqrt{3}$ km



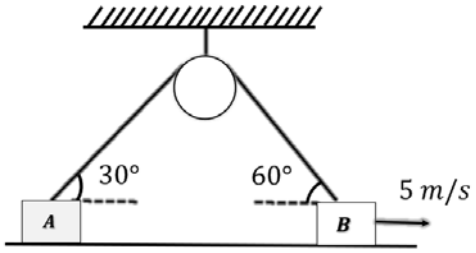
Relative motion

Q.10 A man standing on a road has to hold his umbrella at 30° with the vertical to keep the rain away. He throws the umbrella and starts running at 10 km/h. He finds that raindrops are hitting his head vertically. What is the speed of rain with respect to ground?

(**A**) $10\sqrt{3}$ km/h (**B**) 20 km/h (**C**) $\frac{20}{\sqrt{3}}$ km/h (**D**) $\frac{10}{\sqrt{3}}$ km/h

Constrained Motion

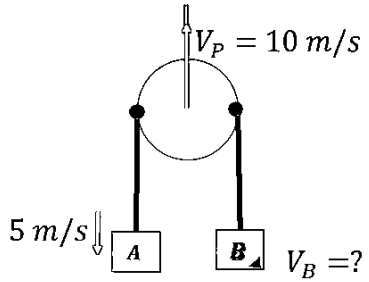
Q.11 In the given constraint, if the surface and pulley is frictionless and string is inextensible, then velocity of the block A parallel to the smooth surface is



(**A**) $\frac{5}{\sqrt{3}}$ m/s (**B**)3 m/s (**C**)5 m/s (**D**)10 m/s

Constrained Motion

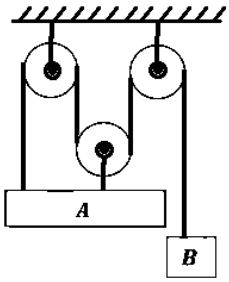
Q.12 In the given constraint, if pulley is frictionless and string is inextensible, then velocity of block B(V_B) is



(**A**)10 m/s (**B**)15 m/s (**C**)20 m/s (**D**)25 m/s

Constrained Motion

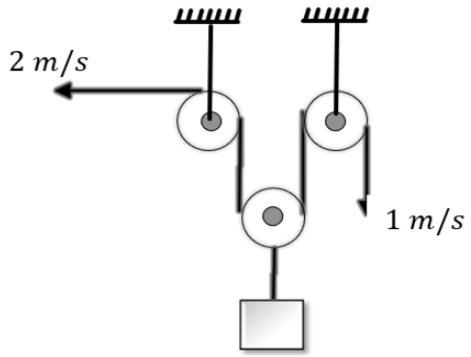
Q.13 At a given instant, block A is moving upwards with velocity of5 m/s, what is velocity of block B at that instant? Assume that the strings are inextensible and pulleys are frictionless.



(**A**)15 m/s ↓ (**B**)15 m/s ↑ (**C**)10 m/s ↓ (**D**)5 m/s ↑

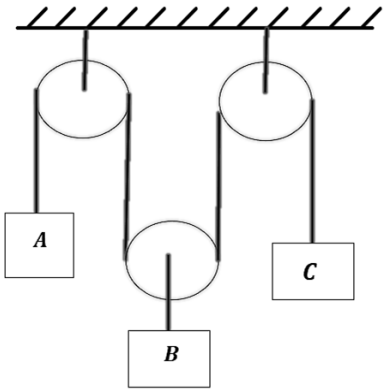
Constrained Motion

Q.14 Find the velocity of the hanging block if the velocities of the free ends of the rope are as indicated in the figure. Assume that the pulleys are frictionless and string is inextensible.



(**A**)3/2 m/s ↑ (**B**)3/2 m/s ↓ (**C**)1/2 m/s ↑ (**D**)1/2 m/s ↓

Q.15 The pulleys in the diagram are all smooth and light. The acceleration of block A is α upwards and the acceleration of block C is f downwards. The acceleration of block B is



(**A**) $\frac{1}{2}$(f − a) Upwards (**B**) $\frac{1}{2}$(a + f) Downward

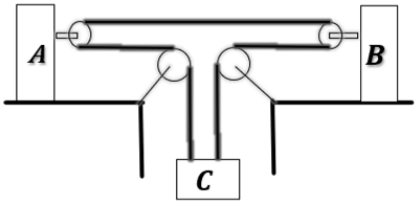
(**C**) $\frac{1}{2}$ (a + f) Upwards (**D**) $\frac{1}{2}$ (a − f) Upwards

Constrained Motion

Q.16 If acceleration of block A is 2 m/s^2 to left and acceleration of block B is 1 m/s^2 to left, then what will be the acceleration or block C? Assume that the surface and pulleys are smooth and string is inextensible.

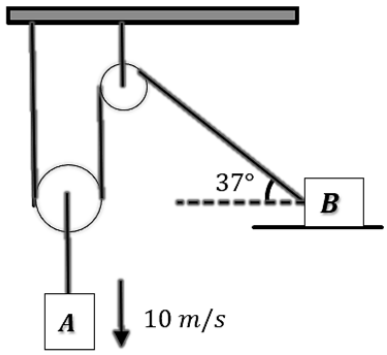
(**A**)1 m/s^2 Upwards (**B**)1 m/s^2 Downwards

(**C**)2 m/s^2 Downwards (**D**)2 m/s^2 Upwards



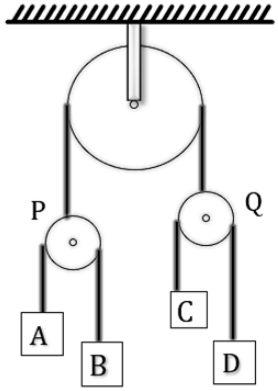
Q.17 Find velocity of block B at the instant shown in figure. Assume the surface and pulleys to be frictionless and string to be inextensible.

(**A**)25 m/s (**B**)20 m/s (**C**)22 m/s (**D**)30 m/s



Constrained Motion

Q.18 In the figure shown below, acceleration of block A is 1 m/s^2 upwards, acceleration of block B is 7 m/s^2 upwards and acceleration of block C is 2 m/s^2 upwards. Then what will be the acceleration of blockD? Assume that the pulleys are frictionless and strings are inextensible

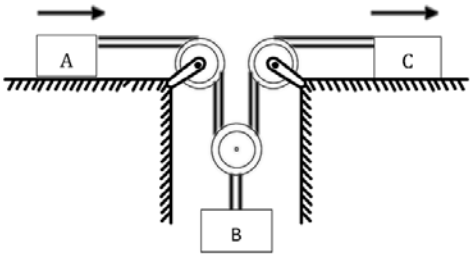


(**A**)7 m/s^{2}Upwards (**B**)2 m/s^{2}Downwards

(**C**)10 m/s^{2}Downwards (**D**)8 m/s^{2}Upwards

Constrained Motion

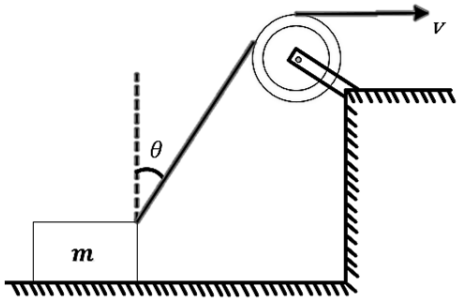
Q.19 Blocks A and C start from rest and move to the right with acceleration $a_A = 12\,t\ m/s^2$ and$a_C = 3\ m/s^2$. Here t is inseconds. The time when block B again comes to rest is (Given that system starts from rest and surface is smooth).



(**A**)2 s (**B**)1 s (**C**) $\frac{3}{2}$ s (**D**) $\frac{1}{2}$ s

Constrained Motion

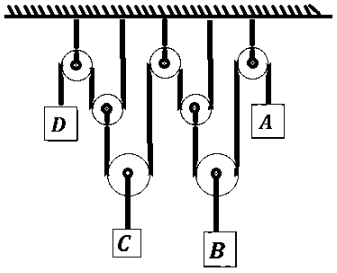
Q.20 A block is dragged on a smooth plane with the help of a rope which moves with a velocity as shown in figure. The horizontal velocity of the block is



(**A**)v (**B**) $\frac{v}{\sin\theta}$ (**C**)v $\sin\theta$ (**D**) $\frac{v}{\cos\theta}$

Constrained Motion

Q.21 Determine the relationship that governs the velocities of four cylinders if v_A, v_B v_C and v_D represents velocities of block A B, C andD. Consider downward velocity as positive and strings inextensible.

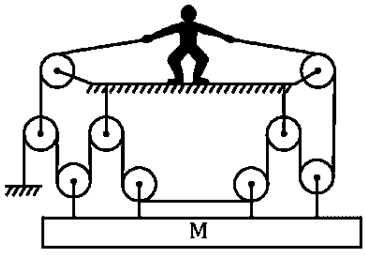


(**A**)$4v_A + 8v_B + 4v_C + v_D = 0$ (**B**)$-4v_A + 8v_B - 4v_C + v_D = 0$

(**C**)$4v_A - 8v_B + 4v_C - v_D = 0$ (**D**)$4v_A - 8v_B - 4v_C + v_D = 0$

Constrained Motion

Q.22 System is shown in the figure and man is pulling the rope from both sides with constant speed 'u'. Then what will be the velocity of the block, if the rope is

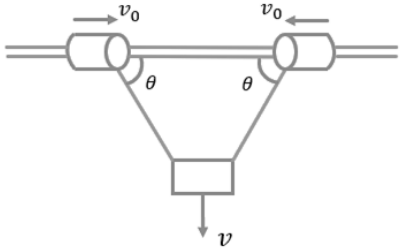


(**A**) $\frac{3u}{4}$ (**B**) $\frac{u}{2}$ (**C**) $\frac{u}{4}$ (**D**)u

Constrained Motion

Q.23 In the figure shown two beads slide along a smooth horizontal rod. If $V = kV_0$ find the value of k if $\theta = 30^0$.

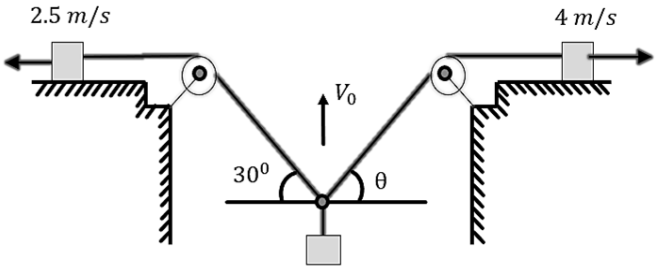
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(D)	(C)	(B)	(B)	(B)	(B)	(B)	(B)	(A)	(B)
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(D)	(A)	(A)	(A)	(A)	(B)	(B)	(B)	(B)
Q.	11	12	13	14	15	16	17	18	19	20
Sol.	(A)	(D)	(A)	(A)	(A)	(A)	(A)	(C)	(D)	(B)
Q.	21	22	23	24	25	26	27	28	29	30
Sol.	(A)	(B)		(B),(D)						



Q.24 The two blocks are moving with constant velocities as shown in the diagram. Assume that the surface is smooth and string is inextensible.

(**A**) The value of V_0 is 4 m/s^2 (**B**) The value of V_0 is 5 m/s^2

(**C**) The value of θ is 37^0 (**D**) The value of θ is 53^0



ANSWER KEY