Forces and Newton's Laws of Motion

Ages 12–15 · Science

Name _____ Class _____ Date _____

A Key terms: match each term to its meaning

Write the letter of the correct meaning in the box next to each term.

1 **Force**	☐	**A** Two equal and opposite forces of the same type that two objects exert on each other (Newton's third law).
2 **Resultant force**	☐	**B** The amount of matter in an object, measured in kilograms (kg); it is the same everywhere.
3 **Balanced forces**	☐	**C** A push or a pull on an object, with both size and direction, measured in newtons (N).
4 **Inertia**	☐	**D** The single force that has the same effect as all the forces acting on an object combined.
5 **Mass**	☐	**E** The force of gravity on an object, measured in newtons: W = mg.
6 **Weight**	☐	**F** Resultant force equals mass times acceleration (F = ma).
7 **Newton's second law**	☐	**G** Forces whose resultant is zero, so the object's motion does not change.
8 **Interaction pair**	☐	**H** The tendency of an object to keep doing what it is doing: to stay at rest or keep moving at the same velocity.

B Quick quiz

Circle the best answer, write its letter, then explain your choice in a few words.

1 A box has a 40 N push to the right and a 15 N friction force to the left. What is the resultant force?

a) 55 N to the right **b)** 25 N to the left
c) 25 N to the right **d)** 40 N to the right

Answer: _____ Why? _____

2 A spacecraft drifts through deep space with its engines off and no forces acting on it. What happens to its motion?

a) It slows down and stops **b)** It keeps moving at constant speed in a straight line
c) It speeds up **d)** It starts to move in a circle

Answer: _____ Why? _____

3 What resultant force gives a 50 kg cyclist and bike an acceleration of 2 m/s²?

a) 25 N **b)** 52 N
c) 100 N **d)** 48 N

Answer: _____ Why? _____

4 An astronaut has a mass of 70 kg on Earth. What is her mass on the Moon?

a) 70 kg **b)** About 12 kg
c) 686 N **d)** 0 kg

Answer: _____ Why? _____

5 A swimmer pushes backwards on the pool wall with a force of 200 N. What force does the wall exert on the swimmer?

a) 0 N, because the wall does not move **b)** Less than 200 N, forwards
c) 200 N backwards **d)** 200 N forwards

Answer: _____ Why? _____

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Answer key for teachers · Ages 12–15 · Science

A Key terms

1	**Force**	C	A push or a pull on an object, with both size and direction, measured in newtons (N).
2	**Resultant force**	D	The single force that has the same effect as all the forces acting on an object combined.
3	**Balanced forces**	G	Forces whose resultant is zero, so the object's motion does not change.
4	**Inertia**	H	The tendency of an object to keep doing what it is doing: to stay at rest or keep moving at the same velocity.
5	**Mass**	B	The amount of matter in an object, measured in kilograms (kg); it is the same everywhere.
6	**Weight**	E	The force of gravity on an object, measured in newtons: W = mg.
7	**Newton's second law**	F	Resultant force equals mass times acceleration (F = ma).
8	**Interaction pair**	A	Two equal and opposite forces of the same type that two objects exert on each other (Newton's third law).

B Quick quiz

1 c) 25 N to the right

The forces act in opposite directions, so subtract: 40 − 15 = 25 N, in the direction of the larger force (to the right).

2 b) It keeps moving at constant speed in a straight line

Newton's first law: with no resultant force, a moving object keeps moving at the same speed in the same direction. No force is needed to keep it moving.

3 c) 100 N

$F = ma = 50 \text{ kg} \times 2 \text{ m/s}^2 = 100 \text{ N}$.

4 a) 70 kg

Mass is the amount of matter and does not change from place to place. Her weight on the Moon is smaller, because the Moon's gravitational field is weaker, but her mass is still 70 kg.

5 d) 200 N forwards

Newton's third law: the wall pushes on the swimmer with a force equal in size (200 N) and opposite in direction (forwards). This force acts on the swimmer, so the swimmer accelerates away from the wall.