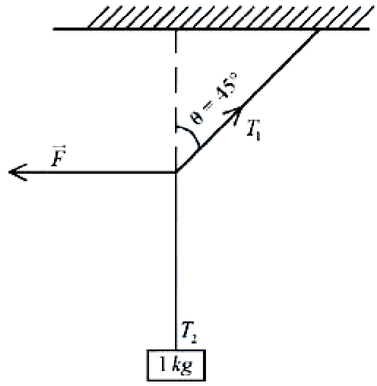
Q1. A 1 kg mass is suspended from the ceiling by a rope of length 4 m. A horizontal force 'F' is applied at the mid point of the rope so that the rope makes an angle of 45° with respect to the vertical axis as shown in figure. The magnitude of F is: (Assume that the system is in equilibrium and $g = 10\ \mathrm{m/s^2}$)



09 Apr 2024 (E)

(1) 10 N
(2) $\frac{10}{\sqrt{2}}$ N
(3) 1 N
(4) $\frac{1}{10\times\sqrt{2}} N$

Q2. 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 : *09 Apr 2024 (M)*

(1) 8 : 1
(2) 5 : 3
(3) 4 : 3
(4) 9 : 7

Q3. A given object takes n times the time to slide down 45° rough inclined plane as it takes the time to slide down an identical perfectly smooth 45° inclined plane. The coefficient of kinetic friction between the object and the surface of inclined plane is : *08 Apr 2024 (E)*

(1) $\sqrt{1-\frac{1}{n^2}}$
(2) $1-n^2$
(3) $1-\frac{1}{n^2}$
(4) $\sqrt{1-n^2}$

Q4. A body of weight 200 N is suspended from a tree branch through a chain of mass 10 kg. The branch pulls the chain by a force equal to (if $g = 10\ \mathrm{m/s^2}$) : *06 Apr 2024 (E)*

(1) 100 N
(2) 200 N
(3) 300 N
(4) 150 N

Q5. A car of 800 kg is taking turn on a banked road of radius 300 m and angle of banking 30°. If coefficient of static friction is 0.2 then the maximum speed with which car can negotiate the turn safely:
$\left(g = 10\ \mathrm{m/s^2}, \sqrt{3} = 1.73\right)$ *06 Apr 2024 (E)*

(1) 264 m/s
(2) 51.4 m/s
(3) 70.4 m/s
(4) 102.8 m/s

Q6. 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: *06 Apr 2024 (M)*

(1) $\frac{1+\sqrt{5}}{\sqrt{5}-1}$
(2) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$
(3) $\frac{1+\sqrt{5}}{\sqrt{2}-1}$
(4) $\frac{\sqrt{3}+1}{\sqrt{2}-1}$

Q7. A heavy box of mass 50 kg is moving on a horizontal surface. If co-efficient of kinetic friction between the box and horizontal surface is 0.3 then force of kinetic friction is : *05 Apr 2024 (E)*

(1) 1.47 N (2) 147 N

(3) 14.7 N (4) 1470 N

Q8. A particle moves in $x-y$ plane under the influence of a force $\vec{F}$ such that its linear momentum is $\overrightarrow{\mathrm{p}}(\mathrm{t})=\hat{\imath}\cos(\mathrm{kt})-\hat{\jmath}\sin(\mathrm{kt})$. If k is constant, the angle between $\overrightarrow{\mathrm{F}}$ and $\overrightarrow{\mathrm{p}}$ will be : ***05 Apr 2024 (E)***

(1) $\frac{\pi}{4}$ (2) $\frac{\pi}{6}$

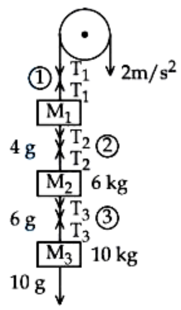
(3) $\frac{\pi}{2}$ (4) $\frac{\pi}{3}$

Q9. 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: ***05 Apr 2024 (M)***

(1) 196 N (2) 291 N

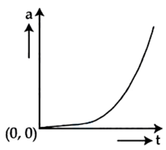
(3) 294 N (4) 297 N

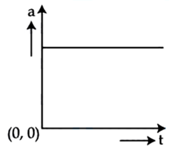
Q10. Three blocks M_1, M_2, M_3 having masses $4\ \mathrm{kg}, 6\ \mathrm{kg}$ and $10\ \mathrm{kg}$ respectively are hanging from a smooth pully using rope 1,2 and 3 as shown in figure. The tension in the rope $1, T_1$ when they are moving upward with acceleration of $2\ \mathrm{ms}^{-2}$ is ______N (if $\mathrm{g}=10\ \mathrm{m/s}^2$).

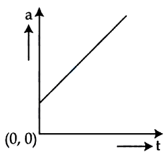


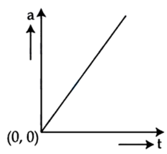
05 Apr 2024 (M)

Q11. A wooden block, initially at rest on the ground, is pushed by a force which increases linearly with time t. Which of the following curve best describes acceleration of the block with time: ***04 Apr 2024 (M)***

(1)


(2)


(3)


(4)


Q12. 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: ***04 Apr 2024 (E)***

(1) 1.7 (2) $\frac{1}{\sqrt{3}}$

(3) 0.5 (4) 1

Q13. A cricket player catches a ball of mass 120 g moving with $25\ \mathrm{m\ s}^{-1}$ 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):

01 Feb 2024 (E)

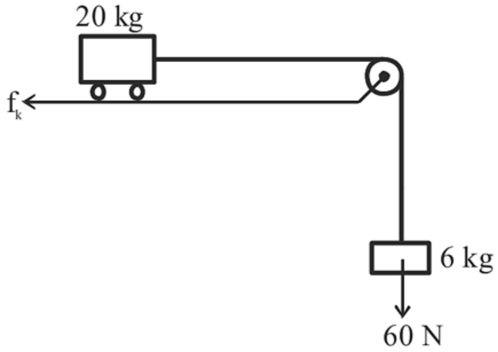
(1) 24 (2) 12

(3) 25 (4) 30

Q14. A body of mass $4\ \text{kg}$ experiences two forces $\overrightarrow{F_1} = 5\hat{i} + 8\hat{j} + 7\widehat{k}$ and $\overrightarrow{F_2} = 3\hat{i} - 4\hat{j} - 3\widehat{k}$. The acceleration acting on the body is: ***01 Feb 2024 (E)***

(1) $-2\hat{i} - \hat{j} - \widehat{k}$
(2) $4\hat{i} + 2\hat{j} + 2\widehat{k}$
(3) $2\hat{i} + \hat{j} + \widehat{k}$
(4) $2\hat{i} + 3\hat{j} + 3\widehat{k}$

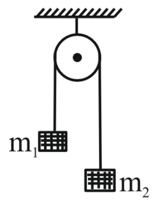
Q15. Consider a block and trolley system as shown in figure. If the coefficient of kinetic friction between the trolley and the surface is 0.04, the acceleration of the system in m s^{-2} is: (Consider that the string is massless and unstretchable and the pulley is also massless and frictionless) :



01 Feb 2024 (M)

(1) 3
(2) 4
(3) 2
(4) 1.2

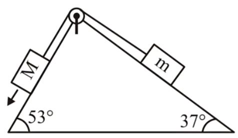
Q16. A light string passing over a smooth light fixed pulley connects two blocks of masses m_1 and m_2. If the acceleration of the system is $\frac{g}{8}$, then the ratio of masses is



31 Jan 2024 (E)

(1) $\frac{9}{7}$
(2) $\frac{8}{1}$
(3) $\frac{4}{3}$
(4) $\frac{5}{3}$

Q17. 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 $M = 10\ \text{kg}$ will move down with an acceleration of $2\ \text{m s}^{-2}$, is: (take $g = 10\ \text{m s}^{-2}$ and $\tan\ 37^\circ = \frac{3}{4}$)



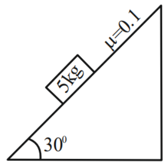
31 Jan 2024 (M)

(1) $9\ \text{kg}$
(2) $4.5\ \text{kg}$
(3) $6.5\ \text{kg}$
(4) $2.25\ \text{kg}$

Q18. A coin is placed on a disc. The coefficient of friction between the coin and the disc is μ. If the distance of the coin from the center of the disc is r, the maximum angular velocity which can be given to the disc, so that the coin does not slip away, is : ***31 Jan 2024 (M)***

(1) $\frac{\mu g}{r}$
(2) $\sqrt{\frac{r}{\mu g}}$
(3) $\sqrt{\frac{\mu g}{r}}$
(4) $\frac{\mu}{\sqrt{rg}}$

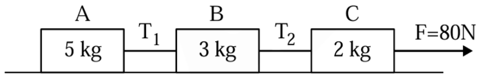
Q19. A block of mass $5\ \mathrm{kg}$ is placed on a rough inclined surface as shown in the figure. If $\overrightarrow{F_1}$ is the force required to just move the block up the inclined plane and $\overrightarrow{F_2}$ is the force required to just prevent the block from sliding down, then the value of $\left|\overrightarrow{F_1}\right| - \left|\overrightarrow{F_2}\right|$ is: [Use $g = 10\ \mathrm{m\ s^{-2}}$]



31 Jan 2024 (E)

(1) $25\sqrt{3}\ \mathrm{N}$ (2) $5\sqrt{3}\ \mathrm{N}$
(3) $\frac{5\sqrt{3}}{2}\ \mathrm{N}$ (4) $10\ \mathrm{N}$

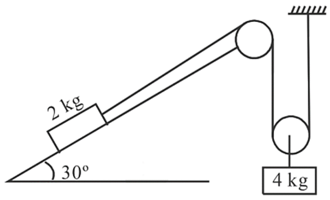
Q20. Three blocks A, B and C are pulled on a horizontal smooth surface by a force of $80\ \mathrm{N}$ as shown in figure. The tensions T_1 and T_2 in the string are respectively:



30 Jan 2024 (E)

(1) $40\mathrm{N},\ 64\mathrm{N}$ (2) $60\mathrm{N},\ 80\mathrm{N}$
(3) $88\mathrm{N},\ 96\mathrm{N}$ (4) $80\mathrm{N},\ 100\mathrm{N}$

Q21. 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 $2\ \mathrm{kg}$ is:



30 Jan 2024 (M)

(1) g (2) $\frac{g}{3}$
(3) $\frac{g}{2}$ (4) $\frac{g}{4}$

Q22. A block of mass m is placed on a surface having vertical cross section given by $y = \frac{x^2}{4}$. If coefficient of friction is 0.5, the maximum height above the ground at which block can be placed without slipping is:

30 Jan 2024 (E)

(1) $\frac{1}{4}\ \mathrm{m}$ (2) $\frac{1}{2}\ \mathrm{m}$
(3) $\frac{1}{6}\ \mathrm{m}$ (4) $\frac{1}{3}\ \mathrm{m}$

Q23. A stone of mass 900 g is tied to a string and moved in a vertical circle of radius $1\ \mathrm{m}$ making $10\ \mathrm{rpm}$. The tension in the string, when the stone is at the lowest point is (if $\pi^2 = 9.8$ and $g = 9.8\ \mathrm{m\ s^{-2}}$) ***29 Jan 2024 (E)***

(1) 97 N (2) $9.8\ \mathrm{N}$
(3) $8.82\ \mathrm{N}$ (4) $17.8\ \mathrm{N}$

Q24. A particle is moving in a circle of radius $50\ \mathrm{cm}$ in such a way that at any instant the normal and tangential components of its acceleration are equal. If its speed at $\mathrm{t} = 0$ is $4\ \mathrm{m\ s^{-1}}$, the time taken to complete the first revolution will be $\frac{1}{\alpha}\left[1 - \mathrm{e}^{-2\pi}\right]$ s, where $\alpha =$______. ***29 Jan 2024 (E)***

Q25. Given below are two statements :

Statement (I) : The limiting force of static friction depends on the area of contact and independent of materials.

Statement (II) : The limiting force of kinetic friction is independent of the area of contact and depends on materials.

In the light of the above statements, choose the most appropriate answer from the options given below :

27 Jan 2024 (E)

(1) Statement I is correct but Statement II is incorrect
(2) Statement I is incorrect but Statement II is correct
(3) Both Statement I and Statement II are incorrect
(4) Both Statement I and Statement II are correct

Q26. A train is moving with a speed of $12 \mathrm{~m~s}^{-1}$ on rails which are $1.5 \mathrm{~m}$ apart. To negotiate a curve radius 400 m, the height by which the outer rail should be raised with respect to the inner rail is (Given, $g=10 \mathrm{~m~s}^{-2}$):

27 Jan 2024 (M)

(1) $6.0 \mathrm{~cm}$ (2) $5.4 \mathrm{~cm}$
(3) $4.8 \mathrm{~cm}$ (4) $4.2 \mathrm{~cm}$

Q27. The position vector of a particle related to time t is given by $\overrightarrow{r}=\left(10 t \hat{i}+15 t^2 \hat{j}+7 \widehat{k}\right) \mathrm{m}$. The direction of net force experienced by the particle is : ***15 Apr 2023 (M)***

(1) Positive x-axis (2) In $x-y$ plane
(3) Positive y-axis (4) Positive z-axis

Q28. Three forces $F_1=10 \mathrm{~N}$, $F_2=8 \mathrm{~N}$, $F_3=6 \mathrm{~N}$ are acting on a particle of mass $5 \mathrm{~kg}$. The forces F_2 and F_3 are applied perpendicularly so that particle remains at rest. If the force F_1 is removed, then the acceleration of the particle is

12 Apr 2023 (M)

(1) $7 \mathrm{~m~s}^{-2}$ (2) $0.5 \mathrm{~m~s}^{-2}$
(3) $4.8 \mathrm{~m~s}^{-2}$ (4) $2 \mathrm{~m~s}^{-2}$

Q29. A block of mass $5 \mathrm{~kg}$ starting from rest pulled up on a smooth incline plane making an angle of 30° with horizontal with an effective acceleration of $1 \mathrm{~m~s}^{-2}$. The power delivered by the puling force at $t=10 \mathrm{~s}$ from the start is _____ W. [Use $g=10 \mathrm{~m~s}^{-2}$] (Calculate the nearest integer value) ***11 Apr 2023 (E)***

Q30. A body of mass 500 g moves along x-axis such that it's velocity varies with displacement x according to the relation $v=10 \sqrt{x} \mathrm{~m~s}^{-1}$ the force acting on the body is: ***11 Apr 2023 (E)***

(1) 125 N (2) 25 N
(3) 166 N (4) 5 N

Q31. A coin placed on a rotating table just slips when it is placed at a distance of $1 \mathrm{~cm}$ from the centre. If the angular velocity of the table is halved, it will just slip when placed at a distance of _____ from the centre:

11 Apr 2023 (M)

(1) $8 \mathrm{~cm}$ (2) $4 \mathrm{~cm}$
(3) $1 \mathrm{~cm}$ (4) $2 \mathrm{~cm}$

Q32. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**
Assertion A : An electric fan continues to rotate for some time after the current is switched off.
Reason R: Fan continues to rotate due to inertia of motion.

In the light of above statements, choose the most appropriate answer from the options given below.

10 Apr 2023 (E)

(1) **A** is correct but **R** is not correct
(2) **A** is not correct but **R** is correct
(3) Both **A** and **R** are correct and **R** is the correct explanation of **A**
(4) Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**

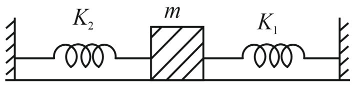
Q33. At any instant the velocity of a particle of mass 500 g is $\left(2t\,\hat{\mathrm{i}} + 3t^2\,\hat{\mathrm{j}}\right)$ m s^{-1} . If the force acting on the particle at $t = 1$ s is $\left(\hat{\mathrm{i}} + x\,\hat{\mathrm{j}}\right)$ N . Then the value of x will be: ***08 Apr 2023 (M)***

(1) 3 (2) 4
(3) 2 (4) 6

Q34. A bullet of mass 0.1 kg moving horizontally with speed 400 $\mathrm{m\ s^{-1}}$ hits a wooden block of mass 3.9 kg kept on a horizontal rough surface. The bullet gets embedded into the block and moves 20 m before coming to rest. The coefficient of friction between the block and the surface is _______. ***08 Apr 2023 (E)***

(1) 0.90 (2) 0.50
(3) 0.65 (4) 0.25

Q35. A mass m is attached to two springs as shown in figure. The spring constants of two springs are K_1 and K_2. For the frictionless surface, the time period of oscillation of mass m is



06 Apr 2023 (M)

(1) $2\pi\sqrt{\frac{m}{\mathrm{K_1+K_2}}}$ (2) $\frac{1}{2\pi}\sqrt{\frac{\mathrm{K_1-K_2}}{m}}$
(3) $2\pi\sqrt{\frac{m}{\mathrm{K_1-K_2}}}$ (4) $\frac{1}{2\pi}\sqrt{\frac{\mathrm{K_1+K_2}}{m}}$

Q36. A small block of mass 100 g is tied to a spring of spring constant 7.5 N m^{-1} and length 20 cm. The other end of spring is fixed at a particular point A. If the block moves in a circular path on a smooth horizontal surface with constant angular velocity 5 rad s^{-1}about point A, then tension in the spring is

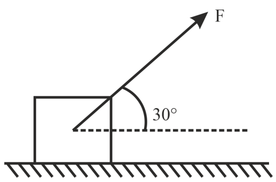
06 Apr 2023 (M)

(1) 0.75 N (2) 0.25 N
(3) 0.50 N (4) 1.5 N

Q37. A block of mass 5 kg is placed at rest on a table of rough surface. Now, if a force of 30 N is applied in the direction parallel to surface of the table, the block slides through a distance of 50 m in an interval of time 10 s. Coefficient of kinetic friction is (given, $g = 10$ m s^{-2}): ***01 Feb 2023 (M)***

(1) 0.60 (2) 0.75
(3) 0.50 (4) 0.25

Q38. As shown in the figure a block of mass 10 kg lying on a horizontal surface is pulled by a force F acting at an angle 30°, with horizontal. For $\mu_s = 0.25$, the block will just start to move for the value of F: [Given g $=$ 10 m $\cdot$ s^{-2}]



01 Feb 2023 (E)

(1) $33.3\ N$ (2) $25.2\ N$

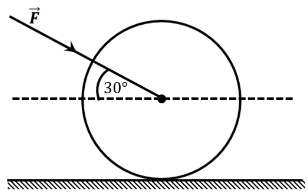
(3) $20\ N$ (4) $35.7\ N$

Q39. A body of mass $10\ \text{kg}$ is moving with an initial speed of $20\ \text{m s}^{-1}$. The body stops after 5 s due to friction between body and the floor. The value of the coefficient of friction is: (Take acceleration due to gravity $g = 10\ \text{m s}^{-2}$) ***31 Jan 2023 (E)***

(1) 0.2 (2) 0.3

(3) 0.5 (4) 0.4

Q40. As shown in figure, a $70\ \text{kg}$ garden roller is pushed with a force of $\vec{F} = 200$ N at an angle of 30° with horizontal. The normal reaction on the roller is (Given $g = 10\ \text{m s}^{-2}$)

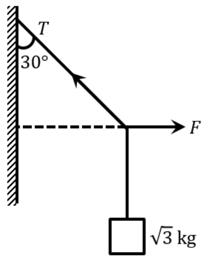


31 Jan 2023 (M)

(1) $800\sqrt{2}$ N (2) 600 N

(3) 800 N (4) $200\sqrt{3}$ N

Q41. A block of $\sqrt{3}\ \text{kg}$ is attached to a string whose other end is attached to the wall. An unknown force F is applied so that the string makes an angle of 30° with the wall. The tension T is : (Given $\text{g} = 10\ \text{m s}^{-2}$)

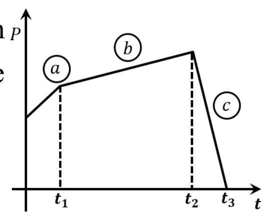


30 Jan 2023 (E)

(1) 20 N (2) 25 N

(3) 10 N (4) 15 N

Q42. The figure represents the momentum time $(p - t)$ curve for a particle moving along an axis under the influence of the force. Identify the regions on the graph where the magnitude of the force is maximum and minimum respectively? If $(t_3 - t_2) < t_1$



30 Jan 2023 (M)

(1) c and a (2) b and c

(3) c and b (4) a and b

Q43. Force acts for 20 s on a body of mass $20\ \text{kg}$, starting from rest, after which the force ceases and then body describes $50\ \text{m}$ in the next 10 s. The value of force will be : ***29 Jan 2023 (E)***

(1) 40 N (2) 5 N

(3) 20 N (4) 10 N

Q44. A block of mass m slides down the plane inclined at angle 30° with an acceleration $\frac{g}{4}$. The value of coefficient of kinetic friction will be : ***29 Jan 2023 (M)***

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

(3) $\frac{\sqrt{3}}{2}$ (4) $\frac{2\sqrt{3}-1}{2}$

Q45. A car is moving on a horizontal curved road with radius $50 \mathrm{~m}$. The approximate maximum speed of car will be, if friction between tyres and road is 0.34. [Take $g=10 \mathrm{~m} \mathrm{~s}^{-2}$] ***29 Jan 2023 (M)***

(1) $3.4 \mathrm{~m} \mathrm{~s}^{-1}$ (2) $22.4 \mathrm{~m} \mathrm{~s}^{-1}$

(3) $13 \mathrm{~m} \mathrm{~s}^{-1}$ (4) $17 \mathrm{~m} \mathrm{~s}^{-1}$

Q46. The time taken by an object to slide down 45° rough inclined plane is n times as it takes to slide down a perfectly smooth 45° incline plane. The coefficient of kinetic friction between the object and the incline plane is: ***29 Jan 2023 (E)***

(1) $\sqrt{\frac{1}{1-n^2}}$ (2) $\sqrt{1-\frac{1}{n^2}}$

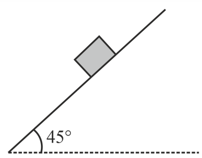
(3) $1+\frac{1}{n^2}$ (4) $1-\frac{1}{n^2}$

Q47. A car is moving with a constant speed of $20 \mathrm{~m} \mathrm{~s}^{-1}$ in a circular horizontal track of radius $40 \mathrm{~m}$. A bob is suspended from the roof of the car by a massless string. The angle made by the string with the vertical will be : (Take $\mathrm{g}=10 \mathrm{~m} \mathrm{~s}^{-2}$) ***25 Jan 2023 (M)***

(1) $\frac{\pi}{6}$ (2) $\frac{\pi}{2}$

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

Q48. Consider a block kept on an inclined plane (inclined at 45°) as shown in the figure. If the force required to just push it up the incline is 2 times the force required to just prevent it from sliding down, the coefficient of friction between the block and inclined plane (μ) is equal to:



25 Jan 2023 (E)

(1) 0.33 (2) 0.60

(3) 0.25 (4) 0.50

Q49. 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.

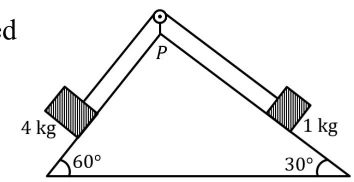
Statement-II: Force exerted by the floor of an elevator on the foot of a person standing on it is more than his/her weight when the elevator goes down with increasing speed.

In the light of the above statements, choose the correct answer from the options given below: ***24 Jan 2023 (M)***

(1) Both Statement I and Statement II are false (2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are true (4) Statement I is false but Statement II is true

Q50. As per given figure, a weightless pulley P is attached on a double inclined frictionless surface. The tension in the string (massless) will be (if $g=10 \mathrm{~m} \mathrm{~s}^{-2}$)



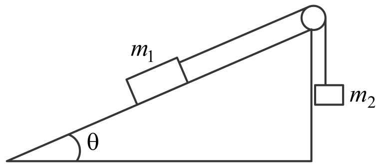
24 Jan 2023 (M)

(1) $\left(4\sqrt{3}+1\right)$ N
(2) $4\left(\sqrt{3}+1\right)$ N
(3) $4\left(\sqrt{3}-1\right)$ N
(4) $\left(4\sqrt{3}-1\right)$ N

Q51. A body of mass 200 g is tied to a spring of spring constant $12.5\ \mathrm{N\ m^{-1}}$, while the other end of spring is fixed at point O. If the body moves about O in a circular path on a smooth horizontal surface with constant angular speed $5\ \mathrm{rad\ s^{-1}}$, then the ratio of extension in the spring to its natural length will be : ***24 Jan 2023 (E)***

(1) 1 : 2
(2) 1 : 1
(3) 2 : 3
(4) 2 : 5

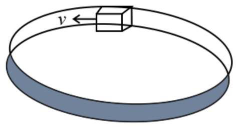
Q52. Two bodies of masses $m_1 = 5$ kg and $m_2 = 3$ kg are connected by a light string going over a smooth light pulley on a smooth inclined plane as shown in the figure. The system is at rest. The force exerted by the inclined plane on the body of mass m_1 will be: [Take $g = 10\ \mathrm{m\ s^{-2}}$]



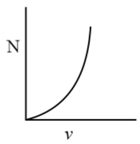
29 Jul 2022 (E)

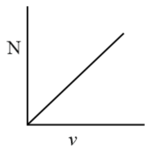
(1) 30 N
(2) 40 N
(3) 50 N
(4) 60 N

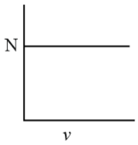
Q53. A smooth circular groove has a smooth vertical wall as shown in figure. A block of mass m moves against the wall with a speed v. Which of the following curve represents the correct relation between the normal reaction on the block by the wall (N) and speed of the block (v)?

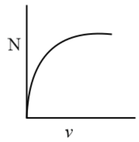


29 Jul 2022 (M)

(1)


(2)


(3)


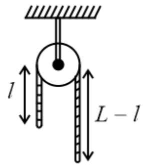
(4)


Q54. A tube of length 50 cm is filled completely with an incompressible liquid of mass 250 g and closed at both ends. The tube is then rotated in horizontal plane about one of its ends with a uniform angular velocity $x\sqrt{F}\ \mathrm{rad\ s^{-1}}$. If F be the force exerted by the liquid at the other end then the value of x will be _____ .
29 Jul 2022 (E)

Q55. A balloon has mass of 10 g in air. The air escapes from the balloon at a uniform rate with velocity $4.5\ \mathrm{cm\ s^{-1}}$. If the balloon shrinks in 5 s completely. Then, the average force acting on that balloon will be (in dyne).
28 Jul 2022 (M)

(1) 3
(2) 9
(3) 12
(4) 18

Q56. 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 pulley. 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 (E)

(1) 6 (2) 2
(3) 1.5 (4) 4

Q57. 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 (E)***

(1) Mg (2) $Mg\cos\theta$
(3) $\sqrt{Mg\sin\theta+Mg\cos\theta}$ (4) $Mg\sin\theta\sqrt{1+\mu}$

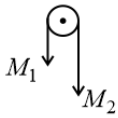
Q58. A block A takes 2 s to slide down a frictionless incline of 30° and length l, kept inside a lift going up with uniform velocity v. If the incline is changed to 45°, the time taken by the block, to slide down the incline, will be approximately: ***27 Jul 2022 (E)***

(1) 2.66 s (2) 0.83 s
(3) 1.68 s (4) 0.70 s

Q59. A bag is gently dropped on a conveyor belt moving at a speed of $2\ \mathrm{m\ s^{-1}}$. The coefficient of friction between the conveyor belt and bag is 0.4 Initially, the bag slips on the belt before it stops due to friction. The distance travelled by the bag on the belt during slipping motion is : [Take $g=10\ \mathrm{m\ s^{-2}}$] ***27 Jul 2022 (M)***

(1) 2 m (2) 0.5 m
(3) 3.2 m (4) 0.8 ms

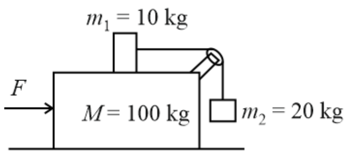
Q60. Two masses M_1 and M_2 are tied together at the two ends of a light inextensible string that passes over a frictionless pulley. When the mass M_2 is twice that of M_1. the acceleration of the system is a_1. When the mass M_2 is thrice that of M_1. The acceleration of The system is a_2. The ratio $\frac{a_1}{a_2}$ will be



26 Jul 2022 (E)

(1) $\frac{1}{3}$ (2) $\frac{2}{3}$
(3) $\frac{3}{2}$ (4) $\frac{1}{2}$

Q61. 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 $2\ \mathrm{ms^{-2}}$. The value of F is (Take $g=10\ \mathrm{ms^{-2}}$)



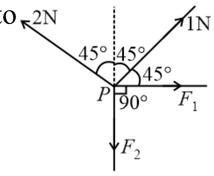
26 Jul 2022 (M)

(1) 3360 N (2) 3380 N
(3) 3120N (4) 3240N

Q62. 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 $4\ \mathrm{m\ s^{-2}}$ and then climbs up with an acceleration of $5\ \mathrm{m\ s^{-2}}$. Choose the correct option $\left(g = 10\ \mathrm{m\ s^{-2}}\right)$ ***26 Jul 2022 (M)***

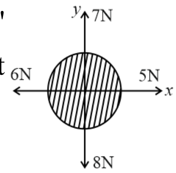
(1) $T = 700$ N while climbing upward
(2) $T = 350$ N while going downward
(3) Rope will break while climbing upward
(4) Rope will break while going downward

Q63. Four forces are acting at a point P in equilibrium as shown in figure. The ratio of force F_1 to F_2 is $1 : x$ where $x =$_____.



25 Jul 2022 (M)

Q64. For a free body diagram shown in the figure, the four forces are applied in the 'x' and 'y' directions. What additional force must be applied and at what angle with positive x-axis so that the net acceleration of body is zero?



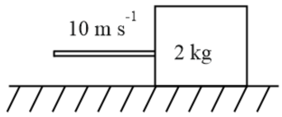
25 Jul 2022 (E)

(1) $\sqrt{2}\ \mathrm{N}, 45^{\circ}$
(2) $\sqrt{2}\ \mathrm{N}, 135^{\circ}$
(3) $\frac{2}{\sqrt{3}}\ \mathrm{N}, 30^{\circ}$
(4) $2\ \mathrm{N}, 45^{\circ}$

Q65. 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 (E)***

(1) g
(2) $\frac{3g}{4}$
(3) $\frac{g}{2}$
(4) $\frac{g}{4}$

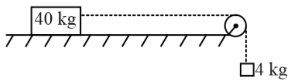
Q66. A block of metal weighing 2 kg is resting on a frictionless plane (as shown in figure). It is struck by a jet releasing water at a rate of $1\ \mathrm{kg\ s^{-1}}$ and at a speed of $10\ \mathrm{m\ s^{-1}}$. Then, the initial acceleration of the block, in $\mathrm{m\ s^{-2}}$, will be



29 Jun 2022 (M)

(1) 3
(2) 6
(3) 5
(4) 4

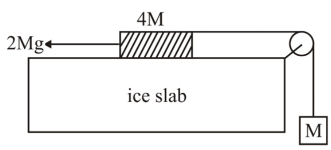
Q67. A block of mass 40 kg slides over a surface, when a mass of 4 kg is suspended through an inextensible massless string passing over frictionless pulley as shown below. The coefficient of kinetic friction between the surface and block is 0.02. The acceleration of block is: (Given $g = 10\ \mathrm{m\ s^{-2}}$.)



29 Jun 2022 (E)

(1) $\frac{8}{11}\ \mathrm{m\ s^{-2}}$
(2) $1\ \mathrm{m\ s^{-2}}$
(3) $\frac{1}{5}\ \mathrm{m\ s^{-2}}$
(4) $\frac{4}{5}\ \mathrm{m\ s^{-2}}$

Q68. 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 $2\ \mathrm{Mg}$ force. In this situation, tension in the string is $\frac{x}{5}\mathrm{Mg}$ 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 (M)

Q69. A block of mass $2\ \text{kg}$ moving on a horizontal surface with speed of $4\ \text{m s}^{-1}$ enters a rough surface ranging from $x = 0.5\ \text{m}$ to $x = 1.5\ \text{m}$. The retarding force in this range of rough surface is related to distance by $F = -kx$ where $k = 12\ \text{N m}^{-1}$. The speed of the block as it just crosses the rough surface will be

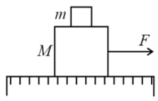
28 Jun 2022 (E)

(1) $2\ \text{m s}^{-1}$
(2) $2.5\ \text{m s}^{-1}$
(3) $1.5\ \text{m s}^{-1}$
(4) zero

Q70. A mass of $10\ \text{kg}$ is suspended vertically by a rope of length $5\ \text{m}$ from the roof. A force of $30\ \text{N}$ is applied at the middle point of rope in horizontal direction. The angle made by upper half of the rope with vertical is $\alpha = \tan^{-1}(x \times 10^{-1})$. The value of x is _____ .
(Given, $g = 10\ \text{m s}^{-2}$)

27 Jun 2022 (E)

Q71. A system of two blocks of masses $m = 2\ \text{kg}$ and $M = 8\ \text{kg}$ is placed on a smooth table as shown in figure. The coefficient of static friction between two blocks is 0.5. The maximum horizontal force F that can be applied to the block of mass M so that the blocks move together will be $(g = 9.8\ \text{m s}^{-2})$



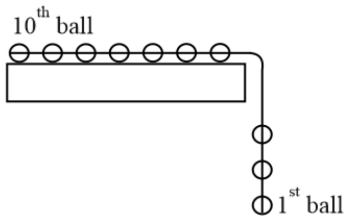
27 Jun 2022 (M)

(1) $9.8\ \text{N}$
(2) $39.2\ \text{N}$
(3) $49\ \text{N}$
(4) $78.4\ \text{N}$

Q72. One end of a massless spring of spring constant k and natural length l_0 is fixed while the other end is connected to a small object of mass m lying on a frictionless table. The spring remains horizontal on the table. If the object is made to rotate at an angular velocity ω about an axis passing trough fixed end, then the elongation of the spring will be ***27 Jun 2022 (E)***

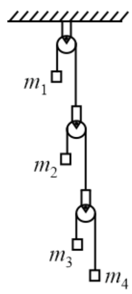
(1) $\frac{k - m\omega^2 l_0}{m\omega^2}$
(2) $\frac{m\omega^2 l_0}{k + m\omega^2}$
(3) $\frac{m\omega^2 l_0}{k - m\omega^2}$
(4) $\frac{k + m\omega^2 l_0}{m\omega^2}$

Q73. A system to 10 balls each of mass $2\ \text{kg}$ 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 (E)

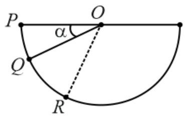
Q74. In the arrangement shown in figure a_1, a_2, a_3 and a_4 are the accelerations of masses m_1, m_2, m_3 and m_4 respectively. Which of the following relation is true for this arrangement?



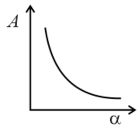
26 Jun 2022 (E)

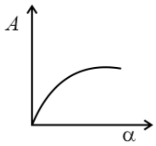
(1) $4a_1 + 2a_2 + a_3 + a_4 = 0$
(2) $a_1 + 4a_2 + 3a_3 + a_4 = 0$
(3) $a_1 + 4a_2 + 3a_3 + 2a_4 = 0$
(4) $2a_1 + 2a_2 + 3a_3 + a_4 = 0$

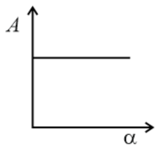
Q75. A ball is released from rest from point P of a smooth semi-spherical vessel as shown in figure. The ratio of the centripetal force and normal reaction on the ball at point Q is A while angular position of point Q is α with respect to point P. Which of the following graphs represent the correct relation between A and α when ball goes from Q to R?

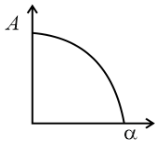


26 Jun 2022 (M)

(1) 

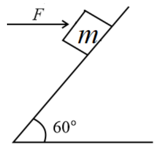
(2) 

(3) 

(4) 

Q76. 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 (M)***

Q77. A block of mass 200 g is kept stationary on a smooth inclined plane by applying a minimum horizontal force $F = \sqrt{x}$ N as shown in figure. The value of $x =$ _____.



25 Jun 2022 (E)

Q78. A curved in a level road has a radius 75 m. The maximum speed of a car turning this curved road can be 30 m s^{-1} without skidding. If radius of curved road is changed to 48 m and the coefficient of friction between the tyres and the road remains same, then maximum allowed speed would be _____ m s^{-1}. ***25 Jun 2022 (E)***

Q79. A uniform chain of 6 m length is placed on a table such that a part of its length is hanging over the edge of the table. The system is at rest. The co-efficient of static friction between the chain and the surface of the table is 0.5, the maximum length of the chain hanging from the table is _____ m. ***25 Jun 2022 (M)***

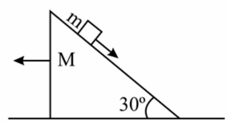
Q80. A disc with a flat small bottom beaker placed on it at a distance R from its center is revolving about an axis passing through the center and perpendicular to its plane with an angular velocity ω. The coefficient of static friction between the bottom of the beaker and the surface of the disc is μ. The beaker will revolve with the disc if : ***25 Jun 2022 (E)***

(1) $R \leq \frac{\mu g}{2\omega^2}$
(2) $R \leq \frac{\mu g}{\omega^2}$
(3) $R \geq \frac{\mu g}{2\omega^2}$
(4) $R \geq \frac{\mu g}{\omega^2}$

Q81. A block of mass 10 kg starts sliding on a surface with an initial velocity of 9.8 ms^{-1}. The coefficient of friction between the surface and block is 0.5. The distance covered by the block before coming to rest is :[use $g = 9.8$ ms^{-2}] ***24 Jun 2022 (M)***

(1) $9.8 \mathrm{~m}$ (2) $4.9 \mathrm{~m}$
(3) $12.5 \mathrm{~m}$ (4) $19.6 \mathrm{~m}$

Q82. 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 $m=8 \mathrm{~kg}, M=16 \mathrm{~kg}$. Assume all the surfaces shown in the figure to be frictionless.



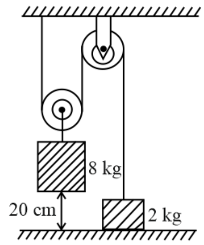
01 Sep 2021 (E)

(1) $\frac{3}{5} \mathrm{~g}$ (2) $\frac{4}{3} \mathrm{~g}$
(3) $\frac{6}{5} \mathrm{~g}$ (4) $\frac{2}{3} \mathrm{g}$

Q83. When a body slides down from rest along a smooth inclined plane making an angle of 30° with the horizontal, it takes time T. When the same body slides down from the rest along a rough inclined plane making the same angle and through the same distance, it takes time αT, where α is a constant greater than 1. The co-efficient of friction between the body and the rough plane is $\frac{1}{\sqrt{x}}\left(\frac{\alpha^2-1}{\alpha^2}\right)$ where $x=$ __________. ***01 Sep 2021 (E)***

Q84. A car is moving on a plane inclined at 30° to the horizontal with an acceleration of $10 \mathrm{~m} \mathrm{~s}^{-2}$ 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 $g=10 \mathrm{~m} \mathrm{~s}^{-2}$) ***31 Aug 2021 (M)***

Q85. The boxes of masses $2 \mathrm{~kg}$ and $8 \mathrm{~kg}$ are connected by a massless string passing over smooth pulleys. Calculate the time taken by box of mass $8 \mathrm{~kg}$ to strike the ground starting from rest. $\left(\mathrm{g}=10 \mathrm{~m} \mathrm{~s}^{-2}\right)$



27 Aug 2021 (E)

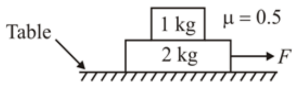
(1) $0.25 \mathrm{~s}$ (2) $0.34 \mathrm{~s}$
(3) $0.2 \mathrm{~s}$ (4) $0.4 \mathrm{~s}$

Q86. The initial mass of a rocket is $1000 \mathrm{~kg}$. Calculate at what rate the fuel should be burnt so that the rocket is given an acceleration of, $20 \mathrm{~m} \mathrm{~s}^{-2}$. The gases come out at a relative speed of $500 \mathrm{~m} \mathrm{~s}^{-1}$, with respect to the rocket: $\left[\text{Use } g=10 \mathrm{~m} \mathrm{~s}^{-2}\right]$

26 Aug 2021 (M)

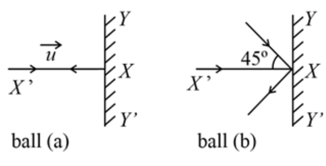
(1) $10 \mathrm{~kg} \mathrm{~s}^{-1}$ (2) $60 \mathrm{~kg} \mathrm{~s}^{-1}$
(3) $500 \mathrm{~kg} \mathrm{~s}^{-1}$ (4) $6.0 \times 10^2 \mathrm{~kg} \mathrm{~s}^{-1}$

Q87. The coefficient of static friction between two blocks is 0.5 and the table is smooth. The maximum horizontal force that can be applied to move the blocks together is _____N (take $g=10 \mathrm{~m} \mathrm{~s}^{-2}$)



26 Aug 2021 (E)

Q88. Two billiard balls of equal mass $30 \mathrm{~g}$ strike a rigid wall with same speed of $108 \mathrm{~kmph}$ (as shown) but at different angles. If the balls get reflected with the same speed, then the ratio of the magnitude of impulses imparted to ball a and ball b by the wall along X direction is:



25 Jul 2021 (M)

(1) $1:1$ (2) $\sqrt{2}:1$
(3) $2:1$ (4) $1:\sqrt{2}$

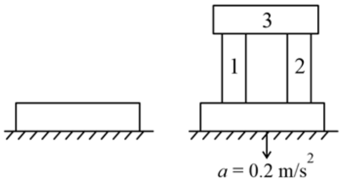
Q89. A force $\vec{F}=\left(40\hat{\mathrm{i}}+10\hat{\mathrm{j}}\right)$ N acts on a body of mass 5 kg. If the body starts from rest, its position vector $\vec{r}$ at time $t=10$ s will be ***25 Jul 2021 (E)***

(1) $\left(100\hat{\mathrm{i}}+400\hat{\mathrm{j}}\right)$ m (2) $\left(100\hat{\mathrm{i}}+100\hat{\mathrm{j}}\right)$ m
(3) $\left(400\hat{\mathrm{i}}+100\hat{\mathrm{j}}\right)$ m (4) $\left(400\hat{\mathrm{i}}+400\hat{\mathrm{j}}\right)$ m

Q90. A bullet of 4 g mass is fired from a gun of mass 4 kg. If the bullet moves with the muzzle speed of 50 ms^{1}, the impulse imparted to the gun and velocity of recoil of gun are ***22 Jul 2021 (M)***

(1) $0.4\ \mathrm{kg\ m\,s^{-1}},\ 0.1\ \mathrm{m\,s^{-1}}$ (2) $0.2\ \mathrm{kg\ m\,s^{-1}},\ 0.05\ \mathrm{m\,s^{-1}}$
(3) $0.2\ \mathrm{kg\ m\,s^{-1}},\ 0.1\ \mathrm{m\,s^{-1}}$ (4) $0.4\ \mathrm{kg\ m\,s^{-1}},\ 0.05\ \mathrm{m\,s^{-1}}$

Q91. A steel block of 10 kg rests on a horizontal floor as shown. When three iron cylinders are placed on it as shown, the block and cylinders go down with an acceleration $0.2\ \mathrm{m\,s^{-2}}$. The normal reaction R' by the floor if mass of the iron cylinders are equal and of 20 kg each is (in N), [Take $g=10\ \mathrm{m\,s^{-2}}$ and $\mu_s=0.2$]



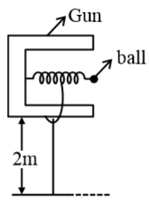
20 Jul 2021 (M)

(1) 716 (2) 686
(3) 714 (4) 684

Q92. The normal reaction N for a vehicle of 800 kg mass, negotiating a turn on a 30° banked road at maximum possible speed without skidding is ____ $\times 10^{3}\ \mathrm{kg\ m\,s^{-2}}$. ***20 Jul 2021 (M)***

(1) 10.2 (2) 7.2
(3) 12.4 (4) 6.96

Q93. In a spring gun having spring constant $100\ \mathrm{N\,m^{-1}}$ a small ball B of mass 100 g is put in its barrel (as shown in figure) by compressing the spring through 0.05 m. There should be a box placed at a distance d on the ground so that the ball falls in it. If the ball leaves the gun horizontally at a height of 2 m above the ground. The value of d is m. $\left(g=10\ \mathrm{m\,s^{-2}}\right)$

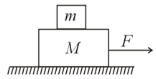


20 Jul 2021 (M)

Q94. A body of mass m is launched up on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of friction between the body and plane is $\frac{\sqrt{x}}{5}$ if the time of ascent is half of the time of descent. The value of x is ***20 Jul 2021 (E)***

Q95. 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 the bullet before hitting the wood is $10\ \mathrm{m\,s^{-1}}$ 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 (M)***

Q96. Two blocks ($m = 0.5$ kg and $M = 4.5$ kg) are arranged on a horizontal frictionless table as shown in the figure. The coefficient of static friction between the two blocks is $\frac{3}{7}$. Then the maximum horizontal force that can be applied on the larger block so that the blocks move together is N. (Round off to the Nearest Integer) [Take g as 9.8 m s^{-2}]



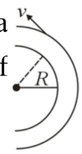
17 Mar 2021 (M)

Q97. Two identical blocks A and B each of mass m resting on the smooth horizontal floor are connected by a light spring of natural length L and spring constant K. A third block C of mass m moving with a speed v along the line joining A and B collides with A.The maximum compression in the spring is

17 Mar 2021 (E)

(1) $v\sqrt{\frac{m}{2K}}$ (2) $\sqrt{\frac{mv}{2K}}$
(3) $\sqrt{\frac{mv}{K}}$ (4) $\sqrt{\frac{m}{2K}}$

Q98. A modern grand-prix racing car of mass m is travelling on a flat track in a circular arc of radius R with a speed v. If the coefficient of static friction between the tyres and the track is μ_s, then the magnitude of negative lift F_L acting downwards on the car is:

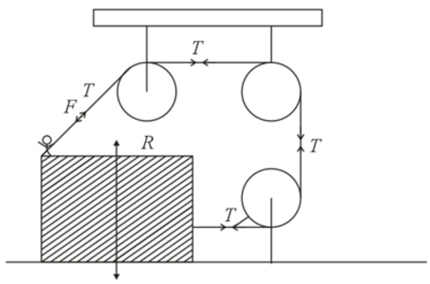


17 Mar 2021 (M)

(1) $m\left(\frac{v^2}{\mu_s R} + g\right)$ (2) $m\left(\frac{v^2}{\mu_s R} - g\right)$
(3) $m\left(g - \frac{v^2}{\mu_s R}\right)$ (4) $-m\left(g + \frac{v^2}{\mu_s R}\right)$

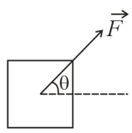
Q99. A body of mass 1 kg rests on a horizontal floor with which it has a coefficient of static friction $\frac{1}{\sqrt{3}}$. It is desired to make the body move by applying the minimum possible force F N. The value of F will be _______. (Round off to the Nearest Integer) [Take $g = 10 \text{ m s}^{-2}$] ***17 Mar 2021 (E)***

Q100. A boy of mass 4 kg is standing on a piece of wood having mass 5 kg. If the coefficient of friction between the wood and the floor is 0.5 , the maximum force that the boy can exert on the rope so that the piece of wood does not move from its place is _____ N. (Round off to the Nearest Integer) [Take $g = 10 \text{ m s}^{-2}$]



17 Mar 2021 (E)

Q101. A block of mass m slides along a floor while a force of magnitude F is applied to it at an angle θ as shown in figure. The coefficient of kinetic friction is μ_K. Then, the block's acceleration a is given by: (g is acceleration due to gravity)



16 Mar 2021 (M)

(1) $-\frac{F}{m}\cos\theta - \mu_K\left(g - \frac{F}{m}\sin\theta\right)$ (2) $\frac{F}{m}\cos\theta - \mu_K\left(g - \frac{F}{m}\sin\theta\right)$
(3) $\frac{F}{m}\cos\theta - \mu_K\left(g + \frac{F}{m}\sin\theta\right)$ (4) $\frac{F}{m}\cos\theta + \mu_K\left(g - \frac{F}{m}\sin\theta\right)$

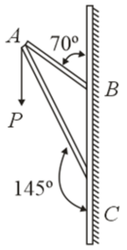
Q102. Statement I: A cyclist is moving on an unbanked road with a speed of 7 km h^{-1} and takes a sharp circular turn along a path of the radius of 2 m without reducing the speed. The static friction coefficient is 0.2. The

cyclist will not slip and pass the curve $\left(g=9.8 \mathrm{~m} \mathrm{~s}^{-2}\right)$
Statement II : If the road is banked at an angle of 45°, cyclist can cross the curve of $2 \mathrm{~m}$ radius with the speed of $18.5 \mathrm{~km} \mathrm{~h}^{-1}$ without slipping. In the light of the above statements, choose the correct answer from the options given below.

16 Mar 2021 (E)

(1) Statement I is incorrect and statement II is correct
(2) Statement I is correct and statement II is incorrect
(3) Both statement I and statement II are false
(4) Both statement I and statement II are true

Q103. Consider a frame that is made up of two thin massless rods AB and AC as shown in the figure. A vertical force $\vec{P}$ of magnitude $100 \mathrm{~N}$ is applied at point A of the frame. Suppose the force is $\vec{P}$ resolved parallel to the arms AB and AC of the frame. The magnitude of the resolved component along the arm AC is xN. The value of x, to the nearest integer, is ____. [Given: $\sin(35^{\circ})=0.573, \cos(35^{\circ})=0.819, \sin(110^{\circ})=0.939, \cos(110^{\circ})=-0.342$]



16 Mar 2021 (M)

Q104. A person standing on a spring balance inside a stationary lift measures $60 \mathrm{~kg}$. The weight of that person if the lift descends with uniform downward acceleration of $1.8 \mathrm{~m} \mathrm{~s}^{-2}$ will be _______ N. $\left[g=10 \mathrm{~m} \mathrm{~s}^{-2}\right]$

26 Feb 2021 (M)

Q105. A particle is moving with uniform speed along the circumference of a circle of radius R under the action of a central fictitious force F which is inversely proportional to R^{3}. Its time period of revolution will be given by :

26 Feb 2021 (M)

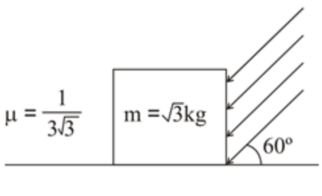
(1) $T \propto R^{\frac{4}{3}}$
(2) $T \propto R^{\frac{5}{2}}$
(3) $T \propto R^{\frac{3}{2}}$
(4) $T \propto R^{2}$

Q106. If two similar springs each of spring constant K_{1} are joined in series, the new spring constant and time period would be changed by a factor:

26 Feb 2021 (M)

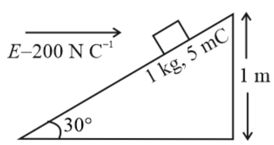
(1) $\frac{1}{2}, 2\sqrt{2}$
(2) $\frac{1}{4}, \sqrt{2}$
(3) $\frac{1}{4}, 2\sqrt{2}$
(4) $\frac{1}{2}, \sqrt{2}$

Q107. As shown in the figure, a block of mass $\sqrt{3}$ kg is kept on a horizontal rough surface of coefficient of friction $\frac{1}{3\sqrt{3}}$. The critical force to be applied on the vertical surface as shown at an angle 60° with horizontal such that it does not move, will be $3x$. The value of x will $\left[g=10 \mathrm{~m} \mathrm{~s}^{-2} ; \sin 60^{\circ}=\frac{\sqrt{3}}{2} ; \cos 60^{\circ}=\frac{1}{2}\right]$



26 Feb 2021 (M)

Q108. An inclined plane making an angle of 30° with the horizontal is placed in a uniform horizontal electric field $200 \frac{\mathrm{N}}{\mathrm{C}}$ as shown in the figure. A body of mass $1 \mathrm{~kg}$ and charge $5 \mathrm{~mC}$ is allowed to slide down from rest at a height of $1 \mathrm{~m}$. If the coefficient



of friction is 0.2, find the time taken by the body to reach the bottom. $\left[g = 9.8\ \mathrm{m\ s^{-2}};\ \sin 30^\circ = \frac{1}{2};\ \cos 30^\circ = \frac{\sqrt{3}}{2}\right]$

26 Feb 2021 (E)

(1) $0.92\ \mathrm{s}$
(2) $1.3\ \mathrm{s}$
(3) $0.46\ \mathrm{s}$
(4) $2.3\ \mathrm{s}$

Q109. The coefficient of static friction between a wooden block of mass 0.5 kg and a vertical rough wall is 0.2. The magnitude of the horizontal force that should be applied on the block to keep it adhere to the wall will be______N. $\left[g = 10\ \mathrm{m\ s^{-2}}\right]$ ***24 Feb 2021 (M)***

Q110. An inclined plane is bent in such a way that the vertical cross-section is given by $y = \frac{x^2}{4}$ where y is in vertical and x in horizontal direction. If the upper surface of this curved plane is rough with coefficient of friction $\mu = 0.5$, the maximum height in cm at which a stationary block will not slip downward is________ cm. ***24 Feb 2021 (M)***

Q111. A particle is projected with velocity v_0 along x-axis. A damping force is acting on the particle which is proportional to the square of the distance from the origin i.e. $ma = -\alpha x^2$. The distance at which the particle stops: ***24 Feb 2021 (E)***

(1) $\left(\frac{2v_0}{3\alpha}\right)^{\frac{1}{3}}$
(2) $\left(\frac{3mv_0^2}{2\alpha}\right)^{\frac{1}{3}}$
(3) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{2}}$
(4) $\left(\frac{2v_0^2}{3\alpha}\right)^{\frac{1}{2}}$

Q112. An insect is at the bottom of a hemispherical ditch of radius 1m. It crawls up the ditch but starts slipping after it is at height h from the bottom. If the coefficient of friction between the ground and the insect is 0.75, then h is : $\left(g = 10\ \mathrm{m\ s^{-2}}\right)$ ***06 Sep 2020 (M)***

(1) $0.20\ \mathrm{m}$
(2) $0.45\ \mathrm{m}$
(3) $0.60\ \mathrm{m}$
(4) $0.80\ \mathrm{m}$

Q113. A spaceship in space sweeps stationary interplanetary dust. As a result, its mass increases at a rate $\frac{dM(t)}{dt} = bv^2\left(t\right)$, where $v(t)$ is its instantaneous velocity. The instantaneous acceleration of the satellite is:

05 Sep 2020 (E)

(1) $-bv^3\left(t\right)$
(2) $\frac{-bv^3}{M(t)}$
(3) $-\frac{2bv^3}{M(t)}$
(4) $-\frac{bv^3}{2M(t)}$

Q114. A block starts moving up an inclined plane of inclination 30° with an initial velocity of v_0. It comes back to its initial position with velocity $\frac{v_0}{2}$. The value of the coefficient of kinetic friction between the block and the inclined plane is close to $\frac{1}{1000}$, The nearest integer to I is : ***03 Sep 2020 (E)***

Q115. A spring mass system (mass m, spring constant k and natural length l) rests in equilibrium on a horizontal disc. The free end of the spring is fixed at the centre of the disc. If the disc together with spring mass system rotates about it's axis with an angular velocity ω, $\left(k >> m\omega^2\right)$ the relative change in the length of the spring is best given by the option: ***09 Jan 2020 (E)***

(1) $\sqrt{\frac{2}{3}}\left(\frac{m\omega^2}{k}\right)$ (2) $\frac{2m\omega^2}{k}$

(3) $\frac{m\omega^2}{k}$ (4) $\frac{m\omega^2}{3k}$

Q116. A particle of mass m is fixed to one end of a light spring having force constant k and unstretched length l. The other end is fixed. The system is given an angular speed ω about the fixed end of the spring such that it rotates in a circle in gravity free space. Then the stretch in the spring is: ***08 Jan 2020 (M)***

(1) $\frac{ml\omega^2}{k-\omega m}$ (2) $\frac{ml\omega^2}{k-m\omega^2}$

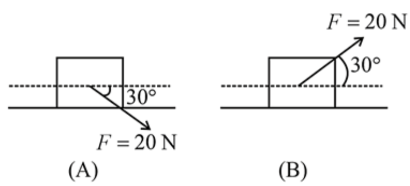
(3) $\frac{ml\omega^2}{k+m\omega^2}$ (4) $\frac{ml\omega^2}{k+m\omega}$

Q117. A mass of 10 kg is suspended by a rope of length 4 m, from the ceiling. A force F is applied horizontally at the mid-point of the rope such that the top half of the rope makes an angle of 45° with the vertical. Then F equals: (Take $\mathrm{g} = 10\ \mathrm{m\ s^{-2}}$ and the rope to be massless) ***07 Jan 2020 (E)***

(1) 100N (2) 90N

(3) 70N (4) 75N

Q118. A block of mass 5 kg is (i) pushed in case (A) and (ii) pulled in case (B), by a force $\mathrm{F} = 20\ \mathrm{N}$, making an angle of 30^o with the horizontal, as shown in the figures. The coefficient of friction between the block and floor is $\mu = 0.2$. The difference between the accelerations of the block, in case (B) and case (A) will be: $\left(\mathrm{g} = 10\,\mathrm{m\,s^{-2}}\right)$



12 Apr 2019 (E)

(1) $3.2\ \mathrm{m\ s^{-2}}$ (2) $0\ \mathrm{m\ s^{-2}}$

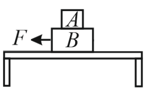
(3) $0.8\ \mathrm{m\ s^{-2}}$ (4) $0.4\ \mathrm{m\ s^{-2}}$

Q119. A spring whose unstrentches length is l has a force constant k. The spring is cut into two pieces of unstretches lengths l_1 and l_2 where, $l_1 = nl_2$ and n is an integer. The ratio k_1/k_2 of the corresponding force constants, k_1 and k_2 will be: ***12 Apr 2019 (E)***

(1) $\frac{1}{n^2}$ (2) n^2

(3) n (4) $\frac{1}{n}$

Q120. Two blocks A and B of masses $\mathrm{m_A} = 1\ \mathrm{kg}$ and $\mathrm{m_B} = 3\ \mathrm{kg}$ are kept on the table as shown in figure. The coefficients of friction between A and B is 0.2 and between B and the surface of the table is also 0.2. The maximum force F that can be applied on B horizontally, so that the block A does not slide over the block B is : [Take $\mathrm{g} = 10\ \mathrm{m/s^2}$]



10 Apr 2019 (E)

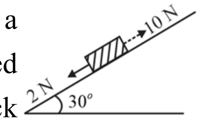
(1) 16 N (2) 12 N

(3) 40 N (4) 8 N

Q121. A ball is thrown upward with an initial velocity $\mathrm{V_0}$ from the surface of the earth. The motion of the ball is affected by a drag force equal to $\mathrm{m}\gamma v^2$ (where m is mass of the ball, v is its instantaneous velocity and γ is a constant). Time taken by the ball to rise to its zenith is: ***10 Apr 2019 (M)***

(1) $\frac{1}{\sqrt{\gamma g}} \ln\left(1+\sqrt{\frac{\gamma}{g}} V_0\right)$
(2) $\frac{1}{\sqrt{\gamma g}} \tan^{-1}\left(\sqrt{\frac{\gamma}{g}} V_0\right)$
(3) $\frac{1}{\sqrt{\gamma g}} \sin^{-1}\left(\sqrt{\frac{\gamma}{g}} V_0\right)$
(4) $\frac{1}{\sqrt{2\gamma g}} \tan^{-1}\left(\sqrt{\frac{2\gamma}{g}} V_0\right)$

Q122. A block kept on a rough inclined plane, as shown in the figure, remains at rest upto a maximum force $2N$ down the inclined plane. The maximum external force up the inclined plane that does not move the block is $10N$. The coefficient of static friction between the block and the plane is: [Take $g = 10\ m/s^2$]



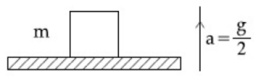
12 Jan 2019 (E)

(1) $\frac{\sqrt{3}}{4}$
(2) $\frac{2}{3}$
(3) $\frac{1}{2}$
(4) $\frac{\sqrt{3}}{2}$

Q123. A particle of mass m is moving in a straight line with momentum p. Starting at time $t = 0$, a force $F = k$ t acts in the same direction on the moving particle during time interval T so that its momentum changes from p to 3p. Here k is a constant. The value of T is ***11 Jan 2019 (E)***

(1) $2\sqrt{\frac{k}{p}}$
(2) $2\sqrt{\frac{p}{k}}$
(3) $\sqrt{\frac{2k}{p}}$
(4) $\sqrt{\frac{2p}{k}}$

Q124. A block of mass m is kept on a platform which starts from rest with a constant acceleration $g/2$ upwards, as shown in the figure. Work done by normal reaction on block in time t is



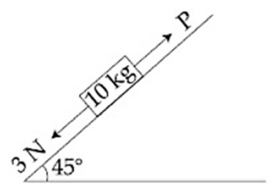
10 Jan 2019 (M)

(1) $-\frac{mg^2t^2}{8}$
(2) $\frac{m\,g^2t^2}{8}$
(3) 0
(4) $\frac{3\,m\,g^2t^2}{8}$

Q125. A mass of 10 kg is suspended vertically by a rope from the roof. When a horizontal force is applied on the rope at some point, the rope deviated at an angle of 45° at the roof point. If the suspended mass is at equilibrium, the magnitude of the force applied is $\left(g = 10\ \mathrm{m\,s^{-2}}\right)$ ***09 Jan 2019 (E)***

(1) 100 N
(2) 200 N
(3) 140 N
(4) 70 N

Q126. A block of mass 10 kg is kept on a rough inclined plane as shown in the figure. A force of 3 N is applied on the block. The coefficient of static friction between the plane and the block is 0.6. What should be the minimum value of force P, such that the block does not move downward? (take $g = 10\ ms^{-2}$)



09 Jan 2019 (M)

(1) 23 N
(2) 25 N
(3) 18 N
(4) 32 N

ANSWER KEYS

1. (1)	**2.** (4)	**3.** (3)	**4.** (3)	**5.** (2)	**6.** (2)	**7.** (2)	**8.** (3)
9. (2)	**10.** (240)	**11.** (4)	**12.** (4)	**13.** (4)	**14.** (3)	**15.** (3)	**16.** (1)
17. (2)	**18.** (3)	**19.** (2)	**20.** (1)	**21.** (2)	**22.** (1)	**23.** (2)	**24.** (8)
25. (2)	**26.** (2)	**27.** (3)	**28.** (4)	**29.** (300)	**30.** (2)	**31.** (2)	**32.** (3)
33. (1)	**34.** (4)	**35.** (1)	**36.** (1)	**37.** (3)	**38.** (2)	**39.** (4)	**40.** (3)
41. (1)	**42.** (3)	**43.** (2)	**44.** (2)	**45.** (3)	**46.** (4)	**47.** (3)	**48.** (1)
49. (2)	**50.** (2)	**51.** (3)	**52.** (2)	**53.** (1)	**54.** (4)	**55.** (2)	**56.** (4)
57. (1)	**58.** (3)	**59.** (2)	**60.** (2)	**61.** (1)	**62.** (3)	**63.** (3)	**64.** (1)
65. (2)	**66.** (3)	**67.** (1)	**68.** (6)	**69.** (1)	**70.** (3)	**71.** (3)	**72.** (3)
73. (36)	**74.** (1)	**75.** (3)	**76.** (2)	**77.** (12)	**78.** (24)	**79.** (2)	**80.** (2)
81. (1)	**82.** (4)	**83.** (3)	**84.** (30)	**85.** (4)	**86.** (2)	**87.** (15)	**88.** (2)
89. (3)	**90.** (2)	**91.** (2)	**92.** (1)	**93.** (1)	**94.** (3)	**95.** (10)	**96.** (21)
97. (1)	**98.** (2)	**99.** (5)	**100.** (30)	**101.** (2)	**102.** (4)	**103.** (82)	**104.** (492)
105. (4)	**106.** (4)	**107.** (3.33)	**108.** (2)	**109.** (25)	**110.** (25)	**111.** (2)	**112.** (1)
113. (2)	**114.** (346)	**115.** (3)	**116.** (2)	**117.** (1)	**118.** (3)	**119.** (4)	**120.** (1)
121. (2)	**122.** (4)	**123.** (2)	**124.** (4)	**125.** (1)	**126.** (4)		