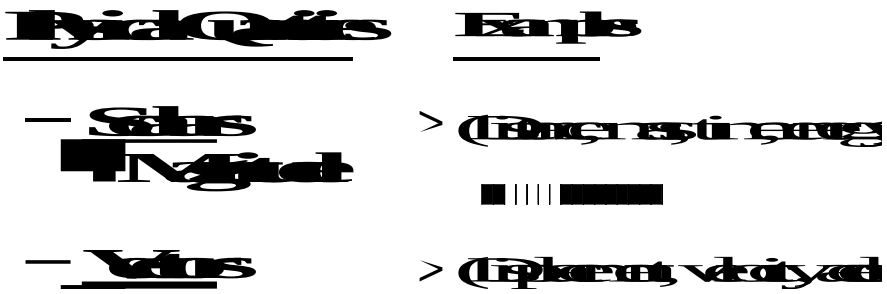
There are two types of quantities in physics, scalars and vectors. As illustrated below, scalars are quantities that have only magnitude (size). Vectors are quantities that have ***both*** magnitude and direction.



Since scalar quantities have only magnitude, they can be added or subtracted using ordinary addition or subtraction. Vector quantities, however, because they also have direction, must be added or subtracted "vectorially". That is to say, their direction must also be taken into account. Thus, it is important to identify a quantity as a ***scalar*** or a ***vector***.

HISTORICAL NOTE

Although Galileo did much work in dynamics, statics has its beginnings in the time of the Greeks. Archimedes of Syracuse (287-212 B.C.), a great geometrician and inventor, laid the foundations for statics with his discovery of the principle of the lever, an exact understanding of density, and his work on hydrostatics (Archimedes' Principle). Many centuries later, advancements in statics were also made by Leonardo da Vinci (1452-1519) and by Simon Stevin (1548-1620). Stevin, a Dutch engineer and mathematician, introduced decimal fractions to the world in 1586. Stevin studied the problem of equilibrium for a body resting on an inclined plane, mastered the parallelogram technique of finding the resultant force and made experiments with falling objects.

1. Define: a) a scalar quantity

A quantity that only has magnitude (size).

b) a vector quantity

A quantity that has magnitude and direction.

2. Classify each of the following quantities as a ***scalar*** or a ***vector***:

a) Velocity **Vector** b) Length **Scalar**

c) Mass **Scalar** d) Force **Vector**

e) Displacement **Vector** f) Speed **Scalar**

3. Define ***force***.

A push or a pull.

4. Explain the difference between ***force*** and ***pressure***.

A force is applied at a point.

A pressure is applied to an area.

5. State the sum of the following in ***basic units***:

a) 15 minutes + 20 seconds **920 s**

b) A force of 5 N left + a force of 2 N right **3 N Left**

c) 500 g + 2 kilograms **2.5 kg**

d) A force of 10 N right + a force of 4 N right **14 N Right**

e) 2 days + 4 hours $\mathbf{1.87 \times 10^5}$

f) 60 km/h left + 12 m/s left **28.7 m/s Left**

g) 300 mm + 150 cm + 1.5 m **3.3 m**

h) 2 years + 6 months $\mathbf{7.90 \times 10^7}$

i) 35 g + 4 kg + 250 g **4.29 kg**

j) A force of 15 N up + 20 N down + 40 N up **35 N Up**

6. Define the following ***forces***:

a) Collinear ***Forces acting along a line.***

b) Coplanar ***Forces acting along a plane.***

c) Concurrent ***Forces acting at a point.***

7. What is a ***resultant force***?

The (vectorial) sum of all the forces acting on a system.

8. For the two forces of 10 N and 20 N, state (yes or no) whether the following given magnitudes can be ***resultants*** of these two forces:

a) 0 **No** b) 10 N **Yes** c) 15 N **Yes**

d) 20 N **No** e) 25 N **No** f) 40 N **No**

9. What is the ***center of gravity*** of an object?

The point where all the mass of an object is concentrated.

It is the point where the force of gravity (i.e. weight) acts.

10. Explain the difference between ***mass*** and ***weight***?

Mass is the amount of matter an object has (a scalar).

Weight is the force of gravity (a vector).

11. Convert the following ***masses*** to ***weights***.

a) 2 kg **20 N**

b) 35 kg **350 N**

c) 60 kg **600 N**

12. Convert each of the following ***weights*** to ***masses***:

a) 5 N **0.5 kg**

b) 28 N **2.8 kg**

c) 800 N **80 kg**

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