



# PHYSICS

## BOOKS - PRINCETON PHYSICS (ENGLISH)

### LINEAR MOMENTUM

#### Examples

1. What is the linear momentum of a car of mass 1,000 kg that is moving at a speed of 20

m/s? what is the momentum of a truck of mass 5,000 kg moving at the same speed?



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2. A football team's kicker punts the ball (mass=0.42 kg) and gives it a launch speed of 30m/s. find the impulse delivered to the football by the kicker's foot and the average force exerted by the kicker on the ball, given that the impact time is 0.0020 s.



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3. An 80 kg stuntman jumps out of a window that's 45m above the ground

Q. How fast is he falling when he reaches ground level?



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4. An 80 kg stuntman jumps out of a window that's 45m above the ground

Q. He lands on a large, air-filled target, coming

to rest in 1.5 s. what average force does he feel while coming to rest?



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5. An 80 kg stuntman jumps out of a window that's 45m above the ground

Q. What if he had instead landed on the ground (impact time=10 ms)?



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6. A small block is struck by a force  $F$  whose strength varies with time according to the following graph:



What is the impulse delivered to the block?



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7. An astronaut is floating in space near her shuttle when she realizes that the cord that's supposed to attach her to the ship has

become disconnected. Her total mass (body+suit+equipment) is 91kg. She reaches into her pocket, finds a 1 kg metal tool, and throws it out into space with a velocity of 6m/s directly away from the ship. if the ship is 10 m away, how long will it take her to reach it?



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**8.** Two balls roll towards each other. The red ball has a mass kg 0.5 kg and a speed of 4 m/s

just before impact. The green ball has a mass of 0.3 kg and a speed of 2m/s. after the head-on collision, the red ball continues forward with a speed of 2m/s. find the speed of the green ball after the collision. was the collision elastic?



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**9.** Two balls roll toward each other. The red ball has a mass of 0.5 kg and a speed of 4m/s just before impact. The green ball has a mass

of 0.3 kg and a speed of 2 m/s. if the collision is perfectly inelastic, determine the velocity of the composite object after the collision.



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**10.** A block of mass  $M=4\text{kg}$  is moving with velocity  $V=6\text{m/s}$  toward a target block of mass  $=2\text{kg}$ , which is stationary ( $v=0$ ). The object collide heat-on, and immediately after the collision, the speed of block  $m$  is 4 times the speed of block  $M$ .



Q. What is the speed of block M after the collision?



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11. A block of mass  $M=4\text{kg}$  is moving with velocity  $V=6\text{m/s}$  toward a target block of mass  $m=2\text{kg}$ , which is stationary ( $v=0$ ). The objects collide head-on, and immediately after the collision, the speed of block  $m$  is 4 times the speed of block  $M$ .

Q. Is the collision elastic?



## Comprehensive Drill

1. An object of mass 2 kg has linear momentum magnitude  $6 \text{ kg} \cdot \text{m} / \text{s}$ . What is this object's kinetic energy?

A. 3J

B. 6J

C. 9J

D. 12J

**Answer: C**



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2. A ball of mass  $0.5 \text{ kg}$ , initially at rest, acquires a speed of  $4 \text{ m/s}$  immediately after being kicked by a force of strength  $20 \text{ N}$ . for how long did this force act on the ball?

A.  $0.01\text{s}$

B.  $0.02\text{s}$

C.  $0.1\text{s}$

D. 0.2s

**Answer: C**



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**3.** A box with a mass of 2kg accelerates in a straight line from 4 m/s to 8m/s due to the application of a force whose duration is 0.5 s. find the average strength of this force.

A. 2N

B. 4N

C. 8N

D. 16N

**Answer: D**



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4. A ball of mass  $m$  travelling horizontally with velocity  $v$  strikes a massive vertical wall and rebounds back along its original direction with

no change in speed. What is the magnitude of the impulse delivered by the wall to the ball?

A. 0

B.  $\frac{1}{2}mv$

C.  $mv$

D.  $2mv$

**Answer: D**



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5. Two objects, one of mass 3 kg and moving with speed of 2 m/s and the other of mass 5 kg and speed 2 m/s, move toward each other and collide head-on. If the collision is perfectly inelastic, find the speed of the object after the collision.

A. 0.25m/s

B. 0.5m/s

C. 0.75m/s

D. 1m/s

**Answer: B**



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6. Object #1 moves toward object #2, whose mass is twice that of object #1 and which is initially at rest. After their impact, the objects lock together and move with what fraction of object #1's initial kinetic energy?

A.  $\frac{1}{18}$

B.  $\frac{1}{9}$



C.  $\frac{1}{6}$

D.  $\frac{1}{3}$

**Answer: D**



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7. Two objects move toward each other, collide, and separate. If there was not net external force acting on the object, but some kinetic energy was lost, then

A. the collision was elastic and total linear momentum was conserved

B. the collision was elastic and total linear momentum was not conserved

C. the collision was not elastic and total linear momentum was conserved

D. the collision was not elastic and total linear momentum was not conserved

**Answer: C**



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8. A wooden block of mass  $M$  is moving at speed  $V$  in a straight line



How fast would be bullet of mass  $m$  need to travel to stop the block (assuming that the bullet became embedded inside)?

A.  $mV/(m+M)$

B.  $MV/(m+M)$

C.  $mV/M$

D.  $MV/m$

**Answer: D**



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9. Which of the following best describes a perfectly inelastic collision free of external forces ?

A. Total linear momentum is never conserved

B. Total linear momentum is sometimes  
(but not always) conserved.

C. kinetic energy is never conserved.

D. Kinetic energy is sometimes (but not  
always conserved).

**Answer: C**



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