

Combining forces and drawing force diagrams

Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · Worksheet

Name: _____ Date: _____ Class: _____

These problems train you to name forces, draw and read free-body diagrams, and find resultant forces along a line and at right angles. You will use $W = m g$, decide whether forces are balanced and link the resultant to motion.

They suit GCSE and IGCSE students, O Level and Class 9-10 learners, and they rise from naming forces to equilibrium and error spotting.

Level: Physics grades 9-10 (GCSE · IGCSE · O Level · Class 9-10) · **Curriculum:** GCSE P5

Problem 1 Name the force (easy)

Name the force described in each case.

1. It pulls objects towards the centre of the Earth.
2. It opposes sliding between two rough surfaces.
3. It acts against a cyclist moving through air.
4. It pushes up on a floating wooden block.
5. It acts along a stretched rope.

Problem 2 Weight of a bag (easy)

Use $g = 9.8 \text{ N/kg}$.

1. Write the equation for weight.
2. Calculate the weight of a bag of rice with mass 4.5 kg.
3. State the direction of the weight.

Problem 3 Forces in the same direction (easy)

Two students push a stalled scooter in Kampala in the same direction with forces of 200 N and 150 N.

1. Calculate the resultant force.
2. State its direction.

Problem 4 Forces in opposite directions (easy)

A box has a 90 N force to the right and a 60 N force to the left.

1. Calculate the resultant force.
2. State its direction.

Problem 5 Balanced or unbalanced (easy)

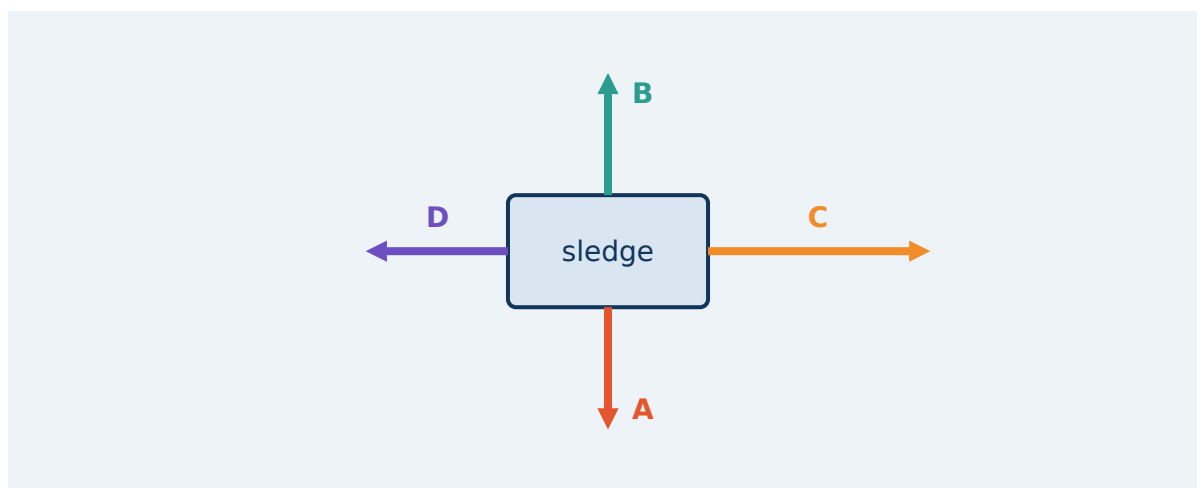
State whether each pair of horizontal forces is balanced.

1. 12 N right and 12 N left
2. 25 N right and 20 N left
3. 8.0 N right and 8.0 N right
4. 0 N and 0 N

Problem 6 Reading a diagram (easy)

Wanjiru pulls a sledge across a field. The arrows A, B, C and D act on the sledge.

1. Name the force for each arrow.
2. State which arrows are probably equal in size if the sledge stays level.
3. State which direction the sledge accelerates if C is larger than D.



Forces on a sledge.

Problem 7 Car on the road (medium)

A car's driving force is 3000 N and the resistive forces total 1800 N.

1. Calculate the resultant force.
2. Describe the effect on the car's speed.
3. State what happens if the driving force becomes 1800 N.

Problem 8 Steady cycling (medium)

A cyclist rides along a flat road at constant velocity. The pedals give a forward force of 85 N.

1. State the resultant force.
2. State the size of the resistive forces.
3. Explain your answer to part 2.

Problem 9 Three forces on a line (medium)

Three horizontal forces act on a post: 40 N east, 25 N east and 90 N west.

1. Calculate the total force towards the east.

2. Calculate the resultant force and its direction.

Problem 10 Standing on a scale (medium)

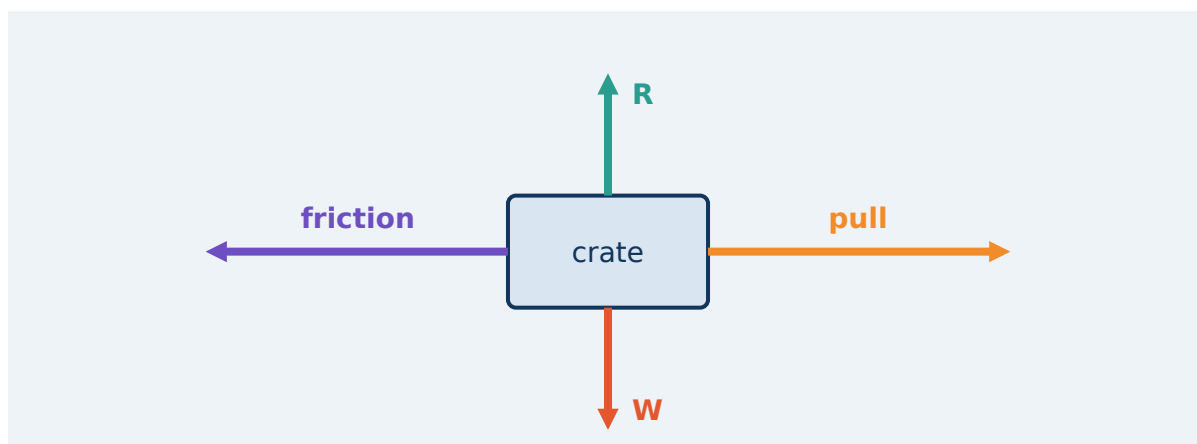
Diego, mass 55 kg, stands still on a bathroom scale. Use $g = 9.8 \text{ N/kg}$.

1. Calculate his weight.
2. State the reaction force of the scale on him.
3. Explain how you know.

Problem 11 Pulling a crate (medium)

Mei in Singapore pulls a crate at constant speed with a horizontal force of 150 N.

1. State the size and direction of the friction force.
2. She now pulls with 210 N. Calculate the new resultant force, assuming friction is unchanged.
3. Describe what happens to the crate.



Constant speed: the pull and friction are equal.

Problem 12 Two forces at right angles (medium)

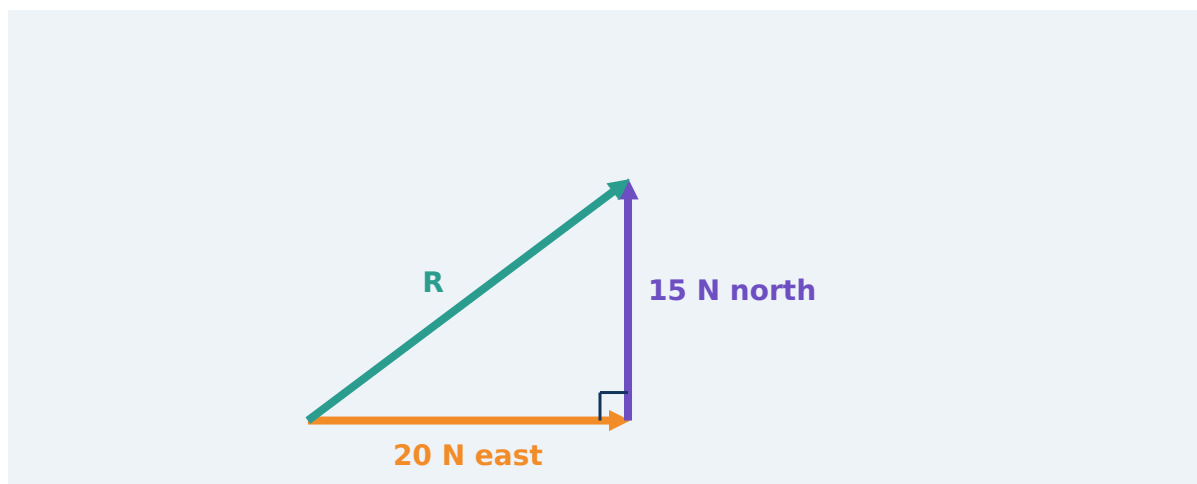
Two forces of 6.0 N and 8.0 N act on a ring at 90° to each other.

1. Calculate the resultant force.
2. Calculate the angle between the resultant and the 6.0 N force.

Problem 13 Scale drawing (medium)

Use a scale of 1 cm to 5 N to find the resultant of 15 N north and 20 N east.

1. State the length of each arrow you draw.
2. Calculate the length of the resultant arrow by Pythagoras.
3. Convert it to a force in newtons.



Not to scale: the triangle uses 4.0 cm and 3.0 cm sides.

Problem 14 Hanging lamp (medium)

A lamp of mass 3.5 kg hangs still from the ceiling by a cord. Use $g = 9.8 \text{ N/kg}$.

1. Calculate its weight.
2. State the tension in the cord and explain.

Problem 15 Rising balloon (medium)

A balloon rises at constant speed. The upthrust is 6500 N and the drag is 300 N.

1. State the resultant force.
2. Calculate the weight of the balloon.

Problem 16 Towing a boat (hard)

A boat is pulled by two ropes at right angles: 120 N east and 160 N north.

1. Calculate the resultant force.
2. Calculate its direction as an angle north of east.
3. Describe the direction in which the boat accelerates.

Problem 17 A ring in equilibrium (hard)

A ring is held still by three forces. Two of them are 30 N east and 40 N north.

1. Calculate the resultant of the two known forces.
2. State the size and direction of the third force.
3. Explain why the third force must be like that.

Problem 18 Push a handcart (hard)

Kofi pushes a handcart of total mass 80 kg with 260 N. Friction is 100 N.

1. Calculate the resultant force.
2. Use $F = ma$ to calculate the acceleration.

3. Calculate the weight of the cart ($g = 9.8 \text{ N/kg}$) and the reaction of the ground.

Problem 19 Parachute opens (hard)

A parachutist of mass 75 kg is falling when the parachute opens. The drag is 1500 N. Use $g = 9.8 \text{ N/kg}$.

1. Calculate her weight.
2. Calculate the resultant force.
3. Describe the effect on her motion.

Problem 20 Spot the errors (hard)

A student draws a free-body diagram of a book resting on a table. It shows a downward arrow of 8.0 N, an upward arrow of 5.0 N and a sideways arrow "force of motion". The student writes: "The forces cancel, so no forces act."

1. Explain what is wrong with the arrow sizes.
2. Explain what is wrong with the sideways arrow.
3. Correct the statement about cancelling.