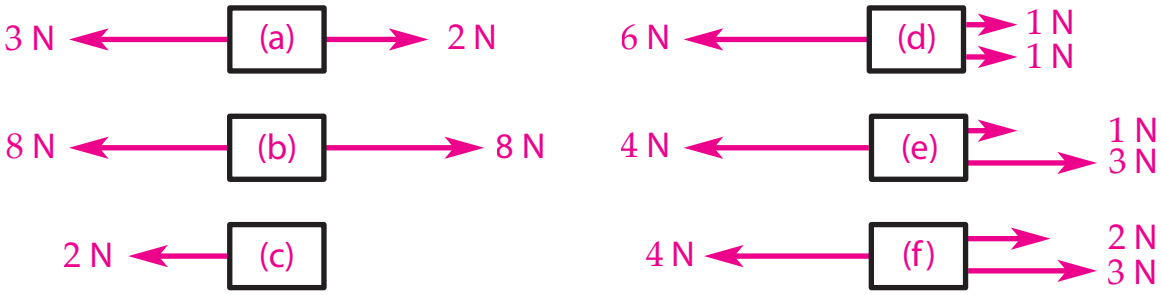
Force and Motion

Forces can be balanced (which means their effects cancel out), or unbalanced.

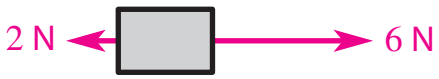
The forces on these blocks are balanced. The total force to the left equals the total force to the right.

1 For each block, decide if the forces are balanced.



If forces are unbalanced, there is a resultant force. To find the resultant force in a direction, we find the total force that way and the total force in the opposite direction. The resultant force is the difference between these totals. It is the single force which has the same effect.

When forces are balanced, the resultant force is zero.



total force to the left $= 2$ N
total force to the right $= 6$ N

The resultant force is $6\text{ N} - 2\text{ N} = 4\text{ N}$ to the right.

total force to the left $= 2\text{ N} + 2\text{ N} = 4\text{ N}$
total force to the right $= 3$ N

The resultant force is $4\text{ N} - 3\text{ N} = 1\text{ N}$ to the left.

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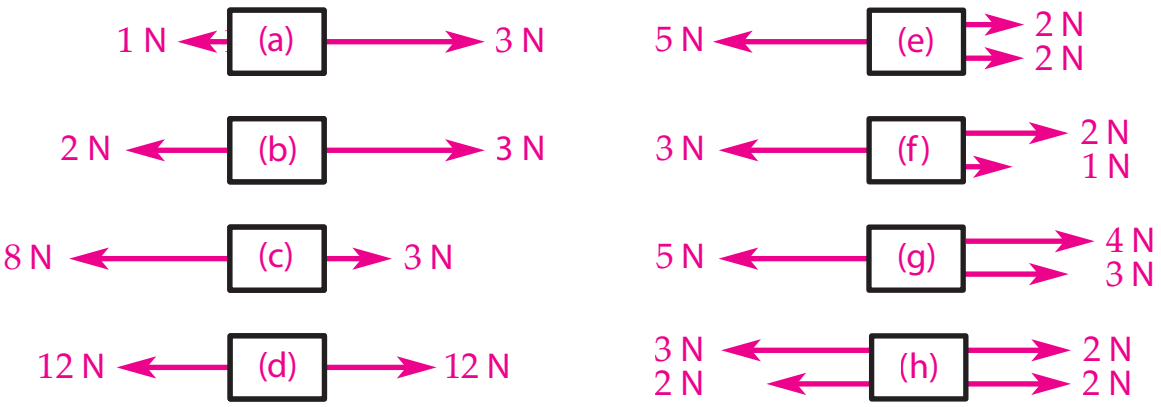
2 What is the resultant force on each block below? For each one give the strength and direction of the resultant force.



3 Add one extra force to each block in question 2 so that the forces on every block are balanced. If the resultant force was already zero, no extra force is needed.

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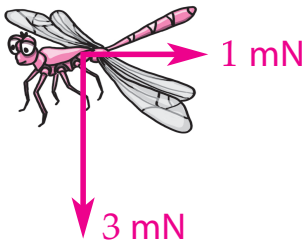
4 The forces on a hovering dragonfly are balanced. Two of the forces (its weight and a force from the wind) are shown. Add two more forces to complete the picture.



The resultant force tells us how an object's motion will change.

- Resultant force **forward** (in the direction of motion) ⇒ Object speeds up
- Resultant force **backwards** (against motion) ⇒ Object slows down
- Resultant force **sideways** ⇒ Object changes direction

5 A penguin is falling. Draw the direction of the resultant force needed
(a) to make the penguin fall faster, (b) to make the penguin fall slower.

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6 Match the forces with their directions. **Forwards** means **in the direction of motion**, and **backwards** means **against the motion**.

What the force is doing		**Direction**
A motor speeding up a model car.		left
A parachute slowing a skydiver.		backwards
A football being stopped by a goalkeeper.		forwards
A propeller turning a drone to the left.		upwards

If the forces are balanced, there is no resultant force.
- If the object is **still**, it doesn't start moving
- If the object is moving, it keeps going with a steady speed in a straight line.

7 Fill in the table to say what will happen to each object. Choose your answers from **speeds up**, **slows down**, **stays still**, **steady speed in a straight line**, **changes direction**.

Object and motion	**Relevant force(s)**	**What happens**
Cat lying on floor	weight = support force	
Rock moving in deep space	no forces	
Planet in circular orbit	gravity force towards star	
Bus at 50 km/h	engine force = friction	
Driver takes foot off accelerator	engine force < friction	
Egg falling to the floor	weight > drag	
Ball just after being thrown upwards	weight	

8 Complete the force diagrams to show the driving as well as drag forces on a cyclist. Use longer arrows for stronger forces.

(a) speeding up

(b) at steady speed

(c) slowing down

9 A leaf falls off a tree. Choosing from the options below, what happens to it when

speeds up **falls at steady speed** **slows down**

(a) it has just started falling,

(b) it is falling slowly (there is very little drag),

(c) falling at a higher speed where drag and weight are balanced,

(d) it hits the ground?