08/09/22

Laws of Motion

M.M.: 30

Class 11th

SECTION A

(MCQs. Do any 19 Ques.)

1. If a running bus stops suddenly, our feet stop due to friction, but the rest of the body continues to move forward due to

(a) momentum (b) force
(c) inertia (d) impulse

2. A smaller and a bigger iron balls are dropped from a small height on a glass pane placed on a table. Only bigger ball breakes the glass pane, because

(a) bigger ball transfers greater momentum than smaller
(b) bigger ball transfers lesser momentum than smaller
(c) bigger ball transfer equal momentum as smaller
(d) None of the above

3. A rocket is going upwards with accelerated motion. A man sitting in it feels his weight increased 5 times his own weight. If the mass of the rocket including that of the man is 1.0×10^4 kg, how much force is being applied by rocket engine? (Take, $g = 10\ \text{ms}^{-2}$).

(a) 5×10^4N (b) 5×10^5N
(c) 5×10^8N (d) 2×10^4N

4. The motion of a particle of mass m is described by $y = ut + gt^2$, find the force acting on the particle.

(a) Zero (b) mg
(c) $2mg$ (d) $3mg$

5. A bullet of mass 0.04 kg moving with a speed of 90 ms^{-1} enters a heavy wooden block and stopped after 3s. What is the average resistive force exerted by the block on the bullet?

(a) 1 N (b) 1.2 N
(c) 2 N (d) 3 N

6. The momentum p (in kg-ms^{-1}) of a particle is varying with time t (in second) as $p = 2 + 3t^2$. The force acting on the particle at $t = 3$ s will be

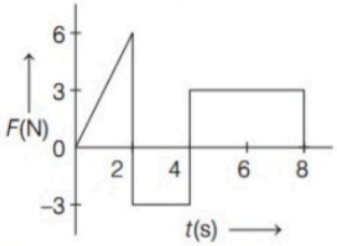
(a) 18 N (b) 54 N
(c) 9 N (d) 15 N

7. A machine gun fires a bullet of mass 40 g with a velocity of 1200 ms^{-1}. The man holding it can exert a maximum force of 144 N on the gun.

How many bullets can be fired per second at the most?

(a) Only one
(b) Three
(c) Can fire any number of bullets
(d) 144×48

8. The force F acting on a particle of mass m is indicated by the force-time graph shown below. The change in momentum of the particle over the time interval from 0 to 8s is

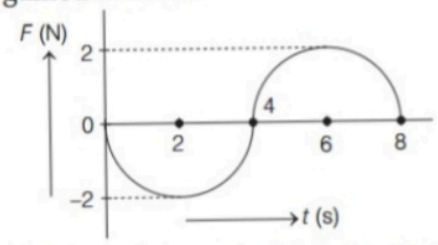


(a) 24 N-s (b) 20 N-s
(c) 12 N-s (d) 6 N-s

9. A particle of mass m is moving in a straight line with momentum p. Starting at time $t = 0$, a force $F = kt$ 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

(a) $\sqrt{\frac{2p}{k}}$ (b) $2\sqrt{\frac{p}{k}}$ (c) $\sqrt{\frac{2k}{p}}$ (d) $2\sqrt{\frac{k}{p}}$

10. The force-time (F-t) graph for linear motion of a body initially at rest is shown in figure. The segments shown are circular, the linear momentum gained in 4 s is



(a) 8 N-s (b) 4π N-s (c) 2π N-s (d) 8π N-s

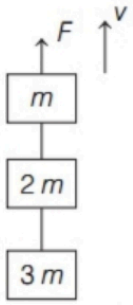
11. A shell of mass 200 g is fired by a gun of mass 100 kg. If the muzzle speed of the shell is 80 m/s, calculate the recoil speed of the gun.

(a) 16 cm/s (b) 18 m/s (c) 4 m/s (d) 16 m/s

12. Three concurrent coplanar forces 1 N, 2 N and 3 N are acting along different directions on a body can keep the body in equilibrium, if

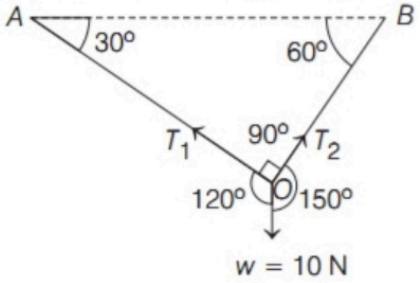
(a) 2 N and 3 N act at right angle
(b) 1 N and 2 N act at acute angle
(c) 1 N and 2 N act at right angle
(d) Cannot be possible

13. Three blocks with masses m, $2m$ and $3m$ are connected by strings, as shown in the figure. After an upward force F is applied on block m, the masses move upward at constant speed v. What is the net force on the block of mass $2m$? (Take, g is the acceleration due to gravity)



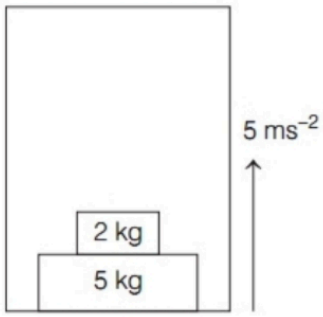
(a) Zero (b) $2\,mg$ (c) $3\,mg$ (d) $6\,mg$

14. A ball of mass 1 kg hangs in equilibrium from a two strings OA and OB as shown in figure. What are the tensions in strings OA and OB? (Take, $g = 10\ \text{ms}^{-2}$)



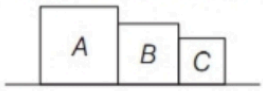
(a) 5 N, 5 N (b) $5\sqrt{3}$ N, $5\sqrt{3}$ N
(c) 5 N, $5\sqrt{3}$ N (d) $5\sqrt{3}$ N, 5 N

15. Find the force exerted by 5 kg block on floor of lift, as shown in figure. (Take, $g = 10\ \text{ms}^{-2}$)



(a) 100 N (b) 115 N
(c) 105 N (d) 135 N

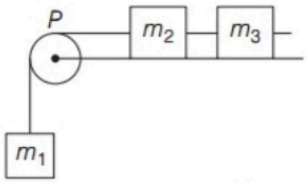
16. Three blocks A, B and C of masses 4 kg, 2 kg and 1 kg respectively, are in contact on a frictionless surface, as shown in the figure. If a force of 14 N is applied on the 4 kg block, then the contact force between A and B is



(a) 2 N (b) 6 N (c) 8 N (d) 18 N

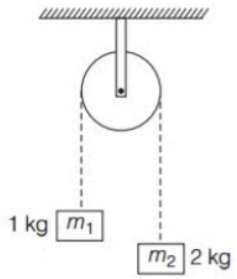
17. A system consists of three masses m_1, m_2 and m_3 connected by a string passing over a pulley P. The mass m_1 hangs freely and m_2 and m_3 are on a rough horizontal table (the coefficient of friction = μ).

The pulley is frictionless and of negligible mass. The downward acceleration of mass m_1 is (Assume, $m_1 = m_2 = m_3 = m$)



(a) $\frac{g(1-g\mu)}{9}$ (b) $\frac{2g\mu}{3}$
(c) $\frac{g(1-2\mu)}{3}$ (d) $\frac{g(1-2\mu)}{2}$

18. Two masses $m_1 = 1$ kg and $m_2 = 2$ kg are connected by a light inextensible string and suspended by means of a weightless pulley as shown in figure.



Assuming that both the masses start from rest, the distance travelled by 2 kg mass in 2 s is

(a) $\frac{20}{9}$ m (b) $\frac{40}{9}$ m

(c) $\frac{20}{3}$ m (d) $\frac{1}{3}$ m

19. A box of mass 2 kg is placed on the roof of a car. The box would remain stationary until the car attains a maximum acceleration. Coefficient of static friction between the box and the roof of the car is 0.2 and $g = 10\ \text{ms}^{-2}$. The maximum acceleration of the car, for the box to remain stationary, is

(a) $8\ \text{ms}^{-2}$ (b) $6\ \text{ms}^{-2}$

(c) $4\ \text{ms}^{-2}$ (d) $2\ \text{ms}^{-2}$

20. A car of mass m starts from rest and acquires a velocity along east, $\mathbf{v} = v\,\hat{\mathbf{i}}\ (v > 0)$ in two seconds. Assuming the car moves with uniform acceleration, the force exerted on the car is *(NCERT Exemplar)*

(a) $\frac{mv}{2}$ eastward and is exerted by the car engine

(b) $\frac{mv}{2}$ eastward and is due to the friction on the tyres exerted by the road

(c) more than $\frac{mv}{2}$ eastward exerted due to the engine and overcomes the friction of the road

(d) $\frac{mv}{2}$ exerted by the engine

21. Two stones of masses m and $2m$ are whirled in horizontal circles, the heavier one in a radius $\frac{r}{2}$ and the lighter one in a radius r. The tangential speed of lighter stone is n times that of the value of heavier stone, when they experience same centripetal forces. The value of n is

(a) 2 (b) 3 (c) 4 (d) 1

22. A person is driving a vehicle at a uniform speed of $5\ \text{ms}^{-1}$ on a level curved track of radius 5 m. The coefficient of static friction between tyres and road is 0.1. Will the person slip while taking the turn with the same speed? (Take, $g = 10\ \text{ms}^{-2}$)

(a) A person will slip, if $v^2 = 5\ \text{m}^2\text{s}^{-2}$

(b) A person will slip, if $v^2 > 5\ \text{m}^2\text{s}^{-2}$

(c) A person will slip, if $v^2 < 5\ \text{m}^2\text{s}^{-2}$

(d) A person will not slip, if $v^2 > 5\ \text{m}^2\text{s}^{-2}$

23. Inertia of an object is directly dependent on ..... .

(a) impulse (b) momentum

(c) mass (d) density

24. A body with mass 5 kg is acted upon by a force $\mathbf{F} = (-3\hat{\mathbf{i}} + 4\hat{\mathbf{j}})$ N. If its initial velocity at $t = 0$ is $u = (6\hat{\mathbf{i}} - 12\hat{\mathbf{j}})\text{ms}^{-1}$, the time at which it will just have a velocity along the Y-axis is ..... . *(NCERT Exemplar)*

(a) never (b) 10 s

(c) 2 s (d) 15 s

25. If impulse I varies with time t as $F(\text{kg ms}^{-1}) = 20t^2 - 20t$. The change in momentum is minimum at ..... .

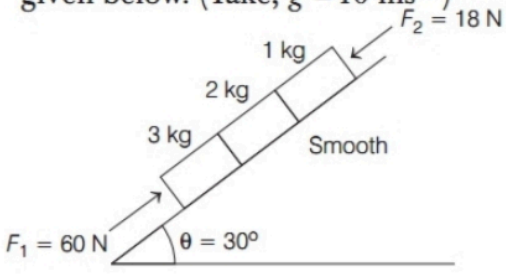
(a) $t = 2$s (b) $t = 1$s

(c) $t = \frac{1}{2}$s (d) $t = \frac{3}{2}$s

SECTION B

(Match the Column - 4 marks)

26. In the diagram shown in figure, match the Column I with Column II and select the correct option from the codes given below. (Take, $g = 10\ \text{ms}^{-2}$)



	Column I		Column II
A.	Acceleration of 2 kg block	p.	8 (SI unit)
B.	Net force on 3 kg block	q.	25 (SI unit)
C.	Normal reaction between 2 kg and 1 kg	r.	2 (SI unit)
D.	Normal reaction between 3 kg and 2 kg	s.	None

SECTION C

Assertion-Reasoning MCQs

(Do any 2 Questions)

For question numbers 27 *to* 29, *two statements are given-one labelled* ***Assertion*** *(A) and the other labelled* ***Reason*** *(R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) are as given below*

(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false and R is also false.

27. **Assertion** A seasoned cricketer allows a longer time for his hands to stop the ball, while catching the ball. His hand is not hurt.

Reason The novice (new player) keeps his hand fixed and tries to catch the ball almost instantly. He needs to provide a much greater force to stop the ball instantly and this hurts.

28. **Assertion** Newton's third law of motion is applicable only when bodies are in motion.

Reason Newton's third law does not applies to all types of forces, e.g. gravitational, electric or magnetic forces, etc.

29. **Assertion** A body of mass 1 kg is making 1 rps in a circle of radius 1 m. Centrifugal force acting on it is $4\pi^2$ N.

Reason Centrifugal force is given by $F = \frac{mv}{r}$.

SECTION D

Case Study Based MCQs

(All Questions are compulsory)

30. A satellite in force-free space sweeps stationary interplanetary dust at a rate $\frac{dM}{dt} = \alpha v$, where M is the mass, v is the velocity of satellite and α is a constant. What is the deceleration of the satellite?

(a) $\frac{-2\alpha v^2}{M}$ (b) $\frac{-\alpha v^2}{M}$
(c) $-\alpha v^2$ (d) $\frac{\alpha v^2}{M}$

31. A body of mass 5 kg is moving with velocity of $v = (2\hat{i} + 6\hat{j})\ ms^{-1}$ at $t = 0$ s. After time $t = 2$ s, velocity of body is $(10\hat{i} + 6\hat{j})\ ms^{-1}$, then change in momentum of body is

(a) $40\hat{i}$ kg-ms^{-1}
(b) $20\hat{i}$ kg-ms^{-1}
(c) $30\hat{i}$ kg-ms^{-1}
(d) $(50\hat{i} + 30\hat{j})$ kg-ms^{-1}

32. A cricket ball of mass 0.25 kg with speed 10 m/s collides with a bat and returns with same speed with in 0.01s. The force acted on bat is

(a) 25 N (b) 50N
(c) 250N (d) 500N

33. A stationary bomb explodes into three pieces. One piece of 2 kg mass moves with a velocity of 8 ms^{-1} at right angles to the other piece of mass 1 kg moving with a velocity of 12 ms^{-1}. If the mass of the third piece is 0.5 kg, then its velocity is

(a) 10 m s^{-1} (b) 20 ms^{-1}
(c) 30 m s^{-1} (d) 40 ms^{-1}

34. A force of 10 N acts on a body of mass 0.5 kg for 0.25s starting from rest. What is its momentum now?

(a) 0.25 N/s (b) 2.5 N/s
(c) 0.5 N/s (d) 0.75 N/s