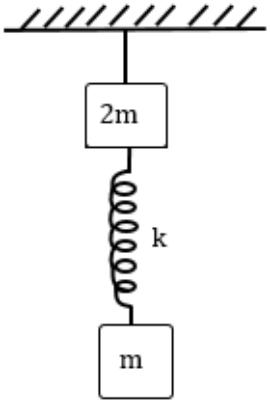
Chapter 6

Newton's Laws of Motion

Exercise

Spring Force

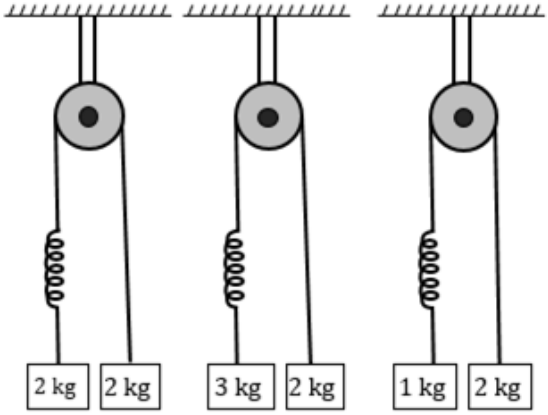
Q.1 Two blocks are connected by a spring, the combination is suspended at rest, from a string attached to the ceiling, as shown in the figure, the string breaks suddenly. Immediately after the string breaks, what is the initial downward acceleration of the upper block of mass **2m**?



(**A**) 0 (**B**) $\frac{3g}{2}$ (**C**) g (**D**) 2g

Spring Force

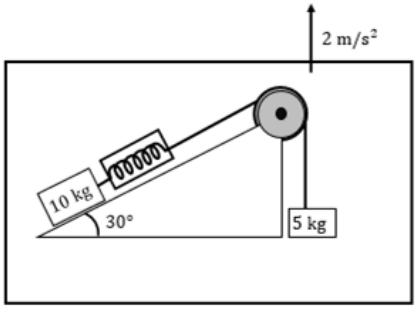
Q.2 Same spring is attached with **2 kg**, **3 kg** and **1 kg** blocks in three different cases as shown in figure. If $\mathbf{x_1}, \mathbf{x_2}$ and $\mathbf{x_3}$ be the extension in the spring in these cases then



(**A**) $x_1 = 0,\ x_3 > x_2$ (**B**) $x_2 > x_1 > x_3$ (**C**) $x_3 > x_1 > x_2$ (**D**) $x_1 > x_2 > x_3$

Pseudo Force

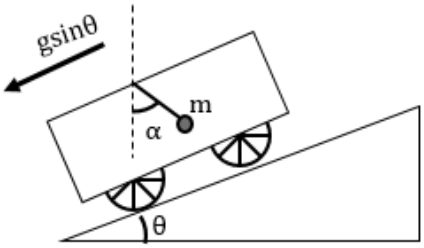
Q.3 In the figure the reading of the spring balanced will be ($\mathbf{g = 10\ m/s^2}$)



(**A**) 50 N (**B**)40 N (**C**)60 N (**D**) 70 N

Pseudo Force

Q.4 A trolley is accelerating down an incline of angle**θ** with acceleration **g sinθ**.which of the following correct.(**α** Is the constant angle made by the string with vertical?)



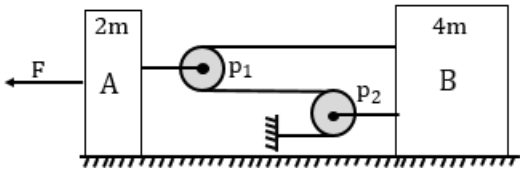
(**A**)$\alpha = \theta$ (**B**)$\alpha = 0°$

(**C**)Tension in the string $T = mg$ (**D**)Tension in the string $T = mg\sec\theta$

Constrained Motion

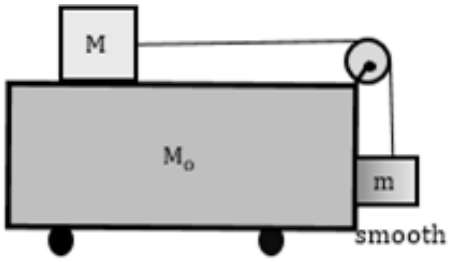
Q.5 Calculate the acceleration of the block**B** in the shown figure, assuming of the surfaces and the pulleys $\mathbf{p_1}$ and $\mathbf{p_2}$ are smooth and string is light

(**A**)$a = \frac{3F}{17m}\ m/s^2$ (**B**)$a = \frac{2F}{17m}\ m/s^2$ (**C**)$a = \frac{3F}{15m}\ m/s^2$ (**D**)$a = \frac{3F}{12m}\ m/s^2$



Pseudo Force

Q.6 Consider the special situation in which both the faces of the block $\mathbf{M_o}$ are smooth, as shown in adjoining figure. Mark out the correct statement(s) If$\mathbf{F = 0}$ the blocks**M** and m cannot remain stationaryfor the unique value of**F**, the blocks**M** and **m** remain stationary with respect to block $\mathbf{M_o}$There exist a range of **F** for which blocks **M** and **m** remain stationary with respect to block $\mathbf{M_o}$ Since there is no friction, therefore, blocks **M** and **m** cannot be in equilibrium with respect to block$\mathbf{M_o}$

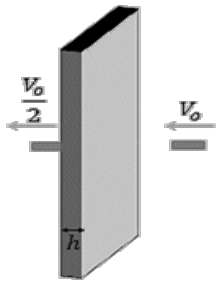


(**A**) Only statement (a) is correct (**B**)Only statement (b) is correct
(**C**)Only statement (c) is correct (**D**)both statement (a) and (b) are correct

Pseudo Force

Q.7 Having gone through a plank of thickness **h**, a bullet changed its speed from $\mathbf{V_o}$ to $\frac{\mathbf{V_o}}{\mathbf{2}}$.Find the time of motion of the bullet in the plank assuming the resistant force to be Proportional to the speed.

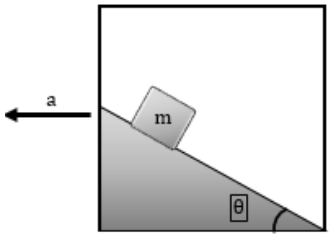
(**A**) $\frac{2h \ln 2}{V_o}$ (**B**) $\frac{h \ln 2}{V_o}$ (**C**) $\frac{2h}{V_o}$ (**D**) None of these



$F \propto V$

Pseudo Force

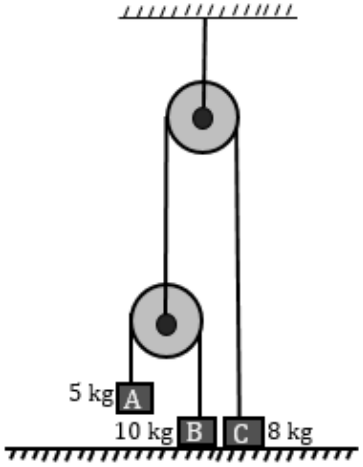
Q.8 A block is sliding along incline as shown in figure.If the acceleration of chamber is **a** as shown in figure. The time required to cover a distance **L** along incline is



(**A**) $\sqrt{\frac{2L}{g\sin\theta - a\cos\theta}}$ (**B**) $\sqrt{\frac{2L}{g\sin\theta + a\sin\theta}}$ (**C**) $\sqrt{\frac{2L}{g\sin\theta - a\cos\theta}}$ (**D**) $\sqrt{\frac{2L}{g\sin\theta}}$

Pulley

Q.9 In the following arrangement the system is initially at rest. The **5 kg** block is now released. Assuming the pulleys and string to be massless and smooth, the acceleration of blocks are

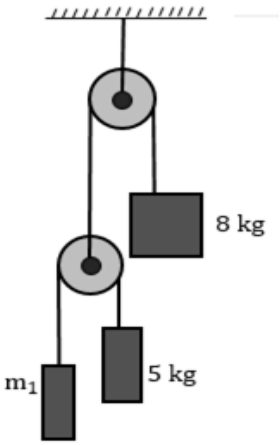


(**A**)$a_A = \frac{g}{7}\ m/s^2$ (**B**)$a_B = 0\ m/s^2$

(**C**)$a_C = \frac{g}{7}\ m/s^2$ (**D**)$2a_c = a_A$

Pulley

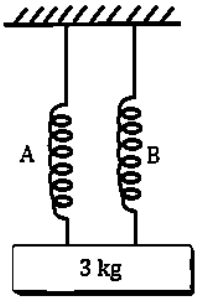
Q.10 At what value of $\mathbf{m_1}$ will **8 kg** mass be at rest_____.



WORKSHEET

Spring Force

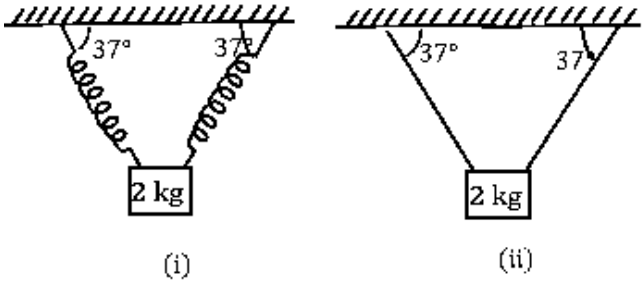
Q.1 Block of **3 kg** is initially in equilibrium and is hanging by two identical springs **A** and **B** as shown in figure. If spring**A** is cut from lower point at $\mathbf{t = 0}$ then, find acceleration of block in$\mathbf{ms^{-1}}$ at $\mathbf{t = 0}$



(A) 5 **(B)**10 **(C)** 15 **(D)**0

Spring Force

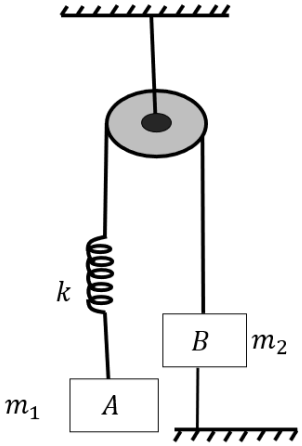
Q.2 The blocks are of mass **2 kg** shown, is in equilibrium. At $\mathbf{t = 0}$ right spring in figure(I) and right string in figure(ii) breaks. Find the ratio of instantaneous acceleration of blocks in fig(I) and fig(ii) (Take $\mathbf{g = 10\ m/s^2}$)



(A)$\frac{24}{25}$ **(B)** $\frac{24}{27}$ **(C)** $\frac{30}{27}$ **(D)** $\frac{25}{24}$

Pseudo Force

Q.3 In the system shown in figure $\mathbf{m_1 > m_2}$. System is held at rest by thread**BC**. Just after the thread cut



(A) Acceleration of$\mathbf{m_2}$ will be upwards.

(B) Magnitude of acceleration of both blocks will be equal to$\left(\frac{\mathbf{m_1 - m_2}}{\mathbf{m_1 + m_2}}\right)\mathbf{g}$

(C) Acceleration of $\mathbf{m_1}$ will be equal to **zero**

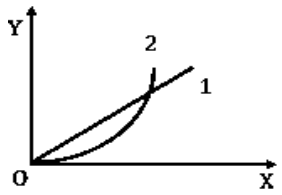
(D) Magnitude of acceleration of two blocks will be $\mathbf{non-zero}$ and **unequal.**

(A) Only statement (A) is correct **(B)** Only statement (B) is correct

(C) Only statement (C) is correct **(D)** Both statements (A) and (C) are correct

Horizontal Force

Q.4 A particle is resting on a smooth horizontal floor. At $\mathbf{t = 0}$, a horizontal force starts acting on it. Magnitude of the force increases with time according to law $\mathbf{F = at}$ where **a** is constant. For the figure shown which of the following statement is wrong?

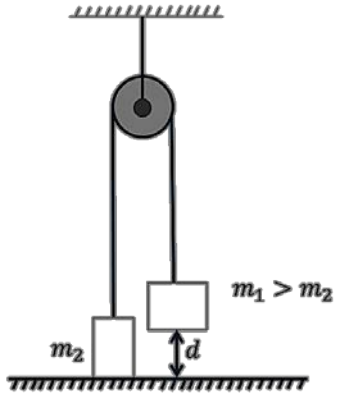


(A) Curve 1 shows acceleration against time **(B)** Curve 2 shows velocity against time

(C) Curve 2 shows velocity against acceleration **(D)** Curve 1 shows acceleration against velocity

Pseudo Force

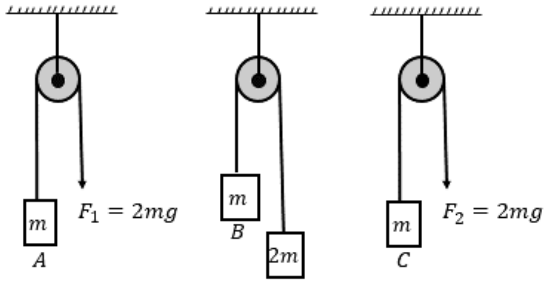
Q.5 If masses are released from the position shown in the figure, then time elapsed before mass $\mathbf{m_1}$ collides with the floor will be



(A) $\sqrt{\frac{2m_1gd}{m_1+m_2}}$ **(B)** $\sqrt{\frac{2(m_1+m_2)d}{(m_1-m_2)g}}$ **(C)** $\sqrt{\frac{2(m_1-m_2)d}{(m_1+m_2)g}}$ **(D)** None of these

Pseudo Force

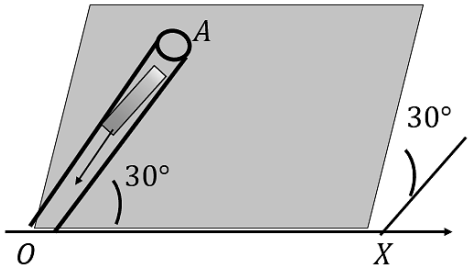
Q.6 In the figure, the blocks A, B and C of mass m each have acceleration a_1, a_2 and a_3 respectively. F_1 And F_2 are external forces of magnitudes 2mg each. What is the relation between the acceleration of the masses A, B andC?



(**A**) $a_1 = a_2 = a_3$ (**B**)$a_1 > a_2 > a_3$ (**C**)$a_1 = a_3 > a_2$ (**D**)$a_1 > a_2 = a_3$

Pseudo Force

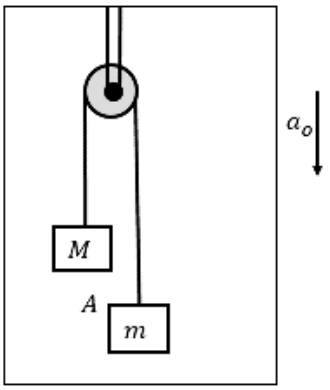
Q.7 An incline plane makes an angle **30°** with the horizontal. A groove **OA = 5 m** cut in the plane makes an angle **30°** with **OX**. a short smooth cylinder is free to slide down the influence of gravity, Find the time taken by the cylinder to reach from **A** to **O**.



(**A**) 1 s (**B**) 2 s (**C**) 3 s (**D**) 4 s

Pseudo Force

Q.8 If the acceleration if the elevator is $a_o = g$, then



(**A**)The acceleration of the masses will be a_o

(**B**)The acceleration of the masses will be $(a_o + g)$

(**C**)The tension in the string will be $\frac{Mm}{M+m}(g + a_o)$

(**D**)Tension in the string will be zero

Instantaneous Force and Impulse

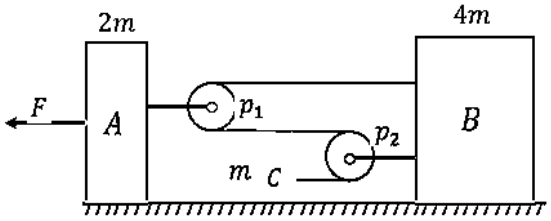
Q.9 A body of mass $m = 5$ kg is thrown at an angle $\theta = 30°$ to the horizontal with the initial velocity $v_o = 20$ m/s. Assume the air drag to be negligible, find the magnitude of momentum increment Δp during the total time of motion.

(**A**) 0 kg m/s (**B**) 50 kg m/s (**C**) 100 kg m/s (**D**)10 kg m/s

Constrained Motion

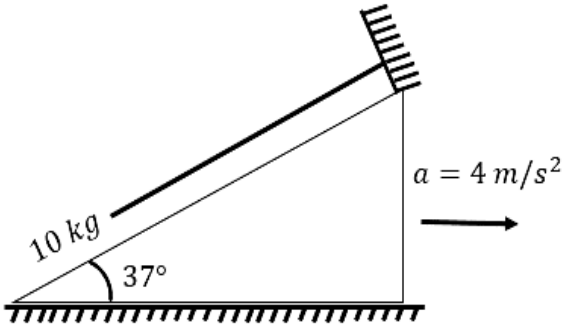
Q.10 In the figure shown, find the acceleration of the block B. Assume all surface to be smooth.

(**A**) a $= \frac{3F}{20m}$ m/s^2 (**B**) a $= \frac{3F}{21m}$ m/s^2 (**C**) a $= \frac{2F}{21m}$ m/s^2 (**D**) a $= \frac{3F}{18m}$ m/s^2



Pseudo Force

Q.11 A body of mass **10 kg** is placed on a smooth inclined plane as shown in figure. The inclined plane is moved with a horizontal acceleration**a**. The normal rection between the block and incline plane is

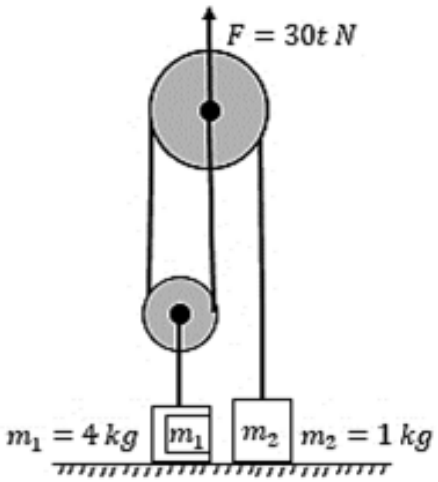


(A)92 N **(B)**44 N

(C)56 N **(D)** cannot be determined

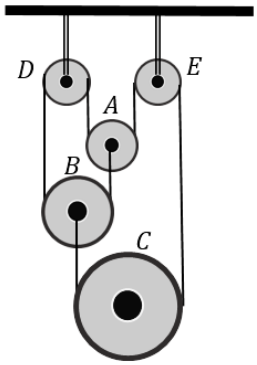
Pulley

Q.12 Force **F** is applied on upper pulley. If **F = 30t** where **t** is time in seconds. Find the time in seconds. Find the time when $\mathbf{m_1}$ losses contact with floor_____.



Pulley

Q.13 IF the pulley system in figure the movable pulleys **A**, **B** and **C** are of mass **1 kg** each. **D** And **E** are fixed pulleys. The strings are light and inextensible. Choose the correct alternative(s). All pulleys are frictionless.



(A) Tension in the string 6.5 N.
(B) Acceleration of pulley A is g/3 Downwards.
(C) Acceleration of pulley B is g/6 Upwards.
(D) Acceleration of pulley C is g/3 Upwards.

ANSWER KEY

Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(B)	(B)	(C)	(A)	(A)	(D)	(A)	(C)	(A),(B),(C),(D)	
WORK SHEET										
Q.	1	2	3	4	5	6	7	8	9	10
Sol.	(A)	(D)	(D)	(D)	(B)	(C)	(B)	(D)	(C)	(B)
Q.	11	12	13							
Sol.	(C)		(A) (B) (D)							