Part A: Finding Net Force

Free Body Diagram

All forces on an object,
Each one represented by an arrow.

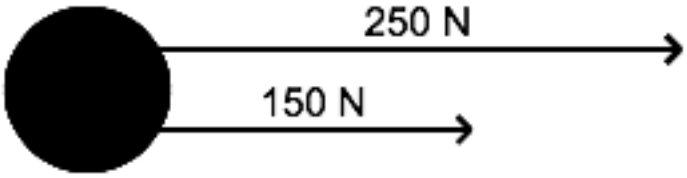
Finding Net Force

If the forces (arrows) are in the same direction, ADD.

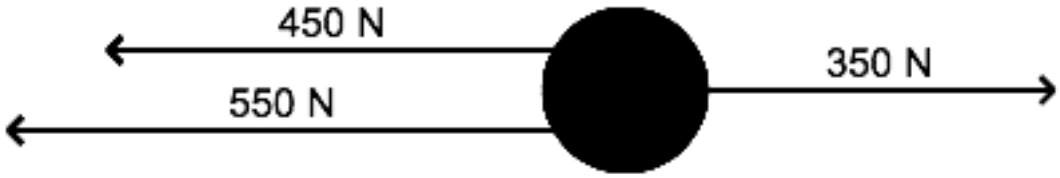
If the force (arrows) are in different directions, SUBTRACT. The direction of the sum is the direction with more force.

A1. Find the net force for this *free-body diagram*. Include the *magnitude* and *direction* in your answer.

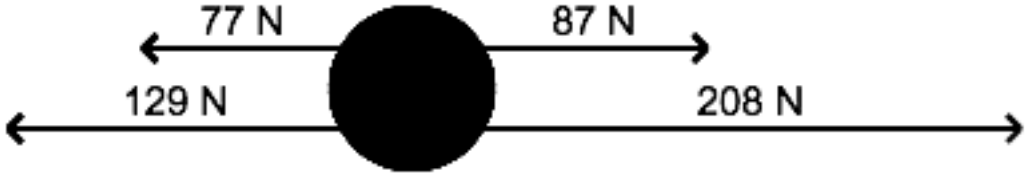
A2. Find the net force. (*Magnitude* and *direction*).



A.3 Find the net force (*Magnitude* and *direction*.)



A.4 Find the net force. (*Magnitude* and *direction*).



A.5. An object is being pushed, showing these two forces.
An object is pushed with a force of 50 N to the right.
Friction resists with a force of 20 N to the left.
a) Draw a free body diagram showing these two forces:

b) Find the net force. (*Magnitude* and *direction*)

A.6. A rocket ship is experiencing three forces.

- An upward thrust of 500 N.
- A weight of 200 N. The direction of weight is always *downward*.
- An air resistance force of 20 N downward.

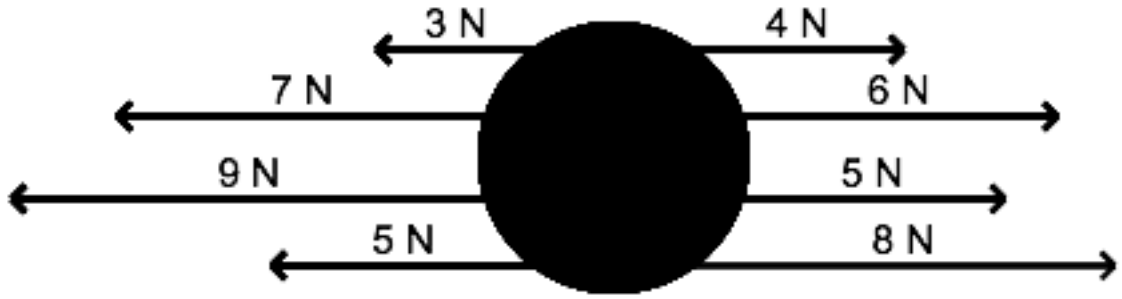
a) Draw a free body diagram showing these three forces.

b) Find the net force. (*Magnitude* and *direction*)

A.7. A book is lying on a table. There are two forces on the book.
It has a weight of 102 N. The direction of weight is always *downward*.
There is an upward normal force of 102 N.
a) Draw a free body diagram.

b) Find the net force. (*Magnitude* and *direction*)

A.8. Find the net force. (*Magnitude* and *direction*)



Part B: The Newton's Second Law Formula

While studying kinematics, we study acceleration. Newton's Second Law helps us explain *why* acceleration happens.

$$\Sigma F = ma$$

Symbol	Quantity	SI Unit
ΣF	Net force	Newtons
m	Mass	Kilograms
a	acceleration	m/s^2

B.1. I kick and exert a net force of 200 N on a rock. The rock has a mass of 2 kg. What will be its acceleration?

Looking For	Formula
Already Know	
Answer in a complete sentence *with unit*:	

B.2. Something is accelerating at a rate of 4 m/s^2. It has a mass of 10 kg. What is the net force on this object?

Looking For	Formula	
Already Know		
Answer in a complete sentence *with unit*:		

B.3. The cabinet has a mass of 200 kg and I push it with a force of 20 N. That is the only horizontal force on the cabinet. What is its acceleration? *Include the unit!*

Looking For	Formula	
Already Know		
Answer in a complete sentence *with unit*:		

B.4. An 80 kg person on a 20 kg bicycle is accelerating at 2 m/s^2. What is the net force on them?

Looking For	Formula	
Already Know		
Answer in a complete sentence *with unit*:		

B.5. When I exert a 100 N net force on my bookshelf, it accelerates at a rate of 4 m/s^s. What is the mass of the bookshelf?

Looking For	Formula	
Already Know		
Answer in a complete sentence *with unit*:		

B.6. A rocket has a mass of 1800 kg. If the rocket thruster gives it a net force of 36000 N, how fast will it accelerate?

Looking For	Formula	
Already Know		
Answer in a complete sentence *with unit*:		

B.7. What is the mass of an object with an acceleration of 5 m/s^2 under a net force of 400 N? *Include the unit!*

Looking For	Formula	
Already Know		
Answer in a complete sentence *with unit*:		

Part C: Finding Acceleration Using Newton's Second Law

C.1. A car moves forward due to a thrust of 2000 N. Air resistance pushes back on the car with a force of 200 N. The car has a mass of 1000 kg.
a) Draw a free-body diagram of the car:

b) What is the net force on the car?

c) What is the acceleration of the car?

Looking For	Formula	
Already Know		
Answer as equation *with unit*:		

C.2. A man is falling due to his weight of 700 N down. He is resisted by an air resistance force of 200 N up. He has a mass of 71 kg.
a) Draw a Free-Body Diagram of the man:

b) What is the net force on the man?

c) What is his acceleration?

Looking For	Formula	
Already Know		
Answer as equation *with unit*:		

C.3. An elephant on roller skates is rolling down a hill. The elephant has a mass of 2,700 kg. A downward force (caused by gravity) of 18900 N pulls him down the track. A frictional force of 7500 N resists his motion.
a) Draw a Free-Body Diagram of the elephant:

b) What is the net force on the elephant?

c) What is its acceleration?

Looking For	Formula	
Already Know		
Answer as equation *with unit*:		

C.4. Three people are pulling on a big, 10 kg barrel.
Jim is pulling 400 N to the right.
Joe is pulling 400 N to the right.
Hector is pulling 1000 N to the left.
a) Draw a Free-Body Diagram of the barrel:

b) What is the net force on the barrel?

c) What is its acceleration?

Looking For	Formula	
Already Know		
Answer as equation *with unit*:		

Part D: Find the Missing Force [simple]

D.1
Two forces act on an object:
5 Newtons to the left.
A mystery force to the right.

The net force is 8 Newtons to the right.
What is the magnitude of the mystery force?

More will be added to this section in the future!

Part E: Find the Missing Force (more complicated)

All of these problems have the letter N in them.
E.1. What does the letter N stand for?

E.2.
Three forces act on an object:
345 N left 454 N right ????? N left

Draw a free-body diagram with 3 forces. On of the forces has unknown magnitude:

The net force is 200 N left.

What is the magnitude of the missing force?

E.3.
43 down 53 down ??? up

Draw a free-body diagram with 3 forces. On of the forces has unknown magnitude:

The net force is 140 N up.

What is the magnitude of the missing force?

E.4.
75 N down 75 N down ??? up

Draw a free-body diagram with 3 forces. On of the forces has unknown magnitude:

The net force is 86 N down.

What is the magnitude of the missing force?

E.5. I'm sitting on a chair.
The chair exerts a force 450 N up. My weight is ?????? N down.

Draw a free-body diagram:

The net force on me is 0 N.

What is my weight [the magnitude of the downward force]?

E.6.
20 N up 18 N down ???????

The net force is 38 N down.

Find the magnitude *and direction* of the missing force:

E.7.
95 N left
66 N left
??????

The net force is 500 N right

E.8.
88 N left 66 N right 27 N left ?????

The net force is 100 N right
Find the magnitude *and direction* of the missing force:

E.9.
9 N down 39 N up 85 N down 59 N up ?????

The net force is 0 N.
Find the *magnitude* and *direction* of the missing force:

Part F: Finding unknown forces

F.1 An object with a mass of 50 kg is accelerating at a rate of 4 m/s^2 upward.
There are two force acting on the object:
500 Newtons down and an unknown force up.
a) Use Newton's Second Law to find the *magnitude* of the net force acting on the object:

Looking For	Formula
Already Know	
Answer as equation *with unit*:	

b) What is the *direction* of the net force?

c) Draw a free-body diagram with two forces. One force has unknown magnitude.

d) What is the magnitude of the unknown force?

F.2 An object with a mass of 10 kg is accelerating at a rate of 3 m/s^2 to the right:
There are two forces acting on this object:
90 Newtons to the right and an unknown force to the left.
a) Use Newton's Second Law to find the *magnitude* of the net force acting on the object:

Looking For	Formula
Already Know	
Answer as equation *with unit*:	

b) What is the *direction* of the net force?

c) Draw a free-body diagram with two forces. One force has unknown magnitude.

d) What is the magnitude of the unknown force?

F.3 An object with a mass of 12 kg is accelerating at a rate of 6 m/s^2 to the left.
There are three forces acting on this object:
100 N to the left 80 N to the right ???? N to the left
a) Use Newton's Second Law to find the *magnitude* of the net force acting on the object:

Looking For	Formula	
Already Know		
Answer as equation *with unit*:		

b) What is the *direction* of the net force?

c) Draw a free-body diagram with two forces. One force has unknown magnitude.

d) What is the magnitude of the unknown force?

F.4 An object with a mass of 20 kg is accelerating at a rate of 8 m/s^2 to the right.
There are three forces acting on this object:
160 N to the right 75 N to the left ??????
a) Use Newton's Second Law to find the *magnitude* of the net force acting on the object:

Looking For	Formula	
Already Know		
Answer as equation *with unit*:		

b) What is the *direction* of the net force?

c) What are the *magnitude* and *direction* of the unknown force?

Answers
A.1
50 N right.

A.2
400 N right

A.3
650 N left

A.4
89 N right

A.5
30 N right

A.6
280 N upward

A.7
Zero

A.8
1 N left

B.1
100 m/s^2

B.2
40 N

B.3
0.1 m/s^2

B.4
200 N

B.5
25 kg

B.6
20 m/s^2

B.7
80 kg

C.1
1.8 m/s^2

C.2
7.04 m/s^2

C.3
4.2 m/s^2

C.4
20 N

D.1
13 N

E.1 Newtons

E.2. 309 N

E.3. 236 N

E.4. 64 N

E.5. 450 N

E.6. 40 N down

E.7. 661 N right

E.8. 149 N right

E.9. 4 N down