LESSON MAKER PRO

Forces in Motion

Calculate how force and mass affect acceleration.

HIGH SCHOOL · PHS.5.4

PHS.5.4 "Use mathematical and computational analyses to show the relationships among force, mass, and acceleration (i.e., Newton's second law)."

NAME _____ DATE _____

THE BIG IDEA

Net force is the combined force on an object. Newton's second law is $F_{net} = ma$, where force is measured in newtons, mass in kilograms, and acceleration in m/s^2. If forces act in opposite directions, subtract their sizes to find the net force and its direction.

WORKED EXAMPLE

A 9 kg cart accelerates at 4 m/s^2. What net force acts on it?

1. Start with $F_{net} = ma$.
2. Substitute: $F_{net} = (9\ kg)(4\ m/s^2)$.
3. Multiply: $F_{net} = 36$ N.

Answer: 36 N

PRACTICE 6 problems

1 A 6 kg object accelerates at 2 m/s^2. Find the net force.

ANSWER _____

2 An 8 kg object accelerates at 5 m/s^2. Find the net force.

ANSWER _____

3 A net force of 30 N acts on a 10 kg object. Find its acceleration.

ANSWER _____

4 A net force of 42 N produces an acceleration of 7 m/s^2. Find the object's mass.

ANSWER _____

5 A 44 N force acts right and a 14 N force acts left on a 6 kg object. Find its acceleration and direction.

ANSWER _____

6 The same 60 N net force acts on a 12 kg cart and a 20 kg cart. Find each cart's acceleration.

ANSWER _____

APPLY IT Show your work

1 An electric skateboard and its rider have a combined mass of 15 kg. The net forward force is 90 N. What is their acceleration?

WORK SPACE

ANSWER _____

2 In a robotics match, one robot pushes a 10 kg robot with 70 N to the right. Another robot pushes it with 20 N to the left. What is the 10 kg robot's acceleration?

WORK SPACE

ANSWER _____

CHALLENGE One step up

A motor pushes a 20 kg sound cart with 75 N to the right while friction acts with 15 N to the left. Then equipment is added, raising the cart's mass to 30 kg. Both forces stay the same. Calculate the cart's new acceleration and explain in one sentence why it is less than before.

WORK SPACE AND ANSWER

Forces in Motion

PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	A 6 kg object accelerates at 2 m/s^2. Find the net force.	**12 N**
2	An 8 kg object accelerates at 5 m/s^2. Find the net force.	**40 N**
3	A net force of 30 N acts on a 10 kg object. Find its acceleration.	**3 m/s^2**
4	A net force of 42 N produces an acceleration of 7 m/s^2. Find the object's mass.	**6 kg**
5	A 44 N force acts right and a 14 N force acts left on a 6 kg object. Find its acceleration and direction.	**5 m/s^2 to the right**
6	The same 60 N net force acts on a 12 kg cart and a 20 kg cart. Find each cart's acceleration.	**12 kg cart: 5 m/s^2; 20 kg cart: 3 m/s^2**

PART 2 · APPLY IT

1. **6 m/s^2 forward** Divide the net force by the combined mass: 90 N / 15 kg = 6 m/s^2 forward.
2. **5 m/s^2 to the right** The net force is 70 N − 20 N = 50 N to the right. Divide by 10 kg to get 5 m/s^2 to the right.

CHALLENGE

2 m/s^2 to the right. The net force stays at 60 N, so increasing the mass from 20 kg to 30 kg reduces the acceleration from 3 m/s^2 to 2 m/s^2.

Accept equivalent unit notation, such as m/s^2. For directional answers, require the correct direction as well as the value.