

2. Force and Translational Dynamics

Starter Quiz · 课前小测

AP Physics C: Mechanics

Name: _____ Score: _____

1. A 1 kg mass is at $x = 0$ and a 3 kg mass is at $x = 4$ m. Where is the center of mass (in m)?
_____ m
2. Which of these is a **field** force (acts without contact)?
 - ☐ friction
 - ☐ gravity
 - ☐ the normal force
 - ☐ tension in a rope
3. A truck (3000 kg) hits a car (1000 kg). During the crash, the force the truck exerts on the car compared with the force the car exerts on the truck is...
 - ☐ much larger (the truck is heavier)
 - ☐ exactly equal and opposite
 - ☐ much smaller
 - ☐ zero
4. An object moving at constant velocity must have a nonzero net force pushing it.
 - ☐ True ☐ False
5. A net force of 20 N acts on a 4 kg cart. What is its acceleration (in $\frac{\text{m}}{\text{s}^2}$)?
_____ m/s^2
6. An astronaut has a mass of 70 kg. What is her weight on Earth (in N, use $g = 9.8$)?
_____ N
7. A box has normal force $N = 50$ N and $\mu_s = 0.6$. What is the maximum static friction (in N)?
_____ N
8. A 6 N force stretches a spring by 0.30 m. What is its spring constant (in N/m)?
_____ N/m
9. A hidden explosion inside a floating system (no outside forces) can shift its center of mass.
 - ☐ True ☐ False
10. The two forces of an action-reaction pair cancel each other out.
 - ☐ True ☐ False

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Answers · 答案

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1. **3 m**
$$x_{cm} = \frac{1(0) + 3(4)}{1 + 3} = \frac{12}{4} = 3 \text{ m} - \text{close to the heavier mass.}$$
2. **gravity**
Gravity is a field force acting at a distance; friction, normal, and tension all require contact.
3. **exactly equal and opposite**
Third-law forces are always equal and opposite, regardless of mass. (The car accelerates more because it has less mass, not more force.)
4. **False**
Constant velocity means zero net force. A force is needed only to *change* velocity, not to maintain it.
5. **5 m/s^2**
$$a = \frac{F_{net}}{m} = \frac{20}{4} = 5 \frac{\text{m}}{\text{s}^2}.$$
6. **686 N**
$$F_g = mg = 70 \times 9.8 = 686 \text{ N.}$$
7. **30 N**
$$f_s^{max} = \mu_s N = 0.6 \times 50 = 30 \text{ N.}$$
8. **20 N/m**
$$k = F/x = 6/0.30 = 20 \frac{\text{N}}{\text{m}}.$$
9. **False**
Explosion forces are *internal*, so they cannot move the center of mass. Only a net external force can.
10. **False**
They act on *different* objects, so they never cancel. Cancellation needs both forces on the same object.