

Combining forces and drawing force diagrams

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

Each answer states the rule used, the substitution and the final value in bold with its unit and direction. Remember that a resultant force always needs a direction as well as a size.

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

Problem 1 Name the force

1. **weight (gravity).**
2. **friction.**
3. **drag (air resistance).**
4. **upthrust.**
5. **tension.**

Problem 2 Weight of a bag

1. $W = m g$.
2. $W = 4.5 \times 9.8 = 44.1$, so **44 N**.
3. **Downwards**, towards the centre of the Earth.

Problem 3 Forces in the same direction

1. $200 + 150 = \mathbf{350\ N}$.
2. In the direction of the push.

Problem 4 Forces in opposite directions

1. $90 - 60 = \mathbf{30\ N}$.
2. To the **right**, the direction of the larger force.

Problem 5 Balanced or unbalanced

1. **balanced** (resultant 0 N).
2. **unbalanced** (5 N right).
3. **unbalanced** (16 N right).
4. **balanced** (resultant 0 N).

Problem 6 Reading a diagram

1. A is the **weight**, B is the **normal reaction**, C is the **pull** (tension) and D is **friction**.
2. **A and B** are equal because there is no vertical movement.
3. To the **right**, in the direction of C.

Problem 7 Car on the road

1. $3000 - 1800 = \mathbf{1200\ N}$ forward.
2. The car **speeds up**.
3. The forces balance, so the car moves at a **constant speed** in a straight line.

Problem 8 Steady cycling

1. The resultant force is **0 N**.
2. The resistive forces total **85 N** backwards.
3. Constant velocity means no change of motion, so the forward and backward forces must balance.

Problem 9 Three forces on a line

1. $40 + 25 = \mathbf{65\ N}$.
2. $90 - 65 = \mathbf{25\ N\ west}$.

Problem 10 Standing on a scale

1. $W = 55 \times 9.8 = \mathbf{539\ N}$.
2. **539 N upwards**.
3. He is at rest, so the resultant is zero and the reaction equals the weight.

Problem 11 Pulling a crate

1. Constant speed means balanced forces, so friction is **150 N backwards**.
2. $210 - 150 = \mathbf{60\ N}$ forward.
3. The crate **speeds up** in the direction of the pull.

Problem 12 Two forces at right angles

1. $R^2 = 6.0^2 + 8.0^2 = 36 + 64 = 100$, so $R = \mathbf{10\ N}$.

2. $\tan \theta = 8.0 \div 6.0 = 1.33$, so $\theta = \mathbf{53^\circ}$.

Problem 13 Scale drawing

1. $15 \div 5 = \mathbf{3.0 \text{ cm}}$ and $20 \div 5 = \mathbf{4.0 \text{ cm}}$.

2. $\sqrt{(3.0^2 + 4.0^2)} = \sqrt{25} = \mathbf{5.0 \text{ cm}}$.

3. $5.0 \times 5 = \mathbf{25 \text{ N}}$.

Problem 14 Hanging lamp

1. $W = 3.5 \times 9.8 = \mathbf{34.3 \text{ N}}$ (about 34 N).

2. The lamp is in equilibrium, so the tension equals the weight: **34.3 N upwards**.

Problem 15 Rising balloon

1. Constant speed, so the resultant is **0 N**.

2. Upward force = downward forces: $6500 = W + 300$, so $W = \mathbf{6200 \text{ N}}$.

Problem 16 Towing a boat

1. $R^2 = 120^2 + 160^2 = 14\,400 + 25\,600 = 40\,000$, so $R = \mathbf{200 \text{ N}}$.

2. $\tan \theta = 160 \div 120 = 1.333$, so $\theta = \mathbf{53^\circ}$ north of east.

3. The boat accelerates in the direction of the resultant, 53° north of east.

Problem 17 A ring in equilibrium

1. $R = \sqrt{(30^2 + 40^2)} = \mathbf{50 \text{ N}}$ at 53° north of east.

2. The third force is **50 N at 53° south of west**, the opposite direction.

3. The ring is in equilibrium, so the total resultant is zero and the third force must cancel the first two.

Problem 18 Push a handcart

1. $260 - 100 = \mathbf{160 \text{ N}}$ forward.

2. $a = F \div m = 160 \div 80 = \mathbf{2.0 \text{ m/s}^2}$.

3. $W = 80 \times 9.8 = \mathbf{784 \text{ N}}$. The cart does not move vertically, so the reaction is **784 N upwards**.

Problem 19 Parachute opens

1. $W = 75 \times 9.8 = \mathbf{735\text{ N}}$ down.
2. Drag exceeds weight: $1500 - 735 = \mathbf{765\text{ N}}$ upwards.
3. The resultant is upward, so she **slows down** while still falling.

Problem 20 Spot the errors

1. The book is at rest, so the upward reaction must equal the weight: **both 8.0 N**.
2. There is no horizontal force on a book at rest, and there is no force called "motion", so the arrow must be **removed**.
3. Forces still act, but they are **balanced**, so the resultant is zero.