

Pushes, pulls and balanced forces

Grade 7 science (Year 8 · Class 7) · Worksheet answers

Each answer shows the reasoning and the result in bold with its unit and direction. When you add forces, always check the directions first: forces in the same direction add and opposite forces subtract.

Level: Grade 7 science (Year 8 · Class 7) · **Curriculum:** MS-PS2-1, MS-PS2-2

Problem 1 Contact or non-contact?

1. **Contact**.
2. **Non-contact** (magnetic).
3. **Contact**.
4. **Non-contact** (gravity).
5. **Contact**.

Problem 2 Unit and instrument

1. The **newton, N**.
2. A **spring scale** (newton meter).
3. Check that the pointer starts at **zero** and hold the scale in the direction of the force.

Problem 3 Forces on a book

1. A is the **support force** from the table (it pushes up).
2. B is the **weight** of the book, the pull of gravity.
3. They are **equal in size** and opposite, so the forces are balanced and the book stays at rest.

Problem 4 Read the scale

1. **10 N**.
2. Each small mark is **0.5 N**.
3. $7 \times 0.5 \text{ N} = \mathbf{3.5 \text{ N}}$.

Problem 5 Arrow lengths

Length = force $\div$ 5 N per cm.

1. $20 \div 5 = \mathbf{4 \text{ cm}}$.
2. $35 \div 5 = \mathbf{7 \text{ cm}}$.
3. $12.5 \div 5 = \mathbf{2.5 \text{ cm}}$.

Problem 6 Balanced or unbalanced?

1. **Balanced** (net force 0 N).
2. **Unbalanced**: net force $15 - 5 = 10 \text{ N}$ upwards.
3. **Unbalanced**: net force $8 - 3 = 5 \text{ N}$ to the right.

Problem 7 Pushing on a wall

1. The wall pushes back with **40 N**.
2. In the **opposite direction** to his push.
3. The wall is fixed to the ground and friction and the structure oppose the push, so the forces on the wall are balanced and the wall stays at rest.

Problem 8 Tug of war

1. Net force = $520 - 485 = \mathbf{35 \text{ N}}$.
2. To the **right** (towards the red team).
3. The forces are unbalanced, so the rope starts to move towards the red team and speeds up.

Problem 9 Steady speed

1. **0 N**, because the speed is steady.
2. **60 N** in the opposite direction to her push.
3. The net force is $80 - 60 = 20 \text{ N}$ forwards, so the cart **speeds up**.

Problem 10 Net force on a box

1. $40 - 15 = \mathbf{25 \text{ N to the right}}$.
2. $50 - 50 = \mathbf{0 \text{ N}}$.
3. It speeds up to the right and does not move up or down.

Problem 11 Parachutist

1. Balanced forces, so air resistance is **700 N** upwards.
2. Net force = $700 - 300 = \mathbf{400\text{ N downwards}}$.
3. She is **speeding up**, because the net force is downwards.

Problem 12 A rolling ball stops

1. **Friction** (and a little air resistance).
2. Ice is smoother, so the friction force is smaller and the ball loses speed more slowly.
3. With zero net force the ball would keep moving at the same speed in a straight line.

Problem 13 Mass and speed gained

1. When the mass doubles, the speed gained **halves**: for the same net force, a bigger mass changes its motion less.
2. 8 kg is double 4 kg, so the speed gained is half of 2 m/s = **1 m/s**.

Problem 14 Kilonewtons

1. $3.5 \times 1000 = \mathbf{3500\text{ N}}$.
2. $12\,000 \div 1000 = \mathbf{12\text{ kN}}$.
3. $0.45 \times 1000 = \mathbf{450\text{ mN}}$.

Problem 15 Find the mistake

1. A steady speed means there is **no change in motion**, so the net force is zero. A force is not needed to keep an object moving.
2. The forward push and the friction are **equal and opposite (balanced)**.

Problem 16 Cart with three forces

1. $25 + 15 = \mathbf{40\text{ N}}$.
2. $60 - 40 = \mathbf{20\text{ N to the right}}$.
3. The cart **speeds up** to the right.

Problem 17 Dragging a block

1. Balanced forces, so friction = **6.4 N**.

2. Net force = $9.0 - 6.4 = 2.6 \text{ N}$ forwards.
3. The block **speeds up**.

Problem 18 Stretching a spring

1. Stretch per newton = $3.0 \div 2.0 = 1.5 \text{ cm/N}$, so $5.0 \times 1.5 = 7.5 \text{ cm}$.
2. Force = $12 \div 1.5 = 8.0 \text{ N}$.
3. Because stretch is proportional to force, equal steps along the scale represent equal steps in force, so the scale can be marked in evenly spaced newtons.

Problem 19 Two skaters

1. **120 N** in the opposite direction (an equal and opposite pair).
2. Each skater feels an unbalanced force, so each one starts to move, in opposite directions.
3. The forces are equal, but Aarav has the **smaller mass**, so the same force changes his motion more.

Problem 20 Tension in a tug of war

1. **0 N**, because $500 \text{ N} - 500 \text{ N} = 0 \text{ N}$.
2. The tension is **500 N**.
3. The two 500 N pulls are an equal pair acting at the two ends. They do not add inside the rope; each point of the rope is pulled with 500 N each way, as in a spring scale held by two people.