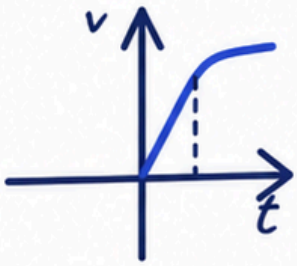
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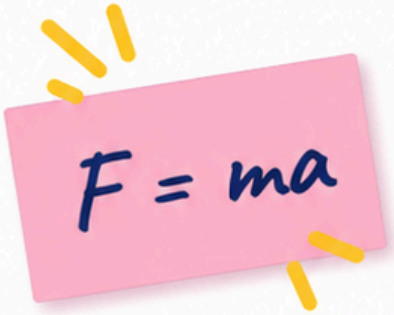
PHYSICS

FORMULAS
CONCEPTS
QUESTIONS
HIGHER GOALS



JEE Main Physics

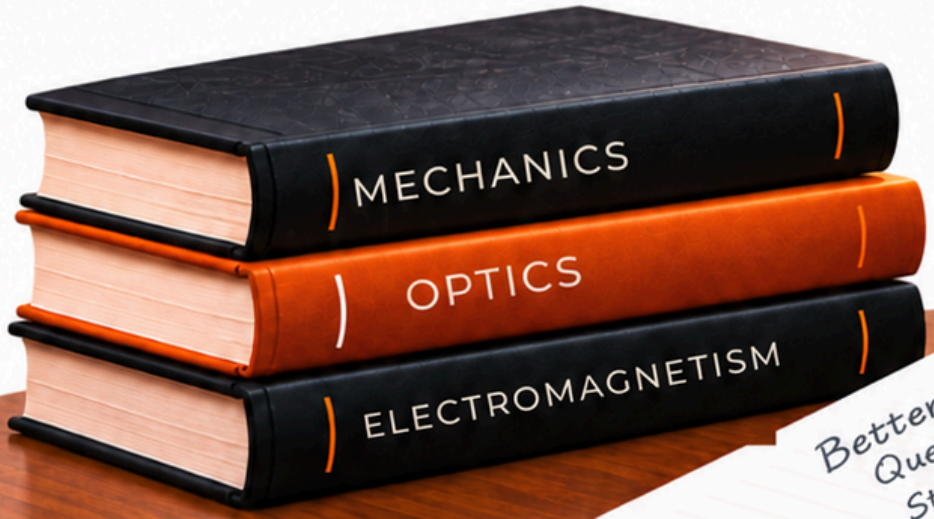
Force, inertia and Newton's laws of motion PYQ







$v = u + at$







Force, inertia and Newton's laws of motion JEE Main PYQ

Previous Year Questions - Topic-wise Collection

Subject: Physics **Years: 2026-2002** **Total Questions: 92**

About this PYQ collection

What is inside

A complete topic-wise set of **92 previous year questions** on **Force, inertia and Newton's laws of motion** from **JEE Main (2026-2013)** and its predecessor **AIEEE (2012-2002)**, across **18 exam years**. **70 questions** are from 2019 onwards, so most of the set reflects the recent NTA pattern.

Questions are arranged to reduce unused page space, with newest-first priority and continuous numbering from 1. Each carries an exam date and shift tag to trace the original paper.

Topic-wise questions

TOPIC	QS	%
Force, inertia and Newton's laws of motion	**92**	100%

Question types

TYPE	QS	%
Single-correct MCQ	**82**	89%
Numerical value	**10**	11%

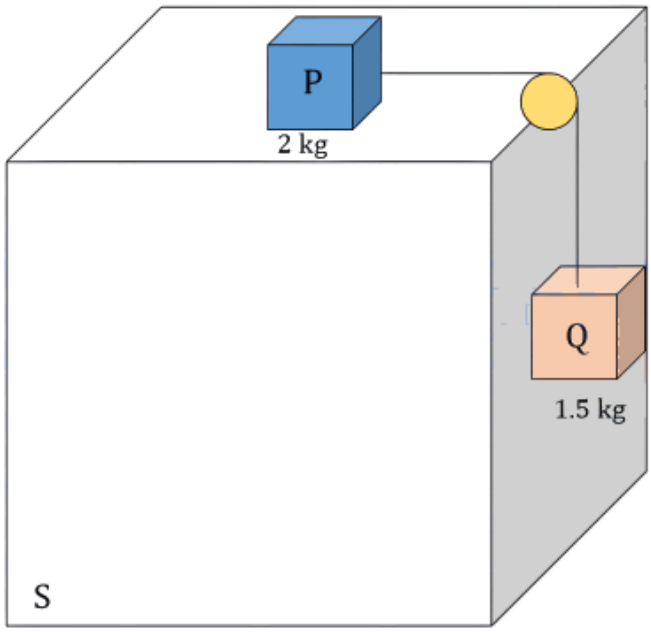
Numerical-value questions have no options; all 10 are from 2021 onwards.

How these questions help you

- **Know where the marks are:** force, inertia and newton's laws of motion make up **92 of 92 questions (about 100%)**.
- **Build speed and accuracy:** practice the concepts and question styles used in previous papers.
- **Learn the patterns:** the same question styles return year after year.
- **Strengthen other chapters:** these concepts support further study in Physics.

Questions – Force, inertia and Newton's laws of motion

1. Two blocks (P and Q) with respectively masses 2 kg and 1.5 kg are joined by a massless thread. These blocks are mounted on a frictionless pully which is fixed on the edge of a cube (S), as shown in the figure below. Block P is positioned on the top surface which has no friction and block Q is in contact with side-surface, having coefficient friction μ. The cube (S) moves towards the right with acceleration of $\frac{g}{2}$, where g is gravitational acceleration. During this movement the block P and Q remain stationary. The value of μ is ____ (take $g = 10\ m/s^2$)



(6 Apr 2026 | Shift 1)

(A) 0.33

(B) 0.67

(C) 1

(D) 0.5

---

2. At $t = 0$, a body of mass 100 g starts moving under the influence of a force $(5\hat{i} + 10\hat{j})$N. After 2 s its position is $(2x\hat{i} + 5y\hat{j})$m. The ratio $x : y$ is ____ . (4 Apr 2026 | Shift 2)

(A) 1 : 2

(B) 2 : 5

(C) 5 : 2

(D) 5 : 4

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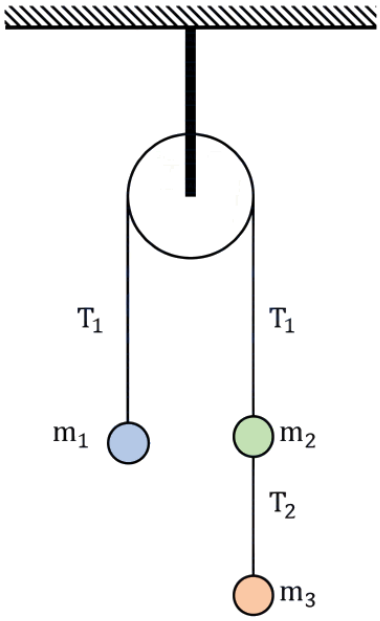
3. A force on an object of mass 100 g is $\left(10\hat{i} + 5\hat{j}\right)$ N. The position of that object at t = 2 s is $\left(a\hat{i} + b\hat{j}\right)$ m after starting from rest. The value of $\frac{a}{b}$ will be _____.

(25 Jun 2022 | Shift 1)

4. Three masses $m_1 = 4$ kg, $m_2 = 4$ kg and $m_3 = 6$ kg are suspended from a fixed smooth frictionless pully as shown in the figure below. The value of T_1/T_2 is

____

(take $g = 10\ \text{m/s}^2$)



(5 Apr 2026 | Shift 1)

(A) 5/3

(B) 2/3

(C) 3/5

(D) 2/5

---

5. A block of mass 5 kg is moving on an inclined plane which makes an angle of 30° with the horizontal. Friction coefficient between the block and inclined plane surface is $\frac{\sqrt{3}}{2}$. The force to be applied on the block so that the block will move down without acceleration is ____ N.
$\left(g = 10\ \text{m/s}^2\right)$.

(28 Jan 2026 | Shift 1)

(A) 25

(B) 12.5

(C) 15

(D) 7.5

---

6. A 4 kg mass moves under the influence of a force $\vec{F} = \left(4t^3\hat{i} - 3t\hat{j}\right)$ N where t is the time in second. If mass starts from origin at $t = 0$, the velocity and position after $t = 2$ s will be:

(21 Jan 2026 | Shift 1)

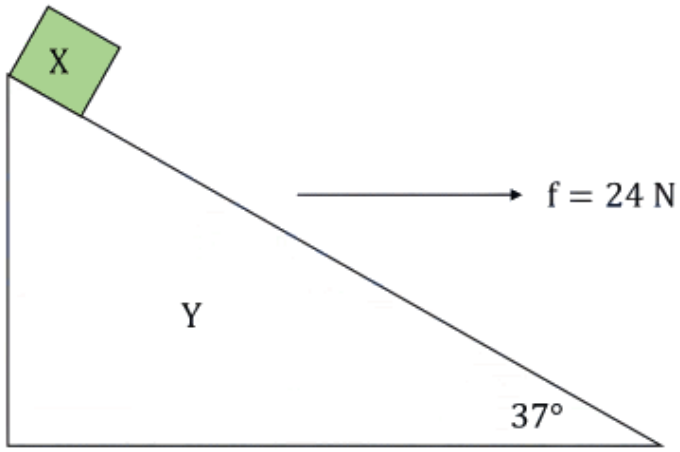
(A) $\vec{v} = 3\hat{i} + \frac{3}{2}\hat{j} \quad \vec{r} = \frac{6}{5}\hat{i} + \hat{j}$

(B) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j} \quad \vec{r} = \frac{6}{5}\hat{i} - \hat{j}$

(C) $\vec{v} = 4\hat{i} - \frac{3}{2}\hat{j} \quad \vec{r} = \frac{8}{5}\hat{i} - \hat{j}$

(D) $\vec{v} = 4\hat{i} + \frac{5}{2}\hat{j} \quad \vec{r} = \frac{8}{5}\hat{i} + 2\hat{j}$

7. A wedge Y with mass of 10 kg and all frictionless surfaces and the inclined surface making 37° with horizontal. A block X with mass 2 kg is placed at the highest point of the wedge as shown in figure is at rest. At $t = 0$ wedge (Y) is pulled toward right with constant force (f) of 24 N . Taking the block X at rest at $t = 0$, the time taken by it to slide down 8.8 m on the slope, while Y is on the move, is ____ s.
(take $\tan(37^\circ) = 3/4$ and $g = 10\ \text{m/s}^2$)



(5 Apr 2026 | Shift 1)

(A) 2
(B) 4
(C) $\sqrt{2}$
(D) $2\sqrt{2}$

---

8. A block is sliding down on an inclined plane of slope θ and at an instant $t = 0$ this block is given an upward momentum so that it starts moving up on the inclined surface with velocity u. The distance (S) travelled by the block before its velocity become zero, is ____ .
(g = gravitational acceleration)

(23 Jan 2026 | Shift 2)

(A) $\frac{2u^2}{g\cos\theta}$
(B) $\frac{u^2}{\sqrt{2}g\cos\theta}$
(C) $\frac{u^2}{2g\sin\theta}$
(D) $\frac{u^2}{2g\cos\theta}$

---

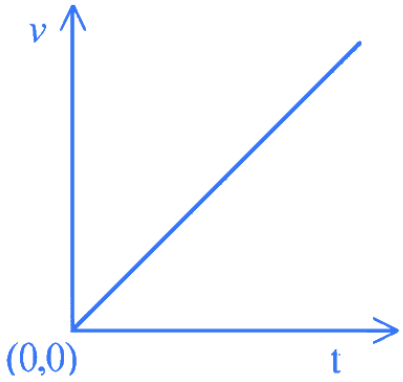
9. A body of mass 2 kg moving with velocity of $\vec{v}_{in} = 3\hat{i} + 4\hat{j}\ \text{ms}^{-1}$ enters into a constant force field of 6N directed along positive z-axis. If the body remains in the field for a period of $\frac{5}{3}$ seconds, then velocity of the body when it emerges from force field is.

(8 Apr 2025 | Shift 2)

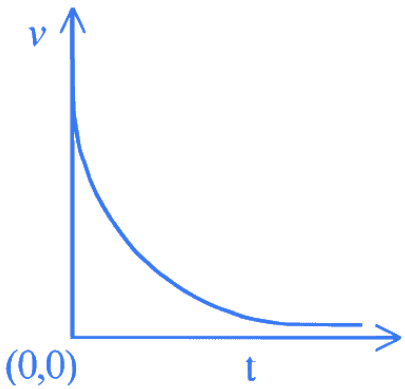
(A) $3\hat{i} + 4\hat{j} + \sqrt{5}\hat{k}$
(B) $4\hat{i} + 3\hat{j} + 5\hat{k}$
(C) $3\hat{i} + 4\hat{j} - 5\hat{k}$
(D) $3\hat{i} + 4\hat{j} + 5\hat{k}$

10. A particle of mass m falls from rest through a resistive medium having resistive force, $F = -kv$, where v is the velocity of the particle and k is a constant. Which of the following graphs represents velocity (v) versus time (t) ? (28 Jan 2026 | Shift 1)

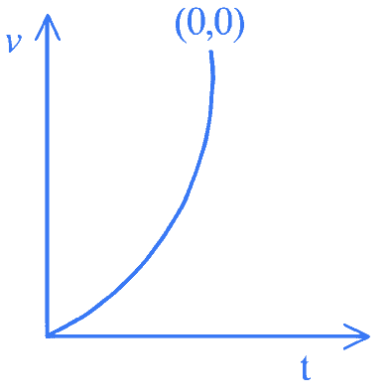
(A)



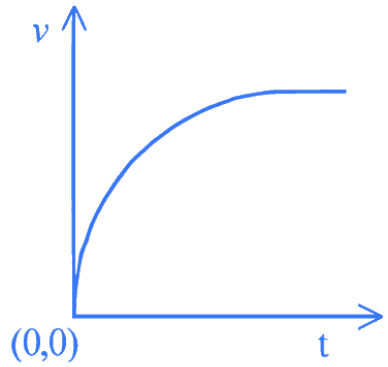
(B)



(C)



(D)



---

11. A cubic block of mass m is sliding down on an inclined plane at 60° with an acceleration of $\frac{g}{2}$, the value of coefficient of kinetic friction is (7 Apr 2025 | Shift 1)

(A) $\frac{\sqrt{3}}{2}$

(B) $\frac{\sqrt{2}}{3}$

(C) $1 - \frac{\sqrt{3}}{2}$

(D) $\sqrt{3} - 1$

---

12. An object with mass 500 g moves along x-axis with speed $v = 4\sqrt{x}$ m/s. The force acting on the object is : (7 Apr 2025 | Shift 2)

(A) 8 N

(B) 4 N

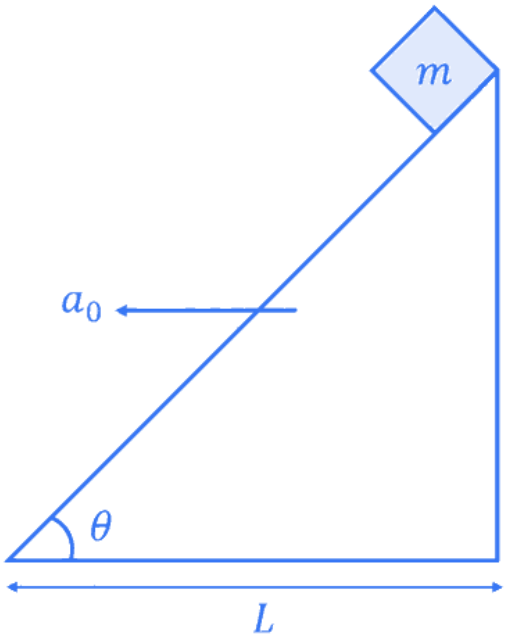
(C) 5 N

(D) 6 N

---

13. A car is moving on a plane inclined at 30° to the horizontal with an acceleration of 10 ms^{-2} parallel to the plane upward. A bob is suspended by a string from the roof of the car. The angle in degrees which the string makes with the vertical is _____. (Take $g = 10\ ms^{-2}$) (31 Aug 2021 | Shift 1)

14. A small block of mass **m** slides down from the top of a frictionless inclined surface, while the inclined plane is moving towards left with constant acceleration a_0. The angle between the inclined plane and ground is θ and its base length is L. Assuming that initially the small block is at the top of the inclined plane, the time it takes to reach the lowest point of the inclined plane is _____.



(28 Jan 2026 | Shift 2)

(A) $\sqrt{\frac{2L}{g\sin\theta - a_0\cos\theta}}$

(B) $\sqrt{\frac{4L}{g\sin 2\theta - a_0(1+\cos 2\theta)}}$

(C) $\sqrt{\frac{2L}{g\sin 2\theta - a_0(1+\cos 2\theta)}}$

(D) $\sqrt{\frac{4L}{g\cos^2\theta - a_0\sin\theta\cos\theta}}$

---

15. A balloon and its content having mass M is moving up with an acceleration 'a'. The mass that must be released from the content so that the balloon starts moving up with an acceleration '3a' will be
(Take 'g' as acceleration due to gravity)

(28 Jan 2025 | Shift 2)

(A) $\frac{3Ma}{2a+g}$

(B) $\frac{2Ma}{3a+g}$

(C) $\frac{3Ma}{2a-g}$

(D) $\frac{2Ma}{3a-g}$

---

16. A player caught a cricket ball of mass 150 g moving at a speed of 20 m/s. If the catching process is completed in 0.1 s, the magnitude of force exerted by the ball on the hand of the player is:

(8 Apr 2024 | Shift 1)

(A) 150 N

(B) 3 N

(C) 30 N

(D) 300 N

17. A light unstretchable string passing over a smooth light pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $\frac{g}{8}$, then the ratio of the masses $\frac{m_2}{m_1}$ is : (9 Apr 2024 | Shift 1)

(A) 5 : 3

(B) 8 : 1

(C) 9 : 7

(D) 4 : 3

---

18. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (where $m_2 > m_1$). If the acceleration of the system is $\frac{g}{\sqrt{2}}$, then the ratio of the masses $\frac{m_1}{m_2}$ is: (6 Apr 2024 | Shift 1)

(A) $\frac{1+\sqrt{5}}{\sqrt{5}-1}$

(B) $\frac{\sqrt{3}+1}{\sqrt{2}-1}$

(C) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$

(D) $\frac{1+\sqrt{5}}{\sqrt{2}-1}$

---

19. A wooden block of mass 5 kg rests on a soft horizontal floor. When an iron cylinder of mass 25 kg is placed on the top of the block, the floor yields and the block and the cylinder together go down with an acceleration of $0.1\ \mathrm{ms}^{-2}$. The action force of the system on the floor is equal to : (5 Apr 2024 | Shift 1)

(A) 297 N

(B) 291 N

(C) 196 N

(D) 294 N

---

20. A particle moves in x-y plane under the influence of a force $\vec{F}$ such that its linear momentum is $\overrightarrow{\mathrm{p}}(\mathrm{t}) = \hat{i}\cos(\mathrm{kt}) - \hat{j}\sin(\mathrm{kt})$. If k is constant, the angle between $\overrightarrow{\mathrm{F}}$ and $\overrightarrow{\mathrm{p}}$ will be : (5 Apr 2024 | Shift 2)

(A) $\frac{\pi}{2}$

(B) $\frac{\pi}{3}$

(C) $\frac{\pi}{4}$

(D) $\frac{\pi}{6}$

---

21. A 2 kg brick begins to slide over a surface which is inclined at an angle of 45° with respect to horizontal axis. The co-efficient of static friction between their surfaces is: (4 Apr 2024 | Shift 2)

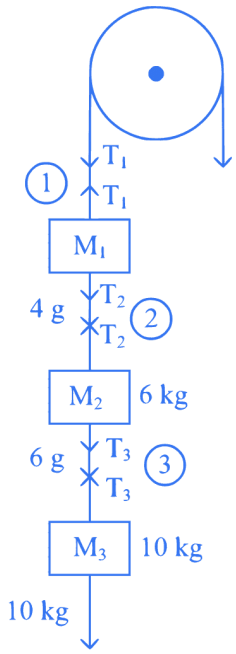
(A) 1

(B) 1.7

(C) 0.5

(D) $\frac{1}{\sqrt{3}}$

22. Three blocks M_1, M_2, M_3 having masses 4 kg, 6 kg and 10 kg respectively are hanging from a smooth pully using rope 1, 2 and 3 as shown in figure. The tension in the rope 1, T_1 when they are moving upward with acceleration of 2 ms^{-2} is _____ N (if $g = 10\ m/s^2$).



(5 Apr 2024 | Shift 1)

---

23. A body of mass 4 kg experiences two forces $\vec{F}_1 = 5\hat{i} + 8\hat{j} + 7\hat{k}$ and $\overrightarrow{F}_2 = 3\hat{i} - 4\hat{j} - 3\hat{k}$. The acceleration acting on the body is : (1 Feb 2024 | Shift 2)

(A) $2\hat{i} + \hat{j} + \hat{k}$

(B) $4\hat{i} + 2\hat{j} + 2\hat{k}$

(C) $-2\hat{i} - \hat{j} - \hat{k}$

(D) $2\hat{i} + 3\hat{j} + 3\hat{k}$

---

24. A cricket player catches a ball of mass 120 g moving with 25 m/s speed. If the catching process is completed in 0.1 s then the magnitude of force exerted by the ball on the hand of player will be (in SI unit) : (1 Feb 2024 | Shift 2)

(A) 30

(B) 24

(C) 12

(D) 25

---

25. The position vector of a particle related to time t is given by $\vec{r} = \left(10t\hat{i} + 15t^2\hat{j} + 7\hat{k}\right) m$

The direction of net force experienced by the particle is : (15 Apr 2023 | Shift 1)

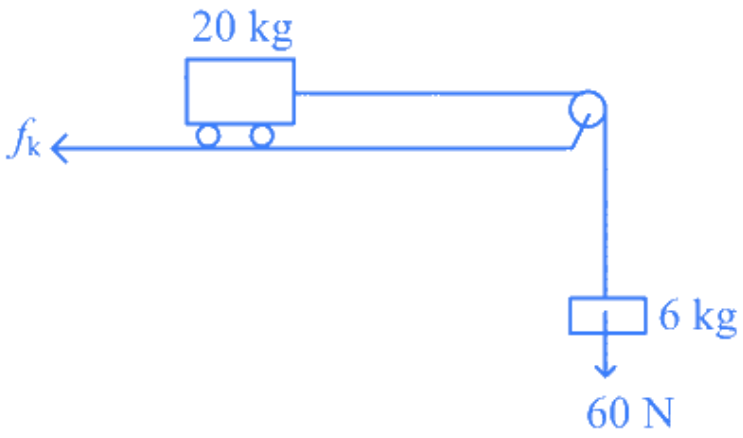
(A) Positive x - axis

(B) Positive y - axis

(C) Positive z - axis

(D) In x - y plane

26. Consider a block and trolley system as shown in figure. If the coefficient of kinetic friction between the trolley and the surface is 0.04 , the acceleration of the system in ms^{-2} is :
(Consider that the string is massless and unstretchable and the pulley is also massless and frictionless) :

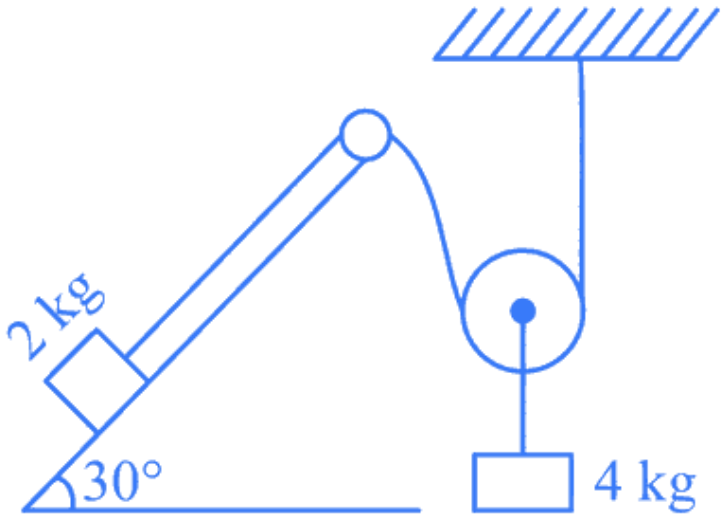


(1 Feb 2024 | Shift 1)

(A) 1.2
(B) 4
(C) 3
(D) 2

---

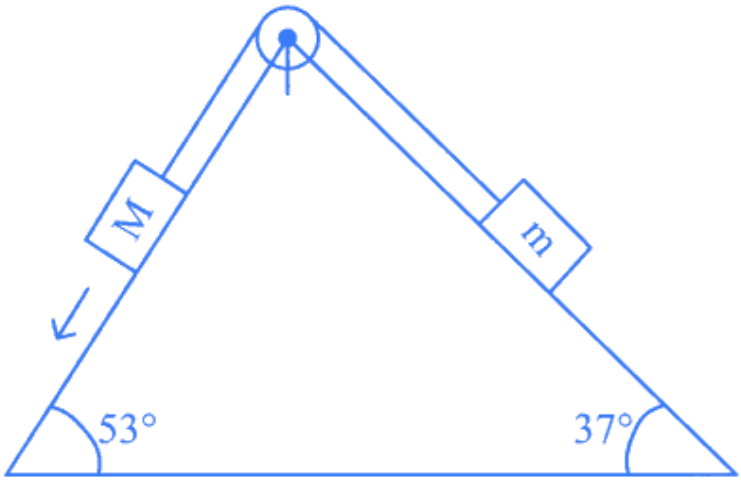
27. All surfaces shown in figure are assumed to be frictionless and the pulleys and the string are light. The acceleration of the block of mass 2 kg is :



(30 Jan 2024 | Shift 1)

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

28. In the given arrangement of a doubly inclined plane two blocks of masses M and m are placed. The blocks are connected by a light string passing over an ideal pulley as shown. The coefficient of friction between the surface of the plane and the blocks is 0.25. The value of m, for which $M = 10$ kg will move down with an acceleration of $2\ \text{m/s}^2$, is: (take $g = 10\ \text{m/s}^2$ and $\tan 37^\circ = 3/4$)



(31 Jan 2024 | Shift 1)

(A) 4.5 kg

(B) 6.5 kg

(C) 9 kg

(D) 2.25 kg

---

29. Three blocks A, B and C are pulled on a horizontal smooth surface by a force of 80 N as shown in figure



The tensions T_1 and T_2 in the string are respectively : (30 Jan 2024 | Shift 2)

(A) 40N, 64N

(B) 60N, 80N

(C) 80N, 100N

(D) 88N, 96N

---

30. A body of mass 500 g moves along x-axis such that it's velocity varies with displacement x according to the relation $v = 10\sqrt{x}\ \text{m/s}$ the force acting on the body is:-

(11 Apr 2023 | Shift 2)

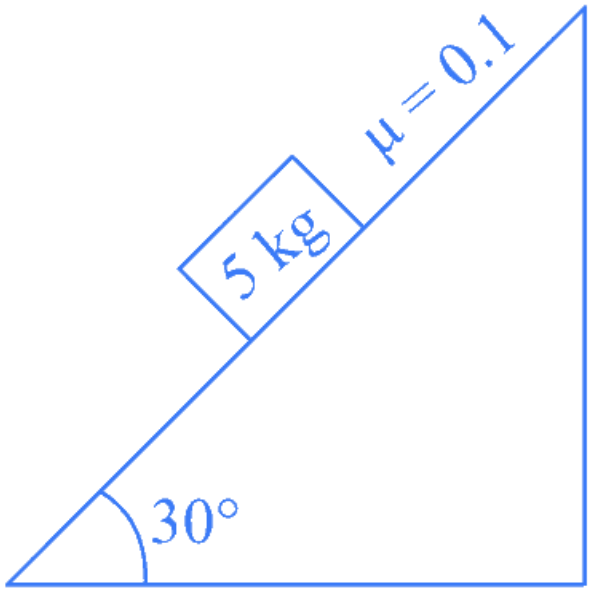
(A) 166 N

(B) 5 N

(C) 25 N

(D) 125 N

31.



A block of mass 5 kg is placed on a rough inclined surface as shown in the figure. If $\overrightarrow{F_1}$ is the force required to just move the block up the inclined plane and $\overrightarrow{F_2}$ is the force required to just prevent the block from sliding down, then the value of $\left|\overrightarrow{F_1}\right| - \left|\overrightarrow{F_2}\right|$ is : [Use $g = 10\ \text{m/s}^2$]

(31 Jan 2024 | Shift 2)

(A) $5\sqrt{3}N$

(B) $\frac{5\sqrt{3}}{2}N$

(C) 10 N

(D) $25\sqrt{3}N$

---

32. At any instant the velocity of a particle of mass 500 g is $\left(2t\hat{i} + 3t^2\hat{j}\right)\ \text{ms}^{-1}$. If the force acting on the particle at $t = 1$ s is $(\hat{i} + x\hat{j})$N. Then the value of x will be:

(8 Apr 2023 | Shift 1)

(A) 2

(B) 4

(C) 6

(D) 3

---

33. A force acts for 20 s on a body of mass 20 kg, starting from rest, after which the force ceases and then body describes 50 m in the next 10 s. The value of force will be:

(29 Jan 2023 | Shift 2)

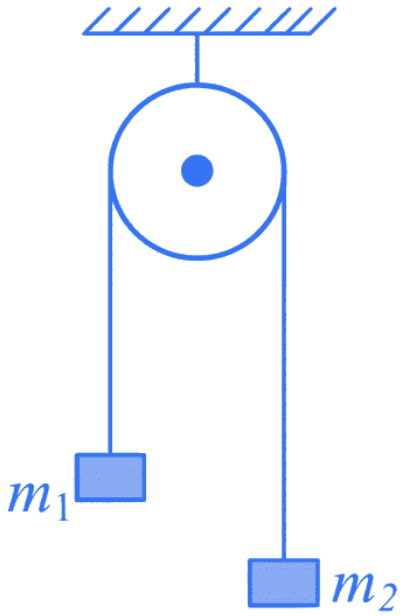
(A) 40 N

(B) 20 N

(C) 5 N

(D) 10 N

34. A light string passing over a smooth light fixed pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $g/8$, then the ratio of masses is:



(31 Jan 2024 | Shift 2)

(A) $\frac{8}{1}$

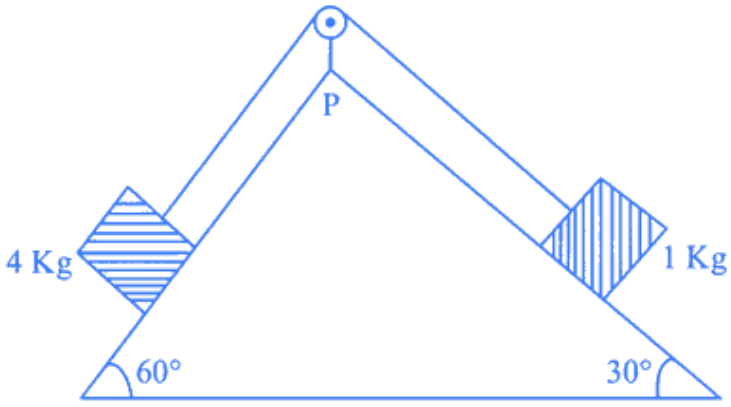
(B) $\frac{9}{7}$

(C) $\frac{5}{3}$

(D) $\frac{4}{3}$

---

35. As per given figure, a weightless pulley P is attached on a double inclined frictionless surfaces. The tension in the string (massless) will be (if g = 10 m/s^2)



(24 Jan 2023 | Shift 1)

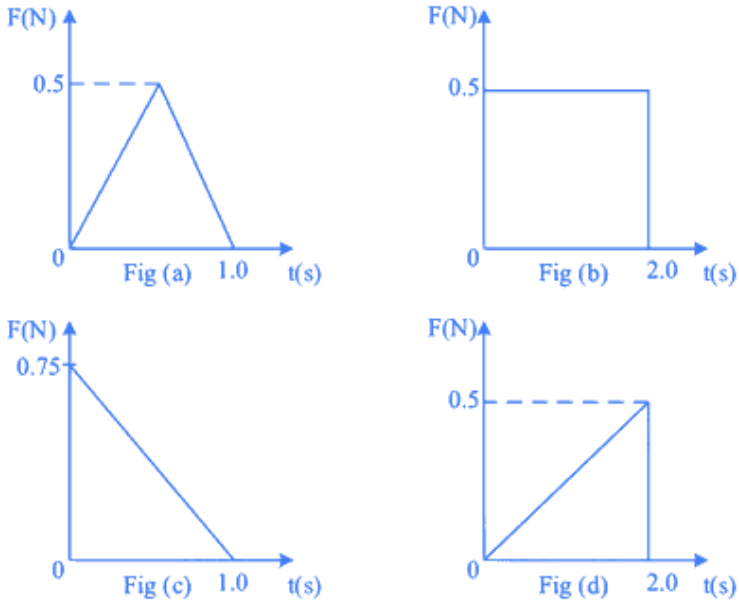
(A) $\left(4\sqrt{3}-1\right) N$

(B) $\left(4\sqrt{3}+1\right) N$

(C) $4\left(\sqrt{3}-1\right) N$

(D) $4\left(\sqrt{3}+1\right) N$

36. Figures (a), (b), (c) and (d) show variation of force with time.



The impulse is highest in figure. (1 Feb 2023 | Shift 2)

(A) Fig (c)

(B) Fig (d)

(C) Fig (a)

(D) Fig (b)

---

37. Given below are two statements :
Statement I : An elevator can go up or down with uniform speed when its weight is balanced with the tension of its cable.
Statement II : Force exerted by the floor of an elevator on the foot of a person standing on it is more than his/her weight when the elevator goes down with increasing speed.
In the light of the above statements, choose the correct answer from the options given below : (24 Jan 2023 | Shift 1)

(A) Both Statement I and Statement II are false

(B) Both Statement I and Statement II are true

(C) Statement I is false but Statement II is true

(D) Statement I is true but Statement II is false

---

38. A balloon has mass of 10 g in air. The air escapes from the balloon at a uniform rate with velocity 4.5 cm/s. If the balloon shrinks in 5 s completely. Then, the average force acting on that balloon will be (in dyne). (28 Jul 2022 | Shift 1)

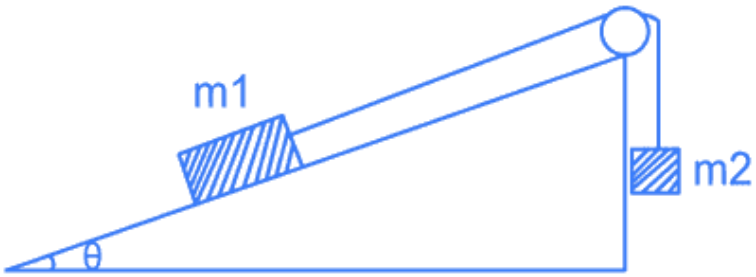
(A) 3

(B) 9

(C) 12

(D) 18

39. Two bodies of masses $m_1 = 5$ kg and $m_2 = 3$ kg are connected by a light string going over a smooth light pulley on a smooth inclined plane as shown in the figure. The system is at rest. The force exerted by the inclined plane on the body of mass m_1 will be : [Take $g = 10\ ms^{-2}$]



(29 Jul 2022 | Shift 2)

(A) 30 N

(B) 40 N

(C) 50 N

(D) 60 N

---

40. A pressure-pump has a horizontal tube of cross sectional area $10\ cm^2$ for the outflow of water at a speed of $20\ m/s$. The force exerted on the vertical wall just in front of the tube which stops water horizontally flowing out of the tube, is :
[given: density of water $= 1000\ kg/m^3$]

(28 Jul 2022 | Shift 2)

(A) 300 N

(B) 500 N

(C) 250 N

(D) 400 N

---

41. A block of mass M slides down on a rough inclined plane with constant velocity. The angle made by the incline plane with horizontal is θ. The magnitude of the contact force will be :

(27 Jul 2022 | Shift 2)

(A) Mg

(B) $Mg\cos\theta$

(C) $\sqrt{Mg\sin\theta + Mg\cos\theta}$

(D) $Mg\sin\theta\sqrt{1+\mu}$

---

42. A block 'A' takes 2 s to slide down a frictionless incline of 30° and length 'l', kept inside a lift going up with uniform velocity 'v'. If the incline is changed to 45°, the time taken by the block, to slide down the incline, will be approximately :

(27 Jul 2022 | Shift 2)

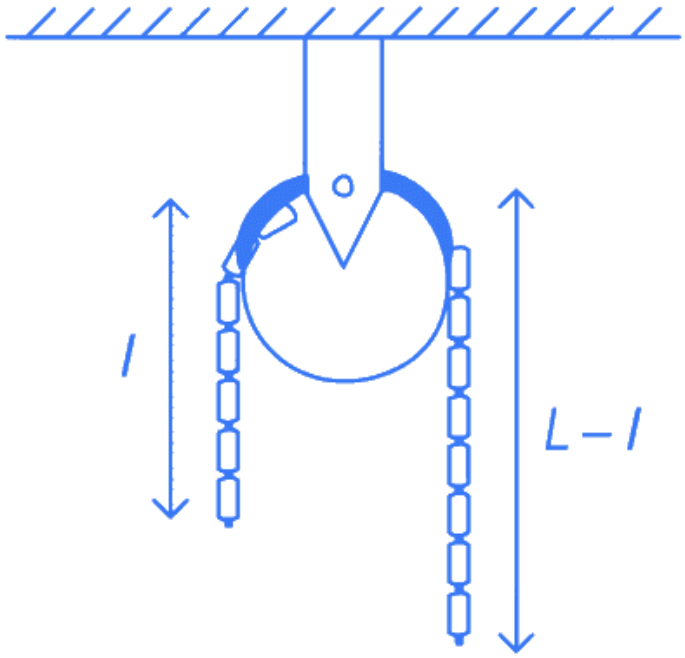
(A) 2.66 s

(B) 0.83 s

(C) 1.68 s

(D) 0.70 s

43. A uniform metal chain of mass m and length 'L' passes over a massless and frictionless pulley. It is released from rest with a part of its length 'l' is hanging on one side and rest of its length 'L $-$ l' is hanging on the other side of the pully. At a certain point of time, when $l = \frac{L}{x}$, the acceleration of the chain is $\frac{g}{2}$. The value of x is _____.



(28 Jul 2022 | Shift 2)

(A) 6

(B) 2

(C) 1.5

(D) 4

---

44. A monkey of mass 50 kg climbs on a rope which can withstand the tension (T) of 350 N. If monkey initially climbs down with an acceleration of 4 m/s^2 and then climbs up with an acceleration of 5 m/s^2. Choose the correct option $(g = 10\ m/s^2)$. (26 Jul 2022 | Shift 1)

(A) $T = 700$ N while climbing upward

(B) $T = 350$ N while going downward

(C) Rope will break while climbing upward

(D) Rope will break while going downward

---

45. A block of mass M placed inside a box descends vertically with acceleration 'a'. The block exerts a force equal to one-fourth of its weight on the floor of the box. The value of 'a' will be (29 Jun 2022 | Shift 2)

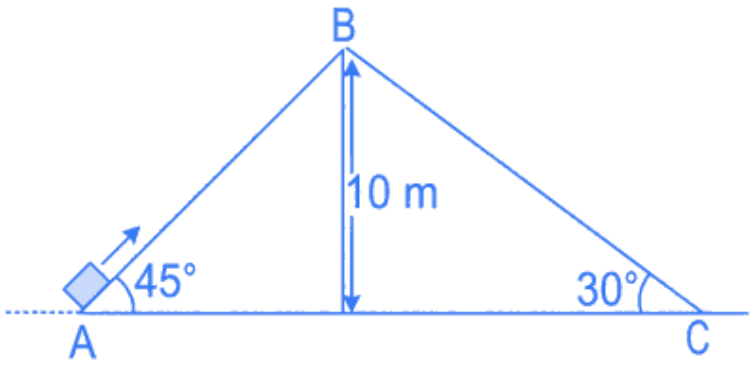
(A) $\frac{g}{4}$

(B) $\frac{g}{2}$

(C) $\frac{3g}{4}$

(D) g

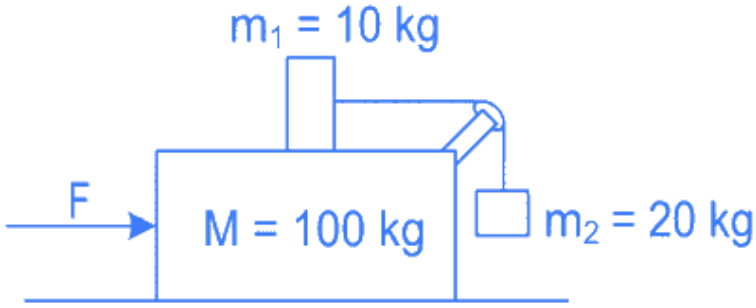
46. Two inclined planes are placed as shown in figure. A block is projected from the Point A of inclined plane AB along its surface with a velocity just sufficient to carry it to the top Point B at a height 10 m. After reaching the Point B the block slides down on inclined plane BC. Time it takes to reach to the point C from point A is $t(\sqrt{2}+1)$ s. The value of t is _____.
(use $g = 10\ m/s^2$)



(27 Jul 2022 | Shift 2)

---

47. Three masses $M = 100$ kg, $m_1 = 10$ kg and $m_2 = 20$ kg are arranged in a system as shown in figure. All the surfaces are frictionless and strings are inextensible and weightless. The pulleys are also weightless and frictionless. A force F is applied on the system so that the mass m_2 moves upward with an acceleration of 2 ms^{-2}. The value of F is :
(Take $g = 10\ ms^{-2}$)



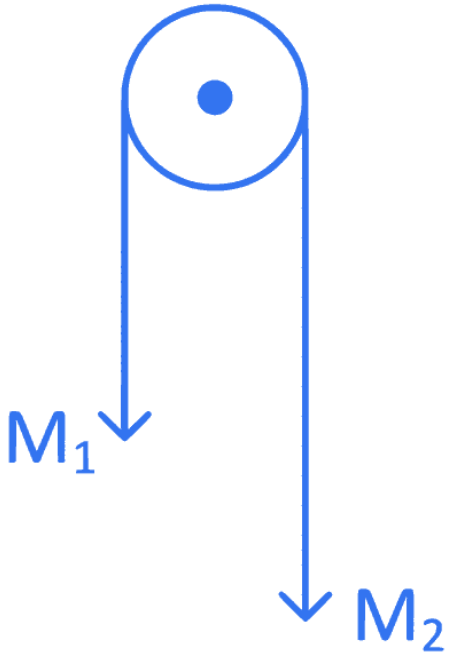
(26 Jul 2022 | Shift 1)

(A) 3360 N
(B) 3380 N
(C) 3120 N
(D) 3240 N

---

48. A body of mass 2 kg moves under a force of $\left(2\hat{i}+3\hat{j}+5\hat{k}\right)$N. It starts from rest and was at the origin initially. After 4s, its new coordinates are (8, b, 20). The value of b is _____. (Round off to the Nearest Integer) (16 Mar 2021 | Shift 2)

49. Two masses M_1 and M_2 are tied together at the two ends of a light inextensible string that passes over a frictionless pulley. When the mass M_2 is twice that of M_1, the acceleration of the system is a_1. When the mass M_2 is thrice that of M_1, the acceleration of the system is a_2. The ratio $\frac{a_1}{a_2}$ will be :



(26 Jul 2022 | Shift 2)

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

---

50. A person is standing in an elevator. In which situation, he experiences weight loss?

(26 Jun 2022 | Shift 1)

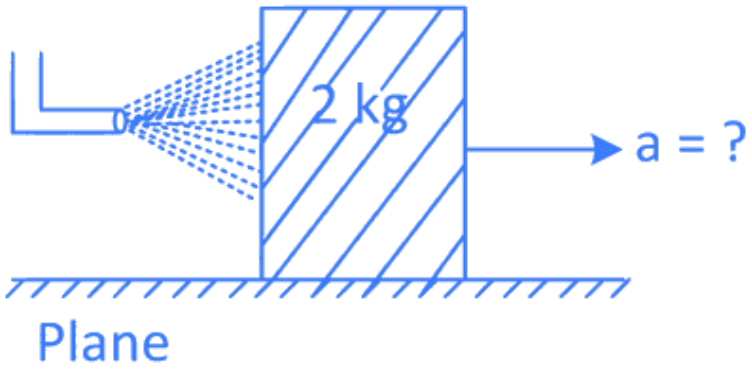
(A) When the elevator moves upward with constant acceleration
(B) When the elevator moves downward with constant acceleration
(C) When the elevator moves upward with uniform velocity
(D) When the elevator moves downward with uniform velocity

---

51. An object of mass 5 kg is thrown vertically upwards from the ground. The air resistance produces a constant retarding force of 10 N throughout the motion. The ratio of time of ascent to the time of descent will be equal to : [Use g $=$ 10 ms^{-2}]. (24 Jun 2022 | Shift 2)

(A) 1 : 1
(B) $\sqrt{2} : \sqrt{3}$
(C) $\sqrt{3} : \sqrt{2}$
(D) 2 : 3

52. A block of metal weighing 2 kg is resting on a frictionless plane (as shown in figure). It is struck by a jet releasing water at a rate of 1 kgs^{-1} and at a speed of 10 ms^{-1}. Then, the initial acceleration of the block, in ms^{-2}, will be :



(29 Jun 2022 | Shift 1)

(A) 3

(B) 6

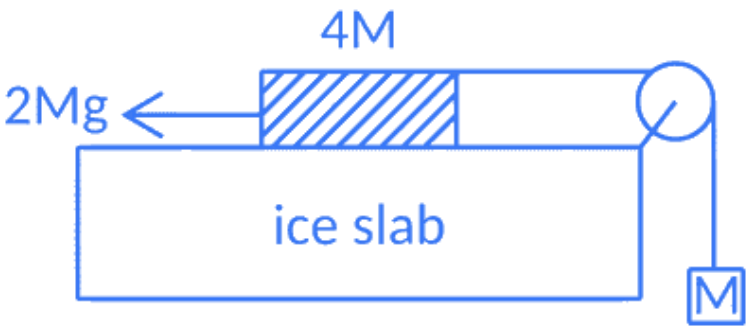
(C) 5

(D) 4

---

53. A hanging mass M is connected to a four times bigger mass by using a string-pulley arrangement, as shown in the figure. The bigger mass is placed on a horizontal ice-slab and being pulled by 2 Mg force. In this situation, tension in the string is $\frac{x}{5}$ Mg for x = _____. Neglect mass of the string and friction of the block (bigger mass) with ice slab.

(Given g = acceleration due to gravity)



(28 Jun 2022 | Shift 1)

---

54. A force $\vec{F} = (40\hat{i} + 10\hat{j})N$ acts on a body of mass 5 kg. If the body starts from rest, its position vector $\vec{r}$ at time t = 10 s, will be :

(25 Jul 2021 | Shift 2)

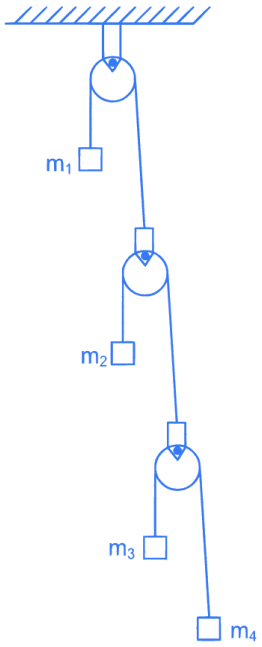
(A) $(100\hat{i} + 400\hat{j})m$

(B) $(100\hat{i} + 100\hat{j})m$

(C) $(400\hat{i} + 100\hat{j})m$

(D) $(400\hat{i} + 400\hat{j})m$

55. In the arrangement shown in figure a_1, a_2, a_3 and a_4 are the accelerations of masses m_1, m_2, m_3 and m_4 respectively. Which of the following relation is true for this arrangement?



(26 Jun 2022 | Shift 2)

(A) $4a_1 + 2a_2 + a_3 + a_4 = 0$

(B) $a_1 + 4a_2 + 3a_3 + a_4 = 0$

(C) $a_1 + 4a_2 + 3a_3 + 2a_4 = 0$

(D) $2a_1 + 2a_2 + 3a_3 + a_4 = 0$

---

56. The initial mass of a rocket is 1000 kg. Calculate at what rate the fuel should be burnt so that the rocket is given an acceleration of 20 ms^{-2}. The gases come out at a relative speed of 500 ms^{-1} with respect to the rocket : [Use $g = 10\ m/s^2$] (26 Aug 2021 | Shift 1)

(A) $6.0 \times 10^2\ kg\ s^{-1}$

(B) $500\ kg\ s^{-1}$

(C) $10\ kg\ s^{-1}$

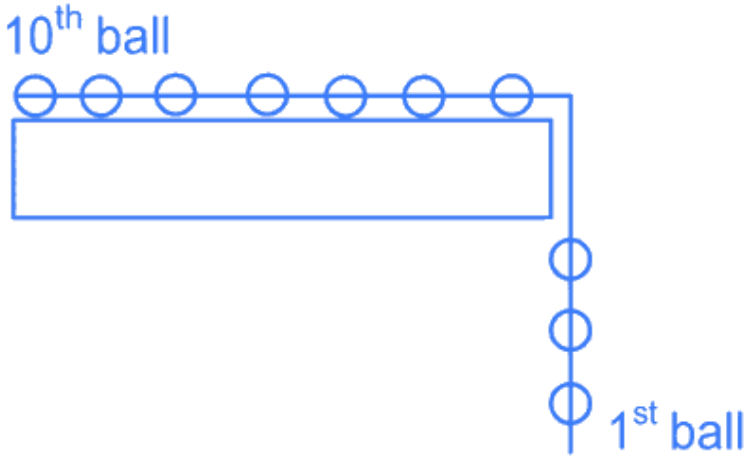
(D) $60\ kg\ s^{-1}$

---

57. A bullet of mass 0.1 kg is fired on a wooden block to pierce through it, but it stops after moving a distance of 50 cm into it. If the velocity of bullet before hitting the wood is 10 m/s and it slows down with uniform deceleration, then the magnitude of effective retarding force on the bullet is 'x' N. The value of 'x' to the nearest integer is _____.

(18 Mar 2021 | Shift 1)

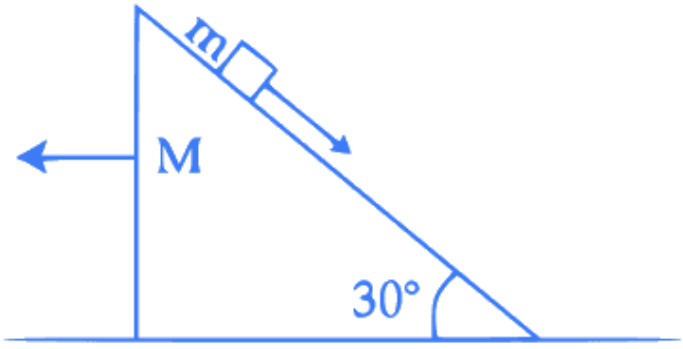
58. A system to 10 balls each of mass 2 kg are connected via massless and unstretchable string. The system is allowed to slip over the edge of a smooth table as shown in figure. Tension on the string between the 7^{th} and 8^{th} ball is _____ N when 6^{th} ball just leaves the table.



(26 Jun 2022 | Shift 2)

---

59. A block of mass m slides on the wooden wedge, which in turn slides backward on the horizontal surface. The acceleration of the block with respect to the wedge is : Given m = 8 kg, M = 16 kg Assume all the surfaces shown in the figure to be frictionless.



(1 Sept 2021 | Shift 2)

(A) $\frac{4}{3}g$

(B) $\frac{6}{5}g$

(C) $\frac{3}{5}g$

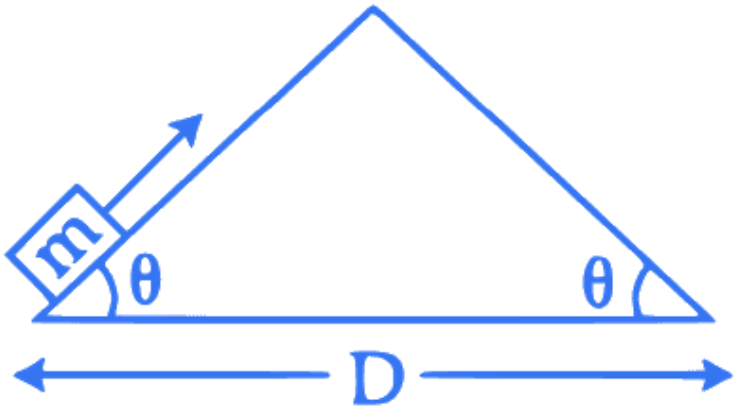
(D) $\frac{2}{3}g$

---

60. A person standing on a spring balance inside a stationary lift measures 60 kg. The weight of that person if the lift descends with uniform downward acceleration of 1.8 m/s^2 will be _____ N. [g = 10 m/s^2]

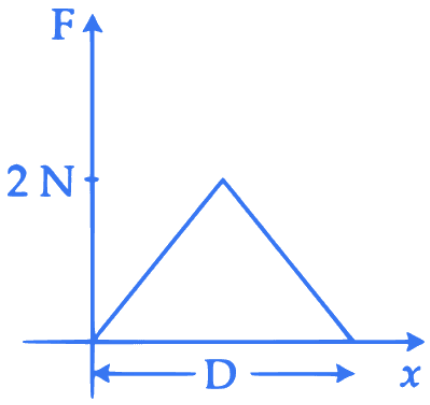
(26 Feb 2021 | Shift 1)

61. An object of mass 'm' is being moved with a constant velocity under the action of an applied force of 2N along a frictionless surface with following surface profile.

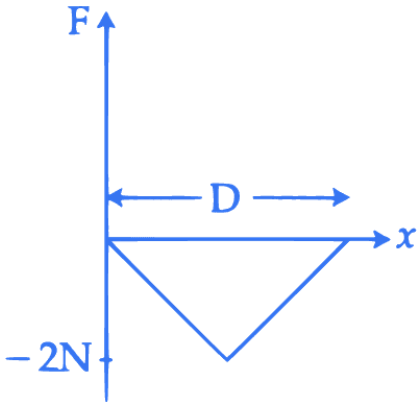


The correct applied force vs distance graph will be : (1 Sept 2021 | Shift 2)

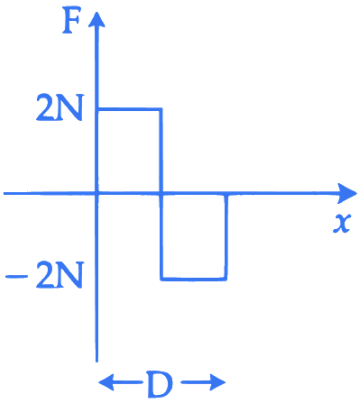
(A)



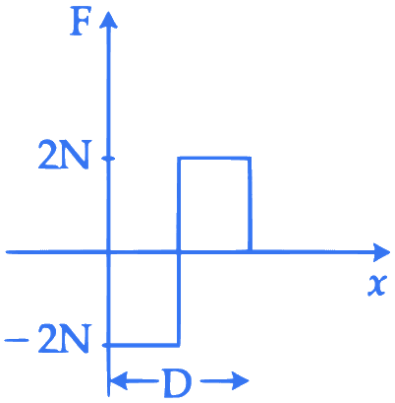
(B)



(C)

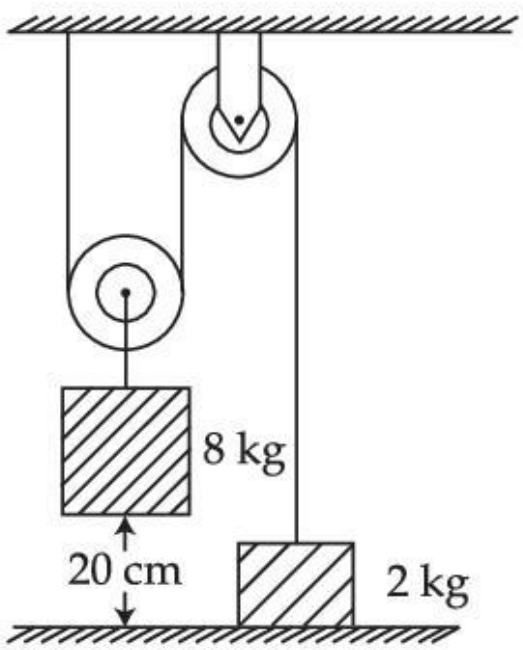


(D)



62. A boy pushes a box of mass 2 kg with a force $\vec{F} = (20\hat{i} + 10\hat{j})\ N$ on a frictionless surface. If the box was initially at rest, then _____ m is displacement along the x-axis after 10s. (26 Feb 2021 | Shift 1)

63. The boxes of masse 2 kg and 8 kg are connected by a massless string passing over smooth pulleys. Calculate the time taken by box of mass 8 kg to strike the ground starting from rest. (use g = 10 m/s^2)



(27 Aug 2021 | Shift 2)

(A) 0.34 s

(B) 0.2 s

(C) 0.25 s

(D) 0.4 s

---

64. A particle of mass M originally at rest is subjected to a force whose direction is constant but magnitude varies with time according to the relation

$$F = F_0\left[1 - \left(\frac{t-T}{T}\right)^2\right]$$

Where F_0 and T are constants. The force acts only for the time interval 2T. The velocity v of the particle after time 2T is :

(27 Jul 2021 | Shift 2)

(A) $2F_0T/M$

(B) $F_0T/2M$

(C) $4F_0T/3M$

(D) $F_0T/3M$

---

65. A body of mass 5 kg under the action of constant force F= Fx$\hat{}$i + Fy$\hat{}$j has velocity at t = 0 s as →v = (6$\hat{}$i −2$\hat{}$jm/s)→v = +6$\hat{}$jm/s→ and at t = 10 s as . The force is:F

(11 Apr 2014 | Single slot)

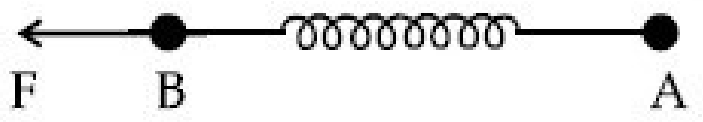
(A) (−3$\hat{}$i + 4$\hat{}$j)N

(B) (−(3)/(5)$\hat{}$i +(4)/(5)$\hat{}$j)N

(C) (3$\hat{}$i −4$\hat{}$j)N

(D) ((3)/(5)$\hat{}$i −(4)/(5)$\hat{}$j)N

66. Two masses A and B, each of mass M are fixed together by a massless spring. A force acts on the mass B as shown in the figure. If the mass A starts moving away from mass B with acceleration 'a', then the acceleration of mass B will be :



(26 Feb 2021 | Shift 2)

(A) $\frac{MF}{F+Ma}$

(B) $\frac{F+Ma}{M}$

(C) $\frac{Ma-F}{M}$

(D) $\frac{F-Ma}{M}$

---

67. A particle moving in the xy plane experiences a velocity dependent force $\overrightarrow{F}=k\left(v_y\hat{i}+v_x\hat{j}\right)$, where v_x and v_y are the x and y components of its velocity $\overrightarrow{v}$. If $\overrightarrow{a}$ is the acceleration of the particle, then which of the following statements is true for the particle? (6 Sept 2020 | Shift 2)

(A) kinetic energy of particle is constant in time

(B) quantity $\overrightarrow{v}\times\overrightarrow{a}$ is constant in time

(C) quantity $\overrightarrow{v}.\overrightarrow{a}$ is constant in time

(D) $\overrightarrow{F}$ arises due to a magnetic field

---

68. A spaceship in space sweeps stationary interplanetary dust. As a result, its mass increases at a rate $\frac{dM(t)}{dt}=bv^2(t)$, where v(t) is its instantaneous velocity. The instantaneous acceleration of the satellite is : (5 Sept 2020 | Shift 2)

(A) $-bv^3(t)$

(B) $-\frac{2bv^3}{M(t)}$

(C) $-\frac{bv^3}{M(t)}$

(D) $-\frac{bv^3}{2M(t)}$

---

69. A small ball of mass m is thrown upward with velocity u from the ground. The ball experiences a resistive force mkv^2 where v is its speed. The maximum height attained by the ball is : (4 Sept 2020 | Shift 2)

(A) $\frac{1}{k}\tan^{-1}\frac{ku^2}{2g}$

(B) $\frac{1}{2k}\tan^{-1}\frac{ku^2}{g}$

(C) $\frac{1}{2k}\ln\left(1+\frac{ku^2}{g}\right)$

(D) $\frac{1}{k}\ln\left(1+\frac{ku^2}{2g}\right)$

70. A ball is thrown upward with an initial velocity V_0 from the surface of the earth. The motion of the ball is affected by a drag force equal to $m\gamma u^2$ (where m is mass of the ball, u is its instantaneous velocity and γ is a constant). Time taken by the ball to rise to its zenith is : (10 Apr 2019 | Shift 1)

(A) $\frac{1}{\sqrt{\gamma g}}\tan^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

(B) $\frac{1}{\sqrt{\gamma g}}ln\left(1+\sqrt{\frac{\gamma}{g}}V_0\right)$

(C) $\frac{1}{\sqrt{\gamma g}}\sin^{-1}\left(\sqrt{\frac{\gamma}{g}}V_0\right)$

(D) $\frac{1}{\sqrt{2\gamma g}}\tan^{-1}\left(\sqrt{\frac{2\gamma}{g}}V_0\right)$

---

71. A liquid of density ρ is coming out of a hose pipe of radius a with horizontal speed v and hits a mesh. 50% of the liquid passes through the mesh unaffected. 25% looses all of its momentum and 25% comes back with the same speed. The resultant pressure on the mesh will be : (11 Jan 2019 | Shift 1)

(A) $\frac{3}{4}\rho v^2$

(B) $\frac{1}{4}\rho v^2$

(C) $\frac{1}{2}\rho v^2$

(D) ρv^2

---

72. A particle of mass m is acted upon by a force F given by the empirical law $F = \frac{R}{t^2}v(t)$. If this law is to be tested experimentally by observing the motion starting from rest, the best way is to plot : (10 Apr 2016 | Shift 1)

(A) v(t) against t^2

(B) log v(t) against $\frac{1}{t^2}$

(C) log v(t) against t

(D) log v(t) against $\frac{1}{t}$

---

73. Water is flowing at a speed of 1.5 m s-1 through a horizontal tube of cross-sectional area 10-2 m2 and you are trying to stop the flow by your palm. Assuming that the water stops immediately after hitting the palm, the minimum force that you must exert should be (density of water = 103 kg m-3) (9 Apr 2014 | Single slot)

(A) 33.7 N

(B) 45 N

(C) 15 N

(D) 22.5 N

---

74. A satellite moving with velocity in a force free space collects stationary interplanetary dust at a rate ofv (dM)/(dt)= αv where M is the mass (of satellite + dust) at that instant. The instantaneous acceleration of the satellite is (26 May 2012 | Single slot)

(A) −(αv2)/(2M2)

(B) −(αv2)/(M)

(C) −αv

(D) −(2αv2)/(M)

75. Two blocks of mass M1 = 20 kg and M2 = 12 kg are connected by a metal rod of mass 8 kg. The system is pulled vertically up by applying a force of 480 N as shown. The tension at the mid-point of the rod is:



(22 Apr 2013 | Single slot)

(A) 144 N

(B) 96 N

(C) 240 N

(D) 192 N

---

76. This question has Statement 1 and Statement 2 . Of the four choices given after the Statements, choose the one that best describes the two Statements. Statement 1: If you push on a cart being pulled by a horse so that it does not move, the cart pushes you back with an equal and opposite force. Statement 2: The cart does not move because the force described in statement 1 cancel each other (26 May 2012 | Single slot)

(A) Statement 1 is true, Statement 2 is true, Statement

(B) Statement 1 is false, Statement 2 is true. 2 is the correct explanation of Statement 1

(C) Statement 1 is true, Statement 2 is false

(D) Statement 1 is true, Statement 2 is true, Statement → 2 is not the correct explanation of Statement 1

77. Sand is being dropped on a conveyer belt at the rate of 2 kg per second. The force necessary to keep the belt moving with a constant speed of 3 ms − 1 will be

(19 May 2012 | Single slot)

(A) 12 N

(B) 6 N

(C) zero

(D) 18 N

---

78. An engine pumps water continuously through a hose. Water leaves the hose with velocity and vm is mass per unit length of the water jet. If this jet hits a surface and came to rest instantaneously, the force on the surface is (7 May 2012 | Single slot)

(A) mv3

(B) mv2 (1)/(2)(1)/(2)→

(C) mv2

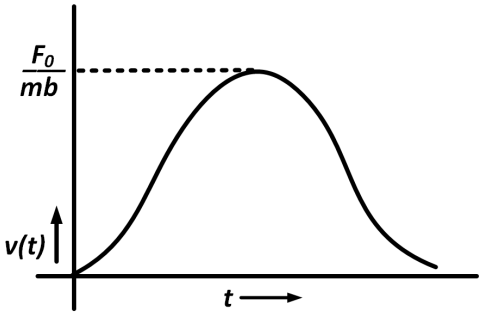
(D) mv3

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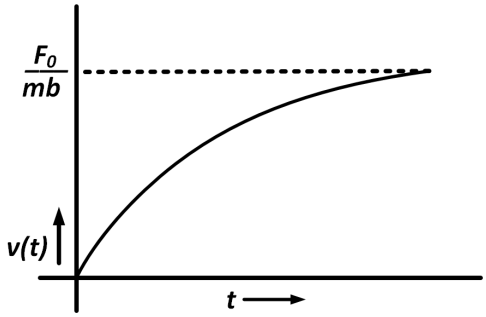
79. A particle of mass m is at rest at the origin at time $t = 0$. It is subjected to a force $F(t) = F_0 e^{-bt}$ in the x direction. Its speed $v(t)$ is depicted by which of the following curves?

(29 Apr 2012 | Single sitting)

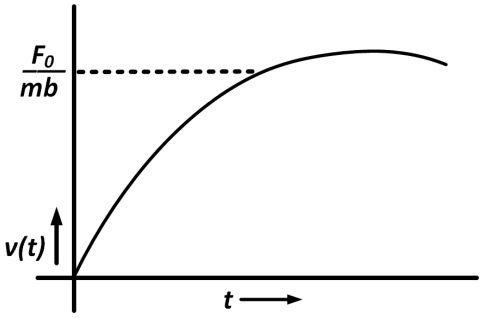
(A)



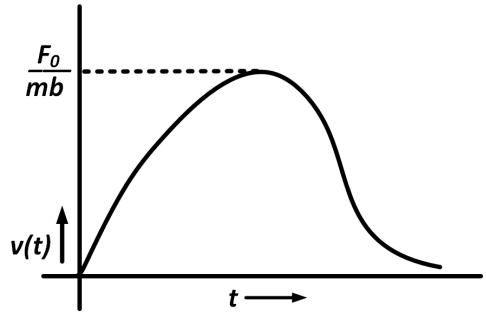
(B)



(C)



(D)



---

80. A rocket with a lift-off mass $3.5 \times 10^4\ kg$ is blasted upwards with an initial acceleration of $10 m/s^2$. Then the initial thrust of the blast is

(26 Apr 2003 | Single sitting)

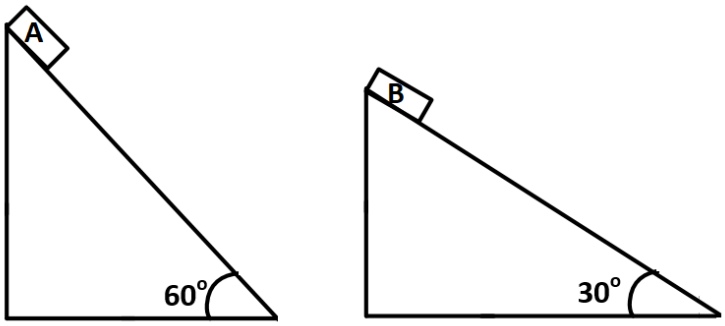
(A) $3.5 \times 10^5 N$

(B) $7.0 \times 10^5 N$

(C) $14.0 \times 10^5 N$

(D) $1.75 \times 10^5 N$

81. Two fixed frictionless inclined planes making an angle 30° and 60° with the vertical are shown in the figure. Two blocks A and B are placed on the two planes. What is the relative vertical acceleration of A with respect to B ?



(25 Apr 2010 | Single sitting)

(A) $4.9ms^{-2}$ in horizontal direction

(B) $9.8ms^{-2}$ in vertical direction

(C) Zero

(D) $4.9ms^{-2}$ in vertical direction

---

82. A block of mass m is connected to another block of $mass\ M$ by a spring (massless) of spring constant k. The block are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is unstretched. Then a constant force F starts acting on the block of mass M to pull it. Find the force of the block of mass m.

(29 Apr 2007 | Single sitting)

(A) $\dfrac{MF}{(m+M)}$

(B) $\dfrac{mF}{M}$

(C) $\dfrac{(M+m)F}{m}$

(D) $\dfrac{mF}{(m+M)}$

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83. A light spring balance hangs from the hook of the other light spring balance and a block of mass $M\ kg$ hangs from the former one. Then the true statement about the scale reading is

(26 Apr 2003 | Single sitting)

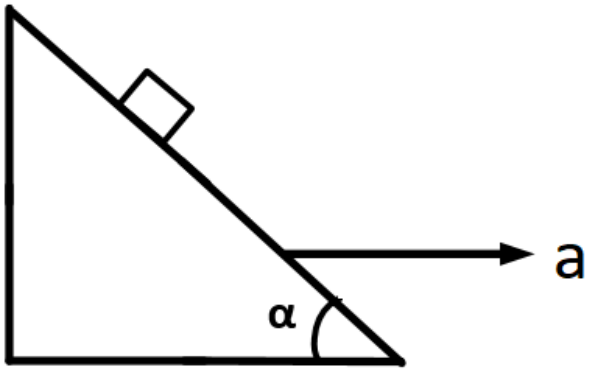
(A) Both the scales read $M\ kg$ each

(B) The scale of the lower one reads $M\ kg$ and of the upper one zero

(C) The reading of the two scales can be anything but the sum of the reading will be $M\ kg$

(D) Both the scales read $M/2\ kg$ each

84. A block is kept on a frictionless inclined surface with angle of inclination $'\alpha'$. The incline is given an acceleration a to keep the block stationary. Then a is equal to



(8 May 2005 | Single sitting)

(A) $g\ cosec\ \alpha$

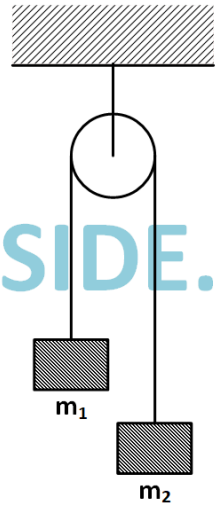
(B) $g/tan\ \alpha$

(C) $g\ tan\ \alpha$

(D) g

---

85. Two masses $m_1 = 5kg$ and $m_2 = 4.8kg$ tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when left free to move? $(g = 9.8m/s^2)$



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(23 May 2004 | Single sitting)

(A) $5\ m/s^2$

(B) $9.8\ m/s^2$

(C) $0.2\ m/s^2$

(D) $4.8\ m/s^2$

86. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of $5m/s^2$, the reading of the spring balance will be

(26 Apr 2003 | Single sitting)

(A) 24 N

(B) 74 N

(C) 15 N

(D) 49 N

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87. A block of mass M is pulled along a horizontal frictionless surface by a rope of mass m. If a force P is applied at the free end of the rope, the force exerted by the rope on the block is

(26 Apr 2003 | Single sitting)

(A) $\frac{Pm}{M+m}$

(B) $\frac{Pm}{M-m}$

(C) P

(D) $\frac{PM}{M+m}$

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88. A solid sphere, a hollow sphere and a ring are released from top of an inclined plane (frictionless) so that they slide down the plane. Then maximum acceleration down the plane is for (no rolling)

(19 May 2002 | Single sitting)

(A) solid sphere

(B) hollow sphere

(C) ring

(D) all same

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89. A lift is moving down with acceleration a. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively

(19 May 2002 | Single sitting)

(A) g, g

(B) $g-a, g-a$

(C) $g-a, g$

(D) a, g

---

90. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is $g/8$, then the ratio of the masses is

(19 May 2002 | Single sitting)

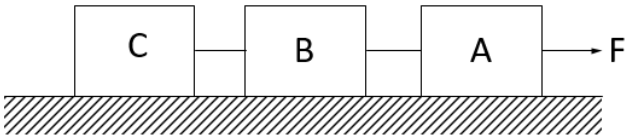
(A) 8 : 1

(B) 9 : 7

(C) 4 : 3

(D) 5 : 3

91. Three identical blocks of masses $m = 2\ kg$ are drawn by a force $F = 10.2\ N$ with an acceleration of $0.6\ ms^{-2}$ on a frictionless surface, then what is the tension (in N) in the string between the blocks B and C?



(19 May 2002 | Single sitting)

(A) 9.2

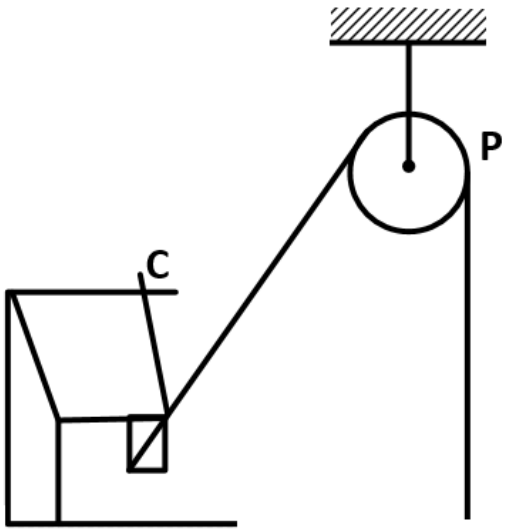
(B) 3.4

(C) 4

(D) 7.8

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92. One end of a mass-less rope, which passes over a mass-less and friction-less pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is 360 N. With what value of maximum safe acceleration (in ms^{-2}) can a man of 60 kg climb on the rope?



(19 May 2002 | Single sitting)

(A) 16

(B) 6

(C) 4

(D) 8