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

   ☐ the normal force

   ☐ gravity

   ☐ 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...

   ☐ exactly equal and opposite

   ☐ zero

   ☐ much larger (the truck is heavier)

   ☐ much smaller

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 resistive force grows larger as the object moves faster.

   ☐ True ☐ False

10. An object moving in a circle at constant speed is accelerating.

    ☐ True ☐ False

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1. **3 m**

   $x_{cm} = \dfrac{1(0) + 3(4)}{1 + 3} = \dfrac{12}{4} = 3$ m – 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**

   $a = \dfrac{F_{net}}{m} = \dfrac{20}{4} = 5\ \frac{\text{m}}{\text{s}^2}$.

6. **686 N**

   $F_g = mg = 70 \times 9.8 = 686$ N.

7. **30 N**

   $f_s^{max} = \mu_s N = 0.6 \times 50 = 30$ N.

8. **20 N/m**

   $k = F/x = 6/0.30 = 20\ \frac{\text{N}}{\text{m}}$.

9. **True**

   Unlike ordinary friction, drag increases with speed – that is why it can eventually balance gravity.

10. **True**

    Its direction changes, so its velocity changes – that is an acceleration, even at constant speed.