Name _____ Date _____

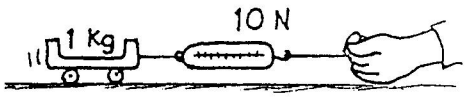
CONCEPTUAL **Physical Science** PRACTICE SHEET

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

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

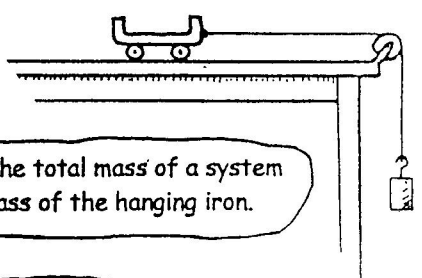


This is the same as the acceleration of free fall, *g*—because a force equal to the cart's weight accelerates it.

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,

$$a = \frac{F}{m} = \frac{10\ \text{N}}{2\ \text{kg}} = 5\ \text{m/s}^2.$$

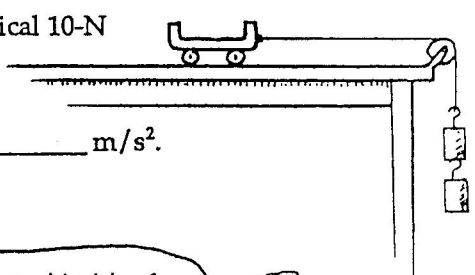
The pulley changes only the direction of the force.



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.



$$a = \frac{F}{m} = \frac{\text{unbalanced force}}{\text{total mass}} = \frac{\qquad}{\qquad} = \_\_\_\_\_\ \text{m/s}^2.$$

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