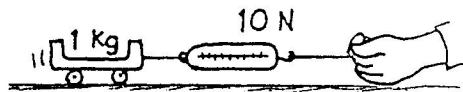CONCEPTUAL **Physical Science** PRACTICE SHEET

Chapter 2: Newton's Laws of Motion
Dropping Masses and Accelerating Cart

1. Consider the simple case of a 1-kg cart being pulled by a 10-N applied force. According to Newton's 2nd law, acceleration of the cart is

$$a = \frac{F}{m} = \frac{10\,N}{1\,kg} = 10\,m/s^2$$

> This is the same as the acceleration of free fall, *g*—because a force equal to the cart's weight accelerates it.

2. Now consider the acceleration of the cart when a second mass is also accelerated. This time the applied force is due to a 10-N iron weight attached to a string draped over a pulley. Will the cart accelerate as before, at 10 m/s²? The answer is no, because the mass being accelerated is the mass of the cart *plus* the mass of the piece of iron that pulls it. Both masses accelerate. The mass of the 10-N iron weight is 1 kg—so the total mass being accelerated (cart + iron) is 2 kg. Then,

> The pulley changes only the direction of the force.

$$a = \frac{F}{m} = \frac{10\,N}{2\,kg} = 5\,m/s^2.$$
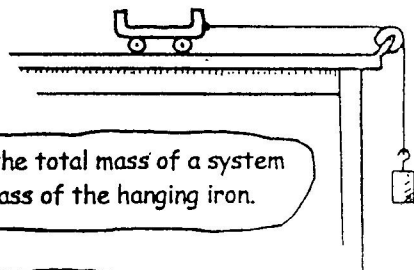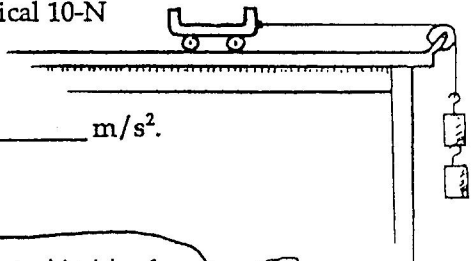
> Don't forget; the total mass of a system includes the mass of the hanging iron.

> Note this is half the acceleration due to gravity alone, *g*. So the acceleration of 2 kg produced by the weight of 1 kg is *g/2*.

(a) Find the acceleration of the 1-kg cart when two identical 10-N weights are attached to the string.

$$a = \frac{F}{m} = \frac{unbalanced\ force}{total\ mass} = \underline{\hspace{3cm}} = \underline{\hspace{1.5cm}}\,m/s^2.$$

> Note that the mass being accelerated is 1 kg for the cart + 1 kg each for the weights = 3 kg.