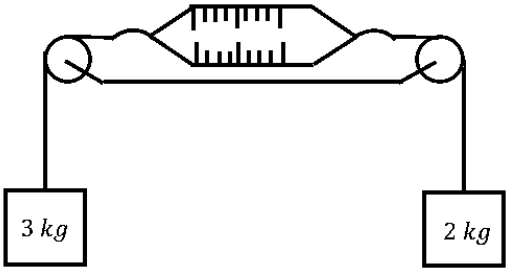
Chapter 6

Newton's Laws of Motion

Exercise

Spring Force

Q.1 Find the reading of the spring balance if it is assumed to be of negligible mass. (Take g = 10 m/s^2)



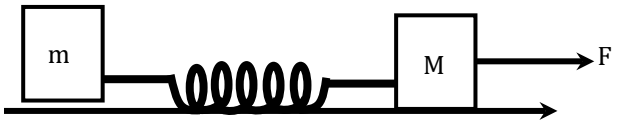
(A)3 kg **(B)**2 kg **(C)**2.5 kg **(D)**2.4 kg

Q.2 A block of mass 2 kg is suspended from the ceiling through a massless spring of spring constant k = 100 N/m. What will be the difference in the elongation of the spring, if another 1 kg mass is added to the mass of the block? (Take g = 10 m/s^2)

(A)0.1 m **(B)**0.2 m **(C)**0.3 m **(D)**0.5 m

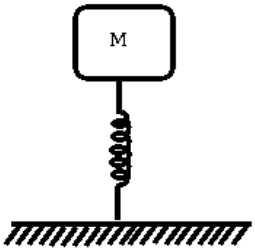
Net Force

Q.3 A block of mass m is connected to another block of mass M by a massless spring of spring constant k.The blocks are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is upstretched. Then a constant force F starts acting on the block of mass M to accelerate it. Find the force on the block of mass m.



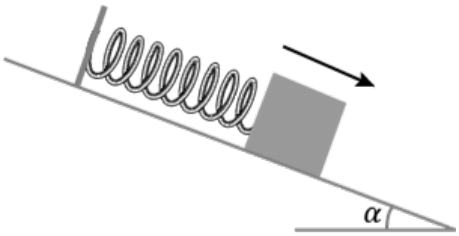
(A) $\frac{MF}{m+M}$ **(B)** $\frac{MF}{m}$ **(C)** $\frac{(M+m)F}{m}$ **(D)** $\frac{mF}{m+M}$

Q.4 A mass m is placed over spring of spring constant k. The acceleration of mass when the compression of the spring is xis.



(A) g **(B)**Zero **(C)** $\left(\frac{kx}{m} - g\right)$ **(D)**$\frac{kx}{m}$

Q.5 A block of mass $m = 15\ kg$ is attached to a spring of stiffness $k = 100\ N/m$. The block descends a plane inclined at an angle $\alpha = 30°$ with horizontal. Assuming there is no friction, determine the acceleration of the block when the spring has stretched by a length $x = 0.05\ m$(Acceleration due to gravity is 10 m/s^2)_____.



(A) 4.66 **(B)** 6.66 **(C)** 66.6 **(D)**66.4

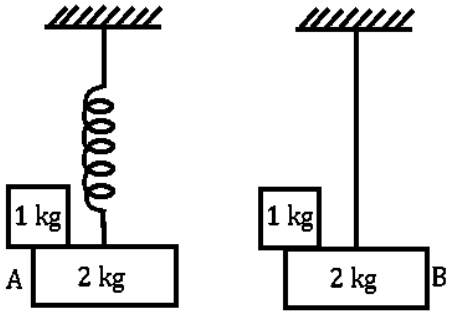
Spring Force

Q.6 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 5 m/s^2, the reading of the spring balance will be (take g = 9.8 m/s^2)

(A)49 N **(B)**24 N **(C)** 74 N **(D)**15 N

Net Force

Q.7 Find the acceleration (in m/s^2) of 2 kg block in the figures (A) and (B) shown at the instant when 1 kg block falls from 2 kg block (at t = 0). (Systems are in equilibrium at t = 0)
(Take g = 10 m/s^2)

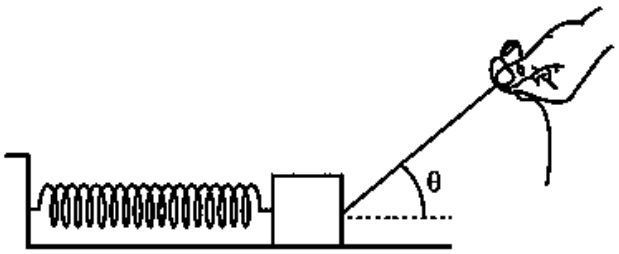


(A)0,0 **(B)**0,5 **(C)** 5,5 **(D)**5,0

Spring Force

Q.8 A block of mass m placed on a smooth floor is connected to a fixed support with the help of a spring of stiffness k. It is pulled by a rope as shown in the figure. Tension force T of the rope is increased gradually without changing its direction, until the block losses contact from the floor. The increase in rope tension T is so gradual that acceleration in the block can be neglected. What is the extension in the spring, when the block losses contact from the floor?

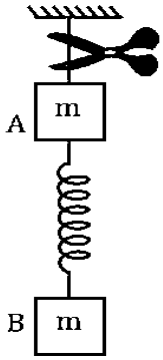
KT of the Problem



(A) $\frac{mg\cos\theta}{k}$ **(B)** $\frac{mg\sin\theta}{k}$ **(C)** $\frac{mg\tan\theta}{k}$ **(D)** $\frac{mg\cot\theta}{k}$

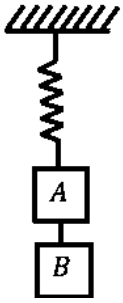
Net Force

Q.9 Two blocks ′A′ and ′B′ of same mass ′m′ connected by a light spring are suspended by a string as shown in figure. Find the acceleration of block ′A′ and ′B′ just after the string is cut.



(A) 0, 2 g **(B)** 0, 0 **(C)** g, g **(D)** 2g, 0

Q.10 Two blocks A and B of mass M and 2M respectively, are hanging from a ceiling by means of a massless spring and a light string as shown. If the string between the blocks is suddenly cut and the downward acceleration is taken positive, then what will be the acceleration of the block A and B?



(A) g, 2g **(B)** 2g, g **(C)** −2g, g **(D)** 2g, − g

WORK SHEET

Definite Integrals

Q.1 Find the Integral of $\int \frac{dx}{(x+1)(x+2)}$

(A) $\log\frac{x+2}{x+1} + C$ **(B)** $\log(x+1) + \log(x+2) + C$

(C) $\log\frac{x+1}{x+2} + C$ **(D)** $\log\frac{x}{x+2} + C$

Projectile Motion

Q.2 A body is projected vertically upwards at time $t = 0$ and it is seen at a height H at times t_1 and t_2 seconds during its flight. The maximum height attained is (g is acceleration due to gravity)

(A) $\frac{g(t_2-t_1)^2}{8}$ **(B)** $\frac{g(t_1+t_2)^2}{4}$ **(C)** $\frac{g(t_1+t_2)^2}{8}$ **(D)** $\frac{g(t_2-t_1)^2}{4}$

Vector Addition

Q.3 Two forces, with equal magnitude F, act on a body and the magnitude of the resultant force is $\frac{F}{3}$. The angle between the two forces is.

(A) $\cos^{-1}\left(-\frac{17}{18}\right)$ **(B)** $\cos^{-1}\left(-\frac{1}{3}\right)$ **(C)** $\cos^{-1}\left(-\frac{2}{3}\right)$ **(D)** $\cos^{-1}\left(-\frac{8}{9}\right)$

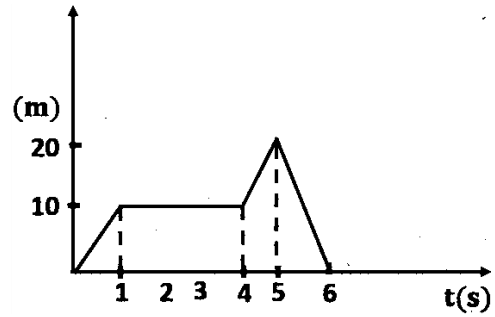
Motion in 1D

Q.4 A body starts from rest and travels with uniform acceleration such that it covers 8 m during the 2^{nd} second. Distance it would travel during 5^{th} second is.

(A) 20 m **(B)** 24 m **(C)** 28 m **(D)** 16 m

s − t Graph

Q.5 Figure shows the graph of x −coordinate of a particle moving along x −axis as a function of time. Average velocity during $x = 0$ to $x = 6$ s is.



(A) 10 m/s **(B)** 60 m/s **(C)** 5 m/s **(D)** 0 m/s

Horizontal And Verticle Components

Q.6 A body is projected with a velocity of 30 m/s at an angle of $60^o$to the horizontal. Find the magnitude of velocity when the angle between velocity vector and acceleration vector120^o.

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

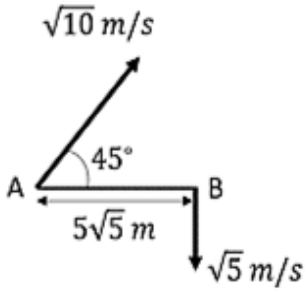
Projectile Motion

Q.7 Two particles are projected from the top of a tower with velocities 20 m/s and 80 m/s in horizontal but in opposite directions. After what time t their velocity vectors will be mutually perpendicular to each other?(Take g = 10 m/s^2)

(A)t = 2 s **(B)**t = 4 s **(C)**t = 6 s **(D)**t = 8 s

Q.8 Two particles start simultaneously from points A and B as shown in the figure. Then what is the minimum distance between them?

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



Q.9 Two cars C_1 and C_2 moving in the same direction on a straight single lane road with velocities 12 m/ sand 10 m/s respectively. When the separation between the two was 200 m, C_2 started accelerating to avoid collision. What is the minimum acceleration of car C_2 so that they don't collide?

(A)m/s^2 **(B)**1 cm/s^2 **(C)** 0.1 m/s^2 **(D)**0.01 cm/s^2

Relative velocity

Q.10 A boat which has a speed of 5 kmph in still water crosses a river of width 1 km along the shortest possible path in 15 minutes. The velocity of the river water in kmph is

(A)1 **(B)**3 **(C)** 4 **(D)**4/3

Combination of Spring

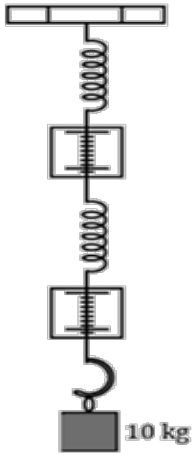
Q.11 A block of mass 10 kg is suspended through two light springs which are balanced as shown in the figure. Then

(A) Both the scales will read 10 kg.

(B) Both the scales will read 5 kg.

(C) The upper scale will read 10 kg and the lower one zero.

(D) The readings may be of any value, but their sum will be 10 kg.



Spring Force

Q.12 A block of 4 kg is suspended from the ceiling through a massless spring of spring constant k = 100 N/m. If 4 kg is replaced by 8 kg, what would be the ratio of elongation in 1st case to 2nd case?

(A) 1 **(B)** 2 **(C)** 1.5 **(D)** 0.5

Spring Force

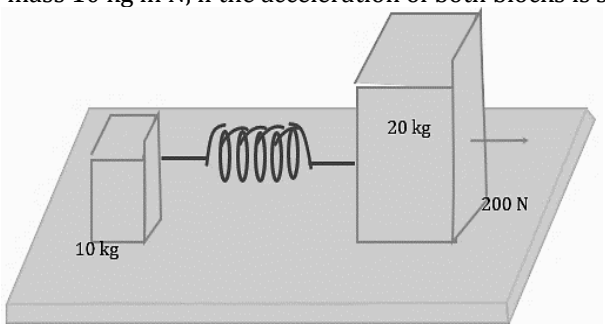
Q13 The two ends of a spring are displaced along the length of the spring. All the displacements have equal magnitudes. In which case or cases, the tension or compression in the spring will have maximum magnitude?

i. The right end is displaced towards right and the left end towards left.
ii. Both ends are displaced towards right.
iii. Both ends are displaced towards left.
iv. The right end is displaced towards left and the left end towards right.

(A) (i) and (iv) **(B)** only (ii) **(C)** (ii) and (iii) **(D)** only (iii)

Spring Force

Q.14 A block of mass 10 kg is connected to another block of mass 20 kg by a massless spring constant k. The blocks are kept on a smooth horizontal plane. Initially the blocks at at rest and the spring is upstretched. Then a constant force 200 N starts acting on the block of mass 20 kg to pull it. Find the force on the block of mass 10 kg in N, if the acceleration of both blocks is same.



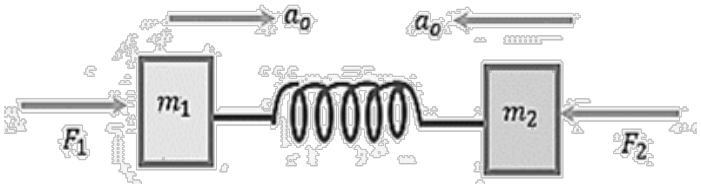
(A) 50/3 **(B)** 100/3 **(C)** 200/3 **(D)** 400/3

Spring Force

Q.15 The lengths of a spring are l_1 and l_2 when stretched with a force of 4 N and 5 N respectively. Its natural length is

(A) $l_2 + l_1$ **(B)** $2(l_1 - l_1)$ **(C)** $(l_2 - 4l_1)$ **(D)** $(5l_1 - 4l_2)$

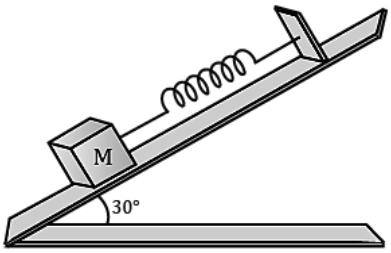
Q.16 Two blocks of masses m_1 and m_2 are connected with a light spring of force constant k and the whole system is kept on a frictionless horizontal surface. The masses are applied forces F_1 and F_2 as shown in figure. At any time, the blocks have same acceleration a_0 but in opposite directions. Then acceleration a_0 is



(A) $\frac{F_1 - F_2}{m_1 + m_2}$ **(B)** $\frac{F_1 - F_2}{m_1 - m_2}$ **(C)** $\frac{F_1 + F_2}{m_1 - m_2}$ **(D)** $\frac{F_1 + F_2}{m_1 + m_2}$

Spring Force

Q.17 A block of mass 5 kg is suspended by a spring balance on a frictionless inclined plane as shown in figure. The spring balance measures



(A)50 N **(B)**25 N **(C)** 500 N **(D)**10 N

Spring Force

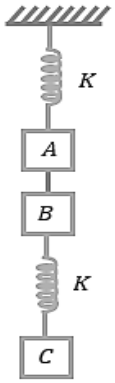
Q.18 A particle of mass 0.3 kg is subjected to a force $F = -kx$ with $k = 15\frac{N}{m}$. What will be the magnitude of its initial acceleration (in $\frac{m}{s^2}$) if it is released from a point $x = 20\ cm$ from its equilibrium position?

(A)10 **(B)**110 **(C) 20** **(D)**120

Combination of Spring

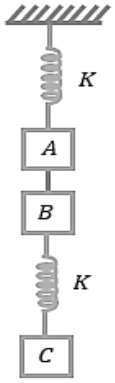
Q.19 The system shown is in equilibrium. Find the acceleration of the block A at the instant just after the spring between ceiling and A is cut. All blocks are of equal masses $'m'$ each and the springs are of equal stiffness. (Assume springs to be ideal).

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



Combination of Spring

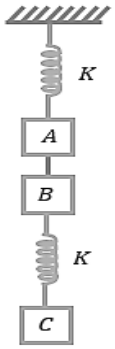
Q.20 The system shown is in equilibrium. Find the acceleration of the block C at the instant just after the spring between ceiling and A is cut. All blocks are of equal masses 'm' each and springs are of equal stiffness. (Assume springs to be ideal).



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

Combination of Spring

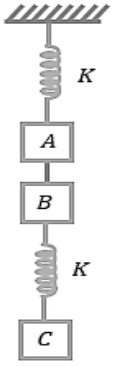
Q.21 The system shown is in equilibrium. Find the acceleration of the blocks A, B and C just after the strings between A and B is cut. All blocks are of equal masses $'m'$ each and springs are of equal stiffness. (Assume springs to be ideal and take downward acceleration to be positive).



(A) $0, \ +2g, \ +g$ **(B)** $0, \ +g, \ +g$ **(C)** $-2g, \ +2g, \ 0$ **(D)** $-2g, \ +2g, \ +g$

Combination of Spring

Q.22 The system shown is in equilibrium. Find the acceleration of the blocks A, B and C just after the spring between B and C is cut. All blocks are of equal masses ′m′ each and springs are of equal stiffness. (Assume springs to be ideal and take downward acceleration to be positive).

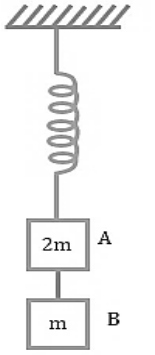


(A) $+g, \ +g, \ -g$ **(B)** $-\frac{g}{2}, \ -\frac{g}{2}, \ +g$ **(C)** $+g, \ -\frac{g}{2}, \ -g$ **(D)** $0, \ \frac{g}{2}, \ -g$

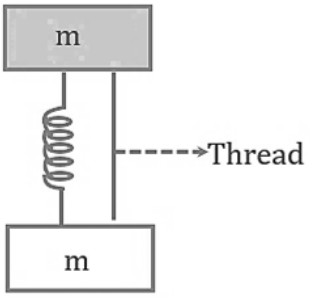
Combination of Spring

Q.23 Two blocks A and B of masses 2m and m, respectively, are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in the figure. The magnitude of acceleration of A and B, immediately after the string is cut, are respectively

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



Q.24 In the diagram, spring is connected between two blocks and it is in compressed state.
Statement-1: Normal reaction on lower block by ground is 2mg.
Statement-2: In equilibrium, net external force must be zero.



(A) Statement-1 is true, statement-2 is true; statement-2 is a correct explanation for statement-1.
(B) Statement-1 is true, statement-2 is true; but statement-2 is not a correct explanation for statement- **(C)** Statement-1 is true, statement-2 is false
(D) Statement-1 is false, statement-2 is true

ANSWER KEY

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