

## Kinetic Energy

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### *Quick Concepts*

- A. In words, what is kinetic energy?
- B. What is the equation (and therefore the definition) of kinetic energy?
- C. What are the units used for kinetic energy?
- D. Is kinetic energy a vector or a scalar? Why?
- E. Can *kinetic energy* ever be negative? Why?

### *Calculations*

1. How much kinetic energy does a 65 kg person running at 2 m/s have?
2. How fast is a 1500 kg car moving if it has a kinetic energy of 200,000 J?
3. What is the mass of something moving at 12 m/s that has a kinetic energy of 1000 J?
4. What is the kinetic energy of a 0.0001 kg bee flying at 5 m/s?
5. A 1200 kg car is driving down the road with a speed of 5 m/s.
  - a. What is the kinetic energy of the car?
  - b. If the car gains 50,000 J of kinetic energy, how much kinetic energy would it have?
  - c. And so how fast would it then be going?
6. A 3 kg box is sliding along the floor. It has an initial speed of 8 m/s.
  - a. How much kinetic energy does it have?
  - b. If it loses 60 J of kinetic energy, how fast will it be going?
7. If you gain kinetic energy, what has to happen to you?
8. If you lose kinetic energy, what has to happen to you?

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9. Both momentum and kinetic energy depend on *mass* and *velocity*.
- Is it possible to have a constant kinetic energy, but a changing momentum? Explain.
  - How about a constant momentum and a changing kinetic energy? Explain.
10. a. Which has more kinetic energy: a mass of 1 kg moving at 2 m/s or a mass of 2 kg moving at 1 m/s?
- b. Which has more momentum: a 1 kg object moving at 2 m/s or a 2 kg object moving at 1 m/s?
11. Imagine there are two objects traveling in opposite directions. A mass of 5 kg moving at 4 m/s to the left and a mass of 5 kg moving at 4 m/s to the right.
- What is the total kinetic energy of the two objects?
  - What is the total momentum of the two objects?
12. Imagine you are driving down the road with a certain speed.
- If you double your speed, how much does your kinetic energy change? how about momentum?
  - If you triple your speed, how much does your kinetic energy change? how about momentum?
  - If you cut your speed in half, what happens to your kinetic energy? how about momentum?

*Answers:*

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|--|----------------|--|--------------|
| 1) 130 J   | 2) 16.3 m/s    | 3) 13.9 kg                                       | 4) 0.00125 J |
| 5. a) 15,000 J                                   | b) 65,000 J    | c) 10.4 m/s                                      |              |
| 6. a) 96 J                                       | b) 4.9 m/s     | 7) speed up                                      | 8) slow down |
| 9. a) Yes. Changing direction at constant speed. |                | b) No. Constant momentum implies constant speed. |              |
| 10. a) the 1 kg mass (2 J vs. 1 J)               |                | b) they are the same. both 2 kgm/s               |              |
| 11. a) 80 J                                      | b) 0 kgm/s     |  |              |
| 12. a) 4x K & 2x p                               | b) 9x K & 3x p | c) 1/4 K & 1/2 p                                 |              |