



PHYSICS

NCERT - NCERT PHYSICS(ENGLISH)

FORCE AND LAW OF MOTION

Solved Examples

1. A constant force acts on object of mass 5 kg for a duration of 2s It increases the object's velocity from $3m/s$ to $7m/s$ Find the

magnitude of the applied force. Now if the force were applied for a duration of $5s$ what would be the final velocity of object?



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2. Which would requires a greater force: accelerating a $2kg$ mass at $5m/s^2$ or a $4kg$ mass at $2m/s^2$?



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3. A motor car is moving with a velocity of $108\text{km}/\text{h}$ and it takes 4sec to stop after the brakes are applied. Calculate the force exerted by the brakes on the motorcar if its mass along with the passenger is 1000kg .



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4. A force of 5N gives a mass m_1 , an acceleration of $10\text{m}/\text{s}^2$, and a mass m_2 , an acceleration of $20\text{m}/\text{s}^2$. What acceleration

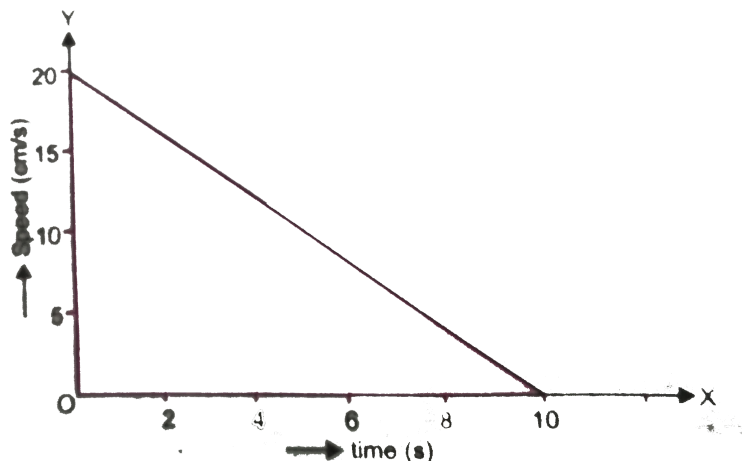
would it give if both the masses were tied together?



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5. The velocity time graph of a ball of mass $20g$ moving along a straight line on a long table is given in (figure) How much force does the

table exert on the ball to bring it to rest?



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6. A bullet of mass $20g$ is fired horizontally with a velocity of $150ms^{-1}$ from a pistol of mass $2kg$. What is the recoil velocity of the pistol?



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7. A girl of mass 40kg jumps with a horizontal velocity of 5m/s onto a stationary cart with frictionless wheels. The mass of the cart is 3kg . What is her velocity as the cart starts moving? Assume that there is no external unbalanced force working in the horizontal direction.



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8. Two hockey players of opposite teams, while trying to hit a hockey ball on the ground collide and immediately become entangled. One has a mass of 60kg , and was moving with a velocity 5.0m/s , while the other has a mass of 55kg and was moving faster with a velocity of 6.0m/s towards the first player. In which direction and with what velocity will they move after they become entangled? Assume that the frictional force acting between the feet of the two players and ground is negligible.



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Exercise

1. Which of the following has more inertia: (a) a rubber ball and a stone of the same size? (b) a bicycle and a train (c) a five-rupees coin and a one-rupee coin?



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2. In the following example, try to identify the number of times the velocity of the ball changes:

"A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team"?

Also identify the agent supplying the force in each case.



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3. Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.



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4. Why do you fall in the forward direction when a moving bus brakes to a stop and fall backwards when it accelerates from rest?



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5. If action is always equal to the reaction, explain how a horse can pull a cart.



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6. Explain, why is it difficult for a fireman to hold a hose, which ejects large amount of water at a high velocity?



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7. From a rifle of mass 4kg , a bullet of mass 50g is fired with an initial velocity of 35m/s . Calculate the initial recoil velocity of the rifle.



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8. Two objects of masses 100g and 200g are moving along the same line in the same direction with velocities of 2m/s and 1m/s , respectively. They collide and after the collision, the first object moves at a velocity of 1.67m/s

in the same direction. Determine the velocity of the second object.



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9. An object experiences a net zero external unbalanced force. Is it possible for the object to be travelling with a non-zero velocity? If yes, state the conditions that must be placed on the magnitude and direction of the velocity. If no, provide a reason.



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10. When a carpet is beaten with a stick, dust comes out of it, Explain.



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11. Why is it advised to tie any luggage kept on the roof of a bus with a rope?



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12. A batsman hits a cricket ball which then rolls on a level ground. After covering a short distance, the ball comes to rest. The ball slows to a stop because (a) the batsman did not hit the ball hard enough, (b) velocity is proportional to the force exerted on the ball, (c) there is a force on the ball opposing the motion ,(d) there is no unbalanced force on the ball, so the ball would want to come to rest.



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13. A truck starts from rest and rolls down a hill with a constant acceleration. It travels a distance of $400m$ in $20s$. Find its acceleration. Find the force acting on it if its mass is 7 metric tonnes (Hint.1 metric tonne=1000kg)



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14. A stone of $1kg$ is thrown with a velocity of $20ms^{-1}$ across the frozen surface of lake and comes to rest after travelling a distance of

50m. What is the force of friction between the stone and the ice?



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15. A 8000kg engine pulls a train of 5 wagons , each of 2000kg , along a horizontal track. If the engine exerts a force of 40000N and the track offers a frictional force of 5000N , then calculate:

(a) the net accelerating force, (b) the

acceleration of the train, and

(c) the force of wagon 1 on wagon 2.



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16. An automobile vehicle has a mass of 1500kg What must be the force between the vehicle and road if the vehicle is to be stopped with a negative acceleration of $1.7\text{m} / \text{s}^2$?



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17. What is the momentum of an object of mass m , moving with a velocity v ?

A. $(mv)^2$

B. mv^2

C. $1/2mv^2$

D. mv

Answer: d



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18. Using a horizontal force $200N$, we intend to move a wooden cabinet across a floor at constant velocity. What is the frictional force that will be exerted on the cabinet?



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19. Two object, each of mass $1.5kg$, are moving in the same straight line but in opposite directions, The velocity of each object is $2.5ms^{-1}$ before the collision during which

they stick together. What will be the velocity of the combined object after collision?



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20. According to the third law of motion, when we push on an object, the object pushes back on us with an equal and opposite force. If the object is a massive truck parked along the roadside, it will probably not move. A student justifies this by answering that the two opposite and equal forces cancel each other.

Comment on this logic and explain why the truck does not move.



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21. A hockey ball of mass $200g$ travelling at $10m/s$ is struck by a hockey stick so as to return it along its original path with a velocity of $5m/s$. Calculate the change in momentum of the hockey ball by the force applied by the hockey stick.



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22. A bullet of mass $10g$ travelling horizontally with a velocity of $150ms^{-1}$ strikes a stationary wooden block and come to rest in $0.03s$. Calculate the distance of penetration of the bullet into the block. Also, Calculate the magnitude of the force exerted by the wooden block on the bullet,



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23. An object of mass 1kg travelling in a straight line with a velocity of 10m/s collides with, and sticks to, a stationary wooden block of mass 5kg . Then, they both move off together in the same straight line. Calculate the total momentum just before the impact and just after the impact. Also, calculate the velocity of the combined object.



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24. An object of mass 100kg is accelerated uniformly from a velocity of 5m/s to 8m/s in 6s . Calculate the initial and final momentum of the object. Also, find the magnitude of the force exerted on the object.



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25. Akhtar, Kiran and Rahul were riding in a motorcar that was a high velocity on an expressway when an insect hit the windshield

and got stuck on the windscreen . Akhtar and Kiran started pondering over the situation. Kiran suggested that the insect suffered a greater change in momentum as compared to the change in momentum of the motorcar (because the change in the velocity of the insect was much more than that of the motorcar). Akhtar said that since the motorcar was moving with a larger velocity, it exerted a larger force on the insect. And as a result, the insect died. Rahul while putting an entirely new explanation said that both the motorcar and the insect experienced the same force and

a change in their momentum. Comment on these suggestions.



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26. How much momentum will a dumb-bell of mass 10kg transfer to the floor if it falls a height of 80cm ? Take its downward acceleration to be $10\text{m} / \text{s}^2$.



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27. The following is the distance-time table of an object in motion:

Time in seconds	Distance in metres
0	0
1	1
2	8
3	27
4	64
5	125
6	216
7	343

(a) What conclusion can you draw about the acceleration? Is it constant, increasing, decreasing, or zero?

(b) What do you infer about the forces acting on the object?



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28. Two persons manage to push a motorcar of mass 1200kg at a uniform velocity along a level road. The same motorcar can be pushed by three persons to produce an acceleration of 0.2m/s^2 . With what force does each person push the motorcar? (Assume that all persons push the motorcar with the same muscular effort).



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29. A hammer of mass $500g$, moving at $50m/s$, strikes a nail. The nail stops the hammer in a very short time of $0.01s$. What is the force of the nail on the hammer?



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30. A motorcar of mass $1200kg$ is moving along a straight line with a uniform velocity of $90km/h$. Its velocity is slowed down to $18km/h$ in $4s$ by an unbalanced external

force. Calculate the acceleration and change in momentum. Also, calculate the magnitude of the force required.



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31. A large truck and a car, both moving with a velocity of magnitude v , have a head-on collision and both of them come to a halt after that. If the collision lasts for 1 s :

(a) Which vehicle experiences the greater force of impact?

(b) which vehicle experiences the greater change in momentum?

(c) which vehicle experiences the greater acceleration?

(d) why is the car likely to suffer more damage than the truck?



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