

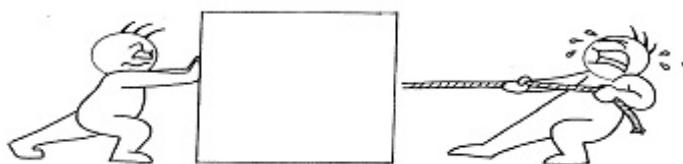
Physics 2204
Unit 2: Dynamics
Worksheet 1: Introduction to Forces



Student Name: _____

Dynamics: is the study of the factors that cause change in motion. It is concerned with the forces that change or produce motion within objects

Force is a push or a pull exerted on an object



A force can affect an object in 3 ways:

- 1) make an object speed up;
- 2) make an object slow down;
- 3) make an object change shape.

Forces are vectors. Therefore it must have a direction and magnitude!

Newton (N) is the standard unit of force. Named after Isaac Newton. 1 N is approximately the same as the amount of gravitational force the Earth exerts on an object with a mass of 100 grams.

THE FOUR MAJOR FORCES IN NATURE:

1. Gravitational Force: the forces that keep objects “stuck” to the earth. Significant only when masses are very large (such as planets), otherwise is very weak for “normal” objects. Acts over very large distances.



2. Electrical and Magnetic Forces – static electricity, magnetism etc.

3. STRONG Nuclear Force: The force that holds the nucleus of an atom together.

4. WEAK Nuclear Force:– The force associated with the behavior of subatomic particles.

Mechanical forces involve contact with an object. Include such things as:

1. Ordinary push and pull forces.
2. Frictional forces.
3. Elastic forces
4. Compression (squeezing) forces
5. Torsional (twisting) forces.

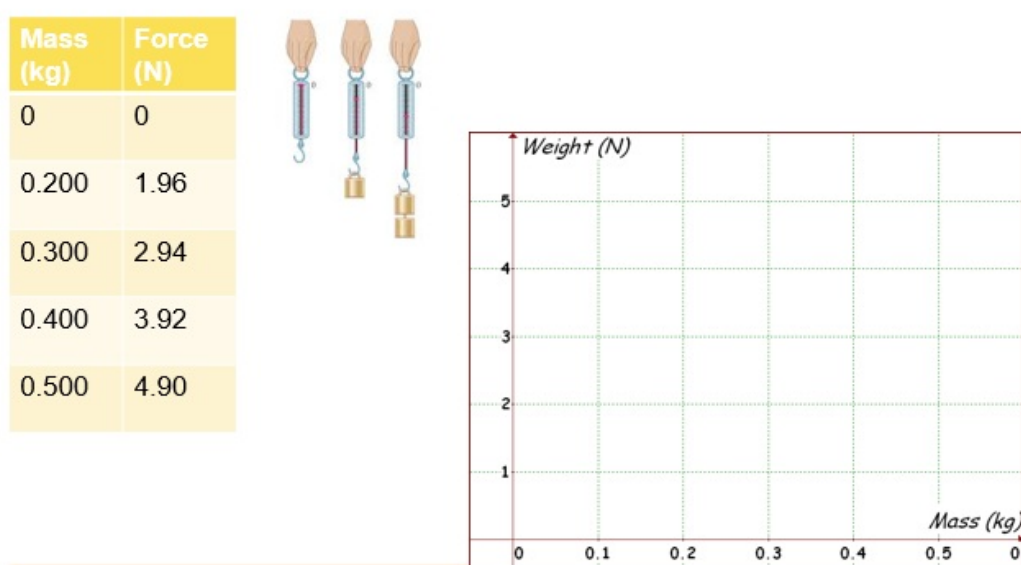
What is the difference between mass and weight?

mass	weight
<ul style="list-style-type: none"> • Mass is a measure of the amount of matter in an object. Mass is not related to gravity. • The mass of an object does not change when it is moved from one place to another. • Mass is commonly measured in grams or kilograms. 	<ul style="list-style-type: none"> • Weight is a measure of the gravitational force between two objects. • The weight of an object does change when the amount of gravitational force changes, as when an object is moved from Earth to the moon. • Weight is commonly measured in newtons.

Weightlessness: When a diver dives off of a 10- m diving board, she is in free-fall. If the diver jumped off of the board with a scale attached to her feet, the scale would read zero even though she is under the influence of gravity. She is “weightless” because her feet have nothing to push against. Similarly, astronauts and everything inside a space shuttle seem to be weightless because they are in constant free fall. The space shuttle moves at high speed, therefore, its constant fall toward Earth results in an orbit around the planet.

Example 1:

Consider small masses being attached to a spring scale (force meter):



(A) Find slope.

(B) What are the slope units?

(C) What does the slope represent?

HOW TO CALCULATE WEIGHT:

Force of Gravity (ie. Weight) of an object due to gravity near the surface of the earth is;

$$\vec{F} = m\vec{g}$$

Force (F) of Gravity is measured in newtons (N)

Mass(m) is measured in kilograms

Acceleration Due To Gravity (\vec{g}) has a value of -9.81 m/s^2

Example 2:

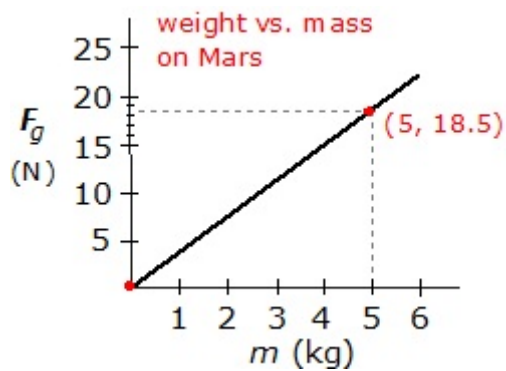
What is the weight of a 72 kg person who is standing in Blaketown?

Example 3:

The lighthouse keeper at Cape Bonavista weighs 804 N. What would be his mass if he flew to the moon?

Example 4:

The graph shows the relation-ship between mass and weight on Mars. Use it to determine the weight of a 85 kg astronaut on Mars.



Example 5:

PART A: MULTIPLE CHOICE

Instructions: Shade the letter of the correct answer on the computer scorable answer sheet provided

1. What is the unit of measure for mass?
(A) Kg
(B) N
(C) N/Kg
(D) m/s^2

2. Which of the following is the best example weight?
(A) 5 kg
(B) $9.8 m/s^2$
(C) 15 N [down]
(D) 20 N N/kg

3. Which of the following is another way of saying weight?
(A) Buoyancy
(B) Elastic Force
(C) Force of Gravity
(D) Friction

4. If you are in a spacecraft moving away from the Earth, what is happening?
(A) Both your mass and your weight are increasing.
(B) Both your mass and your weight are decreasing.
(C) Your mass decreases while your weight remains constant
(D) Your weight decreases while your mass remains constant

5. If you double the mass of an object, What happens to the weight of the object?
(A) $2F_g$
(B) $\frac{1}{2} F_g$
(C) $\frac{1}{4} F_g$
(D) $4F_g$

6. As a Mars rover is sent into outer space. As the vehicle moves from the Earth into outer space, which of the following is correct ?

	Change in Mass	Change in Weight
(A)	No	No
(B)	No	Yes
(C)	Yes	No
(D)	Yes	Yes

7. At a point on the surface of the Earth, the gravitational field strength is 9.8 N / kg . Which pair of values for mass and weight are correct for an object placed at this point?

	Mass-kg	Weight -N
(A)	9.8	10
(B)	10	9.8
(C)	10	98
(D)	98	10

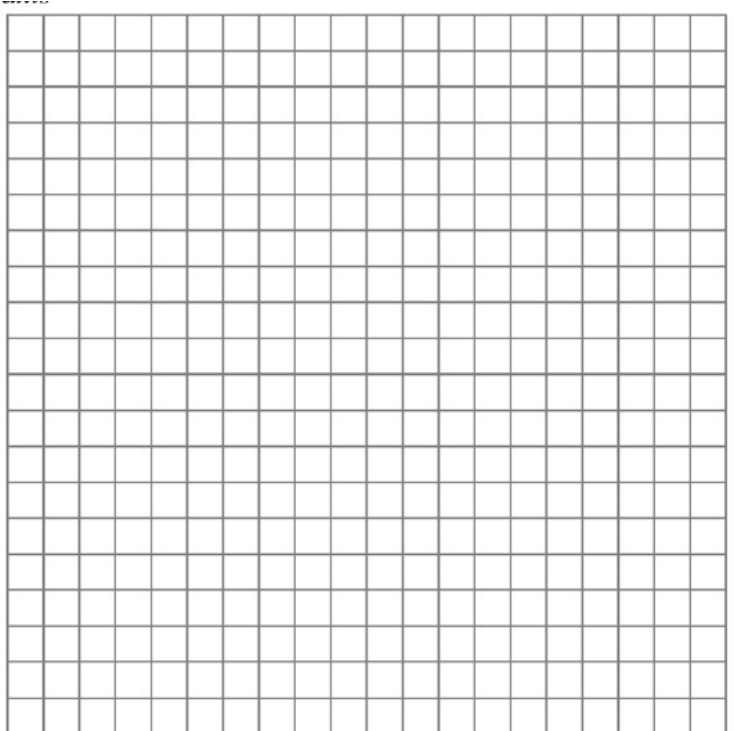
8. Which of the following is equivalent units for m/s^2 ?
- (A) N
(B) $\text{Kg} \cdot \text{N}$
(C) N/kg
(D) Kg/N
9. What is the weight of a 56.0 kg person?
- (A) 5.71 N
(B) 56.0 N
(C) 123 N
(D) 549 N
10. What is the weight of a 45 kg person on earth?
- (A) 9.8 N
(B) 45 N
(C) 99 N
(D) 440 N
11. An astronaut's boots weigh 49 N on Earth, where acceleration of free fall is 9.8 m/s^2 . How much will they weigh on Mars, where acceleration of free fall is 1.6 m/s^2 ?
- (A) 8.0 N
(B) 31 N
(C) 49 N
(D) 78 N
12. An object weighs 8.5 N on the Moon. The gravitational field strength on the Moon is 1.6 N/kg . What is the mass of the object?
- (A) 13.6 kg
(B) 8.5 kg
(C) 5.3 kg
(D) 1.6 kg

PART B: WRITTEN RESPONSE

1. What is the weight of a 7.0-kg bowling ball on Earth's surface?
2. What is the weight of a 7.0-kg bowling ball on the surface of the moon?
3. What is the mass of a 7.0-kg bowling ball on the surface of the moon?
4. Describe what would happen to the spring in a bathroom scale if you were on the moon when you stepped on it. How is this different from stepping on the scale on Earth?
5. The earth exerts a gravitational force of 500 N on an object. What is the mass of the object in kg ? (Show your work.)

6. A physical science test book has a mass of 2.2 kg
- What is the weight on the Earth?
 - What is the weight on Mars ($g = 3.7 \text{ m/s}^2$)
 - If the textbook weighs 19.6 newtons on Venus, What is the strength of gravity on Venus?
7. Of all the planets in our solar system, Jupiter has the greatest gravitational strength.
- If a 0.5 kg pair of running shoes would weigh 11.55 newtons on Jupiter, what is the strength of gravity there?
 - If the same pair of shoes weighs 0.3 newtons on Pluto, what is the strength of gravity on Pluto?
 - What does the pair of shoes weigh on earth?
8. On the surface of Planet X an object has a weight of 63.5N and a mass of 22.5kg. What is the gravitational field strength on the surface of Planet X?
9. You have become an astronaut with NASA and have landed on a new planet. You carry out an experiment to determine the gravitational field using a variety of masses and a force metre. Use the data collected in the table below to create a Force of Gravity versus Mass

Mass - kg	Force of gravity- N
0	0
2.0 kg	7.5
4.0 kg	15.0
6.0 kg	22.5
8.0 kg	30



(A) What is the gravitational Field of this planet?

(B) Use the table below to determine the planet you have landed on.

Planet	$g \text{ (m/s}^2\text{)}$
Mercury	3.61
Venus	8.83
Mars	3.75
Jupiter	26.0
Saturn	11.2
Uranus	10.5
Neptune	13.3
Pluto	0.61

(C) How much would you weigh on this planet?